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ESR 9: Linkages between river habitat dynamics and channel morpho-dynamics at the mesoscale

3 year fixed- term PhD position.

Host institute: University of Trento, Italy (UNITN)

Supervisors: Dr Guido Zolezzi, Dr Paolo Vezza (UNITN), Dr Martina Bussettini (Institute for Environmental Protection and Research- ISPRA, IT), Dr Chris Robinson (Swiss Federal Institute of Aquatic Science and Technology-EAWAG, CH)

Project Description:

Studies aimed at assessing the spatial and temporal availability of river habitat for different biological species mainly assume a static configuration of the river channel. Existing habitat-based methods for environmental flow design and assessment do not explicitly incorporate morphological changes in the relation between habitat availability, sediment transport and channel (bio)morphodynamics at the relevant scales. At the flood event time scale, river morphodynamics may determine a strong spatial rearrangement of the habitat template, both in the wet channel and in the exposed morphological units at low flow. At larger time scales, trajectories of channel adjustments may force dramatic shifts in the ability of a river reach to support habitat diversity at given turnover rates.

The proposed doctoral research topic aims to address the relation between river habitat dynamics and channel morpho-dynamics at the relevant spatial and temporal scales, with a focus on both the habitats in the wet channel and in the dry morphological units at low flow conditions, to encompass habitat conditions of relevance for both fish and terrestrial species, as in the case of birds hatching on bare sediment bars.

This project also benefits from being closely linked to research by other postgraduate and postdoctoral researchers investigating low flow impacts on stream ecosystems. The successful candidate will also gain from being part of a large, interdisciplinary, water research team based at the University of Birmingham.

Objectives:

(1) To quantitatively assess the variability of mesoscale habitat structure due to morphological changes in the river corridor at different time scales (i.e. flood event, decadal), with focus on both the dry channel and the wet channel.

(2) To extend the applicability of mesoscale habitat models at non-wadeable, morphologically complex conditions (i.e., high discharge, large streams) through hydro-morphodynamic modelling;

(3) To develop morphodynamic-sensitive habitat metrics and to assess their use for e-flows design and monitoring over time scales encompassing multiple formative events (decadal or multi-decadal time scale)

Expected outcomes:

(1) Assessment method for temporal persistence of habitat-discharge rating curve across different channel patterns;

(2) Upgraded mesoscale habitat model applicable to a range of river conditions;

(3) Novel “morphodynamic” habitat metrics, accounting for river dynamics/sediment transport

The research will adopt the mesoscale habitat modelling approach and will integrate morphodynamic modelling, field data collection, analysis of morphological change and habitat time series and the application of suitable distribution models for target biological species. Case studies in river with different morphologies and rates of morphological changes will be preferably chosen among sites already subject to habitat modelling in the North of Italy.

Secondments:

One secondment is foreseen at EAWAG (Switzerland), to apply the developed approach on the case study of the Spol River (CH) subject to a unique program of environmental and geomorphic flows for more than a decade. A 3-month secondment to ISPRA – the Italian National Agency for Environmental Research and Protection – will focus on the integration of the proposed approach in existing e-flow assessment frameworks for their possible improvement.