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Assessing the Physical Consistence of Several Gridded Reconstructions Over Europe Through a High-Resolution Climate Paleosimulation

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Comparisons between climate simulation and reconstructions are important to identify drawbacks in the methodologies employed in these reconstructions, and to validate the state-of-the-art climate models employed in future climate projections. Nevertheless, an important drawback in these comparisons is the scale gap between the coarse resolution of current Global Circulation Models and the regional/local scale proxy information used to develop climate reconstructions. This scale gap can be by-passed by using downscaling techniques such as Regional Climate Models, which account for the links between global/hemispherical circulation and regional/local climate.

However, a direct comparison of climate simulations with climate reconstructions must be carefully carried out, because a perfect agreement between them should not be expected even if both were perfect. Nonetheless, although climate simulations represent a simplified version of the actual climate, they provide a complete 3-dimensional picture that is in theory physically consistent. Therefore, they can be helpful to interpret several reconstructed variables over the same area and from different proxies. A further interesting aspect of this comparison is that it might allow to explore the respective contributions from natural and anthropogenic forcings to climate variations at multi-decadal and centennial scales.

In this study, we compare a high-resolution regional simulation (45 km) encompassing Europe for the period 1501-1990 with several gridded reconstructions of temperature, precipitation and sea level pressure available for this area. An analysis of the seasonal leading modes of these variables from the simulation, the CRU observational database and from the reconstructions has been performed, which yields a general good agreement between the simulation and the temperature reconstruction. A poorer agreement can be found however in precipitation, where the main variability modes in the reconstructions have a simpler structure than in the simulations. A Canonical Correlation Analysis has also been performed between the pressure and temperature and pressure and precipitation fields, respectively. In this case, the results obtained within the simulation clearly differ from the reconstructions. The causes for these disagreement, which may lie in deficiencies in the reconstructions methods, in the model physics, or in the imposed external forcings to drive the model, are addressed.