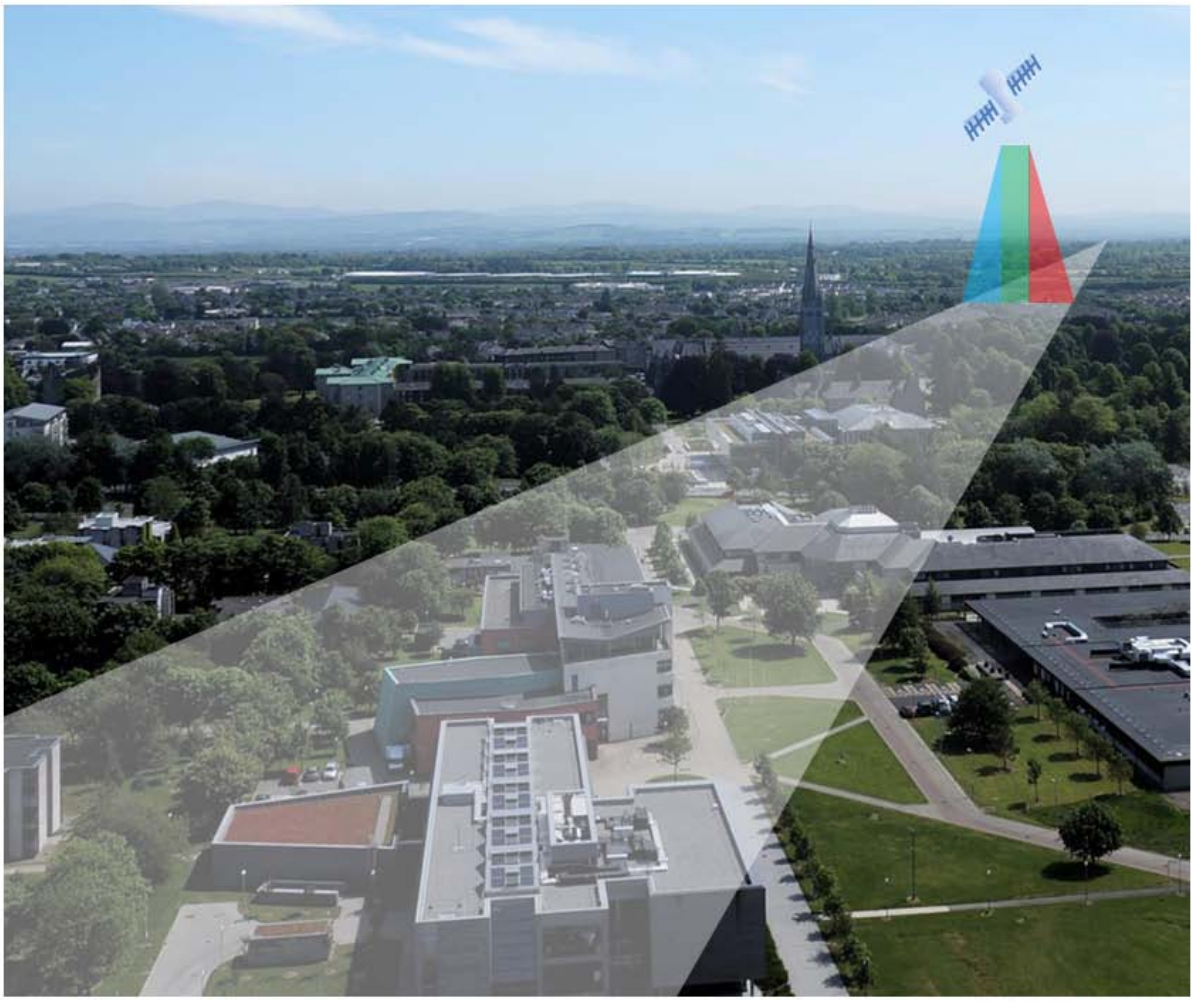
8th Irish Earth Observation Symposium

Maynooth University

30th/31st October 2014

New Opportunities In Earth Observation



NCG National Centre for Geocomputation An tIonad Náisiúnta Geoiomfhriotaíochta

Maynooth University National University of Ireland Maynooth

sfi Science Foundation Ireland

Thursday 30th October			
08.00	**Registration Opens - Tea, Coffee and Pastries**		
09.00	Welcome to the Symposium	Prof. Bernard Mahon, VP Research at Maynooth University	
Session 1: Keynotes		**Chair: Tim McCarthy**	
09.15	Ed Parsons - Geospatial Technologist, Google.		
09.40	Ollie Guinan - VP Ground Software, Skybox Imaging.		
10.05	Peter Baumann - Professor of Computer Science, Jacobs University and CEO, rasdaman GmbH		
10.30	Gordon Campbell - Directorate of EO Programmes, European Space Agency		
10.55	**Morning Coffee and Posters**		
Session 2: Round Table Discussion		**Panel Chairs: Tim McCarthy & Barry Fennell**	
11.15	*Challenges, Opportunities, Stakeholders and Roadmaps - The changing landscape of earth and ocean observation in Ireland.*	Representatives from Government, Academia, Industry and Research Institutes.	
12.30	**Lunch, UAV Demonstrations and Posters**		
Session3 : General Theme		**Chair: Fiona Cawkwell**	**Industry Demonstrations 1 and 2**
14.00	*EO technologies- the cause and solution to the big data question.*	Ciaran Kirk	eCognition
14.20	*Earth Observation and the search for a derelict in the Atlantic ocean - The Hunt for the Red Orlova.*	Chris Reynolds	*Dr. Waldemar Krebs - Geospatial Division, Trimble Navigation.*
14.40	*Innovative Earth Observation Technologies for Agri-Forestry Applications*	Enda Keane	Mass Data Collection - Revolutionizing the way we map - A look at both terrestrial and UAV data collection technologies.
15:00	*Satellites and requirements; the chicken and the egg conundrum.*	McElligot, Scarrott, Dwyer and Shorten	*Matt Kellet - Topcon Positioning, GB and Ireland*
15.20	**Afternoon Tea and Posters**		
Session 4: LiDAR and Geophys		**Chair: Avril Behan**	**Industry Demonstration 3**
15.40	*The Discovery Programme: Remote Sensing and Ireland's iconic archaeology.*	Gary Devlin	Point Cloud Data Management with ERDAS IMAGINE and APOLLO
16.00	*3D Classification of morphologically-distinctive features in the environment from LiDAR point cloud data.*	Seamus Coveney	*IMGS General Manager Ciaran Kirk and IMGS Applications Engineer Glen Bambrick*
16.20	*Big(?) data in Irish archaeology: generating & communicating knowledge from remote sensing data.*	Michael Corcoran	N/A
16.40	*Adding a new dimension to the Irish Soil database: geophysical properties.*	Alduraibi and Gibson	
17. 00	**Day 1 Close**		
19:30	**Symposium Dinner**		

Friday 31st October			
09.10	**Welcome to Day 2**	**Conor Cahalane**	
Session 5: Marine and Water		**Chair: Edel O'Connor**	**Industry Demonstration 4**
9.20	*The application of EO data to monitor Coastal Water Quality.*	Harper, Dobrzanski, Barré and Hanafin	The RIEGL UAV LiDAR Sensor VUX - 1 *Valdis Vanags - LiDAR Systems Engineer, 3D Laser Mapping, UK.*
9.40	*Earth Observation Based Information Services for the Marine Renewable Energy Sector.*	Barré, Hanafin, Harper and Dobrzanski	
10.00	*A new satellite based system for Atlantic and Irish Maritime Surveillance.*	Pratola et al.	N/A
10.20	*Combining earth observation and geochemical tracing techniques for localising groundwater discharge to lakes.*	Wilson and Rocha	
10.40	**Morning Coffee and posters**		
Session 6: Land Cover and Classification		**Chair: Stuart Green**	**Industry Demonstration 5**
11.00	*CORINE 2012*	Kevin Lydon	CoastEye Workshop *Jenny Hanafin - Senior Remote Sensing Scientist, TechWorks Marine*
11.20	*Analysis of texture measures and SAR backscatter values for classification of SAR images.*	Balaji et al.	
11.40	*An Analysis of Temporal Cloud Gap Filling Techniques for Spring Snow Melt Monitoring using MODIS Snow Cover Imagery.*	Hayes and Cawkwell	N/A
12.00	*Land cover pattern in a sub-catchment of the Voi River, Kenya from remote sensing and field data -A comparison of pixel- and object-based classification methods.*	Christoph Raab	
Session 7: Grasslands / Soils		**Chair: Rory Scarrott**	**Industry Demonstration 6**
12.20	*Wide area mapping of non-cropped areas in agricultural landscapes in the UK using Random Forest.*	O'Connell, Bradter and Benton	Real-time situational awareness for resource planning in disaster response and recovery. *Stephen Purcell & William Hynes - Directors, Future Analytics Consulting*
12.40	*Mapping peatland ponds to refine estimates of peatland carbon stock in a boreal peatland in Canada.*	Connolly, Talbot and Pelletier	
13.00	*On lessons learned from remote sensing of Irish grasslands and potential for future operational carbon accounting.*	Cawkwell et al.	N/A
13.20	*Detecting Anomalies from Satellite and Ground Data Source Using Data Analytics Approaches.*	Bi and Zhao	
13.40	**Prize giving and Close**		

Contents

Welcome to the 8th Irish Earth Observation Symposium

Now more than ever we are witnessing a greater interest in Earth Observation (EO) and how it can help us manage global scale challenges arising from shifting socio-demographic patterns and climate change. Closer to home we are seeing an increased focus on EO and how it can be employed to support sustainable management of our natural resources, maintain essential services, safeguard critical infrastructure and protect our environment. EO is also undergoing some exciting developments in terms of new Remote Sensing capabilities such as the ESA's Sentinel missions under Europe's Earth Observation and Monitoring Copernicus programme, an expanding range of high-performance, autonomous platforms for example, Unmanned Aircraft Systems (UAS), as well as an increasing array of emerging multi-thematic sensing instruments, *In-Situ* wireless sensors and mobile devices together with scalable high-performance computational, cloud-based architectures. This escalating multi-sensing capability presents new challenges in how very large volumes of EO data are transformed into useful information in order to provide a deeper understanding of Earth's complex systems in a way that will greatly improve our predictive and assessment capabilities and bring vital societal benefits to people around the globe. The broader aim of EO R&D endeavours should be to provide the right information, in the right format, to the right people, at the right time, in order to make the right decisions. These challenges present new opportunities for researchers, industry, decision-makers and wider society to collaborate, research, develop and innovate.

