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Identifying atmospheric teleconnections from point correlation maps using self-organizing maps

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To identify atmospheric teleconnection patterns in 60 years of NCEP temperature, pressure and geopotential height anomalies, point correlation maps are presented to a Self Organizing Map (SOM), which topologically orders the patterns and provides a measure of frequency of pattern occurrence. Well known patterns can be identified within the SOM, such as the NAO, ENSO and the PNA, however the flexibility of the SOM allows these patterns to be viewed as part of a spectrum, or continuum, of patterns, each identifiable as a variation within a defined teleconnection pattern. The SOM patterns are then clustered to reduce the number of patterns and explore the separation of distinct patterns from the spectrum. Idealized periodic patterns of increasing complexity are used to test and explain the method.

To assess the robustness of the method a SOM was constructed using point correlation maps for 60 years of NCEP surface temperature anomalies. Point correlation maps for the first and last 30 years are then compared to the SOM patterns constructed from the whole period. The patterns were robust and the pattern frequency data was able to identify the increased frequency of ENSO Modoki in the second half of the data, as observed in other studies, illustrating the method's capability to detect changes within teleconnection patterns over time.

This method can be extended by the use of correlation maps from multiple variables presented simultaneously to the SOM, helping to investigate the relationship between different aspects of the atmosphere. For example, correlation maps for surface temperature, surface pressure and geopotential height can be combined to evaluate the state of the atmosphere associated with specific patterns and how changes in the structure affect the form of the teleconnection patterns. Similar insights can be gained by using time lagged point correlation maps to investigate the predictability of teleconnection patterns.