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Hydralab+: Representing timescales of biological change in flume experiments

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Fluvial environments are vulnerable to future climate change due to non-linear responses to shifts in boundary conditions such as a migration to a hydrological regime characterised by more frequent extreme events. The biological component of these systems is critical for understanding the morphodynamic responses since organisms are often at the interface between water and sediment transport systems. Under a changing climate, the growth or decline of a particular species may change the flow dynamics and/or sediment transport. Hence, flume experiments that seek to accurately model the impact of climate change on the morphodynamics of sedimentary systems should consider the interaction between organisms and climate-induced changes in hydrodynamic forcing. This requires the ability to control and/or mimic biological components within flume experiments on timescales that are compatible with climate change forcing.

Here, we present a review of existing research covering morphodynamics-biological interactions in flume experiments. We consider the approaches implemented to scale organisms (e.g. small-scale or chemical surrogates) and how these can be used to represent variations in the biological component over different timescales. Disparities in the scaling of hydrodynamics, morphodynamics and biota using these existing approaches are identified.

During Hydralab+, this review will form the basis to develop innovative experimental protocols to represent total system response to climate change within a laboratory setting (e.g. developing new surrogates that can capture biological responses to climate forcing and enable modelling of longer time periods and longer-term trends). This will allow an improved understanding of the impact of climate change to be developed and potentially guide future adaptation strategies.