PhD position announcement

Biogeochemical approach for the evaluation and improvement of a distributed hydrological model in periurban areas

Context and objectives

Distributed hydrological models are valuable tools for the assessment of the impact of global changes (urbanization, climate change, water management practices) on water resources. However, these models are difficult to calibrate due to their complex structure and high number of parameters. Water quality data can bring additional information to the classic outlet discharge about the decomposition of flow in the stream and the contributions of various catchment parts, and can thus help « getting the right answers for the right reasons ».

This thesis aims at developing and applying a methodology for the evaluation and improvement of distributed hydrological models in periurban catchments, using a large spectrum of biogeochemical data. In particular, it proposes to use fingerprinting of contaminant sources, either chemical or microbiological, such as dissolved organic matter, trace metals, pesticides, count of bacteria and their origins – cattle, humans, dogs,… Contaminant fingerprinting shows a very interesting potential for the characterization of contributions of various land uses to general contamination., in particular in periurban areas where land uses are very contrasted.

The PhD methodology will be based on field work carried on the Yzeron periurban experimental catchment – site of the OTHU observatory and member of the OZCAR Research Infrastructure, and on the distributed hydrological model J2000P developed at INRAE RiverLy (Labbas et al., 2015)[1]. The methodology combines field work, data analysis and modelling as follows (the student will contribute to step 1 and will be in charge of steps 2 to 4):

1. Water sampling during field campaigns will allow to determine the water quality characteristics of elementary watersheds with distinctive land use / soil / geology characteristics (source sampling) and how these water quality fingerprints are mixed down the river during hydrological events (mixing sampling) using simple mixing models

2. Component tracking will be implemented in the J2000P model to be able to reproduce the respective contributions of elementary watersheds to the total streamflow

3. Simulations will be run to reproduce the sampled hydrological events. Simulation results will be compared to the mixing models results following a cross validation strategy

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[1] Labbas, M. et al. (2015). https://doi.org/10.1051/lhb/20150059

4. J2000P will be improved in terms of parameter values and model structure according to these results

Expected outcomes are :

- A better insight into catchment functioning, in particular an assessment of the respective contributions of the different land use types and the impact of groundwater seasonal contributions

- An assessment of the J2000P model in terms of representation of water flow pathways in the catchment

- An extension of the methodological framework of hydrological signatures, developed at INRAE Riverly (Fuamba et al., 2019, Branger & McMillan, 2020; Horner et al., 2020)[2], to biogeochemical data

- The derivation of typical water quality fingerprints, ie characteristics linked to land use / human activity / hydrologic patterns, that can serve prospective water quality studies

Required education and skills

- Level of study : Master or Engineer Diploma in Earth Sciences, Environment or Hydrology

- Good knowledge of hydrology, geochemistry and hydrological modelling

- Good programming skills (R, Java) and previous experience with GIS tools (QGIS)

- Interest for field work and experiments

- Very good skills in English (written and spoken)

- Capacity of independent work

- Ability and interest to work in a multi-disciplinary environment

Working environment

The PhD will be hosted by INRAE RiverLy, 5 rue de la Doua, 69100 Villeurbanne, France, in the Hydrology Team.

The RiverLy research unit develops interdisciplinary research for the management and restoration of river systems and their catchments. RiverLy combines skills in ecology, microbiology, ecotoxicology, environmental chemistry, hydrology and hydraulics. Our researches cover multiple scales from microhabitats to large catchments and global scales. The Hydrology Team studies the assessment of the impact of human activity on hydrological processes and associated risks, at several spatial and temporal scales, using field observation, process-oriented hydrological modelling and statistics.

Fixed-term contrat (36 months), starting in October or November 2020. Gross salary 1770€ / month.

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2 Branger, F. & McMillan, H. K. (2020), https://doi.org/10.1002/hyp.13645; Fuamba, M.; et al.. (2019), https://doi.org/10.1016/j.jhydrol.2018.12.035; Horner, I.; et al. (2020), https://doi.org/10.1002/hyp.13762

Application

Please send the following documents to flora.branger@inrae.fr and matthieu.masson@inrae.fr in support of your application:

- Motivation letter in English (max. 2 pages).

- Curriculum Vitae

- Degrees and transcripts

- One academic writing sample in English of French (e.g. Master thesis or another single-authored piece of written work)

- Names and email addresses of two or more advisors for the recent years.

Only complete applications will be considered.

Application deadline : **31/08/2020**