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A Climatology of Daily Synoptic Circulation Patterns and Associated Surface Meteorology over Southern South America

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A climatology of synoptic scale circulation patterns and associated surface meteorology over southern South America is presented. The synoptic circulation patterns, defined as anomalies in sea level pressure (SLP), 500 hPa geopotential height (Z500), and 250 hPa wind speed (V250) and referred to as large-scale meteorological patterns (LSMPs), are characterized using the self-organizing maps (SOMs) approach. Results show a wide range of possible LSMP types over a 37-year period of study. LSMP type variability can be summarized as a spectrum from patterns dominated by positive SLP and Z500 anomalies with a poleward displacement of the strongest 250 hPa winds, to patterns dominated by similar structures but with anomalies of opposite sign. These LSMPs are connected with lower tropospheric temperature and wind, precipitation, and the frequency of atmospheric rivers (ARs). This highlights which LSMPs are most associated with anomalous and potentially impactful surface meteorology. Results show ARs as primary drivers of precipitation over some of the region and connect the occurrence of ARs to their driving synoptic dynamics. Two important low frequency modes of climate variability, the Southern Annular Mode (SAM) and the El Nino Southern Oscillation (ENSO), show some influence on the frequency of LSMP type, with the SAM more directly related to LSMP type modulation than ENSO. This comprehensive climatology of synoptic variability across southern South America has potential to aid in a mechanistic approach to studying climate change projections of temperature, precipitation, and AR frequency in climate models.