Oral :: Session 1 (A), Barrington Room

Multi-functional EO capabilities of Digital Terrain-AI Platform

A. Magee, G. Misra, P. Lewis, L. Osullivan, S. Keogh, P. Mooney, M.Nurissa, T. McCarthy, R. Fealy

NCG

In the recent decades we have been witnessing an increasing impact of Climate Change from Flooding to Wildfires, Droughts and Storm Damage. Therefore, the need to formulate and implement Sustainable Land Management (SLM) practices is critical. Terrain-AI (a SFI funded project, co-funded by Microsoft) is an initiative that aims to tackle this global challenge, and uses state of the art technologies for multidisciplinary research to measure, verify and report activities across the urban, agricultural, peatlands and forest landscapes. This project leverages the open data cube (ODC) and data catalogues for rapid discovery, access and analysis of big datasets of peta-byte scale. Several case studies ranging from the simple clustering techniques to more advanced machine learning approaches have been developed which are accessible through a web-based, and shareable and editable notebooks in the Jupyter environment. Some of the applications show promising results in leveraging the existing infrastructure in data harmonisation, uncovering farm management activities and real time emergency event response.
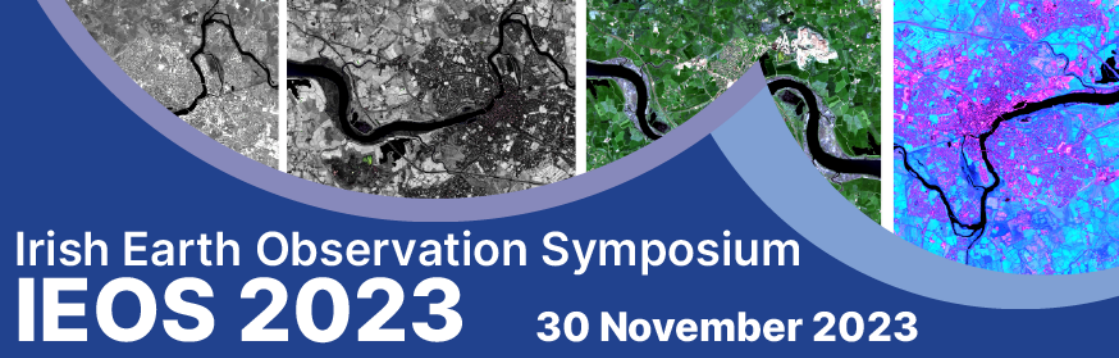
Oral :: Session 1 (A), Barrington Room

Earth Observation DataCube for Ireland

J. Hanafin, A. McKinstry, F. Cawkwell, G. Serbin, P. P. Subrahmanya, M. Fernandez

ICHEC

The aim of this project is to build a DataCube to encourage widespread use and uptake of satellite data in environmental research and monitoring applications across Ireland. This national geospatial data infrastructure and platform as a service (PaaS) will provide a one stop shop for users of EO data. An extensive database of open satellite data from the current set of EO satellites along with an archive going back 40 years for long term change analysis will be included. Analysis-Ready Data (ARD) will be provided, freeing users from the task of pre-processing satellite data, and datasets will be harmonised where possible to facilitate interoperability of different data sources. Access to the datacube and associated data processing services will be provided to accommodate users of differing experience and coding ability, from a basic browser-based viewing tool, to provision of open source GIS tools, to Jupyter notebook capability for python users.

The project was funded by the EPA and work began in March 2023. Progress to date will be reported.

Irish Earth Observation Symposium
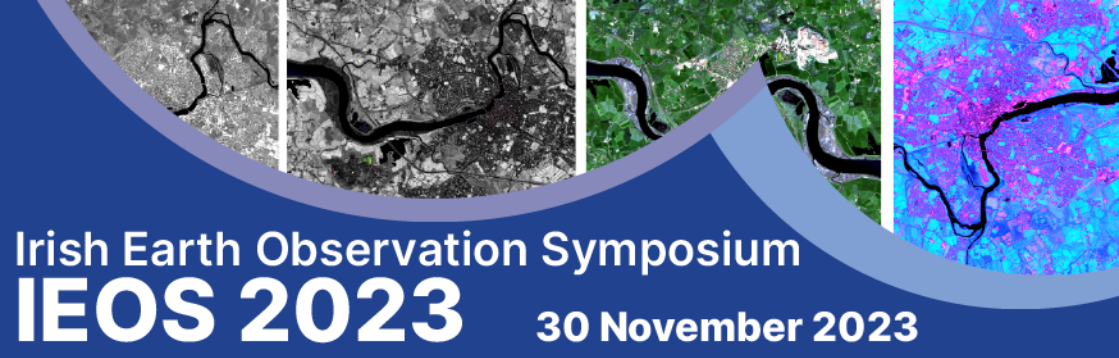# IEOS 2023 30 November 2023

Earth Observation Data Collection, Use and publication as Open Data in the OPW

V. Hussey, R. McDonnell, E. Bridge, P. Hennelly and J. Comer

The Office of Public Works (OPW)

A review of the collection and use of Earth Observation Data in the OPW. A description of Open Data policy and practice. A look forward of some datasets and systems that are in preparation.

Irish Earth Observation Symposium
IEOS 2023 30 November 2023

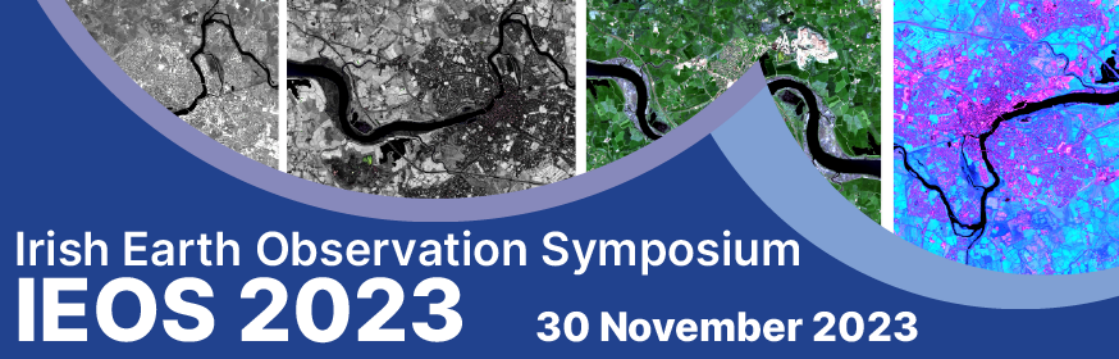*Oral :: Session 1 (A), Barrington Room*

ESA Earth Observation research and commercialisation programmes

N. Bolger

Enterprise Ireland / Irish Delegation to European Space Agency

Presentation of ESA Earth Observation Future EO programme for research topics ranging Science based research (impact from Earth Explorers / Sentinels)   and Applications focused on thematics as well as Industrial Competitiveness

