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Understanding the influence of a warmer climate on the processes leading to Extreme Rainfalls in the Western Mediterranean. A Pseudo-Global-Warming experiment.

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In the Mediterranean region, there is no consensus in trends of observations of extreme rainfall events, nor agreement between models in multi-models' projections. Yet, extreme rainfalls in the Mediterranean region poses significant risks to human life, infrastructure, and ecosystems. In this context, our work aims to better understand the physical processes leading to changes in extreme rainfall in the region. The region of study is the Western Part of the Mediterranean.

We investigate the topic conducting a Pseudo-Global-Warming experiment. We simulated two 10 years periods with WRF at a convection-permitting resolution, which helps to capture extreme rainfall events more realistically. One simulation is for the period 2011-2020, fed by ERA5 reanalysis (past-present), and another simulation for the same period, but with a climate change signal - extracted from 27 GCM (Global Climate Models) – added to the ERA5 data from 2011-2020. The GCM signal is calculated for a high-emission scenario (SSP585) and the period 2070-2099 with respect to 1985-2014.

We show how the characteristics of events producing extreme rainfalls could change in a warmer climate, focusing on their size, intensity, localization, and durations. Furthermore, we provide insights of the physical processes driving these changes by exploring the relationship between extreme rainfall and indicators of atmospheric conditions favoring their occurrence. For example, we show the connection between high Convective Available Potential Energy (CAPE) and extreme rainfall, both in the present and in a warmer future. We also examine how often extreme rainfall events coincide with convective storms or cyclones, and explore how the relationship between storm occurrence and extreme rainfall may change in a warmer future climate.

Our findings offer valuable understanding of the complex dynamics of extreme rainfall events in the Western Mediterranean region, providing crucial insights into the potential impacts of climate change on this vulnerable area.