Re-inspection of results for nonpoint source pollution processes in the research catchment Schäfertal / Lower Harz Mountains

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Introduction and Aims

The diffuse substance leaching from agricultural used areas affects the agricultural used areas themselves and also the surface and groundwaters in the surroundings. The aim of this work is to continue the investigations of runoff formation and the leaching of sediment and phosphor in the catchment area of the brook Schäferbach in a lower Harz mountains and to evaluate the current hypotheses of the related leaching and transport processes.

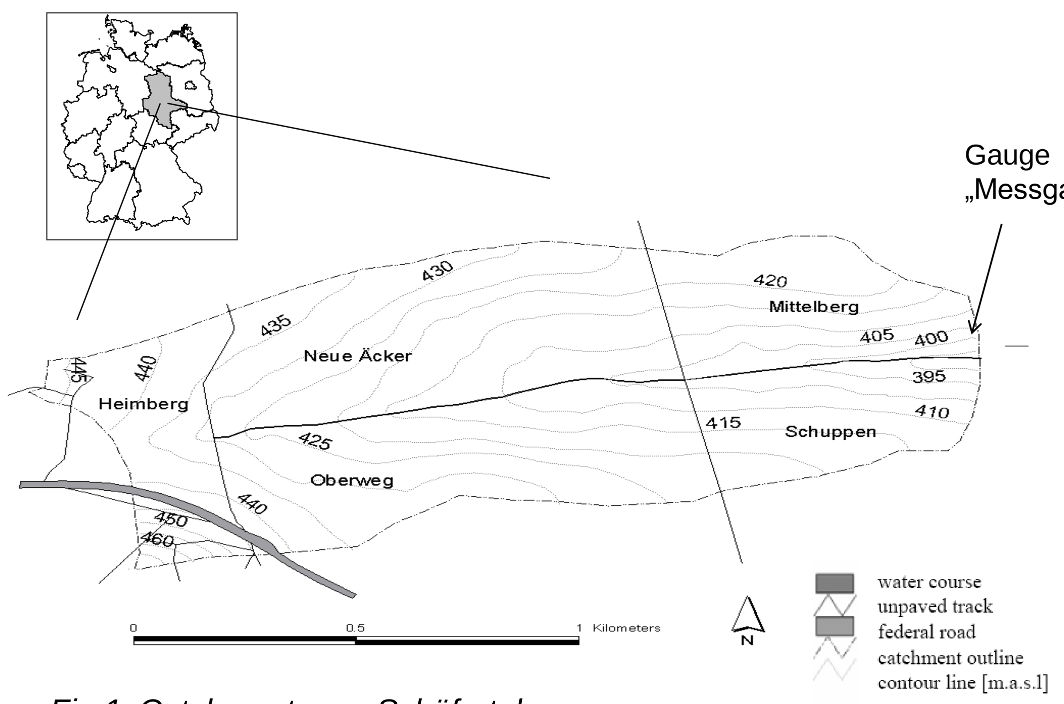


Fig.1: Catchment area Schäfertal

Material and Methods

The Schäfertal catchment has an area of 1.44 km² (Fig. 1) and is locate in the eastern lower Harz mountains. 80 % of the area are hillsides with an slope of 6 % in mean. These hillsides are agricultural used. 20 % of the area are locate in the floodplains and are pasturing areas. At an altitude of 396 m a.s.l. in the east of the area there is an weir which borders the catchment area.

Measurements during high flood events of the period 2001 – 2008 were investigated. The period 2001 – 2003 consists of 8 events and was the basis of former investigations, which resulted in hypotheses. Additional 13 events during the period 2004 – 2008 were evaluated to verify the former hypotheses.

