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High resolution climate and vegetation simulations of the Late Pliocene, a model-data comparison over western Europe and the Mediterranean region

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Abstract. Here we perform a detailed comparison between climate model results and climate reconstructions in western Europe and the Mediterranean area for the mid-Piacenzian warm interval (*ca* 3 Myr ago) of the Late Pliocene epoch. This region is particularly well suited for such a comparison as several quantitative climate estimates from local pollen records are available. They show evidence for temperatures significantly warmer than today over the whole area, mean annual precipitation higher in northwestern Europe and equivalent to modern values in its southwestern part. To improve our comparison, we have performed high resolution simulations of the mid-Piacenzian climate using the LMDz atmospheric general circulation model (AGCM) with a stretched grid which allows a finer resolution over Europe. In a first step, we applied the PRISM2 (Pliocene Research, Interpretation, and Synoptic Mapping) boundary conditions except that we used modern terrestrial vegetation. Second, we simulated the vegetation for this period by forcing the ORCHIDEE (Organizing Carbon and Hydrology in Dynamic Ecosystems) dynamic global vegetation model (DGVM) with the climatic outputs from the AGCM. We then supplied this simulated terrestrial vegetation cover as an additional boundary condition in a second AGCM run. This gives us the opportunity to investigate the model's sensitivity to the simulated vegetation changes in a global warming context.

Model results and data show a great consistency for mean annual temperatures, indicating increases by up to 4°C in the study area, and some disparities, in particular in the northern Mediterranean sector, as regards winter and summer temperatures. Similar continental mean annual precipitation and moisture patterns are predicted by the model, which broadly underestimates the wetter conditions indicated by the data in northwestern Europe. The biogeophysical effects due to the changes in vegetation simulated by ORCHIDEE are weak, both in terms of the hydrological cycle and of the temperatures, at the regional scale of the

European and Mediterranean mid-latitudes. In particular, they do not contribute to improve the model-data comparison. Their main influence concerns seasonal temperatures, with a decrease of the temperatures of the warmest month, and an overall reduction of the intensity of the continental hydrological cycle.

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