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Occurrence and Transition Probabilities for two Weather Classification Systems over Germany

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Weather type classification is a well-established and thoroughly researched field of study in atmospheric sciences. One of its applications is the analysis of occurrence of and transitions between large scale synoptic types. This is typically done by calculating the moving average of, or estimating linear or polynomial fits to relative frequencies. The presented work points out the theoretical inconsistencies implied by such approaches and, instead, employs binomial and multinomial logistic regression for consistent estimation of long-term trends in occurrence and transition probabilities between synoptic types, while assuming first-order Markovian behaviour throughout. The methodological framework's functioning is demonstrated using two prominent examples of weather type classification schemes with regional focus on Germany and central Europe. Temporal refinement to seasonal and monthly level and aggregation into combined groups of classes allows for tracing of observed trends, providing a more comprehensive understanding of the systems investigated. The results, by and large, fit in well with expectations about circulatory changes suggested by research about global warming induced climate change and can be verified by existing research in some cases. Inspection of transition probability changes allows for differentiation between changes in occurrence probability caused by changes in the mean vs. changes in circulatory dynamics. Limitations and favourable implementational details of the approach are determined and the Wald Null test is recommended for assessing statistical significance.