

## Breaking the Way through Snow to Sea Ice

The SnowSAR Tool for Bridling Global Warming



**Benchmarking  
Image-based  
DSM Generation**

*See page 27*



GIM International Interviews  
**Clarissa Augustinus  
& Teo CheeHai**

**Standards and  
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Enablers for Responsible  
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## Policy and Practice

There is often a gap between policy and practice when it comes to knowing and understanding each other. Makers of high-level policy are often unclear about what practitioners can actually deliver in order to reach the set goals. Many of today's high-level policymaking processes involve or build on geospatial data. The United Nations – Global Geospatial Information Management initiative (UN-GGIM), the UN Habitat Global Land Tool Network (GLTN) and the FAO's High Level Panel of Experts are some examples at supranational level, plus there are very many initiatives and projects at national level along with innumerable projects at regional, municipal and city level. The majority of those projects are talking about using geospatial data to the benefit of society. For instance, to decrease poverty in the developing world by securing tenure and land rights, to provide a good disaster response plan in case of disasters big or small, or to plan infrastructure projects in a city as wisely and efficiently as possible – once again, for the citizens' benefit.



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While it is said that geospatial data is very important – and often the decisive factor – in such initiatives, it is at the same time assumed that geospatial data is common and readily to hand; in other words, that it has become a commodity. As if policymakers think there is no need to worry about that practical level of their new policies. The data is there. They just need to improve and design their agreements, contracts and laws so as to ensure that the data is put to use in the right place in order to do its beneficial work.

But it is a huge oversimplification to assume that geodata has become a commodity, that the available geodata is already good enough for all the purposes the high-level policymakers have in mind. Instead, new datasets often need to be acquired, processed and analysed because the existing data is too old or inaccurate. Other times, there will be no data available at all, and no money or knowledge either. In these cases, the gap between policy and practice could be compared to the difference between dreams and reality.

It is therefore good that practitioners themselves and more often their representatives – through the international, professional geospatial bodies like FIG, ICA, IAG, GSDI and ISPRS – are included in the policymaking. They have assumed their rightful places, although sometimes only after having fought hard for them, in most of the supranational initiatives mentioned above such as UN-GGIM and GLTN. Their sole message in sessions, statements and declarations is often: 'Don't forget about the surveying profession, use our knowledge in order to come up with policies that are practical and feasible in light of the techniques, time and money available. Let us deal with the 'geo' part of the thinking!'. This is one of the most important tasks of the professional bodies, because it bridges the gap between the geoprofessional down on the ground and the policymaker way up high – the gap between policy and practice, between dreams and reality.

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**F52**

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The front cover of the final issue of 2013 shows an icebreaker in action navigating through ice-covered waters. The article by Alex Coccia, Neva Lukic and Adriano Meta on page 16 explains the SnowSAR, an advanced technological tool for the research and exploitation of changes brought about by global climate change.

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SatLab

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## Bridging the Gaps between GI and EO

Non-governmental organisations play a helpful, and sometimes essential, role in policy formulation and implementation in Europe at both regional and national levels. The value and benefit of the co-operation between policymakers and umbrella organisations with members of the golden triangle (government, academia and private sector) has grown steadily, and an open dialogue is needed to create an information-exchange infrastructure. To increase the societal-economic benefits for novel technological capabilities, citizens must be key players in deciding the direction of the market. The European Umbrella Organisation for Geographic Information (EUROGI) has decided to utilise its Europe-wide network of GI service providers for regional dissemination activities. The events, hosted by HUNAGI in Budapest in December 2013, will demonstrate how the GI community can yield a leveraged effect in public administration and in Earth observation.

The European Union Location Framework (EULF) aims to improve the integration of location information in e-government. The first workshop on 11 December is about understanding the

issues e-government practitioners face in integrating location into real-world applications as well as learning from best practices of some countries in Europe. Co-organised by the European Commission, Joint Research Centre and the Catholic University of Leuven, along with support from EUROGI, the workshop will integrate the EULF and provide the forum for invited e-Government practitioners and GI experts to share and discuss their experiences [<http://eulfhu.blogspot.com>].

Meanwhile, the EUROGI-led Copernicus Market-Pull-Packs (MPP) initiative is aimed at bridging the gap between the GI and EO community by bringing together the private service industry, prime data providers, universities, value adders

and individual consumers. A series of Copernicus-related Country Surveys on the capacities and technical capabilities are planned with evaluation workshops involving European stakeholders ESA, EC, EEA and EUROGI members as well as domestic users and service providers of GI in each country. A key objective of the first ESA-supported workshop on 12 December is to raise awareness of Copernicus and its benefits. If the potential of Copernicus data and services for updating GI data repositories and developing new applications becomes more decentralised, this will contribute to increasing both the societal and commercial acceptance of the EU Copernicus programme [[www.eurogi.org](http://www.eurogi.org)]. The importance of the Copernicus workshop is emphasised by the fact that Hungary will begin accession negotiations with ESA in December.

Unlike other products, digital content does not lose value by being openly shared. On the contrary! By way of example, the Europa Challenge challenges Europe's best and brightest to build sustainable solutions to be shared with the entire European community. The solutions are intended to serve the INSPIRE Directive and address local, regional, national and international interests. University students and SMEs are challenged to build their applications using NASA's open source virtual globe technology, World Wind. Accept the challenge here: [<http://eurochallenge.com.polimi.it>].

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## Icaros Announces Release of Aerial Oblique Image Mapping System

Icaros, a leading provider of advanced aerial remote sensing technology, has announced the release of its latest aerial remote sensing system, the Icaros Digital Mapper (IDM) 1000. The IDM 1000 combines the Icaros nadir, single-camera IDM 200 mapping system with an additional four oblique (45 degrees from nadir) cameras, designed for advanced analysis and 3D modelling application needs. The IDM 1000 improves on other currently available oblique mapping systems through its hybrid camera design that combines an 80MP mapping nadir camera with 39MP visualisation oblique cameras. ◀

▶ <http://tw.gs/Ray8fv>

## New V-Mapper Mobile Mapping System Launched

3D Laser Mapping, the company behind the renowned mobile mapping system StreetMapper, has launched a brand new addition to its portfolio of mobile mapping solutions. Developed by 3D Laser Mapping in partnership with IGI, V-Mapper is a dynamic, vehicle-mounted 3D mapping system comprising a precision navigation system, state-of-the-art laser scanning technology and an integrated spherical imaging system. ◀

▶ <http://tw.gs/Ray8f2>



V-Mapper 3D mapping system.



## Most Shared

Most shared during the last month from  
[www.gim-international.com](http://www.gim-international.com)

1. Photogrammetry and Laser Scanning on Single Aircraft  
- <http://tw.gs/RYS8dw>
2. Astrium Unveils First WorldDEM Sample Data  
- <http://tw.gs/RaT9i5>
3. Intelligent Robot for Mapping Applications in 3D  
- <http://tw.gs/RaT9iw>
4. UAS Captures 20cm-Resolution Data for 3D Model of Matterhorn  
- <http://tw.gs/RYS8fy>
5. SPOT 6 Satellite Added to European Copernicus Programme  
- <http://tw.gs/RaT9iz>

## LiDAR USA Announces CHC Partnership

LiDAR USA and CHC Navigation have announced an agreement to resell CHC's GPS equipment with ScanLook. CHC Navigation, which is headquartered in Shanghai, China, with three locations in North America, will provide integrated portable GNSS base stations that are optimised for use with the ScanLook product line. The X900+ series uses the same NovAtel OEM6 board as is used internally within the ScanLook INS system. ◀

▶ <http://tw.gs/Ray8g5>

## UK to Provide Strategic Mapping Advice to Kingdom of Bahrain

Ordnance Survey International has announced the signing of a five-year Specialist Advisory Framework Agreement with the Survey and Land Registration Bureau (SLRB) of the Kingdom of Bahrain. The agreement provides an opportunity for both organisations to work together collaboratively on a number of projects. The first of these will be the development of a new long-term strategy which will support SLRB in continuing to develop its role as the authoritative cadastral and mapping authority for Kingdom of Bahrain. ◀

▶ <http://tw.gs/Ray804>



## Earth Observation Data-based Navigation System Wins Copernicus Masters Award



Hartmut Range receives the Copernicus Masters prize.

A navigation system for self-driving vehicles that uses satellite radar data has won the top prize in the European Earth Monitoring Competition. Now in its third year, the Copernicus Masters

competition – previously known as the GMES Masters – received more than 140 business proposals from teams in 23 European countries. The competition seeks innovative solutions for business and society based on Earth observation data, while fostering creative product development and entrepreneurship in Europe. ◀  
▶ <http://tw.gs/Ray8hZ>

## Marmaray Tunnel Demonstrates Intergeo Eurasia's Topics in Practice

The Marmaray Tunnel in Istanbul, Turkey, opened on 29 October, six months before the start of two key industry trade shows: Seismic Safety and Intergeo Eurasia. Described locally as the “project of the century”, the tunnel connects the European and the Asian parts of the city. The spectacular tunnel is a perfect example of the city’s commitment to an earthquake-resistant



future and of the relevance of both trade events’ topics to this and other projects. ◀  
▶ <http://tw.gs/Ray8g1>

*The Marmaray Tunnel under construction in May 2012.*

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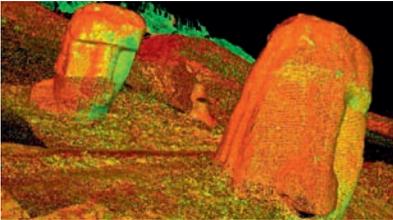
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## Digital Palace of Versailles after 100,000 Laser Scans

It is now possible to visit the famous Palace of Versailles 'virtually'. Digital Versailles has been opened thanks to a FARO laser scanner and Google Earth. The image is part of a digitisation project that includes more than 100,000 scans, which were collected with the FARO Focus3D laser scanner. ◀

▶ <http://tw.gs/Ray80W>



Perspective of Moai on the Rano Raraku slopes, created from laser scan data.

