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How do self-organizing maps relate to modes of circulation?

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Self-organizing maps (SOMs) have recently become one of the most popular methods applied in synoptic climatology to typing circulation patterns. On top of producing a classification, the method is able to organize the types into a rectangular array, that is, to create a two-dimensional representation of a multi-dimensional phase space – a "map" in which similar circulation types tend to be localized close to each other. Although the method was not constructed to find leading modes of circulation variability (teleconnection patterns), unlike for example principal component analysis, previous research suggested that the first two leading modes (principal components) project onto the diagonals of the map such that opposite phases of one mode occupy opposite corners of the map. This suggestion may have been one of the reasons why some researchers attempted to interpret SOMs as a continuum of teleconnections pattern, which is in our opinion a misconception.

The proposed work aims to investigate how two leading mode, as well as additional lower-order modes project onto SOMs. To this end, synthetic datasets were produced with multiple combinations of predefined modes of variability. Preliminary results suggest that if the synthetic data consist of two modes, each explaining approximately half of the total variability, and the SOM is symmetric (e.g., 5×5 patterns), there is a chance (but not certainty) that each mode occupies one diagonal of the map, while the remaining patterns are various combinations of both modes. In asymmetric SOMs (e.g., 4×3 patterns) and/or when a third mode is added, rather diverse results can be obtained when multiple integrations are computed with different initializations (selection of seed points) and different setting of method parameters. In the next step, real circulation patterns will be analyzed in a similar manner.