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Future riverine inorganic nitrogen load to the Baltic Sea from Sweden: An ensemble approach to assessing climate change effects

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The dramatic increase of bioreactive nitrogen entering Earth's ecosystems continues to attract growing attention. Increasingly large quantities of inorganic nitrogen are flushed from land to water, accelerating freshwater and marine eutrophication. Multiple, interacting, and potentially countervailing drivers control the future hydrologic export of inorganic nitrogen. In this contribution, we attempt to resolve these land-water interactions with help of a versatile modeling framework, which uses an ensemble of climate model projections, hydrological simulations and several parameter parsimonious regression models to project future riverine inorganic nitrogen dynamics across Sweden, while maximizing the information value of existing measurements. Our results indicate that the total amount and seasonal pattern of inorganic nitrogen loads in a future climate are mostly influenced by longer growing seasons and more freshwater flowing into the Baltic Sea. The gain in winter streamflow and winter loads is greater than the loss of spring flood, which consequently leads to a considerable overall increase of inorganic nitrogen loading. Consequently, we argue that politically agreed nutrient reductions input goals will be less effective under future climate conditions and that anthropogenic nitrogen sources have to be reduced even further to reach acceptable future loads to the Baltic Sea.