



**European Space Agency**

## **Environmental Crimes Workshop 2024, Frascati, Italy**

***'Elevating Agricultural Compliance and Regulations: Harnessing Earth  
Observation and Remote Sensing for Enhanced Environmental Enforcement'***

**- Environment Agency, England, UK**

# Introductions



Simon Barron  
Environment and Business Directorate  
Manager - Intensive Farming and Strategic Advice



Rushanka Amrutkar  
Environment and Business Directorate  
Senior Advisor – Earth Observation and Remote Sensing

# Need of Agricultural Regulations and Compliance – Earth Observation Programme



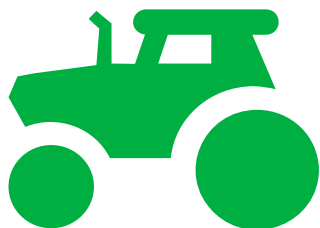
Low Resources with which to regulate. Approximately 300 inspections per annum of 100,000 farms = 1 inspection every 333 years



Growing evidence of environmental impact, 90% non-compliance with slurry storage, high levels of incidents



Legal challenge from environmental pressure groups, well-funded and highly vocal



Industry unwilling to act unless presented with hard, absolute evidence

## Other Drivers

Governments  
IT strategy “4<sup>th</sup>  
industrial  
revolution”

Greater  
availability and  
reduced costs  
of imagery

Enhancing our  
own data  
across EA and  
Defra

# Interactions with Arm length bodies and Stakeholders

- Department of Environment, Food & Rural affairs
- Rural Payment Agency
- Natural England
- Animal and Plant Health Agency
- UK Space Agency
- Space Applications Catapult
- GHGSAT

# Remote Sensing Data

- Sentinel 2
  - Freely available
  - Frequent
  - Adequate resolution for preliminary scanning targets
- LiDAR (in-house 5year entire England coverage) – 1 m DEM
- VHR (Planet, Worldview etc)
  - Specific high risk targets
- Drone (virtual catchment walkovers) – VHR
- GHGSAT – Methane emissions (under UKSA, Space Applications Catapult contract)

.....coupled with Laboratory and Field data for validation



# Making the case – River Axe, Devon



- 90% non-compliance with slurry storage rules
- Catchment wide failure to invest or manage slurry
- Estimated 50% National non-compliance