## 3D Laser Scanning to Preserve the World's Cultural Heritage Sites

Beloved and culturally significant sites like the Great Wall of China, the Taj Mahal and Machu Picchu need protection, or the world risks losing them through natural disasters, war or other threats. CyArk, a non-profit organisation that uses laser scanners to create accurate digital copies of such sites for preservation and educational purposes, has launched an ambitious initiative to digitally preserve 500 heritage sites within the next five years. It has unveiled a new fund to help finance the effort. ◀

▶ <http://tw.gs/Ray8h4>



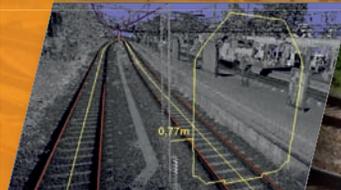
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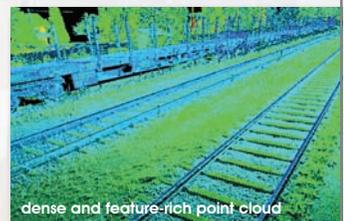


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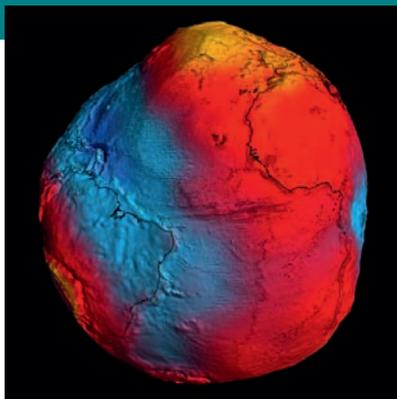


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## GOCE Gravity Mapping Satellite Falls to Earth Safely

At around 01:00 CET on Monday 11 November 2013, ESA's GOCE satellite re-entered Earth's atmosphere on a descending orbit pass that extended across Siberia, the western Pacific Ocean, the eastern Indian Ocean and Antarctica. As expected, the satellite disintegrated in the high atmosphere and no damage to property has been reported. ◀

▶ <http://tw.gs/Ray8fW>

## Bentley Announces Winners of Be Inspired Awards

Bentley Systems, the leading company dedicated to providing comprehensive software solutions for sustaining infrastructure, has announced the winners of its 2013 Be Inspired Awards. The awards honour the extraordinary work of Bentley users in improving the world's infrastructure. They were presented at a ceremony during the conference called 'The Year in Infrastructure 2013' which was held from 29-31 October 2013 in London, United Kingdom. ◀

▶ <http://tw.gs/Ray80z>

## The Venerable Lady Strikes Back

The longest-standing 'remote sensing' technology – photogrammetry – has already been around for 150 years. Indeed, she is a venerable lady in the realm of geodata acquisition, and the founding of the International Society of Photogrammetry, the precursor of ISPRS, back in 1910 underpins this fact. Just as empires and civilisations rise and perish, so too do technologies. Around the year 2000, it seemed that Lidar would emerge as a serious threat for photogrammetry as the main source of 3D point clouds for generating digital elevation/surface models (DEM/DSM). Lidar systems enable rapid acquisition of 3D geodata from (un)manned aircraft and ground-based platforms, either mounted or mobile. Their pulses partially pass through thin foliage, reflect from dune surfaces and other low-textured areas, and directly give x, y and height without the cumbersome computa-

tions needed to obtain measurements through image matching. The pulses also reflect from power lines, making it suitable for inspecting above-ground electricity networks. Therefore, in 2000, the creation of point clouds from overlapping imagery could by no means compete with Lidar. On the other hand, Lidar surveys are very costly and do not capture sufficiently high-quality colour data to create realistic 3D models. Now, with growing interest in 3D city models from urban planners, managers and many others, the feasibility of imagery has been hoisted into the zenith again. CCD arrays have since replaced film



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in the image plane, allowing the dawn of a new type of aerial cameras. They efficiently combine straight vertical views with calibrated oblique imagery. This enables the capture of highly overlapping images for extracting 3D point clouds as well as textures for the generation of 3D models at levels of detail (LoD) 2 and 3. The creation of 3D point clouds from images relies on stereo matching. Introduced over 30 years ago, these algorithms usually start with feature extraction – not only to warrant high reliability but also to save computation time. Next, sub-pixel accuracy is gained through area-based matching by least squares or correlation. Today's DEMs and DSMs may have densities similar to the ground sampling distance (GSD) of the imagery from which they are derived. For example, images with a GSD of 5cm may deliver a density of up to 400 points per square metre. The rise of dense image matching has been propelled by the advent of programmable graphical processing units (GPUs) and new algorithms which together allow amazingly fast matching. Moreover, the costs are low since today's computer power is cheap, and the same is true for digital cameras which provide high-quality imagery, while large overlaps do not add to costs. The pull of using imagery has increased further since open source packages have become available from the field of computer vision. So, once seemingly vulnerable, the venerable lady was reborn around 2010 and has since become a fully fledged competitor to Lidar for 3D model creation, and she may even have the potential to outstrip Lidar altogether.



GIM INTERNATIONAL INTERVIEWS CLARISSA AUGUSTINUS AND TEO CHEEHAI

# A Paradigm Shift

The 5<sup>th</sup> Global Land Tool Network (GLTN) Partners' Meeting held in The Hague, The Netherlands, in November 2013 was the ideal occasion to interview Dr Clarissa Augustinus – the key driver behind GLTN – and Teo CheeHai, president of FIG. Here, they discuss what GLTN means for surveyors.



**Clarissa, the Global Land Tool Network is already recognised throughout the world. Do you agree that it has achieved a lot?**

Yes, there have been many achievements. When we started, we needed a more affordable alternative to the current land administration system which was also interoperable with the current systems. We developed the social tenure domain model (STDM). In one country, we have piloted STDM at municipal level and now the national government wants to scale it up. We started with a very small team; now, it has been popularised and is also being used by slum dweller federations as well as by people working in customary areas. They know that this tool can give them information which allows them to plan, to form a constituency around their rights and to manage the land better.

**Teo, why is the GLTN partnership important for surveyors?**

The GLTN partnership allows us to actively engage in issues and challenges, particularly in the development, demonstration and

deployment of appropriate practices and land tools that leverage our sciences, technologies and knowledge we have acquired over the years.

The partnership is also important in alerting, informing and educating the profession, particularly about the scale of the matter and the fact that billions of people are still in need of secure land and property rights.

**Clarissa, I have noticed that all partners are equal but the surveyors seem to be particularly prominent.**

Yes, when we identified the gap in terms of land tools we found that many of them related to land administration and surveying. So when setting up the agenda of GLTN tools, which we are still working on, many of them are in the domain of surveyors. The development of pro-poor land tools for surveyors and barefoot surveyors is a natural linkage with GLTN. Having land administration organisations as key supporters of GLTN has been absolutely critical to the success of GLTN. And it has drawn other partners who want to engage with surveyors towards the multi-sided GLTN platform.

**The continuum of land rights has brought about a paradigm shift. Clarissa, is it ready for implementation?**

Essentially we can talk about 20 countries that have already moved away from freehold, individual parcels as the only solution for tenure security. The most robust continuum of land rights has been set up by the Namibian government; in 2012, it passed the Flexible Land Tenure Act which is now being implemented. This is the most robust version of the continuum because entails three tenure types – a starter title, a landhold and then a freehold – as a form of property ladder. This entails three tenure types with three subsystems within the same legal framework and institutional system, linking a local property office with the national deeds registry.

**Teo, during the last World Bank Conference on Land and Poverty you organised a session on the continuum of land rights. There is also a continuum in approaches, in accuracy, in spatial units, and so on. Is the profession ready for this?**

The profession must be ready for the continuum, because it provides a range of tenure types and with it a range of approaches and options that is so urgently needed to address issues in providing security of tenure for all. Within the continuum we are articulating and recognising a range of techniques, of technologies and with it a range of accuracies and

Teo CheeHai – Dr Clarissa Augustinus



**Dr Clarissa Augustinus** is chief of the Land, Tenure and Property Administration Section, Shelter Branch, Global Division, in UN-HABITAT. She is the key driver behind GLTN, focusing on innovative pro-poor land tools. The Network has over 60 international partners. Previously she was a senior lecturer at the School of Civil Engineering, Surveying and Construction, University of KwaZulu-Natal, South Africa. She has a PhD in social anthropology on customary and informal land tenure in an informal settlement in Africa.



**Teo CheeHai** is president of the International Federation of Surveyors (FIG). He is a licensed/chartered surveyor in Malaysia. He gained a bachelor's degree in surveying in Australia in 1980, and a master's degree in Malaysia in 2004. He is a past secretary-general of the ASEAN Federation of Land Surveying and Geomatics and a past president of the Royal Institution of Surveyors Malaysia as well as having held a number of positions in the Association of Authorised Land Surveyors Malaysia.

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spatial units. The profession is ready but there will be jurisdictions that still need to rise to the occasion, since we are aware that it cannot be a 'one size fits all' approach.

***There are developments within FIG on fit-for-purpose cadastres. We could also see that as a paradigm shift. There is an urgent need for cadastres to avoid loss of land rights in relation to land grabbing and forced eviction. Teo, could you expand on these developments?***

To explain 'fit for purpose' we could, in a simplistic manner, say the following: it has to be applicable, it has to be appropriate – relevant to the contexts we are working with – and it has to be affordable. Therefore, when designing our intervention, we need to carefully consider the context and culture, the capacities and scale, the opportunities and options, the ability to innovatively and incrementally enhance the effectiveness and efficiency of the intervention at that point in time. And all of that with an eye on achieving maximum benefits. At FIG, we are attempting to collate our collective knowledge of this topic via a publication that we hope will further help to not only articulate but also promote the need to be fit for purpose.

***Clarissa, are there ideas about how to monitor the implementation?***

Yes, we had an Expert Group Meeting of the Global Land Indicators Initiative on Fitness for Purpose Land Indicators. The international land industry – in which surveyors were also represented – managed to reach consensus on four indicators, which need to be proposed to the post-2015 Development Agenda process. These indicators are on firstly perceived tenure security, secondly secure land rights, thirdly the equal rights of women, and fourthly the legal recognition of a continuum of land rights. It was proposed that sub-indicators be developed to report data disaggregation also, and where appropriate, with regard to women and men, the community, businesses, rural, urban, etc.

