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Application of Bayesian belief net in modelling the origin and effects of terrigenous dissolved organic matter in a boreal aquatic ecosystem

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Bayesian belief nets (BBN) are capable of developing holistic understanding of the origin, transportation, and effects of dissolved organic matter (DOM) in ecosystems. The role of riverine DOM, transporting carbon and macronutrients N and P into lakes and coastal areas, has been largely neglected in research about processes influencing aquatic ecosystem functions although dissolved organic matter provides a significant nutrient source for primary producers in aquatic environments. This neglect has also contributed to the environmental policies which are focused in the control of inorganic N and P load. It is of great social and economic interest to gain improved knowledge of whether the currently applied policy instruments act in synchrony in mitigating eutrophication caused by N and P versus DOM load.

DOM is a complex mixture of compounds that are poorly characterized. DOM export is strongly regulated by land use (urban, forest, agricultural land, peat land), in addition to soil type and soil organic carbon concentration. Furthermore, the composition of DOM varies according to its origin. The fate and effects of DOM loads in the fresh water and coastal environments depend, for example, on their biodegradability. Degradation kinetics again depends on the interactions between composition of the DOM pool and the receiving environment.

Impact studies of dissolved organic matter pose a complicated environmental impact assessment challenge for science. There exists strategic uncertainty in the science about the causal dependencies and about the quality of knowledge related to DOM. There is a clear need for systematization in the approach as uncertainty is typically high about many key processes. A cross-sectorial, integrative analysis will aid in focusing on the most relevant issues. A holistic and unambiguous analysis will provide support for policy-decisions and management by indicating which outcome is more probable than another. The task requires coupling complex models of different environmental compartments (soil chemistry, agricultural management practices, aquatic processes, costs and benefits for society) with explicit treatment of uncertainty. In order to achieve policy relevance, these models have to be integrated into resource management. We use a Bayesian belief net to describe the probabilistic dependencies among the driving forces, processes, and impacts relevant to dissolved organic matter in boreal waterways.