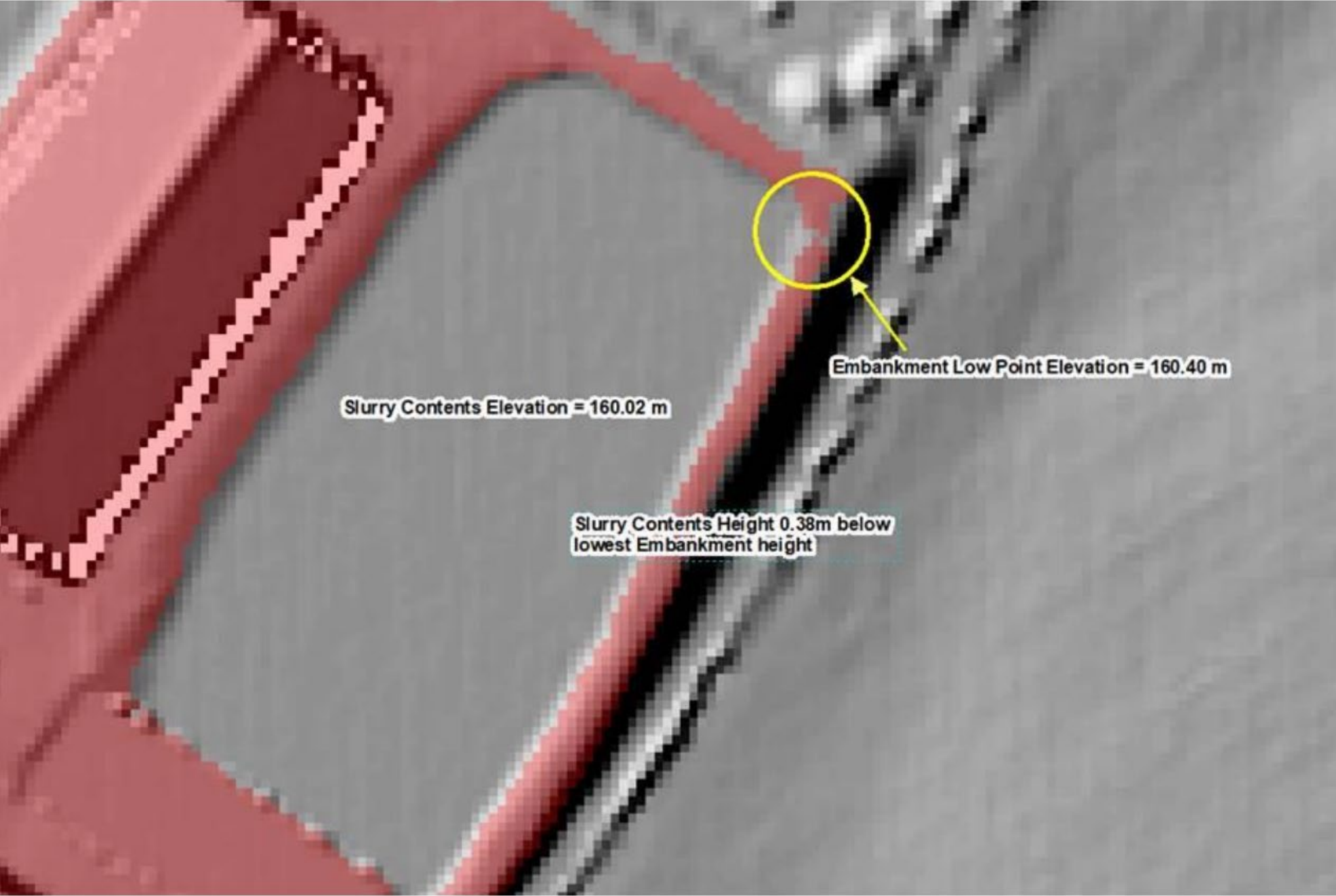
27/04/2016 12:14

27/04/2016 12:14

# Change and shifting the dial

- Strong push from Government reports to adopt technology
- New funding increased resources for inspections from 300 to 4,000 site visits
- Initiated projects to increase footprint by using remote sensing and earth observation (RS/EO)
- Was RS/EO more cost effective
- Gathering data from other data sources to bolster data knowledge e.g. slurry stores
- Tested a variety of hypothesis i.e. what do we want to identify, and which combination of technologies works best and in combination (LIDAR, VHR, Sentinel 2 and AI techniques)

