Monitoring crop status dynamic with PRISMA imagery: vegetation traits estimation and crop residues quantification.

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In the coming years, additional hyperspectral missions, such as the Copernicus CHIME, will increment operationally the data stream already provided by the ASI PRISMA and DLR EnMap missions. This will enable new research possibilities within the “agriculture and food security” domain. In the agri-food sector, hyperspectral data, characterised by narrow bands covering the full range from VIS to SWIR, can provide a unique contribution to better i) estimate within-season crop traits and ii) quantity crop residue presence after harvesting. The retrieval of within-season crop traits allows early warning indications of potential stress, supports smart agriculture practices within a Precision Farming framework, and improves yield estimates. The identification and quantification of Non-Photosynthetic Vegetation (NPV) are fundamental to track sustainable agro-practices for soil conservation (e.g. minimum tillage) and to provide information for the carbon budget in agriculture. In this framework the ASI-PRISMASCIENZA project “PRIS4VEG” exploited a comprehensive multiyear PRISMA dataset (2020 - 2023) together with field bio-parameter measurements and ancillary farm data (e.g., crop sequence and agro-practices) acquired in Jolanda di Savoia site (North of Italy).

A hybrid approach, fine-tuned with an active learning procedure (HAL), was successfully tested on PRISMA hyperspectral data to estimate crop traits, such as leaf area index (LAI), chlorophyll and nitrogen content at both leaf (LCC, LNC) and canopy (CCC, CNC) levels. A machine learning regression algorithm (MLRA), based on enhanced hyperspectral input identified by spectroscopic modelling of diagnostic NPV cellulose-lignin specific absorption features, was used to assess the presence and cover of crop residues. The MLRA was trained using an extensive and well-documented spectral library and tested on independent ground, airborne and spaceborne (i.e., PRISMA) data. PRISMA maps provided interesting spatio-temporal patterns related to Genetics-Environment-Management interactions, demonstrating the contribution of hyperspectral data in generating spatially explicit information for the agro-monitoring sector.