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Mapping agricultural phenology using repetitive optical remote sensing over a peri-urban region

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Framework : map soil organic carbon content, using remote sensing, ground and laboratory measurements, modelling. Project **SURFAC_EGC_SENTINEL_PLEIADES_CO**, financed by CNES (French National Space Agency).

Objectives of this work : determine typology of crop rotations as a further input to modelling.

Remote sensing data used : Landsat-8 surface reflectance, PROBA-V, SPOT4-TAKE5, Pleiades.



Data presentation and preparation

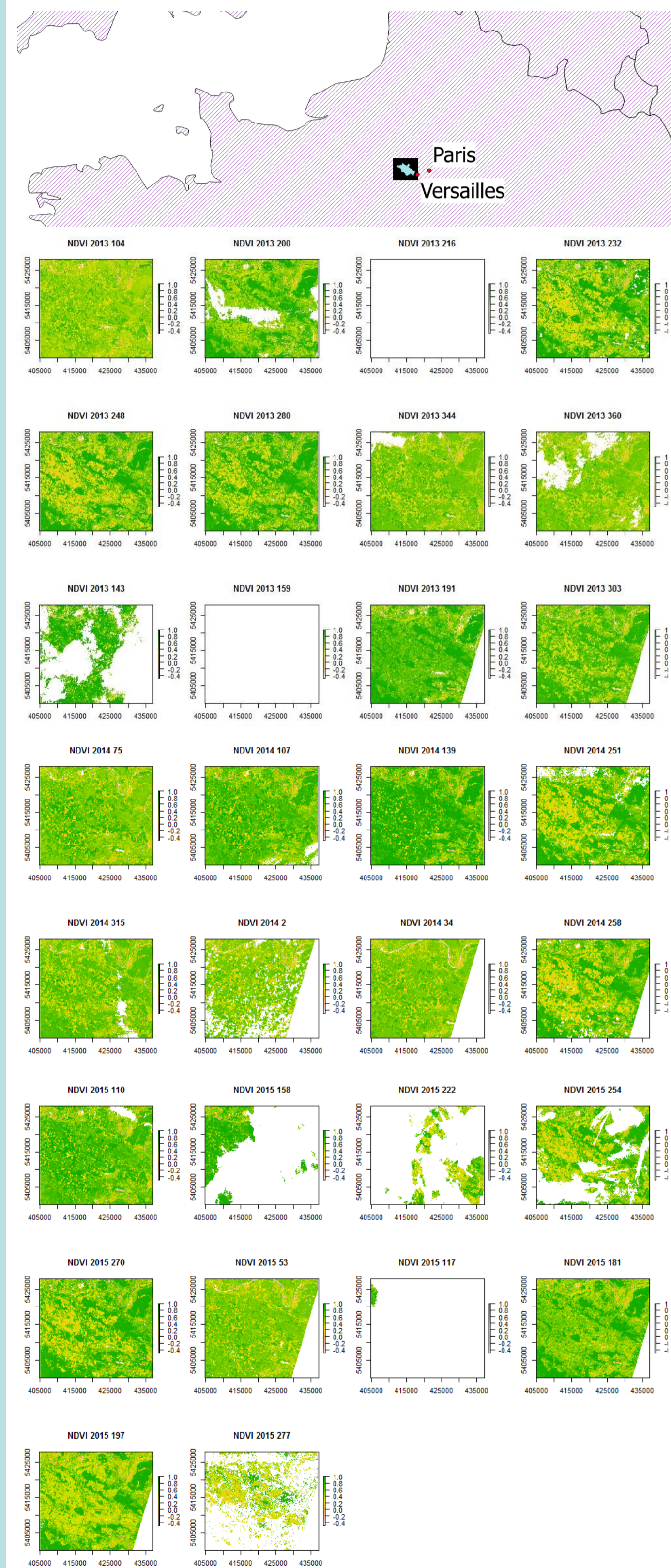


Figure 1 : NDVI from Landsat-8 surface reflectance (LBSR), subsetting and masked for clouds and strong aerosols loads.

