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Natural variability visualized by self-organizing map

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We propose a new method, spherical self-organizing map (SOM) with dynamically growing neurons, to visualize modes of natural variability. In the fields of meteorology and climatology, empirical orthogonal function (EOF) analysis has been traditionally used to extract the leading patterns of natural variability. However, EOF analysis obtains a linear mapping only, and the contribution rate of the two principal components to the total variance is less than 30% for most cases. In the present study, we propose a high speed spherical SOM to obtain a more powerful nonlinear mapping. In our method, starting from a few neurons, we add neurons in the most variance region step by step. We also move neurons in projected sphere. Then, computational time is significantly reduced in a typical case (10000 times faster than conventional SOM). In addition, this high speed SOM allows us to visualize dominant modes of a huge observational climatology dataset in a two-dimensional visible space in a topology-preserving manner. As a result, our SOM successfully distinguishes the modes which are significantly different physical patterns, but projected to near positions with the EOF analysis. Our method therefore gives rise to a better and fast understanding of natural variability in the huge climatology dataset. At present we are detecting and visualizing dominant modes of the natural variability in the climatology datasets in the GCM, in which present climatology are reproduced. We will also visualize dominant modes of climate change in the GCM using our SOM.