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Links between Synoptic Weather Types and Extreme Wet Events in the Arabian Peninsula (1960-2100)

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In this work, an automated version of the Lamb weather type classification scheme was applied to classify daily weather types in the Arabian Peninsula. The output catalogue included ten basic weather types, which describe the direction and vorticity of airflow in the peninsula (i.e. cyclonic, anticyclonic and directional). These large-scale patterns were first defined for the observed climate (1960-2013), allowing for an assessment of the spatial and temporal variations in circulation–rainfall relationships over the peninsula using rainfall data from 209 weather observatories. The same methodology was then applied to assess how the defined weather types will be presented in future climate simulations (under RCP45 and RCP85 emission scenarios) and to explore their probable dependency with rainfall characteristics. In this regard, daily simulated SLP derived from an ensemble of 12 climate models within the CMIP5 project were used for two future time-slices (2035-2060 and 2075-2100). Our findings indicate that the cyclonic (C) type represented the most frequent classification with 69.2% of days, followed by SE directional flows (21%). It was also found that the main circulation features influencing winter (spring) rainfall across the peninsula are the strong influence of the anticyclonic (easterly and southeasterly) air masses. Generally, the role of airflows originating from the Indian Ocean is larger than those of the Mediterranean and the Red Seas. The trend results of defined weather types show that the cyclonic (anticyclonic) conditions tend to decrease (increase). This picture is likely to continue during the 21st century. The only exception corresponds to the summer season. Here, understanding the association between atmospheric circulation patterns and rainfall in the Arabian Peninsula can be important for the understanding of climatic variability and thus developing circulation-based downscaling methods in this region.