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Assessment of projected Mediterranean SST influence on severe precipitation events

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While observations of Mediterranean SST (Sea Surface Temperature) are showing an increasing trend during the last decades, future CMIP6 (Coupled Model Intercomparison Project Phase 6) projections highlight a further increase of approximately 3 °C, according to the SSP3-7.0 (Shared Socioeconomic Pathway) scenario. Among the coastal areas of the Mediterranean Basin, the Calabrian peninsula (southern Italy) is particularly prone to severe hydrometeorological events due to the intense atmosphere-sea interactions, further enhanced by local complex orography.

This study evaluates how the observed and projected Mediterranean SST increase affects the precipitation patterns in Calabria. We performed four months of simulations in a particularly rainy period from September to December 2019 using WRF (Weather Research and Forecasting) model by varying the SST lower boundary conditions. First, we considered actual conditions provided by ERA5 reanalysis. Then, we hypothesised past (a homogeneous decrease of −1 °C, referring approximately to 1980) and future (a homogeneous increase of +3 °C, referring to the end of this century) SST scenarios. Other boundary conditions, also given by ERA5, were not modified.

We focused on 20 rainfall events that actually occurred during the analysed period, whose intensities and spatial patterns were affected by different SST values. Most of the more dangerous events, coming south-eastwards from the Ionian Sea, increased their intensity with higher SST, fueling the atmosphere with water vapour more efficiently. Still, due to the enhanced atmospheric instability, such events were often solved in off-shore storms before reaching the coastline. Therefore, the analysis suggests that if only the SST changes are considered, the frequency of severe inland events will increase due to the enhanced air-sea flux exchange, but the intensity will not.

Further studies will be based on improved, fully-coupled atmospheric, oceanic and hydrological modelling systems and extend the analysis to different Mediterranean regions.