Annex 2

Project „Water bodies without borders" (EstLat 66)

FyrisNP modelling for nutrient load calculation at Latvian project area

February 2020

Introduction

To evaluate the nitrogen and phosphorus loads in water bodies within the Latvian part of project area *FyrisNP* tool for catchment-scale modelling of nutrients was used. N and P loads were modelled for Salaca river basin (30 WBs in project area), Gauja river basin (23 WBs in project area) and Daugava river basin (3 WBs in project area). Modelling was carried out for a period of 18 years (2000-2017).

This annex gives a brief insight into the model concept and provides some examples of modelling results.

Model description

For the dynamic *FyrisNP* model calculates source apportioned gross and net transport of nitrogen and phosphorus in rivers and lakes. The time step for the model is in the majority of applications one month and the spatial resolution is on the sub-catchment level. Retention, i.e. losses of nutrients in rivers and lakes through sedimentation, up-take by plants and denitrification, is calculated as a function of water temperature, nutrients concentrations, water flow, lake surface area and stream surface area. The model is calibrated against time series of measured nitrogen or phosphorus concentrations by adjusting two parameters (Hansson et al. 2008).

Data used for calibrating and running the model can be divided into time dependent data, e.g. timeseries on observed nitrogen and phosphorus concentration, water temperature, runoff and point source discharges, and time independent data, e.g. land-use information, lake area and stream length and width (Hansson et al. 2008).

Input data

In order to perform simulations with the *FyrisNP* model, an Excel-file containing all input data is required. The Excel data file consists of eight to ten different worksheets depending on features used. In an Excel-file must contain data describing sub-catchments (land use data, data about stream lengths and lake areas etc.), data about water temperature, specific runoff, observed P_{tot} or N_{tot} concentrations, minor point sources (in this case data about residents not connected to centralized sewerage system were used), major point sources (data of N and P amounts discharged from waste water treatment plants acquired from national statistical database "Ūdens-2", type specific concentrations (N_{tot} and P_{tot} concentrations in runoff from different land use types), storage (volume changes in Lake Burtnieks).

Running the model

After the Excel file is loaded into the model, the data is automatically subdivided by sub-catchments, and the number of monitoring stations is determined.

Calibration is performed automatically, starting with the Monte Carlo method. When complete, auto calibration is performed. The calibration afterwards is completed with manual calibration. When complete, it is possible to analyse the calibration results - observed concentrations and the simulated concentrations. Figure 1 shows an example of calibration results for a water body G306 Salaca in the Salaca river basin - observed and simulated N_{tot} values.

