

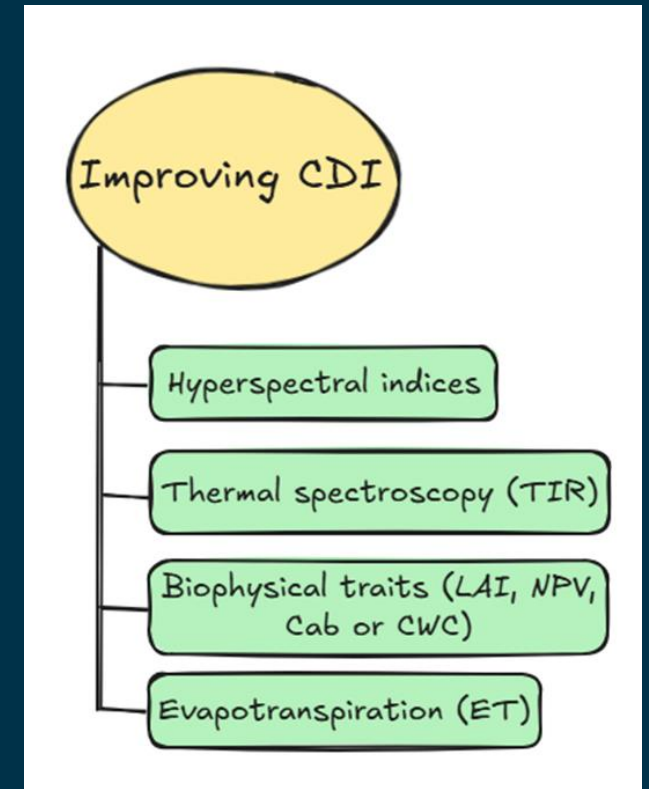
Satellite-based Evapotranspiration Modeling and Hyperspectral Imaging for Regional Indicators of Droughts in Borena, Ethiopia

