IWAS

International Water Research Alliance Saxony

Modelling the fate of organic micropollutants in a tropical reservoir in Brasilia, Brazil

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Motivation

The development of an IWRM is usually assisted by models. Especially when data is scarce and immediate response is required complex models, needing comprehensive data sets and a long time for set up and calibration might fail. Our approach to test our hypothesis and contribute to the understanding of complex processes in Lake Paranoá and its management therefore focuses on the use of a simple model which is able to produce valuable information based on few measurements within a short time.

Hypothesis: Decrease in concentrations of organic micropollutants in Lake Paranoá can not solely be explained by dilution with incoming freshwater from tributaries, groundwater, precipitation or storm water overflow.

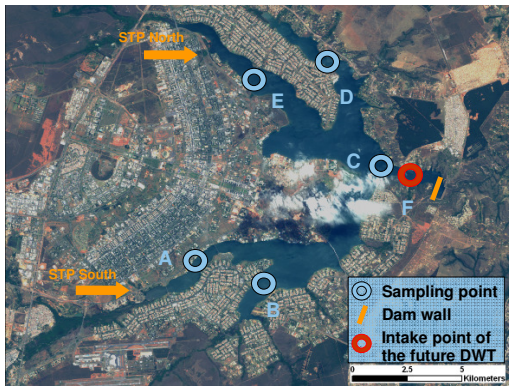

Fig. 1: Lake Paranoá with sampling points A to F and position of STPs

Introduction

Lake Paranoá

- Multiple-use reservoir; use as a drinking water reservoir in the near future
- Observed decrease in concentrations of organic micropollutants like pharmaceuticals, corrosion inhibitors and contrast media from sampling points A, B, D and E in the direction of sampling point C (central point)(see figure 1)
- Surface area: 38 km^2
- Mean depth: 12 m
- Volume: 4.98*10^8 m^3
- Retention time: ~300 days

Compound	*Average load via STPs*
Atenolol	200 g/d
Caffeine	30 g/d
Carbamazepine	40 g/d
Iopromide	700 g/d

Table 1: Average loads for Lake Paranoá, introduced via the two STPs

Methods

- Set up of a 0D-model of Lake Paranoá consisting of ordinary differential equations (ODE) using the *R* environment and the add-on package *deSolve*
- Forcings: measured field data of discharge, precipitation, runoff, evaporation, loads of organic micropollutants received via the two STPs (assumption: no diffuse sources)
- Losses of organic micropollutants were described as best fit to measured data

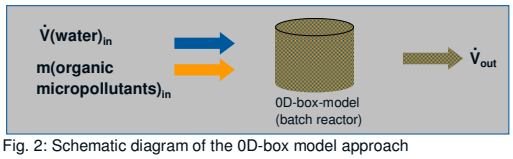

Fig. 2: Schematic diagram of the 0D-box model approach

Results

- Observed decrease in concentrations in Lake Paranoá for atenolol, carbamazepine, caffeine and iopromide can not be explained by dilution alone
- Introduction of significant loss rates (0.003 d^{-1} – 0.01 d^{-1}) to fit the model output to measured data
- Difficult modelling of some concentration gradients supports the existence of diffuse sources for Lake Paranoá (see figure 4)
- No distinction in the model between underlying processes possible

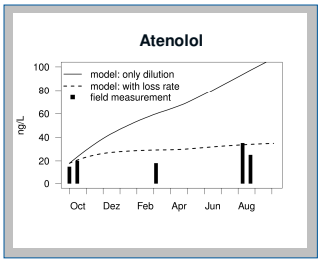

Fig. 3: Modelled concentrations of atenolol (loss rate 0.01 d^{-1}), $T_{1/2}$=69 d)

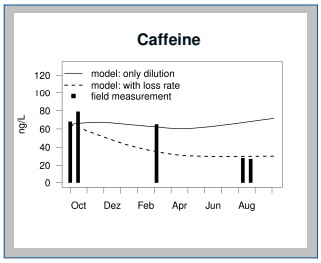

Fig. 4: Modelled concentrations of caffeine (loss rate 0.005 d^{-1}, $T_{1/2}$=138 d)

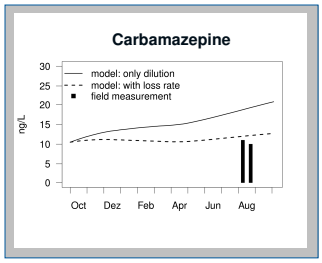

Fig. 5: Modelled concentrations of carbamazepine (loss rate 0.003 d^{-1}, $T_{1/2}$=231 d)

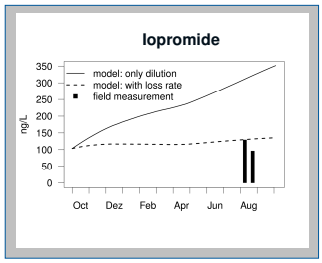

Fig. 6: Modelled concentrations of iopromide (loss rate 0.0075 d^{-1}, $T_{1/2}$=92 d)

Conclusion

- Modelling results clearly show the involvement of further processes leading to the observed decrease in concentrations of organic micropollutants in Lake Paranoá
- Simple 0D-box model as a good tool for better understanding of processes in Lake Paranoá
- Contribution to the management of Lake Paranoá and IWRM for the DF (avoidance of pollution input, recommendations for water treatment)
- Further investigations needed for clarifying and distinguishing the nature of the compound losses
- Further modelling approaches to identify additional sources of diffuse inputs and support of a reduction strategy concerning organic micropollutants for Lake Paranoá

Contact and information

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