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Conditional classification as a tool to identify 3D control domains

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Common classification approaches usually operate on both a fixed regular domain like the NCEP/NCAR reanalysis data and a predefined number of predictors. Such assumptions are convenient for many traditional large-scale weather type classification. However, for finding linkages between atmospheric characteristics and local phenomena there is no rigorous justification for such assumptions. In fact, we would expect atmospheric subspaces with natural shapes varying in time and space.

The proposed approach attempts to optimize the choice of predictors and their corresponding input domain used for conditional classification. Unlike common classification methods, we optimize the input to a semi-objective cluster algorithm to extract atmospheric states with similar observed local scale predictants and allow irregular spatial boundaries for each predictor domain. The optimization requires a cost-function specifying the desired criteria for clustering, e.g., significantly different precipitation distributions of each class. Once, a proper criteria is defined, the classification turns out to be an ordinary optimization problem in terms of minimizing the user-defined cost-function. The approach is not constrained to a specific clustering algorithm; for this study a nonlinear unsupervised clustering method called Self-Organizing Maps (SOM) was utilized. A generic and robust probabilistic Simulated-Annealing algorithm was used for optimization. The algorithm has been applied to precipitation distribution in the Rhineland region (Germany) and Svalbard (Arctic). The results confirm, that physically meaningful predictor domains can be identified by this approach.