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Autoregressive Logistic Regression Applied to Atmospheric Circulation Patterns

Yanira Guanche, Roberto Mínguez, and Fernando J. Méndez
IH Cantabria, Marine Climate and Climate Change, Santander, Spain (guanchey@unican.es)

The study of atmospheric patterns, weather types or circulation patterns, is a topic deeply studied by climatologists, and it is widely accepted to disaggregate the atmospheric conditions over regions in a certain number of representative states. This consensus allows simplifying the study of climate conditions to improve weather predictions and a better knowledge of the influence produced by anthropogenic activities on the climate system.
Once the atmospheric conditions have been reduced to a catalogue of representative states, it is desirable to dispose of numerical models to improve our understanding about weather dynamics, i.e. i) to analyze climate change studying trends in the probability of occurrence of weather types, ii) to study seasonality and iii) to analyze the possible influence of previous states (Autoregressive terms or Markov Chains).
This work introduces the mathematical framework to analyze those effects from a qualitative point of view. In particular, an autoregressive logistic regression model, which has been successfully applied in medical and pharmacological research fields, is presented. The main advantages of autoregressive logistic regression are that i) it can be used to model polytomous outcome variables, such as circulation types, and ii) standard statistical software can be used for fitting purposes. To show the potential of these kind of models for analyzing atmospheric conditions, a case of study located in the Northeastern Atlantic is described. Results obtained show how the model is capable of dealing simultaneously with predictors related to different time scales, which can be used to simulate the behaviour of circulation patterns.