Modeling of fine solids at the river basin scale

Preliminary results for the Weser river basin

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INTRODUCTION

The modeling of emissions of priority pollutants on the river basin scale is limited by the small base of monitoring data for different environmental compartments. One attempt to overcome this shortcoming may be the validation of the modeling results for priority pollutants with a better validated fine solids balance. As the critical particle size of solids for the transport of pollutants is < 63 µm, the modeling was done for solids of that size.

METHODS

The emission of solids via erosion was calculated with the approach by Fuchs et al. (2013) considering soil loss (USLE) and sediment delivery processes. The solid-emissions of tile drainage systems were considered, presuming a concentration of 100 mg/l (Stone & Krishnappan 2002) in the drainage discharge. For municipal waste water treatment plants, the emissions were calculated assuming a concentration of 10 mg/l fine solids in the discharge. The emissions of solids via separated sewer systems was calculated assuming a surface potential of 400 kg/(ha·a) for the impervious areas (Fuchs et al. 2010). Fine solid concentrations of 150 mg/l in the overflow of combined sewers and 200 mg/l (Brombach & Fuchs 2003) in domestic and commercial waste water that is discharged untreated were taken for the modeling.

Exemplarily for priority pollutants, the emissions of zinc were calculated with MoRE and the resulting zinc-load of fine solid from agriculture and urban systems was compared to the loads mentioned in literature.
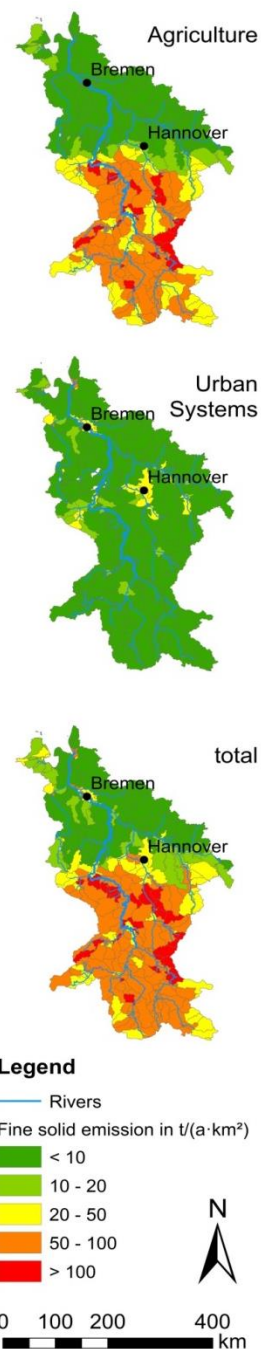

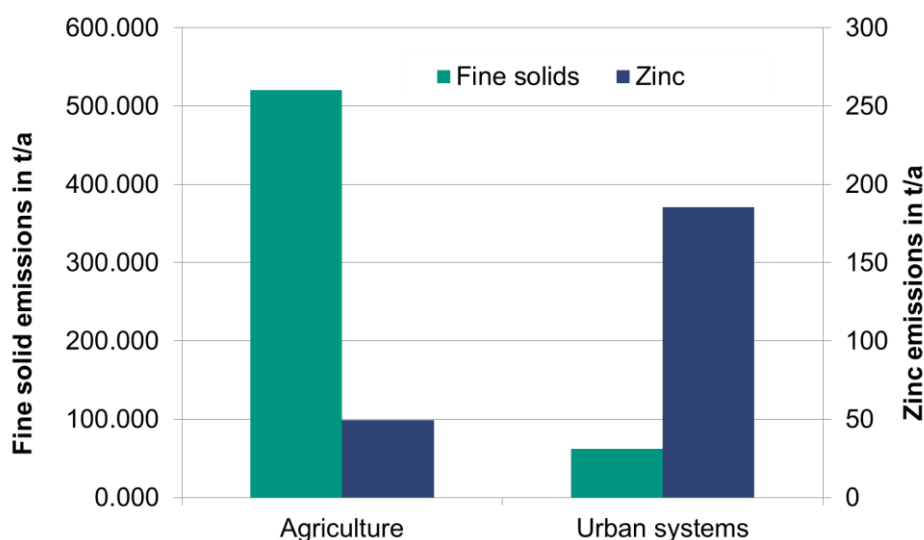Figure 1 Emission of fine solids in the Weser river basin

Figure 2 Emissions of fine solids and zinc from agriculture and urban systems

RESULTS

For the Weser river basin in northern Germany a total input of 582,929 t fine solids per year was calculated (Figure 1). About 90% of the emissions (520,584 t/a) derive from agriculture (erosion and tile drainage), whereas urban systems contribute 62,345 t/a (Figure 2).

Table 1 calculated zinc-load (from MoRE modeling results) compared to measured zinc-load (literature)

		Agriculture	Urban systems
calculated zinc-load of fine solids in mg/kg		95	2970
measured values in mg/kg	range	19 - 127	40 - 69,000
	median	48	2230
Source of measurement values		LABO (2003) regionalized by Fuchs et al. (2013)	Literature review based on Kittlaus (2012)

CONCLUSIONS

Only about 10% of the fine solid emissions but a high percentage of the zinc emissions (62%) derive from urban systems. As zinc is mainly transported by fine particles, this relation results in a high zinc-load of 2970 mg/kg for urban systems, which is consistent with values from literature (Table 1) and is much higher than the load of particles from agriculture (95 mg/kg). Although this study is only a first assessment, the results clearly illustrate the importance of fine solid management in urban areas, where an effective reduction of fine solid emissions can reduce emissions of pollutants to a high extent.

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