

PROJECT SCO EO4WETLANDS - REVIVING WETLANDS: UNVEILING RESTORATION DYNAMICS

USING SATELLITE IMAGES TIME SERIES

T. Lopez^{1,2}, R. Gimenez¹, F. Fernandez¹, R. Antoine², Emma Bousquet¹, P.-L. Frison³, C. Fauchard²,

(1) Cerema, Direction territoriale Occitanie, Satellite Applications team, Toulouse, France (teodolina.lopez@cerema.fr). (2) Cerema, Direction Territoriale Normandie-Centre, Research Team ENDUM, Le Grand Quevilly, France. (3) LaSTIG, Université Gustave Eiffel, ENSG, IGN, Champs-sur-Marne, France.

Introduction

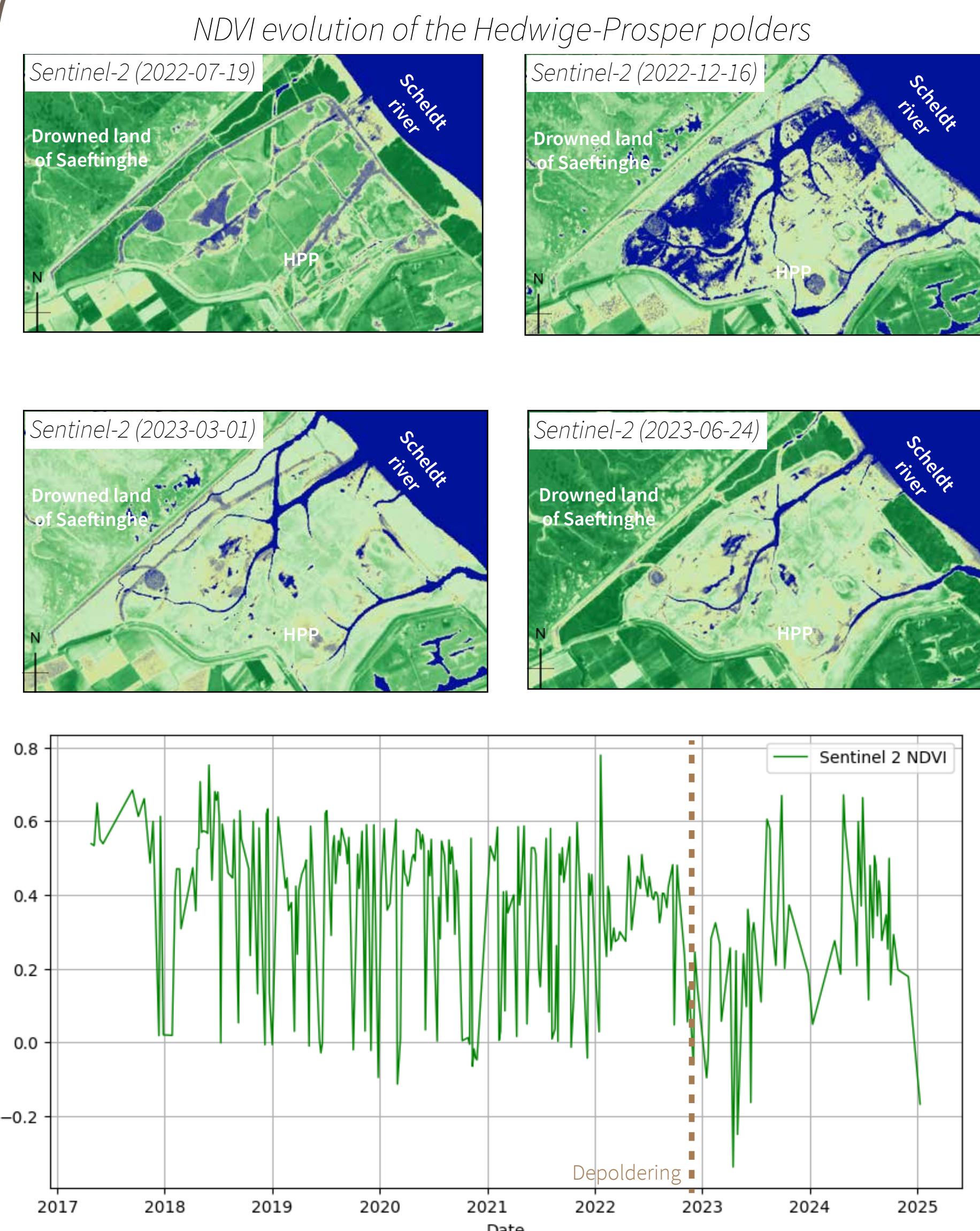
Wetlands are among the critical ecosystems playing a major role in the context of global warming, biodiversity and hydrology. The 2017 World Wetlands Days particularly highlighted how coastal wetlands help cope with disasters such as tidal surges.

