Geophysical Research Abstracts
Vol. 19, EGU2017-15806, 2017
EGU General Assembly 2017

How much spin-up period is really necessary in regional climate simulations?

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A largely discussed topic in regional climate modelling is the spin-up period needed to ensure that all regional climate models (RCMs) components reach a physical equilibrium, due to the inconsistencies between the physics in the RCM and those imposed by the initial conditions (both in soil and atmosphere).

A good characterization of the spin-up period would permit to have larger confidence on the results of RCM integrations, especially in time-slice runs. An immediate consequence would be an optimal exploitation of computational resources for long climate runs, since the computational efficiency becomes largely improved when simulations can be splitted in shorter time slices or periods that can be run independent and simultaneously.

In study we analyse the sensitivity of regional climate experiments to the length of the spin-up time period, as well as the location, through the annual cycle, of the initialization. For this, several regional climate simulations with the WRF model for 1-yr period have been carried out for an Euro-CORDEX compliant domain. All runs simulate the same year, with the same model configuration, and only differ in the initialization of the model in different months of the year, taking spin-up periods varying between 1 day up to 1 year. The “optimal” spin-up period is defined as the shortest period that renders the differences between two consecutive experiments for a selected date lower than certain threshold. This threshold depends on the variable, and is defined having its temporal variability into account. Soil variables such as temperature and moisture were used, as those are the slowest variable, and therefore generally require longer spin-up periods.

The results show that the length of the spin-up period critically depends on the time of initialization, and can take between 2 to 6 months for soil variables.