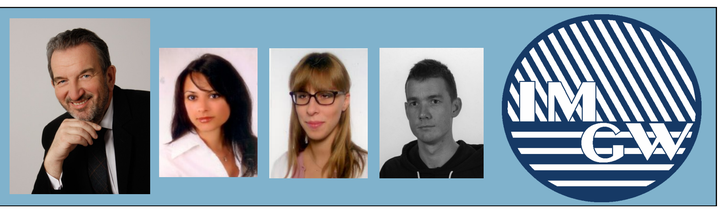
The impact of temporary data uncertainty on SWAT calibration results

INSTITUTE OF METEOROLOGY AND WATER MANAGEMENT

National Research Institute

Mieczysław S. Ostojski, Joanna Gębala, Paulina Orlińska-Woźniak, Paweł Wilk

POLAND

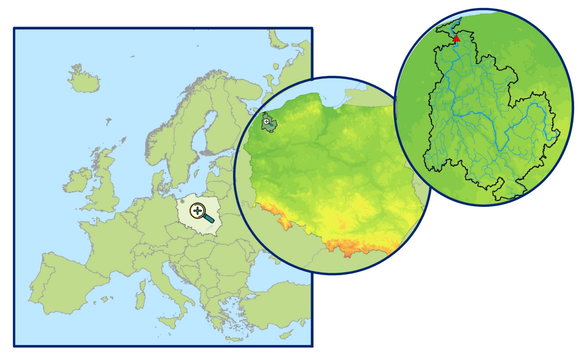


Reasons to Commence Research

- Increasing problem of eutrophication, which causes many social problems and necessitates the specification of the size of nutrient loads discharged into water bodies, including seas.
- The basis of such analysis is usually the monitor measurement results carried out in each country.
- Moreover, these measurements are used in models in the calibration, validation and verification processes of the water quality data.

Macromodel DNS module - SWAT is used to analyze the water quality in a catchment. It allows simulating the nutrient loads at the selected control point as daily-mean, monthly-mean and annual-mean data. Currently the DNS/SWAT calibration process is conducted as a comparison of simulation results; in this case daily values, and instantaneous measurement. This may cause errors due to the daily variation of nutrients concentrations .

Field of Research



Methodology

The article analyzes the representativeness of a single measurement during the day in relation to the daily variation of nutrient loads concentrations in the river profile of a pilot river. For this purpose, three cycles of field study were made. They were compatible with plants in the growing stage season. Measurements were carried out on the Rega River in the West Pomeranian voivodship of Poland, water gauge profile - Trzebiatów. Rega is a river that drains into the Baltic Sea. The Trzebiatów control-point city is located on the 14.86 km of the river. Measurement cycles were carried out in June 2012 (growing season) – I cycle, November 2012 (after the end of the growing season)-II cycle and March 2013 (before the start of the growing season, during spring thaw) – III cycle.

Uncertainty of Measurement

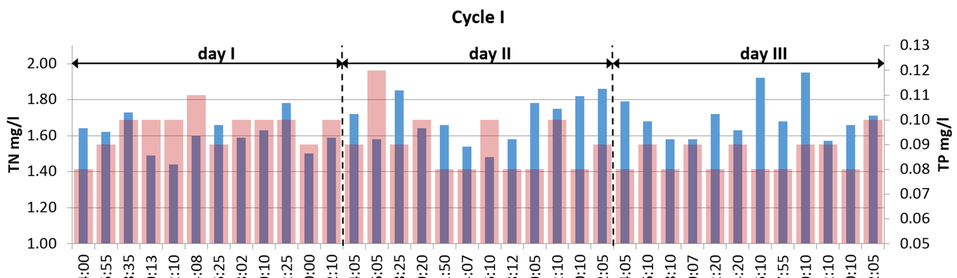
According to State Environmental Monitoring (SEM), measurements of uncertainty are as indicated in the table. SEMs uncertainty takes into account the uncertainty connected with mass chemical designation, samples volume, device errors etc.

