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A global analysis of the environmental cost of river water withdrawals

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World freshwater ecosystems are considerably declining, at a faster rate than other ecosystems. Water withdrawals are identified as one of the main drivers of increasing water stress in several river basins worldwide. So far, much effort has been devoted to quantify water withdrawals and fluvial water consumptions at a global scale; however, comparisons are not simple because the irregular spatiotemporal distribution of freshwater resources entails that the same volume of consumed water does not have the same environmental "cost" in different times or places.
In order to take into account this spatial and temporal heterogeneity, our work proposes a novel index to evaluate the environmental cost of a reference amount of water withdrawn from a generic river section. The index depends on (i) the local environmental relevance of the impacted fluvial ecosystem (e.g., nutrient/sediment transport capacity, width of the riparian region, biodiversity richness) and (ii) the portion of the river network impacted by the reference water withdrawal, that is the downstream drainage network.
In the present work, the index is applied at a global scale with a 0.5° x 0.5° spatial resolution and employing annual average data of river discharge. Globally, regions and countries more environmentally vulnerable to water depletion are identified. Since the proposed index systematically assesses the environmental cost by accounting for the downstream propagation effect of a water withdrawal on the fluvial ecosystem, it aims to support decision-making in global transboundary river basins as well.