

## Introduction

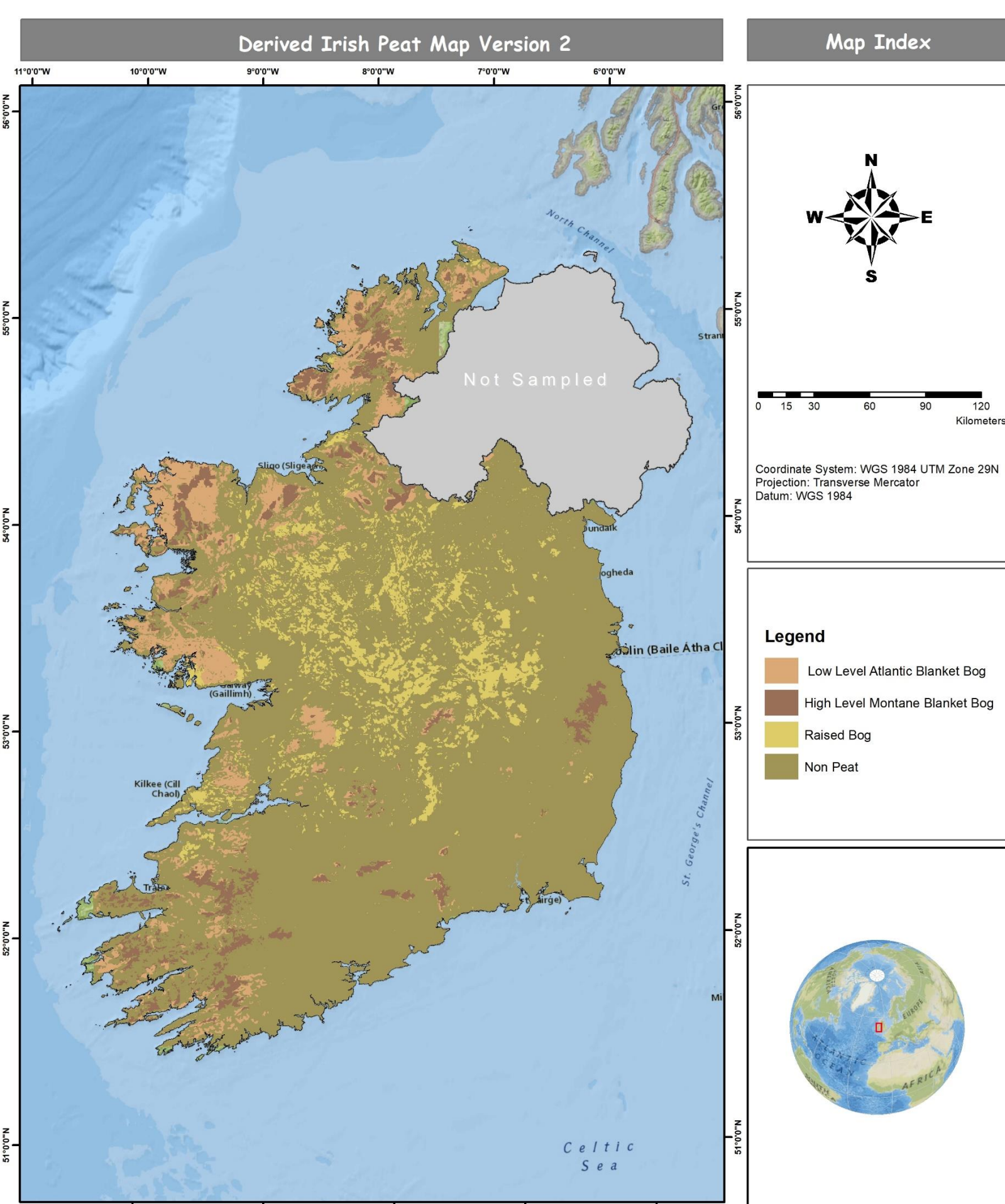


Figure 1: Derived Irish Peat Map version 2 (Connolly & Holden, 2009)