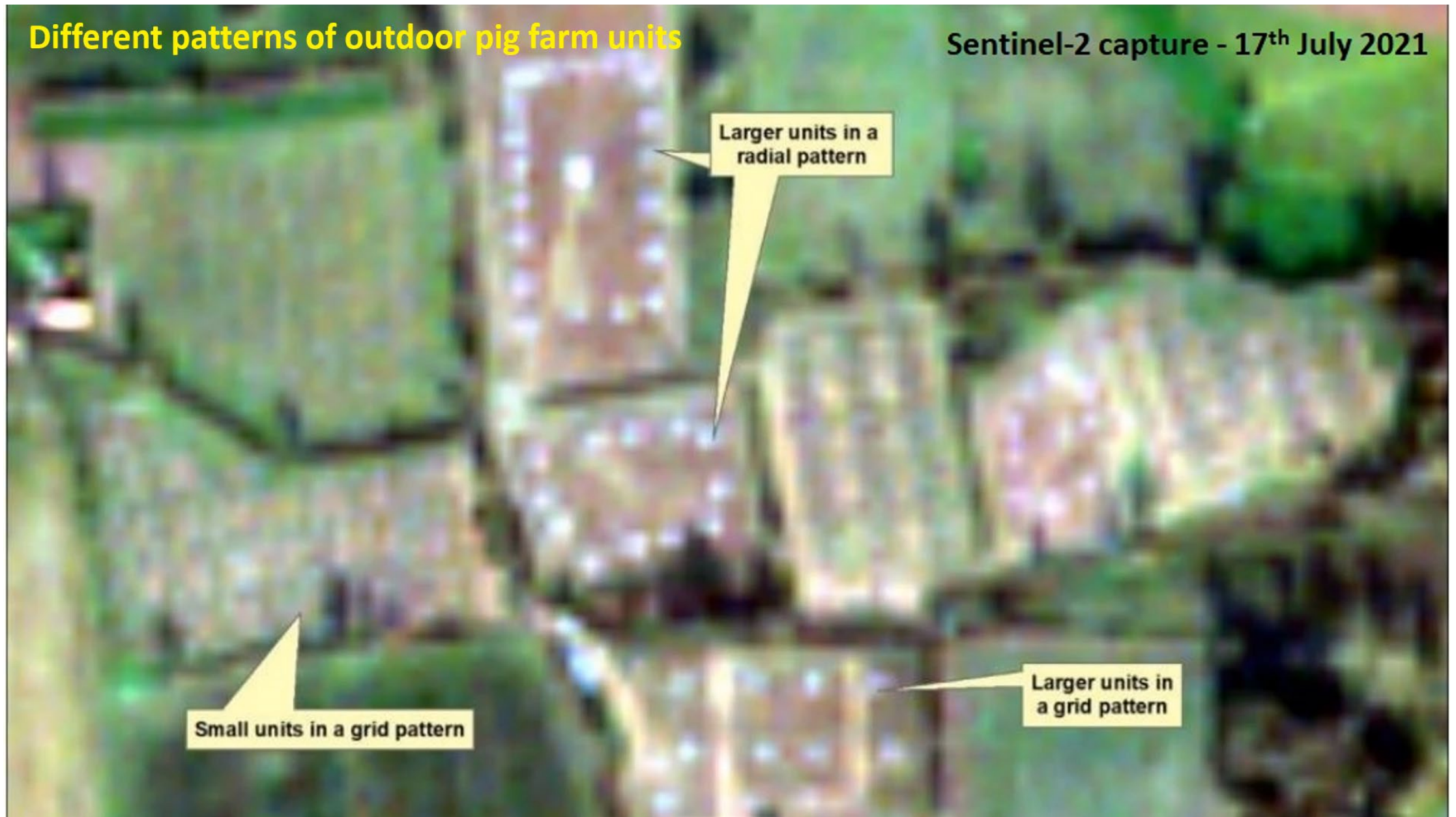




Demonstrating how LIDAR data can be used to identify the lowest point on an earth embankment enclosing a slurry store. The edge of the red shading indicates the elevation of the lowest point on the embankment