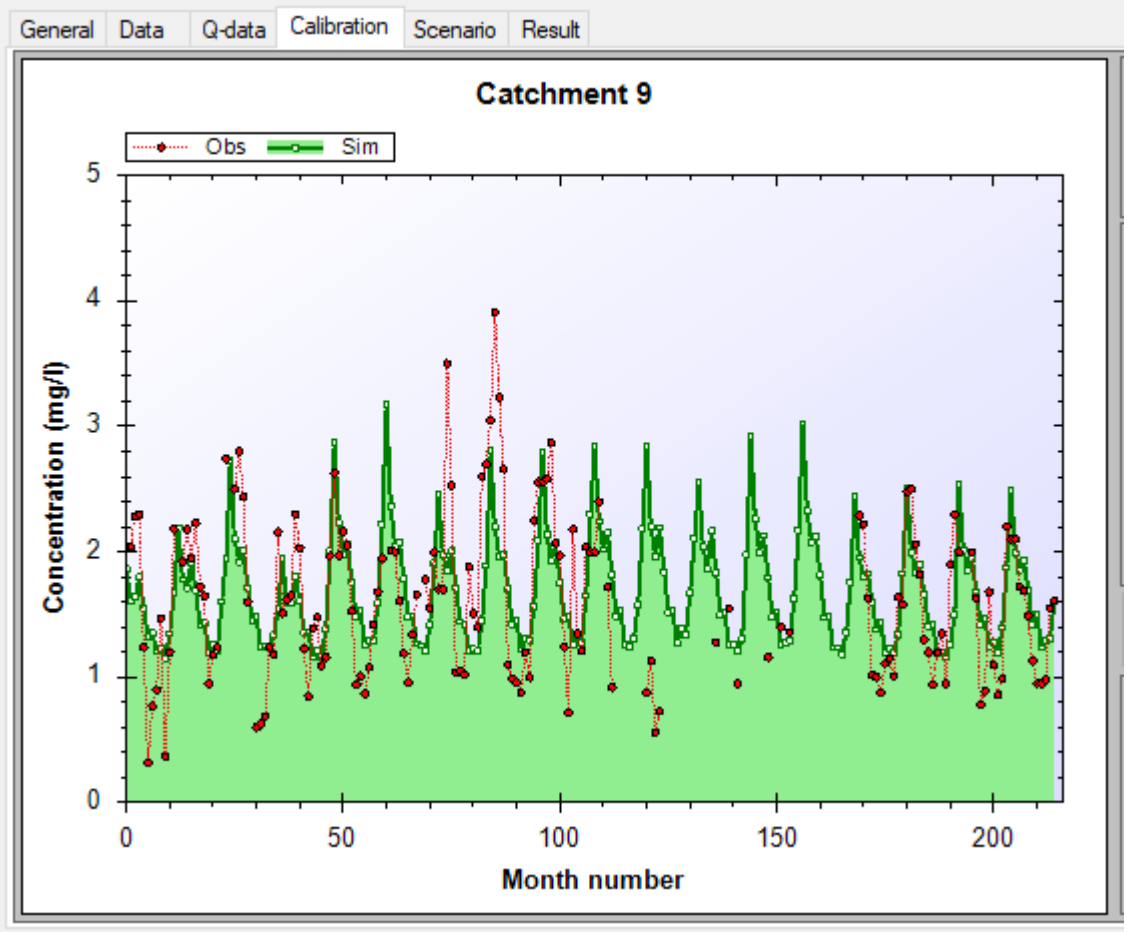

Figure 1. *Calibration result (observed values and simulated for WB G306 Salaca).*

The Result section shows the results of the modelling. "Internal load" shows the incoming load in the water body and the outgoing load. "Sources" show how much load is given from different land use types or minor or major point source, as seen in a plot (Figure 2).

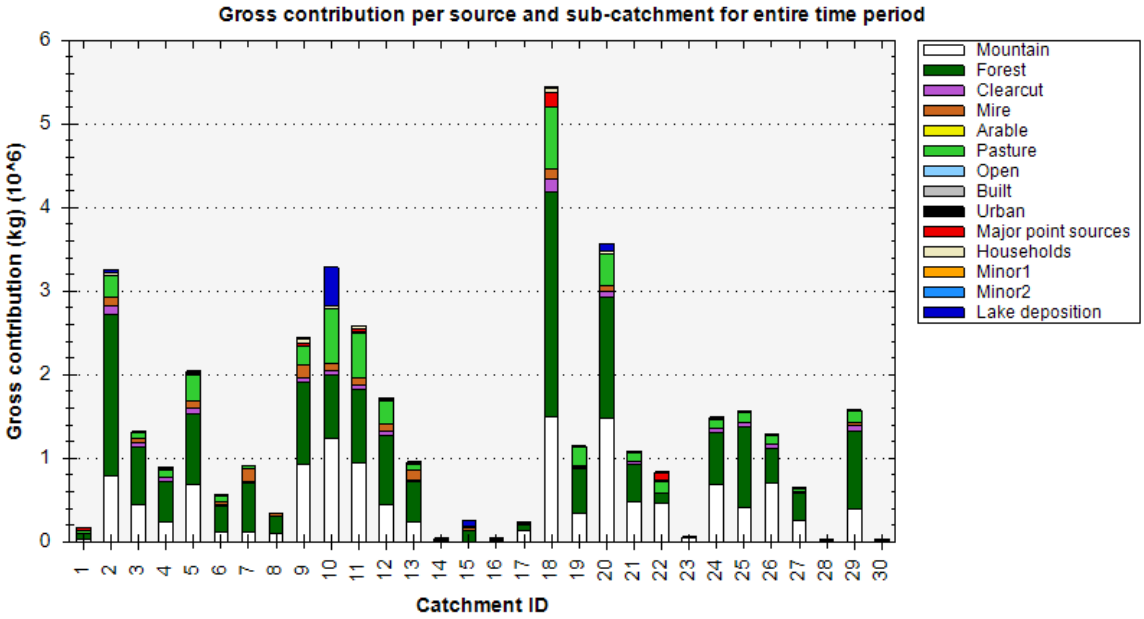

Figure 2. *Nitrogen loads from various sources in Salaca river basin WBs over the whole time period.*

Loads are also calculated by months. This data can be transferred to an Excel file for further analysis or graphical presentation. Figure 3 shows the N load volumes by months in the whole modelled period for the water body G306 Salaca.

