Earth Observation and the implementation of the WFD in Ireland

epaEcology
Monitoring and Assessment

epaCatchments
Healthy • Resilient • Productive
Valued water resources supporting vibrant communities

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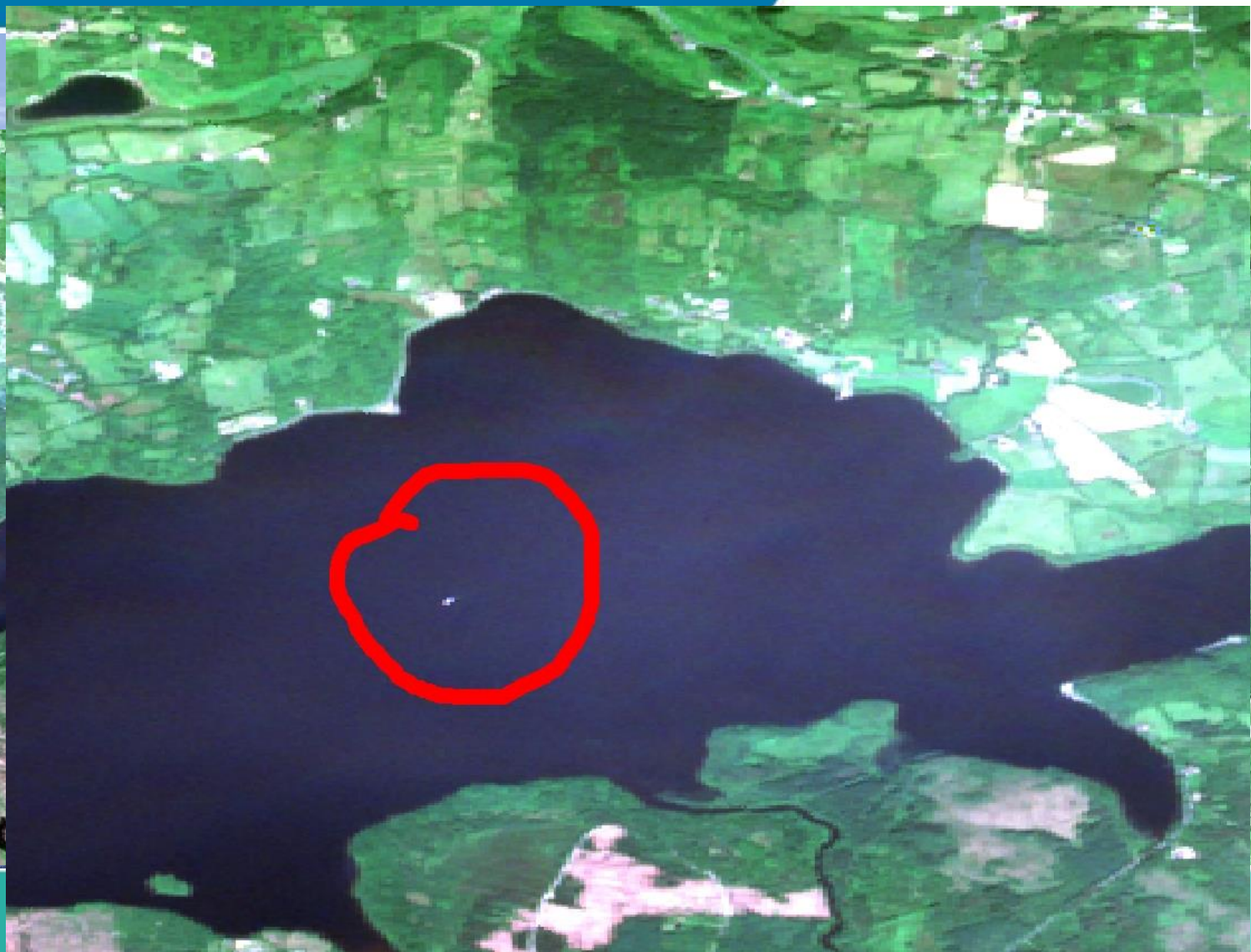
Consiglio Nazionale delle Ricerche

Contents

- Main Q: Can Earth Observation help the implementation of the WFD for lakes in Ireland?
- Intro
- Present work
  - Proof of concept
  - Trial in an Area for Action
- Future plans
  - Expanding knowledge & acting to extend the 224 monitored lakes with predictions for the 818 WFD lakes

“I hear lake water lapping with low sounds by the shore”
*……..Ever feel you a*re you being watched?



Early attempts in Ireland 1970s

The Use of Landsat Imagery for Lake Water Quality Monitoring in Ireland

M.L. McGarrigle and D.A. Murray
Department of Zoology, University College Dublin, Dublin 4.

Analysis of two frames of LANDSAT imagery demonstrates that variations in the reflections of Irish lakes can be detected. A relationship between reflectance values from lakes in the green and red LANDSAT multispectral bands and chlorophyll levels in the lakes is demonstrated. It is suggested that digital LANDSAT imagery may be used to monitor lake water quality in Ireland.

Sentinel-2: high-resolution (e.g. imagery of vegetation, soil and water cover)

ATMOSPHERE MONITORING

MARINE ENVIRONMENT MONITORING

LAND MONITORING

CLIMATE CHANGE

EMERGENCY MANAGEMENT

SECURITY

€6 Billion

Copernicus Sentinel 2

- Sentinel-2 Spatial resolution of 10,20,60m ~small lakes feasible.
- Image width 290km
- Revisit time short

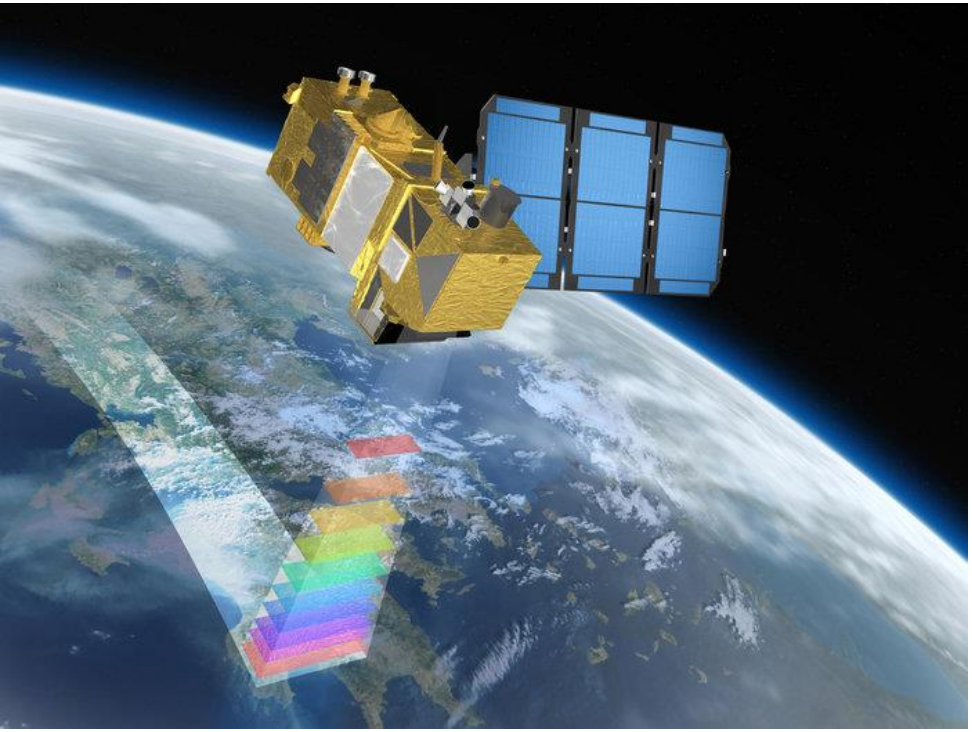
Early research using 1st images had promising relationships with in-situ Chlorophyll *a* e.g.

