Spatial structure of the Arctic Oscillation, North Atlantic Oscillation and Polar-night Jet related variation

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To explain the change of the meteorological conditions around the north polar region, Arctic Oscillation (AO) and North Atlantic Oscillation (NAO) indices are widely used. The AO and the NAO are often treated as one phenomenon. Here we propose to separate the Atlantic NAO which is characterized by a north-south seesaw of surface pressure over the Atlantic Ocean sector from the AO (or hemispheric NAO) which can be characterized by a seesaw between the polar region and midlatitudes. Usually, the leading Empirical Orthogonal Function (EOF) of the surface pressure is used to define the AO, but the use of the hemispherical EOF is problematic, especially over the North Pacific sector where an independent source of variability, such as the PNA, exists and mixed up.

A characteristic spatial pattern of the above mentioned Polar-Midlatitude Seesaw has no clear center of action over Pacific and North Atlantic Ocean, but a center of action is located over Europe. Such a teleconnection pattern has been found by Exner in 1913. He showed a seesaw pattern by using a mean pressure data of polar stations and a station data of Lugano in Switzerland.

Tropospheric variation related to the stratospheric polar vortex or polar night jet exhibits rather Polar-Midlatitude Seesaw pattern than the AO or NAO-like one. This pattern is closely related to the topography of the region surrounding the north pole.

The principal process producing a Polar-Midlatitude Seesaw patter in the surface pressure is a change in vertical winds in the polar troposphere driven by wave forcings. Upward motion in the polar region induces meridional flows near the surface, especially around the Norwegian Sea and Bering Strait, which induce wavy patterns in the surface pressure. The importance of distinguishing this pattern from the NAO, or AO in understanding the recent trends is also addressed.