

Implementing an open data EO platform to enable better environmental outcomes for the UK Government

Sam Franklin

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FOSS4G Global 2021

Overview

- **Background to the project**
- **What was the problem?**
- **Implementation > the Earth Observation Data Service**
- **The use cases related to Environmental Sustainability**
- **Some hard lessons learned**

Who were we working for?



Department
for Environment
Food & Rural Affairs

We are responsible for improving and protecting the environment. We aim to grow a green economy and sustain thriving rural communities. We also support our world-leading food, farming and fishing industries.

Defra is a ministerial department, supported by [33 agencies and public bodies](#).



Forestry Commission



Forest Research



Marine
Management
Organisation



Rural Payments
Agency



Environment
Agency



**Selection of
the 33
agencies
active on the
project**

**+5000
technical
staff**

Use Cases



But what is the problem(s) that needed to be solved ?

Existing ARD Generation

- Time cost of generating ARDs
- Different communities = different tooling
- Duplicated effort



Resilience

- High availability + strict SLAs
- Independent ARD store > mission critical services

Access

- Common access point across all Defra bodies
- Simple portal UI + technical interfaces

Bespoke ARD Details

Justification



Report outlined the case for specialised new ARD format for sentinel2 (2017) [link](#) suggesting advantages over ESA's Sen2cor approach.

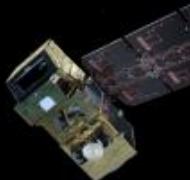
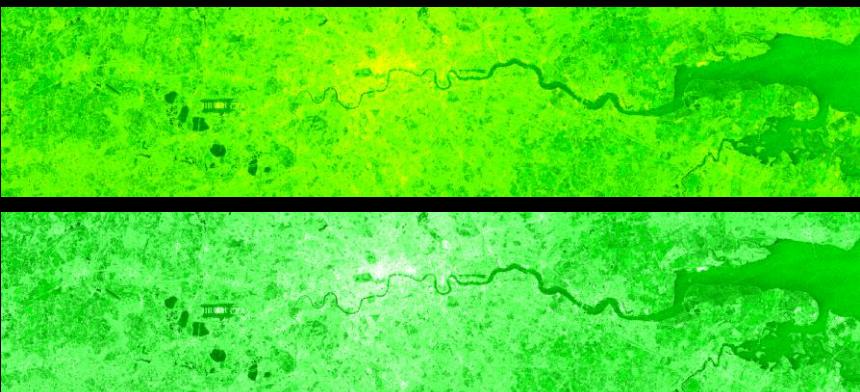
Common Features

- Single (band stacked) COG
- Topographic correction > UK 10m DEM
- Reprojected to “British National Grid” (EPSG:27700)
- INSPIRE/COES metadata



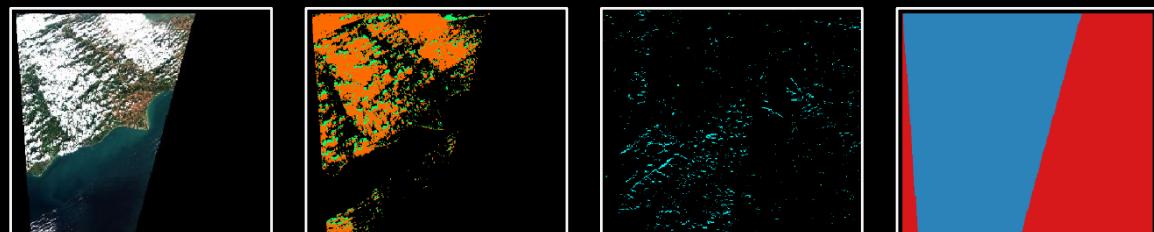
Sentinel 1

- ESA's Snap S1Toolbox generates normalised radar backscatter image with VV and VH bands.
- Orbit file correction applied
- border and thermal noise removal
- radiometric calibration & normalisation



Sentinel2

- ARCSI generates single stacked Standardised Surface reflectance image plus mask rasters for cloud, topographic shadows, saturation, and valid pixels
- Band sharpening to 10m (removing the native 60m ESA Bands 1, 9 and 10) atmospheric correction