The central theme underpinning this year's symposium is to explore how these challenges and opportunities impact the growing EO community here in Ireland. The event's theme, "New opportunities in Earth Observation", poses some interesting question such as: 'What's our vision of the role of EO in Ireland?'; 'How can we, as a relatively small nation, develop and exploit EO science & technology?'; ' What are we doing now that could be done better?'; 'Where are the barriers and what do we, as stakeholders, need to do?'. The other, equally important, role of this annual event is to enable colleagues to present their work, learn about EO developments, share their stories, build networks and meet new people. This year we have a full programme of presentations, parallel workshops, Industry stands, technology demonstrations, poster sessions and social gatherings. We extend a warm welcome to you to join us and look forward to meeting you all over this two day event and hope, most of all, that you enjoy the 8th Irish Earth Observation Symposium here at Maynooth University.

We would like to acknowledge the funding support provided by the Vice President's Research Office, Maynooth University and Science Foundation Ireland for helping us host this year's symposium.

The IEOS 2014 Scientific Committee

IEOS 2014 Scientific Committee

Maynooth University
Tim McCarthy (Chair), Conor Cahalane, Paul Gibson, Melina Lawless

University College Cork
Fiona Cawkwell, Ned Dwyer, Rory Scarrott

Dublin Institute of Technology
Avril Behan

Teagasc
Stuart Green

NUI Galway
Colin Brown

Dublin City University
Dermot Diamond, Fiona Regan

Marine Institute
Edel O'Connor

Geological Survey of Ireland
Xavier Monteys

Enterprise Ireland
Barry Fennell

University of Limerick
Dan Toal

About Maynooth University

Welcome to the National University of Ireland Maynooth (Maynooth University) a research university of international standing and a scholarly community of over 9,000 students and 800 staff.

Maynooth University is a very distinctive university, a collegial institution strongly focused on the humanities, social sciences, mathematics, computation and natural sciences, and equally committed to research, teaching and engagement. Its distinctive features and character owe much to its unique history and heritage. Maynooth University was formally established as an autonomous university as recently as 1997, yet traces its origins to the foundation of the Royal College of St. Patrick in 1795, making it, simultaneously, Ireland's youngest university and one of its oldest educational institutions.

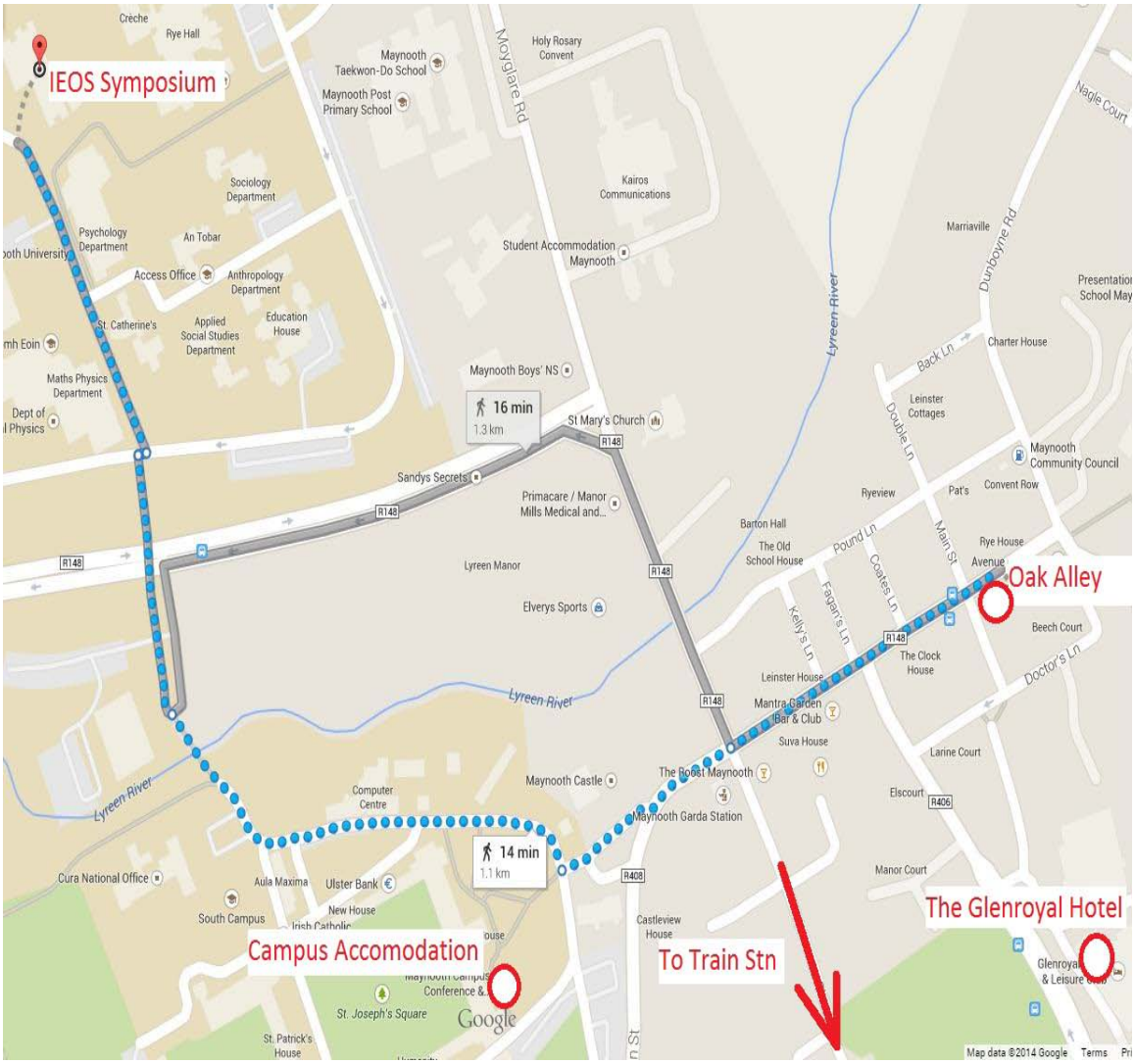
The Universities Act, 1997, restructured the National University of Ireland and the college at Maynooth became the National University of Ireland, Maynooth (Maynooth University), a university in its own right, independent of St Patrick's College Maynooth. Maynooth University is a thriving research enterprise, a vibrant and exciting place to learn, and importantly, is a university that maintains a very strong connection between research and teaching, and a very strong commitment to teaching and learning.

