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Managing wildfire disturbance in moorlands and heathlands

Introducing the Moors for the Future Pilot, Peak District National Park

Winner of The Copernicus Masters Sustainable Living Challenge 2016

Gail Millin-Chalabi

Ioanna Tantanasi

Adam Johnston

Team based at The University of Manchester - School of Environment, Education & Development (SEED)

BogFest 2017 – Moors for the Future Partnership and IUCN UK Peatland Programme - 22nd September 2017

MOORS FOR THE FUTURE PARTNERSHIP

Copernicus masters

CATAPULT Satellite Applications

sterling geo

MANCHESTER 1824 The University of Manchester

PROBLEM: LAND COVER IMPACTS

WILDFIRES PRODUCE DEVASTATING ENVIRONMENTAL AND ECONOMIC IMPACTS

118,00

GRASSLAND FIRES RECORDED BY FIRE & RESCUE 2011-2012 U.K

FIRE & RESCUE SERVICES

£55M PER YEAR ON WILDFIRE RESPONSE

£1M PER LARGE WILDFIRE

1,738 GRASSLAND, WOODLAND & CROP FIRES IN 2015 - 2016

784 ACCIDENTAL
954 DELIBERATE

IRS

LACK OF AVAILABLE DATA ESPECIALLY AROUND **AREA BURNED** AND **BURN SEVERITY.**

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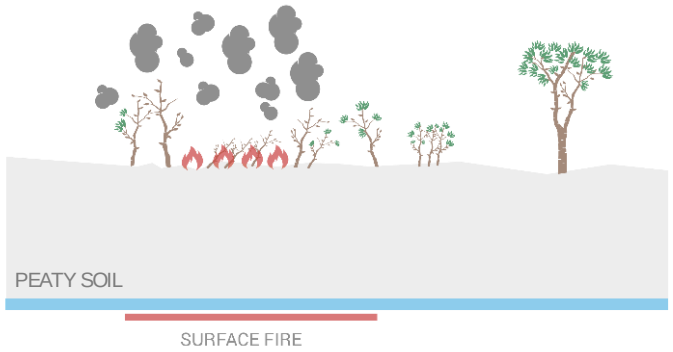
WILDFIRES | HOW THEY IMPACT THE ENVIRONMENT

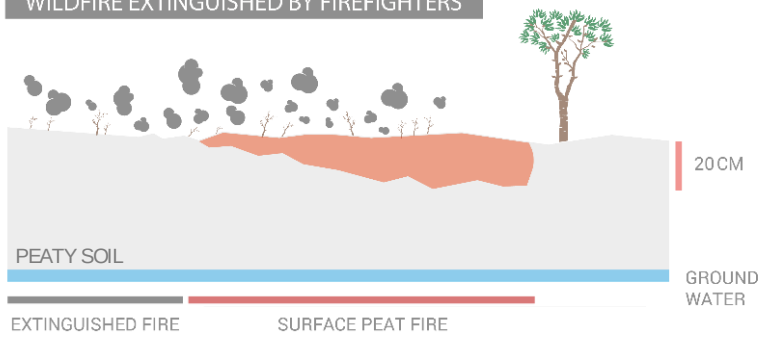
1

WILDFIRE STARTED VIA MAN MADE ACTIVITY



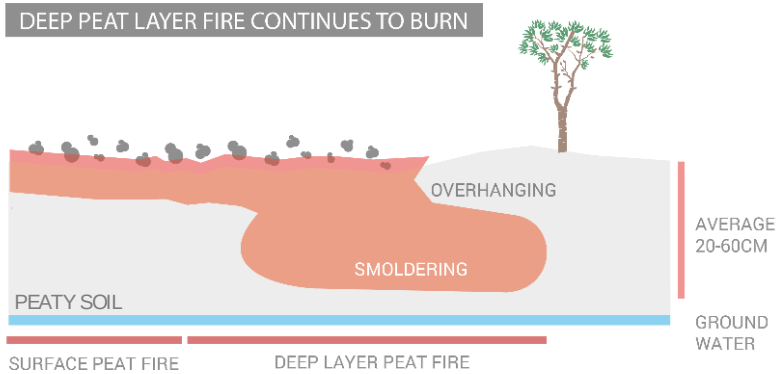
2

WILDFIRE EXTINGUISHED BY FIREFIGHTERS



3

DEEP PEAT LAYER FIRE CONTINUES TO BURN



PROBLEM: SMOULDERING NATURE OF MOORLAND WILDFIRES

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Fuel Moisture Content (FMC)

