

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



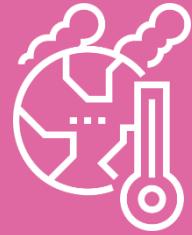
**Selection of
the 33
agencies
active on the
project**

**+5000
technical
staff**

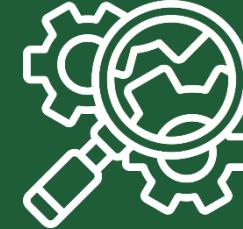
Use Cases



INCIDENT
RESPONSE
& RISK



NATURAL
CAPITAL &
CLIMATE
CHANGE
POLICIES



HABITAT/
LANDUSE
CHANGE
DETECTION



BARE
SOIL
ANALYSIS



CROP
MAPPING



LIVING
ENGLAND
& HABITAT
MAPPING

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.

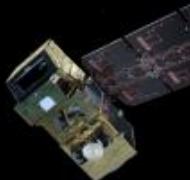
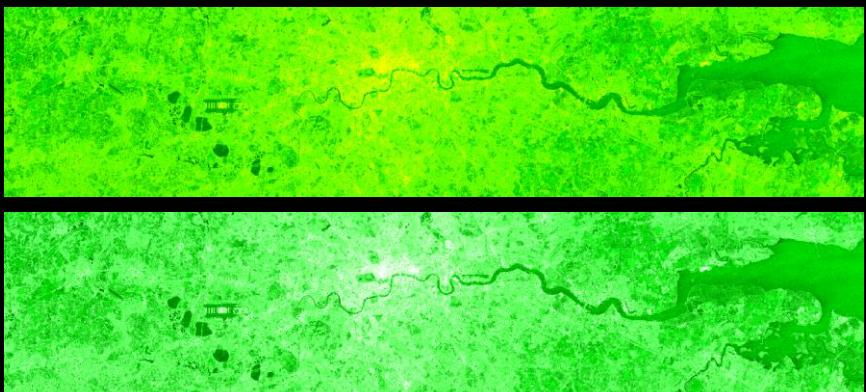
Common Features

