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

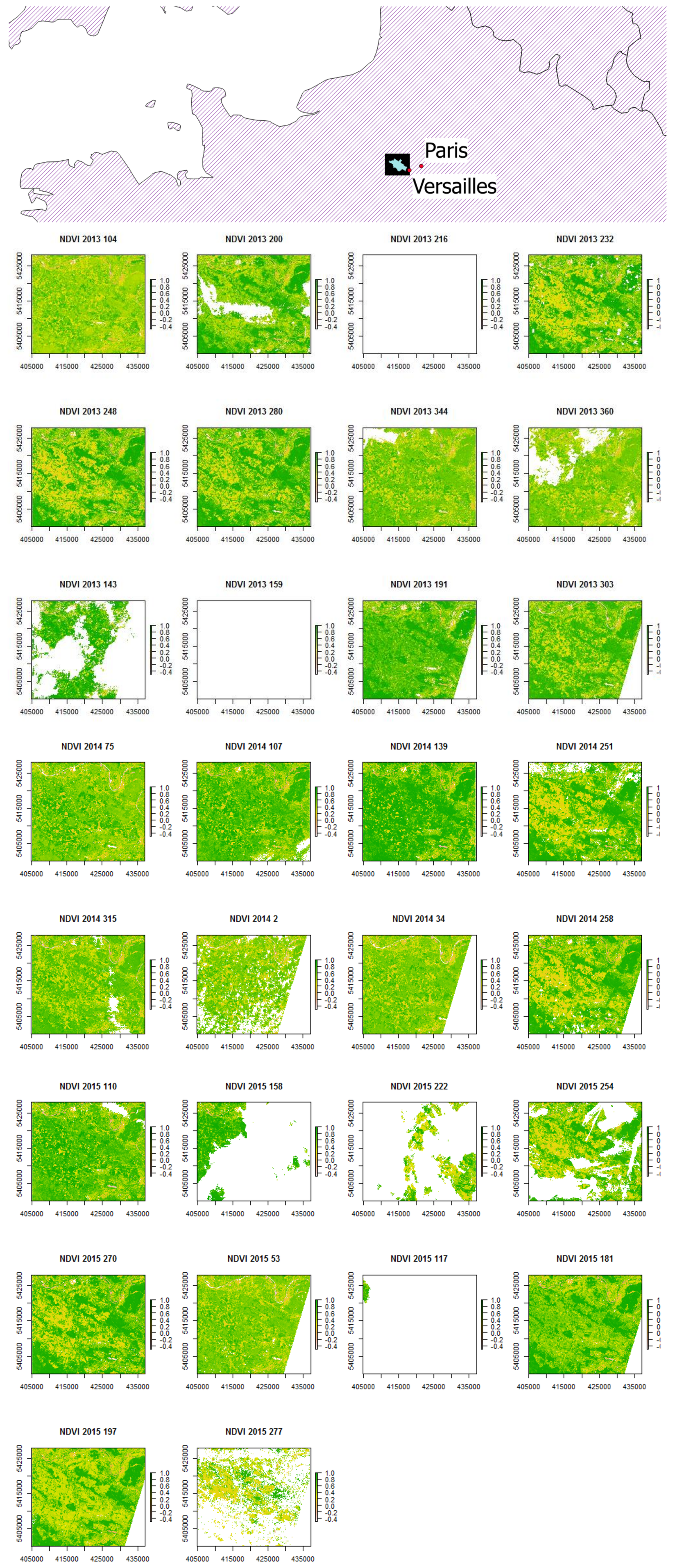


Figure 1 : ***NDVI from Landsat-8 surface reflectance (L8SR)****, subsetted and masked for clouds and strong aerosols loads.*

