



**GSDI**  
Global Spatial Data  
Infrastructure Association



## **GSDI 15 World Conference Proceedings**

### **Spatial Enablement in the Smart Homeland**

**29 November – 2 December 2016**

**Taipei, Taiwan**

**Abstracts**

## Table of Contents

A web-based platform for detention facility design on developing sites.....	1
Using Probabilistic Seismic Hazard Analysis in Assessing Seismic Risk for Taipei City and New Taipei City.....	2
Integrated Real Estate Registration and Chinese NSDI to Strengthen the Government Spatial Data Management.....	3
Worldwide status of national geoportals 2016.....	4
Qualitative disaster information delivery through cloud technology .....	6
Arctic Spatial Data Infrastructure (Arctic SDI).....	7
GIS enabled e-Governance .....	8
The information society is here: where is the SDI?.....	9
Risk management methodologies used in railway system - a case study of Alishan Forest Railway in Taiwan.....	10
The governance of INSPIRE implementation .....	11
Democratization of key public sector information in Zimbabwe - the road towards Open Government?.....	13
Coastal and Marine SDIs: towards an assessment of the worldwide developments and the related needs for harmonization and coordination.....	14
Spatial Data Infrastructure in New Brunswick, Canada: Twenty Years on the Web.....	15
Susceptibility and early warning threshold for rainfall-induced shallow landslide in Taiwan	16
Real-time Public Sentiments Analysis and Information Integration Platform for Disaster Prevention and Victims of Disaster Rescue based on Social Networks .....	17
Promotion and Applications of Census Geography in Taiwan: Integration of Social Economic Data into SDI .....	18
Development of a location-based real time air quality alert system.....	23
Exploiting Synergies between Land and Marine SDI.....	25
Geoscape - Capturing Australia's Built Environment.....	26
Serving feature-based topographic maps for facilitating cross-domain applications in SDI...	27
Application of Radar Imaging Technology for Hillslope Disaster Assessment.....	28
Application of multi-scale monitoring to evaluate sediment transport and remediation efficiency in Shih-Men reservoir watershed.....	30
Earthquake probability assessment for the active faults in Taiwan.....	32
Risk analysis, management and governance of debris flow torrents in Taiwan.....	34
The open data application on real-time transportation information and dynamic vehicle positioning.....	36
The initiative of SWCB data governance policy .....	37
2D Map visualization of nationwide LiDAR digital elevation models .....	39
Development of the operational platform for flood inundation forecasting in lowland areas.	40

Development and application of grid-based seismic impact assessment techniques for power system .....	41
The impact of spatial enablement and visualisation on business enterprise databases - what your data have been trying to tell you.....	42
TPEG for timely distribution of emergency alert warnings.....	43
Urban Analytics Data Infrastructure: Critical SDI for Urban Management in Australia .....	46
Towards a spatially enabled open platform for Singapore .....	47
Assessing the quality of building footprints on OpenStreetMap: a case study in Taiwan .....	48
Lowering the barrier to OSM contribution and citizen mapping services development for city governments.....	50
The theory versus the reality of alignment between e-Gov and SDI in Pakistan .....	51
Open spatial data infrastructures for the extractives sector in countries affected by fragility, conflict and violence: promises and challenges.....	52
State of SDI Readiness in Indonesian Local Government.....	54
Applying geo-data to evaluate the appropriateness of bus network .....	55
Matching and relative orientation of spherical panorama images .....	56
Change detection through object-based analysis on UAV-derived orthoimages and digital surface models .....	57
Landslide warning using ensemble precipitation forecasting.....	58
An open standard solution for a smart agriculture monitoring application .....	59
Analysis of the barriers to land administration in Pakistan .....	60
Land surface temperature variation and land cover changes based on satellite imagery data.	61
Classification of eco-environmental vulnerability for environmental protection in the Thua Thien – Hue Province, Vietnam.....	62
Exploring motivations and barriers for spatial data sharing between regional NRM bodies and state government authority in Australia .....	63
Building Resilience of Vulnerable Groups Using Spatial Data and Technology: A Case of 2015 Nepal Earthquake and Informal Settlements in Kathmandu.....	64
Geospatial and statistical information for extreme events and disasters relief.....	65
Challenges of Taiwanese national airborne LiDAR mapping for geohazard assessment .....	66
Al Madinah Al Munawwara SDI supports physical infrastructure planning .....	67
and data sharing across local governments .....	67
A Point-Based Adaptive Filtering Algorithm for Lidar Data Classification in Urban Environment.....	68
Image processing and feature extraction for building information modelling .....	69
Role of coastal/marine atlases in human-centric SDIs .....	72
Techniques for economic valuation of a spatial data infrastructure .....	73
The generation of well geo-referenced floor plans and application in indoor navigation system .....	75
Integrating smart phone and Kinect for fall detection .....	76

Spatial data infrastructure for sustainable developing in Nigeria .....	77
Real property loss relief in the scope of disaster governance .....	78
Comprehensive analysis of flood disaster risk identification to cultural heritage in Taiwan ..	80
Analyzing recent trends and developments in the SDI network.....	81
Convergence of spatial data infrastructure and data revolution.....	83
Evaluation of Success of National Geographic Information Infrastructure (NGII): User Satisfaction Perspective (A case in Nepal) .....	85
What is effective governance for SDI's? .....	86
A study of vegetation coverage and water storage capacity in Datu tableland before and after human development in 2000 to 2015.....	88
The application of GIS to the government's Regulatory Impact Assessment: A case study of the agricultural zoning policy in Taiwan .....	90
Cloud solutions for Homeland SDI.....	91
Taming big data with metadata.....	93
National elevation data strategy for Canada .....	94
Metadata catalogue based on GeoNetwork Opensource at Environment and Climate Change Canada (ECCC): a use case .....	96
CEOS Working Group on Information System and Services (WGISS) earth observation data access infrastructure and interoperability standards .....	97
Evaluating INSPIRE: testing and validating as a way to steer and guide implementation actions .....	99
The GIS-based online building energy saving platform for SME in Taiwan .....	101
Geospatial technology innovations for land tenure security in East Africa - getting needs ..	102
WWF-SIGHT and why spatial environmental and social data is crucial for conservation...	103
An urban environmental sensing infrastructure with crowdsourcing and spatial big data for early warning of critical conditions .....	105
An intelligent vehicle monitoring system based on IoT technology using for urban area ....	107
Profiling topological characteristics of street network to identify urban traffic congestion..	109
Investigating spatial and temporal patterns of thermal environment in street-level scale in the metropolitan area in Taiwan .....	112
Applying ultra-low frequency electromagnetic wave remote sensing techniques to hyporheic zone water supply potential analyses - A case study on southern Taiwan .....	114
Development of Spatial Data Infrastructure Policy: The Web Map Server Interface in Thailand .....	115
Integrating web GIS and augmented reality techniques in nuclear accident response .....	117
Integrating geographic information systems for sustainable high speed rail life cycle management - a case study of Taiwan high speed rail.....	120
Assessment of building evacuation scenarios considering panic and knowledge of exits using a 3D GIS agent-based model .....	122

Analysis of the correlation of tourism on Internet community - using the travel reviews in Taichung City as an example .....	123
Geospatial education in India: Opportunities and challenges in context of smart cities and Digital India programs .....	124
Application of remote sensing and geo-spatial technology in terrain analysis and terrain classification in context of creation of SDI for marine and coastal regions .....	125
Identifying flood-prone areas due to sea level rise in nearby communities of Imbang River in Western Visayas, Philippines.....	126
Web- and mobile-based data collection using VGI for building feature mapping/attribution in the flood-prone zones of Western Visayas, Philippines .....	128
Development of indicators for spatial assessment of heat vulnerability within cities: the case of Tapiei City .....	129
Surface creeping analysis of the Fengshan Fault in SW Taiwan from GPS observations and PSInSAR.....	131
Smart disaster communities: building a global disaster management platform .....	132
Risk Modeling of Accidents in the Power System of Ukraine Based on SDI.....	133
Blueprint for the STIG1.0: Defining core SDI principles and setting up performance indicators .....	135
Accuracy analysis of distance model correction using Bluetooth low energy technology on indoor positioning system.....	136
Automatic matching and geo-referencing of historical aerial images .....	137
Are estimation algorithms applicable for disaster managements? – an experimental demonstration of disaster-information-integration platform named ‘G-space platform’ .....	138
Governance quality and disaster risk - a strong correlation.....	139
Applications of geographic names in K12 education of Taiwan.....	140
Assessing the importance of NSDI and spatial data transparency for biodiversity conservation and the environment: Making a case for a global NSDI index.....	142
SWOT and PEST Analysis on Mongolian National SDI .....	145
Key words: Mongolia, SWOT, PEST .....	145
Abstract.....	145
It has been 20 years since spatial data infrastructure (SDI) has spread across the world. During this time, several countries has started establishing their own SDI, all of which are different from each other. Mongolia has been using geographic information system (GIS) software for mapping since 1990. Nowadays many organizations and some private companies in Mongolia are dealing with remote sensing and GIS activities.....	145
Since 2004 there have been discussions and plans for founding a National Spatial Data Infrastructure (NSDI), starting from 2012. The NSDI is one of seven main key components of the “National Program to Establish an Integrated System of Registration and Information of Mongolia” (2008). The project is to facilitate and support data exchanges between and within organizations, for efficient cadastral procedures, registration and taxation, and other related activities, etc. NSDI is a web based and centralized system which covers administration of geoinformation databases all over the country among government departments.....	145

The PEST factors, combined with external micro-environmental factors and internal drivers, can be classified as opportunities and threats in a SWOT analysis. In order to establish a promotion strategy for SDI system implementation project, internal and external factors are derived through using SWOT and PEST analysis. ....	145
This research aims at a SWOT and PEST analysis to identify the key internal and external factors in the SDI legal system, internship between government organizations, human resources, data resource and security that are important for achieving the objectives in the Mongolian situation. ....	145
Assessment of OpenStreetMap – a case of Kampala.....	146
I4D - Intelligence for decision by Airbus Defence and Space.....	147
Support of individual autonomy to control privacy exposure within increasingly ubiquitous tracking societies.....	148
Earth Observation by Airbus Defense & Space: Today and Tomorrow .....	149

## **A web-based platform for detention facility design on developing sites**

Kwan Tun Lee<sup>1\*</sup>, Meng-Chiu Hung<sup>1</sup>, Chuo-Fang Cai<sup>2</sup>  
Wei-Fan Tseng<sup>1</sup>, Yi-Ping Chan<sup>1</sup>, Ying-Fang Pai<sup>2</sup>, Yu-Han Hsu<sup>1</sup>, Ya-Chi Huang<sup>1</sup>  
Yu-Hsun Liao<sup>1</sup>, Ching-Chu Yu<sup>1</sup>, Nai-Kuang Chen<sup>1</sup>, He-Chung Lin<sup>1</sup>, Kuo-Feng Tseng<sup>1</sup>  
Wei-Chen Tseng<sup>1</sup>, Huan-Yuan Chen<sup>1</sup>

<sup>1</sup>Geographic Information System Research Center, National Taiwan Ocean University,  
Keelung, Taiwan, ROC.

<sup>2</sup>Architecture and Building Research Institute, Ministry of the Interior, ROC.

\*Corresponding author: [ktlee@ntou.edu.tw](mailto:ktlee@ntou.edu.tw)

**Keywords:** detention facility, web-based platform, hydrological analysis

### **Abstract**

Rapid development of populated urban areas in Taiwan has stimulated the change of hydrological environment in the past twenty years. The land development has resulted in increasing the runoff peak and shortening the time to peak discharge, which reduce the resilience of cities during severe rainstorms. Considering that engineering measures may not be easy to implement in populated cities, detention facilities installed on building basements have been proposed to compromise the increase of surface runoff resulting from development activities. In this study, a web-based operational platform has been developed to integrate the GIS technologies, hydrological analyses, as well as relevant regulations for the design of detention facilities. The design procedure embedded in the system includes a prior selection of the type and size of the detention facility, integrated hydrological analysis for the developing site, and inspection of relevant regulations. After login the platform, designers can access the system database to retrieve road maps, land use coverages, and sewer network information. Once the type, size, inlet, and outlet of the detention facility are assigned, the system can acquire the rainfall intensity-duration-frequency information from adjacent rain gauges to perform hydrological analyses for the developing site. The increase of the runoff volume due to the development and the reduction of the outflow peak through the construction of the detention facility can be estimated. The outflow peak at the target site is then checked with relevant regulations to confirm the suitability of the detention facility design. The proposed web-based platform can provide a concise layout of the detention facility and the drainage way of the developing site on a graphical interface. The design information can also be directly delivered through a web link to authorities for official inspection to simplify complex administrative procedures.

## Using Probabilistic Seismic Hazard Analysis in Assessing Seismic Risk for Taipei City and New Taipei City

Ming-Kai Hsu<sup>1</sup>, Yu-Ju Wang<sup>2</sup>, Chin-Tung Cheng<sup>3</sup>, Kuo-Fong Ma<sup>1</sup>, Ke Siao-Syun<sup>4</sup>

<sup>1</sup>Department of Earth Sciences, National Central University, Taiwan  
Principal contact for correspondence: kensheu2002@gmail.com

<sup>1</sup>kuofongm@gmail.com

<sup>2</sup>Institute of Nuclear Energy Research, Atomic Energy Council, Executive Yuan, Taoyuan City, Taiwan - <sup>2</sup>wangzu885@gmail.com.tw

<sup>3</sup>Disaster Prevention Technology Research Center, Sinotech Engineering Consultants Inc., Taipei City, Taiwan - <sup>3</sup>ctcheng@sinotech.org.tw

<sup>4</sup>opbook@ncdr.nat.gov.tw

**Keywords:** seismic hazard, seismic risk, exposure, structural vulnerability, fragility

### Abstract

In this study, we evaluate the seismic hazard and risk for Taipei city and new Taipei city, which are important municipalities and the most populous cities in Taiwan. The evaluation of seismic risk involves the combination of three main components: probabilistic seismic hazard model, exposure model defining the spatial distribution of elements exposed to the hazard and vulnerability functions capable of describing the distribution of percentage of loss for a set of intensity measure levels. Seismic hazard at Taipei city and New Taipei city assumed as the hazard maps are presented in terms of ground motion values expected to be exceeded at a 10% probability level in 50 years (return period 475 years) and a 2% probability level in 50 years (return period 2475 years) according to the Taiwan Earthquake Model (TEM), which assesses two seismic hazard models for Taiwan. The first model adopted the source parameters of 38 seismogenic structures identified by the TEM geologists. The other model considered 33 active faults and was published by the Central Geological Survey (CGS), Taiwan, in 2010. The 500m by 500m Grid-based building data were selected for the evaluation which capable of providing detail information about the location, value and vulnerability classification of the exposed elements. The results from this study were evaluated by the Openquake engine, the open-source software for seismic risk and hazard assessment developed within the global earthquake model (GEM) initiative. Our intention is to give the first attempt on the modeling the seismic risk from hazard in an open platform for Taiwan. An analysis through disaggregation of hazard components will be also made to prioritize the risk for further policy making.

## **Integrated Real Estate Registration and Chinese NSDI to Strengthen the Government Spatial Data Management**

Chengfeng Luo<sup>1</sup>, Minghui Hao<sup>2</sup>, Joep Cromptvoets<sup>3</sup>, Bastiaan Van Loenen<sup>4</sup>

<sup>1,2</sup>Chinese Academy of Surveying and Mapping, P.R. China

<sup>3</sup>KU Leuven, Public Management Institute, Brussels, Belgium

<sup>4</sup>Delft University of Technology, OTB Research Institute for Housing, Environment and Mobility Studies, Delft, the Netherlands

<sup>1</sup>Principal contact for correspondence: [chfluo@163.com](mailto:chfluo@163.com)

<sup>2</sup>[haomh@casm.ac.cn](mailto:haomh@casm.ac.cn), <sup>3</sup>[joep.cromptvoets@soc.kuleuven.be](mailto:joep.cromptvoets@soc.kuleuven.be), <sup>4</sup>[B.vanLoenen@tudelft.nl](mailto:B.vanLoenen@tudelft.nl)

**Keywords:** NSDI, China, real estate registration, government spatially management

### **Abstract**

The China Government enacted the Provisional Regulations on Real Estate Registration (RER) in July 2015. These regulations were in full operation from the beginning of 2016. In this context, real estate refers to land, sea, houses, trees and other fixed objects which have spatial distribution and are subject to social and economic activities in the same time. The RER provides opportunities to strengthen the Chinese National Spatial Data Infrastructure (NSDI), because the RER involves spatial information which can be shared with stakeholders of the NSDI. The paper explores the relationship between the Chinese NSDI and RER in order to find a mutual way to inspire their developments in the same time. This exploration includes several issues. First, a clear definition of sharable information is necessary which helps to reduce data duplication and extend the application of Chinese NSDI. Second, there must be a common recognition and strong coordination among powerful ministries which can improve the adjustment of business processes. Third, reasonable mechanisms and feasible approaches should be explored from different perspectives to underpin the spatial governance level. Fourth, government administrators must achieve the strategic benefits of integrating RER and NSDI from multiple perspectives, and fifth the influence and profile should be evaluated based a long term consideration. The development of NSDIs is a dynamic process and the performance of RER is a key point for the Chinese NSDI. By integrating RER, the Chinese NSDI can penetrate to the actual process of government management and improve the capability of spatially assistant decision-making.

## Worldwide status of national geoportals 2016

Joep Cromptvoets<sup>1</sup>, Bastiaan van Loenen<sup>2</sup>, Roos Teeuwen<sup>2</sup>

<sup>1</sup> KU Leuven, Public Management Institute, Leuven, Belgium

<sup>2</sup> Delft University of Technology, OTB Research Institute for Housing, Environment and Mobility Studies, Delft, The Netherlands

<sup>1</sup>joep.cromptvoets@soc.kuleuven.be; <sup>2</sup>B.vanLoenen@tudelft.nl

**Keywords:** Spatial Data Infrastructure, national geoportals

### Abstract

A geoportal is a type of web portal that is used to find and access geographic information and associated geographic services (e.g., display, editing, analysis) via the Internet. Geoportals are important for the effective use of geographic information systems (GIS) and are a key element of Spatial Data Infrastructure (SDI) (Cromptvoets, 2016).

Over the last two decades, many governments and private companies have invested tens of billions of US Dollars in the development of geographic information, largely to serve specific communities (e.g., agriculture, urban/rural planning, and mining) within local, state, national, international, and even global contexts. The focus has increasingly shifted towards a platform for integrating geographic information by means of SDIs. SDIs facilitate access to existing geospatial data and services necessary to successfully use GIS. Moreover, SDIs facilitate the exchange and sharing of geospatial data between stakeholders within the geographic information community. This community mainly includes mapping agencies, universities, governmental and nongovernmental organizations, and private companies.

Geoportals can be considered as gateways to SDI. They are not a repository where data are simply stored, but can be seen as a one-stop shop for geospatial data, sourced from numerous agencies. The performance of geoportals can vary enormously depending on numerous factors, such as the functionalities offered, the quality of the information offered, and a user's capacity. In 1994, the US Federal Geospatial Data Committee (FGDC) established the National Geospatial Data Clearinghouse, aimed at facilitating efficient access to the overwhelming quantity of existing geospatial data (from federal agencies) and coordinating its exchange, with the objective of minimizing duplication (in the collection of expensive geospatial data) and assisting partnerships where common needs exist. The NGDC is considered the earliest implementation of a geoportal. Since 1994, the number of countries implementing national geoportals has steadily grown. As of February 2014, around 120 countries have an operational national geoportal in place and 12 countries initiated projects to launch a geoportal in the short-term (Cromptvoets, 2016). Most countries in Asia, Europe, the Middle-East, Oceania, North America, and South America have established a geoportal for their nation, whereas most countries in Africa still have not established such a portal. However, several African initiatives to launch national geoportals appear promising. These national geoportals are evolving worldwide in tandem with national SDIs. A body of literature published in scientific/popular journals and conference proceedings describe the existing experiences (e.g., see conference papers of the Global Spatial Data Infrastructure Association).

National geoportals are continuously evolving. In this context, it is important to have a longitudinal perspective when establishing and maintaining national geoportals. A first detailed study of monitoring all national geoportals worldwide started in 2000 (Crompvoets, 2016). This paper presents the worldwide status of national geoportals in 2016.

### References

- Crompvoets, J., 2016. Geoportals. In: D. Richardson, N. Castree, M. Goodchild, W. Liu, A. Kobayashi, & R. Marston (Eds.), *The International Encyclopedia of Geography: People, the Earth, Environment, and Technology*. Hoboken, NJ: Wiley/Association of American Geographers.

## Qualitative disaster information delivery through cloud technology

James Yichu Chen<sup>1</sup>, Meng-Han Tsai<sup>2</sup>, Tzong-Hann Wu<sup>3</sup>, Shiang-Wen Yang<sup>4</sup>, Shih-Chung Kang<sup>5</sup>

Department of Civil Engineering, National Taiwan University, Taiwan

<sup>5</sup> Principal contact for correspondence: skc@caece.net

<sup>1</sup>yie@yie.cc, <sup>2</sup>menghan@caece.net, <sup>3</sup>doo79824@caece.net, <sup>4</sup>kentony0531@gmail.com

**Keywords:** countering decision making, disaster data/information, delivery system, customize

### Abstract

When countering disaster, the disaster prevention unit requires to compile and analyze real time precipitation and disaster information from different locations in Taiwan immediately to conduct countering decision in time. These data are mostly presented in the PowerPoint format reports and delivered in hard copies (print outs). Producing PowerPoint and printing consume massive amounts of time, therefore they are unable to update and deliver the latest disaster information. This results in the insufficiency on the instantaneity and accuracy of disaster data, and thus incapacitating the efficiency of countering decision. To solve this lacking synchronicity in data, this study developed a qualitative disaster information delivery system (Disaster Show, D-Show in short). We first attempted to digitalize the paper works and developed D-Show (Alpha) through the existed internet photo album application. D-Show was introduced to the actual disaster countering operation in 2010 and solved the data synchronization problem. After 4 years of actual disaster prevention experience, however, we found that D-Show (Alpha) carry issues on management, presentation and operation, three aspects. Thus, we further developed D-Show (Beta) by adopting cloud technology. On management, D-Show (Beta) provided system with speeded deployment mechanism that largely reduced the time required for system initial setting and follow-up update; and structuralized data naming principle to increase the convince for managing data. On presentation, D-Show (Beta) was able to conduce the sequencing and identifying of the disaster data, allowing the disaster data to be presented more intuitively. And on operation, D-Show (Beta) allowed user to perform customized disaster data marking and exploration for disaster countering decision judgment and analysis. The research team conducted a practicality testing in 2015 to verify D-Show (Beta) developed in this study. On the annual D-Show update, each device only took 3 minutes to update, which was 70% less time consuming than D-Show (Alpha). During Typhoon Noul in 2015, D-Show (Beta) took only 2 minutes to file 150 briefing reports (in PowerPoint format), saving 98% of the filing time.

## Arctic Spatial Data Infrastructure (Arctic SDI)

Heli Ursin  
National Land Survey of Finland, Finland  
heli.ursin@nls.fi

**Keywords:** spatial information, SDI, Arctic

### Abstract

The aim of the Arctic SDI (<http://arctic-sdi.org/>) is to provide politicians, governments, policy makers, scientists, private enterprises and citizens in the Arctic with access to geographically related Arctic data, digital maps and tools to facilitate monitoring and decision making. The Arctic SDI is an infrastructure that provides a web portal with easy access to:

- geoportal for geospatial data viewing and discovery
- searchable metadata catalogue
- authoritative reference data as a Web Map Service (WMS)
- thematic data

The Arctic Spatial Data Infrastructure is cooperation between the 8 National Mapping Agencies of Canada, Finland, Iceland, Norway, Russia, Sweden, USA and Denmark. It is based on a voluntary multilateral cooperation and focused on accessible authoritative geospatial reference data. The Arctic SDI Geoportal is based on Oskari (<http://www.oskari.org/>), which is an open source framework - originally developed in the National Land Survey of Finland - for browsing, sharing and analyzing of geographic information, utilizing in particular distributed spatial data infrastructures. The framework is used as a basis of the Arctic SDI Geoportal as well as a significant number of other geoportals, Web GIS applications and e-Government services.

## GIS enabled e-Governance

Bolorchuluun Chogsom<sup>1</sup>, Tsogtdulam Munaa<sup>2</sup>, Narantuya Davaa<sup>3</sup>

<sup>1,2</sup>Department of Geography, National University of Mongolia  
<sup>1</sup>bolorchuluun@num.edu.mn, <sup>2</sup>tsogtdulam@num.edu.mn

<sup>3</sup>Department of Biology, National University of Mongolia  
<sup>3</sup>dnarantuya@yahoo.co.uk

**Keywords:** e-governance, Mongolia, information and communication technologies

### Abstract

E-Governance has broader area of implications. It can be used in various aspects of governance system. With the advancement in the sector of Information and Communication Technologies (ICT), the Governments of economies have stepped forward to adopt e-governance in different service sectors. The growing application of information and communication technologies and their subsequent use on strengthening interaction with citizens has given rise to a new governance paradigm as E-Governance.

The Government of Mongolia declared ICT as one of the key economically important sectors. Approved in 2005 E-Mongolia National Program missions “enhancing people’s life quality by establishing new economic environment, improving country’s competitiveness and providing sustainable development”. Three frameworks dealt within the program that are government-legislation; business-economy; and human development; and four policies of government-to-citizens, government-to-business, government-to-government and infrastructure.

This paper shall review e-governance initiative, actions and challenges faced in the case of Mongolia and develop recommendations.

## **The information society is here: where is the SDI?**

Martin Salzmann

Cadaastre, Land Registry and Mapping Agency of the Netherlands

[martin.salzmann@kadaster.nl](mailto:martin.salzmann@kadaster.nl)

### **Abstract**

In the past 15 years SDI's have been developed, come into operation and matured. At the same time, we have witnessed the emergence and coming of age of the information society. SDI's were originally designed from an infrastructural perspective, whereas the information society is closer to a network based approach.

The good news is that location information is an accepted and much used part of the information society. In the e-Government of the Netherlands half of the key registers have a location component. Our new national Environmental Protection Act will see a full (spatial) digital implementation. Moreover, users are spatially enabled and increasingly the internet of Things (IoT) also make devices and sensors location based.

At the same time, putting geodata on the web means that SDI's enter mainstream data infrastructures. We will discuss our experiences in our extended use of spatial information based on the SDI approach. Especially in the public domain there is still a need to work within a well-defined spatial data infrastructure. Not only at the national level, but also in our regional (European) context where INSPIRE is still a forceful stimulus of opening spatial data. At the same time, we are increasingly working in a generic data and network-environment instead of a dedicated SDI. For the time being we will service both worlds, but we think that in the long run spatial will still be special as a data type, but not special as a data element. This gives us the opportunity to make our offering even more spatially enabled.

## **Risk management methodologies used in railway system - a case study of Alishan Forest Railway in Taiwan**

Tu-Huan Lin<sup>1</sup>, Chian-Shan Suen<sup>2</sup>

Sinotech Engineering Consultants, Inc.

<sup>1</sup>thlin@sinotech.org.tw, <sup>2</sup>james\_suen@sinotech.org.tw

**Keywords:** risk management, railway system, hazard database

### **Abstract**

Regarding risk management in railway systems, a series of methodologies in the European standard EN 50126 are well defined and applied on many railway systems. The purpose of EN 50126 is to manage hazards throughout the entire V-typed lifecycle, including the design, construction, operation, and all the way to decommissioning. Hazard's causes, mitigations, and residual risk class are updated accordingly during the entire life cycle. In common railway practices, risk management starts at the beginning of the project; thus the hazard database is often built up by system providers and then transferred to operators. Since the providers' duty is to meet the quantitative requirements of safety and availability, and it is difficult to implement quantitative analysis of natural disasters, especially when the provider is not usually held liable, most providers only focus on equipment failure and neglect management of hazards that are beyond our control, such as flooding, earthquake, mudslide, etc. In many cases, these disasters will become the main threats to the system after the handover. It is necessary to recheck the hazard database, reconsider the measurements, and then mitigate the impact of disasters.

The proposed case study was implemented on the Alishan Forest Railway, which is a traditional railway system and has operated for more than 100 years since its establishment. The system is famous for its beautiful high mountain railway and Z-shaped switchback lines. Unfortunately, because parts of the railroads were damaged by typhoons or earthquakes in recent years, these disasters had led to significant rockslides and collapsed tunnel. In order to understand the risk of disasters and required mitigations, this study followed EN 50126 to reconsider the impact of natural disasters and planned to improve the existing hazard database. However, the hazard database does not have data on the Alishan Forest Railway from the beginning, and we needed to take other railway systems into consideration and select for the applicable ones. The discussed hazards and corresponding mitigations will also be entered into the database. The result demonstrates that we can clarify the impact of natural disasters and understand how many possible mitigations the system has. It helps operators to find out the weakness of the system and then prioritizes the action plans. By adopting plan-do-check-act cycle in ISO 31000, the operators could trace the performance of the mitigations during the practical operation, and then modify the action plans to improve the performance. In general, this study achieved in showing how to analyze the risk of disasters systematically, and this methodology could be applicable in both railway systems and other domains.

## The governance of INSPIRE implementation

Joep Cromptvoets<sup>1</sup>, Ian Masser<sup>2</sup>, Glenn Vancauwenberghe<sup>3</sup>

<sup>1,2</sup>KU Leuven, Public Governance Institute, Leuven, Belgium

<sup>3</sup>KU Leuven, Spatial Applications Division, Leuven, Belgium

<sup>1</sup>Joep.cromptvoets@soc.kuleuven.be, <sup>2</sup>ian.massier@soc.kuleuven.be

<sup>3</sup>glenn.vancauwenberghe@kuleuven.be

**Keywords:** Spatial Data Infrastructures, governance, governance instruments, INSPIRE

### Abstract

This paper reviews the ongoing governance efforts of the European Union and its National Member States to create a multinational infrastructure for spatial information in the European Community (INSPIRE) [1]. To achieve this, it is necessary to establish a measure of governance between the users and providers of the information so that information and knowledge can be combined. The effective implementation of infrastructures for spatial information before 2021 requires governance by all those with an interest in the establishment of such infrastructures, whether as contributors or users. By governance we mean the structures, policies, actors and institutions by which INSPIRE is managed through decisions on accessing, sharing, exchanging and using the relevant available spatial information. Appropriate governance instruments [2] which extend to the various levels of government and take account of the distribution of powers and responsibilities within the Member States should therefore be established [3].

In this context, Member States must ensure that appropriate instruments and policy mechanisms are designated for governance, across the different levels of government, the contributions of all those actors and institutions with an interest in their infrastructures for spatial information. These governance instruments and policies will coordinate the contributions of, inter alia, users, producers, added-value service providers and coordinating bodies, concerning the identification of relevant data sets, user needs, the provision of information on existing practices and the provision of feedback on the implementation of this Directive. In turn, the European Commission will be responsible for governing INSPIRE at Community level with the assistance of relevant organizations and such as by the European Environment Agency and Joint Research Centre. To strengthen the governance between the European and Member States levels, a contact point has to be established to be responsible for contacts in relation to this Directive. This contact point is supported by a governance instruments and relevant policies taking account of the distribution of powers and responsibilities with the Member State [1].

This paper systematically reviews the governance of INSPIRE at the European Commission as well as Member State levels based on the qualitative country reports, other implementation evaluation reports [3], and the experiences of the INSPIRE Monitoring and Implementation groups and the Thematic Clusters. The review focuses on the different types of instruments used and how these instruments are used. The review outcomes could contribute to the creation of sustainable platforms that encourage different actors and institutions to participate, to discuss and argue various interests, and to strengthen the collaboration during policy making and implementation.

## References

- [1] Commission of the European Communities, 2007. Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007. Establishing an Infrastructure for Spatial Information in the European Community (INSPIRE). Official Journal of the European Union L108, 1-14.
- [2] Verhoest, K. and G. Bouckaert, 2005. Machinery of government and policy capacity: The effects of specialization and coordination. In: M. Painter (Ed.) Challenges in State Policy Capacity. Springer.
- [3] Masser, I. and J. Crompvoets, 2015. Building European Spatial Data Infrastructures. ESRI Press.

## **Democratization of key public sector information in Zimbabwe - the road towards Open Government?**

Edward Kurwakumire

Tshwane University of Technology, South Africa  
KurwakumireE@tut.ac.za

**Keywords:** democratization, open data, public sector information, e-Government

### **Abstract**

The world today has evolved into an information society. Information is key to the operation of government and all sectors of the economy. Good information is needed to formulate informed decisions. The information needs to be accurate and accessed at the required time. Online access of basic information by citizens through the creation of one stops is the concept that most governments are advocating for. This is known as e-government which is the subject of discussion of this study. This study concentrates on spatial data and Public Sector information. Enhanced access to spatial data and other public sector information has a bearing on good governance, sustainable development and eventually the adoption of open government by nations. A comprehensive study is done in major government departments to determine what public sector information, access mechanisms, interagency exchange and availability of information to the public. Available electronic services are assessed as part of e-government evaluation using a set of indicators. Spatial data access is reviewed from different stakeholders including public sector, local government, Non-governmental organisations and private sector agencies. Factors motivating and impeding organisations to share spatial data and PSI are also analysed. The benefits of sharing key information across government are discussed. This study evaluates spatial data access and key public sector information. E-government is assessed to analyse access of key government services by the public. This readiness is in the end, the key to open government. This study borrows concepts from the fields of Public Administration, E-government, Economics and Spatial Data Infrastructures. The world is building towards knowledge economies in which openness in terms in information, knowledge and governance is crucial. Public participation should be encouraged in planning and governance issues and in the creation of community based spatial data sets.

## **Coastal and Marine SDIs: towards an assessment of the worldwide developments and the related needs for harmonization and coordination**

Jade Georis-Creuseveau<sup>1</sup>, Joep Crompvoets<sup>2</sup>, Roger Longhorn<sup>3</sup>

<sup>1</sup>LETG-Brest Geomer (UMR 6554 CNRS), European Institute of Marine Science, University of Western Brittany, France

<sup>2</sup>KU Leuven, Public Governance Institute, Leuven, Belgium

<sup>3</sup>GSDI Association, Bredene, Belgium

<sup>1</sup>jade.georis-creuseveau@univ-brest.fr, <sup>2</sup>joep.Crompvoets@soc.kuleuven.be,

<sup>3</sup>rlonghorn@gsdi.org

**Keywords:** marine SDI, coastal, marine, geoportal, assessment

### **Abstract**

Due to the intensity and magnitude of changes that characterize marine and coastal areas and the sustainable approaches, such as Integrated Coastal Zone Management (ICZM) and maritime spatial planning (MSP) aiming to manage these territories between different levels of government, and across jurisdictional boundaries, the needs for coastal and marine SDIs are becoming more evident, especially at the national level and in cross-border situations.

Indeed, the integration of different types of information and various sources of knowledge, the preparation of spatial management plans, and the development of scenarios to assess the possible impacts deriving from different coastal uses are the cornerstones of these approaches. Coastal and Marine SDIs contribute to environmental policy By facilitate, access, sharing and use of spatial data related to marine and coastal areas across a broad range of stakeholders by promoting data and metadata harmonization, services interoperability and geospatial community coordination.

Based on a longitudinal web survey and involvement in projects and workshops, this paper sheds light on the current worldwide developments of national and international initiatives related to marine and coastal SDI.

The results suggest that international developments are underway for geoportals enabling users to have access to various data concerning coastal and marine zones. Four types of initiatives were distinguished: Atlas-like geoportals, (2) Hydrographic Office geoportals, (3) Oceanographic/Marine Data Centre geoportals, and (4) Hybrid geoportals. Despite the integrated approach promoted by ICZM and MSP concepts and related regulations, the results indicate that platforms allowing access to a wide range of data related to marine, coastal and land territories are not commonly found. True data harmonization and services interoperability, which are the underpinning principles for SDIs, need to be improved. Best coordinate of the numerous different organizations who are now involved in these marine SDI-related initiatives is also a fundamental issue.

## **Spatial Data Infrastructure in New Brunswick, Canada: Twenty Years on the Web**

David B. Finley<sup>1</sup>, Andrew MacNeil<sup>2</sup>, David J. Coleman<sup>3</sup>

<sup>1,2</sup>Land Information Infrastructure Secretariat, Service New Brunswick, Province of New Brunswick, P. O. Box 1998, Fredericton, NB E3B 5G4, Canada

<sup>3</sup>Department of Geodesy and Geomatics Engineering, University of New Brunswick, PO Box 4400, 15 Dineen Drive, Fredericton, New Brunswick, E3B 5A3, Canada

<sup>1</sup>david.finley@snb.ca, <sup>2</sup>andrew.macneil@snb.ca, <sup>3</sup>drdjc.gmail.com

**Keywords:** SDI, web GIS, Internet, land administration, cadastral, Canada, eGovernment

### **Abstract**

In September 1996, the Province of New Brunswick, Canada became the first jurisdiction in the world to offer World Wide Web-based access to complete and integrated online property mapping, ownership and assessment information covering an entire province or state. Service New Brunswick's Real Property Information Internet Server (RPIIS) was originally developed by Caris/Universal Systems Ltd. (Caris) in conjunction with the University of New Brunswick Department of Geodesy and Geomatics Engineering and with substantial input from Service New Brunswick (SNB) staff. The Caris Internet Server technology on which it was based was recognized, at the time, to be "...the first commercial Internet/mapping GIS" platform.

The paper examines the twenty-year evolution of land information infrastructure refinement in New Brunswick since that time, beginning with the early vision of linking land information with environmental and resource-based information to support improved decision-making. Since 1996, policy and operational issues encountered by SNB included ones related to charging for data, use of geospatial data in eGovernment and eGovernance, data custodianship and incremental updating, involvement of the private sector, and the contrasting "push-pull" between open data initiatives and personal data privacy concerns – issues also faced by other jurisdictions across North America, Europe and Australasia over the same period.

