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Land-atmosphere feedbacks in EURO-CORDEX: analysis and impact on the precipitation recycling in a changing climate

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Land-atmosphere interactions are known to play a key role on climate and are expected to be critical to understand its evolution as a consequence of climate change. These land-air feedbacks are of utmost importance in those regions and periods when the intensity of evapotranspiration is high and, at the same time, controlled by soil moisture availability. In the Mediterranean Basin, the amount of rainfall coming from evapotranspiration over land represents a relevant fraction of the total precipitation in the year. Furthermore, many of these areas are affected by water limitations and are expected to be more sensitive to the impact of climate change along the upcoming decades. The latent and sensible heat fluxes in the Euro-CORDEX simulations (0.11 and 0.44) are the starting point for an assessment of the expected changes in the surface evapotranspiration and evaporative fraction (EF) in a changing climate. The changes in the heat fluxes and EF between 2071-2100 and 1971-2000 exhibit a large spread. The majority of the models forecast an increase in EF in Scandinavia and a decrease in the Mediterranean and Iberia.
The WRF model, is also used to explore 3D land-atmosphere coupling over the different regions within the European CORDEX domain, at 0.44 horizontal resolution and for a high resolution domain (9km) over the Iberian Peninsula (IP). We start our analysis by computing the recycling ratio, for the hindcast (1989-2009), through the method of Eltahir and Bras, as a first approach to quantify the intensity of land-atmosphere feedbacks and their impact on the rainfall regime. This method, much more accurate than analytical Integral Moisture Budget recycling models, allows us to explore the spatial distribution of recycling over Europe and therefore focus our analysis on the most sensitive regions. The highest recycling ratio occurs in central and eastern Europe in late spring and summer; where the percentage of precipitation from evapotranspiration is higher than 50%. With the exception of Scandinavia and the Alps in August, the recycling ratio suffers a reduction in the future, although some areas experience an increase in future precipitation, which occurs mostly during the winter and late autumn, when recycling ratios are lowest. Thus this increase is mostly due to the advection of moisture associated to the trajectory of frontal systems.

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