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Solar activity affects frequency and persistence of circulation types over Europe

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A collection of a large number of classifications of circulation patterns is used to detect effects of the 11-year solar cycle on tropospheric circulation over Europe. The classifications are defined over several domains covering whole Europe; they are based on 18 different objective classification methods and differ in the number of types and the classified variable. The classifications were assembled within the COST733 Action "Harmonization and Applications of Weather Types Classifications for European Regions." The advantage of such a multi-classification approach is that peculiarities or biases present in any single classification (catalogue) that might influence the detected solar signal are eliminated once a large ensemble of classifications is used. The solar activity is quantified by the solar 10.7 cm flux. The analysis concentrates on winter (December to March); months with low, moderate, and high solar activity are analyzed separately. Within each solar activity class, frequencies of occurrence of individual circulation types and their mean life time (persistence) are calculated. Differences in the occurrence and lifetime of individual types between solar activity groups indicate the presence of a solar activity effect on atmospheric circulation over Europe. Statistical significance of these differences is estimated by block resampling. An enhanced frequency under solar minima and a reduced frequency under solar maxima are observed almost exclusively for the types with easterly flow over central Europe. On the other hand, a reduced frequency under solar minima and an enhanced frequency under solar maxima are found for the types with westerly flow over central Europe. This is in agreement with previous results, based on other circulation characteristics, which indicate a zonalization of tropospheric circulation over Europe under solar maxima.