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Precipitation frequency in MED and EURO-CORDEX ensembles from 0.44° to convective permitting resolution: what explains the differences?

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Dynamical models are a major tool for studying climate variability and its evolution. But despite the refinements in resolution and efforts to revise the dynamical and physical processes, rainfall extremes are still poorly represented, even at regional scales. Recent studies using convection-permitting simulations have demonstrated the improvement in representing heavy rainfall. In this study, we investigate the impacts of different model resolutions and convection representations (parameterized vs. explicit) in simulating precipitation frequency over Europe and the Mediterranean and try to explain the difference between model ensembles by focusing on triggering processes. For this purpose, we used a multi-model data-set with three different resolutions (0.44°, 0.11° and 0.0275°) produced in the context of the MED and EURO-CORDEX and the CORDEX Flagship Pilot Study on convection (FPSCONV). At 0.0275°, deep convection is explicitly represented while at 0.44° and 0.11°, it is parameterized with different schemes. In addition, to partially separate the impact of the higher resolution and convective schemes, we remapped the outputs of resolution 0.0275° to the 0.11° grid. To explain the difference in simulating precipitation frequency, a multi-variate approach is applied, in which precipitation is considered in the statistical relationship with tropospheric temperature and humidity - derived from colocated observations at the supersite SIRTA near Paris and some GPS stations. The results show that precipitation frequency in the higher resolution simulations is reduced because of a lower probability to exceed the critical value of integrated water vapor (IWVcv) over which precipitation picks up for different temperature bins. At low temperature, the probability decreases mostly due to a different humidity distribution in high resolution simulations, but for the temperature bins where the dominant precipitation type changes to convective precipitation, the decrease of probability to exceed IWVcv is mainly explained by a higher value of IWVcv. In these bins, the differences

between 0.0275° and 0.44°, 0.11° resolutions become larger over southern Europe and the Mediterranean. This is not clear over mountain areas, where processes of triggering are more linked to orography than convection. Our results also suggest a decrease of model spread at higher temperature, and a stronger impact of switching off convective schemes than increasing resolution.

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