Evaluation and result of the runoff formation process

Table 1: Overview of the flooding events

Flooding event	Characteristic of the runoff	Maximal runoff [l s^{-1}]	Maximal precipitation [mm]	Soil	Process characteristics
06. Feb. 2001	snow melting	59	4.6	unfrozen	typical bimodal
30. März 2001	snow melting + rain	97	2.5	unfrozen	typical bimodal
20. Jan. 2002	snow melting + rain	175 (85 melting)	32.9	frozen	unusual
26. Feb. 2002	snow melting + rain	146	25.6	partly frozen	typical bimodal
04. Mai 2002	rain	27	18.6	unfrozen	typical bimodal
30. Nov. 2002	rain	63	29.8	unfrozen	typical bimodal
26. Dez. 2002	snow melting + rain	91	3.1	frozen	unusual
02. Jan. 2003	snow melting + rain	268	27.3	frozen	unusual
03. Feb. 2004	snow melting + rain	77	6.5	unfrozen	typical bimodal
20. Jan. 2005	snow melting	11	3	unfrozen	typical bimodal
03. Feb. 2005	snow melting	47	2.8	partly frozen	unusual
16. März 2005	snow melting	114	0	partly frozen	partly typical partly unusual
30. Mai. 2005	rain	16	31.2	unfrozen	typical bimodal
09. Feb. 2006	snow melting	190	4.8	frozen	unge-wöhnlich
16. Feb. 2006	snow melting	180	3.5	partly frozen	unge-wöhnlich
27. März 2006	snow melting	449	2.1	partly frozen	unge-wöhnlich
20. Jan. 2007	rain	74	51.2	unfrozen	typical bimodal
12. Dez. 2007	snow melting	80	12.3	unfrozen	typical bimodal
20.Jan. 2008	snow melting	103	6.7	partly frozen	unusual
03.März 2008	snow melting + rain	28	16.6	unfrozen	typical bimodal
31.März 2008	snow melting	43	2.2	partly frozen	unge-wöhnlich

The evaluation shows an runoff regime with a dominance of the winter month (Table 1). The high variability of the events can attributed to snow melting, soil moisture and situations of frozen and unfrozen soils. Ground frost is only in exceptional cases the crucial factor for high floods. In fact ground frost is the most crucial parameter for hydrographs with untypical characteristics. Highfloods with unfrozen soils show, however, typical bimodal characteristics resulting from the periglacial soil complex (Fig. 2).

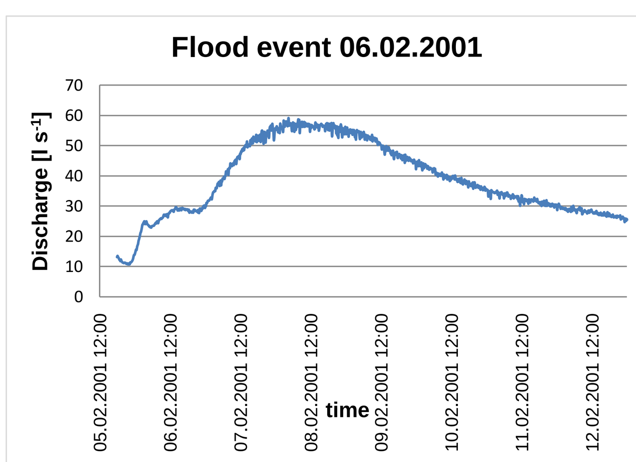


Fig.2: Typical bimodal hydrograph

Evaluation and result of the sediment transport

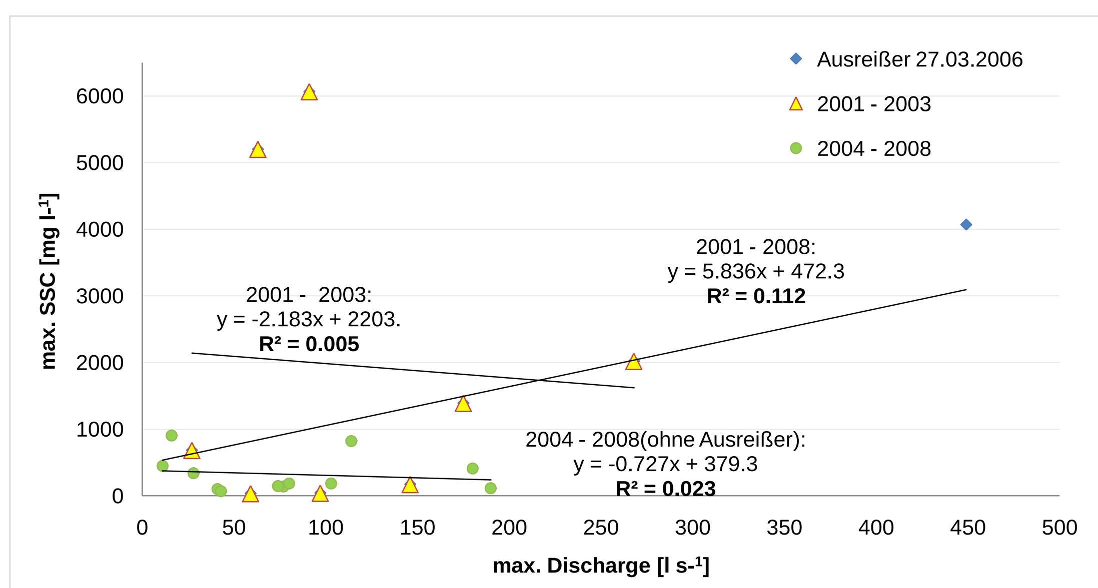


Fig. 3: Effect of hydrology on the sediment transport

Sediment is transported mainly independently of the hydrological parameters. There is neither a correlation between sediment transport and runoff or maximum runoff (Fig. 3) nor a correlation of the sediment mass flux to the mentioned parameters.