Figure 4 : Comparative dataset, Vaudour et al. (2015). See area in Fig.3. Crop map obtained from the SVM classifier implemented on the bi-temporal 3 and 24 April 2013 Pleiades images.

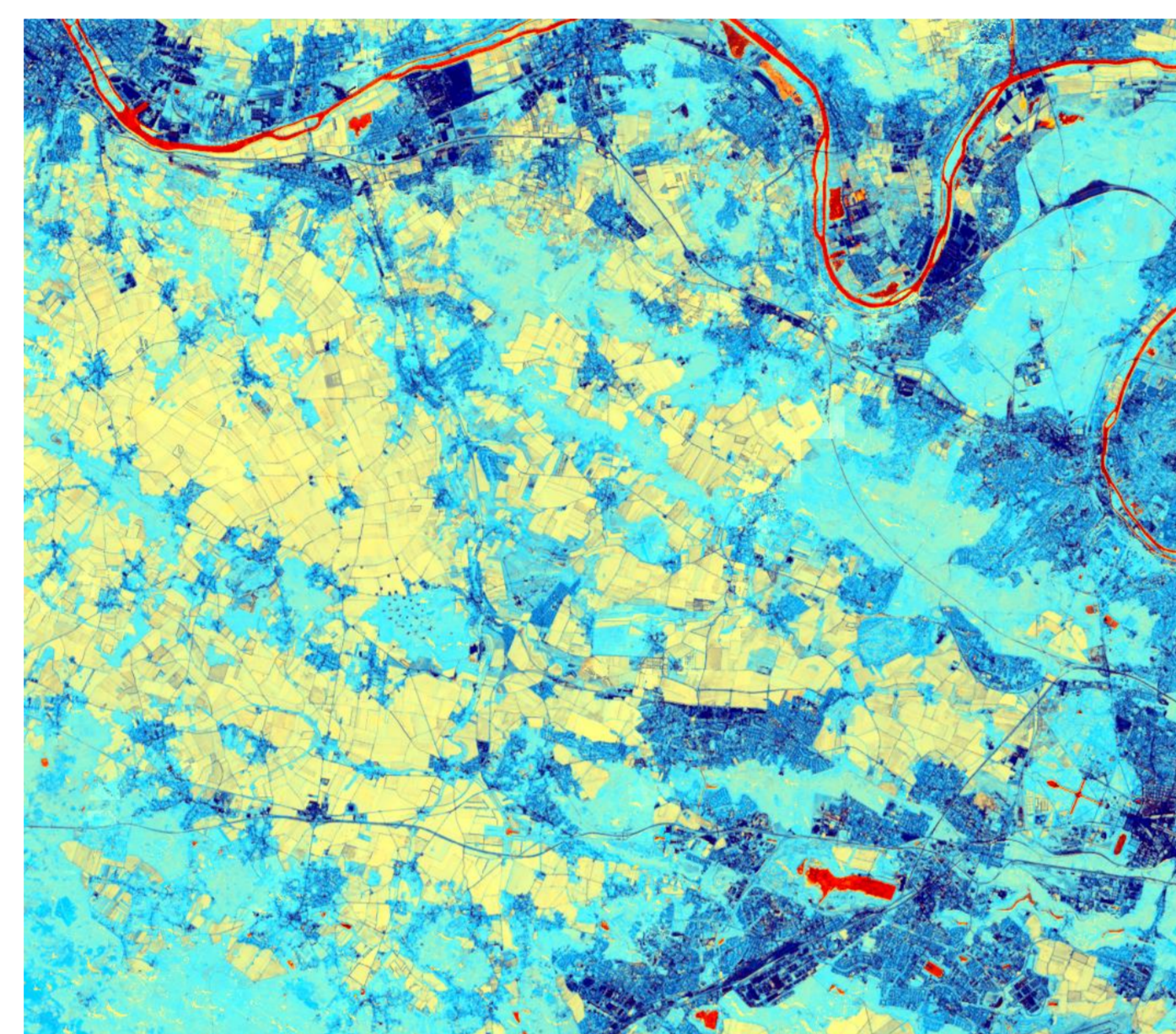


Figure 2 : temporal variability based colour composite image, based on NDVI min, max and amplitude within 3 years. Indicative range : Yellow : [0.2-0.8], Red : [-0.6-0.1], Dark blue : [0.2-0.3], Cyan : [0.6-0.8].

