



## **How to recognize a real teleconnection from a ghost pattern: Guidelines based on synthetic data**

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Atmospheric teleconnections (modes of low-frequency variability of atmospheric circulation) are commonly detected by principal component analysis (PCA). Although many papers have argued that rotation is a necessary prerequisite to make outputs of PCA interpretable, several patterns have been defined in the Northern Extratropics by using unrotated PCA and are still being analyzed and discussed. These patterns include Arctic Oscillation, Barents Oscillation, and summer East Atlantic pattern. Such patterns do not correspond to real structures present in atmospheric circulation, and we coined term 'ghost patterns' for them because although they do not exist in reality, people believe in their existence and some even believe they have seen them.

This contribution proposes a methodology aiming to recognize a real mode of variability from a ghost. It is based on synthetic data with a known internal structure, which are subject to several analyses: one-point correlation maps are calculated for them, and the sensitivity of outputs of PCA to spatial and temporal subsampling is examined. We clearly demonstrate that rotated PCA must be used if one wants to detect real teleconnections and not to be mistaken by ghosts.