Nonlinear analysis of very long time series: opportunities and challenges

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Many nonlinear methods of time series analysis require a minimal number of observations in the hundreds to thousands, which is not always easy to achieve for observations of environmental systems. Eddy Covariance (EC) measurements of the carbon exchange between the atmosphere and vegetation provide a noticeable exception. They are taken at high temporal resolution, typically at 20 Hz. This generates very long time series (many millions of data points) even for short measurement periods, rendering finite size effects unimportant. In this presentation, we investigate high-resolution raw data of 3D wind speed, CO_2 concentrations, water vapor and temperature measured at a young forest plantation in Southeast Norway since July 2018. Guiding for the analysis is the gain or added value of the high resolution compared to more aggregated data, i.e. the scaling behavior of nonlinear properties of the time series. We present results of complexity analysis, Tarnopolski diagrams, q-Entropy, Hurst analysis, Empirical Mode Decomposition and Singular System Analysis. This provides detailed insights into the nature of dynamics of carbon fluxes across this system boundary at different temporal scales.