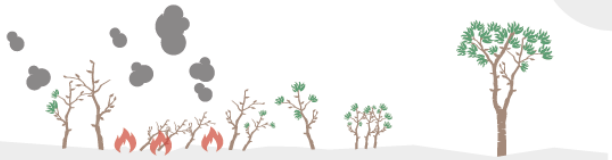
LOW INTENSITY

JUNE

ACTIVITY

HIGH FMC (WET)
NO WIND
LOW TEMP

WILDFIRE (UNMANAGED)
NO BURN IN THE PEAT



SURFACE FIRE

ECONOMIC AND ENVIRONMENTAL IMPACT IS NEGLIGIBLE

NATURAL REGENERATION

SOME IMPACT ON WILDLIFE AND BIRDS SUCH AS THE GOLDEN PLOVER AND DUNLIN

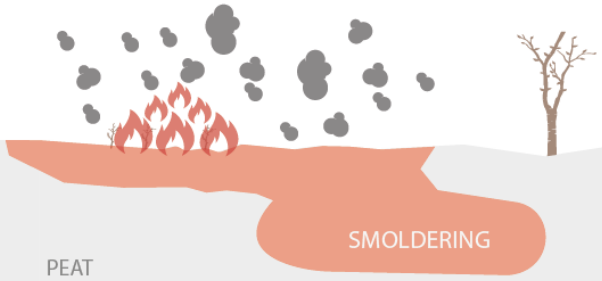
HIGH INTENSITY

MARCH

ACTIVITY

LOW FMC (DRY)
NO RAIN (2 WEEKS)
HIGH TEMP
MAN MADE

BURNS THROUGH PEAT
BURNING FOR DAYS/WEEKS



PEAT FIRE

ECONOMIC AND ENVIRONMENTAL IMPACT IS **HIGH**

IMPACT 1 — VEGETATION LOSS

IMPACT 2 — CO_2 RELEASE

IMPACT 3 — INCREASE IN RUNOFF (FLOODING)

IMPACT 4 — EROSION (GULLIES)

IMPACT 5 — WATER DISCOLORATION/ CONTAMINATION

Al-Moustafa *et al.,* (2012)

SOLUTION

Need for a **national monitoring and detection tool** of peat moorland and heathland wildfires by **generating products from Earth Observation data** to help:

Understand patterns of **wildfire occurrence** and **UK wildfire regimes**

Mitigate against **wildfire risks**

Target **land management**, **peat restoration**, and **reseeding**

Model carbon losses

Reduce water discolouration and associated **costs**

Moors for the Future Partnership are currently working on the **MoorLIFE 2020 Project** funded by the **EU LIFE Programme** and co-financed by Severn Trent Water, Yorkshire Water and United Utilities.

Davies *et al.*, (2016); MFFP (2015)

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EnviroSAR is a **targeted solution** for **peat moorland** and **heathland restoration**, in the **UK.**

We analyse **satellite radar data** to **mitigate wildfire risks**, **support** planning and execution of **land restoration activities** and **aim to reduce water discolouration** and associated **costs.**

MOORS FOR THE FUTURE PARTNERSHIP

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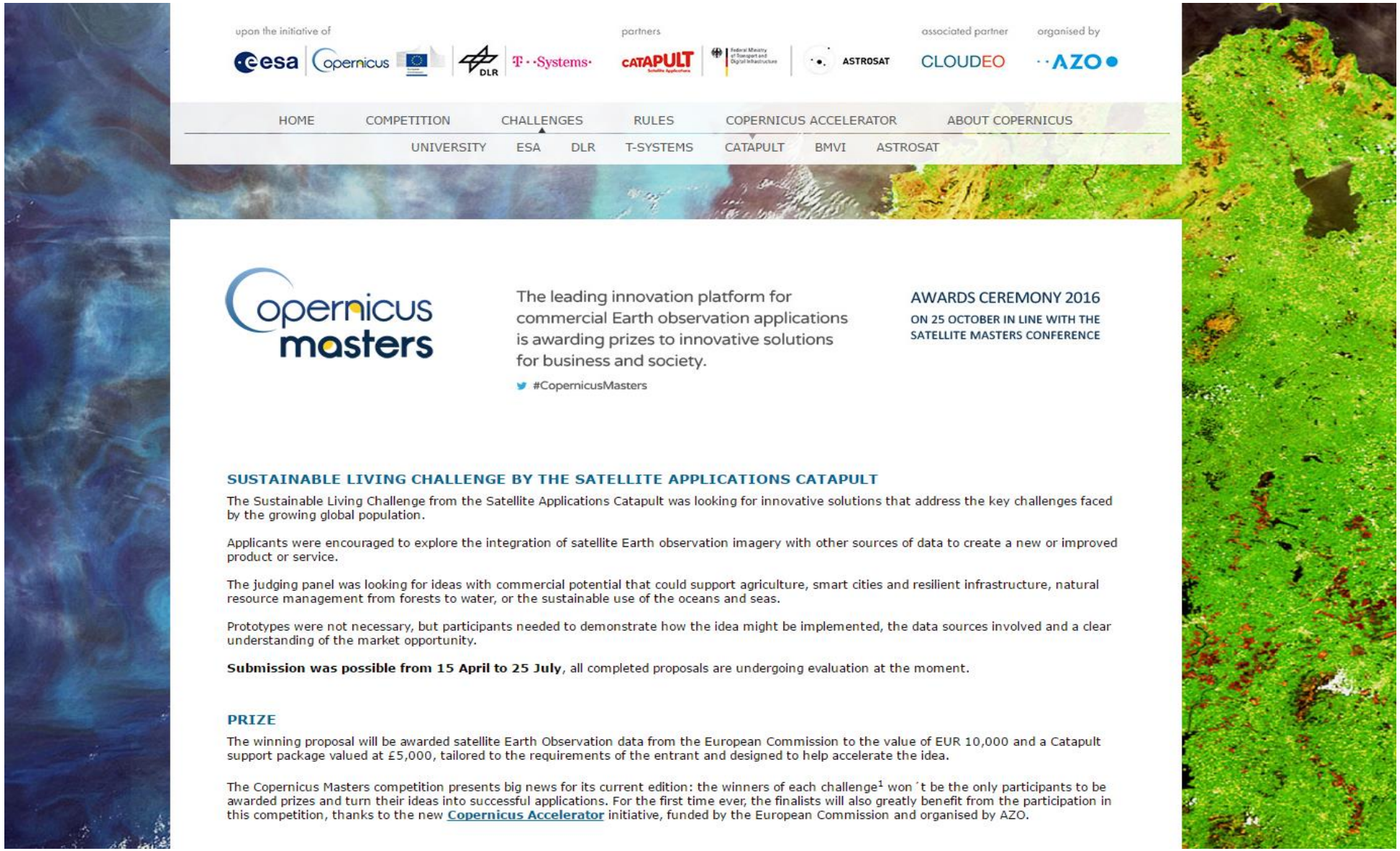
Submission of EnviroSAR idea to the Copernicus Masters Competition – 25 July 2016



