SOCSENSIT: Spatial dynamics of topsoil Organic Carbon with remote SENSIng for croplands enriched with organic urban wastes over Time

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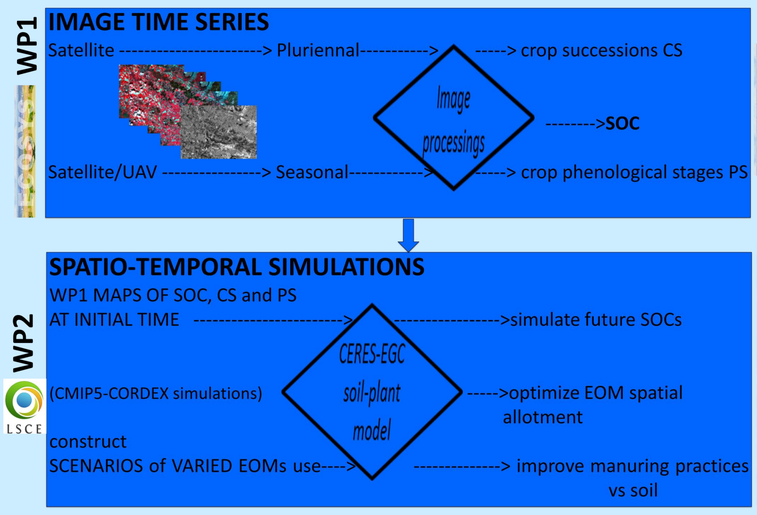
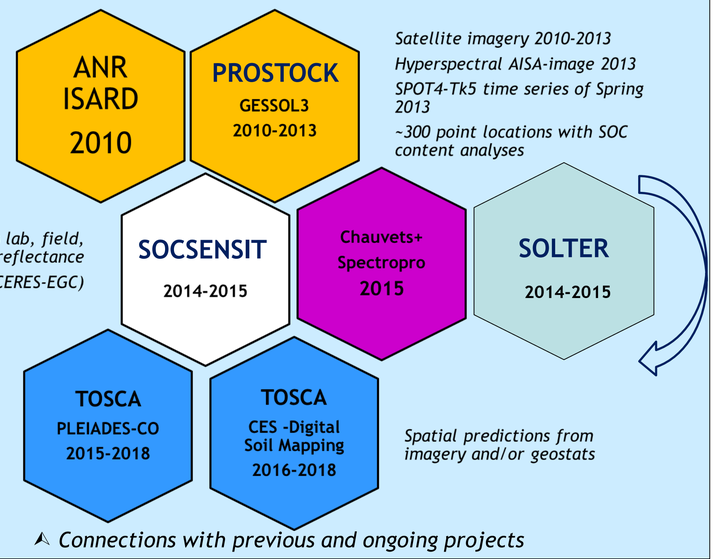
Objectives – structuration



Overall project structuration

Objectives : assess spatio-temporal variability of topsoil organic carbon (SOC), crop successions and phenological parameters in Versailles agricultural plain using high resolution remote sensing time series and develop optimization tools for exogenous organic matter (EOM) land application under present and future climate

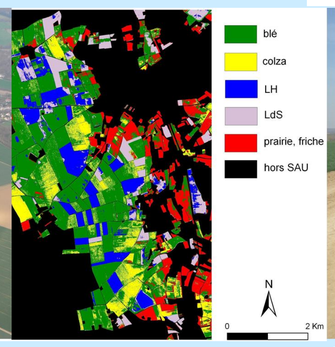
Project start : March 2014
Duration : 24 months
Budget : 17000 €



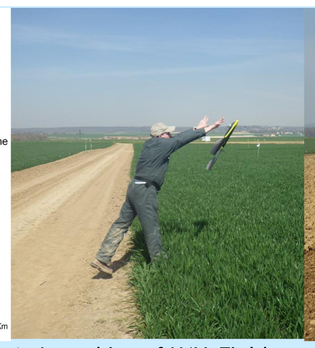
Connections with previous and ongoing projects

