Objectives of the project

The objectives of the HYPOS project are to:

1. Assess the accuracy of the biophysical parameters using full hyperspectral information or reduced hyperspectral information.
2. Assess the potential of the red edge spectral bands to estimate the two vegetation biophysical variables, leaf area index (LAI) and leaf or canopy chlorophyll content.
3. To achieve this goal, the project has been split in four main tasks:
   1) Build a database containing hyperspectral data and biophysical parameters.
   2) Develop and evaluate methods for hyperspectral data reduction.
   3) Develop, test and compare retrieval algorithms making use of reduced hyperspectral information (OSA) against retrieval algorithms receiving as input the full hyperspectral wavelength information (WSA).
   4) Provide guidelines and recommendation for future hyperspectral optical missions and in-situ campaigns.

A large database built for the study

The Discrete Anisotropic Radiative Transfer (DART) model provided by CESBIO was used to simulate structurally homogeneous and heterogeneous vegetated landscapes within the spectral domain of 0.4 – 2.5 µm at the spatial resolution of Sentinel-2 and spectral resolution of 1 nm. DART Output are simulated vegetation BRF at various spatial resolution (BOA/TOA) and Spectra.

6 sites:
- Maize field
- Citrus orchard
- Beech forest
- Spruce forest
- Pine Stand
- Floodplain forest

Airborne hyperspectral data
- Acquired during SEN3EXP (2009) ESA campaign over Barrax (Spain)
- Acquired by CzechGlobe over the spruce, beech and Floodplain forests.

Sentinel 2 data

In situ ground measurements

Vegetation parameter selected
- Biochemical quantities
- Biophysical quantities
- Water and moisture
- Stress (water stress, senescing...)

Data Band selection

Validation

A methodology has been developed to assess the performance of the SVR method to estimate the Cab, Carotenoid, water contents and LAI when a full hyperspectral reflectance spectra or a selected number of bands is available.

Selective spectral bands usually correspond to clustered contiguous spectral bands:
- Chlorophyll: 540-560nm, 660-680 nm, 700-725nm, NIR
- Carotenoids: 520-550nm, 660-680 nm, 700-725nm, NIR
- EWT: 1080-1120nm, 1350-1400nm, 2000-2050nm
- LAI: 750-850nm, 1300-1400nm, 1500nm, 1650-1750nm

Software for Data dimension reduction and Vegetation parameter retrieval

In this study, two retrieval chains for some biochemical parameters using a full spectrum as input or a partial spectrum. In both cases, the main algorithm used for the retrieval is a support vector regression. The selection of the best wavelength for the partial spectrum recovery is done through a SFS-Lasso algorithm which follows the recommendations made by the IRSTEA.

The application is run using GUI or command line tools. It is implemented in Python. The GUI is an easy tool to assess the performance and see the results.

Input are ASCII files (LUTs) containing reflectance spectra and associated biochemical parameters. Hyperspectral images can be also imported for the testing.

Output are:
- The SVR model for SFS-Lasso and SVR methods,
- Retrieved parameters for the training and testing Phases.