Toming *et al*. 2016:

- R^2 = 0.83 between Chlorophyll *a* and Sentinel-2 data

Photo ESA

Layers of data and not just “photos”



Images ESA and Sentinel 2

Developing a proof of concept

1. Get images Free https://scihub.copernicus.eu/dhus/#/home

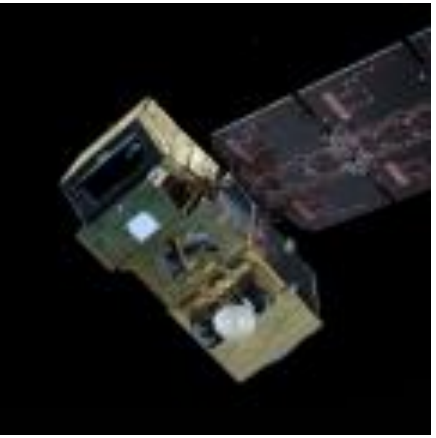
2. Perform atmospheric correction

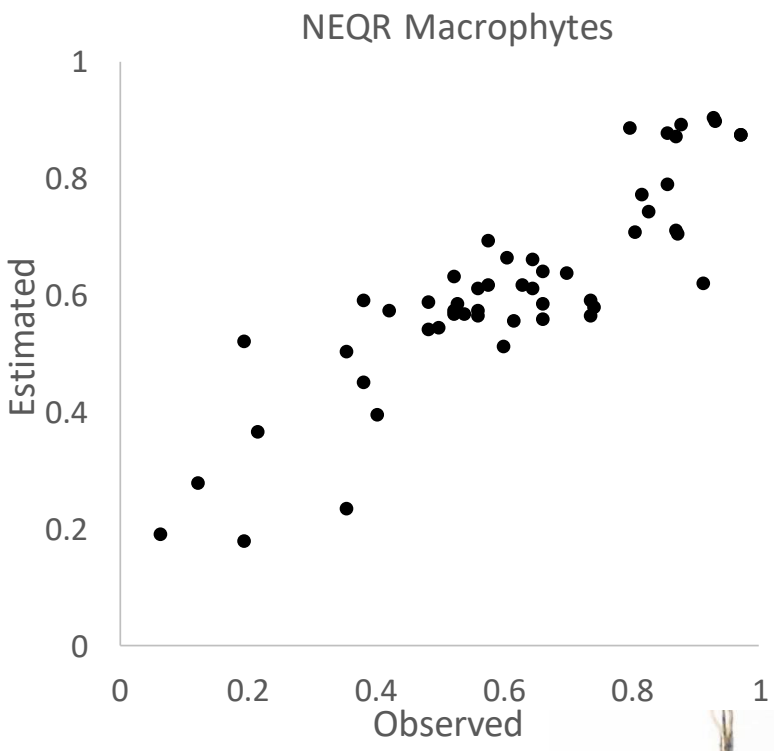
3. Develop model relating satellite data with directly measured lake ecology quality.

4. Test model and estimate for unmonitored lakes

An Ecological Quality Ratio, from aquatic plant assessment is used to assess our 224 monitored lakes