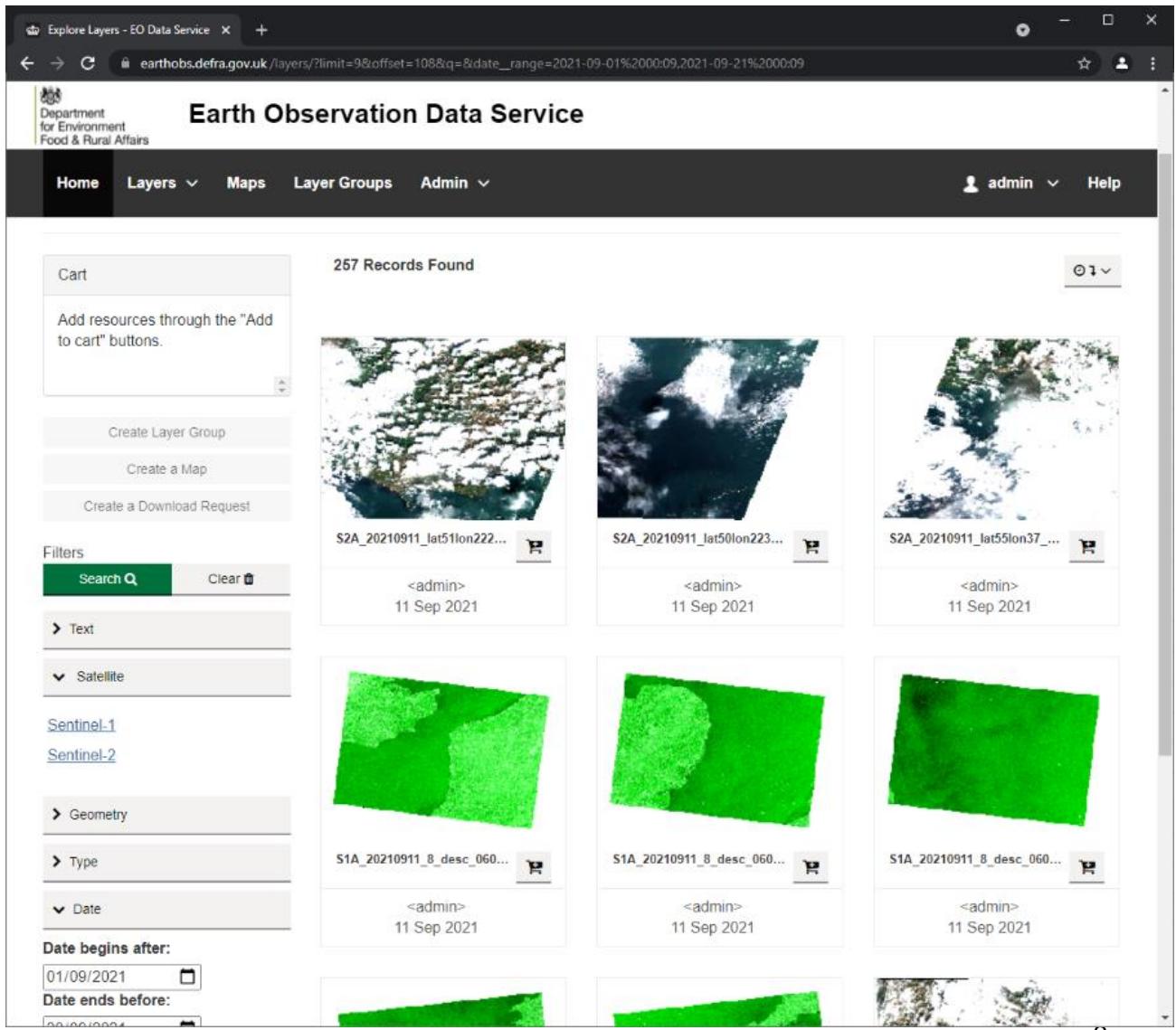


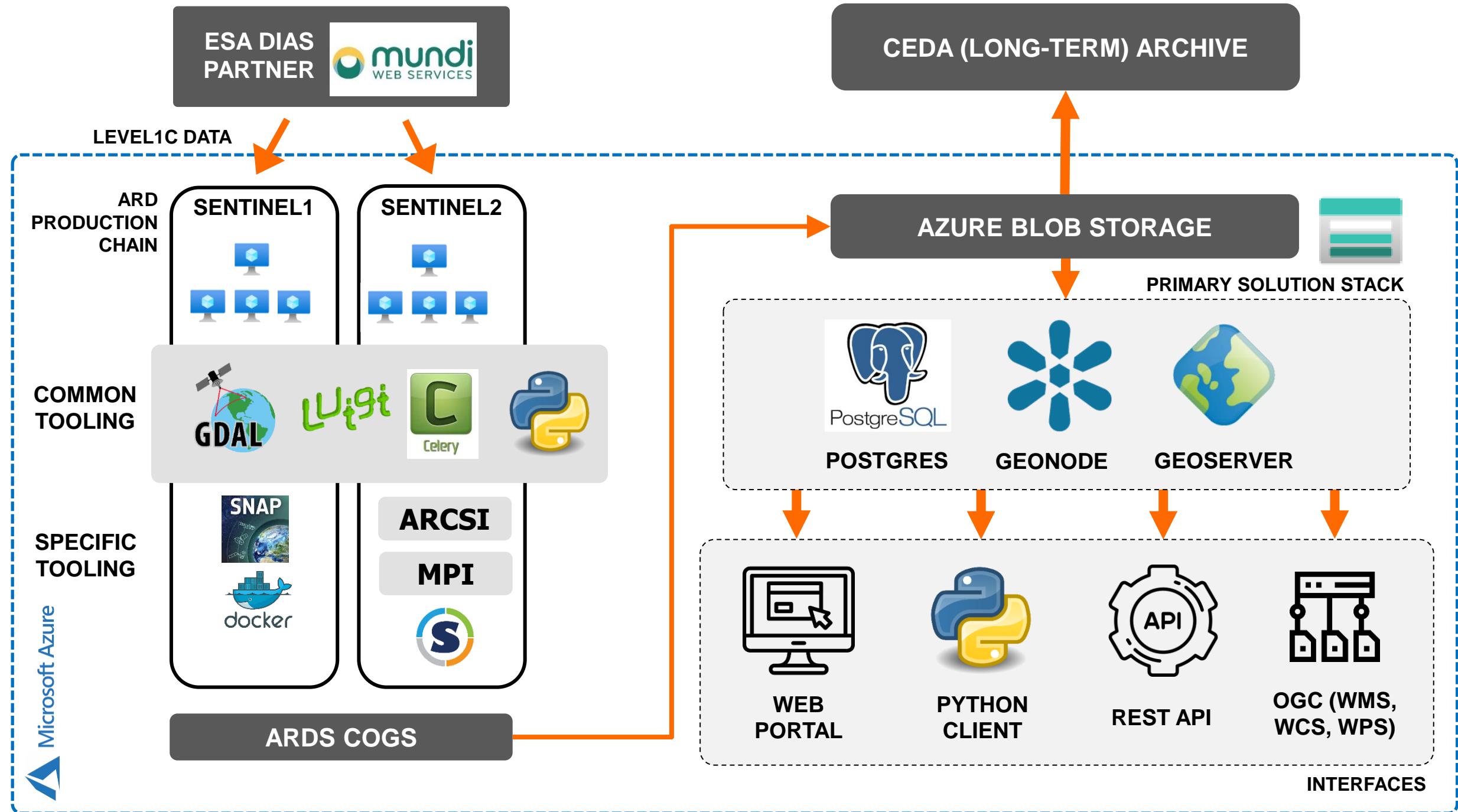
The implementation ... the Earth Observation Data Service

Earth Observation Data Service

Delivery Overview

- Collaborative project
Defra-inhouse, JNCC and CGI.
- Automated ARD production = ~10hr from acquisition to availability
- ARD store is rolling 18 months + archive to UK's CEDA under Open licence
- Multiple interfaces into the data on a full open source stack
- Timescales: Early 2018 PoC to with “GoLive” Mid 2020





Extended features in the Geonode portal

- Added custom search filters to Geonode such as satellite platform, cloud-cloud filters, user-defined geometry

Earth Observation Data Service

Home Layers Maps Layer Groups Admin admin Help

Explore Layers

Upload Layers

Cart

Add resources through the "Add to cart" buttons.

Create Layer Group

Create a Map

Create a Download Request

Filters

Search Clear

Satellite

Sentinel-1

Sentinel-2

Geometry Enabled

Type

Cloud Coverage

Min: %

Max: %

Use the controls on the left of the map to select an area of interest by drawing a polygon or rectangle. The results will be filtered so that only datasets intersecting the area of interest are displayed.