upon the initiative of: esa | Copernicus | DLR | T-Systems

partners: CATAPULT | Federal Ministry of Transport and Digital Infrastructure | ASTROSAT

associated partner: CLOUDEO

organised by: AZO

HOME | COMPETITION | CHALLENGES | RULES | COPERNICUS ACCELERATOR | ABOUT COPERNICUS

UNIVERSITY | ESA | DLR | T-SYSTEMS | CATAPULT | BMVI | ASTROSAT

copernicus masters

The leading innovation platform for commercial Earth observation applications is awarding prizes to innovative solutions for business and society.

#CopernicusMasters

AWARDS CEREMONY 2016

ON 25 OCTOBER IN LINE WITH THE SATELLITE MASTERS CONFERENCE

SUSTAINABLE LIVING CHALLENGE BY THE SATELLITE APPLICATIONS CATAPULT

The Sustainable Living Challenge from the Satellite Applications Catapult was looking for innovative solutions that address the key challenges faced by the growing global population.

Applicants were encouraged to explore the integration of satellite Earth observation imagery with other sources of data to create a new or improved product or service.

The judging panel was looking for ideas with commercial potential that could support agriculture, smart cities and resilient infrastructure, natural resource management from forests to water, or the sustainable use of the oceans and seas.

Prototypes were not necessary, but participants needed to demonstrate how the idea might be implemented, the data sources involved and a clear understanding of the market opportunity.

Submission was possible from 15 April to 25 July, all completed proposals are undergoing evaluation at the moment.

PRIZE

The winning proposal will be awarded satellite Earth Observation data from the European Commission to the value of EUR 10,000 and a Catapult support package valued at £5,000, tailored to the requirements of the entrant and designed to help accelerate the idea.

The Copernicus Masters competition presents big news for its current edition: the winners of each challenge[1] won´t be the only participants to be awarded prizes and turn their ideas into successful applications. For the first time ever, the finalists will also greatly benefit from the participation in this competition, thanks to the new **Copernicus Accelerator** initiative, funded by the European Commission and organised by AZO.

Copernicus Sustainable Living Challenge Award - 25 October 2016 - Madrid, Spain

MULTIDISCIPLINARY TEAM

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OVER 10 YEARS OF COMBINED EXPERIENCE IN REMOTE SENSING AND STAKEHOLDER ENGAGEMENT FOR CARBON MANAGEMENT

Dr Gail Millin-Chalabi
Director/ Technical Lead

- PhD in SAR/ InSAR Burn Scar Characterisation and Persistence (awarded in 2016)
- Over 10 years using remote sensing data
- 12 years of national scale SDI development
- Landmap – Copernicus Best Service Challenge 2013

