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Influence of teleconnection on water quality in agricultural river catchments

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Influences such as weather, flow controls and lag time play an important role in the processes influencing the water quality of agricultural catchments. In particular weather signals need to be clearly considered when interpreting the effectiveness of current measures for reducing nitrogen (N) and phosphorus (P) losses from agricultural sources to water bodies. In north-western Europe weather patterns and trends are influenced by large-scale systems such as the North Atlantic Oscillation (NAO) and the position of the Gulf Stream, the latter expressed as the Gulf Stream North Wall index (GSNW index). Here we present five years of monthly data of nitrate-N concentration in stream water and groundwater (aggregated from sub-hourly monitoring in the stream outlet and monthly sampling in multilevel monitoring wells) from four agricultural catchments (ca. 10 km2) together with monitored weather parameters, long-term weather data and the GSNW index. The catchments are situated in Ireland on the Atlantic seaboard and are susceptible to sudden and seasonal shifts in oceanic climate patterns. Rain anomalies and soil moisture deficit dynamics were similar to the dynamics of the GSNW index. There were monitored changes in nitrate-N concentration in both groundwater and surface water with no apparent connection to agricultural management; instead such changes also appeared to follow the GSNW index. For example, in catchments with poorly drained soils and a 'flashy hydrology' there were seasonal dynamics in nitrate-N concentration that correlated with the seasonal dynamics of the GSNW index. In a groundwater driven catchment there was a consistent increase in nitrate-N concentration over the monitored period which may be the result of increasingly more recharge in summer and autumn (as indicated by more flux in the GSNW index). The results highlight that the position of the Gulf Stream may influence the nitrate-N concentration in groundwater and stream water and 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. These results need to be considered in the context of existing measures to mitigate diffuse pollution, possible reviews of measures and the expectation of water quality trends and targets.