

# Recent developments with the NERC Earth Observation Technology Cluster

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Paul Aplin<sup>1</sup>, Alison Marsh<sup>1</sup>, Danny Donoghue<sup>2</sup>, Nick Tate<sup>3</sup>,  
Graham Ferrier<sup>4</sup>, Doreen Boyd<sup>1</sup>, Mark Danson<sup>5</sup> and Allen Pope<sup>6</sup>

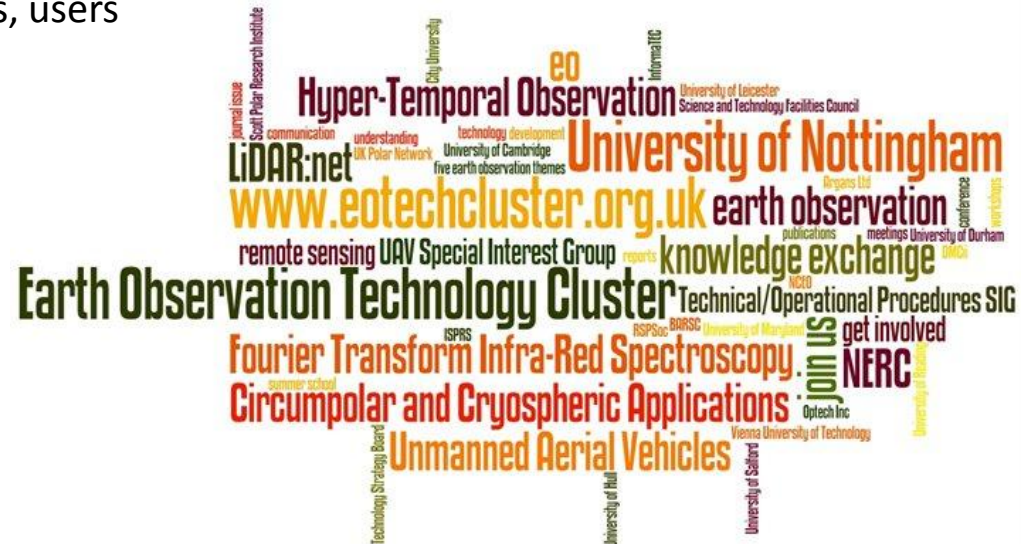
<sup>1</sup>University of Nottingham, <sup>2</sup>University of Durham, <sup>3</sup>University of Leicester,  
<sup>4</sup>University of Hull, <sup>5</sup>University of Salford, <sup>6</sup>Scott Polar Research Institute





# Rationale

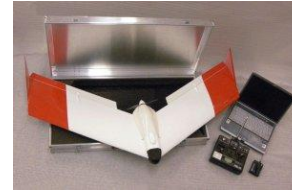
- Promotes communication regarding state-of-the-art technology used in EO of the land surface
- Covers the full range of terrestrial EO operation
  - from platform and sensor development,
  - through image retrieval and analysis,
  - to environmental modelling and thematic application
- Serves the whole EO technology community, and more
  - Researchers, developers, suppliers, users
  - Academia, government, industry
  - Multiple disciplines





# Themes

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1. Low-Altitude UAV Earth Observation  
Prof Danny Donoghue, University of Durham



2. LiDAR:net  
Dr Nick Tate, University of Leicester

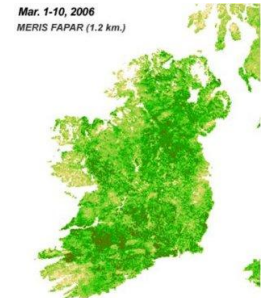


3. Field-Based Fourier Transform InfraRed Spectroscopy  
Dr Graham Ferrier, University of Hull



4. Hyper-Temporal Earth Observation  
Dr Doreen Boyd, University of Nottingham & Prof Mark Danson, University of Salford

5. Circumpolar and Cryospheric Earth Observation  
Allen Pope, Scott Polar Research Institute





# UAV workshop

- Joint EO Technology Cluster/RSPSoc UAV SIG event
- University of Durham, 6-7 July 2011
- 40 international participants
- Representing research and industry
- Keynote, seminar and poster papers
- Practical UAV demonstrations
- Round-table agenda-setting discussion
- RSPSoc Annual Lecture & Conversazione
- Follow-up event planned



