Mapping Soil Properties by Geostatistics/DSM
Benefits of farm scale digital soil mapping

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CONTEXT & CHALLENGES
(Based on literature review)

Most of the world’s soils are only in fair, poor, or very poor condition\(^1\). And their condition is getting worse in far more cases than it is improving especially with the soil erosion, lack of soil nutrients and soil acidity problems. The latest European and national results show that the situation of soils in Spain is also quite critical; Examples include the issue of erosion\(^2\) and soil loss\(^3\)\(^4\) and the low carbon content\(^5\) in Spanish soils, among others. Moreover, providing essential soil information and maps of soil properties is crucial for food security, soil productivity and climate change studies.

\(^1\)Status of the World’s soil resources, Global Soil Partnership, FAO, 2015: [http://www.fao.org/3/a-i5228e.pdf](http://www.fao.org/3/a-i5228e.pdf)

At the same time, in recent decades soil science has experienced rapid development with the introduction of new technologies and the enormous increase in their capabilities to computerize. Moreover, there has always been a demand of tailored soil information to support other areas of knowledge such as ecology, hydrology, regional planning, etc.
OBJECTIVE & HYPOTHESES

Objective(s) / Research question(s)/ Hypotheses

- To improve soil-related layers which are the base for various studies and disciplines such as sustainable land-water-nutrient-watershed-soil-agriculture management by using digital soil mapping techniques (R-K, random forest, PLSR, regression trees, etc.) for food security, mitigate soil threats and achieve better agricultural development.

- Mapping soil ecosystem services and soil biodiversity for the sustainable development and better integrated ecosystem services

- To improve soil nutrient management on farm scale with the precision agriculture (satellite technologies and soil sampling) and digital soil mapping techniques
  - Reduce fertiliser and/or lime expenditure
  - Improve yield where nutrients or acidity are limiting factors
  - Provide a nutrient management plan to justify fertiliser usage
  - Reduce environmental impact by eliminating application to areas with high nutrient status.

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METHODOLOGY

Digital Soil Mapping

“Digital soil mapping is an approach to find out relations between known soil data and environmental parameters to produce soil maps, (predicting from the measured points to the continues surfaces)”

- Aggregating the soil input data (putting the different databases into the same order (same projection system, resolution and spatial extent), data quality checks, aggregating the databases);
- Preparing auxiliary variables at pan-European scale (deciding on the variables, putting the variables into the same order, preparing the auxiliary variables (such as slope, aspect, elevation, compound topographic index (CTI), soil moisture, NDVI vegetation index, CORINE land-cover classification, parent material, clay-silt-sand contents, WRB soil classification, geological formations, temperature, precipitation, land productivity, etc.) for the analysis (normalisation, etc.));
- Applying geostatistical technique(s) (deciding on the techniques that will be applied (Regression-Kriging (RK), Partial Least Squares Regression (PLSR), Cubist regression trees (CRT), Random Forests (RF), Quantile Regression Forests (QRF) or Artificial Neural Network (ANN)) and building the model);
- Validation of the map.
REFERENCES

FAO Project with The Soil Fertilizer and Water Resources Central Research Institute of Turkey
National Geospatial Soil Fertility and Soil Organic Carbon Information System (UTF/TUR/057/TUR)

Combining Soil Databases for Topsoil Organic Carbon Mapping in Europe

European Commission-JRC

Project: Ecosystem Services for Rural Development

Development of soil database in Spain for the management of soil ecosystem services for climate change scenarios
EXPECTED RESULTS / IMPACT (INNOVATION)

- Maps of soil properties (OC, pH, EC, Phosphorus (P$_2$O$_5$), pH; lime (CaCO$_3$); cation exchange capacity (CEC); potassium (K$_2$O); field capacity; wilting point; Clay content; sand content; silt content; bulk density) for Mediterranean Countries
- C stocks of the Mediterranean Countries
- Adaptation of regional digital soil mapping for precision agriculture
- Land-use capability map
- Vulnerability map
- Yield maps – realistic yield goals
- Nutrient budget – nutrient management plans
- Threat maps
- Risk assessments
- Land degradation in Med-Countries
PROPOSED PARTNERSHIP

Partner 1:
The ARIMNet2 2016 call covers two topics:
• Topic 1: Promoting sustainable agriculture for socio-economic development. (DSM can be applied)
• Topic 2: Valorising local products through food value chains improvement. (DSM can be applied)

Partner 2:
• This kind of study based on state-of-art methods is also crucial and might be extended for whole Mediterranean countries.
• We have already been working with Med-Countries on marine studies and wetlands (MED-IAMER Project, SWOS and MAES, etc.), so we would like to open another collaboration field (sustainable agriculture and soil) for our team.
• Our aim is developing a partnership to extend this project with Med-partners.
Thank you for your attention!