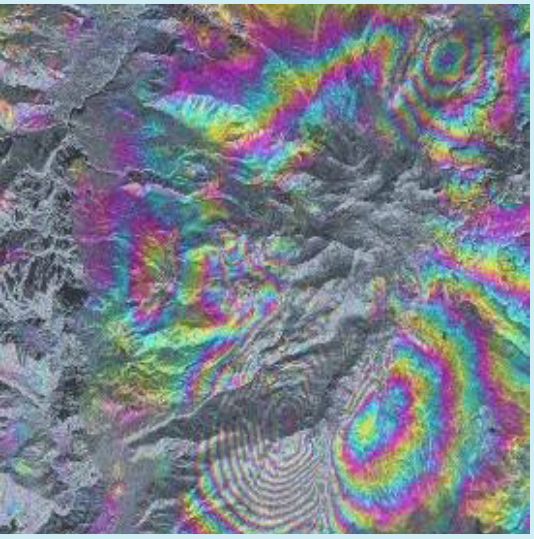
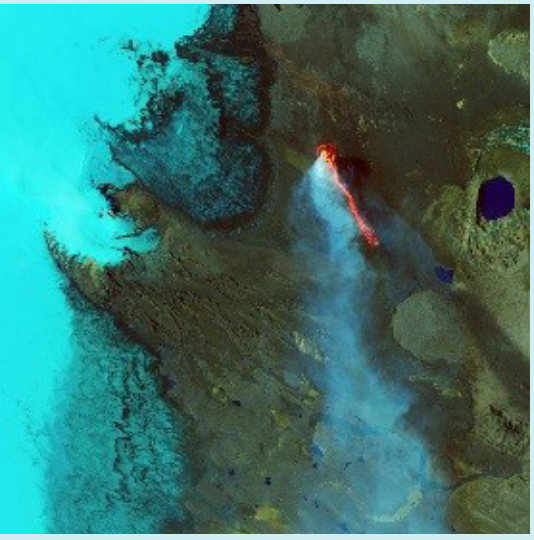
GRSG Geological Remote Sensing Group

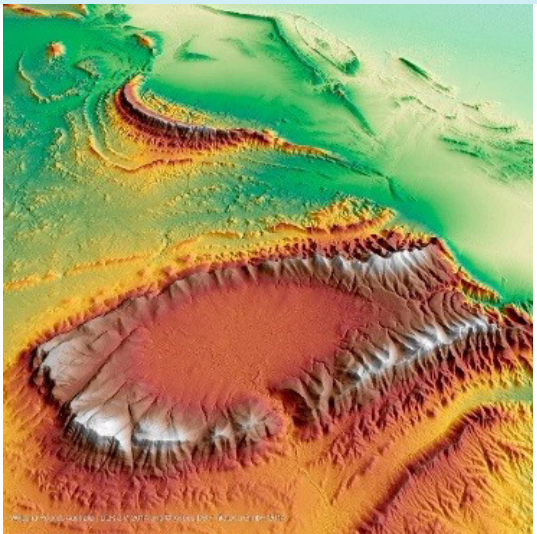


CONFERENCE 2016 ABSTRACT BOOK

The Future of Geological Remote Sensing

Innovation and Challenges





7th to 9th December 2016

Arup, 8 Fitzroy Street, London

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Conference WiFi:

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The Geological Remote Sensing Group (GRSG) is a Special Interest Group affiliated jointly with The Geological Society of London and the Remote Sensing and Photogrammetry Society. It was founded in 1989 to raise awareness and encourage the use of remote sensing technologies in the geoscientific and related communities. The GRSG seeks to represent the views of industry, government and academic individuals and organisations - resulting in a balanced scientific, technological and commercial viewpoint.

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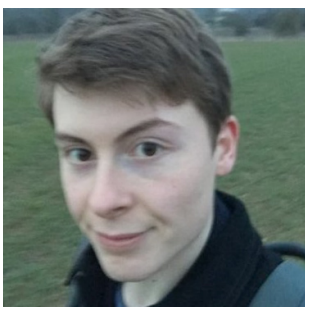

Hummingbird Technologies

Imperial College Incubator, South Kensington

London

Email: barnaby_gordon@yahoo.com

WELCOME FROM THE GRSG

Luke Bateson

Chairman, GRSG

Dear meeting participants,

On behalf of the organising committee of the Geological Remote Sensing Group I welcome you to our 27th annual meeting! The theme for the conference is "Future of Geological Remote Sensing: Innovation and Challenges".

We are extremely grateful for the support offered to the GRSG by ARUP in providing such a fantastic conference venue in the heart of London. We do our best to remove as many barriers for the attendance of this conference and having the use of such a suburb venue is key in making it an affordable conference to attend. In the same vein, the networking opportunities provided by the coffee and lunch breaks and during the evening social events are key to many peoples continued involvement in the GRSG. We would not be able to hold these without the support from our sponsors so I would also like to also thank all the sponsors (see page 6). Please show your appreciation by visiting their exhibition stands and saying hello (they are all very nice people).

Once again we have a great programme with a wide range of interesting talks and posters on almost all aspects of geological remote sensing. With this year's conference being held in the ARUP building in London we have particularly strong focus on engineering applications on the first day; including the use of EO techniques to monitor geohazards and large infrastructure projects. We will also look at new developments in EO relevant technologies. On the second and third days we have some very interesting sessions on mineral exploration, geological mapping, oil and gas and mining – hopefully something for everyone.

Sadly this will be my last conference as the Chairman and as a committee member, I have been on the committee for 8 years (which is probably too long) and it has really been a fantastic experience. It is a great place to meet people from the industry and make some genuine friends; due to this the committee meetings and conference are events that I really look forwards to. The committee needs some new members so if you would like to be involved in something that is really good fun, will mean that you meet lots of new people and increase your profile then please come and find one of the committee members.

I hope you enjoy the meeting!

Luke Bateson, Chairman

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Ice Breaker

TUE 6 DEC 6PM

The Glassblower

40-42 Glasshouse street

London W1B 5JY

Nearest Tubes: Piccadilly Circus (Piccadilly line / Bakerloo line)

Cash bar, buffet finger food provided

Wine Reception

WED 7 DEC 6PM

ARUP, Conference Venue

Arup, 8 Fitzroy Street, London

Nearest Tubes: Warren Street or Goodge Street (Northern Line), Euston Square (Hammersmith and City/Circle and Metropolitan lines)

Wine reception commences after the AGM close at the conference venue. Free to attend

Conference Dinner

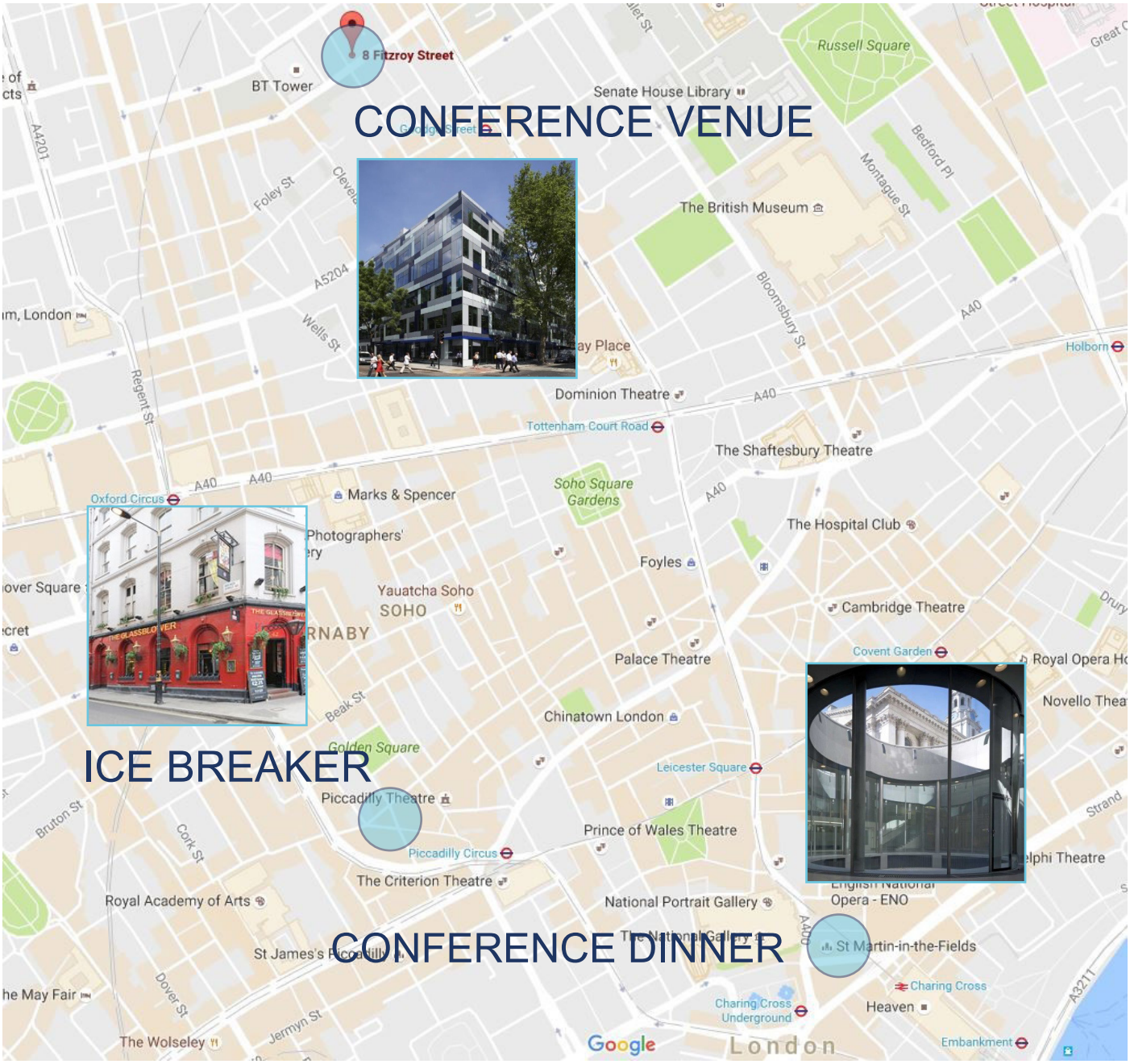
THU 6 DEC 7.30PM

St. Martin's in the Fields

Trafalgar Square, London WC2N 4JJ

Nearest Tubes: Charing Cross (Bakerloo line / Northern line), Leicester Square (Northern line / Piccadilly line). Walkable from conference venue (~20 mins) with a number of pubs on the way. Access via glass entrance to the Crypt. Additional charge.

CONFERENCE MAP



WED 7 DEC

DAY 1

CONFERENCE PROGRAMME

08.30 - 09.30	Registration and Coffee	
09:30	Welcome	Welcome + Introduction to the GRSG by Chairman, Luke Bateson
09.40	Innovation and Challenges: The Use of Remote Sensing in Geohazard and Risk Management	Matthew Free, Arup
AM1	Engineering Applications 1	Chair: Jason Manning, Arup
10:10	Crossrail's InSAR case study and potential future applications in the construction industry	Javier González Martí, Crossrail, UK
10:30	Ten Years of Monitoring the LUSI Mud Volcano: Combining innovation remote sensing techniques to meet a unique engineering challenge	Andrew Hart, Atkins, UK
10:50-11:20	Coffee Break 1 (+ Poster Session + Exhibition)	
AM2	Ground Based / UAV	Chair: Marc Goossens, Geosense
11:20	Boat based mapping of geological features using 3D-Photogrammetry and hyperspectral imaging system (Case study: Greenland)	Sara Salehi, GEUS, Denmark
11:40	LIME: Interpretation, visualisation and communication of 3D models in geoscience	Simon Buckley, Uni Research CIPR, Norway
12:00	Developing UAV systems for landscape and atmosphere monitoring at the British Geological Survey	Colm Jordan, BGS, UK
12:20	Quantitative 3D remote digital compositional and structural characterisation of outcrops using hyperspectral emission spectroscopy	Graham Ferrier, University of Hull, UK
12:40	Introduction to GBDX	Alex Gow, DigitalGlobe, UK
13:00-14:00	Lunch + DigitalGlobe Workshop: GBDX Platform	
PM1	Engineering Applications 2	Chair: Andrew Hart, Atkins
14:00	Natural hazard risk mitigation in mountain environments – the role of remote sensing	Jason Manning, Arup, UK
14:20	Continuous, Remote and Long-Term Tunnelling Monitoring with InSAR	Alessandro Ferretti, Altamira-TRE, Italy
14:40	Photo-based condition monitoring of engineering infrastructure' (applied examples from underground tunnel monitoring incl. CERN)	Yung Loo, Arup, UK
15:00	The influence of ground control on the accuracy of ultra-high resolution aerial photogrammetry from UAVs (Unmanned Aerial Vehicles) and methods for dealing with large data.	Charlton Bland, Atkins, UK
15:20-15:50	Coffee Break 2 + Planet Demonstration	
PM2	Technology Developments and Innovation	Chair: Charlotte Bishop, NPA
15:50	Convolutional Neural Network Approach to Classifying Ground Penetrating Radar Images	Patrick Carson, UCL, UK
16:10	Implementing the change vector analysis technique for assessing spatio-temporal dynamics of land-use and land-cover in the Mu Us Sandy Land, China	Prof. Arnon Karnieli, Ben-Gurion University of the Negev, Israel
16:30	Relationship between gamma radiation and light spectrum using airborne survey and Worldview-2 in South Portuguese zone, Portugal.	Gabriel Barberes, University of Coimbra, Portugal
16:50	A photogrammetry-based method for morphometric analysis of rock breakdown forms near Meteor Crater, Arizona	Ankit Verma, Trinity College, Dublin
17:10	EnVision: The Proposal for Europe's Revolutionary New Mission to Venus	Richard Ghail, Imperial College, UK
17:30	The Geological Remote Sensing Group Annual General Meeting (AGM)	
18:00	Wine Reception at Arup (Free to attend)	

THU 8 DEC

DAY 2

CONFERENCE PROGRAMME

08.30 - 09.30	Registration and Coffee	
09:30	Welcome	
09.40	Keynote: Spectral Sensing Technologies Applied to Onshore Hydrocarbon Exploration	Carlos Roberto Souza Filho, UNICAMP, Brazil
AM1	Oil and Gas 1	Chair: Carlos Roberto Souza Filho
10:10	The influence of basement structure and drainage networks on prospectivity in the East African Rift System	Rowan Edwards, CGG NPA Satellite Mapping, UK
10:30	Support applications in shallow water and coastal zone: Advances in Satellite Derived bathymetry and seafloor mapping and monitoring	Dr Peter Hausknecht, Earth-i, UK (on behalf of EOMAP)
10:50	Introduction to the EO Broker Energy platform	Anoop Pandey, Satellite Applications Catapult, UK
11:10-11:40	Coffee Break 1 (+ Poster Session + Exhibition)	
AM2	Mineral Exploration 1	Chair: Dan Taranik, Exploration Mapping
11:40	Mineral Mapping of Core Using Combined High-Resolution SWIR and LWIR Sensors	David Browning, Terracore, South Africa
12:00	Characterizing Hydrothermal Alteration Using WorldView-3 and ASTER Data in the High-Sulfidation Epithermal Jagüelito Deposit, San Juan, Argentina	Prof Diego Fernando Ducart, UNICAMP, Brazil
12:20	Remote Sensing of the Copper Creek District, Arizona. Results from Aster, Airborne Hyperspectral and Field Spectroscopy	Marc Goossens, Geosense, Netherlands
12:40	Spectral Geology and Remote Sensing used for Mineral Exploration in the Abu Marawat Concession, Eastern Desert, Egypt	Micky Brown, Mappa Mundi, UK
13:00-14:15	Lunch	
PM1	Geohazards 1	Chair: Dietmar Backes, Uni Luxembourg
14:15	Temporal Monitoring of the 2014-2015 Bárðarbunga eruption, Iceland	Mariel Dirscherl, University College London
14:35	Geomorphometric characteristic of selected fossil landslides in the Vipava Valley, SW Slovenia	Tomislav Popit, University of Ljubljana, Slovenia
14:55	On Safe Ground? Analysis of European Urban Geohazards using satellite radar interferometry	Ren Capes, University of Portsmouth, UK
15:15	Brazilian flooding resilience: evidences from National Geologic Service	Luciana Oranges Cezarino, Politecnico di Milano, Italy
15:35-16.05	Coffee Break 2 (+ Poster Session + Exhibition)	
PM2	Geological Mapping 1	Chair: Luke Bateson, BGS
16:05	Geological mapping using Worldview 3 - comparisons with ASTER and hyperspectral results	Rob Hewson, University of Twente, Netherlands
16:25	Hyperspectral mineralogical and lithological mapping of metasediments and metavolcanics of Gamsberg, Aggeneys, South Africa.	Dr Martin Schodlok, BGR, Germany
16:45	Distribution of hydrothermally altered zones and their relation with fracture patterns at the Domeyko range between 20° 35' S and 21° 17'S, (Región de Tarapacá, Chile): a remote sensing and GIS study	Byron Szadman, Universidad de Chile, Chile
17:05	Hot stones: mapping igneous kimberlites under Kalahari cover using LWIR imagery	Neil Pendock, Consultant, South Africa
17:25	Multisensoral detection of laterites and there water storage capacity in Burkina Faso	Prof. Dr. Cornelia Glaesser, University of Halle, Germany
18:30	Conference Dinner at St. Martin's in the Field (Additional Charge)	