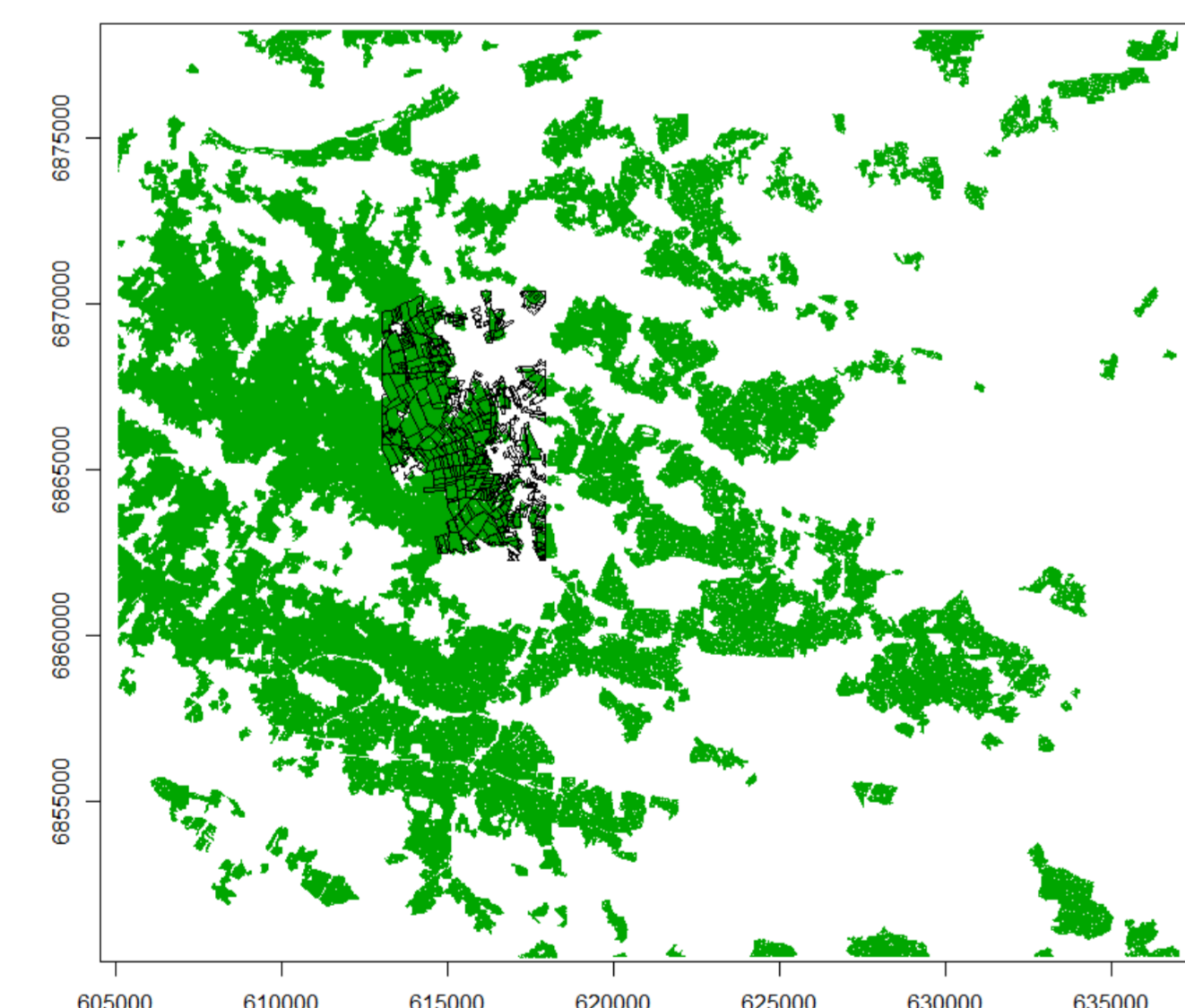
