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Spatial variability of the North Atlantic Oscillation

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The North Atlantic Oscillation (NAO) is a seesaw in mass (or anticorrelation in pressure) between a northern center of action, located close to Iceland, and a southern center of action, located close to the Azores. It is assumed to have a fixed spatial structure during winter and an index of time variability is measured, the NAO index. However, it is well documented that there was a shift in location of the northern center of action of the NAO from the two decades 1958-1977 to the two decades of 1978-1997.

In this talk we examine dynamical changes associated with the aforementioned shift in the northern center of action of the NAO. We then go on to examine variability in the location of both centers of action over a longer time period, or from 1871. The analysis results in two possible approaches to understanding the evolution of the NAO.

First, we define an additional index (to the NAO index), the angle index, to describe decadal atmospheric variability in the region associated with spatial shifts in the centers of action of the NAO. The angle index measures the angle that the great circle connecting the two centers makes with the meridian running through the northern center. It gives supplemental information to the NAO index alone.

In light of the slow movement of the NAO, one may need more than the one dominating climate pattern to describe low-frequency atmospheric variability in the region. However, it is conceptually attractive as well as economical to summarize atmospheric low-frequency variability by referring to one climate pattern, especially when one is examining interactions with other parts of the climate system such as sea-ice variability. As our second approach we are developing an alternative to the static EOF-based (or correlation based) definition of the NAO. Our work to develop a dynamic statistical model to characterize the evolution of the NAO will be briefly described.