Seperately, ESA's InCubed programme will be presented, , which is industry led and which will focus on the business and financial viability of the venture, resulting typically in a TRL7 output

National LIDAR

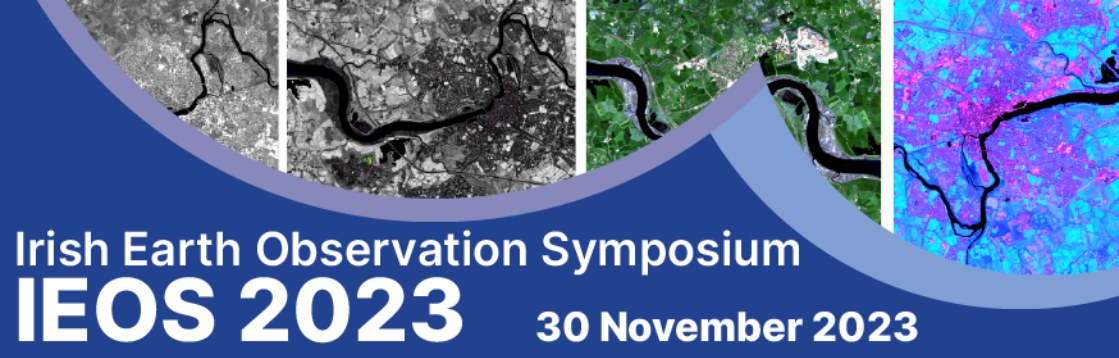T. McCarthy, D. McInerney, J. Connolly, S. Green, K. Verbruggen, J. Cudden, C. Bray, R. Fealy, H. Mangan, X., Monteys

Knocking information theory out of the park: new measures of spectral diversity from space

D. Rocchini

Uni Bologna

Oral :: Session 2 (B), Barrington Room

The Area Monitoring System - Use of Earth Observation in determining compliance with CAP schemes

R. O'Loughlin

Compass Informatics

This presentation provides an overview of the Area Monitoring System (AMS) developed for the Department of Agriculture, Food and the Marine (DAFM) and details the algorithms and processes involved in the generation of results. It is a fully automated approach in the observation, analysis and assessment of agricultural activity on farmland using Copernicus Sentinel satellite data, the results of which are used in the processing of payments from CAP-related schemes. Open-source Sentinel-1 and Sentinel-2 data are used to determine compliance with Common Agricultural Policy (CAP) schemes. A system of python-based algorithms and business rules determine this compliance by assessing crop predictions, land eligibility, and determination of an agricultural event(s) over the monitoring period. The AMS supports DAFM in making observation-based informed payment decisions, optimising resource allocation and supports sustainability objectives within the Irish agricultural sector.

Oral :: Session 2 (B), Barrington Room

From Prototype to Operational Service: Expansion and Upgrade of EU Grassland Watch

G. Smith, S. Kleeschulte, T. Soukup, A. Telletxea, S Ourevitch, R. van der Kerchove, H. Gallaun, B. Herrero, L. Tranvik, L. Halada, and B. Combal

Specto Natura

Grasslands are important for the maintenance of biodiversity and food production, and affect ecological processes. They represent a significant area of the EU and almost 60 % of Ireland. As part of the Birds and Habitats Directives the European Commission established the Natura 2000 network that protects the sites of threatened species and natural habitats. The Biodiversity Strategy for 2030 outlines a comprehensive, ambitious, and long-term plan to protect nature and reverse the degradation of ecosystems.

Against this background, the Copernicus for Natura 2000 project developed a consistent and effective monitoring service specifically for grassland sites based on an EO-data processing and analytical workflow which generated maps and indicators and provided access via a prototype EU Grassland Watch (EUGW) platform.

The current prototype will now become a fully operational EUGW service. The updated service will be more user-driven with a stronger stakeholder engagement and a user community that are closely involved in the developments. It will include additional Natura 2000 sites and be able to integrate newly designated areas. It will providing more thematic detail, more interpretable information and insights, and have a user-friendly interface with greater flexibility for user specific results.

Oral :: Session 2 (B), Barrington Room

Detection of hedgerows using CAMEO platform

E. Baykiev

Compass Informatics

The goal of the CAMEO (Creating an Architecture for Manipulating Earth Observation data) project is to unlock the potential of Earth Observation data for different kind of users. CAMEO use cases would include agriculture, such as crop identification & monitoring, land classification, surface texture mapping, climate services like longitudinal analysis of weather patterns, forestry and marine monitoring. Compass is working on the development of a 'Hedgerows Change Detection' demonstrator, which allows users to monitor change of hedgerows across Ireland over time. The demonstrator uses openly available data, such as Sentinel-2, as well as proprietary VHR (very high resolution) imagery with machine learning methods (MaskRCNN, RandomForest) to identify hedgerows and calculate lateral variations in their distribution across time. The platform's infrastructure allows deployment of large-scale image and Earth Observation data processing.

Monitoring Biodiversity in Agricultural Supply Chains - A case study in Irish Dairy

C. White

Trinity College Dublin

Agrifood corporates are under increasing pressure from regulatory policy and voluntary reporting standards to measure biodiversity in their supply chains. The EU Biodiversity Strategy for 2030 sets a 10% 'high diversity landscape feature' target for agriculture, while both habitat extent and condition are key metrics to report under the EU's Corporate Sustainability Reporting Directive and global voluntary initiatives like Science Based Targets for Nature.

In response to this demand for biodiversity supply chain data, an EO application has been developed by the FarmZeroC project to measure biodiversity across a dairy supply chain in West Cork. Taking inspiration from the National Landcover Map, an object-based image analysis approach with a random forest classifier and 6000 labelled training segments was developed to classify 12 landcovers. Using very-high resolution imagery from Airbus' Pleiades satellite and including seasonal data from Sentinel 1 and 2 resulted in reasonable classification accuracy, with an F1 score of 0.86.

A habitat condition application has been developed, using the spatial relationships between habitats and ecological principles, that ingests a habitat extent map and produces a habitat condition map, satisfying the demand for extent and condition biodiversity data.

Issues around scaling these applications to whole supply chains will be discussed.

BeachMark: a Sentinel-2 derived waterlines benchmark dataset for coastal monitoring applications

Y. Castillo-Campo, X. Monteys, A. Laure Beck and C. Cahalane

Maynooth University

The waterline (land-water interface) must be mapped accurately and consistently to properly monitor coastal change and satellites provides a unique cost-effective alternative to traditional methods to enable this. Waterlines from satellites are often derived by spectral indices methods that lead to the separation between land and water. However, the accuracy of these products is tied to the spatial resolution of the sensor that collects the data. Environmental factors that affect the accuracy of the derived waterlines that we are attempting to measure, such as weather, vegetation and sea conditions, are not taken into consideration when assessing the accuracy of these products. In our research, Sentinel-2-derived-waterlines were selected in Bull Island, Dublin for the creation of a new benchmark dataset (BeachMark) and methodology to explore the waterline models. In our initial analysis, a horizontal accuracy assessment was performed by using the mean absolute distance between the GNSS reference line and the Sentinel-2-derived waterline. The vertical accuracy assessment was then calculated by the difference between the attributed waterline height compared with the mean elevation of the GNSS. The development of reference validation models can allow more efficient application of satellite data for monitoring, and understanding how environmental variables affect these waterlines.

