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# Are Northern Hemisphere teleconnection patterns stable over the last 500 yr?

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The climate variability of the atmospheric circulation is characterized by a number of preferred patterns, the so-called teleconnection patterns. These patterns, like the North Atlantic Oscillation (NAO) or the Pacific North American (PNA) pattern, modulate the heat, moisture and momentum fluxes, and influence the strength and the location of major cyclone tracks. Studies show that not only the low-frequency variability connected to teleconnections changes with time, but also the centers of action shift. Thus, there is still a need to understand the low-frequency variability and the stability of these teleconnections.

A detailed analysis is undertaken of teleconnection patterns of the Northern Hemisphere in an ensemble of GCM simulations for the past 500 years and a 1990 control simulation. Four transient simulations are performed with the Community Climate System Model (version 3.0, CCSM3), using time-varying greenhouse gas, solar, and volcanic forcing functions.

Both teleconnection patterns will be analyzed, employing daily to seasonal data. Preliminary results show for the Atlantic-European region that the NAO-type pattern is not stable in time. In particular, the southern center of action moves from its classical position of the Azores – Spain to the eastern part of the Mediterranean leading to a meridional flow pattern. The anticorrelation of the northern and the southern centers of action show also strong decadal variations. This instability of teleconnections is resembled by climate field reconstructions showing a similar shift of the location

of the southern center of action and changes in the anticorrelation. However, testing the multi-variate regression technique, used as reconstruction method, in the ’model world’ shows that the method underestimates the variability, as EOF filtering and the decrease of proxy informations back in time lead to a reduction of the degrees of freedom. The ensemble simulations show no clear connection to natural and anthropogenic forcing functions suggesting that the instability of teleconnection patterns and their low-frequency behavior is dominated by internal atmosphere-ocean dynamics. Note that only one model set up is used; thus, this result could be model dependent, due to the model uncertainties (e.g., the coarse resolution).