After discussing early initiatives, challenges and issues mentioned above, the paper then tracks and analyzes the changes in Web-based services offered since 1996 in response to a widening and more sophisticated customer base, shifts in government/business relationships, and changes in technologies for data collection, management and communication. The paper concludes with a discussion of current key information initiatives of Service New Brunswick (SNB) and how they pertain to the fulfilment of the original vision.

## **Susceptibility and early warning threshold for rainfall-induced shallow landslide in Taiwan**

Lun-Wei Wei<sup>1</sup>, Chuen-Ming Huang<sup>2</sup>, Wei-Kai Huang<sup>3</sup>, Ching-Fang Lee<sup>4</sup>, Ting-Chi Tsao<sup>5</sup>,  
Chung-Chi Chi<sup>6</sup>

<sup>1,2,3,4,5</sup> Disaster Prevention Technology Research Center, Sinotech Engineering Consultants,  
Inc., Taipei, Taiwan, R.O.C.

<sup>6</sup>Central Geological Survey, Ministry of Economic Affairs, New Taipei City, Taiwan, R.O.C.

<sup>1</sup>wwei@sinotech.org.tw, <sup>2</sup>odin@sinotech.org.tw, <sup>3</sup>wuangwk@sinotech.org.tw,  
<sup>4</sup>cflee@sinotech.org.tw, <sup>5</sup>tctsao@sinotech.org.tw, <sup>6</sup>chitc@moeacgs.gov.tw

**Keywords:** landslide, susceptibility, early warning, rainfall threshold, disaster

### **Abstract**

Landslide is one of the most serious natural disasters that cause casualties and economic loss. In Taiwan, most of the landslides are triggered by heavy rainfall brought by typhoons and monsoons. Thus, the evaluation of landslide susceptibility and the establishment of early warning threshold for rainfall-induced landslide are important issues. This study uses a great quantity of SPOT images before and after 16 typhoon events from 1996 to 2011 for the interpretation of landslides induced by rainfall. We also extract geomorphological characteristics such as gradient, slope roughness, terrain curvatures from 5-meter resolution DEM, and geological characteristics such as rock strength, dip slope, fault density, fold density from 1:50,000 geological map. Besides, rainfall data of each typhoon event is also collected as triggering factor.

Logistic regression is adopted and predisposing factors mentioned above are used for landslide susceptibility analysis in this study. For establishing the early warning threshold for landslides, this study chooses 24-hour accumulated rainfall ( $R_{24}$ ) and the 3-hour mean rainfall intensity ( $I_3$ ) as long-term and short-term rainfall index respectively. The early warning signals are divided into 4 categories including red, orange, yellow and green according to the concept of hazard matrix which contains the magnitude of landslide (landslide susceptibility and landslide ratio of slope units) and the occurrence possibility of landslide (30%, 60% and 90% thresholds determined by historical disaster records). Validation with landslides caused by Typhoon Soudelor (6<sup>th</sup> to 9<sup>th</sup>, August, 2015) in northern Taiwan shows that these thresholds can issue warning signals 1 to 3 hours prior to the occurrence of landslides. This may provide crucial information for the evacuation and reduce damages. An early-warning system is also built in this study for regional land-use planning and disaster prevention.

## **Real-time Public Sentiments Analysis and Information Integration Platform for Disaster Prevention and Victims of Disaster Rescue based on Social Networks**

Nai-Wei Lo<sup>1</sup>, Kuo-Hui Yeh<sup>2\*</sup>, Raylin Tso<sup>3</sup>, Kuo-Yu Tsai<sup>4</sup>, Bor-Shiun Lin<sup>5</sup>

<sup>1</sup>Department of Information Management, National Taiwan University of Science and Technology, nwlo@cs.ntust.edu.tw

<sup>2</sup>Department of Information Management, National Dong Hwa University, khyeh@mail.ndhu.edu.tw

<sup>3</sup>Department of Computer Science, National Chengchi University, raylin@cs.nccu.edu.tw

<sup>4</sup>Department of Management Information Systems, Hwa Hsia Institute of Technology, kytsai@cc.hwh.edu.tw

<sup>5</sup>Sinotech Engineering Consultants, Inc., bosch.lin@sinotech.org.tw

**Keywords:** crowdsourcing, disaster prevention, refugee rescue, public sentiments analysis, social network, semantic model analysis

### **Abstract**

With the rapid advancement of social network services, people tend to exchange and share information online. Massive global information is aggregated promptly and circulated quickly via the social networks, such as Facebook, LINE, PTT and Dcard. How to extract useful information from the social networks to support decision making on public events is one of the most important research issues for Taiwan government. In this paper, we focus on the information integration of disaster events and the analysis of public sentiment on social networks. Three goals are thoroughly investigated. First, we develop an automatic data collecting mechanism to retrieve disaster relevant information from social networks and implement semantic model analysis techniques to extract precise information related to disaster events. Secondly, combining Jieba system, i.e. a Chinese word segmentation utility, and the semantic orientation pointwise mutual information (SO-PMI) algorithm, we implement a sentiment analysis tool to determine public sentiments on social networks via semantic orientation on disaster events. Thirdly, as the data correctness plays a crucial role with the viewpoint of data quality, it is important to provide a judgement mechanism for evaluating the correctness of information retrieved from social networks. We thus propose a crowdsourcing based approach which is based on the masses feedback to verify the correctness of extracted information on social networks.

## **Promotion and Applications of Census Geography in Taiwan: Integration of Social Economic Data into SDI**

Bor-Wen Tsai<sup>1</sup>, Shengming Pong<sup>2</sup>, Hsunwen Wu<sup>3</sup>

<sup>1</sup>Department of Geography, National Taiwan University, Taiwan

<sup>2</sup>Department of Statistics, Ministry of the Interior, Taiwan

<sup>1</sup>tsaibw@ntu.edu.tw, <sup>2</sup>moi1548@moi.gov.tw, <sup>3</sup>moi1010@moi.gov.tw

**Keywords:** national spatial data infrastructure, census geography

### **Abstract**

#### **Background**

SDI (Spatial Data Infrastructure) is the relevant base collection of technologies, policies and institutional arrangements that facilitate the availability of and access to spatial data (GSDI, 2001). The NGIS (National Geographic Information System) is a nation level SDI (NSDI) established by Taiwan government in 1990. Until 2015, 24 data standards and the TGOS (Taiwan Geospatial One Stop), a web service platform for data distribution and service, have been formulated and established. This NSDI has contributed to the efficacy of data sharing. However, social economic data was not included until 2006 because of the inherent nature of privacy concern. In 2006, a Census Geography system for demographic and social economic data was developed by the Ministry of Interior as a part of NSDI. It is a mechanism for demographic and social economic data to be associated with spatial location and aggregated by relevant spatial units (Tsai, et al., 2012). The system comprises a statistical area and six levels of dissemination areas for data provision in terms of different level of detail. This paper reports the promotion and applications of the census geography system. A typical example of actual price registration of real estate transaction is illustrated in details.

#### **Promotion**

Before the census geography system was established, demography and social economic data were aggregated by jurisdictional areas either in text form of digital format or in tabular form of report. Consequently, it is difficult to illustrate spatial distribution or variation of social economic status. However, people are accustomed to use this type of data for a long time. After the completion of implementing census geography system, the Ministry of Interior began to disseminate benefit of this new data form. There are 116 data items have been aggregated and distributed by either 1<sup>st</sup> level or 2<sup>nd</sup> level dissemination areas (Fig.1). Among those data items, 27 items were included in government's open data sets(data.gov.tw) for public use. A portal of the NGIS social economic data was established. Users can produce thematic maps online or download data for advanced analysis. 191590 data has been downloaded until April 2016. In addition, 86 workshops, seminars or forums were held in past five years.

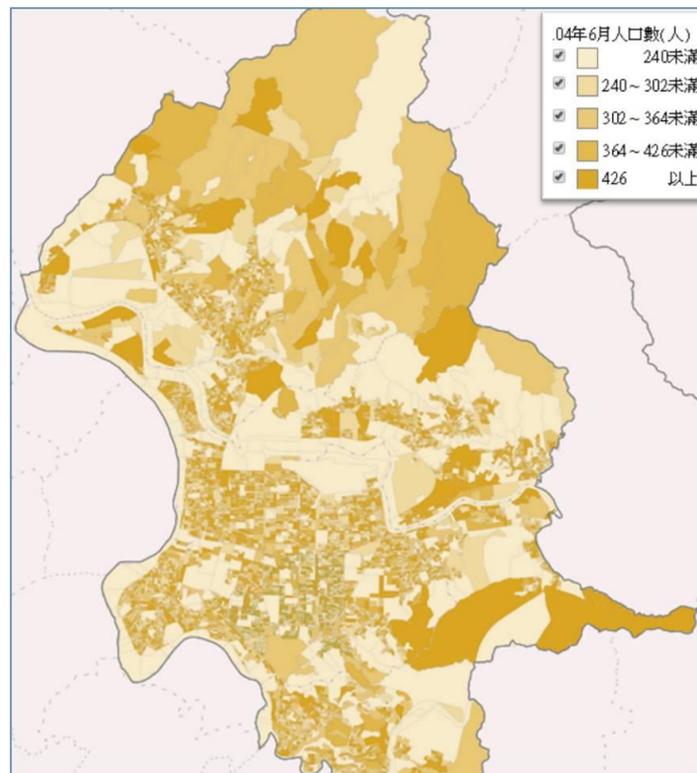


Figure 1. Population Distribution by 1<sup>st</sup> Dissemination Area

## Applications

In consequence, GIS practitioners and researchers are getting acquainted with the census geography system and begin to adopt these data on their professional works. Dengue fever prevention (Fig. 2), vulnerable people estimation (Fig.3), and population exposure assessment in potential flood area are significant examples. The price information of real estate transaction system is a newly established service. The real estate market for house or land is not transparent traditionally. Since real estate price rose accelerating in the past few years, the authority was requested to provide transaction price for better decision making when purchasing a house or land. However, privacy issue must be taken into consideration. The original system moves the transaction location arbitrary to secure privacy (Fig. 4). In this case, the price may not reveal relevant information. The alternative method is to aggregate transaction prices by census geography. Figure 5 shows average transaction prices presented by the 2<sup>nd</sup> dissemination area. The average price of a small area provides more accurate information than any single transaction event. People can make a better decision.

## Conclusion

Census geography is a part of the Taiwan NSDI specific for demographic and social economic data. After the completion of the system implementation in 2012, the Ministry of Interior has put much efforts on promotion. GIS practitioners and researchers has begun to adopt this new form of data. Many applications have been conducted. The census geography system has proven to be beneficial to government decision-makers and researchers in terms of the discovery of spatial characteristics of demographic and social economic data. The privacy of individuals is secured as well.

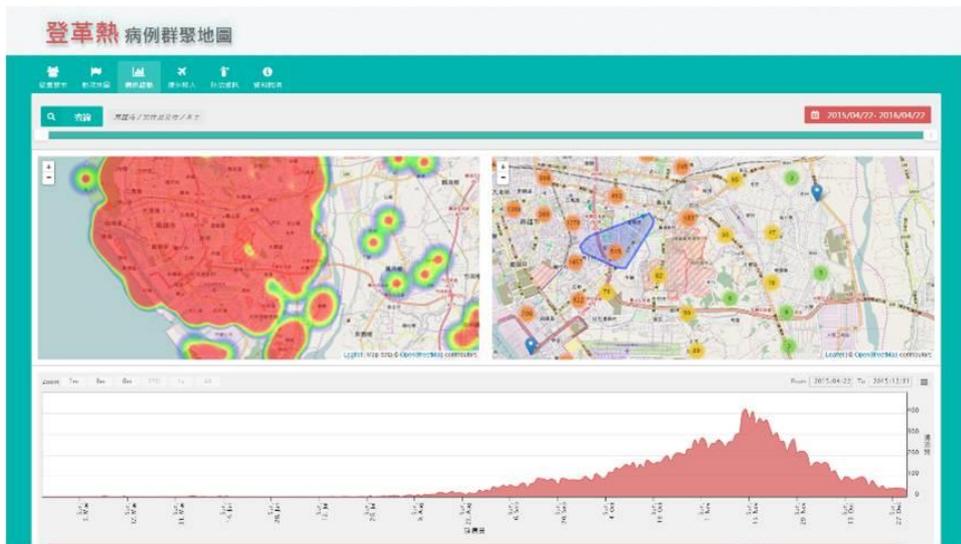


Fig. 2  
Population  
Distribution in  
Dengue Hot  
Spots

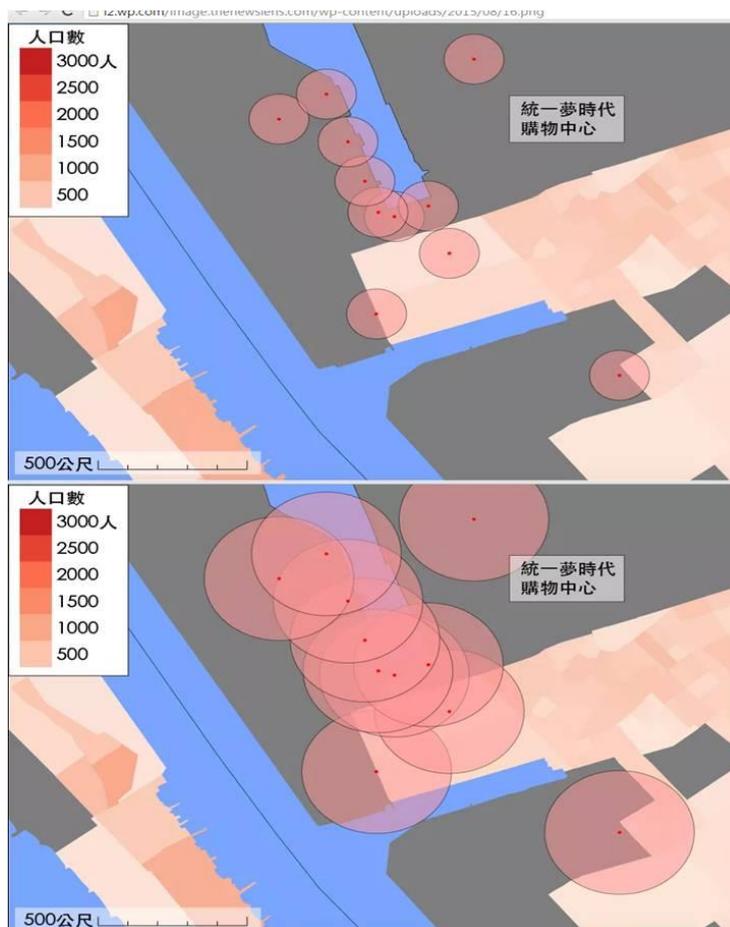


Figure 3. Vulnerable  
People Estimation



Fig.4 Query of Real Estate Transaction



Fig.5 Average Transaction Price by the 2<sup>nd</sup> Dissemination Areas

## References

- GSDI (2001) The SDI Cookbook, ver.2, in D. Nebert eds., Washington D.C.: SDI
- Tseng, Ya-Ping, Lin, Mei-Chun and Su Ming-Daw (2014) Integrating Dengue Case into Spatial Statistical Area and Classification System for Hotspot Analysis, Journal of the Chinese Statistical Association, 52(3):379-396.

- Tsai, Bor-Wen, Chen, Chin-Hong and Shen, Jeremy (2012) Establishment of the Census Geography in Taiwan, GSDI 13, Quebec: GSDI.
- The Price Information of Real Estate Transaction System, Ministry of Interior, <http://lvr.land.moi.gov.tw/login.action>

## Development of a location-based real time air quality alert system

Bor-Wen Tsai<sup>1</sup>, Yu-Feng Chien<sup>2</sup>

<sup>1</sup>Professor, Department of Geography, National Taiwan University

<sup>2</sup>Research Assistant, Academia Sinica

### Abstract

#### Background

Air pollution is a crucial issue for residents' health in urban areas. Many sources may cause air pollution such as sandstorm, industrial emission, or motor vehicles. Taipei city is the capital of Taiwan with more than 2.5 million population. The main source of air pollution comes from 1.8 million registered motor vehicles and additional vehicles from nearby townships. The monitoring and warning system becomes the most urgent service by the city government. The Taiwan Environmental Protection Agency (EPA) has implemented 60 air quality monitoring stations in the whole island (<http://taqm.epa.gov.tw/taqm/tw/default.aspx>). However, there are only 6 stations locate in Taipei city. In consequence, residents in Taipei do not have sufficient information to escape from air pollution in commuting.

#### Method

An alternative monitoring system was developed in this study. This study employs the emerging GIS (geographic information system) LBS (location-based service) technology to incorporate real-time traffic data provided by the Department of Transportation, Taipei City Government. The carbon monoxide emission for each street segment is calculated from the data ([http://teds.epa.gov.tw/new\\_main1-2.htm](http://teds.epa.gov.tw/new_main1-2.htm)). Then, the emission is translated to pollution concentration based on the concept of street canyon (Qin and Kot, 1993; Barrefors, 1996). The spatial estimation of the pollution concentration from motor vehicle is verified by comparing with the 6 EPA monitoring stations. Finally, an Android-based mobile application (APP) is developed to provide real-time alert when walking or driving in an air-polluted area.

#### Result

The estimated pollution concentration data is compared with monitoring data on hourly basis in terms of weekday and weekend. Fig 1 and Fig 2 show the results of Station VELJA00 for weekday and weekend respectively as an example. Results show a slightly systematic difference between estimated and monitoring data. The maximum difference for weekday and weekend is 0.55 ppm and 0.56 ppm respectively. This difference can be attributed to the ignorance of micro climate.

A location-based real time air quality alert system is developed. An air quality map will show on screen with different colors indicating different pollution levels. In addition, The APP will give a sound warning when approaching a 100-meter buffer zone of a polluted street segment (Fig. 3).

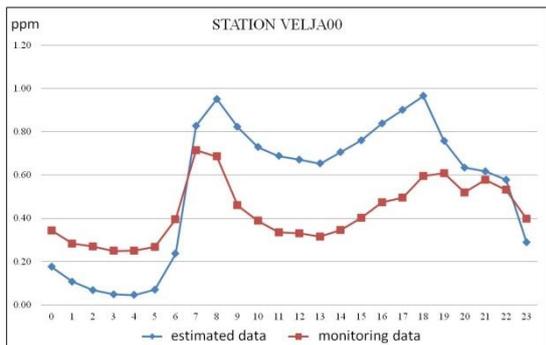


Fig. 1 comparison for weekday data

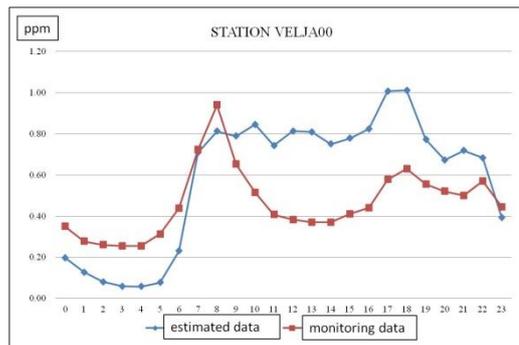


Fig.2 comparison for weekend data

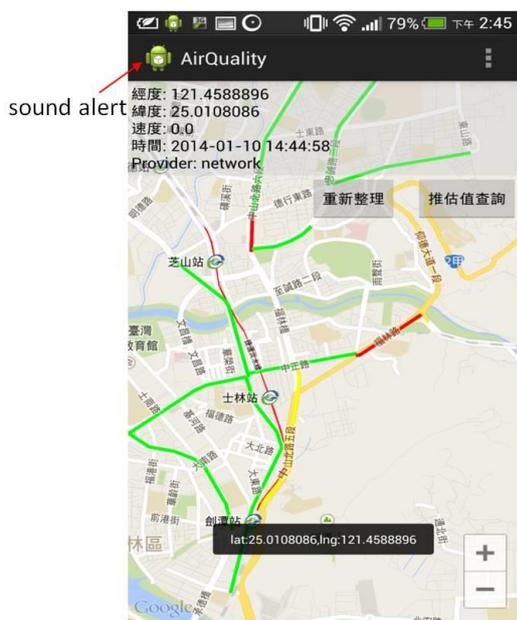


Fig. 3 a LBS real time air quality APP

References

- Barrefors, G. (1996) Air pollutants in road tunnels. Science of The Total Environment, 189–190: 431-435.
- Qin, Y. and Kot, S. C. (1993) Dispersion of vehicular emission in street canyons, Guangzhou City, South China (P.R.C.). Atmospheric Environment. Part B. Urban Atmosphere, 27(3): 283-291.

## Exploiting Synergies between Land and Marine SDI

Andrew Maurice Coote

ConsultingWhere Ltd, London, United Kingdom

andrew.coote@consultingwhere.com

**Keywords:** spatial data infrastructure, management, economic value, marine

### Abstract

The traditional divide between land and sea in terms of acquisition technology is beginning to disappear. Advances in satellite and Light Detection and Ranging (LiDAR) technologies have the potential to provide “fit for purpose” data across the coastal zone. Furthermore, many of the strategic issues for SDI development, including overall national policy, governance and information management are common to both the land and marine domains. Some of the strategic challenges include ontologies, standards for interoperability, assessing economic value, data accessibility, human capacity and governance arrangements.

The author has recently been working internationally on several national-scale projects that aim to take a holistic view of Spatial Data Infrastructures, bridging the traditional divide between marine and land-focused efforts. He will outline some of the key learnings from this work illustrated with examples of best practice.

These experiences have revealed many opportunities for synergies between the communities. They are pertinent and timely in a period where the roles of National Mapping Agencies (NMAs) and Hydrographic Authorities are under scrutiny in many countries.

To this background, he will begin by considering the economic drivers which are push factors for more integrated approach. These include the need internally within SDI-lead organisations for efficiency and externally for the link between socio-economic development and SDI to be more clearly articulated. The consequent impact on national policy frameworks and how these play out through organisational re-structuring and information management will then be examined. The final part of the presentation will focus on how respective communities can work more closely together and in the process become more relevant and visible in a world of rapidly changing requirements.

## Geoscape - Capturing Australia's Built Environment

Dan Paull<sup>1</sup>, Kate Mann<sup>2</sup>

PSMA Australia, Australia

<sup>1</sup>dan.paull@psma.com.au, <sup>2</sup>kate.mann@psma.com.au

**Keywords:** spatial data infrastructure, building footprint, roof area, elevation, satellite based sensors, Geoscape

### Abstract

Geoscape is a new location dataset for Australia that will capture the observed built environment for the entire continent and anchor it in a reliable geospatial base. While derived from a variety of terrestrial and satellite based sensors, it is a dataset to support analytics at the continental level. Geoscape is being funded and developed by Australia's national mapping data provider, PSMA Australia. The dataset includes 3D building attributes, land cover, tree heights, and elevation. Geoscape also captures features such as roof materials, swimming pools and solar panels. Geoscape will link together numerous attributes to build up a greater understanding of what exists at every address in Australia - buildings, building attributes and land cover. Geoscape's scale and scope is unprecedented. The first capture phase for the Adelaide region is now available and covers some 16,000 square kilometres and includes a mix of urban, peri-urban and rural areas. Full delivery of Geoscape in 2017 will provide location, distribution and physical characteristics for over 15 million structures across 7.6 million square kilometres. Geoscape is a dataset to support analytics at the continental-scale and will provide easily extractable information to empower government decision-making, urban and regional planning, risk estimation, and emergency response. This makes the availability of Geoscape an exciting milestone in the support of Australia's digital economy.

For more information, see <http://www.psm.com.au/geoscape>.

## **Serving feature-based topographic maps for facilitating cross-domain applications in SDI**

Jung-Hong Hong<sup>1</sup>, Chin-Sung Yang<sup>2</sup>

Dept. of Geomatics, National Cheng-Kung University, Taiwan, R.O.C.

<sup>1</sup>Associate Professor - junghong@mail.ncku.edu.tw

<sup>2</sup>PhD. Student - struts@geomatics.ncku.edu.tw

**Keywords:** topographic map, feature, SDI, cross-domain

### **Abstract**

The development of domain applications often requires a tremendous volume and a wide variety of data from different resources. A well-developed Spatial Data Infrastructure (SDI) can successfully meet such sharing demands. To spatially enabling the use of domain data, we argue topographic maps can play an active role in the SDI and should be aggressively shared with all participants to reduce unnecessary and duplicated investments, and improve the quality and consistency of the cross-domain applications. This paper presents a feature-based service mechanism, such that users from other domains can take full advantages of the high-quality topographic map data in their applications. The distributed topographic features are designed following a standardized and self-describe principle, such that users can acquire fundamental information, as well as correctly interpret auxiliary information, e.g., semantics, technical specification and data quality, for further operation references. As topographic map data includes a large volume of continuously updated data depicting the phenomena in the real world, this mechanism offers a sustainable foundation for bridging the supply-and-demand communication between participating domains and in the meantime establish a solid and common spatial reference for the NSDI.

## **Application of Radar Imaging Technology for Hillslope Disaster Assessment**

Chun-Kai Chen<sup>1</sup>, Bor-Shiun Lin<sup>2</sup>, Cheng-Yang Hsiao<sup>3</sup>

Disaster Prevention Technology Research Center, Sinotech Engineering Consultants, Inc.,  
Taiwan

<sup>1</sup>ckchen@sinotech.org.tw, <sup>2</sup>bosch.lin@sinotech.org.tw, <sup>3</sup>darryl@sinotech.org.tw

**Keywords:** radar, disaster assessment, landslides

### **Abstract**

Affected by the recent anomalous global climate and frequent typhoons as well as storms during the flood seasons, Taiwan's rainfall is one of the highest in the world. Extreme rainfall events with long duration and high intensity, which cause sediment hazards such as landslides, debris flows, and river siltation are very common. These affect the safety of irrigation facilities and threaten the lives and property of nearby residents besides causing immediate economic loss.

Relevant data collection after major natural disasters is often very urgent due to the necessarily for disaster relief; therefore, remote sensing technology is often used internationally to conduct post-disaster data collection and wide-scope data surveys. Currently, the most widely used satellite-based remote sensing methods in Taiwan are optical in nature. However, after typhoons or storms, clouds often appear and mask the target for several days, which affects the availability of optical satellite images for analysis. This all-weather imaging capability can accomplish the objective of post-disaster real-time data collection better than optical satellite.

This study attempted to collect radar monitoring system specifications and operational data as well as to establish satellite SAR image pre-processing, satellite SAR image detecting technology, and radar imaging detecting technology at hillslope disaster variation point and radar technology to detect hillslope disaster elevation SAR variation. These have been successfully applied on actual cases. This study concludes that SAR can be utilized as:

1. Satellite radar image pre-processing technology: which targets repeatedly observed pre- and post-disaster radar images and searches for large quantities of conjugate points that are evenly distributed and highly reliable to conduct automated matching process. At the same time, it also targeted Taiwan's terrains to create localized radar pre-processing operation workflow to produce accurate ortho-rectified image and digital terrain model information, aiding environmental variation detection and increase the overall efficiency.
2. Satellite radar imaging in hillslope disaster change point detecting technology: After radiometric correction, image ortho-rectification, and filtering processing, ortho-rectified SAR image can be complemented with automated image identification technology to establish hazard change point detecting technology to quantify and assess hillslope disaster change's area.

3. Satellite radar technology observing hillslope disaster elevation change: establish hillslope disaster elevation change technology such as phase comparison method and digital terrain subtraction method to observe and then generate digital terrain models, landslide earth volumes, elevation change volume, and stream-way change suitable for Taiwan to obtain the quantified post-disaster data.

## **Application of multi-scale monitoring to evaluate sediment transport and remediation efficiency in Shih-Men reservoir watershed**

Bor-Shiun Lin<sup>1</sup>, Chun-Kai Chen<sup>2</sup>, Cheng-Yang Hsiao<sup>3</sup>

Disaster Prevention Technology Research Center, Sinotech Engineering Consultants, Inc.,  
Taiwan

<sup>1</sup>bosch.lin@sinotech.org.tw, <sup>2</sup>ckchen@sinotech.org.tw, <sup>3</sup>darryl@sinotech.org.tw

**Keywords:** multi-scale monitoring, sediment transport, remediation efficiency

### **Abstract**

#### **Introduction**

This study utilized the multi-scale monitoring technology which incorporated field investigations to establish reliable real-time data for validating the efficiency of Shih-men watershed's management project. The management project aims to reveal vegetation recovery, extent of soil and water conservation, and the reduction of sediment yields as well as to mitigate the sediment disasters and trace topological changes. The results show that all of the engineered watersheds have met the above expected targets and that sediment discharges are under control.

#### **Background**

The recent global climate change dramatically increased natural disasters. Of those, many were compound disasters. In northern Taiwan, Shih-men Reservoir (see fig. 1) is a critical infrastructure that provides potable water to resident. Shih-Men Reservoir began operation in June, 1964. During the flood seasons of 2001 to 2005, typhoons Toraji, Nari, Aere, Haitang, Matsa, Talim, and Longwang struck Taiwan and caused serious sediment disasters. Masses of sediment were washed into the reservoir, resulting in increased turbidity both in the reservoir and rivers within the watershed. This far exceeded the capacity of the Shih-Men water treatment plant, triggering a severe water shortage. It had tremendous impacts on the Taiwan public and industry. To solve this problem, Legislative Yuan passed "Special Statute for managing and remediating Shih-Men Reservoir watershed and its catchment area.

In accordance with the "2006 to 2011 Shih-Men Reservoir Watershed and its Catchment Remediation Plan" relevant agencies were asked to propose multipurpose remediation plans. The primary goals of the proposed plans are to reduce reservoir turbidity levels, extend the life of the dam and improve remediation efficiency. Watershed conservation and remediation can be separated into two periods: The first period was implemented from 2006 to 2009 and primarily focused on the remediation of exposed landslide scarps and placement of check dams. The second period was implemented from 2009 to the current year, 2011, and was primarily focused on the vegetative recovery of slopes. The study aims to uses a multi-scale monitoring technique paired with field measurements to produce time referenced sediment migration data and then uses this data to validating the efficiency of Shih-men watershed's management project.

## Study Area

Sule catchment is a typical remediation area. Sule River is situated in Fuxing Township of Taoyuan County. It intersects the Sule Bridge on Provincial Road Tai 7 Line. The watershed area is approximately 5.96 km<sup>2</sup>. The recent typhoons and heavy rains have caused a series of disasters, triggering serious sedimentation and erosion in the watercourse. Debris destroyed Sule Bridge, its surrounding farms, and nearby roads several times. Since 1996, the Sule watershed has been frequented by many typhoon rains. However, of those typhoons, three caused major landslide and debris flows to occur: Typhoon Aere (2004/08/23), Typhoon Haitang (2005/07/16) and Typhoon Matsa (2005/08/03). Rains associated with these storms exceeded the 24-hour rainfall of a 10-year storm in Taiwan. Rainfall patterns associated with typhoon Matsa were especially intense and caused rapid stream height increases and landsliding in the source area of the Sule catchment. These intense rainfalls also reduced shear strengths of soils and caused shallow slope failure in the weathered rock of the source areas and serious sediment disasters. Rainfall associated with Typhoon Aere were also incredibly intense. 24 hour accumulated rainfall exceeded 1000 mm and caused the most serious damage to the Sule watershed. Stream banks simultaneously failed and the downstream Sule bridge was swept away by resulting debris flow. After Typhoon Aere, SWCB started to plan remediation engineering for the environmental restoration. Since 2006, and the initiation of the Shimen reservoir remediation plan, six separate engineering works have been completed in the Sule catchment. 4. The aim of the projects has been divided into two categories: Debris flow restoration works and debris flow re-construction works. Those works included check dam, river bed foundation, and riverbank retaining wall construction as well excavation of deposited sediments. At the same time, monitoring was performed for evaluating the remediation efficiency. The following section will introduce how to use multi-scale monitoring to validate the above.

## Multi-scale monitoring

Multi-scale monitoring was to use in Shih-men reservoir watershed to study remediation efficiency and the topographical changes before and after remediation and flood seasons. This allows for comprehensive understanding of sediment changes and sediment yield estimation to quantify the remediation efficiency. This study estimated both local and overall sediment productions, including using erosion pin to monitor soil loss on different surfaces. Telemetry was complemented by airborne LiDAR to calculate failure volume and sand trapping capacity. High-resolution images from multiple periods were used to study the extent of surface vegetation to demonstrate the effectiveness of watershed remediation and restoration

## **Earthquake probability assessment for the active faults in Taiwan**

Yirui Lee

Sinotech Engineering Consultants, Inc., Taiwan

yirui@sinotech.org.tw

**Keywords:** active fault, logic tree, earthquake probability model

### **Abstract**

Due to the fast plate motions, there have been frequent high seismic activities in Taiwan. According to historical records, the most destructive earthquakes in Taiwan were mainly caused by inland active faults. The Central Geological Survey (CGS) of Taiwan has been publishing active fault maps in Taiwan since 1998. It has 33 active faults in the 2012 active fault map.

After the Chi-Chi earthquake, CGS launched a series of projects to investigate the details to better understand each active fault in Taiwan. We gathered these collected data for developing active fault parameters, and referred to certain experiences from Japan and United States to establish a methodology for earthquake probability assessment via active faults.

The first step is to collect the fault parameters, which include fault geometry (length, rupture depth, and dip), segmentation, and slip rate. We calculated the characteristic earthquake magnitude of each fault by its rupture area. Empirical source scaling equations (e.g., Wells and Coppersmith, 1994; Yen and Ma, 2011) were used for this purpose.

Every possible case considered, we needed to divide fault segment to establish a rupture model. A fault rupture model is a weighted combination of the rupture cases of a fault. The long-term slip rate data can be applied in characteristic earthquake model to obtain the recurrence interval. The gathered data were integrated as a fault parameter table for the following work. We calculated the recurrence interval of earthquake by characteristic earthquake model. Finally, we used appropriate “probability model” to estimate the 30-, 50- and 100-year conditional probability of earthquakes.

Our research is to calculate the earthquake probability of the 33 active faults in Taiwan. The parameters of active faults are important information which can be applied in the following seismic hazard analysis and seismic simulation.

If the parameters of an active fault are not clear when collecting data, we will suggest the Central Geologic Survey a more detailed investigation for this fault. We also might suggest that a fault with high earthquake probability should be monitored constantly and to be paid more attention to prevent and mitigate the earthquake disaster.

## References

- Cheng, C. T., 2002: Uncertainty analysis and de-aggregation of seismic hazard in Taiwan. Ph.D. Dissertation, Institute of Geophysics, National Central University, Chung-Li, Taiwan (in Chinese).
- Cheng, C. T., S. J. Chiou, C. T. Lee, Y. B. Tsai, 2007: Study on probabilistic seismic hazard maps of Taiwan after Chi-Chi earthquake. *Journal of GeoEngineering*, 2, 19–28.
- Cheng, C. T., P. S. Hsieh, P. S. Lin, Y. T. Yen and C. H. Chan, 2015: Probability seismic hazard mapping of Taiwan. *Encyclopedia of Earthquake Engineering*, 1-25.
- Edward H. Field, Glenn P. Biasi, Peter Bird, Timothy E. Dawson, Karen R. Felzer, David D. Jackson, Kaj M. Johnson, Thomas H. Jordan, Christopher Madden, Andrew J. Michael, Kevin R. Milner, Morgan T. Page, Tom Parsons, Peter M. Powers, Bruce E. Shaw, Wayne R. Thatcher, Ray J. Weldon, II, and Yuehua Zeng (Working Group on California Earthquake Probabilities), 2013: The Uniform California Earthquake Rupture Forecast, Version 3 (UCERF3). USGS Open-File Report 2013–1165, 115 pp.
- Ellsworth, W. L., M. V. Matthews, R. M. Nadeau, S. P. Nishenko, P. A. Reasenbergs and R. W. Simpson, 1999: A physically-based earthquake recurrence model for estimation of long-term earthquake probabilities. U. S. Geological Survey, Open-File Report 99-522, 22 pp.
- Headquarters for Earthquake Research Promotion (HERP), 2014: The National Seismic Hazard Maps for Japan 2014 version.
- Working Group on California Earthquake Probabilities 2003 (WGCEP 2003), 2003: Earthquake probabilities in the San Francisco Bay region: 2002-2031. USGS Open-File Report 03-214, 234 pp.
- Working Group on California Earthquake Probabilities 2007 (WGCEP 2007), 2008: The uniform California earthquake rupture forecast, Version 2. USGS Open-File Report 07-1437, 96 pp.
- Wells, D. L. and K. J. Coppersmith, 1994: New empirical relationships among magnitude, rupture length, rupture width, rupture area, and surface displacement. *Bull. Seismo. Soc. Am.*, 84, 974-1002.
- Yen, Y. T. and K. F. Ma, 2011: Source-Scaling Relationship for M 4.6–8.9 Earthquakes, Specifically for Earthquakes in the Collision Zone of Taiwan. *Bull. Seismo. Soc. Am.*, 101(2), 464–481, doi: 10.1785/0120100046.
- Youngs, R. R. and K. J. Coppersmith, 1985: Implications of fault slip rates and earthquake recurrence models to probabilistic seismic hazard estimates. *Bull. Seismo. Soc. Am.*, 75, 939-964.