About the NCG

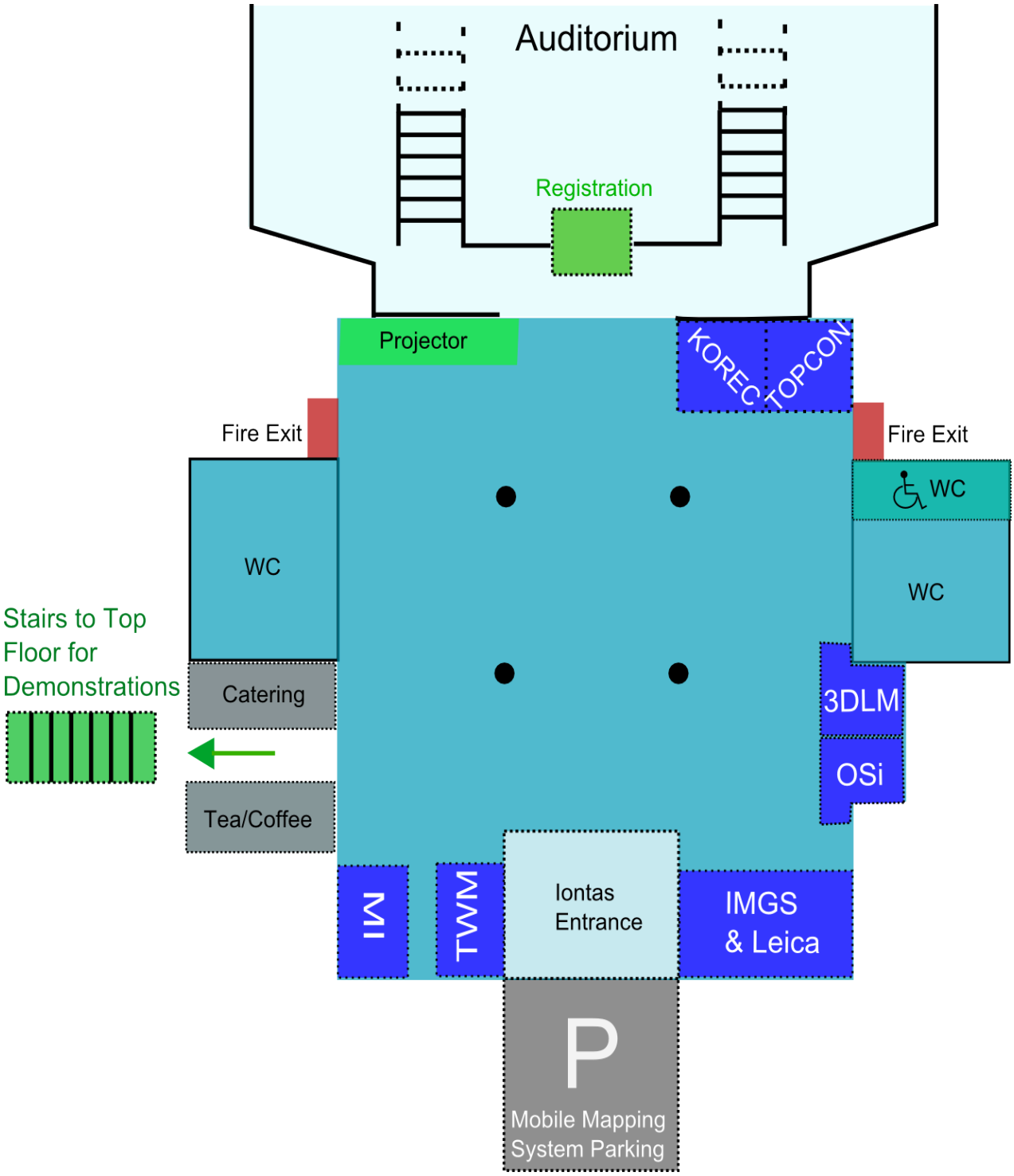
The National Centre for Geocomputation (NCG) was established in 2004 with a research grant from SFI and prides itself in maintaining an international reputation in G.I. Science, Geocomputation and Geoinformatics. The present centre's Director is Professor Chris Brunsdon and the core group's interests cover a diverse range of research areas including Earth Observation, Mobile Mapping Systems, including Unmanned Aircraft Systems (UAS), Geospatial modelling, Spatial Statistics, Geovisualisation, Interoperability and Cloud based architectures. The NCG has led and continues to play a leading role in a variety of projects including the SFI funded Strategic Research (Cluster) in Geospatial Technology (www.stratAG.ie), SFI Industry Fellowships, European Road Safety, ESPON and the Petroleum Infrastructure Programme, delivering geospatial innovation in Marine, Land, Transportation, Environment and Health sectors. The centre boasts two of the originators of Geographical Weighted Regression (Brunsdon & Charlton) and has also enabled the spin-out geospatial multimedia company, iGeotec.

Symposium Dinner

The IEOS2014 symposium dinner will be held in Oak Alley, Maynooth. Oak Alley is **on Main Street, Maynooth and beside Maynooth Library**. It is just a short walk from the symposium venue, Maynooth Train Station and also the Glenroyal Hotel and Campus Accommodation. Oak Alley specialises in Cajun and Creole dishes, created by a transfusion of West European, African, Caribbean and native Indian influences in most traditional dishes like GUMBO, JAMBALAYA and CAJUN CHICKEN. The symposium **dinner will begin at 19:30** but we have an area reserved upstairs in Oak Alley from 19:00. We would love to see you there! If you have not already booked your spot for the dinner speak to one of the symposium organisers and we can arrange it.



Symposium Map



Abstracts for Oral Presentations

Session 3: Thurs 14.00: General Theme

EO technologies - the cause and solution to the big data question.

Ciarán Kirk

General Manager, IMGS.

The geospatial industry today continues to struggle with managing the big data deluge phenomenon. Even though processing and storage becomes more affordable every year, organisations still must determine smart strategies for data acquisition, storage, management and delivery of now even petabytes of geospatial data. The massive uptake in geospatial data collection is been driven by factors including advancements in sensor technology, lower costs and faster update cycles. Added to this, there is an explosion of new data collection technologies such as UAVs. This big data is taking up more and more space, and is stored in a variety of ways across the enterprise.

Ciarán Kirk, General Manager with IMGS (the Hexagon Geospatial distributor for Ireland) will discuss the problem and provide solutions to managing big data, compressing the data and sharing it across the enterprise.

Session 3: Thurs 14.20: General Theme

Earth Observation and the search for a derelict in the Atlantic ocean - The Hunt for the Red Orlova.

Chris Reynolds

Director, Irish Coast Guard.

The MV Lyubov Orlova was taken out of service in 2010 and remained in St. John's Newfoundland for two years awaiting disposal. After a series of incidents during her tow for decommissioning in January 2013 the Orlova became a floating black-out derelict in the North Atlantic Ocean. Two signals were picked up in 2013 and the source of these signals was believed to be automatic signals produced by lifeboats falling in to the ocean. Locating a derelict vessel in the Atlantic like the Orlova is difficult and as she was drifting roughly Eastwards she it was feared she could make landfall anywhere from the Norwegian Arctic to Africa. Predictive modelling used by the Irish Coast Guard supported by similar work by the USCG predicted landfall in North West Ireland.

As a blacked-out 100m long, 3000 tonne derelict she clearly posed a serious hazard to shipping in the approaches to Irish and European waters. If the Orlova ran aground potential problems on the Irish coastline ranged from residual oil to a biohazard caused by the numerous rats on board leaving the wrecked vessel and coming ashore.

The Irish Coast Guard applied satellite tracking technology and cooperated with numerous bodies including ESA, EMSA, EUSC, USCG, Icelandic Coast Guard, the EU Commission and the Irish Air Corps to try to locate the Orlova.

Session 3: Thurs 14.40: General Theme

Innovative in Earth Observation Geotechnologies for Forest Management

Enda keane

CEO at TreeMetrics Ltd., NSC, Mahon, Cork

TreeMetrics was established in 2005 and has developed their technology in different forest environments around the world. The company has developed a unique set of solutions to better measure and improve the management of the forest resource. Treemetrics are the first company in the world to offer information services based on multi-platform (airborne & terrestrial) 3D laser scanning systems coupled with satellite Remote Sensing. The company is at the forefront of research and development of Earth Observation (EO) technologies for more effective forest harvesting. TreeMetrics pioneered the use of laser-scanning technology to measure volume and quality of standing tree crops coupled with satellite mapping and a 'real-time forest intelligence system' that allows forestry owners to monitor the quality and volume of timber remotely throughout the harvesting process. TreeMetrics is engaged in a number of EO R&D projects targeted at Forest Management including funding programmes coordinated by ESA and EU agencies. TreeMetrics is also involved in an SFI funded project with Maynooth University exploring the potential for integrated Unmanned Aircraft Systems (UAS) and satellite Remote Sensing for seamless forest stand mapping and monitoring.

Session 3: Thurs 15.00: General Theme

Satellites and requirements; the chicken and the egg conundrum.

Dee McElligott*[1], Rory Scarrott*[2], Ned Dwyer[12] Marc Shorten[1]

1. Daithi O'Murchu Marine Research Station, Gearhies, Bantry, Co. Cork
2. Coastal and Marine Research Centre, University College Cork, Irish Naval Base, Haulbowline, Cobh, Co. Cork

At the heart of satellite design and information exploitation is firstly, understanding who the potential users may be, and secondly, how best to promote the value of using the information gathered from Earth Observation (EO) resources. The FP7 funded project 'Support for Aquaculture and Fishing Industries' (SAFI) is using a comprehensive communications strategy to (a) establish who our users are and what services they require, and (b) to support the evaluation of service acceptance and utility. Engagement and communication with target audiences are critical tools working in tandem with service development, ensuring the services SAFI will offer to potential users are relevant to them, and are streamed at the most appropriate level to their operational needs. Furthermore communication and dissemination of information to audiences beyond the consulted users is a critical goal for the SAFI project. Potential users within the general public should ideally feel adequately informed to provide targeted feedback on the services developed, or recommend its potential to be exploited.

Potential users were identified and consulted from the project outset to ensure that SAFI's planned outputs will be: (a) useful to the targeted sectors, (b) achievable using the data sources, facilities and expertise of the project partners, and (c) presented in a way that would highlight the benefit of the applications to the real-world situations of the targeted sectors. SAFI shall culminate in the development, deployment, and evaluation of an integrated web-GIS decision support service, broadcasting information on fisheries and aquaculture indicators to the various concerned stakeholders (industry, public administrations in charge of fishery/aquaculture planning, EO service providers, and the wider public), fed by a service of EO high level data processing.

This work on user requirements and dissemination of EO data and other similarly targeted projects, further deepens the reach and impact of EO data on our society, and may eventually lead to shaping the focus of future EO missions.

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Session 4: Thurs 15.40: LiDAR and Geophysics

The Discovery Programme: Remote Sensing and Ireland's iconic archaeology.

Gary Devlin

The Discovery Programme, Dublin

The Discovery Programme is a centre for Irish Archaeological Research with a mission to explore Ireland's past and its cultural heritage by conducting advanced research in archaeology and related disciplines. Gary Devlin of the Discovery Programme will give a presentation showing some of the remote sensing techniques used in this research and the sites where these techniques have been applied. Some of Irelands most iconic sites will be shown including the Hill of Tara, Brú na Bóinne, Glendalough, Clonmacnoise and Skellig Michael, whilst the remote sensing techniques discussed will include LiDAR, geophysics, terrestrial laser scanning and object scanning.

The Discovery Programme is currently participating in a 3 Year co-funded EU project: 3d Icons, to digitally document and make accessible 3D models of some of the most iconic archaeology, monuments and architecture across Europe. This presentation will also summarise the work involved in this project to digitally record archaeological monuments, buildings and architectural detail and the dissemination of this data online.

Session 4: Thurs 16.00: LiDAR and Geophysics

3D Classification of morphologically-distinctive features in the Environment from LiDAR point cloud data.