FRI 9 DEC

DAY 3

CONFERENCE PROGRAMME

08.30 - 09.00	Registration and Coffee	
09:00	Welcome	
09.10	Keynote: Australia's Version 2 ASTER mineral maps unmixed of the effects of green and dry vegetation	Tom Cudahy, CSIRO, Australia
AM1	Geological Mapping 2	
09.40	ASTER Value-Added product	Koki Iwao, AIST, Japan
10:00	Spatial hyper-depth spectral analysis using the VNIR-SWIR region for innovative soil classification.	Yaron Ogen, Tel-Aviv University, Israel
10:20	The copper mining cycle in Chile - application of EO data and digital mapping techniques	Tom Jones, Satellite Applications Catapult, UK
10:40-11.10	Coffee Break 1 (poster session + exhibition)	
AM2	Oil & Gas 2	
11:10	Airbus DS Data Portal – Meeting the changing requirements of the Remote Sensing community	Alasdair Kyle, Airbus Defense and Space, UK
11:30	High spatial resolution satellite Earth Observation – a reliable tool for site monitoring across Mining, Oil and Gas and Engineering	Peter Hausknecht, Earth-i, UK
11:50	Operational ice charting in mid-latitudes using Near Real Time SAR imagery	Carles Debart, KSAT, Norway
12:10	Characterization of tight shales from spectral imagery of drill core.	Benoit Rivard, University of Alberta, Canada
12:30-13:30	Lunch	
PM1	Oil & Gas and Mining 2	
13:30	Intermittent SBAS (ISBAS) to characterize surface deformation over rural areas: implications for onshore oil and gas regulators and operators	Alessandro Novellino, Geomatic Ventures Limited, UK
13:50	GEO: Earth Observations for managing Minerals and Non-renewable Energy Resources	Stephane Chevrel, BRGM, France
14.10	Comparison between linear and non linear spectral unmixing methods for hyperspectral data	Asmau Muktar Ahmed, University of Kingston, UK
14.30	Conference Closing Remarks	
14.45	Afterglow - Location TBC	

WED 7 DEC

9:40

INNOVATION AND CHALLENGES: THE USE OF REMOTE SENSING IN GEOHAZARD & RISK MANAGEMENT

M. FREE, DIRECTOR OF GEOHAZARD & RISK MANAGEMENT

ARUP, UK

Geohazard and risk management requires the equal consideration of hazards, exposure and vulnerability within the following equation:

Risk = Hazard x [Exposure x Vulnerability]

The hazards considered here refer to the broad range of geological hazards that occur onshore or offshore worldwide. Exposure here refers to the assets or value at risk which typically includes population, buildings, infrastructure, economic or environmental value and vulnerability refers to the likelihood of damage or loss occurring if the exposed assets or value at risk are impacted by the hazards.

A broad range of remote sensing methods are successfully used to investigate geohazards. Similarly, remote sensing methods are successfully applied to the assessment of the distribution of the assets at risk. However, there remain a number of challenges to achieve even reasonable modelling of the built environment and surprisingly the modelling of the distribution of people in that environment. Also surprisingly, there remains considerable challenges to reasonable determination of the vulnerability of both the built environment and the population within the built environment when subjected to geohazards.

A number of case studies are presented which illustrate challenges to modelling the built environment and how these challenges can be resolved. Also presented are a number of innovative examples of how people are accurately modelled in the built environment.

WED 7 DEC

10:10

CROSSRAIL'S INSAR CASE STUDY AND POTENTIAL FUTURE APPLICATIONS IN THE CONSTRUCTION INDUSTRY

J. GONZALEZ MARTI, S. NEVARD AND J. SANCHEZ BARRUETABENA

CROSSRAIL, UK

According to the UN World Urbanisation Prospects, 2014 revision (United Nations, 2014), by 2050 66.4% of the world's population will be living in urban areas, which means that about 6.34 billion people will be living in urban areas, approximately 500 million of which will be living in Mega-cities (>10 million inhabitants). A good example of this is the 9 new residents per day in London (including new-borns).

What this means is that for those cities to be able to sustain this population without creating ghettos and isolating part of their population they will need to invest in efficient ways of transporting people and resources from one point to another, as it has been proved over and over that urban transportation plays a pivotal role in poverty reduction or population distribution, given its symbiotic relationship with the urban economy (National League of Cities. Centre for Research & Innovation).

With current technologies, underground transportation methods are the ones that have a bigger impact and provide the most cost effective solutions with the least known environmental implications, although their construction implies big risks due to the potential damage to assets and to human lives.

How does this affect the Instrumentation and Monitoring industry? One of the major challenges for the client is to guarantee that the different assets, once the construction activity has ceased, are left in the same condition as before the start of the activity. This is difficult because with the current approaches to monitoring a good deal of installation and preparation are required, often not allowing much time between the time the instrumentation is set up and the start of the works, which doesn't give enough background data to have a proper understanding of the assets' natural behaviours.

InSAR could provide this kind of information with a relatively small budget providing a strong knowledge of the assets' preconstruction behaviour, which could be tracked while the construction activity in going on, and once it has ceased, with no (or very limited) installation costs, minimal health and safety risks, and with a small risk of the persistent scatterers being damaged, and of course maintaining a similar monitoring accuracy to other systems.

WED 7 DEC

10:30

TEN YEARS OF MONITORING THE LUSI MUD VOLCANO: COMBINING INNOVATION REMOTE SENSING TECHNIQUES TO MEET A UNIQUE ENGINEERING CHALLENGE

A.HART, F. KING

ATKINS, UK

On 29 May 2006, the LUSI mud volcano erupted in the Sidoarjo regency of East Java, Indonesia. Fourteen people were killed and around 40,000 people lost their homes in the immediate aftermath. Unlike other mud volcanoes, LUSI has erupted almost continuously, burying villages, factories and farmland to now cover an area of almost six square kilometres. The erupting mud is now largely confined by earth embankments that surround LUSI on all sides.

After being approached by a client concerned about mud reaching nearby industrial facilities and the potential for ground subsidence resulting from the eruption, Atkins has been monitoring and assessing these risks since early 2007. This work has included using a combination of optical satellite imagery interpretation to map and monitor the extent of the mud flows erupting from LUSI and Differential Interferometric Synthetic Aperture Radar ('DifSAR') analysis techniques to map and monitor ground movements around the mud volcano area. This work, which has been assisted by a number of technical specialists, has also included occasional field visits to verify the results of the remote sensing interpretations against actual ground conditions, and the review of available scientific literature.

To date, the remote sensing work has shown that while the flow of mud from LUSI is now being constrained by the earth embankments surrounding the mud volcano, the ground movements are effecting a slightly larger area. They have also shown that ground movements in the surrounding area are also being heavily influenced by other anthropogenic factors.

This presentation will provide an overview of the ongoing eruption and how it has developed since 2006. It will also highlight how the use of remote sensing mapping techniques has allowed for the risks posed by the eruption to be monitored over an extended period of time in an innovative but cost-effective manner, as well as the importance of field verification in such work.

WED 7 DEC

11:20

BOAT BASED MAPPING OF GEOLOGICAL FEATURES USING 3D-PHOTOGRAMMETRY AND HYPERSPECTRAL IMAGING SYSTEM (CASE STUDY: GREENLAND)

S. SALEHI[1,2], S. JAKOB[3] AND E. VEST SORENSEN[1]

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[2] DEPARTMENT OF GEOSCIENCES AND NATURAL RESOURCE MANAGEMENT, UNIVERSITY OF COPENHAGEN
[3] HELMHOLTZ-ZENTRUM DRESDEN-ROSSENDORF, HELMHOLTZ INSTITUTE FREIBERG FOR RESOURCE TECHNOLOGY, DIVISION OF EXPLORATION, FREIBERG, GERMANY

Arctic environments provide a challenging ground for geological mapping and mineral exploration. Inaccessibility and harsh conditions complicate ground surveys and a dense cover of ice, vegetation, and lichens hinders supportive remote sensing surveys. Steep coastal cliffs are often the only accessible major outcrops, but are mostly not observable by air- or space-borne remote sensing data due to their off-nadir viewing angle. Former studies of those cliff sections focused on the manual interpretation of ground- or boat-based RGB images. However, detailed spectral data is missing, which is essential for common semi-automatic remote sensing data processing and interpretation of mineralogy and structures as well as mapping subtle mineralogical differences.

This contribution introduces an approach for photogrammetry and hyperspectral remote sensing of near-vertical cliff sections of geological outcrops in central west Greenland. A 3D image-based surface reconstruction technique is developed to enable a semi-automated outcrop evaluation. The focus lies hereby on the integration of digital photogrammetry with boat-based hyperspectral imaging to complement Digital Outcrop Models (DOM) with quantitative information about mineral variations in the outcrop. This add-on information allows for distinctions between rock formations, or for defining barren ground versus potential economic ore deposits. The project focuses on: 1) integration of hyperspectral images with the photogrammetry derived DOM´s, 2) geometric distortion correction of boat-based hyperspectral images, 3) extraction and mapping of geological features from close range hyperspectral images. The extreme off-nadir (nearly horizontal) scanning view and the resulting scan geometry need to be taken into account during processing. This contribution also highlights future possibilities for rapid semi-automatic interpretation of the data and advances in technology.

Our approach provides a promising workflow for off-nadir remote sensing campaigns in coastal artic environments including photogrammetry and hyperspectral imagery even in remote regions, which are only accessible by boat and can hardly be observed by classic geological mapping.

WED 7 DEC

11:40

LIME: INTERPRETATION, VISUALISATION AND COMMUNICATION OF 3D MODELS IN GEOSCIENCE

S. J. BUCKLEY, K. RINGDAL, B. DOLVA, N. NAUMANN, T. H. KURZ

UNI RESEARCH CIPR, NORWAY

Usage of 3D photorealistic modelling of topography has dramatically increased in recent years, in large part due to developments to acquisition hardware and processing software. This is epitomised by the recent uptake in photogrammetry, driven by innovations in computer vision that have brought higher automation and reliability into the traditional processing pipeline. In geology and other geoscience disciplines, the result is an expanding variety of users and applications, making geomatics techniques fundamental to provide a spatial framework for later analysis. In addition to 3D datasets, multi-sensor data fusion combining surface shape with a new generation of imaging sensors (e.g. multi/hyperspectral, thermal, GB-InSAR) and geophysical methods add a new dimension to state-of-the-art research in geoscience applications.

Despite the current ease of acquiring and processing 3D photorealistic models, new users from outside geomatics are still faced with a steep learning curve for analysing and presenting 3D data. Interpretation tools for measuring and digitising features found in 3D textured models are critical for quantitative mapping. In addition, digitisation of field areas allows for pre-fieldwork planning and post-fieldtrip study, valuable in education for teaching concepts in e.g. geology. This contribution presents LIME, a lightweight, high performance software package for viewing and interacting with 3D models and related data types. The software has been developed for over five years, and focuses on the novel integration of disparate geospatial and field data, such as 3D models, georeferenced images and maps, logs, interpretation panels, and hyperspectral images. In addition, measurement and interpretation can be carried out by digitising in the 3D scene.

Finally, high quality visual outputs can be generated, such as by projecting 3D data onto photorealistic models to generate novel texture overlay layers. These features are exemplified through using case studies in hyperspectral imaging, geophysical data integration and digital outcrop mapping.




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WED 7 DEC

12:00

DEVELOPING UAV SYSTEMS FOR LANDSCAPE & ATMOSPHERE MONITORING AT THE BRITISH GEOLOGICAL SURVEY

C.JORDAN[1], C. ROCHELLE[1], S. HOLYOAKE[1], P. HOBBS[1], N. KING[2], S. SURTEES[2] AND K. TRAUT[2]

[1] BRITISH GEOLOGICAL SURVEY, UK
[2] QUESTUAV LTD, UK

Traditionally the British Geological Survey (BGS) has mapped and monitored a diverse range of environments using a combination of ground-based, conventional airborne and satellite data, however Unmanned Aerial Vehicles (UAVs) are proving to be a viable complementary technology. Since the 1980's the BGS has developed, tested and utilised a range of UAVs for a variety of geoscience applications. The UAV technology is often cutting-edge or proto-type, requiring significant development.

BGS UAVs include a petrol-powered parafoil, a powered glider, multi-rotors, delta-wings and a kite. Until recently, the application of these platforms has focussed on geological/geomorphological mapping, primarily using photogrammetry and/or structure from motion (sfm). Landslide monitoring is a prime example of this form of photogrammetry from UAVs, with multi-temporal acquisitions yielding valuable insights via orthophotographs, point clouds and elevation models. In Aldbrough and Hollin Hill (coastal and inland landslides respectively, in Yorkshire) UAV stereo-photography has complemented terrestrial laser scanning and assorted data to provide a greater understanding of landslide dynamics and coastal retreat. The UAVs have also been used to gain information about features such as sinkholes when rapid responses are required.

More recently BGS has been undertaking a project with QuestUAV Ltd. (co-funded by InnovateUK) to assess the feasibility of a UAV-based gas monitoring system. We have built a prototype methane gas monitoring system by incorporating a miniaturised novel open-path laser sensor on a highly-modified fixed-wing UAV. The aim is efficient and flexible assessment of fugitive gas emissions. While initially aimed at the energy sector, it is expected that the UAV methane monitoring system (and subsequent sensors for other gases) will also be valuable elsewhere e.g. for volcano monitoring and geothermal assessments.
It is evident that existing UAV platforms are providing key geoscience photographic and elevation datasets. Novel platform, sensor and visualisation system developments are also beginning to fill important gaps in atmospheric and geophysical data acquisition, manipulation and exploitation.

WED 7 DEC

12:20

QUANTITATIVE 3D REMOTE DIGITAL COMPOSITIONAL AND STRUCTURAL CHARACTERISATION OF OUTCROPS USING HYPERSPECTRAL EMISSION SPECTROSCOPY

G. FERRIER[1] D.PATON[2], C. K. YEW[1], H. MORTIMER[3], D. COSTANTINO[2]

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[2] SCHOOL OF EARTH AND ENVIRONMENT, UNIVERSITY OF LEEDS, LEEDS, UNITED KINGDOM.
[3] RAL SPACE, SCIENCE AND TECHNOLOGY FACILITIES COUNCIL, RUTHERFORD APPLETON LABORATORY

A highly novel, low cost, high spectral resolution, low power (battery), lightweight (1.3kg) Imaging Fourier Transform InfraRed (FTIR) spectrometer which offers the capability to identify key sedimentary lithologies accurately providing a methodology to significantly increase the volume, coverage, and level of detail, of structural and compositional information at sample-borehole-site and basin scales, at very low cost has been developed. The low cost, high spectral resolution, and portability of the MicroFTS provides a step-change in the operational deployability and capabilities of an Imaging FTIR with a significant increase in the potential applications including mapping surface compositions and gas flux analysis.

The accurate characterisation of lithology and mineralogy in rock volumes and the associated sedimentary and structural architecture of a hydrocarbon basin is central to predicting the presence and volumetrics of hydrocarbon resources. A more integrated approach to the analysis of the sedimentary architecture using a quantitative, digital- based characterisation of borehole cores and outcrops would enhance the accuracy of basin analysis used in exploration. Although there have been significant advances in the accuracy of modelling the geometry of geological interfaces remotely using Terrestrial LiDAR Scanning (TLS), the definition of the rock volume itself has been restricted by severe limitations in the range and accuracy of the mineralogical and lithological information retrievable using photographs. While spectral reflectance based remote sensing methods have demonstrated some capabilities in resolving rock compositions the operational utility is severely restricted by the limited range and accuracy of minerals that can be detected and the effects of viewing configuration and illumination conditions. A NERC funded project is currently underway investigating the potential of emission spectroscopy, integrated with TLS data, to provide information on minerals not identifiable in reflectance spectra.

WED 7 DEC

14:00

NATURAL HAZARD RISK MITIGATION IN MOUNTAIN ENVIRONMENTS - THE ROLE OF REMOTE SENSING

J. MANNING

ARUP, LONDON, UK

Mountain environments are subject to a wide range of natural hazards that impact communities, infrastructure and lives. Key natural hazards include earthquakes, volcanoes, landslides, mudflows, floods, Glacial Lake Outburst Floods (GLOF) and avalanche. Whilst remote sensing has a key role in being able to support mapping, monitoring and analysis of these hazards, it is the use of the remote sensing data combined with other data(sets) in conjunction with sound geoscience and engineering knowledge that allows for appropriate mitigation actions to be devised and implemented.