Satellite estimated vs boat observed Aquatic plant Ecological Quality Ratio

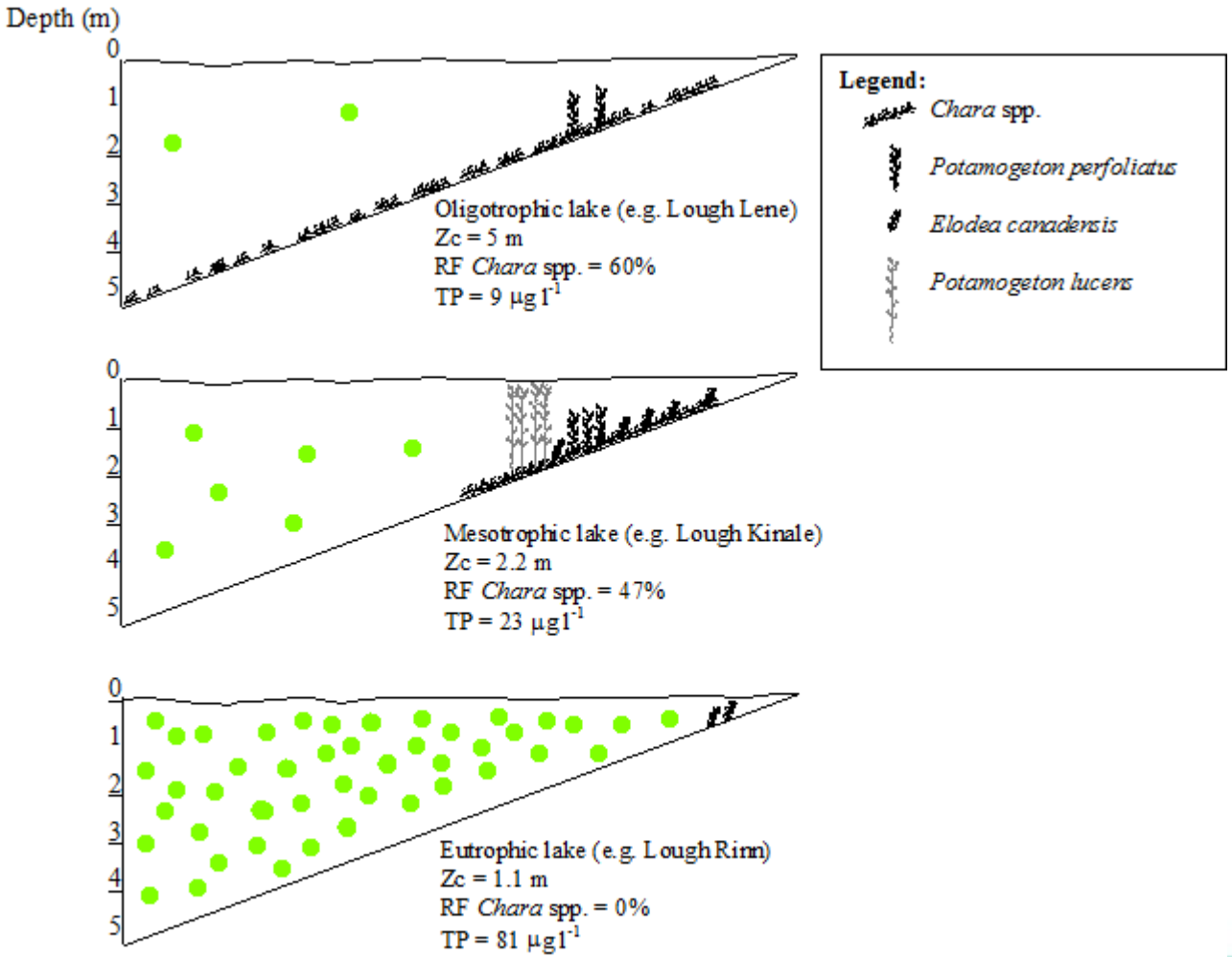




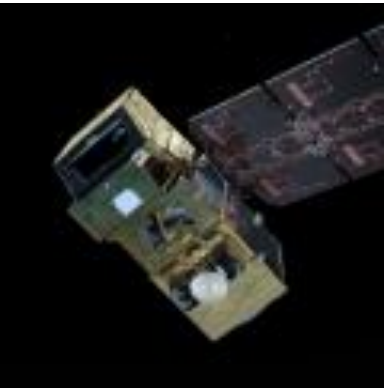
$R^2 = 0.77$

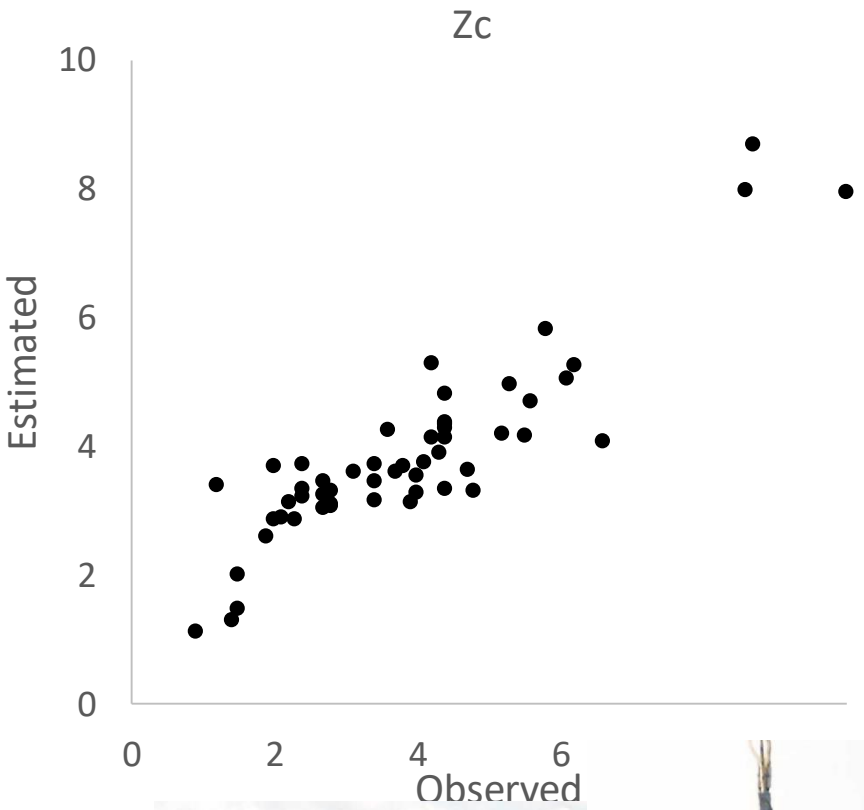
n = 56

As nutrients and algae increase (eutrophication) the shade restricts the plants to shallower depths.