Seamus Coveney

School of Geographical and Earth Sciences, University of Glasgow.

The classification of features, vegetation and land cover from imagery plays a major role in applied remote sensing science. Applications range from land cover mapping, forestry, ecological monitoring and coastal mapping through to urban feature modelling. However, using 2D imagery to classify a 3D world can involve compromises. For example, the spectral segregation of functionally distinct features, vegetation classes and land cover classes may sometimes be complicated by the presence of within-class spectral variability, making thematic classification difficult to achieve. The identities of many features that occur within natural and anthropogenic environments are related to their morphological form, in addition to their spectral response. It is proposed in this presentation that the 3D spatial relationships between point cloud data and their horizontal and vertical neighbours might be used for the classification of a broad range of morphologically-characteristic 3D features, vegetation classes and land cover classes.3D (x, y & z) morphological measurements are derived from a 2-metre resolution unstructured xyz airborne LiDAR point cloud data set, and these are considered as prospective morphological dimensions from which morphological classification might be attempted in the absence of any spectral information. Initial results suggest that a 3D Morphological Classification approach offers potential for the recognition of a relatively diverse range of features, vegetation and land cover classes from 3D point cloud data.

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Session 4: Thurs 16.20: LiDAR and Geophysics

Big(?) data in Irish archaeology: generating & communicating knowledge from remote sensing data.

Michael Corcoran

School of Archaeology, University College Dublin.

The ever-increasing availability and accessibility of modern remote-sensing-facilitated survey techniques has been enthusiastically embraced by the heritage sector in Ireland. Developments in aerial and terrestrial laser scanning, aerial imaging and geophysical prospection, adopted early-on by initiatives such as the Discovery Programme, have been at the forefront of recent research programmes of varying scales from community projects, to post-graduate research to local authority heritage audits. Whether actively capturing or interrogating existing data, the exploitation of high-volume datasets has resulted in the production of archaeological information on a scale never before seen. However, the extent to which this boom in data generation has been met by an appropriately-scaled response regarding the reporting, storing, management and integration of different datasets is questionable. This is, of course, key to the creation of archaeological knowledge.

Using case studies from contemporary research, this paper will critically evaluate the extent to which Irish archaeology has embraced the necessary methodological and cultural shifts associated with the successful use of high-volume remote-sensing data. What are some of the current strategies adopted by heritage management organisations to create and curate information from high-volume datasets? What is the outlook for archaeological research in the light of an increasing data backlog; and what is required of the heritage sector in order to stay ahead of the curve? This paper will attempt to address these issues.

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Adding a new dimension to the Irish Soil database: geophysical properties.

Samar Alduraibi* and Paul Gibson

Environmental Geophysics Unit, Geography Department, Maynooth University.

Soils are generally classified based on physical and chemical properties such as colour, texture and structure. However, soils also possess geophysical characteristics such as resistivity or magnetic susceptibility which are usually totally ignored often because they are poorly understood. Variations in these properties reflect the environmental history of the soils. Magnetic susceptibility has been used to: map heavy metal pollution, map soil erosion on slopes, been employed in locating soil boundaries, reconstructing palaeoclimates, determining upland sediment sources and as a rainfall proxy. 2D resistivity profiling shows an order of magnitude variation in electrical resistivity for the soils of Kildare. Magnetic susceptibility for the Kildare and Wicklow soils varies over 2 orders of magnitude with some soils exhibiting ferrimagnetic and others paramagnetic behaviour. Variations in low frequency magnetic susceptibility, percentage of superparamagnetic grains and fractional susceptibility for the soil were determined. Measurements of the variation of susceptibility with temperature in the range 20-800^{o}C showed different patterns. Some soils appears to have their magnetism carried by magnetite alone and yield an abrupt change at the Curie temperature of 580^{o}C whereas others clearly contain a range of minerals, yielding a more complex pattern due to alteration and conversion processes.

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Session 5: Fri 9.20: Marine and Water

The application of EO data to monitor Coastal Water Quality.

Kieran Harper*, Jarek Dobrzanski, Nicolas Barre, Jenny Hanafin.

TechWorks Marine, 1 Harbour Road, Dun Laoghaire, Co. Dublin.

A large percentage of the world's population live within, or close to, coastal regions which provide 61% of the world's total GDP. Commercial activities in coastal areas include, transport, shipping, oil and gas exploration, mineral extraction, fisheries and tourism. All of these activities depend greatly on the coastal ecosystem being a healthy and living ocean. The coastal habitat, in general, needs to be managed and maintained for future generations. The marine industry depends enormously on water quality. Shellfish beds in coastal zones are adversely affected by physical and chemical pollutants. On a global scale coastal ecosystems play a significant role in carbon fixing and oxygen production.

This ESA funded C-Wams (Coastal Water Attribute Monitoring from Satellite data) project has been exploring the use of Earth Observation satellite data, combined with in-situ data, for scientific and industrial activities associated with the coastal environment, particularly for water quality monitoring. The output from the C-Wams project is presented through an easy to use CoastEye web application which provides a suite of tools to visualise, manipulate and analyse data from the coastal marine environment based on in-situ and earth observation geophysical data. The specific aims of this project is to utilise EO data for regional water quality monitoring in the coastal zone and to develop a framework to supply the commercial and non-commercial sectors with value added satellite data products and to employ future satellite data for marine spatial planning.

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Session 5: Fri 9.40: Marine and Water

Earth Observation Based Information Services for the Marine Renewable Energy Sector.

Nicolas Barre*, Jenny Hanafin, Kieran Harper, Jarek Dobrzanski.

TechWorks Marine, 1 Harbour Road, Dun Laoghaire, Co. Dublin.

RESGrow is a collaborative project funded by European Space Agency and run by Irish oceanography and remote sensing specialists TechWorks Marine Ltd. It aims to develop information services for the renewable energy sectors (offshore wind energy, hydropower, solar energy, tidal and wave energy, biomass) utilising products derived from satellite measurements, to support and augment rather than replace local in-situ monitoring. To aid the marine energy resource assessment, TechWorks Marine is working on the assimilation of altimetry data into a numerical wave model. Altimeter data are one of the only observation methods providing us with spatial distribution of wave properties necessary for assimilation into such models. The models are currently our only means of achieving the spatial and temporal resolution required by our end-users. Two types of product are proposed for ocean energy resource assessments and marine operational services: Marine climatology information for design and operational planning and feasibility studies; Nowcast operational services for feasibility studies based on near-real time mode: shipping and offshore operations.

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Session 5: Fri 10.00: Marine and Water

A new satellite based system for Atlantic and Irish Maritime Surveillance.

C. Pratola[1], Y. Wu[1], C. O' Mahony[1], N. Dwyer[1], B. Hannah[2], A. Watkins[2], P. Kiernan[3]

1. Coastal and Marine Research Centre (CMRC), University College Cork, Irish Naval Base, Haulbowline, Cobh, Co.Cork.
2. National Space Centre (NSC) Ltd, Elfordstown Earthstation, Elfordstown, Midleton, Co. Cork.
3. Skytek, 32 Lower Leeson Street, Dublin.

Interest in Maritime Surveillance has increased worldwide over the recent decades, leading to demand for the development of new and improved systems, with a particular focus on maritime security and safety applications. In this context, the ANISTIAMO (Addressing New challenges In Satellite based mariTIme surveillance and Arctic MOnitoring) project funded by the European Space Agency (ESA) has been conceived to assess requirements for: fisheries protection; detection and tracking of vessels engaged in criminal activities; monitoring of "no-go" areas; and locating polluting vessels or vessels in distress. Ship detection has been traditionally carried out using patrol ships or aircrafts, which can be costly, able to cover limited areas, and dependent on weather conditions. Despite coastal-based surveillance systems, such as Automatic Identification System (AIS), being widely used, such systems only allow for the monitoring of a relatively small area (up to 40km offshore) and of vessels that have AIS on-board. Satellite imagery provides an opportunity to overcome these limitations. The possibility to periodically and frequently observe the same geographical area, by acquiring images over wide regions and during all weather and illumination conditions, makes synthetic aperture radar (SAR) a suitable option for maritime surveillance applications. Improving maritime security in the northeast Atlantic Ocean and Irish Sea by the use of SAR imagery for ship detection and tracking along with satellite based AIS is the focus of ANISTIAMO. ANISTIAMO will contribute to the development of Irish capacity for vessel detection using SAR images, as well as creating an automated decision support system which will be able to analyse SAR imagery with multiple other information feeds, e.g. satellite and terrestrial AIS, Vessel Monitoring System (VMS) and CCTV. This will provide Irish maritime agencies with an improved awareness of the maritime picture that can be used to guide and inform operations within Ireland's marine jurisdiction.

Combining earth observation and geochemical tracing techniques for localising groundwater discharge to lakes.

Jean Wilson* and Carlos Rocha

Biogeochemistry Research Group, Department of Geography, School of Natural Sciences, University of Dublin, Trinity College, Dublin 2.

The combination of thermal satellite remote sensing and geochemical tracing has been demonstrated as a robust, affordable and effective technique to identify potential groundwater discharge sites in coastal areas on a regional scale. Here, the approach is evaluated in its applicability to lakes and verified as an appropriate and powerful means to localise groundwater discharge sites in lacustrine environments. Surface water temperature patterns generated from Landsat 7 ETM+ Thermal Infrared (TIR) images are used to detect groundwater inputs captured as anomalous cold plumes visibly emanating from lake margins during summer months. Qualitative assessments of groundwater inputs are completed using natural tracers via continuous measurements of radon (^{222}Rn, $t_{½}$ = 3.82 days) and conductivity to verify the presence of groundwater and to identify localised seepage sites or groundwater "hotspots".