***We have the Voluntary Guidelines from FAO, we have the Land Governance Assessment Framework from the World Bank, we have flexible standards for land administration and fit-for-purpose approaches. Teo, how can FIG support capacity development?***

We are a Federation of national-level organisations. One of our strategic focuses during our current work plan is to engage the membership, recognising that global agreements, initiatives and progress must be cascaded down to the national and operating levels. Our vision statement includes the phrase, "Next door to everywhere" which outlines the challenge we set ourselves as a global organisation to impact on the local practitioners. We do this through our publication series and our website as part of our communication strategy. We organise global and regional forums and participate in regional and national activities. FIG Commissions and FIG Networks also have their thematic and regional activities. Through all these activities, we continue to advocate and communicate, inform and at times instruct, disseminate relevant information and messages and promote such agreements and initiatives. We include all segments of our membership that may come from scientific, research and academic institutions; technologies, technological products and services providers; national and regional public agencies as well as sole or private practitioners.

***During the Partners' Meeting in The Hague, there was an introduction by Ms Gerda Verburg, chair of the Committee on World Food Security. She talked about multinational companies who do not want their business to have land acquisition-related problems. Maybe we could think about the development of a 'Fair Land Transaction Label'. Clarissa, up to which level could GLTN support such an approach?***

GLTN is currently working on this issue, for instance to support

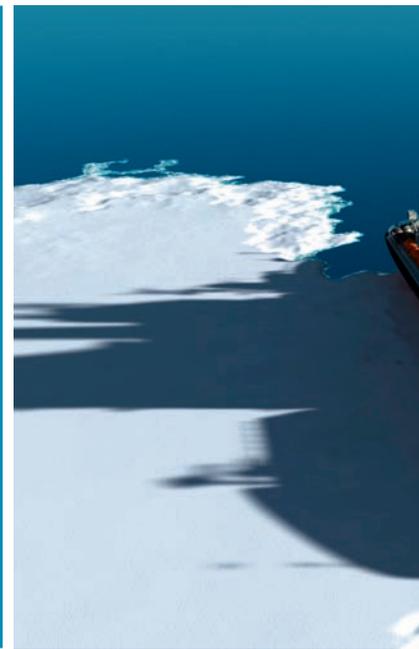
IFAD in regard to what are called 'inclusive business models'. We are also working on it with the African Union, UNECA and African Development Bank-led initiative; they have asked us to design and action learning and training around this issue. As far as the creation of solutions goes, I think we have to talk about land professionals being in the critical path but not being involved in the whole path. Lots of governance and political will is needed here. But what the land profession has to supply are the tools that are needed for fair trade, such as pro-poor land records that protect the rights of occupiers when investors come in, such as the valuation of unregistered land which is needed for compensation purposes and for cutting deals, and such as the STDM itself which would be used to manage the records over time in such a way that they remain fair deals. The land profession is key to putting a 'fair deal' in place, and it plays a critical role in a country-wide land administration system which includes these different approaches. Land professionals should be involved in the overarching management of the systems, in the creation, development and monitoring of the application, and in the implementation of the systems. It's not about the individual parcels or spatial units. It's about managing the whole process, and the ethics associated with the process.

***Given all those developments, there will be an enormous impact on the surveying profession. Teo, what is your message to the industry?***

There is an opportunity for the profession, and that opportunity must not be missed: to contribute to efforts that make a difference, that will end up enhancing our relevance as a profession. For instance, as Clarissa has just outlined, so that we can ensure that the knowledge about people-to-land relationships is used properly to make fair deals. ◀

THE SNOWSAR TOOL FOR BRIDLING GLOBAL WARMING

# Breaking the Way through Snow to Sea Ice



Global warming is a very hot topic nowadays. Although there are still some who doubt its existence, it has recently become so obviously visible as to exceed even the most imaginative expectations of many scientists. In fact, global warming's visibility is the result of invisibility – namely of the snow and ice which is disappearing from the Earth's surface at a very fast pace. This is important for several reasons. Firstly, more than a sixth of the Earth's population depends on fresh water derived from the spring runoff of melted snow and ice. Due to accelerated melting in the last four decades, it is seriously questionable whether future generations will have access to a sufficient amount of fresh water. Secondly, the Arctic Ocean is losing its sea ice extremely rapidly, and some scientists even forecast that it will remain free of sea ice by as early as 2020.

While various disadvantages are associated with this change, the melting of the sea ice is also opening

up new possibilities, such as the navigable Northern Sea Route (NSR) which reduces the shipping distance

between Europe and East Asia by almost a third. This passage, which is currently opened for several months per year, is seeing more and more traffic every year, but to navigate this route ships still need some advanced technological tools.

One such advanced technological tool for the research and exploitation of changes brought about by global climate change was manufactured from scratch in 2011 by high-tech company MetaSensing. It was called the SnowSAR.



**Alex Coccia** was born in Perugia, Italy, in 1978. After obtaining his degree in electronic engineering at the University of Perugia, he moved to The Netherlands within Delft University of Technology.

Since 2011, he has been employed as a radar system engineer at MetaSensing, where he follows airborne measurement campaigns.

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**Neva Lukic** was born in Zagreb, Croatia, in 1982. Her educational background is within the area of humanities, but she is also keenly interested in broader perspectives in the fields

of science and technology. Since 2012, she has been working as management assistant at MetaSensing.

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**Adriano Meta** is founder and director of MetaSensing. He holds a masters degree from Rome University, Italy, and a PhD cum laude in radar technology from Delft University of Technology,

The Netherlands. Dr Meta is the author of several papers and patents. He worked for advanced research institutes and aerospace agencies in several countries before founding MetaSensing.

✉ adriano.meta@metasensing.com



▲ Icebreaker in action navigating through ice-covered waters.

▲ Aerial view of the Austrian Alps during SnowSAR acquisitions in January 2013.

**RADAR SENSOR**

The SnowSAR is a radar sensor which was commissioned to support the European Space Agency's (ESA) Cold Region Hydrology High-Resolution Observatory (CoReH2O) mission candidate Earth Explorer 7 satellite. Together with international partners, the idea of CoReH2O is to research the properties of snow and ice by employing a space-borne twin-frequency (X and Ku bands) polarimetric Synthetic Aperture Radar (SAR) instrument.

In order to optimally design the system and to develop retrieval algorithms, it was necessary for ESA managers and scientists to mimic the future satellite radar data. The SnowSAR was created to meet the short-term need for an airborne SAR platform to do so. The SnowSAR instrument, unique in the world, is a polarimetric radar sensor which simultaneously operates at the two frequency bands targeted by the CoReH2O: X-band signals can moderately penetrate snow layers, reaching in some cases the underlying ground, while Ku-band

signals are more sensitive to shallow, dry snow. By simultaneously using both of these two frequency bands, the SnowSAR can reveal the amount of freshwater stored in the snow and ice. Besides developing the sensor itself, in the past three years MetaSensing has conducted several SnowSAR measurement campaigns for ESA and has processed the acquired SnowSAR data according to the CoReH2O specifications.

The SnowSAR radar sensor has proven its snow and ice-monitoring capabilities both in three of the countries which have a share of the land in the Arctic Circle, namely Finland, Canada and United States (Alaska), and outside of the Arctic Circle (in Austria).

**SNOW MEASUREMENT**

Snow pack structure and morphology can differ quite widely from region to region, depending on different terrain types and on the background composition. The first two SnowSAR measurement campaigns in the winters of 2011 and 2012 were conducted in collaboration with the



Finnish Meteorological Institute in the Lappish region of Finland, which is an example of the typical Eurasian taiga belt. There, the landscape is relatively flat or gently rolling, characterised by boreal forests, open and forested bogs, many lakes and barren hill-top sites. For the new campaign of 2013, the SnowSAR found a number of new clients, all of whom play an important role in Earth observation for hydrology, climate monitoring and cryosphere studies – namely ENVEO from Austria, Environment Canada, the University of Alaska and NASA. Consequentially, SnowSAR's field of action was broadened to include new scenarios such as the European Alps and

▲ Some of the SnowSAR missions in the last three years in the Arctic region. MetaSensing is already studying potential new missions in the Svalbard Islands in the Arctic Ocean.



# Accurate



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▲ Cessna 208 hosting the SnowSAR during acquisitions over Toolik Lake, Alaska, in 2013.

the North American Arctic region (both in Canada and in Alaska).

In the European Alps the observed scenario, while also involving snow, was different. In collaboration with ENVEO, a company specialised in Earth observation for hydrology, climate monitoring and cryosphere studies, and supported by the Austrian Federal Research Centre for Forests, Natural Hazards and Landscape (BWF), the SnowSAR was operated in the Alps close to the city of Innsbruck.

In Canada, in collaboration with Environment Canada – an important body in the development

► The Piper PA-32R Saratoga used in Finland during SnowSAR missions of 2012.



The monitored area measures approx. 80 square kilometres and it is mainly characterised by a relatively homogeneous background soil moisture and temperature. The action of wind on the varying morphology creates spatially variable Snow Water Equivalent (SWE) fields, making it an ideal

Toolik Lake, on the north slope of Alaska just a few days after the flights over the Canadian site. There, snow stays for 8-10 months each year and there is lots of wind. This combination often results in blowing snow which in turn produces barchans, snow dunes, sastrugi, large drifts and other interesting snow features to be interpreted. It is for that reason that dozens of experimental studies on the windblown flux of snow have been conducted in that area over the years. An Arctic snow campaign was planned there, involving many expertise groups in snow remote sensing (University of Alaska, Colorado State University, Bose state, CRREL, NSF, etc.), on the same days that the SnowSAR was in Canada. It was decided to merge the ongoing campaigns in order to increase the range of snow conditions covered by the two studies as well as to increase the portfolio of technologies used and the size of the ground crews, thus enhancing the ability to produce validation data. ►

## Ongoing campaigns were merged in order to increase the range of snow conditions covered

of new knowledge on the state, variability and change in the cryosphere – the SnowSAR acquired data approximately 250km north of the Arctic Circle in the Northwest Territories. The observed scenario, the Trail Valley Creek (TVC), mainly consists of a treeless open tundra watershed in proximity to the town of Inuvik and close to the Mackenzie Delta, which is Canada's largest freshwater delta.

environment for the evaluation of retrieval sensitivity. SnowSAR airborne measurements add value to data on that area, where other snow measurements and distributed hydrological modelling activities have been performed since 1995.

