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Drought and Flood Alter Soil Pore Connectivities and Local Ionic Strengths to Regulate C Bioavailability

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The extent and duration of extreme moisture events such as inundation and drought are projected to increase as climate continues to change globally. As soils are alternatively in dry or wet conditions, water, or the lack of it, drives the soil carbon cycle across a wide range of spatial scales. Quantitative elucidation of these processes is needed to evaluate the degree of uncertainty that can be mitigated by including this knowledge in next generation land-carbon models.

Hydrologic connection within the soil pore network is a determinant of the transport potential of both SOC species and of any planktonic soil microorganisms. It couples with ionic strength in that the local ionic strength is a factor controlling the relative desorption of complex versus simple SOC species. It is unknown, however, how this affects the potential transport or mobilization of microorganisms.

The objective of this research was to evaluate the combined role of water as a solvent and as a conduit on soil C cycling, by measuring the effect of drought vs saturation on the mobilization of soil C in three different soils exposed to laboratory manipulations. Three hypotheses are addressed: i) soils subjected to a simulated drought will have greater proportions of complex C species in their pore waters; ii) soils subjected to extended saturation will have a greater proportion of simpler C; and iii) soils held at field-moist conditions will reflect the resource islands that occur as a result of discontinuous water connections and have the greatest chemical diversity. We found that inundation events following drought can significantly increase the quantity of C in soil pore waters compared with soils that were previously field-moist. Even when the *quantity* of soluble C in pore waters is unchanged by historical drought, the *quality* of the C in the soluble pool changes. This suggests that the chemical and biological processes that occur in response to extreme hydrologic events are sensitive to soil and ecosystem moisture history.