Despite difficulties in acquiring appropriate and cloud free satellite imagery and inevitable mismatches between satellite image acquisition and in-situ lake survey dates the results are extremely promising. Temperature values generated from the thermal images reveal a strong negative correlation with measured radon which implies that decreases in surface water temperatures are associated with increases in radon activity and hence groundwater inputs to the lake. Moreover, mapped temperature anomalies display a similar pattern of spatial variability as the mapped radon and conductivity anomalies which further suggests that the observed anomalies are inextricably linked and in particular, relate specifically to the locations of groundwater inflow and mixing processes present in the lake.

The study demonstrates the suitability of the approach as a comprehensive preliminary assessment tool for identification and localisation of groundwater discharge entry points into lakes for use potentially in any region where discernible temperature gradients exist. Evaluating the potential occurrence and understanding where groundwater discharge occurs is the first step towards more in-depth geochemical surveys that seek to clarify the role played by groundwater in lacustrine nutrient budgets.

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CORINE 2012.

Kevin Lydon

Environmental Protection Agency, Johnstown Castle, Wexford.

CORINE (Co-ORdinated INformation on the Environment) is a pan-European landcover dataseries which was first released in 1990 with subsequent releases in 2000, 2006 and the current release for the reference year of 2012. One of the first initiatives of its kind, CORINE was introduced as a means of compiling geo-spatial environmental information in a standardised and comparable manner across the European continent. CORINE has since become a key data source for informing environmental and planning policy on a national and European scale. This is especially true for Ireland where in the absence of a dedicated Irish landcover dataseries, CORINE is the de-facto national landcover dataset.

The EPA has been managing the production of CORINE in Ireland since the 2000 release. In 2011, the EPA undertook an internal review of the CLC mapping process to try and address concerns that the dataset did not provide value for money in terms of the quality of the dataset and the time/costs involved in producing it. The internal review devised a new semi-automated methodology which would take advantage of improved availability of in-situ datasets, software and expertise. These changes to the CORINE project aimed to produce CLC 2012 in a more efficient manner whilst also producing a dataset of higher quality.

CORINE 2012 has been successfully completed for Ireland and is due for release in Q4 of 2014. A large amount of effort was dedicated to revising the existing CORINE 2006 dataset and these revisions and improvements were carried through to the current 2012 release through the 2006-2012 change dataset. All three datasets are deliverables of the CORINE 2012 project and will be made freely available to the public via the EPA GEOPORTAL site http://gis.epa.ie/.

Analysis of texture measures and SAR backscatter values for classification of SAR images.

Preethi Malur Balaji*[1], Fiona Cawkwell[1], Ned Dwyer[1], Brian Barrett[1], Stuart Green[2]

1 Geography Department, University College Cork.
2Teagasc, REDP, Ashtown Research Centre, Ashtown, Dublin 15.

The COFORD council for forest research and development is currently funding a four year project to support the development of the Irish national forest Greenhouse Gas reporting system (CARBWARE). The main objective of this work package is to develop methods for characterizing forest cover in Ireland and monitoring forest disturbance events, such as deforestation, thinning, clear-felling, fire and regeneration, using microwave remote sensing imagery.

Analysis of an L-band ALOS PALSAR image of Cork shows higher backscatter values (σ^0, measured in dB) for forest areas. A difference of 5-6 dB has been observed for the areas that are deforested as identified from the National Forest Inventory (NFI) data and Forest Inventory and Planning system (FIPS) datasets. Using these changes the SAR image can be classified into forest and non-forest areas and a classification schema can be developed to characterize the different disturbance events based on the backscatter values and the changes in texture associated with these events. The Gray Level Co-occurrence Matrix (GLCM) was computed in four directions (0^0, 45^0, 90^0 and 135^0) to extract texture measures using a window size of 11×11. Occurrence measures such as mean, variance and data range and co-occurrence measures such as entropy, homogeneity and angular second moment were extracted from both speckle filtered and unfiltered intensity images (in dB). From the results obtained, it was observed that only the mean from the occurrence measure could bring a difference between the chosen three different classes (forests, grasslands and urban). Also the change in the forested area between the years 2007 and 2010 was highlighted. The deforested area in the 2010 imagery could be identified.

The radiometrically corrected backscatter and mean values obtained from the texture measures will now be used as input vectors for the support vector machine (SVM) classifier.

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An Analysis of Temporal Cloud Gap Filling Techniques for Spring Snow Melt Monitoring using MODIS Snow Cover Imagery.

Samuel Hayes*, Fiona Cawkwell

Department of Geography, University College Cork.

Cloud cover obscuration is one of the main limiting factors to effective snow cover monitoring using optical satellite imagery. To overcome this, numerous studies have developed and applied a variety of temporal Cloud Gap Filling (CGF) techniques, which replaces cloud covered pixels from the target day with cloud free pixels from one or more neighbouring days. Despite the large cloud reductions and high levels of accuracy reported, these studies either used just a few days for accuracy analysis or averaged their accuracy statistics over months or years, rendering analysis of how well these methods perform on a day to day basis under changeable snow conditions impossible. This research addresses this problem by applying several temporal CGF methods to MODIS snow cover imagery during the spring thaw over south central Saskatchewan, Canada, for the years 2012 to 2014. Temporal CGF methods tested were 1 Day Back (1DB), 1 Day Forward (1DF), 2 Days Back (2DB), 2 Days Forward (2DF) and 3 Day Window (3DW), which achieved average cloud reductions of 41%, 43%, 64%, 67% and 66%, with average errors of 1.6%, 1.9%, 2.5%, 3.7% and 2.6% respectively. However, strong positive correlations were found between the rate of snow cover decline and the daily errors in each CGF method tested. Furthermore, in particular instances with reduced cloud cover away from the target day and strong daily snow cover declines, anomalous daily errors of >5% occurred 7 times more often, with a maximum daily error of 15.6% measured with the 1DB method. These large errors could severely limit the use of CGF methods in many operational forecasting and decision making settings, such as flood risk forecasting associated with spring thaw snow melt. However, temporal CGF methods may prove more useful in non-operational settings.

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Land cover pattern in a sub-catchment of the Voi River, Kenya from remote sensing and field data - a comparison of pixel and object-based classification methods.

Christoph Raab

Geography Department, University College Cork.

The population and environment in a sub-catchment of the Voi River, Kenya is characterised by subsistence agriculture and is vulnerable to erosive processes. Heavy rain events, associated with periodic movement of the inter-tropical convergence zone, causes gully erosion induced damage to infrastructure such as schools and streets, as well as in agricultural areas which introduces the issue of food security for the growing population of the semi-arid area.

Hence, it is necessary to determine the actual land cover pattern as the first step towards understanding the interactions between the environmental components and anthropogenic activities. The aim of this study is to derive land cover information for a 44km^2 region of a high resolution WorldView-2 satellite image acquired on 23rd January 2012. The maximum likelihood and random forest algorithms represent two pixel based measures for land cover classification. In addition, object-based image segmentation is applied with the use of the super-pixel contour algorithm (SPC), with the segmentation parameters adjusted semi-automatically.

With an Overall Accuracy (OA) of 85.45 % and a Kappa value (K) of agreement of 0.84 the random forest algorithm applied to the area provided the best result compared to the common maximum likelihood approach (OA= 77.9 % and K = 0.76) and the SPC. The object-based SPC could only be tested for a subset but is assumed as not capable of a significant increase of accuracy.

About 75 % of the sub-catchment study area is covered with vegetation (graminoids, forbs, shrubs and trees), whereas bare areas are detected for 16 % of the study site. Large parts of the pediment areas adjacent to the business district of Voi town are covered with informal settlements, which puts pressure on a number of environmental factors that lead to the erosion of vulnerable areas. Therefore, the anthropogenic activities in the area investigated can be seen as a trigger as well as a catalyser of gully erosion.

Session 7: Fri 12.20: Grassland / Soils

Wide area mapping of non-cropped areas in agricultural landscapes in the UK using Random Forest.

Jerome O Connell*, Ute Bradter, Tim G. Benton

School of Biology, Facility of Biological Sciences, University of Leeds, Leeds, UK.

The need for agriculture to be sustainable and not damaging to the environment by compromising other ecosystem services is increasingly recognised in a variety of international reports. Knowing the amount and layout of non-cropped areas in an agricultural landscape allows for estimation of background level biodiversity which could be used in conjunction with other datasets to model the relationship between ecosystem service provision and food productivity. This study aims to classify non-cropped features such as trees, hedges and grassy margins. Colour InfraRed (CIR) aerial photography from the Landmap database was used with image segmentation in 5 different sites in the UK (52.38° lat, 0.81° long). Object variables were calculated using the software package eCognition based on spectral, textural, contextual and geometric calculations. Objects were then used in the ensemble learning classifier Random Forest (Breiman, 2001) for the classification of a variety of cropped and non-cropped features. A single and two tier object hierarchy were devised with variable importance assessed based on presence/absence with respect to Out-Of-Bag (OOB) error over 50 iterations. Mean OOB error varied with class structure scenarios, however a steady state was general achieved between 10 to 25 variables. Spectral variables were ranking as most importance in all class scenarios with textural and geometric variables less significant. Fuzzification was permitted for the hierarchical classifier by using the proportion of votes from parent objects as an input variable for the classification of child objects. Analysis of the influence of training data size on classification accuracy revealed a minimum of 7.5% of the total number of objects in the scene to achieve an OOB error of <0.15. Current results on overall classification accuracy show Kappa values between 0.85 to 0.91, which compared favourably with a traditional hybrid pixel based classification (0.55). A distance decay function is currently being developed for wide area mapping of such features.

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Mapping peatland ponds to refine estimates of peatland carbon stock in a boreal peatland in Canada.