## **Risk analysis, management and governance of debris flow torrents in Taiwan**

Ting-Chi Tsao<sup>1</sup>, Chih-Hao Hsu<sup>2</sup>, Chen-Yu Chen<sup>3</sup>, Hsiao-Yuan Yin<sup>4</sup>, Hsiao-Yu Huang<sup>5</sup>

<sup>1,2</sup>Disaster Prevention Technology Research Center, Sinotech Engineering Consultants, Inc., Taiwan

<sup>3</sup>Soil and Water Conservation Bureau, Council of Agriculture, Taiwan

<sup>4,5</sup>Debris Flow Disaster Prevention Center, Soil and Water Conservation Bureau, Council of Agriculture

<sup>1</sup>tctsao@sinotech.org.tw, <sup>2</sup>ansonhsu@sinotech.org.tw, <sup>3</sup>cychen@mail.swcb.gov.tw, <sup>4</sup>sammya@mail.swcb.gov.tw, <sup>5</sup>shiaoyue@mail.swcb.gov.tw

**Keywords:** debris flow, Taiwan, risk analysis, risk treatment, risk governance

### **Abstract**

Debris flow hazard had been one of the major slope hazards in Taiwan, through proper risk management and risk governance could effectively reduce the possible losses. This study reviews the spatial distribution of the risk treatments conducted by government agencies in the past 15 years in Taiwan to identify if the villages with high debris flow risk torrents were properly covered. Soil and Water Conservation Bureau (SWCB) is in charge of the mitigation and management of debris flow hazards in Taiwan. As of 2015, there are 1,673 potential debris flow torrents which distributed in 684 villages around Taiwan and each torrent has been identified with different risk levels (high, medium, low). SWCB has the responsibility to assist the local governments to prevent debris flow hazards by conducting the risk treatments in advance.

Risk is the probability of harmful consequences or expected losses resulting from a given hazard to a given element at danger or peril over a specified time period. In Taiwan, the risk level of enlisted potential debris flow torrents is based on the product of potential degree and protected object degree. The analysis procedure was modified by SWCB and published in 2013. When SWCB went public the information of potential debris flow torrents, the risk classification of each torrent (high, medium, low) were also provided. Of the 1,673 torrents, 485 were classified as high risk, 474 are medium risk, and 714 are low or no risk. 278 villages held at least one high risk torrent, and 406 held only none-high risk (medium or low) torrents.

In this paper, we focus on the debris flow risk governance during the preparedness stage, which reflects the degree of risk awareness before the onset of the hazard. The four risk treatments include:

- (1) Debris flow prevention and evacuation drill (2,160 counts between 2004 and 2014);
- (2) Debris flow education and publicity (675 counts between 2000 and 2014);
- (3) Debris flow disaster resistant community (445 counts between 2007 and 2014);

(4) Debris flow volunteer specialists (1,004 qualified specialists as of 2014).

It could be assumed that the more items or more frequent the treatments were conducted within the village, usually represented the higher degree of risk awareness to the inhabitants, and would reduce hazard losses.

Of the 278 villages holding high risk torrent, 14 did not hold any education and publicity, 83 had never held any evacuation drill, 53 were not yet becoming disaster resistant community, 49 had no qualified volunteer specialists. In total, 2 villages did not hold any of the 4 types of risk treatments.

Agencies could easily understand and monitor the completeness of debris flow risk treatments within each village, thus could screened out those required more attention and adjust the resources to speed them up. For those villages occupy too much resources, some should be release to those urgently needed, thus could better distribute the most needed mitigation efforts to those in need, and to reach the most cost-benefit value.

## References

- Chou J. S., Yang K. H., Cheng M. Y., Tu W. T. (2013). Identification and assessment of heavy rainfall-induced disaster potentials in Taipei City. *Nat. Hazards* 66: 167-190.
- Lin M. L., Wen H. Y. (2006). Potential analysis and mitigation priority assessment of potential debris-flow torrents. *Sino-Geotechnics* 110: 35-44 (in Chinese)
- Schneiderbauer S., Ehrlicj D. (2004). Risk, hazard and people's vulnerability to natural hazards, A review of definitions, concepts and data. Joint Research Centre, European Commission, EUR 21410.
- SWCB (2013). Manual for Potential Debris Flow Torrent Mapping. Soil and Water Conservation Bureau, Nantou, Taiwan.
- Tsao T. C., Lo W. C., Chen C. Y., Cheng C. T., Chen M. C. (2012). Debris flow risk ranking and management - A case study in Taiwan. 12th Congress INTERPRAEVENT 2012, Grenoble, France, 373-384.

## The open data application on real-time transportation information and dynamic vehicle positioning

Shi Shin<sup>1</sup>, Wing Lin<sup>2</sup>, Ming-Chih Hsieh<sup>3</sup>, Chuan-Ying Shiao<sup>4</sup>, En-Fu Chang<sup>5</sup>, Shu-Yu Huang<sup>6</sup>

Sinotech Engineering Consultants, Inc., Taiwan

<sup>1</sup>shin@sinotech.org.tw, <sup>2</sup>winglin@sinotech.org.tw, <sup>3</sup>sssssss@sinotech.org.tw,  
<sup>4</sup>chuaning@sinotech.org.tw, <sup>5</sup>efchang@sinotech.org.tw, <sup>6</sup>syhuang@sinotech.org.tw

**Keywords:** spatial information, transportation, open data, web services, geographic information

### Abstract

Due to the rapidly increasing popularity of mobile devices and cloud services, the trend toward web service utilization has recently become widely adopted in many spatial information applications. Within the great variety of spatial information, transportation data are very relevant to our everyday lives. In addition, transportation data are required by many and have plenty of location-based useful information. Through the frequent usages of GPS, tracking, and navigation functions on mobile devices, spatial data based applications have acquired a great deal of attention across governments and enterprises. There are numerous convenient applications now becoming accessible online continuously. Transportation mobile applications are also growing fast in the smartphone app stores.

Along with the global evolution in increasing public resources on social activities, promotion of government open data has become a mainstream policy in almost every developed country, and has achieved several significant accomplishments. According to the Open Data Index evaluation by Open Knowledge Foundation at United Kingdom in 2015, Taiwan has jumped to the top level globally. There is a multitude of open data, especially the real-time and practical information, provided by Taiwanese government. Therefore, this article attempted to use the TGOS SOA services and Open Data as data sources, combining GPS function of mobile devices to develop a basic LBS application. The application focuses on transportation information, to provide easy, speedy, and integrated information services.

This article selects public transportation systems around Taipei as a case study, choosing several common query functions to develop a server-side service system for essential information, such as route, schedule, ticket and position information of Taiwan High Speed Rail, Taiwan Railways, Taipei Metro System, as well as Taipei Joint Bus System. In the meantime, this study developed a client-side query system for Android phones as well. Furthermore, this study expected to raise transportation efficiency, and advance toward the objectives of energy conservation and reduced carbon dioxide emission.

## The initiative of SWCB data governance policy

Tien-Yin Chou<sup>1</sup>, Lan-Kun Chung<sup>2</sup>, Pi-Hui Huang<sup>3</sup>, Wen-Yuan Ku<sup>4</sup>, Hsing-Yen Ma<sup>5</sup>

<sup>1,2,3,4</sup>GIS Research Center, Feng Chia University, Taiwan

<sup>5</sup>Information Management Section, Planning Division, Soil and Water Conservation Bureau, Taiwan

<sup>1</sup>jimmy@gis.tw, <sup>2</sup>peter@gis.tw, <sup>3</sup>pinky@gis.tw, <sup>4</sup>cool@gis.tw,  
<sup>5</sup>neoma0901@mail.swcb.gov.tw

**Keywords:** data policy, asset, life cycle, data policy, asset, life cycle spatial data infrastructure

### Abstract

Soil and Water Conservation Bureau(SWCB), as the authority for Taiwan soil and water conservation as well as slopeland management, has been collecting hundreds of terabytes of data such as satellite and aerial images, field investigation data, geographic data and sensors data since the 1990's. Faced with increasing data issues, SWCB began to establish their geospatial data warehouse in 2005 by using RDBMS and upgraded gradually over the decade. A central database management mechanism has been made to solve the storage problem. However, data usage in SWCB is still a hard issue when one needs to integrate or fuse various data together to support decision making because of no common vocabularies, standards and data catalog.

With deep research and lessons learnt from trench in the decade, SWCB has found the most essential problem with its channel of data usage is lack of data governance policy, which led SWCB to reform their data policy in 2016. Although SWCB is still developing its data policy, the principles of SWCB's data policy has been addressed, which are: data as asset, data is shared, data is accessible, data is secured, data trustee, data vocabulary and standards, etc.,

Data, whether geospatial or not, should be seen as national assets. Therefore, data should be managed as an asset. The dataset manager should oversee and audit the status of data during its life cycle. The dataset manager needs to define what activities should be done at each life cycle phase.

SWCB is defining its own data lifecycle phases, which are define-inventory-obtain-access-maintain-evaluate-reserve. In the context of data assets, a data asset management mechanism is coming up which covers every data life cycle phase will ensuring data can be overseen under a pre-defined quality control before use. SWCB's data policy is independent from technologies due to its universality and generality and will be a good role model to other authorities who is lack of data policy.

### References

- Federal Geographic Data Committee. (2014). National Geospatial Data Asset Management Plan

- ISO 55000:2014(en). (2014). Asset management — Overview, principles and terminology - <https://www.iso.org/obp/ui/#!iso:std:55088:en> [Accessed 29 April 2016]
- NGDA Lifecycle Maturity Assessment - <https://www.geoplatform.gov/A-16-NGDA-Theme-Community/LMA> [Accessed 29 April 2016]
- Office of Management and Budget. (2013). Federal Enterprise Architecture Framework version 2.
- Robinson, M. (2008). A History of Spatial Data Coordination
- TOGAF, Architecture Principles - <http://pubs.opengroup.org/architecture/togaf8-doc/arch/chap29.html> [Accessed 23 April 2016]
- United States Government Accountability Office. (2015). GEOSPATIAL DATA Progress Needed on Identifying Expenditures, Building and Utilizing a Data Infrastructure, and Reducing Duplicative Efforts - <http://www.gao.gov/products/GAO-15-193> [Accessed 29 April 2016]

## 2D Map visualization of nationwide LiDAR digital elevation models

Yi-Hsing Tseng

National Cheng Kung University, Taiwan

tseng@mail.ncku.edu.tw, tsengyihsing@gmail.com

**Keywords:** visualization, 2D, digital elevation model, topographic parameter, raster mapping

### Abstract

Meter-level resolution Digital Elevation Models (DEMs) have become widely available since airborne LiDAR systems are popular. Although displaying high-resolution DEMs with stereo viewing screen allows us to realistically experience the topographic changes, it is difficult to overlay or inter-analyze with other thematic maps. This study devotes to the theory of deriving topographic parameters from high-resolution DEMs and the visualization of the parameters as raster maps, such as hillshade maps, slope maps, aspect maps, openness maps and multi-directional hillshade maps and so on. These maps enable users to observe topographic features with two-dimensional maps. For demonstration, maps of some example topographic parameters are generated with the Global Mapper. The characteristics and advantages of each topographic parameter will be analyzed through a visual investigation of the maps. The tint scheme and color continuity of multiple frames will be discussed as well. The combination of multiple topographic parameters into a map will also be assessed to display topographic information, which meets the requirements of some particular applications. This study is expected to be useful for a variety of applications of high-resolution DEMs.

### References

- Chiba, T., Kaneta, S. I., & Suzuki, Y. (2008). Red relief image map: new visualization method for three dimensional data. *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, 37(B2), 1071-1076.
- Loisios, D., Tzelepis, N., & Nakos, B. (2007, August). A methodology for creating analytical hill-shading by combining different lighting directions. *Proceedings of 23rd international cartographic conference, Moscow* (p. 78).
- Veronesi, F., & Hurni, L. (2014). Changing the light azimuth in shaded relief representation by clustering aspect. *The Cartographic Journal*, 51(4), 291-300.
- Yokoyama, R., Shirasawa, M., & Pike, R. J. (2002). Visualizing topography by openness: a new application of image processing to digital elevation models. *Photogrammetric engineering and remote sensing*, 68(3), 257-266.

## Development of the operational platform for flood inundation forecasting in lowland areas

Hsiang-Kuan Chang<sup>1</sup>, Rong-Kang Shang<sup>2</sup>, Hsi-Ching Lin<sup>3</sup>, Jen-Gaw Lee<sup>4</sup>, Yong-Jun Lin<sup>5</sup>,  
Jihn-Sung Lai<sup>6</sup>

<sup>1,5</sup> Center for Weather Climate and Disaster Research, National Taiwan University, Taiwan

<sup>2,3,4</sup> National Center for High-performance Computing, Taiwan

<sup>6</sup> Hydrotech Research Institute, National Taiwan University, Taiwan

<sup>1</sup>d95622002@ntu.edu.tw, <sup>2</sup>rkshang@gmail.com, <sup>3</sup>sclin@nchc.narl.org.tw,

<sup>4</sup>jglee0318@gmail.co, <sup>5</sup>vovman@gmail.co, <sup>6</sup>jslai525@gmail.com, <sup>6</sup>jslai525@ntu.edu.tw

**Keywords:** operational platform, flood inundation forecasting, disaster prevention

### Abstract

During typhoon approaching Taiwan, it tends to bring the threat of heavy rains and results in flood inundation and other compounded disasters in lowlands. Real time observations and forecasts are helpful to make appropriate decisions for disaster reduction and response under changing conditions. However, the procedures of data collection and model simulation are complicated and time-consuming to complete the task. Establishing an instantaneous and effective flood warning system becomes a vital issue. An operational information platform is developed in this study by linking various datasets with numerical models for flood inundation forecasting.

The framework of platform can be sketched as a process flow with four components, including data, model, display, and management. Data integration, model computing, data visualization, and task application are the major functions supported by cyberinfrastructure with high performance computing and high capacity data storage. Through adopting a common exchange mechanism, data from a variety of sources can be transferred and stored in the platform. For a flood inundation model, rainfall is one of the most important factors. Therefore, this operational platform regularly gathers the latest precipitation forecasts as input data over the internet. If the precipitation reaches a given threshold, numerical model will be executed to simulate the pluvial flood inundation for the next few hours. Then the simulation results containing the inundation extent and depth are converted into maps. The spatiotemporal changes of rainfall and flood inundation can be displayed and browsed through visualization tools. The whole process of inundation forecasting can be conducted at operational platform periodically and automatically. In addition, inundation maps can be overlaid with other spatial data, such as demographics, pump location, and transportation network. These data analysis and applications will assist decision maker in disaster assessment and resource allocation.

Based on actual examination, a lot of time and manpower can be saved by the utilization of high performance information platform. Thus, instant disaster warning information can be provided and a real-time decision can be made. Furthermore, because the observational, forecasting, and simulated data are all stored in the platform, it is simple and useful to make a comparison between different circumstances. For example, a comparative analysis between archived pre-warning data and real disaster situation can help to improve future disaster prevention strategies.

## **Development and application of grid-based seismic impact assessment techniques for power system**

Carol C. Wu<sup>1</sup>, Chung-Sheng Lee, Siao-Syun Ke, Sheu-Yien Liu

National Science and Technology Center for Disaster Reduction (NCDR), Taiwan

Principal correspondent: <sup>1</sup>carolwu@ncdr.nat.gov.tw

**Keywords:** earthquake, impact scenario, power system, seismic response

### **Abstract**

In last decade, several large-scale earthquakes have struck major population areas and caused heavy casualties and losses in many countries. Therefore, to understand the impact and disaster scenarios of assumed large-scale earthquakes to urban areas becomes an urgent and crucial task to the central and local governments of Taiwan. The purpose of this research is to develop an integrated research and application platform, Taiwan Earthquake Impact Research and Information Application (TERIA), which is established to evaluate the impact scenario of earthquakes to the metropolitans in Taiwan. Using TERIA platform in this study, the post-earthquake scenario analysis focused on power system as examples. Incorporated with geographic information system (GIS) analysis in 500m×500m grids, the characters of ground shaking and liquefaction for whole area are provided. To conclude with it, the objective of this unique platform is to furnish a comprehensive impact and damage scenario to fulfil the necessary data for planning disaster mitigation strategies and preparedness actions that make the cities in Taiwan more resilient to earthquakes.

## **The impact of spatial enablement and visualisation on business enterprise databases - what your data have been trying to tell you**

<sup>1</sup>Yiqun Chen<sup>1</sup>, <sup>1</sup>Abbas Rajabifard<sup>2</sup>, <sup>1</sup>Geoff Spring<sup>3</sup>, <sup>1</sup>Ged Griffin<sup>4</sup>, <sup>2</sup>Judy Gouldbourn<sup>5</sup>

<sup>1,2,3,4</sup>University of Melbourne, Australia

<sup>5</sup>Volunteer Fire Brigades Victoria, Australia

<sup>1</sup>yiqun.c@unimelb.edu.au, <sup>2</sup>abbas.r@unimelb.edu.au, <sup>3</sup>geoff.spring@unimelb.edu.au,  
<sup>4</sup>g.griffin@student.unimelb.edu.au, <sup>5</sup>judy.gouldbourn@gmail.com>

**Keywords:** spatial-temporal concurrency, disaster management, decision making, 4D spatial data visualisation

### **Abstract**

Historically business enterprises have been gathering data as part of their “business as usual” operations. The evolution of the digital era has both enhanced this capability and increased the rate at which data is collected at unprecedented levels. The parallel evolution of spatially enabled data, data analytics and the visualisation of data presents opportunities to analyse spatial-temporal databases to a degree never before available. This ability provides the opportunity to incorporate the results of this analysis into corporate planning processes, policy and strategy development and risk identification and mitigation. However, this new capability may also identify deficiencies in historically utilised databases which have led to poor decision making and setting of policy and strategy that has unknowingly limited business performance, misdirected capital investment and impacted resource utilisation.

This paper will address these issues by understanding of the concept of “concurrency” in database visualisation via a spatially enabled decision support tool developed by the Centre for Disaster Management and Public Safety (CDMPS), the University of Melbourne. A specific case study is performed to analyse historic incidents and explore response capacities across Victoria. A snapshot of emergency management data has been subjected to data cleaning, aggregation and harmonisation processes to support our proposed spatial-temporal concurrency analysis methodology. The output identifies key components such as demands and supplies. Each of these components can be investigated at various temporal granularity levels such as daily, monthly and yearly. Besides statistics, the developed tool can also interactively manipulate the results on a 4D visualisation engine by using dynamic demand-supply heat maps and spider webs that precisely describe the concurrent characteristics. The developed system helps decision makers better understand when and where demands are triggered and how supplies are distributed in busy seasons and eventually identify research priority needs to enhance their workforce planning capability.

## TPEG for timely distribution of emergency alert warnings

Teun Hendriks<sup>1</sup> and Matthias Unbehaun<sup>2</sup>

Traveller Information Services Association

<sup>1</sup>t.hendriks@tisa.org, <sup>2</sup>m.unbehaun@tisa.org

**Keywords:** disaster management, geospatial data, Emergency Alerts and Warnings, TPEG, location-based services

### Abstract

Emergency Alerts and Warnings are one of the primary duties of any public or private broadcaster or service provider alike: to warn the public of impending danger. Emergency alerts may be issued for typhoon warnings, severe thunderstorms, flooding, but also security hazards or hostile acts.

Distribution of Emergency Alert Warnings should use international standardized and widely adopted protocols to ensure compatibility with all types of devices and even reach visitors from foreign countries. This paper discusses the TPEG application ‘Emergency Alerts and Warnings’ (TPEG2-EAW), which is currently under development within TISA. Coming from the traffic & travel information realm, TPEG is a truly interoperable and worldwide adopted protocol, which offers significant benefits in the context of emergency alert warnings. TPEG2-EAW intends to provide a simple, but general message format for sending all kinds of hazard or emergency alerts or public warnings to different types of devices. The objective of TPEG2-EAW is the consistent dissemination of warning messages, countrywide, or by means of the embedded location referencing methods restricted to a hotspot or a geographical region.

TISA development of TPEG2-EAW targets an efficient, yet universally applicable warning application to provide a simple, extensible format for digital representation of warning messages and notifications.

### References

- Booch, G. (2005). The unified modeling language user guide. Pearson Education India.
- iHeartMedia, (2012), TPEG archive of the Total Traffic Network TPEG service contents for October 30th, 2012.
- ISO/TS 21219-2 (2014) Intelligent transport systems -- Traffic and travel information (TTI) via transport protocol experts group, generation 2 (TPEG2) -- Part 2: UML modelling rules.
- ISO/TS 21219-3 (2015) Intelligent transport systems - Traffic and travel information (TTI) via transport protocol experts group, generation 2 (TPEG2) -- Part 3: UML to binary conversion rules
- ISO/TS 21219-4 (2015) Intelligent transport systems -- Traffic and travel information (TTI) via transport protocol experts group, generation 2 (TPEG2) -- Part 4: UML to XML conversion rules

- ISO/TS 21219-5 (2015) Intelligent transport systems - Traffic and travel information (TTI) via transport protocol experts group, generation 2 (TPEG2) -- Part 5: Service framework (TPEG2-SFW)
- ISO/TS 21219-15 (2016) Intelligent transport systems -- Traffic and travel information (TTI) via transport protocol experts group, generation 2 (TPEG2) -- Part 15: Traffic event compact (TPEG2-TEC)
- NOAA (2016), NWR Specific Area Message Encoding (SAME), at <http://www.nws.noaa.gov/nwr/info/nwrsame.html> [Accessed July 20, 2016]
- OASIS, (2010), Common Alerting Protocol Version 1.2, at <http://docs.oasis-open.org/emergency/cap/v1.2/CAP-v1.2-os.html>, [Accessed July 20, 2016]
- Redding.com (2016), Powerful typhoon slams into Taiwan; killing 2, injuring 66, at [redding.com](http://redding.com): Powerful-typhoon-slams-into-Taiwan-killing-2-injuring-66 [accessed July 20, 2016]
- South China Morning Post (2016), Typhoon Nepartak brings chaos to eastern China, at SCMP: typhoon-nepartak-brings-chaos-eastern-china [Accessed July 20, 2016]
- TISA – Traveller Information Services Association, [www.tisa.org](http://www.tisa.org) [accessed May 23, 2016]
- Wikipedia (2016), Effects of Hurricane Sandy in New York, at [wikipedia](http://wikipedia.org): Effects\_of\_Hurricane\_Sandy\_in\_New\_York [Accessed July 20, 2016]
- WMO (2016), WMO registry of Alerting authorities by WMO Member or Organization, at <http://alerting.worldweather.org/> [Accessed July 20, 2016]

## Technology trends for spatial data infrastructure in Africa

Collins Mwange Mwangu

Institution of Surveyors of Kenya, Kenya

cmwange@gmail.com

**Keywords:** spatial data infrastructure, Africa, GDI, SDI

### Abstract

Over the past few years, several technologies, notably Cloud Computing, Volunteered Geographic Information (VGI), Free and Open Source Software (FOSS), Internet of Things (IoT) and Linked Data, have emerged. Such technologies have great potential in supporting wider adoption of SDIs. Coupled with maturing industry web services such as Web Map Service (WMS) and Web Feature Service (WFS), there could be no better time that African countries can to quicken development of their SDIs by adopting the new technologies.

This paper investigates the potential of emerging technologies that can support development of SDIs, through a simple geospatial application based on Google Cloud Services (GCS). Despite the availability of cloud services such as Amazon Web Services Elastic Compute (AWS EC2) and Microsoft Azure Engine, we chose GCS as the development platform.

GCS is an attractive option for several reasons. First, it is a flexible and powerful cloud platform, providing services such as Google Compute Engine (GCE), Google Container Engine (GKE) and Google App Engine (GAE). Secondly, GCS is still relatively new and therefore little geospatial research has been carried out. More importantly, our application can take advantage of Google's vast cloud infrastructure, including GAE (a PaaS cloud) and versatile authentication and authorisation framework. PaaS clouds can be used to extend SDIs by providing geoprocessing services based on tools such as Web Processing Service (WPS).

We specifically use GKE, IaaS cloud, to showcase several technology trends. The Kenya Certificate of Primary Education (KCPE) results of 2015, together with school mapping data of 2007, are used in the study. We obtain shapefiles of Kenya's key administrative boundaries from the Independent and Electoral and Boundaries Commission (IEBC). Using PostgreSQL/PostGIS DBMS, we carry out several operations and spatial analysis typically common in SDIs.

The technologies and services showcased through our application include GCS, OGC Web Services, FOSS, Open Layers, Linux, Docker Containers and Kubernetes. We demonstrate the huge potential of new technologies in supporting development of SDIs. We further show that highly scalable geospatial services can be deployed in the cloud, greatly improving the reliability and performance of SDIs. The spatial analysis carried out may be of interest to practitioners in the education sector, who may adapt the system for their use.

## **Urban Analytics Data Infrastructure: Critical SDI for Urban Management in Australia**

Abbas Rajabifard<sup>1</sup>, Serene Ho<sup>2</sup>, Soheil Sabri<sup>3</sup>

Centre for Spatial Data Infrastructures and Land Administration, Department of Infrastructure Engineering, The University of Melbourne, Australia

<sup>1</sup>abbas.r@unimelb.edu.au, <sup>2</sup>sereneh@unimelb.edu.au, <sup>3</sup>soheil.sabri@unimelb.edu.au

**Keywords:** SDIs, cities, Australia, urban management, urban analytics

### **Abstract**

Spatial data infrastructures (SDIs) are fundamental to enabling informed decision-making across a variety of industries and sectors but has primary relevance for managing land and land-related resources. Given the primacy of cities in meeting future sustainable development goals, SDIs are increasingly prominent in supporting the identification and management of urban-related issues such as water, energy, infrastructure and transportation, but also in the implementation and governance of urban policies aiming to deliver economic impact, social equity, housing, accessibility of public spaces and public safety.

This paper describes a new research initiative funded by the Australian Research Council that will see the development of an SDI to support urban analytics and urban research capabilities focused on Australian cities. This is a timely development for Australia, which is not only one of the most urbanised countries in the world, but is also witnessing high levels of growth rates in its urban areas uncommon in western developed countries. The Urban Analytics Data Infrastructure (UADI) intends to support multi-disciplinary, cross-jurisdiction, national-level analytics and through the design of its architecture, seeks to provide the urban research community with a digital infrastructure that responds to current challenges related to data access, sharing and application. Importantly, the UADI will build on significant existing urban research infrastructure, specifically the Australian Urban Research Information Network and its nationally federated Data Hubs. This is both critical and core SDI development for Australia, and will advance governments, industry and academia in undertaking more advanced data-driven modelling to support sustainable development in Australia's cities.

## Towards a spatially enabled open platform for Singapore

Siau Yong Ng<sup>1</sup>, Gavin Chunqing Chen<sup>2</sup>

GeoSpatial Division, Singapore Land Authority, Singapore

<sup>1</sup>Ng\_Siau\_Yong@sla.gov.sg, <sup>2</sup>gavin\_chen@sla.gov.sg

**Keywords:** spatial data infrastructure, crowdsourcing, open source, location-based services

### Abstract

Smart city aims to improve lives of its residents, create more opportunities, and build stronger communities. Spatial Data Infrastructure (SDI), as a framework to promote geospatial data sharing and consumption, will be one of core foundations to achieve the vision.

With the increasing ubiquity of mobile devices and the connection, the public becomes more connected and accessible. This trend provides the government an opportunity to not only offer user-centric service anytime and anywhere, but also enrich its data via crowdsourcing and in return to be able to enable data-rich and analytics-based services to the public. In addition, with the evolvement of technologies, the government can deliver reliable and authoritative services despite the development budget is often under pressure.

In this paper, we present the effort from Singapore Land Authority (SLA) on developing SDI for the smart homeland by means of a spatially enabled open platform to serve the public in a comprehensive and collaborative manner from the aspects of data and services, technology and development approach.

The platform enables new ways of data creation via multiple directions, namely, government to residents, residents to government, and residents to residents, for example, leveraging crowdsourcing to chronicle Singapore's history. Our platform also offers special data and location-based services in Singapore local context.

We choose open source to implement the platform and host it in the cloud environment. The full open source stack consisting of Leaflet, MapBox, CartoDB, and MongoDB increases the collaboration opportunities with the larger developer communities. The cloud computing technology saves us the operating cost and eases the scalability issue.

Being aligned with Singapore government's direction on building in-house capabilities direction, our platform is developed in house with a team of application specialists. This in-house development approach supports the agile project methodology to improve the responsiveness to changes and reduce the time to market. Moreover, the specialists strengthen their geospatial capacities and competencies, and this can ensure the sustainable manpower growth needed for a continuous development of SDI for smart homeland.

## Assessing the quality of building footprints on OpenStreetMap: a case study in Taiwan

Kuo-Chih Hung<sup>1</sup>, Mohsen Kalantari<sup>2</sup>, Abbas Rajabifard<sup>3</sup>

University of Melbourne

<sup>1</sup>hung.kuochih@gmail.com, <sup>2</sup>mohsen.kalantari@unimelb.edu.au, <sup>3</sup>abbas.r@unimelb.edu.au

**Keywords:** data quality, Volunteered Geographic Information, VGI, building footprint, spatial data infrastructures

### Abstract

In recent years, an emerging trend in information community is the growing use of web applications to collect and share geographic information. Such initiatives have reduced the inaccessibility of geodata. Collaborative mapping platforms such as OpenStreetMap (OSM) have become important sources of geodata and potentially complementary for any Spatial Data Infrastructure initiatives. However, as volunteered geodata were generated from people with various skill levels, quality issues such as missing details and incomplete content are inevitable in this approach.

In this study, we assessed the completeness and the geometric accuracy of OSM building footprints in two major metropolitan areas of Taiwan: Taipei City and Taichung City. We compared OSM quality with a reference dataset from authority. The completeness assessment was computed in different scales by computing the total number and the total area. The assessment shows mixed results. The completeness of total area (CArea) is 17.4% in Taipei and 12.8% in Taichung respectively. The highest complete location is Central district of Taichung (CArea = 74.3%). Generally, the central business districts have higher completeness than the low-density areas. The consistency of the completeness is a significant issue in two cities. An interesting finding is that the resolution of OSM building footprints in several districts of Taichung is higher than the reference dataset.

Then, we used an overlap method to identify OSM building footprints corresponding with the reference dataset. The completeness (Coverlap) in Taipei reaches 86.1%. 100 corresponding buildings with a 1:1 relation to the reference building were sampled randomly to measure the geometric accuracy. Using a turning function, the geometric accuracy assessment identifies that 10% is very similar to the reference building yet 12% is very dissimilar. The result also showed that the number of vertices in OSM building footprints is only 35% as compared with the reference dataset. Thus, we conclude the authoritative data is more complex in building representation.

Furthermore, as the Taiwanese OSM community intended to tag the building footprint for evacuation, we tried to identify the completeness of evacuation building in the two cities. The result shows that 47.1% of evacuation building can be identified on OSM.

These results indicate that the completeness of OSM building footprints is not consistent, and the OSM building representation is not as complex as the reference dataset. Nevertheless, the

OSM building footprints in high resolution show a great potential and better completeness for use, particularly in a scenario of disaster management. We also found that the high-resolution footprints are due to the promotion of the university education. Such action would improve OSM as a better source for a large-scale SDI platform and enabling a resilient society.

## Lowering the barrier to OSM contribution and citizen mapping services development for city governments

Chao-Kuei Hung

Chaoyang University of Technology

ckhung@cyut.edu.tw

**Keywords:** OpenStreetMap, OSM, tourism, local businesses, public transportation, crowdsourcing, governance

### Abstract

OpenStreetMap fits well with the trends of government open data and citizen participation. Unfortunately, even with the advancement of Free Software editors such as josm and iD, the entrance barrier to OSM editing contributions is still considerably higher than that to wikipedia contributions for example. In OSM, area- and street-information can be relatively complete in many cities, but POI information is usually quite sparse even in big cities. Yet governments, businesses, residents, tourists, and mobile app developers would all benefit from a more comprehensive coverage of such POI information.

Of the three types of elements in OSM, if we focus on nodes alone and ignore ways and relations, the complexity of editing activities can be reduced significantly. Apart from the coordinates, only tags ("amenity", "leisure", etc.) need to be edited. Tag editing of many nodes can be conducted in a spreadsheet instead of in map-editing software. The former is obviously more manageable to the untrained person.

Therefore, the idea is to complement traditional mapping parties with the following process:

1. creating densely populated and minimally tagged POI's,
2. exporting all existing POI's of an area from OSM into an online spreadsheet,
3. having a group of untrained people edit the sheet collaboratively to add more tags, and
4. importing the POI's from the spreadsheet back to OSM.

Ethercalc, the Free Software collaborative online spreadsheet, meets the editing requirements nicely. It provides csv export as an additional URL postfixed with ".csv" from the original spreadsheet URL. To provide visual feedbacks to the participants while the spreadsheet is still actively edited and not yet imported back to OSM, we develop a web app ChorusMap using the leaflet javascript library. ChorusMap can be run directly in the browser. It simply displays the OpenStreetMap background along with nodes aggregated from various geojson and/or csv files, each specified as a remote URL. It can be used for other kinds of map editing tasks requiring collaboration as well.

We plan to test and streamline this process. With this significant reduction in participant training, hopefully we can help the OSM project grow stronger by "thickenening" the long tail of the editing contribution.

## **The theory versus the reality of alignment between e-Gov and SDI in Pakistan**

Walter T. de Vries<sup>1</sup> and Asmat Ali<sup>2</sup>

<sup>1</sup>Technical University of Munich, wt.de-vries@tum.de

<sup>2</sup>Survey of Pakistan, asmatali@yahoo.com

**Keywords:** SDI, electronic government, congruency theory, eGovernment

### **Abstract**

A common notion is that the governance and performance of spatial data infrastructures (SDI) and Electronic Government (eGov) are closely interlinked. However, in practice this notion does not hold. We test why this is so, using the empirical context of a developing country, Pakistan. The main question is thus to which extent are eGov and SDI implementation strategies are re-enforcing or obstructing each other. The present research makes use of congruency theory. The basic tenets of congruency theory are that governments perform well (1) to the extent the authority patterns are congruent (2) with the authority patterns of other units of society, and if those patterns exhibit balanced disparities (3). Each of these aspects can be further detailed with several descriptive and normative aspects. In this article the theory is applied to evaluate past and current activities in eGov and SDI in Pakistan and to assess the degree of congruence between the two. Proxies of authority patterns include adjacency, contingency, and proximity. The assumption is that if all authority proxies of both eGov and SDI are high then the authority patterns are considered congruent with each other. Performance is evaluated based on durability, civil order, legitimacy and decisional efficacy. If all these proxies are high, then performance is high. If both authority patterns in eGov and SDI are high and performance of both SDI and eGov is high then both are congruent. If any of the proxies are not congruent then this is probably the reason for low performance. Finally, balanced disparities are evaluated using mimetic, coercive and normative isomorphism. If the organization of eGov and SDI implementation is largely isomorphic in all these aspects then the disparities are considered balanced. The proxies were evaluated for Pakistan for the period 2010-2016 based on personal communication and experience on the one hand and documentary evidence on the other hand. The degree of congruency was inferred and interpreted qualitatively. Initial results suggest that there appears some degree of congruency, but based on the comparison of the proxies for durability and legitimacy there are also considerable differences. Finally, the degree of isomorphism is only partial. In particular, mimetic isomorphism is low, indicating limited crossovers between the two communities. This implies only partial congruence. The conclusion is that whilst many of the objectives of eGov and SDI in Pakistan are similar, in the process of implementation they are currently insufficiently reinforcing each other. One of the main reasons is that unlike the eGov projects the SDI objectives and policies are insufficiently embedded in public awareness campaigns and implementation by multiple public organizations. This affects public legitimacy.

## Open spatial data infrastructures for the extractives sector in countries affected by fragility, conflict and violence: promises and challenges

Nicolas Ray<sup>1</sup>, Pierre Lacroix<sup>2</sup>, Gregory Giuliani<sup>3</sup>, Pauliina Upla<sup>4</sup>, Abbas Rajabifard<sup>5</sup>, David Jensen<sup>6</sup>

<sup>1,2,3</sup>University of Geneva, Institute for Environmental Sciences, Switzerland  
<sup>3,4,6</sup>UNEP

<sup>5</sup>University of Melbourne, Australia

<sup>1</sup>nicolas.ray@unige.ch, <sup>2</sup>Pierre.Lacroix@unige.ch, <sup>3</sup>gregory.giuliani@unepgrid.ch,  
<sup>4</sup>auliina.upla@unep.org, <sup>5</sup>abbas.r@unimelb.edu.au, <sup>6</sup>David.jensen@unep.org

**Keywords:** spatial data infrastructure, geospatial data, geographic information, environment, extractive, mining, SDI, land information

### Abstract

Over 80% of the 50 fragile states identified by OECD in 2015 are rich in one or more extractive resources of global economic importance. If managed sustainably, these natural assets could fundamentally contribute to peacebuilding and statebuilding, and be the foundation for economic growth and diversification as well as longer term sustainable development. While the potential benefits to fragile states are large, so are the risks. If extractive resources are not developed with the correct mix of rules, institutions and governance safeguards in place, they will likely contribute to the onset of the resource curse – a combination of negative development outcomes, poor economic performance, rent seeking, social conflict and large scale environmental degradation.

One of the critical success factors in transforming the economic and social potential of extractive resources into tangible development outcomes is access to authoritative information by all stakeholders. Access to information both sharpens and informs dialogue and decision making processes among stakeholders and is critical towards understanding how the myriad of benefits and risks can be shared in an equitable manner. However, in many fragile states, authoritative information itself is a scarce resource, with massive information asymmetries among stakeholders.

The on-going transparency revolution in the extractive sector, through initiatives such as the Extractive Industries Transparency Initiative, is a critical step forward in terms of providing all stakeholders transparent access to information in the extractives sectors. While the initial focus has been on financial and contractual aspects, stakeholders are now demanding access to further information on social and environmental risks and benefits. They are also requiring data in the extractives sector to be published in an open data format to promote accessibility, analysis and visualization. A third trend is the disaggregation of data from the national to the local level, combined with heightened transparency around contractual compliance and performance at the site level.

