Earth Observation for Performance, Delivery and Resilience

Earth Observation has been used successfully for planning response to and monitoring recovery from incidents, events or emergencies. This document presents case studies on fire mapping, storm damage detection and landslide monitoring and indicates their ease of adoption.

Complexity

- (green) Clear method and straightforward
- (amber) Clear method but complex
- (red) Possible; needs research

Resource

- £ Low
- ££ Medium
- £££ High

Case Study I: Fire mapping and recovery

NatureScot use time series data from Sentinel-2 to derive vegetation indices and automatically map fire extents in upland habitats. The outputs are validated by visual inspection and updated annually. Due to the infrequent updates, the method is currently only used to monitor the extent of past fires. More frequent mapping and additional assessment of vegetation recovery would be possible if the workflow is automated and developed further.

The method is based on the thresholding of vegetation indices which is well understood and used operationally. Due to a manual and labour-intensive approach to validation, the workflow is currently only applied to the annual mapping of muirburn events. However, more frequent updates and assessment of vegetation recovery would be possible if the method is developed further. This would require research into an automated validation process and may involve the development of a machine learning workflow instead of, or alongside, the thresholding approach. Another limitation is caused by the availability of cloud free imagery, especially in winter. This could be improved by including commercial, high-resolution data into the analysis or investigating the use of Sentinel-1 data which is more complex but freely available.

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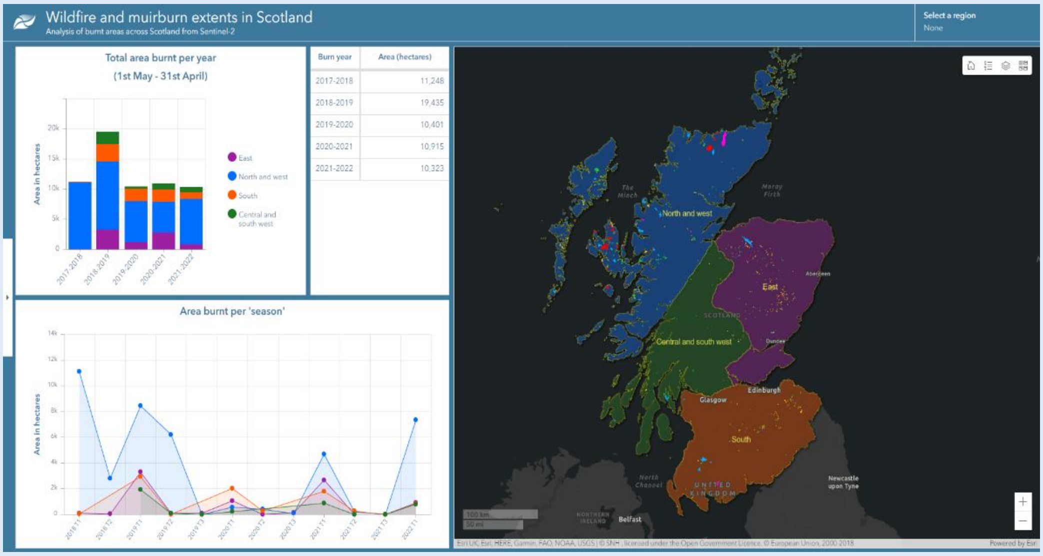
A workflow for processing the required data is already in place but would need a small expert team to improve and maintain, especially when outputs are to be produced more frequently. Data storage and processing is already taking place in the JASMIN cloud environment which comes with a small annual charge. Further charges occur from the ESRI license which is used to make the outputs available to users in an online dashboard. Costs would increase if data with very high spatial resolution is purchased for this work only or if more complex data processing (e.g. coherence) is required to improve the method.



Case study I: Wildfire and Muirburn portal for Scotland

Further products and applications

Copernicus Emergency Management/ Flood mapping / Landscape Evaluation Tool /Heat & drought mapping

JNCC Joint Nature Conservation Committee

Earth Observation for Performance, Delivery and Resilience

Scottish Government Riaghaltas na h-Alba gov.scot

Case Study II: Wind blow mapping

Scottish Forestry Coilltearachd na h-Alba

Following Storm Arwen in November 2021, Sentinel-1 data coupled with novel machine learning approaches have been used by Forest Research to identify potential areas of windblown trees across England and Scotland. The assessment focussed on conifer stands and areas greater than 0.1 ha only. The map indicates the presence of windblow rather than exact boundaries of damage. Some but not all of the detected stands have been validated against ground data from Scottish Forestry and the public.