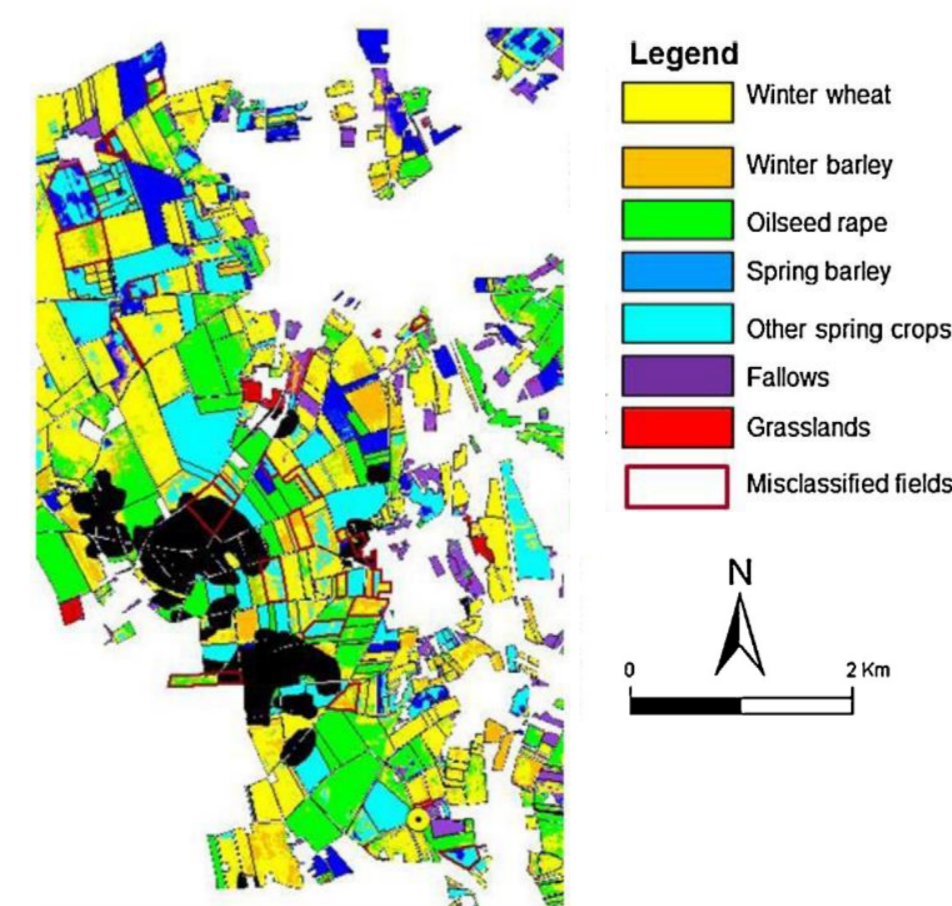