To enable this broader movement towards full transparency of revenues, risks and benefits across the entire extractive industry value chain, one of the most immediate needs is georeferenced information on extractive concession boundaries, the location of specific operations, production information and beneficial ownership. The possibility to overlay this

information with other contextual data (e.g., environment, socio-economic, conflict-related) can facilitate improved identification of potential social and environment risks and benefits, while also offering opportunities for improved spatial planning and connecting extractive infrastructure and services to the broader economy.

In this paper, we will describe how new trends and technical innovations linked to transparency, open data and spatial data infrastructures are being combined and leveraged to support improved access to authoritative information in the extractive sector in DR Congo. We will explore both the technical as well as the political and governance challenges faced and how these can be tackled. This will be done using the experience gained by the authors in the design and implementation of a new Open Data Platform for the Extractive Sector called MAP-X (Mapping and Assessing the Performance of eXtractive Industries).

## State of SDI Readiness in Indonesian Local Government

Heri Sutanta<sup>1</sup> and Trias Aditya<sup>2</sup>

Research Centre for SDI Development (PPIDS), Department of Geodetic Engineering,  
Faculty of Engineering, Universitas Gadjah Mada, Indonesia

<sup>1</sup>herisutanta@ugm.ac.id, <sup>2</sup>triasaditya@ugm.ac.id

**Keywords:** spatial data infrastructure, readiness, local government

### Abstract

The development of SDI in Indonesia was started more than 20 years ago. It was initially named the National GIS initiative, although what was meant was SDI. Only recently SDI has gained more attention both from central government and local governments. The enactment of the Law on Geospatial Information (4/2011) was a milestone that significantly sped up geospatial information development. The law strengthened the previous legal umbrella of the Presidential decree 85/2007 on the National Spatial Data Network. After the enactment of the law, the presidential decree was revised in the Presidential Decree of 27/2014 on National Geospatial Information Network. In it, the number of government agencies who were mandated to develop SDI was expanded from 14 central government agencies/ministries to the whole of central government agencies/ministries and all level of local governments. Before the issuance of the Presidential Decree 27/2014, development of local government SDI was voluntary. In effect, only a small number of local governments built local SDI and less than 10% of local government could join the national geoportal.

Assessment of SDI readiness in Indonesian local government was based on five pillars stated in the Law of Geospatial Information as well as in the Presidential Decree 27/2014. They consist of the following elements: policy, institutional arrangement, human resources, technology, and standards. For this research, these five pillars were regrouped into four aspects: policy and regulation, institutional arrangement, human resources, technology and standards, and added with geospatial data aspect. A questionnaire was then developed and distributed to the Local Development Planning Agency (LDPA) in all local governments. The questionnaires were sent to 510 districts and cities which resulted in 155 responses coming from 33 out of 34 provinces in Indonesia. Of the 155 responses, they come from 120 districts and 35 cities. The SDI readiness index was developed by assigning appropriate scores to the responses in each question.

From the calculation of the SDI readiness index, the average score was 32.39, the highest was 84.11, and the lowest was 3.74. The average score for districts and cities was 36.66 and 31.14, respectively. Cities' SDI readiness index was higher in all aspects compared to that of districts. Only 17% of the cities has readiness index above 50, while for the districts only 9%. Among the five aspects investigated, the availability and management of geospatial data obtained the highest score followed by technology, human resources, policy, and institutional arrangement, with the following score of 58.49, 28.03, 26.54, 23.84, and 23.00, respectively. To accelerate and sustain the development of local SDI, attention need to be put on the two lowest aspects as they form the foundation of local SDI. This first comprehensive national survey could portray SDI readiness in Indonesian local governments. Although there was significant development in the last few years, the SDI development in Indonesian local government still faces difficult challenges ahead.

## Applying geo-data to evaluate the appropriateness of bus network

Chih-Hung Chang<sup>1</sup>, Jau-Ming Su<sup>2</sup>, Chao-Neng Chang<sup>3</sup>, Chih-Kang Lin<sup>4</sup>, Mei-Hui Shen<sup>5</sup>,  
Chin-Tung Tsai<sup>6</sup>

<sup>1,2,4,5</sup>Chung Hua University, Department of Transportation Technology and Logistics  
Management, Taiwan

<sup>3,6</sup>Operation and Management Division, Institute of Transportation, Ministry of  
Transportation and Communications, Taiwan

<sup>1</sup>chihhung97@gmail.com, <sup>2</sup>jaumingsu@gmail.com, <sup>3</sup>cnchang@iot.gov.tw,  
<sup>4</sup>johnlin1172@gmail.com, <sup>5</sup>miche9889@gmail.com, <sup>6</sup>chintung@iot.gov.tw

**Keywords:** public transportation usage rate, service population coverage, Taiwan Geospatial One-Stop portal, TGOS

### Abstract

In recent years, many resources have been invested in public transportation development in Taiwan. Although the Ratio of the Users of Public Transport has increased significantly, the pace of growth has already started to slow down. Thus, all levels of the governments are attempting to boost the ratio of the users of public transport by planning new transit service routes with potential. Due to the limitations of forecasts derived from conventional transportation demand data, some local and foreign scholars and research organizations have employed the service population indicator to plan transit service routes.

In this study, we utilize a variety of geospatial data, such as village and street number diagrams from the Taiwan Geospatial One-Stop Portal, created by the Information Center, Ministry of the Interior; the Household Registration Statistics database; the Bus Dynamic Information System implemented by the Directorate General of Highways, Ministry of Transportation and Communications (MOTC); and other big data sources such as income and land use data. This will enable government transportation agencies to assess the benefits of new transit routes using transportation demand data and the service population indicator.

Based on this analysis, highway authorities can perform objective assessments to quickly determine if the public transit service in a particular area is adequate. This helps remove the administrative blind spots caused by the necessity to employ rules of thumb in the past due to the lack of relevant information, thus making the supply of public transportation services better able to meet the needs of local residents. The analysis will improve the administrative capability of the highway authorities to properly allocate resources for transportation services.

## Matching and relative orientation of spherical panorama images

Pin-Yun Chen<sup>1</sup>, Tsung-Che Haung<sup>2</sup>, Yi-Hsing Tseng<sup>3</sup>

Department of Geomatics, National Cheng Kung University, Taiwan

<sup>1</sup>pinyunchen@gmail.com, <sup>2</sup>qaz30162@gmail.com, <sup>3</sup>tseng@mail.ncku.edu.tw,  
<sup>3</sup>tsengyihsing@gmail.com

**Keywords:** image matching, RANSAC, essential matrix, spherical panorama images

### Abstract

People are paying more and more attention to the use of Spherical Panorama Images (SPIs) for many applications. To apply SPIs in photogrammetric application such as bundle adjustment or land mapping like frame images do, conjugate points matching and the relative relationship between SPIs are important issues.

Through observing the moving pattern of feature points, the relative positions and orientation between camera stations may be solved. In this study, there are three test cases using Ladybug 5 system developed by Point Grey including camera movement, self-rotation and oblique. Image features are extracted and matched by Speed-Up Robust Features (SURF) algorithm (Bay, 2008), and the concept of Random Sample Consensus (RANSAC) is applied to improve the accuracy of conjugate feature points matching. Although RANSAC general model is not well enough to detect the features on spherical panorama images, we proposed a method using Essential Matrix model to improve this deficiency.

Once the conjugate points are found, the relationship between image stations can be explained by Essential matrix base on the coplanar condition and SVD decomposition. From the estimation of Essential Matrix, the rotation and translation parts can be extracted up to scale. Similar to that of frame camera, there are four possible solutions, the angle between two image stations is used to judge the correct solution.

The results show that the quantity and quality of corresponding pairs influences the accuracy of the relative positions and orientations between two images. Although the error matching pair can be found and removed by RANSAC, the distortion come with projection still make trouble for SURF algorithm. A suitable way is that apply matching not on the plane image to improve quality of corresponding pairs.

## **Change detection through object-based analysis on UAV-derived orthoimages and digital surface models**

Yu-Ching Lin<sup>1</sup>, Hung Wei Pan<sup>2</sup>, Ming-Da Tsai<sup>3</sup>

Environmental Information and Engineering Department, Chung Cheng Institute of Technology, National Defense University, Taiwan

<sup>1</sup>yuching.ncl@gmail.com, <sup>2</sup>sidpan1995@gmail.com, <sup>3</sup>scott.tasi@gmail.com

**Keywords:** geospatial data, UAV, orthoimage

### **Abstract**

Unmanned Aerial Vehicle (UAV) attached with a non-metric camera is becoming a popular platform for acquisition of aerial images. It allows users to readily acquire geospatial data, with low cost. With rapid development of computer science and photogrammetry, generation of digital surface models, orthoimage, and 3D, color point clouds become an automatic process. Some commercial software, such as Agisoft Photoscan or Pix4Dmapper, enable users to rapidly produce these UAV-derived products, without geomatics background needed. However, how to use the UAV-derived geospatial data to effectively investigate the change of the Earth surface over time is of importance. Extracting useful information from low-cost geospatial data would further extend the advantages of employing UAV. This study makes good use of UAV-derived orthoimage and digital surface models (DSM) to identify where the change of the earth surface has occurred and the magnitude. A set of orthoimages and DSMs are considered to be historical data, which are produced through standard photogrammetric procedures. The Ground Sampling Distance (GSD) for UAV-derived orthoimage and historical orthoimages is 13 cm and 25 cm; the grid size for UAV-derived DSM and historical DSM is 25 cm and 2 m.

An object-oriented analysis is a popular method for digital image classification. The technique of image segmentation is employed to convert an image into multiple objects. In this study, we assign different weights to the orthoimages and the difference of the DSMs over time for the segmentation process. Such a strategy helps rapidly identify significant changes to the earth. In addition, the magnitude of the change is estimated.

## Landslide warning using ensemble precipitation forecasting

Yong-Jun Lin<sup>1</sup>, Hsiang-Kuan Chang<sup>2</sup>, Jih-Sung Lai<sup>3</sup>, Rong-Kang Shang<sup>4</sup>

<sup>1,2,3</sup> Center for Weather Climate and Disaster Research, National Taiwan University, Taiwan

<sup>3</sup> Hydrotech Research Institute, National Taiwan University, Taiwan

<sup>4</sup> National Center for High-performance Computing, Taiwan

<sup>1</sup>vovman@gmail.com, <sup>2</sup>d95622002@ntu.edu.tw, <sup>3\*</sup>jslai525@gmail.com,  
<sup>3</sup>jslai525@ntu.edu.tw, <sup>4</sup>rkshang@gmail.com

**Keywords:** landslide, warning, ensemble precipitation

### Abstract

Typhoon Soudelor (August, 2015) stroke southern New Taipei City, Taiwan. It brought huge damages to Xindian District and Wulai District, and those damages including 7 large landslides, blockages to access roads, and strands of hundreds of residents. The main reasons of landslide due to the high intensity rain brought by Typhoon Soudelor. The rain gauges near the sites of landslides recorded the maximum hourly rainfall of 70 (mm) and the accumulative rainfall is 500-800 (mm). The largest area of the above-mentioned landslide is 9.7 ha.

According to the study conducted (Cheng et. al, 2014), the average 3hr-rainfall intensity and 24hr-accumulative-rainfall can be used for indicators for the rainfall threshold of triggering landslide. Based on the historical landslide events, three rainfall thresholds of triggering landslide can be found for probability of 30%, 60%, and 90% respectively. Using the rainfall data of Typhoon Soudelor, it is found that the rainfall recording in gauges located very near the line of probability of 90%. The average 3hr-rainfall intensity of 70 (mm/hr) and 24hr-accumulative-rainfall of 700 (mm) are used for probability of 90%. As for probability of 30%, the 3hr-rainfall intensity is 30 (mm/hr) and 24hr-accumulative-rainfall is 300 (mm). As for probability of 60%, the 3hr-rainfall intensity is 50 (mm/hr) and 24hr-accumulative-rainfall is 500 (mm).

This study adopted ensemble precipitation forecast for landslide warning which is provided by Taiwan Typhoon and Flood Research Institute (TTFRI). The precipitation ensemble forecast is the product of Taiwan Cooperative Precipitation Ensemble Forecast Experiment (TAPEX). There are 22 members of dynamic models which are provided by different institutions in Taiwan. A case study of Typhoon Dujuan (September, 2015) is shown. Thus, a real-time landslide warning using ensemble precipitation forecasting is established.

## **An open standard solution for a smart agriculture monitoring application**

Hsin-Hsien Chen<sup>1</sup> and Chih-Yuan Huang<sup>2</sup>

<sup>1</sup> Department of Civil Engineering, National Central University No.300, Jhongda Rd., Jhongli Dist., Taoyuan City, Taiwan 320

<sup>2</sup> Center for Space and Remote Sensing Research, National Central University No.300, Jhongda Rd., Jhongli Dist., Taoyuan City, Taiwan 320

<sup>1</sup> 101302027@cc.ncu.edu.tw, <sup>2</sup> cyhuang@csrsr.ncu.edu.tw

**Keywords:** Internet of Things, IoT, plug-and-play, environment, agriculture

### **Abstract**

In recent years, the Internet of Things (IoT) has attracted attention from many domains. Various automatic and efficient IoT applications are envisioned, such as smart energy management system, smart home, smart logistics. While the IoT connects uniquely identifiable objects to the Internet, users can remotely access the sensing and tasking capabilities of IoT devices. The sensing capability allows users to monitor device status and surrounding environmental properties. And the tasking capability allows users to remotely control IoT devices.

However, different manufacturers produce IoT products with different proprietary protocols. This heterogeneity issue prevents users from accessing different IoT devices with a uniform communication protocol. To address the heterogeneity issue, interoperable IoT standards should be applied. While there have been standards designed for IoT web services (e.g., OGC SensorThings API) and local communication platforms (e.g., 6LoWPAN, ZigBee, LoRA), a standard-based end-to-end procedure of deploying and configuring IoT devices is currently missing.

Therefore, to achieve the IoT plug-and-play vision, this research first proposes an IoT capability file that can describe the sensing and tasking capabilities of an IoT device, and then designs an automatic registration procedure allowing an IoT device to automatically advertise its capabilities to an IoT web service.

In general, this research focus on defining the communication between IoT devices and a smart gateway that can detect new devices in local networks, understand the capability file, and communicate with web services and devices. To prove the concept, an agriculture monitoring application is designed and developed to monitor in-filed environmental data.

## **Analysis of the barriers to land administration in Pakistan**

Asmat Ali<sup>1</sup> and Munir Ahmad<sup>2</sup>

Survey of Pakistan

<sup>1</sup>asmatali@yahoo.com, <sup>2</sup>munir.ahmad@yahoo.com

**Keywords:** land administration and management, land reforms, barriers, Pakistan

### **Abstract**

Why land administration is strategically important and challenging especially for developing countries such as Pakistan, what exactly are the barriers and how geospatial technologies, literature as well as best practices related to land administration can help to break the barriers? To address these questions, this paper investigates land administration in the country to identify barriers and their nature such as policy, legal, economic, political, institutional and technical that are being faced at various levels of governments from national to provincial. We make use of questionnaire and semi structured interviews of the experts involved in land administration as instrument to collect and validate data in addition to study the latest reports by World Bank, US-Aid, UNDP-Pakistan, Asian Development Bank and FAO etc. We then critically review relevant literature to determine the existence of the identified barriers and their frequency of occurrence in other countries as well. This helps to discover gap between theory theories and practices. The literature review coupled with study of best practices is benefited to gain knowledge about resolution of the issues. Finally, the paper presents recommendations to be adopted by Government of Pakistan to implement successful land administration and management system in the country. The paper finds that although Government of Pakistan has vision to setup the state of the art system for land administration in the country but still it is far away from the reality. The paper concludes that sustainable development and poverty alleviation is just a dream without an effective, efficient and fit for purpose Land Administration System (LAS).

## Land surface temperature variation and land cover changes based on satellite imagery data

Yuei-An Liou<sup>1</sup>, Nguyen Kim Anh<sup>2</sup>, Ming-su Li<sup>3</sup>

<sup>1</sup>Center for Space and Remote Sensing Research, National Central University, No. 300, Jhongda Rd., Jhongli District, Taoyuan City 32001, Taiwan, ROC

<sup>2,3</sup>The Graduate Institute of Hydrological and Oceanic Sciences, National Central University, No. 300, Jhongda Rd., Jhongli District, Taoyuan City 32001, Taiwan, ROC

<sup>1</sup>yueian@csrrs.ncu.edu.tw, <sup>2</sup>kimanh.nguyen2010@hotmail.com, <sup>3</sup>mlincuihs@gmail.com

**Keywords:** ecological thermal indices, eco-environment, Thua Thien - Hue Province, Landsat data

### Abstract

Urban area is a complex eco-environment involving a variety of anthropogenic activities. Its sustainable development is affected by many factors, such as topographical appearance, hydro-meteorological environment, and social economics. Due to urban sprawl and less vegetation, urban areas often exhibit higher thermal signatures than less disturbed rural areas. Thermal signatures represent the thermal status resulting from energy balance at land-air interface. In this study, Land Surface Temperatures (LSTs) are retrieved from Landsat TM, ETM, and OLI & TIRS (Thematic Mapper, Enhanced Thematic Mapper, and Operational Land Imager & Thermal Infrared Sensor, respectively) and serve as basis to derive ecological thermal index for assessing ecological dynamics in years 1989, 2003, and 2014. The Thua Thien - Hue Province, Vietnam, is chosen as a study area because it is a coastal province vulnerable to climate change. Its LST is found to increase by 0.7 °C and 1.5 °C for the 1989-2003 and 2003-2014 periods, respectively. Thermal environment index maps are utilized to categorize ecological conditions into six levels (excellent, good, normal, bad, worse, and worst). To demonstrate urban development a major contributor to thermal anomaly, correlation between LST and Normalized Difference Build-up Index (NDBI) is analysed. The correlation is positive with coefficient values 0.87, 0.89, and 0.84 for 1989, 2003, and 2014, respectively. In contrast, LST-Normalized Difference Vegetation Index (NDVI) is found negatively correlated with corresponding coefficient values -0.81, -0.81, and -0.76, indicating that vegetation reduces thermal intensity. In addition, areas associated with excellent, good, and normal thermal environmental levels are decreased over the same period of time.

## **Classification of eco-environmental vulnerability for environmental protection in the Thua Thien – Hue Province, Vietnam**

Nguyen Kim Anh

The Graduate Institute of Hydrological and Oceanic Sciences, National Central University,  
No. 300, Jhongda Rd., Jhongli District, Taiwan  
Taiwan Group on Earth Observations, Hsinchu, Taiwan, ROC  
kimanh.nguyen2010@hotmail.com

**Keywords:** vulnerability, eco-environment, AHP, GIS, Landsat 8 OLI and TIRS (operational land imager and thermal infrared sensor), remote sensing

### **Abstract**

Assessment of the eco-environment aims to identify the vulnerable regions with influencing factors, including hydro-meteorology, topography, land resources, and human activities, so that effective measures for environmental protection and management may be proposed. In this study, an assessment framework is proposed to assess the vulnerable eco-environment by using 16 variables with 6 of them constructed from Landsat 8 satellite images. The remaining variables were extracted from digital maps. Each variable was evaluated and spatially mapped with the aid of an analytical hierarchy process (AHP) and geographical information system (GIS). The Thua Thien - Hue Province that has been experiencing urbanization at a rapidly rate in both population and physical size in the recent decades is selected as our study area where the urban use, agricultural practice, and aquaculture activities have inevitably invaded into natural zones. An eco-environmental vulnerability map is assorted into six vulnerable levels consisting of potential, slight, light, medium, heavy, and very heavy vulnerabilities, representing 14%, 27%, 17%, 26%, 13%, 3% of the study area, respectively. It is found that heavy and very heavy vulnerable areas appear mainly in the low and medium lands with high intensification of social-economic activities. Tiny percentages of medium and heavy vulnerable levels occur in high land areas probably caused by agricultural practices in highlands, slash and burn cultivation and removal of natural forests with new plantation forests. Based on our results, three ecological zones requiring different development and protection solutions are proposed to restore local eco-environment toward sustainable development.

## **Exploring motivations and barriers for spatial data sharing between regional NRM bodies and state government authority in Australia**

Dev Raj Paudyal

School Civil Engineering and Surveying, Faculty of Health, Engineering and Sciences,  
University of Southern Queensland, Toowoomba, Queensland-4350, Australia

paudyal@usq.edu.au

**Keywords:** natural resource management, spatial data, Spatial Data Infrastructure (SDI), case study, Australia

### **Abstract**

Spatial data sharing is recognised as one of the important components of Spatial Data Infrastructure (SDI) development. The data sharing processes provide several benefits to the organisations involved. However, there are many issues that hinder sharing spatial data between organisations. In Australia, state government organisations are the custodians of spatial information necessary for natural resource management and regional NRM bodies are responsible to regional delivery of NRM activities. The sharing of spatial data between government agencies and regional NRM bodies is therefore as an important issue for improving natural resource management outcomes.

The aim of this paper is to explore the motivations and barriers for spatial data sharing, and its impacts on spatial data infrastructure (SDI) development in natural resource management sector in Australia. Further, it critically reviewed the spatial data sharing literatures and developed a framework. A case study method was used to collect primary data from 14 regional natural resource management (NRM) bodies responsible for catchment management in Queensland. A semi-structured interview was conducted with 14 regional NRM bodies, state government organisation and Queensland regional NRM groups collectives (RGC). In total 18 interviews were conducted; 14 from regional NRM bodies, two from state government organisations and two from the RGC. The qualitative data were analysed using QSR NVivo software. The results show that the motivation for spatial data sharing were to better organise information and knowledge, to reduce cost, to share risks and resources, to avoid duplication and to enhance better collaboration and networking. Various constraints such as lack of policy, lack of trust, privacy, confidentiality and funding were identified and categorised into five different areas as policy, technological, organisational, cultural and economic. The issues related to policy, organisational, cultural, and economic were found to be more important in comparison with technological issues. We found spatial data sharing has significant impacts on spatial data infrastructure development in catchment management sector in Australia.

## **Building Resilience of Vulnerable Groups Using Spatial Data and Technology: A Case of 2015 Nepal Earthquake and Informal Settlements in Kathmandu**

Dr Dev Raj Paudyal<sup>1</sup>, Professor Kevin McDougall<sup>2</sup>, Professor Rahul Mehrotra<sup>3</sup>

<sup>1,2</sup>School Civil Engineering and Surveying, Faculty of Health, Engineering and Sciences,  
University of Southern Queensland, Australia

<sup>3</sup>Graduate School of Design, Harvard University, USA

<sup>1</sup>paudyal@usq.edu.au, <sup>2</sup>kevin.mcdougall@usq.edu.au, <sup>3</sup>mehrotra@gsd.harvard.edu

**Keywords:** informal settlements, earthquake, community resilience, land administration, spatial data infrastructure (SDI)

### **Abstract**

Informal settlements are the common features of urban growth in most developing countries and are typically the product of an urgent need for shelter by the urban poor. Rapid urbanisation, inefficient land administration and inadequate capability to cope with the housing needs of people in urban areas have contributed to the development of informal settlements or slums. The problem related to informal settlements is a very serious urban issue for developing countries. Informal settlers are more exposed and vulnerable to natural hazards than the general population and they are more likely to be affected and displaced by disasters. They tend to receive less housing assistance in their aftermath and are one of the vulnerable groups after disasters as they do not have legal land ownership documents and they are invisible on the records of city authorities. The humanitarian response and the reconstruction program led by central government or concerned authority tends to overlook informal settlers.

The spatial data and technology can play a significant role for building resilience of vulnerable urban groups such as informal settlers. This paper explores the role of spatial data infrastructure (SDI) and technology for disaster risk reduction and community resilience. A case of Nepal Earthquake 2015 has been taken as a case study.

## **Geospatial and statistical information for extreme events and disasters relief**

Mario Martínez Jaramillo

INEGI, Mexico

mario.jaramillo@inegi.org.mx

**Keywords:** measurement of extreme events and disasters, disasters risk reduction, recovery, geospatial statistical data, emergencies

### **Abstract**

It seems no region in the world is immune to the effects of extreme events and disasters. Having good Spatial Data Infrastructure and statistical data is one of the requirements for effective risk reduction and recovery. If not, how can we locate, reduce or measure extreme events and disasters?

The session will discuss data gaps and possibilities provided by the combination of geospatial, existing statistics and earth observations data, and share the results of a survey on how statistical and geospatial offices are currently contributing to this area. The session will also reflect on the collaboration needed to measure progress towards the 2030 Sendai Framework for Disaster risk reduction.

The year 2015 has become the most important in terms of attention and measurement of Extremes and Disasters at a global level because the inertia and interest of the work of the various member countries of the UN have culminated in the establishment of various working groups, which contribute to building frameworks address the ravages of climate change on several fronts to address: Emergencies in the face of Disasters (UN-GGIM), Disaster Risk Reduction (UNECE DRR), Measurement of Extreme Events and disaster (UNECE MEED); the recurring issue was the importance of joint international work across user communities and expert networks working on statistics, climate issues, spatial data and disaster risk Reduction; to address the extremes events and disasters in all their phases: prevention, preparedness, response and reconstruction.

## **Challenges of Taiwanese national airborne LiDAR mapping for geohazard assessment**

Jin-King Liu<sup>1</sup>, Li-Yuan Fei<sup>2</sup>, Wei-Chen Hsu<sup>3</sup>, and Hao-Chih Chen<sup>4</sup>

<sup>1</sup> CEO, LIDAR Technology Co. Ltd., jkliu@lidar.com.tw.

<sup>2</sup> Director, Environmental and Engineering Geology Division, Central Geological Survey, MOEA, feily@moeacgs.gov.tw.

<sup>3</sup> General Manager, LIDAR Technology Co. Ltd., ianhsu@lidar.com.tw.

<sup>4</sup> Project Manager, LIDAR Technology Co. Ltd., joshuachen@lidar.com.tw.

**Keywords:** geohazard, point clouds, big data, digital elevation model (DEM)

### **Abstract**

Morakot hit Southern Taiwan on 8-9 August 2009. The tropical cyclone unleashed record rains of 2110 mm in 24 hours with highest record of accumulated rainfalls of more than 3000 mm in southern Taiwan, causing the worst flooding in a century. The area hit by the typhoon is around 10 thousand square kilometers. Landslides and flooding are the most important primary disasters. The authorities realized that the country was dreadfully lacking in detailed, accurate and current elevation data, as well as aerial imagery. In response, a national airborne LiDAR mapping program spanning 2010 to 2015 was launched with the aim of simultaneously capturing the territory (36,000km<sup>2</sup>) by airborne LiDAR and digital imagery. The results include very detailed digital elevation models (DEM) and digital surface models (DSM) of 1m grid and digital aerial photograph of 50 cm grid, as well as an inventory of the geological disastrous features with the acquired LiDAR data and images. In this paper, discussion will include the challenges of natural physiographical conditions and limited resources posed by this large-scale, long-term project and their resolutions with explicit guidelines, organization of task forces, automatic tools and full waveform capabilities.

In conclusion, the quality and accuracy of the resultant digital terrain models can be realized by (1) open-minded coordination of the 6 task forces, namely the client, the 4 survey teams, and the external QA team; (2) a well-prepared guidelines of airborne LiDAR survey; (3) new efficient tools should be implemented to facilitate automatic production and automatic quality check; and (4) a mass production software for processing full waveforms for detecting the weak echoes from the bare ground of dense forests to enhance a higher penetration rate and thus a better quality of DTM.

## **Al Madinah Al Munawwara SDI supports physical infrastructure planning and data sharing across local governments**

Eng Sari<sup>1</sup>, Engr Nasr Kahshhogi<sup>2</sup>, Dr Abdul Salam Mohammed<sup>2</sup>, Prof Dr Shahrum Bin Ses<sup>2</sup>

<sup>1</sup>Al Madinah Development Authority, Saudia Arabia

<sup>2</sup>GTT Inc., Saudi Arabia

Correspondent contact: pmasalam@gmail.com

### **Abstract**

Al-Madīnah al-Munawwarah in the Kingdom of Saudi Arabia, has set a high-level commitment to establish local SDI in compliance with Saudi National level SDI initiatives. It is primarily developed to support the urban planning activities of the Al Madinah Development Authority. As a win-win Situation, MDA supports other local government agencies with common data content standards and guidelines that are prepared as part of the SDI. Technical support is also given to these agencies for generating and maintaining spatial data sets in comply with the data standardization framework prepared for the MSDI. The approach has made MDA as the nodal SDI agency and hence spearhead entire SDI developmental activities in the province. In the past, government entities in the province have invested heavily in GIS technology and geospatial data to meet their own organizational needs. It is, however, now in an excellent position to leverage that investment by establishing the necessary institutional capabilities that are needed to support more effective sharing and utilization of spatial data.

MSDI is now empowering government and academic community with more than 100 map layers such as cadastral data, ortho-imagery, elevation data, transportation, land use, soils, utility networks, etc. Some of these entities have already established transaction-based data maintenance that ensures most updated spatial data and delivered to the MSDI community in a timely manner through the MSDI geo-portal. All the layers that are maintained in the common data model have some level of metadata that is accessible through the geo-portal. Also detailed description of these layers is maintained in the form of Data Dictionary. ISO metadata standards are used for maintaining the metadata sets.

Uniqueness of the MSDI is its approach in empowering spatial data consuming agencies such as ‘Schools’, ‘Hospitals’, ‘Religious establishments’, etc. Necessary tools are provided in the portal for these agencies with high quality spatial data that enable them in geo-referencing rich set of attributes data maintained by these agencies. The entire development of the SDI was achieved through private partnership.

The ultimate goal of MSDI is to create a seamless network of interoperable geospatial portal that will provide easy access to all geospatial information in the emirate. The essential value of MDSDI is widely recognized across the community, and huge cost savings are already being realized in several ways. All spatial data maintained by organizations for their own business purposes is now standardized according to the broader needs of the community. This lead to improved and newer usages of the data, thereby leveraging the value of the data investment. The paper deals with the methods, approaches, techniques and tools adopted for the implantation of MSDI for local SDI community in Al Madinah that is emerging as standard practices for NSDI in the Kingdom.

## **A Point-Based Adaptive Filtering Algorithm for Lidar Data Classification in Urban Environment**

You Shao<sup>1</sup> and Samsung Lim<sup>2</sup>

School of Civil and Environmental Engineering, University of New South Wales, Sydney,  
NSW 2052, Australia,

<sup>1</sup>jack.shaoyou@hotmail.com, <sup>2</sup>s.lim@unsw.edu.au

**Keywords:** Lidar, point classification, adaptive filtering, rasterization

### **Abstract**

Over the last decade, many filtering algorithms have been developed to classify lidar point clouds. As a result, interpolation-based filters, slope-based filters and morphological filters have been widely accepted. Most of the filtering algorithms require the raw lidar data to be rasterized, however, rasterization often causes a significant loss of information. To overcome the information loss, we propose an adaptive filtering algorithm that classifies lidar data effectively into ground points and non-ground points in urban areas. The test results show that, by using an adaptive window size indicator, the proposed algorithm can classify more than 96% of ground points with an accuracy of 0.4 m in typical urban areas, and more than 90% of ground points in areas where complicated buildings are present.

## Image processing and feature extraction for building information modelling

Caitlin McHugh<sup>1</sup> and Samsung Lim<sup>2</sup>

The University of New South Wales, Australia

<sup>1</sup>caitlin.mchugh@student.unsw.edu.au, <sup>2</sup>s.lim@unsw.edu.au

**Keywords:** image processing, feature extraction, building information modelling, facade geometry

### Abstract

As-built Building Information Models (BIMs) have the potential to improve construction performance by replacing conventional documentation, facilitating greater access to site information and providing more accurate representations than models based on CAD drawings. Applications using as-built BIMs to improve construction processes rely on efficient and accurate collection of data to emulate the dynamic nature of a construction site. Current methods used to collect and process data for building information models are time intensive or require specialist equipment. In contrast, applications based on computer vision only require a digital camera and can be run on a personal computer. The main aim of this study is to investigate the use of image processing to extract information about building geometries. In this paper, popular feature extraction algorithms in obtaining information about façade geometries such as corners and edges were assessed. The feasibility of identifying areas of windows from extracted geometries was also investigated, as locations and areas of windows are important in the energy analysis of existing buildings. A number of promising results were produced; however, further work is required before feature extraction can be considered as a viable alternative for collecting information for as-built BIMs.

### References

- BECERIK-GERBER, B., JAZIZADEH, F., LI, N. & CALIS, G. 2011. Application areas and data requirements for BIM-enabled facilities management. *Journal of construction engineering and management*, 138, 431-442.
- BHATLA, A., CHOE, S. Y., FIERRO, O. & LEITE, F. 2012. Evaluation of accuracy of as-built 3D modeling from photos taken by handheld digital cameras. *Automation in construction*, 28, 116-127.
- BÖHM, J. 2004. Multi-image fusion for occlusion-free façade texturing. *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, 35, 867-872.
- BOUKAMP, F. & AKINCI, B. 2007. Automated processing of construction specifications to support inspection and quality control. *Automation in Construction*, 17, 90-106.
- CANNY, J. 1986. A computational approach to edge detection. *Pattern Analysis and Machine Intelligence, IEEE Transactions on*, 679-698.
- CHUANG, Y.-Y., CURLESS, B., SALESIN, D. H. & SZELISKI, R. A bayesian approach to digital matting. *Computer Vision and Pattern Recognition*, 2001. CVPR

2001. Proceedings of the 2001 IEEE Computer Society Conference on, 2001. IEEE, II-264-II-271 vol. 2.
- DAVIES, E. R. 2012. Computer and machine vision: theory, algorithms, practicalities, Academic Press.
  - DAVIS, L. S. 1975. A survey of edge detection techniques. *Computer Graphics and Image Processing*, 4, 248-270.
  - DELIS, E. A. & DELIS, A. 1995. Automatic fire-code checking using expert-system technology. *Journal of computing in civil engineering*, 9, 141-156.
  - DERICHE, R. & GIRAUDON, G. 1993. A computational approach for corner and vertex detection. *International journal of computer vision*, 10, 101-124.
  - ERNSTROM, J. W. 2006. The contractors' guide to BIM, Associated General Contractors of America.
  - FANG, M., YUE, G. & YU, Q. The study on an application of otsu method in canny operator. *International Symposium on Information Processing (ISIP)*, 2009. Citeseer, 109-112.
  - FRAM, J. R. & DEUTSCH, E. S. 1975. On the quantitative evaluation of edge detection schemes and their comparison with human performance. *Computers, IEEE Transactions on*, 100, 616-628.
  - FRUEH, C., JAIN, S. & ZAKHOR, A. 2005. Data processing algorithms for generating textured 3D building facade meshes from laser scans and camera images. *International Journal of Computer Vision*, 61, 159-184.
  - GHISI, E. & TINKER, J. A. 2005. An ideal window area concept for energy efficient integration of daylight and artificial light in buildings. *Building and environment*, 40, 51-61.
  - GRADY, L., SCHIWITZ, T., AHARON, S. & WESTERMANN, R. Random walks for interactive alpha-matting. *Proceedings of VIIP*, 2005. 423-429.
  - GREGSON, P. 1993. Using angular dispersion of gradient direction for detecting edge ribbons. *Pattern Analysis and Machine Intelligence, IEEE Transactions on*, 15, 682-696.
  - HANCOCK, E. R. & KITTLER, J. Adaptive estimation of hysteresis thresholds. *Computer Vision and Pattern Recognition*, 1991. *Proceedings CVPR'91.*, IEEE Computer Society Conference on, 1991. IEEE, 196-201.
  - HARRIS, C. & STEPHENS, M. A combined corner and edge detector. *Alvey vision conference*, 1988. Manchester, UK, 50.
  - HEATH, M., SARKAR, S., SANOCKI, T. & BOWYER, K. Comparison of edge detectors: a methodology and initial study. *Computer Vision and Pattern Recognition*, 1996. *Proceedings CVPR'96*, 1996 IEEE Computer Society Conference on, 1996. IEEE, 143-148.
  - KHALLIL, M. & AGGOUN, A. Edge detection using adaptive local histogram analysis. *Acoustics, Speech and Signal Processing*, 2006. *ICASSP 2006 Proceedings*. 2006 IEEE International Conference on, 2006. IEEE, II-II.
  - KIM, H., SAKAMOTO, R., KITAHARA, I., TORIYAMA, T. & KOGURE, K. Robust silhouette extraction technique using background subtraction. *10th Meeting on Image Recognition and Understand*, MIRU, 2007.
  - KITCHEN, L. & ROSENFELD, A. 1980. Gray-level corner detection. DTIC Document.
  - LEE, S. C. & NEVATIA, R. Extraction and integration of window in a 3D building model from ground view images. *Computer Vision and Pattern Recognition*, 2004. *CVPR 2004. Proceedings of the 2004 IEEE Computer Society Conference on*, 2004. IEEE, II-113-II-120 Vol. 2.