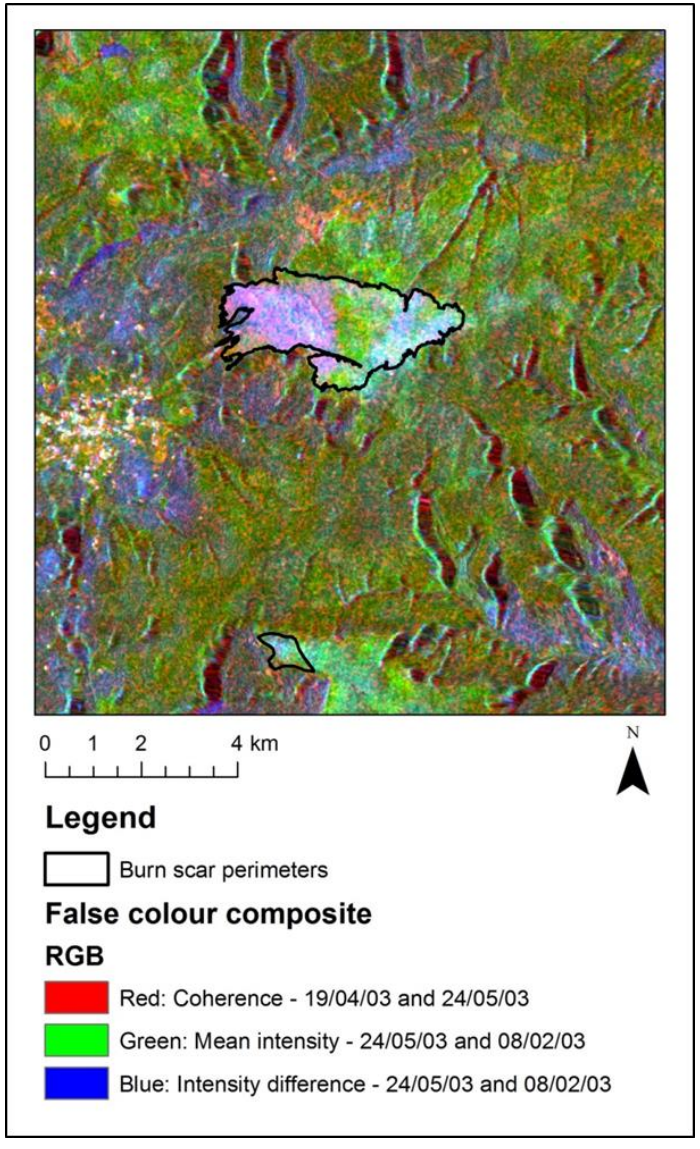
Dr Ioanna Tantanasi
Sales & Marketing Lead

- PhD in Adaptive Management, Stakeholder Engagement, and Carbon Management in the Peak District, UK
- In-depth knowledge and access to stakeholder database via Knowledge for Wildfires online platform (NERC-funded)
- Established network (> 6 years) of our target market

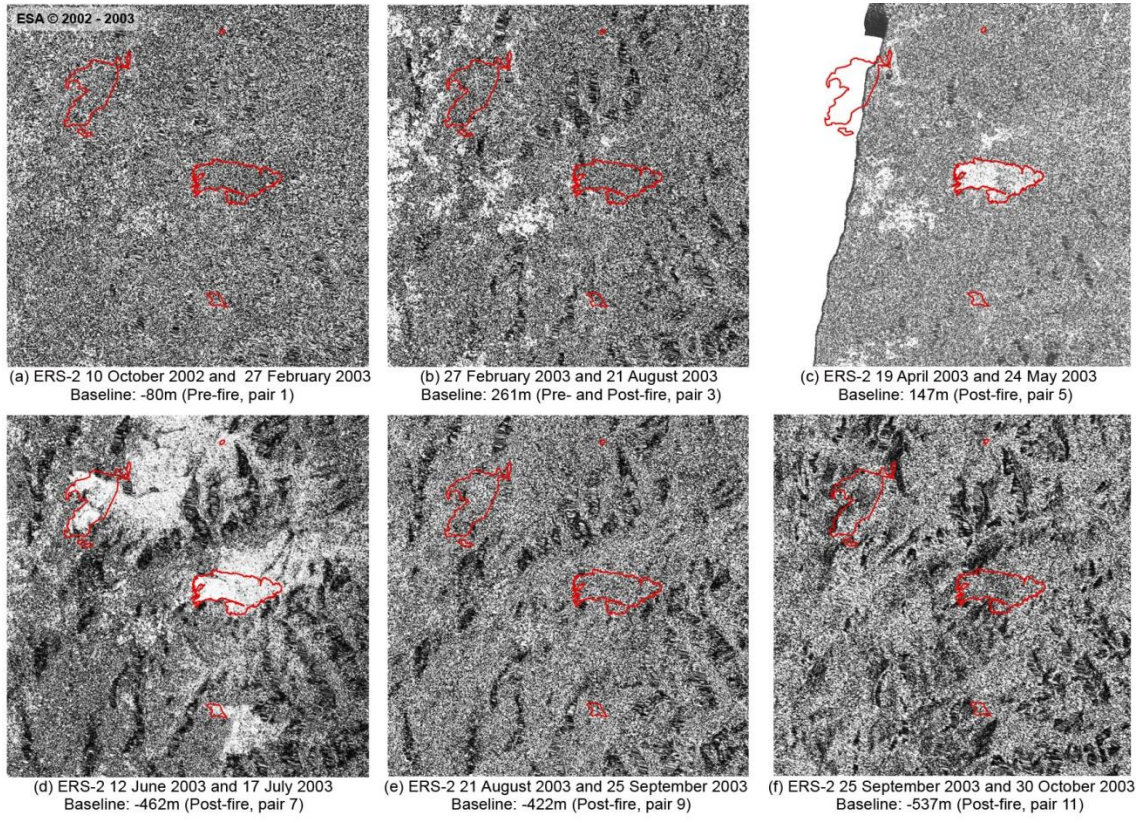
Adam Johnston
Research & Development Lead

- BSc in Geography (University of Manchester, First class)
- MSc in GIS (University of Leeds, due to start September 2017)
- Radar processing experience in SNAP

SAR Colour Composite – Bleaklow burn scar



InSAR Time Series – PDNP 2003 wildfires



(a) ERS-2 10 October 2002 and 27 February 2003
Baseline: -80m (Pre-fire, pair 1)

(b) 27 February 2003 and 21 August 2003
Baseline: 261m (Pre- and Post-fire, pair 3)

