



Euro-FLOW: a European training and research network for environmental FLOW management in river basins. A MARIE SKŁODOWSKA-CURIE ACTIONS Innovative Training Network (ITN) funded under H2020-MSCA-ITN-2017

ESR 3: Integrating water quantity and quality in eco-hydrological relationships

3 year fixed- term PhD position.

Host institute: NERC Centre for Ecology and Hydrology (CEH), UK (degree awarded by University of Leeds, UK)

Supervisors: Dr François Edwards, Dr Mike Hutchins (CEH), Dr Megan Klaar (University of Leeds), Sian Davies (Environment Agency), Dr Nataša Smolar-Žvanut (Slovenian Water Agency)

Project Description:

The trade-offs between the conservation of river ecosystems and the supply of water for human needs are an important challenge for the EU and its member states. Two conflicting drivers must be addressed, on the one hand environmental legislation requires more water to remain in rivers, and on the other hand human development dictates more water usage. Adequate 'environmental flows' are necessary to support good ecological status of rivers and maintain key river habitats under favourable condition as required by EU regulations. However, a certain level of water quality is also necessary to comply with these environmental laws and meet society's needs.

Because flow determines the concentrations of dissolved chemicals, retaining sufficient environmental water is essential to dilute pollution from sewage inputs as well as from diffuse sources, such as run-off from agricultural and urban areas. The process of assigning suitable environmental flows (e.g. aquifer and surface abstraction rates, reservoir or dam releases, flow augmentation schemes) is complex because it must satisfy the diverse flow requirements of a range of river plants and animals, while also modulating water quality.

The studentship will produce a framework for environmental flow setting that spans river types, biotic groups and the nature of the flow regulation, and also delivers key aspects of water quality. To support the framework a process-based river network model is available. It has been configured in the form of a sensitivity analysis to assess the impact of combinations of two or more climatic- or management-induced stressors on eutrophication. It can be used to identify the extent to which combinations of stressors act synergistically, and the intention is to expand its scope (i) to more-specifically represent flow regulation scenarios (ii) to link with novel assessments of a wider set of biotic indicators. By analysing existing datasets, gathering new field measurements at key times/locations and setting up bespoke models, the research will generate new understanding of how water quantity and quality can be co-managed to maintain and enhance river ecosystems and the services humans derive from them. The research programme will include placements with national water regulatory agencies.

Objectives:

(1) To define sets of water quantity/quality requirements for multiple biotic groups (fish, invertebrates, plants, algae) using existing datasets. New data gathered with flow gauging and water sample analyses,

including use of sensor-based continuous monitoring to characterise ecosystem metabolism, will be used to further investigate key aspects such as flow extremes and specific management contexts

(2) To examine through modelling approaches whether these requirements of flow (e.g. minimum flow, flow variability, flood pulse frequency) and water quality (e.g. nutrients, temperature, sediment) are independent, interactive or additive for the different biotic groups

(3) To explore the links and feedbacks between flow and water quality requirements across different river types with different pressures in terms of their flow regulation and water pollution

Expected outcomes:

(1) A new holistic framework of environmental flow assessment for multiple biotic groups

(2) A classification of water quality/quantity requirements mapped onto a river typology

(3) Comparative models for rivers with different flow regulation pressures

Secondments:

Slovenian Water Agency, 3 months in year 2 or 3 for analysis of flow-habitat-water quality linkages

Environment Agency, 3 months in year 2 or 3 to develop evidence links to back up policy guidance.