- MEDINA-CARNICER, R., MADRID-CUEVAS, F. J., CARMONA-POYATO, A. & MUÑOZ-SALINAS, R. 2009. On candidates selection for hysteresis thresholds in edge detection. *Pattern Recognition*, 42, 1284-1296.
- MELZNER, J., ZHANG, S., TEIZER, J. & BARGSTÄDT, H.-J. 2013. A case study on automated safety compliance checking to assist fall protection design and planning in building information models. *Construction Management and Economics*, 31, 661-674.
- MOKHTARIAN, F. & MOHANNA, F. 2006. Performance evaluation of corner detectors using consistency and accuracy measures. *Computer Vision and Image Understanding*, 102, 81-94.
- MORAVEC, H. P. 1980. Obstacle avoidance and navigation in the real world by a seeing robot rover. DTIC Document.
- MORTENSEN, E. N. & BARRETT, W. A. Intelligent scissors for image composition. *Proceedings of the 22nd annual conference on Computer graphics and interactive techniques*, 1995. ACM, 191-198.
- PERSSON, M.-L., ROOS, A. & WALL, M. 2006. Influence of window size on the energy balance of low energy houses. *Energy and Buildings*, 38, 181-188.
- RAMESH, T., PRAKASH, R. & SHUKLA, K. 2010. Life cycle energy analysis of buildings: An overview. *Energy and Buildings*, 42, 1592-1600.
- ROTHER, C., KOLMOGOROV, V. & BLAKE, A. Grabcut: Interactive foreground extraction using iterated graph cuts. *ACM Transactions on Graphics (TOG)*, 2004. ACM, 309-314.
- SHAW, D. & BARNES, N. Perspective rectangle detection. *Proceedings of the Workshop of the Application of Computer Vision, in conjunction with ECCV 2006*, 2006. Citeseer, 119-127.
- SIRMACEK, B., HOEGNER, L. & STILLA, U. Detection of windows and doors from thermal images by grouping geometrical features. *Urban Remote Sensing Event (JURSE), 2011 Joint, 2011. IEEE*, 133-136.
- SOBEL, I. & FELDMAN, G. 1968. A 3x3 isotropic gradient operator for image processing.
- STAUFFER, C. & GRIMSON, W. E. L. Adaptive background mixture models for real-time tracking. *Computer Vision and Pattern Recognition, 1999. IEEE Computer Society Conference on.*, 1999. IEEE.
- SUN, J., JIA, J., TANG, C.-K. & SHUM, H.-Y. Poisson matting. *ACM Transactions on Graphics (ToG)*, 2004. ACM, 315-321.
- TOYAMA, K., KRUMM, J., BRUMITT, B. & MEYERS, B. Wallflower: Principles and practice of background maintenance. *Computer Vision, 1999. The Proceedings of the Seventh IEEE International Conference on*, 1999. IEEE, 255-261.
- TUCERYAN, M. & JAIN, A. K. 1998. Texture analysis. *The handbook of pattern recognition and computer vision*, 2, 207-248.
- WANG, J. & COHEN, M. F. 2008. *Image and video matting: a survey*, Now Publishers Inc.
- WENZEL, S., DRAUSCHKE, M. & FÖRSTNER, W. 2008. Detection of repeated structures in facade images. *Pattern Recognition and Image Analysis*, 18, 406-411.
- ZHENG, Z., WANG, H. & TEOH, E. K. 1999. Analysis of gray level corner detection. *Pattern Recognition Letters*, 20, 149-162.
- ZIOU, D. & TABBONE, S. 1998. Edge detection techniques-an overview. *Pattern Recognition And Image Analysis C/C Of Raspoznavaniye Obrazov I Analiz Izobrazhenii*, 8, 537-559.

## **Role of coastal/marine atlases in human-centric SDIs**

Roger Longhorn

GSDI Association, Fazantenlaan 24, Bredene 8450 Belgium  
International Coastal Atlas Network (ICAN) Project, UNESDO IOC IODE, Ostend, Belgium  
rlonghorn@gsdi.org, ral@alum.mit.edu

**Keywords:** coastal, marine, atlas, interoperability, SDI

### **Abstract**

Within the framework of the UNESCO IOC IODE International Coastal Atlas Network (ICAN) Project, a coastal web atlas (CWA) is defined as a collection of digital maps and datasets with supplementary tables, illustrations and information that systematically illustrate the coast, often with cartographic and decision support tools, all of which are accessible via the Internet. This presentation examines the role that coastal and marine atlases play in presenting coastal/marine data to decision makers, businesses and citizens within a national spatial data infrastructure programme or initiative. The International Coastal Atlas Network (ICAN) aims to be a global reference for the development of coastal web atlases and has developed tools to permit digital, online atlases to be created following accepted standards and increased interoperability. A key aim of ICAN is to share experiences and to find common solutions to CWA development (e.g., user and developer guides, handbooks and articles on best practices, information on standards and web services, expertise and technical support directories, education, outreach, and funding opportunities, etc.), while ensuring maximum relevance and added value for the end users. Some of the recent achievements of ICAN include the publication of a handbook on how to develop a coastal web atlas and the ongoing development of an interoperability demonstrator showing how CWAs can be linked together into networks of regional (intra-national and international) networks.

Because a coastal atlas can take on many forms other than just a portal into a database as with many SDI-related geoportals, they lend themselves well to engaging with non-technical decision makers and citizens, for example in education and 'story telling', to raise awareness of a wide range of issues relating to the coastal and marine environment. This presentation briefly presents some of the tools offered for creating interactive and interoperable CWAs and examines how some of the existing coastal/marine atlases that are part of the ICAN Project present information in different formats and how these can impact on the goal of imparting useful information on the state of our coasts and marine regions to non-technical users.

## Techniques for economic valuation of a spatial data infrastructure

Andrew Maurice Coote<sup>1</sup> and Alan Smart<sup>2</sup>

<sup>1</sup>ConsultingWhere Ltd, London, United Kingdom

<sup>2</sup>ACIL ALLEN Economic Consultants, Australia

<sup>1</sup>andrew.coote@consultingwhere.com, <sup>2</sup>a.smart@acilallen.com.au

**Keywords:** socio-economic value, spatial data infrastructure, SDI

### Abstract

In the increasingly challenging financial circumstances faced by many nations, the need to be able to robustly demonstrate the socio-economic benefits of investment in Spatial Data Infrastructures (SDI) is becoming a necessity rather than a nicety. Where Governments are promoting open data (free at the point of use) policies, SDI custodians are further challenged by the need to make the case for increased funding from Government appropriation.

Furthermore, there is a strong body of evidence that many very worthy and important SDI projects are not being approved because the benefits are not being expressed in terms that decision makers, balancing multiple competing priorities across many sectors, understand.

The authors have been heavily involved in many of the recent national efforts to quantify the value of SDI and present them using standard international methodologies adopted for economic and financial appraisals.

The presentation will consider the lessons learned from these, and other studies, particularly in Europe, Australasia and North America and consider how these can be cost-effectively applied to developing countries.

The underlying economic principles considered will include concepts such:

- What is a public good and what geospatial data types meets the criteria;
- The apportioned value of information within particular application use cases;
- Understanding the value chain as information is consumed in an increasingly complex digital environment;
- Benefits transfer as a technique for establishing value using pre-existing studies in other geographies;
- The different considerations between benefits realised (ex-post) and predictive (ex-ante) studies
- Valuing non-market benefits, such as safety, amenity and quality of life.

The methodologies and techniques introduced will include economic welfare analysis, cost-benefit analysis, input-output multipliers, General Equilibrium Modelling, multi-variate analysis, stated preference and revealed preference. The aim will be to explain terms in ways

that SDI practitioners can understand and compare the relative merits of methodologies for different types and levels of investment.

This presentation is part of the outreach initiative of the GeoValue community. The GeoValue community, with sponsorship from organisations such as NASA, USGS, JRC and EuroSDR, hold regular events to promote multi-disciplinary understanding of how to value investment in all types of geospatial system including earth observation, SDI and GIS.

## **The generation of well geo-referenced floor plans and application in indoor navigation system**

Guang-Je Tsai<sup>1</sup>, You-Liang Chen<sup>2</sup>, Kai-Wei Chiang<sup>3</sup>

Department of Geomatics Engineering, National Cheng-Kung University, Taiwan

<sup>1</sup>tpp1114@gmail.com, <sup>2</sup>eltonboy78@gmail.com, <sup>3</sup>kwchiang@mail.ncku.edu.tw

**Keywords:** indoor navigation, portable mapping system, map rectification

### **Abstract**

Indoor navigation systems for common users have recently received a lot of interest. Since the penetration of indoor navigation applications and location-based services strongly relies on accurate indoor maps such as blueprints. Navigation or positioning systems have been widely developed for Location-Based Services (LBS) applications and it comes along with a keen demand of indoor floor plans for displaying results even improving the positioning performance. Generally, the floor plans produced by sketch maps are not accurate enough to incorporate to the indoor positioning system. This study concentrates on generating the highly accurate floor plans based on the robot mapping technique using the portable mapping system. To improve the accuracy of floor plans and transform them into the global coordinate system for seamless applications, this study builds a testing and calibration field using the traditional outdoor control survey method implemented in indoor environments for evaluating the absolute accuracy of floor plans and map rectification. Based on an indoor control survey, this study proposes a novel procedure for building indoor floor plans that includes data acquisition and a map rectification method using the affine transformation to solve the scale and deformation problems in traditional sketch maps. This study presents the map rectification method and transfers the map coordinate from local coordinate system into world coordinate system such as WGS84. The preliminary results presented in this study illustrate that the final version of the building floor plan reach 1-meter absolute positioning accuracy using the proposed portable mapping systems and rectified sketch maps that combine with the map rectification. These maps are also applied in smart-phone based indoor navigation system and achieve the 1 to 2-meter positioning accuracy.

## **Integrating smart phone and Kinect for fall detection**

Hone-Jay Chu<sup>1</sup>, Guang-Je Tsai<sup>2</sup>

Department of Geomatics Engineering, National Cheng-Kung University, No. 1, Daxue Road, East District, Tainan 701, Taiwan

<sup>1</sup>honejaychu@gmail.com, <sup>2</sup>tpp1114@gmail.com

**Keywords:** smartphone, Kinect, fall detection, senior care

### **Abstract**

Smartphones are widely applied in various applications because of the recent developments in mobile sensing and wireless communication technologies. For senior care, location-based fall detection and alarm system are necessary. This study applies a smartphone as the location-based platform and considers accelerometers to detect the fall down in the aged. Based on the three axis accelerometer, the state of fall down can be determined. Moreover, to reduce false detection of the fall detection system, the Kinect is used to assist the smartphone fall detection system. With the depth data collection, this study extracts the skeletal joints from color stream and depth stream for fall detection. Both Kinect and smartphone sensors can be combined for obtaining the sufficient information. The fall index from the smartphone is used to analyze and detect the fall motion. Kinect sensor is provided the skeleton model and the images to recognize the fall down. These images while falling motion happened can be transmitted to the web server. The proposed server can demonstrate the information of the location of fall detection. Activity monitors are used to monitor fall down movements from the web server.

## **Spatial data infrastructure for sustainable developing in Nigeria**

Akpee Dinebari<sup>1</sup>, Friday Gaage<sup>2</sup>, Aogo Tosin<sup>3</sup>, Florence Fred Nwaigwu<sup>4</sup>, Needam Yiinu<sup>5</sup>

Department of Surveying and Geoinformatics, School of Environmental Technology, Ken Sarowiwa Polytechnic, (Formerly Rivers State Polytechnic), Bori Ogoni, Rivers State, Nigeria

<sup>1</sup>Corresponding author: akpee2001@yahoo.com  
<sup>2</sup>friaabe@gmail.com, <sup>3</sup>tosbell@yahoo.com, <sup>4</sup>flobbyf@yahoo.com,  
<sup>5</sup>needamiinu@yahoo.com,

**Keywords:** spatial data infrastructure, sustainable development, geo-information policy

### **Abstract**

The expanding human requirements and economic activities are placing overwhelming pressures on the resources and ecosystem, creating conflicts, risk situation and resulting in suboptimal use of both land and natural resources. Broad sustainable development goal aims to provide a just balance economic, ecological and social development on the basis of comprehensive planning and decision process. The implementation of sustainable development goals requires that all decisions are made with accurate, timely and reliable referenced data. Spatial data infrastructure (SDI) can leverage a better way to manage these data. SDI is often used to denote the relevant based collection of technologies, policies and institutional arrangement that facilitate availability and access to spatial data. SDI also provides a basis for spatial data discovery, evaluation, data sharing and application for users and providers (Nebert, 2004). This paper reviews the geospatial data handling environment and SDI implementation in the study area to expose current state of SDI handling/geospatial data sourcing and the weakness of implementation strategies thereby providing the needed strategy and approach that can fast track the development of SDI in the study area.

## Real property loss relief in the scope of disaster governance

Zhixuan Yang<sup>1</sup> and Abbas Rajabifard<sup>2</sup>

<sup>1</sup>School of Investment and Construction Management, Dongbei University of Finance and Economics, China

<sup>2</sup> University of Melbourne, Australia

<sup>1</sup>zhixuan\_yang@126.com, <sup>2</sup>abbas.r@unimelb.edu.au

**Keywords:** real property, natural disaster, loss relief, disaster governance, urban China

### Abstract

Natural disasters, particularly catastrophic ones, cost tremendous loss of real property. In China over the recent ten years, natural disasters such as earthquake, flood, typhoon, debris flow and landslide, have impacted the country in real physical property loss, physical damage of land and building, and, loss of legal rights to private property. In the current state of affair, the Chinese central government is the main organisation that takes the responsibility of post-disaster loss relief. Insurance/private-public rescue cooperation has not grown in tandem with the need of the market to take over this responsibility from the central government. Therefore, there is a current debate on whether there is a need for private sector to take some responsibilities for an effective loss relief in China. At the same time, loss relief focus is mostly on the post-disaster phase, while in the pre-disaster phase, disaster reduction is not substantially highlighted.

To minimize disaster on the impact to the population and loss of property, a robust national system of governance from strict regulations/building codes are applied in planning stage to prompt first response when disasters, i.e. earthquake or flood, need to be put in place on a national/local level in order to reduce risk to property loss and loss of lives beforehand. Meanwhile, In the post-disaster phase, the collaboration of the public and private sectors is vital to mitigate the loss in the first response. If implemented, this holistic approach both from pre-disaster to post-disaster and from top-down to bottom-up will benefit the nation, which will be sustainable in the long run.

This paper will answer the research question of “How should the loss-relief system work in the face of natural disasters under the domain of good disaster governance?”.

In this paper, crucial issues, i.e. the degree of loss caused by natural disasters, value loss in real estate valuation, building code and regulations, current loss relief approaches e.g. insurance products of property casualty, the government and private sector capacities to respond to disasters, i.e. earthquake, flood, are discussed in detail.

The methodologies adopted in this research paper will include:

- Literature review of residents’ awareness of disasters, importance of good disaster governance through insurance, insurance products’ design and governments’ role in the loss relief;

- Interview of stakeholders in the aspect of disaster loss relief, i.e. insurers, insurees, etc. to test the mechanism of the current relief system.

The paper will propose the improvement of the current relief system in the following aspects:

- Capacity building at the government level e.g. building code and regulation, disaster education, loss-relief policy, subsidy, compulsory insurance, local jurisdiction authorization and etc.;
- Insurance and reinsurance improvement at the private level;
- Voluntary mutual arrangement, donations and NGO at the public level, particularly for the poor.

## **Comprehensive analysis of flood disaster risk identification to cultural heritage in Taiwan**

Jieh-Jiuh Wang

Department of Architecture, Ming Chuan University, Taiwan

[jjwang@mail.mcu.edu.tw](mailto:jjwang@mail.mcu.edu.tw)

**Keywords:** cultural heritage, climate change, risk identification, risk map, preventive conservation, flood

### **Abstract**

The frequency and the scale of disasters are both increased due to the global climate change in recent years. Preservation strategies to cultural heritage shall take both the entire environment and the large-scale disasters into consideration. Unfortunately, the thought on disaster preparedness to cultural heritage in Taiwan still concentrates on fire, decay, structural reinforcement for single building and ignores concepts of the environment as a whole. These traditional preservation practices are unable to resist the frequent natural hazards in scale and tends caused by climate change. This study adopts the perspective of risk identification and uses the geographic information systems to construct flood risk thematic maps on cultural heritage. Study result finds the positive correlation between the disaster risk of cultural heritage and the rainfall intensity. Historical buildings are the most affected cultural heritage by flood, which is followed by municipality /county monuments, national monuments, and historical site. None of the traditional settlements and cultural landscapes is affected. It might be related to the taboo space (shelter) in the traditional culture regarding site selection. Affected cultural heritage mainly concentrates in central and northern Taiwan, while the heritage in northern and eastern Taiwan suffers from more serious flooding depth.

## Analyzing recent trends and developments in the SDI network

Glenn Vancauwenberghe<sup>1</sup>, Danny Vandenbroucke<sup>2</sup>, Joep Cromptvoets<sup>3</sup>

<sup>1,2</sup>KU Leuven - Spatial Applications Division, Leuven, Belgium

<sup>3</sup>KU Leuven - Public Governance Institute, Leuven, Belgium

<sup>1</sup>glenn.vancauwenberghe@kuleuven.be, <sup>2</sup>danny.vandenbroucke@kuleuven.be,  
<sup>3</sup>joep.cromptvoets@soc.kuleuven.be

**Keywords:** spatial data infrastructure, network perspective

### Abstract

Spatial data infrastructures (SDI's) are about dealing with geographic data and information in a more open, interconnected and interoperable manner. SDI's can be seen as a collection of technological and non-technological arrangements that give shape to a network of spatial data relationships between producers and users of spatial data. From a network perspective, SDI's have led to the establishment of new spatial data flows between these actors, the introduction of new actors in the network, but also to the removal of barriers that hinder or prevent the flow of data between producers and users.

Analyzing SDI's from a network perspective provides a unique approach to study the exchange and use of spatial data, and the impact of SDI's. The network perspective enables the detailed analysis of how flows of spatial data between data users and data producers are arranged and facilitated by an SDI. Moreover, the network perspective allows for an analysis of the mutual relationships between different actors and arrangements within an SDI framework. It is the aim of these SDI arrangement to minimize the impedance of spatial data flows through the implementation of SDI components. While SDI arrangements will only remain in place in case they are successful in doing this, the future development of these arrangements will be focused on removing existing barriers and lowering the impedance of the network.

Specific concepts, tools and measurements can be used to analyze these SDI networks, thereby contributing to a better understanding of the impact of SDI development. Typical network concepts such as density and centralization allow to measure and express the key characteristics of the network. The concept of network impedance focuses on barriers that hinder or prevent the flows of data in the network. Measuring all these different network parameters contributes to a better understanding of the complex interactions between different SDI arrangements.

The aim of the paper is to analyze recent developments in SDI implementation through the application of the network perspective. The paper will build further on earlier research on the development and application of the network approach on spatial data infrastructures in Flanders. Using the analysis of the Flemish SDI network in 2008 as a starting point, the paper will examine how the network of spatial data flows has changed in recent years, and how these changes are driven or influenced by different technological and non-technological developments. The paper will show how recent developments such as the implementation of network services and the application of linked and open data have steadily transformed and shaped the network of spatial data flows. Based on the results and findings of the analysis of

the current status of the SDI network, recommendations will be formulated on the future development of spatial data infrastructures.

## Convergence of spatial data infrastructure and data revolution

Chukwudozie Ezigbalike<sup>1</sup>, Léandre Ngogang Wandji<sup>2</sup>, Peter Kinyua Njagi<sup>3</sup>, Zacharia Chiliswa<sup>4</sup>

<sup>1,2,3</sup>African Centre for Statistics, United Nations Economic Commission for Africa, Addis Ababa, Ethiopia

<sup>4</sup>University of Bradford, UK

<sup>1</sup>cezigbalike@uneca.org, <sup>2</sup>Ingogangwandji@uneca.org, <sup>3</sup>pnjagi@uneca.org,

<sup>4</sup>zchiliswa@yahoo.com

**Keywords:** data revolution, data communities, Volunteered Geographic Information, VGI, citizens, SDGs, official statistics

### Abstract

As defined in the African Data Consensus (ADC), the data revolution is “... [The] process of embracing a wide range of data communities and diverse range of data sources, tools, and innovative technologies, to provide disaggregated data for decision-making, service delivery and citizen engagement; and information for Africa to own its narrative.”

The data revolution envisaged a (new) partnership involving governments, civil society, development partners and, most importantly, citizens. The concomitant emphasis on leaving no one behind require that all actors, stakeholders and beneficiaries should have access to relevant information to play their respective roles in the development process, including implementation, monitoring and reporting on progress.

These partnership and inclusive aspects are already at the core of spatial data infrastructures. The emphasis of the SDGs, in which context the data revolution was introduced, on disaggregation of data on several topics, but especially (gender and) geography, makes geospatial data indispensable for the data revolution. It is therefore imperative that two concepts should converge, and this paper argues, and proposes strategies, for this convergence.

The paper will review different definitions and concepts of data revolution and explain the rationale behind the definition proposed in the African Data Consensus. The ADC introduced the concept of data communities, as a way of dealing with ensuring that professional communities and stakeholders, who understand particular data themes, are given the mandate to produce them. The paper will establish the similarities between this concept and the custodianship principle of SDIs.

The data revolution presents the opportunity to open up the “data ecosystem” to more actors to be involved in providing data, including citizens. This opportunity however, raises a challenge with regards to the legal frameworks underpinning the production and dissemination of data and statistics. Even though Principle 5 of the Fundamental Principles of Official Statistics stipulates that data for statistical purposes may be drawn from all types of sources, it still falls short of the full involvement of other actors implied by the data revolution. Another opportunity presented by the data revolution is in technology. Advances in information and communication

technologies now allow data to be amassed from unexpected sources, processed in previously unimagined ways, and presented in new formats and media to wider audiences. These new approaches are now being incorporated into statistical systems that are being transformed and modernized. Notable among the innovations in data collection and dissemination are the use of mobile devices for data collection, and the potential for big data as a source of statistics.

This form of data provisioning is already established in the geospatial information community in the form of Volunteer Geographic Information (VGI). The paper will examine how VGI is being incorporated into SDIs for lessons for the statistical offices that are expected to continue to coordinate the expanding data ecosystems.

## **Evaluation of Success of National Geographic Information Infrastructure (NGII): User Satisfaction Perspective (A case in Nepal)**

Nab Raj Subedi<sup>1</sup>, Diego Navarra<sup>2</sup>, Christiaan H. J. Lemmen<sup>3</sup>, Dev Raj Paudyal<sup>4</sup>

<sup>1</sup>National Land Use Project, Ministry of Land Reform and Management Kathmandu, Nepal

<sup>2</sup>CLIMATEXCHANGE, London, United Kingdom

<sup>3</sup>Department of Urban and Regional Planning and Geo-information Management (ITC-PGM) at the faculty of ITC, Netherlands

<sup>4</sup>University of Southern Queensland, Australia

<sup>1</sup>Principal contact for correspondence: nawrajsubedi@yahoo.com

**Keywords:** spatial data infrastructure, SDI, information infrastructure, evaluation

### **Abstract**

The multiplicity of dimensions of a National Geographic Information Infrastructure (NGII) makes a holistic evaluation an impracticable activity if not impossible. However, an NGII can be evaluated based on user satisfaction, which is a function of multiple factors that influence its users. The evaluation of Nepalese NGII from a user satisfaction perspective has been carried out by conceptualizing an evaluation framework that uses measurable indicators perceived by users and, finally validated statistically. Indicators were selected comparing user satisfaction indicators for information systems and key variables of SDI and finally verified in the field. An index was derived by integrating all the measured satisfaction on weight assigned indicators is used to denote the level of success. It was found that the success level of NGII is below the “slightly satisfied level i.e. 1” although positive with an overall mean success index of 18% in comparison to the extremely satisfied conditions in an ideal case (100%). “Standard” was found as the only component of NGII which is quite satisfying, whereas highly weighed indicators such as effort applied for collaborative SDI and partnership, up-to-datedness of data, pricing revealed a negative satisfaction. Indicators like availability, accessibility, means of request and completeness are in a very low level of positive satisfaction. This framework, generated by synthesizing concepts of evaluation for user satisfaction, evaluates an NGII through perceptual means. The framework brings to the fore the aspects of NGII that need immediate attention relative to others to be able to push-up the overall success level. We conclude that the user satisfaction construct can be used to evaluate an NGII by comparing satisfaction on indicators and these indicators differ from SDI to SDI.

## What is effective governance for SDI's?

Jaap-Willem Sjoukema<sup>1</sup>, Arnold Bregt<sup>2</sup>, Joep Cromptvoets<sup>3</sup>

<sup>1,2</sup>Laboratory of Geo-Information Science and Remote Sensing, Wageningen University, P.O. Box 47, 6700 AA Wagening, Netherlands

<sup>3</sup>KU Leuven - University of Leuven, Public Management Institute, Parkstraat 45, 3000 Leuven, Belgium

<sup>1</sup>jaap-willem.sjoukema@wur.nl, <sup>2</sup>arnold.bregt@wur.nl, <sup>3</sup>joep.cromptvoets@soc.kuleuven.be

**Keywords:** spatial data infrastructure, SDI, governance, model

### Abstract

Spatial data infrastructures (SDI) play an increasing role in the governance of society. Many societal issues are supported by spatial data infrastructures. Considering the importance of SDIs, it is surprising that the governance of SDI's itself did not receive a lot of scientific and practical attention. This is partly due to the complex, multi-stakeholders, multi-level, technical and open character of SDI's. However, with the increasing role of SDIs, more insight in appropriate governance models is essential.

The governance of SDIs is at this moment in The Netherlands, Belgium and other countries, world-wide quite often a matter of trial and error. There is hardly any evidence-based research on the effect of potential governance interventions (e.g. open data policy, change in funding, coordination structure, participation of the private sector) on the effectiveness and efficiency of SDIs. The governance issue has become more urgent over the years. Former weaker SDI-components, such as standards, technology and data have significantly improved over the years (Bregt & Cromptvoets, 2000; Bregt, 2006). It might well be that SDI-governance is the "weakest link" of current SDIs.

The overall long-term objective of a new research project is to develop effective governance models for spatial data infrastructures. As a first step the following concept research results based on literature review and qualitative research will be presented:

- A definition of governance within the context of SDI's;
- A view on the current SDI governance practices in the Netherlands and Belgium;
- An outlook towards promising SDI governance models,

Due to the complex nature of SDI's, it is the question what effective governance of SDI's exactly is. How can we define this and how do SDI practitioners think about effective governance? Can it be achieved? This presentation will discuss the answers for these questions and will give an outlook on research and practical challenges of SDI governance.

## References

- Bregt, A. K. & J.W.H.C. Crompvoets, 2000. Geo-informatie in de netwerksamenleving, een tweeluik. Vi Matrix 8 93) pp 16-19
- Bregt, A.K., 2006. Value added services en de Nationale geo-informatie infrastructuur. In: Proceedings Conferentie "Promoting value-added GI services", Den Haag, pp. 77-81.
- Vandenbroucke, D., J. Crompvoets, G. Vancauwenberghe, E. Dezzers, J. Van Orshoven, 2009. A Network Perspective on Spatial Data Infrastructures: Application to the Sub-national SDI of Flanders. Transactions in GIS, 2009, 13(s1): pp. 105–122.

## **A study of vegetation coverage and water storage capacity in Datu tableland before and after human development in 2000 to 2015**

Tien Ying-Ping<sup>1</sup>, Chang Kuo-Chen<sup>2</sup>, Chen Chun-Kai<sup>3</sup>

<sup>1,2</sup>Department of Geography, National Taiwan Normal University, Taiwan

<sup>3</sup>Disaster Prevention Technology Research Center, Taiwan

<sup>1</sup>noah0901@hotmail.com, <sup>2</sup>twnrsworld@hotmail.com, <sup>3</sup>tp6rmp4d93@gmail.com

**Keywords:** vegetation coverage, water interception and storage, flood reduction

### **Abstract**

Datu tableland is located between the land of Taichung Basin and Taichung's Western Coastal Plain. It is a large Urban Green Corridors with multi-functions such as recreation, water resources conservation, air purification, and Ecological Service. In this study, we plan an integrated approach to investigate the impacts of land use and land cover (LULC) changes on hydrology at different scales in Datu tableland.

Hydrological modelling will be conducted for the LULC maps from remote sensing images at three times in three river watersheds of Datu tableland using the rain-runoff model. The remotely sensed data for grassland before and after tableland development are used to evaluate the vegetation coverage benefits by the established threshold for land cover discrimination. The total water storage capacity is estimated also before and after tableland development.

The result shows that the main LULC changes in this morphologic region from 2000 to 2015 were the transformation of farmland into built-up land, or forests into grassland and built-up land. The changes also decrease total water storage capacity in three river watersheds of Datu tableland. The approach of quantifying the impacts of LULC changes on hydrology provides quantitative information for stakeholders in making decisions for land and water resource management. By linking a hydrological model and an ecological service model to remote sensing image analysis. The anticipated benefits for flood reduction may be also presented in disaster prevention.

### **References**

- Ye HAN, Zhongxue ZHOU. Evaluation on ecosystem services in haze absorption by urban green land and its spatial pattern analysis in Xi'an. *Geographical Research*, 2015, 34(7): 1247-1258
- Chaplot V. Impact of DEM mesh size and soil map scale on SWAT runoff, sediment and NO<sub>3</sub>-N loads predictions [J]. *Journal of Hydrology*, 2005, 312: 205-222
- Savary S, Rousseau AN, Quilbe R (2009) Assessing the effects of historical land cover changes on runoff and low flows using remote sensing and hydrological modeling. *J Hydrol Eng* 14(6): 575–587.

- Baldyga TJ, Miller SN, Driese KL, Gichaba CM (2008) Assessing land cover change in Kenya's Mau Forest region using remotely sensed data. *Afr J Ecol* 46(1): 46–54
- Sahin V, Hall MJ (1996) The effects of afforestation and deforestation on water yields. *J Hydrol* 178 (1–4): 293–309.
- Hernandez-Guzman R, Ruiz-Luna A, Berlanga-Robles CA (2008) Assessment of runoff response to landscape changes in the San Pedro subbasin (Nayarit, Mexico) using remote sensing data and GIS. *J Environ Sci Health A Tox Hazard Subst Environ Eng* 43(12): 1471–1482. doi: 10.1080/10934520802253465 PMID: 18780225
- Helmschrot J, Flugel WA (2002) Land use characterisation and change detection analysis for hydrological model parameterisation of large scale afforested areas using remote sensing. *Phys Chem Earth* 27 (9–10): 711–718.
- Hernandez M, Miller SN, Goodrich DC, Goff BF, Kepner WG, Edmonds CM et al. (2000) Modeling runoff response to land cover and rainfall spatial variability in semi-arid watersheds. In *Monitoring Ecological Condition in the Western United States*. pp. 285–298.
- Githui FW (2009) Assessing the impacts of environmental change on the hydrology of the Nzoia catchment, in the Lake Victoria. PhD thesis, Vrije Universiteit Brussel, Brussels, Belgium.
- Sharma T, SatyaKiran PV, Singh TP, Trivedi AV, Navalgund RR (2001) Hydrologic response of a watershed to land use changes: A remote sensing and GIS approach. *Int J Remote Sens* 22(11):2095–2108.
- Miller S, Semmens D, Goodrich D, Hernandez M, Miller R, Kepner W, et al. (2007) The Automated Geospatial Watershed Assessment Tool. *Environmental Modeling & Software* 22: 365–377.
- Gao, Y., Zhang, W.(2009) LULC classification and topographic correction of Landsat-7 ETM+ Imagery in the Yangjia River watershed: the Influence of DEM Resolution, *Sensors*, 9:1980-1995.
- Arsanjani JJ, Kainz W, Mousivand AJ (2011) Tracking dynamic land-use change using spatially explicit Markov Chain based on cellular automata: the case of Tehran. *Int J Image Data Fusion* 2(4): 329–345.
- Munoz-Villers LE, Lopez-Blanco J (2008) Land use/cover changes using Landsat TM/ETM images in a tropical and biodiverse mountainous area of central-eastern Mexico. *Int J Remote Sens* 29(1): 71–93.
- Sirikulchayanon P, Sun WT, Oyana J (2008) Assessing the impacts of the 2004 Tsunami on mangroves using GIS and remote sensing techniques. *Int J Remote Sens* 29(12): 3553–3576.
- Michel C, Vazken A, Perrin C (2005) Soil conservation service curve number method: how to mend a wrong soil moisture accounting procedure. *Water Resour Res* 41(W02011): 1–6. PMID: 16173154 *Advances in Meteorology Volume 2015 (2015)*, Article ID 676030, 10 pages <http://dx.doi.org/10.1155/2015/676030>

## **The application of GIS to the government's Regulatory Impact Assessment: A case study of the agricultural zoning policy in Taiwan**

Chia-Yi Cheng<sup>1</sup> and Chen-Fu Lu<sup>2</sup>

<sup>1</sup>Department of Agricultural Economics, National Taiwan University, Taipei, Taiwan

<sup>2</sup>Agricultural Technology Research Institute, Agricultural Policy Research Center, Taipei, Taiwan

<sup>1</sup>d98627002@ntu.edu.tw, <sup>2</sup>d98627001@ntu.edu.tw

**Keywords:** geospatial data, geographic information, governance, environment

### **Abstract**

Agricultural zoning is a major mean of farmland conservation and it has been a key component in policy for the prevention of urban sprawl and non-agricultural development of farmland in Taiwan. However, despite political commitments to the policy, there is currently little empirical evidence regarding the actual economic impact and effectiveness of this policy. This study adds to current knowledge by assessing the effect of agricultural zoning policy based on the Regional Planning Act which was amended in 2000 in Taiwan and using big data in combination with datasets from a management information system (MIS) and geographic information system (GIS). With the assistance of the GIS, we extracted geospatial and analytic data from map profiles along with data from a social economic dataset. By using the repeated cross-sectional zoning data at a village level and information about paddy planting areas for the first crop season in 2010 and in 2014, we applied a random effects panel regression to examine the influences of the planned zoning on cropland. Our results demonstrate that the zoning impact on paddy fields located in common agricultural zones is a significant decrease in area of about 4 hectares. However, within special agricultural districts and urban planning areas, the zoning effects seem to be positive but insignificant. This suggests the agricultural zoning policy in Taiwan is likely to discourage farmers from farming, which may prompt them to engage in alternative land use.

## Cloud solutions for Homeland SDI

Joana Simoes<sup>1</sup>, Paul Van Genuchten<sup>2</sup>, Maria Arias de Reyna<sup>3</sup>

<sup>1</sup>GeoCat, Portugal, joana.simoes@geocat.net

<sup>2</sup>GeoCat, Netherlands, paul.vangenuchten@geocat.net

<sup>3</sup>GeoCat, Spain, maria.arias@geocat.net

**Keywords:** Spatial Data Infrastructure, SDI, OGC services, metadata, geospatial data

### Abstract

In recent times, the exponential growth of location-referenced sensor data, combined with exposure to internet of "traditional" GIS data stores has resulted in an increase in the volume of available geospatial data. There is a growing demand for combining all these different sources and resources into new information, to improve situational awareness that could lead to better, or "smarter", decisions. Combining data stores or data streams is an operation which requires computer power, memory and storage. This makes geospatial storing and processing a very good candidate for cloud computing.

Cloud computing is a paradigm for enabling, on demand, network access to a shared pool of configurable computing resources, which can be rapidly provisioned with minimal management effort [1]. High availability is a key property of cloud computing, and this is achieved by using techniques which are abstracted from the final user. Another key advantage is removing the management effort of running a similar infrastructure in in-house servers, and the consequent reduced IT costs.

One of the critical issues associated to cloud computing is the existence and adoption standards that will enable cross platform interoperability, consistent security mechanisms, and information sharing. Not relying on standards, risks to result in the creation of data "silos". In the case of geospatial information, OGC standards are a valuable asset, which enables developers to make geospatial information and services accessible, whether or not these services are provided via the cloud. These standards, when combined with the increased availability of a good internet connection, allow a single point of access to distributed data sources, reducing storage redundancy and the risk for data inconsistency.

GeoCat Live is a docker-based solution to provision servers on the cloud, which implement a Spatial Data Infrastructure (SDI). The solution takes advantage of the docker framework to achieve an easy and quick setup (one-click), some degree of customization, and resilience to failure. By tackling aspects such as security and backups, we aim to provide a solid, hassle-free and cost-effective, alternative, for homelands to run their SDIs on the cloud. Live relies heavily on geospatial standards, in order to promote the interoperability of services, data and metadata. Examples of these standards include OGC Web Services (OWS) or the INSPIRE profile. It is entirely based on mature Free and Open Source Geospatial software, such as GeoNetwork, GeoServer and PostGIS.

In this talk we will describe the technical background of our solution, as well as the architecture of our product, and the product roadmap. In order to demonstrate its capabilities, we will also

give examples of the usage of GeoCat Live, from the point of view of the end user. We aim to demonstrate the usefulness of this solution, which covers a basic need for most homelands: to run a SDI.

## References

[1] McKee, Lance, Reed, Carl and Ramage, Steve. Open Geospatial Consortium. OGC Standards and Cloud Computing. Draft – OGC’s Geospatial Cloud White Paper: OGC 11-036, 2011.

## Taming big data with metadata

Joana Simoes<sup>1,3</sup>, Paul Van Genuchten<sup>2</sup>, Jeroen Ticheler<sup>3</sup>

<sup>1</sup>GeoCat, Portugal, joana.simoes@geocat.net

<sup>2</sup>GeoCat, Netherlands, paul.vangenuchten@geocat.net

<sup>3</sup>GeoCat, Netherlands, jeroen.ticheler@geocat.net

**Keywords:** big data, catalog services, metadata, geonetwork, open source

### Abstract

In recent years, we have watched an explosive growth of geospatial data. While in one hand this could be due to the “piling up” of time series from traditional data sources (e.g.: remote sensing), on the other hand there is an emergence of new geospatial datasets (e.g.: data generated by sensors, or by "humans as sensors"); these new sources are somehow linked to relatively recent phenomena such as the Internet of Things (IoT), or Volunteer Geographic Information (VGI).

Big Data has been often defined based on its five properties (or five V's): Volume, Velocity, Variety, Veracity and Value [1]. Although much emphasis has been put on addressing the first two V's, by developing innovative frameworks that can ingest Petabytes of data in real-time, or near real-time, a similar effort is needed in addressing the Variety, Veracity and Value of Big Data. And this is where we think that Metadata can help.