## Different patterns of outdoor pig farm units

Sentinel-2 capture - 17<sup>th</sup> July 2021










## Legend


 Outdoor Pig Detections


### GEOLOGY

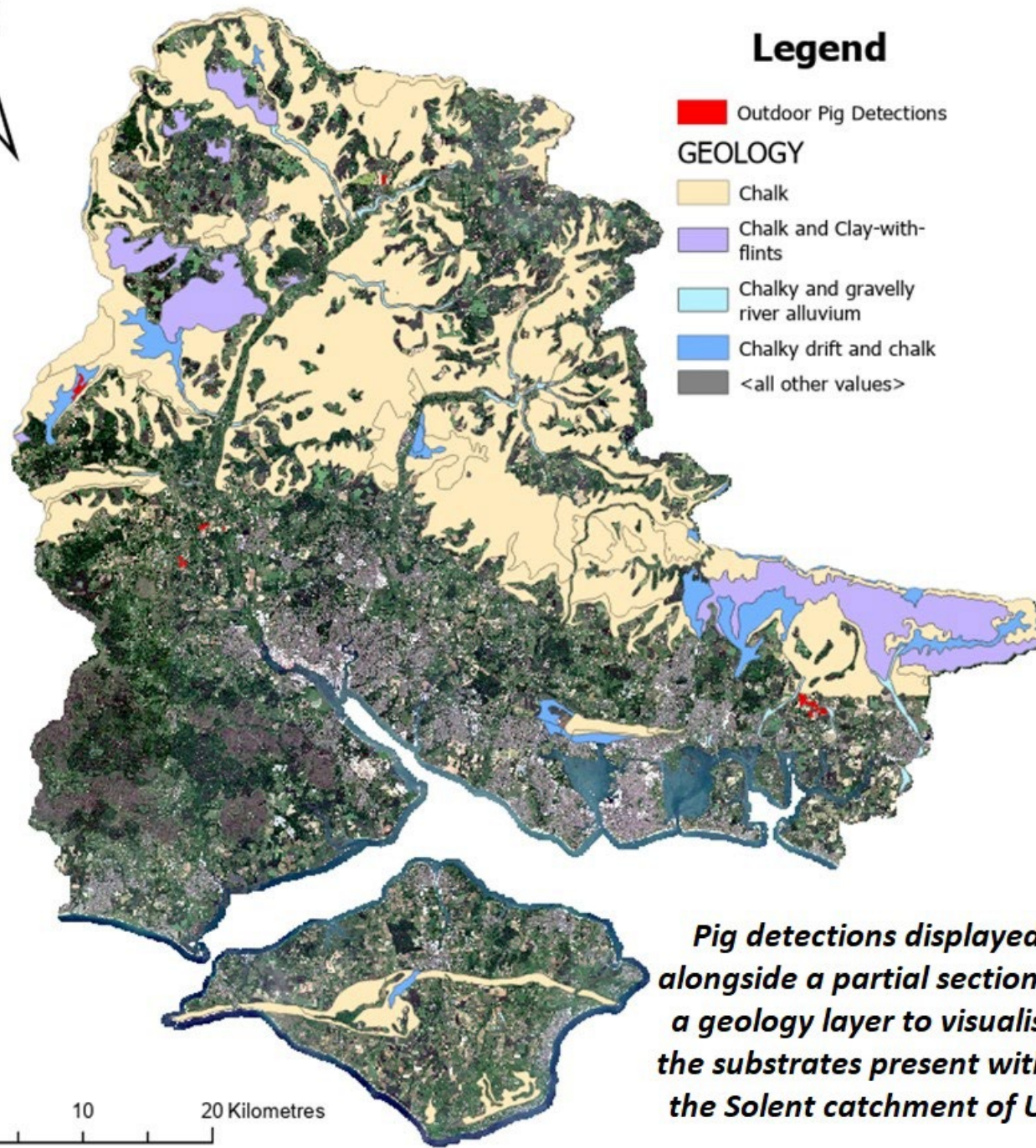
 Chalk

 Chalk and Clay-with-flints

 Chalky and gravelly river alluvium

 Chalky drift and chalk

 <all other values>






*Pig detections displayed alongside a partial section of a geology layer to visualise the substrates present within the Solent catchment of UK*

