Schäfergraben

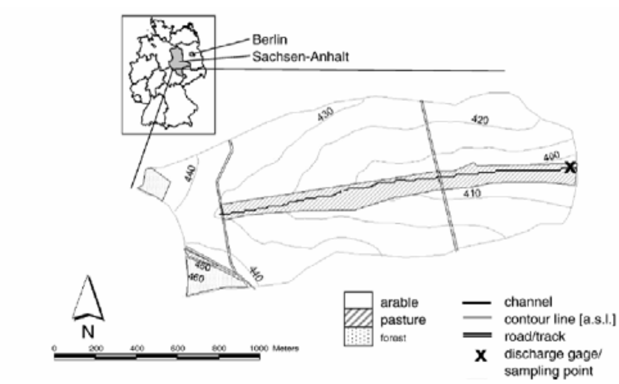
Schäfertal, Harz Mountains, Germany

Hochschule Magdeburg • Stendal

Basin characteristics

River Basin / River Basin (according EU-WFD)	Selke, Bode, Saale, Elbe
Operation (from… to…)	1968 - ongoing
Gauge coordinates / Gauge datum:	11°3´10´´ E, 51°39´16´´
Catchment area:	1.44 km²
Elevation range:	392 – 474 m asl
Basin type: (alpine, mountainous, lowland)	Low mountain
Climatic parameters: (mean precipitation, temperature and others)	630 mm a^{-1}, 6.9 °C (Station Schäfertal 1968-2006)
Land use:	> 80% arable, pasture / set aside, forest
Soils:	Cambisol, Luvisol, gleyic Luvisol
Geology:	Palaeozoic greywacke and argillaceous shale
Hydrogeology: (Type of aquifers, hydraulic conductivity)	Fractured rock aquifer
Characteristic water discharges: (Q_{min}, Q_{max}, Q_{mean})	0 / 36 / 0.33 [mm/d]

Map of the research basin



Mean hydrograph

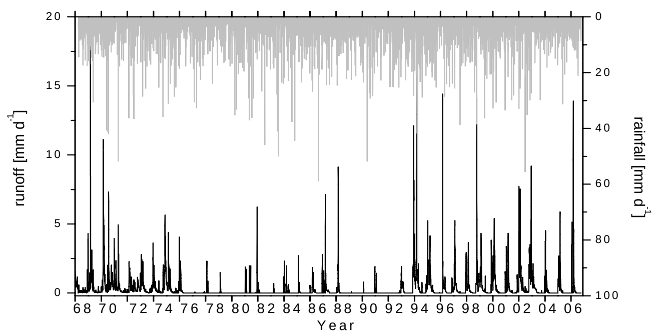


Fig. 1 Rainfall and discharge variation of the Schäfertal from 1968 until 2006

Special basin characteristics (hydrogeology, lakes, reservoirs etc.)

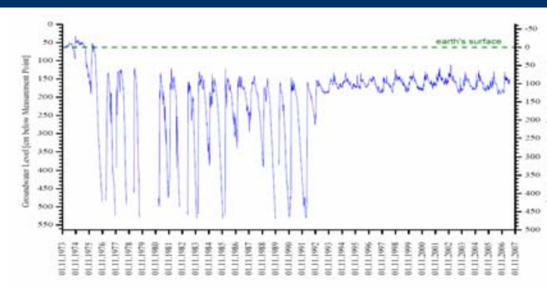


Fig. 2 Modification of groundwater level and discharge and runoff generation by mining activities

Instrumentation and data

Meteorology	Hydrology	Others
air temperature air humidity and air pressure wind speed (2, 5, 10 m) wind direction short and long wave radiation PAR heat-flux several temperature sensors at different above-ground heights and soil depths	five automatic rainfall gages “watermark” soil moisture sensors, TDR and tensiometers continuous measurements of discharge, ground water table at numerous points snow cover height and water equivalent tile drain flows	temperature in discharge electric conductivity of discharge biweekly manual and automatic event water sampling for sediment yield, phosphorus nitrogen DOC / LC-DOC soil water sampling with suction plates and chemical characterisation