Metadata is often defined as "data about the data", and it is key to discover datasets, to assess their quality, and to use and preserve these datasets in the long term (e.g.: survivability of data). Having more and more heterogeneous information, does not necessarily bring any value to businesses and organizations, unless this information is discoverable, interoperable, and ensures a certain degree of quality. To enforce these properties, a variety of technologies have been introduced, such as OGC standards (e.g.: CSW), metadata profiles (e.g.: INSPIRE) and best practices (e.g.: Spatial Data on the Web best practices).

On this talk we are going to discuss some of these technologies and related challenges, in the context of a Spatial Web Catalog - GeoNetwork Opensource. We are also going to discuss strategies for metadata creation inspired by the crowdsourced paradigm, which can increase the levels of confidence in data quality by a process of peer review. We intend to demonstrate how metadata can be used as a privileged asset, not only for discovering and managing Big Geo Data, but also to enforce its quality and, ultimately to increase its value.

### References

[1] Xu, C., & Yang, C. (2014). Introduction to big geospatial data research. *Annals of GIS*, 20(4), 227-232.

## National elevation data strategy for Canada

Paula McLeod<sup>1</sup>, David Bélanger<sup>2</sup>, Nouri Sabo<sup>3</sup>

Natural Resources Canada, Canada Centre for Mapping and Earth Observation, Canada

<sup>1</sup>paula.mcleod@canada.ca, <sup>2</sup>david.belanger@canada.ca, <sup>3</sup>Nouri.sabo@canada.ca

**Keywords:** elevation, LiDAR, data management, spatial data infrastructure

### Abstract

Elevation data is a fundamental data theme that has been provided by Natural Resources Canada (NRCAN) to Canadians as essential geographic information. The renewal and enhancement of national elevation data coverage has recently been identified as a priority for Canada's SDI. LiDAR data provide new opportunities for enhancing elevation information, products and services. The elevation project team at CCMEQ (Canada Center for Mapping and Earth Observation), Natural Resources Canada (NRCAN) has created a strategy to increase high-resolution elevation data coverage in the country by optimizing past and future investments in elevation data acquisition. The strategy also aims to improve accessibility to these data.

The acquisition strategy is composed of two main components:

- 1) In the North (North of the productive forest line) NRCAN is collaborating with the United States. The project aims to create in the public domain a 2m resolution elevation surface model for the whole Arctic in 2017. The elevation is derived from high resolution satellite imagery.
- 2) In the South part of the country (South of the productive forest line) more accurate elevation data such as Lidar are needed for forest inventory, flood plain mapping, agriculture, infrastructure etc. To acquire this Lidar data, the federal government is working with provinces and territories to free-up existing data and participate in new acquisitions.

As part of this strategy, NRCAN are also working on the following subjects:

- Development of a system for the management and dissemination of elevation data (including Lidar data) and elevation derivative products;
- Development of a national Lidar data acquisition guideline;
- Development of a national elevation data inventory management system;
- Extraction of cartographic features (others than elevation) from Lidar data.

To implement the strategy, CCMEQ is acquiring a large inventory of Airborne Laser Data (LiDAR). These data are particularly massive and their management and processing require enormous computing capacity. CCCMEQ experts are developing innovative approaches to address the problems of managing, processing and disseminating elevation big data. To achieve

this, the team will use a data structure GeoHashTree (see [http://publications.gc.ca/collections/collection\\_2015/rncan-nrcan/M103-1-4-2014-eng.pdf](http://publications.gc.ca/collections/collection_2015/rncan-nrcan/M103-1-4-2014-eng.pdf)).

In addition, to facilitating the management of point clouds this structure reduces data storage space considerably, while also facilitating data access and handling.

For the short term, DEMs and derivative products at 2m resolution (GEOTIFF) will be disseminated publicly. We want to also create a mosaic including multi-resolution (resolution between 5m to 300m) DEMs for web services (WMS,WCS, ...).

## **References**

[http://publications.gc.ca/collections/collection\\_2015/rncan-nrcan/M103-1-4-2014-eng.pdf](http://publications.gc.ca/collections/collection_2015/rncan-nrcan/M103-1-4-2014-eng.pdf)

## **Metadata catalogue based on GeoNetwork Opensource at Environment and Climate Change Canada (ECCC): a use case**

Maria Arias de Reyna<sup>1</sup>, Jose Garcia<sup>2</sup>, Jeroen Ticheler<sup>3</sup>

<sup>1,2</sup>GeoCat, Spain - maria.arias@geocat.net, jose.garcia@geocat.net

<sup>3</sup>GeoCat, Netherlands - jeroen.ticheler@geocat.net

**Keywords:** spatial data infrastructure, SDI, governance, environment, geographic information

### **Abstract**

Environment Canada and Climate Change Canada (ECCC) are committed to protecting the environment, conserving the country's natural heritage, and providing weather and meteorological information to keep Canadians informed and safe.

Environment Canada and Climate Change Canada use GeoNetwork Opensource as a metadata geoportal to manage a data publication process for data produced by the different departments.

An internal catalogue is used to register spatial resources by users in the different departments. Once the metadata is created and validated according to a set of defined rules, the data and metadata go through a revision process where they will be reviewed by different users to verify the quality.

Approved registrations, indicated as open data, are published publicly in an open data portal and can be accessed via the portal or with the OGC:CSW protocol. Also the related resources are deployed publicly as GIS services (OGC:WMS/OGC:WFS) in an automated way.

On this talk we are going to discuss a high-level architecture of the system and the related challenges to support the publication process and the integration with external systems.

## **CEOS Working Group on Information System and Services (WGISS) earth observation data access infrastructure and interoperability standards**

Gabor Remetey<sup>1</sup>, Andrew E. Mitchell<sup>2</sup>, Mirko Albani<sup>3</sup>

<sup>1</sup>HUNAGI, Hungary & GSDI Association Liaison

<sup>2</sup>Goddard Space Flight Center, NASA, USA

<sup>3</sup>ESRIN, European Space Agency (ESA), Italy

<sup>1</sup>gabor.remetey@gmail.com, <sup>2</sup>Andrew.E.Mitchell@NASA.gov, <sup>3</sup>mirko.albani@esa.int

**Keywords:** earth observation, EO, spatial data infrastructure, SDI, geospatial data, CEOS, GEO, WGISS

### **Abstract**

The Committee on Earth Observation Satellites (CEOS) serves as a focal point for international coordination of the satellite Earth Observation (EO) programs of the world's government agencies, along with agencies that receive and process data acquired remotely from space. As the “space arm” of the intergovernmental Group on Earth Observations (GEO), CEOS is promoting exchange of data while implementing high priority actions to optimize societal benefit and inform decision making for securing a prosperous and sustainable future for humankind.

A new generation of EO satellites creates significant volumes of data with comprehensive global coverage that for many important applications, a ‘lack of data’ will no longer be the limiting factor. Recent research and development activities have resulted in new applications that offer significant potential to deliver impact to important environmental, economic and social challenges, including at the regional and global scales necessary to tackle ‘the big issues’.

Many satellite data users, particularly those in developing countries, lack the expertise, infrastructure and internet bandwidth to efficiently and effectively access, process, and utilize the growing volume of space-based data for local, regional, and national decision-making. Furthermore, even sophisticated users of EO data typically invest a large proportion of their effort into data preparation. This is a major barrier to full and successful utilization of space-based data, and threatens the success of major global and regional initiatives supported by CEOS. As data volumes grow, this barrier is becoming more significant for all users.

New architectures and players are removing obstacles to data uptake with advanced cloud storage and processing capabilities.

CEOS is currently performing a study of future data access and analysis architectures. One major outcome of the study will be a report listing recommendations for the way forward for CEOS and its agencies, including in relation to standardisation, interoperability etc, and how the current CEOS priorities might benefit from the proposed activities.

The Working Group on Information Systems and Services (WGISS) is a subsidiary body of CEOS tasked with promoting collaboration in the development of systems and services that manage and supply these observatory data. WGISS creates and demonstrates prototypes supporting CEOS and GEO requirements. WGISS also addresses the internal management of EO data, the creation of information systems and the delivery of interoperable services. The activities and expertise of WGISS span the full range of the information life cycle from the requirements and metadata definition for the initial ingestion of satellite data into archives through to the incorporation of derived information into end-user applications.

Through WGISS, CEOS is harmonizing the aspects of data systems necessary to facilitate interoperability.

WGISS will continue to work towards a common understanding of the information model for satellite data, the identification and testing of common search criteria for satellite data products, and adaption and testing of the common standards and protocols to describe, search, and access satellite data.

WGISS recognizes that existing Spatial Data Infrastructures (SDIs) play an important role in EO applications in many societal benefit areas. WGISS anticipates the evolution of future data system architectures and SDIs are effective tools to support the activities related to the Sustainable Development Goals adopted by the United Nations (UN).

## References

- <http://ceos.org/ourwork/workinggroups/wgiss/>
- <http://www.earthobservations.org>
- <http://gsdiassociation.org>
- <http://www.un.org/sustainabledevelopment/sustainable-development-goals/>

## **Evaluating INSPIRE: testing and validating as a way to steer and guide implementation actions**

Danny Vandenbroucke<sup>1</sup>, Ann Crabbe<sup>2</sup>, Stijn Keijers<sup>3</sup>

SADL, KU Leuven, Leuven, Belgium

<sup>1</sup>danny.vandenbroucke@kuleuven.be, <sup>2</sup>ann.crabbe@kuleuven.be, <sup>3</sup>stijn.keijers@kuleuven.be

**Keywords:** spatial data infrastructure, SDI, geographic information, assessment, testing, validating

### **Abstract**

In 2014, the European Commission conducted a mid-term evaluation of the implementation of the INSPIRE (Infrastructure for Spatial Information in Europe) Directive. The evaluation consisted of a public survey, the testing and validation of the technical INSPIRE components (metadata and services) and an internal desktop study. It also included an assessment of data sharing measures and policies already implemented operationally in the Member States.

For the testing and validation of the technical components, a sample-based approach was applied to select, test and validate existing INSPIRE components in all EU Member State countries against the INSPIRE monitoring information. The testing started from the declared data sets and services and their characteristics (e.g. conformity) by the Member States, trying to find the resources back in the European geo-portal and test them against the INSPIRE specifications using the EC JRC Resource Browser tool. Explanations for not finding data sets and services, or for not being able to access them were sought for by contacting data and service providers in order to better understand e.g. implemented limitations to public access.

Based on these first insights and after the European Commission sent a letter to Member States to ask for further clarifications and plans for action, Belgium performed in 2015-2016 a more extensive validation exercise of all its INSPIRE metadata and service resources. Existing testing and validation tools were used and compared, including the INSPIRE resource browser, the Spatineo tools and others. The exercise revealed several issues. First, none of the tools is 'perfect' and cover all INSPIRE validation requirements. Second, and even more important, the results of the testing and validation should be handled with care. Indeed, testing and validation should be done for different purposes. For data and service providers, the results help to find deficiencies and improve the quality of the data, services and their metadata. For SDI/INSPIRE governance bodies the results provide input to understand the major issues and to take the appropriate actions.

The paper will present how the testing and validation was done, provide an overview of the results, some lessons learned and the way the results are being used to steer the INSPIRE implementation process. Did INSPIRE improve access and sharing of geospatial resources in practice? What are the major issues and barriers that persist? What are Member States currently doing to improve access and sharing?

## References

- Ansoorge, C. and Craglia, M. (2014). Mid-term evaluation report on INSPIRE implementation. European Environment Agency: Copenhagen.
- Vandenbroucke, D., Bamps, C., Beckers, V., Nevelsteen, K., Crabbé, A., Keijers, S., Tirry, D., Beringhs, K., Martirano, G., Mäs, S. and Dimond, M. (2014). INSPIRE Evaluation: Summary of findings for EU Member States - Assessing data and services metadata resources through direct observations. SADL/KU Leuven: Belgium.

## The GIS-based online building energy saving platform for SME in Taiwan

Tu Huan Lin

Green Energy and Environmental Laboratory, Industrial Technology Research Institute,  
Taiwan  
thlin@sinotech.org.tw

**Keywords:** GIS, EnergyPlus, building, policy, small-medium enterprises, SMD, energy

### Abstract

According to the Energy Law in Taiwan, every major energy user has the obligation to submit annual energy record to the government together with own saving target and the plan for the next year. On the other hand, government has also established task forces to investigate their energy use on-site and help discover saving potential accordingly. However, small-medium enterprises (SME) are not intensively monitored by the government due partly to the relatively small amount of energy consumption per store and the number of them are too many to conduct on-site energy investigation, even though their saving potential is empirically considered large.

To more efficiently access the profile and potential of SME energy efficiency opportunities, chain stores are the first priority because of the scalability. Various approaches such as high performance envelope, efficient equipment and energy management system are applied but cause more argument on the selection of most appropriate approaches with regard of the best financial investment decision, not to mention SMEs are widely spread in different location of the city where local weather variation should be considered.

Industrial Technology Research Institute (ITRI) develops an online GIS building energy visualization and saving platform, aiming to access the energy efficiency and saving potentials of large number of SME, particularly chain stores, effectively and accurately. This platform integrates several functions including the GIS energy consumption data visualization, together with normalized EUI of each building to monitor real-time energy status and facilitate energy policies by analyzing historical data to determine saving potential among the same type of chain stores. EnergyPlus is embedded in this platform together with local official and proprietary databases such as weather, energy-labeled equipment, green materials as well as local/international standards. Unlike EnergyPlus, users such as policy makers and owners are only required to input basic information through a user interface in five steps: 1. Geometry and envelope properties, 2. Internal loads, such as the number of people, interior and exterior lighting features and other equipment, 3. Operating schedules, 4. Refrigeration and air conditioning setup, and 5. Location of the building of which local weather will be selected. When the information is submitted, users can easily obtain details of hourly energy demand loads down to the individual building level. Optimum utility rates and ranking of recommended saving measures according to return of investment (ROI) in addition to full results are calculated and provided by EnergyPlus as well. This platform integrates geographical information and energy simulation to help users more effectively understand their energy status and determine their best policies and saving measures. It has been successfully applied to local chain stores in 2015 and saved 5-15% annually and will undergo a bench scale demonstration in local cities in 2016.

## **Geospatial technology innovations for land tenure security in East Africa - getting needs**

Ine Buntinx<sup>1</sup>, Serene Ho<sup>2</sup>, Joep Cromptvoets<sup>3</sup>, Bruno Broucker<sup>4</sup>, Valérie Pattyn<sup>5</sup>

<sup>1,2,3,4</sup>KU Leuven, Leuven, Belgium

<sup>5</sup>Leiden University, Leiden, Netherlands

<sup>1</sup>ine.buntinx@kuleuven.be, <sup>2</sup>serene.ho@kuleuven.be, <sup>3</sup>joep.cromptvoets@kuleuven.be,  
<sup>4</sup>bruno.broucker@kuleuven.be, <sup>5</sup>v.e.pattyn@fgga.leidenuniv.nl

**Keywords:** capturing needs, land administration, land tenure security

### **Abstract**

Sub-Saharan Africa has an immense challenge to rapidly and cheaply map millions of unrecognized land rights. Current recording and mapping approaches did not succeed to meet the promising expectations: disputes abound, investment is impeded, and the community's poorest lose out. In order to cope with these challenges a research project called 'its4land' is carried out. Its4land is a European Commission Horizon 2020 project aiming to develop an innovative suite of land tenure recording tools for three East African countries (Ethiopia, Kenya, Rwanda). These land tenure tools are inspired by geo-information technologies, including smart sketchmaps, UAV's, automated feature extraction and geocloud services. For each African country two specific case locations are selected. The six case locations are Bahir Dar city (Ethiopia), Robit Bata rural Kebele (Ethiopia), Kisumu County (Kenya), Kajiado County (Kenya), Musanze City (Rwanda) and Busogo (Rwanda). In order to reach this overarching research goal, a fundamental first step is to "get needs", i.e. capture the specific needs, readiness, market opportunities of end-users in the domain of land tenure information recording. Therefore, this paper aims to elaborate the research design responding to these fundamental first step. This includes actor and case-specific data collection and other methods like Actor Network Theory, Multi-Actor Multi-Criteria Analysis and Market Gap Analysis. An integrated design is also proposed to facilitate a coordinated approach to the complicated data collection and analysis requirements. This way, the diverse nature of the actors of interest with regards to readiness and potential impact on the project is taken into account.

## **WWF-SIGHT and why spatial environmental and social data is crucial for conservation**

Susanne Franziska Schmitt<sup>1</sup>, Paolo Tibaldeschi<sup>2</sup>, Pablo Izquierdo<sup>3</sup>, David Patterson<sup>4</sup>, Ludo Nijsten<sup>5</sup>, Aurelie Shapiro<sup>6</sup>

<sup>1</sup>WWF-UK, United Kingdom, [sschmitt@wwf.org.uk](mailto:sschmitt@wwf.org.uk)

<sup>2,3</sup>WWF-Norway, Norway, [ptibaldeschi@wwf.no](mailto:ptibaldeschi@wwf.no), [Pizquierdo@wwf.no](mailto:Pizquierdo@wwf.no)

<sup>4</sup>Nataure FX, New Zealand, [djp071@gmail.com](mailto:djp071@gmail.com)

<sup>5</sup>WWF-Netherlands, the Netherlands, [lnijsten@wwf.nl](mailto:lnijsten@wwf.nl)

<sup>6</sup>WWF-Germany, Germany, [aurelie.shapiro@wwf.de](mailto:aurelie.shapiro@wwf.de)

**Keywords:** geographic information, environment, conservation, development, spatial transparency, early engagement, WWF

### **Abstract**

Land-use change from infrastructure, mining, agricultural or forestry developments is the biggest driver of habitat loss for wildlife and can threaten essential ecosystems services. A global conservation organisation such as WWF needs to be able to anticipate and engage earlier with the actors that can influence the location, extent and execution of major projects that drive land-use change. These are namely governments, companies and financial institutions. To do this we need spatial intelligence and an easy to use, online mapping platform that integrates key development and environmental datasets.

WWF-SIGHT is a cloud-based Arc- GIS mapping tool that is integrated with the WWF Global Observation and Biodiversity platform (GLOBIL). GLOBIL centralises and mobilises geo-spatial data from around the organization for monitoring and evaluation, assessment of ecosystem status and provides an outlet for public communications and marketing.

WWF-SIGHT has been piloted by WWF-UK and WWF-Norway. It is a WWF internal tool and will soon provide WWF's global network with the capacity to quickly assess questions, from simple spatial mapping to complex land-use scenarios and understanding development conflicts in different regions, such as, the Amazon biome.

WWF-SIGHT provides an up-to-date means to visually comparing proposed or existing development projects and activities against key social and environmental metrics almost anywhere in the world. Its vision is to improve decision making through providing easy access to integrated spatial information, and allowing analysis prior to, or early in, the project life-cycle. This should help contribute to reduced environmental and social risk and more sustainable investment and development.

WWF-SIGHT provides much needed early intelligence on development activities, in particular in the extractives sector, which is fundamental for informing robust land-use planning, policy and investment. Moreover, by improving data transparency WWF-SIGHT aims to highlight the wider social and environmental costs of unsustainable development, fostering greater

accountability for governments, companies, and investors. We are also discussing with financial institutions and representatives of extractive companies what a tool of this kind could do to reduce financial and operational risk if, for example, used for early environmental and social risk screening with outputs tailored to the sectors information and reporting needs. Sector-wide adoption by the finance and extractives sector of such spatial early environmental and social risk screening tools could go a long way to avoiding detrimental environmental and social effects.

## **An urban environmental sensing infrastructure with crowdsourcing and spatial big data for early warning of critical conditions**

Chih Hong Sun<sup>1</sup>, Joe-Air Jiang<sup>2</sup>, Jehn-Yih Juang<sup>3</sup>, Tzai-Hung Wen<sup>4</sup>, Hsiang-Hsu Lin<sup>5</sup>

<sup>1</sup>Department of Geography, National Taiwan University, Taiwan

<sup>2</sup>Department of Bio-industrial Mechatronics Engineering, National Taiwan University, Taiwan

<sup>3,4,5</sup>Department of Geography, National Taiwan University, Taiwan

<sup>1</sup>chsun2145@gmail.com, <sup>2</sup>jajiang@ntu.edu.tw, <sup>3</sup>jjuang@ntu.edu.tw, <sup>4</sup>wenthung@ntu.edu.tw, <sup>5</sup>d04228004@ntu.edu.tw

**Keywords:** spatial big data, crowdsourcing, sensor web, geographic information

### **Abstract**

Technologies and applications of Internet of Things (IoT) and big data analytics are the key emerging issues in academia and industries. Understanding and shaping the theories of environmental sensing and the protocols of multiple-source spatial data collection, communication, sharing and analytics for better environmental monitoring and management are the key issues in geographic information science. Therefore, the objective of the project is to establish an urban environmental sensing infrastructure with crowdsourcing and spatial big data for early warning of critical conditions. Based on the infrastructure, we will also emphasize on innovative applications for detecting urban critical conditions, including street-scale heat environment and near real-time population flow in urban settings. We propose the framework of the project which is composed of four sub-projects, including: 1. a crowdsourcing decision support platform for multiple-source sensor data fusion and analytics; 2. establishment of intelligent wireless environmental sensing and traffic monitoring systems; 3. conducting the application for analyzing temporal-spatial patterns of urban street-level thermal environmental and physiological equivalent temperature; and 4. Establishment of a multilayer urban population flow modeling framework for assessing spatial transmission risk of contagious disease. In summary, this project will establish an urban environmental sensing infrastructure to further understand the interactions between physical and social environment for detecting early warning signals of urban critical conditions.

### **References**

- [1] Battle, Robert, and Dave Kolas (2012). Enabling the geospatial semantic web with parliament and geosparql. *Semantic Web 3.4*: 355-370.
- [2] Celino, Irene, et al (2012). UrbanMatch-linking and improving Smart Cities Data. LDOW.
- [3] Tim Berners-Lee, et al(2006). Tabulator: Exploring and Analyzing linked data on the Semantic Web.
- [4] Yu, H. and Robinson, D.G. (2012). The new ambiguity of 'open government. *UCLA Law Review Discourse* 59: 178-208

- [5] Rob Kitchin, Tracey P. Lauriault & Gavin McArdle (2015). Knowing and governing cities through urban indicators, city benchmarking and real-time dashboards. *Regional Studies, Regional Science*, 2(1), 6-28.
- [6] David Lee, Jesus Ricardo Alvarez Felix, Shan He, Dietmar Offenhuber & Carlo Ratti (2015). CityEye: Real-time Visual Dashboard for Managing Urban Services and Citizen Feedback Loops. Paper presented at Computers in Urban Planning and Urban Management Conference.
- [7] Dylan Miyake (2016). Government & City Dashboards: What You Need To Know. Clear Point Strategy. Retrieved from: <https://www.clearpointstrategy.com/government-city-dashboards/>.
- [8] Craglia, M., Leontidou, L., Nuvolati, G., & Schweikart, J. (2004). Towards the development of quality of life indicators in the 'digital' city. *Environment and Planning*, 31(1), 51–64.
- [9] Berners-Lee, T., Hendler, J., and Lassila, O. (2001). The Semantic Web. *Scientific American*, 29-37.
- [10] Feigenbaum, L., Herman, I., Hongsermeier, T., Neumann, E., and Stephens, S. (2007). The semantic web in action. *Scientific American*, 297(6), 90-97.
- [11] [King, B. and Reinold, K. (2008). Finding the concept, not just the word: a librarian's guide to ontologies and semantics. Oxford: Chandos.
- [12] Noy, N. and McGuinness, D. (2001). Ontology development 101: a guide to creating your first ontology. Retrieved from [http://protege.stanford.edu/publications/ontology\\_development/ontology101.pdf](http://protege.stanford.edu/publications/ontology_development/ontology101.pdf)
- [13] McGuinness, D. and Van Harmelen, F. (2004). OWL web ontology language overview. W3C recommendation, 10(10), 2004. Retrieved from: <http://www.w3.org/TR/owlfeatures/>
- [14] Yu, L. (2011). A developer's guide to the semantic web. Berlin, Heidelberg: Springer-Verlag Berlin Heidelberg.
- [15] Shadbolt, N., Hall, W., and Berners-Lee, T. (2006). The semantic web revisited. *Intelligent Systems, IEEE*, 21(3), 96-101.
- [16] Bizer, C., Heath, T. and Berners-Lee, T. (2009). Linked Data - the story so far. *International Journal on Semantic Web and Information Systems*, 5(3): 1-22.
- [17] Heath, T. (n.d.). Linked data: connect distribute data across the web. Retrieved from <http://linkeddata.org/home>
- [18] W3C (n.d.). Linked Data. Retrieved from <http://www.w3.org/standards/semanticweb/data>
- [19] Hart, G. (2013). *Linked data a geographic perspective*. Boca Raton: CRC Press.
- [20] Klyne, G. and Carroll, J. J. (2004). Resource Description Framework (RDF): Concepts and Abstract Syntax. Retrieved from <http://www.w3.org/TR/2004/REC-rdfconcepts-20040210/>
- [21] Virtuoso RDF Views over RDBMS Data Sources - Part 1 - <https://www.youtube.com/watch?v=bj7AbJ0ZYCK>
- [22] Virtuoso RDF Views over RDBMS Data Sources - Part 2 - <https://www.youtube.com/watch?v=yXNlcISS0aY>

## **An intelligent vehicle monitoring system based on IoT technology using for urban area**

Joe-Air Jiang<sup>1</sup>, Chih-Hong Sun<sup>2</sup>, Jehn-Yih Juang<sup>3</sup>, Tzai-Hung Wen<sup>4</sup>, Xiang-Yao Zheng<sup>5</sup>,  
Zheng-Wei Ye<sup>6</sup>

National Taiwan University

<sup>1</sup>jajiang@ntu.edu.tw, <sup>2</sup>chsun2145@gmail.com, <sup>3</sup>jjuang@ntu.edu.tw, <sup>4</sup>wenthung@ntu.edu.tw,  
<sup>5</sup>r99631025@gmail.com, <sup>6</sup>r03631015@ntu.edu.tw

**Keywords:** IoT, intelligent vehicle sensor, smart city, smart traffic.

### **Abstract**

This study proposes to develop an intelligent monitoring system for the urban traffic and environmental management. In the proposed system, embedded system-based sensing devices are installed in vehicles to monitor the roads that each car takes, and the environmental parameters around the roads, including temperature, humidity, illumination, suspended particulates, and carbon monoxide. In this study, the sensed data will be directly transmitted to a decision support platform for traffic-related analysis to improve the use of roads, road safety and reduce traffic congestion. With the proposed vehicle sensing devices that deliver the sensing data to the decision support platform, drivers can make smart traffic decisions through the response from the proposed system. So drivers can avoid traffic bottlenecks and further reduce energy consumption and costs of cars. Moreover, the proposed system is capable of detecting damping coefficients, car speed, tire pressure, and oil consumption, and it can also provide information about potholes or road repaving as a preventive measure, so drivers can drive their cars in a more comfortable way. The proposed system is not only a safety and environmental monitoring system but the implementation of the concept of urban traffic and environmental management. Combining the adaptability analysis with IoT and information and communication technologies, this study is able to generate accurate information regarding major roads in urban area of Taiwan and provide better solutions to the improvement of road safety and conditions and the reduction of traffic congestion, and eventually helps the development of the cities in Taiwan.

### **References**

- [1] Palmisano, Samuel J. "A Smarter Planet: The Next Leadership Agenda", Council on Foreign Relations, November 6, 2008.
- [2] Zubizarreta, I. "Smart City Concept: What It Is and What It Should Be", 2016
- [3] Joe-Air, J. "A Novel Weather Information-Based Optimization Algorithm for Thermal Sensor Placement in Smart Grid", 2016.
- [4] Coutaz, J. "A First-Person Experience with End-User Development for Smart Homes" 2016.
- [5] Dabnath, A. "Sustainable Urban Transport Smart Technology Initiatives in Singapore" 2011.

- [6] Gubbi, J. “Internet of Things (IoT): A vision, architectural elements, and future directions” 2013.
- [7] Joaquim, B. “Short-term real-time traffic prediction methods: a survey” 2015.
- [8] Babicheva, T.S. “Numerical Methods for Modeling of Traffic Flows at Research and Optimization of Traffic on the Signal-controlled Road Intersections” 2015
- [9] Mirchandani, P. “Rhodes to Intelligent Transportation Systems.” 2005.
- [10] Maxemchuk, N.F. “Architectures for intelligent vehicles” 2015.
- [11] Donato, T. “Evaluation of emissions of CO2 and air pollutants from electric vehicles in Italian cities” 2014.
- [12] Hafner, M.R. “Automated Vehicle-to-Vehicle Collision Avoidance at Intersections” 2011

## **Profiling topological characteristics of street network to identify urban traffic congestion**

Tzai-Hung Wen<sup>1</sup>, Wei-Chien (Benny) Chin<sup>2</sup>

Department of Geography, National Taiwan University, Taiwan

<sup>1</sup>wenthung@ntu.edu.tw, <sup>2</sup>wcchin.88@gmail.com

**Keywords:** traffic congestion, PageRank algorithm, network topology

### **Abstract**

With a growing number of developing cities, the capacities of roads cannot meet the rapidly growing demands of cars, causing congestion. Understanding the spatial-temporal process of traffic flow and detecting traffic congestion are important issues associated with developing urban policies to resolve congestion. The topological structure of a street network influences the turning probabilities between streets and the moving speeds of automobiles on those streets. Moreover, the connectivity of road segments reflects the degree of the road system facilitating people to their destination. Therefore, the objective of this study is to propose an innovative analytical procedure for investigating the traffic demands in terms of the traffic flow concentration and complexity of the road network based on turning probability. First, we proposed a flow-based ranking algorithm (Flow-based PageRank, FBPR) to determine the traffic flow concentration. Second, we analyzed the real volumes of vehicle movements to calibrate the turning probability. Finally, we measured the topological complexity in terms of outgoing entropy. Congested segments are defined as the street segments that are prone to traffic congestion. By overlapping the traffic demand in terms of FBPR scores and the topological complexity of street segments, congested segments can be identified. The results show that by relying on the topological characteristics of streets, most congested segments identified in the study successfully included the streets identified as the ten most congested streets or segments with slow moving speeds based on vehicle detector (VD) monitoring. The congested segments might also be sources of traffic congestion. Traffic demands can be determined by FBPR scores, which capture human movements, and street complexity can be measured by the outgoing entropy, which represents the topological complexity in terms of turning probability. We also examined the association of urban land use types with traffic demand and street complexity. Identifying the topological characteristics of traffic congestion provides comprehensive insights for city planners, and these characteristics can be used to further understand congestion spreading.

### **References**

- Batten, D. F. (1995). Network cities: creative urban agglomerations for the 21st century. *Urban Studies*, 32(2): 313-327.
- Rodrigue, J. P., Comtois, C., & Slack, B. (2013). *The geography of transport systems*. Routledge.
- Alderson, A. S., & Beckfield, J. (2004). Power and position in the world city system. *American Journal of Sociology*, 109(4): 811-851.

- Derudder, Witlox, & Catalano. (2003). Hierarchical tendencies and regional patterns in the world city network: a global urban analysis of 234 cities. *Regional Studies*, 37(9), 875-886.
- El-Geneidy, A., and Levinson, D. (2011). Place Rank: Valueing spatial interactions. *Networks and Spatial Economics*, 11(4): 643-659.
- Blumenfeld-Lieberthal, E., & Portugali, J. (2010). Network cities: A complexity-network approach to urban dynamics and development. In *Geospatial Analysis and Modelling of Urban Structure and Dynamics* (pp. 77-90). Springer Netherlands.
- Jiang, B. (2009). Ranking spaces for predicting human movement in an urban environment. *International Journal of Geographical Information Science*, 23(7): 823-837.
- Freeman, L. C. (1978). Centrality in social networks conceptual clarification. *Social Network*, 1(3): 215-239.
- Knowles, R. D., Shaw, J., & Docherty, I. (2008). *Transport geographies: mobilities, flows and spaces*. Blackwell Publishing.
- Shaw, J., & Docherty, I. (2013). *The transport debate*. Policy Press.
- Kerner, B. S. (1999). Congested Traffic Flow: Observations and Theory. *Transportation Research Record*, No. 1678, pp. 160-167.
- Kwon, J., Mauch, M., Varaiya, P. (2006). Components of congestion: delay from incidents, special events, lane closures, weather, potential ramp metering gain, and excess demand. *Transportation Research Record: Journal of the Transportation Research Board*, 1959(1), 84-9.
- Gall, A. I., & Hall, F. L. (1989). Distinguishing between incident congestion and recurrent congestion: a proposed logic. *Transportation Research Record*, (1232).
- Smith, B. L., & Demetsky, M. J. (1994). Short-term traffic flow prediction: neural network approach. *Transportation Research Record*, (1453).
- Van Der Voort, M., Dougherty, M., & Watson, S. (1996). Combining Kohonen maps with ARIMA time series models to forecast traffic flow. *Transportation Research Part C: Emerging Technologies*, 4(5), 307-318.
- Whittaker, J., Garside, S., & Lindveld, K. (1997). Tracking and predicting a network traffic process. *International Journal of Forecasting*, 13(1), 51-61.
- Smith, B. L., Williams, B. M., & Oswald, R. K. (2002). Comparison of parametric and nonparametric models for traffic flow forecasting. *Transportation Research Part C: Emerging Technologies*, 10(4), 303-321.
- Stathopoulos, A., & Karlaftis, M. G. (2003). A multivariate state space approach for urban traffic flow modeling and prediction. *Transportation Research Part C: Emerging Technologies*, 11(2), 121-135.
- Coifman, B. (2003). Identifying the onset of congestion rapidly with existing traffic detectors. *Transportation Research Part A: Policy and Practice*, 37(3), 277-291.
- Yang, X., Liu, J., Vaidya, N. H., & Zhao, F. (2004, August). A vehicle-to-vehicle communication protocol for cooperative collision warning. In *Mobile and Ubiquitous Systems: Networking and Services, 2004. MOBIQUITOUS 2004. The First Annual International Conference on* (pp. 114-123). IEEE.

- Vlahogianni, E. I., Karlaftis, M. G., & Golias, J. C. (2005). Optimized and meta-optimized neural networks for short-term traffic flow prediction: a genetic approach. *Transportation Research Part C: Emerging Technologies*, 13(3), 211-234.
- Castillo, E., Menéndez, J. M., & Sánchez-Cambronero, S. (2008). Predicting traffic flow using Bayesian networks. *Transportation Research Part B: Methodological*, 42(5), 482-509.
- Pu, W., Lin, J., & Long, L. (2009). Real-time estimation of urban street segment travel time using buses as speed probes. *Transportation Research Record: Journal of the Transportation Research Board*, (2129), 81-89.
- Tchrakian, T. T., Basu, B., & O'Mahony, M. (2012). Real-time traffic flow forecasting using spectral analysis. *Intelligent Transportation Systems, IEEE Transactions on*, 13(2), 519-526.
- Lippi, M., Bertini, M., & Frasconi, P. (2013). Short-term traffic flow forecasting: An experimental comparison of time-series analysis and supervised learning. *Intelligent Transportation Systems, IEEE Transactions*, 14(2), 871-882.
- Bauza, R., & Gozávez, J. (2013). Traffic congestion detection in large-scale scenarios using vehicle-to-vehicle communications. *Journal of Network and Computer Applications*, 36(5), 1295-1307.
- Lv, Y., Duan, Y., Kang, W., Li, Z., & Wang, F. Y. (2015). Traffic flow prediction with big data: A deep learning approach. *Intelligent Transportation Systems, IEEE Transactions*, 16(2), 865-873.

## Investigating spatial and temporal patterns of thermal environment in street-level scale in the metropolitan area in Taiwan

Jehn-Yih Juang<sup>1</sup>, Hsin-Hong Lin<sup>2</sup>, Chih-Hong Sun<sup>3</sup>, Joe-Air Jiang<sup>4</sup>, Tzai-Hung Wen<sup>5</sup>

National Taiwan University, Taiwan

<sup>1</sup>jjuang@ntu.edu.tw, <sup>2</sup>wadx103511@gmail.com, <sup>3</sup>chsun2145@gmail.com,  
<sup>4</sup>jajiang@ntu.edu.tw, <sup>5</sup>wenthung@ntu.edu.tw

**Keywords:** thermal environment, heat stress, air quality, wireless sensor network, smart city, early warning system

### Abstract

The urban heat island effect (UHI) caused by the regional-to-global environmental changes, dramatic urbanization, and shifting in land-use compositions has becoming an important environmental issue in recent years. The strengthen of UHI effect significantly enhances the frequency of high temperature, and influences the thermal environment in urban area. In addition, the urban expansions due to dramatic increasing in urban populations and traffic loading significantly impacts the air quality in many metropolitan areas, especially in Asia.

In this study, the main objective is to quantify and characterize the temporal and spatial distributions of thermal environment in different cities in Taiwan, especially in the Greater Taipei Metropolitan Area by using monitoring data from Central Weather Bureau (CWB), and Environmental Protection Administration (EPA). In addition, in this study, we are going to conduct the analysis on the distribution of physiological equivalent temperature in the micro scale in the metropolitan area by using the observation data and the numerical model, RayMan, to investigate how the thermal environment is influenced under different conditions. According to the meteorological data from CWB frequency of high temperature (greater than 27 °C) in the major metropolitan areas in Taiwan (Taipei, Taichung, and Kaohsiung) have increased in the past 50 years from 1960 to 2010. In this study, we characterize heat environment in the greater Taipei metropolitan area by using the meteorological data collected from CWB and EPA. In addition, we apply RayMan model to quantify the physiological equivalent temperature (PET) and characterize of the spatial and temporal distributions of the heat environment over different scales in the Taipei metropolitan area. The results can be integrated into the management and planning system, and provide sufficient and important background information for early warning systems for metropolitan area.