The SCO project EO4Wetlands, awarded with the SCO 2022 label, follows on the Interreg Polder2C's project, a full-scale experiment of depoldering by dike breaching, in the polders of the Living Lab Hedwige-Prosperpolder (LLHPP) near Antwerp, has given Cerema and its partners the opportunity to develop a wetland monitoring tool. It incorporates (1) satellite images acquired in the visible, radar and thermal infrared wavelength, as well as their derived products and (2) in situ datasets.

The Hedwige-Prosper polders are located on the Dutch-Belgian border on the Scheldt delta. They are located near the Drowned land of Saeftinghe, a salt marsh, which will be used as a proxy to better understand the changes underway in the former Hedwige-Prosper polders.

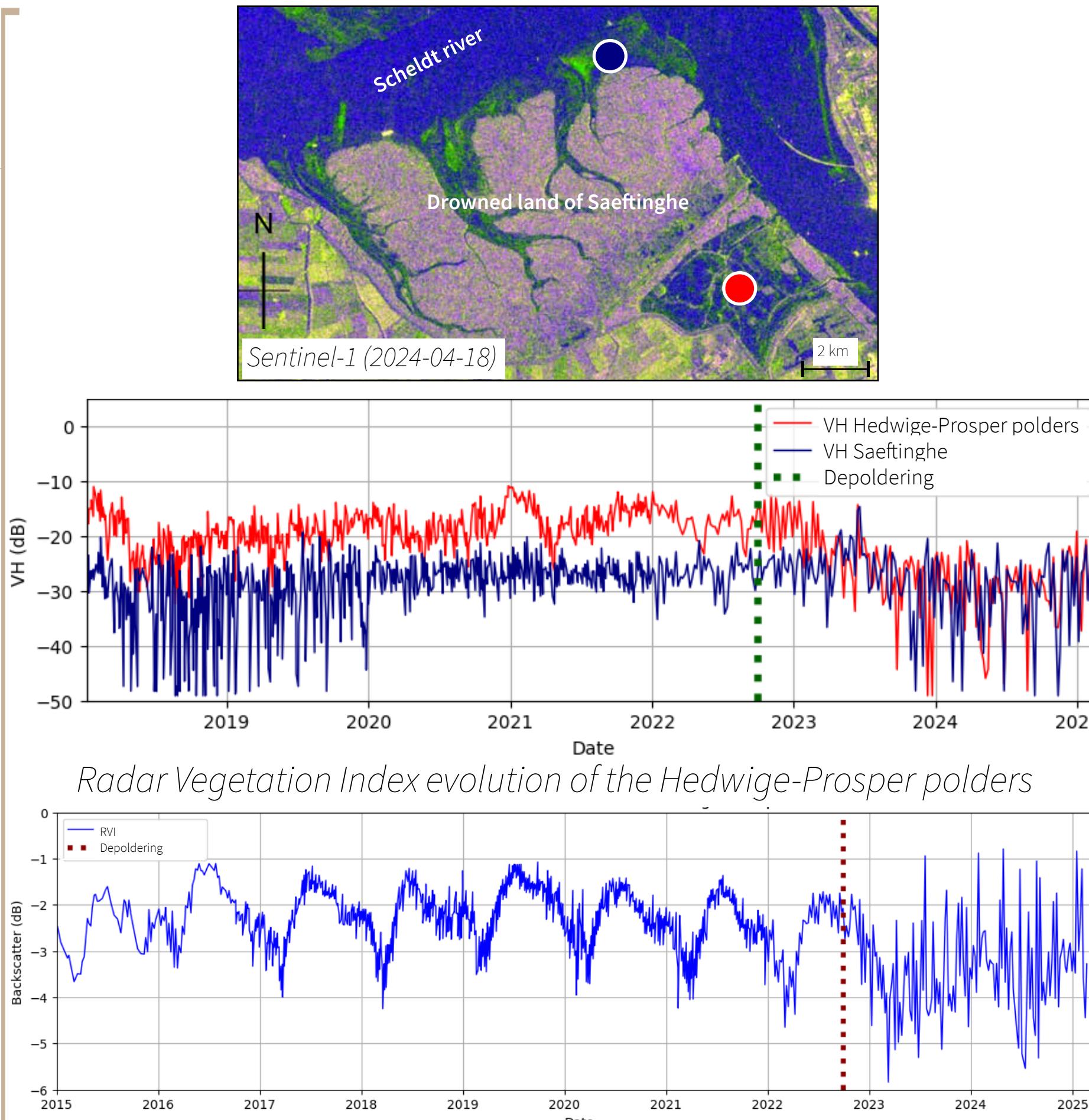
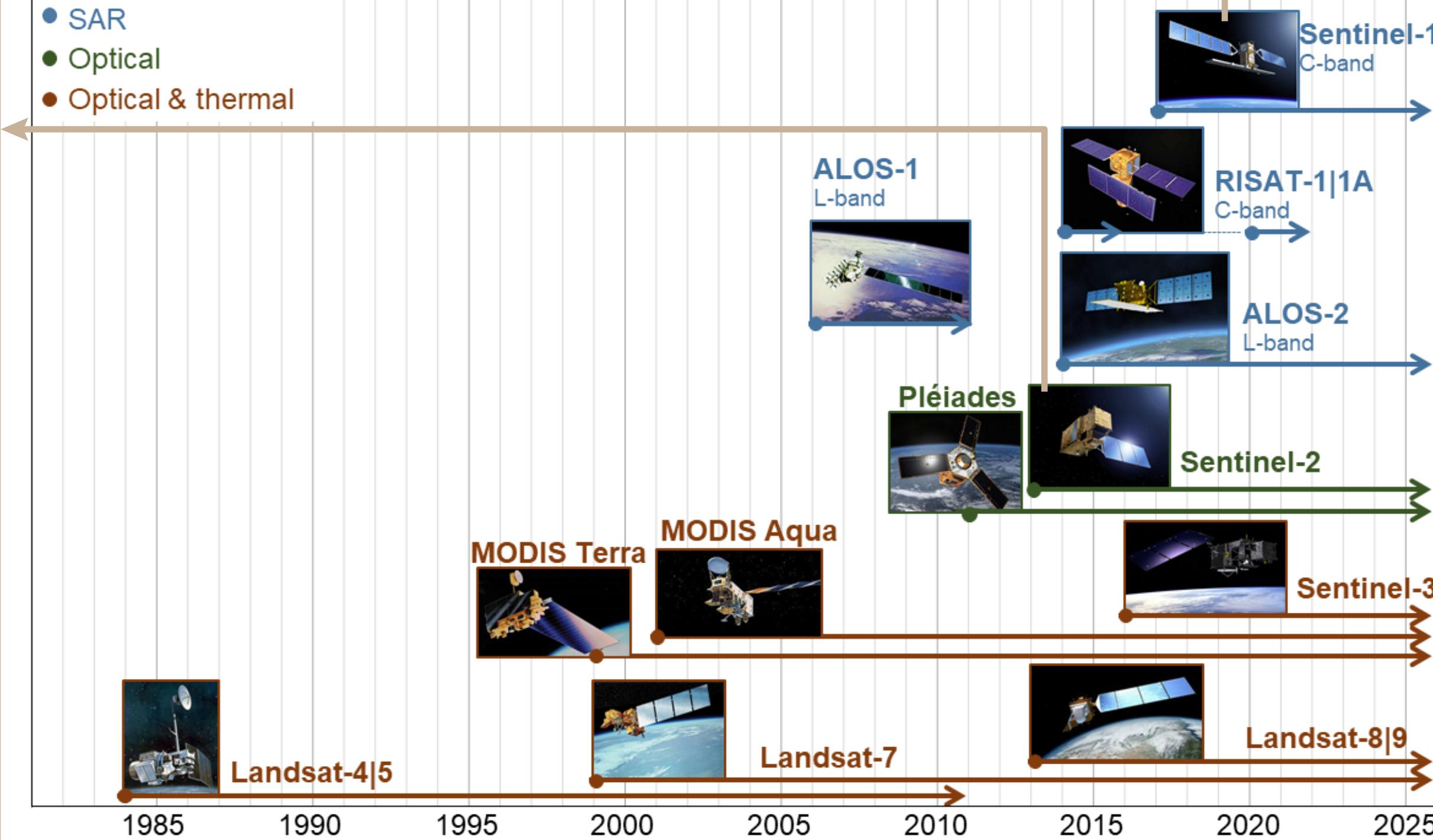


Short-term evolution of the Hedwige-Prosper polders (HPP)



The figure shows the evolution of the NDVI before and after depoldering. As expected, the mean NDVI value decreases with regular flooding of the HPP. However, the renaturation process is beginning to impact the NDVI signal.

