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Precipitation over the Arabian Peninsula: Global Forcing and Tele-connections

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We investigate the spatio-temporal variability of precipitation over the Arabian Peninsula, its relationships with large-scale climate indices and atmospheric circulation patterns, and its possible connection with the dynamics of sea surface temperatures in the Pacific and Atlantic Oceans, and in the Mediterranean.
Whether El Niño-Southern Oscillation has been shown to be one of the primary drivers of precipitation inter-annual variability over this region, the role of North Atlantic Oscillation in shaping the extremely intermittent hydro-climatology of the Arabian Peninsula has been scarcely explored in the literature.
Using a composite analysis of Global Precipitation Climatology Centre (GPCC) precipitation data for winter months (DJFM), we observed that during El Niño years when the North Atlantic Oscillation (NAO) persist in a negative phase, the Arabian Peninsula receives more rainfall while precipitation drastically decreases during La Niña years and when NAO is in its positive phase. Also, El Niño winters are more conducive to a negative NAO phase.
Basing on NCEP/NCAR Reanalysis, we also found a distinct shift in phase of Rossby wave patterns during El Niño and La Niña years, most likely mediated by the winter sub-tropical stream. Rossby waves are known to have an equivalent barotropic structure that projects to the lower troposphere. Our analysis highlighted how the jet stream position is shifted towards low latitudes during El Niño years. Since the subtropical jet stream is also affecting precipitation over the Arabian Peninsula – being the core of the subtropical jet stronger during the winter over this region – we conjecture that the combined effect of the shift in the position of the jet stream and the change of phase of Rossby waves (with associated low level vorticity anomalies) during El Niño years could result in an increase of onshore moisture advection from neighboring oceans.This could be the cause of increased precipitation in particular upon encountering mountains terrains, as far down stream of Saudi Arabia.