Monitoring supply chain deforestation risk globally with EO data

J. Torres-Batllo, A. Melchiorre, A. Prins, E. DeLancey, S. Sanfey

NGIS EU

With the EU putting forestry as one of its flagship initiatives for the European Green Deal and for achieving targets in biodiversity and GHG by 2030 the issues of assessing deforestation that exists in the supply chains of many core commodities has become central to many commercial and governmental entities worldwide.

Companies are looking to assess their exposure to and report on the deforestation associated with their supply chain to meet EU requirements on deforestation-free products and also to assess the carbon emissions throughout their value chain. Governments are looking to detect, quantify and enhance their forests and the ecosystem services they provide. The main driver of deforestation globally as well as in the EU is the expansion of agricultural land that is linked to the production of commodities like soy, beef, palm oil, wood, cocoa, coffee, rubber and some of their derived products, such as leather, chocolate, tyres, or furniture. Earth Observation data has been used for over 10 years to monitor forests globally at high resolution (30 m) and it can be used to develop tailored solutions for deforestation risk reporting.

This paper presents an object-based Deforestation Risk Index (DRI) derived from annual global forest maps to assess and minimise the risk companies' supply chain poses to forest loss and to provide quantified carbon storage information to decision-makers. The methodology was tested over large shaded-trees plantations (coffee and cocoa), in northern Africa, South America and Indonesia with encouraging results of predicting the amount of deforestation detected in 2022 based on historical data and other geophysical factors.

Development of the DAFM National Woody Vegetation Map using high-resolution imagery

M. O'Connor, M. Foley, R. O'Hara, J. Craddock, D. McGovern, S. Molloy

Mallon Technology

The development of a DAFM National Woody Vegetation Map focuses on the identification of specific 'woody vegetation' in accordance with the targets set out in the Common Agricultural Policy's (CAP) emerging Area Monitoring System (AMS). Using Machine Learning software eCognition, the map is developed through a supervised classification. Training data is collected on identified Areas of Interest (AOI) using high-resolution Bluesky imagery at 0.5m resolution, with specific attention to regionality and vegetation cover. Imagery layers used include a 0.5 resolution RGBI and nDSM, while the eCognition production ruleset developed focuses on values extracted from a number vegetation indexes (NDVI, NDYI, SAVI, GRVI) and the generation of eCognition feature layers including Texture Dissimilarity and HSI Colour Transformation. A robust model validation measures the accuracy of the output, with classification and validation processed on a county-by-county basis. Limitations identified through this process include the classification of upland areas, with particular attention to heather and bracken. The results demonstrate a way of identifying vegetative characteristics through Machine Learning, achieving a National F1 score of 74%. Furthermore, the development of the eCognition ruleset will allow for the updating of the Woody Vegetation Map and promote the continued monitoring under the aims of the AMS.

Oral :: Session 3 (C1), Barrington Room

Spatial quantification of greenhouse gas emissions resulting from conversion of peat swamp forest to oil palm plantation in SE Asia

P. Aplin

MIC, Limerick

Rapid expansion of oil palm plantation into SE Asia's tropical forest is causing irreversible environmental damage, especially greenhouse gas (GHG) emission from converted peat swamp forest. One particular problem has been that emissions' estimates have used binary comparison of pristine forests against mature oil palm plantations. Such comparisons overlook the conversion process itself and how GHG emissions can vary at different stages. Here, emissions are examined at four different stages of conversion – intact forest, drained forest, new oil palm plantation, mature oil palm plantation – and use a combination of field measurement and image analysis to quantify GHG emissions resulting from the whole conversion process. Detailed analysis is conducted in North Selangor Peat Swamp Forest (NSPSF) in Malaysia, and then the findings are extrapolated over SE Asia. Results from multitemporal Landsat analysis in NSPSF show a threefold increase in oil palm cover between 1989 and 2016, from 24,930 to 70,070 ha; while tropical forest cover shrank over the same period from 145,570 ha to 88,400 ha. Annual GHG emissions from conversion of peat swamp forest to oil palm plantation in SE Asia are estimated to be 0.39 Gt CO_2 eq yr−1, equating to 21.3% of total SE Asian GHG emissions.

Oral :: Session 3 (C1), Barrington Room

Role of EO in National land use policy

S. Green

Teagasc

There is a sudden urgency around Land use in Ireland. For many years land use and land cover policy was fragmented and data hard to come by, with proxies such as the Land Parcel Information System or limited European sources such as CORINE or ad hoc maps made from infrequent or expensive satellite observations.

Now all is changed land use information is in demand as never before as its importance in Green House Gas reporting, climate mitigation planning and sustainability agendas. The program for Government included a review of land use in Ireland, Phase 1 is complete and Phase is underway. Land use will have targets for reduction in emissions in the future and these will need to be validated. The new Nature restoration law will demand regular accurate land-cover and land-use maps.

This brief overview will explore the historical and current use of Earth Observation data in crafting and meeting these Irish policy objectives. Near future needs will be outlined and data gaps discussed. These needs will challenge our current status quo around accuracy and precession of EO derived data for land use and demand new approaches in delivery and communication from the EO community In Ireland.

Irish Earth Observation Symposium
IEOS 2023   30 November 2023

Oral :: Session 3 (C1), Barrington Room

Forest EO Program in Coillte - current status and next developments.

D. McInerney, J.P. Pereira, R. O'Shea, S. Fitzpatrick, K. Burke, L. Malone

Coillte

TBC

Oral :: Session 4 (C2), Pery Room

Detection of grazing using Sentinel-1 derived 2D signals

E. Baykiev

Compass Informatics

The Department of Agriculture, Food and the Marine (DAFM) are manging the Area Monitoring System   project, which is dedicated to the development of agricultural markers and automated detection of agricultural activity in relation to payments for farmers. Grazing is an agricultural activity that is difficult to detect. Aside from its limitations in both spatial and temporal resolution, Sentinel-1 signals are typically too noisy to easily detect changes is grass height. This presentation will describe a model implemented to identify grazing events, and a new approach currently being investigated. An initial approach focused on parcel-based CNN (convolutional neural network) model to estimate when grazing occurred, but a new approach using a combination of Sentinel-1 coherence, VV backscatter and VH backscatter time-series has been developed and has greatly improved the results of this automated analysis. A method to utilise 2D signals is being investigated. This presentation will describe the work completed, and future work planned. The work is exclusively done with open-source python libraries, such as TensorFlow, Pandas, NumPy and Sci-Kit Learn, and later can be scaled for other markers and purposes.