(c) ERS-2 19 April 2003 and 24 May 2003
Baseline: 147m (Post-fire, pair 5)

(d) ERS-2 12 June 2003 and 17 July 2003
Baseline: -462m (Post-fire, pair 7)

(e) ERS-2 21 August 2003 and 25 September 2003
Baseline: -422m (Post-fire, pair 9)

(f) ERS-2 25 September 2003 and 30 October 2003
Baseline: -537m (Post-fire, pair 11)

- SAR can penetrate clouds providing a high temporal resolution of coverage
- InSAR techniques can be used to understand structural canopy change of the pre- and post-fire vegetation (Millin-Chalabi *et al.*, 2014; Millin-Chalabi, 2016).
- SAR and InSAR techniques allow the spatial extent of the wildfire to be assessed and monitored, highlighting areas of vegetation removal
- GPS data from MFFP was used to quality assure SAR/ InSAR results

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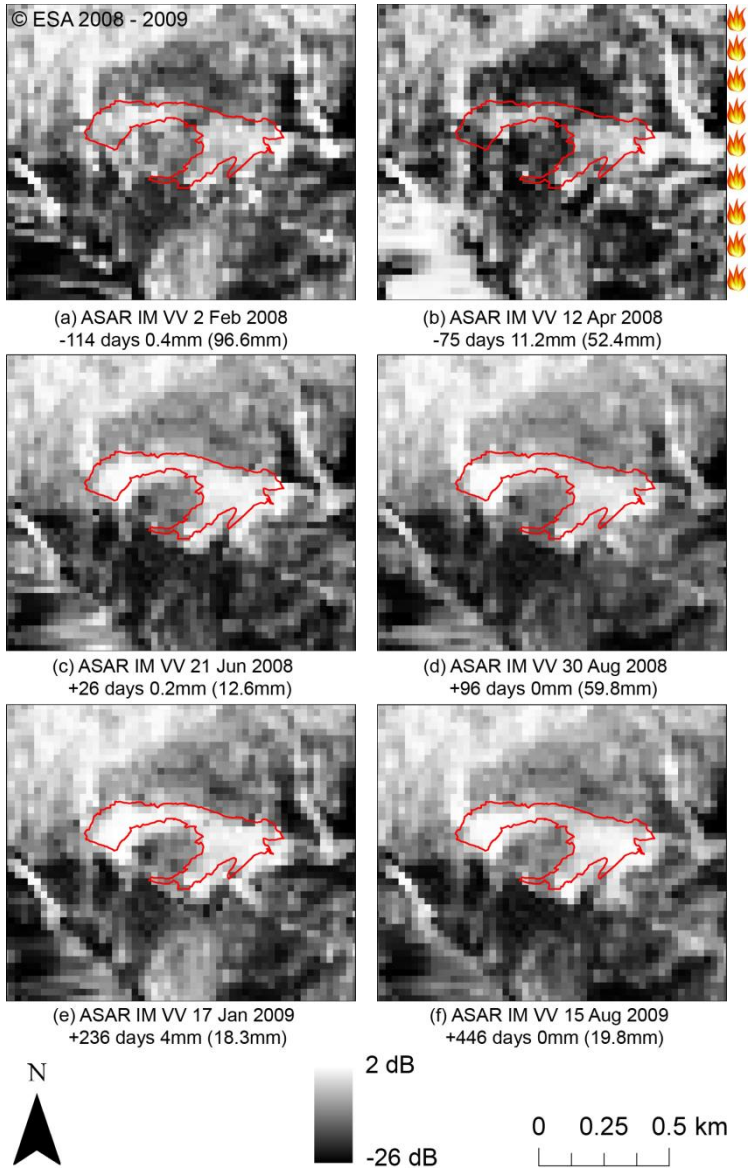
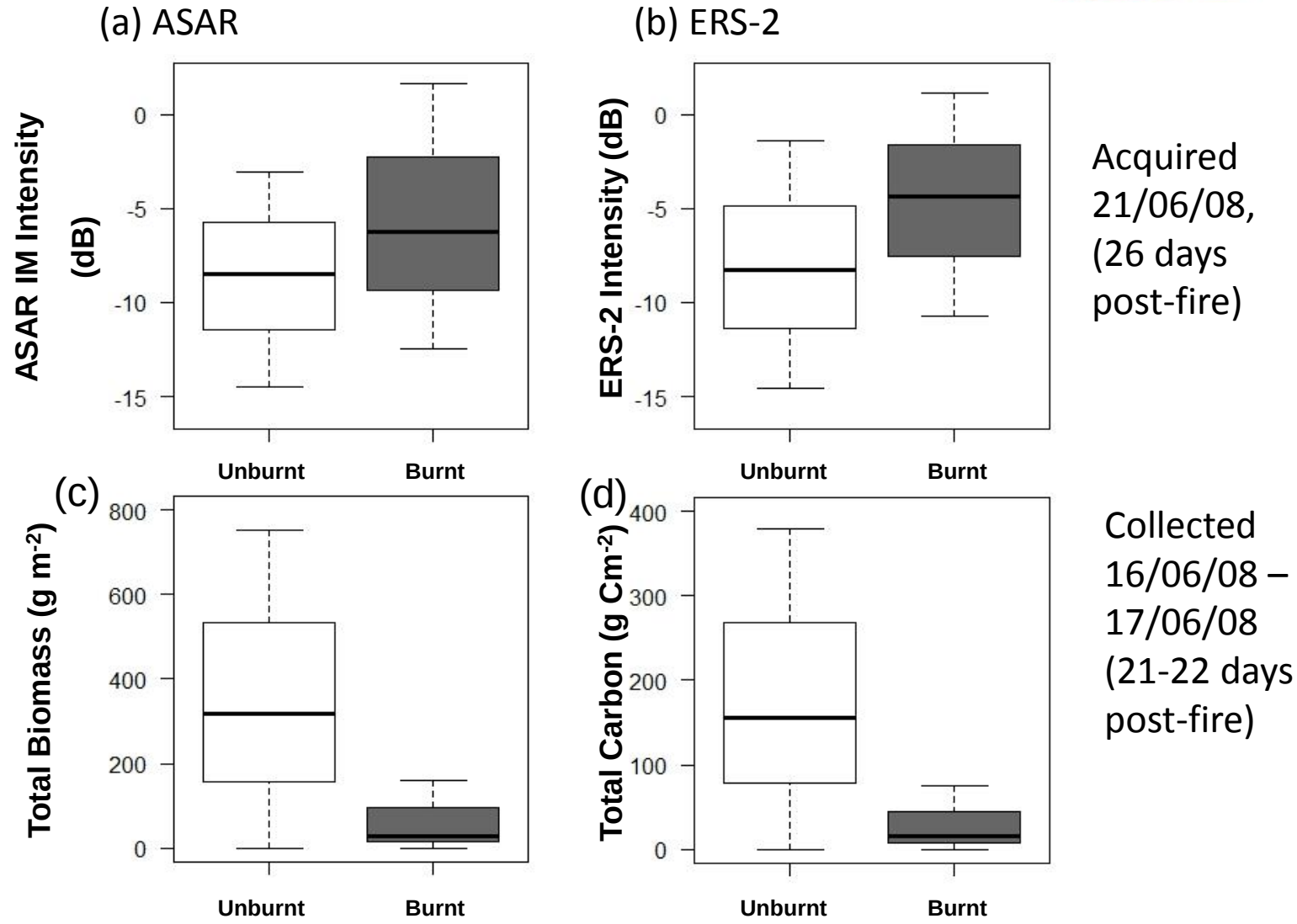
Edale 2008 SAR Intensity Time Series





