EGU24-11026, updated on 25 Apr 2024
https://doi.org/10.5194/egusphere-egu24-11026
EGU General Assembly 2024

Downscaling ESA CCI Soil Moisture: From 0.25° to 0.01° using a two-step machine learning approach

Thomas Himmer[1], Carolina Damm[1], Luca Zappa[1,2], and Wouter Dorigo[1]
[1]TU Wien, Research Group Climate and Environmental Remote Sensing, Department of Geodesy and Geoinformation, Austria (thomas.himmer@geo.tuwien.ac.at)
[2]Environment Agency Austria

Soil moisture (SM) is a key component of the Earth system and a key factor in climatological and hydrological processes as it regulates water, carbon and energy fluxes between land and atmosphere. For various applications – including monitoring and forecasting of hydro-climatic extremes (floods, droughts), forest fires, and crop yield estimation – high-resolution SM information is required. Currently, the ESA CCI (Climate Change Initiative) product provides a long-term, global record of SM with daily temporal resolution and a spatial resolution of 25km (0.25°). This coarse resolution can limit its usefulness in some of the mentioned fields of application.

This study aims to improve the spatial resolution of the ESA CCI SM product to 1km (0.01°) through machine learning, incorporating dynamic and static ancillary variables influencing the spatial organization of SM at this finer scale. This procedure consists of two steps, in which the coarse resolution data is first downscaled to 0.05° and then further to 0.01°. Currently, the ancillary variables used in the downscaling process consist of land cover information from the Copernicus Global Land Service (CGLS) including soil properties, land cover types, the Normalized Difference Vegetation Index (NDVI) and a digital elevation model. Recent assessments against in-situ measurements from the International Soil Moisture Network (ISMN) across Europe reveal that the downscaled SM offers a more detailed portrayal of the spatial distribution of SM compared to the original ESA CCI product while retaining the high temporal accuracy. However, these investigations also show that the impact of the NDVI on the model prediction is small.

In future iterations of the downscaling model, the goal is to explore possibilities for incorporating more influential variables that achieve greater information gain (e.g. Land surface temperature) and to examine other machine learning approaches in addition to the currently used random forest regressor to further improve the downscaling accuracy.