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Background phosphorus concentrations in Danish groundwater and surface water bodies

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Quantitative information on the background concentration and loading of phosphorus is important when establishing the pressure-impact pathway for Danish streams, lakes and estuaries The background phosphorus loading thus determines present day lowest phosphorus loadings without influence from point sources and agriculture. We have mapped the background concentration of phosphorus in Danish groundwater and streams based on monitoring in 3000 groundwater wells, 7 small streams draining undisturbed catchments (1990-2010) and 19 streams draining small undisturbed catchments being monitored during 2004-2005.

The concentration particulate P (PP) was found to be nearly constant within eight major georegions of Denmark (0.018 mg $\pm$ 0.010 mg P L-1. On contrary, the concentration of total dissolved P (TDP) was found to vary between 0.011-0.071 mg P L-1 within the eight georegions. We have also time series of background total P concentrations from 7 small undisturbed catchments covering the period 1990-2010. No significant trends have been observed in total P concentrations from these streams during the period 1990-2010. The average annual background loss of total phosphorus amounts to 730 tonnes P or 29% of the total loading of phosphorus from the Danish land to sea during the period 2007-2011.

The measured TDP concentration in groundwater was much higher under reduced conditions (median: 0.10-0.15 mg P L-1) than in oxidized groundwater (<0.02 mg P L-1). Clear links could be established between TDP concentrations in reduced groundwater and the geological formations where chalk aquifers have low TDP concentrations and interglacial marine clay deposits having high TDP concentrations. No significant relationship could, however, be established between TDP concentration in oxidized groundwater and in stream water within the catchment to the 19 streams draining uncultivated areas. A modelling of the potential discharge of TDP from deeper reduced groundwater to surface waters in Denmark was performed with the MIKE SHE having a grid size of 1x1 km The (DK-model) (Henriksen et al., 2003). The discharge of TDP is low on the Danish Islands (< 1 kg P km-2) but very high in the western part of Jutland (10-17 kg P km-2). The question that can be raised is if these large quantities of TDP from deeper groundwater actually reach surface water or how much of the modelled TPD flux is sorbed in river valley sediments before discharging to surface water?

References

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