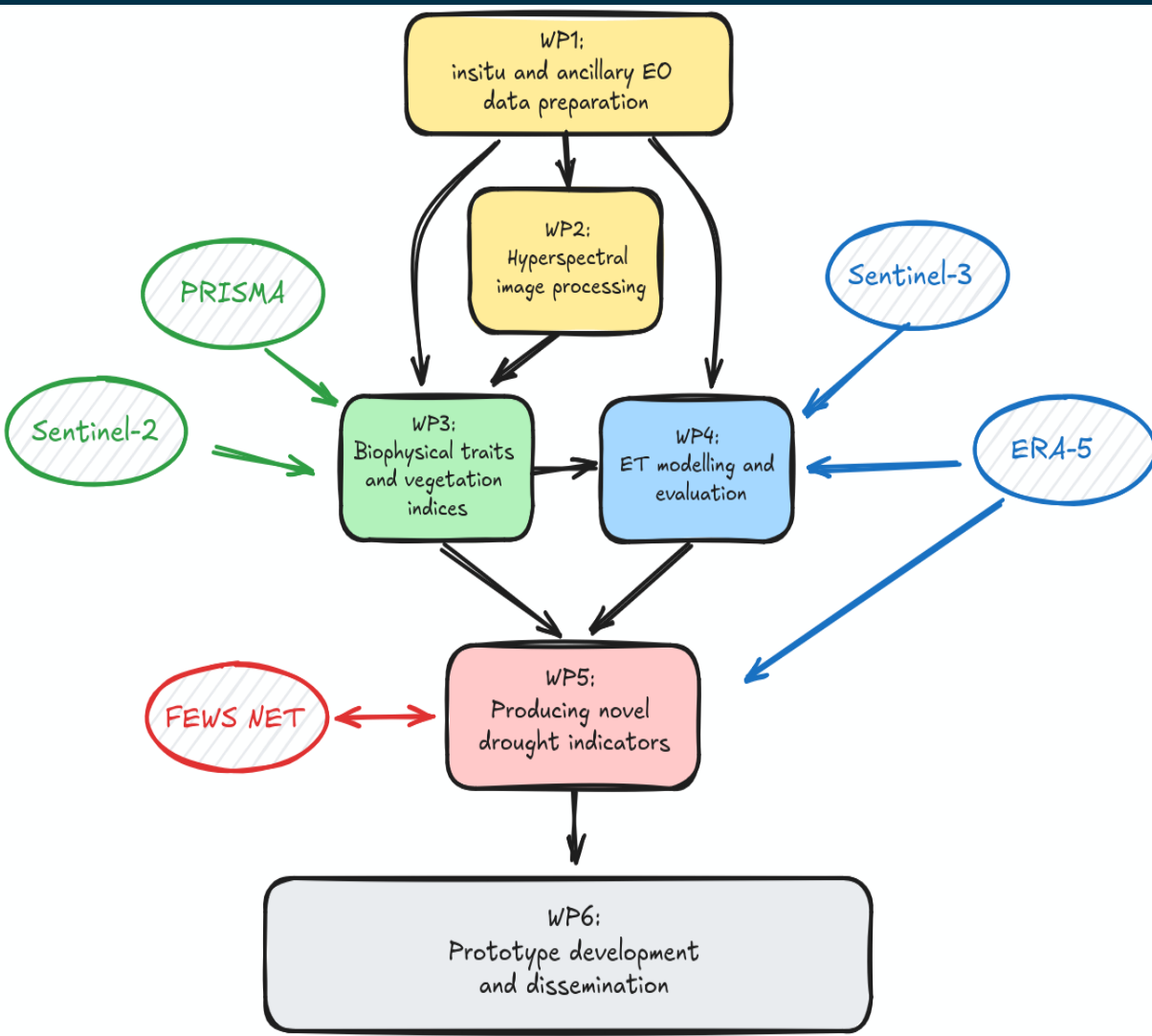


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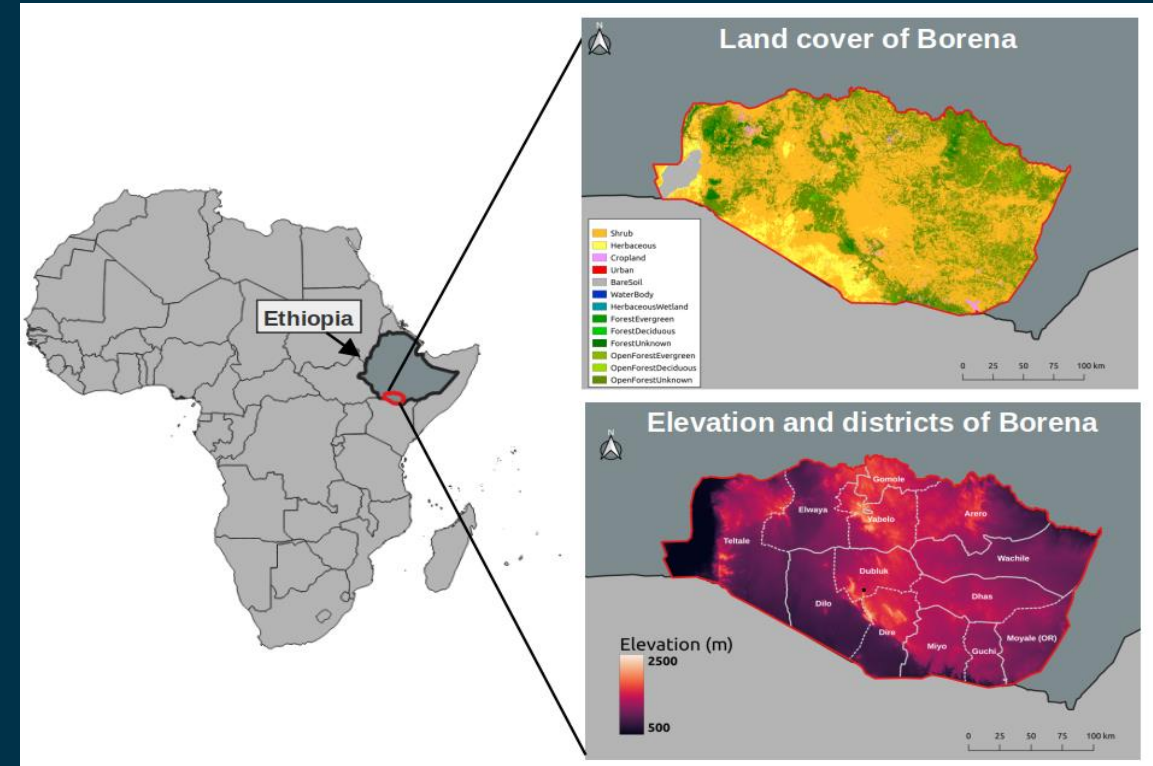
- The Horn of Africa is one of the most drought-prone and vulnerable regions globally.
- In the Borena zone of Southern Ethiopia, a primary pastoral rangeland, recent droughts (2021–2022) severely affected millions of people, and their livestock.
- A critical lack of timely, accurate, and readily available data prevents local authorities and NGOs from implementing effective mitigation strategies.
- Traditional drought indicators (DIs) rely heavily on meteorological data (e.g., rainfall), which fail to capture the actual physiological state or productivity of rangelands.
- EO data, particularly hyperspectral and thermal imaging, offers a faster response to water deficit than traditional multispectral indices.

