Machine learning techniques for spatial interpolation of the IASI Land Surface Temperature, Dew Point Temperature and water deficit index

Fabio Della Rocca[(1)], Italia De Feis[(1)], Giuliano Liuzzi[(2)], Rocco Giosa[(2)], Pamela Pasquariello[(2)], Guido Masiello[(2)], Carmine Serio[(2)]

[(1)] Istituto per le Applicazioni del Calcolo "Mauro Picone" IAC-CNR

Via Pietro Castellino 111, Napoli, Italy

EMail: f.dellarocca@na.iac.cnr.it

[(2)] University of Basilicata, Department of Engineering,

Viale Ateneo Lucano, 10, Potenza, Italy;

ABSTRACT

2023 has surpassed 2016 as the warmest year on record since 1850, bringing us closer to the 1.5°C limit set by the Paris Agreement. High temperatures increase the likelihood of extreme events, with heatwaves and droughts being particularly prominent. Climate change has led to a rise in the frequency of droughts, affecting regions that had never experienced such events, including the Mediterranean mid-latitude area. Assessing drought events is crucial and satellite data can provide significant assistance due to its large spatial coverage and continuous data supply.

To improve the knowledge of the drought events, we studied two important climate variables (Land Surface Temperature and Dew Point Temperature) retrieved from the Infrared Atmospheric Sounder Interferometer (IASI), and the derived index Water Deficit Index (wdi) that we have already proven to be useful in detecting drought events. The IASI profiling capability for surface parameters, atmospheric temperature, and water vapor is leveraged in this new index.

Unfortunately, infrared sensors such as IASI cannot penetrate thick cloud layers, so observations are blinded to surface emissions under cloudiness bringing sparse and not homogeneous distributed data over a given spatial region. For this reason, we exploited the capability of machine learning algorithms (Boosting, Random Forest and Neural Network) to convert IASI L2 data to a regular grid L3. Specifically, we trained a model that can predict the three variables of interest over a 0.05° regular grid, using, data from other sensors as a proxy together with vegetational products, soil indexes, and territorial and geographic information as covariates.

The goodness of the proposed approaches has been tested over the Po Valley region, which experienced an intense drought in the last three years causing high vegetation and soil water stress, considering 9 years of IASI data (2015-2023).

Overall, we found that these methods can yield good results, allowing a simultaneous retrieval of missing information over a regular grid and downscaling.