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Statistical downscaling of daily temperatures in Portugal for 1950-2015: variability and trends

André Fonseca and João Andrade Santos
UTAD, CITAB, School of Sciences and Technology, Physics Dep., Vila Real, Portugal (jsantos@utad.pt)

Climate research in Portugal is often constrained by the lack of homogeneous, temporally and spatially consistent and long-term climatic time series. To overcome this limitation, we develop new very high resolution gridded datasets (∼1 km) of daily minimum, maximum and mean air temperatures over Portugal. The grid has a regular 0.01º horizontal resolution and spans over the period of 1950–2015. Daily temperatures are statistically downscaled from gridded temperatures (∼25 km, E-OBS), but following a pattern downscaling approach. Daily anomalies (with respect to their multi-year daily means) were obtained from the interpolated E-OBS dataset. The multi-year daily means were smoothed by a low-pass Lanczos filter, with cut-off frequency at 30 days and 500 coefficients, so as to remove high-frequency noise from the seasonal component. Third, the daily anomalies were added to the corresponding calendar daily baseline patterns. The corresponding baseline patterns are estimated using multivariate linear regressions (exploratory variables: elevation, latitude and distance to the coastline), followed by a kriging of biases/residuals (universal kriging) from the climatic normals at a network of 36 weather stations throughout Portugal. The database was evaluated using a 5 year fold station cross-validation scheme (at 36 weather stations) and several skill scores. The new datasets significantly improve on the previous available datasets in both spatial resolution and time period. Interpolation uncertainty is quantified by the determination of daily mean, standard errors and trend for every grid square and for the three databases. Further, a preliminary analysis of climate variability and trends in temperatures and in their extremes is undertaken. These novel temperature datasets can be applied to several areas of research, such as hydrologic modeling, ecology, agriculture and forestry, contributing to more accurate decision support systems.