Activities during project

Airborne reconnaissance (Vaudour E., 6 april 2015)



Digital processings of Pléiades imagery (Vaudour et al., 2015)



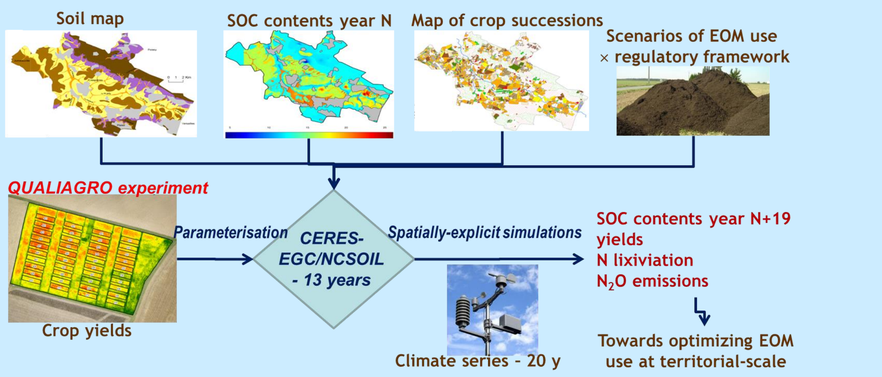
Launching of UAV. Field campaign at the SIC experiment - April 2015

Different types of soil preparation. Field campaign at the SIC experiment - April 2015

Spectral measurements. SIC experiment

GPS positionning. SIC experiment - M2 intership (Chadim, 2015)

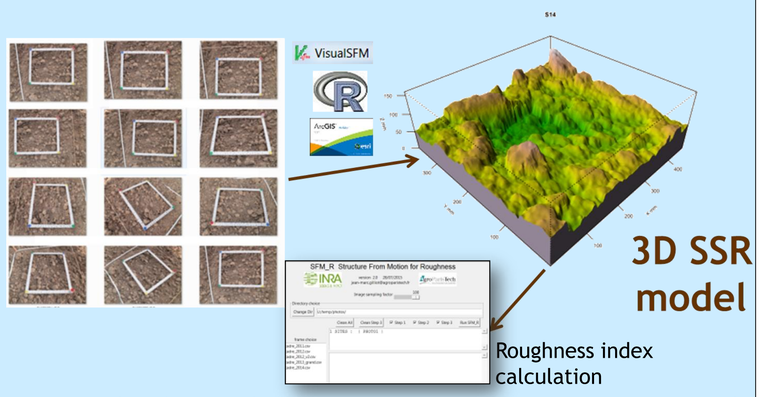
Field campaign jointly with M2 GSSE students - September 2015



General flowchart of the simulation approach for EOM management at territorial-scale (Noirot-Cosson, 2016; Noirot-Cosson et al., 2016, 2017)

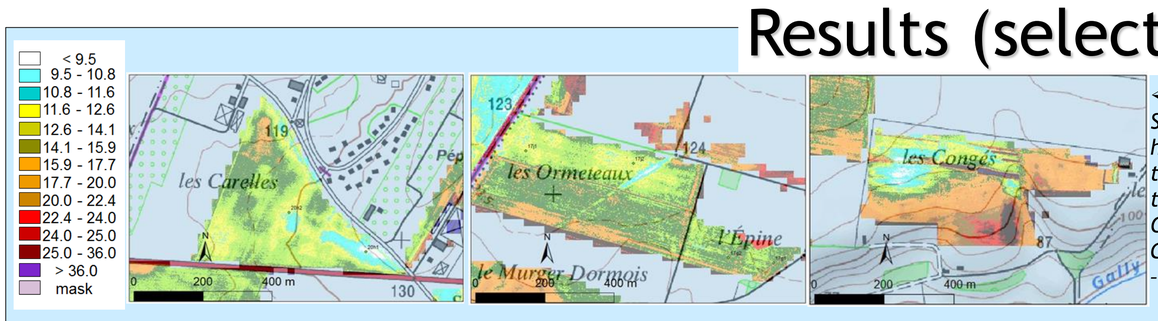
WP1
- 2 field campaigns in 2015
- SOC content prediction (i) from UAV or hyperspectral images (ii) from cokriging plus regression kriging
- Field retrieval of soil roughness
- Mapping of crops and cultural operations using very high spatial resolution Pléiades images
- Mapping of crop phenology using Landsat8 and SPOT4 Tk5

