PROPOSAL FOR FLUXNET SYNTHESIS PUBLICATION

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TITLE OF PAPER AND OUTLINE

Time scale dependent parameter estimation: principle and example elaboration in an model-eddy covariance data fusion experiment

Background: Despite the overall success of many model--data synthesis approaches, heavy biases can occur when model assumptions are violated or confounding effect obscure some apparent process responses (Davidson et al. 2006, Carvalhais et al. 2008). This is a cause of serious concern in earth system sciences where monitoring time series contain a wide range of quasi--oscillatory patterns of characteristic frequency (Ghil et al. 2002, Pezzuli et al. 2005, Stoy et al. 2009). The multiscale variability is caused by the fact that the behavior of several compartments and subsystems is often integrated in, and sampled from, a common output signal. Accordingly, selecting singular subsignals in cases where distinct frequency classes are attributable to independent subsystems is the natural prerequisite for investigating different processes (Mahecha et al. 2007). Working with raw signals instead, complicates the joint analysis of models and data since an unambiguous interpretation cannot be guaranteed. One well known example is the temperature sensitivity of biological processes, e.g. the problem of correctly quantifying and representing respiratory processes on “ecosystem scales” in dependence of temperature (Curiel-Yuste et al 2004, Davidson and Janssens 2006). Studies of this kind share problem that intrinsically fast temperature responses can be easily confounded by effects due to slowly varying changes in the overall biological activity. Polemically speaking: the conventional way of inferring temperature sensitivities of biological processes from real world time series is expected to be erratic under real world conditions. Although some recent advances have been made to solve this problem for specific questions (Gu et al. 2008), no general methodology could be developed so far.

AIM: To develop a generic methodology to overcome problems of process identification when confounding factors operate on different characteristic scales. We propose to perform model parameter estimation explicitly on different time scales, *i.e.* exploring subsignals of the time series under investigation which are characterized by fluctuations of characteristic frequency. We claim that associating the parameter estimation process to different characteristic fluctuations allows for separating undesired secondary effects from the estimates, and thus substantially reduces parameter uncertainties. The methodology will be elaborated using an example model: the Q_{10}-model where we aim at illustrating the principle using a range of artificial experiments and real world applications (FLUXNET).

METHODS: Technically, this alternative parameter estimation strategy is based on “Singular Signal Analysis” (Ghil et al. 2002, or Mahecha et al. 2007 in the context of eddy covariance data) to decompose the original time series, and the method is referred to as “Singular Signal Analysis for Parameter Optimiztion, SSA--PO”, hereafter

RESEARCH QUESTIONS: This almost purely methodological paper will search to answer the following questions:

I. Is it technically possible to retrieve correct parameters using SSA-PO of synthetic respiration signal when these are heavily affected by seasonal changes in total biological activity and random errors (noise) scaling with flux magnitude?
II. Is it technically possible to retrieve correct parameters using SSA-PO of synthetic respiration signal when these are heavily affected by seasonal changes in total biological activity and by external variables (simulated here as correlated red noise) influencing the signal in dependence of flux magnitude?
III. How do temperature sensitivities of night time NEE behave when derived with the SSA-PO framework?
IV. Do apparent global patterns of temperature sensitivities of night time NEE hold when explicitly considering different time scales in the optimization?

PROPOSED SITES TO BE INVOLVED

We use only one site year per site. A site year is selected if in one year a minimum of 240 high quality night time NEE estimates can be computed after aggregating the half hourly fluxes to nightly averages. We request permission to use the following site years:

AU-Tum2003	DE-Gri2006	JP-Tom2003
BE-Bra2006	DE-Har2005	NL-Hor2006
BE-Vie2001	DE-Meh2005	NL-Loo2003
BR-Ban2005	DE-Tha2003	PT-Mi22006
BR-Ji22001	DK-Lva2005	SE-Nor1999
BR-Sa12002	DK-Ris2004	UK-Ham2004
BR-Sa32002	DK-Sor2001	UK-PL32006
BW-Ma12000	FI-Hyy1998	US-ARM2003
CA-Ca12002	FI-Sod2006	US-Ho12003
CA-Ca22005	FR-Fon2006	US-IB22005
CA-Ca32003	FR-Gri2005	US-KS22005
CA-Let2002	FR-Hes2003	US-MMS2005
CA-Mer2002	FR-LBr2006	US-MOz2006
CA-NS12001	GF-Guy2004	US-Me32004
CA-Oas1999	HU-Mat2004	US-NR12002
CA-Ojp2005	IT-BCi2006	US-PFa1998
CA-Qfo2005	IT-Cpz2004	US-SO22004
CA-SJ22004	IT-Lec2006	US-SP12005
CA-SJ32005	IT-MBo2005	US-SRM2005
CA-TP42005	IT-PT12003	US-Ton2005
CA-WP12005	IT-Ren2005	US-Var2003
CH-Oe12006	IT-Ro12001	US-WBW1999
CN-Cha2003	IT-Ro22004	US-Wkg2006
CN-Do12005	IT-SRo2001	US-Wrc2002
CN-HaM2003	JP-Mas2003	
DE-Geb2004	JP-Tak2002	

Please note that data are only used for illustration of the theoretical developments and most sites will be specifically mentioned except for a list containing the explicit references.

PROPOSED RULES FOR CO-AUTHORSHIP

The main focus of the paper is on the methodology of the SSA-PO concept and we aim to submit this paper preferably fast in order to establish the method for subsequent studies. These circumstances narrow the possibility of intellectual input (the SSA-PO theory is now well developed yet we lack a real world application) and thus we think that a co-authorship should not be implied automatically, but acknowledgment and citation of the PI's work. The rules as proposed in the latest official disclaimer for the FLUXNET synthesis will be respected.

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