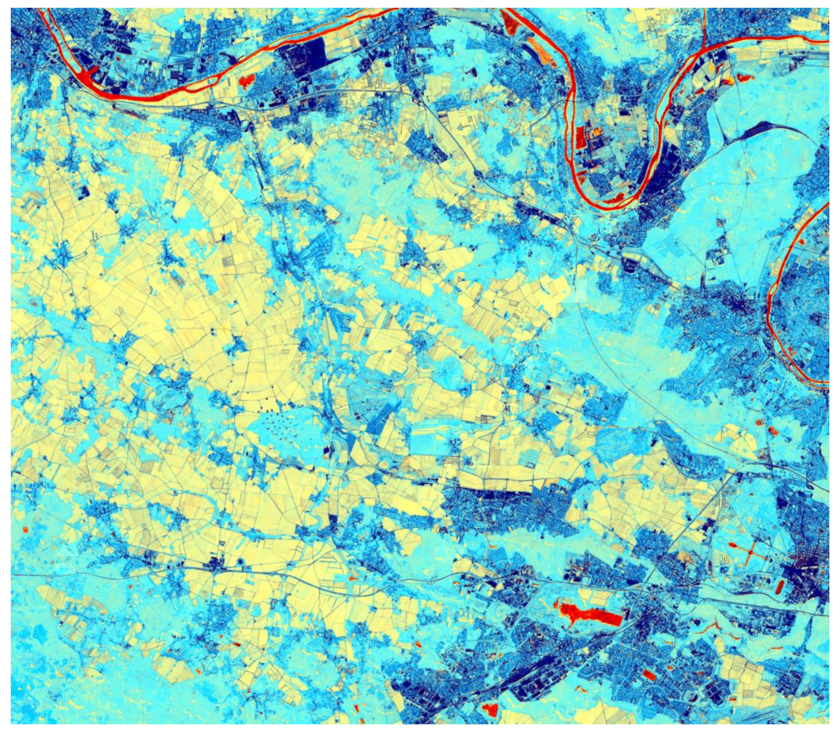


Figure 2 : temporal variability based colour composite image*, based on NDVI min, max and amplitude within 3 years. Indicative range : Yellow : [0.2-0.8]. Red : [-0.6-0.1]. Dark blue : [0.2-0.3]. Cyan : [0.6-0.8].*

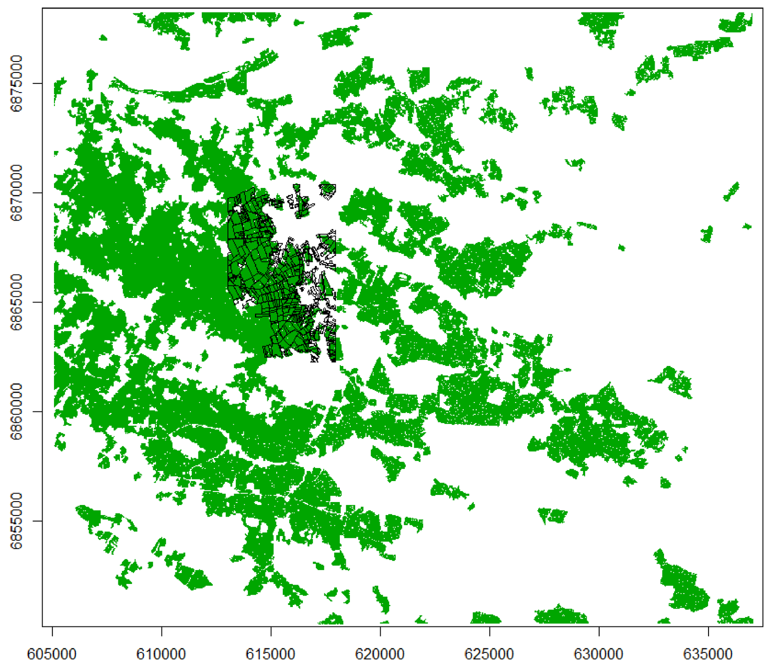


Figure 3 : crop mask*, selected as* $NDVI_{min}<0.3$ *and* $NDVI_{max}>0.6$*. Morphological reconstruction dilatation filter was applied to remove isolated pixels.*
Vector layer : stands from national land parcel registry subdivised by individual crops based on high resolution imagery (Vaudour et al.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

