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A multi-dimensional Sentinel-based Soil Monitoring Scheme (S2MoS) for soil clay content estimation

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SSS10.1: Digital soil mapping meets remote sensing for soil monitoring and assessment

e-shape
EuroGEOSS Showcases: Applications Powered by Europe

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OVERARCHING OBJECTIVE

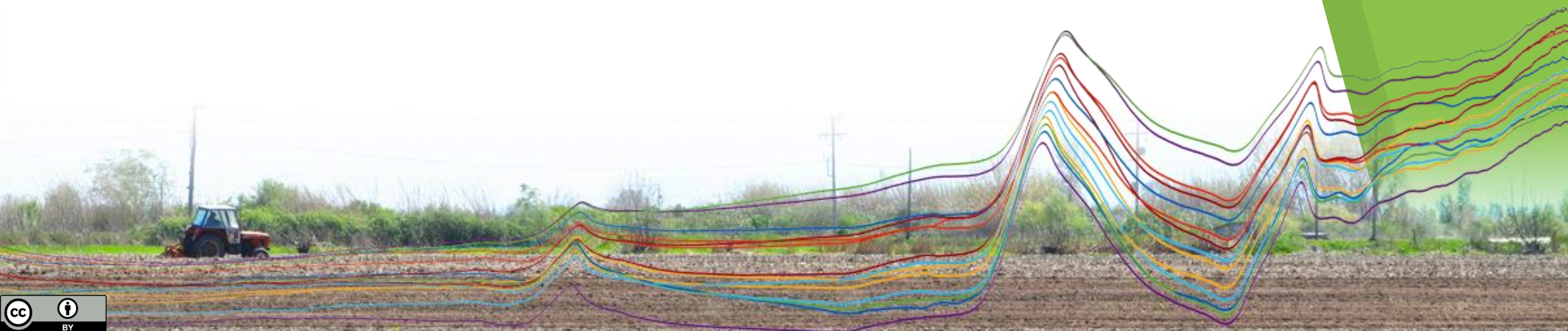
multi-input Sentinel-based Soil Monitoring Scheme (S2MoS)

- open-access EO data
- cloud computing

=> for topsoil monitoring

Key novelties

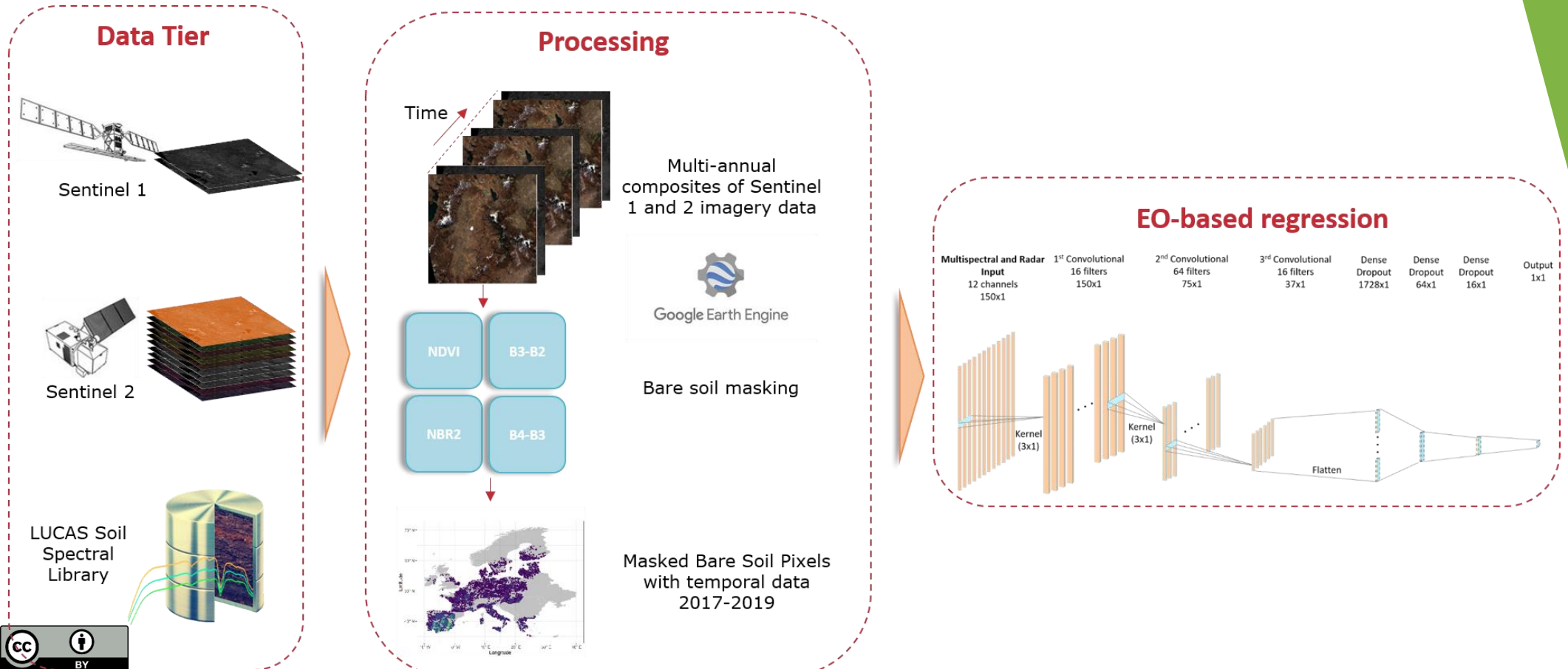
1. Synergistic use of SAR (Sentinel-1) and optical images (Sentinel-2)
2. Multi-temporal analysis (inter- and intra-annual changes)
3. Convolutional Neural Networks (CNNs) to produce fine resolution soil maps



