Estimating photosynthetic and non-photosynthetic vegetation fractional cover and traits in semi-arid tree-grass ecosystems using field spectroscopy and Sentinel 2 images

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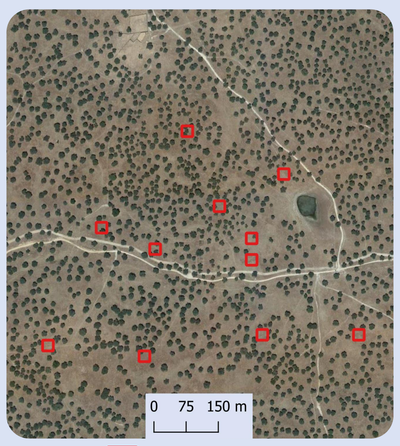
ABSTRACT

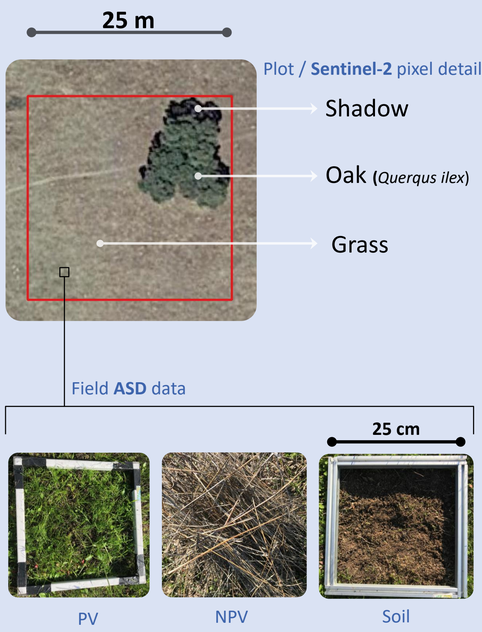
Mixed tree-grass ecosystems are one of the most prevalent forms of terrestrial vegetation across the globe. They provide the basis for livestock production and significantly impact regional and global food quality. However, these ecosystems represent a challenge for remote sensing applications due to the spectral heterogeneity stemming from the multiple landscape features such as grasses, trees and shadows. The aim of this study was to use Sentinel 2 images to estimate PV and NPV fractions in the herbaceous layer of a tree-grass ecosystem and develop empirical models to relate estimated NPV fractions and key vegetation traits, such as Aboveground biomass (AGB) associated to senesced vegetation. This information will allow to analyze the impact of NPV spatio-temporal variability on grassland productivity as standing senescent plants can compete with green vegetation and difficult seed germination

STUDY AREA

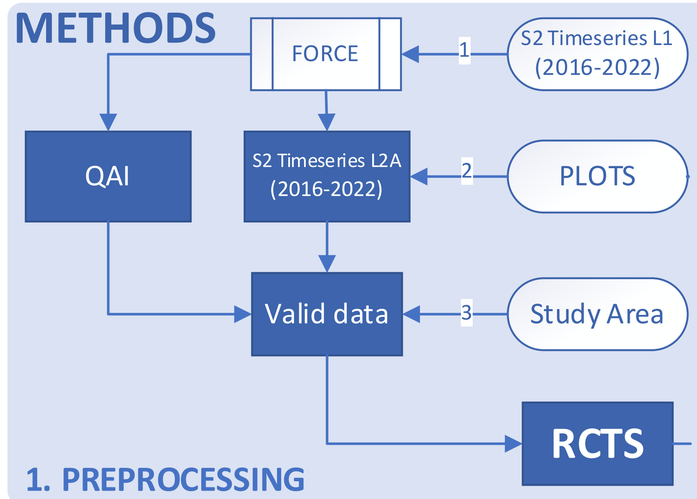
Majadas de Tiétar research station monitors various aspects of the carbon cycle, climate, vegetation, and soil in a Mediterranean tree-grass ecosystem. It is supported by Fundación CEAM, the Spanish National Research Council (CSIC), University of Extremadura, and Max Planck Institute for Biogeochemistry