Peatlands are an important ecosystem due to their role in carbon sequestration as well as other ecosystem services including; climate regulation and water regulation. Peatlands cover a small fraction (~3 %) of the terrestrial surface (Misney et al., 2019). Nevertheless, they account for approximately one-third of global Soil Organic Carbon (SOC) stock. In Ireland, peatlands cover ~21% of the land area (Fig. 1) and account for between 50-75% of the total SOC stock (Renou-Wilson et al., 2011). However, much of this area has been

degraded through anthropogenic activities such as drainage and peat extraction. SmartBog will take an interdisciplinary approach to address these issues using GIS, Earth Observation and Machine Learning (ML). This will directly support rehabilitation and conservation activities, aiding identification of candidate sites for rewetting and restoration.

## Methodology

### Multi-Scale (Spatio- Temporal) NDVI Maps:

Multi-Scale (Spatio-Temporal) NDVI mapping will be conducted using data acquired with sensors at three different levels (Ground, Air and Space). Starting from the ground level, NDVI maps and C/GHG emission status will be acquired using IoT (Internet of Things) sensors/ Flux towers (Fig.3 (a)). This will provide highly accurate in-situ observation. On the next level, data from very high resolution aerial imagery (~25 cm) (Fig.3 (b)) will aid in providing cloud free observation at National scale. The RGBI images will be used to create NDVI maps. While the aerial imagery will provide very high spatial resolution maps, due to the cost the images will be acquired one time only. This gap in temporal resolution will be hence filled by Copernicus Sentinel – 2 sensors in the Space (Fig.3(c)). Cloud free Spatio-temporal (yearly) NDVI maps will be generated using Google earth Engine (GEE) platform. The result from the preliminary analysis performed using GEE can be seen in the NDVI maps below (Fig.2).