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



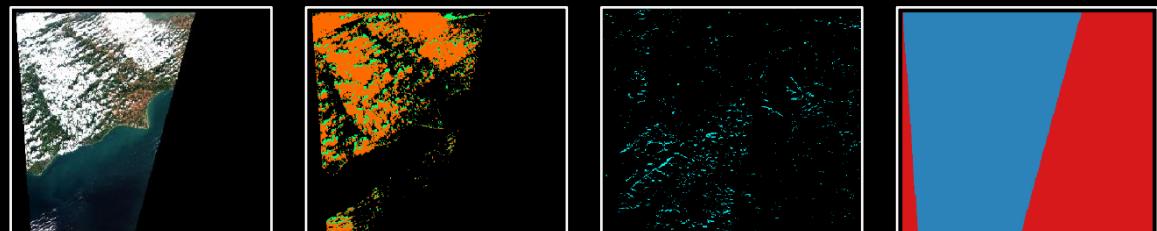
Sentinel 1

- 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

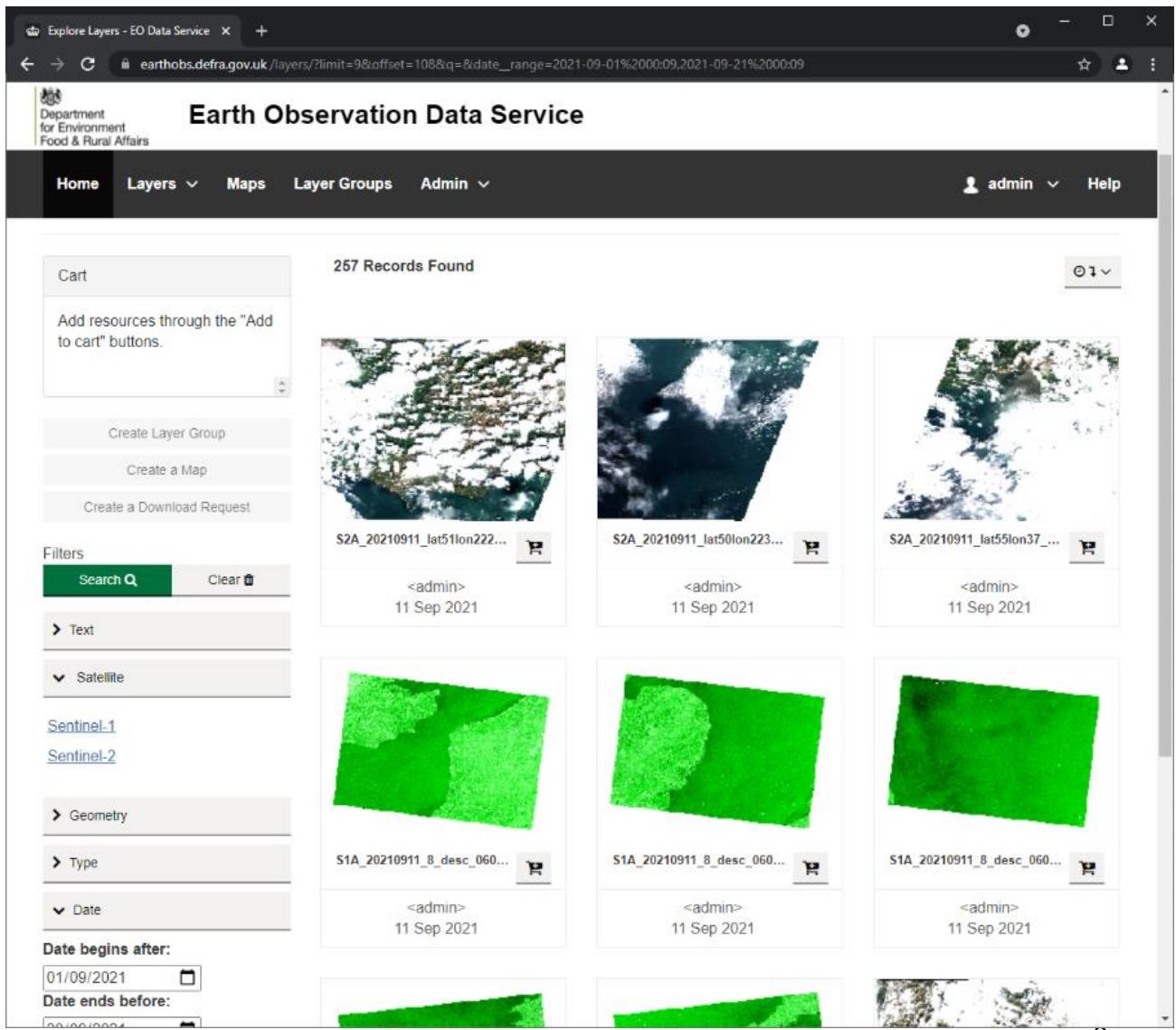


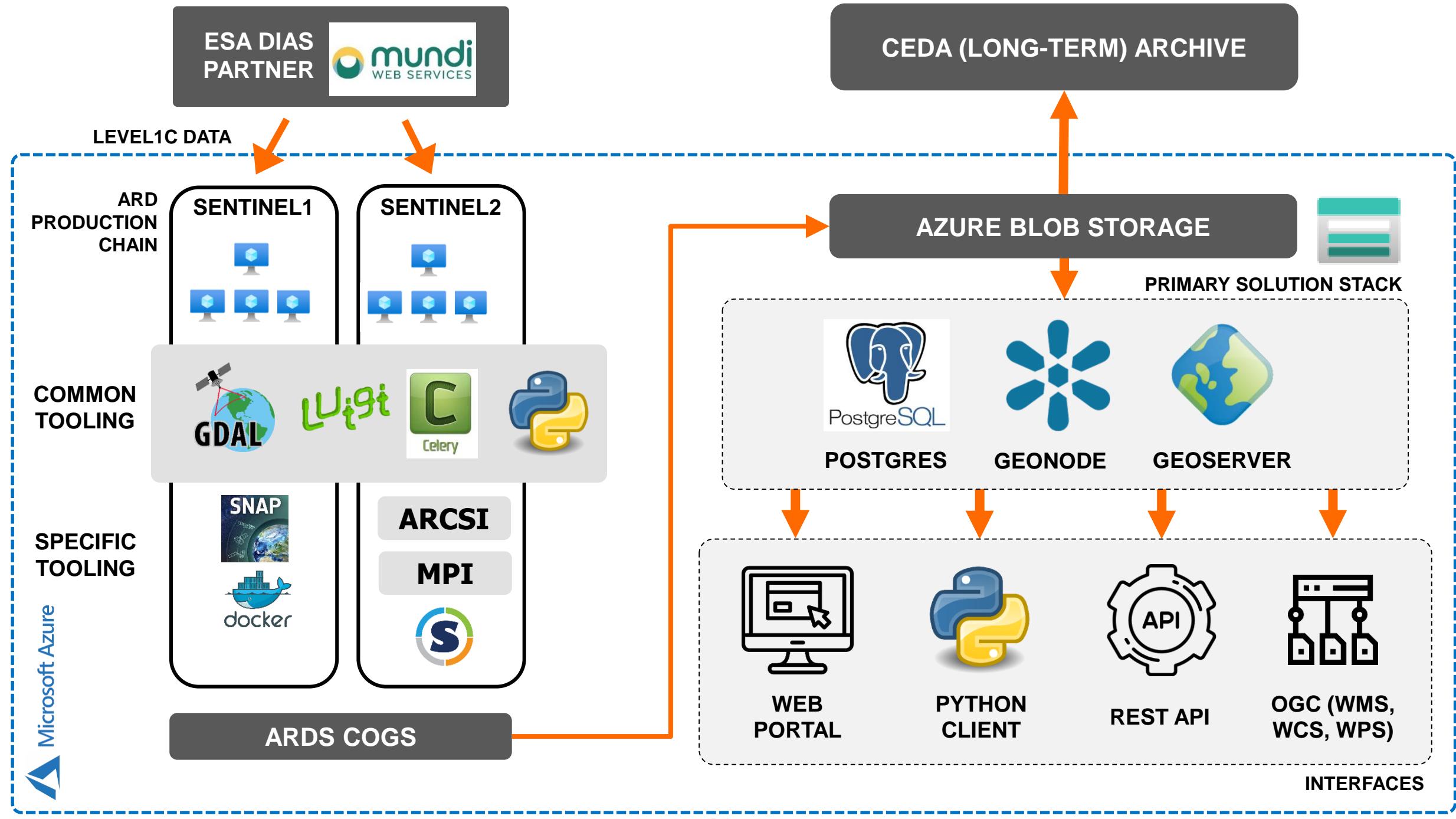
The implementation ... the Earth Observation Data Service

