Development of a Spatially Upscaled Soil Spectral Library (SUSSL) of cropland signatures for EO sensors data simulation and impact on topsoil organic carbon prediction models

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ESA WOSOMS: WORLD SOIL MONITORING SYSTEM

- **Main goal:** Development of a global Soil Monitoring System to provide yearly estimations of Soil Organic Carbon (SOC) at global scale

- Approach: Spectral Modelling + Digital Soil Mapping
- Modular implementation, cloud platform
- At least yearly updates
- Spatial resolution 100m globally (50m for Europe)
- Validation over three European regions
- 3 project phases, currently at Feasibility analysis

https://www.world-soils.com/

Funding period: 2020-2023
Consortium: 8 partners

- Feasability study: Assessing the effects of applying laboratory spectral models to the EO scale taking into account the effect of mixed pixels in a realistic landscape

Development of a Spatially Upscale Soil Spectral Library (SUSSL)

- **Simulation of "landscape-like" reflectance spectra based on LUCAS SSL**

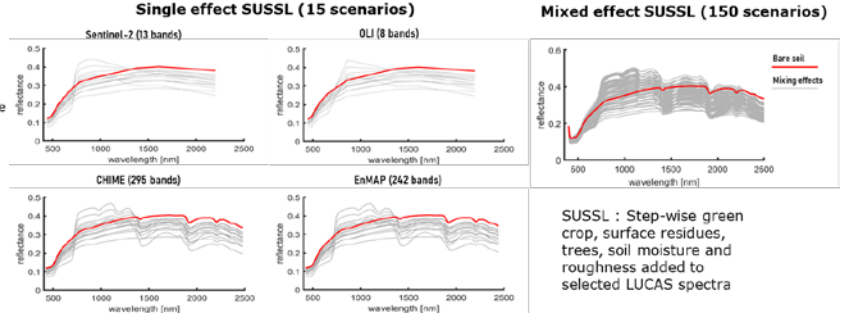
Disturbance effects	Mixing steps	Modelling principle
Early green crops	10, 20, 30	Virtual 3D soil / plant landscape scenarios modeling sampled by Monte-Carlo ray-tracing technique (HySimCaR, Kuester et al. 2014)
Crop dry residues	10, 20, 30	
Forest/Trees	10, 20, 30	Linear mixing with tree spectrum (*pinus ponderosa*) to simulate pixels at agricultural field borders and individual trees within crops
Soil roughness (microtopography)	10, 20, 30	Linear mixing with shadow reflectance using MODTRAN diffuse sky irradiance to simulate shaded soils
Soil moisture	very low, low, medium	Physically based simulation of soil moisture levels using the MARMIT 2.0 model (Bablet et al. 2018)

Generation of spatially upscaled SSL (SUSSL) databases at 1 nm spectral resolution

- Single effect SUSSL (as defined above)
- Mixed effect SUSSL (linear combination of single effects) up to 40% disturbing effects

Convolution to current and upcoming EO sensors

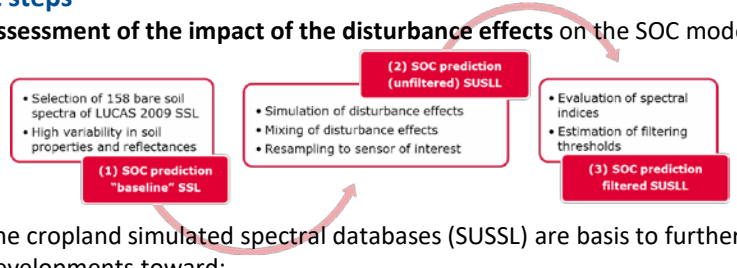
- Convolution to EO sensors spectral response functions
- Application of disaggregation and unmixing techniques



SUSSL : Step-wise green crop, surface residues, trees, soil moisture and roughness added to selected LUCAS spectra

Next steps

- **Assessment of the impact of the disturbance effects** on the SOC modelling



- The cropland simulated spectral databases (SUSSL) are basis to further developments toward:
  - Improved methods for correction/removal of the disturbance effects
  - Improved modeling of topsoil properties from EO data

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