In Alaska, the acquisitions were performed over the tundra in the Brooks Range foothills, close to

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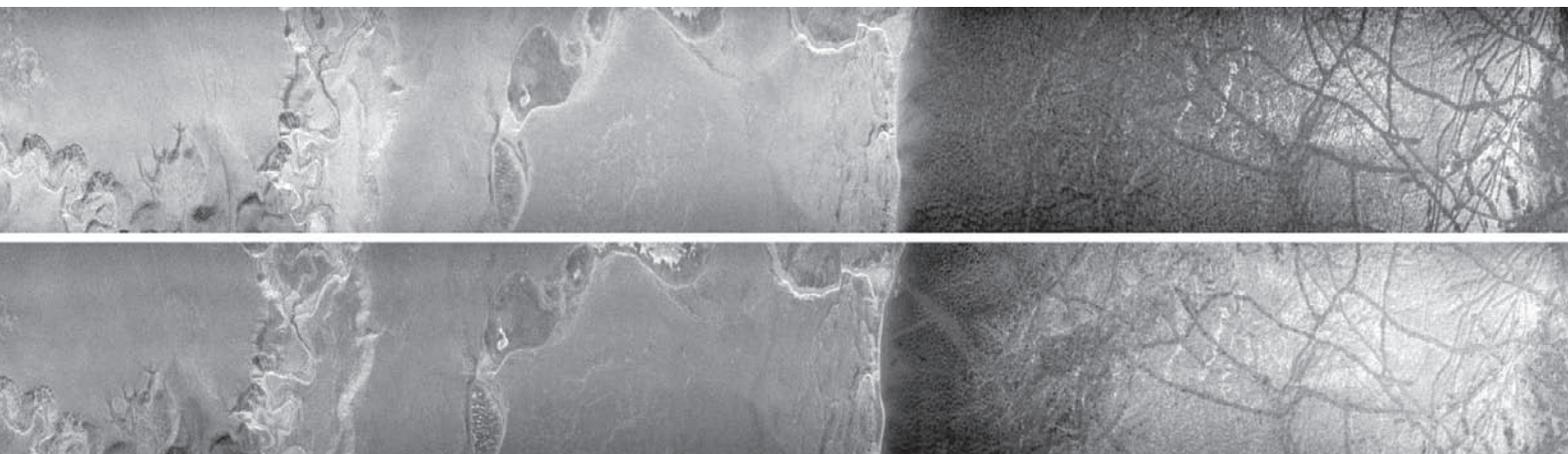
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### MEASURING SEA-ICE POTENTIAL

Although the 2011-2013 campaigns measured and monitored sea ice less than snow, by acquiring certain data MetaSensing has proved that its SnowSAR sensor can penetrate beneath the frozen surface of the sea. In Lapland, for example, the flight missions for retrieving SWE were also conducted over sea ice, namely over

## MetaSensing is currently exploring the potential for a new campaign in the Arctic Ocean

the Bay of Bothnia. The monitoring of sea ice is also significant since there are many different types and forms of sea ice in polar regions, depending on the melting stage or the amount of snow cover. To gain a complete view, it is important to capture data on all of these types.

In Canada, the flight missions were conducted over Husky Lake and the structure of the sea ice is clearly visible on the images: the ice thickness was approximately 1.5 metres, with between 20 and 40cm of snow on top. Thanks to providing images of such high quality, the SnowSAR sensor could be valuable when installed on the icebreaker ships which navigate the NSR, where the weather and ice conditions are very unstable and subject to sudden changes. Installing an ice radar sensor such as the SnowSAR

on icebreakers could help crews to identify the best passage through the ice and to navigate their way through it effectively.

### CONCLUSION

The views from the aircraft during SnowSAR acquisitions reveal both the beauty and harshness of the icy whiteness of Arctic and Alpine

landscapes. Despite working under challenging extreme-weather conditions, the system has collected a huge amount of radar data during recent winter seasons. From this data, an advanced processing phase has generated an exclusive set of SAR images on different locations on Earth.

The SnowSAR instrument has worked under various types of Arctic

and Alpine conditions, with very flexible schedules due to weather and logistics issues and with a number of different participating teams from all over the world. Despite the challenges, several missions have been successfully accomplished in Finland, Austria, Canada and Alaska. Thousands of SnowSAR snow and sea-ice images are currently being produced by MetaSensing, and these will be analysed by some of the world's most important snow research bodies.

The SnowSAR instrument, a polarimetric multiband high-resolution radar sensor, has clearly demonstrated its potential in terms of monitoring snow and sea ice. This solution can open up possibilities for new commercial applications such as affordable mapping and monitoring of routes through sea ice, especially in increasingly interesting areas like the Arctic region. In this respect, MetaSensing is currently exploring the potential for a new campaign in the Arctic Ocean, such as the Svalbard Islands. ◀

▲ Example of SnowSAR co-polar images acquired on the X and Ku band (bottom and top respectively) during the Canadian mission in March 2013. The border between snow-covered land (on the right) and ice (on the left) can be clearly seen.

### FURTHER READING

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ENABLERS FOR RESPONSIBLE GOVERNANCE OF TENURE

# Standards and Smart Systems

The Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security were officially endorsed by the Committee on World Food Security (CFS) at its 38<sup>th</sup> (Special) Session on 11 May 2012. Since then implementation has been encouraged by the G8, G20, Rio+ 20, United Nations General Assembly and Francophone Assembly of Parliamentarians. The Voluntary Guidelines represent an unprecedented international agreement on the governance of tenure, and place secure access to land, fisheries and forests firmly in the context of food security. Their CFS endorsement followed on from an inclusive, transparent consultation process started by FAO and including the participation of civil society organisations, private-sector representatives, academics, researchers and international organisations. The aim of the Guidelines is to promote food security and sustainable development by improving secure access to land, fisheries and forests and protecting the legitimate tenure rights of millions of people, many of whom are poor and food insecure.

Appropriate and transparent land administration systems are key concerns of countries wanting to implement the Voluntary Guidelines. Such systems include support for recording of rights, valuation, taxation, regulated spatial planning

and resolution of disputes; all of these topics are dealt with in the Voluntary Guidelines. Some of these systems have, as key reference points for their implementation, international standards of one kind or another, from the broad standards of the

Voluntary Guidelines themselves to ISO 19152 (Land Administration Domain Model) and to the IVSC's IVS (International Valuation Standards Council's International Valuation Standards). What these have in common is that they are all



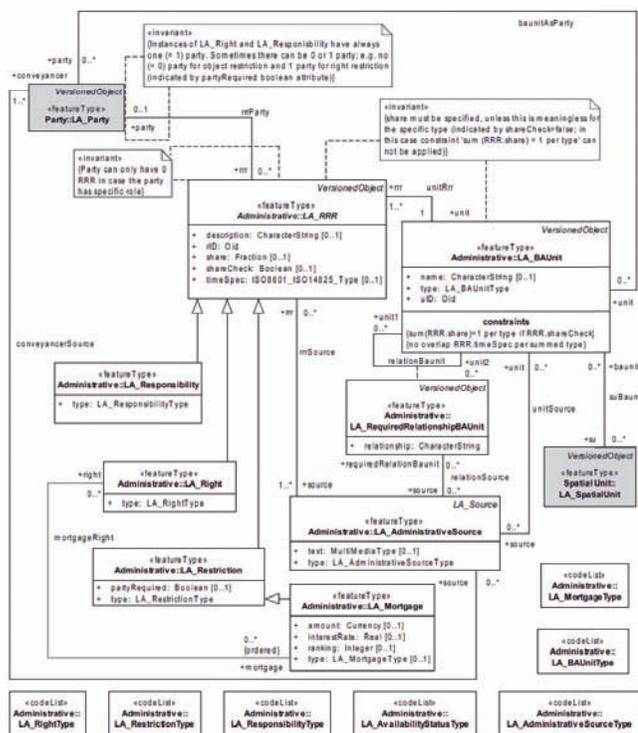
**Paul Munro Faure** is deputy director of the Climate, Energy and Tenure Division in FAO and leads the land tenure team. He holds an MA in land economy from Cambridge University, an MSc in rural planning from Reading University, and a PhD from the School of Oriental and African Studies, University of London, UK. He is visiting professor at Oxford Brookes University and at the Royal Agricultural University, UK.

✉ [paul.munrofaure@fao.org](mailto:paul.munrofaure@fao.org)



**Neil Pullar** is the SOLA Open Source Software coordinator within the FAO NRC Land Tenure team. He holds a master's degree in surveying from the University of Otago and a postgraduate diploma in social sciences – computer science from Massey University (New Zealand).

✉ [neil.pullar@fao.org](mailto:neil.pullar@fao.org)



◀ Figure 1, A subset of LADM – the ‘Administrative package’ (ISO 19152).

directly with the records of tenure rights section of the Guidelines by providing a means of recording tenure rights. SOLA also contributes to improvements in many other sections of the Guidelines dealing with the delivery of services, safeguards (with particular reference to gender equality, which is an issue also covered in several other sections of the Voluntary Guidelines), public land, fisheries and forests, indigenous peoples and other communities with customary tenure systems, informal tenure, markets, investments, land consolidation, restitution, redistributive reforms, expropriation and compensation, valuation, taxation, spatial planning, resolution of disputes, climate change and natural disasters.

founded on parcel-based and legally, geographically and temporally defined data; data that can be recorded, extracted, manipulated and used on the basis of standard data models and appropriate software.

**LADM**

The Land Administration Domain Model (LADM) – as the principal example of a standard discussed in this article – was officially accepted as international standard ISO 19152 on 6 November 2012 following a four-year consideration by the ISO TC 211 technical committee. The goals of the LADM are: (i) to facilitate a common understanding of a data model supporting core land administration functions, (ii) to support the development of land administration software applications, (iii) to facilitate cadastral data exchange, and (iv) to support data quality management in land administration. A subset of LADM is represented in Figure 1.

**SOLA OPEN SOURCE SOFTWARE**

The Solutions for Open Land Administration (SOLA) open source software project is an implementation of LADM insofar as the design of the SOLA database is based on LADM. LADM has also facilitated

the refinement of not only the SOLA database design, but also the specification of software functionality required in different countries to support good land administration and responsible governance of tenure. The endorsement of the Voluntary Guidelines came at a time when public concern about the problems of weak governance of tenure had increased. As a result, many countries are now looking at ways to improve governance of tenure. Obviously, responsible governance of tenure is more than just the introduction of computerised systems. However, once policy and legal frameworks have been overhauled, public information campaigns have increased awareness of the services provided and costs involved, work processes in agencies responsible for tenure administration have been streamlined and offices suitably refurbished, then computerised systems become a must. These systems must be affordable, sustainable and be able to support improved work processes, improved service delivery, record management and transparency (to land records and requests for services).

