Monitoring sediment and phosphorous flux using composite sampling in Passaúna river

Monitoring of sediment and phosphorus transport in the Passauna river using composite and discrete sampling up-stream of the reservoir.

Context

The high spatial and temporal variability of river water quality of can lead to large uncertainties for the environmental protection planning and water management. River monitoring is important in order to detect short-term changes and long-term trends in water quality status. For the calibration of mass flux models for watershed management the monitoring data is essential. The main approach for reducing these uncertainties is to chose a suitable sampling strategy. A restriction thus for long-term monitoring are the costs of sampling and analyse of the samples. Composite sampling is a cost effective alternative as it is integrating many single samples in a composite sample. The composite sampling was used to assess the transported sediment and phosphorous mass over more than one year.

Objectives/Goals

- Quantification of the long-term sediment and Phosphorus input to Passaúna Reservoir
- Better understanding of the seasonal dynamics of the river fluxes
- Validation and calibration of mass flux modelling results from Passaúna catchment
- New cost-effective sampling strategy

Methodology

The flow proportional composite sampler (LVS) was installed at the Passaúna River, upstream of the PU reservoir.

After each 8000 m³ of discharge a sample of ~20 L was pumped into the tank until 1 m³ was full. The filling of tank took between 10 and 3 days. The resulting composite sample in the tank was analyzed in two components: settled material from the tank bottom (Sed) and supernatant water (SW). After dividing both components, the sediment grainsize distribution was determined and the total Phosphorus (TP) content analyzed for the <0.63 µm fraction. Also the contents of solids and phosphorous in the supernatant water were determined. Additionally, one grab sample from the river was taken each time the tank was emptied.

Afterwards the amount of sediment and Phosphorous can be calculated for each sampling period.

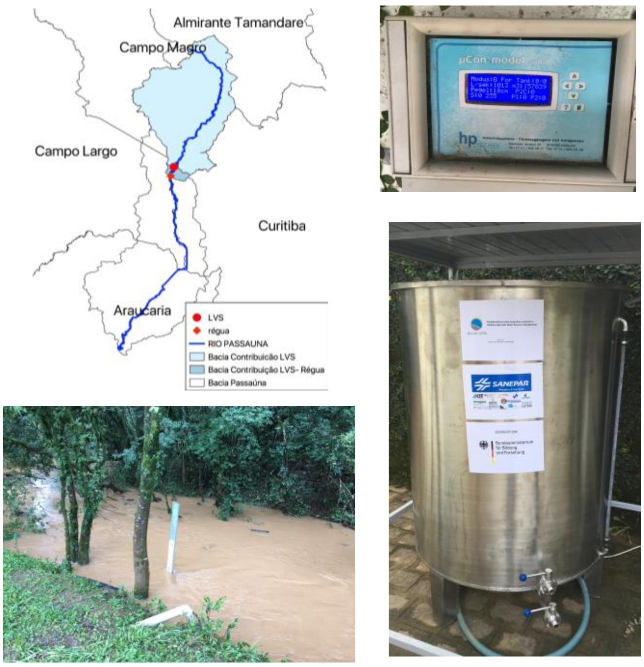

Fig.1. Overview from the LVS (location and installation)

The tank concentration is the average concentration in the I sampling period and was calculated as:

$$C_i = \frac{\text{Sed} + \text{SW}}{\text{Tank volume}} = \frac{\text{Mass}_{\text{Sed},i} + (C_{SW} * \text{Vol}_{SW})_i}{\text{Tank\_volume}_i}$$

The load in the sampling period was calculated as:

$$\text{Load}_i = Q_{\text{total},i} \text{x} C_i$$

Where Q total is the toal water volume that flows in the river during the ith period.