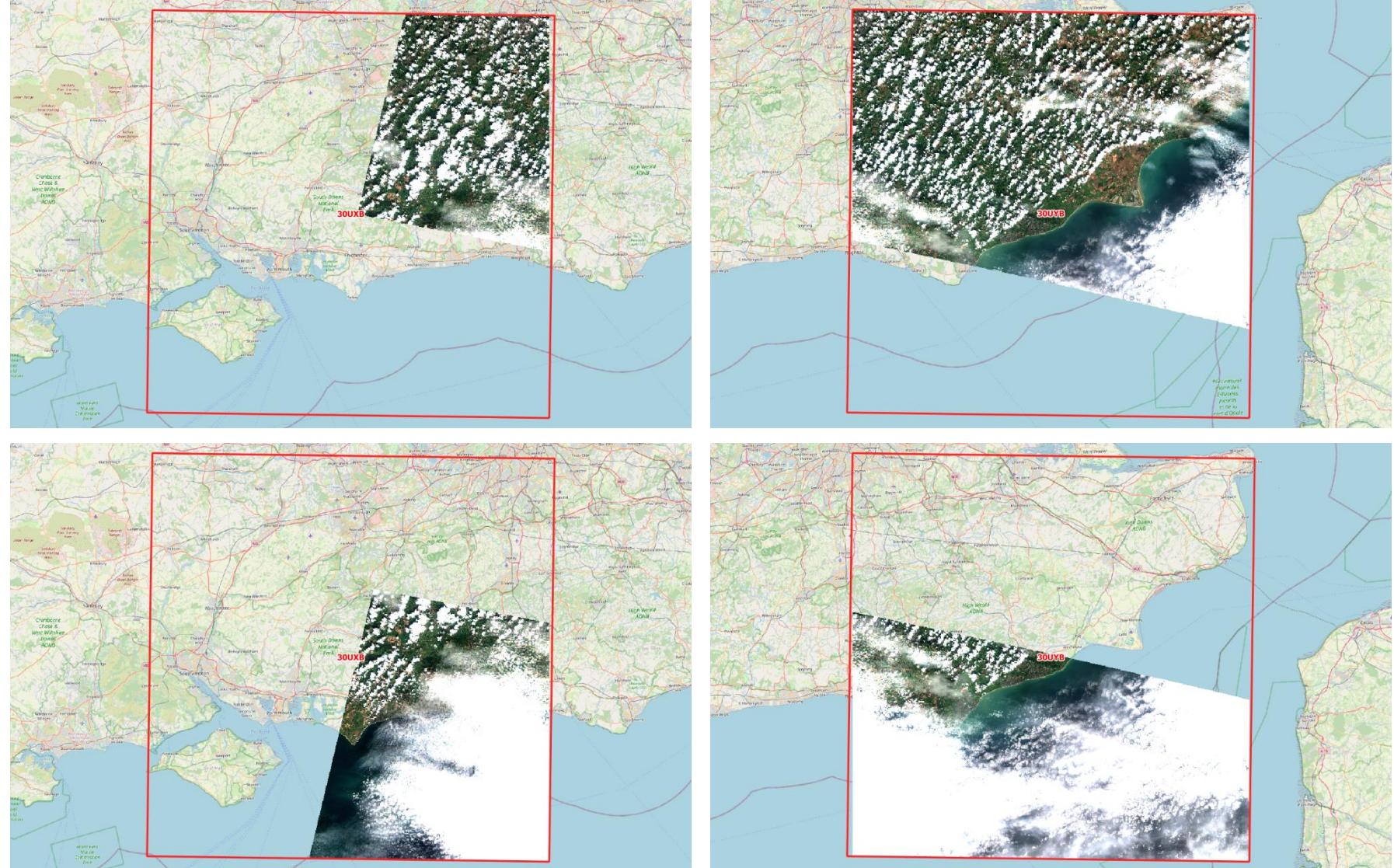
11 Records Found

0 1

The screenshot shows the 'Explore Layers' section of the Geonode portal. On the left, there's a sidebar with options like 'Cart', 'Create Layer Group', 'Create a Map', and 'Create a Download Request'. Below that is a 'Filters' section with three main categories: 'Text', 'Geometry', and 'Type'. The 'Text' category has dropdowns for 'Satellite' (with 'Sentinel-1' and 'Sentinel-2' selected) and 'Cloud Coverage' (with 'Min' at 0% and 'Max' at 100%). The 'Geometry' category has a checkbox 'Enabled' checked. The 'Type' category has a checkbox 'Cloud Coverage' checked. To the right is a map of the UK with various cities labeled. A light blue polygon is drawn over London and parts of the surrounding areas. A tooltip above the map says: 'Use the controls on the left of the map to select an area of interest by drawing a polygon or rectangle. The results will be filtered so that only datasets intersecting the area of interest are displayed.' On the far right, there are two thumbnail images of satellite imagery labeled 'S2A_20210908_lat52lon...' with a shopping cart icon below them. At the top, there's a navigation bar with 'Home', 'Layers', 'Maps', 'Layer Groups', 'Admin', a user icon 'admin', and 'Help'. The title 'Earth Observation Data Service' is at the very top.