The method is ready to be used operationally at national scale but requires further work to improve and validate the outputs. A major limitation is the focus on conifer stands only and re-training of the machine learning models would be required to include other species. This could be time consuming if relevant training data is not available. Other areas for improvement include a more exact mapping of the damage rather than simply detecting the presence of windblow and a more thorough, quantitative assessment of error rates. This requires the collection of additional validation data, either from higher resolution (optical) imagery or in form of ground observations (e.g. provided by citizen scientists).

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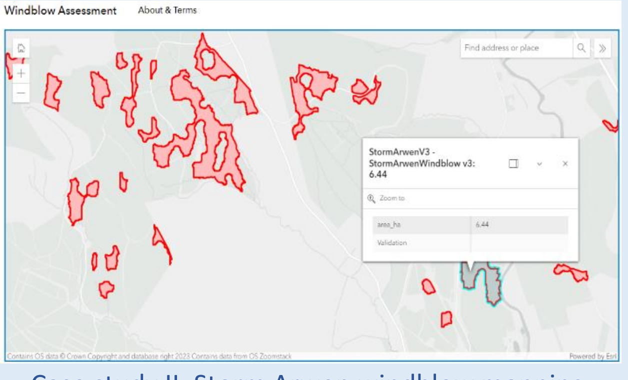
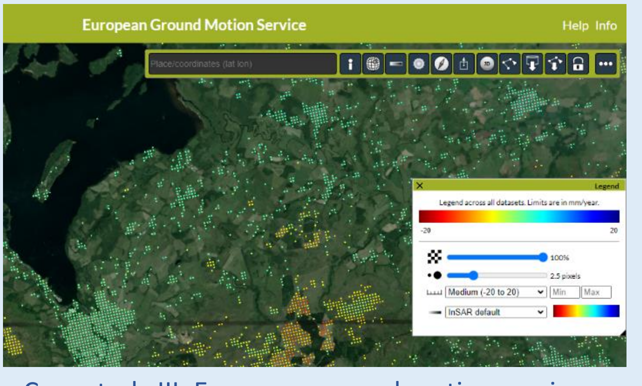
A workflow for processing the required data is already in place but would need a small expert team to improve and maintain, especially when outputs are to be produced in near-real time. Data storage and processing is expected to take place in a cloud environment such as Amazon Web Services or JASMIN which have a small to medium monthly charge. Costs would be high if data with very high spatial resolution is purchased following an event or if more complex data processing (e.g. coherence) is required to improve the method.



Case study II: Storm Arwen windblow mapping



Case study III: European ground motion service.

Case Study III: Landslide mapping

Sentinel-1 time series data is used to detect, monitor and forecast landslide risk, for example due to mining activities, engineering works or over eroding peatlands. Using interferometric synthetic aperture radar (InSAR) enables the mapping of existing ground instabilities and the monitoring of surface motion with millimetre accuracy. With Sentinel-1 data being collected every 6 days (more frequently in some places), weekly updated risk mapping is possible*.

The InSAR method is very precise, well understood and widely applied operationally, for example in engineering or natural disaster monitoring. However, the method is based on complex physics, requires expert knowledge for analysis and is computationally expensive in its implementation. UK specific monitoring services are currently under development in academia and as an ESA feasibility project. A European wide operational service is provided by Copernicus but only updated annually at a spatial resolution of 100m.

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Even though the method is applied widely for disaster monitoring, setting up a Scotland specific inhouse service would be difficult to implement and costly. All UK-based case studies are still in the research phase and a significant amount of work and expert knowledge would be needed for setting up operational systems. Data storage and processing costs would be medium to high due to complexity and size of data, especially if frequent update rates are required. *Requires the replacement of the S1B platform scheduled for 2023

Published: 2024-03. Reference to any specific product or entity does not constitute an endorsement or recommendation by JNCC or Scottish Government. Other products may be available.