METHODOLOGICAL APPROACH

Data Processing to create multispectral and radar back scattering time – series of masked bare soil pixels

EO-based regression analysis supported by Convolutional Neural Networks



EARTH OBSERVATION DATA AND REFERENCE SOIL DATABASES

- **~ 42,113** surface reflectance images (2017–2019)
- ~ **79605** VV and VH data; H corresponds to horizontal and V to vertical polarization (2017–2019)
- Agricultural soil samples from the **LUCAS 2009** topsoil database — consistent soil spectral library

Google Earth Engine

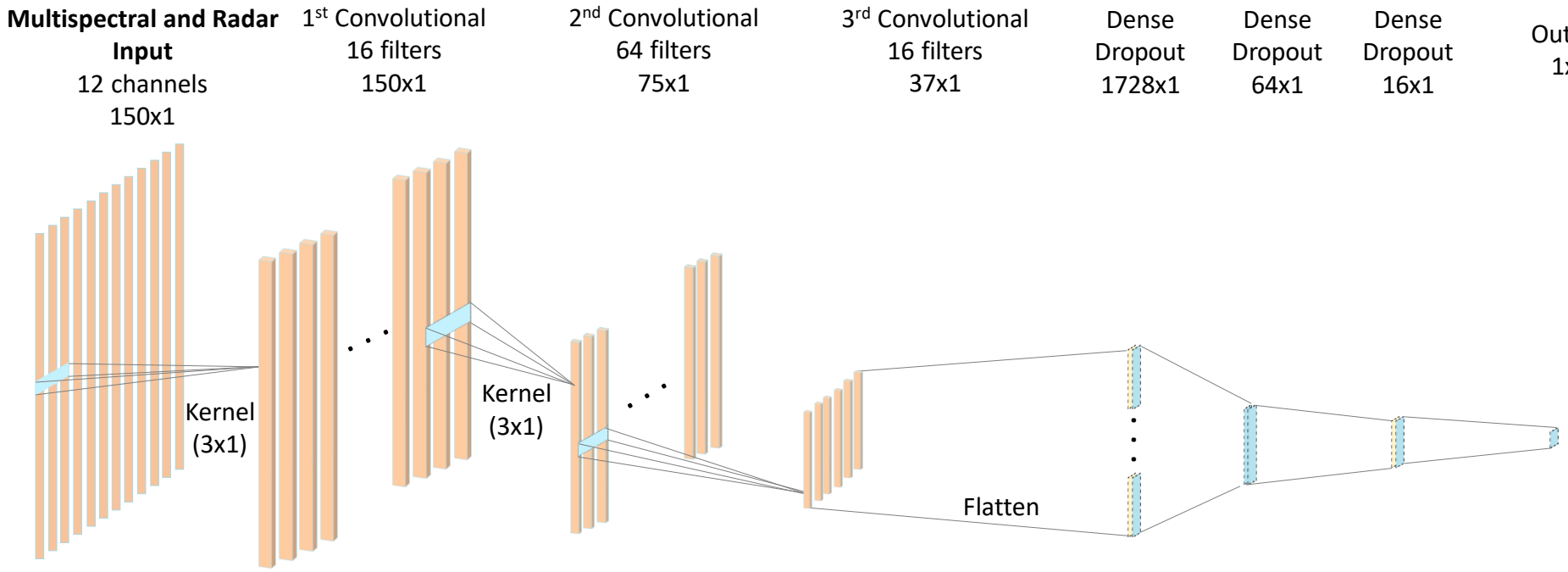
opernicus

EO- BASED REGRESSION WITH CNNS

- Deep learning: **1-Dimension Convolutional Neural Networks** using as predictors ***both*** radar and multispectral imagery data of bare soil pixels

- Evaluate the complementary information of inter- and intra-annual spectral variations in the chemometric modeling

- A combination of various layers to filter a given input and extract information from specific spectral regions

