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Air Temperature estimation from Land Surface temperature and solar Radiation parameters

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Air Temperature (AirT) is a fundamental parameter in a wide range of applications such as climate change studies, weather forecast, energy balance modeling, efficiency of Photovoltaic (PV) solar cells, etc. Air temperature data are generally obtained through regular measurements from meteorological stations. The distribution of these stations is normally sparse, so the spatial pattern of this parameter cannot be accurately estimated by interpolation methods.

This work investigated the relationship between Air Temperature measured at meteorological stations and spatially contiguous measurements derived from Remote Sensing techniques, such as Land Surface Temperature (LST) maps, emissivity maps and shortwave radiation maps with the aim of creating a continuous map of AirT. For LST and emissivity, MSG-SEVIRI LST product from Land Surface Analysis Satellite Applications Facility (LSA-SAF) has been used. For shortwave radiation maps, an Artificial Neural Networks ensemble model has been developed and previously tested to create continuous maps from Global Horizontal Irradiance (GHI) point measurements, utilizing six thermal channels of MSG-SEVIRI.

The testing sites corresponded to three meteorological stations located in the United Arab Emirates (UAE), where in situ measurements of Air Temperature were available. From the starting parameters, energy fluxes and net radiation have been calculated, in order to have information on the incoming and outgoing long-wave radiation and the incoming short-wave radiation.

The preliminary analysis (day and Night measurements, cloud free) showed a strong negative correlation (0.92) between Outgoing long-wave radiation - GHI and LST- AirT, with a RMSE of 1.84 K in the AirT estimation from the initial parameters. Regression coefficients have been determined and tested on all the ground stations. The analysis also demonstrated the predominant impact of the incoming short-wave radiation in the AirT hourly variation, while the incoming long-wave radiation remains almost constant during the testing period.

To conclude, the final AirT maps have been used to calculate continuous maps of Net Radiation, showing an important application of the output of this work for surface energy balance retrieval.