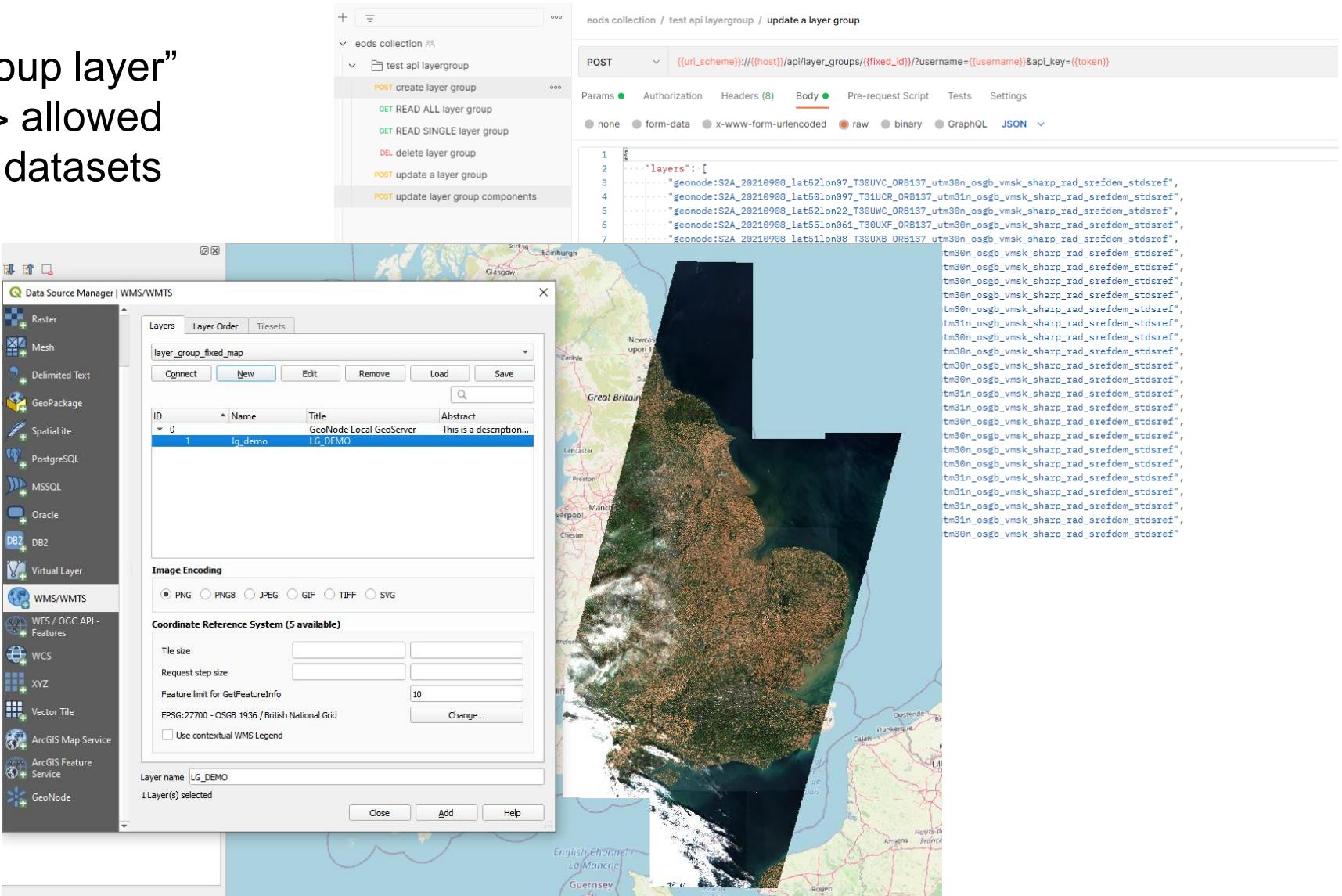
Extended features in the Geonode portal

- Enriched search API fields to expose info about split (reprocessed) ESA granule products



Extended features in the Geonode portal

- Exposed Geoserver “group layer” feature to Geonode UI > allowed creation of user mosaic datasets



