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Shifts in Interannual Sea-Ice Patterns in the Southern Ocean in Association with Large-Scale Atmospheric Modulation

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We verified persistence of the Antarctic circumpolar wave with 4-year cycles of eastward synchronous propagations of the spatial patterns of sea-ice concentration (SIC) of wavenumber 2 around the Antarctic. An empirical orthogonal function (EOF) analysis of newly available passive microwave satellite data for 1979–2003 objectively demonstrates that the spatial pattern of SIC with wavenumber 2 propagated eastward only in 1984–1994. In other years, no significant eastward propagating features were identified. The results from our atmospheric data analyses show that interannual variations in sea-ice patterns are associated with differences in the dominant large-scale atmospheric patterns. In non-propagating years, variance of the tropospheric Antarctic oscillation (AAO) predominated. However, when SIC anomalies propagated eastward, the AAO variance was secondary to that of the Pacific South American (PSA) teleconnection pattern having 4-year cyclicity. Such periodic PSA enables the SIC anomalies to propagate eastward with a periodically reinforced dipole pattern. The modulation of large-scale atmospheric variability is one possible cause of the shift in the SIC pattern. The switch of the atmospheric EOF leading mode from the PSA pattern to the AAO in the mid-1990s corresponded to a shift in the SIC pattern and supports the presence of atmospheric modulation.