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The evolution of extreme precipitations in high resolution scenarios over France

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Over the past years, improving the modelling of extreme events and their variability at climatic time scales has become one of the challenging issue raised in the regional climate research field.

This study shows the results of a high resolution (12 km) scenario run over France with the limited area model (LAM) ALADIN-Climat, regarding the representation of extreme precipitations. The runs were conducted in the framework of the ANR-SCAMPEI national project on high resolution scenarios over French mountains.

As a first step, we attempt to quantify one of the uncertainties implied by the use of LAM : the size of the area on which the model is run. In particular, we address the issue of whether a relatively small domain allows the model to create its small scale process. Indeed, high resolution scenarios cannot be run on large domains because of the computation time. Therefore one needs to answer this preliminary question before producing and analyzing such scenarios.

To do so, we worked in the framework of a « big brother » experiment. We performed a 23-year long global simulation in present-day climate (1979-2001) with the ARPEGE-Climat GCM, at a resolution of approximately 50 km over Europe (stretched grid). This first simulation, named ARP50, constitutes the « big brother » reference of our experiment. It has been validated in comparison with the CRU climatology. Then we filtered the short waves (up to 200 km) from ARP50 in order to obtain the equivalent of coarse resolution lateral boundary conditions (LBC). We have carried out three ALADIN-Climat simulations at a 50 km resolution with these LBC, using different configurations of the model :
* FRA50, run over a small domain (2000 x 2000 km, centered over France),
* EUR50, run over a larger domain (5000 x 5000 km, centered over France as well),
* EUR50-SN, run over the large domain (using spectral nudging).

Considering the facts that ARPEGE-Climat and ALADIN-Climat models share the same physics and dynamics and that both regional and global simulations were run at the same resolution, ARP50 can be regarded as a reference with which FRA50, EUR50 and EUR50-SN should each be compared.

After an analysis of the differences between the regional simulations and ARP50 in annual and seasonal mean, we focus on the representation of rainfall extremes comparing two dimensional fields of various index inspired from STARDEX and quantile-quantile plots. The results show a good agreement with the ARP50 reference for all three regional simulations and little differences are found between them.

This result indicates that the use of small domains is not significantly detrimental to the modelling of extreme precipitation events. It also shows that the spectral nudging technique has no detrimental effect on the extreme precipitation. Therefore, high resolution scenarios performed on a relatively small domain such as the ones run for SCAMPEI, can be regarded as good tools to explore their possible evolution in the future climate. Preliminary results on the response of precipitation extremes over South-East France are given.