### References

- Andreas Matzarakis, H. M., Moses G. Iziomon (2000). "Applications of a universal thermal index: physiological equivalent temperature." *Int J Biometeorol*: 43:76–84.
- Chen, Y.-C., T.-P. Lin and A. Matzarakis (2014). "Comparison of mean radiant temperature from field experiment and modelling: a case study in Freiburg, Germany." *Theoretical and Applied Climatology* 118(3): 535-551.

- Lin, T. P. and A. Matzarakis (2008). "Tourism climate and thermal comfort in Sun Moon Lake, Taiwan." *Int J Biometeorol* 52(4): 281-290.
- Matzarakis, A., F. Rutz and H. Mayer (2007). "Modelling radiation fluxes in simple and complex environments--application of the RayMan model." *Int J Biometeorol* 51(4): 323-334.
- Matzarakis, A., F. Rutz and H. Mayer (2010). "Modelling radiation fluxes in simple and complex environments: basics of the RayMan model." *Int J Biometeorol* 54(2): 131-139.

## **Applying ultra-low frequency electromagnetic wave remote sensing techniques to hyporheic zone water supply potential analyses - A case study on southern Taiwan**

Yu Hung Chen

National Taiwan University, Taiwan  
ntuapplebringer@gmail.com

**Keywords:** hyporheic zone, alternative water sources, ULF-EM wave

### **Abstract**

With growing instability of spatial and temporal precipitation variability and water supply in Taiwan, utilizing alternative water sources is one of the important trends in water resources development. Understanding that hyporheic water is one of the resources that has the characteristics of slow flow velocity, low turbidity, high water quality and low ecological impact, it has a great potential to be utilized. However, the researches about hyporheic water are mainly focused on the interrelationships between the hyporheic zone and its biological ecosystem. The researches about hyporheic water utilization are relatively insufficient and the potential water content can't be effectively estimated. Therefore, the objective of this study is to propose an innovative procedure to investigate three-dimensional distribution of the hyporheic zone and measure the potential utilizing capacity in prototype well that intakes hyporheic water in southern Taiwan. We also made measurements in wet and dry seasons to see the time series change. In this study, we firstly proposed Ultra Low Frequency Electromagnetic Wave Remote Sensing Techniques (ULF-EW RS), underground remote sensing techniques that passively receives natural magnetotelluric signals and has higher precision than traditional geophysical prospecting methods, to investigate the hyporheic zone. Second, we estimated the volume of water content and calibrated the results with hyporheic exchange model. Finally, we use water level data from 5 wells near the prototype well to verify the results. The results show that by applying ULF-EW RS techniques, in most cases the hyporheic zones identified in the study successfully matched the ground true well data and model simulation results, which provides an effective way to evaluate hyporheic water in southern Taiwan.

### **References**

- Smith, J. (2005). Groundwater-surface water interactions in the hyporheic zone: Environment Agency.
- Tonina, D. (2012). Surface water and streambed sediment interaction: The hyporheic exchange: CRC Press, Taylor & Francis Group: London, UK.
- Water resources agency (2012). The Preliminary investigation and tests of interflow resources and riverbank water intake works evaluation near the kaoping river: Southern Region Water Resources Office: Kaohsiung, Taiwan.
- Taiwan Water Corporation (2012). Basic engineering design report about hyporheic well in Kaohsiung: Kaohsiung, Taiwan.
- Wang Wen-xiang & YANG Wu-yang (2005). New development on exploration research of natural electric magnetic wave method: Coal Science and Technology: 33(1): 8-19.

## **Development of Spatial Data Infrastructure Policy: The Web Map Server Interface in Thailand**

Phurith Meeprom<sup>1</sup> and Kaew Nualchawee<sup>2</sup>

Geoinformatics Faculty, Burapha University. 169 Long Had Rd. Bangsean, Chonburi, 20131, Thailand

<sup>1</sup>phurith@buu.ac.th, <sup>2</sup>knualchawee@yahoo.com

**Keywords:** SDI, web map server, standard, FGDS

### **Abstract**

This paper describes the Spatial Data Infrastructure (SDI) context and Thailand standards development which has been officially launched by The National Geo-Informatics Board in 2012. The SDI in Thailand consists of two periods, i.e. the first period is for 5 years (2011-2015) and the second period is for 2 years (2016-2017) to improve and refine the five activities. The SDI in Thailand development and implementation is to start with five activities to be carried out, namely, development of NSDI Portal, development of geospatial information standards, development and integration of base data, development and integration of FGDS, and capacity building.

For the WMS in Thailand development is in the part of SDI Portal and Data Clearinghouse, can support GIS community in Thailand leading to a more systematically development and usage of technology. In addition to, the part of development of FGDS, the 13 fundamental geographic datasets development have been in progressing stages based on standardized protocols accepted and accessible by all stakeholders in the community.

### **References**

- Burapha University, 2009. Final Report, Studying in ISO19128: Web Map Interface (2005). Bangkok: Geo-Informatics and Space Technology Development Agency (Public Organization).
- Chaowalit Silapathong, Kaew Nualchawee, and Supan Karnchanasutham. Toward Spatially Enabled Country and Society: The Case of Thailand. Proceeding in ACRS 2012. <http://a-a-r-s.org/acrs/index.php/acrs/acrs-overview/proceedings-1?view=publication&task=show&id=481>.
- Christiaan Lemmen, Peter van Oosterom, Rohan Bennett, The Land Administration Domain Model, Land Use Policy, Volume 49, December 2015, Pages 535-545, ISSN 0264-8377, [http://dx.doi.org/10.1016/j.landusepol.2015.01.014.\(http://www.sciencedirect.com/science/article/pii/S0264837715000174\)](http://dx.doi.org/10.1016/j.landusepol.2015.01.014.(http://www.sciencedirect.com/science/article/pii/S0264837715000174))
- Chulalongkorn University, 2004. Final Report, Master Plant on National GIS, Bangkok: Geo-Informatics and Space Technology Development Agency (Public Organization).

- Thitawadee Suvachananonda, Chaowalit Silapathong and Anusorn Kunarsa. Metadata Implementation for Thailand Spatial Data Infrastructure. Proceeding in ACRS 2006. [http://a-a-r-s.org/aars/proceeding/ACRS2006/Papers/P-3\\_Q38.pdf](http://a-a-r-s.org/aars/proceeding/ACRS2006/Papers/P-3_Q38.pdf).
- National Committee on Geo-Informatics, National Geo-Informatics Development Integration Plan 2011-2015.

## **Integrating web GIS and augmented reality techniques in nuclear accident response**

Yung-Ching Lee<sup>1</sup>, Tien-Yin Chou<sup>2</sup>, Ching-Yun Mu<sup>3</sup>

<sup>1</sup>Geographic Information Systems Research Center, Feng Chia University, Taiwan

<sup>2</sup>Department of Land Management, Feng Chia University, Taiwan

<sup>3</sup>Geographic Information Systems Research Center, Feng Chia University, Taiwan

<sup>1</sup>leo@gis.tw, <sup>2</sup>jimmy@gis.tw, <sup>3</sup>jackie@gis.tw

**Keywords:** nuclear accidents, emergency response, web GIS, augmented reality

### **Abstract**

During nuclear accidents, when radioactive materials spread into the environment, the people in the affected areas should evacuate immediately. However, few information systems are available regarding escape guidelines for nuclear accidents. Many countries have therefore devised emergency response strategies, including confining nuclear accident sites, monitoring site changes, evacuating population from the site, organizing relief personnel, and establishing emergency response centers. In order to implement these strategies, many researchers proposed Information Technology(IT)-based methodologies and applications. Government agencies and personnel use these methodologies and applications to deal efficiently with nuclear accidents.

However, during nuclear accidents, although evacuating people near the accident sites and avoiding exposure within the radioactive environment are top priorities, few studies have investigated the information systems that address these issues. Therefore, in our research, we took advantages of Web GIS, such as computerization, network accessibility and Augmented Reality on mobile phones to develop a system and Mobile Escape Guidelines (MEG) to provide useful data for disaster responsible organization. We referred to the OGC (Open Geospatial Consortium) specifications, i.e. WMS (Web Map Service), WFS (Web Feature Service), WPS (Web Processing Service) and applied AJAX (Asynchronous JavaScript and XML) technologies to display spatial data and provide spatial query. We could markup hot areas, warm areas and cold areas for responsible staves to control the accident scene. And the staves could provide decision making sheets for related organizations by using “cross spatial queries” to handle important information like traffic, population, nearby schools and emergency calls.

Furthermore, our system provided multiuser functionality. Responsible staves could operate our system at the same time to run tasks with each other and publish messages to avoid mistakes. With this system, the loss from disasters would be effectively reduced and the tasks would run in good order. Mobile Escape Guidelines (MEG) adopts two techniques. One technique is the geographical information that offers multiple representations; the other is the augmented reality that provides semi-realistic information services. When this study tested the mobile escape guidelines, the results showed that this application was capable of identifying the correct locations of users, showing the escape routes, filtering geographical layers, and rapidly generating the relief reports. Users could evacuate from nuclear accident sites easily, even without relief personnel, since using slim devices to access the mobile escape guidelines

is convenient. Overall, this study is a useful reference for a nuclear accident emergency response.

## References

- [1] Chian-Hsin Chang, 2003. A Study of the Disaster Prevention and Protection System in Taiwan with the Local Government's Nuclear Accident Emergency Response as an Example, Master's thesis, Institute of Public Affairs Management, National Sun Yat-sen University.
- [2] Central Intelligence Agency: <https://www.cia.gov/>
- [3] Ehrhardt, J. and Kelly, G.N., 1997, "The RODOS System: Decision Support for Off-Site Emergency Management in Europe", Sixth Topical Meeting on Emergency Preparedness and Response.
- [4] Karlberg, O., 1997, "Emergency Decision Support System in Sweden with Focus on Nuclear Accident", Sixth Topical Meeting on Emergency Preparedness and Response.
- [5] Leung, S.W., G.E. and Start, 1997, "End-User Focused Emergency Response Support", Sixth Topical Meeting on Emergency Preparedness and Response.
- [6] Gargett, J. and Appelbaum, J., 1997, "Information System for Radiological Emergency Preparedness - Comprehensive Software Systems Prove their Value in Action", Sixth Topical Meeting on Emergency Preparedness and Response.
- [7] United States Department of Homeland Security: <http://www.dhs.gov/>
- [8] Wen-Hwa Wang, 2007. Air Dispersion Modeling and Verification, Institute of Nuclear Energy Research.
- [9] Bartzis, J., Ehrhardt, J., French, S., Lochard, J., Morrey, M., Papamichail, K.N., Sinkko, K., Sohler, A., 2000. RODOS: decision support for nuclear emergencies. In: Zanakis, S.H., Doukidis, G., Zopounidis, C. (Eds.), Recent Developments and Applications in Decision Making. Kluwer Academic Publishers, pp. 379e395.
- [10] Battista, C., 1994. Chernobyl: GIS model aids nuclear disaster relief. GIS World 7 (3), 32e35.
- [11] Diehl, S., Neuvel, J., Zlatanova, S., Scholten, H., 2006. Investigation of user requirements in the emergency response sector: the Dutch case. Second Symposium on Gi4DM, India.
- [12] Drnarevi, V., Jevti, N., Djuri, R., 2006. USB-based radiation monitor. Nuclear Technology & Radiation Protection XXI (2), 73e78.
- [13] Federal Emergency Management Agency (FEMA), 2011. The Federal Emergency
- [14] Management Agency Available at: <http://www.fema.gov/pdf/about/pub1.pdf>. Gartner, Inc, 2011. Market Share: Mobile Communication Devices by Region and Country Available at: <http://www.gartner.com/it/page.jsp?id141764714>.
- [15] Höllerer, T., Feiner, S., Hallaway, D., Bell, B., 2001. User interface management techniques for collaborative mobile augmented reality. Appeared in Computers and Graphics 25 (5), 799e810.
- [16] Huang, Z.E., 2000. The Research Regarding Nuclear Accident Emergency Response Information System. National Tsing-Hua University.
- [17] International Atomic Energy Agency (IAEA), 2008. The International Nuclear and Radiological Event Scale Available at: <http://www.iaea.org/Publications/Fact%20sheets/English/ines.pdf>.

- [18] International Atomic Energy Agency (IAEA), 2011. Fukushima Nuclear Accident Information Sheet Available at: <http://www.iaea.org/About/japan-infosheet.html>.
- [19] Kimura, S., Sahoo, S.K., Shiraishi, K., Watanabe, Y., Ban-Nai, T., Los, I.P., Korzun, V.N., Tsygankov, N.Y., Zamostyan, P.V., Shevchuk, V.E., 2006. Radiation monitoring using imaging plate technology: a case study of leaves affected by the Chernobyl nuclear power plant and JCO criticality accidents. *Nuclear Technology & Radiation Protection XXI* (1), 41e47.
- [20] Lesjak, M., 2003. Automatic early warning systems for the environment. *Nuclear Technology & Radiation Protection XVIII* (2), 44e50.
- [21] Mabit, L., Bernard, C., 2007. Assessment of spatial distribution of fallout radionuclides through geostatistics concept. *Journal of Environmental Radioactivity* 97,206e219.

## **Integrating geographic information systems for sustainable high speed rail life cycle management - a case study of Taiwan high speed rail**

Yi-Yiung Tommy Jen<sup>1</sup>, Paul Yang<sup>2</sup>, Calvin Lin<sup>3</sup>

<sup>1</sup>Operation Control Center, Taiwan High Speed Rail Corporation, Taiwan

<sup>2</sup>Information Technology Division, Taiwan High Speed Rail Corporation, Taiwan

<sup>3</sup>Technical Development Department, Taiwan High Speed Rail Corporation, Taiwan

<sup>1</sup>tommy\_jen@thsrc.com.tw, <sup>2</sup>mingchang\_yang@thsrc.com.tw, <sup>3</sup>calvin\_lin@thsrc.com.tw

**Keywords:** geographic information, disaster management, high speed rail

### **Abstract**

Transport infrastructure is one of the most important factors for a country's progress. Taiwan High Speed Rail Corporation (THSRC) as a Critical Infrastructure (CI) operates in the western part of Taiwan where 90% of Taiwanese population lives. With a Build-Operate-Transfer (BOT) approach, Taiwan High Speed Railway (THSR) is a high technology project and as such aims to make the best possible practices of new technology at all levels. This paper describes the research and development for the application of Geographic Information System (GIS) and related technologies to enhance the management capacity of THSRC. GIS provides the framework within which relevant project information can be captured, stored, manipulated, analyzed and retrieved, including topographic base maps, survey data and cadastral data related to the right of way, construction design and as-built drawings, geological and environmental data, aerial and satellite imagery and many other forms of data which have a geographic or spatial component. The resulting data model of the railway and its environment forms a valuable asset for the THSRC in the form of accessible project records to be continuously enhanced and referenced throughout the railway's life cycle including construction, and also sustainable operations and maintenance phases.

THSRC has combined a variety of information and communication technologies, to develop a comprehensive GIS platform to enhance its management capability. In construction phase, GIS assists in this effort by capturing relevant construction related data and converting it to information through its data modeling, storage, analysis and visualization abilities as the foundation for asset management in THSRC. With the latest state of the art GIS technologies, THSRC has achieved to compile all civil structures, track components, structures and alignment geometries, safety geospatial information, engineering and topographic information into the corporate spatial database. In operations and maintenance phases, THSRC has also developed additional geospatial functions to improve real-time information retrieval and decision-making support by integrating on-board GPS, mobile devices to provide location-based services, etc. This platform not only helps the monitoring of real-time train operation but also identifies the environmental danger along the high speed line. The system uses Microsoft ASP.NET and Google Earth/Map API as development tools to integrate the locations and features of THSRC facilities including stations, depots, train operation status, Disaster Warning System (DWS) including the instant information of weather, rivers flood levels, landslides, earthquakes and intrusion sensors. In addition, network agent technology is integrated to

retrieve useful information regularly from Open Government Data, including rainfalls and flood levels by Central Weather Bureau (CWB) and Water Resources Agency (WRA) to compare with the THSRC DWS database.

The real-time train location information and location-based service are provided to both front-line staff and management level via smart phones and tablets to provide more accurate, real-time and customized made information for passenger evacuation, navigation, and decision-making. Therefore, with the application of GIS and communication technologies, it is aimed to enhance its overall management capabilities in operations and emergency management of THSRC, and thereby ensuring better safety to its passengers and ultimately improving customer satisfaction.

## **Assessment of building evacuation scenarios considering panic and knowledge of exits using a 3D GIS agent-based model**

Edgardo Gonzales Macatulad

Dept. of Geodetic Engineering, University of the Philippines, Philippines

edgardo.macatulad@coe.upd.edu.ph

**Keywords:** 3D GIS, geosimulation, building evacuation, GAMA

### **Abstract**

Building evacuation planning is done with the goal of evaluating the egress of building occupants including the exit locations, the escape routes, and the corresponding egress times. The traditional approach utilizes drills which usually incur corresponding costs and inconvenience. In this study, a 3D GIS-based geosimulation model for building evacuation is developed using the GAMA simulation platform as an alternative and complement to actual evacuation drills. PEOPLE agents are modeled to represent the building occupants. FLOORS, ROOMS, INDOOR\_PATHS and EXIT\_POINTS agents are modeled from the 3D GIS building layers of the case study building. The simulation involves PEOPLE agents evacuating to their target EXIT\_POINTS along the INDOOR\_PATH. Their movement is affected by their chance of panic (CoP) and chance of knowledge to exit (CoKE) attributes. If the CoP value is true, the speed of the PEOPLE agent is multiplied by an assumed value of 1.5. Otherwise, they retain the base speed of 0.83 m/s. If the CoKE value is true, the PEOPLE agent is assigned the target EXIT\_POINT corresponding to the designated exit attribute of the ROOMS where the PEOPLE agent is located. If CoKE is false, the PEOPLE agent selects a random exit. Weights applied to the INDOOR\_PATH computed from the number of PEOPLE agents currently on the same INDOOR\_PATH also affect the movement speed. The egress time periods for different simulation runs were computed and analyzed to examine the effects of varying CoP and CoKE values on the evacuation time. In general, the increase in CoP values resulted to an increase in the total egress time. Extreme values were obtained at CoP equal to 1 in which the movement speed of the PEOPLE agents greatly decreased the total egress time. With CoP equal to 1, the increase in CoKE still caused decrease in the total egress time. As CoKE is increased, the total egress time decreased correspondingly. At CoKE equal to 1, the increase in CoP still contributed to increased total egress time. From these results, it can be concluded that even if panicking PEOPLE are moving faster, egress time is reduced if they have knowledge of the exit. Likewise, even if PEOPLE have knowledge of the exits, they can evacuate more efficiently if they do not panic.

## **Analysis of the correlation of tourism on Internet community - using the travel reviews in Taichung City as an example**

Tien-Yin Chou<sup>1</sup>, Mei-Ling Yeh<sup>2</sup>, Cheng-Ting Wu<sup>3</sup>, Shun-Ren Lai

Geographic Information Systems Research Center, Feng Chia University, Taiwan

<sup>1</sup>jimmy@gis.tw, <sup>2</sup>milly@gis.tw, <sup>3</sup>jerry@gis.tw

**Keywords:** volunteer geographic information, big data, semantic analysis

### **Abstract**

In recent years, with the rise of the two-day weekend travel and tourism industry, but also in rural areas gradually transformed into sightseeing, disaster prevention and agro-based, such as different type of mode of operation, and to promote its rural characteristics through community or network marketing, etc., is also extremely helpful to bring rural development. So then of Rural Development, the sightseeing is a representative index has, along with the widespread use of smart phones, smart devices by the masses can take pictures, time and upload it to the community to share the action, share these things all with the coordinates of points, or unintentionally disclose the geographic location of the message, are the manifestations of the masses feeds, also known as the voluntary space information (Volunteered geographic information, VGI), these data are constantly increasing every day It became a huge data repository. In this study, combined with rural regeneration Soil Conservation Service in the community-wide Taichung, Taiwan utilization of the most common face book (Facebook), to construct a complete VGI large data repository via Facebook API and automated search programs, and rural the spatial location classification, explore punch masses of information, information filtering seized nuclear, punch press and praise the number of special events and statistics. In addition, this study will also make use of semantic analysis (Semantic Analysis) mode for non-structural information VGI, the capture and sightseeing with the connection of keywords to enhance the accuracy and effectiveness of VGI data. This study is hoped that through the establishment of a keyword search and information gathering mode, the filter useful and correct spatial information to provide the Government of analysis and resource allocation decisions tourism use.

## **Geospatial education in India: Opportunities and challenges in context of smart cities and Digital India programs**

Mahender Kotha<sup>1</sup> and Pravin D Kunte<sup>2</sup>

<sup>1</sup>Department of Earth Science, Goa University, Goa, India

<sup>2</sup>Geological Oceanography Division, National Institute of Oceanography, Goa, India

<sup>1</sup>mkotha@unigoa.ac.in, <sup>2</sup>kunte@nio.org

**Keywords:** geospatial, education, India, opportunities, SDI

### **Abstract**

Geospatial technologies are one of the rapidly evolving subject worldwide. Influence of this growth will also result in changing scenarios in various related aspects including among other things the accompanying job markets at regional, national and international level. A review on the studies of the Geospatial job market in India gives a relatively sorry state of picture with regard to availability of educated, skilled and qualified professional work force for its growing Geospatial industry. Further, in the context of recently launched of Smart Cities & Digital India programs by Government of India is a big step forward to transform the country into a digitally empowered knowledge economy, it is expected that the demand –supply gap of Geospatial professionals is going to be further widened. The proposed paper discusses the experience of current Geospatial teaching methodologies at undergraduate and postgraduate level, and the need for introduction of different programs using different modes of delivery will be discussed. The paper further focuses on various opportunities and challenges that are going to be emerged with changing scenarios in geospatial Industry particularly with reference to the educational needs. The weak spatial thinking skills and geography background, difference in IT and geospatial technology literacy levels, implementing a need-based student-centered / project-based learning methodologies in different modes of course delivery, a restructured geospatial course curriculum are some of the other issues that are expected to make a relevant contribution to discussion on the needs for Geospatial capacity building in particular and development towards a Digital India general. The paper also presents some anticipated implications of National Geospatial Policy (NGP-2016) with regard to development of SDI in India.

## **Application of remote sensing and geo-spatial technology in terrain analysis and terrain classification in context of creation of SDI for marine and coastal regions**

Sar bani Saha<sup>1</sup>, Pravin D Kunte<sup>2\*</sup>, Mahender Kotha<sup>3</sup>

<sup>1</sup>SRM University, Chennai, India

<sup>2</sup>National Institute of Oceanography, Goa, India

<sup>3</sup>Goa University, Goa, India

<sup>2\*</sup>Principal contact: kunte@nio.org

**Keywords:** terrain analyses, bathymetry benthic modeler, topography

### **Abstract**

Terrain analysis includes the collection, analysis, evaluation and interpretation of geographic information on the natural and manmade features of the terrain (topographic or benthic), and combined with other relevant factors to predict the terrain effect on various operations. The present cogitation encapsulates the surface analysis of South Western part of India and Benthic Terrain Analysis of Eastern Arabian Sea using remote sensing in Geospatial domain. The topographic analysis of the Western India is carried out using the spatial analyst tools in Arc GIS 10.2 software and The NASA Shuttle Radar Topographic Mission (SRTM) data to understand the terrain characteristics. Terrain analysis of southern Maharashtra and Goa region is validated using ASTER 3D remote sensing data. Using improved e-topo2 bathymetry data and Benthic Terrain Modeller (BTM) extension of Arc GIS version 10.2, bathymetry position Index (BPI) at broad, fine and standard scale is achieved for preparing slope, depth, and rugosity maps. Based on bathymetry derivative maps, benthic terrain map of the Eastern Arabian Sea is generated and is used to classify benthic environment of the Ocean. Geospatial study is carried out to generate base-level information for terrain analysis and classification. Terrain analysis is a key element in 3D Visualization, Flight Simulation, Project Cost Estimation, Cut and Fill Calculations, Route Feasibility, Environment and Risk Assessments, Line of Sight Analysis, Surface Analysis, Watershed Analysis etc. It is demonstrated that Geospatial technique is one of the most useful tools for surface analysis, benthic terrain analysis and mapping in shortest time and less cost.

## Identifying flood-prone areas due to sea level rise in nearby communities of Imbang River in Western Visayas, Philippines

Naressa Belle Ambos Saripada<sup>1</sup>, Chito Lim Patiño<sup>2</sup>, Jonnifer Rafal Sinogaya<sup>3</sup>

University of the Philippines Cebu Phil-LiDAR 1, Lahug, Cebu City, 6000, Philippines

<sup>1</sup>nasaripada@up.edu.ph, <sup>2</sup>clpatino@up.edu.ph, <sup>3</sup>jrsinogaya1@up.edu.ph

**Keywords:** sea level rise, inundation, flooding, feature extraction, disasters, hazard exposure

### Abstract

Coastal communities and habitats are always threatened with the continuing rise of sea levels. The consequences of sea level rise worsened by climate change can bring higher and more frequent flooding to low-lying land areas and loss of near shore coastal habitats. Coastal communities are highly vulnerable especially during typhoon events, inevitably leading to loss of properties and ultimately lives. It is important to identify which communities are highly at risk from flooding and submersion. In this study, nearby communities of Imbang River in Western Visayas, Philippines affected by sea level rise are identified and quantified. These communities are quantified by mapping building structures using an automated building extraction approach on LiDAR data and orthoimages. The extraction methodology applied an object-based image analysis to segment, classify and extract buildings. The total area of the extracted buildings using the automated extraction method is 3.16 km<sup>2</sup> covering 2.18% of the 144.76 km<sup>2</sup> floodplain. Meanwhile, affected areas are identified by simulating sea level rise within the floodplain of Imbang River using a thresholding query based approach on digital elevation model. The simulation used different scenarios of sea level rise categorized as low (1-meter rise), medium (5-meter rise) and high (20-meter rise) level. Almost 35% to 80.4% of the total land building areas will be flooded under the three different scenarios. The highest inundated area of building structures affected by sea level rise is estimated to be about 2.54 km<sup>2</sup> on the 20-meter sea level rise, while the lowest estimated to be about 1.113975 km<sup>2</sup> on the 1-meter sea level rise.

### References

- Asian disaster Preparedness Center (2014). Living on the bank of a stream in Silay. Asian disaster Preparedness Center.
- Definiens (1995-2014) eCognition Developer 9. eCognition Software. Trimble Germany GmbH, Arnulfstrasse 126, 80636. Munich, Germany.
- ESRI (Environmental Systems Resource Institute). 2015. ArcMap 10.2.2. ESRI, Redlands, California.
- Demirkesen, A., Evrendilek, F., Berberoglu, S. (2007). Environmental Monitoring and Assessment 138(1-3):101-6.
- Kemp, A., Horton, B., Donnelly, J., Mann, M., Vermeer, M., and Rahmstorf, S. (2010). "Climate related sea-level variations over the past two millennia", Proceedings of the National Academy of Sciences of the United States of America, March 25, 2011, Center

National d'Etudes Spatiales (CNES), Toulouse Cedex 9, France, pp.1-2 vol. 108 no. 27, 11017–11022, doi: 10.1073/pnas.1015619108

- Kopp, R., Kemp, A., Bittermann, K., Horton, B., Donnelly, J., Gehrels, W., Hay, C., Mitrovica, J., Morrow, E. Rahmstorf, S. (2016). "Temperature-driven global sea-level variability in the Common Era", Proceedings of the National Academy of Sciences of the United States of America, January 4, 2016, Centre National d'Etudes Spatiales, Toulouse, France, pp.1-2 vol. 113 no. 6, E1434–E1441, doi: 10.1073/pnas.1517056113
- Kumar, M. (2015). Remote sensing and GIS based sea level rise inundation assessment of Bhitarkanika forest and adjacent eco-fragile area, Odisha, International Journal of Geomatics and Geosciences, Volume 5, No 4, 2015
- Lowe, A. (2015). Rapid rise in sea levels makes Philippines more vulnerable to natural disasters, Channel News Asia, (May), at <http://www.channelnewsasia.com/news/asiapacific/rapid-rise-in-sea-levels/1877242.html> [accessed 01 July 2015]
- Martin Isenburg, LAStools - efficient tools for LiDAR processing. Version 111216, <http://lastools.org>.
- Permanent Service for Mean Sea Level (PSMSL), 2016, "Tide Gauge Data", Retrieved 11 Jul 2016 from <http://www.psmsl.org/data/obtaining/>
- Rietbroek, R. Brunnabenda, S., Kuschea, J., Schröterb, J, and Dahlec, C (2015). "Revisiting the contemporary sea-level budget on global and regional scales", Proceedings of the National Academy of Sciences of the United States of America, November 30, 2015, Centre National d'Etudes Spatiales, Toulouse, France, pp.1-2 vol. 113 no. 6, 1504–1509, doi: 10.1073/pnas.1519132113
- Saripada, N., Patiño, C, Olavides, R. and Sinogaya, J. (2016). "Running To Safety: Analysis Of Disaster Susceptibility Of Neighborhoods And Proximity Of Safety Facilities In Silay City, Philippines", International Society for Photogrammetry and Remote Sensing, July 12-19, 2016. Prague, Czech Republic, pp. 1-5. Unpublished.
- Simon J. Holgate, Andrew Matthews, Philip L. Woodworth, Lesley J. Rickards, Mark E. Tamisiea, Elizabeth Bradshaw, Peter R. Foden, Kathleen M. Gordon, Svetlana Jevrejeva, and Jeff Pugh (2013) New Data Systems and Products at the Permanent Service for Mean Sea Level. Journal of Coastal Research: Volume 29, Issue 3: pp. 493 – 504. doi:10.2112/JCOASTRES-D-12-00175.1.
- Upton, J. (2016). Study Reveals Stunning Acceleration of Sea Level Rise, Climate Central (February), at <http://www.climatecentral.org/news/study-reveals-acceleration-of-sea-level-rise-20055> [accessed 01 July 2016]

## **Web- and mobile-based data collection using VGI for building feature mapping/attribution in the flood-prone zones of Western Visayas, Philippines**

Jarlou Terana Valenzuela<sup>1</sup>, Rey Sidney Carredo<sup>2</sup>, Christine Zoilo Coca<sup>3</sup>, Chito Lim Patiño<sup>4</sup>,  
Jonnifier Rafal Sinogaya<sup>5</sup>

University of the Philippines Cebu Phil-LiDAR 1, Lahug, Cebu City, 6000, Philippines

<sup>1</sup>jarlouvalenzuela@gmail.com, <sup>2</sup>rscarredo@gmail.com, <sup>3</sup>christinezcoca@gmail.com,  
<sup>4</sup>clpatino@up.edu.ph, <sup>5</sup>jrsinogaya1@up.edu.ph

**Keywords:** mobile GIS, building attribution, volunteered geographic information, VGI, data collection, database development, disaster management

### **Abstract**

The rapid increase of the Philippine population and its economy has spurred an urban sprawl in various cities and towns across the country. The rise of building structures used for residential, commercial, medical, and industrial purposes have entailed land use conversion which presents a challenge for government monitoring. Comprehensive mapping and inventory of building structures for the purpose of urban planning, disaster risk management, and other applications have been lacking due to the limited manpower and financial resources of the national and local governments. A platform for Volunteered Geographic Information (VGI) data collection is thus useful when the government machinery cannot keep up with the expanse of the urban sprawl. Furthermore, geospatial databases populated by VGI would aid decision-makers in the formulation of government socio-economic policies, urban planning, and disaster management plans including loss estimation in the event of disasters.

This study incorporates both web-based tools and android mobile application in creating a framework that can be used in geospatial mapping of building structures. Using available Digital Surface Model (DSM) which is derived from LiDAR data and orthophotos, building outlines are manually extracted to create a geospatial database of the building structures in the flood-prone zones of Western Visayas, Philippines. Each building outline is represented by a polygon, referred here as digitized building. The geographic coordinates of the vertices of the digitized buildings are extracted and uploaded to the database server so that it will be readily available for download in web-based and mobile application. These geographic coordinates when downloaded are linked to create a digitized building which is overlaid to Google Map. The database framework includes building attributes such as building materials, building height, and number of floors which are essential information in disaster management. The framework uses unified structures across web and mobile which incorporates the application of VGI. Building structures are mapped and attributed by mobile device users who act as efficient local contributors.

## **Development of indicators for spatial assessment of heat vulnerability within cities: the case of Taipei City**

Wanyu Shih<sup>1</sup> and Leslie Mabon<sup>2</sup>

<sup>1</sup>Department of Urban Planning and Disaster Management, Taiwan

<sup>2</sup>School of Applied Social Studies, Robert Gordon University, Aberdeen, Scotland, UK

<sup>1</sup>shih@mail.mcu.edu.tw, <sup>2</sup>l.j.mabon@rgu.ac.uk

**Keywords:** climate change adaptation, land surface temperature, resilience, urban planning, vulnerability assessment

### **Abstract**

This paper develops and trials a model for integrating physical and socio-economic data to assess heat vulnerability within the urban areas of Taipei City. Spatial planning for resilience to climate-related events such as excess heat requires understanding of the differences in physical exposure and socio-economic vulnerability that can exist within a city. Moreover, societal vulnerability is determined not only by economic or demographic factors, but also by less tangible cultural drivers. We exemplify our integrated model for physical and social vulnerability assessment through application to the case of Taipei City, Taiwan.

Due to the difference in urban development pattern, heat is not evenly distributed in cities so as to the magnitude of heat exposure. This study adopted remotely sensed data from LANDSAT 8 to assess the relationship between the thermal patterns and landscape characteristics whereby a set of exposure indicators was determined. Three exposure indicators, namely impervious surface rate, proximity to mountains, and tree and water proportion, were included, because:

1. the normalized difference built-up index (NDBI) has a strong positive linear relationship with land surface temperature;
2. areas closer to mountains were cooler and;
3. trees and waters have cooling effect.

Socio-economic vulnerability for each village within Taipei City was calculated by integrating publicly-available datasets from the Department of Statistics, Ministry of the Interior. Based on a review of existing social science literature into factors influencing sensitivity and adaptive potential for climate change adaptation, key variables from the datasets were selected. These reflected not only population demographics and economic characteristics, but also less tangible determinants of vulnerability such as social capital, access to information and access to knowledge within each village. The variables were assigned relative weightings according to their importance in extant literature. In turn, a socio-economic vulnerability score and ranking was calculated for each village within Taipei, allowing quantitative comparison with land surface temperature.

The socio-economic indicators suggest the most vulnerable areas are located in the Da'An and Zhongzheng areas of the city - areas of higher than average income. This suggests a complex

range of factors such as inequality and social capital may inform the vulnerability of an area to heat-related events, and reinforces the need for spatial data which can give decision-makers a sense of the socio-cultural makeup of an urban space in order to more effectively plan for resilience.

Based on the Taipei case we caution that there can be marked differences in the nature, extent and resolution of socio-economic data within and between municipalities. Researchers must therefore be prepared to be flexible with how they use socio-economic data in particular to assess vulnerability, and should exercise caution to avoid assumption about what the most 'important' variables will be in a given social context. It is imperative to reflect on where the scale of socio-economic data may mask differences or inequalities within spatial units. Moreover, cognisance should also be paid to potential ethical issues (distress, stigmatisation) that may arise when marking areas out as 'vulnerable' through spatial data analysis.

## Surface creeping analysis of the Fengshan Fault in SW Taiwan from GPS observations and PSInSAR

Kuo-En Ching<sup>1</sup>, Chuan-Min Chao<sup>2</sup>, Jiun-Yee Yen<sup>3</sup>, Kwo-Hwa Chen<sup>4</sup>, Ruey-Juin Rau<sup>5</sup>,  
Chien-Liang Chen<sup>6</sup>

<sup>1,2,5</sup>National Cheng Kung University, Taiwan

<sup>3</sup>National Dong Hwa University, Taiwan

<sup>4</sup>National Taipei University, Taiwan

<sup>6</sup>Central Geological Survey, Taiwan

<sup>1</sup>kuenmiao@yahoo.com.tw, <sup>2</sup>hnca333@gmail.com, <sup>3</sup>jyyen@gms.ndhu.edu.tw,  
<sup>4</sup>khchen@mail.ntpu.edu.tw, <sup>5</sup>raurj@mail.ncku.edu.tw, <sup>6</sup>surveydo@moeacgs.gov.tw

**Keywords:** GPS, DInSAR, creeping fault

### Abstract

The Fengshan fault, originally identified by the geomorphic analysis, penetrates from the southern area of Tainan city in the north to the downtown of Kaohsiung city in the south in SW Taiwan. Based on previous GPS analysis, this fault is a major active creeping fault with approximately 15 mm/yr left-lateral strike slip rate. However, no historical disastrous earthquakes occurred on this fault and no geological evidence to prove the existence of the Fengshan fault. To realize the location and kinematics of the Fengshan fault, GPS observations during 2007-2015 from 44 continuous and campaign-mode stations and another 68 GPS satellite control point data between 1997 and 2010 are used to estimate the surface horizontal velocity field in this study relative to the station KMNM in Chinese continental margin. In addition, 17 Synthetic Aperture Radar (SAR) images from ALOS PALSAR from 2007-2011 are also adopted in this study to evaluate the Line-of Sight (LOS) velocity field in SW Taiwan for increasing the spatial resolution of surface deformation. Because the southern tip of Fengshan fault is passed through the subsidence region of the Pingtung Plain and this fault is a strike-slip fault, levelling vertical velocities are used to remove the contribution of land subsidence from the LOS velocities. According to the analysis of above all data, the northern segment of the Fengshan fault is creeping with the creeping rate of approximately 13 mm/yr and the southern segment of the fault is probably locked with the rate of approximately 17 mm/yr. In addition, two mud volcanos are discovered at two end points of the northern creeping segment of the Fengshan fault, which may imply the reason of surface creeping on the Fengshan fault. The thick mud may decrease the friction on the fault plane and promote the generation of the creeping fault in S Taiwan. If any constructions are passed through the creeping fault, a continuous damage will be occurred due to the movement of the fault. Therefore, it is important to build up a real-time monitoring network to identify the kinematics of the creeping fault.

