Project 12 (TWP1): Developing and testing a stretched version of the IPSL Earth system model

Project lead: Jean-Louis Dufresne and Férdéric Hourdin
Post-doctoral researcher : Guillaume Levavasseur
Project Start/End : October 2014 – March 2015

Position offer:

The excellence laboratory L-IPSL of the Institut Pierre-Simon Laplace offers an engineer position of 1 year to join a collaborative effort involving the IPSL climate model development team in order to develop and customize the use of a stretched version of the IPSL-ESM. The scientific goal behind this development is to simulate the climate at the regional scale for past, present and future climate conditions, and to allow the analysis the interactions between global and regional climate and between climate and biogeochemistry cycles.

Context: Simulating the climate at regional scale at higher horizontal resolution than that of usual global climate models is of high interest. This allows to better represent the orthographic effects and facilitates the comparison between model and local observations. This higher resolution can be obtained by using global models at very high resolution or by limited-area models. Each of these methods has its strengths and weaknesses. An attractive and alternative method is to use global models with stretched grid.

The IPSL-CM5 model is and Earth System Model that includes a representation of the physical and the biogeochemistry (carbon cycle, aerosols, chemistry...) processes at the global scale, for both the atmosphere, land surface, ocean and sea-ice. The atmospheric component, LMDZ, has a stretchable longitude-latitude grid that allows refinement of the horizontal grid over any specific region. The objective of the proposed work is to develop tools that allow an easy use of this refinement capability over any continental regions and for the various configurations of this ESM.

Description of work: In order to make effective an customize the use of the LMDZ “zoom” capability in the IPSL-ESM system, it is necessary to develop an ensemble of generic tools. This should include in particular interpolation procedures on the zoomed grid, as well as the development and upgrade of scripts that automatically downwoad the required input datasets, interpolate the data on the model grid, and run the simulations. The work will be done in three main steps: (1) creation of the zoom, the initial states and interpolation of all the variables necessary to drive the physical part of the model with prescribed SST (2) interpolation of all the variables necessary to drive the biogeochemistry part of the model over continents with prescribed SST and (3) same but with a coupling with the ocean and sea-ice. Two regions will be used for benchmarking in link with project that involve the IPSL-ESM team: Europe and West Africa.

The candidate should have a solid experience in FORTRAN and shell programing and a good general knowledge in climate modeling.

Supervision team: The work will be conducted at IPSL under the main supervision of J-L Dufresne, M-A Foujols and A. Caubel, and in close connection with other researchers and engineer of the IPSL Climate Modeling Center, from IPSL (J. Ghatas, S. Denvil, P. Cadule), LMD (F. Hourdin, L. Fairhead, F. Cheruy), LSCE (A. Cozic, P. Peylin).

Duration and salary: The engineer will be recruited for 12 months with a net monthly salary around 2000 euros, commensurate with experience. This includes social services and health insurance.

Contact for applications: Applications should include a vita, a statement of interests and the names of at least two references including e-mail addresses and telephone numbers. Applications should be submitted by e-mail to J-L Dufresne (Jean-Louis.Dufresne@lmd.jussieu.fr).

Results:

The IPSL-CM model is an Earth System Model that includes a representation of the physical and the biogeochemistry (carbon cycle, aerosols, chemistry...) processes at the global scale, for both the atmosphere, land surface, ocean and sea-ice. The atmospheric component, LMDZ, has a stretchable longitude-latitude grid that allows refinement of the horizontal grid over any specific region. The objective of this project was to develop tools that allow an easy use of this refinement capability over any continental regions and for the various configurations of this ESM. The scientific goal behind this development is to simulate the climate at the regional scale for past, present and future climate conditions, and to allow the analysis the interactions between global and regional climate and between climate and biogeochemistry cycles.

An engineer has been hired in order to develop and customize the use of a stretched version of the IPSL-ESM. He has developed interpolation procedures to interpolate all the required data on the model grid and run the simulations. The two regions used for benchmarking were Europe and West Africa. Tests have been made with the atmospheric model over continents and prescribed SST. These include the physical processes of the atmosphere but also aerosol emissions and interactions with the vegetation.

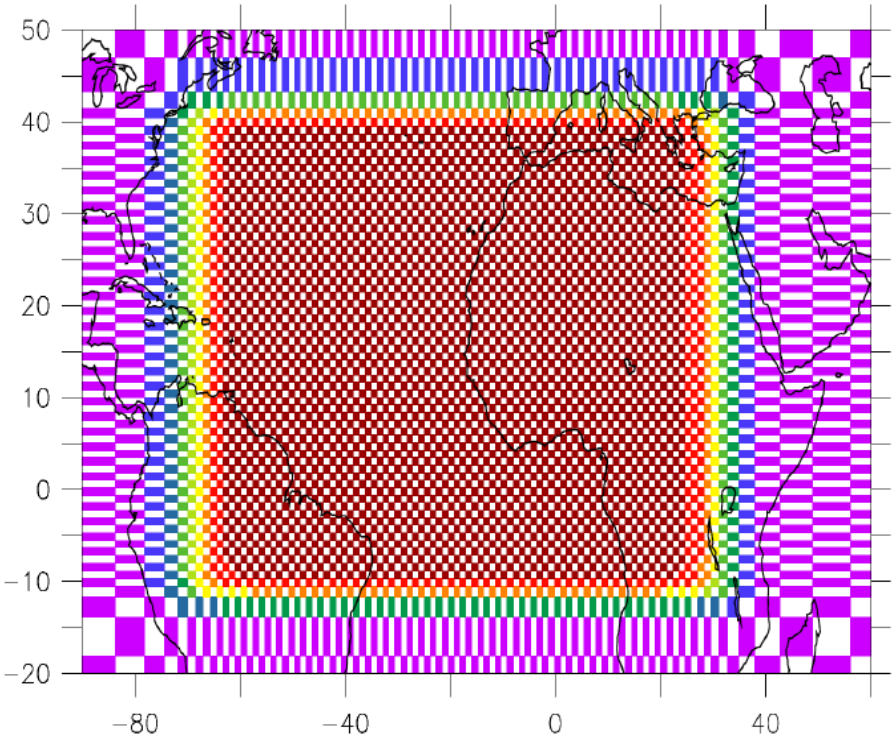

Figure: Example of the use of the zoom capability of LMDZ over the West-Africa and equatorial ocean region. This zoom is used to analyze atmosphere-aerosol interactions and will be use to analyze atmosphere-ocean interactions.