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Role of the Angola Low in modulating southern African austral summer rainfall and relationships with synoptic and interannual modes of variability

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The Angola Low has been suggested in many previous studies to be an important regional feature governing southern African rainfall variability during austral summer, which is, in particular, expressed through modulations of El Niño Southern Oscillation (ENSO) impacts on rainfall at the interannual timescale. Here, we analyse a variety of state-of-the-art reanalyses (NCEP2, ERA-Interim and MERRA2) and rainfall data (in situ rain-gauges and satellite-derived products) for: i) identifying the recurrent regimes of the Angola Low (position and intensity) at the daily timescale; ii) diagnosing how they modulate the spatio-temporal variability of austral summer rainfall; and iii) examining their relationships with synoptic convective regimes and ENSO, both at the interannual timescale.

The recurrent regimes of the Angola Low are identified over the 1980–2015 period by applying a cluster analysis to daily 700-hPa wind vorticity anomalies over the Angola sector from November to March. The exact number and morphological properties of vorticity regimes vary significantly among the reanalyses, in particular when using the lowest spatial resolution reanalysis (i.e. NCEP2) that leads to detect less diversity, smoothest patterns and weakest intensity across the recurrent regimes. Despite such uncertainties, the regimes describing active Angola Low are quite robust among the reanalyses. Three preferential locations (locked over eastern Angola, shifted few degrees eastward or south-westward), which significantly impact on the rainfall spatial distribution over tropical and subtropical southern Africa, are identified. Independently from its location, Angola Low favours moisture advection from the southwest Indian Ocean and reduces moisture export towards the southeast Atlantic, hence contributing to increase moisture convergence over the subcontinent. Lead/lag correlations with synoptic convective regimes suggest that Angola Low may be a local precursor of tropical-temperate troughs, but this relationship is far from being systematic and quite sensitive to the reanalyses. Finally, the influence of ENSO on the seasonal occurrence of active Angola Low appears to be highly dependent on the choice of the reanalyses. For instance, active Angola Low tends to be independent from ENSO in NCEP2, while it is clearly driven by ENSO, through increasing occurrence during La Niña conditions, in ERA-Interim and MERRA2. Our results point thus toward strong uncertainties in state-of-the-art reanalyses for studying regional circulation features, and their connection with large-scale climate dynamics at the interannual timescale.