John Connolly*[1], Julie Talbot[2,4], Luc Pelletier[3,4]

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2Département de Géographie, Université de Montréal, Montréal, Québec, Canada.
3Department of Natural Resource Sciences, McGill University, Quebec, Canada.
4The Global Environmental and Climate Change Centre, McGill University, Canada

The total global spatial extent of peatlands is small ranging between 4 - 6% of the terrestrial environment but they contain up to 33% of the global soil organic carbon (SOC) stock. Current total stocks are estimated to be 547 Gt of C. Therefore on a meter for meter basis peatland store more carbon than any other terrestrial ecosystem. The long-term rate at which carbon accumulates (LORCA, the total carbon per unit area divided by the time since the beginning of accumulation) shows large variability with values ranging from 3.4 to 70.6 g C m^{-2} yr^{-1}. These rates are dependent on factors such as the balance between temperature and precipitation or on growing season length and net photosynthetically active radiation.

The estimated amount of carbon stored in peatlands is, in many cases, based on spatial extrapolations of carbon content values from peat core analysis or modelled from peat depth measurements. However, these estimations ignore fine scale features that occur in peatlands, such as small open water features (ponds <1km^2) which can extend over large areas on peatlands. Over regional scales, these ponds are generally poorly documented and their presence may impact on current carbon pool estimates. Ponds may be up to or greater than 2m in depth and store much less carbon per unit area than in adjacent vegetated areas. Studies on the west Siberian peat carbon pond identified water bodies larger than 1 km^2 and applied a lower carbon density to these surfaces. However, not accounting for the presence of ponds smaller than 1 km^2 (and often only several meters across) in a peatland could lead to an overestimation of LORCA and lead to errors in the calculation of the carbon store. To our knowledge, no study presenting C accumulation rates in peatlands have corrected their estimation nor mentioned the presence of ponds, even if they covered large portion of their site.

In this research, an object oriented approach was used to detect and map pond features on a patterned peatland in Quebec, Canada. A Worldview2 geo- and orthorectified multispectral image (panchromatic spatial resolution 0.50cm) was acquired on 27th of May, 2012. It covers ~5.57 km^2 of the Grande PléeBleue raised peatland. Feature Analyst, an object oriented extension in ArcGIS, was used to select training data which is used to extract the pond features. An iterative process allows the user to correct the results. Our results indicate that this process is useful in detecting all but the smallest open water features. The resulting spatial data may be integrated with models to improve estimations of regional and global peatland carbon stocks.

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On lessons learned from remote sensing of Irish grasslands and potential for future operational carbon accounting.

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3 FERS Ltd, 117 East Courtyard, Tullyvale, Cabinteely, Dublin 18

An improved understanding of land-use impacts on terrestrial carbon is a necessary part of both Irish and international efforts to mitigate climate change. Grasslands represent approximately 90% of agricultural land in Ireland, and about 65% of the total land cover, and as such, any policy decisions encouraging land-use change (e.g. afforestation) will result in large scale grassland conversion. A two-year research project (Irish Land Mapping Observatory - ILMO) has recently concluded, evaluating the potential of optical and microwave data for classification of grasslands in Ireland, where field sizes are small, cloud cover is frequent and grass management practices operate on a time scale of 3-4 weeks. 16-day composite MODIS data of 250m resolution demonstrated the benefits offered by a high temporal resolution to detect differences in grass growth intensity and homogeneity, as well as possible short term changes, such as silage cutting, however the relatively low spatial resolution proved to be problematic. By contrast, both DMC and Landsat proved capable of capturing the inter-field variability, but the low frequency of acquisitions, combined with the prevalent cloud cover over Ireland, precluded their use for determining land cover on the basis of phenological behaviour. ENVISAT ASAR and ERS microwave data allowed for data acquisition regardless of cloud cover, but with only a small number of archive images available, could not detect short term changes within the field management.

Integrating land cover and its change over 16 years with OSi PRIME2 polygons indicated that transitions between improved and semi-improved grassland, and scrub sub-categories within the grassland category, resulted in a large sink (sequestration) of CO_2, equivalent to 0.3 to 1 t CO_2 per ha per year for two counties. The outcomes of the ILMO project are exciting given upcoming satellite launches, with Sentinel-2 in particular offering potential for monitoring short term biophysical changes in the Irish agricultural landscape. These images hold value for operational products for carbon accounting purposes as well as land management and change detection.

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Session 7: Fri 13.20: Grassland / Soils

Detecting Anomalies from Satellite and Ground Data Source Using Data Analytics Approaches

Yaxin Bi[1] and Guoze Zhao*[2]

1 School of Computing and Mathematics, Ulster University, UK.

2 Key Laboratory of Earthquake Dynamics of China, Institute of Geology, China Earthquake Administration.

This work will report the progress of the project supported by European Space Agency, which is aimed to developing viable methods and techniques for detecting anomalies from space and terrestrial electromagnetic data that are observed by satellites and the network of the Control Source Extremely Low Frequency (CSELF) in China and investigating the correlation between anomalies and earthquakes. Presently two initial algorithms for change detection have been developed and implemented. The first algorithm is developed on the basis of the wavelet theory. The second one is based on the Martingale method that is concentrated on detecting individual isolated change points within the electromagnetic data. The preliminary evaluation for both algorithms has been carried out on the four years NOAA Outgoing Longwave Radiation (OLR) data and the investigation into the correlation the changes detected and the Wenchuan and Puer earthquakes has also been conducted. The results demonstrate the promising of the algorithms, the next step work will be to apply these algorithms to a large scope of satellite data and ground data to investigate the statistical relation between the anomalies and earthquakes.

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Abstracts for Parallel Industry Demonstrations

Industry Demonstration 1 : Thurs 14.00

eCognition

Waldemar Krebs

Geospatial Division, Trimble Navigation.

Facing the challenging increase of remote sensing data available now and in very near future the most powerful tools are required to effectively extract the enormous amount of information stored in satellite, aerial and LIDAR data. Easy access to data and high automation in information extraction are regular requests of remote sensing analysts. The latest Trimble eCognition products are designed to best fulfil the requirements of remote sensing and GIS professionals, students and scientists bridging remote sensing to GIS.

With eCognition Essentials we will present our latest product leveraging the unique power of object-based eCognition technology with an easy to use intuitive interface. eCognition Essentials software is an all-in-one solution that allows users of any skill level to quickly produce high-quality, GIS-ready deliverables from satellite imagery. Based on core eCognition software technology, eCognition Essentials' guided workflow makes analysis of remote sensing data faster, saving time in rule-set definition. eCognition Essentials will be demonstrated live and discussed.

The easy connection of all eCognition products to the Trimble InSphere Data Marketshare allow the user the fastest and most convenient access to the needed data. The latest products from eCognition and highlight in version 9 will be presented and different ready to use applications will be demonstrated. Successful projects and studies about:

- Cadaster update using eCognition Architect Solution in Rheinland-Pfalz
- Pipeline monitoring in USA
- Oil Slick detection by Geoscience Australia
- UAV data processing with Essentials case study

will be presented and discussed.

Industry Demonstration 2 : Thurs 14.40

Mass Data Collection - Revolutionizing the way we map - A look at both terrestrial and UAV data collection technologies.

Matt Kellet

Topcon Positioning GB and Ireland

Topcon are a global leader in the provision of precise positioning solutions for the construction, agricultural and survey & mapping industries. The digitisation of the world around us has lead to an ever increasing demand for mapping large areas quickly and accurately. Traditional survey & mapping technologies are not able to meet this requirement, which has meant alternative solutions needed to be found. Topcon's Mass data collection solutions utilise terrestrial and airborne sensors to rapidly map large areas to a high degree of accuracy. Neither terrestrial or airborne systems on their own can fully meet the demand, so it is important to consider how these technologies can be combined and work together to provide complete 3D digitised models of the world around us.

Industry Demonstration 3 : Thurs 15.40

Point Cloud Data Management with ERDAS IMAGINE and APOLLO

Ciarán Kirk (IMGS General manager) and Glen Bambrick (IMGS Applications Engineer)

IMGS

During this demonstration, the IMGS team will outline how Point Cloud can be analysed, stored, catalogued and served up via webs services. We will demonstrate how ERDAS IMAGINE provides the tools to help you visualise, classify and analyse point cloud and LiDAR data.

We will address the challenges of managing such big data including automatic cataloguing, data compression and download via our clip, zip and ship interface in ERDAS Apollo.

- ERDAS IMAGINE is a versatile and comprehensive product that combines geospatial image processing, GIS tools, remote sensing, photogrammetry, LiDAR analysis and radar processing in one application.

- ERDAS APOLLO is a comprehensive data management, analysis and delivery system. This system provides organisations who have a lot of geospatial data in multiple locations, a way to catalogue, search, discover, process and securely publish large volumes of data to their end users.

- IMGS are Ireland's leading supplier of spatial solutions for government, utility and telecommunications industries. Our solutions enable our customers to Survey, Visualise, and Integrate spatial data into their enterprise information systems.