Figure 3 : crop mask, selected as $NDVI_{min} < 0.3$ and $NDVI_{max} > 0.6$. Morphological reconstruction dilatation filter was applied to remove isolated pixels. Vector layer : stands from national land parcel registry subdivided by individual crops based on high resolution imagery (Vaudour et al. 2015).



Typology of NDVI temporal variations in NDVI for agricultural areas.

Constraint : incomplete time series (clouds, aerosols).

Methods for 2013 :

1/ Missing data reduction → Maximum value composite in July 2013 (DOY 191-200), December 2013 (344-360), September 2014 (251-258).

2/ Kmeans classification on pixels with only valid data (2013_{DOY104}, 2013_{July}, 2013_{DOY248}, 2013_{DOY280}, 2013_{Dec}, 2014_{DOY75}, 2014_{DOY107}, 2014_{DOY139}, 2014_{Sept}, 2014_{DOY315}, 2015_{DOY110}, 2014_{DOY276}). 60 classes → 60 temporal profiles.

2/ Assignment of all pixels (including pixels with missing values) to a temporal profile.

3/ Clustering temporal profiles according to their mutual correlations, and grouping the classified pixels on this basis.

Results :

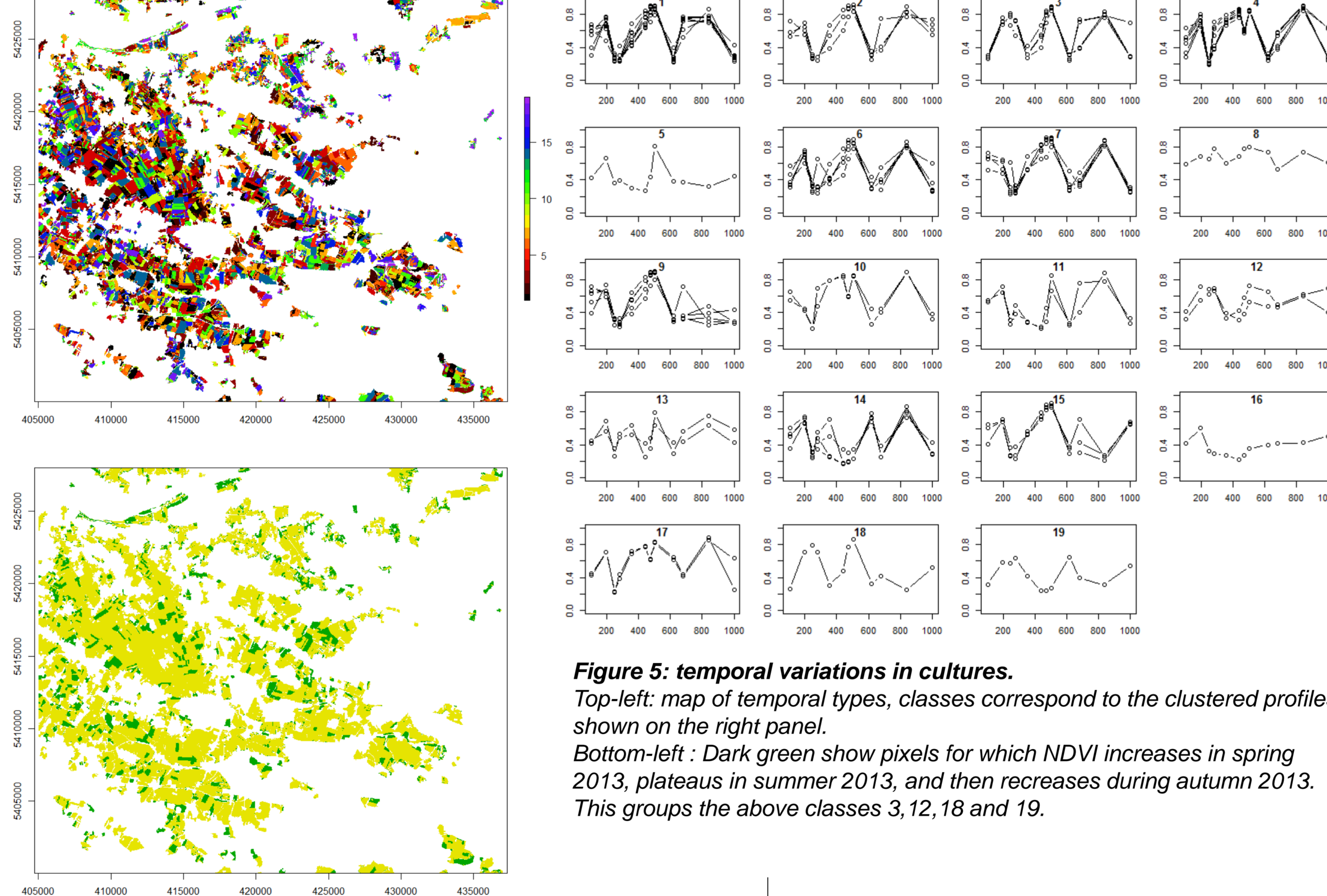


Figure 5 : temporal variations in cultures.

