Spatiotemporal variability of soil-plant relationships in a heterogeneous coastal farmland in Northern Italy

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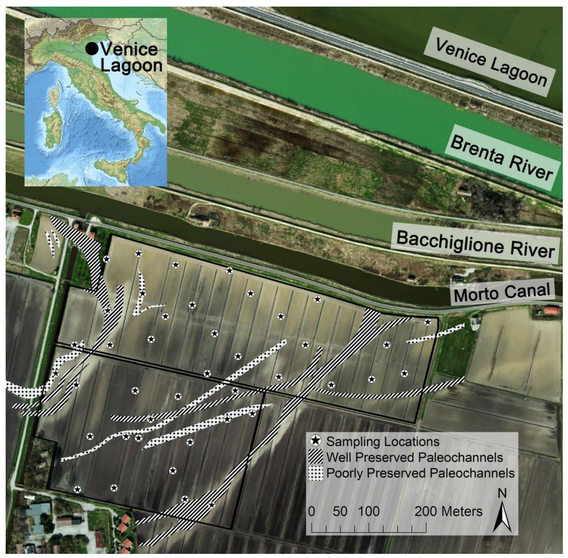
1. Rationale

Coastal farmland in north-eastern Italy is often characterized by high spatial variability of yield within a single field due to contrasting soil types (from silty clay to sand), salt water contamination, and other edaphic factors (e.g., acidic peats).

In this study, remote sensing canopy reflectance and geospatial soil-sensor data are used to understand spatiotemporal variations of plant vigor. This analysis supports the selection of temporally dynamic site-specific management units.

2. Site and Measurements



SITE

Rain-fed maize (*Zea mays* L.) 21-ha field at the southern margin of the Venice Lagoon, Italy.
2010 Rainy year: 539 mm. 2011 Dry year: 200 mm

MEASUREMENTS

-**Soil** properties at 41 locations (0-1.2m)
-**Geospatial sensor measurements**: apparent electrical conductivity (ECa), bare-soil reflectance, micro-elevation
-**Remote sensing canopy reflectance**: WorldView II (once a season, during the pre-tasseling stage)
-Ground-truth **leaf-analyses** (ions, mass, reflectance)
-**Yield** maps

3. Crop and Soil

- Scudiero et al. (2013. http://dx.doi.org/10.1016/j.compag.2013.08.023) showed that yield at the site was a function of salinity, texture, bulk density, soil organic carbon
- EC_a was a proxy for salinity and bulk density
- Bare-soil NDVI was a proxy for clay and soil organic carbon

4. Remote Sensing: Plant vs. Soil

GEOGRAPHICALLY WEIGHTED REGRESSION (GWR)

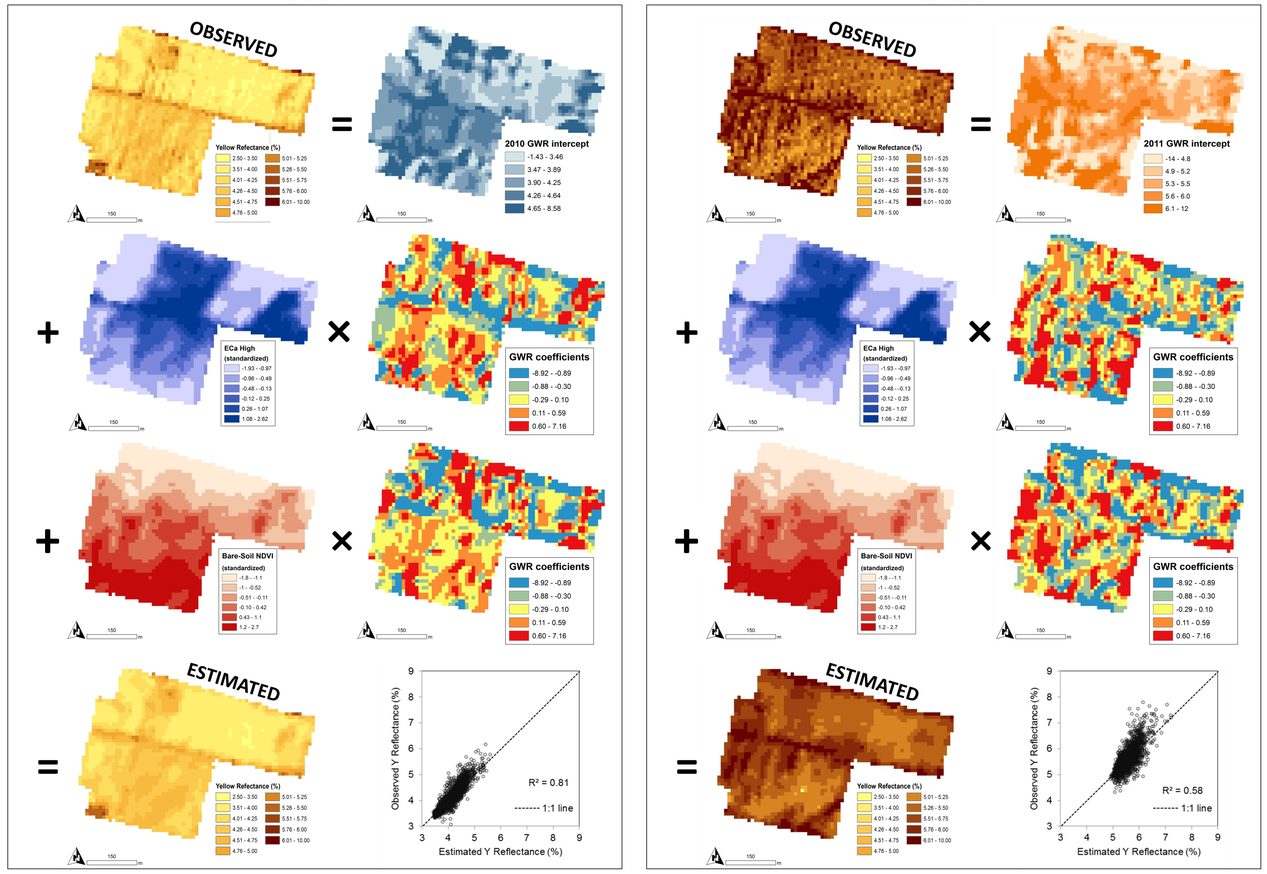
• Local regressions using standardized maps of ECa (0-1.5 m) and bare-soil NDVI as explanatory variables (based on 30 neighbors)

•The slope maps (for ECa and bare-soil NDVI) can be used as an indication on how soil is limited

GWR RESULTS

• Soil properties related to the sensors account for most of the crop variability

Pre-tasseling yellow (Y) reflectance



5. Remarks

- GWR slopes can be used to identify areas of interest, such as:
  - ➢ High Y reflectance (=poor plant performance) influenced by ECa (=high salinity)
  - ➢ High Y reflectance influenced by low ECa (=low water retention capacity)
- Soil sensor data can be used to interpret remote sensing canopy reflectance
- The use of GWR may help delineate **time-specific management zones** (e.g., for precision irrigation) → further investigation is needed

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