Industry Demonstration 4 : Fri 9.20

The Riegl UAV LiDAR Sensor VUX - 1

Valdis Vanags

LiDAR Systems Engineer - 3D Laser Mapping

The innovative sensor by RIEGLwas designed to meet the challenges of emerging surveying solutions by UAS, gyrocopters, and ultra-light aircraft, both in measurement performance and in system integration. The RIEGLVUX-1 is very lightweight and compact(227x180x125 mm)LiDAR sensor with 3.85 kg overall weight, that can easily be mounted in any orientation onto professional UAS/UAV/RPAS. It has a 330 degree field of view. Data can be acquired with 10 mm survey-grade accuracy using the scan speed up to 200 scans per second and the measurement rate up to 500 000 measurements per second producing the extremely high quality LiDAR data with regular point pattern and perfectly parallel scan lines. Internal storage is using 240 GByte SSD Memorywhich makes it possible to collect data for several hours at flight altitudes up to more than 1 000 ft. Alternatively data can be provided as real-time line scan data via the integrated LAN-TCP/IP Interface. Typical scanner applications include:

- Corridor Mapping and Inspection (Powerlines, Railway Tracks, Pipelines)
- Surveying of Urban Environments;
- Construction-Site Monitoring;
- Topography and Mining;
- Agriculture and Forestry;
- Archeology and Cultural Heritage Documentation;
- Defense;
- Wide Area Mapping;
- Flood Zone Mapping;
- Glacier and Snowfield Mapping;
- the Academic Markets.

Industry Demonstration 5 : Fri 11.00

CoastEye Workshop

Jenny Hanafin

Senior Remote Sensing Scientist - TechWorks Marine Ltd.

CoastEye is a new web portal, designed by TechWorks Marine to give fast access to satellite data products for commercial users. Our satellite data products include sea surface temperature, chlorophyll, turbidity, total suspended matter, wave height, wave period and wave power.

CoastEye is more than a data visualisation tool. It allows the users to query data and generate time series. You can select an area of interest for a particular parameter and generate statistics on the selected area: the mean value and the standard deviation. Time series can also be generated for individual points.

CoastEye takes the work out of accessing, processing and interpreting satellite data. Come and see our demonstration workshop, or stop by our stand in the exhibition area during IEOS 2014.

Industry Demonstration 6 : Fri 12.20

Real-time situational awareness for resource planning in disaster response and recovery.

Stephen Purcell and William Hynes

Directors - Future Analytics Consulting, Fitzwilliam Square, Dublin.

The protection of Europe's population and infrastructure is derived from a multi-faceted approach to surveillance and protection of the citizen (in compliance with European societal values) and the critical infrastructure assets that are essential for the efficient and effective functioning of society (such as the channels of energy supply and transportation networks).

Remotely Piloted Aircraft Systems (RPAs) have an important role in facilitating citizen protection and critical infrastructure monitoring. Equally, RPAs are an important asset in undertaking reconnaissance and damage/needs assessment, during the post-disaster recovery stage (such as a large scale natural disaster), and to achieve the most effective response to an event, supported by real-time situational awareness.

Future Analytics Consulting Ltd. (FAC) is a Chartered Spatial Planning, Research and Socio-economic Development Consultancy based in Dublin. FAC is recognised as an innovative, multidisciplinary SME advocating an 'evidence based' ethos to its project activities, where enhanced decision-making is facilitated through the application of a broad range of spatial and socio-economic data. FAC is actively engaged in the area of European research and development, and is presently participating in a number of Seventh Framework Programme applied-research projects. The area of societal resilience is an important focus for FAC, contributing to the research and development of improving post-disaster response and recovery methods, enhancing emergency service response tools.

This session will demonstrate an overview of these projects, and our vision for the application of RPAs in security and disaster recovery operations.

Abstracts for Poster Presentations

Poster 1 : Comparative analysis of NDVI & SAVI Vegetation Indices for the assessment of citrus crop production based on MODIS sensors

Liria Boix

Expresión Gráfica, Diseño y Proyectos, University of Málaga (currently at the NCG)

Decision making in agriculture has always been present in remote sensing studies as a support for evaluation production of different types of crops. This study is based on the evaluation of ten years of citrus crop yield on unsupervised land in Southern Spain. Three areas have been analysed calculating regression using NDVI and SAVI index as from images obtained from MODIS sensors. Although the results show that performance between NDVI and SAVI indices are related, their relation with production for this specific area is very weak and therefore it is necessary to integrate more environmental variables in order to correctly evaluate production with as from data obtained from spatial sensors.

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Poster 2 : Neural network classification of generic remote sensing data in a high performance computing environment.

Fiona Byrne*[1], Colin Brown[1] and Ivor Marsh[2]

1. Earth and Ocean Sciences, School of Natural Sciences and Ryan Institute, NUI Galway.
2. Monterrey Software Solutions.

A system is being developed to classify multi-angular, multi-frequency, multi-temporal remote sensing data in a High Performance Computing (HPC) environment. The objective is to create a robust, fast classification system of satellite-borne electromagnetic and ship-borne acoustic remote sensing data to characterise biophysical properties associated, for example, with land change use, climate-driven environmental impacts, and geophysical properties of the seafloor for classification of surficial seafloor geology and associated benthic habitats.

The initial approach is to develop an implementation of an unsupervised Artificial Neural Network (ANN) known as a Kohonen self-Organising Map (SOM). SOMs preserve the topology of the input space and produce mappings of high-dimensional data to a two-dimensional surface, so facilitating interpretations. Accelerated training

of the SOM map will be carried out by distributing the workload on a CPU cluster using C++ and Message Passing Interface. This machine learning algorithm will be used to classify high- and medium-resolution, multi-spectral and multi-temporal data from the Sentinel satellite systems (Sentinels-1, -2 and -3) and multi-frequency, multibeam acoustic data. An example of the power of the SOM compared to standard classification techniques (e.g. k-means clustering) will be demonstrated. Examples of Sentinel-1 data from Greenland and multibeam acoustic data from Galway Bay will be presented.

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Poster 3 : Groundwater and Land Resources from the Tellus Border airborne survey.

Yvonne O'Connell and Eve Daly

Biogeoscience Group, Department of Earth & Ocean Sciences, National University of Ireland, Galway, Ireland.

The Tellus and Tellus Border surveys are EU INTERREG funded regional mapping projects that collected geo-environmental data on soils, water and rocks across Northern Ireland and the six border counties of Donegal, Sligo, Leitrim, Cavan, Monaghan and Louth. The surveys comprised geochemical soil sampling and remotely sensed airborne geophysics data. Our research involves analysis of the airborne geophysics data (including magnetics, radiometrics and electromagnetics) from the coastal zones of Dundalk Bay and Carlingford Lough to detect edges of bodies and lineaments associated with bedrock geological trends, fracture zones and igneous dykes that have the potential to identify structurally controlled groundwater pathways. Identifying groundwater pathways in the coastal zone is important for the management of fresh water resources in coastal aquifers, and protection against land-based sources of organic and inorganic contaminant plumes which can be transported via preferential groundwater pathways to the sea. Detailed analysis of the airborne geophysical data has facilitated the detection and mapping of numerous basalt dykes, unmapped faults, variations in soil types, previously unmapped NE-SW Caledonian trending structures within the Silurian bedrock, possible outflow of fresh groundwater to the sea and saline influence into gravel aquifers along the coast. The results of this research demonstrate the potential of airborne Geophysics to act as a reconnaissance tool for future ground based environmental sensor technology to examine water fluxes and water quality in real time.

Poster 4 : The Potential of Satellite Imagery to Detect Changes to Ireland's Peatlands Over Time.

Marguerite Walsh* and Fiona Cawkwell

Department of Geography, University College Cork, Ireland.

In Ireland and around the world the importance of peatlands as a carbon store, for biodiversity, as an amenity and as a part of tradition, is coming to the fore. In recognition of this, a number of legislative measures have now been put in place, such as the E.U. Habitats Directive, to prevent their destruction. To ensure that these laws are adhered to the peatlands must be monitored in an objective, consistent and repeatable manner, hence this study to explore the potential offered by time series of satellite imagery.

Landsat images over a 38 year period were acquired for the Bog of Allen, a large raised bog which underlies much of Co. Offaly. Parts of this bog have been industrially cut for peat (around Tullamore), while in other areas it is being conserved (Clara Bog).

The industrially cut peatlands showed large areas of spectrally distinct bare ground, devoid of vegetation. The area of cutaway bog at selected Bord na Móna sites has more than doubled since 1975; this is not unexpected as they are not protected under the Habitats Directive. The levels of native vegetated peat, which typically border the industrial cuttings have remained relatively constant with time.

On the other hand, since 1987, Clara Bog has been declared a Special Area of Conservation. This study shows an areal increase in the natural peatbog vegetation, particularly between the images acquired in 1975 and1988, indicating successful conservation and restoration of cut peatland. While the amount of exposed peat also increased over the time period, this was predominantly along the margins due to hand-cutting.

The value of satellite imagery to detect these changes over time, and to quantify the impact of legislative and land management measures, is clearly evident, and will continue to be of importance in monitoring further changes to these valuable ecosystems.

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Poster 5 : SAFI: Supporting our Aquaculture and Fisheries Industries

Scarrott, R.G.*, Dwyer, N., McElligott, D., Shorten, M., Mangin, A., Vincent, C., Lesne, O., Lecouffe, C., Defaux, V., Silva, J-P., Gaspar, M., Santos, M., Rufino, M., Tazi, O., Morales, J., Moreno, O.

With the launch of the Sentinel satellite series progressing, the task remains to adapt Europe's use of Earth Observation data and integrate it into applications that can facilitate more informed decision making that balances the need between environmental protection and economic activity. The aquaculture and fisheries sectors present obvious opportunities for this, with operational and planning decisions often made on the basis of limited data and information. These industries could significantly benefit from the availability of and easy access to satellite-derived information products that can complement information from in-situ sensors and models.

The FP7-funded "Supporting our Fisheries and Aquaculture Industries" (SAFI) project (http://www.safiservices.eu) shall develop a decision support service specifically for these sectors. The pan-European collaboration is using Earth Observation data products, combined with in-situ environmental data, species habitat and growth data, to derive a series of indicators which can inform operators and managers about factors affecting commercial species (e.g. habitat suitability, potential relative productivity levels, potential growth rates, physiochemical environmental conditions).All will be available via an online web-GIS based decision support service providing information in a clear and easy to interpret way.

