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Modelling the effects of climate on long-term patterns of dissolved organic carbon concentrations in the surface waters of a boreal catchment

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Abstract. Dissolved organic carbon concentrations ([DOC]) in surface waters are increasing in many regions of Europe and North America. These increases are likely driven by a combination of changing climate, recovery from acidification and change in severity of winter storms in coastal areas. INCA-C, a process-based model of climate effects on surface water [DOC], was used to explore the mechanisms by which changing climate controls seasonal to inter-annual patterns of [DOC] in the lake and outflow stream of a small Finnish catchment between 1990 and 2003. Both production in the catchment and mineralization in the lake controlled [DOC] in the lake. Concentrations in the catchment outflow were controlled by rates of DOC production in the surrounding organic soils. The INCA-C simulation results were compared to those obtained using artificial neural networks (ANN). In general, "black box" ANN models provide better fits to observed data but process-based models can identify the mechanism responsible for the observed pattern. A statistically significant increase was observed in both INCA-C modelled and measured annual average [DOC] in the lake. This suggests that some of the observed increase in surface water [DOC] is caused by climate-related processes operating in the lake and catchment. However, a full understanding of surface water [DOC] dynamics can only come from catchment-scale process-based models linking the effects of changing climate and deposition on aquatic and terrestrial environments.

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