**VOLUNTARY GUIDELINES**

In terms of how SOLA implements the Voluntary Guidelines, it deals

**IMPLEMENTATION OF THE LADM**

It was decided to use LADM as a basis for the SOLA database design (see Figure 2) in order to profit from the considerable international domain knowledge in land administration that resulted from the prolonged discussion and consultation associated with its formulation and consideration by ISO. That has also been useful in creating a common vocabulary for the discussion of land administration concepts in the context of computerised land administration systems. The UML Class Diagram definition used in LADM needed to be ported into a Relational Model in order to implement it in the most common form of current database technologies. For each package in LADM, a schema was introduced in the SOLA database. The LADM Survey package was not ported because it was decided to use the spatial extension provided by the relational database management system (in this case PostgreSQL with the PostGIS spatial extension).

**REQUIRED LADM EXTENSIONS**

It became apparent at an early stage that the SOLA database would need further schema and data elements ▶



there are rights, right holders, qualified by conditions of use, compliance reviews, licence fees, new licences, renewal of licences, cancellation of licences and transfer of licences. All this software functionality is now included in SOLA, especially since its

most recent extension to include lease management support.

**CONCLUDING REMARKS**

As noted, SOLA – and other software applications addressing the same issues – contribute to most, if not

all, areas addressed by the Voluntary Guidelines. Not only through the recording of, provision of and ability to display information, but also by providing the potential for far greater transparency, analysis and understanding all of these different dimensions of tenure – and accordingly of monitoring and improving policy development. As the SOLA software develops into areas including state land management and mass appraisal, its potential for extending into broader support for the implementation of the Voluntary Guidelines will be progressively realised. ◀

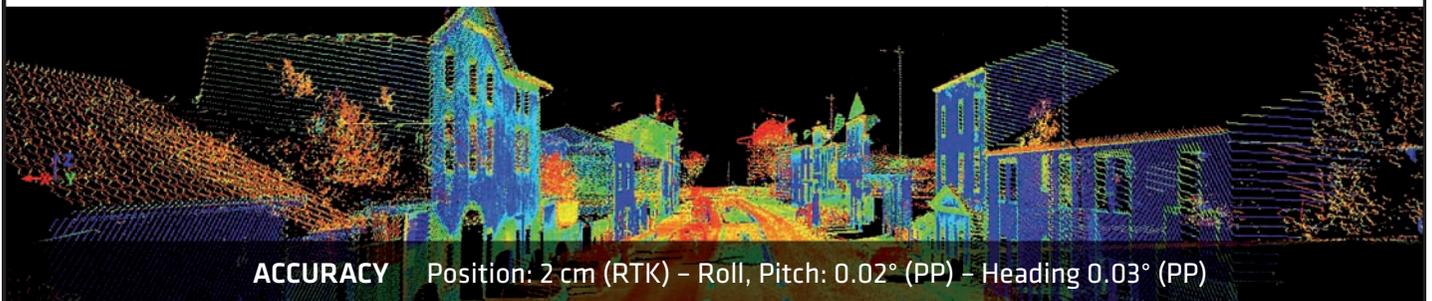
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**MORE INFORMATION**

[www.fao.org/nr/tenure/voluntary-guidelines/en/](http://www.fao.org/nr/tenure/voluntary-guidelines/en/)  
[www.flossola.org](http://www.flossola.org)

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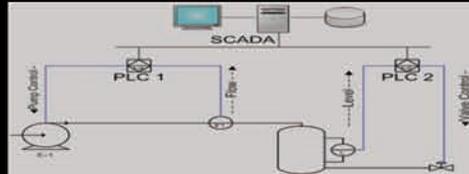


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THE POTENTIAL FOR HIGH-QUALITY AIRBORNE DATA COLLECTION

# Benchmarking Image-based DSM Generation

In view of the rapid advancement in photogrammetric technology and software for 3D reconstruction, the European Spatial Data Research Organisation (EuroSDR) initiated a benchmark project on image-based generation of Digital Surface Models (DSM). Such a comparative evaluation provides a platform for software developers to demonstrate the potential of their ongoing work. Furthermore, it can help users like national mapping and cadastral agencies responsible for state-wide generation of high-quality DSMs to understand the applicability of

such tools while triggering further developments based on their needs. The comparative results from 10 participants presented here provide comprehensive insight into the landscape of dense matching algorithms and demonstrate the current potential of image-based photogrammetric data collection.

To limit the data-processing effort required by potential participants, the test was restricted to subsets of aerial image flights. Thus, two representative datasets consisting of two aerial

image sub-blocks with different land cover and block geometry were prepared. The first dataset, Vaihingen/Enz, is representative for data usually collected during state-wide DSM generation in areas with varying land cover. It covers a semi-rural area of undulating terrain. Both ground sampling distance and image overlap are rather moderate. The sub-block selected for the benchmark consists of three strips each with 12 images, resulting in four to nine images per object point (Figure 1). The DSM had to be generated for the block



**Norbert Haala** is a professor at the Institute for Photogrammetry, University of Stuttgart, where he is responsible for research and teaching in photogrammetric computer vision and

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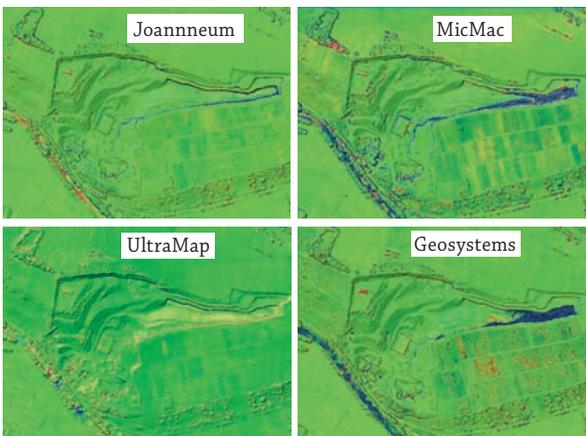
◀ Figure 1, Vaihingen/Enz block, ortho photo, GSD is 20cm.



▶ Figure 2, Perspective of the reconstructed Munich dataset, GSD is 10cm.



▲ Figure 3, Ortho (left) and median DSM with RMS differences (right) for all solutions for a Vaihingen/Enz sub-section.



▲ Figure 4, Exemplary DSM differences Vaihingen/Enz, colour-coded between -2m and +2m.

had to use the orientation parameters made available for the image blocks without modification. No 3D point clouds were taken into account, the evaluation was limited to a DSM raster in predefined size and resolution. The project was initiated in February 2013, and participants were given until May 2013 to submit their results. As a first review, these were then presented and discussed during the 2<sup>nd</sup> EuroSDR workshop on 'High Density Image Matching for DSM Computation' which was held at the Federal Office of Surveying and Metrology in Vienna, Austria, in June 2013. Software systems presented at the workshop were SocetSet 5.6 (NGATE) from BAE Systems, Microsoft's UltraMap V3.1, Match-T DSM 5.5 from Trimble/inpho, ImageStation ISAE-Ext from GeoSystems, Pixel Factory from Astrium, the DSM Tool from the Royal Military Academy (RMA) of Brussels, the remote sensing software package from Joanneum Research, MicMac developed at IGN, SURE from the Institute for Photogrammetry (IfP), University of Stuttgart and the FPGA implementation of the SGM algorithm from the German Aerospace Center (DLR).

centre measuring 7.5km x 3km. Its pre-defined grid width of 0.2m corresponds to the ground sampling distance (GSD) of the aerial imagery used. The second test dataset is more typical for applications in densely built-up urban areas, where images are usually captured at a higher overlap and resolution. The Munich dataset covers the central part of the city and was captured at a GSD of 10cm with 80% in flight and 80% cross flight overlap. This results in up to 15 folded object points and thus a considerable redundancy. The image sub-block to be processed consists of three image strips each with five images. The area to be processed measures 1.5km x 1.7km (Figure 2).

#### EASY-TO-USE TEST PROCEDURE

To enable a larger number of participants from varying backgrounds, the test was designed to be simple to implement while providing a basis for generating comparable datasets. All participants

respect to this median is overlaid additionally. As it is also visible from the corresponding ortho image in Figure 3 (right), larger differences occur in the shaded area of the quarry, in the river area, in the vicinity of patches of trees and in the area of the vineyards.

Figure 4 shows separate DSM differences for a number of single solutions. These differences between -2m and +2m are colour-coded differently than the RMS differences in Figure 3. For a quantitative analysis, elevation profiles were additionally extracted. These lines are overlaid on the ortho image in Figure 3 (left). The elevation profiles for line 0 are depicted in Figure 5. While all elevations are very similar for the well-illuminated area of the quarry, there are larger differences for some solutions in the area subject to shadow. For object surfaces not subject to image-matching problems, differences between almost all solutions are in the order of 20cm, i.e. in this case equal to the GSD.

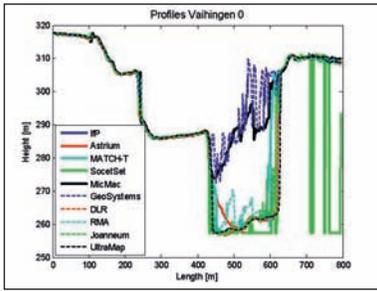
Similarly, results for the test area Munich are presented in Figure 6. Differences between the respective solutions are mainly visible in small details and steep edges which occur close to buildings. Furthermore, shadows seem to result in larger differences and increased noise for the reconstructed surfaces.

Elevations for the exemplary profile 0, which is also overlaid on the ortho image of Figure 6, are depicted Figure 7. The first part of the profile is on the ground which is covered by a cast shadow. Especially in this area some solutions appear relatively noisy, and relatively large differences for another solution occur at the step edge defined by the façade. A closer view of the profile at two dormers is given in Figure 7 (right). As it is visible all solutions follow the shape of these structures

#### EVALUATION OF DSM QUALITY

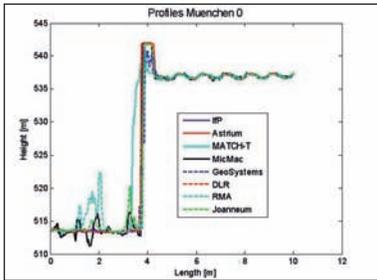
Since it is difficult to retrieve high-quality reference surfaces from independent measurements, the participants' results were used to generate a median DSM for evaluation purposes. While this median cannot be regarded as independent ground truth, differences between the respective solutions can nevertheless be captured.

