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A hydromorphological framework for the evaluation of e-flows

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Anthropogenic alteration of hydromorphological processes in rivers is a major factor that diminishes river health and undermines environmental objectives envisaged by river protection policies. Specifying environmental flows to address those impacts can be a key strategy for the maintenance of functional river processes and the achievement of those objectives.
Environmental flows are determined by various methods and approaches, based primarily on hydrological and/or hydraulic evaluations, although holistic methodologies, considering the many interacting factors that structure aquatic ecosystems, including sediments, are increasingly used.

Hydrological and geomorphological processes are highly coupled and any change in one typically affects the other. The coupling varies over different spatial and temporal scales, and changing either hydrological or geomorphological processes can result in alteration of river habitats, ultimately impacting ecological processes.
In spite of these linkages, current restoration approaches typically focus only on changes on hydrological regime as a means promoting ecological enhancements.
Neglecting sediment transport and its interaction with flow in shaping riverine habitats is likely to results not only in minor or no enhancements in the ecology, but may also increase the costs of water use.

A more integrated view of how human activities jointly affect sediment regime, river morphology and river flows is therefore needed in order to determine the most effective actions to rehabilitate river processes to desired states. These states involve considerations of the combination of intrinsic (“natural”) conditions (e.g. river sensitivity and morphological potential, off-site conditions) and socio-economic constraints.
The evaluation of such factors, the analysis of different scenarios, and the selection of appropriate actions require the contextualization of river reaches within a wider spatial-temporal hydromorphological framework. Here we present such a general multiscale, process-based hydromorphological framework, and discuss its application to the problem of how best to analyse and estimate e-flows.