Top-left: map of temporal types, classes correspond to the clustered profiles shown on the right panel.

Bottom-left: Dark green show pixels for which NDVI increases in spring 2013, plateaus in summer 2013, and then decreases during autumn 2013. This groups the above classes 3, 12, 18 and 19.

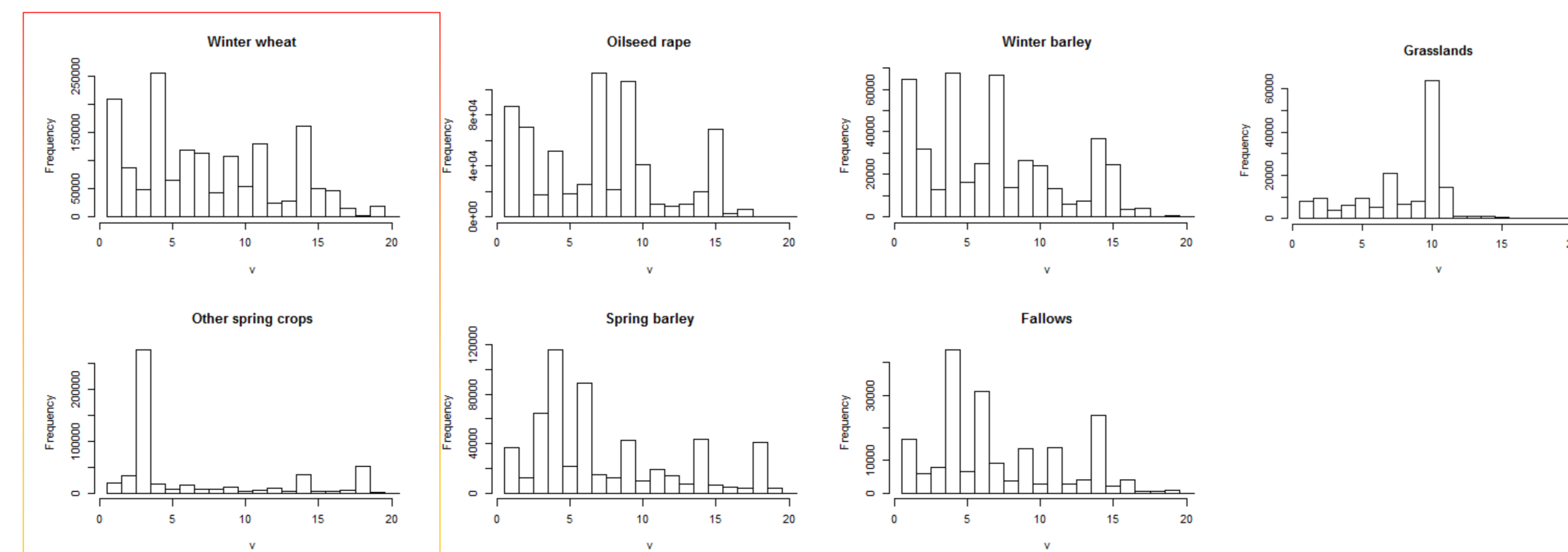


Figure 6 : comparison of the temporal classes (Fig. 5) with classes obtained from multi-spectral classification in April 2013 (Fig. 4)

Conclusion

Pixel aggregation based on NDVI temporal variations across 3 years (cultural cycle of 4 years in the study area).

Some agreement with multipectral classification in spring 2013 : e.g. NDVI variation type 3 matches well to spring cultures.

Some disagreement : e.g. NDVI variation type 4 is not specific to any crop mapped.