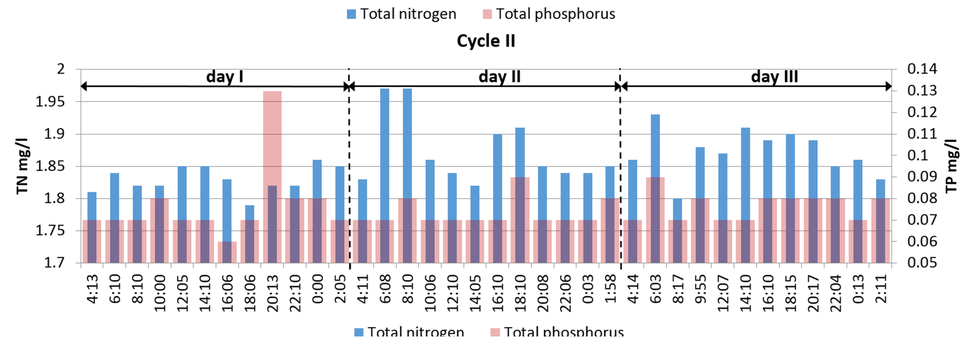
Lp	Area of research	Extended uncertainty (%) k=2 (trust level 95%)
1	TN	20
2	PN	10,5

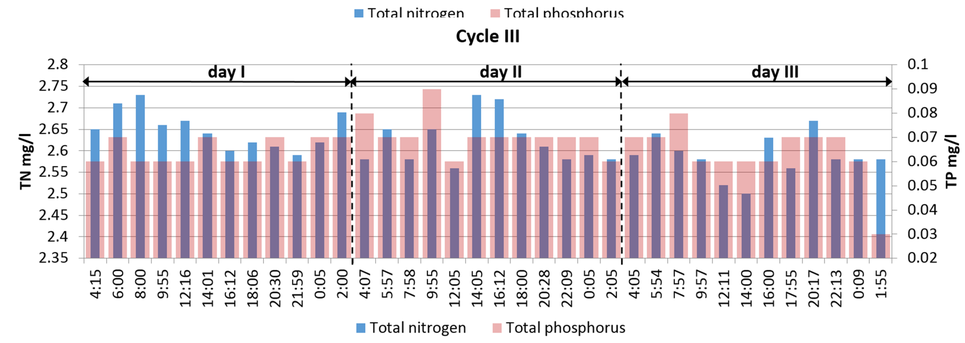
Additionally, it is valuable to include uncertainty connected with daily variability of nutrients concentrations.

Results

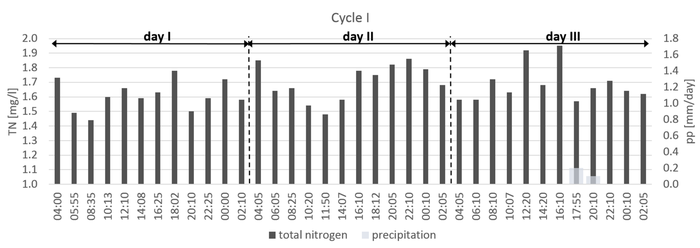
Cycle	Day [dd.mm.rrrr h:mm]		
	day I	day II	day III
cycle I	27.06.2012 4:00 - 28.06.2012 4:00	28.06.2012 4:00 - 29.06.2012 4:00	29.06.2012 4:00 - 30.06.2012 4:00
cycle II	28.11.2012 4:00 - 29.11.2012 4:00	29.11.2012 4:00 - 30.11.2012 4:00	30.11.2012 4:00 - 01.12.2012 4:00
cycle III	13.03.2013 4:00 - 14.03.2013 4:00	14.03.2013 4:00 - 15.03.2013 4:00	15.03.2013 4:00 - 16.03.2013 4:00

