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Modelling heavy precipitation in the Mediterranean

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Besides usually mild climate, the Mediterranean area also concentrates the major natural risks related to the water cycle, including heavy precipitation, flash-flooding and severe cyclogenesis. Mediterranean is also one of hot spots for regional climate change, with extreme weather causing considerable risks to society and economy. For those reasons, major field experiments in the Mediterranean in last two decades such as MAP and Hymex investigated heavy precipitation in the area and contributed to better understanding of the mechanisms of heavy precipitation events as well as to improving capability of modelling and predicting these high-impact weather events. Yet, accurate representation of heavy precipitation events remains one of the greatest challenges of the current early warning systems.

Favorable environmental conditions conducive to heavy precipitation in the Mediterranean include different aspects of synoptic scale and mesoscale forcing. Ingredients based approach since long identifies moisture, instability and lift as key prerequisites for heavy precipitation. Various processes, including large-scale forcing, mesoscale cyclogenesis, low level jet streams, orographic lift, convergence zones, evaporation from the sea, among others, contribute to generating and maintaining conditions favorable for heavy precipitation. Variety of these processes span across scales and relate through non-linear interactions posing considerable challenges to numerical simulations and predictions. While state-of-the-art modelling and prediction of heavy precipitation events has advanced considerably reaching horizontal grid spacing of convective scales, there are still several grand challenges such as parametrizing resolved and unresolved processes in the gray-zone, atmosphere – sea – land – atmospheric composition coupling, convective-scale initialization, and treatment of uncertainties on convective scales. Improved understanding of the processes at play and the related model developments show essential to improve the capability of modelling and predicting high-impact weather events.