## **Smart disaster communities: building a global disaster management platform**

Abbas Rajabifard<sup>1</sup> and Katie Elizabeth Potts<sup>2</sup>

University of Melbourne

<sup>1</sup>abbas.r@unimelb.edu.au, <sup>2</sup>kepotts@unimelb.edu.au

**Keywords:** disaster management, smart disaster communities, technical platform

### **Abstract**

As the disaster management community grows, so too does the need for a smart disaster community where all researchers in the field can coordinate, collaborate, and interact to develop and deliver the best outcomes for wider society. In the area of disaster management research there are many organizations, groups, centres and individual researchers working towards the common goal of improved disaster management practices through disaster risk reduction, minimizing and mitigating against the impacts of disasters, better responding to disasters, and developing resilient communities. To ensure that these groups are not working in isolation, a networked approach is needed to facilitate sharing, collaboration, engagement, integration, and to minimize duplication and isolation of research. A Global Disaster Management Platform is one possible solution to address this growing need – a platform that can bring together and connect disaster management specialists, disaster management groups, and international organizations dedicated to this field, and enable them to share and collaborate on disaster management issues. The Centre for Disaster Management and Public Safety at the University of Melbourne proposes to develop such a platform, which aims to increase awareness of the advances, developments and initiatives underway in the area of disaster management while connecting disaster management research at the global level. The Global Disaster Management Platform (GDMP) is based around a vision for this rapidly growing field: more sharing, increased collaboration, and enhanced awareness of the current research taking place. A platform such as the GDMP has the goal to facilitate the expansion of international collaboration and engagement resulting in long-term research and training activities, and to provide a forum for researchers to share and become aware of different disaster related research taking place. Under the GDMP researchers from all countries and all organizations will have a platform to list information about their research and view and learn of other research taking place worldwide. So far, in the development of the GDMP, the focus has been on facilitating collaboration with Asia, Latin America, and wider societies for the development of disaster management research and engagement. As part of these developments, two international events – one in September 2014, and a second in October 2015, have been held to help formulate the GDMP. The events enabled the showcasing of research and breakthroughs in the field of disaster management and the opportunity to foster engagement and support collaboration between local and international industry, government and academia. These events attracted participation from over 15 countries, and at a small scale demonstrated the value of international collaboration and engagement in the area of disaster management research. This paper will detail the establishment of a Smart Disaster Community enabled through the conceptualization and development of a Global Disaster Management Platform.

## **Risk Modeling of Accidents in the Power System of Ukraine Based on SDI Data**

Viktor Putrenko

World Data Center for Geoinformatics and Sustainable Development  
National technical university of Ukraine “Kyiv polytechnic institute”  
37, Peremohy Ave., 03056, Kyiv, Ukraine  
putrenko@wdc.org.ua

**Keywords:** NSDI, risk modeling, Bayesian network, power transmission network, spatial modeling

### **Abstract**

Using the data of the national spatial data infrastructure in Ukraine for the study of risk assessment of critical assets is one of the most important applied problems. Relevant and comprehensive spatial data about climatic conditions, engineering networks, and accident statistics should be provided by mapping services and local management companies for capabilities of decision support solutions and prediction emergencies.

Power industry is a one from basic industry in Ukraine and a strategic sector in any country. Power industry security is a component of country security in general. Hazardous situations (accidents) on the objects of energy power systems usually arise from defects in the manufacture and operation of the equipment, personnel rules violation and other factors and lead to the forced termination of energy supply, causing a threat to the life of society.

Primary part of the power transmission networks are the overhead power transmissions lines, because of this there is a threat of adverse impact of climatic factors on the power transmission network components. Extreme climatic conditions lead to accidents on the power lines, so the problem of analysis of climate impacts on the power transmission network and prediction the consequences of these effects are direct component of power system security problem. Extreme accidents analysis shows that more than half of the failures on overhead power lines caused by the ice and wind overloads on the wires, cables and other structures.

Bayesian network is used to simulate accidents on power grid objects. Bayesian network is a graphical model that encodes probabilistic relationships among studied variables. The graphical model has several advantages for data analysis: coding dependencies between all variables and easy handling situations when data are missing; studying the possibility of using cause-effect relationships; avoiding the need to "fit" the data.

Model development for accident under the influence of climatic factors takes following stages: defining models variables and relations between them; Bayesian network structure construction, determining the possible values of variables and a priori probabilities; Bayesian network learning and refining its structure (variables and their probabilities); model testing using accidents data at power lines and meteorological observations; prediction the occurrence of accidents involving information about the accident using the constructed model. Bayesian networks prediction is based on a Bayesian classifier, which is statistically optimal classifier,

which minimizes the risk of misclassification. Bayesian network model was tested using the technique of cross-validation.

Variables that are used for accidents simulation are the following: ice weight, event duration and ice growth period, type of topography, the constructions lifetime, the wind speed at the maximum ice load period, month of ice load occurrence, altitude and wind direction at the beginning and after reaching the maximum size of ice. Model development is performed on meteorological observations, accidents cases data and geospatial data of power grid from SDI organizations network.

Zoning maps for the area of interest were constructed with QGIS, marking on the maps locations of accidents that have occurred, and predictable accidents place.

## **Blueprint for the STIG1.0: Defining core SDI principles and setting up performance indicators**

B. Nushi<sup>1</sup>, B. Van Loenen<sup>2</sup>, J. Crompvoets<sup>3</sup>

<sup>1</sup> TU Delft, Delft, The Netherlands, b.nushi@tudelft.nl

<sup>2</sup> TU Delft, Delft, The Netherlands, b.vanloenen @tudelft.nl

<sup>3</sup> KU Leuven, Leuven, Belgium, joep.crompvoets@soc.kuleuven.be

### **Abstract**

Spatial Data Infrastructures (SDIs) have been developed over the last decades all over the world. SDI is the integration of several components to create a platform which enables a wide variety of stakeholders to access, share and use spatial data in an efficient and effective way. To stimulate the SDI development effectively and efficiently, it is key to assess the progress and benefits of the SDI. Currently, several SDI assessment methods exist. However, most assessment methods are analyzing the SDI as a whole, which does not allow understanding their internal dynamics and none of these appear to meet the requirements of practitioners. Thus, SDI decision makers are still without any guidance on the success of their SDI.

The research on this paper stands on an ongoing PhD research project on the development of a sound foundation for an academic theoretical framework for the STIG, Stress Test for Infrastructure of Geographic information. The last paper was focused on the similarities of the Financial infrastructures with the Spatial Data Infrastructures and if the financial stress testing which is commonly used to assess the sustainability and success of the financial system can be used for SDI assessment. Based on a review of the nature and concept of the SDI and Financial Infrastructure (FI) we conclude that there is significant similarity between these two infrastructures and the stress test methodology is likely to be an appealing alternative way of assessing SDIs.

The purpose of this paper is to define the Core SDI Principles based on the 29 Basel Core Principles and setting up the Core SDI performance indicators. Additionally, a set of essential and additional assessment criteria for each Core SDI Principle will be defined. From all the examined types of risk factors and methods to construct financial stress tests, the Multi-factor Stress tests (Hypothetical and a Non-systematic Subjective scenario model) are most promising as a basis for SDI assessment. This hypothetical scenario first chooses and then stresses risk factors based on expert inputs including users, producers, data owners, management, consultants etc. SDI practitioners can construct hypothetical scenarios when no historical scenarios match the special features of their situation or when they want to stress new combinations of risk factors. Stress testing as a SDI assessment method once implemented in the decision-making process, can effectively increase system robustness of a SDI. When implementing stress testing, challenges remain in modeling the interaction of different risk factors and their impacts. Such things as: integrating stress testing at different levels and making stress tests workable, realistic and timely remain complicated. These issues will be addressed in the research further developing the Stress Test for Infrastructure of Geographic information: the STIG. The paper ends with a shortlist of issues for discussion on the way to move forward.

## **Accuracy analysis of distance model correction using Bluetooth low energy technology on indoor positioning system**

Yun-Tzu Kuo<sup>1</sup>, Jhen-Kai Liao<sup>2</sup>, Kai-Wei Chiang<sup>3</sup>

Department of Geomatics, National Cheng Kung University

<sup>1</sup>yuki31210@gmail.com, <sup>2</sup>cacalut1690@gmail.com, <sup>3</sup>kwchiang@mail.ncku.edu.tw

**Keywords:** indoor positioning, Bluetooth, wireless technology,

### **Abstract**

This study focuses on improving accuracy of Bluetooth-based indoor positioning system. The distance model correction is proposed and applied in testing environments. Bluetooth wireless technology is the global wireless standard that exchanges data over short distance between devices. With the development of wireless technologies, Bluetooth has developed to a new version 4.0 which is called Bluetooth Low Energy (BLE) in 2010, and it is a new wireless personal area network technology. Its characteristics of low cost, low energy consumption, and interoperability bring about a suitable tool for connecting network between devices. Most of the mobile devices are equipped with Bluetooth functionality that also makes it a good candidate for indoor positioning. Beacon, which is the application of BLE-based technology, is capable of transmitting information and one of the signals is called Received Signal Strength Index (RSSI) which can be converted to distance depending on the model of signal strength and real distance.

This research utilizes beacon in indoor positioning system. After detecting the RSSI from beacon, the distance between transmitter and receiver can be estimated through a distance model. The unknown position is subsequently calculated by trilateration. However, the signal strength of BLE will be influenced by the surrounding environments, i.e. multipath effect and shelter which make the signal weak and unstable. The feeble signal leads to poor accuracy of estimated distance and positioning result. To improve the performance of the positioning method, this research proposes a novel method, which corrects the distance derived from the model. The proposed distance model correction is based on the differential which is similar to the principle of Global Positioning System (GPS). To obtain better positioning accuracy, it exploits reference station which is a known point to compute the residual of distance so as to correct the distance observation from receiving station. Once the distance of receiving station to each beacon is revised, the positioning result calculated by trilateration will be closer to the real position. This research has some check points in different testing environments. Finally, this study uses Root Mean Square Error (RMSE) and standard deviation to evaluate the accuracy of the check points which the true location is survey by the total station. The experimental results show that the positions after distance model correction are more concentrated and closer to real position in terms of overall accuracy.

## Automatic matching and geo-referencing of historical aerial images

I-Wen Chen<sup>1</sup>, Hou-Ren Chen<sup>2</sup>, Yi-Hsing Tseng<sup>3</sup>

Department of Geomatics, National Cheng Kung University, No.1, University Rd., Tainan  
City 70101, Taiwan, ROC

<sup>1</sup>sjasper1323@gmail.com, <sup>2</sup>P66024146@mail.ncku.edu.tw,

<sup>3</sup>tseng@mail.ncku.edu.tw

**Keywords:** historical aerial images, automatic image matching, image registration

### Abstract

Nowadays, aerial images present a “bird’s-eye” view of geographical environment, and historical one provides the spatial information in the past. Through multi-temporal aerial images, we can analyze dynamic environmental changes. In Taiwan, Research Center for Humanities and Social Sciences (RCHSS) of Academia Sinica, has collected and scanned abundant historical maps and aerial images. By being processed through methods of computer vision, those materials can achieve greater value. Most of the historical aerial images haven’t been registered since there were no precise POS system for orientation assisting in the past. To handle the great quantity of images, we develop an automatic process to match historical aerial images by Scale Invariant Feature Transform (Lowe, 2004). This matching algorithm extracts extreme values in scale space, and becomes invariant image features, which are robust in rotation, scale, noise, and illumination. If two images have the same image feature point, we can use these points to do affine transformation or projective transformation for image alignment. Research that using feature points of SIFT for automatic registration of historical aerial images has proven feasible (Rau, 2014).

After image matching and alignment automatically, we only have the relative orientation of images. We still have to add control points manually for registration through least square adjustment based on collinear equation. Finally, we can use those feature points extracted by SIFT to build control image database in future work. Every new image will be query image and be extracted. If features of new points match with the point data in database, it means that the query image probably is overlapped with control images and then become new control data. After feature extracting, all computation is based on point data instead of image data, so the requirement of computation is low. With the growth of the database, more and more query image can be matched and aligned automatically. Also, further study such as multi-temporal environmental changes can be investigated by using this temporal spatial data system.

## **Are estimation algorithms applicable for disaster managements? – an experimental demonstration of disaster-information-integration platform named ‘G-space platform’**

Hideki Hayashi<sup>1</sup>, Akinori Asahara<sup>2</sup>, Hitoshi Tomita<sup>3</sup>, Yuichi Ogawa<sup>4</sup>, Natsuko Sugaya<sup>5</sup>,  
Yoshihide Sekimoto<sup>6</sup>, Akihito Sudo<sup>7</sup>, Takehiro Kashiya<sup>8</sup>, Toshikazu Seto<sup>9</sup>, Hiroki  
Ishizuka<sup>10</sup>, Satoshi Nishiyama<sup>11</sup>

<sup>1,2,3,4,5</sup>Hitachi, Ltd., Japan

<sup>6,7,8,9</sup>University of Tokyo, Japan

<sup>10,11</sup>KDDI Corporation, Japan

<sup>1</sup>hideki.hayashi.xu@hitachi.com, <sup>2</sup>akinori.asahara.bq@hitachi.com,

<sup>3</sup>hitoshi.tomita.jg@hitachi.com, <sup>4</sup>yuichi.ogawa.nf@hitachi.com,

<sup>5</sup>natsuko.sugaya.tr@hitachi.com, <sup>6</sup>sekimoto@iis.u-tokyo.ac.jp, <sup>7</sup>sudoa@iis.u-tokyo.ac.jp,

<sup>8</sup>kashiya@iis.u-tokyo.ac.jp, <sup>9</sup>tosseto@csis.u-tokyo.ac.jp, <sup>10</sup>hk-ishizuka@kddilabs.jp,

<sup>11</sup>sa-nishiyama@kddi.com

**Keywords:** disaster management, disaster estimation, spatio-temporal data, people flow data

### **Abstract**

Estimation algorithms are needed to estimate the damage situation in large-scale natural disasters from observed information that is often insufficient. Are the estimation algorithms applicable for disaster management? This is a serious question for those of us involved in a national Japanese research project known as “research and development of techniques about use and application of real-time information in the G-space platform.” In this paper, we present an experimental demonstration as our final evaluation of this project. We developed an integrated demonstration system implementing people number estimation using cell-phone connection logs and simulation data search using small amounts of real-time data to confirm usability. The virtual disastrous scenario set for the demonstration was a huge M7.3 earthquake that hits Tokyo. The demonstration system was presented to 39 participants (including 26 government officers and 13 university/industry experts) from 13 organizations on Jan. 27–28, 2016 for review. We sent a questionnaire to all participants afterward and nine organizations responded. In total, seven organizations responded with “Yes” to the question about whether our techniques were applicable for disaster management, thus confirming the effectiveness of the developed techniques.

## **Governance quality and disaster risk - a strong correlation**

David Oliver Kasdan

Graduate School of Governance, Department of Public Administration, SungKyunKwan  
University, Republic of Korea, Republic Of

dokasdan@gmail.com

**Keywords:** disaster management, governance

### **Abstract**

Disaster risk management is a complex endeavour that entails compensations for factors both natural and human made. While the “hard sciences” attempt to deal with the natural factors, such as predicting hazards and engineering solutions, the role of social sciences are becoming increasingly sophisticated to contend with the varieties of populations and contexts that exist. The trends in research on topics of resilience and comparative behaviours suggest that myriad aspects of society are worthy of investigation in terms of potential effects on disaster risk management. The influence of human activities on disaster risk, such as climate change, only compounds the complexity.

A recent study (author, 2016) demonstrated that broad indicators of socio-cultural dimensions measured at the national level are related to disaster risk. This paper takes that study in another direction to discuss the relationship between the quality of a nation’s governance and its disaster risk. While several established indices incorporate some measures of governance quality in their disaster risk indices, a decidedly administrative perspective is missing in the literature. Disaster risk management as a specialized function of government is highly dependent on the quality of that government, as considered by the administrative pillars of efficiency, effectiveness, and equity.

Starting from the theory of governance that develops those pillars, this study then uses the World Risk Index and Worldwide Governance Index to provide an empirical analysis of the relationship. Those findings are then situated in several real contexts to demonstrate how the relationship between disaster risk and governance quality is realized. Issues of trust-risk, policy implementation, administrative ethics, democratic participation, and compliance are discussed. Of particular concern is the extent that better quality governance can mitigate disaster risk when other factors of a population are taken into account.

## Applications of geographic names in K12 education of Taiwan

Lay Jinn-Guey<sup>1</sup>, Chen Chang-An<sup>2</sup>, Wu Jia-Rong<sup>3</sup>, Kao Ching-Jen<sup>4</sup>

<sup>1,2,3</sup>Department of Geography, National Taiwan University, Taiwan

<sup>4</sup>Department of Geography, Chinese Culture University, Taiwan

<sup>1</sup>jglay5835@gmail.com, <sup>2</sup>anchang38@gmail.com, <sup>3</sup>d99228005@ntu.edu.tw,  
<sup>4</sup>chingjen1958@gmail.com

**Keywords:** geographic names database, K-12 education

### Abstract

Geographic names are reflection of what people think of a particular place, including its surrounding environment, community, culture, and histories. As geographic names carry abundant spatial and historical meanings, study of geographic names may help understand the characteristics and development of a place. In order to better manage the geographic names of Taiwan, the Ministry of Interior (MOI) has created a comprehensive geographic name database and established a Geographic Names Information Service (GNIS) website. This research aims to explore the potential of using this website for high-school education. Specifically, we developed 10 teaching modules to be used in K-12 geographic classes and organized a series of workshops for K-12 geography teachers. The analysis discussed how these teaching modules and workshops were designed and the results of their applications. In sum, participants were positive to the use of the website above-mentioned and encouraged to introduce it in the classroom. They agreed that geographic names would significantly help developed the sense of places and strengthen the spatial thinking of students, which are important concepts and skills in geographic teaching.

### References

- (1) AAG (1994). *Geography for Life: National Geography Standards*, Washington DC, USA.
- (2) Abe, Akiyoshi (1997). *Geographical Names Study in Taiwan*. Wu-ling Press.
- (3) Cai, Pei-Huei, Yi-Huei Chen, Jhuan-Jie Lu (2013). *Taiwan Names Illustrated story*. Hiking Taiwan Press.
- (4) Chen, Chin-Yuh (2006). *The Significance of Recognizing the Old Names of Taiwan's Districts-A Study of the History and Development of Tuku Town, Yuanlin County*. Tatung University General Education Center Report, 2, 171-200.
- (5) Chen, Guo-Jhang (2004). *Taiwan Gazetteer*. Department of Geography, National Taiwan Normal University.
- (6) Chen, Guo-Jhang (2007). *Taiwan Toponymy Collection*. Department of Geography, National Taiwan Normal University.
- (7) Chen, Lua-Feng (2005). *Place Name Teaching and the Application of Map to Place Name Teaching*. *The Journal of Regional Studies in Humanity and Social Sciences*, 8, 77-105.
- (8) Chen, Zheng-Xiang (1993). *Taiwan Gazetteer*. Southern Bookstore.

- (9) Jhang, Su-Bin (2012). Political and Social Development in the Qing Dynasty in Taiwan (1684 ~ 1858). Retrieved from <http://content.teldap.tw/index/blog/?p=3575>.
- (10) Jian, Jhang-Shun (2003). Significance in The History of Education in The Formation and Development of Taiwan Place Names: In Guishan Township, Taoyuan County Center. National Taiwan Normal University Institute of History.
- (11) Lee, Nan-Heng (2008). Place-Name Changes of Taiwan in 1920: A Brief Study into Its Origin and Phonetic Transition. *Journal of Geographical Research*, 48, 47-61.
- (12) Lin, Man-Gong (1997). Tea, Sugar, Camphor Industry and Socio-Economic Changes of Taiwan (1860-1895). Lianjing Press.
- (13) Lu, Jhuan-Jie (2014). Taiwan Has Been Misunderstood Old Place Names. Hiking Taiwan Press.
- (14) Lu, Jhuan-Jie (2015). Taiwan hidden truth in map. Hiking Culture Press.
- (15) Ministry of the Interior. Taiwan Geographic Names Information Service Network website. Retrieved from <http://gn.moi.gov.tw>.
- (16) Shiu, Je-Ming (1996). Research for Changes of Administrative Division and Place Names. *Journal of Cartography*, 7, 37-62.
- (17) Shuie, Yea-Huey (2006). The Study of Fruit Place-names in Taiwan. *The Journal of Social Studies Education Research*, 11, 119-175.
- (18) Sun, Ying-Lung (2007). Historical Origins of Geographical names produced in Taiwan. *Taiwan Heritages*, 38, 126-135.
- (19) Wang, Po-Shan, Hsiu-Yu Han, Ching-Ju Huang, Hsuan-Fan Ko, Mu-Yung Chang (2006). The Connotation of Animal's Place Names in Taiwan Area. *The Journal of Social Studies Education Research*, 11, 1-45.
- (20) Wei, Yen-Tsao (2004). The Relationship between Taiwan Hohlo Place Names and Pronunciation Structures of Hohlo Language. *Environment and Worlds*, 9, 55-82.
- (21) Wei, Yen-Tsao & Tsao, Chih-Chung (2013). Using the Typical Place Names between Hakka and Southern Min in Atlas to Restructure Historical Dialect Boundary in the Ancestral Homes of Taiwan Hakka and Southern Min. *Taiwan Museum Quarterly*, 32(4), 54-59.
- (22) Yu, Chen-Hao (2002). The Discussion of the Toponym Annotation on the Map in the Social Subject Textbook of Primary School and Middle School. *Journal of Cartography*, 12, 41-52.

## Assessing the importance of NSDI and spatial data transparency for biodiversity conservation and the environment: Making a case for a global NSDI index

Georgina Chandler<sup>1</sup>, Joep Cromptvoets<sup>2</sup>, Paul Jepson<sup>3</sup>, Susanne Schmitt<sup>4</sup>

<sup>1</sup> Formerly Spatial Transparency Research Officer WWF-UK, georgiechandler@gmail.com

<sup>2</sup> KU Leuven Public Governance Institute, joep.cromptvoets@kuleuven.be

<sup>3</sup> Conservation Governance Laboratory, University of Oxford, paul.jepson@ouce.ox.ac.uk

<sup>4</sup> WWF-UK, SSchmitt@wwf.org.uk

**Keywords:** spatial data, NSDI, transparency, accuracy, interoperability, openness, biodiversity conservation, indexing, Sustainable Development Goals

### Abstract

Biodiversity conservation and land use planning are inherently spatial, and as increasing pressures are placed on land use, it is vital for decision-making to be well-informed and integrated. Within the environment sector open, accurate, and exchangeable spatial data can empower the organisations responsible for environmental decision-making. Critically, it can help them prevent and resolve land use conflicts by encouraging early engagement in ‘problematic’ development projects. These are all functions that a NSDI can provide if effectively mobilized within a country. This study investigated spatial transparency issues in eight WWF-UK priority countries through interviews and questionnaires sent to in-country spatial data users and experts. The research also gained an insight into awareness of NSDI, use of NSDI, and potential applications and need for improvements, with the ambition of highlighting the importance and potential of effective spatial data infrastructures for the environment sector. The conclusion drawn was that a way of assessing progress towards SDI at a national scale was greatly needed. The scoring that a comprehensive and stakeholder relevant Index to assess NSDI provides will allow investment and decision-making to be directed towards problematic areas of NSDI development, and will promote collaboration and motivation between government departments and other stakeholders to improve their spatial data quality, management and availability. This would have long-term benefits for development and environment agendas.

### References

- BirdLife (2016) Important Bird and Biodiversity Areas, BirdLife, Available: <http://www.birdlife.org/worldwide/programmes/sites-habitats-ibas>, Accessed: 31/07/16.
- Chandler, G. (2015) How can countries better integrate biodiversity conservation and development needs into spatial land use planning? Developing an index to benchmark the state of NSDI globally, in part fulfilment of MSc Biodiversity Conservation and Management (2015), University of Oxford, School of Geography and the Environment.
- Chandler, G., Jepson, P., Schmitt, S. And Mulyani, M. (2016) A National Spatial Data Infrastructure Index: Justification and Design, Smith School of Enterprise and Environment, Oxford University, UK, Available: <http://www.smithschool.ox.ac.uk/research-programmes/protected-area/Chandler-NSDI-DiscussionPaper.pdf> Accessed 31/07/16.

- Cromptvoets, J., Rajabifard, A., van Loenen and Delgado Fernandez, T (eds.) (2008) A Multi-view framework to assess SDIs, Space for Geo Information (RGI), Wageningen University and Centre for SDIs and Land Administration, Department of Geomatics, The University of Melbourne, Available: [http://www.csdila.unimelb.edu.au/publication/books/mvfasdi/MVF\\_assessment\\_SDI.pdf](http://www.csdila.unimelb.edu.au/publication/books/mvfasdi/MVF_assessment_SDI.pdf), Accessed: 31/02/16.
- Eken et al., (2004) Key Biodiversity Areas as Site Conservation Targets, *BioScience*, 54(12): 1110-1118.
- Mulyani, M. (2014) Chapter 5, PhD Thesis, University of Oxford, School of Geography and the Environment, UK.
- Samadhi, T. N. (2014) Indonesia ONE MAP: Forging a functioning National Geospatial Functioning National Geospatial Information Network Infrastructure, Locate14 Conference, National Convention Centre, Canberra, 8th April 2014, Available: [ggim.un.org/knowledgebase/Attachment279.aspx?AttachmentType=1](http://ggim.un.org/knowledgebase/Attachment279.aspx?AttachmentType=1) Accessed: 31/07/16
- Schmitt, S. And Tibaldeschi, P. (2016) WWF-SIGHT Integrating spatial data to guide land use planning, policy and investment, WWF-UK, Available: [http://assets.wwf.org.uk/downloads/2016\\_wwf\\_sight\\_mapping\\_platform\\_1.pdf](http://assets.wwf.org.uk/downloads/2016_wwf_sight_mapping_platform_1.pdf) Accessed: 31/-7/16
- Shapiro, A. C., Nijsten, L., Schmitt, S. and Tibaldeschi, P. (2015) GLOBIL: WWF's global observation and biodiversity information portal, The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Volume XL-7/W3, 36th International Symposium on Remote Sensing of Environment, 11–15 May 2015, Berlin, Germany, Available: <http://www.int-arch-photogramm-remote-sens-spatial-inf-sci.net/XL-7-W3/511/2015/isprsarchives-XL-7-W3-511-2015.pdf> Accessed 31/07/16.
- Snell, J. and Carpenter, J. (2013) Future trends in geospatial information management: the five to ten year vision, Ordnance Survey (UK) at the request of the Secretariat for the United Nations Committee of Experts on Global Geospatial Information Management, Available: <http://ggim.un.org/docs/Future-trends.pdf> Accessed: 31/07/16.
- Technische Universitat Wien (2015) European Smart Cities 4.0: Why Smart Cities?, Technische Universitat Wien, Vienna, Available: <http://www.smart-cities.eu/?cid=1&ver=4>, Accessed: 31/07/16.
- Trainor, T. (2015) in UN News Centre (2015) UN body stresses vital role of geospatial data to achieving sustainable development goals, Available: <http://www.un.org/apps/news/story.asp?NewsID=51608#.V53wY7grLb1> Accessed: 31/07/16.
- UN-SDSN, CIESIN and Open Data Watch (2015a) Data for Development: An action plan to finance the data revolution for sustainable development, UN-SDSN, Available: <http://unsdsn.org/resources/publications/data-for-development-an-action-plan-to-finance-the-data-revolution-for-sustainable-development/> Accessed: 31/07/16.
- UN-SDSN, Open Data Watch, CIESIN, PARIS21, SFU, UNESCO (2015b) Data for Development: A needs assessment for SDG monitoring and statistical capacity development, UN-SDSN, Available: <http://unsdsn.org/wp-content/uploads/2015/04/Data-for-Development-Full-Report.pdf> Accessed: 31/07/16.
- Vandenbroucke, D., Cromptvoets, J. and Jenssen, K. (2011) INSPIRE and NSDI State of Play: D1.1 - Report on the Methodology, K.U.Leuven Spatial Applications Division, Research and Development, Available:

<http://inspire.ec.europa.eu/reports/stateofplay2009/INSPIRENSDISoP-D.1.1-ReportonMethodology-v2.1.3.pdf> Accessed: 31/07/16.

- WWF-UK (2015) Safeguarding outstanding natural value: The role of institutional investors in protecting natural World Heritage sites from extractive activity, WWF-UK, Available: [http://www.wwf.org.uk/about\\_wwf/press\\_centre/?unewsid=7683](http://www.wwf.org.uk/about_wwf/press_centre/?unewsid=7683), Accessed: 31/07/16.

## **SWOT and PEST Analysis on Mongolian National SDI**

<sup>1</sup>Tsogtdulam Munaa, Bolorchuluun Chogsom, Baasandolgor Tumursukh

Department of Geography, National University of Mongolia,

<sup>1</sup>Corresponding author: [tsogtdulam@num.edu.mn](mailto:tsogtdulam@num.edu.mn)

**Key words:** Mongolia, SWOT, PEST

### **Abstract**

It has been 20 years since spatial data infrastructure (SDI) has spread across the world. During this time, several countries has started establishing their own SDI, all of which are different from each other. Mongolia has been using geographic information system (GIS) software for mapping since 1990. Nowadays many organizations and some private companies in Mongolia are dealing with remote sensing and GIS activities.

Since 2004 there have been discussions and plans for founding a National Spatial Data Infrastructure (NSDI), starting from 2012. The NSDI is one of seven main key components of the “National Program to Establish an Integrated System of Registration and Information of Mongolia” (2008). The project is to facilitate and support data exchanges between and within organizations, for efficient cadastral procedures, registration and taxation, and other related activities, etc. NSDI is a web based and centralized system which covers administration of geoinformation databases all over the country among government departments.

The PEST factors, combined with external micro-environmental factors and internal drivers, can be classified as opportunities and threats in a SWOT analysis. In order to establish a promotion strategy for SDI system implementation project, internal and external factors are derived through using SWOT and PEST analysis.

This research aims at a SWOT and PEST analysis to identify the key internal and external factors in the SDI legal system, internship between government organizations, human resources, data resource and security that are important for achieving the objectives in the Mongolian situation.

## Assessment of OpenStreetMap – a case of Kampala

Anthony Gidudu<sup>1</sup> and Gloria Owona<sup>2</sup>

Department of Geomatics and Land Management  
Makerere University, P.O. Box 7062, Kampala, Uganda

<sup>1</sup>agidudu@cedat.mak.ac.ug; <sup>2</sup>gowona@cedat.mak.ac.ug

**Keywords:** OpenStreetMap, OSM, Kampala, assessment, positional accuracy, crowdsourcing

### Abstract

Like many developing countries, access to geospatial data presents a big challenge. One of the major reasons for this is a lack of a National Spatial Data Infrastructure (NSDI) through which geospatial data collected by different stakeholders can be shared. As a consequence, there is duplication of data collection efforts, usage of geospatial data with different cartographic properties for the same areas, high cost of data collection etc. Other challenges include the fact that this data is rarely updated and there is bureaucracy attached to accessing these datasets. The conglomeration of these challenges has inspired the consideration of alternative sources of geospatial data, more so freely available geospatial data. OpenStreetMap (OSM) is a geospatial dataset whose main distinguishing quality is that it is free to access and distribute. It contains information about cultural features such as roads, buildings, powerlines etc., collected through crowdsourcing. Crowdsourcing for the Uganda OSM dataset began in 2012 and to date a substantial amount of data has been accumulated, especial for the capital city – Kampala. This dataset is continuously updated through the efforts of volunteers some of whom have had insufficient training in mapping or cartography. To members of the geospatial community, this potentially presents doubts about the accuracy of the dataset and hence its usefulness. It is in this context that this paper therefore sought to assess the Kampala OSM dataset. The assessment involved comparing the OSM dataset against three known existing datasets: The Uganda National Roads Authority (UNRA) dataset, Justice Law and Order Sector (JLOS) dataset and extracted roads from a 2014 orthophoto. These were then used to assess positional accuracy, data completeness, consistency and attribute accuracy of the OSM data.

The results show that OSM data had positional accuracies of 91%, 62%, 53% when respectively compared to UNRA, JLOS and extracted road data from 2014 Kampala orthophoto. This can be explained by the fact that OSM data is mostly collected using hand held GPS which can have positional accuracies of up to 10m. With a 99% data completeness accuracy, evidently much of Kampala has been collected which means that OSM can be reliably used for routing studies among others. There was however poor consistency and attribute accuracy of 5% and 23% respectively which could be attributed to the reference data having out of date place names. There also could have been instances where and when the wrong attribute e.g. road name was assigned to the OSM dataset. This can be remedied by ensuring proper quality control before uploading the data for sharing. From the questionnaires, it was observed that there has been growing use and application of OSM data in Geospatial community. Most awareness has come out of training workshops however, more can still be done. There is also need to expand the domain areas in which OSM data can be used, as this will go a long way in reaching out to more potential users. Ultimately as OSM takes root, potentially less resources will need to be spent on collecting this data.

## **I4D - Intelligence for decision by Airbus Defence and Space**

Michael Quast

Airbus Defence and Space, France

michael.m.quast@airbus.com

**Keywords:** I4D, analysis, data fusion, virtual globe

### **Abstract**

I4D is a turn-key solution for data fusion and geospatial analysis, allowing simple management, access and exploitation of all types of geo-located data (raster imagery, vector data, multimedia files, and any other geo-located information) and is highly interoperable via OGC (Open Geospatial Consortium) standard interface compliance.

In operation and constantly improved for more than 10 years, I4D is daily used by more than 3000 operators all over the world.

I4D is a modular and scalable solution including two main components: On the one hand I4D Explorer, a virtual globe for simple and effective access to a multiple data repository and on the other hand I4D Data Centre, a scalable data storage and management solution allowing data security, availability, and highly automated data management processes. In addition to this infrastructure, specific data sets and training programs enable the solution to be used in full autonomy.

I4D functions enable an efficient spatiotemporal analysis of a situation allowing fast decision making. Thus, the I4D solution is suited for many military and civil applications such as defence, security, environment and disaster/crisis management.icos – LAMP.

## **Support of individual autonomy to control privacy exposure within increasingly ubiquitous tracking societies**

Professor Harlan J. Onsrud

Spatial Informatics Faculty, School of Computing and Information Science, University of  
Maine, Orono, Maine, USA 04469-5711

onsrud@spatial.maine.edu

**Keywords:** privacy, sensors, personal information

### **Abstract**

We live increasingly within modern societies in which every human, object and communication is tracked all the time and everywhere. Sensors and affiliated support technologies being deployed within our static surroundings and carried with us include those that are able to *locate* (both outside and inside buildings), *see* (ranging from automated identification of objects to specific individuals), *hear* (from detection of specific sounds to transcribing language), *smell* (sensing of specific gases), *feel* (detection of specific conditions such as temperature, humidity, and motions) and *communicate*. Sensors in and attached to our bodies now regularly communicate in modern societies through our phones, cars, offices, homes, transportation infrastructure, and with objects along our travel paths. Often invisibly embedded within our stationary and mobile surroundings, sensor data along with massive data collected through our digital transactions and activities is providing myriad benefits in enhancing the quality of our lives. Yet most of us have extremely limited and cumbersome control, at best, over our personal information exposure. Personalized and readily personalized data as well as services based upon that data are widely accessed, mined, exchanged and sold across and among the commercial and government sectors. Legal controls are largely ineffectual in a global race to the bottom in terms of allowing corporate and commercial sectors free reign to extract and retain indefinitely data about our movements, interactions and transactions. This talk contemplates an ethics-driven combined technological and legal approach for granting individuals control over their information exposure and speculates on the potential acceptability of the approach within national legal and cultural frameworks.

## Earth Observation by Airbus Defense & Space: Today and Tomorrow

Patrice Galey

AsiaPacific Business Development, Intelligence  
Airbus Defence and Space (TCISP), 110 Seletar Aerospace View, Singapore 797562  
patrice.galey@astrium.eads.net

**Keywords:** satellites, imaging, space, earth observation, EO, markets

### Abstract

Airbus DS / Intelligence has over 30-year experience in operating imaging satellites, and currently manages a constellation of Optical and SAR satellites (SPOT6/7, Pleiades 1A & 1B, TerraSAR-X and Tandem, DMC). Airbus DS / Intelligence has a strong, established global presence in marketing its imagery services in both commercial and government sectors in more than 100 countries. In parallel, Airbus DS / Space Systems is a market leader in designing and manufacturing Earth observation satellites using state-of-the-art technologies. Airbus DS has also developed partnerships with international operators and has established cooperation to distribute data from Third Party Satellites such as KazEOsat-1 or the Taiwanese's EO system Formosat-2 (still in the portfolio more than 10 years after launch).

Over the past few years, the EO market has drastically evolved, with the emergence of new entities building and marketing medium resolution constellation satellites, while the market incumbents such as Airbus DS / Intelligence keep evolving their capabilities with increased resolution and imaging capacities. While its current capabilities will extend beyond 2020, Airbus DS / Intelligence is committed to offer continuity of services beyond 2020, ensuring delivery of best-in-class products and services, all with the clear objective to remain the #1 EO services provider worldwide and for the years to come.

The presentation will provide a general overview on Markets Trends and Technology evolutions, as well as providing information on EO users expectations and expected services level to continue developing EO based Solutions in various applicative field: from Forestry to Agriculture, from Land Planning to Cartography, from Disaster Management to risks assessment, from Surveillance to Intelligence, etc.

