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Daily Weather Types Computed from Early Instrumental Data back to 1763

Mikhaël Schwander (1,2) and Stefan Brönnimann (1,2)

(1) Institute of Geography, University of Bern, Switzerland (mikhael.schwander@giub.unibe.ch), (2) Oeschger Centre for Climate Change Research , University of Bern, Switzerland

The use of weather types can be beneficial for historical climatology, which increasingly targets day-to-day variability but lacks comprehensive atmospheric circulation fields further back than 1871 (start of the Twentieth Century Reanalysis). A new statistical method is used to generate a daily weather type classification (WTCs) covering the last 250 years. The method uses an existing classification (e.g. CAP, GWT) available for a reference period and extends it back to the end of the 18^{th} century. The CAP classification used in our study is available from 1957 onward. It has been computed by MeteoSwiss using ERA-40/ERA-Interim reanalyses. In order to produce a weather types time series which covers a longer time period than the available reanalyses, early instrumental data from weather stations are used. The CAP classification is taken as a reference for a determined period. Let x be a vector with information from stations 1...n for one day. x contains weather data from several stations. For example, t=temperature, p=pressure, Δp=pressure tendency.

$$x = \{t_1, p_1, \Delta p_1, t_2, p_2, \Delta p_2, ..., t_n, p_n, \Delta p_n\}$$

Further, let i denote the weather type (1 to 9 for CAP9). Then, the weather type of day t is the type i that minimizes the following function (Mahalanobis distance):

$$D\left(i\right) = x_t^T \sum\nolimits_i^{-1} x_t$$

$\sum_i$ is the covariance matrix of x for all days in the reference period that pertain to the weather type i.

Instrumental data form Western/Central Europe are used in order to cover the period 1763-2008. All the data need to be available for the reference period, so the whole time series is calibrated over the same period. The performance of the new classification method then needs to be analyzed. Such assessments can be for example done by comparing the new time series with the ones obtained from reanalyses (ERA-Interim, 20CR). One purpose of this new WTC is to analyze the impact of solar activity on European weather patterns. This analysis is based on the frequency of occurrence of weather types.