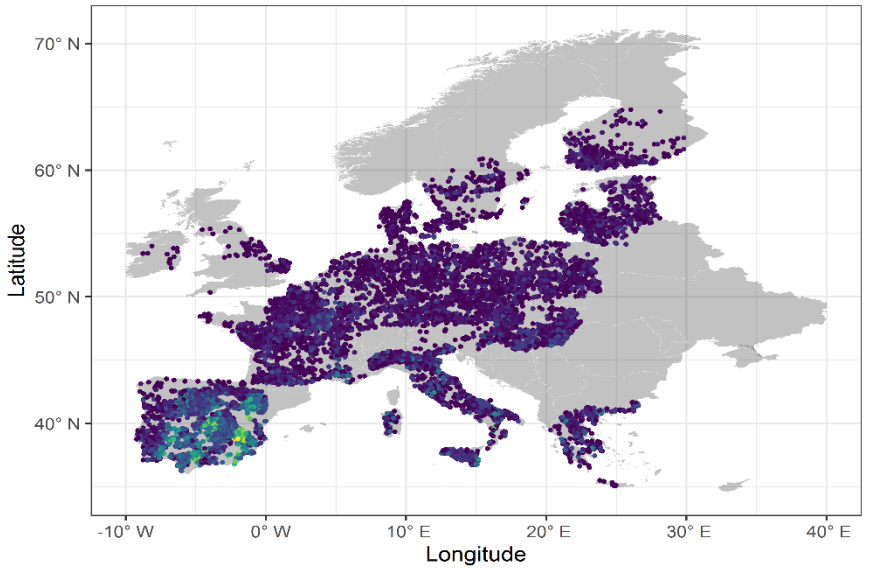


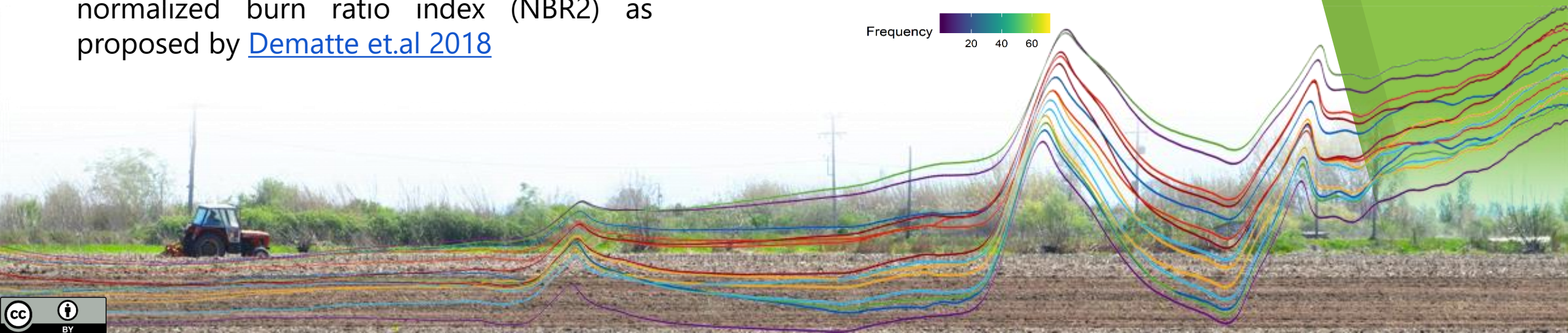
BARE SOIL MASKING RESULTS ON CLOUD

Google Earth Engine provides **a cloud-based contribution to Earth Observation for bare soil masking**

Bare soil masking based on normalized difference vegetation index (NDVI), normalized burn ratio index (NBR2) as proposed by [Dematte et.al 2018]