Results

The monitoring in the Passauna river started Februar 2018 until January 2020 there are 33 composite samples and 40 grab samples. Figure 2 a and b shows the results of total phosphorus (mg/l) and suspended solids (mg/l). The suspended solids concentration showed

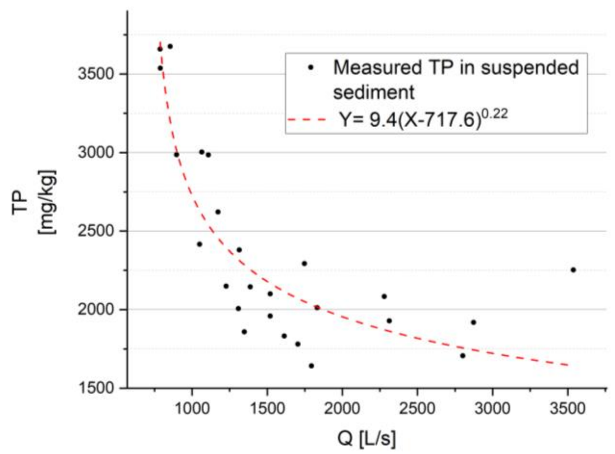

Fig. 2 Relation between average Q during a sampling period of LVS and the TP content of the suspended sediment in (mg/kg)

an increasing trend with increased discharge while the TP showed decreasing values with increased discharge.

This trend in the TP input (Figure 2) can be attributed to the high input of TP from urban areas in case of low flow conditions and from arable land through erosion in case of the mid flow conditions.

The TP results imply that the TP input from the point sources is rather important in terms of eutrophication as the TP for urban areas is easy available for the microorganisms to consume. By a simple balance for the monitoring period it was calculated that from the baseflow there was an input of 3.7 ton of TP. The grab sampling showed rather uniform results with the values fluctuating from 0 until 0.10 mg/l TP with some sporadic high values.

Discussion

During the samling period, it was rather problematic to sample the high flow events. The problem were mainly technical related (regarding pumping equipment) and not to the efficiency and reliability of the whole system itself. For having a representative sampling, important would be to have a number of samples for high flow conditions. The sampling of high flow conditions could make it possible to derive the actual mass flux also from the agricultural areas (erosion and surface runoff)

Innovation/Outlook

- ✓ Increased temporal resolution in river water quality monitoring
- ✓ Precise estimation of mass flux
- ✓ Location of relevant pathways

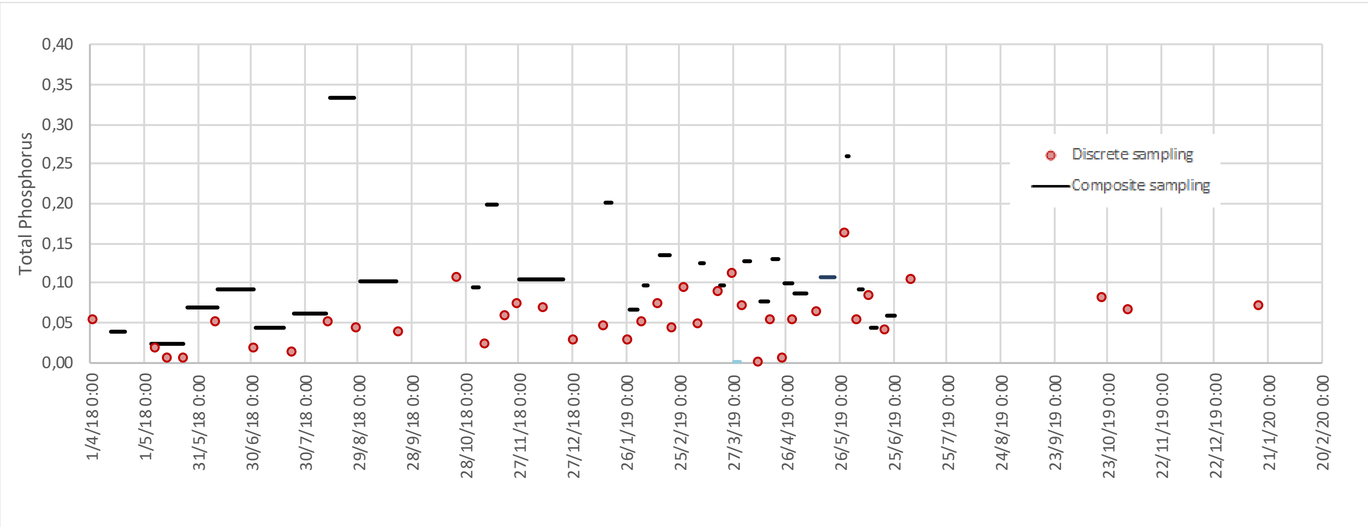

Fig. 3 Overall results from LVS monitoring

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