Evaluation of gridded near surface air temperature datasets across complex terrain

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Near surface air temperature is a key variable used in wide range of applications showing environmental conditions across the earth. Standard meteorological observations generally provide the best estimation with high accuracy over time for a small area of influence. However, considerable uncertainty arises when point measurements are extrapolated or interpolated over much larger areas. Satellite remote sensing data have emerged as a viable alternative or supplement to in situ observations due to their availability over vast ungauged regions. Thus, spatial patterns of air temperature can be derived from satellite remote sensing.

In this study, we evaluate the performance of several satellite-based products of near surface air temperature to determine the best product in estimating daily and monthly air temperatures. Era5 Land, SMAP Level 4, AgERA5, MERRA2 products are used with 1120 ground-based gauge stations for the period 2015-2019 over complex terrain and different climate classes according to Köppen-Geiger climate classification in Turkey. Moreover, several traditional and more sophisticated machine learning downscaling algorithms are applied to increase products' spatial resolution. The agreement between ground observations and the different products and the downscaled temperature product is investigated using a set of commonly used statistical estimators of mean absolute error (MAE), correlation coefficient (CC), root-mean-square error (RMSE) and bias.

Performance analysis of satellite-based air temperature products with ground-based observations on monthly time series has shown that ERA5 Land and SMAP L4 products have similar capabilities. However, analysis on daily time series depicted that ERA5 Land is superior to SMAP L4 product. Results indicate that bicubic interpolation performs best on downsampling Era5 Land product daily time series. However, Random Forest algorithm is superior on monthly time series.