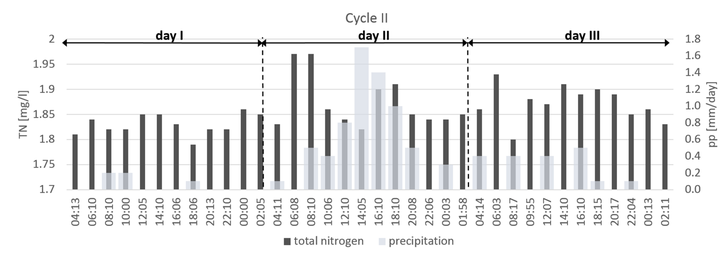


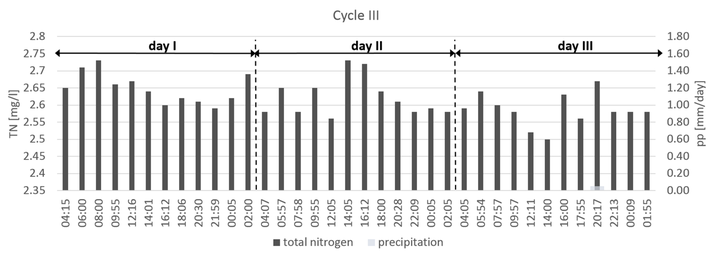




- The influence of the precipitation in the basin connected with the transportation of the nitrogen concentration has been analyzed. Cyclic variability of daily nitrogen concentration has been observed.
- As far as phosphorus is concerned, the observed variability was periodical, probably connected with anthropogenic point sources.



