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Is the analog method able to reconstruct precipitation over Europe?

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The analog method, a technique originally designed for weather forcast, has found many applications in climate studies. It has been traditionally used as a tool to perform statistical downscaling, for example using large-scale fields like SLP as predictor of other regional-dependent variables such as precipitation. However, it can also be used inversely in the so-called up-scaling modus. In this case, local information can be used to estimate large-scale fields. The latter approach can be used as a tool to produce climate field reconstructions based on proxy indicators of past local climate. The analog method used for field reconstruction technique has several advantages over traditional methodologies. First, it is a non-linear method, which reduces the well known problem of the underestimation of past variability by most reconstructions. Second, it does not make any assumption on the statistical nature of the variable which is attempted to be reconstructed. The latter feature makes it specially interesting for the reconstruction of non-gausian variables, such as precipitation.

However, the analog method relies on a requirement not easy to meet: a “sufficiently large” pool of prototype cases which can be used as analog for any situation. Here, “sufficiently large” depends on the nature of the variable under reconstruction: its autocorrelation, its spatial coherence, etc. In the case of precipitation, the required size of this pool is generally much larger than in the case of temperature, and these analogs have to provide fine regional details which can not be provided by coarse resolution gridded data sets, as those produced by Global Circulation Models.

Here we use a new 2000 year-long regional simulation for Europe at 45 km spatial resolution as the pool for the analog method to reconstruct precipitation fields. We have designed an experiment with pseudo-proxies to test to what extent the analog method, used with this large pool of 2000 seasons, has real capability to be used to reconstruct seasonal precipitation over Europe once real proxy data is used in the search of the analogs. Our results show that the method preserves very well the variance, although the correlation decreases very fast when we look at locations not very close to the pseudo-proxies, especially in summer. Different modifications can be applied to the method to increase the correlation, but the variance is then reduced. A trade-off between correlation and variance is apparent, and seems to be the bottleneck of the method.