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A monsoon-like Southwest Australian circulation and its relation with rainfall in Southwest Western Australia

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Using the NCEP/NCAR, ERA-40 reanalysis, and precipitation data from CMAP and Australian Bureau of Meteorology, the variability and circulation features influencing the southwest Western Australia (SWWA) winter rainfall are investigated. It is found that the climate of southwest Australia bears a strong seasonality in the annual cycle and exhibits a monsoon-like atmospheric circulation, which is termed as the southwest Australian circulation (SWAC) for its several distinct features characterizing a monsoonal circulation: the seasonal reversal of winds, alternate wet and dry seasons, and an evident land-sea thermal contrast. The seasonal march of the SWAC in extended winter (May to October) is demonstrated by pentad data. An index based on the dynamics normalized seasonality was introduced to describe the behavior and variation of the winter SWAC. It is found that the winter rainfall over SWWA has a significant positive correlation with the SWAC index in both early (May to July) and late (August to October) winter. In weaker winter SWAC years there is an anti-cyclonic anomaly over southern Indian Ocean resulting in weaker westerlies and northerlies which are not favorable for more rainfall over SWWA, and the opposite combination is true in the stronger winter SWAC years. The SWAC explains not only a large portion of the interannual variability of SWWA rainfall in both early and late winter, but also the long term drying trend over SWWA in early winter. The well-coupled SWAC-SWWA rainfall relationship seems to be largely independent of the well-known effects of large-scale atmospheric circulations such as the Southern Hemisphere Annular Mode (SAM), El Niño/Southern Oscillation (ENSO), Indian Ocean Dipole (IOD) and ENSO Modoki (EM). The result offers qualified support for the argument that the monsoon-like circulation may contribute to the rainfall decline in early winter over SWWA.