In order to mitigate risk there are a range of risk management strategies that can be employed. To inform Disaster Risk Management (DRM) strategies requires assorted inputs to identify and quantify the distribution, frequency and scale of individual hazard threats, together with collection of exposure data (who, what, where is at risk). Use of archive data is an essential component to DRM, enables analysis of time histories and temporal change. Examples include monitoring flood frequency and extents, glacier surges and retreat, landslide recurrence, deforestation, soil erosion etc.

The continuing developments in new and improved sensors, increased temporal resolution, ease of access to data (new & archive), speed of delivery and software analytical processes are making real differences to support DRM. The challenge is to further increase access and wider use of this RS data. Free and open access data policies of the USGS and EC/ESA Copernicus programmes are particularly beneficial. In developing countries, where capacity is constrained (finance, internet-speed, training of staff), there is a need to improve the local capacity to support DRM in order to further mitigate exposure to natural hazards and improve the lives of people in mountain regions. DRM solutions can include both hard interventions (protecting buildings & infrastructure) and soft interventions (education & training). Examples of hard interventions include engineering design of critical infrastructure (e.g. bridges & flood protection stuctures) resilient to natural hazards. The combination of hard and soft interventions make communities more resilient by ensuring they have more capacity to cope with the range of natural hazard threats.

Examples will be presented from the use of diverse remote sensing datasets (SRTM, ASTER, Corona, Sentinel-2 and high resolution, Pléiades, WV2), together with the benefit of combining with archive data, other digital datasets and field observations. Examples from the Pamir mountains (Tajikistan), Tien Shan (Kazakhstan & Kyrgyzstan) and Hajar/Oman mountains (Oman & UAE) shall be presented.

WED 7 DEC

14:20

CONTINUOUS, REMOTE AND LONG-TERM TUNNELLING MONITORING WITH INSAR

C. GIANNICO, A. BELSON, A. URDIROZ, G. FALORNI

TRE ALTAMIRA, ITALY

Interferometric Synthetic Aperture Radar (InSAR) is one of the most advanced remote sensing technologies for monitoring ground deformation over infrastructure, capable of identifying millimetre displacements by processing satellite radar images.

Urban environments are most susceptible to risk from tunnelling activities due to the high density of existing infrastructure and public safety requirements. InSAR was included in the "ITAtech Guidelines for Remote Measurements Monitoring Systems" at WTC 2015 and is now widely used to monitor tunnels throughout the world for the design, construction and maintenance phases.

InSAR data can minimise survey time and associated costs compared to traditional techniques, especially for wide-area surveys. During the design phase, historical ground movement maps can be created for the characterisation of pre-existing subsidence phenomena by analysing archived satellite data back to 1992, also aiding the planning of new infrastructure routes. Throughout tunnel construction, InSAR can be used to identify and quantify, both spatially and temporally, any deformation phenomena caused by ground works and for post-construction it can determine the extent of ground settlement over new structures.

With the recent launch of the Sentinel satellite by ESA as well as the availability of X-band high resolution satellites, continuous monitoring projects and rapid reporting updates can now provide near real-time and long-term stability monitoring solutions for infrastructure.
Three case studies are presented:
1. Canada Line Rapid Transit Metro, Vancouver: long-term monitoring project to detect surface deformation along the entire alignment prior to, during and post construction. A clear signature was identified in the deformation data that corresponded well with the timing of tunnel excavation.

2. Gran Paris Express, Paris: 15 years of monitoring over 200km of underground metro line and 68 new stations during and after the construction, with monthly reporting. The historical analysis (1992-2015) has allowed the client to make informed decisions about which areas required additional geotechnical survey campaigns prior to tunnelling works.

3. Urban Railway Tunnel, Italy: a single-track rail tunnel excavated in urban area in difficult, geological, hydrogeological and geotechnical conditions. InSAR helped resolve uncertainties in the underground geological and hydrogeological models

WED 7 DEC

14:40

PHOTO-BASED CONDITION MONITORING OF ENGINEERING INFRASTRUCTURE' (APPLIED EXAMPLES FROM UNDERGROUND TUNNEL MONITORING INCL. CERN)

Y. LOO

ARUP, UK

In recent years advances in digital cameras and processing of images have enabled a step change to be achieved in photographic condition based monitoring of civil engineering assets. The technology has been deployed to support condition survey and degradation monitoring in tunnel infrastructure owned and maintained by large infrastructure owners such as CERN, National Grid and Network Rail.

The technique involves capturing high quality images of the entire tunnel structure. The initial step involves reconstructing images to develop a three dimensional or immersive model of the tunnel. Repeat surveys are carried out to acquire further condition survey information at subsequent times and to compare with the original survey. Change detection techniques and object recognition algorithms are then applied to compare survey information acquired at different times.

The use of these rigorous techniques remove the subjectivity of establishing the change of condition of assets between successive inspections. When combined with automating the process of acquiring and processing images, the techniques support better decision making relating to the ongoing maintenance of tunnel assets. Cost saving and health and safety benefits are also achieved through automation minimising the time required by inspectors to spend in tunnels.

WED 7 DEC

15:00

THE INFLUENCE OF GROUND CONTROL ON THE ACCURACY OF ULTRA-HIGH RESOLUTION AERIAL PHOTOGRAMMETRY FROM UAVS (UNMANNED AERIAL VEHICLES) AND METHODS FOR DEALING WITH LARGE DATA.

C.BLAND

ATKINS, UK

The miniaturisation of high quality cameras, sophisticated airborne platforms and GNSS (Global Navigation Satellite System) componentry has enabled surveyors to turn to UAV derived aerial photogrammetry as a viable and well warranted tool for mine and quarry surveys. Furthermore, significant advancements in the field of computer visualisations/vision have resulted in sophisticated photogrammetry software based on SfM (Structure from Motion) algorithms which have enabled non-photogrammetrists to process aerial survey data (imagery) in a highly automated fashion. This has served to reduce the barrier of entry into the aerial survey market.

This presentation considers the accuracy attainable from near fully automatic processing software and how the type and method of exterior control influences the overall processing accuracy. Furthermore, the presentation considers the results in relation to the surveying principle of 'Economy of Accuracy' which states that a survey should only ever be as accurate as it needs to be, but never less. This principle governs all survey work and is especially important in UAV work as the implementation of ground control can constitute up to 50% of the overall cost of the field survey.

The presentation focuses on a UK quarry as a case study and examines the influence of independent ground (exterior) control on Digital Terrain Modelling (DTM) and stockpile volume accuracy in comparison to using purely airborne control methodology. Finally, the presentation will look at a different UK quarry and discuss how advancements in the science of computer vision (gaming technology) can be used to help manage and exploit large data files which result from information rich data capture techniques.

WED 7 DEC

15:50

CONVOLUTIONAL NEURAL NETWORK APPROACH TO CLASSIFYING GROUND PENETRATING RADAR IMAGES

P. CARSON

UCL, LONDON

The detection and disposal of landmines is one of the most intractable problems facing the world today (Plett et al., 1997). Every year landmines kill 15,000 – 20,000, mostly women and children and mostly in countries of peace (UN, 2016). Massive tracts of land across the globe remain overrun with landmines and are too dangerous for productive use. The presence of mines continues to seriously impede social and economic development.

According to the International Committee of the Red Cross (ICRC), in the last fifty years more damage has been done from landmines than nuclear and chemical weapons combined (ICRC, 1996). Mines weeping and demining processes are risky and costly tasks. Conventional techniques include sniffer dogs and handheld metal detectors both of which are highly likely to lead to injuries and fatalities. Ground Penetrating Radar (GPR) has a wide range of applications and it has been extensively used for landmine detection (Daniels, 2004). The ability to detect buried ordnance at depth in a variety of soils through unobtrusive, nondestructive methods is why GPR is considered an attractive approach to demining.

Furthermore the democratisation of unmanned aerial vehicle (UAV) technology has made the possibility of pairing a lightweight GPR sensor with a UAV an exciting reality. Recent advancements in deep learning artificial neural networks has led to a significant improvement in pattern recognition tasks such as object classification in images. This project is focused on the machine learning aspect of the proposed system. This paper presents an automated threat detection method based on a convolutional neural network (CNN) approach.

Through supervised learning the CNN is initially trained on simulated 2dimensional GPR Bscan data generated by gprMax (Warren., et al 2015), an opensource piece of software that simulates electromagnetic wave propagation. Once a significant level of detection accuracy has been achieved through a training regime based on increasingly complex simulated GPR Bscans, real, UAV captured GPR data will be drip fed into the CNN to test its competency.

WED 7 DEC

16:10

IMPLEMENTING THE CHANGE VECTOR ANALYSIS TECHNIQUE FOR ASSESSING SPATIO-TEMPORAL DYNAMICS OF LAND-USE AND LAND-COVER IN THE MU US SANDY LAND, CHINA

PROF. A. KARNIELI

BEN-GURION UNIVERSITY OF NEGEV, ISRAEL

Sandification refers to land degradation in sandy areas. Considerable attention has been given to sandification processes in China since vast areas of sandy deserts are located in the north of the country within arid and semi-arid climatic zones.

The current paper is aimed at assessing the land-use/land-cover spatial and temporal dynamics over the Mu Us Sandy Land, China, via change detection methodology based on spaceborne images. Two biophysical variables, NDVI, positively correlated with vegetation cover, and albedo, positively correlated with cover of exposed sands, were computed from a time series of merged NOAA-AVHRR and MODIS images (1981 to 2010). Generally, throughout the study period, NDVI increased and albedo decreased.

Improved understanding of spatial and temporal dynamics of these environmental processes was achieved by using the Change Vector Analysis (CVA) technique applied to NDVI and albedo data extracted from four sets of consecutive Landsat images, several years apart. Changes were detected for each time step as well as over the entire period (1978 to 2007). CVA created four categories of land-cover change – vegetation, exposed sands, water bodies, and wetlands.

The CVA's direction and magnitude result in pixel-based maps of the change rather than broad qualitative classes, such as slight-, moderate-, or severe land degradation that previously presented for this region. Each of the four categories has a biophysical meaning that was validated in selected hot-spots, employing very high spatial resolution images (e.g., Ikonos).

Careful selection of images, taking into account inter and intra annual variability of rainfall, enables differentiating between short-term conservancies (e.g., drought) and long-term alterations. NDVI and albedo, although comparable to tasseled cap's brightness and greenness indices, have the advantage of being computed using reflectance values extracted from various Landsat platforms since the early 1970s.

It is shown that, over the entire study period, the majority of the Mu Us Sandy Land area remained unchanged. Part of the area (6%), mainly in the east, was under human-induced rehabilitation processes, in terms of increasing vegetation cover. In other areas (5.1%), bare sands were found to expand to the central-north and the southwest of the area.

WED 7 DEC

16:30

RELATIONSHIP BETWEEN GAMMA RADIATION AND LIGHT SPECTRUM USING AIRBORNE SURVEY AND WORLDVIEW-2 IN SOUTH PORTUGUESE ZONE, PORTUGAL.

G. A. BARBERES[1] , M. T. BARATA[1], P. E. FONSECA[2] & R. PENA DOS REIS[1]

[1] UNIVERSITY OF COIMBRA. PORTUGAL.
[2] GEOFCUL – DEPARTMENT OF GEOLOGY AT SCIENCES FACULTY OF LISBON & IDL - INSTITUTO D. LUIS. CAMPO GRANDE

The relation between gamma radiation and light spectrum has not been well studied over the past years. The most part of the few works address the issue in a "space science" context. This work aims to establish this relation using airborne gamma radiation and WorldView-2 (WV-2) images, applied over an area with 1000 km2 in the South Portuguese Zone, Faro district, southwestern of Portugal. From the geological point of view these formations are characterized by turbiditic sequences (flysch facies) composed by rhythmic intercalations between greywackes and shales, from upper Carboniferous.

The airborne radiometric survey data, used in this work, was operated by Rio Tinto Zinc Co. (RTZ) in 1991 and was generously donated by the National Laboratory of Energy and Geology (Geological Survey) from Portugal. WorldView-2 satellite images are courtesy of the DigitalGlobe Foundation.

The sample points of airborne gamma survey (with 75m distance) were used as a reference for extraction of pixels' values, from the aforementioned satellite images. Therefore, each one of the 205,430 points contains 13 different information, being them 9 WorldView-2 bands, total count (TC-cps), thorium (Th-cps), uranium (U-cps) and potassium (K-cps).

The data were processed and analyzed using IBM SPSS software in order to verify if the correlations between variables were mathematically expressive. Using the Pearson correlation, we demonstrated that there are significant correlations between the gamma radiation and the light spectrum being predominantly an inverse proportionality but sometimes also direct.

Taking into account the costs for gamma radiation survey, if this method was applied for radiometric data acquisition, using the area of this project as an example, this implies a cost reduction, between 45% and 98.2%, requiring just a few days to acquire, process and analyze satellite images.

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WED 7 DEC

16:50

A PHOTOGRAMMETRY-BASED METHOD FOR MORPHOMETRIC ANALYSIS OF ROCK BREAKDOWN FORMS NEAR METEOR CRATER, ARIZONA

A. VERMA AND M. BOURKE

TRINITY COLLEGE DUBLIN, IRELAND

Rock breakdown is an important process in the evolution of landforms and sediments. Despite the emergence of several techniques (e.g., Structure from Motion, optical 3D scanners, portable laser scanners) to study surface texture/topography in other branches of science, to date there are no established technique to accurately describe and measure the morphometry of 3D rock breakdown forms in the field.

A photogrammetry based method is proposed in this study to characterize rock breakdown on boulders and bedrock. In this study, we used the Structure from Motion (SfM) photogrammetry technique to generate sub-millimetre resolution Digital Elevation Model (DEM) of weathered rock surfaces. Structure for Motion photogrammetry is a universal 3D measuring technique applied in a wide range of interdisciplinary fields. It requires low-cost consumer-grade DSLR camera which is easy to carry in the field.

These methods were pilot tested on extensively weathered Triassic Moenkopi Sandstone outcrops near Meteor Crater in Arizona. Images were taken in the field using Nikon D5500 and was processed in highly automated commercially available software Agisoft Photoscan to build dense point cloud. Further, point clouds were registered to a local 3D coordinate system (x, y, z) developed using an equilateral triangle coded marker and exported as DEMs. The DEMs generated using SfM technique permit high-resolution morphometric characterisation and quantification of 3D breakdown forms at a range of scales.

We analyse these DEMs using a series of areal surface roughness parameters and geomorphometric classification methods adapted from landscape analysis. The results from this case study confirms the efficacy of the method and highlights that the technique used is reasonable and feasible. This study developed a low-cost photogrammetry-based approach which will open new opportunities to the quantitative assessment of morphology of rock breakdown forms in 3D beyond those specifically outlined in this study.

WED 7 DEC

17:10

ENVISION: THE PROPOSAL FOR EUROPE'S REVOLUTIONARY NEW MISSION TO VENUS

R. C. GHAIL, C. WILSON, T. WEIDEMAN, C. DUMOULIN, A. C. VANDAELE, P. J. MASON, J. HELBERT, L. BRUZZONE, AND C. COCHRANE.

IMPERIAL COLLEGE, LONDON, UK

New discoveries of Earth-sized planets in orbit around other stars stimulates the need to better understand the planets orbiting our own Sun, particularly those closest and most similar to Earth. Venus is profoundly alien and Mars the more benign planet, but in geological terms, and in the parameters currently accessible for characterising exoplanets, Venus is the most Earth-like planet in the Solar System. Mars may have had a past environment favourable for life but at one tenth the mass, it was unable to sustain its early benign environment. Being so similar to Earth, Venus may also have had a habitable past, possibly even sustaining a living biosphere so why has Venus not turned out more like Earth?

ESA's 2006-2014 Venus Express, the most successful mission to Venus in the last two decades, revealed a far more dynamic and active planet than expected, uncovering tantalising evidence for present day volcanic activity that demands further investigation.

We propose a new mission, EnVision, whose goals are to determine the level and nature of current geological activity, determine the sequence of geological events that generated its range of surface features, assess whether fundamental changes in the nature of geological activity have occurred with time, and to understand the organising geodynamic framework that controls the release of internal heat over the history of the planet.

With its unparalleled European instrument and technology heritage in surface change detection and monitoring, EnVision will revolutionise our understanding of Venus and enable us to understand why our closest neighbour is so different.

Here we present the main elements of the science case for EnVision and how we intend to achieve its goals.

THU 8 DEC

09:40

SPECTRAL SENSING TECHNOLOGIES APPLIED TO ONSHORE HYDROCARBON EXPLORATION

C.R SOUZA FILHO

UNIVERSITY OF CAMPINAS, BRAZIL

In this work, we overview the application of spectral remote sensing performed in the visible-near infrared (VNIR), short-wave infrared (SWIR) and longwave infrared (LWIR) wavelengths for characterization of seepage systems as an exploration indicator of hydrocarbon (HC) accumulations.

The study encompasses the analysis of macro, micro and miniseepages. A macroseepage is defined as visible indications of oil & gas on the surface or in the air detectable directly by a remote sensing approach. A microseepage is expressed as invisible traces of light HCs in the soil and sediment that is detectable by its secondary footprints in the strata, hence an indirect remote sensing target. Some macroseeps have a diffused lateral flow in near-surface fractures and subsequently trigger the formation of local alterations around the main oil/gas show, which are now coined miniseepages.

