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Modelling suspended sediment Pb concentrations in upland catchments in the southern Pennines, UK

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Over the last few years there has been growing concern over the release of potentially toxic heavy metals from upland peat catchments to receiving surface waters. The top 10 cm of peat soils of the Peak District National Park in the southern Pennines, UK, are heavily contaminated with anthropogenically derived, atmospherically transported Pb. This is due to the close proximity of this region to urban and industrial centres. Peat erosion is widespread in the National Park and many peatland catchments exhibit severe gullying. The results of this study reveal that gully erosion is releasing sediment-associated Pb into the fluvial system of the National Park, but mean Pb concentrations vary between study catchments. Gully extent in the National Park was mapped using elevation residual analysis on a LiDAR digital elevation model. A gully depth algorithm was then used to calculate average gully depth for the study catchments. Variability in mean sediment-associated Pb concentrations can be explained by differences in mean gully depth. The Pb content of suspended sediment exported from catchments characterised by shallow peat gullies is higher than that exported from catchments with deep peat gullies. This is due to conservative mixing of peat as it moves down peat gully faces. There is a strong relationship (r^2 = 0.82) between the mean Pb content of suspended sediments and the catchment attribute of mean gully depth. The combination of this relationship with the LiDAR derived gully depth mapping has allowed the development of a predictive spatial model of stream sediment-associated Pb concentrations across catchments in the National Park. This model may be particularly useful for catchment managers who are currently involved in the restoration of eroding peatlands in the southern Pennine uplands.