More information about Majadas de Tiétar research station

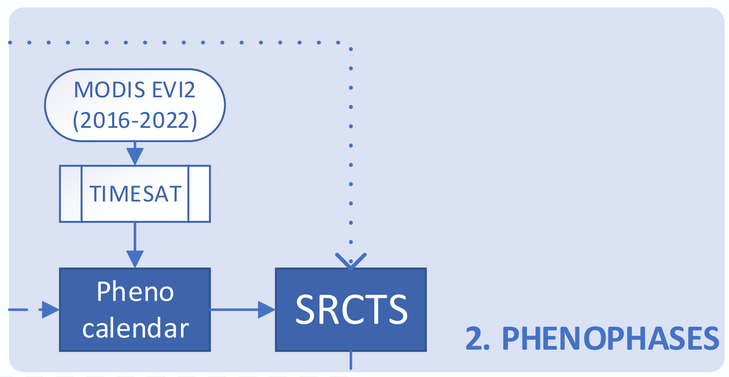


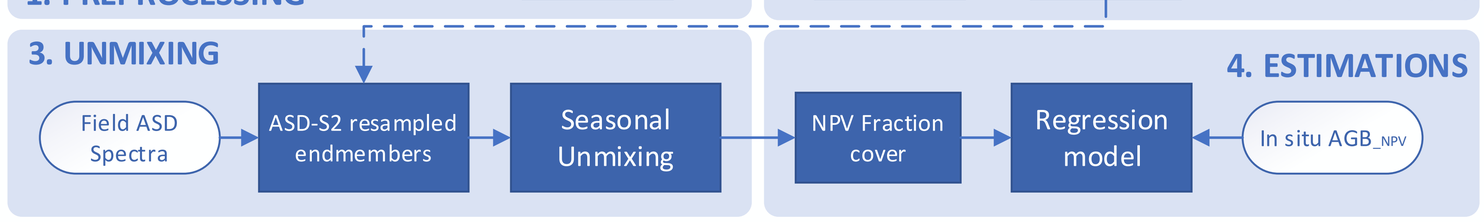


METHODS

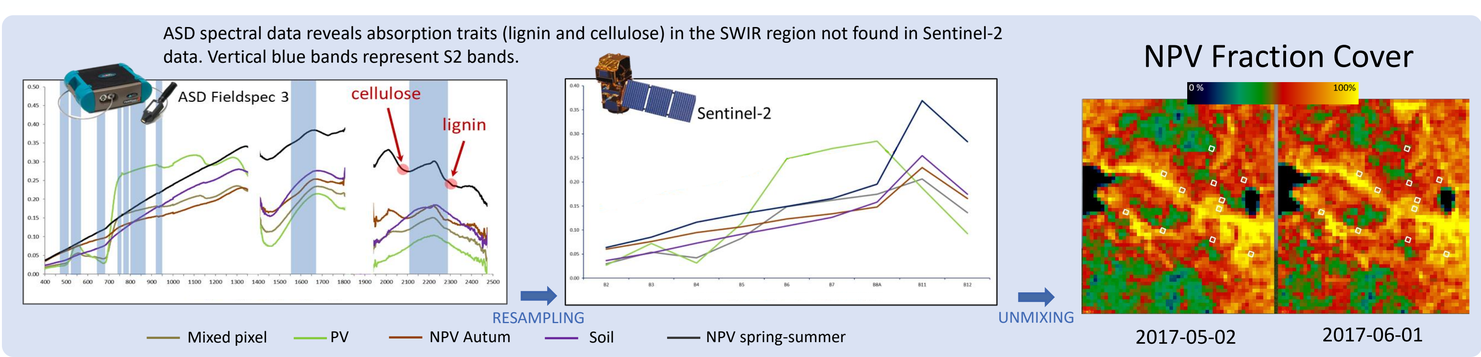


QAI: Quality Assurance Information
RCTS: Radiometrically Corrected Time Series
SRCTS: Seasonal Radiometrically Corrected Time Series





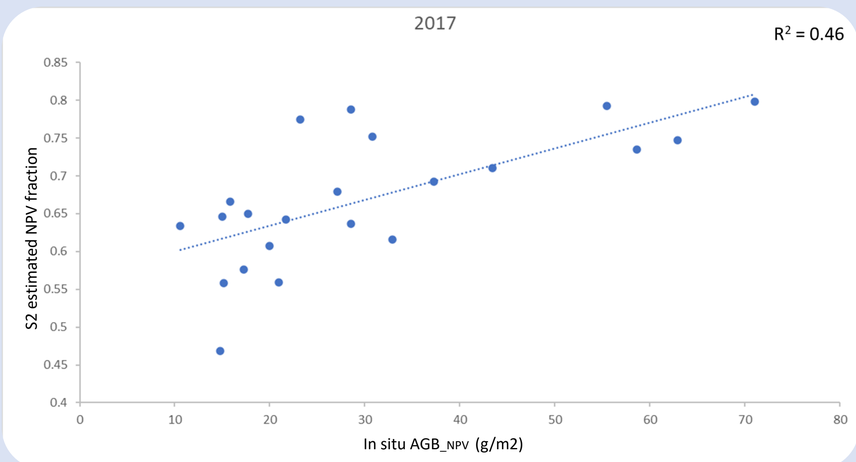
ASD spectral data reveals absorption traits (lignin and cellulose) in the SWIR region not found in Sentinel-2 data. Vertical blue bands represent S2 bands.



RESULTS

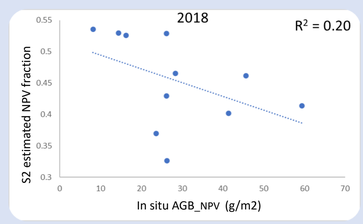
In situ AGB_NPV vs S2 estimated NPV fraction: Grass decay season

Ⓐ Grass Decay – Year 2017



PV and NPV fractions + FLOWERS no bare soil

Ⓑ Grass Decay – Year 2018

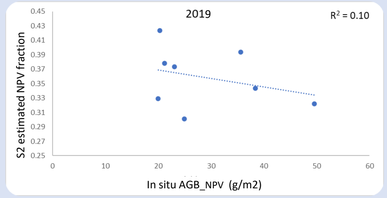


PV and NPV fractions, no bare soil or flowers

2017-05-02

2017-06-01

Ⓒ Grass Decay – Year 2019



- A partially constrained unmixing with a sum-to-unity constraint on the abundance fractions was applied using ENVI 5.7 image analysis software and endmember´s spectral library obtained with an ASD Fieldspec 3 spectroradiometer
- Linear regression was applied to resulting S2 image fractions to relate NPV fraction with in situ AGB_NPV (g/m2) as derived from the senescent vegetation samples.
- Best correlation (R^2=0.46) was achieved during the grass decay season, where a mixture of green and senescent species is usually found in semi-arid grasslands (A).
- **Flowering** caused the **shifting from direct to inverse relationship between in situ AGB_NPV and S2 estimated NPV fraction** , which confirms the need to consider phenology, including flowering, in the development of NPV estimation models in highly dynamic herbaceous covers.

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JAE INTRO

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