Ecological role of karstic groundwater in peatlands in the context of climate change. The case study of the Frasne peatland (Jura Mountains, France)

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Groundwater (GW) inputs potentially modify the hydrological cycle of peatlands and associated downstream ecosystems in karstic regions. However, the interplay between ground and surface water is complex and depends on climatic conditions and land-use.

Suspected in the Jura Mountains since decades, we present here a study on the ecological role of karst-peatland interactions realized in the Forbonnet bog (Frasne peatland complex, 46.826 N, 6.1754E, 852 m a.s.l). The bog has been restored in 2015-16 by backfilling of artificial drains.

The site is located in a wide karstifed syncline covered by moraine deposits. We hypothesize the presence of complex interactions between peat, moraine and karst reservoirs dependent on hydraulic conditions and modified by climate change and mitigation programs.

Five years of the peatland outlet monitoring highlights a multiscale range of water supply mechanisms. Mean summer Electrical Conductivities (EC, June-October) are positively correlated with total rainfall of the preceding winters (P, November-May), suggesting that karst GW inputs in winter mainly drive the summer baseflow. In spring and autumn, the non-linear relationships between P, T and discharge imply interactions between saturated and non-saturated peat layers. Finally, winter outflow is characterized by fast responses to P events, suggesting overflow of the saturated media.

To better explain these interactions, both EC profiles variability and contrasted hydraulic head response to restoration allowed to identify various exchange processes. A range of advective-diffusive GW upflows from the karst could sustain the ecosystem functions.

This multi-proxy approach argues in favor of a nested hydrological system involving various water origins: (i) regional karstic GW, (ii) lateral seepage from the neighboring elevated wooded peatlands and (iii) local rainfall. Ongoing work aims to quantify these water fluxes in more detail in order to improve peatland management.

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