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RSPSoc UAV SIG © Nigel King 2011



# Chester city walls

- Advantages of technologically advanced UAVs:
  - they are low-cost, flexible and accessible
  - resulting data can be processed quickly
  - high resolution aerial photography taken from viewpoints that other platforms cannot reach



- E.g. Cheshire West and Chester Council recently surveyed its historic city walls to ascertain their condition.
  - One section required a UAV that could fly close to the wall without endangering local people or the structure itself
  - The survey work was completed quickly and without disruption to wall-users, residents or businesses
  - On-board camera captured high-resolution photographs with a deliberate degree of overlap, so ideally suited for image processing





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- Strategy meeting in 2010
  - Proposed future activities include:
    - Developing a network/community of practice from academia, industry and NERC
    - Dedicated workshops on technical developments and/or applications of terrestrial LiDAR
    - A scoping report to input into both the technical Earth Observation development and the NERC Technologies programme
    - Peer-reviewed journal special issues





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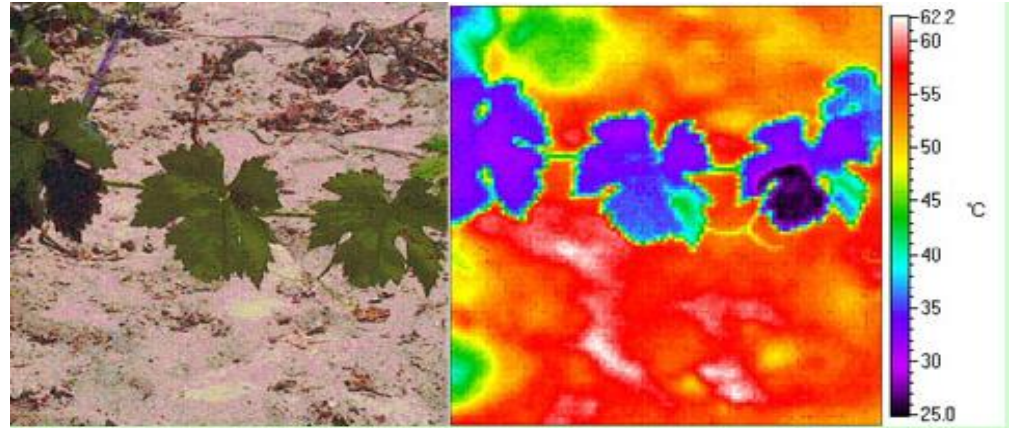
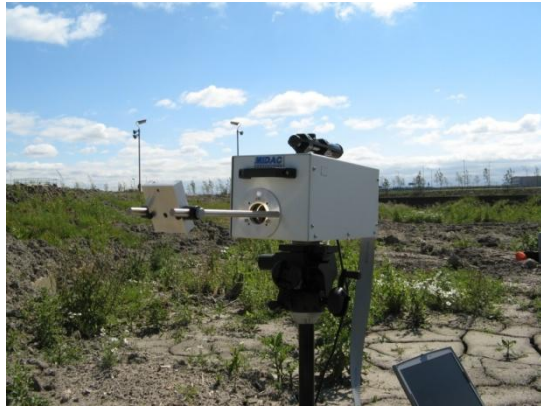
## Environmental applications of FTIR spectroscopy and Thermal Emissivity Imaging

- The utility of field-based FTIR spectroscopy and thermal emissivity imaging (specifically 8-14 microns) to a wide range of geological and environmental applications has been demonstrated by a number of academic studies over recent years
- FTIR spectroscopy and thermal emissivity imaging have the capability of providing information on the composition of rock, sediment, soil, vegetation or atmosphere that reflectance spectroscopy cannot
- Field-based FTIR techniques and spectral emissivity imaging have the potential to significantly advance the application of remote sensing to a wide range of environmental processes and problems

Theme Leader – Dr Graham Ferrier, [g.ferrier@hull.ac.uk](mailto:g.ferrier@hull.ac.uk)