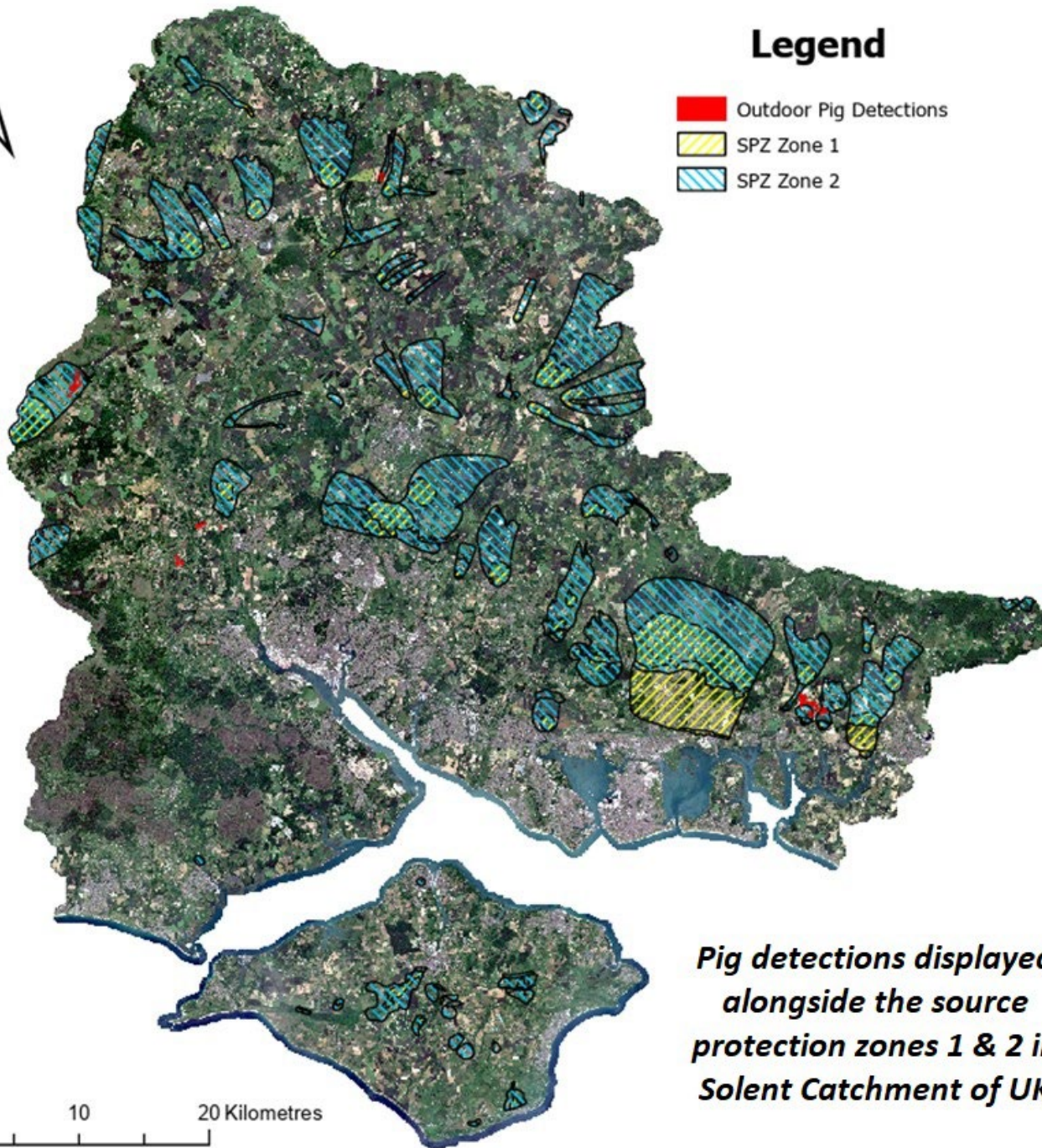
0 10 20 Kilometres





## Legend

-  Outdoor Pig Detections
-  SPZ Zone 1
-  SPZ Zone 2



*Pig detections displayed  
alongside the source  
protection zones 1 & 2 in  
Solent Catchment of UK*

0 10 20 Kilometres



# Bare Earth Mapping – Low NDVI indicate the likely presence of bare soil



Helpful to send inspection letters if bare soil persists post winter



# High resolution satellite imagery showing erosion pathways in an arable field near Ross-On-Wye

Environment Agency A.L.E.R.T - Agricultural Land Environmental Risk Tool

Some layers will only appear when you zoom in. Please be patient while layers load