WP2
- Construction of scenarios of EOM use
- Coupling of CERES-EGC outputs and GIS
- 20 y-simulations of EOM use at the scale of Versailles Plain ***(see SOLTER poster)***



SSR: soil surface roughness estimation -a 3D photogrammetric approach based on Visual SFM (Gilliot et al., 2017)

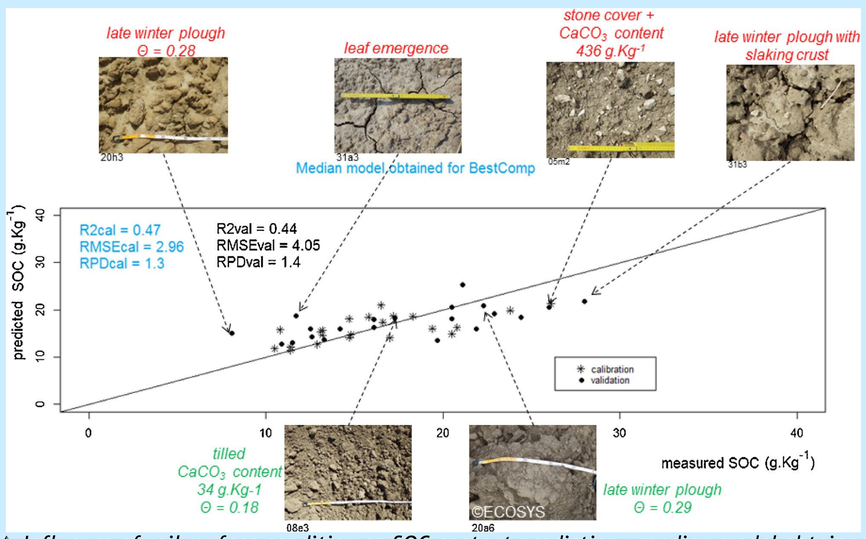
Results (selection)-perspectives



Within-field variations in SOC predicted contents from hyperspectral AISA image. In transparency, 1:25000 topographical map Scan25®, Copyright French Geographical Institute (IGN) - (Vaudour et al., 2016)

MAPPING OF SOC CONTENTS FROM VIS-NIR HYPERSPECTRAL AIRBORNE IMAGE

-74 field samples/spectra (28 synchronous) spread over 221 km²-croplands were used
-Best model = cross-validated PLSR constructed with the synchronous raw spectra
-Regional validation RMSE range of 3.73 - 4.49 g. Kg-1 and ~4 g. Kg-1 in median
-Best model achieved regional 3.73 / within-field 1.44 g. Kg-1 validation RMSEs

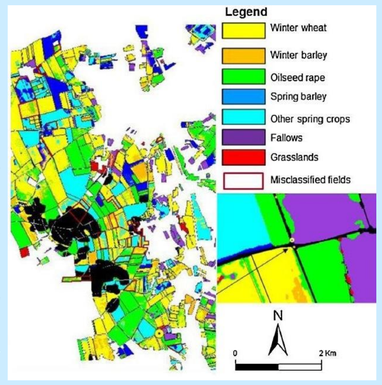


Influence of soil surface condition on SOC content prediction : median model obtained from the bootstrapped-PLSR (Vaudour et al., 2016)