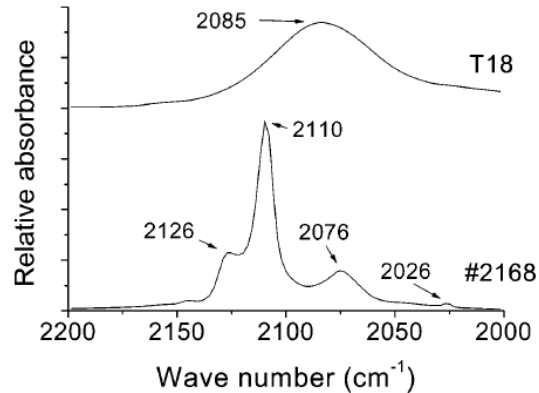
# Environmental applications of FTIR spectroscopy

## Vegetation

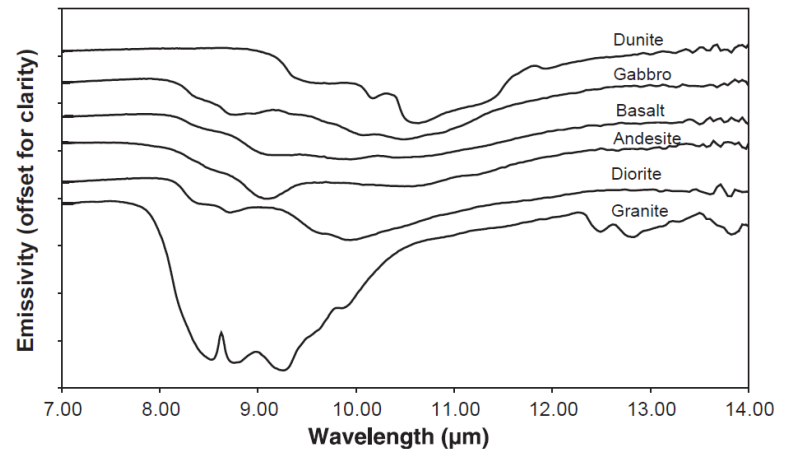


False colour thermal image (right) of grape-vine leaves, showing the temperature difference between non-transpiring (42 oC light blue-green) and wet (25 oC blue-black) areas of the leaves.

## Soil contamination (e.g. cyanide)



## Geology (e.g. characterising igneous rock)



# Applied and commercial applications of field-based FTIR spectroscopy

## Detection from Long Distances

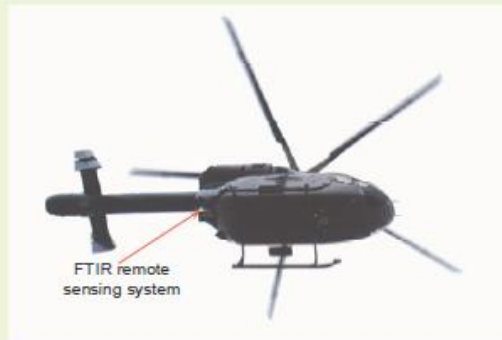
Release of Sulfur Hexafluoride



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Signal (NEAT)

