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Water and nutrient transport in a tidal influenced Danish lowland river: monitoring strategies and model validation

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In order to estimate the emission of nutrients and sediment loads to fjords and marine coastal waters, accurate estimates of the discharge, nutrients and suspended sediment in coastal rivers are required. However, rivers in coastal areas are often influenced by tide and wind driven backwater, which can create a non-linear relationship between water stage and discharge. Furthermore, complex flow systems and stratification of the water column can be developed in such environments, whereby representative water samples are difficult to obtain. Denmark has a long coast line compared to the total area and the majority of the coastline is ungauged primarily due to these monitoring difficulties. Hence, the total water runoff and nutrient loads to coastal waters are estimated from a national hydrological model, with only few data available for validation. Therefore, water and nutrient transport in a tidal-influenced Danish lowland river were investigated by applying a new monitoring strategy for continuous data collection. The specific objective was to set up a water and nutrient balance for the coastal catchment based on the monitoring results, and conduct a comparison with the model estimates from the national hydrological model.

Approximately three km from the river outlet a gauging station was set up for the period June 2011 to July 2013. Average water velocities were measured continuously in one depth across the river with an acoustic Doppler velocity sensor. Furthermore, water conductivity and turbidity were measured with two sensors, one near the channel bed and one in the upper part of the river profile. Also composite water samples were collected in two depth levels every two hours, together with monthly traditional grab samples. All water samples were analysed for total nitrogen, nitrate, ammonium, total phosphorous, and phosphate.

A good correlation is found between the model estimates and the measured river discharge except during high flows. This is expected to be caused by the highly variable relation between water stage and river discharge revealed by the measured water velocities and not captured by the hydrological model. The analysis of sediment and nutrients in the two different water depths show a stratification during the different flow conditions, likely due to the the complex flow structures developed by tide and backwater. A comparison with the model estimates of nutrient fluxes will be performed, to investigate if the stratification observed plays a significant role for the validation results.