Mapping Past Flood Events with Sentinel-1, Copernicus Derived Products and Open-Access Spatial Datasets

P. Coogan, Z. Ferch, S. McGlynn, C. O'Kelly

TechWorks Marine

As an SME partner of the DTIF-funded CAMEO project, TechWorks Marine is developing a flood extent mapping demonstrator for the online project platform to showcase its functionality. This demonstrator uses a combination of stakeholder data, publicly available tide gauge data and Copernicus satellite and derived products. The stakeholder, the Office of Public Works, has provided a dataset of past-flood event reports with no associated extents. Using Sentinel-1 SAR imagery captured at reported event locations from 2015 to 2023, extents can be derived. For each spatial subset, SAR data is speckle filtered and thresholding is applied. This is done for both Lee-Sigma and Refined-Lee filters before the thresholded products are merged. All products from all processing regions within a Sentinel-1 image are then combined. ESA 10m WorldCover landcover masks are applied to remove tree-cover and built-up areas. Permanent water bodies are removed using a combination of open access spatial datasets and manually added missing data. Slope and HAND masks derived from the Copernicus 30m DEM are used to mitigate false positives introduced by topography. The derived extent shapefile metadata provides the nearest water gauge, water level at image acquisition and peak times and the water level difference at these times.

SAR & InSAR application on temperate raised peatlands: new insights on links between remote sensing estimates and ecohydrological parameters

A. Hrysiewicz, E.P. Holohan, S. Donohue, C.D. Evans, J. Williamson, S. Regan, A. Jonay Jovani-Sancho, N. Callaghan, J. White, J. Lyons, J. Kowalska, H. Cushnan

UCD School of Earth Sciences / SFI Centre for Research in Applied Geosciences (iCRAG)

Links between satellite-derived Synthetic Aperture Radar (SAR) data and related interferometric (InSAR) data and eco-hydrological peat parameters remain uncertain in temperate peatlands and have lacked ground validation. Here we analyse SAR/InSAR products and in-situ measurements from Sentinel-1 C-Band data for three temperate raised bogs: Ballynafagh bog (Co. Kildare, IE), Cors Fochno (Wales, UK) and Cors Caron (Wales, UK). For Ballynafagh bog, the variation of InSAR-derived VV coherence in time is shown to be related to the soil moisture and ground water level. It is not affected by vegetation changes caused by a wildfire in June 2019, thus indicating that C-band SAR backscatter is primarily from the underlying soil. On Welsh bogs, peatland surface displacements (from 2015 to 2023) from InSAR processing are validated by in-situ measurements to mm-precision. The peat surface of Cors Fochno is subsiding at the centre and rising at the edges while Cors Caron is mostly subsiding. Both bogs are also affected by annual oscillations of displacements. In-situ water table data show that the motion is closely related to variation in shallow groundwater levels. Our results can be interpreted as evidence that SAR and InSAR can enable accurate monitoring of the surface motions of temperate raised peatlands.

Oral :: Session 4 (C2), Pery Room

Evaluation of using Sentinel-1 time series data to identify bare soil fields that do not grow winter cover crop

M.P. Logakrishnan, J. Zimmermann, S. Green

Teagasc

The cultivation of winter cover crops plays a crucial role in mitigating the leaching and runoff of residual nitrates into groundwater and nearby streams. Farm surveys may not be viable options for determining which farms failed to adhere to the obligations due to their cost and time requirements. The persistent cloud cover over Ireland could hinder the viability of optical satellite imaging technology. As Synthetic-Aperture Radar (SAR) works under difficult cloud conditions, this study aimed to assess the monitoring capabilities of SAR in detecting farms that do not cultivate cover crops. A total of 18 Sentinel-1 GRD and SLC images were downloaded for two sites: Lullymore (October 2019 to January 2020) and Gorey (October 2020 to January 2021). Radar Vegetation Index (RVI) and SAR polarimetric parameters (entropy, alpha, and anisotropy) were calculated in addition to the default backscatter. Parcel-level statistics such as mean and standard deviation were determined. Multiple models were developed by including different combinations of variables, statistics, and temporal images. The DrCIF model, which utilizes images from November and December and incorporates backscatter, exhibits the highest overall performance. The overall accuracy, producer's and user's accuracy, and kappa of the best-performing model are 92%, 77%, 80%, and 0.73, respectively.

Oral :: Session 4 (C2), Pery Room

Remote Assessment of Geotechnical Slope Stability with InSAR: Challenges and Solutions

S. Azadnejad, A. Hrysiewicz, F. O'Loughlin, H. Eoghan, S. Donohue

University College Dublin

Geotechnical infrastructure slopes are an essential part of the transportation and flood defence networks. If they fail it can cause loss of life, disruption to transport services and the expense of repair. It is, therefore, essential to assess the stability of slopes to ensure the safety of infrastructures. Assessing the stability of geotechnical slopes can be done using both in-situ measurements and remote sensing observations. In-situ measurements offer precise and localized data but are time-consuming, expensive, and limited in terms of spatial coverage. In recent years, Interferometric Synthetic Aperture Radar (InSAR) has emerged as a powerful remote sensing tool for monitoring and measuring the displacement of the Earth's surface. This technique provides measurements over large areas and enables continuous monitoring without the need for physical instrumentation, thus reducing cost and labor for monitoring. In this work, we present a comprehensive review of the potential and challenges associated with using InSAR for monitoring the stability of different geotechnical slopes. We also discuss the innovative solutions we have developed to address these challenges.

Oral :: Session 5 (D1), Barrington Room

Urban Sprawl Computation toolkit with EO Data

H. Ballal

Geodesignhub

Despite many efforts to curb urban sprawl, it continues to progress dramatically. From 1990 to 2014, urban sprawl increased by 95 percent worldwide. During this period, the built-up area grew by an average of around 1.2 square kilometres (more than 160 football fields) every hour. (Source: https://doi.org/10.1371/journal.pstr.0000034).

We now have opensource tools to process EO data e.g. Global Human Settlements Layer (GHSL) that enable us to build a set of indicators for calculation of Urban Sprawl. In this talk we will discuss the processing toolset and how it can help in rapid generation of sprawl indicators using EO data.

Artificial Surface Detection from Sentinel data

R. Marciniak, G. Serbin, C. McCoy

Mallon Technology

This project involves the vital role of Machine Learning (ML) in automating the identification of artificial structures like roads, buildings, and industrial facilities, using algorithms such as Random Forest (RF).

The approach focuses on employing RF in Google Earth Engine (GEE). Data from Sentinel 1 and 2 satellites were utilized, with cloud removal applied to generate single images for specific time periods. To better classify surfaces, multiple shorter time periods were combined as successive bands in multispectral imaging.

GEE has limitations in the number of pixels, that can be processed in one query. Therefore, generating products for larger regions required tiling and storing parts of the process in Google Cloud Project.