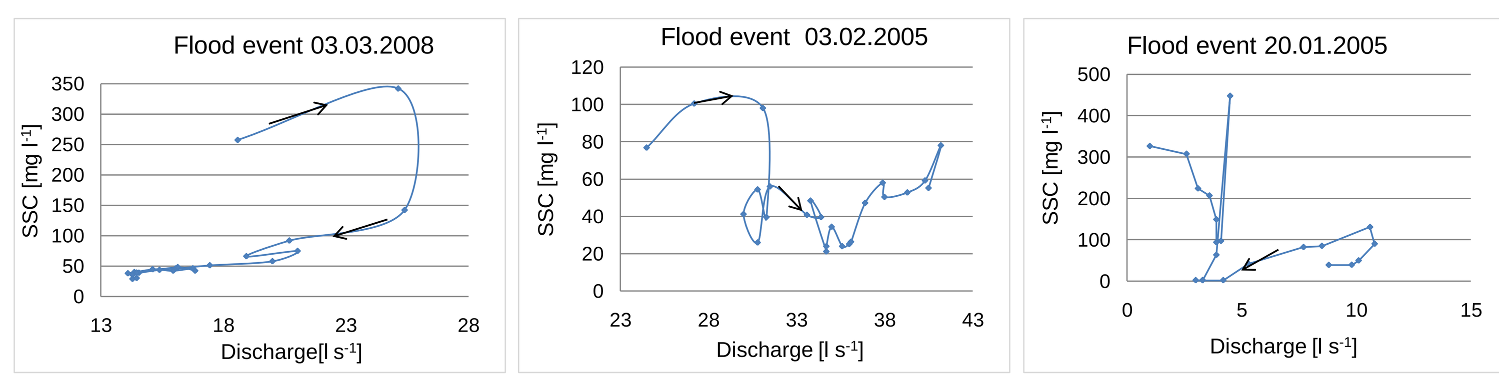


Fig. 4: Hysteresis curves

From 2001 till 2003 there are 2 kinds of hysteresis curves, clockwise and anticlockwise. There was also a clear sediment source. After 2004 there are additional kinds of curves but no curves with anticlockwise characteristics. Instead of that, chaotic characteristics (Fig. 4, centre) and curves with a high concentration peak (Fig. 4, right) can be found. The variability of the curves is growing with the amount of high flood events. Thus, only very limited results can be found.

Evaluation and result of the phosphorous transport

A unifom accumulation of phosphor can not be found in the Schäfertal. During the period 2001 – 2003 the mass flux is correlated with the location of the field which was fertilised. Fields which are located near the gauge „Messgarten“ provided a higher amount than fields which are more distant from the „Messgarten“. However, the values after 2004 do not approve this hypothesis. The ratio of sediment and phosphor does not correlate with the location of the fertilized field.

