Lecture | Towards new model-data integration opportunities in Earth system sciences*

Dr. Christoforos Pappas (Université de Montréal)

Thursday 14.09.2017, 14:00, Room D217, Faculty of Environmental Sciences, Czech University of Life Sciences, Prague

Terrestrial ecosystem processes respond differently to hydrometeorological variability across timescales, and so does our scientific understanding of the underlying mechanisms. Long-term variability of the terrestrial carbon cycle is not yet well constrained and the resulting climate-biosphere feedbacks are highly uncertain. Here we present a comprehensive overview of hydrometeorological and ecosystem variability from hourly to decadal timescales integrating multiple in situ and remote-sensing datasets characterizing extra-tropical forest sites. We find that ecosystem variability at all sites is confined within a hydrometeorological envelope across sites and timescales. Furthermore, ecosystem variability demonstrates long-term persistence, highlighting ecological memory and slow ecosystem recovery rates after disturbances. However, simulation results with state-of-the-art process-based models do not reflect this long-term persistent behaviour in ecosystem functioning. Accordingly, we develop a cross-time-scale stochastic framework that captures hydrometeorological and ecosystem variability. This framework offers a parsimonious and mathematically tractable approach for modelling ecosystem functioning and for understanding its response and resilience to environmental changes. Our analysis offers a perspective for terrestrial ecosystem modelling, combining current process understanding with stochastic methods, and paves the way for new model–data integration opportunities in Earth system sciences.

*Pappas, C., M. D. Mahecha, D. C. Frank, F. Babst, and D. Koutsoyiannis (2017), Ecosystem functioning is enveloped by hydrometeorological variability, *Nat. Ecol. Evol.*, *1*(9), 1263–1270, doi:doi:10.1038/s41559-017-0277-5.

Workshop | Stochastic methods in Earth system sciences: an introduction

Drs. Christoforos Pappas (Université de Montréal) and Yannis Markonis (Czech University of Life Sciences)

Thursday 21.09.2017, 09:00, Room Z119, Faculty of Environmental Sciences, Czech University of Life Sciences, Prague

This 6-hour workshop focuses on (i) applications of stochastic methods in Earth system sciences, and (ii) integration of stochastic and deterministic approaches for understanding and modelling the Earth system. The workshop will provide hands-on training in *R* programming language on stochastic modelling of Earth system processes, including, but not limited to, hydrometeorological (e.g., temperature and precipitation) and ecosystem processes (tree growth and terrestrial carbon dynamics). Moreover, new model-data integration approaches will be presented, confronting across a continuum of spatial and temporal scales observed patterns with deterministic and stochastic simulation results. Knowledge of basic statistics and *R* programming language are prerequisites for participating.

Enrolment to the workshop: strnadf@fzp.czu.cz

Dr. Christoforos Pappas is a post-doctoral fellow at the Département de géographie and Centre d'études Nordiques of Université de Montréal. Dr. Pappas holds a diploma degree in civil engineering (National Technical University of Athens, Greece) and a Doctoral degree in environmental engineering (ETH Zurich, Switzerland). His research stems around the interdisciplinary field of ecohydrology and is geared towards a predictive understanding of ecosystem functioning and resilience to environmental stress. Dr. Pappas' research focuses on the spatiotemporal continuum of ecosystem functioning, consisting of data collection, analyses and modelling of short-term and local-scale plant physiological processes to long-term ecosystem variability and its implications for regional and global atmosphere-biosphere feedbacks (i.e., drought-induced forest losses and terrestrial carbon source-sink dynamics).

Dr. Yannis Markonis is an associate researcher at the Department of Water Resources and Environmental Modelling. Dr. Markonis holds a diploma degree in environmental engineering (Technical University of Crete, Greece) and a Doctoral degree in civil engineering (National Technical University of Athens, Greece). His research focuses in multi-scale hydroclimatic fluctuations and their stochastic analysis and modelling. Recently, he has been studying large-scale droughts over Europe and he is interested in the description of such phenomena in the context of the dynamics of global water cycle and their relationship with global climatic change. To this end, his research interests include data-driven methodologies for analysing big datasets, e.g. satellite products, methods for uncertainty quantification and techniques for determination of causality between hydroclimatic variables.