Training the model used data from Wexford County for 2021, combining open-source and government datasets with and without parcels-buffer. The model leverages different training data versions and periods to enhance performance. By using a voting system, the model assigns probabilities to pixel classifications.

Testing covered the entire Republic of Ireland for 2022, with over a million parcels examined. The model achieved 97% accuracy, 26% precision, and 48% recall, making it suitable as an initial detection system, though expert judgment is still needed for the final decision.

Identification of Potential Sites for a Multi-Purpose Dam Using a Dam Suitability Stream Model

Q.M. Yasir, Z. Shao, Z. Jahangir, A. Rahman., S. Mahmood

Mary Immaculate College, Limerick

Optimal site selection of a dam is one of the crucial tasks in water resource management. In this study, a dam suitability stream model (DSSM) is utilized to identify potential sites for constructing multi-purpose dams. In DSSM, each input parameter is weighted using the analytic hierarchy process (AHP), and then weighted overlay analysis is performed in a Geographical Information System (GIS) environment. Compared to the previous studies, this study showed different results based on the crucial parameter that is "stream order". Two resultant site suitability maps are prepared to differentiate the importance of stream order. Each of the resulting maps visualizes four classes of suitability from highly suitable to least suitable. The proposed sites will store water for a variety of uses at the local and regional level and reduce flood risk, which can be very useful for hydrologists and disaster risk managers.

Oral :: Session 5 (D1), Barrington Room

The Use of Earth Observation and Machine Learning for Industrial and Waste Crime Identification and Prevention

Z. Ferch, S. Coughlan, C. O'Kelly, S. McGlynn

TechWorks Marine

TechWorks Marine has completed an EPA funded research project "The Use of Earth Observation and Machine Learning for Industrial and Waste Crime Identification and Prevention" and will present the outputs of this work. Current Earth Observation technologies and methodologies are reviewed and assessed for their applicability in waste-crime management in Ireland. Waste-crimes are damaging to the environment and human health, have an impact on an area's aesthetics, and are often costly to remediate. Waste-crime can occur at any scale, from one person's roadside bin bag to the pollution of entire waterbodies by industrial actors. Figuring out when, how frequently, or if an environmental crime has occurred, is not simple. Perpetrators may be left to continue committing offenses, making waste-crime sites more difficult to remediate. Example cases within Ireland and from other locations are examined, including illegal landfills, wastewater discharge, and peat mining. Three service recommendations are proposed, aimed at different user groups with various funding capabilities. The most comprehensive recommended service would utilize both publicly and commercially available Earth observation data, in conjunction with records of previous waste crime and industrial non-compliance incidents, to build a machine learning algorithm for detecting such crimes at a national scale.

Oral :: Session 5 (D1), Barrington Room

Comparative Assessment of Land Use and Land Cover with Landsat and Sentinel-2 Data using Passive Image Classification

M. Saddiqi, R. Kaan Dereli

UCD, School of Chemical and Bioprocess Engineering

A comparative assessment of land use and land cover was conducted using Landsat and Sentinel-2 datasets, employing the Maximum Likelihood Classification (MLC) technique. Seven distinct land cover classes were defined, encompassing Agricultural Landscapes, Anthropogenic Landscapes, Aquatic Bodies, Barren Landscapes, Forested Landscapes, Open and Green Landscapes, and Wetland.

For each dataset, classification error matrices were prepared, and the performance of classification method was evaluated through the calculation of overall accuracy and Cohen's kappa coefficient (K). The results of this study revealed that Sentinel-2 data exhibited superior performance compared to Landsat data, as evidenced by higher overall accuracy and kappa values. The accuracy assessment demonstrated that the classification performance for Sentinel-2 data was categorized as very good (substantial), whereas Landsat data achieved a classification performance rating of good (moderate) following the Landies and Koch classification criteria. The study also stated multiple sources of uncertainty impacting classification accuracy, including errors in image acquisition, data processing, and interactions between instrument resolution and ground-level ecological processes.

The results of this study could be used in studies related to the impact of urbanization, forestation and deforestation on climate change, as well as the hydrology of the study area.

Oral :: Session 6 (D2), Pery Room

Multiscale Observations of Species Richness across Irish Semi-Natural Grasslands

S. Hayes, F. Cawkwell, O. Lynch Milner, K.L. Bacon, E. Halpin, A. Wingler

UCC

Semi-natural grasslands provide many ecosystem services, fodder for animals, and contribute significantly to carbon sequestration and biodiversity. As such, it is important to understand how these ecosystems have, and will, respond to land use management and climate change. As part of the StableGrass project, vegetation indices derived from Landsat 7 were compared with biodiversity indices across 12 sites from the 2007-2012 Irish Semi Natural Grasslands Survey. A negative correlation ($r = -0.45$, $p < 0.01$) was found between species richness and NDVI. In summer 2023, six of the sites were re-surveyed using the DJI Mavic 3 Multispectral UAV, along with field observations of species and their abundance. Once more, a significant negative correlation was found between UAV derived NDVI and species richness ($r = -0.50$, $p < 0.05$), supporting the previous correlations and suggesting that higher NDVI values are associated with fewer species in Irish semi-natural grasslands. Further work will incorporate Landsat 8 and 9, and Sentinel 2 data captured in different months of summer 2023 and also explore the spectral variation hypothesis and machine learning methods as an alternative means of deriving species richness, functional traits and yield metrics from both multispectral UAV and spaceborne platforms.

Oral :: Session 6 (D2), Pery Room

UAV-based multispectral mapping for discriminating fire-damage levels in a peatland

R.S. de Lima, F. Cawkwell, K. Sepp

University College Cork/Estonian University of Life Sciences

Peatlands are important carbon sinks facing threats from intensifying wildfires, leading to significant emissions of greenhouse gases. This study used multispectral UAV data to distinguish different fire damage levels in an Estonian peatland. Fieldwork was undertaken at two locations to assess vegetation as being unaffected, partially damaged (burned but without ash or charcoal cover), and consumed (with ash or charcoal cover). Seven vegetation indices were calculated from visible and NIR data to classify damage in decision tree models. Model training and validation used 140 and 60 samples, respectively. NIR and red edge were the most effective bands for fire damage discrimination, with 69.9% and 71.3% accuracy. NDVI performed best among the simple indices, with 80.1% accuracy in discriminating the different levels of damage. A triangular-area index (TAI) comprising reflectance in red, green, and NIR wavelengths slightly improved the classification of consumed areas compared to NDVI (88.1% vs 82.1%). For other damage levels, NDVI and TAI accuracies were 86.9% and 90.8% for unaffected areas, and 60.7% and 63.1% for partially damaged vegetation, respectively. Thus, UAV data were useful for detecting fire damage in peatlands, and further work will be conducted to evaluate whether Sentinel-2 equivalent bands are reliable on larger scales.