Airborne Pipeline Surveillance



FTIR remote sensing system

## Remote Sensing of Volcanic Gases

Cooperation with INGV



## Industrial Emissions

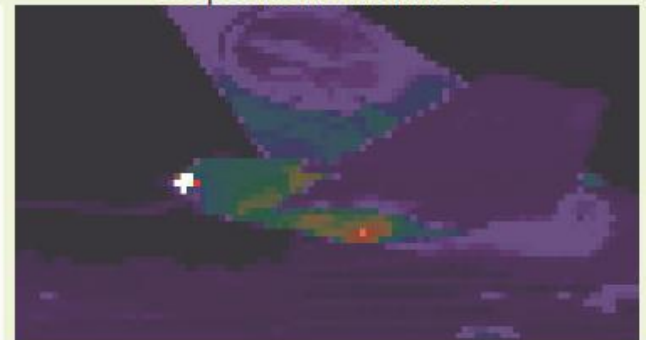
Ammonia



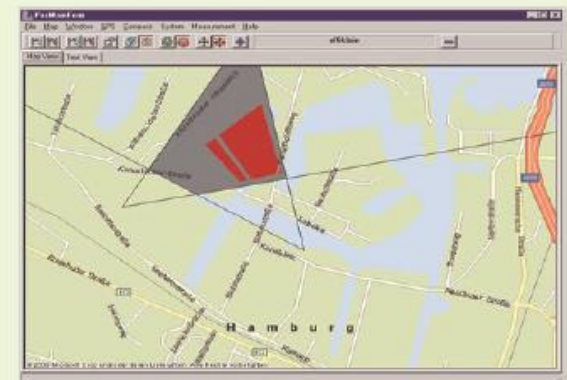
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Coefficient of correlation

Measurement of Aircraft Exhaust Gas Cooperation with IMK-IFU



## Tomographic Mapping





## Programme of Knowledge Exchange Activities

Conference	Activity	Sectors of community attending	Date and Location
<b>Geo-environmental Remote Sensing GRSG</b>	Joint EARSeL-GRSG session at GRSG 2011 annual conference  (**FREE REGISTRATION**)	All sectors of UK and overseas EO community Both academic and commercial	7-9 December 2011, ESA, Frascati, Rome
<b>Workshop on FTIR and Thermal Remote Sensing</b>	Workshop to demonstrate applications and technological developments relating to FTIR and thermal emissivity imaging techniques	All sectors of UK and overseas EO community	2012, UK Venue/dates tbc

Contact Theme Leader – Dr Graham Ferrier at [g.ferrier@hull.ac.uk](mailto:g.ferrier@hull.ac.uk) regarding further information about the theme activities



GRSG Geological Remote Sensing Group

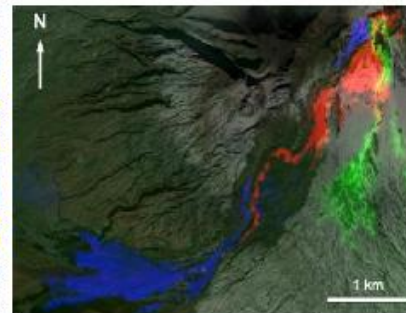
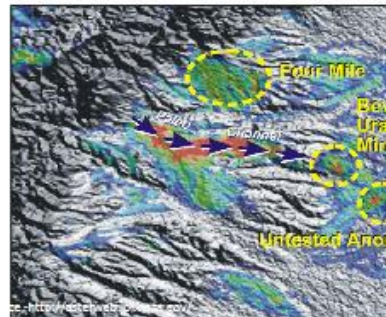


## GRSG Annual General Meeting 2011

7th – 9<sup>th</sup> December 2011, ESA ESRIN, Frascati, Italy

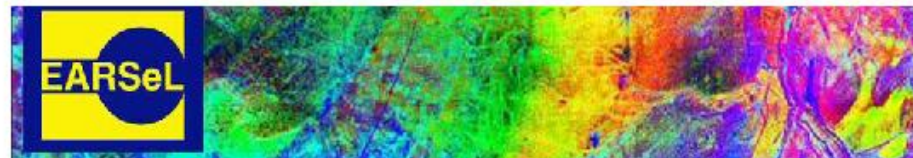
**GRSG–EARSel Joint session on Thermal Remote Sensing**

Papers are invited that present new results from applied and fundamental research that explores the application of thermal remote sensing in mapping, monitoring and understanding the geology and geological processes.



For more details on the conference and to register please see <http://earth.eo.esa.int/workshops/grsg2011/>

Call for papers closes 30<sup>th</sup> of September 2011



EARSel Special Interest Group on Thermal Remote Sensing (SIG-TRS)



- NERC Consortium Grant proposal
- Proposed future activities include:
  - Workshop on hyper-temporal EO
  - Review on hyper-temporal EO

