

Influence of solar activity on the occurrence of Central European weather types from 1763 to 2009

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A new time series of daily weather types is used to analyse the impact of solar activity on European tropospheric weather. For this we apply a unique weather type classification which is a reconstruction of an existing classification (CAP9, cluster analysis of principal component) used by MeteoSwiss and computed from 1957 onward using the ERA-40 and ERA-Interim reanalyses dataset. For the reconstruction a new method was applied using early instrumental data. The new classification (CAP7) contains 7 types and covers the period 1763-2009. It allows us to analyse the European climate variability over almost 250 years.

We use this dataset to study the influence of the 11-year solar cycle on late winter Central European weather patterns. The CAP7 classification and the sunspot number time series allow us to analyse changes in the occurrence of weather types linked to solar variability over 247 years. The solar activity is divided in 3 classes (low, moderate, high) for January, February and March using subjective thresholds (33rd and 66th percentiles). The days in the 3 solar activity classes are then classified according to the CAP7 weather types. The results show a reduction in the occurrence of westerly and west south-westerly types under low solar activity for the period 1763-2009. We observe also a higher frequency of easterly, northerly and high pressure types. Under high solar activity the occurrence of westerly and west south-westerly types increases. A look on different periods over the 250 years shows a high variability in the occurrences and the solar signal varies over the time for most of the types. Only the reduction in the occurrence of westerly and west south-westerly types under low solar activity is visible over the whole time series.

The within-type differences are also investigated with composites computed with ERA-40/Interim from 1958 to 2009. The zonal flow over Europe is reduced under low solar activity relative to high activity with an increase in the sea level pressure and in the blocking frequency over Scandinavia. Also the easterly and north-easterly types have an enhanced continental flow over Europe under low solar activity. On average, due to the changes in the occurrence of weather types as well as the within-types changes, late winter temperatures over Central Europe are lower under low solar activity.