Find address or place

60m

51.913 -2.525 Degrees

Esri UK, Esri, HERE

**Layer List**

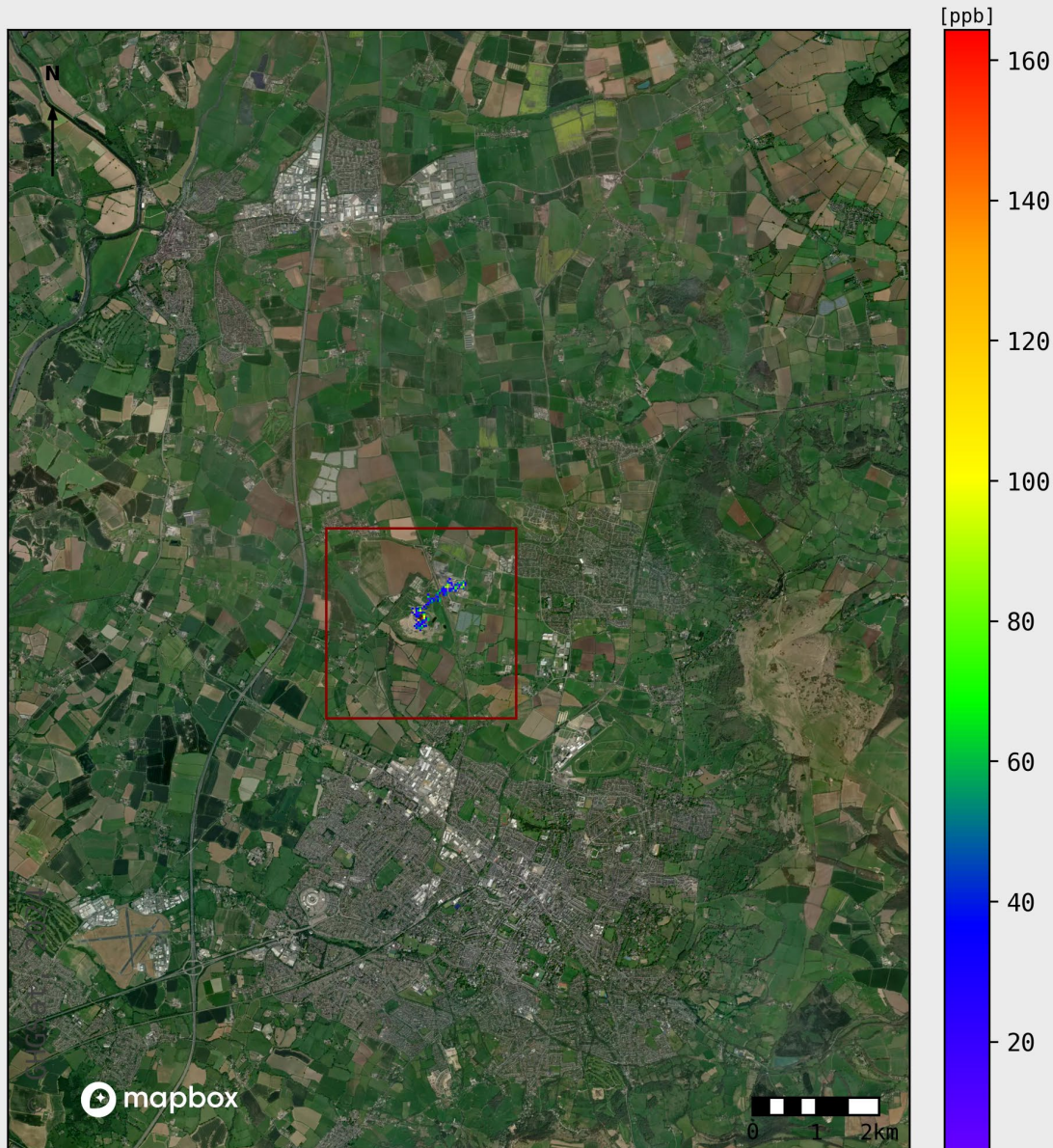
- Slurry Store Database (not exhaustive) ...
- OS Permanent Water - Rivers, Lakes and Ponds ...
- OS Permanent Water Buffered 10m ...
- Probable Overland Flow 2022 - Yellow to Red ...
- Probable Overland Flow 2022 - Black ...
- Ponding Or Error Derived From LIDAR2022 ...
- Operational Catchments WFD Cycle 2 ...
- WFD River Waterbody Catchments - Cycle 2 ...
- ALERT Catchments - LIDAR-derived 2022 ...
- CS\_Water\_Quality\_Priority\_Areas ...
- Pre-WW2 land use (Dudley Stamp) ...
- Simplified Crop Map Of England 2022 ...
- Simplified Crop Map Of England 2021 ...
- Simplified Crop Map Of England 2019 ...
- Broad Soil Groups - DEFRA Classification ...
- Theoretical Overland Flow Accumulation Grids 2022 ...
- Slope greater than 12 Degrees ...
- Slope greater than 7 Degrees ...
- Slope greater than 3 Degrees ...
- LIDAR Slope Optimised for Embankments ...
- Aspect ...



# National coverage high detailed overland flow pathways predicting where erosion pathways might occur. Also slope threshold shown derived from LIDAR data. Useful for targeting landscape interventions





**277 kg/hr**


Product:  
Column averaged CH<sub>4</sub> concentration in excess of local background.