Here, we will demonstrate a multiple scale approach to sense all these types of HC seepages. Variations at field and airborne scale include: i) detection of oils mixed with multiples soil substrates in controlled lab and field experiments using lab ultraespectral (ASD) and airborne hyperspectral (ProSpecTIR) sensors in the SWIR range; ii) detection of real oil shows using airborne hyperspectral AVIRIS SWIR data in the Ventura basin (USA); iii) detection of tar sands employing field and airborne hyperspectral AISA-Fenix SWIR data in the Parana basin (Brazil); iv) detection of a variety of gaseous HC flows using airborne hyperspectral SEBASS & HyTES LWIR (TIR) data, both in controlled experiments and in actual leaks.

We will also test earlier and recently operational orbital sensors for seepage mapping, including ASTER, WorldView-3 (WV-3) and Sentinel-2 in HC-bearing sedimentary basins in Brazil (Parana and Tucano) and Iran (Alborz). The WV-3 satellite comprises a high spatial resolution sensor with eight channels in the visible and near-infrared (VNIR) and extra eight channels in the short-wave infrared (SWIR). The spatial resolutions are 0.31 m (panchromatic), 1.24 m (VNIR) and 3.7 m (SWIR). The SWIR dataset, however, is released commercially at 7.5m resolution. WV-3 SWIR channels 9, 12, and 16 (centred at 1210, 1730, and 2330 nm) intersect, respectively, some key hydrocarbon (HC) absorption bands at 1200, 1700, and 2300 nm. WV3 VNIR and SWIR channels also cover several spectral features linked to alteration minerals that occur above HC accumulations, including Fe-oxides, Fe-hydroxides and Fe-sulphates, clays and carbonates.

Sentinel-2 carries a sensor with 13 bands in the VNIR (11) and SWIR (2) with spatial resolutions varying between channels (10 m, 20 m and 60 m). With most bands concentrated in the VNIR range, it offers unique possibilities for detection and mapping of bleaching effects associated to HC seepage. The wealth of successful case studies approached here should help fostering new applications of multiple spectral sensing technologies to hydrocarbon exploration and production in frontier basins.

THU 8 DEC

10:10

THE INFLUENCE OF BASEMENT STRUCTURE AND DRAINAGE NETWORKS ON PROSPECTIVITY IN THE EAST AFRICAN RIFT SYSTEM

S. BREED, D. NECEA, R. EDWARDS, M. BROADLEY

NPA SATELLITE MAPPING, CGG SERVICES (UK) LTD

Regional fault patterns around onshore intra-continental rift basins (eg. East African Rift System -EARS), show the regional structural framework and context for reservoir development within these basins. By delineating fault trends in the presently active EARS, it is possible to examine the influence of major faults on the geometry of the rifts, the development of drainage networks and the sediment distribution and quality within the basins.

Many basins in the EARS are still under- or even unexplored. The scarcely available data for onshore East Africa is generally old and of low quality, except for a few basins explored in the past decade. The only available dataset that covers the entire region is satellite data; as such we have used Landsat 8 OLI imagery and SRTM1 DEM data to create the first contiguous 1:200,000 scale geological map of the EARS.

Rifts are environments of low stress, so development and growth of normal faults is controlled by inherited weaknesses. This is because the tensile strength to overcome these weaknesses is generally lower than the tensile strength of surrounding rocks (depending on orientation of the weakness, relative to the stress field). Therefore pre-existing basement fabrics largely control the location and geometry of faults leading to currently active rift basins being concentrated in areas of previous intense deformation. Such examples include the Precambrian and Palaeozoic Mobile Belts, as well as older rift basins (Karoo, and/or Cretaceous - Paleogene rifting), which are mostly found between several cratons in East Africa. The structural basement grain also controls local pre-existing weaknesses, which determine the orientation of the faults and fault blocks within the rift basins and therefor the formation of structural traps. In areas of stacked rifts, multiple petroleum systems and play types can develop, and traps from one rift episode can be charged by source rocks from another.

Basin boundary fault architecture determines sediment distribution by shaping pathways for sediment supply into basins. Extents of drainage basins, and lithologies eroded within them provide an indication on reservoir quality within the basins. In rifts that develop in areas of pre-existing weaknesses, many boundary faults establish their maximum length early on during the deformation, which makes it common for drainage patterns to be established early on too. This information can be used to get a first-pass overview of basin prospectivity, as provenance and sedimentation determine distribution of potential reservoirs, source rocks and seals. Where no direct evidence (from drilling, good quality seismic, etc.) is available, this methodology helps understand what can be expected in the subsurface. Particularly in areas that currently lack (good quality) data, by combining the geological map with fault activity data and drainage analysis, explorers can rapidly screen individual rift basins, as well as focus the more expensive follow-up exploration work.

THU 8 DEC

10:30

SUPPORT APPLICATIONS IN SHALLOW WATER AND COASTAL ZONE: ADVANCES IN SATELLITE DERIVED BATHYMETRY AND SEAFLOOR MAPPING AND MONITORING

T. HEEGE[1], P. HAUSKNECHT[2], K. HARTMAN[1] AND M. WETTLE[1]

[1] EOMAP GERMANY
[2] EARTH-I UK

The coastal and shallow water zone is a dynamic environment with various stake holders and conflicting interests. Most recent and up-to-date, high resolution geo-information for the coastal zone is often not accessible or requires significant costs and time efforts. Especially when it comes to geospatial information in the shallow water zone. Information on bathymetry, habitats or geomorphology are in particular very scarce, but is often mandatory for any development approvals on coastal zone activities, which may involve modeling, planning and engineering.

Satellite derived geospatial products and services have reached a high degree of service readiness (semi-operational), which allows the usage as an integrated tool or as a single information data set to support the day-to-day work for these applications. It provides up-to date maps and monitoring information which will directly support various tasks in the coastal zone.

Key benefits of satellite services are costs savings such as a published cost saving of Shell Qatar which saved 1 Mil USD by using satellite derived bathymetric data to support a seismic survey campaign, rapid data access for big and remote areas. The presentation will showcase use cases of the O&G sector, such as impact assessment, planning phase and offshore construction phase in which satellite services have been used and how they have been integrated into the current practice.

More insight will be provided for related topics such as the understanding of uncertainties and how new and future satellite missions will support the O&G activities in the coastal and nearshore regions.

THU 8 DEC

10:50

INTRODUCTION TO THE EO BROKER ENERGY PLATFORM

A.PANDEY

CATAPULT, UK

The Oil and Gas (O&G) sector is under ever increasing pressure to comply with the highest standards of Health, Safety, Security and Environment, whiste minimising costs. Earth Observation (EO) has a strong role to play in helping the industry in this regard, but the industry finds it increasingly difficult, either directly or indirectly, to work in an informed manner with the wide range of Earth Observation providers, products and services. The EO Broker will provide the opportunity for the O&G industry to use EO data through the creation of a new website – the "EO Broker (Energy)".

The aim of the EO Broker will be a single location that enables O&G users to access information about EO-related suppliers, download some key EO-related data sets and search for products and services without requiring previous in-depth knowledge of EO. The EO Broker will enable two-way correspondence between O&G users and EO suppliers. This will allow users to ask questions and request further information from potential suppliers. EO Broker users will be directed to the relevant EO supplier should they want to purchase products and/or services. Beyond the scope of the current project, the EO Broker will have application to other market sectors and cover a broader range of geospatial products and services.

The EO Broker is an ESA funded demonstrator showing how EO suppliers, products and services could be gathered together in a single location and presented in an easy to use solution. The project will show an initial prototype at the GRSG event in December 2016 with the aim to gather feedback from members of the O&G community. A mature version of the demonstrator will be shown at an event in 2017 (TBC). The project will complete in November 2017, by which time the project aims to have confirmed a route to operationalise the solution and make available to interested parties.

THU 8 DEC

11:40

MINERAL MAPPING OF CORE USING COMBINED HIGH-RESOLUTION SWIR AND LWIR SENSORS

D. BROWNING, T. KOSANKE, P. HARRIS AND P. LINTON

TERRACORE INTERNATIONAL, SOUTH AFRICA

Hyperspectral Imaging to date has been used to map mineralogical changes in cores largely utilizing only the SWIR region (1000 - 2500 nm). This region, however, is poor for detecting silicates. The recent combination of SWIR and LWIR (7.5 – 12 micron) sensors provides data over an extended wavelength range, enabling validation of mineralogy across separate wavelength regions, as well as identification of a wider range of minerals and mineral species than previously possible with SWIR alone. LWIR sensors provide additional data in applications where dark samples provide poor reflectance for SWIR sensors. The need in the Oil & Gas Industry to differentiate carbonate, clay, and silicate mineral species in dark core provides a unique case study for SWIR-LWIR core imaging implementation.

Through a partnership with ALS Oil and Gas, some of the highest hyperspectral spatial resolutions to date have been captured by TerraCore utilizing Specim's LWIR sensor. High spatial resolution across the SWIR-LWIR wavelength ranges has led to higher signal to noise ratios, resulting in highly accurate spectral parameter extraction. The reduced pixel size of these data also reduces mineral mixtures, resulting in more accurate and detailed mapping of the textural relationships of the minerals in situ.

High-resolution SWIR and LWIR datasets enable geologists and petrophysicists to distinguish previously undetectable, subtle variations in mineral composition with depth along a core providing continuous, high-resolution information that discrete analytical methods do not offer. Additionally, combining the high-resolution SWIR and LWIR data with other measurements allows geologists and petrophysicists to determine the control of mineralogy on the physical properties of the rock, facilitate rock typing, and identify 'sweet spots'.

THU 8 DEC

12:00

CHARACTERIZING HYDROTHERMAL ALTERATION USING WORLDVIEW-3 AND ASTER DATA IN THE HIGH-SULFIDATION EPITHERMAL JAGÜELITO DEPOSIT, SAN JUAN, ARGENTINA

D. F. DUCART[1], C. R. SOUZA FILHO[1] AND G. PENSADO[2]

[1] UNICAMP, BRAZIL
[2] MEXPLORT PERFORACIONES MINERAS, ARGENTINA

Remote sensing data obtained were used to map the hydrothermal alteration in the Jagüelito deposit, host in the Andes Front Range of Argentina. Jagüelito, a high sulfidation deposit located in the southeast sector of the El Indio-Pascua Lama precious metal belt, is related to Miocene volcanism hosted in a Permo-Triassic basement [1]. The permeable volcaniclastic units allowed hydrothermal acid fluid circulation, generating a secondary porosity, or vuggy silica in alteration cores. This high porosity product served as a conduit for the posterior hydrothermal fluids responsible for gold and silver mineralization. This work presents results of a research focused on hydrothermal alteration surficial patterns in the Jagüelito deposit using Worldview-3 and Advanced Spaceborne Thermal Emission Reflection Radiometer (ASTER) multispectral sensor data in order to map the size and zonation of the hydrothermal system.

Conversion to radiance and atmospheric correction were applied to Worldview-3 and ASTER images. A "decision tree classification" method was performed on both images to map different mineral associations. The classification included a group of masks to detect snow and shadow areas, and band ratios to identify the spectral feature morphology associated with each mineral group. The results mapped the advanced argillic, silicic and phyllic alteration of the area. These results illustrate spectral data's exceptional ability in providing valuable information for mineral exploration activities in the Andes.

THU 8 DEC

12:20

REMOTE SENSING OF THE COPPER CREEK DISTRICT, ARIZONA. RESULTS FROM ASTER, AIRBORNE HYPERSPECTRAL AND FIELD SPECTROSCOPY

M. GOOSSENS[1], D COULTER, J. LAMBOITTE AND J SANDBERG

[1] GEOSENSE, NETHERLANDS

Remote sensing data obtained were used to map the hydrothermal alteration in the Jagüelito deposit, host in the Andes Front Range of Argentina. Jagüelito, a high sulfidation deposit located in the southeast sector of the El Indio-Pascua Lama precious metal belt, is related to Miocene volcanism hosted in a Permo-Triassic basement [1]. The permeable volcaniclastic units allowed hydrothermal acid fluid circulation, generating a secondary porosity, or vuggy silica in alteration cores. This high porosity product served as a conduit for the posterior hydrothermal fluids responsible for gold and silver mineralization. This work presents results of a research focused on hydrothermal alteration surficial patterns in the Jagüelito deposit using Worldview-3 and Advanced Spaceborne Thermal Emission Reflection Radiometer (ASTER) multispectral sensor data in order to map the size and zonation of the hydrothermal system.

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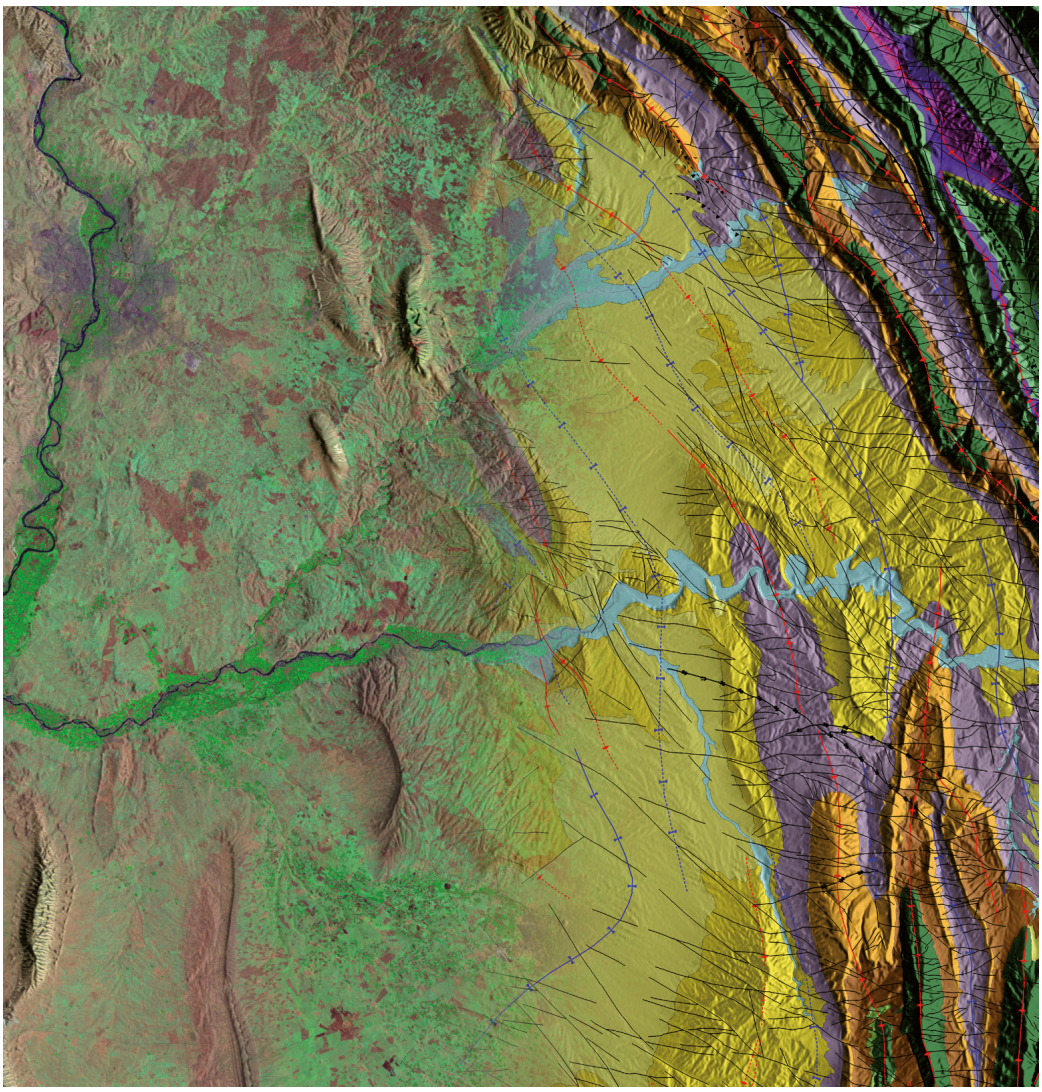

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THU 8 DEC

12:40

SPECTRAL GEOLOGY AND REMOTE SENSING USED FOR MINERAL EXPLORATION IN THE ABU MARAWAT CONCESSION, EASTERN DESERT, EGYPT

M. BROWN, R. CAVANEY AND J. YATES

[1] MAPPA MUNDI SURVEYS LTD, UK
[2] ATON RESOURCES INC

Aton Resources is exploring for gold, silver and base metal deposits in the Eastern Desert of Egypt. The Abu Marawat Concession contains a 40km long gold mineralised trend that runs between the Abu Marawat Gold Project in the NE and the Hamama VMS project in the SW. There are numerous exploration sites in the area that have been mined in recent and/or ancient times including Semna (a sheeted gold bearing quartz vein in granodiorite) and Sir Bakis (a gold rich quartz vein deposit).

Spectral processing of LANDSAT-8 and ASTER regional Remote Sensing data using MMSL's Mineral Mapping techniques has identified some of the known sites within the area as possible hydrothermal alteration linked with mineralisation and some new targets were also generated.

