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Continuum of teleconnections: principal component analysis versus self-organizing maps

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Self-Organizing Maps (SOMs) is a classification technique based on artificial neural networks, which produces typical patterns (types) as its output and organizes them into a rectangular array. SOMs have been applied to the detection of typical circulation patterns. It has been suggested that two strongest teleconnections (expressed in terms of leading two principal components) tend to appear along the main diagonals of the SOM array, with opposite polarities in its opposing corners. It is, however, unclear whether and to what extent SOMs are able to capture variability coming from higher-order (weaker, other than the two leading ones) teleconnections.
Another attempt to relate teleconnections and SOMs consists in interpreting teleconnections as a continuum of patterns, which is visualized by SOMs. This is a kind of misconception in our opinion, however, because SOMs provide a classification of circulation patterns into individual types, whereas teleconnections cannot be interpreted this way: any circulation type (regardless of whether obtained by a SOM or any other classification method) can be approximated, equally to any atmospheric state, by a linear combination of teleconnections.
The objective of this contribution is to compare SOMs and PCA in order to clarify the difference of both methods in atmospheric pattern recognition. To evaluate the relationship between teleconnections and both techniques we use synthetic datasets with predefined patterns of variability. We create four simple abstract pressure patterns (zonal flow, meridional flow, a centred high/low, and an off-centre high/low), with and without noise components, to serve as known variability patterns.