Perspective 1 : Densifying time series

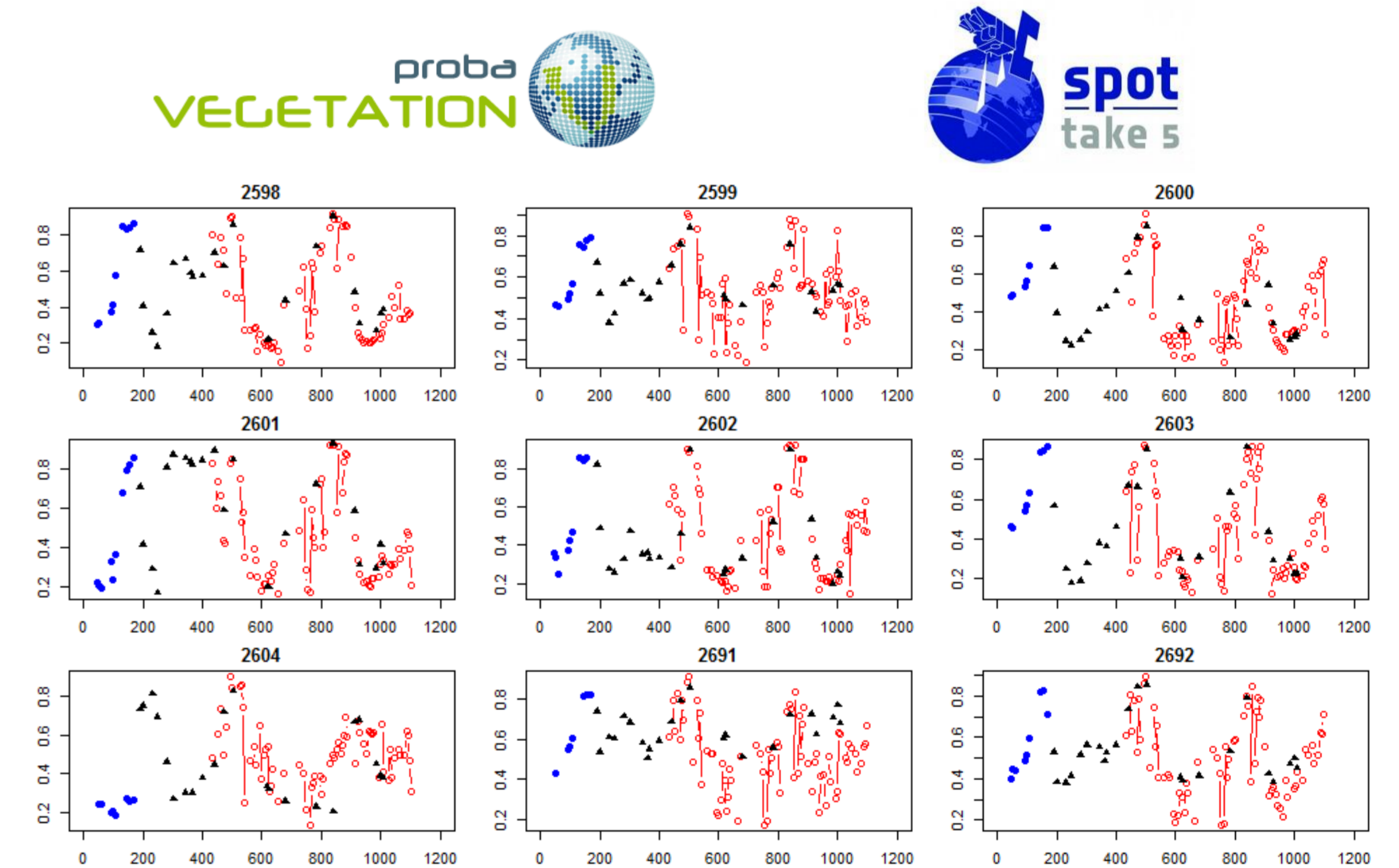


Figure 7 : NDVI temporal variations, stand-wise. Landat, PROBA-V (100m central camera), SPOT4-TAKES. 9 stands from Fig. 3.

Perspective 2 : input to crop models for soil organic carbon modelling



Prostock-Gessol3 project