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



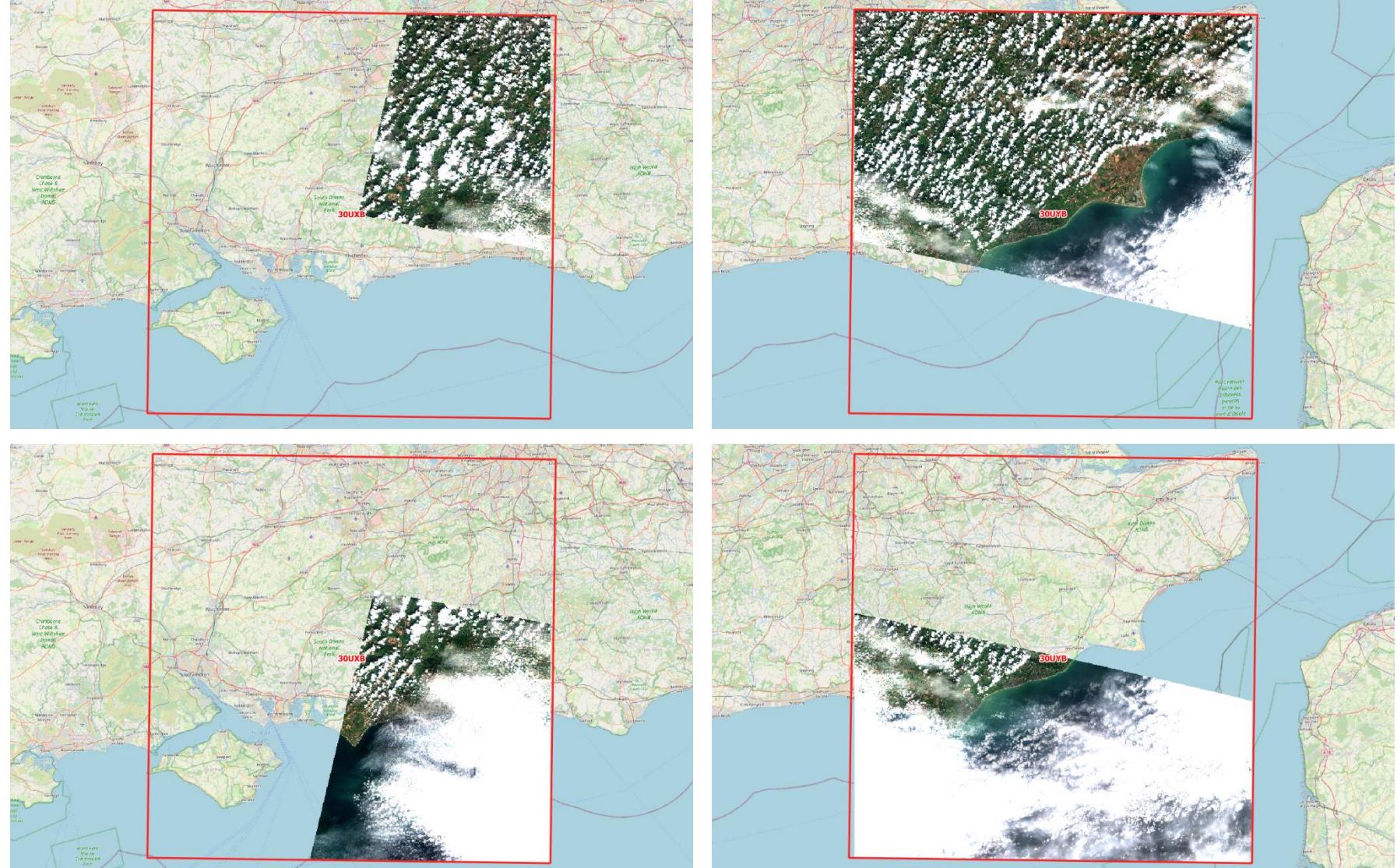


Extended features in the Geonode portal

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