Oral :: Session 6 (D2), Pery Room

Combined UAV Photogrammetry, Lidar and Radiometric Surveys of Rath Bog, Co Wicklow

Q. Crowley, P. Casey, M. Mousavi Aghdam

Trinity College Dublin

A novel application of combined UAV photogrammetry, lidar and radiometric surveys was conducted on Rath Bog, Co Wicklow. The area was surveyed by an exploration company in 1979, with an estimated 42 tonnes of uranium contained in the peatland. The site was never developed for uranium mining, and has since been utilised for forestry and agriculture. Although the anomalous radiological signature of the peatland is known, there is no published evidence of a radiological hazard assessment of the site. A DJI M300 RTK UAV equipped with an L1 Zenmuse and customised Georadis DA230 gamma detector were deployed to conduct a high-spatial resolution photogrammetry, lidar, and radiometric survey of the site. The DJI M300 RTK UAV employs a GNSS system for RTK positioning within 1cm. The L1 Zenmuse integrates a Livox Lidar and a camera. The Georadis DA230 integrates two BGO gamma detectors. The UAV survey confirms the presence of a radiometric anomaly on the site. Empirical Bayesian Kriging was used to produce high spatial resolution ($1m^2$) 3D models of gamma dose rate, total gamma counts, uranium, thorium, and potassium. The methodology developed here can be used in a wide variety of radiation protection, environmental, archaeological, agricultural, and forestry applications.

Sky wars: mobbing in Columba livia domestica towards drones in Puerto Deseado, Argentina

E. Padulosi, Scaravelli, D. Eugenia de San Pedro, M., Pastrana, S., Diaz, F., Procopio, D.

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The application of drones in wildlife primarily focuses on species detection and the potential disturbance caused remains still under evaluation. In the city of Puerto Deseado, in Argentina's Santa Cruz Province, a total of 106 drone flights were conducted between March and April 2023. Employing two quadcopters, these flights were intended to capture street-level imagery for stray dog population assessments. These flights provided an opportunity to observe local avian fauna behavior. Within the urban landscape, we identified 32 pigeon groups, each comprised of 10 to 40 individuals. As the drones approached the flocks, they perceived them as potential threats, resulting in instances of mobbing. Additionally, we assessed the presence of five raptor species within the city. This behavior suggested that pigeons associated the drones' shape and movement with potential predators. Similar mobbing instances were recorded in individuals of Falco sparverius and Falco peregrinus. In these cases, it is plausible that the drones were perceived as either potential predators or competitors. Animal responses to Unmanned Aerial Vehicles (UAVs) are species-specific and may vary across different age groups. The mobbing response of pigeons is quite intriguing and can offer insights into the flight protocols to be employed for safe aerial wildlife observations.

Optimizing Land Cover Classification Accuracy in Hyperspectral Imagery Using Advanced Image Fusion Techniques

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UCD

There is a need for very detailed land cover (LC) information in cities, which are characterized by extreme spatial heterogeneity. This information is needed to assess micro-scale (1-10 m) environments for use in studies on biodiversity, tree canopy cover, air quality and accessibility to green spaces, as examples. However, the spectral information needed to identify LC types is rarely available at these scales. This research paper presents an analysis of the Coupled Non-negative Matrix Factorization (CNMF) algorithm's role in advancing land cover (LC) classification through the fusion of PRISMA hyperspectral imagery within Dublin's urban landscape. By fusing low-resolution hyperspectral PRISMA data (30m) with high-resolution PRISMA-Panchromatic imagery (5m), the study explores the sophisticated capabilities of the CNMF fusion technique. The algorithm's adeptness at enhancing spatial resolution was evident upon visual assessment, demonstrating a notable enhancement over the original PRISMA imagery. The quantitative analysis, utilizing standard performance indicators—Peak Signal-to-Noise Ratio (PSNR), Correlation Coefficient (CC), Root Mean Square Error (RMSE), and Universal Image Quality Index (UIQI)—revealed impressive scores of 36.589, 0.973, 0.149, and 0.915, respectively. These figures are not merely numerical values; they serve as a compelling endorsement of the CNMF's capability to preserve the visual characteristics and structural homogeneity of the original hyperspectral imagery post-fusion, ensuring minimal compromise on the original data's characteristics. Further assessment of LC classification accuracy, facilitated by a Support Vector Machine (SVM) supervised classification scheme, indicated that CNMF algorithm

substantially outperforms original PRISMA imagery in terms of overall accuracy (OA) ($OA\_CNMF>OA\_PRISMA$) with scores of 0.978 and 0.812, respectively. Additionally, the Kappa coefficient (K) comparisons underscored CNMF's superior performance ($K\_CNMF>K\_PRISMA$), achieving superior performance with scores of 0.95, and 0.751, respectively. The CNMF algorithm's outperformance was further confirmed through a detailed analysis of individual class differentiation, with user accuracy (UA) for water, trees, industrial roofs, bare soil, and asphalt classes recorded at 0.996, 0.933, 1, 0.990, and 0.990, respectively. Conclusively, this study affirms the robustness of the CNMF algorithm in enhancing the spatial resolution of hyperspectral imagery and its critical role in optimizing land cover classification accuracy. These findings represent a substantial contribution to remote sensing and hyperspectral image analysis, underscoring the potential of CNMF as a significant tool for environmental monitoring and urban planning.

Irish Earth Observation Symposium
IEOS 2023 30 November 2023

Poster :: Session Posters, Barrington Room

Estimation of Peat Thickness using UAV-Based Gamma Spectrometry

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Peatlands are crucial for carbon storage and play a significant role in mitigating greenhouse gas emissions. In Ireland, where peatlands make up approximately 17% of the land area, accurate measurement of peat thickness is essential for understanding their carbon storage potential and informing land management practices. Conventional methods for measuring peat thickness are time-consuming and costly. To address this need, a monitoring system was developed, which utilises data collected from a combination of lidar and gamma detector sensors mounted on a drone. As peatlands are ombrotrophic, they typically contain very low concentrations of gamma-emitting radioelements. Quaternary sediments, or bedrock geology situated under accumulations of peat are therefore usually the primary gamma-emitting materials in bogs. A Partial Least Square Regression model was used to estimate peat thickness by investigating the spatial correlation between peat thicknesses, variation in gamma does rates and radioelement activities.. The results showed that the system was able to accurately estimate peat thickness with a high degree of precision. This study highlights the potential of using drones equipped with sensors to improve the accuracy and efficiency of peat thickness measurements, which can inform management practices that promote the sustainable use of peatlands and help mitigate climate change.