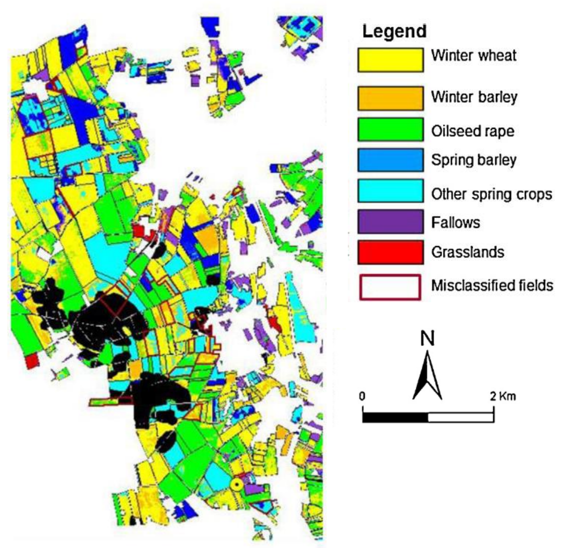
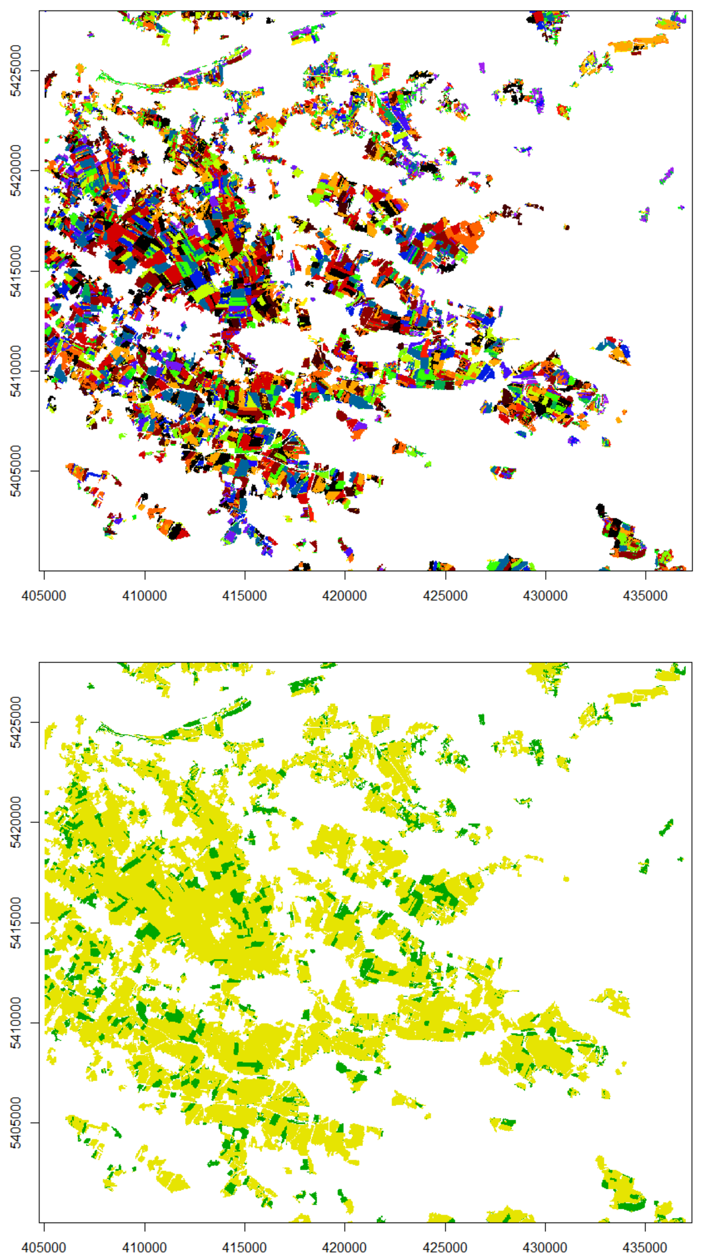


Figure 4 : Comparative dataset, *Vaudour et al. (2015). See area in Fig.3. Crop map obtained from the SVM classifier implemented on the bi-temporal 3 and 24 April 2013 Pléiades images.*

Typology of NDVI temporal variations in NDVI for agricultural areas.

Constraint : incomplete time series (clours, 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_{DOY270}). 60 classes → 60 temporal profiles.
2/ Assignation 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 :