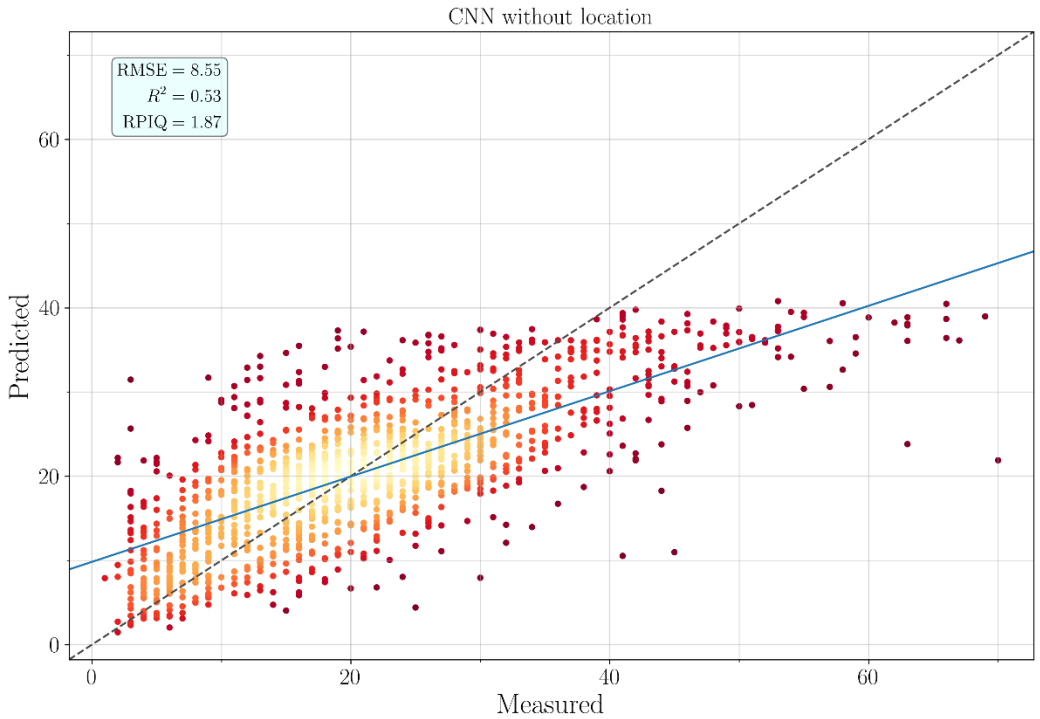
Selected Bare soil pixels for 2019

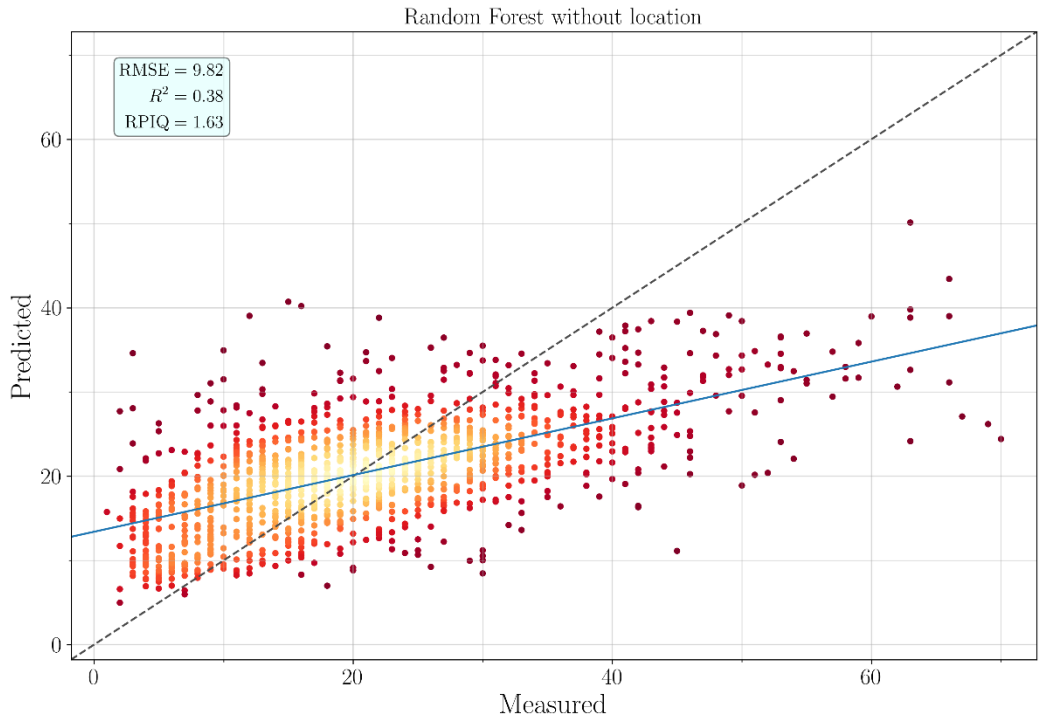




PRELIMINARY RESULTS AND COMPARISON WITH CURRENT STATE OF THE ART

A higher prediction performance (**R2=0.53**) was achieved by the inclusion of both types (SAR and optical) of observations using the convolutional neural network model, demonstrating a significant improvement of in overall accuracy compared to the RF using the multi-year median optical composite

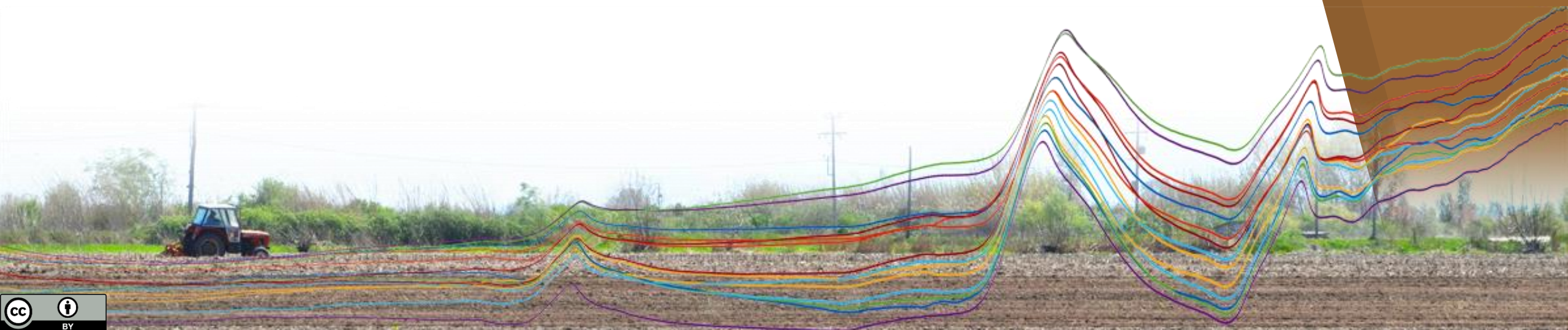




CONCLUSIONS AND FUTURE STEPS

- Evaluate a new a multi-input architecture's potential to **combine effectively** the complimentary information contained in the pool of both **optical and radar spectral** information and those from auxiliary variables (Tziolas et.al. 2020, MDPI)

- Utilize upcoming release of **LUCAS version of 2015** as well as new efforts in Africa and **Latin America** based on agreed set of harmonization principles that will allow us to have better chance of chemical attributes estimation within an intra-annual calibration of models



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