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Climate-change impacts on dissolved organic matter in glacier-fed streams

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Mountain glaciers are vanishing worldwide because of climate change, triggering cascading downstream effects. Today, glaciers are recognized as stores of dissolved organic matter (DOM), which once released, can support the microbial metabolism and food webs in glacier-fed streams. This glacier-derived DOM is often reported to be ancient and highly bioavailable. However, our understanding of how such DOM may change in the future, as mountain glaciers continue to melt, remains limited.

We aimed to determine whether the quantity and quality of DOM in glacier-fed streams are shifting as glaciers retreat. Leveraging DOM data from the Vanishing Glaciers project and using a space-for-time substitution approach, we investigated how both DOM quantity and quality may change across a wide range of glacier-fed streams worldwide. We analyzed optical properties of DOM sampled as close to the glacier snout as possible in 181 glacier-fed streams draining the world's major mountain ranges. Dissolved organic carbon (DOC) concentrations in these streams were very low (median: 146.3 ppb, interquartile range (IQR): 99.4-211.7 ppb). Parallel Factor Analysis (PARAFAC) identified six major DOM components, highlighting a dominance of proteinaceous compounds in the glacier-fed streams. Furthermore, by integrating additional optical measures, such as fluorescence (median: 1.5, IQR: 1.3-1.7), humification (median: 0.4, IQR: 0.2-0.5) and biological (median: 1.6, IQR: 1-2.3) indices, we will characterize DOM composition and potential sources. These data will be compared to glacier coverage, stream water stable isotopes, major ions, the mineralogical composition of suspended sediments and benthic chlorophyll *a*. Our unique large-scale dataset allows us to improve current understanding of DOM dynamics and related carbon cycling in glacier-fed aquatic ecosystems, which are now changing at an unprecedented pace because of climate change.