A spectral survey is being conducted with collection of a suite of spectral samples from hydrothermally altered rocks associated with mineralisation in the area. Spectral analysis of these samples will be done using an ASD Terraspec Instrument at ALS Romania. The spectral profiles will be used to further our understanding of the spectral geology of the hydrothermal alteration and also to define at least two areas for acquisition of WorldView-3 Imagery to bring our spectral mapping capability from the regional to the prospect scale.

This presentation will include a brief overview of the geology and mineral deposits of the area. The processing and results from the regional Remote Sensing survey will then be described showing the existing and new targets with field checking results. The results from the spectral analysis of the field samples will be covered with the implications for the likely suitability of WorldView-3 imagery for prospect scale spectral mapping.

If WV-3 imagery has been acquired already then initial results will be presented. Otherwise we plan to present the results at this forum in 2017.

THU 8 DEC

14:15

TEMPORAL MONITORING OF THE 2014-2015 BAROARBUNGA ERUPTION, ICELAND

M. DIRSCHERL

UCL, UK

Topographical information is of fundamental interest for a wide range of disciplines including glaciology, agriculture, communication network planning, or hazard management. In volcanology, elevation data is of particular interest when assessing material flows throughout a volcanic system.

To obtain accurate estimates of time-varying topography in volcanic active regions, high-resolution digital elevation models (DEMs) are required. Whilst ground-based GPS measurements and photogrammetry are restricted in terms of temporal and spatial resolution, the monitoring with airborne laser scanning (LiDAR) depends upon meteorological and illumination conditions and is limited by volcanic ash clouds. The use of space- and airborne synthetic aperture radar (SAR) overcomes such issues and allows the generation of medium- to high-resolution DEMs with interferometric techniques (InSAR). To monitor and evaluate topographical changes and especially volumetric gains and losses during the 2014-2015 Bárðarbunga eruption, Iceland, time sequences of TanDEM-X and F-SAR InSAR DEMs were evaluated differencing pairs of elevation models.

The 2014-2015 volcanic eruption was associated with the rare event of a caldera collapse, visible on the surface of the Vatnajökull glacier, as well as a major effusive eruption in the Holuhraun plain. In order to guarantee the reliability of the topographical analysis at both locations, DEM absolute and relative height errors were investigated and raised the importance of accounting for the impact of system parameters, the SAR processing and the local environment before processing the DEMs. Acquisitions over the snow-covered Bárðarbunga caldera were especially affected by microwave penetration into snow and DEMs over the Holuhraun lava field implied large height errors due to fast moving lava flows.

Considering the TanDEM-X dataset, the topographical analysis over the Bárðarbunga caldera revealed a total volume loss of approximately -1.40 ± 0.13 km3 and the volume gain of the generated lava field was computed at +1.44 ± 0.03 km3. Taking into account the calculation of rates, the temporal development of caldera collapse and lava effusion was found to exhibit a near-exponential decrease. The ratio between subsidence and lava volume moreover indicated the coupling between the processes. The quality of the applied workflow and achieved results was finally verified comparing the results to other reference data and revealed the overall excellent agreement.

THU 8 DEC

14:35

GEOMORPHOMETRIC CHARACTERISTIC OF SELECTED FOSSIL LANDSLIDES IN THE VIPAVA VALLEY, SW SLOVENIA

T. POPIT, B. ROŽIČ AND T. VERBOVŠEK

UNIVERSITY OF LUBLJANA, SLOVENIA

A variety of surface features of the northern slopes of the Vipava Valley in Western Slovenia is mostly represented by the gravitational sedimentary bodies, which were formed by geomorphological processes in Quaternary. With a visual interpretation of shaded digital elevation model and indicators of surface roughness, calculated from the ALS data, we can generally clearly identify the form, prevalence and the characteristics of the surface of individual sedimentary bodies.

The aim of the study is to analyse the geomorphological properties of Podrta gora and Gradiška gmajna fossil landslides, where we roughly identify two main types of movements: structurally conditioned movement and movement that originate from gravitational slope processes. In addition to the material properties, the level of the surface roughness also depends on the depositional processes of slope deposit. These were formed by complex sedimentary events and are intertwined in the geological past. Complexity of these processes is expressed in the form of large rotational carbonate and breccia blocks, which were gravitationally sliding on the flysch basement, the upper weathered part of the flysch or on the muddy sediment. Rotational blocks of Podrta gora landslide exhibit a very low surface roughness, representing the first phase of the transport. Blocks of breccia are also inclined (rotated) toward the slope.

On their outer edges, reverse tilting of breccia blocks occurs and the formation of steep walls with an extremely high degree of surface roughness and also smooth areas in the hinterland depression. Massive avalanche gravel developed from the sediment constituting the rotated blocks, and this was transported into the valley in the form of debris avalanche. Double phase of the Podrta gora event is proven also by the geometry of a secondary main scarp (convexity in the direction of the slope) of the rotated block.

Morphometric analysis showed some specific features concerning the structure. The most distinctive geomorphological element is the downward movement of the huge carbonate block along the Predjama fault that is positioned in the hinterland of fossil landslides and the high intensity of slope processes of Podrta gora and Gradiška gmajna landslides in this area. The results suggest that the whole area might be a part of a large rotary slip of a carbonate massif along the old fault structures.

THU 8 DEC

14:55

ON SAFE GROUND? ANALYSIS OF EUROPEAN URBAN GEOHAZARDS USING SATELLITE RADAR INTERFEROMETRY

R. CAPES AND R. TEEUW

UNIVERSITY OF PORTSMOUTH, UK

Urban geological hazards involving ground instability are costly, can be dangerous, and affect nearly everybody, yet information relating to type, extent or distribution within Europe's towns is largely unknown. A reason for this is the impracticality of measuring ground instability associated with the many insidious processes that are often hidden beneath buildings and imperceptible to normal means of detection. Satellite radar interferometry, InSAR for short, offers a remote sensing technique able to map mm-scale ground deformation over wide areas from one image to the next given an archive of suitable multi-temporal radar data.

The EC FP7 Space Project PanGeo (www.pangeoproject.eu) conducted between 2011 and 2014, incorporated the InSAR technique into work that mapped the area of unstable ground in 52 of Europe's largest towns, representing ~15% of the total EU population. In partnership with all Europe's national geological surveys, the project developed a standardised geohazard-mapping methodology and recorded 1286 instances of 19 types of geohazard covering nearly 17,000km2.

Presented here is an analysis of the results of the downloading and further processing of the PanGeo-project output data to provide a first understanding of the distribution of geohazards by type across European towns, along with their frequency and probability of occurrence. Intersection with Eurostat's GeoStat data also provides a systematic estimate of population exposures. Satellite radar interferometry is clearly shown as a valuable and unique tool in the detection and mapping of urban geohazard phenomena.

THU 8 DEC

15:15

BRAZILIAN FLOODING RESILIENCE: EVIDENCES FROM NATIONAL GEOLOGIC SERVICE

L. O. CEZARINO, C. A. MUNOZ, M. A. Z. NUCCI, M. A. BROVELLI

POLITECNICO DI MILANO, ITALY

Coastal areas are highly susceptible to the effect of climate change, particularly to sea level and extreme rainfall events, resulting in increased social and environmental vulnerabilities (ZANETTI ET AL., 2016). Only in 2016 Brazil has lost six people, displaced over 500 and affected more than 75.000 on flooding disasters (FLOODLIST, 2016). On the other way around big sized cities are growing at 18% rate until 2019 (DA MATA ET.AL., 2006).

Initiatives have arisen to minimize vulnerabilities like geological studies and local agent's partnerships with space agencies, but scare data is available about resilience programs on disasters. Based on that, this paper aims to describe Brazilian contingency resilience to flooding through Open Source Disaster Management Software of Sahana foundation using National Geologic Service open data.

Results show that resilience is being developed specially connected to hills support construction and geologic land taxonomy. Disasters communication channels, social simulation evacuation plans, expert training and designed methods to city development are still missing. Future studies point to the need of crowd contributing open for individual participation opportunities aligned to public policies to city disaster resilience.

THU 8 DEC

16:05

GEOLOGICAL MAPPING USING WORLDVIEW 3 - COMPARISONS WITH ASTER AND HYPERSPECTRAL RESULTS

R. D. HEWSON, C. A. HECKER, H. M. A VAN DER WERFF, F. D. VAN DER MEER AND S. JONES.

[1] UNIVERSITY OF TWENTE, NETHERLANDS
[2] RMT UNIVERSITY, MELBOURNE AUSTRALIA

The launch of DigitalGlobe's WorldView-3 (WV-3) in August 2014 has contributed to the growing number of sensors that the geoscience community has available to map and monitor its resources. Its sixteen VNIR-SWIR bands at a higher spatial resolution than previously offered for civilian satellite image users (Kruse et al., 2015). The eight SWIR bands of WV-3 offers some of the mineral group discrimination abilities of the six SWIR bands of ASTER, although lacking a 2.4 um detector, enabling identification of the diagnostic 2.33-2.36 um absorption features, associated with MgOH bearing phyllosilicates and carbonate minerals. However, WV-3 SWIR sensing offers the opportunity to re-examine areas affected by ASTER's SWIR Crosstalk additive noise issues, where the discrimination of AlOH bearing phyllosilicates can be potentially distorted by anomalous "false" positives (Hewson & Cudahy, 2011).

A study was undertaken to examine the capabilities and processing options for WV-3 using the Cuprite, Nevada, and Mt Fitton, South Australia, remote sensing test sites. Both test sites contain a range of host rock types with hydrothermal mineral alteration overprinting, previously acquired by airborne hyperspectral and ASTER imagery, and possessing the control of detailed published geological mapping. WV-3 radiance at the sensor imagery of Cuprite and Mt Fitton was calibrated and processed to Log Residuals (Green & Craig, 1985), post dark pixel subtraction for aerosol effects, and both band parameter and Mixture Tuned Matched Filtering (MTMF) spectral unmixing (Kruse et al., 1993) techniques were attempted for geological mapping. Empirical Line Method (ELM) (Smith & Milton, 1985) and ENVITM 's FLAASH atmospheric correction routines were also applied to derive surface reflectance's which was also used as input for the MTMF spectral unmixing technique.

The WV-3 Log Residual, ELM, and FLAASH results produced favourable comparisons to previous published geological mapping and hyperspectral results. Despite the lack of a 2.4 um detector, the WV-3 was capable of discriminating Mt Fitton's Balcanoona Dolomite from the talc / tremolite alteration. The simulation of shaded topographic relief / low irradiance, under solar illumination at the time of Mt Fitton WV-3 acquisition, also revealed the absence of false anomalies, unlike observed from ASTER's Crosstalk effects, particularly for winter acquisitions (Hewson & Cudahy, 2011). The use of Log Residual WV-3 radiance data for MTMF processing at Cuprite also produced similar mineral mapping outcomes as generated using ELM reflectance's, by this study, and also by Kruse et al. (2015).

THU 8 DEC

16:25

HYPERSPECTRAL MINERALOGICAL AND LITHOLOGICAL MAPPING OF METASEDIMENTS AND METAVOLCANICS OF GAMSBERG, AGGENEYS, SOUTH AFRICA

M. C. SCHODLOK AND M. FREI

BGR, GERMANY

Conventional hyperspectral remote sensing covering the wavelength range from the visible light up to the shortwave infrared (VNIR-SWIR) is a well-known and accepted technology. It provides e.g. information to map secondary mineral phases of alteration zones to support the exploration of minerals deposits. With the improvements in sensor development modern and operational hyperspectral imaging systems covering the thermal infrared wavelength (TIR) range are now available. Using the full wavelength range of the optical remote sensing improves mapping and exploring mineral deposits as well as their surrounding geology.

This enables the geologists to additionally detect e.g. anhydrous silicates such as quartz and feldspar, garnets and pyroxenes. This study demonstrates the usage of a full optical wavelength range hyperspectral airborne data set to characterize and map lithology and mineralogy of the Gamsberg, Aggeneys South Africa and its lead, zinc and copper mineralization. Spectral data (VNIR-SWIR, 04 – 2.5 nm and TIR, 7.7 – 11.4 µm) were simultaneously acquired during a flight campaign in July/August 2015 with a spatial resolution of 2.5 m and 99 flight lines with an overall coverage of approximately 1000 km^2.

The data were preprocessed by ATCOR4 to retrieve surface reflectance data for the VNIR-SWIR and emissivity data for TIR based on the normalized emissivity method. The mineral mapping is based on a multi-feature extraction method applied on the significant diagnostic spectral features. Ambiguities were minimized by defining rules such as a minimum number of spectral features for a given mineral and by combination of features from VNIR-SWIR and TIR if applicable.

This study presents the results of the spatial surface distribution of mineral phases at Gamsberg and demonstrates the improvement of mineral classification by combining VNIR-SWIR and TIR spectral information. The results are discussed in context of the Gamsberg mineralization and geology.

THU 8 DEC

16:45

DISTRIBUTION OF HYDROTHERMALLY ALTERED ZONES AND THEIR RELATION WITH FRACTURE PATTERNS AT THE DOMEYKO RANGE BETWEEN 20° 35' S AND 21° 17'S, (REGIÓN DE TARAPACÁ, CHILE): A REMOTE SENSING AND GIS STUDY

B.SZADMAN[1], J. LATTUS[1,2], G. FUENTES[1,3] AND F. HERVE[1,4]

[1] UNIVERSITY OF CHILE, CHILE
[2] SRGIS GEOLOGIA Y GEOMATICA LTDA
[3] UNIVERSITY SANTO TOMAS, CHILE
[4] UNIVERSITY ANDRES BELLO, CHILE

We present here the results of the treatment and analysis of satellite images (Landsat-8 and ASTER) for recognition of hydrothermally altered zones, which are primary guides for exploration of porphyry copper deposits.

The main objective of this study was to assess the distribution of hydrothermally altered zones and their relation with fracture patterns at the Cordillera de Domeyko between 20° 35' and 21° 17'S, through analysis of Landsat-8 and ASTER satellite images together with GIS techniques. The selected study area was chosen because it holds three known deposits (Quebrada Blanca, Rosario-Collahuasi and Ujina) that define the northernmost mining district of the Eocene-Oligocene metallogenic belt of northern Chile, which is the most important concentration of copper worldwide.

Visual and automatic detection of lineaments were performed using several sources of information, such as panchromatic images, digital elevation models (DEM) and true color Landsat and ASTER images. Two different methods to extract automatic lineaments where used, including different input images, directional filters and automatic extraction parameters to compare and validate this technique.

Also, hydrothermally altered zones were identified using band ratio analysis with Landsat-8 images. Of the 8 areas identified as hydrothermally altered zones (three are known deposits and five were detected with satellite images), four were selected for identification of specific mineralogy and recognition of hydrothermal zones (Advanced Argillic, Sericitic, Propylitic and Quartz) with ASTER images, resulting in favorable spectral response for each one.

Finally, an analysis was made regarding on how fractures (lineaments) control the location of known porphyry copper deposits and newly identified hydrothermally altered areas. Results show that hydrothermally altered zones are distributed along: (i) N-S fractures; (ii) NS-NW fracture set intersections; and (iii) NS-NE fracture set intersections. This pattern evidence that hydrothermally altered zones distribution is structurally controlled, either by basement-core anticlines and/or by strike-slip tectonics.

THU 8 DEC

17:05

HOT STONES: MAPPING IGNEOUS KIMBERLITES UNDER KALAHARI COVER USING LWIR IMAGERY

N.PENDOCK

INDEPENDENT CONSULTANT / TERRACORE INTERNATIONAL, SOUTH AFRICA

The ASTER database of three million images was placed in the public domain in April. The availability of high quality multispectral thermal imagery collected over two decades is a useful resource for hindsight exploration.

We present the example of the Damtshaa diamond mine in Botswana which was opened in 2003. A novel temperature/emissivity separation algorithm was performed on 2000 and 2015 vintage scenes and emissivity endmembers were extracted.

The 2015 image was used as ground truth to identify an ultramafic emissivity endmember which occurs in both images and demonstrates the utility of satellite thermal imagery for kimberlite exploration under cover.

