Combining point correlation maps with self-organizing maps to investigate atmospheric teleconnection patterns in climate model data

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**Method**

Point correlation maps from NCEP/NCAR SLP (1) were used for SOM training. Size of hexagons proportional to number of hits, black: NCEP/NCAR, grey: FORTE.

**Results**

The SOM identifies many of the well known teleconnections, some of which are shown below, along with their corresponding locations on the SOM. The bottom left and top right corners of the SOM both represent the North Atlantic Oscillation. As these patterns are made from correlation maps with base points in opposite centers of action (shown by yellow contours), the patterns are inverted. The SOM located them on opposite sides because they oppose each other. Similar patterns, such as the Indian and African Monsoons are located next to each other on the SOM. Comparing the distribution of hits on the SOM (black and grey hexagons) show NCEP/NCAR and FORTE hits respectively reveals how well FORTE reproduces the observed teleconnections. For example cluster 2, near the top left of the SOM, which corresponds to the North Pacific oscillation, is reproduced well by FORTE, with a frequency of occurrence of 2.0% compared to NCEP/NCAR’s 2.2%. The FORTE pattern and the location of the base points are also in good agreement. In contrast FORTE provides no hits for the Indian Monsoon cluster (top center of the SOM), indicating teleconnections in this region are poorly represented by FORTE.

**Introduction**

Teleconnections are one of the main sources of inter-annual to inter-decadal variations in weather and climate and, because of their medium term impact, are informative when producing seasonal and long-range forecasts. As the climate changes, the spatial and temporal structure of teleconnections may change, so it is important to understand present day teleconnections and how they are represented in climate models.

This study identifies teleconnection patterns in 60 years of NCEP/NCAR sea level pressure (SLP) reanalysis data (Kalnay et al. 1996) and uses these patterns to assess the skill of the medium complexity climate model FORTE (Sinha and Smith, 2002; Wilson et al. 2009).

We use a new method combining point correlation maps, which identify the relationships in grid data, with a self-organizing map (SOM) (Kohonen, 1982), which groups the large number of correlation maps into teleconnection types, arranges them topologically (similar patterns are close together, different patterns are far apart) and provides a measure of frequency of occurrence for each pattern. See the box on the left for details.

**Discussion**

The combination of correlation maps with SOMs can identify teleconnections in a grid dataset and identify the regions that are important for their existence. The frequency of occurrence of any given pattern in the original dataset is useful when aiming to understand the influence of a pattern.

Using the method to compare NCEP and FORTE shows that FORTE is able to produce realistic teleconnection patterns, albeit generally too zonally orientated, with geographically variable skill. The Indian Ocean is a weak area for FORTE, while the North and equatorial Pacific and North Atlantic are reasonably well reproduced. The accuracy of frequency of occurrence is variable between patterns.

**Future Work**

This method will be used to evaluate teleconnection representation in a subset of the CMIP3 suite of historical runs and to investigate how the structure of teleconnections are projected to change in the future. Additional variables will be included, such as sea surface height, temperature and precipitation, to gain an understanding of the impacts and 3D structure of teleconnections.

**References**


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