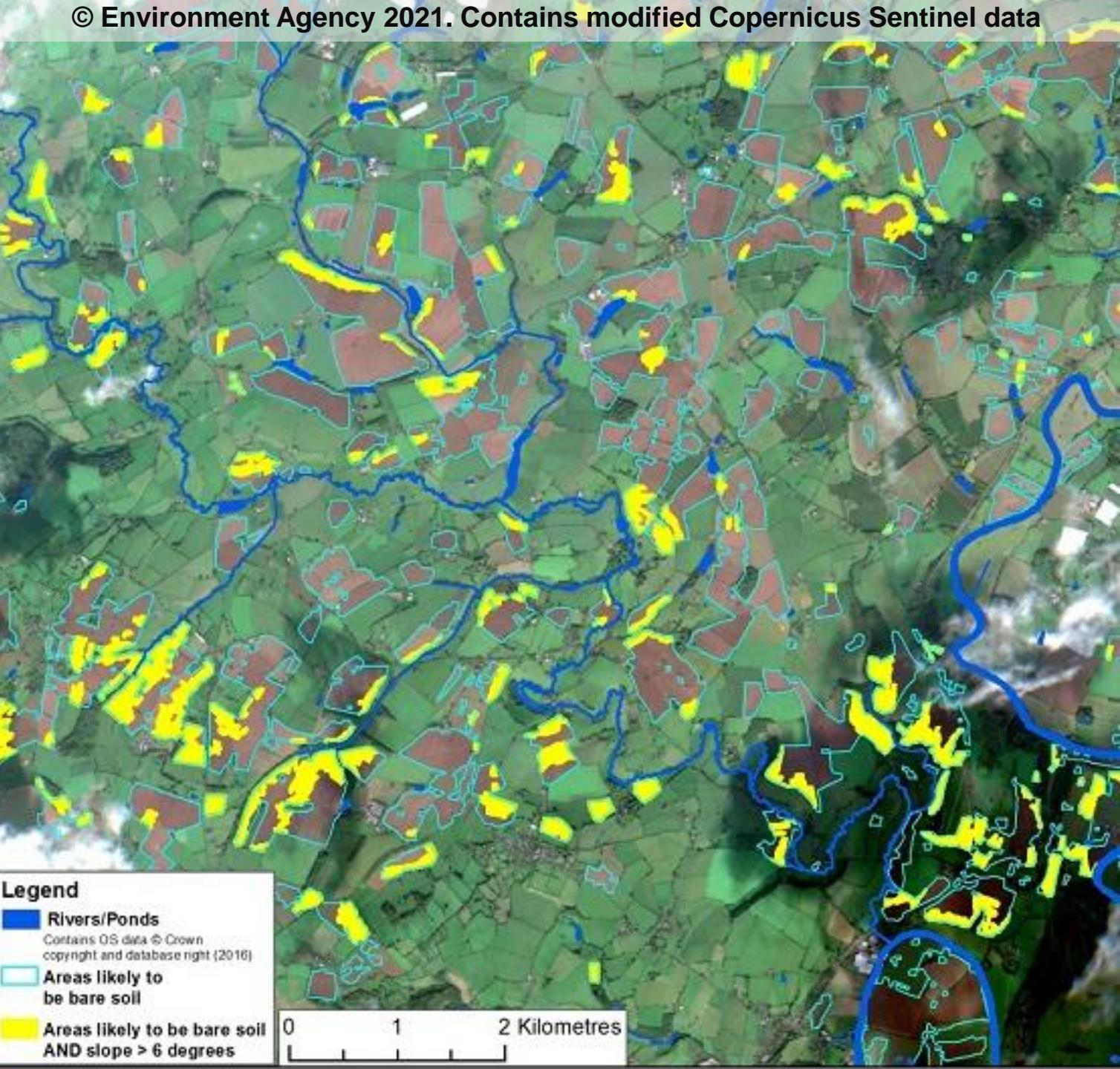
The project use cases

Bare Earth Analysis

Sentinel2 (winter) + LiDAR = risk-based model to identify “high risk” bare earth runoff locations, particularly after summer potato/maize harvests.

Impacts

- **Flooding Risk**
- **River water quality > sediment load, phosphates.**
- **Soil resource loss**
- **Lack of carbon retention in soil**



Bare Earth Analysis

Work led to the #soilpatrol programme (press release) aimed to proactively contact landowners to raise awareness of potential issues



Dave Throup
@DaveThroupEA

Latest available satellite imagery analysed by our friends [@EnvAgencyGeomat](#) to identify possible areas of bare soil in [#Herefordshire](#)

Environment Officers use slope, soil type data and intel received to target this week's [#soilpatrol](#)



