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Using a long-term climate simulation to address future changes in Western Europe precipitation regimes due to global warming

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Moisture transport and Atmospheric Rivers (ARs) over the Northeastern Atlantic are a very relevant process for the inter-annual variability of precipitation over Western Europe. Based on a long-term transient simulation (850-2100CE) from the CESM model, we have showed that moisture transport towards Western Europe (using the vertically integrated horizontal water vapor transport, IVT) has been increasing significantly since pre-industrial period, in a clear association with the global warming trend. Both current and projected changes (using RCP 8.5) significantly exceed the range given by inter-annual to inter-decadal internal/external variability observed during the last millennium.

We have checked the emergence of the temperature, IVT and precipitation signals in Iberia and the UK, showing that while the first two have now clearly emerged from the pre-warming state, precipitation series are still slightly below that threshold. Nevertheless, projections clearly show an increase in rainfall at higher latitudes (i in phase with a warmer and moister atmosphere); and a decrease at lower latitudes decoupled from the overall increase in moisture availability. Additionally we have explored the role played by large-scale circulation and atmospheric dynamics for these contrasting projections. Overall, results show that a poleward migration of moisture corridors and ARs explain a significant fraction of these projected trends. Based on the Clausius–Clapeyron relation we have separated the thermodynamical from dynamical changes. We also show how that a significant increase in subtropical anticyclonic activity over Iberia is responsible for: i) dynamical circulation changes; ii) a shortening of the wet season; iii) to less efficient precipitation regimes in the region. These results highlight the urge to adapt to a drying trend in Mediterranean-type climates, as a consequence of Global Warming.

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