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# Spatial similarity and transferability of analog dates for precipitation downscaling over France

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High-resolution weather scenarios generated for climate change impact studies from the output of climate models have to be spatially coherent. Analog Models (AMs) have a high potential to generate such scenarios. For each prediction day, they use as scenario the weather observed for days in a historical archive that are analog according to different predictors. When a same "analog date" is chosen for a prediction at several sites, the spatial coherency is automatically fulfilled. The optimal predictors and next the optimal analog dates are however expected to depend on the location for which the prediction has to be made.

In this study, a set of 8,981 locally AMs – specifically optimized for the probabilistic prediction of 8,981 local precipitation "stations" over France – is used to explore the two following questions:

- How does the domain-optimized AM perform for precipitation prediction at another location if the analogy domain used to identify the analog dates (in terms of spatial shape of 1000 and 500 hPa geopotential fields) is optimized to predict precipitation at a given location (question of transferability)?
- To what extent are the analog dates derived from a first AM domain-optimized for a given location similar to those of a second AM domain-optimized for a second location (question of similarity)?

The mean similarity level of analog dates obtained from two different AMs is assessed with the percentage of issued predictions for which the number of identical analog dates is larger to a given percentage threshold. The spatial transferability is assessed with the loss of prediction performance – expressed by the Continuous Ranked Probability Skill Score (CRPSS) – when the transposed AM is used instead of the locally domain-optimized one.

In our case, the mean similarity level is very low excepted when the two locations are very close. The spatial transferability of the optimal analog dates obtained for a given location is conversely very wide: when they are used for the prediction at all other locations, the loss of prediction performance is very low over large area (up to 500 km) and a quasi-optimal prediction can be obtained.

The spatial transferability is sensitive to the presence of high mountainous massifs. It also depends on the parameters of the AM. For instance, it decreases when the length of the archive from which the analog dates are identified grows or when humidity is used as a second level analogy predictor. In these cases, the lower spatial transferability of the analog prediction model is associated to a refinement of the model. For locations that are up to 400 km far from the location used for the optimization, the performance improvement due to the introduction of humidity predictor is larger than the higher performance loss resulting from the poorer transferability of the model.

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