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New statistical techniques in studying the river flux and evaluating hydrological models

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We propose an ensemble of new tools of statistical physics for analysis of hydrological time series (river flux, in cumecs): (i) detrended fluctuation analysis (DFA); (ii) multifractal detrended fluctuation analysis (MFDFA); (iii) periodic volatility analysis; and (iv) long-term volatility analysis. The latter two were introduced in [1].

To filter out the complex seasonal periodicities in the river data, we introduce a Fourier-domain based filtering technique eliminating the annual periodicity and its harmonics from both the power spectrum (which is associated with the linear properties of the time series) and from the volatility series (which is associated with nonlinear properties of the time series). We apply this phase-substitution filtering technique on hydrological time series and compare resulting nonlinearities with those derived with standard filtering techniques [2].

The proposed statistical techniques are shown to represent a useful tool for evaluating hydrological models. We introduce a stochastic model of river flux and, by means of the statistical analysis, show that its output records reproduce the scaling behaviour of the real flux [3]. These techniques are applied to compare real and ASGi model-produced fluxes of three Bavarian rivers and show their close similarity [4]. We suggest that our methods and conventional hydrological criteria, like Daily Root Mean Square, Nash-Sutcliffe Efficiency, and Percent Bias, can be complementary useful for more advanced analysis of hydrological data.

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