Remote sensing monitoring of soil water buffering in Agricultural Terraced Landscapes:
 an application of OPTRAM methodology in Tuscany Region, Italy

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OBJECTIVES

The aim of this work is to test the Optical Trapezoidal Method (OPTRAM) developed by Sadeghi et al. (2017) for the remote sensing monitoring of soil moisture, at high resolution, in a terraced landscape. The objectives of the work are to:

• confirm the hypothesis of a universal parametrization of the OPTRAM methodology,

• test the robustness of the methodology by an uncertainty analysis on the model parameters.

OPTRAM can predict the moisture content in the first 5 cm of soil with an accuracy of 0.04-0.05 cm³ cm⁻³

OPTICAL TRAPEZOIDAL METHOD (OPTRAM)

The OPTRAM methodology is based on the pixel distribution in a scatter plot of two variables, the Normalised Difference Vegetation Index (NDVI) and the SWIR Transformed Reflectance (STR), calculated as:

\[ \text{NDVI} = \frac{\text{PRED} - \text{RED}}{\text{PRED} + \text{RED}} \]

\[ \text{STR} = \left(1 - \frac{\text{SWIR}}{\text{RED}}\right)^2 \]

With PRED, RED and SWIR calculated as the reflectance in red, near infrared and short-wave infrared wavelengths.

The NDVI-STR scatterplot assumes a trapezoidal shape. Pixel that correspond to saturated soil are located on the top edge of the trapezoid (Wet Edge), while pixel correspondent to dry soil are located on the bottom edge (Dry Edge).

Optimally, the scatterplot will show a shape that is consistent with the expected soil moisture content for each soil type. The optimal parameters for the model can be determined by minimizing the difference between the observed and predicted soil moisture values.

RESULTS: OPTRAM PARAMETRIZATION

Study area: (a) location of Greve catchment, (b) location of Lamole within the Greve catchment, (c) overview of the Vineyard 2 and 2.

RESULTS: DIFFERENCE

Area: (a) location of Greve catchment, (b) location of Lamole within the Greve catchment.

RESULTS: SENSITIVITY ANALYSIS

An uncertainty analysis, that has been realised by varying sₚ coefficient between 6 and 18, with 100 successive steps, showing V2 more humid than V1 for all the dry season (July and August) regardless of sₚ value. Only for the image of 26/09/2016 values are almost equal given the high level of soil moisture in Greve catchment.

CONCLUDING REMARKS

The test of OPTRAM methodology confirmed the robustness of the method. The basic hypothesis of an uniform parametrization for any given location, e.g. a river catchment, was confirmed. In addition to this, a sensitivity analysis showed how the direction of the differences in soil moisture, and the magnitude of the difference itself is not heavily affected by the uncertainty in parametrization.

The methodology has been tested for Lamole terraced landscape in Italy, where a terraced vineyard was found to be more humid than a non-terraced one, with a ground resolution of 10 m. Preliminary results suggest that agricultural terraces can retain soil moisture in summer even in temperate Mediterranean climate. However, further analysis is needed to avoid biases given by non-uniform groundwater dynamics between the sites.

REFERENCES


Physical characteristics of the studied vineyards:

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<th>Vineyard</th>
<th>Orientation</th>
<th>Area [ha]</th>
<th>Slope [m/m]</th>
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