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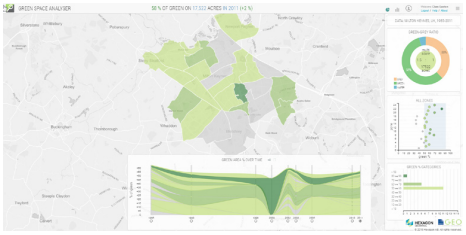

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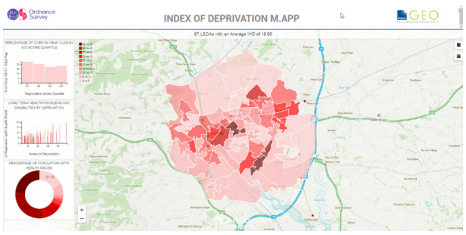

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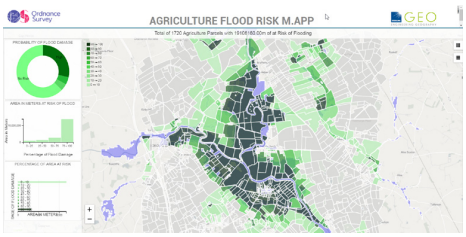

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THU 8 DEC

17:25

MULTISENSORAL DETECTION OF LATERITES AND THERE WATER STORAGE CAPACITY IN BURKINA FASO

M. KASNER, M. DENK AND C. GLAESSER

MARTIN LUTHER UNIVERSITY HALLE, GERMANY

With regard to the ongoing climate change and associated water supply problems in developing countries different it is necessary to built up water reservoirs for the precipitation. In Burkina Faso different laterite units are varying in suitability for storing water. The test site is located in the northern part of Burkina Faso with low precipitation. The main objective of the presentation is the detection of laterite types with ASTER, Landsat 8 and WorldView 2 satellite data. Therefore existing field samples from previous works (NIKIEMA, 2009) are being examined with XRF, XRD and spectroscopy and also a range of mineral ratios and colour composites for highlighting different types of laterite are being created.

Certain mineral ratios such as the Iron Oxide Ratio or a self-invented Test Ratio were tested and the results were compared between the sensors. The advantages of the different methods and sensors were discussed. More over we create sensor specific colour composits from different ratio images to enhance the separability of the laterites.

Comparing the different methods we can develop a multisensor workflow for detecting the laterites, laterite debris, granites, schist, sands and clay, In this manner lateritic debris units, suitable for storing water, can be detected on wide areas, especially on Greenstone-Belt-mountain-ranges with high relief intensity. Furthermore probably aeolian transported sands from the Sahara can be detected, which might also be suitable for water storage in these regions.

The result can be validated by applying the method on areas with different geological signature and subsequent comparison to high resolution satellite imagery.

FRI 9 DEC

9:00

KEYNOTE: AUSTRALIA'S VERSION 2 ASTER MINERAL MAPS UNMIXED OF THE EFFECTS OF GREEN AND DRY VEGETATION

T. CUDAHY, M. JONES AND M. CACCETTA

CSIRO MINERAL RESOURCES, AUSTRALIA

One of the main objectives of the CSIRO-GSQ Queensland 3D Mineral Mapping project is public delivery of state-wide ASTER geoscience maps corrected for a number of issues that hindered optimum geological use of the Australian ASTER Version 1 (V1) geoscience maps. One of these issues was variable vegetation cover for which the new Version 2 (V2) ASTER mineral products have addressed through new unmixing methods. This unmixing has resulted in more than double the number of pixels being detected with mineral information (previously recorded as "null" data) and with this information being more seamless (e.g. less evidence of paddock boundaries and fire scars).

The improved accuracy has been statistically assessed using Geoscience Australia's National Geochemical Survey of Australia sample suite. The improvement in geological mapping was tested for a number of areas, including Mt Carlton 140 km SSE of Townsville where Evolution Mining had delineated a 20 km narrow zone of advanced argillic and phyllic alteration with patches of economic Au-Cu mineralisation. This zone was mapped out post 2008 using field spectrometry to reveal a suite of high sulphidation alteration minerals including alunite, pyrophyllite, dickite and/or kaolinite characteristic of advanced argillic alteration in both surface samples and drill core.

The spectral band passes of ASTER were designed to measure and map advanced argillic (and other) alteration though the ASTER V1 geoscience maps failed to show any related mineral information for this area, presumably because of vegetation cover. In contrast, the ASTER V2 processing clearly maps this alteration zonation from satellite data that was collected >5 years before Evolution Mining began its detailed field mapping. A similar vegetation unmixing method was also tested on Digital Globe's WV-3 satellite imagery from the Starra area in the Mount Isa Block.

The success of this vegetation unmixing methodology on multispectral remote sensing data means that seamless 3D maps of mineralogy can now be generated more easily from "fresh rock to space" with significant opportunities for exploration across Queensland (and beyond).

FRI 9 DEC

9:40

ASTER VALUE-ADDED PRODUCT

K. IWAO, J. ISHII, H. YAMAMOTO, K. OBATA AND S. TSUCHIDA

AIST, JAPAN

Geological Survey of Japan (hereafter GSJ) released ASTER, Advanced Spaceborne Thermal Emission and Reflection Radiometer, Value-Added (hereafter ASTER-VA) product free of charge in April, 2016. Its data of about 3 million images collected from 2000 to 2016 cover the entire globe, and have great potential for use in variety of businesses.

Aiming to promote their use, GSJ has distributed them for free with added value so as to meet not only for the exploration but the industry needs.

A technique to simulate a blue band, which ASTER lacks, has been developed to reproduce images in natural color. For example, it enables a composite image of forests to look more natural. The data can easily be integrated with other GIS data as images are ortho-rectified with DEM with geographic coordinates.

MADAS is a system which can search for the ASTER-VA data without registration. ASTER-VA can be browsed and download as KML and GeoTIFF format. ASTER-VA data as KML can be browsed on Google Earth etc. ASTER-VA displayed on a map makes it easy to sight the state of the earth surface as the pseudo -natural color image.

It is also possible to take a look the image with a tablet terminal or a smart phone by using the satellite imagery inspection application. The user can also download ASTER-VA which is ortho-rectified, when the Tar button is pushed. This ASTER-VA contains all the ASTER ortho-rectified bands plus generated scene based DEM, except for the band3B data.
Atmospheric correction is not applied for the image. GeoTIFF format is applied which is easy to use with GIS software. Data is compiled as a single tar.gz file which can be uncompressed by using free software.

FRI 9 DEC

10:00

SPATIAL HYPER-DEPTH SPECTRAL ANALYSIS USING THE VNIR-SWIR REGION FOR INNOVATIVE SOIL CLASSIFICATION

Y. OGEN AND E. BEN DOR

TEL AVIV UNIVERSITY, ISRAEL

Visible, near infrared and shortwave infrared (VNIR–SWIR) spectroscopy has proven to be an efficient, rapid and low-cost method for soil spectral analysis that can improve on the results from traditional methods used today to conduct soil surveys.

Nonetheless, this tool is being used mostly at the laboratory and surface levels. The main objective of this paper is to demonstrate a new optical method for characterizing soil profiles that provides an alternative for the rapid and accurate extraction of soil entities for classification/taxonomical purposes. We combined airborne hyperspectral data using the FENIX sensor for surface classification and ASD spectral measurements of soil samples for sub-surface analysis.

A total of 643 soil samples were taken from 45 cores, of which 40 cores were divided into 15 samples, 4 cores into 9 samples and 1 core into 7 samples each core representing a soil profile. Samples were air-dried, crushed and sieved, and then measured using an ASD spectrometer under laboratory conditions. In addition, clay content (%) was determined using laser diffraction for supplementary information. The 3D spectral data were analyzed with the SAM algorithm, spectral gradient ( ) and a gley horizon parameter ( ), which identifies soil-formation processes such as gleying along the soil's core.

The ASD spectral data were analyzed by k-means clustering for the classification of soil samples using SPSS software. The results suggest that these parameters can provide satisfactory results for distinguishing between the soil horizons remotely using spectral information in 3D. Moreover, the method demonstrates satisfactory feasibility for obtaining soil types from 3D spectral sensing, as well as for evaluating catena development and other spatial distributions of soils.

This work is, to the best of our knowledge, the first successful attempt to classify soils using 3D spectral information and should be further developed for geological cores and deep-drilling characterization.

FRI 9 DEC

10:20

THE COPPER MINING CYCLE IN CHILE - APPLICATION OF EO DATA AND DIGITAL MAPPING TECHNIQUES

S. SPITTLE AND T. JONES

CATAPULT, UK

The Satellite Applications Catapult is leading an international team of British and Chilean organisations which are investigating how satellite technology can improve mining operations in Chile's Coquimbo region, with a particular focus on small and medium sized companies which often represent the major part of local economies.

Alongside the Catapult, the five-strong "Project Hephaestus" consortium includes the British Geology Survey, and from Chile the Empresa Nacional de Mineria (ENAMI), the Servicio Nacional de Geologia y Mineria (SERNAGEOMIN) and the Comision Chilena del Cobre (COCHILCO). There are also many UK and European value adding companies and information data suppliers with UK Trade and Investment at the British Embassy Santiago providing essential location coordination and facilitation support.

The project is focused around the sustainable economic development of medium sized mineral extraction companies in Chile with the following vision: empowering all relevant parties in the small to medium sized mineral extraction supply chain, via increased use of data and associated analytics. This will enable evidence based decisions on where to focus efforts to stabilise and then enhance economic support for the regional mining eco-system.

The project, Hephaestus, was split into three overarching activities: supply chain modernisation, environmental impacts and geological exploration. The British Geological Survey took a lead on the geological exploration with the Catapult leading the other two areas. This presentation will be focused on a number of the identified applications of EO for the mining sector in Chile – with specific examples.

FRI 9 DEC

11:10

AIRBUS DS DATA PORTAL – MEETING THE CHANGING REQUIREMENTS OF THE REMOTE SENSING COMMUNITY

A.KYLE

AIRBUS DEFENSE AND SPACE, UK

There is no doubt we are currently entering a new era within Remote Sensing; as satellite technology improves we are seeing a steady increase in product innovation that makes use of optical and radar imagery. In addition, advances in technology have lowered the costs of satellite production leading to an increasingly competitive market.

Despite these advances in satellite technology, the end products are often distributed to the user/customer via methods such as physical media and FTP. In a market that is becoming increasingly security conscious; and with larger data volumes combined with advanced analytics, web-based data delivery and access mechanisms are becoming progressively more important. In order to address these requirements the 'Airbus DS Data Portal' has been developed offering a cloud based portal system that allows satellite data and derived products and analytics to be hosted, delivered and displayed via a secure and easy to use platform.

Effective data management is relevant to a range of industries including Oil, Gas and Mining (OGM) with potential issues storing and accessing vast amounts of data. This has led companies to adopt portal systems in order to reduce inefficiencies associated with data management and is especially relevant at present given the downturn affecting these industries. The development of the Portal also aligns with the increasing requirement for good data management within the Remote Sensing community, including Civil Engineering, Geomatics, Security and Crisis Monitoring and Environmental Monitoring.

The Data Portal provides 'Data Hosting Solutions', 'Web Services' which display relevant products and 'Data Management Services' which allows tailor made solutions for customers such as customised applications and bespoke portals for internal and external datasets.

In this presentation the Portal will be demonstrated for a range of remote sensing datasets for a number of application areas including the global seeps database and onshore geological interpretation products.

FRI 9 DEC

11:30

HIGH SPATIAL RESOLUTION SATELLITE EARTH OBSERVATION – A RELIABLE TOOL FOR SITE MONITORING ACROSS MINING, OIL AND GAS AND ENGINEERING

P. HAUSKNECHT

EARTH-I, UK

Data availability from satellite resources has increased over the last few years and the consumption of data has grown to absorb that increased supply.

The ESA / EU Sentinel programme has well and truly pushed the medium resolution satellite data into the 'Big Data' space and service providers are fast coming up with the tools to harvest such free data volumes.
On the other side the high resolution spatial satellite sector has been left to the commercial providers and such data has often been seen as expensive or not suitable for operational monitoring, partly due to limited reliable availability. But this is changing now and new players are entering the market; the cost for 'fit for purpose' and highly reliable satellite sensors has come down and the market is getting more competitive. Fresh high resolution optical data is potentially available for every place on earth every day, of course cloud cover permitting. Data collection capabilities, on board storage and a global network of downlink stations have almost but done away with any data collection restrictions seen in the past. And new concepts of small cube-sat type space sensors will likely revolutionise data availability in the next few years.

Monitoring of infrastructure, from development to decommissioning, will not be a 'nice to have' but an essential part of any responsible manager's information tool box, to be at any time in a position to make the most informed decisions with an up-to-date situational awareness. Such capabilities also support the oil & gas industry's efforts on the establishment of a Common Operating Picture for any emergency response, highlighting the importance of Earth Observation or remote sensing as published in the recent OGC document.

Of particular relevance is the decommissioning of assets in the North Sea and the environmental friendly, clean and safe operation to achieve that effectively with little or no negative environmental impact. Regular monitoring of the asset and its environment, utilising Earth Observation and complementary techniques, will help to assure the operator that procedures are going to plan and also allow the public and the regulator to gain a better understanding of the events in question. There is great credit to be gained from high value reporting and documentation with detailed spatial information.

Requests for innovative solutions and suggestions to standardise monitoring procedures - even proposals for joint industry projects - can be published at the OGEO portal, a joint initiative if the IOGP's EO subcommittee together with EARSC and ESA, developed as a consequence of industry consultation. The cooperation of all the oil & gas industry to develop guidelines, procedures and even standards will make Earth Observation a more efficient tool and the expertise. Support from the service providers will ensure efficient data provision and fit for purpose EO solutions.

FRI 9 DEC

11:50

OPERATIONAL ICE CHARTING IN MID-LATITUDES USING NEAR REAL TIME SAR IMAGERY

S. VERMYAYEV[1], C. DEBART[2], Y. KADRANOV[1] AND A.SIGITOV[1]

[1] ICEMAN, KAZAKHSTAN
[2] KSAT, NORWAY

Operational ice charting is mainly performed with means of SAR imagery. Due to peculiarities of planning imagery acquisition in mid-latitude regions, where revisit of a single satellite may be up to three days, multimission programs utilising several platforms are normally considered to achieve up to daily coverage. Multi-mission (up to 5 different satellites), multi-sensor (both optical & radar of different resolutions) in NRT (Near Real Time) are essential data inputs to an ice charting team, whose goal is to provide time critical daily summary and forecasts to Oil&Gas operators in the ice covered waters of the Caspian Sea in winter.

In order to ensure consistency between the interpretation of different images we have evaluated several ice features that formed in the stationary zone of the Caspian sea during winter 2015-2016. As the features didn't move significantly in a certain period of the season they could be traced on SAR images provided by KSAT and acquired with various satellites with a certain degree of confidence that is discussed in this case study.

FRI 9 DEC

12:10

CHARACTERIZATION OF TIGHT SHALES FROM SPECTRAL IMAGERY OF DRILL CORE.

B.RIVARD[1], J. FENG[1], H. CORLETT[2] AND N. HARRIS[1]

[1] UNIVERSITY OF ALBERTA, CANADA
[2] ALBERTA GEOLOGICAL SURVEY, CANADA

Shale reservoirs are major resources of natural gas and oil. The total organic carbon (TOC) content and the quartz/clay ratio of shales are critical elements of reservoir characterization. TOC influences the volumes of hydrocarbon generated and the fraction of porosity. The quartz/clay ratio influences the mechanical properties of formations and therefore whether they are prone to develop natural or hydraulically induced fractures. Quantitative measurements of these properties are now based on either direct chemical analyses of rock samples or interpretations of well logs.

Well logs provide a continuous record but average properties at scales up to one meter. Chemical measurements are a subsample of the entire formation and offer an incomplete or blurry record of the rock properties that vary significantly at smaller scales. Continuous high-resolution spectral imaging measurements of properties that control hydrocarbon storage and flow and the rock mechanical strength of reservoirs would be very valuable.

From the collection of shortwave infrared (1-2.4µm) and longwave infrared (8-12µm) spectral imagery at a spatial resolution better than 1mm/pixel, we report on the predicted distribution of TOC, several minerals and geochemical indices for a number of shale formations. Predictive models are constrained by approximately 100 analyses of TOC and whole rock geochemistry.

These data are used to: 1) highlight sedimentological evidence not perceived visually, 2) defined formational and intra formational boundaries, and 3) examine geochemical and mineralogical changes and patterns across stratigraphic sections. Spectral imaging of drill core in high resolution maps reveals the distribution of minerals and organic matter in shale section that otherwise appeared largely monotonous to the eye.

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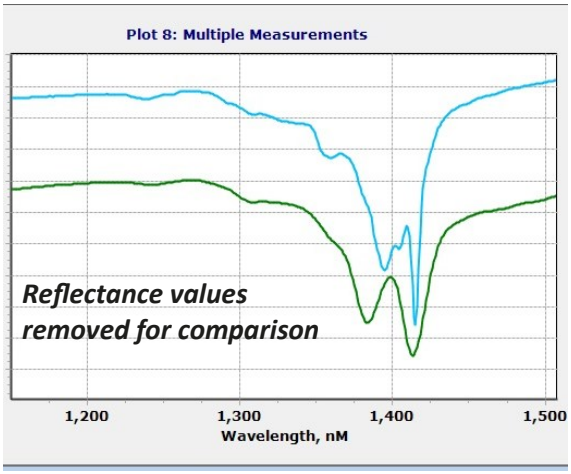
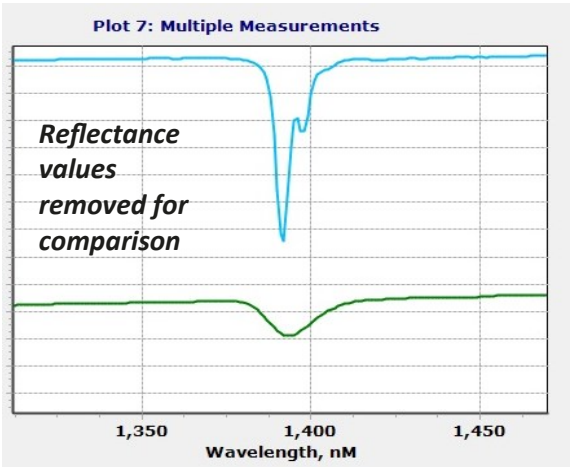


Kaolinite scan feature close-up.
Top – SR-6500
Bottom—standard field spectrometer



Talc scan feature close-up.
Top– SR-6500
Bottom—standard field spectrometer

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SPECTRAL EVOLUTION

FRI 9 DEC

13:30

INTERMITTENT SBAS (ISBAS) TO CHARACTERIZE SURFACE DEFORMATION OVER RURAL AREAS: IMPLICATIONS FOR ONSHORE OIL AND GAS REGULATORS AND OPERATORS

A.NOVELLINO[1], A. SOWTER[1], D. GEE[1] AND S. MARSH[2]

[1] GEOMATIC VENTURES LIMITED, UK
[2] UNIVERSITY OF NOTTINGHAM, UK

Satellite radar interferometry is a well-documented technique for the characterisation of ground motions over large areas. However, the measurement density is often constrained by the land use, with best results obtained over urban areas.

