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Evaluation and comparison of different RCMs simulations of the Mediterranean climate: a view on the impact of model resolution and Mediterranean sea coupling.

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As regularly stated by numerous authors, the Mediterranean climate is considered as one major climate 'hot spot'. At least, three reasons may explain this statement. First, this region is known for being regularly affected by extreme hydro-meteorological events (heavy precipitation and flash-floods during the autumn season; droughts and heat waves during spring and summer). Second, the vulnerability of populations in regard of these extreme events is expected to increase during the XXIst century (at least due to the projected population growth in this region). At last, Global Circulation Models project that this regional climate will be highly sensitive to climate change. Moreover, global warming is expected to intensify the hydrological cycle and thus to increase the frequency of extreme hydro-meteorological events.

In order to propose adaptation strategies, the robust estimation of the future evolution of the Mediterranean climate and the associated extreme hydro-meteorological events (in terms of intensity/frequency) is of great relevance. However, these projections are characterized by large uncertainties. Many components of the simulation chain can explain these large uncertainties : (i) uncertainties concerning the emission scenario; (ii) climate model simulations suffer of parametrization errors and uncertainties concerning the initial state of the climate; and (iii) the additional uncertainties given by the (dynamical or statistical) downscaling techniques and the impact model. Narrowing (as fine as possible) these uncertainties is a major challenge of the actual climate research. One way for that is to reduce the uncertainties associated with each component.

In this study, we are interested in evaluating the potential improvement of : (i) coupled RCM simulations (with the Mediterranean Sea) in comparison with atmosphere only (stand-alone) RCM simulations and (ii) RCM simulations at a finer resolution in comparison with larger resolution. For that, three different RCMs (WRF, ALADIN, LMDZ4) were run, forced by ERA-Interim reanalyses, within the MED-CORDEX experiment. For each RCM, different versions (coupled/stand-alone, high/low resolution) were realized.

A large set of scores was developed and applied in order to evaluate the performances of these different RCMs simulations. These scores were applied for three variables (daily precipitation amount, mean daily air temperature and the dry spell lengths). A particular attention was given to the RCM capability to reproduce the seasonal and spatial pattern of extreme statistics.
Results show that the differences between coupled and stand-alone RCMs are localized very near the Mediterranean sea and that the model resolution has a slight impact on the scores obtained. Globally, the main differences between the RCM simulations come from the RCM used.

Keywords: Mediterranean climate, extreme hydro-meteorological events, RCM simulations, evaluation of climate simulations