Prediction of drought classes in Portugal by Markov chains and its relationship with the North Atlantic Oscillation

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Drought is a well known phenomenon of uncertain occurrence, which gives it stochastic and probabilistic characteristics. In this paper, two probability forecasting models of the 1-month SPI in Portugal are implemented and validated: 1) Firstly a Markov chain model of drought severity classes based on SPI and 2) The same Markov model coupled with a Markov chain governing stochastic transitions between atmospheric regimes of NAO (North Atlantic Oscillation) and AO (Arctic Oscillation). Giving the known influence of large-scale atmospheric circulation on seasonal precipitation, we have shown the improved forecasting performance of model (2) for predictions at 1, 2 and 3 months ahead. This influence is still corroborated by statistically significant delayed correlations between SPI and the NAO and AO indexes. Homogeneous and non-homogeneous (annual cycle depending) versions of models 1 and 2 are tested. As expected the non-homogeneous models performing much better. Typical items from Markov chains are still computed: 1) running probabilities predicted by the Markov chains; 2) expected residence time in each severity class; 3) expected first passage time; 4) recurrence time in each severity class and 5) short-term drought class prediction. Finally, time-series of the most probable severity class are compared with those of the observed classes. From that The Heidke and Peirce skill scores (HSS and PSS) are evaluated.