The Intermittent Small Baseline Subset (ISBAS) method was conceived to improve the coverage of the standard SBAS methods over non-urban classes so that areas exhibiting intermittent coherence are considered alongside those displaying full coherence.

The result provides improved coverage and characterisation of ground motion over areas affected by instabilities. The greatest impact of the ISBAS implementation is in rural areas by showing up to four times increase of radar targets coverage if compared to SBAS conventional methods which provided limited results due loss of coherence.

The technique has been already successfully and validated through ground truth data over the gas production and geostorage site of Alkmaar area in Netherlands thanks to ERS and ENVISAT imagery. These results confirmed the capability of the ISBAS method to provide a more regular sampling of land motion measurements over gas fields that may be critically used in future to infer the properties of buried, fluid-filled, porous rock and improve modelling of land surface displacements caused by gas fields.

FRI 9 DEC

13:50

GEO: EARTH OBSERVATIONS FOR MANAGING MINERALS AND NON-RENEWABLE ENERGY RESOURCES

STEHPANE CHEVREL[1] AND STUART MARSH[2]

[1] CONSULTANT, MINPOL, DREISTETTEN, AUSTRIA
[2] UNIVERSITY OF NOTTINGHAM

GEO, the Group on Earth Observations, recognizes the societal importance of energy and minerals and has approved a new "Energy and Mineral Resource Management" Societal Benefit Area during its twelfth Plenary Session in Mexico City in November 2015.

As part of this Societal Benefit Area, the GEO Community Activity "EO for managing Mineral and Non-Renewable Energy Resources" (CA-06) aims at i) developing integrated EO-based tools and information for the resource assessment, monitoring and forecasting of geological resources (including mineral and fossil resources, raw material), ii) developing tools for monitoring the impact of mining operations and iii) identifying and fostering implementation of strategic measures for the competitive, reliable and sustainable management of geo-resources exploitation and treatment of re-usable materials.

Mineral and non-renewable energy resources today lack dedicated EO system or program and currently use EO systems and programs from other SBAs. Global coverage by high-spectral resolution spaceborne sensors in particular is currently not available and upcoming missions still will not provide the required high spectral resolution to cover the needs of the raw material community.
Numerous studies and projects demonstrated the value of imaging spectroscopy in particular in mineral prospecting as well as in the assessment of environmental impacts of mining and post-mining. Potential raw materials benefits and opportunities however are still untapped, while on the other hand technology is mature enough to fill important observation gaps.CA-06 hence, together with the mineral remote sensing community, strongly advocates for operational hyperspectral spaceborne missions ensuring a global systematic coverage at no (or marginal) costs and at required spectral and spatial resolution. This probably could not be achieved without institutional support at national and/or international level. The fight against illegal mining in developing countries, with its often disastrous environmental and societal consequences, could facilitate gaining such a support. CA-06 will actively promote the use of EO in this sector.

Preparatory works consist in the demonstration of the potential of the upcoming missions, exploiting of current soil spectral models for applications at regional scale, and the development of global spectral library of soils for future quantitative soil spectroscopy from laboratory to spaceborne applications.
The ASTER Geoscience Map of Australia, generated from satellite ASTER data, thanks to its global coverage, has paved the way for the production of a global mineral map of the Earth's surface to be later delivered to GEOSS.
EO can help to achieve the UNDP Sustainable Development Goals (SDGs) through provision of global reach, non-invasive, scalable, temporal, accurate maps and models of land surface composition and condition at all stages of the resource development cycle from exploration and discovery through to mine closure. CA-06 is well positioned to work with the UNDP and WEF to help harness this array of EO technologies to develop and deliver those critical information products that will have greatest SDG impact.

FRI 9 DEC

14:10

COMPARISON BETWEEN LINEAR AND NON LINEAR SPECTRAL UNMIXING METHODS FOR HYPERSPECTRAL DATA

A M. AHMED, Y ZWEIRI, O. DURAN AND M. SMITH

UNIVERSITY OF KINGSTON, UK

Spectral unmixing is a key process in identifying spectral signature of materials and quantifying their spatial distribution over an image.

The main aim of this paper is to investigate linear and nonlinear methods used to solve spectral unmixing problem, the methods were compared based on their prediction accuracy, robustness against noise and computational time using laboratory simulated data with respect to different levels of Signal to Noise Ratio (SNR).

Results show that the nonlinear models performs well in the presence of high SNR but are computationally expensive while the linear models does better with low SNR.

POSTERS

ALL DAY

REFLECTANCE AND IMAGING SPECTROSCOPY APPLIED TO SEAMLESS DETECTION OF PETROLEUM HYDROCARBON POLLUTION IN BARE SOILS

R. E. CORREA PABON[1], C. R. DE SOUZA FILHO[1] AND W. J. DE OLIVIERA[2]

[1] UNICAMP, BRAZIL
[2] PETROBRAS, BRAZIL

Accidental releases of hazardous waste related to the extraction, refining and transport of oil and gas are inevitable. Petroleum facilities and intrinsic pipelines present environmental pollution risks, threatening both human health and ecosystems.

Research has been undertaken to enhance the conventional methods for monitoring hazardous waste problems and to improve time-consuming and cost-effective ways for leak detection and remediation process. In this study, both reflectance and imaging (hyperspectral) spectroscopy are used for detection and characterization of petroleum hydrocarbon (PHC) contamination in latosols. Laboratory and field measurements of PHC-contaminated and PHC-free soils were yielded using a portable high resolution spectroradiometer (2150 channels) covering visible, near infrared and shortwave infrared wavelengths (VNIR-SWIR: 350-2500 nm).

The hyperspectral dataset was acquired with an instrument covering 357 channels in the VNIR-SWIR range at 1 m of spatial resolution. Narrow intervals of reflectance spectra were analyzed to identify the primary mineral and PHC absorptions bands in soil samples and to investigate the spectral match with hyperspectral data. The Multiple Endmember Spectral Mixture Analysis (MESMA) method was employed in three hierarchical levels to classify the hyperspectral imagery. Classification products yielded from MESMA models at the second and third level were 92% and 93% accurate in discriminating dominant land cover classes and detecting contaminated soils. The results demonstrated the applicability of reflectance and imaging spectroscopy to identify bare soils contaminated by PHC leaks and spills.

These technologies can also provide useful information for remediation initiatives, thereby avoiding further problems with hazardous waste.

POSTERS

ALL DAY

PROPOSAL OF THE NEW SPATIAL FILTERS FOR THE LINEAMENTS MAPPING: APPLICATION TO THE HYBRID IMAGES RESULTING FROM THE MERGING OF LANDSAT 8 AND PALSAR IMAGES OF THE PRECAMBRIAN BASE OF ABOUTELFAN (CENTRAL MASSIF, CHAD)

D. RIRABE[1,2], K. F. KOUAME[1], I. MOUSSA[2], V.-C JOFACK SOKENG[1] AND M.B. SALEY[1]

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[2] INSTITUT UNIVERSITAIRE POLYTECHNIQUE DE MONGO (IUPM)

This study is related to a part of the area of Guéra, located between the latitudes 11°44' and 12°28' and longitudes 18°30' and 19°10'.It lies within a more general scope of the lithostructural mapping of the central massif of Chad for the comprehension of its geodynamic evolution and for the development of a hydrogeological model with discrete fractures.

The principal objective aims at showing the contribution of the proposal filters for the lineaments mapping. The study is based on the exploitation of L8-PALSAR images, resulting from the fusion of Landsat 8 and PALSAR images followed by a descriptive statistical study.

A comparative study of the lineaments extracted on the second principal component from images L8-PALSAR filtered with the filters proposed and those from Sobel in the four directions from space (NS, EW, and NW) shows that the features obtained by the new filters present a great number and cumulated lengths higher than those of Sobel.

POSTERS

ALL DAY

ANALYZING ACTIVE LAVA FLOW THERMAL USING SPACE BASED REMOTE SENSING SWIR-TIR BANDS DURING 2014-2015 HOLUHRAUN ERUPTION, ICELAND

M. AUFARISTAMA[1,2], A. HOSKULDSSON[1], I. JONSDOTTIR1 AND T. THORDARSON[1]

[1] UNIVERSITY OF ICELAND, ICELAND
[2] UNIVERSITAS PADJADJARAN, INDONESIA

Effusive eruption produce basaltic lava flows which pose a threat to human activity that can be mitigated by considering how flows are emplaced. This eruption produces two fundamentally different lava morphologies, pahoehoe and aa, that can be linked to different rates and mechanisms of flow advance.

Holuhraun is a lava field in the Icelandic Highlands, north of Vatnajökull which is the largest effusive eruption in Iceland since the Laki eruption in 1783–84 A.D, with an estimated lava volume of ~1.2 km3 covering an area of ~84 km2. The lava field was created by fissure eruptions during August 2014-February 2015. Remote sensing technique using satellites and airborne is alternative tool to monitor in detail the eruption area that is inaccessible or difficult to access.

In this study we used SWIR and TIR from Landsat 8 datasets from the beginning of eruption and then using dual band method (Lombardo, Merucci, & Buongiorno, 2006) to determine the thermal structure of active lava flows within Holuhraun lava field. We successfully derived the hot temperature model of lava flow within range 600-1073 celcius during beginning-the end of eruptions. Hot component mostly dominated by vent, lava channel and breakout.

The mean temperature of the lava vent is decreased during the eruption (highest in mid of October-November 2014).Validation of temperature has to be performed using ground truth temperature (FLIR) and other satellite datasets (Hyperion, ASTER, ALI, etc). This topic still remains open for further study to derive multicomponent thermal structure in order to get better analyses of lava flow emplacement mode and morphology.

POSTERS

ALL DAY

HIGH RESOLUTION SPOT 6 IMAGERY DEPICTS MOTOR VEHICLE POLLUTION INDUCED VARIATIONS IN ROADSIDE GRASS VIGOUR ON CONTRASTING GEOLOGY AT MAFIKENG, SOUTH AFRICA

C. MUNYATI

NORTH WEST UNIVERISTY, MMABATHO, SOUTH AFRICA

Chemicals in motor vehicle exhaust fumes, tyre and brake components as well as cargo pollute the soil in the vicinity of highways. The chemicals affect soil fertility through chemical properties such as potential of hydrogen (pH), cation exchange capacity (CEC), and base saturation (BS), which in turn can influence the vigour of roadside grass. In semi-arid savanna environments such as that in northwestern South Africa such pollution can contribute to rangeland degradation.

Advances in sensor capabilities present opportunities for rangeland managers to quantify the effect of the motor vehicle pollution on rangelands. In this study high spatial resolution images from the recently launched SPOT 6 were used in assessing the effect of the motor vehicle pollution on the vigour of grass within 100m of the four main highways at Mafikeng, South Africa.

The geology of the area is andesite and limestone, and the soils are petric calcisols. Under the two treatments of urban and rural highways soil samples were collected in 60m transects radiating from the roadside, at 20m intervals. BS, CEC and pH were then determined from the samples, and their inter-treatment statistical differences determined using analysis of variance.

Rain season (peak grass vigour) SPOT 6 images of the study area were than obtained. The image data were converted to top-of-atmosphere reflectance. Pan-sharpening through resolution merge enhanced the 6m resolution of the multispectral bands to the 1.5m resolution of the panchromatic band. In locations where the roadside grass cover was undisturbed by human activity NDVI values generally correlated with soil fertility, and increased away from the roadside irrespective of the geology.

The effect was significantly more acute along the urban highways ($F = 39.7$, $p < 0.01$). The detection of the spatial patterns was made possible by the improved spatial and spectral resolution capabilities of the SPOT 6 sensors.

POSTERS

ALL DAY

THE METHODOLOGY OF GEODYNAMIC POLYGON DEVELOPMENT BASED ON GEODYNAMICAL ACTIVE ZONES DISTRIBUTION MAPS

A.FREMD, D. TALGARBAYEVA, A. YELISSEYEVA AND B. ISKAKOV

NATIONAL CENTRE OF SPACE RESEARCHES AND TECHNOLOGIES, ALMATY, KAZAKHSTAN

As a rule, any mineral resource field development is accompanied by deformation processes caused by disturbance of geodynamic equilibrium of geological environment. Consequences of such disturbance are manifested in induced seismic activity and accompanying phenomena, sometimes resulting in environmental disasters of different scale. In order to prevent unexpected occurrence and unpredictable consequences of man-caused events, instrumental monitoring systems are created. Their creation requires reasonable grounds in the form of geodynamic zoning maps. Creation of such maps is a very responsible stage influencing the configuration of geodynamic monitoring networks and hence all subsequent results and conclusions.

For the purpose of geodynamic zoning in most cases the results of engineering survey works are used, including the data of geomorphologic and geophysical studies, assessments of rock massif stress-strain behavior, etc., that require a lot of efforts and time.

This work is focused on methods of using the Earth remote sensing (ERS) data for the purpose of geodynamic zoning. The results are illustrated by an example of digital elevation model (DEM) analysis for the territory of Central Kazakhstan, including the Karaganda coal basin. Proceeding from the obtained results, a geodynamic grounding has been developed for the network of comprehensive monitoring of the territory under investigation. The Karaganda coal basin geodynamic polygon network project has been developed and justified.

POSTERS

ALL DAY

HIGH RESOLUTION SATELLITE DATA FROM THE DMC3 CONSTELLATION FOR EMERGENCY RESPONSE

DR. PETER HAUSKNECHT

EARTH-I, UK

Earth Observation or remote sensing as it is generally known can provide discrete information about landscape and infrastructure if it is acquired at a suitable spatial resolution. Satellite data equal or below one meter resolution are described as very high resolution and show enough structure to allow for relevant details to be mapped. In recent times the term situational awareness has become prominent and up-to-date high resolution satellite data is an important part of such situational awareness. In particular in the event of an emergency response, which relies heavily on a variety of information sources, Can we have a 'good image' of the area, is often the first question.

Such high resolution satellite images, but also the value add data derived from it, alone or in combination with other data sources became very important in the recent wildfires in Canada near the town of Fort McMurray, a hub for the oil sands industry in this part of the world. Not only needed the fire responders need to know where the actual fires were burning, but local councils and the emergency departments needed to know which areas were affected and how much. Low resolution satellite data from MODIS, indicating where the fires were, medium resolution data from Landsat and Sentinel, but also high resolution data from sensors like DMC3 and Deimos helped local authorities in this crisis situation.

Timeliness and repeatability is hereby an important and additional factor. If the data aren't collected in time or not at the required intervals their individual value diminishes considerable. New satellite resources, such as the recently launched DMC3 constellation contribute additional resources to the already established supply sources and allow increased daily provision of very high spatial optical satellite data.

POSTERS

ALL DAY

COMPARISON OF SURFACE ROUGHNESS MODEL AND CLASSIFICATION OF GEOTHERMAL MANIFESTATION USING POLARIMETRIC SAR (SENTINEL-1A) AND DEM DATA

T. WITRA, A. SAEPULOH, A.B. HARTO, R. NURTYAWAN AND K. WIKANTIKA

INSTITUT TEKNOLOGI BANDUNG, INDONESIA

Surface roughness is a physical property which is used in many applications. One of them is to detect geothermal manifestations. In this study, surface roughness is calculated by a pin-meter. This tool can measure fragments on a surface.

However, there is a possibility that the tool still has surface elevation effect or surface profile. By using surface roughness model from sentinel-1A SAR image and digital elevation model (DEM) are able to prove that pin meter can measure the fragments. The selected areas are Wayang Windu and Patuha, Indonesia. Modelling the surface roughness by sentinel image is done by utilizing backscattering coefficient and local incidence angle. Then, it will be formed as an initial model.

Surface roughness model from DEM is formed by elevation value. Both model are compared to pin meter data by counting the determination correlation value. The best model between them will be used to classify the characteristics of geothermal manifestation and it will be compared with pH over the study area. Classification is done based on location and pattern of scatter plot.

