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A unified typology for small European rivers

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A large number of chemicals such as pharmaceuticals, pesticides and industrial chemicals are in daily use. In Europe alone, an estimated 100,000 chemicals are in current use, of which 30,000 are produced in quantities larger than one ton per year. Chemicals can enter freshwater ecosystems as an intended (e.g. deliberate emission as in the case of pesticides) or unintended (e.g. wastewater discharge as in the case of pharmaceuticals) byproduct of their use. In the environment, many chemicals (hereafter called toxicants) can exert adverse toxic effects on freshwater organisms and in turn on ecosystem functions. The potential toxic effects of chemicals are often examined within the context of Ecological Risk Assessment (ERA). ERA consists of standardized procedures and methods to evaluate the environmental risks of ecological systems. An open question is to what extent ERA needs to account for differences between recipient ecosystems that are subject to chemical exposure. For example, in the European context, is a single ecological threshold concentration per substance sufficient or is the sensitivity of the organism's dependent on water body size, geology or climate.

As previous studies have shown that the latter factors influence the community composition of algae and invertebrates, we aim to compare the sensitivity of communities across macroecological gradients.

We established a typology of small streams for eight European countries that captures the major macroecological gradients and identified typical ecological assemblages for each type. The typology is based on the Catchment & Characteristics Modelling 2 database and incorporates catchment properties such as climate, geology, and altitude as well as river attributes such as sinuosity and flow regime statistics. The latter are derived from modeled daily discharge values. Through CLARA-clustering of the resulting data, we obtained a classification into 14 stream classes. We focused on smaller rivers as they constitute the majority of river length, host a higher share of biodiversity than large rivers, and are more susceptible to pollution. The presented typology is built from the ground up with openly accessible data. All code will be made publicly available; thus, it will be easy to update, modify, and extend the typology. Beyond our application the typology can be used to regionalize ecological and hydrological models, to inventory the number and state of different river types or to develop individualized conservation programs.

Based on the identified typical assemblages we can also present preliminary relative sensitivities of stream types towards different toxicants.