

## The analogue method for precipitation prediction: finding better analogue situations at a sub-daily time step

Analogue methods (AMs) predict local weather variables (predictands), such as precipitation, by means of a statistical relationship with predictors at a synoptic scale. The analogy is generally assessed on gradients of geopotential heights first, in order to sample days with a similar atmospheric circulation. Other predictors, such as moisture variables, can also be added in a successive level of analogy.

The search for candidate situations for a given target day is usually undertaken by comparing the state of the atmosphere at fixed hours of the day for both the target day and the candidate analogues. The main reason is the use of daily precipitation time series due to the length of their available archives, and the unavailability of equivalent archives at a finer time step. However, it is unlikely for the best analogy to occur at the very same hour, while it may be found with a time shift of some hours as it can occur at a different time of day. In order to assess the potential for finding better analogues at a different hour, a moving time window (MTW) has been introduced.

The MTW resulted in a better analogy in terms of the atmospheric circulation, with improved values of the analogy criterion on the entire distribution of analogue dates. The improvement was found to grow with the analogue rank due to an accumulation of better analogues in the selection. A seasonal effect has also been identified, with larger improvements in winter than in summer, supposedly due to stronger diurnal cycles in summer that favour predictors at the same hour for the target and analogue days.

The impact of the MTW on prediction skill has been assessed by means of a sub-daily precipitation series transformed into moving 24h totals at 6h time steps. The prediction skill was found to have improved by the MTW, and even to a greater extent after recalibrating the AM parameters. Moreover, the improvement was greater for days with heavy precipitation, which are generally related to more dynamic atmospheric situations where timing is more specific and which are fewer in the meteorological archive.

However, in order to produce quantitative precipitation predictions the MTW requires sub-daily precipitation time series, which are generally available for a shorter period than daily precipitation archives. Therefore, two simple temporal disaggregation methods were assessed in order to make longer archives usable with the MTW. The assessed approaches were not successful, emphasizing the need to use time series with an appropriate chronology. These should be available in the near future, either by means of growing archives of measurements or by the establishment of regional precipitation reanalysis data at sub-daily time step.

The use of the MTW in the AM can already be considered now for several applications in different contexts, may it be for operational forecasting or climate-related studies.