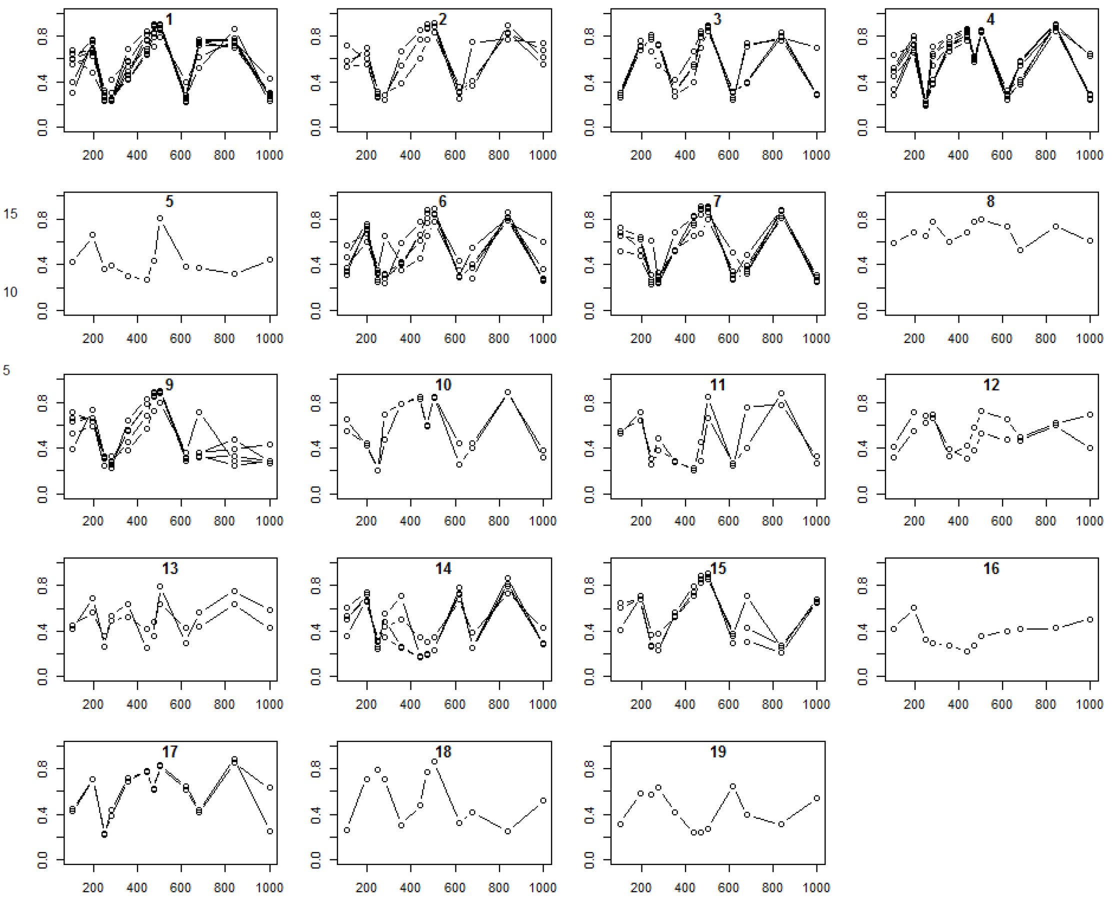


Figure 5: temporal variations in cultures.
Top-left: map of temporal types, classes correspond to the clustered profiles shown on the right panel.
Bottom-left : Dark green show pixels for which NDVI increases in spring 2013, plateaus in summer 2013, and then recreases during autumn 2013. This groups the above classes 3,12,18 and 19.

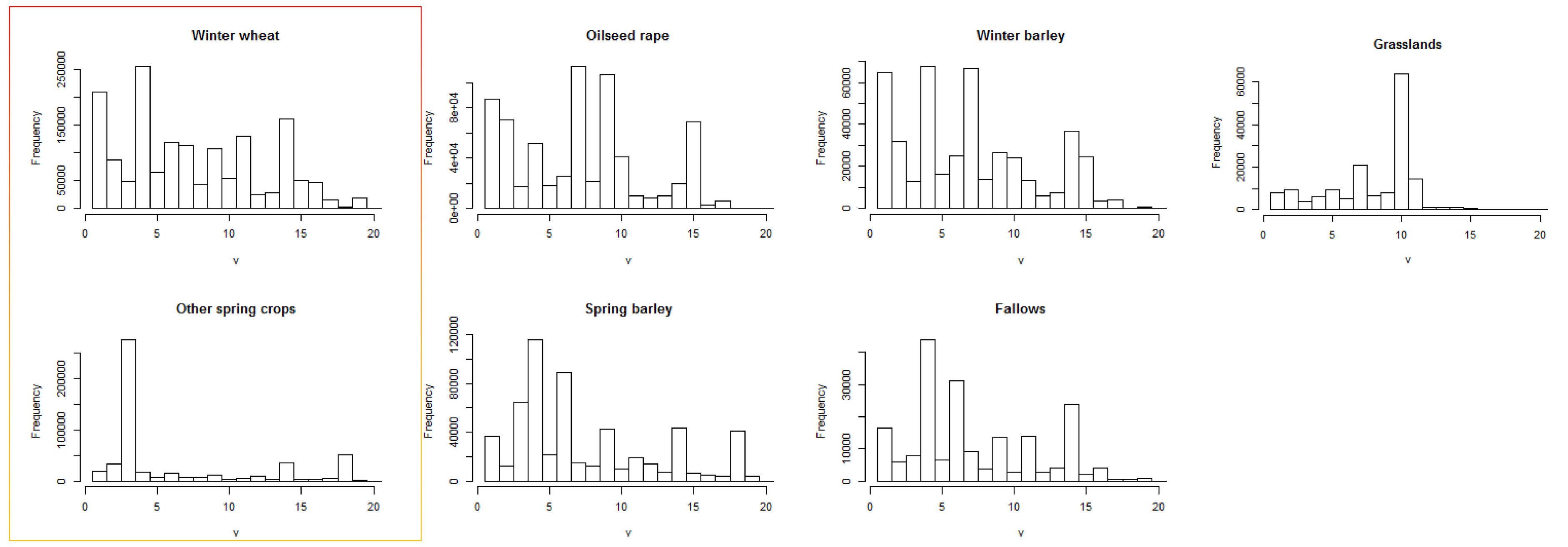


Figure 6 : comparison of the temporal classes (Fig. 5) with classes obtained from multi-spectral classification in April 2013 (Fig. 4)

