Geophysical Research Abstracts
Vol. 18, EGU2016-3125-1, 2016
EGU General Assembly 2016

Two-way against one-way nesting for climate downscaling in Europe and the Mediterranean region using LMDZ4

Shan Li, Laurent Li, and Hervé Le Treut

Laboratoire de Météorologie Dynamique (LMD), Université Pierre et Marie Curie, Sorbonne Universités, IPSL/CNRS, 4, Place Jussieu, Casier 99, 75252 Paris Cedex 05, France (Shan.Li@lmd.jussieu.fr)

In the 21st century, the estimated surface temperature warming projected by General Circulation Models (GCMs) is between 0.3 and 4.8 °C, depending on the scenario considered. GCMs exhibit a good representation of climate on a global scale, but they are not able to reproduce regional climate processes with the same level of accuracy. Society and policymakers need model projections to define climate change adaptation and mitigation policies on a global, regional and local scale.

Climate downscaling is mostly conducted with a regional model nested into the outputs of a global model. This one-way nesting approach is generally used in the climate community without feedbacks from Regional Climate Models (RCMs) to GCMs. This lack of interaction between the two models may affect regional modes of variability, in particular those with a boundary conflict. The objective of this study is to evaluate a two-way nesting configuration that makes an interactive coupling between the RCM and the GCM, an approach against the traditional configuration of one-way nesting system. An additional aim of this work is to examine if the two-way nesting system can improve the RCM performance.

The atmospheric component of the IPSL integrated climate model (LMDZ) is configured at both regional (LMDZ-regional) and global (LMDZ-global) scales. The two models have the same configuration for the dynamical framework and the physical forcings. The climatology values of sea surface temperature (SST) are prescribed for the two models. The stretched-grid of LMDZ-global is applied to a region defined by Europe, the Mediterranean, North Africa and Western North Atlantic. To ensure a good statistical significance of results, all simulations last at least 80 years. The nesting process of models is performed by a relaxation procedure of a time scale of 90 minutes. In the case of two-way nesting, the exchange between the two models is every two hours.

The relaxation procedure induces a boundary conflict, particularly in the eastern boundary for temperature and geopotential height. A correlation analysis on the synoptic scale evaluates the relationship between the GCM and the RCM. The beginning of the simulations shows a great consistency of the two models. When dominant dynamics apply, RCM inherits most of the GCM signal with a consistent spatial structure. On the contrary, when the atmospheric circulation is weak, there are not that many effects transferred from the GCM to the RCM. When the RCM has its own dynamics, the boundary conflict is more pronounced. Winter season is chosen for the two-way nesting test due to the predominant role of the atmospheric dynamics in winter. The new approach of a two-way nesting system reduces boundary bias, having a influence in some cases in climate model projections. The effect of two-way nesting is enhanced when using a finer grid.