DANAS en clima presente y futuro: downscaling híbrido con “machine learning” y modelos regionales de alta resolución

Cut-off lows in present and future climate: hybrid downscaling using machine learning and convection-permitting regional models

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RESUMEN

This study focuses on the optimal downscaling of cut-off low (COL) events to convection-permitting scales using ensemble approaches under both present-day and future climate conditions. The geographical area of interest is Southern Europe, one of the three regions worldwide with the highest occurrence of COLs [1]. The presence of a COL is frequently associated with intense precipitation; in the Valencia region of eastern Spain, it accounts for approximately 80% of extreme rainfall events [2]. To capture the full range of variability associated with these events, two complementary ensemble-generation strategies are proposed. The first approach relies exclusively on dynamical downscaling with a regional climate model, using an intermediate-resolution domain that is sufficiently large to generate a physically plausible ensemble. This approach may also help correct some of the biases present in the driving models, such as those identified in CMIP5/CMIP6 simulations [3]. However, given the high computational cost of generating such ensembles, a second approach combines machine learning (ML) techniques with numerical modeling. In this framework, ensembles are generated using the ECMWF AIFS model, providing a computationally efficient global-scale ensemble. The ensemble members are subsequently grouped using clustering techniques, allowing the selection of representative members that are then dynamically downscaled to convection-permitting resolution.The regional climate model HCLIM [4] is employed for the high-resolution simulations. Preliminary results are presented for selected COL events affecting the Iberian Peninsula, illustrating the ability of the proposed methodologies to capture precipitation extremes associated with these systems. Beyond its application to the present-day climate, this framework is also designed to support future climate assessments, for example through the use of pseudo-global warming techniques.

References:

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