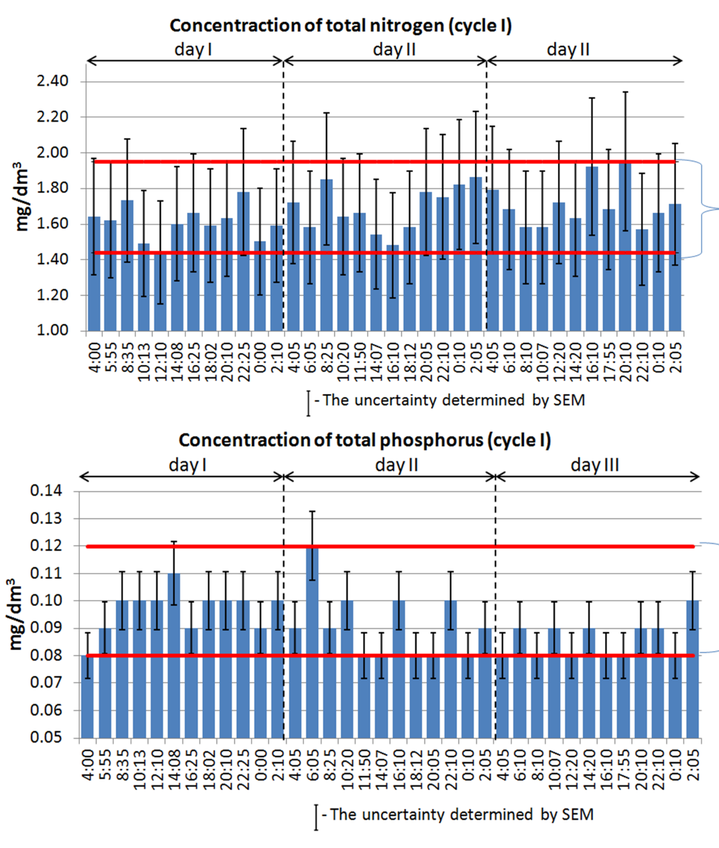


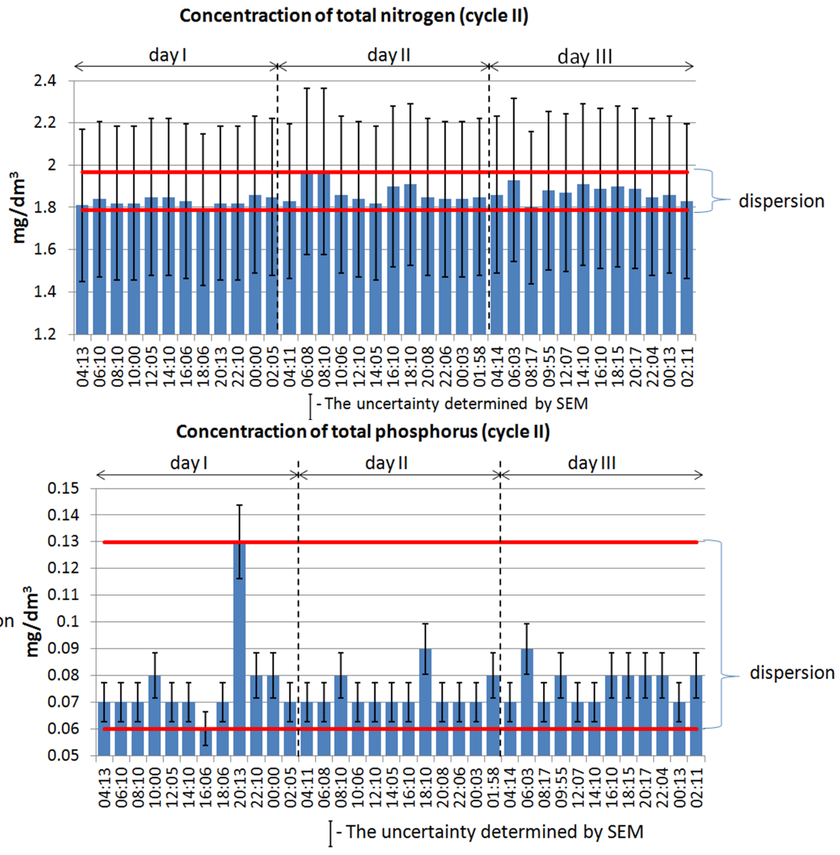


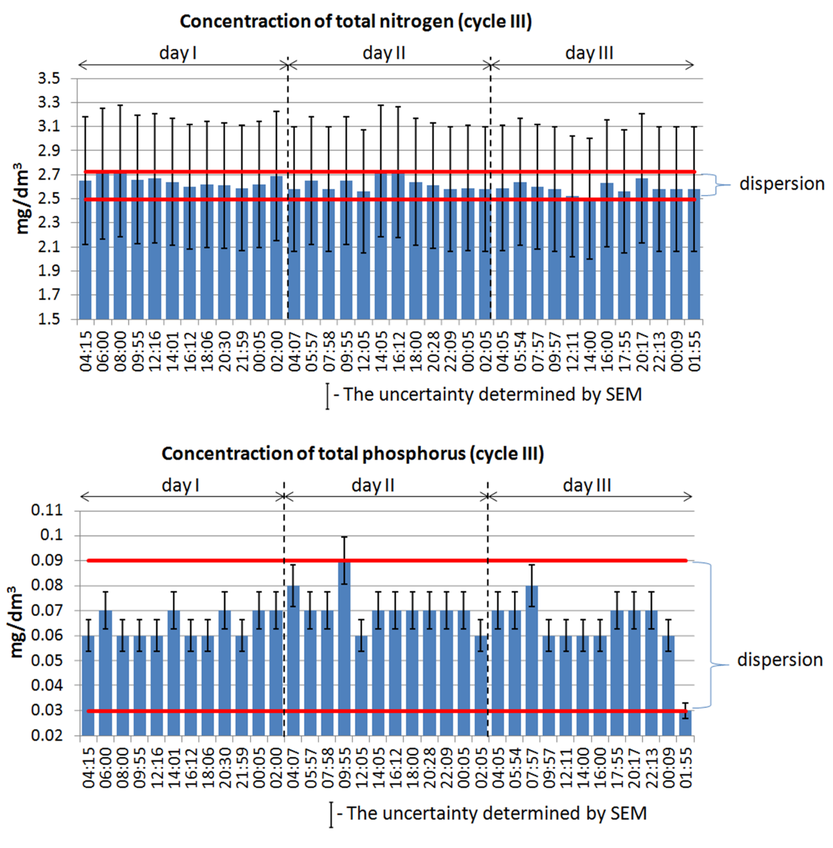
The variability of nutrients concentration is irrespective of actual precipitation, that is, current changes in the amount of water on the profile. The daily variability results from a complex set of factors, which create a vast uncertainty of the water quality studies, which are based on a single daily measurement, more than on monthly measurements, which occurs in Polish conditions.

The analysis gave interesting results. There was a significant change observed in the size of nutrients concentration during the day (up to 31% for total nitrogen and to 91% for total phosphorus). This trend is maintained regardless of the stage of plant growth. After combining variability of measurement with uncertainty of measurement, the uncertainty range of the benchmark for modeling is widened.

Survey cycle	Daily variation of measurements	
	Total nitrogen	Total phosphorus
cycle I	31%	44%
cycle II	10%	93%
cycle III	9%	91%







With regard to the fact that the current basic methods to count the amount of pollutants drained by surface waters are based on mathematical models, their calibration (models) ought to be based on average daily data.

When little data is available, the analysis of calibration, verification and validation of results, ought to be based on an uncertainty range which takes into consideration the exact amount of daily variability of particular nutrients.

It might be difficult to match the model data to monitoring data that defines the result of calibration when little monitoring data is used. In addition, it might be impossible when the uncertainty is wrongly evaluated.