*Mar. 1-10, 2006*  
*MERIS FAPAR (1.2 km.)*

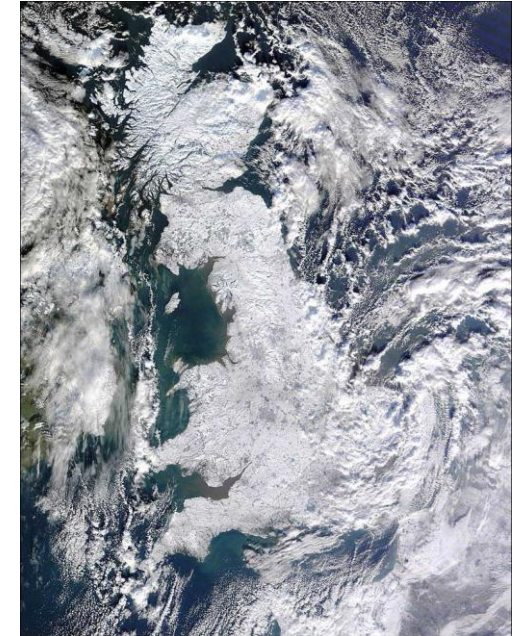




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## Why the Cold and the Poles?

- Understanding the cryosphere is a key part of understanding the Earth and its climate
- EO technology has profoundly improved our understanding of the cryosphere:
- Enabling observation of large areas such as the Arctic Ocean
- Facilitating studies of glaciers in remote and/or rugged zones including the Himalayas
- High resolution 3D modelling for monitoring valley glaciers and continental ice sheet flow models
- Snow monitoring, avalanche prediction and iceberg/sea ice forecasts



**Theme Leader – Allen Pope, [ap556@cam.ac.uk](mailto:ap556@cam.ac.uk)**

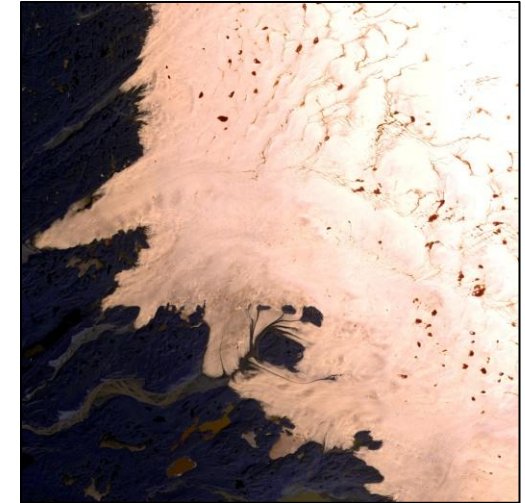


- Joint EO Technology Cluster/UK Polar Network event
- University of Reading, 20-22 July 2011
- Early career scientists instructed by experienced practitioners
- Lectures, practical exercises, students' posters and career panel discussion
- Online yearbook at [www.eotechcluster.org.uk](http://www.eotechcluster.org.uk)
- Production of outreach teaching materials



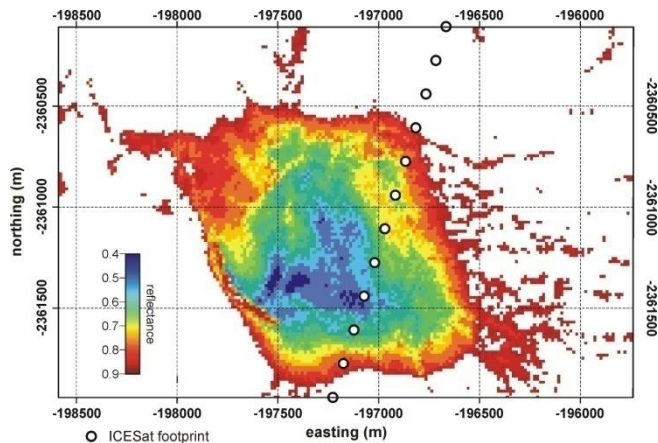


- Satellite data essential to determine characteristics of large areas such as the Greenland Ice Sheet
- Water stored in thousands of summer meltwater lakes drain to the ice bed, acting as a lubricant and accelerating ice flow velocity
- This acceleration process may increase iceberg production, and thus Greenland's contribution to sea-level rise
- Researchers at Swansea University are using high-resolution satellite sensor images to predict glacier acceleration

