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Temperature trends and uncertainties over peninsular Spain and the Balearic Islands

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Six gridded datasets of mean, minimum and maximum temperatures and one dataset of 22 individual sites distributed over mainland Spain and the Balearic Islands are compared. The gridded datasets vary in spatial resolution, temporal coverage and interpolation procedures as well as in the number of individual predictor sites used to create them. The six gridded datasets start in 1901 (1951) in the longest (shortest) case and extend until present or some date within the last decade. The spatial resolution ranges from 0.11° to 1 km. The site-resolved dataset includes the 22 longest data records over Spain, reaching back until the mid-19th century and thus complementing the temporal analysis of this study. The availability of datasets with different levels of predictor data, methodologies and final characteristics allows for an assessment of the observational uncertainties in temperature climatologies and trends at the local/regional scales.

The structure of the spatial patterns for the climatologies of the mean, minimum and maximum temperatures is quite consistent across datasets, with the coldest temperatures over areas of the Pyrenees and mountain ranges in winter and the hottest ones over the Guadalquivir Valley in summer. However, notable differences are observed at a regional scale, particularly over the highest elevation regions where average discrepancies greater than 3 °C are found. Mean temperatures increase since 1970s between 1-2 °C, and uncertainties range from 0.2 to 0.5 °C across datasets. The spatial distribution of trends shows that warming is widespread but there are notable differences in magnitude, spatial distribution and even sign of the trends depending on the database considered. The relevant variability estimated among datasets leads to a low confidence on where the warming peaks annually and seasonally. A Principal Component Analysis is used to filter out signals that account for low amounts of regional variance and focus on those responsible for the long term responses. The first principal component reproduces the trends in each dataset and season, and is consistent with the forced response to external forcing found at global and hemispherical scales. This PC accounts for a large percentage of variance in each dataset and season. The corresponding spatial patter has uniform sign and its regional variability varies considerably across datasets with differences being larger in scale than the resolution of the datasets. The results can be relevant for model evaluation and detection and attribution studies over this region.

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