Univariate and Multivariate Bayesian Latent Factors Decompositions in Spatio-Temporal River Flow Analysis

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We analyze temporal and spatial patterns in river flow series in Brazil, through temporal and spatio-temporal latent factor decompositions for univariate and multivariate series for some of the most important rivers in electricity generation in Brazil. We use computationally efficient Bayesian inference and representation procedures based on the Gaussian Markov Random Fields (GMRF) structure.

The univariate analyzes are based on component decompositions of trend, seasonality, and cycle. The trend component is formulated using a structure of a first and second order random walks, and we also discuss how to utilize a long memory process using an approximation based on a mixture of autoregressive processes to approximate a Fractional Gaussian Noise process.

Additionally, we propose common and specific trend, seasonality, cycle, and climate covariate factor structures to analyze multivariate river flow series, analyzing the joint effects of climate variables on the spatio-temporal flow dynamics, and we also discuss how the full structure of river networks can be incorporated in the analysis.

The statistical decompositions also permit to verify the effects of climatic changes in rainfall and temperature patterns in long term river flow patterns and the possible impacts on electricity generation and water supply in Brazil.