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DYNAMICO, an atmospheric dynamical core for high-performance climate modeling

Thomas Dubos (1), Yann Meurdesoif (2), Aymeric Spiga (3), Ehouarn Millour (4), Lluis Fita (5), Frédéric Hourdin (6), Masa Kageyama (7), Abdoul-Khadre Traore (8), Sandrine Guerlet (9), and Jan Polcher (10)

(1) LMD/IPSL, Ecole Polytechnique, Palaiseau, France (dubos@lmd.polytechnique.fr), (2) LSCE/IPSL, CEA-CNRS, Gif-sur-Yvette, France (yann.meurdesoif@cea.fr), (3) LMD/IPSL, Université Pierre et Marie Curie, Paris, France (spiga@lmd.jussieu.fr), (4) LMD/IPSL, CNRS-Université Pierre et Marie Curie, Paris, France (ehouarn.millour@lmd.jussieu.fr), (5) LMD/IPSL, CNRS-Ecole Polytechnique, Palaiseau, France (lluis.fita@lmd.jussieu.fr), (6) LMD/IPSL, CNRS-Université Pierre et Marie Curie, Paris, France (Frederic.Hourdin@lmd.jussieu.fr), (7) LSCE/IPSL, CEA-CNRS, Gif-sur-Yvette, France (Masa.Kageyama@lsce.ipsl.fr), (8) LMD/IPSL, CNRS-Université Pierre et Marie Curie, Paris, France (Abdoul-khadre.Traore@lmd.jussieu.fr), (9) LMD/IPSL, CNRS-Université Pierre et Marie Curie, Paris, France (sandrine.guerlet@lmd.jussieu.fr), (10) LMD/IPSL, CNRS-Ecole Polytechnique, Palaiseau, France (jan.polcher@lmd.jussieu.fr)

Institut Pierre Simon Laplace has developed a very scalable atmospheric dynamical core, DYNAMICO, based on energy-conserving finite-difference/finite volume numerics on a quasi-uniform icosahedral-hexagonal mesh. Scalability is achieved by combining hybrid MPI/OpenMP parallelism to asynchronous I/O. This dynamical core has been coupled to radiative transfer physics tailored to the atmosphere of Saturn, allowing unprecedented simulations of the climate of this giant planet.

For terrestrial climate studies DYNAMICO is being integrated into the IPSL Earth System
Model IPSL-CM. Preliminary aquaplanet and AMIP-style simulations yield reasonable results when compared to outputs from IPSL-CM5. The observed performance suggests that an order of magnitude may be gained with respect to IPSL-CM CMIP5 simulations either on the duration of simulations or on their resolution. Longer simulations would be of interest for the study of paleoclimate, while higher resolution could improve certain aspects of the modeled climate such as extreme events, as will be explored in the HighResMIP project.

Following IPSL's strategic vision of building a unified global-regional modelling system, a fully-compressible, non-hydrostatic prototype of DYNAMICO has been developed, enabling future convection-resolving simulations.

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Dubos, T., Dubey, S., Tort, M., Mittal, R., Meurdesoif, Y., and Hourdin, F.: DYNAMICO-1.0, an icosahedral hydrostatic dynamical core designed for consistency and versatility, Geosci. Model Dev., 8, 3131-3150, doi:10.5194/gmd-8-3131-2015, 2015.