The products and service are being developed in close consultation with operators and key stakeholders in the aquaculture and fisheries sectors across Europe. This shall ensure that, once developed, the Earth Observation data is being processed, refined and delivered as targeted information that is of maximum benefit to the industry and related regulatory bodies.

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Poster 6 : Monitoring and modelling dune barrier behaviour using terrestrial laser scanning: issues for consideration in vegetated dune environments

Sarah Kandrot[1], Prof. Robert Devoy[1], Dr. Fiona Cawkwell[1], Jeremy Gault[2]

1 Department of Geography, University College Cork, Ireland.
2 Coastal and Marine Research Centre, University College Cork, Cork, Ireland

Terrestrial LiDAR is emerging as a useful tool for the precise quantification of the geomorphology of various micro- to meso-scale landforms. This poster examines issues related to the use of terrestrial laser scanning as a geomorphological monitoring tool in vegetated coastal dune environments. Using TLS and corresponding ground truthing data collected from vegetated coastal dune environments at Inch and Rossbeigh, Co. Kerry, various vegetation filtering and interpolation techniques were assessed. Errors associated with scan registration, vegetation filtering, and DEM generation were quantified. It is concluded that elevation and volumetric change detection is limited by the propagation of these errors. This work is part of a wider research project on the morphodynamic evolution of a breached barrier system under storm impacts and sea-level rise.

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Poster 7 : Monitoring and modelling dune barrier behavior using terrestrial laser scanning: issues for consideration in vegetated dune environments

Sarah Kandrot[1], Prof. Robert Devoy[1], Dr. Fiona Cawkwell[1], Jeremy Gault[2]

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errors. This work is part of a wider research project on the morphodynamic evolution of a breached barrier system under storm impacts and sea-level rise.

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Poster 8 : Mobile Mapping Research Group

Tim McCarthy, Paul Lewis, Conor Cahalane and Rónán O' Braonáin

National Centre for Geocomputation, Maynooth University.

The Mobile Mapping Research Group's chief objective is to research and develop novel methodologies for capturing, processing and analysing multi-sensor data from a variety of mobile platforms including; transportation survey vehicles, aircraft and marine vessels. The group has designed and constructed their own road survey Mobile Mapping System (MMS) comprising integrated LiDAR, imaging and navigation sensors. Research here has focused on modelling geometry of LiDAR sensor data acquisition, LiDAR feature extraction algorithms and computational cloud architectures to store and deliver very large MMS datastreams. More recently, the group has expanded its mapping research capabilities to include Remotely Piloted Aircraft Systems (RPAS). These light-weight (2kg to 5kg) Unmanned Aerial Vehicle (UAV) platforms can be used to acquire and produce orthorectified image maps over small areas for examples, forest plantations, farms, campuses, quarries and coastal areas. The groups most recent fixed-wing UAV purchase includes a state of the art, hyperspectral sensor capable of imaging over 100 spectral bands between 400nm - 950nm. The group is presently involved in mapping projects that include Oil-spill Response, Forestry Inventory, Marine Bathymetry, Road Infrastructure and Land Use.

Poster 9 : Ubipix GeoSpatial Multimedia Solutions

Tim McCarthy, Paul Lewis, Bryan Deegan and Rónán O' Braonáin

National Centre for Geocomputation, Maynooth University.

Ubipix is a cloud-based platform that enables GPS tagged video and images to be recorded, uploaded, published, analysed and shared online. Ubipix was developed in 2012 by iGeotec, a spin-out from National centre for Geocomputation (NCG) at Maynooth University. Our team of mobile mapping specialists, geospatial scientists and software engineers have designed the Ubipix stack around open source software and libraries.. As well as providing free Ubipix Smartphone Apps, the platform also

supports a growing range of 3rd party devices and formats including off the shelf POV, FPV, dashcams etc. Ubipix provides a range of multi-tiered geospatial video and imaging services from simple single-track publishing to integrated GIS plugins to more comprehensive corporate solutions delivered as stand-alone Instances that are managed wholly by the customer. The platform is presently used for Transportation (e.g. Road Safety and Maintenance) as well as Utility (e.g. Pipeline and Powerline ROW) applications. Future development plans include multi-sensor integration, near real-time operation and flexible storage options

Poster 10 : MIMIC: Mobile Mapping Point Density Calculator

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Mobile Mapping Systems (MMSs) enable high density spatial data to be collected along route networks and in urban environments. These data can then be utilised in a number of ways, such as route safety audits, road authority mapping, infrastructure surveys and change detection for national mapping agencies. Combining high accuracy navigation sensors, LiDAR and imaging sensors onboard a moving platform enable surveys to be carried out rapidly. The primary focus of the research community to date has been on developing automated or semi-automated algorithms for processing the large point clouds captured by modern terrestrial or mobile mapping systems. Consequently, assessing the performance of these systems has been overlooked. We have developed a method for determining the quantitative resolution of point clouds collected by a MMS with respect to known objects at specified distances for different system configurations and types of MMS. This system is called the Mobile Mapping Point Density Calculator or MIMIC.

Poster 11 : Decision Support for Oil-Spills (DSOS)

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Marine petroleum affects the environment, economy, and quality of life for coastal inhabitants leading to concerns that include resource exploration, recovery, transportation, and resultant oil spill contingency planning, mitigation, and remediation (Jensen et al., 1990). Oil spills have, for many decades, been a significant environmental risk within marine environment worldwide. In recent years we have seen vast improvements in safety standards leading to decreases in the number of

accidents worldwide. Accidental oil spills such as the Deepwater Horizon incident in 2010 remind us of the dramatic impacts that oil can have on the environment. These events also remind us of the importance of efficient emergency planning & response management. Oil spills pose serious threats to the marine environment and place a lot of pressure on the entities that are responsible for the emergency response and clean-up operations, such as Oil companies and national authorities. Geospatial technologies such as Remote Sensing and GeoInformatics play an important role in helping collate, analyse and visualise information in order to make good decisions when managing offshore oil-spills.

The main aim of this project is to develop a prototype geospatial decision support platform to provide more effective information management when responding to oil-pollution incidents in the marine environment. The core research activity comprises designing, building and assessing a self-organising, cloud-based Geoinformatics platform architecture, based around the Common Operational Picture model. This platform will be used to host an online oil-spill incident response instance that can be accessed by coordinators, responders and observers alike whether in the command centre or out in the field.

The expected outcomes of these projects include developing a powerful prototype scalable platform to develop novel emergency response methodologies, carry out scenario simulation and train personnel. This prototype platform will, in turn, help build and integrate the offshore O&G industry's operational capability for emergency preparedness and response.

Poster 12 : Development of an automated coastal bathymetric methodology using applied remote sensing techniques

Conor Cahalane[1], Jenny Hanafin[2], Kieran Harper[2], Nicolas Barré[2], Paul Harris[3], Charlotte O'Kelly[2], Xavier Monteys[4], Tim McCarthy[1]

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2 TechWorks Marine Ltd, Dun Laoghaire, Dublin.
3 Rothamsted Research, United Kingdom.
4 Geological Survey of Ireland.

Bathymetry is traditionally acquired using shipborne echo sounding equipment, recording depth values as single-shot points or via multibeam sensor arrays. This method produces accurate depth measurements at points or along transects but is constrained by relatively high operating cost and inability to survey in very shallow waters or complex maritime (navigation) regions. By comparison, other remote

sensing methods offer more flexible, efficient and cost-effective means of mapping bathymetry over broad areas. Remote sensing of bathymetry falls into two broad categories: non-imaging and imaging methods. The non-imaging method includes Airborne LiDAR and is able to produce accurate bathymetric information over clear waters at a depth up to 70m (Irish and White, 1998). However, this method is costly and experience in Irish waters gained from the INFOMAR research program has resulted in very poor results in seabed detection along the East coast and limited penetration in the West coast up to 15m (Coveney and Monteys, 2011).

Satellite optical sensing for bathymetry detection, can be implemented either analytically or empirically, or by a combination of both. Analytical or semi-analytical implementation is based on the manner of light transmission in water. It requires inputs of a number of parameters related to the properties of the atmosphere, water column, and bottom material. Thus, it is rather complex and difficult to constrain when many unknown parameters are used or in a dynamic coastal area. By comparison, empirical implementation is much simpler and requires the input of fewer model parameters. Both implementations can produce fine-detailed bathymetric maps over extensive turbid coastal and inland lake waters quickly, even though a minimum of concurrent depth samples are essential. The detectable depth is usually limited to 20-30m.

Geographical Weighted Regression (GWR) is a branch of Geostatistics which has demonstrated its usefulness in modelling complex spatial patterns & phenomena (Harris et al, 2011a & Harris et al., 2011). A pilot study carried out by researchers at the Geological Survey Ireland (GSI) and SFI funded StratAG group in Dublin Bay using SPOT satellite data has indicated strong potential in bathymetric mapping. As a follow-up to this project, an SFI funded Industrial Fellowship has allowed the NCG, TechWorks Marine and the GSI to select additional test sites around the country and they are in the process of investigating this method.

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The Marine Institute is the national agency responsible for Marine Research, Technology Development and Innovation (RTDI). We seek to assess and realise the economic potential of Ireland's 220 million acre marine resource; promote the sustainable development of marine industry through strategic funding programmes and essential scientific services; and safeguard our marine environment through research and environmental monitoring.

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TechWorks Marine is an established in situ marine company, which is expanding into Remote Sensing and developing new products and data delivery services through a number of European Space Agency projects. Our products include Earth Observation (EO) data combined with models to provide targeted data to our customers.

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