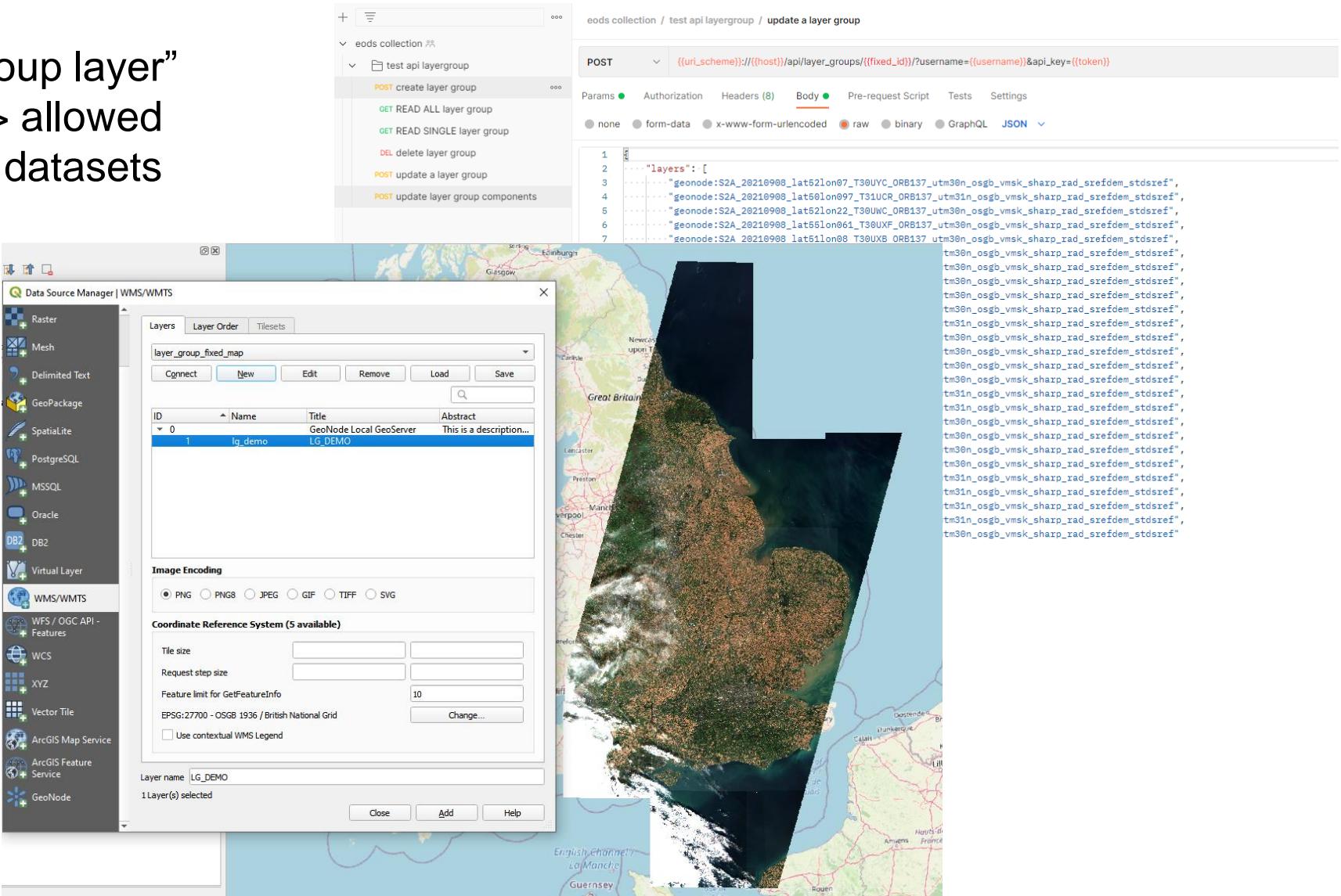
Extended features in the Geonode portal

- 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



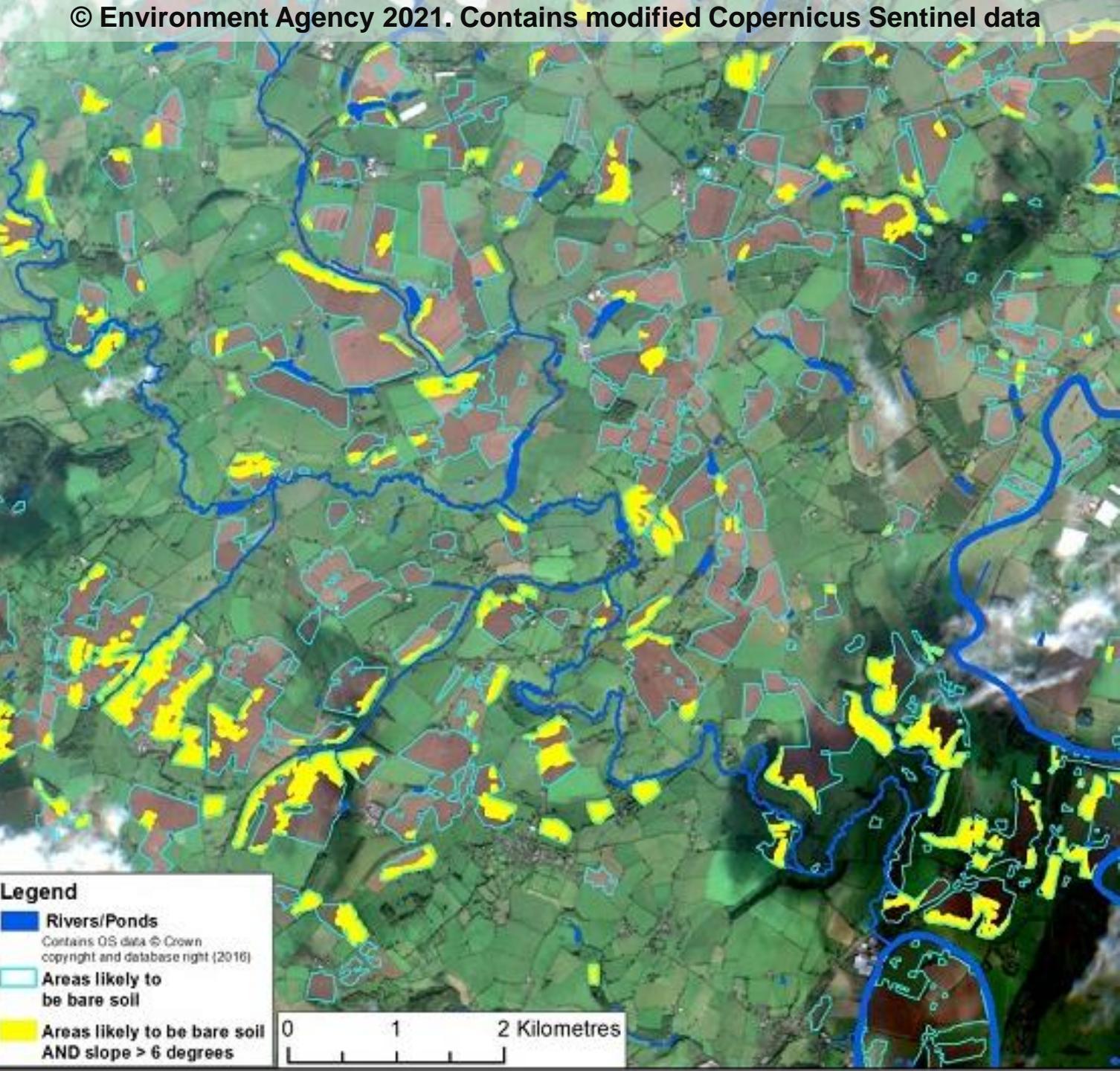
The project use cases