Satellite data used to monitor the renaturation of the Hedwige-Prosper polders before and after the depoldering

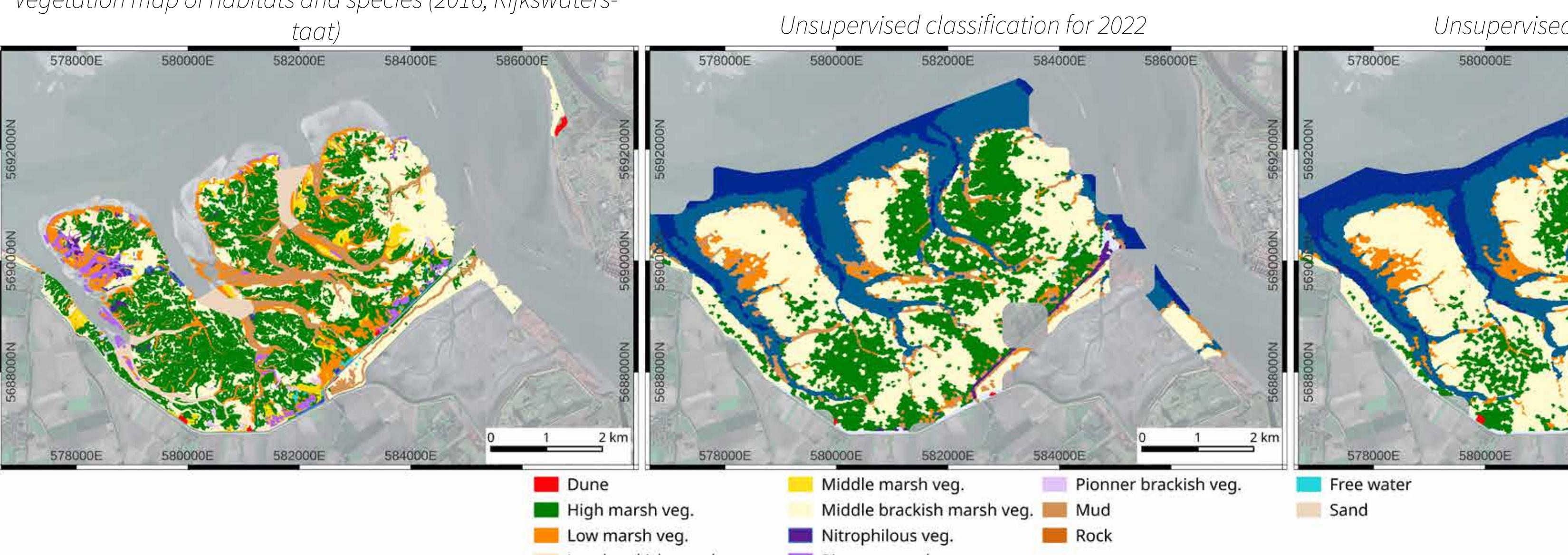


As shown in the first graphic, the radar data indicates that, since the depoldering and the beginning of the renaturation, the backscattering in VH of the HPP is closer to that observed at the flooded border of the Drowned land of Saeftinghe.

The second graphic shows how the RVI has changed over time for the HPP. Following the depoldering, the signal initially becomes highly variable, and the backscattering value decreases from ~-2.5 dB to ~-4 dB.