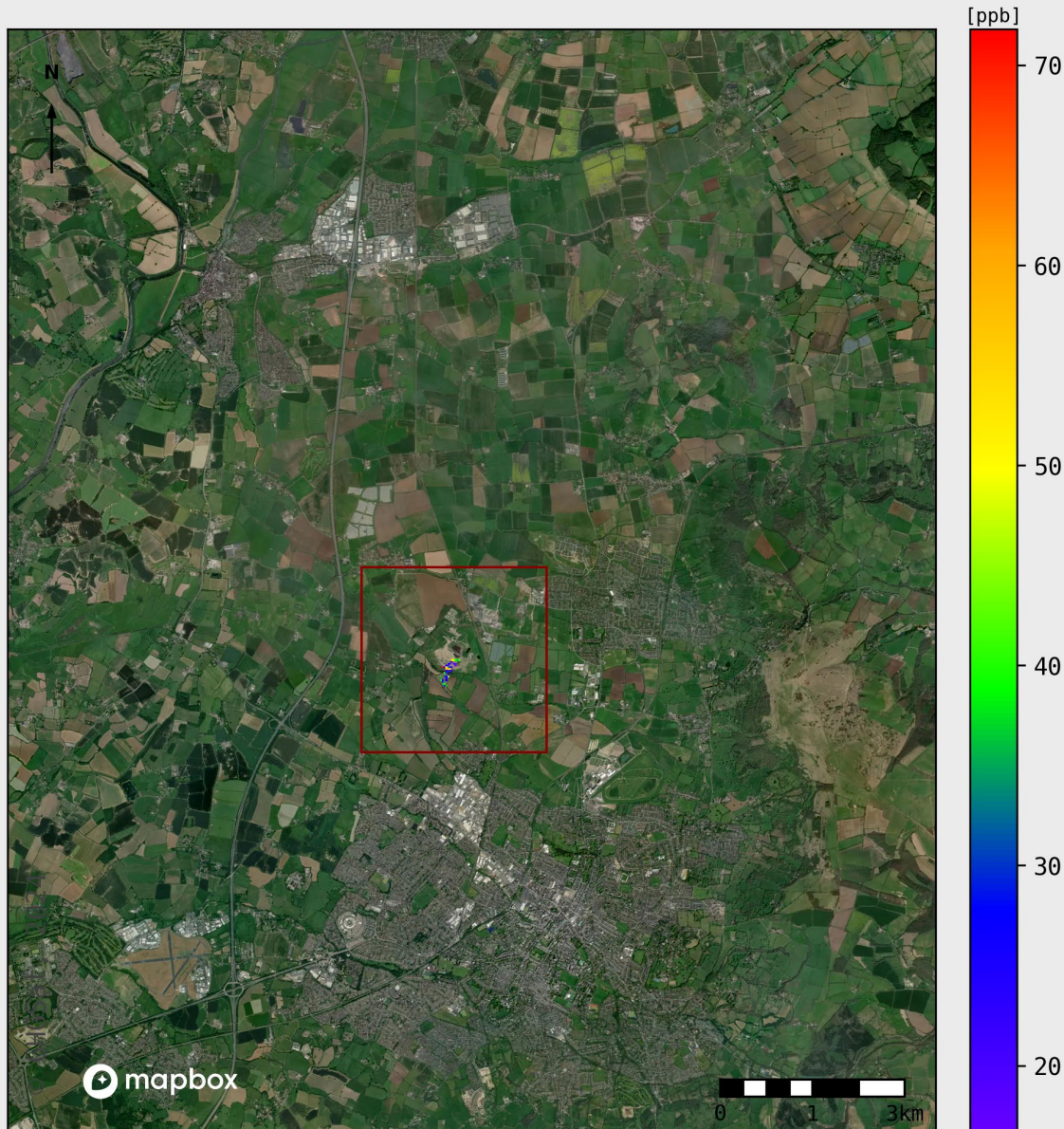
Background Image:  
© Mapbox: <https://www.mapbox.com/about/maps>  
© OpenStreetMap: <http://www.openstreetmap.org/copyright>  
© Maxar: <https://www.maxar.com>

