PreSens
PRECISION SENSING

Scientific Paper:

Science of the Total Environment (2022) 838, 155950

When water returns: Drying history shapes respiration and nutrients release of intermittent river sediment

José Schreckinger[1,2], Michael Mutz[1], Clara Mendoza-Lera[2]
[1]Department of Freshwater Conservation, Brandenburg University of Technology Cottbus Senftenberg, Bad Saarow, Germany
[2]Koblenz-Landau University, Institute of Environmental Sciences, Landau, Germany

Abstract:

Climate change and anthropogenic water demand have increased the frequency and duration of drying periods across rivers and streams worldwide. However, the biogeochemical processes during the water return in desiccated riverbeds are still unclear. Drying is a complex and diverse process and biogeochemical implications upon flow resumption may depend on attributes of the drying and river sediment characteristics (i.e., organic matter content [OM]). In order to understand the effect of drying duration and intensity on the biogeochemical dynamics following flow resumption, we exposed OM- and non-enriched river sediment from an intermittent river section to three different drying intensities (low: shade and rain; moderate: no shade and rain; high: no shade and no rain), each for three drying durations (10, 30 and 90 days). We determined the sediment-associated microbial respiration and dissolved organic carbon (DOC), ammonium-nitrogen (NH4-N), nitrate-nitrogen (NO3-N) and soluble reactive phosphorus (SRP) net release/retention rates of the nine drying treatments in flow-through microcosms over four days past flow resumption. Under the most intense and prolonged drying, non-enriched sediments showed a lag response in respiration on the first day after flow resumption, while all other treatments had either a linear increase or an early pulse in respiration. After 48 h, respiration remained constant, with minor changes in respiration dynamics regardless of the OM content of the sediment and drying attributes. The drying duration and intensity had greater effects on SRP release/retention soon after the flow resumption, while NH_4-N and NO_3-N release/retention rates were more strongly affected four days later. Our results suggest that drying attributes influence the biogeochemical dynamics more strongly during the first 24 h upon flow resumption. However, neither respiration nor nutrient dynamics recovered within four days to levels of the sediments before drying for any drying treatments. Hence, the attributes of the drying have considerable implications in rivers biogeochemistry upon flow resumption.

Keywords: ammonium, DOC, dry riverbed, nitrate, microbial functioning, SRP