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Heavy rainfall in Mediterranean cyclones: Contribution of deep convection and warm conveyor belt

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In this study, we provide an insight to the role of deep convection (DC) and the warm conveyor belt (WCB) as leading processes to Mediterranean cyclones heavy rainfall. To this end, we use reanalysis data, lighting and satellite observations in order to quantify the relative contribution of DC and the WCB to cyclones rainfall, as well as to analyse these processes spatial and temporal variability respect to the cyclones centre and life cycle.

Results show that the relationship between cyclone rainfall and intensity shows high variability and demonstrates that even intense cyclones may produce low rainfall amounts. However, when considering rainfall averages for cyclone intensity bins, a linear relationship was found. We focus on the 500 most intense tracked cyclones (responsible for about 40-50% of the total Mediterranean rainfall) and distinguish between the ones producing high and low rainfall amounts. DC and the WCB are found to be the main cause of rainfall for the former (producing up to 70% of cyclone rainfall), while, for the latter, DC and WCB play a secondary role (producing up to 40% of rainfall). Further analysis showed that DC and WCB are rather distinct processes, being rarely collocated. In fact, rainfall due to DC tends to occur close to the cyclones' centre and to their eastern sides, while WCB tends to produce rainfall towards the northeast. Finally, DC was found to be able to produce higher rain rates than WCBs.

Our results demonstrate in a climatological framework the relationship between cyclones intensity and processes that lead to heavy rainfall, one of the most prominent environmental risks in the Mediterranean. Therefore, we set perspectives for a deeper analysis of the favourable atmospheric conditions that provoke high impact weather. Our study has been performed in the context of the project: Cyclone processes leading to extreme rainfall in the Mediterranean region (ExMeCy; Marie Skłodowska-Curie actions, grant agreement-658997)