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Impact of discharge data uncertainty on nutrient load uncertainty

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Uncertainty in the rating-curve model of the stage-discharge relationship leads to uncertainty in discharge time series. These uncertainties in turn affect many other analyses based on discharge data, such as nutrient load estimations. It is important to understand how large the impact of discharge data uncertainty is on such analyses, since they are often used as the basis to take important environmental management decisions. In the Baltic Sea basin, nutrient load estimates from river mouths are a central information basis for managing and reducing eutrophication in the Baltic Sea. In this study we investigated rating curve uncertainty and its propagation to discharge data uncertainty and thereafter to uncertainty in the load of phosphorous and nitrogen for twelve Swedish river mouths.

We estimated rating curve uncertainty using the Voting Point method, which accounts for random and epistemic errors in the stage–discharge relation and allows drawing multiple rating-curve realisations consistent with the total uncertainty. We sampled 40,000 rating curves, and for each sampled curve we calculated a discharge time series from 15-minute water level data for the period 2005–2014. Each discharge time series was then aggregated to daily scale and used to calculate the load of phosphorous and nitrogen from linearly interpolated monthly water samples, following the currently used methodology for load estimation. Finally the yearly load estimates were calculated and we thus obtained distributions with 40,000 load realisations per year – one for each rating curve.

We analysed how the rating curve uncertainty propagated to the discharge time series at different temporal resolutions, and its impact on the yearly load estimates. Two shorter periods of daily water quality sampling around the spring flood peak allowed a comparison of load uncertainty magnitudes resulting from discharge data with those resulting from the monthly water quality sampling.