Satellite estimated vs boat observed Aquatic plant depth of colonisation



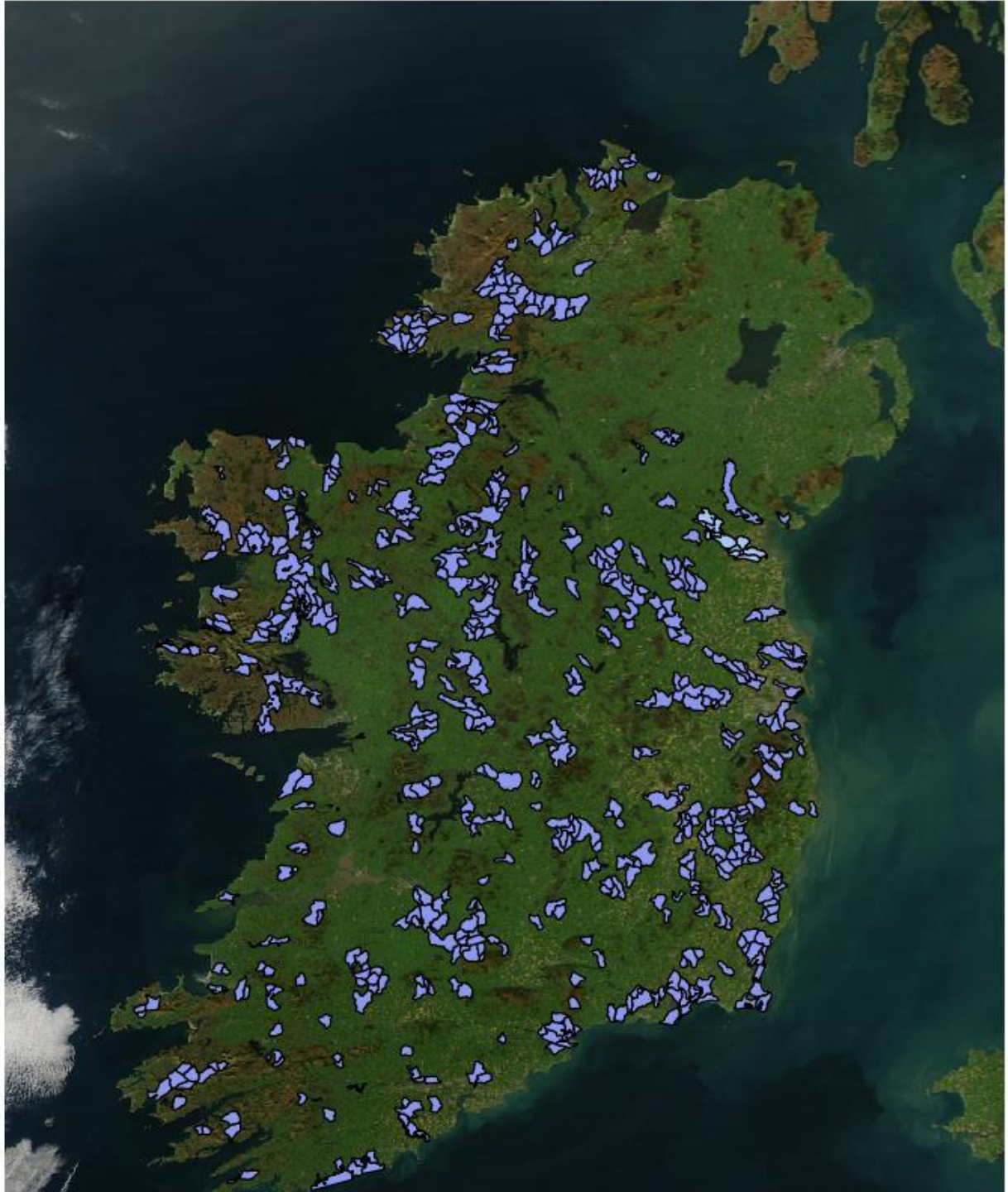


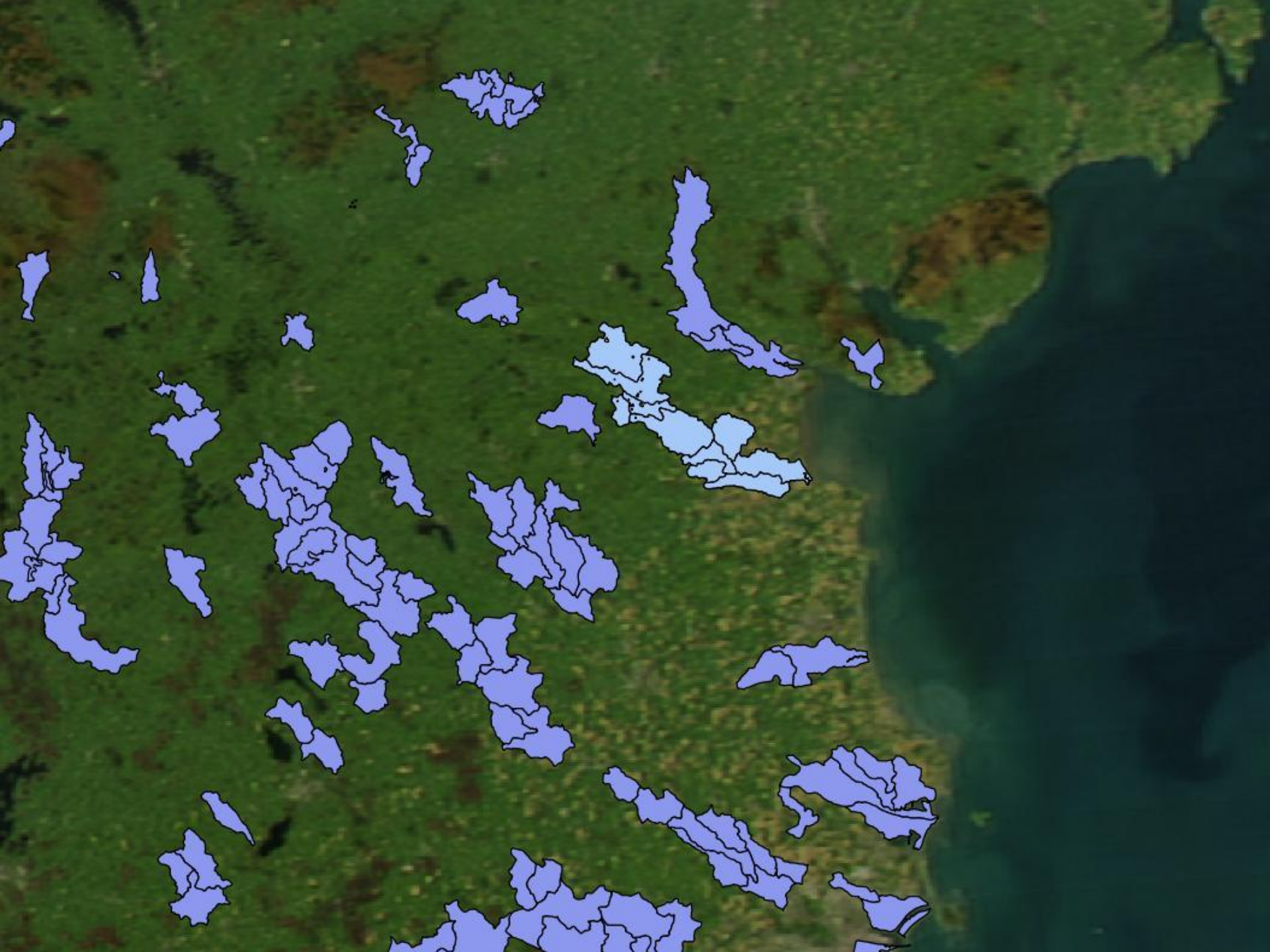
$R^2 = 0.80$

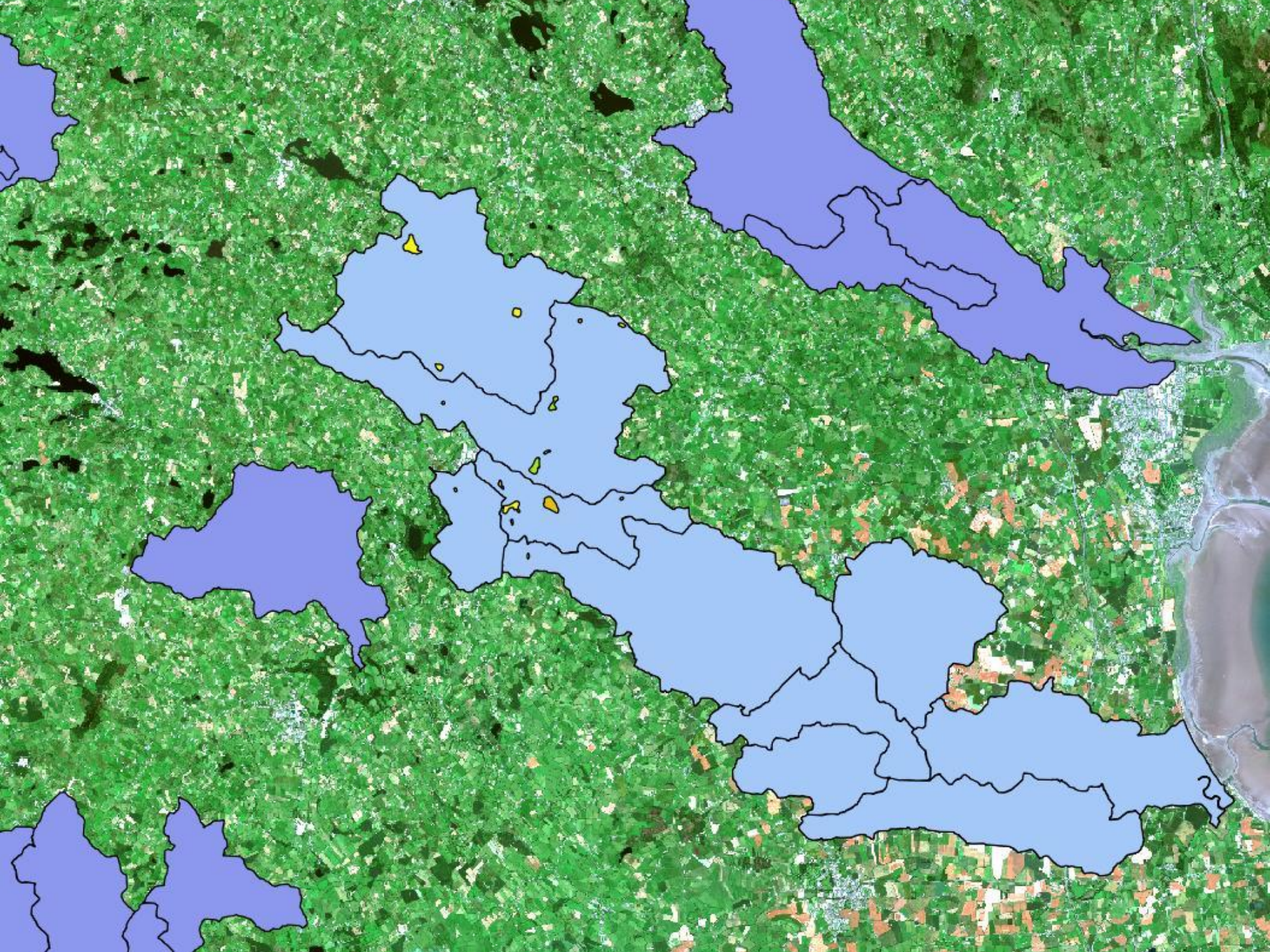
n = 56

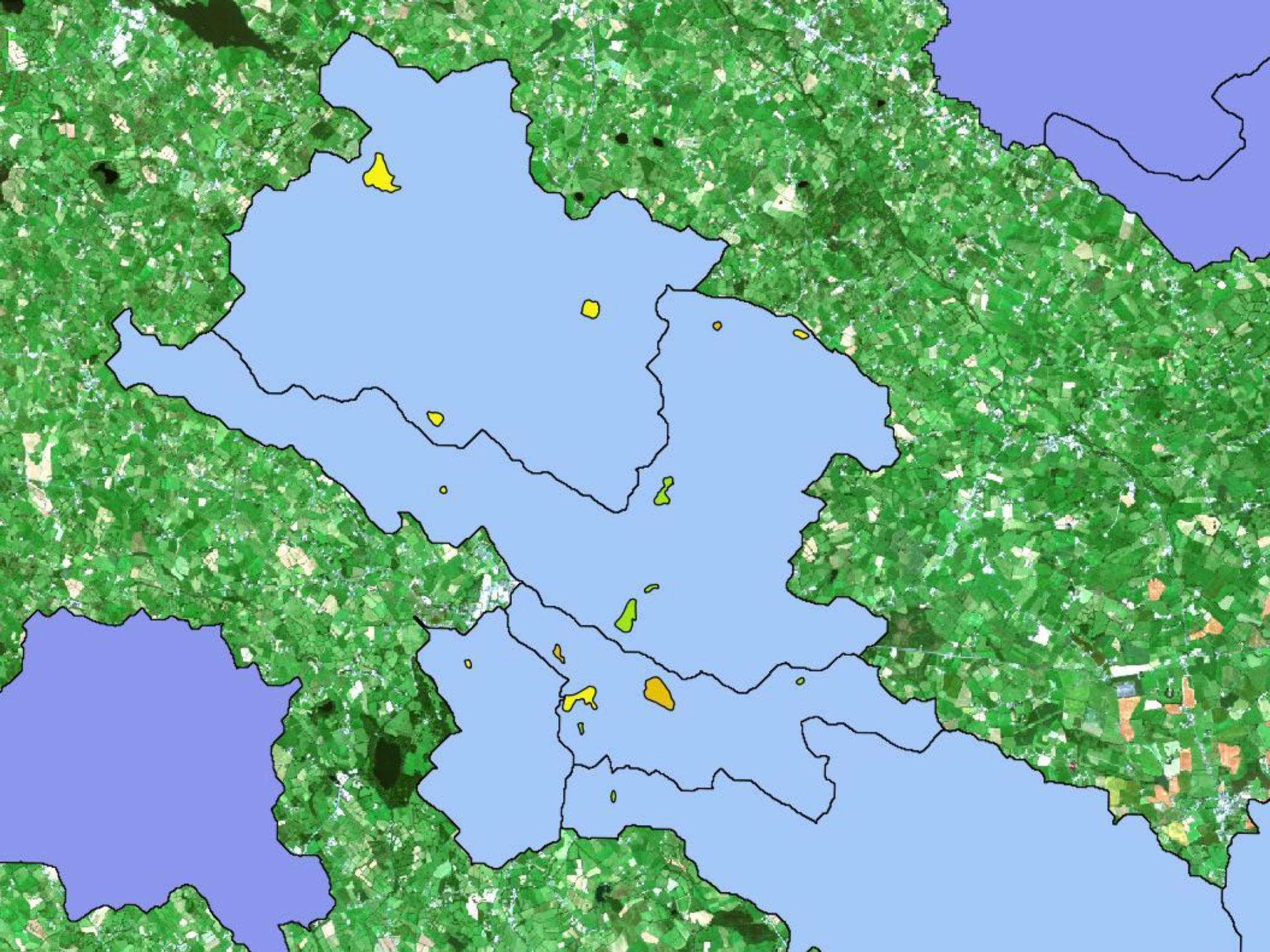
Testing it out on an Area for Action

