PhD Opportunity, INRAE Lyon, France:

CPOM and GHG emission dynamics from intermittent rivers and ephemeral streams: a river-network perspective

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A **fully-funded PhD project** is available to model the dynamics of terrestrial leaf litter and greenhouse gases (GHG) in intermittent rivers and ephemeral streams at the network scale.

One of the greatest challenges of the 21st century is to understand and mitigate the effect of climate change on ecosystems. Climate change, by exacerbating the recurrence of overly dry years, is predicted to cause more frequent and intense hydrological droughts worldwide. Drying (i.e. the loss of surface water) is a severe natural disturbance for many river ecosystems, altering biogeochemical processes and biodiversity, and shifts from perennial to intermittent flow regimes are becoming more and more common due to water abstraction and climate change. The effects of drying on river ecosystem processes are increasingly studied at the local scale (e.g. microhabitat, river reach), yet little remains known about its effects at the river network scale, which is relevant to inform an adaptive management that minimizes drought impacts on river ecosystems and associated services (e.g. water provisioning, climate regulation, energy production).

River networks are dendritic aquatic continuums within terrestrial matrices and drying affects network-wide flows of coarse particulate organic materials (CPOM) and organisms by fragmenting this continuum, subsequently modifying C-related ecosystem processes and GHG emissions. River networks form meta-ecosystems, defined as sets of sub-ecosystems linked by lateral (terrestrial / aquatic), vertical (surface / subsurface) and longitudinal (upstream / downstream) flows of organisms and CPOM. Drying alters these links along with the rates of CPOM accumulation and processing within them and their constituent biotic communities. The respiration of this CPOM, even during the dry phases, can produce substantial amount of GHG emissions to the atmosphere. CPOM can also accumulate in in-stream reservoirs and pools, where specific environmental conditions alter its processing. These accumulation areas (river-reservoir transition zones) are known to be the place of intense GHG emissions. Organisms usually occur where their preferred resources are located but due to drying and dispersal limitations, mismatches between resource availability and processing can occur if organisms cannot reach those resources. Although recent studies have assessed organism dispersal along the river network within the metacommunity framework, little is known about how organism and CPOM flow within the entire meta-ecosystem and how these flows affect CPOM processing in the context of drying and fragmentation by reservoirs. Understanding the drivers of organism and resource spatial flows among sub-ecosystems is essential as mismatches between these flows, e.g. if organisms are present but resources are lacking (or vice versa) could lead to alteration of ecosystem processes locally and at the meta-ecosystem scale.

The main goal of this PhD project is to **study, in a river meta-ecosystem perspective**, **the dynamics of CPOM, decomposers and associated GHG emissions at the river-network scale, including the effects of fragmentation by drying and reservoirs** This will be achieved through combining field experiments, meta-analysis and modelling. Three main questions will be explored:

-What are the mechanisms driving the lateral, vertical and longitudinal flows of CPOM and decomposers (invertebrates, bacteria and fungi) and associated GHG emissions in river networks fragmented by drying event and reservoirs;
-Where, when and under which conditions fragmentation of river networks leads to mismatches between resources and organisms availability affecting CPOM processing and meta-ecosystem dynamics?
-Can we, in a meta-ecosystem perspective, predict the spatiotemporal dynamic of CPOM processing and associated GHG emissions in river networks and guide the management of reservoirs.

The research will be performed at Inrae (National Research Institute for Food, Agriculture and the Environment, formerly IRSTEA) in Lyon, France, within a highly collaborative and stimulating environment. This project will be part of on-going European efforts (eg. SMIRES, a starting H2020 project on drying river networks) and involve many cross-disciplinary interactions (ecology, hydrology, hydraulic, biogeochemistry, GIS, modelling). Strong interactions with Foulquier's (LECA, University of Grenoble-Alpes) and Singer's (University of Innsbruck) groups are expected, along with close collaboration with EdF (Electricité de France). Applicants will have a strong background in aquatic ecology and ecological modelling, interest in designing experiments and conducting field and lab work, as well as strong skills in oral and written communications. A M.Sc. Ecology, Biogeochemistry, Environmental Sciences or related disciplines (to be completed by June 2020) is required to apply. Start date is September 2020 for a 3 year period. Salary ~ 1800 Euros / month (net). Speaking French is not required. Application review will begin February 2020 and continue until March 15, 2020.

Applicants should send a CV, a list of three references (along with contact phone and email), and a cover letter summarizing qualifications and research interests to Tibo Datry (thibault.datry@inrae.fr).