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Improving GIS-based month-to-month air temperature maps with satellite-derived land surface temperature

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Improving the methodologies for the generation of digital environmental GIS-based maps is an open issue that should allow to better understand how the climate variables affect some environmental conditions that drives many ecosystem services dynamics related to the state of vegetation, water resources, species richness and diversity, landscape changes, etc.

This study proposes an empirical methodology for improving the month-to-month air temperature (Tair) mapping (minimum and maximum) using satellite land surface temperature (LST) besides of meteorological data and geographic information. The study area corresponds to Catalonia, northeastern Iberian Peninsula on the Mediterranean coast. This region is characterized by a heterogeneous orography with elevations ranging from sea level to about 3000 m. It has variable water availability both intra-annually and inter-annually due to repeated drought periods. The climate is typically Mediterranean.

The present methodology consists on multiple regression analysis combined with the spatial interpolation of residual errors using the inverse distance weighting. In the multiple regression, we used variables whose influence is well documented in the bibliography: altitude, latitude, continentality, potential solar radiation and a topographic wetness index. Additionally, different operational daytime and nighttime remote sensing LST products from MODIS, ATSR-2 and AATSR have been considered for the thirteen-year period (2003-2015) analysed.

They correspond to the four months more characteristics of the seasonal dynamics of a Mediterranean climate: March, June, September and December. A leave-one-out cross-validation procedure has been included in order to compare predicted with observed values. The results can be considered operational given the feasibility of the models employed (linear dependence on predictors that are nowadays easily available), the robustness of the leave-one-out cross-validation procedure and the improvement in accuracy achieved when compared to classical Tair modelling results. It is showed that nighttime LST provides a good proxy not only for minimum Tair, but also for maximum Tair. The improvement achieved by the inclusion of remote sensing LST products was higher for minimum Tair (up to 0.35 K on December), especially over forests and rugged lands. Results are really encouraging as there are generally few meteorological stations in zones with these characteristics, clearly showing the usefulness of remote sensing to improve information about areas that are difficult to access or simply with a poor availability of conventional meteorological data.

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