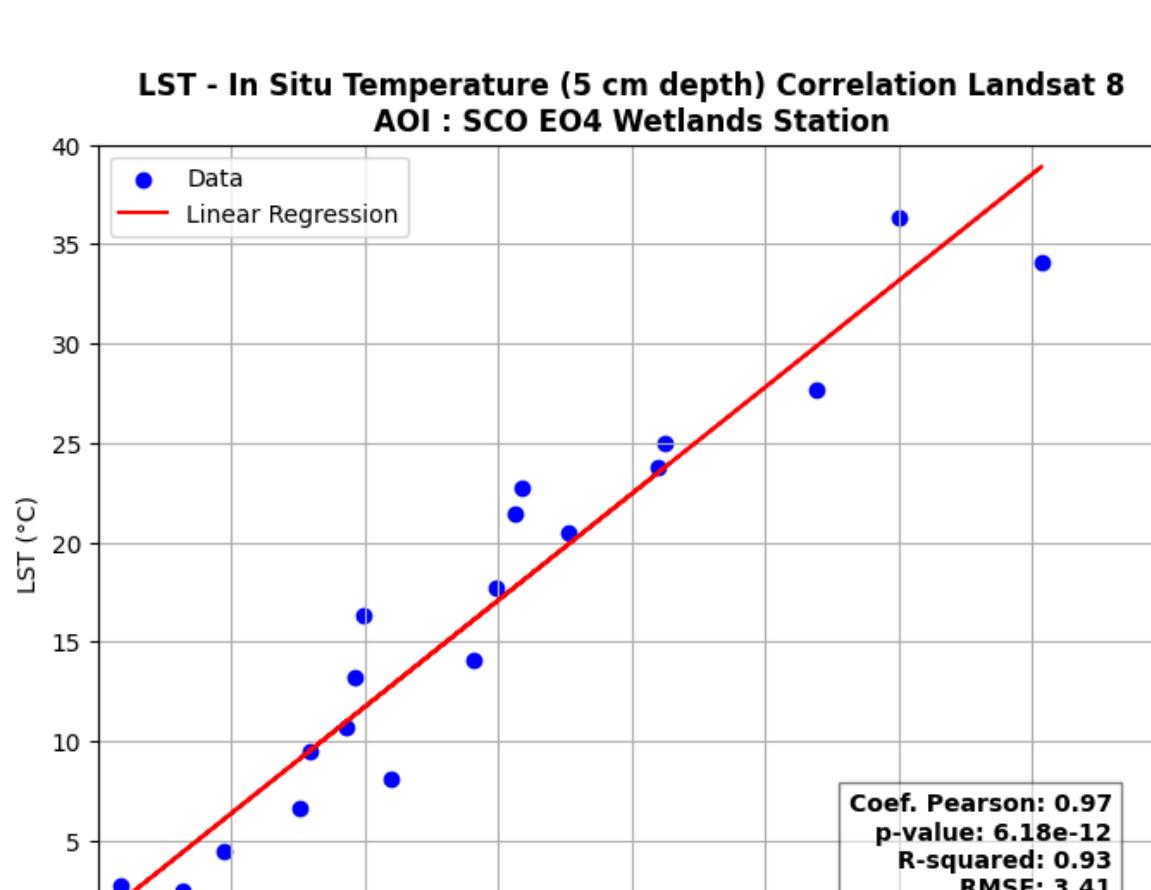
The study of renaturation and vegetation evolution can be derived from the automatic classification of Sentinel-2 time series.

Vegetation map of habitats and species (2016, Rijkswatersstaat)



- Constant/regular water zones (shades of blue);
- Pioneer vegetation (shades of violet);
- Low marsh vegetation (shades of orange);
- Medium brackish marsh vegetation (shades of yellow);
- High marsh vegetation (shades of green);
- Dry dunes (red).

In situ data



The soil moisture and temperature profile (© Campbell Scientific) provides information on the evolution of soil temperature at depths ranging from 5 cm to 100 cm, for example. These data can be used to compare the value of the soil temperature at 5 cm with surface temperature estimates by satellite. The evolution with depth, when compared with external forcing (such as tides and precipitation), provides insight into the major process controlling its evolution.

Key takeaways & perspectives

- The SCO project EO4Wetlands offers a unique chance to observe the transformation of a new wetland in the context of rising sea levels.
- In order to study the evolution of the HPP and the Drowned land of Saeftinghe, a database of images has been compiled from 2018 for Sentinel, and from 1985 for Landsat.
- Adding data acquired with different wavelengths, spatial resolutions and temporal resolutions can enable us to study various aspects, including:
 - the correlation between the different data, particularly those associated with the sensors installed on the study site;
 - the influence of climate change on wetlands over the 40 years of available data;
 - the influence of tides and meteorological phenomena on variables measurable from satellite and in situ sensors data.
- The classification method developed in the project provides an initial diagnosis of how major habitat classes have changed over time. As it is based on unsupervised classification, the results can be reproduced anywhere. However, as this example demonstrates, prior knowledge of the terrain is required to interpret the classification maps.

The main outcome of this project is the creation of a digital twin of the HPP and the Drowned land of Saeftinghe regrouping all the data-set (satellite, LiDAR, in situ sensors)

Find more information on this EO4Wetlands' Story map