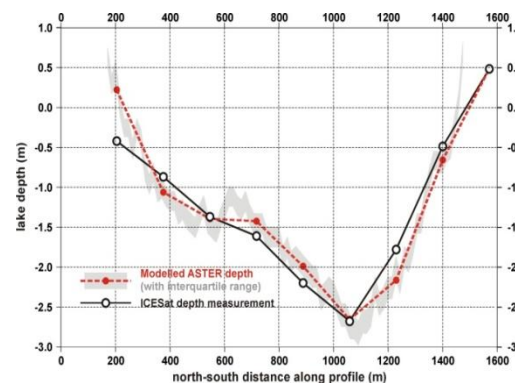


Example of meltwater lake. Pixels show reflectance values of the water from an ASTER image (15 m resolution)

Researcher: Laura Cordero Llana  
[493052@swansea.ac.uk](mailto:493052@swansea.ac.uk)



Depth profile of the lake, showing the depth given by ICESat measurements





- Further events throughout 2011 and 2012
  - Workshops
  - Demonstrations
  - Conferences
- Wide access publications
  - Geoxonnections overview
  - Sensed articles
  - Review/scoping papers
- Lobbying/guiding future policy
  - Natural Environment Research Council ‘Hyper-temporal remote sensing’ consortium grant proposal
  - European Cooperation in Science and Technology ‘Thermal infrared emissivity spectroscopy’ knowledge exchange grant proposal
  - Natural Environment Research Council ‘Wildfire suppression using UAVs’ knowledge exchange grant proposal support
  - European Space Agency ‘Space and the Arctic – how can space-based systems support European policies’ grant proposal support



## TRAINING DAYS

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### EARTH OBSERVATION TECHNOLOGY CLUSTER

**ALISON MARSH AND DR PAUL APLIN REPORT ON A UK UNIVERSITY-LED KNOWLEDGE EXCHANGE INITIATIVE THAT HAS GLOBAL REACH**

From studying land use, traffic cameras, through using the latest unmanned aerial technology for rapid surveying, to investigating to smart, the Earth Observation Technology Cluster has it all covered. The Cluster, based at the University of Nottingham, but working internationally, is a two-year knowledge exchange project funded by Britain's Natural Environment Research Council.

Cluster activities cover the full range of EO operations: new platform and sensor development, image retrieval and analysis, data applications and environmental monitoring. Five key themes are being investigated in depth, including Unmanned Aerial Vehicles, LiDAR (Light Detection and Ranging), Fourier Transform Infrared Spectroscopy, hyper-temporal modelling, and polar applications. The Cluster aims to engage a wider EO community through workshops, demonstrations and networking to promote these technological advances.

Everyone is used to recycling waste these days, but how about EO data? A collaborative project at the University of Nottingham's School of Geography and Department of Electronic Engineering analyses images from the Highways Agency's traffic cameras to determine the type of vegetation present and the colour components of this vegetation. This 'Bridging the Gap' project, funded by the Engineering and Physical Sciences Research Council, requires automated processing to deal with the 4,500 images acquired daily. This generates phenological data relating to the vegetation life-cycle, such as the timing of leaf fall and budding.

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The number and type of courses available at GIS247 is being extended. The first phase of this is the release of a number of training presentations around the theme 'GIS - Essentials'.

These presentations address a series of topics that are the foundation to the knowledge of users successfully implementing and analysing data in their GIS software.

A further key development at GIS247 is

now the ability to pick and pay for access to specific courses. Until now, a GIS247 license has given users access to ALL the learning for their chosen GIS software. We have added to this approach with the ability for users to pick and choose a specific course or course that they want access to, and pay accordingly. This is all supported by a new streamlined online ordering capability which gives greater flexibility to users wishing to follow an e-learning approach.

To take a look at our latest developments visit our Training Catalog <http://www.gis247.com/catalog>



# Call for papers

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- Special Issue on EO Technology Cluster in *Remote Sensing* open access journal
- Open access publishing can reach the maximum possible audience
- *Remote Sensing* recently accredited by Scopus, Europe's leading citation database
- EO Technology Cluster will help cover authoring fees (*Remote Sensing* fee = ~£360)
- Papers invited on any aspect of technology used in EO of the land surface
- Queries: [EOTechCluster@nottingham.ac.uk](mailto:EOTechCluster@nottingham.ac.uk)





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