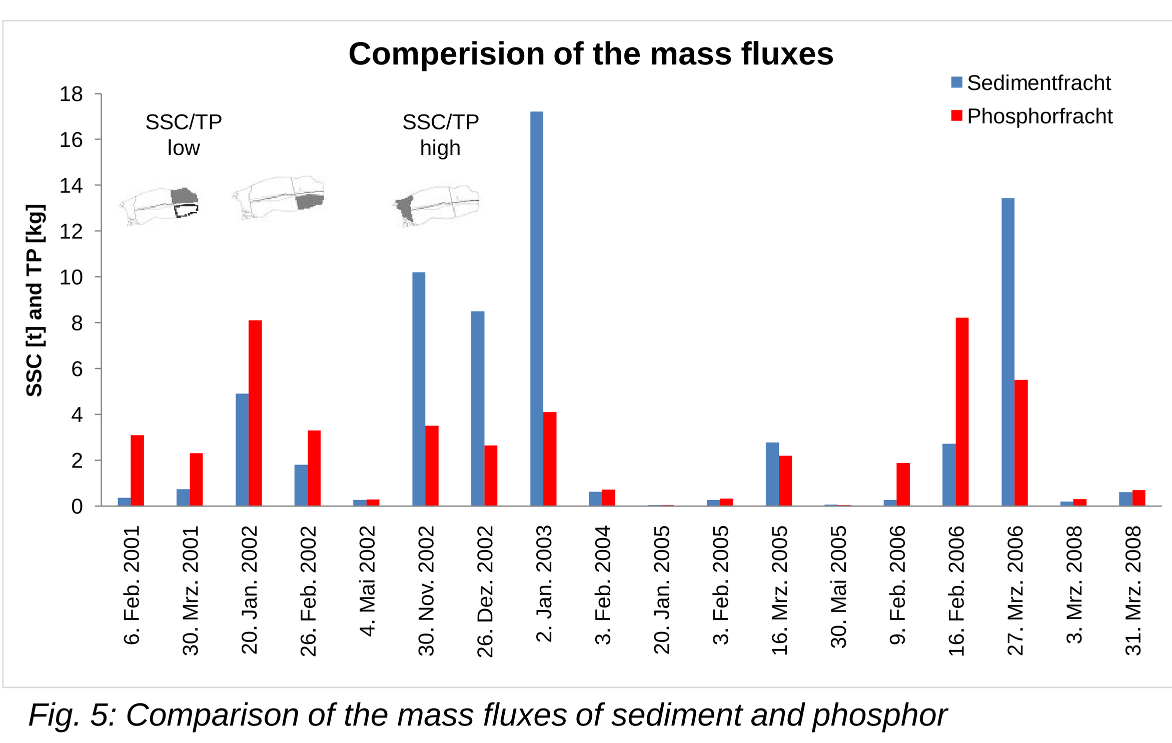
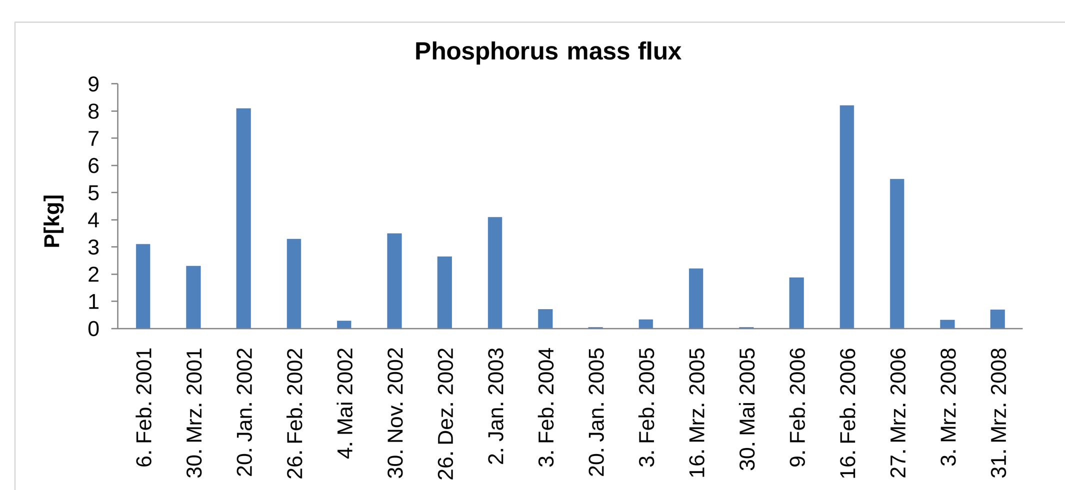


Fig. 5: Comparison of the mass fluxes of sediment and phosphor



	2001	2002	2003	2004	2005	2006	2008
Mittelberg	Triticale	grain	fallow	fallow	rapeseed	rapeseed	Winter-grain
Schuppen	rapeseed	grain	grain	Sommer-grain	Winter-grain	Sommer-grain	rapeseed
Neue Äcker	peas	grain	grain	Triticale	rapeseed	rapeseed	Sommer-grain
Oberweg	grain	peas	grain	Triticale	Winter-grain	Sommer-grain	Winter-grain
Heimberg	grain	grain	rapeseed	Triticale	Winter-grain	rapeseed	Winter-grain

Fig. 6: Comparison of phosphor mass flux and crop rotation

Despite of the fact of independency of the processes of phosphor and sediment transport there are dependency at single events. Phosphor is increasing leached due to fertilising (Fig. 6). An increasing sediment transport can be observed in periods of spring grain cultivation because this crop is connected with a fallow during winter.