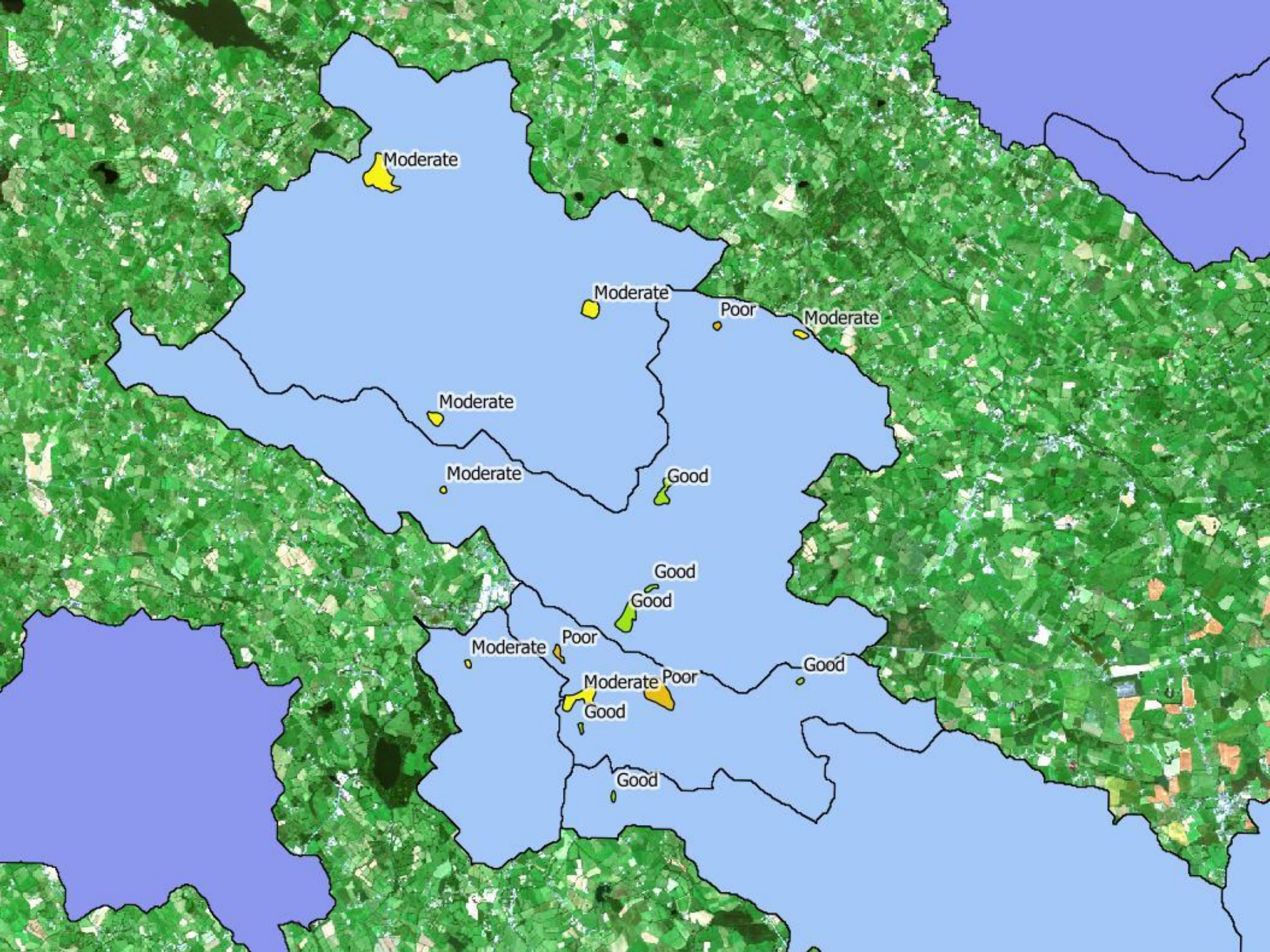
- Potential to estimate status for unmonitored lakes
- Ran model to predict aquatic plant status for 44 lakes/ponds from the Glyde-Proules area for action catchment.
  - Results were obtained from 16 lakes.
  - The remainder were either too small, dry or shallow.







