EMS Annual Meeting Abstracts
Vol. 15, EMS2018-233, 2018

AO, BO, CO, ...? How to recognize a real teleconnection pattern from a fake

Radan Huth (1,2) and Romana Beranová (2)

(1) Charles University, Faculty of Science, Dept. of Physical Geography and Geoecology, Praha 2, Czechia (huth@ufa.cas.cz), (2) Institute of Atmospheric Physics, The Czech Academy of Sciences, Praha 4, Czechia

AO (Arctic Oscillation) and BO (Barents Oscillation) have been identified as modes of variability (teleconnections) in sea level pressure (SLP) by unrotated principal component analysis (PCA). AO is typically defined as the first mode of SLP northward of 20 N, while BO is the second or third mode of such an analysis. AO appears as a tripole pattern with one centre residing over the Arctic and two other centres of the opposite sign located over the North Atlantic in the area of the Azores high and over the North Pacific in the area of the Aleutian low. AO has been used in numerous climatological studies and studies of atmospheric dynamics. BO consists of two major centres with opposite signs, one of which is located over northern Eurasia, the other extending from Greenland across the Canadian Archipelago towards Beaufort Sea. BO has been related e.g. to sea ice transport in the Arctic. Several studies have shown that unrotated PCA is prone to produce modes (patterns) that do not correspond to real correlation structures in the data, that is, that are statistical artifacts. Instead, rotated PCA is generally recommended as a suitable tool for detection of teleconnections.

For a teleconnection pattern to be considered realistic, one must demonstrate that it corresponds to real correlation structures. Although a physical realism of AO has been doubted many times on various grounds and AO has been clearly demonstrated to be a statistical artifact rather than a real teleconnection, its wide use has continued.

The objective of this contribution is to demonstrate that both AO and BO, if conventionally defined (that is, being produced by unrotated PCA), are not real atmospheric features (teleconnections) and to contrast their behavior with the North Atlantic Oscillation (NAO), which is defined from rotated PCA. To this end, we (i) compare AO, BO, and NAO with corresponding (auto-)correlation maps, (ii) analyze their sensitivity to spatial subsampling, that is, we attempt to identify them over domains of different positions and sizes, and (iii) analyze their sensitivity to temporal subsampling, that is, we examine whether, and how much, they change between temporal subperiods. Our results clearly indicate that, unlike NAO, which is a real mode of atmospheric variability, AO and BO are not real teleconnections and should be not interpreted as such.

And what about CO? It has not been identified by anyone yet, but we are afraid that an improper use of PCA could result in an alleged identification of another spurious, really non-existing mode (teleconnection) in future. We hope that our analysis will help prevent this from happening.