The result shows that the model from sentinel has higher correlation value thus pin-meter roughness data has been reduced from topographic effects effectively. Based on the best model, we conclude that on geothermal manifestation, between pH and surface roughness have inversely proportional correlation generally.

POSTERS

ALL DAY

APPLICATIONS OF EARTH OBSERVATION FOR LANDSLIDE INVENTORY MAPPING FOR DISASTER RISK REDUCTION AND EMERGENCY RELIEF AND IN THE CARIBBEAN AND NEPAL

C.JORDAN[1], T. DIJKSTRA[1], S. GREBBY[1]+, C. V WESTEN[2], A. DENSMORE[3], N. ROSSER[3] AND M. VAN DER KOOIJ[4]
[1] BRITISH GEOLOGICAL SURVEY, UK
[2] UNIVERSITY OF TWENTE, FACULTY OF GEOINFORMATION SCIENCE AND EARTH OBSERVATION (ITC), NETHERLANDS
[3] UNIVERSITY OF DURHAM, UK
[4] MACDONALD, DETTWILER AND ASSOCIATES LTD, CANADA

Landslides cause considerable human and economic losses around the world. They can be triggered by factors including intense or persistent rainfall, thawing of snow or ice, earthquakes and human interventions in the landscape. Landslide inventory maps are crucial for disaster risk reduction and emergency relief because they record the state of the landscape, help to identify the landslide impacts and provide evidence to model where future landslides may occur. The importance of landslide data, and its acquisition using Earth Observation techniques, is demonstrated here in two contrasting situations. The first is landslide inventory mapping to determine the current and future landslide hazard in the Caribbean, while the second was initiated as a rapid response in the midst of the emergency relief effort following a series of earthquakes in Nepal.

The Caribbean is heavily affected by natural hazards with over 5 billion US$ in losses in the last 20 years (source: CRED database). In October 2010 Hurricane Tomas hit St Lucia resulting in seven deaths and 5,952 people severely affected. The financial cost of the damage was estimated at US$336.2 million (43.4% of GDP; ECLAC, 2011). The ESA-funded British Geological Survey (BGS) eoworld2 project utilised very high resolution, multi-temporal satellite imagery to deliver 'risk information services', including landslide inventories of St. Lucia for 2010-2014. The services were based on image interpretation using a combination of high-resolution optical Pleiades and RapidEye satellite imagery (accessed through the ESA Third Party Mission scheme) and supplemented by reconnaissance field mapping. The landslide inventories were combined with information such as land cover/land use (also derived from eoworld2 satellite imagery) and geology in a World Bank CHARIM project led by ITC to generate landslide susceptibility maps outlining the future hazard posed by landslides. Frequent interaction with stakeholders such as planners and engineers helped to ensure that the results are fit-for-purpose and will have sustainable application in the island states.

The 2015 earthquake sequence in Nepal, including the Mw 7.8 Gorkha earthquake of 25 April and the Mw 7.3 Dolakha aftershock of 12 May, triggered several thousand landslides. The BGS and Durham University responded to an urgent UK Government request to provide advice on the impact of co-seismic landslides. The results were disseminated freely and openly (e.g. via the ESA Geohazards Exploitation Platform and the Humanitarian Data Exchange) to ensure maximum utilisation of the results. Satellite imagery interpretation was the optimum method to produce timely inventories and maps of landslides e.g. https://www.disasterscharter.org/image/journal/article.jpg?img_id=157332&t=1431084341836.

Imagery from the International Charter, Space and Major Disaster (and from other suppliers) was used by the UK team working with other agencies such as ICIMOD, USGS, NASA, CSA and MDA. The resulting inventories (>3500 landslides) were used by relief organisations (e.g. World Food Programme, MapAction, UNOSAT) to help plan and deliver aid. The mapping effort helped identify the main areas affected by landsliding, but it was also hampered by a number of issues, including availability of suitable cloud-free imagery, difficulty in identifying landslides, and coordination between the different mapping teams, data providers and potential end-users. It was apparent that the hazard posed by landslides would persist throughout the monsoon due to rainfall triggering. Therefore the mapping effort, led by Earth Observation, continued into 2016 with funding from the UK Department for International Development Science for Humanitarian Emergencies and Resilience (SHEAR) programme to produce monthly landslide inventories using imagery provided by ESA, CEOS Seismic Pilot, UNOSAT and CSA/MDA. Pleiades and WorldView II data were tasked monthly throughout the monsoon and manually interpreted. Radarsat-2 data were acquired every 24 days in the knowledge that cloud cover would be a particular challenge, with change detection algorithms used to identify landslides on the radar data.
The two case studies highlight the contribution of satellite imagery to real world applications of geohazard disaster risk reduction, both as part of a wider study (e.g. in the Caribbean) and as a rapid response to a natural disaster (e.g. Nepal). Lessons learnt include the importance of international coordination and the provision of the right type of derived information in a timely manner to a range of end-users.

POSTERS

ALL DAY

PLAYING THE SPATIAL RESOLUTION GAME: 'FREE' LANDSAT / SENTINEL & COMMERCIAL VHR DATA

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When do we need VHR in geological mapping / exploration / mining or development?

The last years have seen an increased provision of very high resolution satellite data* (VHR) by a number of providers in the commercial satellite data supply world. Since 2015 satellites produced by SSTL^ in the UK are part of this family, with the launch of 3 identical DMC3 satellites providing multispectral images with a panchromatic channel better than 1 metre spatial resolution. The high agility and revisit rate provide for imaging opportunities of every place on earth at least once a day – cloud cover depending.

Looking also at all the other suppliers the availability of high resolution satellite data is better than ever. But do we really need that? And since one has to pay commercial rates, is that value for money or are the new 10m Sentinel-2 data the new norm with enough information? The answer is yes and no – application depending. However, in most cases a high resolution satellite data set should be part of the baseline mapping exercise to fully understand the area in question.

This paper will look at some examples and compare the information content from different sensors. Demonstrating the DMC3/TripleSat high resolution data capability we show some image examples amongst others from Australia near Mt. Isa, Qld in the mining district, Surat basin, Qld – where shale gas development is happening and Greenbushes, WA an active mine.

*1 metre GSD and better is the definition; ^ Surrey Satellite Technology Ltd

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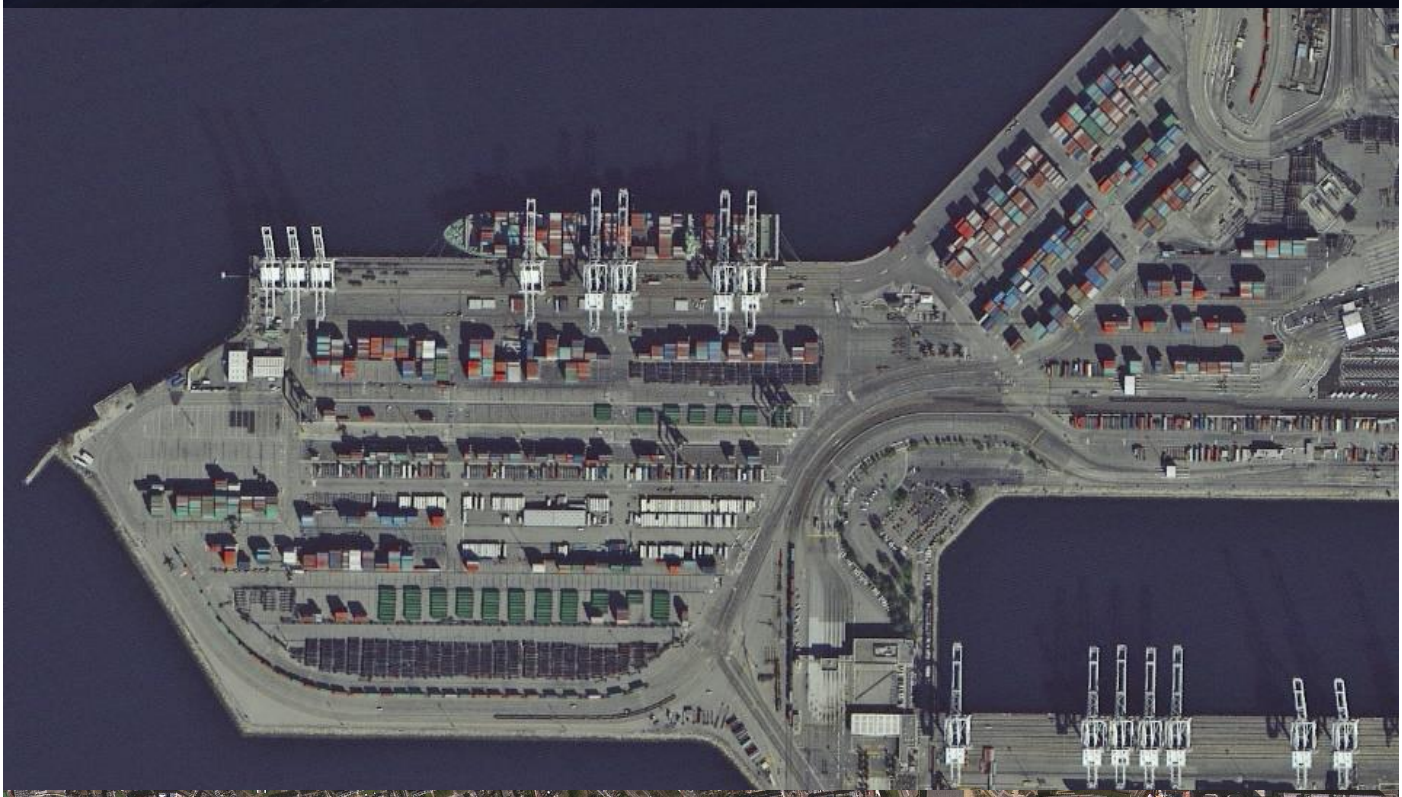
Earth-i provides satellite imagery and value-added services to clients across global geographies and diverse industries, NGO and governmental sectors including Defence, Security & Intelligence, Energy & Natural Resources, Agriculture, Urban Management and Environmental & Disaster Response.



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For advanced information solutions from very high resolution satellite data contact: Dr. Peter Hausknecht at peter.hausknecht@earthi.co.uk

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The Geological Remote Sensing Group

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- **Available for GRSG student members in full or part-time University programs**
- **Deadline for application:**
  15th April 2017

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Membership is valid for 12 months from date of membership registration.

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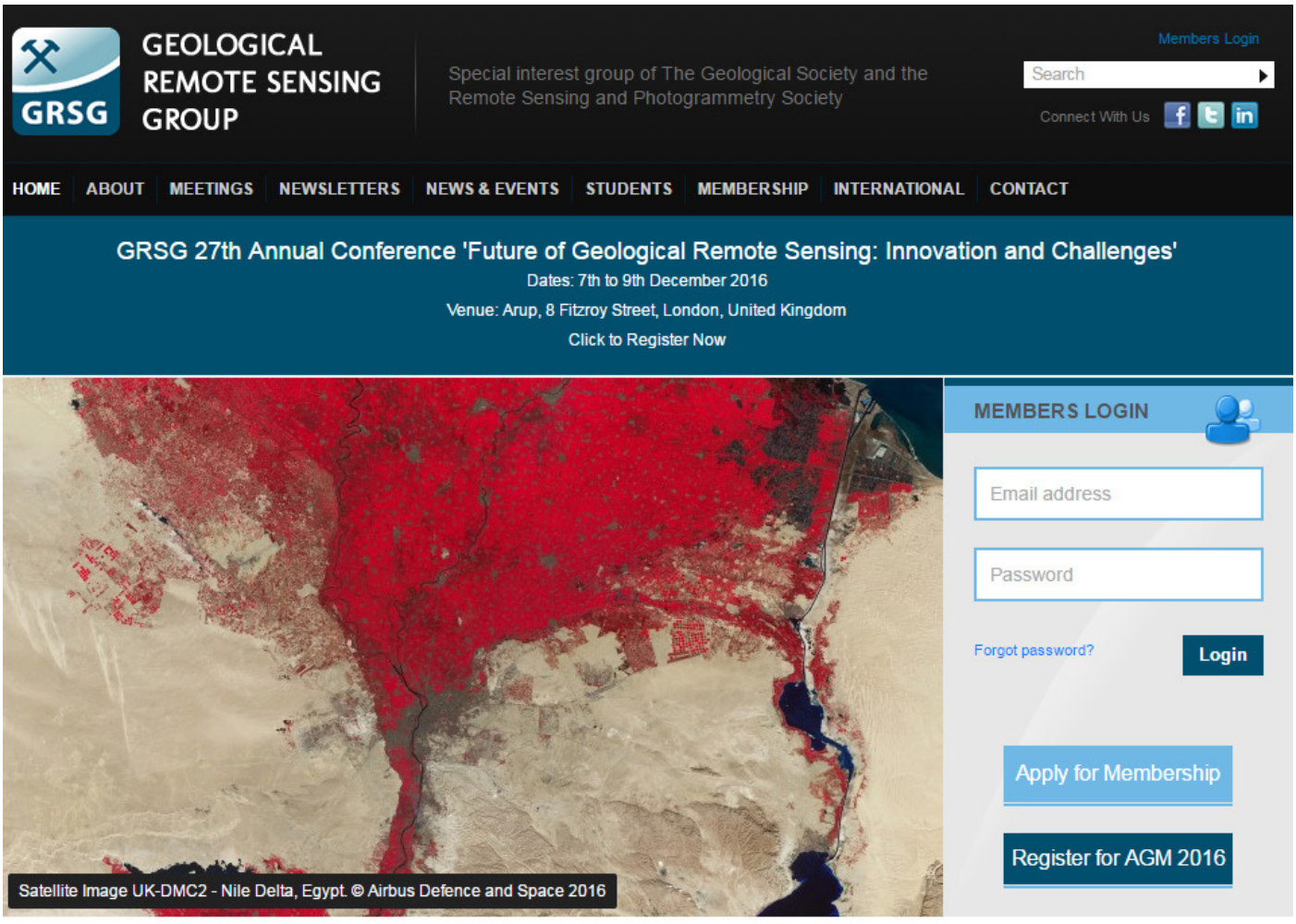

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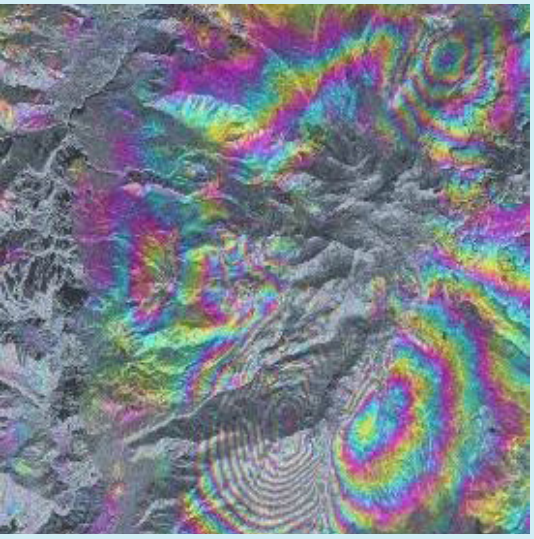

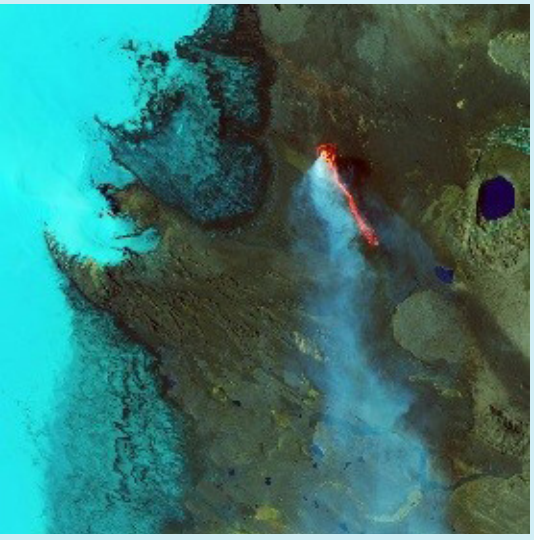

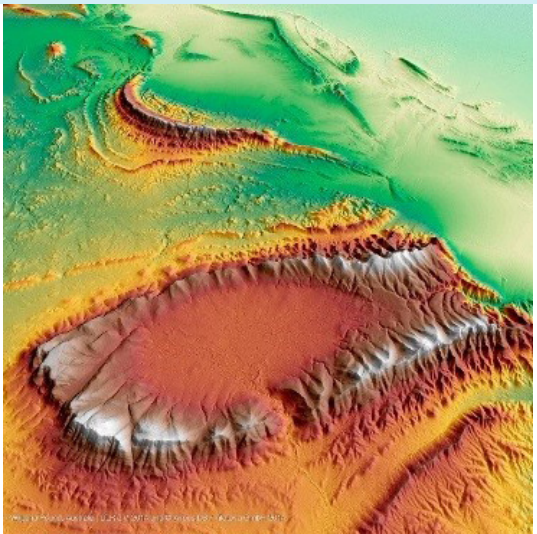

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