- The primary goal of SEMHy-ARID is to leverage state-of-the-art EO datasets to propose novel composite drought indicators (CDIs) for the pastoral rangelands of the Borena region by developing evapotranspiration (ET)-based metrics and hyperspectral imaging workflows to better capture vegetation responses to drought and impacts on grassland productivity, which is vital for pastoral activities.





Borena, Southern Ethiopia



Characterized by bimodal rainfall and diverse agroecological strata

- The PRISMA hyperspectral data outperformed Sentinel-2/3 multispectral imagery in estimating complex vegetation traits (LAI, Biomass).
- It provided a more accurate distinction between photosynthetic (green) and non-photosynthetic (dry) vegetation.
- The integration of the pyTSEB and py3SEB models, validated against Eddy Covariance towers, successfully captured the water stress dynamics of the Borena rangelands.
- The 3SEB model proved particularly robust for the mixed shrub-grassland ecosystems found in the study area.
- The newly developed Regional Indicator of Drought showed a faster response to water deficit compared to traditional indices like NDVI.
- This "early-warning" capability is critical for pastoralists to make decisions before livestock health deteriorates.

- Stakeholders workshop held in Yabelo (Ethiopia)



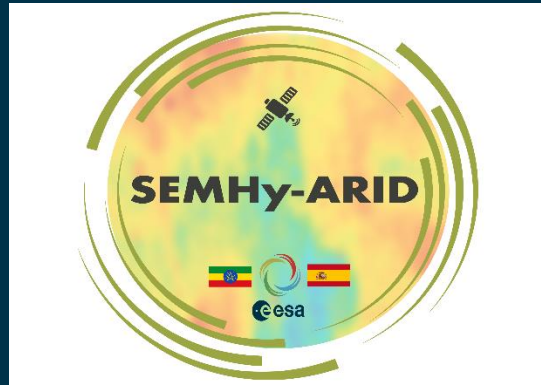


- Geometric and radiometric correction of hyperspectral images from the PRISMA satellite
<https://github.com/md-raya/prisma-image-preprocessing>
- Theoretical and practical workflows for implementing TSEB and 3SEB models to estimate evapotranspiration with cloud-based satellite imagery from the Copernicus program
<https://github.com/VicenteBurchard/py3seb-copernicus>
- Field data collected via EPicollect5
<https://five.epicollect.net/project/semhyarid/data>
<https://five.epicollect.net/project/semhyarid-oct>
- Updated pyCDI to use Destination Earth meteorological datasets instead of Google Earth Engine and develop a specific jupyter notebook for the practical ‘hands-on’ session in the workshop held in Yabelo
<https://github.com/VicenteBurchard/pyCDI>
https://github.com/VicenteBurchard/pyCDI/blob/main/pyCDI_WorkshopBorena.ipynb



- Expand the ET modeling framework to other semi-arid rangelands in Ethiopia, specifically the Afar region.
- Integration of the drought indicators into the RESTORE project, funded by the Spanish National Research Council (CSIC).
- Transitioning from "research indicators" to "operational tools" for use by the Ministry of Agriculture and regional NGOs in Borena.
- Establishing a long-term communication network between the project team and stakeholders to provide technical support for the Jupyter Notebook tools.
- Completion and submission of the two drafted research articles to peer-reviewed journals.
- Presentation of final project outcomes at the EO AFRICA R&D Forum 2026 in Dar es Salaam, Tanzania (May 25–27).

Recommended image resolution 1200 x 675 pixels - landscape format



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SEMHy-ARID project completed! 🌍 After 15 months, we improved drought early-warning using PRISMA hyperspectral data + ET models. Results to be presented at EO AFRICA R&D Forum 2026. @esa @EOAFRICARD1 @SpecLab_CSIC @CSIC

Bridging the Gap in Drought Monitoring: The SEMHy-ARID Project

We are thrilled to share the final results of our 15-month research journey in the Borena Zone of Ethiopia! By combining high-resolution PRISMA hyperspectral imaging with advanced evapotranspiration modeling (pyTSEB/py3SEB), our team has developed a more sensitive early-warning system for rangeland health.

Key Achievements:

- Proved the superior performance of hyperspectral data in detecting drought stress.*
- Developed open-access, cloud-based Jupyter Notebooks for local stakeholders.*
- Trained 30+ professionals from Borena University, local gov, and NGOs in Yabelo*

We'll be presenting these findings at the EO AFRICA R&D Forum 2026 in Dar es Salaam this May!