Acquired 21/06/08, (26 days post-fire)

Collected 16/06/08 – 17/06/08 (21-22 days post-fire)

- Smaller scale wildfires of 0.10 km^2 have been characterised using SAR intensity data improving on current burned area products available through EFFIS (Millin-Chalabi, 2016).
- Active C-band radar provides a persistent signal in the landscape for over a year after a deep-seated wildfire

PROPOSED WORKFLOW

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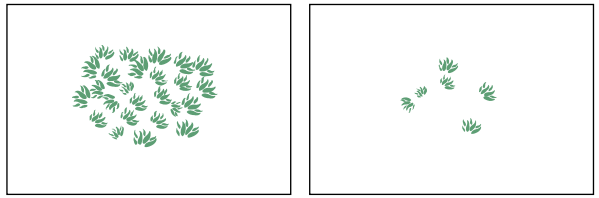
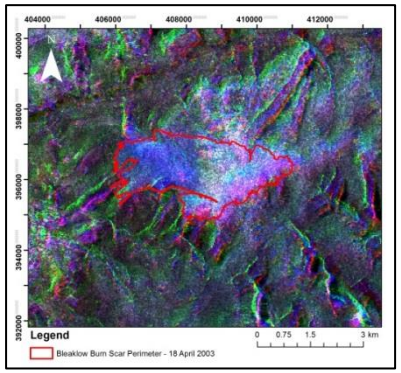
DOWNLOAD DATA → **PRE-PROCESS IN SNAP** → **VISUAL PRODUCT COMBINE SAR/ INSAR DATASETS** → **CLASSIFICATION KEY FUTURE R&D WORK** → **ANALYSE DATASET RESULTS** → **ERDAS APOLLO SERVICE DELIVERY**

- SENTINEL -1A/ -1B
- ERS2 - ARCHIVE
- ASAR - ARCHIVE
- RADARSAT 1/2

Canopy change
(Structural ground change)

