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Analysis of moisture recycling at unprecedented resolution in the western Mediterranean region

Damián Insua Costa[1], Jessica Keune[1,2], Akash Koppa[1], Christian Massari[3], and Diego G. Miralles[1]
[1]Hydro-Climate Extremes Lab, Ghent University, Ghent, Belgium
[2]European Centre for Medium-Range Weather Forecasts, Bonn, Germany
[3]National Research Council, Research Institute for Geo-Hydrological Protection (CNR-IRPI), Perugia, Italy

The western Mediterranean region is a climate change hotspot, where the increase in temperature far exceeds the global average. This is causing its hydrological cycle to be highly impacted, with an increase in the frequency and intensity of droughts, extreme precipitation and floods. For this reason, a more holistic understanding of the atmospheric branch of water cycle and its connexion to meteorological changes is needed. Here we use satellite-based observational data recently generated within the 4DMED-Hydrology ESA project to analyse the atmospheric water transport in the region at an unprecedented resolution. Specifically, we combine a Lagrangian back-trajectory model for moisture tracking (FLEXPART–HAMSTER; Keune et al., 2022) with observed evaporation and precipitation data to quantify moisture recycling at 1 km spatial resolution. Our results show average local precipitation recycling rates close to 30% in summer months, in agreement with previous studies (Batibeniz et al., 2020), but this rate is highly variable over time, being much higher in periods of drought, when water supply is most needed. Likewise, the results reveal that evaporation recycling is highly spatially variable, meaning that moisture evaporated in some parts of the Mediterranean region is much more efficiently rained within the same region than others. For instance, in the Po Valley, the fraction of evaporation that returns to the region as rain is much higher than in its surroundings, which is why we consider it as a Mediterranean moisture source hotspot. Our findings demonstrate how meteorological anomalies can affect the transfer of water through the atmosphere in the region, and highlight the importance of investing in high-resolution Earth observation to advance our understanding of the different branches of the hydrological cycle.

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