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Bayesian downscaling of ensemble prediction systems. Application to climate change scenarios

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An adaptation of the standard analog downscaling method to deal with Ensemble Prediction Systems (EPS) is introduced using a Bayesian framework. To this aim, a predefined number of 'weather types' is considered. This task is carried out using a topology preserving clustering method (the Self-Organizing Maps, SOM), which projects the weather types into a 2D lattice, so neighboring (similar) types of weather in the reanalysis space are also neighbors in the 2D lattice. Thus, each of the weather modes acts as a set of analogs for all the clustered atmospheric patterns.

Using this framework, the members of a EPS forecast define a Probability Distribution Function (PDF) on the weather types space which preserves the original spread of the ensemble (due to the topology-preserving property). A probabilistic forecast for a local predictand is computed as its posterior probability given the EPS forecast (expressed as a PDF of the weather types). As we show in this work, this framework can also be efficiently used for quantifying the spread, or uncertainty, of the local predictions.

We illustrate the application of this technique to produce regional climate change scenarios in Spain. An intuitive and visual appealing estimation of the climate change is derived measuring the time-varying differences (e.g., Kullback-Leibler) of the PDFs corresponding to future climate projections.