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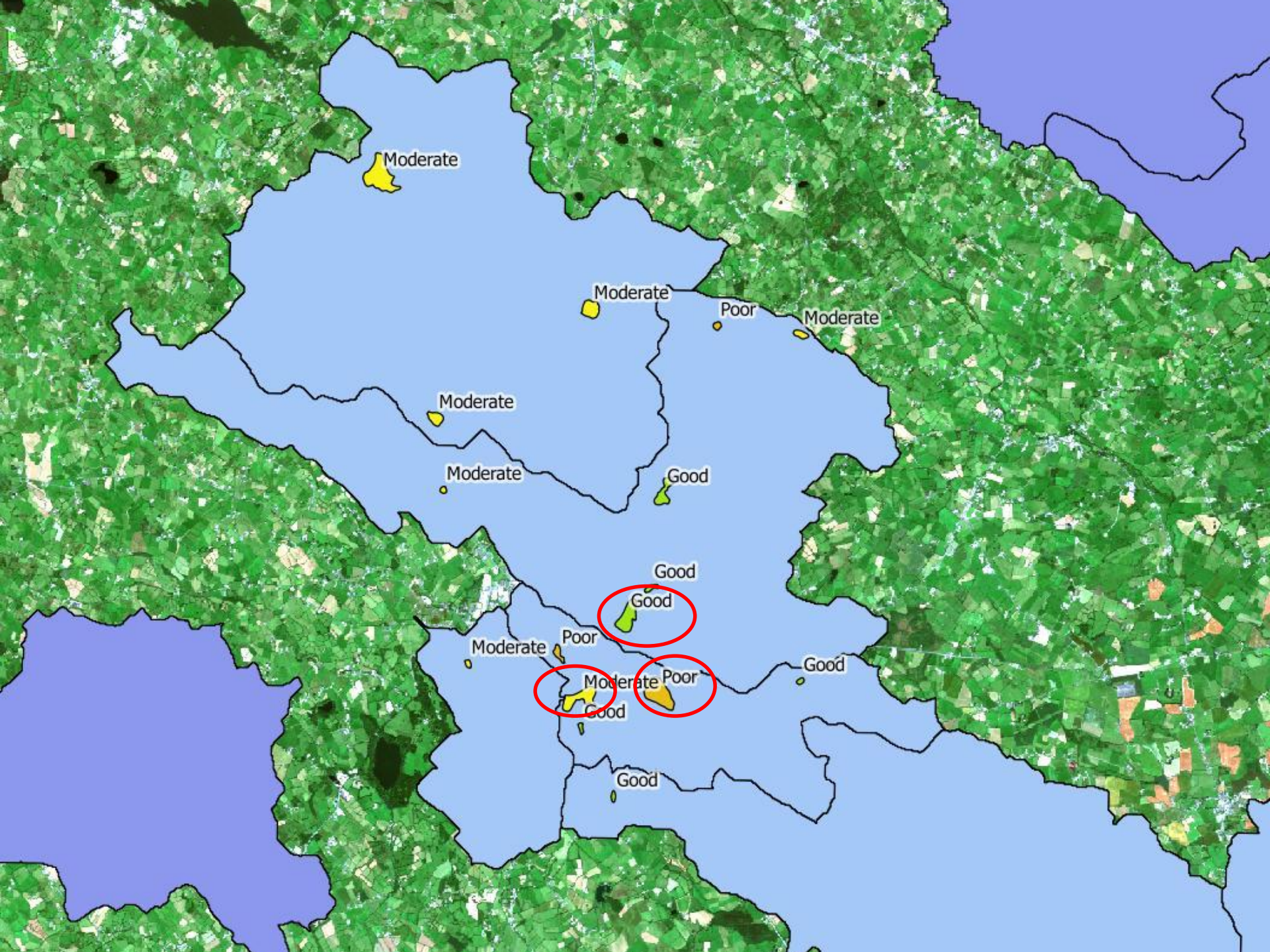
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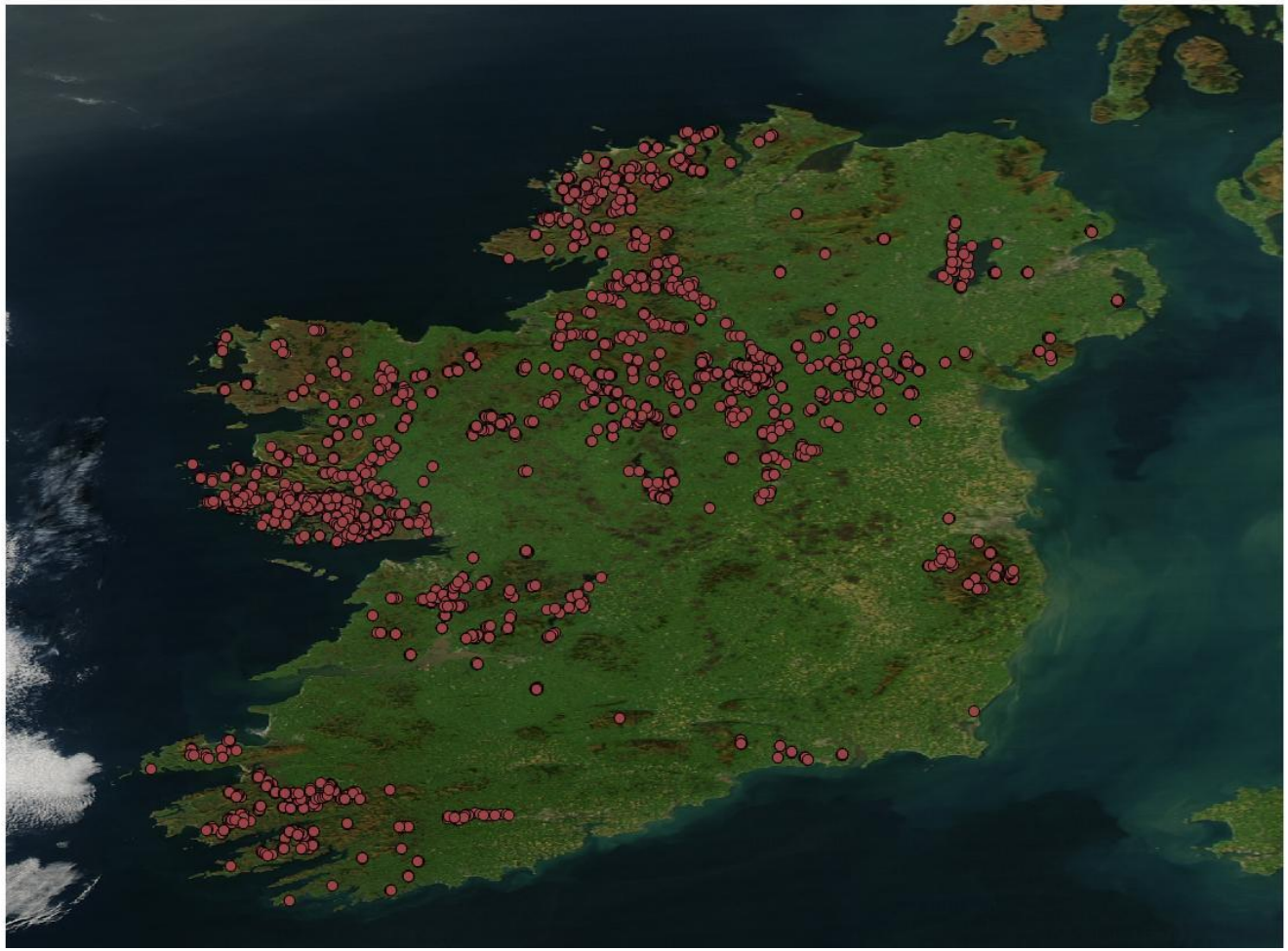
Imagery from Copernicus Sentinel 2 (17/7/2017)

Future plans

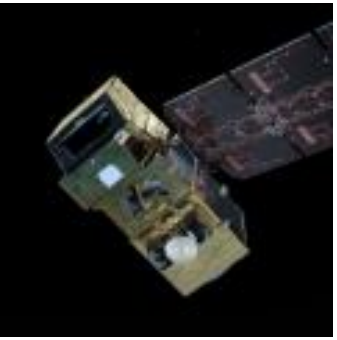
- Expanding knowledge moving from 224 monitored lakes to predictions for the 818 WFD lakes