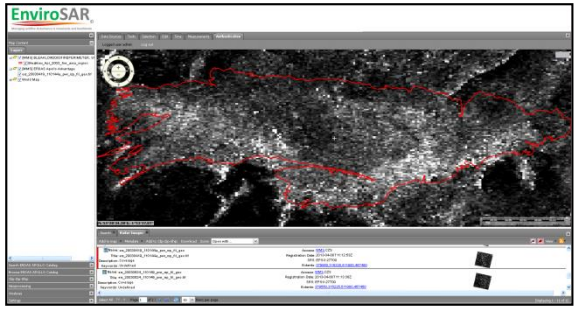


Change detection showing lack of vegetation, indicative of large burn



- Bleaklow burn scar
- Spatial extent – 7 km^2

- Intensity products
- Coherence products



- WMC - Web Map Context
- ISO 19115 XML metadata files
- Interoperable OGC services

sentinel-1

SNAP SURVEY

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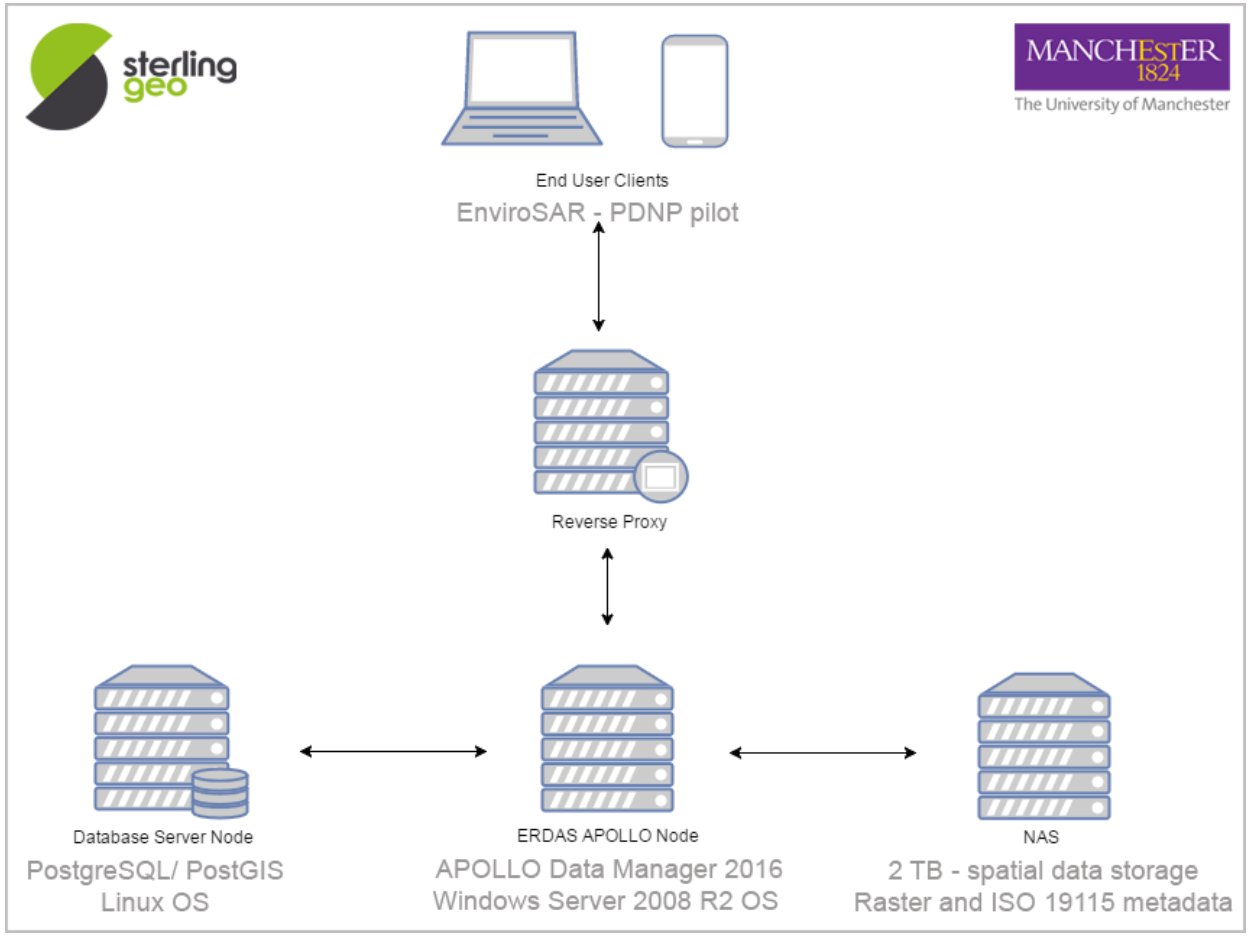
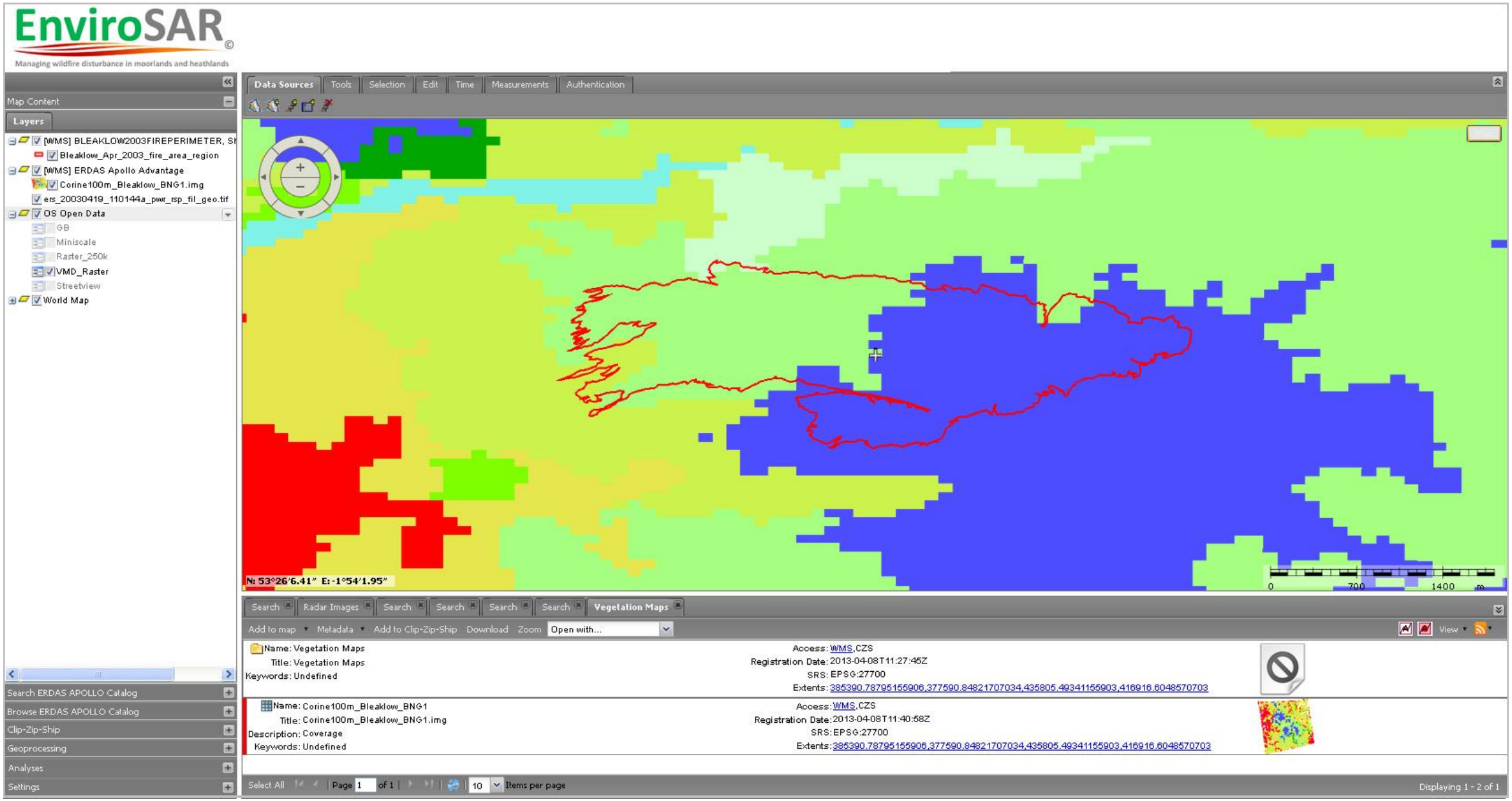
PDNP Pilot: Spatial Data Infrastructure



