Influence of the Boreal Autumn SAM on Winter Precipitation over Land in the Northern Hemispherer

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As an atmospheric oscillation with a global scale, the Southern Hemisphere (SH) annular mode (SAM) not only contributes to SH climate variability, but also to climate anomalies in the Northern Hemisphere (NH). This paper demonstrates that the strong (weak) boreal autumn SAM usually favors a positive (negative) tripole precipitation pattern in the NH, with more (less) precipitation over the equator and mid-latitudes, but less (more) precipitation in the subtropics. The corresponding mechanism is examined based on reanalysis data and numerical modeling. It is suggested the boreal autumn SAM is associated with changes in surface subpolar westerlies, which influence the surface heat exchange and drive the meridional oceanic Ekman flow, redistributing heat near the surface. Through these, warmer (colder) and colder (warmer) sea surface temperature (SST) belts in the SH middle and high latitudes form in response to the positive (negative) boreal autumn SAM, respectively. Such a positive (negative) Southern Ocean SST dipole pattern can persist into the boreal winter via the "memory" of SST. It can then affect the vertical motion in the SH meridional circulation, and strengthen (weaken) the NH upward and downward branches. These anomalous vertical flows favor a positive (negative) tripole precipitation anomalies pattern in the NH under suitable moisture conditions. Such an "ocean–atmosphere coupled bridge" allows the influence of the boreal autumn SAM to persist into the following season and affect the NH climate. Hence, this work suggests that the boreal autumn SAM provides a significant forecasting signal for the NH climate in the following winter.

Key words: Southern Hemisphere annular mode, ocean–atmosphere coupled bridge, Precipitation