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IPSL-CM5A2. An Earth System Model designed to run long simulations for past and future climates.

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The IPSL-CM5A model was developed and released in 2013 "to study the long-term response of the climate system to natural and anthropogenic forcings as part of the 5th Phase of the Coupled Model Intercomparison Project (CMIP5)" [Dufresne et al., 2013]. Although this model also has been used for numerous paleoclimate studies, a major limitation was its computation time, which averaged 10 model-years / day on 32 cores of the Curie supercomputer (on TGCC computing center, France). Such performances were compatible with the experimental designs of intercomparison projects (e.g. CMIP, PMIP) but became limiting for modelling activities involving several multi-millenial experiments, which are typical for Quaternary or "deeptime" paleoclimate studies, in which a fully-equilibrated deep-ocean is mandatory. Here we present the Earth-System model IPSL-CM5A2. Based on IPSL-CM5A, technical developments have been performed both on separate components and on the coupling system in order to speed up the whole coupled model. These developments include the integration of hybrid parallelization MPI-OpenMP in LMDz atmospheric component, the use of a new input-ouput library to perform parallel asynchronous input/output by using computing cores as "IO servers", the use of a parallel coupling library between the ocean and the atmospheric components. Running on 304 cores, the model can now simulate 55 years per day, opening new gates towards multi-millenial simulations. Apart from obtaining better computing performances, one aim of setting up IPSL-CM5A2 was also to overcome the cold bias depicted in global surface air temperature (t2m) in IPSL-CM5A. We present the tuning strategy to overcome this bias as well as the main characteristics (including biases) of the pre-industrial climate simulated by IPSL-CM5A2. Lastly, we shortly present paleoclimate simulations run with this model, for the Holocene and for deeper timescales in the Cenozoic, for which the particular continental configuration was overcome by a new design of the ocean tripolar grid.