- Satellite data – optical (when available) and radar (Copernicus C-band)
- Digital terrain models
- Fire location points and perimeters and other field survey data
- Photographs
- PDF and Word Documents (fire reports and field observations)
- Weather and land cover data

MINIMUM VIABLE PRODUCT: Peak District National Park



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2016

Product validation with PDNP for pre-Sentinel wildfires

- Use of KfWf wildfire stakeholder database
- Obtain funding – Copernicus Masters Competition
- Technical Partnership: Sterling Geo

2017

Develop key infrastructure for PDNP pilot

- Pilot SDI/geoportal prototype/ MVP
- Completion of Copernicus Accelerator Programme
- Apply for ESA Kick-starter and ESA BIC
- Establish Client Partnership: MFFP

2018

- R&D for Copernicus datasets – PDNP pilot using post Sentinel – 1A/ -1B case studies
- Ingest results into geoportal

2019-2020

Expand products:

- Continue R&D work with Copernicus datasets with PDNP
- Expand to heathland regions i.e. Dorset Heathland Partnership
- Potentially address other environmental risks using SAR/InSAR techniques

Benefits

EnviroSAR will:

- **Save water** companies money by highlighting areas of high peat erosion through bespoke maps
- **Save conservation** groups time and money by generating burnt area maps remotely from radar and optical data rather than ground surveys
- **Add-value** by combining existing field data with Copernicus EO products to generate new information on burned area regeneration rates

ACKNOWLEDGEMENTS

- Sharing of field data and letters of support - Jon Walker, Tia Crouch and Paul Titterton (MFFP)/ Gareth Clay (The University of Manchester)
- Letters of support - Paul Hedley (Northumberland Fire and Rescue Service) and Andy Elliott (Dorset Heathland Partnership)
- Technical support – Sterling Geo
- Funding support - University Manchester Intellectual Property (UMIP)/ SEED, Satellite Applications Catapult (SAC), Science Technology Funding Council (STFC) and European Commission (EC).
- Special thanks to Julia McMorrow, (Senior Lecturer in Remote Sensing and NERC Knowledge Exchange Fellow at The University of Manchester) for her ongoing support.

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Thanks for Listening
Any Questions?

Email: info@envirosar.com
Website: www.envirosar.com/
Twitter: @EnviroSAR

Poster also available to view in the Marquee
Your participation needed (survey open until 31/12/17) http://bit.ly/2fjEQ1t