Uncovering the hidden: Leveraging sub-pixel spectral diversity to estimate plant diversity from space

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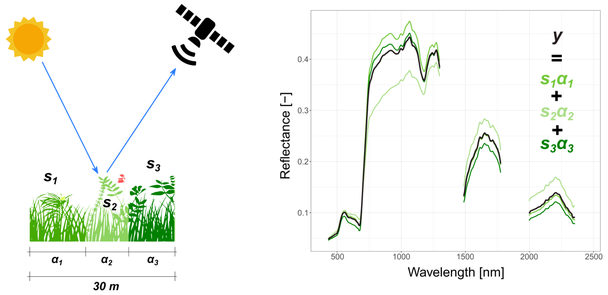
Background:

- Spectral diversity has emerged as a valuable proxy for plant diversity.
- Pixel size of spaceborne data limits the estimation of local plant diversity via spectral diversity in grasslands.

Assumption:

- Spectral signature of a pixel is a linear combination of spectra of unique spectral species present within that pixel (i.e., plant endmembers s_1, s_2, s_3) weighted by their corresponding abundances (α_1, α_2, α_3).



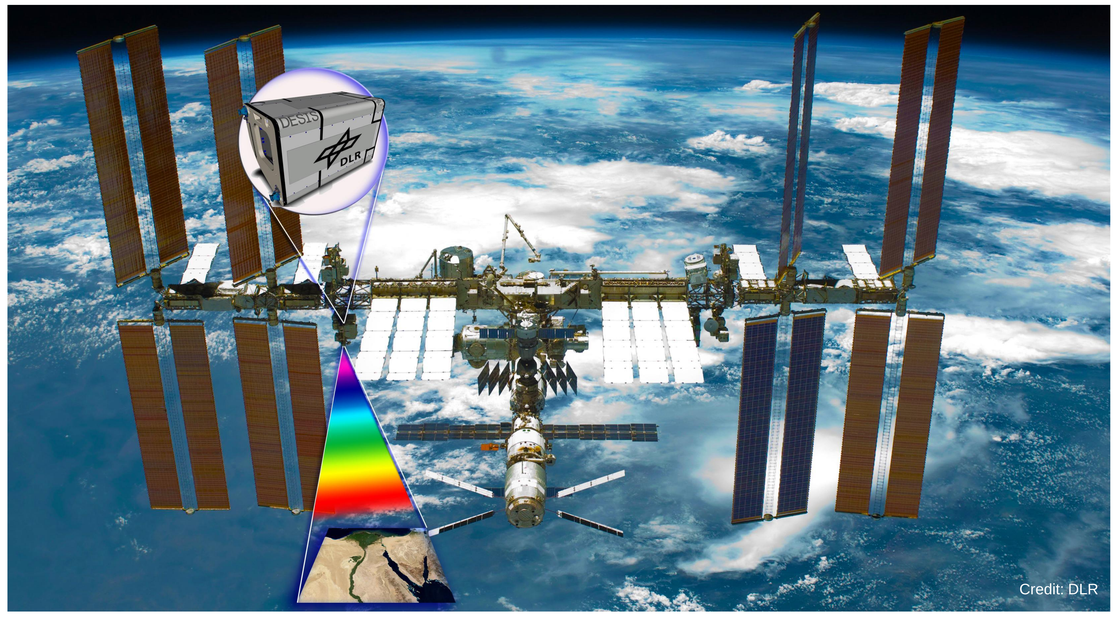
Method:

- Applying spectral unmixing to derive the abundance (α_i) of unique spectral species (s_i).
- Calculating subpixel spectral diversity from s_i and α_i using the spectral species richness and Simpson index.
- Using subpixel spectral diversity as a proxy of plant community diversity.

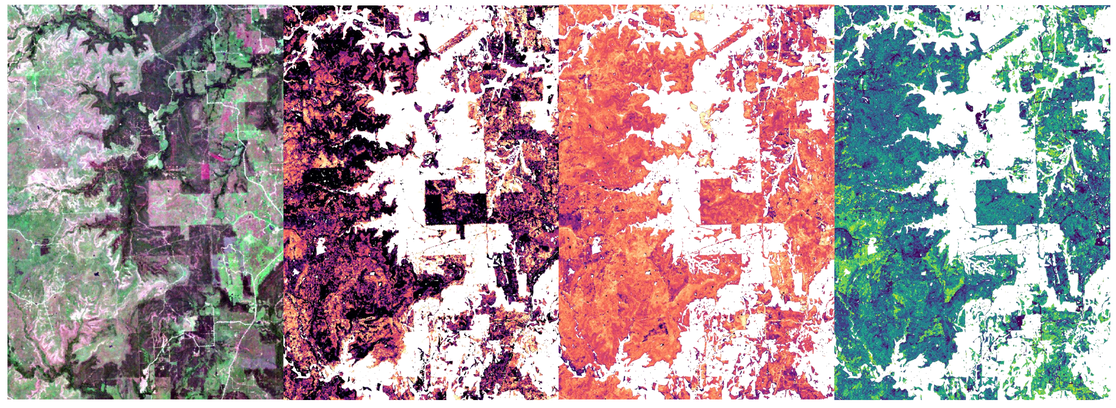
Implications:

- Results obtained from DESIS data have been encouraging, indicating the potential of forthcoming spaceborne imagers to map plant diversity.
- Further developments and tests on different ecosystems and datasets are needed to operationalize the approach.

Capturing **plant diversity** with **spaceborne** imaging spectroscopy



DESIS data at 30m resolution | Spectral endmember abundance | Endmember diversity



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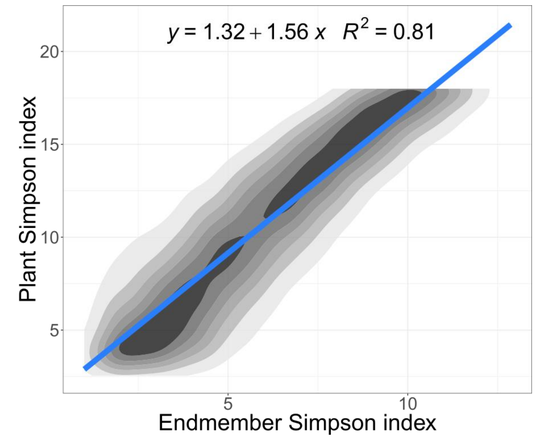
Results from simulated data: 15,000 simulated communities (3-17 prairie grassland species per community and soil; signal-to-noise ratio of 60).



Results from real-world DESIS data: Significant relationship between endmember diversity from DESIS data and *in-situ* measured taxonomic Simpson index and phylogenetic evenness in prairie grasslands. These results are from 100 240 m × 240 m plots and their corresponding spectra at the Joseph H. Williams Tallgrass Prairie Preserve, Oklahoma.