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Discharge behaviour of Atlantic raised bogs

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The role of bogs as storage systems of water and flow regulators has been disputed for a long time. One opinion is that bogs act as sponges that store water during wet periods and release it in dry times. The other is that bogs are filled with water and cannot store much in addition, which results in almost instantaneous flow peaks and short recession times. The question which side is right is addressed.

A model on the linear proportionality of acrotelm transmissivity T_a [L^2T^{-1}] and specific discharge v_a [LT^{-1}] was developed. T_a depends on the water level and the large decrease of hydraulic conductivity with depth. The model is combined with the depletion equation of a linear reservoir. The time constant j of such a system depends on a system constant C_1 [L^2], the storage coefficient μ [1] and T_a, according to $j = C_1 \frac{\mu}{T_a}$. The depletion model reads $v_{at} = v_{a0} \exp\left(-\frac{t}{j}\right)$, where t is time and the subscripts denote time t elapsed since starting time (t=0). At small j, e.g. one day, a system produces large and short discharge peaks; at large j the opposite occurs.

Because of the proportionality of v_a and T_a and the inverse proportionality of j and T_a, j is inversely proportional to v_a. Thus a second system constant $C_2 = jv_a$ [L] may be defined. This implies a non-linear behaviour of bog discharge, where the outflow shows large short peaks at high discharge rates, turning into low and long lasting peaks at smaller discharges.

The model was tested successfully on discharge data from Raheenmore Bog, Ireland, where j changed from less than a day at $v_a > 7$ mm/d to more than 10 days at $v_a < 0.5$ mm/d. This shows that a simple answer in the discussion is impossible. The data analysis also showed that C_2 was affected significantly by a single unusually dry summer.