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High-resolution climate projections of temperature and precipitation in an orographic complex Archipelago: case of the Canary Islands

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Islands are one of the most sensible systems with regard to the possible effects of the climate change. They usually have fragile socio-economical structures and very rich natural ecosystems with a high percentage of endemisms. In addition, these systems are natural laboratories to test different climatic modelling strategies of dynamic interactions between the land, ocean and atmosphere as well as cloud-aerosol interactions. In order to design effective adaptation/mitigation strategies is fundamental to obtain accurate climatic projections, throughout the 21st century, with the optimal resolution to conveniently model the key climatic elements and processes in these complex systems. We present the results of dynamical downscaling experiments for the Canary Islands, at convection-permitting resolutions of few kilometers, which are useful to define suitable strategies for reducing the impacts of climate change.

We developed two strategies, one that uses as input to the WRF model two individual CMIP5-GCM models (GFDL and MIROC) and then the outputs are averaged. The simulations were performed for three periods, one at present (1980-2010) and two in the future (2030-2060 and 2070-2100), and for two different greenhouse gases scenarios (RCP4.5 and RCP8.5) defined in CMIP5.

A second methodology, much less demanding from the computer-resources point of view than the first one, called pseudo global warming (PGW) was developed. In this PGW approximation, initial and boundary conditions used to compute the present climatology, are directly taken from reanalysis (ERA-Interim). Meanwhile, for future periods, initial and boundary conditions for the regional model integrations are given by the sum of a climate perturbation signal to the same reanalysis data used for the present simulation. This perturbation, or global warming increment, is estimated from about 10 CMIP5-GCM projections for the variables of interest based on their monthly mean values. WRF simulations have been conducted for three decades, present (1995-2004), at the middle (2045-2054) and at the end (2090-2099) of the century and for RCPs4.5 and 8.5. The climatologies obtained with both strategies are compared. One of the main features of these projections is the strong dependence of the temperature increase with height, which is a crucial behavior to evaluate the evolution of natural ecosystems under a warmer climate.