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Are changes in weather masking the efficacy of measures aimed at mitigating diffuse pollution?

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Interpretations of the efficacy of mitigation measures for reducing nitrogen (N) and phosphorus (P) losses from agricultural sources to water bodies are challenged by the temporal variability of air temperature and rainfall. Influences are different depending on flow controls, associated time lags and nutrient transformations that may occur along the pathways. In Europe weather patterns and trends are influenced by large-scale weather systems over the North Atlantic. One of the most prominent teleconnection patterns that affect the weather across all seasons is the North Atlantic Oscillation (NAO). In northwestern Europe a positive phase in the NAO index over the winter period is often associated with elevated air temperatures in summer and more frequent large rain events in winter than normal. The objective of this study was to investigate the catchment-scale influences and relationships of naturally altered hydro-meteorological processes on the diffuse N and P losses to waters, in order to distinguish natural climate effects from those caused by adaptive management (increased agricultural intensity, decreased nutrient use etc.).

Here we present six years of monthly nitrate-N and total reactive P concentrations in stream water (aggregated from sub-hourly monitoring) in six, ca. 10 km2, Irish agricultural catchments with different hydrological flow controls and land use. The locations of the catchments make them susceptible to sudden and/or seasonal shifts in weather.

Changes in long term air temperatures and rainfall were investigated and annual N and P concentrations were compared to the NAO. During the monitored period (2009-2015) there was a steady increase in wintertime NAO index, reaching positive values in recent years, resulting in higher air temperatures and more frequent large rain events in winter. In some settings annual N and/or P concentrations were positively correlated to the three-year moving average NAO index ($R2 > 0.90$). Catchments with free draining soils and permeable bedrock appeared sensitive to weather shifts for N loss via belowground pathways while catchments with poorly drained soils were sensitive for P loss via surface pathways. In such settings there is a risk that monitored changes in water quality due to nutrient management could be confounded by the effect of a larger weather cycle and the short term water quality targets may be difficult to reach.