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

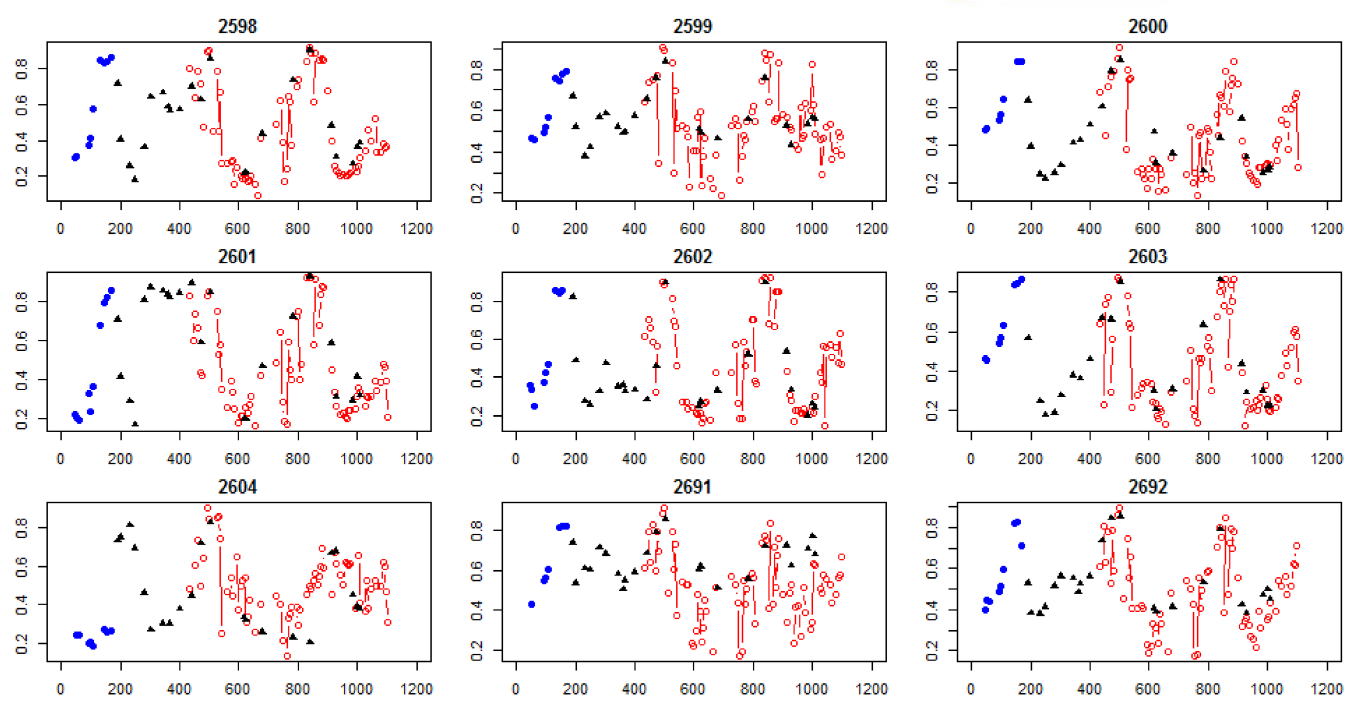


Figure 7: NDVI temporal variations, stand-wise. Landat, PROBA-V (100m central camera), SPOT4-TAKE5*. 9 stands from Fig. 3.*

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

Prostock-Gessol3 project

Vaudour, E., Gilliot, J.M., Bel, L., Lefevre, J., Chehdi, K., (2016a). Regional prediction of soil organic carbon content over temperate croplands using visible near-infrared airborne hyperspectral imagery and synchronous field spectra. International Journal of Applied Earth Observation and Geoinformation, 49, 24-38. DOI: 10.1016/j.jag.2016.01.005
Vaudour, E., Noirot-Cosson, P.E., Membrive, O., (2015). Early-season mapping of crops and cultural operations using very high spatial resolution Pléiades images. International Journal of Applied Earth Observation and Geoinformation, 42, 128-141. DOI:10.1016/j.jag.2015.06.003

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