MAPPING OF CROPS AND CULTURAL OPERATIONS

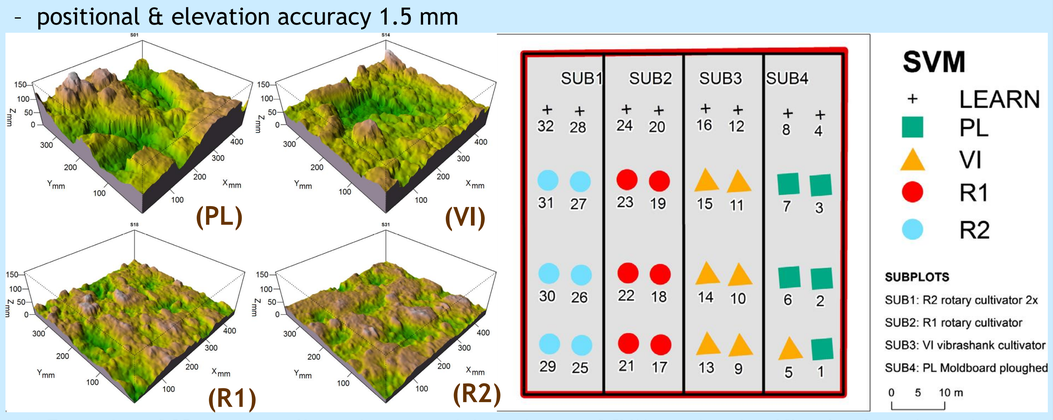
- Cultural operations were well discriminated (class accuracies > 77%)
- Within-field early stage patterns of winter cereals were discriminated
- 89.7% per-field accuracy with all class accuracies > 76% for the simplified crop map

Crop map obtained from a bidate Pléiades dataset- (Vaudour et al., 2015)



RETRIEVAL OF SOIL ROUGHNESS

- positional & elevation accuracy 1.5 mm



Examples of 3D-output soil roughness models and map of SVM results classification into 4 roughness levels using STI and Zm indices (Gilliot et al., 2017)

PERSPECTIVES

-renewed and abundant questions generated: influence of past landuse from retrospective remote sensing? Influence of soil roughness and/or moisture on prediction performance ? Performance of new sensors (Sentinel….), their coupling, and new time series (PROBA-V…) ? Scaling of time series ?
-applicability to other regions (Saclay plateau, Brittany, Alsace, Languedoc…) →PROLEG, GRAINE-PRO (resp. S. Houot, ECOSYS Grignon) and ASSETS (resps. B. Gabrielle/P. Garnier, ECOSYS Grignon)

BENEFITS

-leverage effect: WP1 continuation through ongoing TOSCA projects (SENTINEL_PLEIADES-CO (resp. E. Vaudour, ECOSYS Grignon) and CES Cartographie Numérique des Sols (digital soil mapping) (resp. P. Lagacherie, LISAH Montpellier)
-federating remote sensing community at the level of the LabeX and beyond
-Theia ART across Ile-de-France

Main publications

1) Gilliot, J.M., Vaudour, E., Michelin, J., 2017. Soil surface roughness measurement: a new fully automatic photogrammetric approach applied to agricultural bare fields. Computers&Electronics in Agriculture, 134, 63-78.
2) Noirot-Cosson, P.E., Dhaouadi, K., Etiévant, V., Vaudour, E., Houot, S., 2017. Parameterisation of the NCSOIL model to simulate C and N short-term mineralisation of exogenous organic matter in different soils. Soil Biology & Biochemistry, 14, 128-140.
3) Noirot-Cosson, P.E., Vaudour, E., Gilliot, J.M., Gabrielle, B., Houot, S., 2016. Modelling the long-term effect of urban waste compost applications on carbon and nitrogen dynamics in temperate cropland. Soil Biology & Biochemistry, 94, 138-153.
4) Vaudour, E., Gilliot, J.M., Bel, L., Lefevre, J., Chehdi, K., 2016. 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.
5) 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.