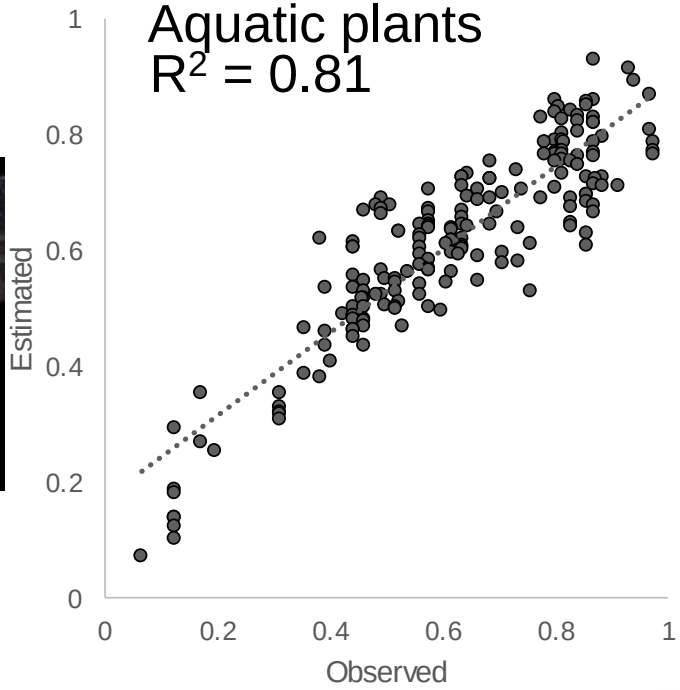
- More data received in January provided results for 818 lakes (2016, 2017, 2018)

