Prediction of mean monthly river discharges in Colombia through Empirical Mode Decomposition

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The hydro-climatology of Colombia exhibits strong natural variability at a broad range of time scales including: inter-decadal, decadal, inter-annual, annual, intra-annual, intra-seasonal, and diurnal. Diverse applied sectors rely on quantitative predictions of river discharges for operational purposes including hydropower generation, agriculture, human health, fluvial navigation, territorial planning and management, risk preparedness and mitigation, among others. Various methodologies have been used to predict monthly mean river discharges that are based on "Predictive Analytics", an area of statistical analysis that studies the extraction of information from historical data to infer future trends and patterns. Our study couples the Empirical Mode Decomposition (EMD) with traditional methods, e.g. Autoregressive Model of Order 1 (AR1) and Neural Networks (NN), to predict mean monthly river discharges in Colombia, South America.

The EMD allows us to decompose the historical time series of river discharges into a finite number of intrinsic mode functions (IMF) that capture the different oscillatory modes of different frequencies associated with the inherent time scales coexisting simultaneously in the signal (Huang *et al*. 1998, Huang and Wu 2008, Rao and Hsu, 2008). Our predictive method states that it is easier and simpler to predict each IMF at a time and then add them up together to obtain the predicted river discharge for a certain month, than predicting the full signal. This method is applied to 10 series of monthly mean river discharges in Colombia, using calibration periods of more than 25 years, and validation periods of about 12 years. Predictions are performed for time horizons spanning from 1 to 12 months. Our results show that predictions obtained through the traditional methods improve when the EMD is used as a previous step, since errors decrease by up to 13% when the AR1 model is used, and by up to 18% when using Neural Networks is combined with the EMD.

REFERENCES

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