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**

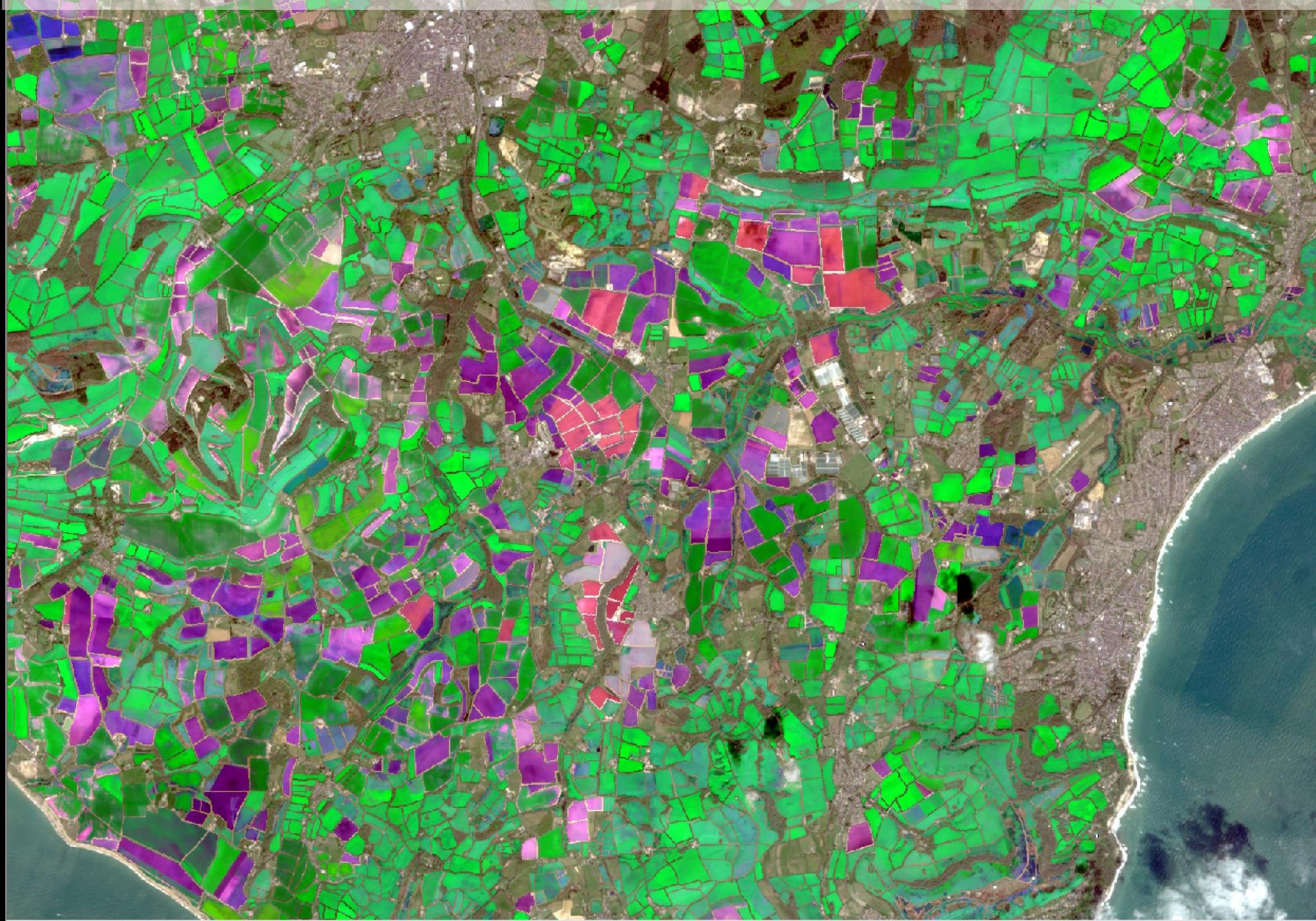


Plastic Sheeting Use Case

**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.

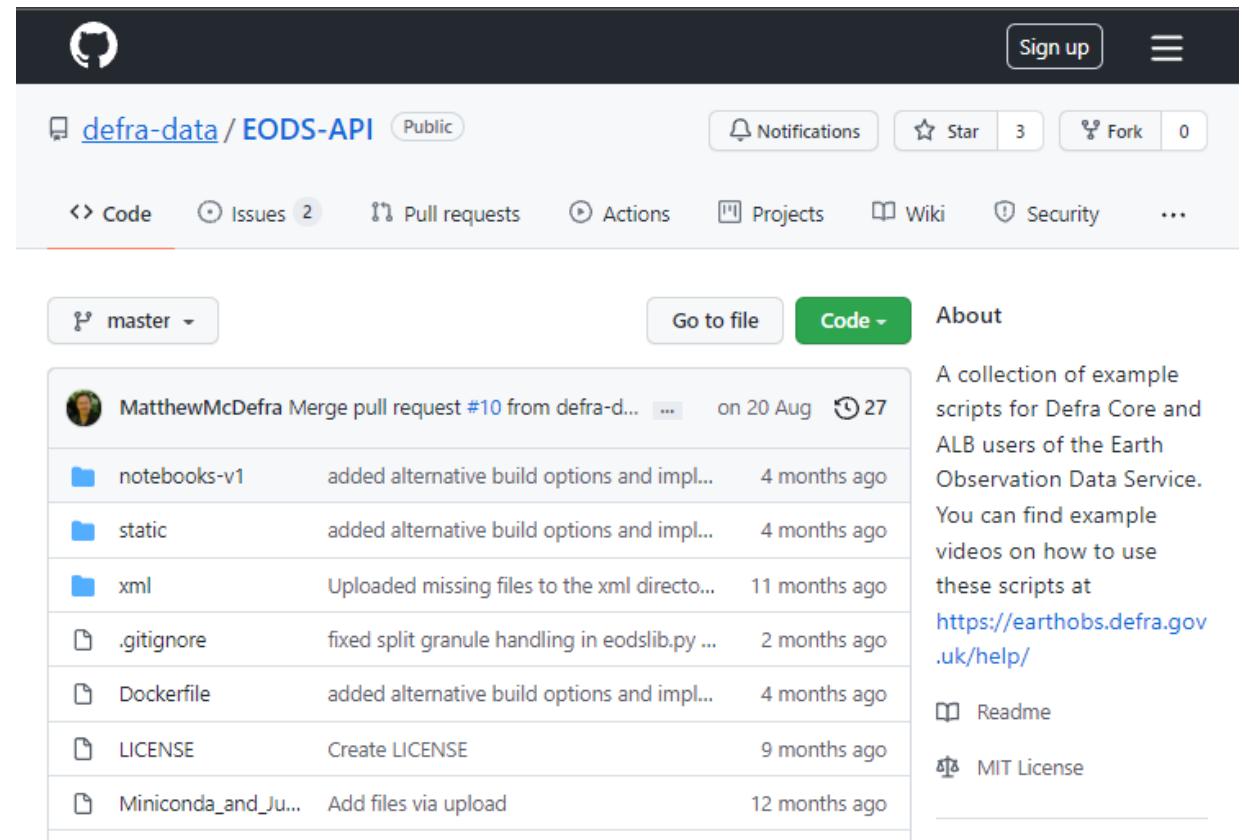
Method > involves logic modelling and Deep Learning to identify areas.



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
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

