# Cross-RI dataset provision of UAV multi platform hyperspectral data and site level measurements over different RI ecosystem sites (eLTER, ICOS, ANAEE) and comparison with satellite products.

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This work proposes frameworks to improve vegetation monitoring using airborne and satellite remote sensing imagery. Remote sensing enables rapid, georeferenced assessments of crops and ecosystems based on the spectral properties of canopy components. However, traditional approaches, such as vegetation indices rely on empirical methods that use few spectral bands, limiting their ability to estimate plant traits. Additionally, image interpretation is affected by sensor-specific factors (e.g., spatial/spectral resolution), acquisition geometry, and atmospheric conditions. Coarse-spatial resolution can result in mixed spectral signatures, particularly in heterogeneous landscapes. Our approach addresses these limitations through physically based processing strategies.

This study presents a hybrid approach for crops and forests monitoring integrating canopy reflectance spectra simulated with radiative transfer models, like PROSAIL with remote sensing images using machine learning. This method enables estimation of plant traits, such as chlorophyll content, Leaf area index or water content, considering all bands and minimizing external factors. This study also presents the integration of airborne images for unmixing spectral signatures in coarse-spatial resolution satellite images using multiple endmember spectral mixture analysis (MESMA).

The hybrid model showed accurate results in agricultural scenarios, including i) identification of nitrogen (N) treatments and early N status estimation, ii) distinguish between traditional and intensive olive orchard management practices with satellite time series, and iii) detecting periodical cuttings of alfalfa forage production to maximize yield and quality. The model also displayed good results in forest ecosystems by i) estimating Gross Primary Productivity in European forest types combining plant traits and by ii) early detection of a fungus outbreak in a pine forest. The use of a spectral library obtained with high-resolution aerial images allowed unmixing spectral signatures in PRISMA satellite products for urban and rural landscape planning. Overall, this work refines and validates remote sensing modelling techniques to enhance decision-making in vegetation management and territorial planning.

**Keywords: Remote sensing, Radiative transfer models, Multiple endmember spectral mixture analysis.**