Plastic Sheeting Use Case

**Increases the
risk of surface
water run-off =
flooding issues**

**Contributes to
microplastic
pollution**

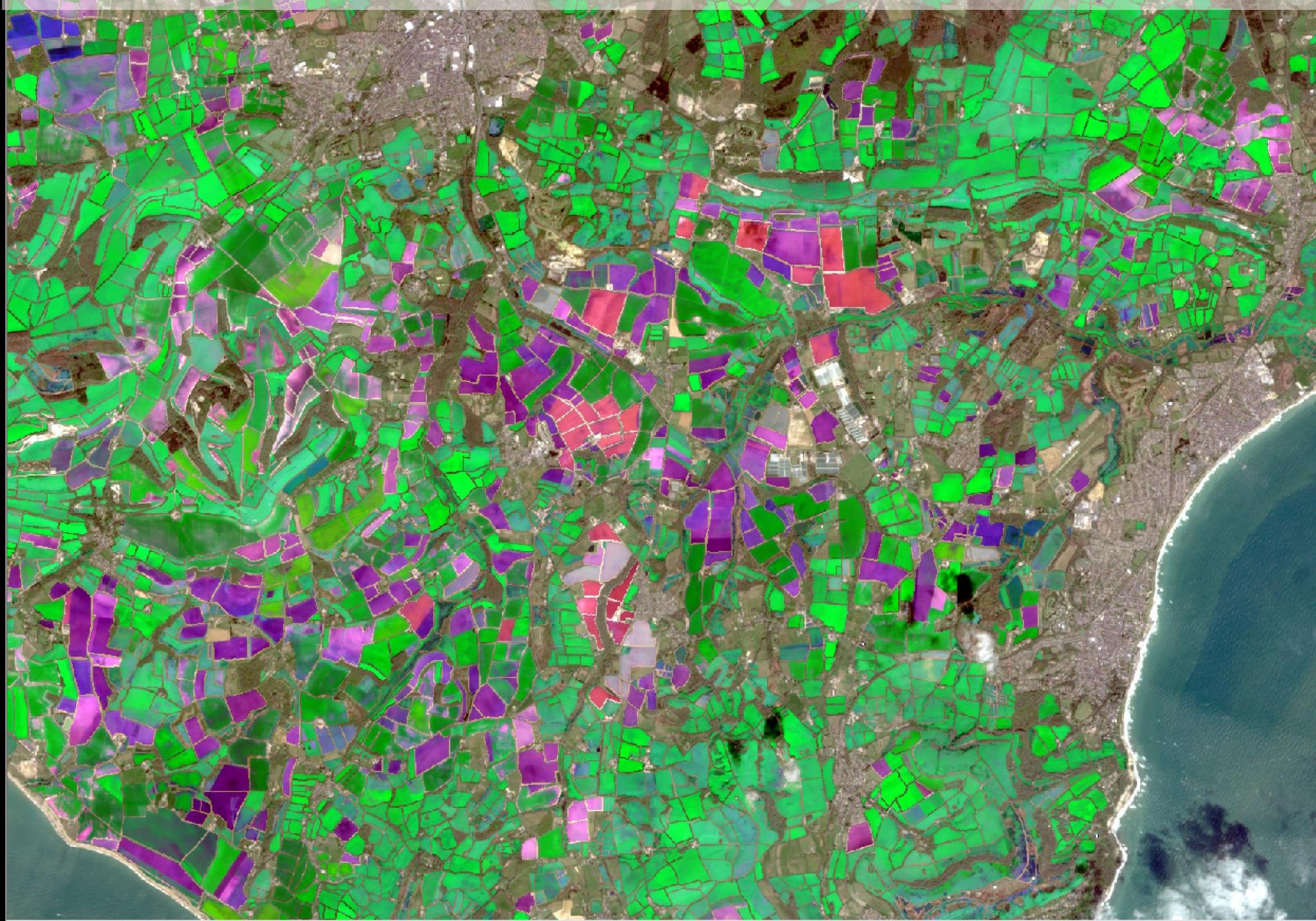


Plastic Sheeting Use Case

**Simple False
Colour applied
with RED, NIR,
SWIR1 channels.**

**Red fields =
likely plastic
sheeting**

© Environment Agency 2021. Contains modified Copernicus Sentinel data



Plastic Sheeting Use Case

- * Increases the risk of surface water run-off = flooding issues
- * Contributes to microplastic pollution



Pig Farm Identification

Impacts > local water quality (run-off) and air quality.

Imagery > SENTINEL2 + high resolution airborne LiDAR.