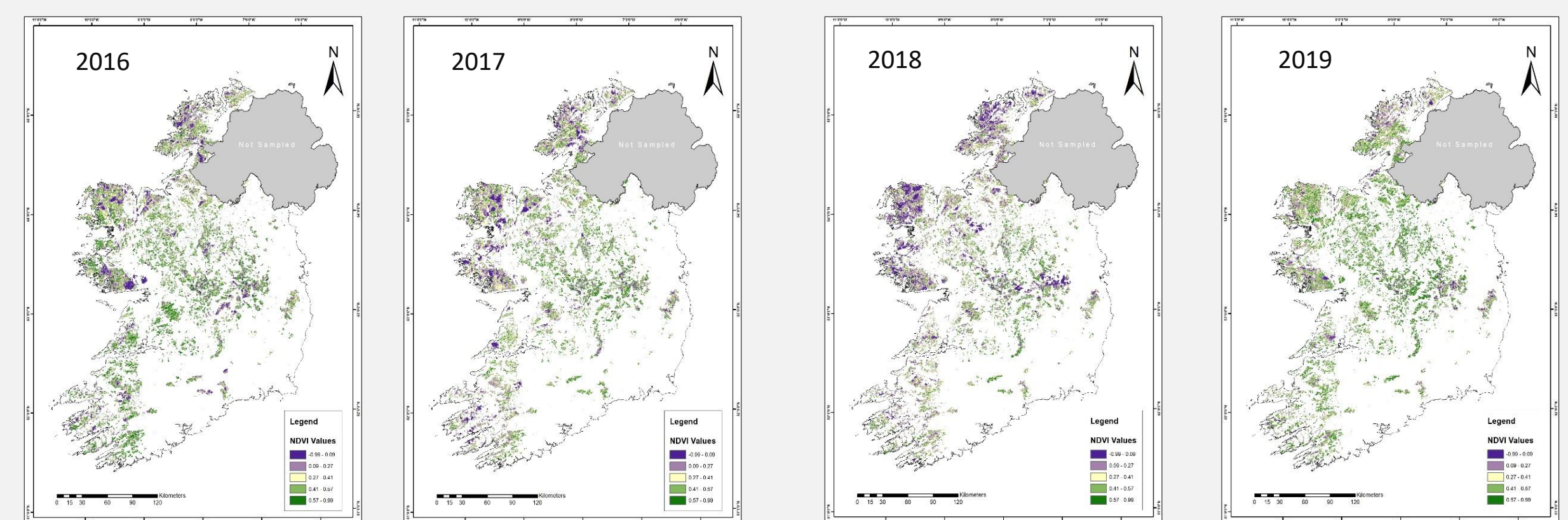


Figure 2: NDVI Maps

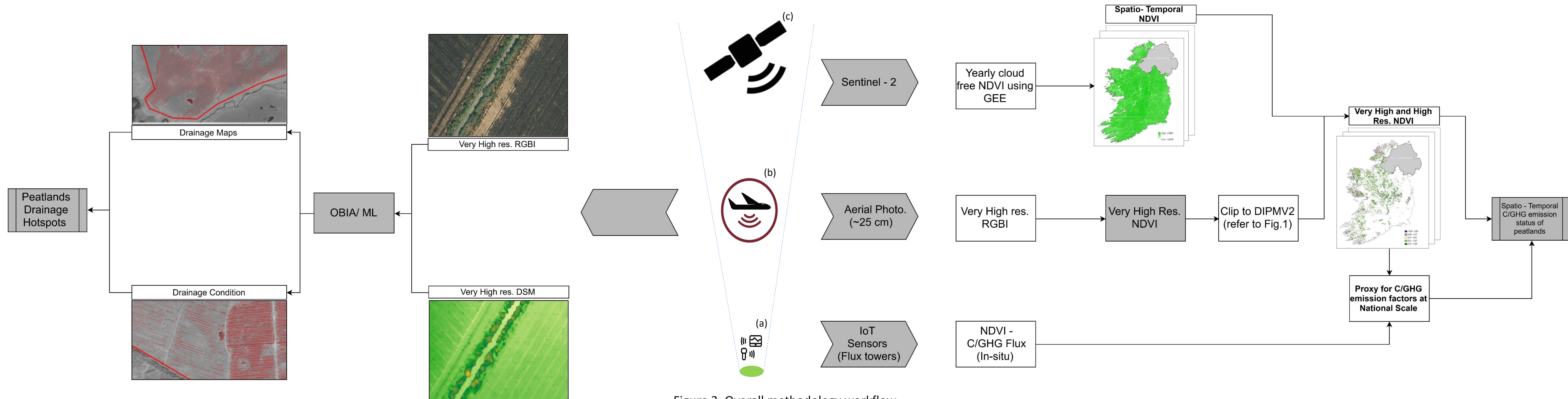


Figure 3: Overall methodology workflow

## Methodology Cont.

### Peatland Drainage Mapping:

As mentioned before, anthropogenic disturbance is one of the main causes of peatland degradation. The very high resolution aerial images will also be used to map peatlands drainage on a national scale (Ireland). Two different products, RGBI (Red, Green Blue, Infrared) and DSM (Digital Surface Model) with spatial resolution of ~0.25 meter and 1 meter respectively (Fig.4) will be used in combination to generate highly accurate maps of drainage.

ML and Semi-automatic Object-Based Image Analysis (OBIA) will be used to map Land Use/Land cover (LULC), peatland drainage and habitat condition at national scale. The area covered by peatlands in Ireland is 1.43 Mha. This requires automated mapping using afore mentioned techniques. This will not only aid towards determining the spatial extent of peatlands (Fig.5) in Ireland but also help determining the drainage condition.

