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Hydrol. Earth Syst. Sci., 8, 485-502, 2004

www.hydrol-earth-syst-sci.net/8/485/2004/

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## The water quality of streams draining a plantation forest on gley soils: the Nant Tanllwyth, Plynlimon mid-Wales

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**Abstract.** The water quality of the Nant Tanllwyth stream in the Plynlimon region of mid-Wales is related to the key hydrobiogeological controls and the effects of conifer harvesting based on an analysis of rain, cloud, stream and groundwater measurements. The results show the normal patterns of stream water quality response to hydrology. Thus, there is a high damping of atmospheric inputs due to storage in a highly heterogeneous soil and groundwater system. Correspondingly, there is a highly dynamic response for components such as calcium, bicarbonate and aluminium. This response links to the relative inputs of acidic and aluminium-bearing soil waters under high flow conditions and base enriched bicarbonate bearing waters from the groundwater areas under baseflow conditions. The introduction of a deep borehole near the main stem of the river opened up a groundwater flow route to the stream and other parts of the catchment. There were two aspects to this. Firstly, it caused a change to the stream water quality, particularly under baseflow conditions, by increasing the concentrations of calcium and magnesium and by reducing the acidity. The monitoring shows that this change has persisted for over eight years and that there is no sign of reversion to pre-borehole times. Secondly, it caused a change in the groundwater level and chemistry at a borehole on the other side of the river. This feature shows that the fracture system is of hydrogeochemical and hydrogeological complexity. The effects of conifer harvesting are remarkable. At the local scale, felling leads to the expected short term increase in nitrate, ammonium and phosphate from the disturbance of the soil and the reduction in uptake into the vegetation. Correspondingly, there is a reduction in sodium and chloride linked to reduced scavenging of atmospheric inputs from cloud water by the vegetation and also due to increased dilution potential due to reductions in transpiration by the trees. However, within the main stream, virtually no change is observed in stream water quality with felling, except for a decrease rather than an expected increase in nitrate concentration. It seems that the increase in phosphate, for a system that is essentially phosphate limiting, has stimulated biological activity in the stream leading to increased uptake of nitrate and ammonium. However, there is little change in the sodium and chloride in the stream and there are important issues of the representative nature of studying small scale drainage areas. Boreholes, introduced to assess the impacts of the felling programme, show unexpected variations in

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groundwater chemistry. These variations are associated with the complexity of both flow routing and the chemical reactivity within the groundwater and lower soil zones, rather than changes that can be linked specifically to felling. The implications of the study are discussed in relation to both process understanding and forestry management practices.

Keywords: water quality, acidification, conifer, harvesting, pH, nitrate, ammonium, phosphate, nutrients, alkalinity, Plynlimon, Wales, Tanllwyth, streams, groundwater

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Citation: Neal, C., Reynolds, B., Neal, M., Wickham, H., Hill, L., and Williams, B.: The water quality of streams draining a plantation forest on gley soils: the Nant Tanllwyth, Plynlimon mid-Wales, Hydrol. Earth Syst. Sci., 8, 485-502, 2004. ■ [Bibtex](#) ■ [EndNote](#) ■ [Reference Manager](#)