

Project title: **Terrestrial EO**

Principal Investigator: **Prof. Dr. Olena Dubovyk**

Agricultural and ecological systems are undergoing accelerated transformations driven by climate variability, land degradation, drought intensification and biodiversity decline. Assessing these processes at high spatial and temporal resolution requires the integration of multisensor Earth Observation (EO) data with scalable analytical frameworks capable of handling continental to global time series.

The research activities of the Chair of Terrestrial Remote Sensing at the University of Hamburg focus on developing integrative EO–AI methodologies for monitoring key indicators of ecosystem functioning, including agricultural drought dynamics, vegetation–productivity trajectories, soil organic carbon (SOC) variability, land-degradation assessments in alignment with **SDG 15.3.1**, biodiversity proxies, and early-warning signals for climate-induced ecological transitions. These activities rely on multispectral, hyperspectral, radar and thermal satellite missions (Sentinel-1/2/3, Landsat series, MODIS, VIIRS, among others) combined with physically informed modelling, geostatistical methods, and interpretable machine-learning approaches (e.g. SHAP-based attribution, generalized additive models, manifold learning and UMAP-derived resilience metrics).

The required workflows include the ingestion and preprocessing of petabyte-scale satellite archives, multi-year continental to pan-African analyses, large ensembles of model simulations, and GPU-accelerated deep-learning components such as temporal convolutional architectures, autoencoders and EO-based segmentation models. These tasks necessitate highly parallelized computation, fast I/O access, and substantial long-term storage capacity.

The activities support multiple research lines within **CLICCS**, the **EO AFRICA R&D Facility**, and several international collaborations.