Poster :: Session Posters, Barrington Room

Mapping wildfire events in Ireland from 2000-2024 from satellite imagery

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University College Cork

The EPA funded Fire, Land and Atmospheric Remote Sensing of EmissionS (FLARES) project developed a methodology for deriving burned areas and estimating emissions from wildfires (defined as biomass burning events resulting in charred vegetation) that occurred in Ireland from 2015-2021. The results from FLARES demonstrated that the optical 10-30m spatial resolution data from ESA's Sentinel-2 and the USGS Landsat-8 platforms significantly improved previous estimates of burned area derived from international programmes such as FIRMS and EFFIS, which focus on fires in excess of 30ha in size, and can identify only actively burning fires based on an elevated heat signal. However, the six year time series precluded any analysis of spatial or temporal variations in the number, timing, location or magnitude of fire events. The follow-on project, FLARES-PPLUS (FLARES-Projections, Policy and Land Use and cover Synthesis) aims to use the FLARES methodology to extend the time series of annual burn events back to 2000, using the Landsat 5-9 platforms along with Sentinel-2 and other imagery as required. The project also intends to integrate climate and land management data to better understand the drivers of fire over the last two decades and project how fire events may change in the future.

Poster :: Session Posters, Barrington Room

Calculating erosion rates along Cork coastline: automating an essential first step to assess coastal vulnerability.

E. Chalen□□□

University College Cork

Coastlines worldwide are coming under increasing pressure due to climate change and human activity. With 61% of its population living within 5 km of the coastline, and the highest proportion of all Irish counties living within 100 metres of the coast (CSO, 2016), Cork County is "particularly vulnerable" (Cork County Council, 2019). Therefore, Cork County Council has funded a 3.5-year research project that will capture and assess all available information related to erosion and vulnerability along its coastline. The most recent erosion rates dataset, the Irish Coastal Protection Strategy Study (ICPSS), determined a linear erosion rate from manual digitisation of the vegetation line for the period 1970-2006. This research presents an automated approach to coastal vegetation line detection using a visible-band index; the Normalized Green–Blue Difference Index. This index has been applied to historical aerial photography (from the OSi for 2000, 2005, 2012 and 2015-2018 and from the OPW for 2021). An elevation mask derived from OPW LiDAR data is used to filter noise from low-tide waters and seaweed. Results show good agreement with manually digitised lines in a faster and more objective manner. Additionally, lines are more detailed than the ICPSS, allowing more focused identification of erosion sites.

Poster :: Session Posters, Barrington Room

Accelerating electric vehicle (EV) adoption: A spatial data driven approach to planning public car charging infrastructure

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Irish Centre for High End Computing

The electrification of the country's car fleet is critical for achieving ambitious climate action goals. Access to charging stations is a major barrier for widespread adoption of EV, especially impacting lower socio-economic groups whose homes cannot easily facilitate charger installation. This study aims to understand the demand for public charging stations in residential areas and their spatial distribution. Leveraging high-resolution remote sensing data and AI models, the project will identify households requiring public charge points. Geospatial analytics and high-end computing will support AI modeling and spatial data analysis. Aligning with national strategies and plans, and engaging local authorities and ZEVI as stakeholders, the research will help to ensure equitable access to EV charging infrastructure, contributing to Ireland's just transition and sustainable mobility goals. The results will inform the deployment of an expanded charging network by local authorities crucial for achieving Ireland's very ambitious EV car fleet targets.

Poster :: Session Posters, Barrington Room

Spatiotemporal Change Analysis of Snow Cover in Response to Land Surface Temperature Using Landsat and in-situ data: A Study of Gilgit Baltistan, North Pakistan

P. Aplin, B.A. MacGabhann, A. Rahman

Mary Immaculate College, Limerick

The study aims to investigate the spatiotemporal change analysis of snow cover in response to land surface temperature (LST) using Landsat and in-situ data in Gilgit Baltistan, North Pakistan. Snow cover dynamics and their relationship with LST are of critical importance, influencing water resources, ecosystem functioning, and human livelihoods in mountainous regions.

The methodology involves the utilization of Landsat 5, 7, and 8 satellite imagery to derive key indices, including LST, normalized difference vegetation index (NDVI), and normalized difference snow index (NDSI). Google Earth Engine will be employed to calculate these indices, enabling efficient processing and analysis of large-scale datasets. Additionally, weather station data will be collected, spanning from 1990 to 2022. Statistical analyses such as correlation, regression, and trend analysis will be applied to the station data to investigate the relationship between snow cover extent and LST.

Predictions for the years 2032 and 2042 will be made based on the weather station data, offering insights into future snow cover changes in response to projected temperature trends. Furthermore, predictions will be generated using satellite imagery from each decade between 1990 and 2022, facilitating the assessment of historical

snow cover patterns and the identification of long-term trends.

This research holds significant importance as it will contribute to understanding the complex dynamics between snow cover and land surface temperature in the Gilgit Baltistan region. By incorporating satellite and in-situ data, this study will comprehensively analyze snow cover changes and their drivers. The findings will be valuable for decision-making processes related to water resource management, disaster risk reduction, and climate change adaptation strategies.

Moreover, It will provide a framework for studying the spatiotemporal dynamics of snow cover about land surface temperature, enabling comparisons and enhancing understanding across different geographic locations. The outcomes of this study will inform and guide future research endeavors in other regions sharing similar characteristics.

Poster :: Session Posters, Barrington Room

EZ-InSAR: An Easy-to-use Open-source Toolbox for Mapping Ground Surface Deformation using Satellite Interferometric Synthetic Aperture Radar

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Satellite Interferometric Synthetic Aperture Radar (InSAR) is a space-borne geodetic technique that can map ground displacement at millimetre accuracy. Since 2015, the Copernicus Sentinel-1 SAR satellites have opened a new era for InSAR applications, due to their short revisit cycle (6-12 days), systematic acquisitions over land, and open-data access policies. Although several open-source software packages exist for processing the Sentinel-1 SAR data, obtaining high-quality ground deformation maps still requires a deep understanding of the InSAR theory and the related computational tools. Here we present an open-source toolbox, EZ-InSAR, for a user-friendly implementation of InSAR displacement time series. EZ-InSAR integrates the three most renowned open-source tools to generate interferograms and displacement time series by using the state-of-art algorithms within a seamless Graphical User Interface. EZ-InSAR reduces the user's

workload by automatically downloading the SAR and required imagery products. We illustrate the EZ-InSAR processing capabilities by revealing recent ground deformation at Campi Flegrei (>100 mm/yr) and Long Valley (<10 mm/yr) calderas via Sentinel-1 time-series and GNSS analysis. Our tests indicate that the EZ-InSAR toolbox provided here can serve as a valuable contribution to the community for ground deformation monitoring and geohazard evaluation, as well as for disseminating bespoke InSAR observations for all.

