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Impact of the winter North Atlantic Oscillation (NAO) on the Western Pacific (WP) pattern in the following winter through Arctic sea ice and ENSO

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This study tested the hypothesis that Asian weather and climate in a given winter can be predicted 1 year in advance. On the basis of a 51-year statistical analysis of reanalysis data, we propose for the first time that the positive phase of the Western Pacific (WP) pattern in the winter is linked to the negative phase of the North Atlantic Oscillation (NAO) in the previous winter, and vice versa. We show that there are two possible mechanisms responsible for this interannual remote linkage. One is an Arctic mechanism. Extensive Arctic sea ice in the summer after a negative NAO acts as a bridge to the positive phase of the WP in the next winter. The negative (positive) phase of the winter NAO changes oceanic currents in the North Atlantic and weakens (strengthens) oceanic heat transport into the Arctic. This weakened (strengthened) heat transport also slows down (speeds up) the reduction of sea ice in the spring. A condition of more (less) ice than normal then persists until the season of ice freezing in autumn. In winter, all of the Arctic Ocean is covered by sea ice, regardless of the autumn ice area. Less (more) ice production during the freezing season reduces (increases) the heat released from the ocean to the atmosphere in the Arctic. An anomalously small (large) heat flux excites stationary Rossby wave propagation, which induces warm (cold) advection to Japan.

The other mechanism involves the tropics. An El Niño occurrence after a negative winter NAO acts as another bridge to the positive phase of the WP in the following winter. The timescale of the Arctic route is nearly decadal, whereas that of the tropical route is about 3–5 years. The tropical mechanism indicates that the NAO remotely excites an El Niño in the second half of the following year. A process perhaps responsible for the El Niño occurrence was investigated statistically. A negative NAO in the winter increases Eurasian snow cover. This anomalous snow cover then intensifies the cold air outbreak from Asia to the western tropical Pacific. This outbreak can intensify the westerly wind burst and excite El Niño in the following year. We suggest that the phase of the NAO in the winter could be a predictor of the WP in the following year. Detailed is in Oshika, Tachibana and Nakamura in Climate Dynamics (2014), DOI: 10.1007/s00382-014-2384-1.