Monthly nutrient emissions and loads to the Odra River Basin

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Conclusion

- temporal variation of nutrient emissions is mainly driven by hydrology and temperature
- detailed information about seasonal effects
- identification of relevant emission pathways
- identification of nutrient emission hotspots
- use for direct allocation of measures
- basis for cost-effectiveness analysis of measures to reduce emissions and loads

Spatial distribution

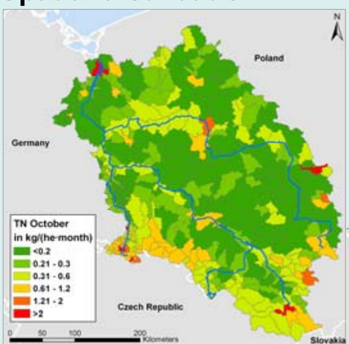
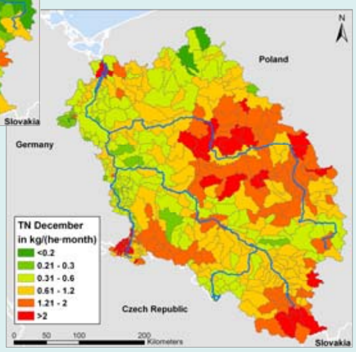


Figure 2 & 3: Example for inter annual TN emission dynamics October and December 2005 (TP emission dynamics shows nearly the same trend but more moderate)

- In **dry months** less variability of emissions between analytical units than in wet months



- In **wet months** strong increase of emissions in the Warta sub-basin and mountainous areas
- In remaining areas moderate changes of emissions
- For TP evenly distributed increase of emissions with few exposed hotspots

Site description

- Odra River Basin is located in the south of the Baltic Sea and distributed to the area of Poland (89%), Czech Republic (6%) and Germany (5%)
- Odra Catchment (118.000km²) covers 6.8% of Baltic catchment and discharges into the Szczecin lagoon
- 60% of the area is in agricultural use
- one of the most important nutrient emitter to Baltic Sea

Method

- application of MONERIS to model nutrient emissions and loads from the Odra catchment to the Szczecin lagoon on annual and monthly basis (www.risym.de/moneris)
- estimation of effectiveness for nutrient reduction measures in two different scenarios (Venohr et al., 2010 submitted)

→**EI**: **E**ntire **I**mplementation of measures to all analytical units

→**PI**: **P**artly **I**mplementation of more extensive measures, only to analytical units with an above average share on the loads (Impact ratio >1,1)

Assumptions for scenarios (Table 1):

- implementation of Waste Water Ordinance in WWTP
- reduction of atmospheric deposition after EMEP forecast
- decreasing soil loss by sustainable land cultivation (SL) for different slopes (MS)
- establishing of buffer strips (BS)
- Improvement of sewer systems by additional soil filters (RBF) and increased storage volume
- limit nitrogen surplus without atmospheric deposition

Scenario	WWTP	Urbane System	Nitrogen Surplus	Erosion	Retention Pond	Atmo. Deposition
EI	Implementation of Waste Water Ordinance	RBF: ± 20 % MKS: ± 20 %	Max. 40 kg/ha	SL: -90 % MS: >4 % BS: 10 %	20 ha/km²	NOx -33 % NHy ±0 %
PI		RBF: ± 50 % MKS: ± 50 %	Max. 20 kg/ha	SL: -90 % MS: >2 % BS: 50 %	50 ha/km²	

Table 1: Assumptions for Scenarios

Results

- considerable differences between spatial distribution (Figure 2 & 3) and total amount of nutrient emissions between dry and wet months (Figure 1)
- most intense dynamic for TN & TP emissions is given by drainage (Figure 1) (220 t/October to 7400 t/December) caused by higher precipitation
- but for TP are emissions via drainage of minor importance
- inter annual variability of emissions from urban systems, erosion and surface runoff determine the total dynamic of TP emissions
- caused by additional water internal retention processes the fluctuation of loads is more intense

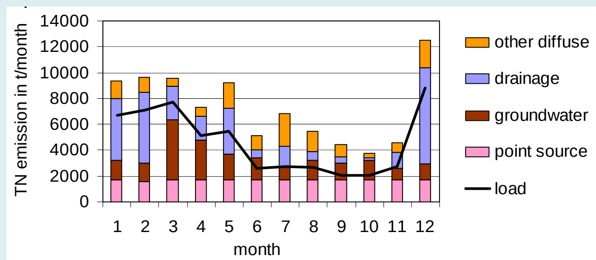


Figure 1: Monthly Nitrogen emissions at Odra River Basin in the year 2005

- as reduction goal for the Odra is defined as in the early 1960s, according to EU Water Framework Directive
- compared to the 1960s reduction of nutrient emissions and loads in the Odra River Basin by 20-25% (TP) and 40-50% (TN) can be derived
- in reference to P-loads the scenarios reach the reduction goal, for N-loads reduction goal will be missed
- scenario **PI** and **EI** show a similar potential for the reduction of emissions (Table 2), but the result suggest a higher potential of the reduction of loads when implementing scenario **PI**
- areas with an Impact ratio > 1,1 cover 35% (TN) and 48% (TP) of total River Basin (areas for **PI** Scenario)
- application of more extensive measures to selected analytical units have a similar potential to emissions and loads than the uniform application of moderate measures to al analytical units

Table 2: Reduction potentials for scenarios

Scenario	WWTP	Urbane System	Nitrogen Surplus	Erosion	Retention Pond	Atmo. Deposition	Total	Load
EI	N: -4.4 P: -9.5	N: -0.2 P: -0.8	N: -0.9 P: -0.0	N: -0.4 P: -4.7	N: -3.6 P: -1.0	N: -5.6 P: -0.8	N: -14.2 P: -16.7	N: -15.9 P: -21.6
PI		N: -0.1 P: -0.6	N: -2.2 P: -0.1	N: -0.4 P: -4.0	N: -2.3 P: -0.6		N: -13.6 P: -16.1	N: -16.0 P: -22.8

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