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Application of seasonal climate forecasts for electricity demand forecasting: a case study on Italy

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Use of electricity, due to electric heating and cooling (HVAC) equipment, is strongly influenced by weather variables, mainly air temperature. For this reason, an accurate temperature prediction can be useful for electricity providers and managers to manage the grid and schedule operations effectively. This work will focus on Italian demand, disaggregated by eight regions, during the period 1990-2007 considering summer (JJ) and winter (JF) average demands. During the last ten years Italy experienced a strong diffusion of HVAC equipments and this trend is clearly visible in observed data.
Analysis has been performed using 2-metres temperature data from two sources: reanalysis and seasonal forecasts, both considering an Euro-Mediterranean geographic domain.
ERA-INTERIM reanalysis will be used to model electricity use and therefore assess potential predictability. Then ECMWF System4 Seasonal Forecasts will be used with one month of lead time to predict average demand during the period considered. A linear regression has been performed between the main modes (selected with the 99% of variance retained) of temperature anomaly and summer electricity demand for each year. In this way, the application of EOF/PCA techniques on temperature fields allowed to detect the effect of particular patterns (e.g. heat-waves) on electricity demand.
Performance have been evaluated with a leave-one-out cross-validation. As expected, the use of reanalysis led to lower errors with respect to the use of seasonal forecasts, with an overall RMSE 15% lower (0.90 versus 1.06) during summer. However, the use of seasonal forecasts leads to higher performance in the South than in the rest of Italy, due to the more intense use of air conditioning in the hottest zone of the country. Differently, in winter the gap between reanalysis and seasonal forecast becomes very small with a difference smaller than 1%.