

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 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 similar to 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. This is a consequence of using standard daily precipitation time series, which are available over longer periods than sub-daily data. However, it is unlikely for the best analogy to occur at the exact same hour for the target and candidate situations. A better analogue situation may be found with a time shift of several hours since a better fit can occur at different times of the 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 and showed improved values of the analogy criterion on the entire distribution of the extracted analogue dates. The improvement was found to increase with the analogue rank owing to an accumulation of better analogues in the selection. A seasonal effect has also been identified, with larger improvements shown in winter than in summer. This may be attributed to stronger diurnal cycles in summer that favour predictors taken at the same hour for the target and analogue days.

The impact of the MTW on the precipitation prediction skill has been assessed by means of a sub-daily precipitation series transformed into moving 24 h totals at 12-h, 6-h, and 3-h time steps. The prediction skill was improved by the MTW, as was the reliability of the prediction. Moreover, the improvements were greater for days with heavy precipitation, which are generally related to more dynamic atmospheric situations in which the timing is more specific and for which fewer records are available in the meteorological archive.

The improvements of the analogy criterion and the performance scores on precipitation were both found to be higher for MTWs with a smaller time step of 3 h. A 3-h MTW provides eight times more candidate situations even though they are not fully independent. Since the MTW provides additional situations to the pool of possible analogues, it can be considered as an inflation of the meteorological archive. Because this technique is very simple and easily applicable, it should be considered for several applications in different contexts, such as operational forecasting or climate-related studies.