Irish Earth Observation Symposium
IEOS 2023 30 November 2023

Discrepancies between Level 2 Landsat and Sentinel 2 Reflectance Data Highlighted using Multispectral UAV Imagery

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UCC

Semi-natural grasslands provide numerous ecosystem services and contribute significantly to carbon sequestration and biodiversity. In locations such as Ireland, where cloud free conditions are rare, consistency in Earth observation sensors is critically important for the effective long-term monitoring of terrestrial vegetation. As part of the StableGrass project, examining links between biodiversity, functional traits, soil carbon storage and yield stability, six semi-natural grassland sites were surveyed using the DJI Mavic 3 Multispectral UAV in summer 2023. These surveys were compared with level 2 Landsat 8 surface reflectance data by creating NDVI images and generating statistics for the 6 sites and their 25 relev□□□□ Moderate correlations were found between their respective NDVI variations ($r2 = 0.24$, $p < .05$) but with a significant offset – UAV values averaging +0.36 higher than Landsat 8. A similar comparison was then carried out between the UAV and level 2 Sentinel 2 derived NDVI images. A very strong relationship was found ($r2 = 0.70$, $p < .01$), with an average difference of just 0.01, suggesting the problem lies with Landsat 8. Here we present statistics regarding these differences and explore the reasons underlying them, such as atmospheric correction methods, spatial resolution, geometric accuracy, and land management practices.

Poster :: Session Posters, Barrington Room

A Web-based Peatland Spatial-temporal & Restoration Monitoring System: A Case Study of Clara Bog

M. Gitahi, S. Mathew, G.M. Afrasinei

TU Dublin & AtkinsR□□□□□□

Peatlands, often overlooked in detailed spatial documentation compared to major land use changes, have suffered extensive drainage for human needs, impacting greenhouse gas emissions and ecological balance. This study aims to address the gap by creating an innovative web-based monitoring system for Clara bog. Through comprehensive site assessments, utilizing advanced satellite imagery and classification algorithms, the research aims to understand past and current conditions, as well as restoration initiatives. Leveraging Landsat and Sentinel satellite imagery, the study utilizes NDVI and NDWI analysis to discern changes that have occurred in Clara bog. The composite images undergo comprehensive classification employing support vector machine, random forest, and bagged tree classification machine learning techniques over a five-decade timeframe. Clara bog eco-tope data are utilized for data training and the most accurate supervised classification algorithm is determined through different evaluation metrics. The ultimate outcome is an interactive web platform for peatland monitoring at Clara bog, driven by the best classification model. This system aims not only to fill a critical spatial documentation void but also exemplifies the power of web maps in comprehending and visualizing dynamic patterns and changes in the natural landscape.
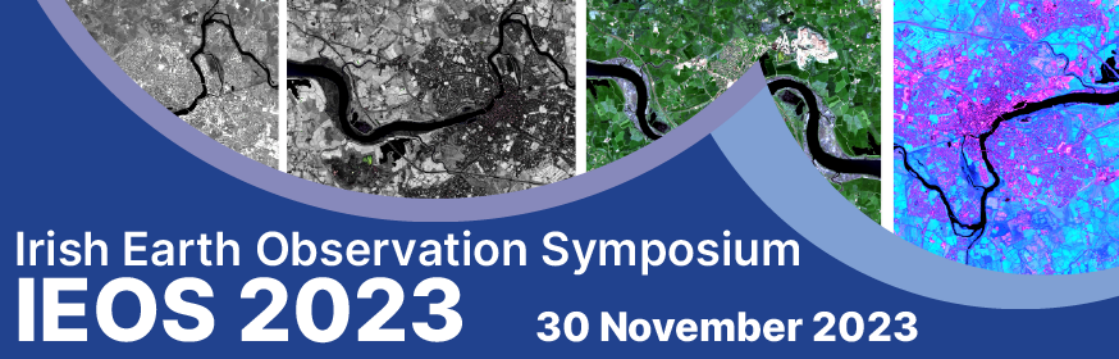
Introduction to Geospatial Python

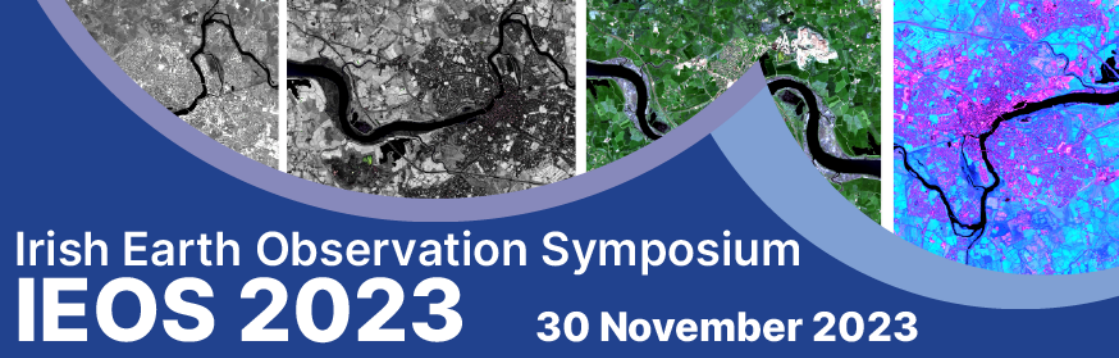B.A. MacGabhann

UL Geography

Workshop :: Session Workshop A2, UL Geography Lab

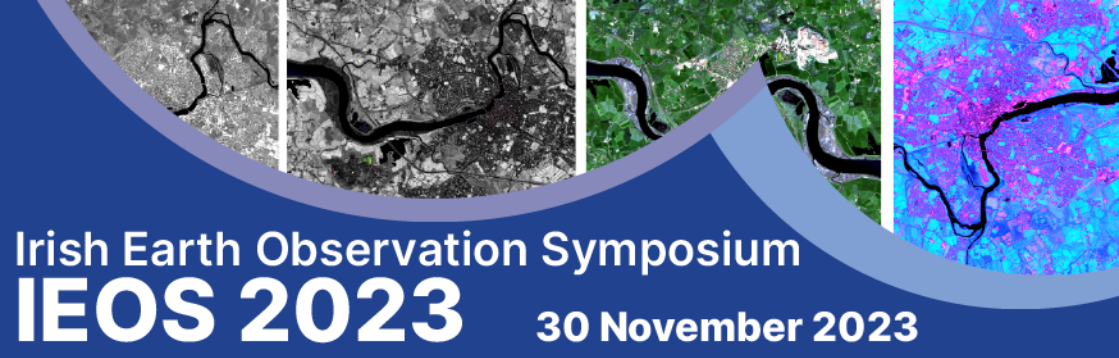# Advanced Python for Remote Sensing

J. Zimmerman

Teagasc

Workshop :: Session Workshop B1, UL Glucksman Library Data Visualization Lab

Women in Geospatial Group

M. Murphy

Mallon Technologies

Workshop :: Session Workshop B2, UL Glucksman Library Data Visualization Lab

ICHEC EO Data Cubes

J. Hanafin

ICHEC

Irish Earth Observation Symposium
IEOS 2023 30 November 2023

Workshop :: Session Workshop C1, UL Biological Sciences

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M. O'Neill, D. McInerney

Coillte