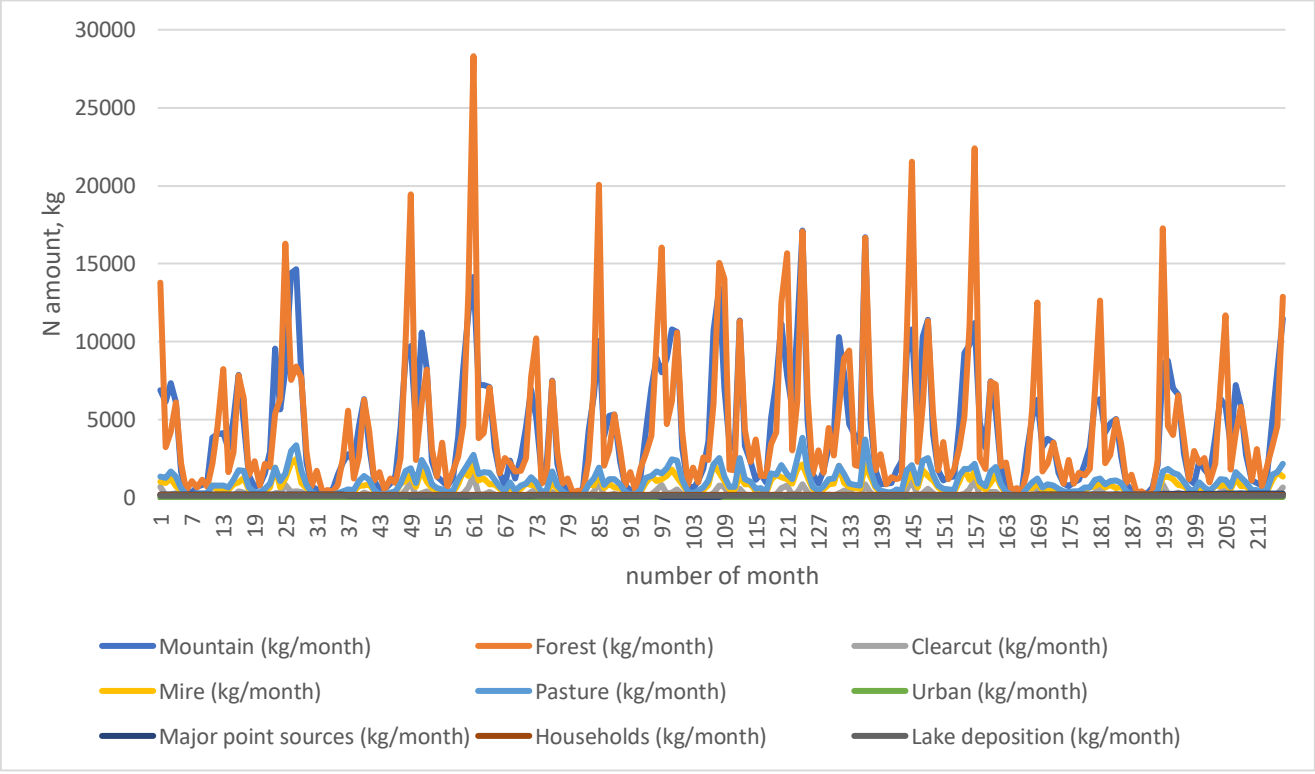

Figure 3. *N load volumes by months*

Conclusions

After modeling of the Salaca, Gauja and Daugava river basins, results for the water bodies included in the project area were compiled. Table 1 shows the amounts of N and P from different sources in the whole modelled period for the whole modelled project area.

Table 1. *N and P loads from different sources in modelled project area (2000-2017).*

	Arable lands, t	Forests, t	Clearcuts, t	Mires, t	Pastures, t	Urban areas, t	WWPT, t	Households, t	Lake deposition, t
N amount in modelled project territory (2000-2017)	17108.4	30375.7	1787.6	1518.2	8439.0	31.2	764.2	608.1	1300.4
P amount in modelled project territory (2000-2017)	300.2	483.0	28.2	30.6	152.8	2.1	140.3	96.4	4.7

References

Hansson, K., Wallin, M., Djodjic, F., Orback, C. 2008. The *FyrisNP* model Version 3.1 – A tool for catchment-scale modelling of source apportioned gross and net transport of nitrogen and phosphorus in rivers. A user´s manual. Institutionen för miljöanalys, SLU.