Figure 3 shows an ortho image of a subset and a shaded relief representation of this median DSM for a part of the Vaihingen/Enz test area. A colour-coded representation of the root mean square (RMS) differences of all DSMs with

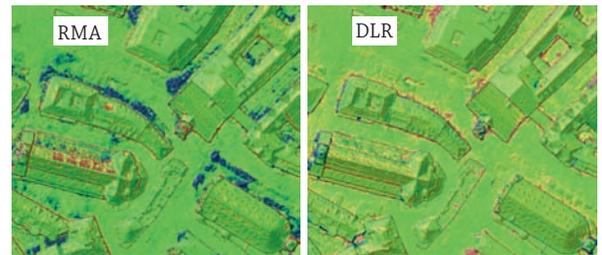
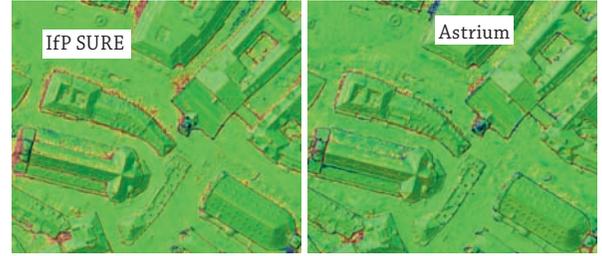
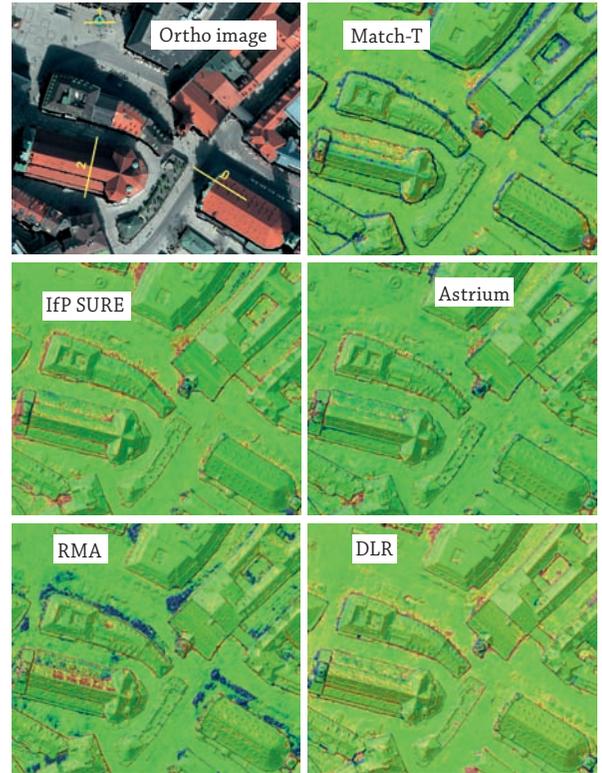
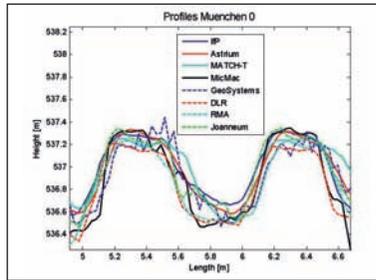


◀ Figure 5, DSM profiles Vaihingen/Enz.

▶ Figure 6, DSM differences to median surface Munich, colour-coded between -2m +2m.



▲ Figure 7, DSM profiles Munich. +2m.



correctly, while the difference is in the order of 10cm, which again is equal to the GSD of that dataset.

**RUN-TIME**

In addition to the geometric DSM quality, the quality of a software solution also depends on the computational efficiency and the processing time required. This is not only influenced by the implemented algorithm, but of course also results from the hardware environment used. Due to the considerable amount of reading and writing operations, data ingest, which depends on the available storage system and network environment, is another factor of influence. Therefore, participants were asked to provide information on their hardware environment, processing strategy and time effort for processing the benchmark data. The hardware environments varied from standard desktop PCs with single, multi-core or multiple high-end graphics cards to the application of larger computer clusters. Therefore the documented processing times do not allow for a clear ranking but rather demonstrate the general capacity of image-matching algorithms for area-covering DSM collection. Generally speaking, acceptable run-times were reached for a number of software systems even if a standard hardware environment was used. Thus, processing for the Munich dataset with 15 images at 220MP/image and Vaihingen/Enz with 36 images and 136MP/image could be realised in about 4 hours.

**CONCLUSION**

Even though stereo-matching for the automatic generation of elevation data from aerial images was originally introduced more than two decades ago, considerable progress has been made only recently. State-of-the-art digital airborne cameras provide imagery of good dynamic and signal-to-noise ratio. Furthermore, approaches like semi-global matching (SGM) allow for the efficient implementation of additional constraints, e.g. the preferences of smooth surfaces. These developments enable a per-pixel elevation estimation, even for difficult scenarios like low-texture areas.

The EuroSDR benchmark project shows that a growing number of software tools for detailed and reliable image-based DSM generation are available. Processing not only benefits from improved algorithms but also takes advantage of large image overlaps in order to efficiently eliminate erroneous matches. This provides a considerable reliability

of DSM at vertical accuracy close to the sub-pixel level. However, some scenarios can still cause problems during image-based surface reconstruction. A few solutions showed decreasing accuracies when shadows were cast. Differences between the respective results also increased for fine object structures close to the resolution of the available images.

Current software development for image matching is advancing at a considerable pace. Thus, the major aim is not to rank the systems, but rather to demonstrate their capacity for area-covering quality data collection. Furthermore, continuous improvements can be expected, both for matching accuracy and computational performance. Thus the benchmark project will be continued for future updates. ◀

**FURTHER READING**

- EuroSDR (2013): <http://www.ifp.uni-stuttgart.de/euroedr/ImageMatching/> Web page of the EuroSDR 'Benchmark on Image Matching' project.
- Fritsch, D., Pfeifer, N. & Franzen, M. (Eds.) (2013): Proceedings of the 2<sup>nd</sup> EuroSDR workshop on High Density Image Matching for DSM Computation. EuroSDR Publication Series, No. 63. See also <http://geo.tuwien.ac.at/news/2nd-workshop-on-high-density-image-matching-for-dsm-computation-successfully-completed-2013-06-19/>
- Haala, N. (2013): The Landscape of Dense Image Matching Algorithms, *Photogrammetric Week 2013*, Wichmann Verlag, pp. 271-284.

# Changing Times – Time for Change

SatLab Geosolution is a Swedish satellite positioning solution company with its headquarters in Gothenburg on the west coast of Sweden. The company was founded by a group of passionate and pioneering engineers who between them have more than 40 years of experience in the geospatial and GNSS industry. SatLab Geosolution engineers are keenly aware of the missing technical and administrative features of the products that are currently available on the market. Thanks to this awareness, all of the company's products reflect the high standards requested by the surveying community.

The idea of creating a new GNSS surveying receiver company came about around the end of 2009. The basic idea was to have design and development in Sweden and production in Asia. In early 2010, initial steps were taken to find a suitable ODM partner for the production, and a production agreement was signed in March 2010. In July of that year, SatLab Turkey was founded, based in Ankara. The company's first product, the iSurvey SL500, a survey-grade 'on the pole' solution was subsequently officially launched at Intergeo 2010 in Nuremberg, Germany. At around the same time, SatLab s.r.o was also founded in Jicin, Czech Republic.

The company strategy was to establish wholly owned companies in parts of Europe where there were

investments in infrastructure and, from these regional companies, to manage a network of distributors in surrounding countries. The strategy also included development of a GNSS receiver brand with a Swedish identity, product quality and customer service/support but in a price range suitable for the regions.

## NEW GROUP OF CUSTOMERS

Nowadays, 'on the pole' GNSS RTK equipment is a commodity. RTK is not what it used to be; it was a 'heavy nightmare' with cables, radio modems and batteries, not to mention the necessity of having your own base station – which meant it had a sizable price tag too! Reliability was not that good either, calling for an extensive service and support organisation if you were to stay in business. In today's world, most countries have CORS networks which makes the surveyor's life so much easier. Also, modern RTK systems have virtually no cables at all and, thanks to modern lithium batteries, the equipment stays powered up for the whole day. This ease of use and also a significant price

drop on these systems is attracting a new group of customers: businesses like landscaping companies, architects, disaster rescue teams, fire fighting and police organisations will increasingly start using this technology in their daily work.

## CHINESE MARKET

With Chinese manufacturers arriving on the scene, a different situation is set to evolve in the GNSS surveying equipment marketplace. So far, Chinese manufacturers have been relying on Western technology for the signal-receiving and processing aspects of their products but, in view of their own Beidou satellite system, they will soon start to integrate domestically developed core technology. The current domestic market for 'on the pole' GNSS surveying systems in China is approximately 40,000 systems/year. With quantities of this magnitude, the price point of the systems is completely different to what is experienced in the US or in some European countries. So far, there has been some reluctance among the



Every month *GIM International* invites a company to introduce itself in these pages. The resulting article, entitled Company's View, is subject to the usual copy editing procedures, but the publisher takes no responsibility for the content and the views expressed are not necessarily those of the magazine.



▲ SatLab's French distributor ITS Ecartip giving product training in Gabon.



▲ SatLab management team joins together at Intergeo 2012 in Hanover, Germany.

professional surveying community to buy high-tech surveying products from China. The main reasons have been issues like service and support, doubts about product quality and the availability of spare parts, badly written manuals and suchlike.

**SWEDISH IDENTITY**

SatLab Geosolution is addressing all these issues by having a range of GNSS products with a Swedish identity, guaranteeing product quality and an industry-standard service and support organisation at a price point very much appreciated by customers. The company has also decided to use only one supplier of field software for all products, since that makes it much easier to support the end user. One could argue that this is a limitation of sorts, but the advantages far outweigh the disadvantages.

**GROWTH AND INVESTMENT**

The company has enjoyed tremendous growth over the past three years. Today, there are 17 active distributors, primarily in Eastern European countries, selling SatLab products.