Applied models

1. AKWA-M, WASIM-ETH, DIFGA
2. Candy, Integrated Winter erosion and Nutrient Load Model
3. Erosion3D

Main scientific results

Detailed analyses of the hydrograph and groundwater measurements allow the separation of three periods with distinct differences in water balance and runoff generating processes (Fig. 1). The first period until 1973 is characterised by a naturally balanced water flow with soil moisture increase and storage filling in winter and high discharge situations during spring. Base flow contribution guaranteed a minimum of water flow during summer time. The following periods were characterised by plot realignment and draining of a pasture area. Most important was the opening of an underground mining that leads to a decrease of the regional groundwater level. The related hydrological situation with long dry periods and episodic flash floods had significant negative effect on the chemical and biological water quality. In the course of the safe keeping at the end of the mining activity the groundwater level rose again since 1993 and has reached a new stable situation in 1999.

The complex catchment response to runoff generation and sediment or P loads is documented in varying hysteresis curves. There is also evidence for depletion of sediment availability during some events. An event specific sediment/P relationship can be identified as a result of source area characteristics and connectivity aspects.

To simulate the transformation of precipitation into runoff regression models are suitable. From preconsiderations correlations between discharge, precipitation, temperature, snowmelt and soil water runoff can be postulated. The quantification of snowmelt and soil water runoff is currently not possible because a continuous running runoff model is actually still in preparation. Therefore, a reduced regression model between the parameters runoff Q and precipitation P was established. The reduced model is a coupling between “moving averages” for Q with a part to consider P. For the case of m = 2 the following formulation was found:

$$Q(t) = \gamma_o P(t) + \gamma_1 P(t-1) + \beta_1((Q(t-2) + Q(t-3) + Q(t-4) + Q(t-5))/4) + \varepsilon_n$$

with Q(t) … discharge at day t, γ, β_1… weighting factors, P(t) … precipitation at day t and ε_n ... certain degree.

Key references for the basin

1. BORCHARDT, D. 1982. Untersuchungen zur Variabilität von Abflussbildungsprozessen in Hochwasserentstehungsgebieten des unteren Mittelgebirges. Wasserwirtschaft-Wassertechnik, 11: 382-385.
2. WENK, G., BUCHHOLZ, K., SENST, M. & JOHN, H. 1998. Differenzierte Untersuchung des Abflußkomponentenregimes hydrologischer Untersuchungsgebiete unter den Bedingungen von Bergbaufolgemaßnahmen und Bewertung geoökologischer Auswirkungen als Beitrag zum Hochwasserschutz und zur Sicherung der Wassergüte der Selke. Unveröffentlichter Abschlussbericht Band I/II, IWM Institut für Wasserwirtschaft GmbH an der Hochschule Magdeburg-Stendal (FH).
3. OLLESCH, G., SUKHANOVSKI, Y., KISTNER, I., RODE, M. and MEISSNER R. 2005. Characterisation and modelling of the spatial heterogeneity of snowmelt erosion. Earth surface Processes and Landforms 30:197-211.
4. OLLESCH, G., KISTNER, I., MEISSNER, R. and LINDENSCHMIDT, K.-E. 2006. Modelling of snowmelt erosion and sediment yield in a small mountain catchment. Catena 68: 161-176.

Contact

Prof. Dr. habil. Frido Reinstorf
Department of Water and Waste Management
University of Applied Sciences Magdeburg-Stendal
Breitscheidstraße 2
39114 Magdeburg
GERMANY
Telefon: +49-(0)391-8864480 / +49-(0)391-8864357 (Sekr.)
Fax:+49-(0)391-8864430
E-Mail: frido.reinstorf@hs-magdeburg.de