Timestamp:  
2024-05-09 14:10:41 UTC

Observation ID:  
CjFAAUg

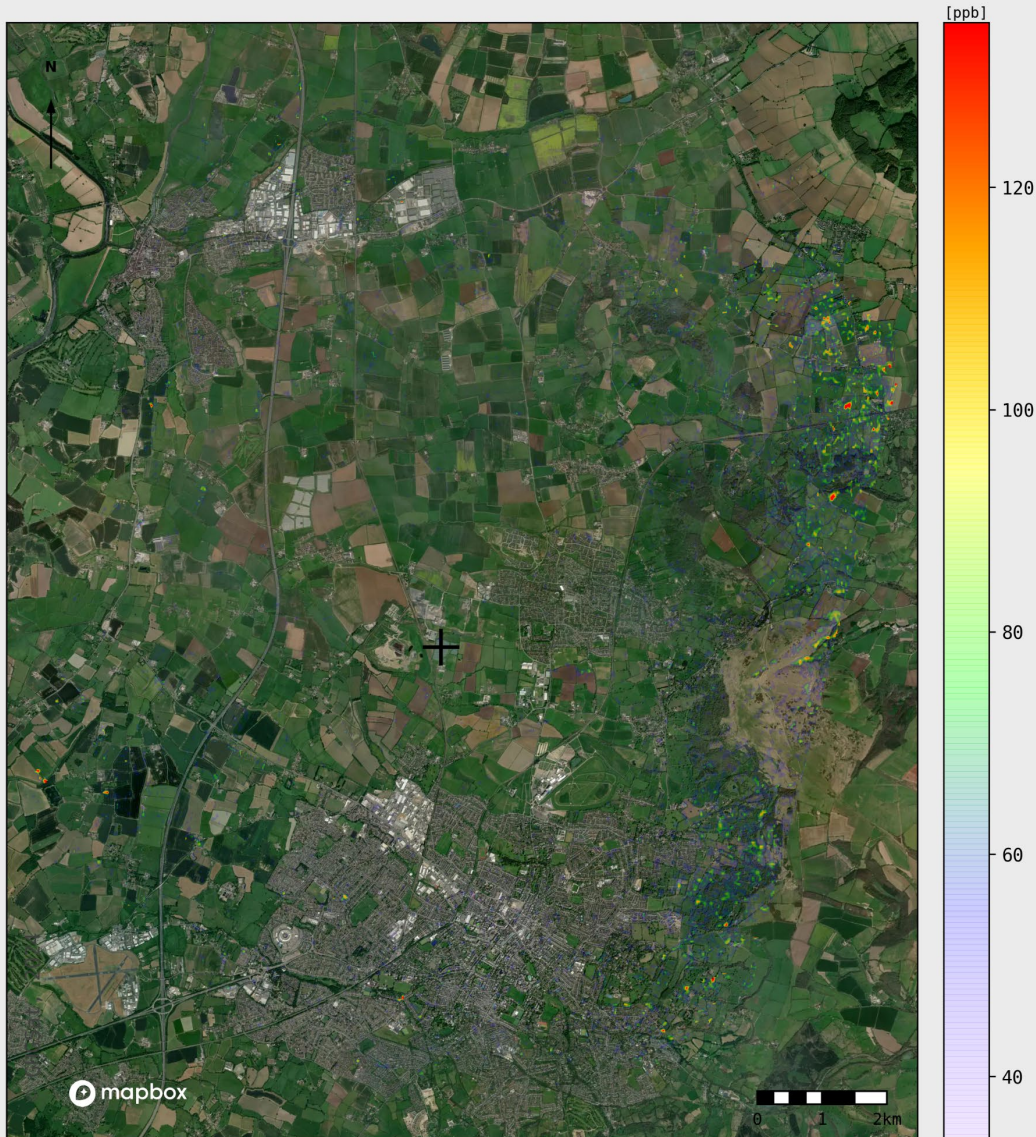
Satellite:  
GHGSat-C3



**260 kg/hr**

Product:  
Column averaged CH<sub>4</sub> concentration in excess of local background.  
Background Image:  
© Mapbox: <https://www.mapbox.com/about/maps>  
© OpenStreetMap: <http://www.openstreetmap.org/copyright>  
© Maxar: <https://www.maxar.com>  
Timestamp:  
2024-05-19 10:13:46 UTC  
Observation ID:  
0jp6fUg  
Satellite:  
GHGSat-C6





## Interpretation, Limitation and Plan

- Satellites have potential to detect emissions for future.
- No current ground validation capability
- Plan to feed into EA's National Incidence management response system to inform ground officers immediately
- Further satellite tasking to check agricultural emissions

# Summary

- **successfully transitioning towards utilisation of EO and RS in agricultural compliance and regulations**
- **Operational products generation**
- **Web based system for farmers and officers (ALERT tool – Soon to be public)**

## Looking forward

- **Deployment of AI for Earth Observation on a wider spatial scale (National)**
- **Integrate AI + EO + Domain Expertise + Judiciary system within public framework to implement better agricultural regulations for achieving high compliance ...influencing policies**
- **Allocate resources intelligently (Field Vs Remote monitoring)**
- **Bridging conversational, intentional and implementation gap between farmers and EA for better environment**

# Thank You

**For queries contact us at -**  
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