▲ SatLab 2014 product news was presented at Intergeo 2013 in Essen, Germany.

During 2014, the organisation will be incorporating SatLab LLC in the USA, which is another key target market. Future growth will not only come from operations but also from launching new products and solutions. The company will soon be launching a brand new survey-grade GNSS system capable of tracking all available satellite systems to be used in surveying and machine control systems. Moreover, SatLab

Geosolution AB has recently invested in developing a 3D laser scanning system together with its Chinese ODM partner as well as Wuhan University in China. The first product is expected to be available towards the end of 2014. As the company itself says: 'Changing times – time for change'. ◀

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[www.satlabgps.com](http://www.satlabgps.com)

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- ◇ Intelligent fault diagnosis and audio reminder function;
- ◇ Built-in transmitting-receiving UHF radio, 3G/GPRS, Bluetooth;
- ◇ Internal NANDFLASH and Micro SD card, and support external U-drive;
- ◇ Standardized design, exchangeable base and rover.

## K8 (GIS data collector/ GNSS handheld/ RTK controller)

- ◇ 50-channels, with built-in high sensitive and anti-jamming GNSS antenna, compatible with Compass;
- ◇ 3.7 inches professional sunlight-readable color touch screen;
- ◇ Standard large capability Li-ion battery;
- ◇ Support GPRS/3G, Bluetooth, WiFi, UART, Large memory extension ---- USB, Micro SD card.

## N8 (High precision mobile GIS platform/ industrial pad/ RTK controller)

- ◇ 8.4 inches professional sunlight-readable color touch screen;
- ◇ Applying surveying GNSS motherboard and antenna, support Compass;
- ◇ Win7 OS, support all popular software;
- ◇ Industrial design, IP65 standard;
- ◇ Support 3G, Bluetooth, WiFi;
- ◇ Built-in air pressure sensor, electronic compass, temperature and humidity sensor, gyroscope, high definition camera.

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## Meeting of Global Land Tool Network Partners

FIG is one of the partners in the UN-HABITAT Global Land Tool Network (GLTN). A GLTN partner meeting was held in The Hague, The Netherlands, from 11-14 November 2013.

GLTN was inaugurated in 2006. It is a coalition of 60 global land partners and includes rural and urban civil society organisations, research and capacity development institutions, NGOs, UN agencies, professional associations, and development partners. Areas of work are development and implementation of land tools, frameworks and approaches; capacity development; and knowledge management, advocacy and communication.

70% of the developing country population is outside formal land register. Worldwide there is increasing insecurity of tenure: it is estimated by FIG that only 1.5 billion out of 6 billion rights are registered. Conventional land administration approaches are too expensive and cannot go to scale. Pro-poor approaches are needed to secure land rights for all. GLTN wants to provide appropriate land tools, frameworks and approaches that enable the implementation of pro-poor and gender-sensitive land policies and land reforms at scale.

The accomplishments of 'Phase 1' (2006-2011) are as follows:

- Knowledge management: improved global knowledge to support the realisation of equitable land rights
- Advocacy: increased awareness of, and commitment to, equitable land rights
- Tool development and capacity building: strengthened capacity to enhance quality of land governance, management and

Area of work	Tools/frameworks/approaches/crosscutting
Access to land and tenure security	Family and group rights, land record management, deeds and titles, continuum of land rights, co-management approaches, participatory enumeration, socially appropriate adjudication, statutory and customary;
Land administration and information	Spatial units (STDM), modernising of land agencies budget approaches;
Land-based financing	Land value sharing;
Land Management and planning	Land readjustment, city wide slum upgrading, land use planning, city wide planning, regional land use planning;
Land policy and legislation	Expropriation, eviction and compensation, legal allocation of the assets of a deceased person, regulatory framework for the private sector;
Crosscutting	Land governance, capacity development, gender, youth, grassroots, post disaster / post conflict, indicators, land in the Muslim world, environment, human rights;
Approaches	Pro-poor land policy development and land donor coordination.

#### GLTN areas of work.

administration through pro-poor gendered land tools and training activities

- GLTN institutional capacity: strengthened GLTN institutional capacity to carry out equitable land rights.

A GLTN 'Phase 2' was initiated in 2012 and must be accomplished by 2018 with the following expected outcomes:

- Strengthened policy frameworks, tools and approaches to deliver security of tenure at scale
- Improved global knowledge and awareness
- Strengthened capacity of partners, land actors and targeted countries and/or cities/municipalities through key implementation strategies.

The realisation of 'Phase 2' was the focus of the event in The Hague. The network is growing, and new partners were welcomed into the network. Key advances, challenges and opportunities were identified and discussed and country-level engagement opportunities and joint

initiatives were identified and explored.

The core of the strategy and interventions at country level would be through value addition and working through, and with, partners. Main areas of interventions at country level are: knowledge and awareness building, land policy reform, donor co-ordination, capacity development, and tool development and implementation.

GLTN will work with a variety of stakeholders, including national, local and municipal governments, development partners, civil society, grassroots organisations and other non-state actors, to catalyse and add value to existing processes.

FIG is an active partner in the network and was well represented during the partner meeting. ◀

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## SDI in Africa: Reflections following GSDI 14

The GSDI 14/AfricaGIS 2013/Global Geospatial Conference has come and gone. With leading keynote speakers, an excellent technical programme, a vibrant exhibit hall and over 500 participants from 60 countries, it has already been recognised as one of the largest geospatial conferences held in Sub-Saharan Africa over the past two decades. Special thanks again to our sponsors, our speakers, workshop hosts, local organising committee members, the very capable UNECA staff, the volunteers and all the delegates that made the event such a success.

I was especially struck by three things I saw and heard at the event in Addis Ababa, and I believe they will contribute to spatial data infrastructure efforts developing differently in that part of the world:

- The people: I was so impressed with the number of presentations by, and discussions held with, emerging young geospatial professionals based in various African private companies, government departments and NGOs. Their calibre was top notch and their enthusiasm unmatched. They have high expectations, less patience than their predecessors, and a critical mass of them are prepared to help make things happen.
- The institutions: we received so much direct and indirect support from national geospatial data organisations across Africa (and special thanks to the Ethiopian Mapping Agency and its staff). They are working very hard with limited budgets and have much still to do. Like their counterparts in more developed countries, they are trying to simultaneously cultivate increasing demand for



*GSDI council members.*

geospatial data, adjust to competition from new data suppliers (government, industry and volunteers) and update decades-old attitudes and practices in order to address the expectations of a new, better-informed and better-equipped generation of end users. Not an easy job.

- The absolute reliance on a different paradigm for communication: early applications of SDI efforts in more developed countries were planned and built with 'in-ground' wire or fibre-based communications in mind. That will not work in Africa, where mobile telephone infrastructure predominates and a very different set of location-based services will define what people expect from – and how they interact with – their mainstream spatial data infrastructures. Politicians have to make choices, and this may place real funding pressure on more 'traditional', government-related SDI activities and products. In addition, this introduces to the

mix the values and priorities of other vitally important institutions: the telecom companies.

As is true everywhere, economic, social and in some cases security pressures facing African nations right now will influence both the choice and the 'look & feel' of SDI services and how fast they continue to roll out in each country. There is a striking need for informed, pragmatic leadership in moving SDI forward in Africa, and the risks are high. But, having said that, what an opportunity and what an inspiring group of players to watch! ◀

*Dr David Coleman is president of the GSDI Association, a professor of geomatics engineering and dean of the Faculty of Engineering at the University of New Brunswick in Canada.*

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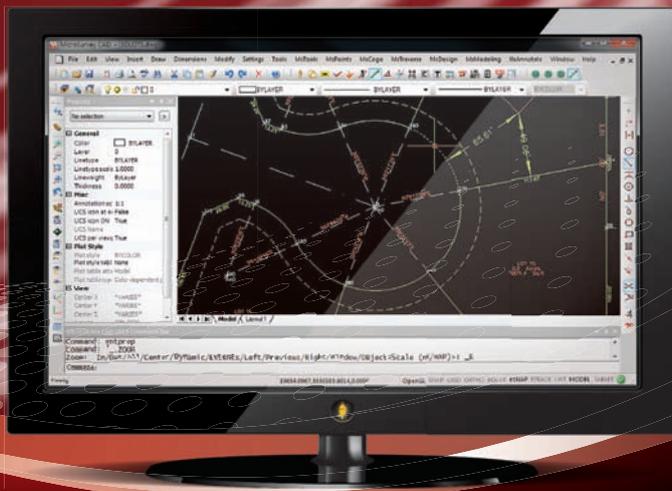
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Since the predecessor of the IAG, the 'Mitteleuropäische Gradmessung', was established back in 1862, IAG celebrated its 150<sup>th</sup> anniversary in 2012. Celebrations climaxed in September 2013 at the IAG Scientific Assembly in Potsdam, Germany. This location is particularly significant since the first ever meeting, in April 1862, was organised by General Baeyer, as representative of the Kingdom of Prussia, in Berlin. The participants were several geodesists from the Kingdom of Saxony and the Austrian-Hungarian Empire.

## 2<sup>nd</sup> Joint FIG/IAG/ISPRS International Symposium on Deformation Monitoring

For many years, FIG (Commission 6 Engineering Surveys) and IAG (Commission 4 Positioning & Applications) have run joint symposia in the field of structural monitoring. This is unsurprising as geodesy has always provided the reference datum methodology and the precise positioning techniques for deformation monitoring. Many geodesists with an affinity with engineering have therefore been interested in, and have contributed to, structural monitoring activities. The 2<sup>nd</sup> Joint International Symposium on Deformation Monitoring (JISDM) also attracted new sponsorship from another geospatial association, the International Society for Photogrammetry & Remote Sensing (ISPRS).

JISDM was held on the picturesque campus of the University of Nottingham, UK, from 9 to 10 September 2013. Around 200 people from 26 countries attended the conference. Leica Geosystems (UK) as Platinum sponsor was joined by five Gold sponsors (TOPRS, Hi-Target, China Railway Major Bridge Reconnaissance & Design Institute, China University of Mining & Technology, and Global Satellite Navigation Technology). 10 organisations and companies showed off their latest deformation monitoring solutions at the associated exhibition.

