Geophysical Research Abstracts
Vol. 17, EGU2015-5798-1, 2015
EGU General Assembly 2015

Recurrence Analysis of Eddy Covariance Fluxes

Holger Lange (1), Milan Flach (2), Thomas Foken (3), and Michael Hauhs (3)

(1) Norwegian Forest and Landscape Institute, Forest Ecology, N-1431 Ås, Norway (holger.lange@skogoglandskap.no), (2) Max-Planck Institute for Biogeochemistry, D-07701 Jena, Germany (milan.flach@posteo.de), (3) University of Bayreuth, BayCEER, D-95440 Bayreuth, Germany

The eddy covariance (EC) method is one key method to quantify fluxes in biogeochemical cycles in general, and carbon and energy transport across the vegetation-atmosphere boundary layer in particular. EC data from the worldwide net of flux towers (Fluxnet) have also been used to validate biogeochemical models. The high resolution data are usually obtained at 20 Hz sampling rate but are affected by missing values and other restrictions.
In this contribution, we investigate the nonlinear dynamics of EC fluxes using Recurrence Analysis (RA). High resolution data from the site DE-Bay (Waldstein-Weidenbrunnen) and fluxes calculated at half-hourly resolution from eight locations (part of the La Thuile dataset) provide a set of very long time series to analyze. After careful quality assessment and Fluxnet standard gapfilling pretreatment, we calculate properties and indicators of the recurrent structure based both on Recurrence Plots as well as Recurrence Networks. Time series of RA measures obtained from windows moving along the time axis are presented. Their interpretation is guided by three different questions: (1) Is RA able to discern periods where the (atmospheric) conditions are particularly suitable to obtain reliable EC fluxes? (2) Is RA capable to detect dynamical transitions (different behavior) beyond those obvious from visual inspection? (3) Does RA contribute to an understanding of the nonlinear synchronization between EC fluxes and atmospheric parameters, which is crucial for both improving carbon flux models as well for reliable interpolation of gaps? (4) Is RA able to recommend an optimal time resolution for measuring EC data and for analyzing EC fluxes? (5) Is it possible to detect non-trivial periodicities with a global RA?
We will demonstrate that the answers to all five questions is affirmative, and that RA provides insights into EC dynamics not easily obtained otherwise.