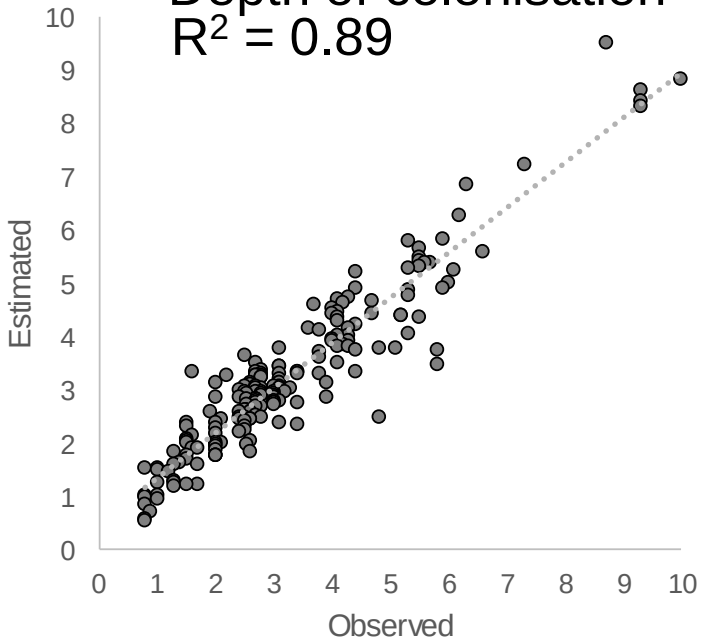
224 monitored vs 818 WFD lakes



Additional data improved relationships ….but a lot of data cleaning needed

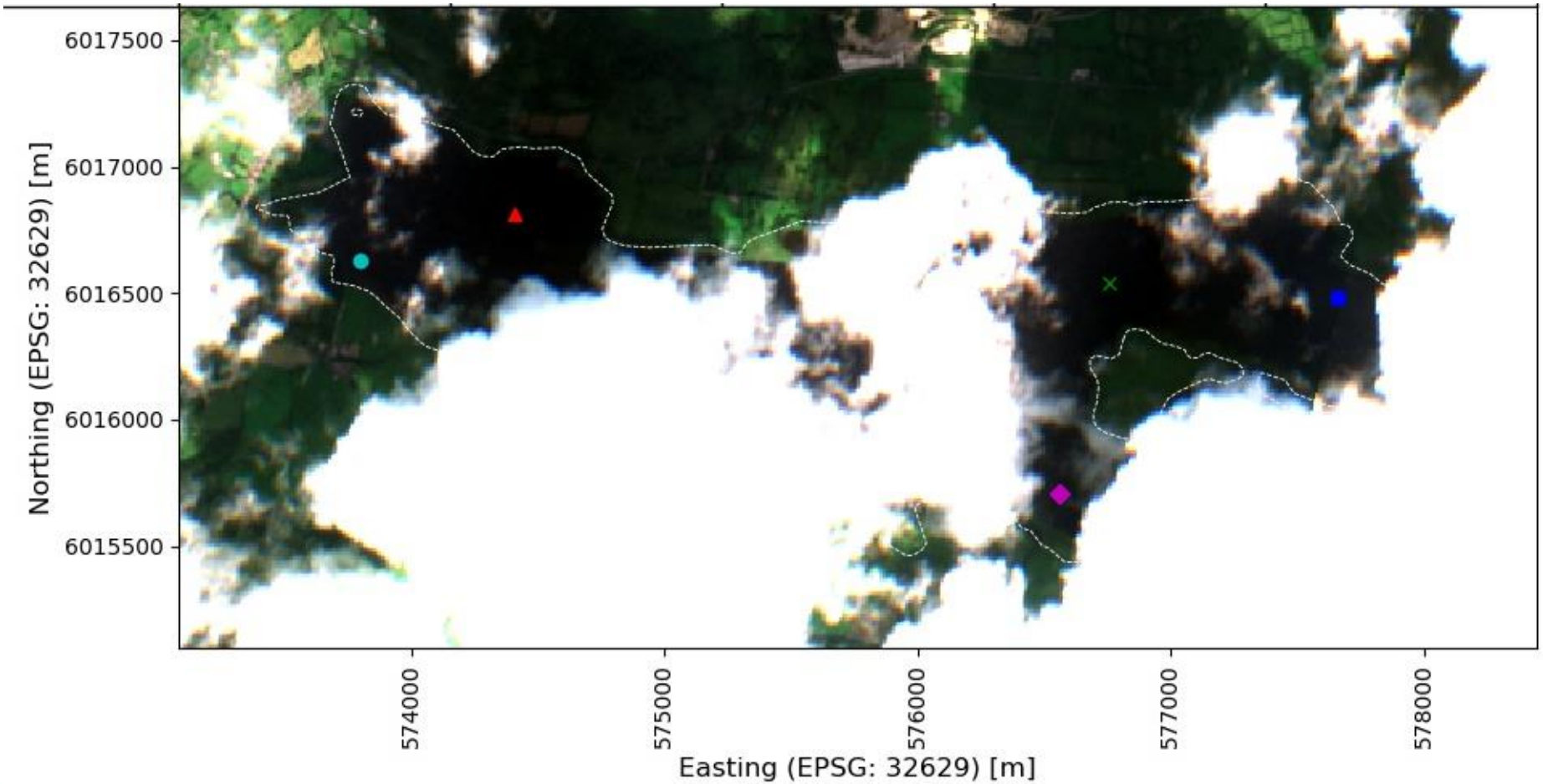






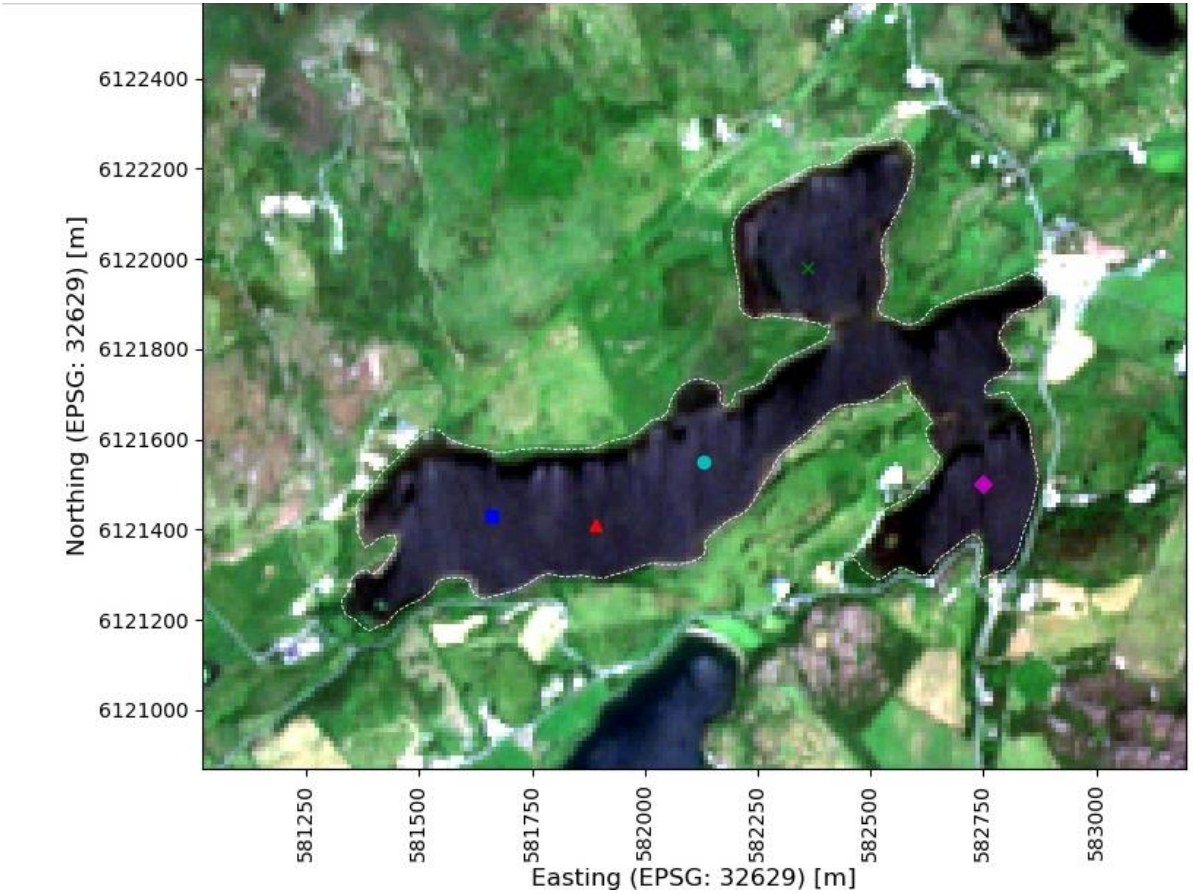
n = 190

Results need manual inspection -cloudy



Cloud Reflection also interferes

- Lough Kindrum



Other projects:

- INFER – Irish EPA funded project
  - –NUIG, ICHEC and DKIT
  - Chlorophyll *a*
  - Transitional waters and lakes.
  - Google Earth engine and other resources

- EOMORES –developing product as part of an EU project.
  - EPA selected as an interested end user.
  - White paper on future use in WFD in preparation.

Benefits

- Expanding knowledge moving from 224 monitored lakes to predictions for the 818 WFD lakes
- Status predictions for unmonitored lakes will help characterisation – focusing investigative monitoring to areas of risk.
- The River Basin Management Plan identified 32% of the 818 WFD lakes as *Under review*. This work can help - removing uncertainty and classifying more as either *At risk* or *Not at risk*.
- Lakes in Areas for Action to be processing first – *at the request of LAWPRO*

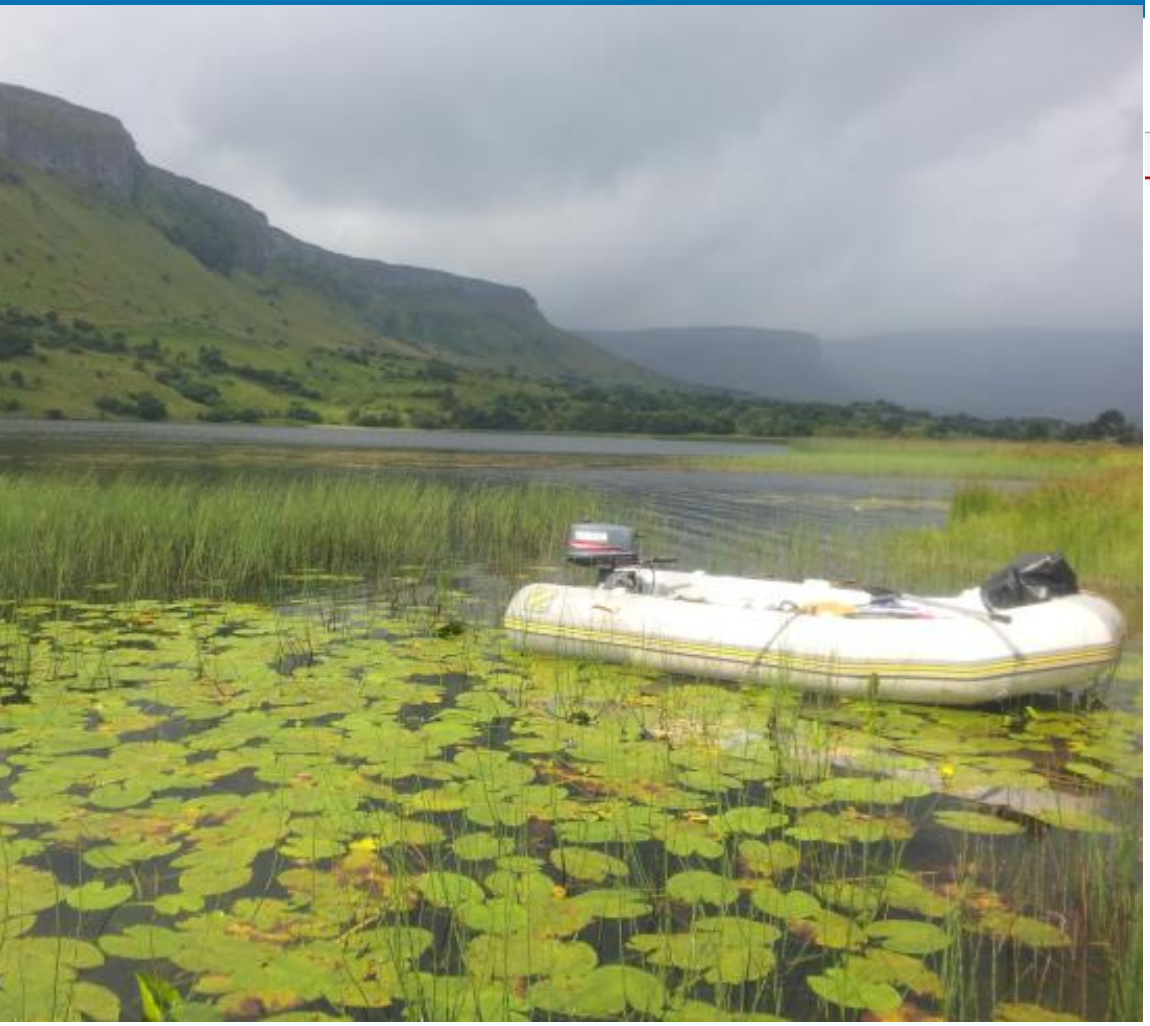
Local Authority Waters Programme

vibrant communities | catchment assessment | healthy waters

Benefits

- Intercalibration – Earth observation can be used across borders (we included NIEA lakes at their request).
- Earth Observation is likely to be part of WFD revision – we are preparing.
- Small waterbodies, important for biodiversity, can be done (down to 1 ha).
- Earth observation will provide direct data on lakes rather than inferring risk
- Can’t deliver full implementation of WFD monitoring
  - but fills a lot of gaps: unmonitored lakes, holistic catchment assessment of lakes, etc.

Thanks



THE IRISH TIMES

Mon, Nov 19, 2018

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Pollution police look to space to monitor over 800 Irish lakes

Environmental body says use of satellites a major step forward when checking water quality

about 18 hours ago

Brian Hutton

Lough Ree, one of 812 Irish lakes now being monitored from space.

The health of more than 800 Irish lakes is to be monitored from space for the first time using satellites, in a move that could help authorities detect pollution more quickly and in waters that have never previously been tested.

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