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A comparison of stable isotope analysis, hydrological modelling and indicator plant species to estimate groundwater dependence in an acidic valley mire

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Mires (peatlands in which peat is currently accumulating) provide many environmental services including biodiversity support, carbon sequestration and water quality maintenance and improvement. However provision of these services requires the maintenance of a shallow groundwater table (GWT), and is therefore sensitive to the magnitude and temporal variability in groundwater, surface runoff and precipitation inputs. However, the respective contribution of these inputs to acidic valley mires commonly found in basement regions is still poorly understood. Using physically-based modelling, Duranel (2015) estimated that groundwater influxes from the underlying weathered granite contributes about a third of the annual water inputs to a mire of international conservation importance located in the French Massif Central. The groundwater upwelling rate was the main factor explaining the variability in GWT depth within the mire, especially during late summer when the surface peat is most exposed to desaturation.

Here we report a follow-up study that employed stable isotopes to independently estimate the respective contribution of precipitation and groundwater upwelling to the peat pore water at the surface of the mire. Preliminary results corroborate those obtained through hydrological modelling, but also show that groundwater dependence is highly variable across the mire. Unexpectedly, they suggest that fog may contribute substantially to the mire's overall water balance in late summer.

The groundwater contributions estimated through both hydrological modelling and isotopic analysis are compared with plant and bryophyte communities in order to identify the potential of ecological indicators for assessing groundwater dependence within these ecologically important habitats.