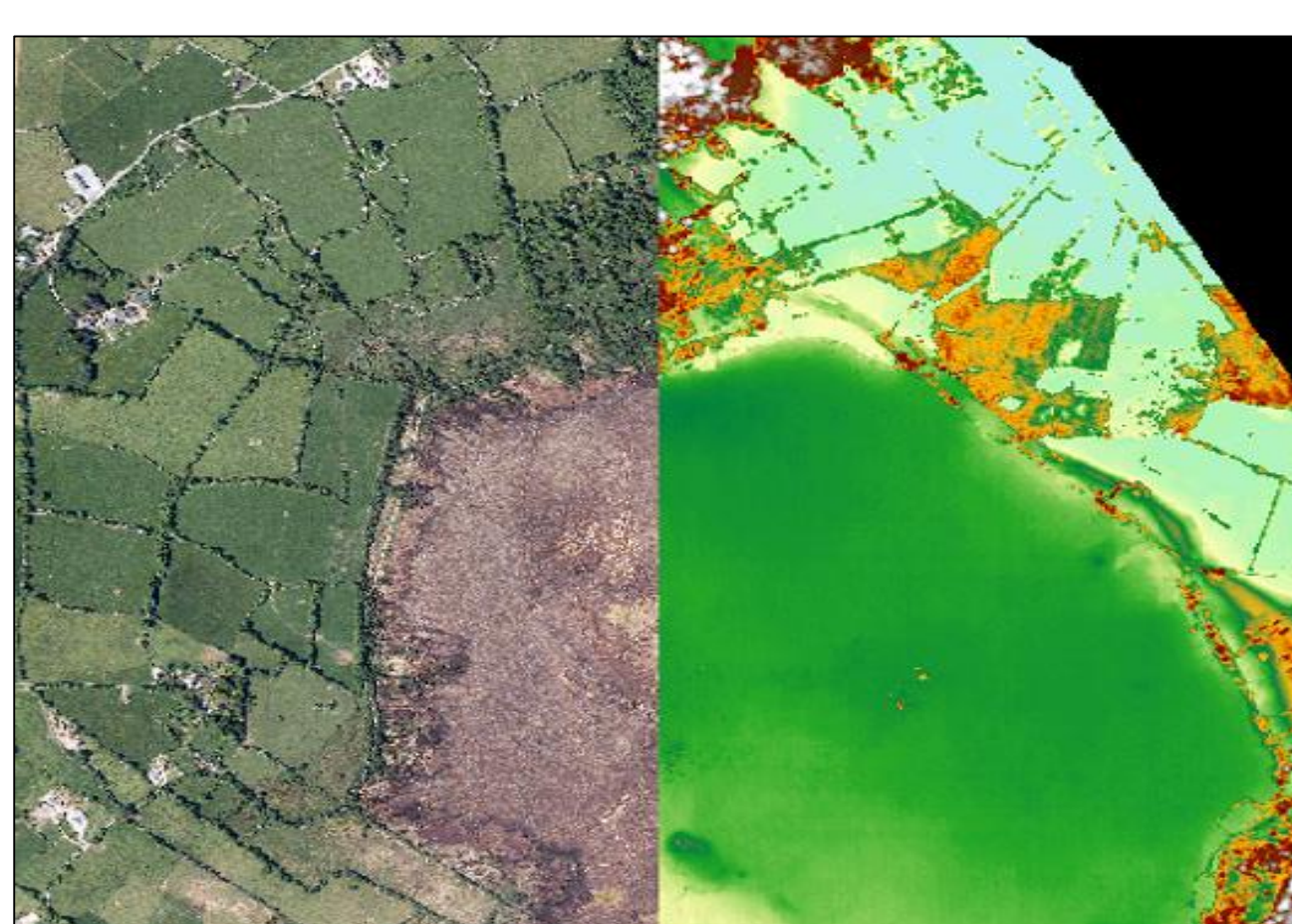


Figure 4: Very high res. Optical image and DSM

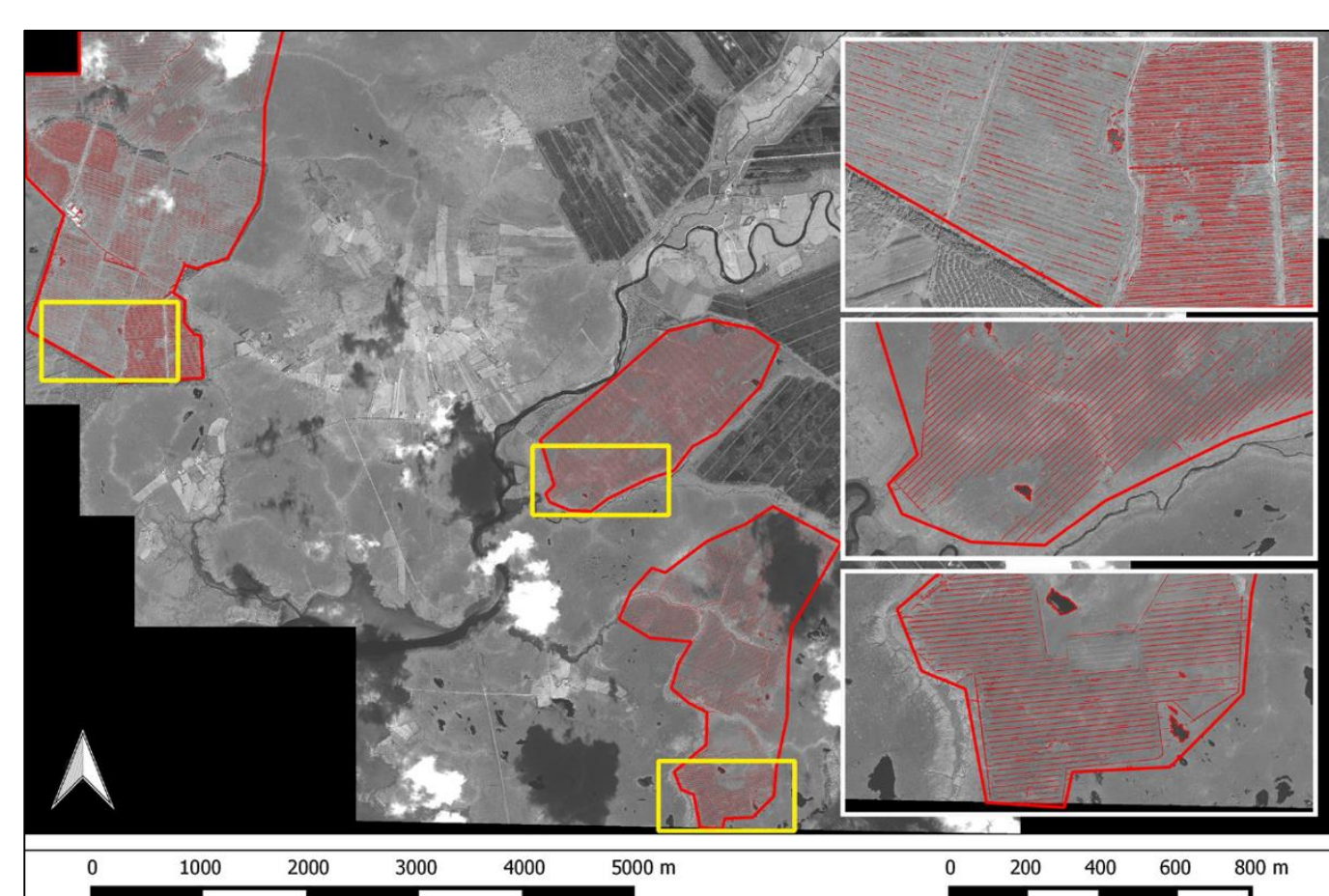


Figure 5: OBIA drains (Connolly & Holden, 2017)

## Intended Outcomes

- SmartBog is in its initial start-up phase.
- Next steps include acquisition of very high resolution aerial photographs.
- Initial assessment at raised bogs in the midlands of Ireland.
- Updated peatland Land use map of Ireland will be created.
- Very high resolution peatland drainage maps, representing peatland spatial extent and habitat condition.
- Multi scale NDVI maps of peatland will be generated to determine C/GHG emission status.

## References

- Connolly, J. and Holden, N. M. (2017). Detecting drains on a blanket bog using object based image analysis and very high resolution satellite imagery. Carbon Balance and Management, 12(1):7.
- Connolly, J. and Holden, N. M. (2009) Mapping peat soils in Ireland; updating the Derived Irish Peat Map. Irish Geography, 3, 343-352.
- Minasny, Budiman, et al. (2009) Digital mapping of peatlands—A critical review. Earth Science Reviews, 196.
- Renou-Wilson et al. (2011). BOGLAND Sustainable management of peatlands in Ireland. STRIVE report No 75 prepared for the Environmental Protection Agency (EPA), Johnstown Castle, Co Wexford, 157.