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Modelling the mid-Pliocene Warm Period climate with the IPSL coupled model and its atmospheric component LMDZ5A

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Abstract. This paper describes the experimental design and model results of the climate simulations of the mid-Pliocene Warm Period (mPWP, ca. 3.3–3 Ma) using the Institut Pierre Simon Laplace model (IPSLCM5A), in the framework of the Pliocene Model Intercomparison Project (PlioMIP). We use the IPSL atmosphere ocean general circulation model (AOGCM), and its atmospheric component alone (AGCM), to simulate the climate of the mPWP. Boundary conditions such as sea surface temperatures (SSTs), topography, ice-sheet extent and vegetation are derived from the ones imposed by the Pliocene Model Intercomparison Project (PlioMIP), described in Haywood et al. (2010, 2011). We first describe the IPSL model main features, and then give a full description of the boundary conditions used for atmospheric model and coupled model experiments. The climatic outputs of the mPWP simulations are detailed and compared to the corresponding control simulations. The simulated warming relative to the control simulation is 1.94 °C in the atmospheric and 2.07 °C in the coupled model experiments. In both experiments, warming is larger at high latitudes. Mechanisms governing the simulated precipitation patterns are different in the coupled model than in the atmospheric model alone, because of the reduced gradients in imposed SSTs, which impacts the Hadley and Walker circulations. In addition, a sensitivity test to the change of land-sea mask in the atmospheric model, representing a sea-level change from present-day to 25 m higher during the mid-Pliocene, is described. We find that surface temperature differences can be large (several degrees Celsius) but are restricted to the areas that were changed from ocean to land or vice versa. In terms of precipitation, impact on polar regions is minor although the change in land-sea mask is significant in these areas.

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