Forecasting inflow persistence using climate-informed Hidden Markov Models: An Application to Orós Reservoir in Brazil

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The state of Ceará, North-eastern of Brazil, is a region that historically suffers droughts. Evidence has shown that droughts periods are related to climate-teleconnections at the Pacific and Equatorial Atlantic Ocean. Several studies have shown high correlations between climate indices and hydrological records. Annual predictions based in models relying in climate information are useful to predict dry and wet period inflows and help water reservoir operations. This work assess the performance of climate-informed Non-Homogeneous Hidden Markov Models (NHMMs) to forecast annual inflow persistence of Orós reservoir, located in the state of Ceará, Brazil. NHMMs represent the system as a set of hidden climate states that influence the inflows occurrence and allow include climate information to influence the transition between climate states. The forecasting models included NHMMs, Autoregressive NHMMs (AR-NHMMs) and Autoregressive with Exogenous Variables Model (ARX) based on the NINO 3 climate index. Values of deficit volume, dry lengths and number of dry periods of inflow forecasts to one and five years ahead shown NHMMs performance is as good as the results provided by the ARX model. Improvement in the determination of dry and wet volumes and wet lengths when an AR-NHMMs was used. It is shown that similar to ARX models, NHMMs can forecast annual dry and wet period inflows to aid in water resources management.