There were four keynote speeches in the opening ceremony. Professor Chris Rizos, president of IAG, gave a talk on 'Engineering Geodesy: Its Links to Modern Geodetic Practice'; Professor Andreas Weiser from ETH Zurich presented 'From Spatially



Some of the participants on the Forth Road Bridge excursion.

Discrete to Areal Deformation Analysis: Methodical and Instrumental Challenges in Terrestrial Geomonitoring'; Mr Barry Colford, Bridgmaster of the Forth Road Bridge, discussed 'The Maintenance of Long Span Bridges'; and Dr Xiaolin Meng, as JISDM organiser, introduced the topic 'GeoSHM: GNSS and EO for Structural Health Monitoring of Bridges'. In the closing ceremony, JISDM Platinum sponsor Leica presented its monitoring work and experience on Europe's largest infrastructure project: Crossrail at Paddington, London.

JISDM 2013 had received 180 paper abstracts, with 80 papers selected as oral presentations in 20 parallel sessions, and 30 paper abstracts were presented as posters. The Chartered Institution of Civil Engineering Surveyors and the Sino-UK Geospatial Engineering Centre at the University of Nottingham jointly awarded six student paper prizes. The conference welcome dinner was held at Colwick Hall, the ancestral home of Lord Byron. Professor Chris Rudd, pro-vice-chancellor of the University of Nottingham, accompanied by other senior colleagues from the university, gave a very warm

welcome speech to the JISDM delegates.

After the conference, a technical tour was arranged for 38 people to the Forth Road Bridge, Scotland, on 11 and 12 September. The current Forth Road Bridge was the longest suspension bridge outside the USA when it was opened in 1964. The Forth Bridge, a railway bridge adjacent to the road bridge, was the first major structure in Britain to be constructed of steel when it opened in 1890. Technical staff guided the JISDM delegates around the maintenance facilities and described their current and future difficulties in bridge management. A visit to the Forth Bridge and the new Forth Road Bridge (named the 'Queensferry Crossing') site was included.

Conference peer-reviewed papers will be published as special issues of five journals: *Journal of Navigation*, *Survey Review*, *Journal of Applied Geodesy*, *Applied Geomatics*, and *ICE Forensic Engineering*. ◀

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## Looking Back on ICC 2013

The organisers of the International Cartographic Conference (ICC) 2013, held in Germany during late August, did a great job. The biennial ICCs, presented by ICA but organised locally, are hosted around the globe, and it would be difficult to find a more comfortable and efficient location than the congress centre on the banks of the River Elbe in Dresden.

The content of the conference was, as usual, a stimulating mix of presented research, opinion, description and prediction in our broad-ranging discipline. The scope of the presentations was enormous: there were well over 100 sessions with intriguing titles: 'Mapping emotions', 'Rock depiction and relief representation', 'Ontologies and standards in SDI', 'Hydrological extreme events', 'Historical surveying and mapping', 'Map perception', etc. Some of ICA's new Commissions, approved at the last General Assembly, had a notable impact on the programme. Hence, 'map design' was a prominent theme, as was 'web services-oriented geobusiness'. Other new Commissions promoted sessions on their topics in areas such as 'Cognitive visualisation', 'Art and cartography', 'Data quality', 'Open source geospatial technologies', 'Neocartography', 'GI for sustainability', and 'Cartography in early warning and crisis management.'

In addition, ICCs feature general sessions designed to inform, intrigue and enthuse the delegates. The speakers chosen for the opening ceremony, along with the plenary speakers who started each day of the conference, did just that. Starting with the Interior Minister of



*Students from the international masters in cartography course met the Conference chairman and the ICA president at the Dresden ICC.*

Saxony in the opening ceremony, the conference was able to detect what the outside world thinks of, needs from and can contribute to cartography. From Jack Dangermond's vision of how maps can tell stories to address serious global challenges, through Eric Loubier's masterful overview of the role of interoperability for effective map data handling, to Chris Board's highly personal account of a career which helped mould the current shape of ICA and cartographic research, all seven keynote speakers had valuable messages to convey.

Further aspects of the Dresden ICC which contributed to its success included the spacious and well-planned technical and map exhibition displays, a vibrant poster exhibition, the Young Scientists' sessions, and the Children's Map competition. The awarding of prizes to outstanding map products is a highlight of any ICC, and this year the standard of cartography remained very high. Awards were also presented to individual cartographers of distinction, and to

student travel-bursary winners.

The hosts of the ICC, from the students working as support staff to the Conference president, were cheerful, enthusiastic and above all helpful, ensuring that each one of the 1,400 delegates was made welcome and able to extract maximum benefit from their visit. The lasting memory of Dresden ICC 2013 will be the sheer breadth of cartographic activity, research and curiosity, reflected in a stimulating programme, demonstrating the scope and skill of cartographers from all over the world. The ICA president, in his opening address, encouraged us all by saying, "It's OK to be a cartographer"; by the end of the conference, we all acknowledged that it is not only OK, but also an undoubted privilege and an exciting challenge to be a cartographer. ◀

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## ISPRS Technical Commission V Symposium



*The ISPRS Technical Commission V is dealing with numerous technologies and applications.*

The ISPRS Technical Commission V is dealing with close-range imaging and ranging sensors as well as applications in the field of industrial metrology, cultural heritage, architecture, biomedical and geosciences. Commission V is investigating consumer-grade and professional cameras and active sensors such as terrestrial laser scanners, range cameras, gaming or stripe projection sensors, that are combined and used for 3D representations and analyses of static and dynamic objects or scenes. Systems and algorithms for real-time 3D imaging, mobile mapping applications and 3D modelling issues are also being developed.

The ISPRS Technical Commission V Symposium will take place in Riva del Garda (Italy) on 23-25 June 2014. The Symposium will feature three days of plenary and parallel sessions with speakers invited from research and commercial domains. An exhibition will present the most important business players in the close-range domain.

The main topics of the Symposium are:

- Vision metrology and industrial applications
- Cultural heritage data acquisition and processing
- Terrestrial 3D imaging and sensors
- Algorithms and methods for terrestrial 3D modelling
- Mobile mapping and unmanned vehicle systems for 3D surveying and mapping.

The ISPRS Technical Commission V Symposium will provide ample opportunities for scientific exchange and discussion. All submitted papers will be handled electronically according to two types of submissions: (1) full papers undergoing a double-blind peer-review process, and (2) extended abstracts undergoing a review process. Important dates to note for the Symposium are:

- Full paper or extended abstract submission: 7 March 2014
- Notifications to the authors: 25 April 2014

- Final paper submission: 12 May 2014

The ISPRS Technical Commission V Symposium is being organised in collaboration with the Bruno Kessler Foundation, ARIDA (Association for Real-time Imaging and Dynamic Analysis) and SIFET (Italian Society of Photogrammetry and Remote Sensing). ◀

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[www.isprs.org](http://www.isprs.org)

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## Future events

► **DECEMBER**

**AGSE 2013 International Conference**  
Ahmedabad, India  
from **16-19 December**  
For more information:  
E: agse2013@cept.ac.in  
W: www.agse2013-cept.in



**ISPRS workshop on  
'Innovative learning tools'**  
Ahmedabad, India  
from **20-21 December**  
For more information:  
E: isprs2013@cept.ac.in  
W: www.isprs.org

### 2014

► **FEBRUARY**

**Oldenburger 3D Tage**  
Oldenburg, Germany  
from **12-13 February**  
For more information:  
E: christina.mueller@jade-hs.de  
W: http://bit.ly/182z8m0

**EuroCOW**

Castelldefels, Spain  
from **12-14 February**  
For more information:  
W: www.eurocow.org

**International LiDAR Mapping Forum**

Denver, CO, USA  
from **17-19 February**  
For more information:  
E: lcorkhill@divcom.com  
W: www.lidarmap.org/international

► **APRIL**

**AAG Annual Meeting 2014**  
Tampa, FL, USA  
from **8-12 April**  
For more information:  
W: www.aag.org/annualmeeting

**ENC-GNSS 2014**

Rotterdam, The Netherlands  
from **14-17 April**  
For more information:  
W: www.enc-gnss2014.com

**Interexpo GEO-SIBERIA-2014**

Novosibirsk, Russia  
from **16-18 April**  
For more information:  
E: argina.novitskaya@gmail.com  
W: http://expo-geo.ru/event/27\_Interexpo-GEO-Siberia-2013

**Intergeo Eurasia 2014**

Istanbul, Turkey  
from **28-29 April**  
For more information:  
E: ofreier@hinte-messe.de  
W: www.intergeo-eurasia.com

► **MAY**

**Geospatial World Forum 2014**  
Geneva, Switzerland  
from **05-09 May**  
For more information:  
E: info@geospatialworldforum.org  
W: www.geospatialworldforum.org

**Esri Africa User Conference 2014**

Cape Town, South Africa  
from **06-08 May**  
For more information:  
E: auc@esri.com  
W: www.esri.com/events/auc

**MundoGEO#Connect Latin**

**America 2014**  
Sao Paulo, Brazil  
from **07-09 May**  
For more information:  
E: connect@mundogeo.com  
W: http://mundogeoconnect.com/2014/en

**GEOBIA 2014**

Thessaloniki, Greece  
from **21-23 May**  
For more information:  
E: igitas@for.auth.gr  
W: geobia2014.web.auth.gr

**GEO Business Show 2014**

London, UK  
from **28-29 May**  
For more information:  
E: info@geobusinessshow.com  
W: http://geobusinessshow.com

► **JUNE**

**GEO Summit 2014**  
Bern, Switzerland  
from **03-05 June**  
For more information:  
E: dkatzer@geosummit.ch  
W: www.geosummit.ch/de/index.html

**5th International Conference on Cartography & GIS**

Riviera, Bulgaria  
from **15-21 June**  
For more information:  
E: bgcartography@gmail.com  
W: http://iccgis2014.cartography-gis.com/home.html



**XXV FIG International Congress 2014**

Kuala Lumpur, Malaysia  
from **16-21 June**  
For more information:  
E: fig@fig.net  
W: www.fig.net/fig2014

**AfricaGEO 2014**

Cape Town, South Africa  
from **01-03 July**  
For more information:  
E: aparker@ruraldevelopment.gov.za  
W: www.africageo.org

► **OCTOBER**

**Intergeo 2014**  
Berlin, Germany  
from **07-09 October**  
For more information:  
E: dkatzer@hinte-messe.de  
W: www.intergeo.de

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