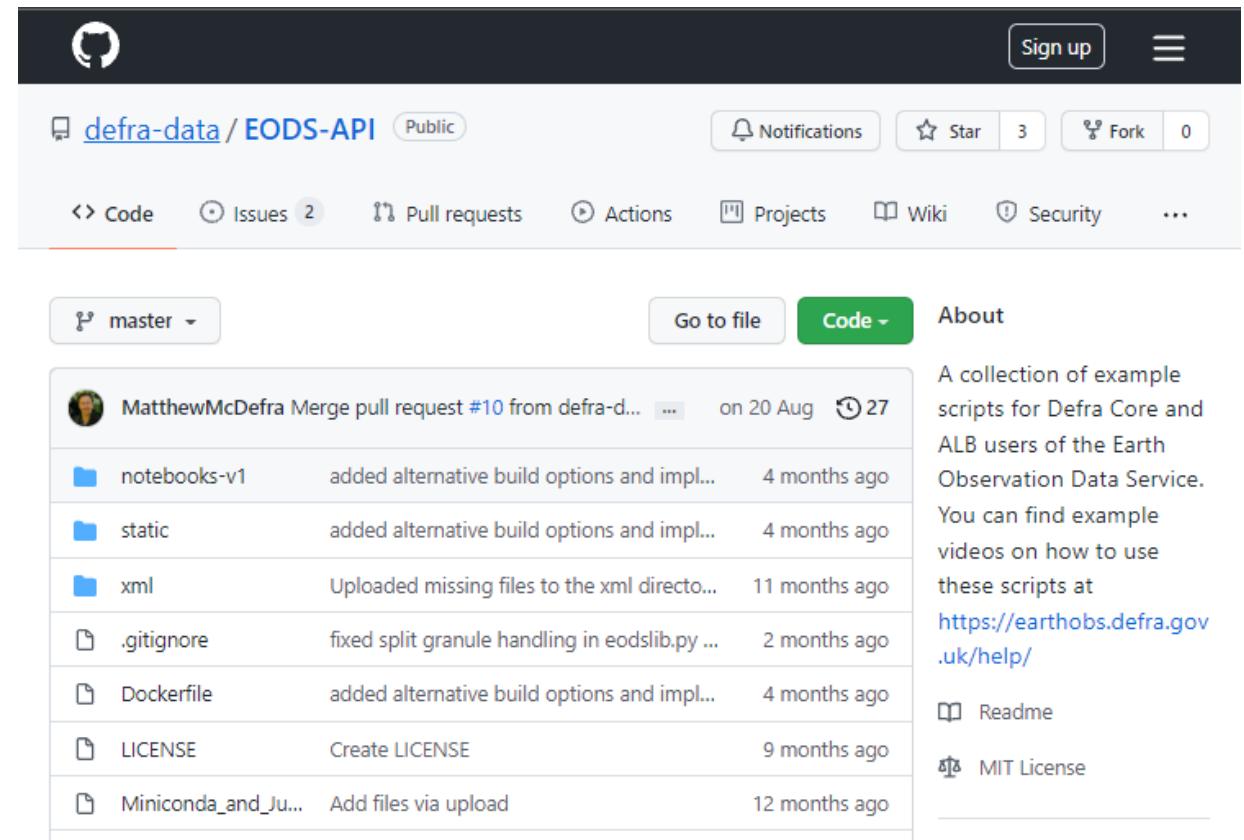
Method > involves logic modelling and Deep Learning to identify areas.



What were the hard lessons learned

LESSON LEARNED 1

- During design COGs > unfamiliar. Implemented to improve WMS rendering
- We did not make direct access to COG ARDs in the storage account instead users extract via a WPS interface.
- Late feedback was that using WPS was barrier to entry.
- The project maintains the [EODSLIB](#) python client under an MIT licence to improve search/discovery and the download experience.



LESSON LEARNED 2

- Metadata accessible via XML and the Catalogue Service for the Web (CSW).
- STAC json standard was relatively immature, so not implemented.
CSW protocol > not easy to parse
- Now we would be keen to generate STAC metadata as this seems the new standard for EO metadata, but have not undertaken any research or sized the effort required.
- Stand up a STAC API service > duplication of the CSW?



Defra and JNCC Sentinel-1 Analysis Ready Data (ARD) ⓘ		Description	Size	Actions
0 dirs	30 files			
	S1B_20210906_23_desc_064453_064518_VVH_G0_GB_OSGB_RTCK_SpkRL.tif		3.9 GB	
	S1B_20210906_23_desc_064453_064518_VVH_G0_GB_OSGB_RTCK_SpkRL_meta.xml		16 KB	
	S1B_20210906_23_desc_064518_064543_VVH_G0_GB_OSGB_RTCK_SpkRL.tif		3.9 GB	
	S1B_20210906_23_desc_064518_064543_VVH_G0_GB_OSGB_RTCK_SpkRL_meta.xml		16 KB	
	S1B_20210906_23_desc_064543_064608_VVH_G0_GB_OSGB_RTCK_SpkRL.tif		3.9 GB	
	S1B_20210906_23_desc_064543_064608_VVH_G0_GB_OSGB_RTCK_SpkRL_meta.xml		16 KB	



Translator



Useful Links

- Earth Observation Data Service Blog: <https://defradigital.blog.gov.uk/2020/06/18/making-it-easier-to-access-and-use-earth-observation-data/>
- CEDA Archive ARD Datastore (under OGL licence) for S1
<https://catalogue.ceda.ac.uk/uuid/05cea0662aa54aa2b7e2c5811e09431f>
- CEDA Archive ARD Datastore (under OGL licence) for S2
- <https://catalogue.ceda.ac.uk/uuid/bf9568b558204b81803eeebcc7f529ef>
- S1 (snap+luigi) processing container
 - repo: <https://github.com/jncc/s1-ard-processor>
 - dockerhub <https://hub.docker.com/r/jncc/s1-ard-processor>
- S2 (arcsi) processing container
 - repo <https://github.com/jncc/s2-ard-processor> and
 - dockerhub <https://hub.docker.com/r/jncc/s2-ard-processor/>
- Defra Earth Observation Road Map (2015):
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/488133/defra-earth-obs-roadmap-2015.pdf

Thanks for listening!

Sam Franklin
sam.franklin@cgi.com
CGI

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CGI EODS team

