

A Comparison of Fractional Vegetation Cover in Camarena, Spain from DESIS and EnMAP Observations

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Fractional vegetation cover (FVC) is an important measure for the conservation, restoration and maintenance of biodiverse environments, giving the spatial patterns and distributions of photosynthetically active (PV) and non-photosynthetically active (NPV) vegetation as well as bare soil (BS) in a given region. Using hyperspectral remote sensing observations from DESIS and EnMAP (Environmental Mapping and Analysis Program), we derive FVC for Camarena, Spain, a semi-arid region southwest of Madrid and an important test site for the upcoming Copernicus Hyperspectral Imaging Mission for the Environment (CHIME), and compare the results from both sensors.

DESIS (Alonso et al., 2019, Krutz et al., 2018) and EnMAP (Guanter et al., 2015, Stuffer et al., 2005) are both hyperspectral remote sensing instruments with spatial resolutions of 30 m but they differ in other key aspects. DESIS has a spectral range of 400-1000 nm and a maximum spectral resolution of 2.55 nm whilst EnMAP has a range of 400-2500 nm and a resolution of 6.5-10 nm. The SWIR bands of EnMAP make it far more useful for the derivation of FVC than DESIS due to characteristic absorption features above 1500 nm which help to disentangle NPV and BS spectra. Nevertheless, abundances can still be derived from the FVC processing, accepting that the RMSEs are higher for the DESIS results (13% for PV, 18% for NPV, 9% for BS) than for the EnMAP results (12% for PV, 14% for NPV, 4% for BS) (Marshall et al., 2021).

The FVC processing of the DESIS and EnMAP images consists of three steps. After some pre-processing (band removal and smoothing), pure spectra are retrieved from the image using the spatial-spectral endmember extraction method developed by Rogge et al., 2011. This method creates a global set of endmembers from the image after the masking of pixels which are not vegetation or soil. Secondly, the extracted endmembers are classified with a Logistic Regression (for DESIS) or a Random Forest (for EnMAP) classifier (Paulik, 2018) which were trained from a spectral library containing 631 samples. Three classes are used for the classification: PV, NPV and BS. Unmixing is the final stage which uses a MESMA approach (Bachmann et al., 2009) where each pixel is considered to be a linear combination of one PV spectrum, one NPV spectrum and one BS spectrum from the labelled endmember library. The class abundances are the weights found in the linear unmixing and an extra shade component is considered.

In this work, we will present FVC maps derived from EnMAP and DESIS of Camarena which is a semi-arid region covering approximately 75 km² in the Province of Toledo, Spain, where the land is mainly used for rainfed agriculture. It has an undulating topography with vegetation growing on sloping areas that were either not considered good enough for farming or later abandoned. Since June 2019, 60 cloud free images were acquired by DESIS over the region and EnMAP has so far acquired 8 cloud free images in this area since launch in April 2022. Several EnMAP images in July-August 2022 coincide closely with a DESIS observation which will enable quantifiable comparisons to be made between the two sensors and allow for an evaluation of the results considering the different wavelength ranges of each sensor.

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