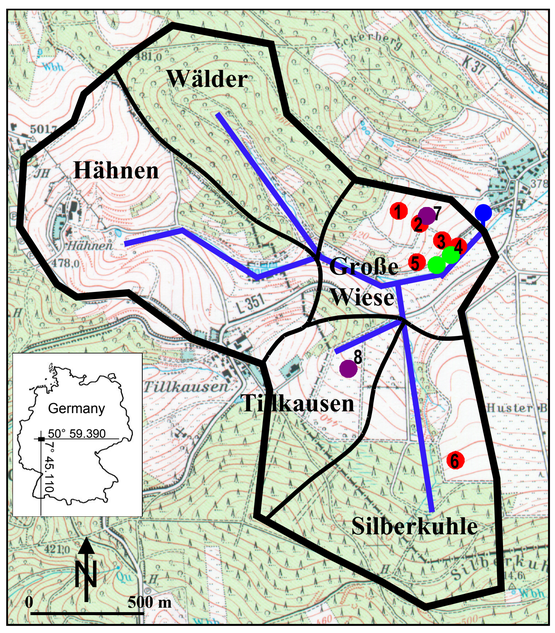
Husten

Obere Brachtpe, Germany

Basin characteristics

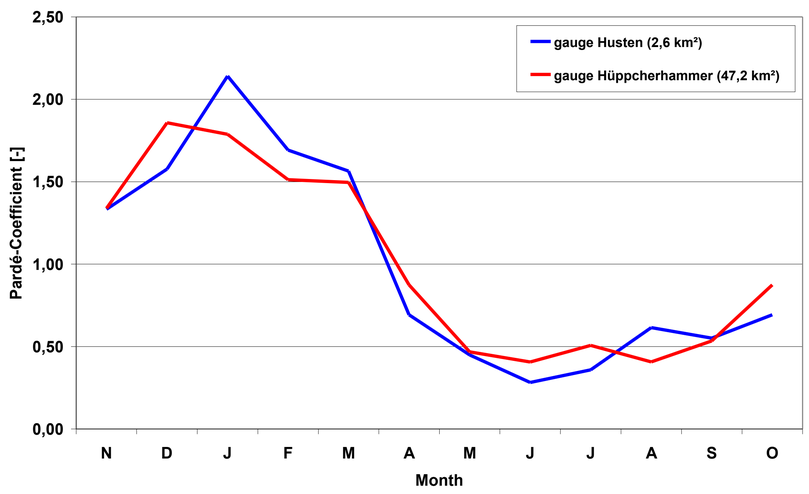
River Basin / River Basin (according EU-WFD)	Rhine
Operation (from… to…)	1999 to 2007
Gauge coordinates / Gauge datum:	N 50° 59.390, E 007° 45.110
Catchment area:	2,55 km²
Elevation range:	382 to 425 m a.s.l.
Basin type: (alpine, mountainous, lowland)	low mountain range
Climatic parameters: (mean precipitation, temperature and others)	P: 1250 mm/a; T: ø 8°C
Land use:	pasture, spruce forest
Soils:	Cambisol, Stagnosol, Gleysol, Anthrosol
Geology:	clay and silt shale, fine graided sandstone
Hydrogeology: (Type of aquifers, hydraulic conductivity)	unconfined aquifer hydraulic conductivity: $2*10^{-5}$ m/s (shallow groundwater)
Characteristic water discharges: (Q_{min}, Q_{max}, Q_{mean})	Q_{min}: 0,006 m³/s; Q_{max}: 3,16 m³/s; Q_{mean}: 0,078 m³/s

Map of the research basin



- soil hydrological measurement stations
  1) upperslope
  2) middleslope
  3) footslope
  4) bottom
  5) divergent slope
  6) middleslope north
- climate station
  7) middleslope south
  8) middleslope north
- groundwater monitoring
- gauge Husten
- catchment „Obere Brachtpe“
- subcatchments
- channel „Brachtpe“

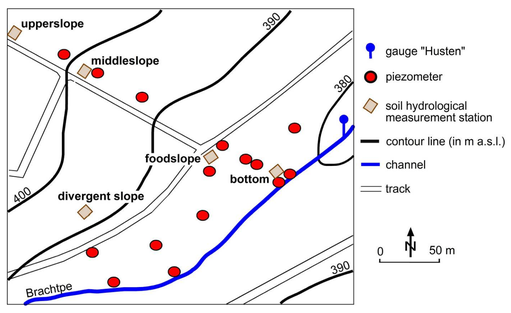
Mean hydrograph / Pardé flow regime

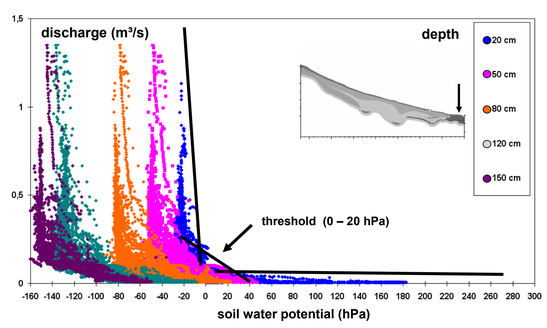


Pardé flow regime for gauge Husten (2000-2008) and gauge Hüppcherhammer (1966-2007).
Gauge Husten is part of catchment Hüppcherhammer.

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

1. Landscape of the catchment “Obere Brachtpe” is typical for this region.
2. Hydrometric data (i.e. soil water potential and groundwater level) is available in a very high spatial and temporal resolution at a convergent and a divergent hillslope.





Instrumentation and data

Measured hydrological parameters	Measuring period	Temporal resolution	Number of stations
precipitation, temperature, air moisture, wind speed, wind direction	2000 - 2007 2003 - 2006	10 min 10 min	1 1
discharge	since 1999	15 min	1
soil water potential	2000 – 2007 2002 - 2007	10 min 10 min	4 2
groundwater level	2001 - 2007	10 min	8
groundwater level	2000 - 2007	weekly	6

Applied models

1. Kinematic wave model (Rezzoug et al. 2005)

Main scientific results

1. <u>Influence of relief on runoff processes</u>

Based on the relationship between groundwaterlevel respectively soil moisture and the runoff measured at the catchment outlet, the hillslope catchment area can be distinguished between two hydrological systems; the “upslope zone” and the “riparian zone”. While the relationships of the piezometers in the riparian zone have an exponential correlation and indicate a groundwater storage, the relationships of the piezometers in the upslope zone show a linear correlation. This distinction is caused by the decreasing slope inclination in the riparian zone and consequently by the decreasing hydraulic gradient.

The analysis of temporally high-dissolved data of the groundwater dynamics in relation to the discharge of the receiving stream during several rainfall/runoff events shows the influence of the slope form and of the flat „riparian zone“ on the runoff processes. Due to the convergent slope form the subsurface runoff is concentrated in the depth contour of the hillslope. Caused by the small slope inclination in the flat riparian zone the velocity of water flow is reduced and groundwater from the slope is transported to the channel with a time lag. In consequence of this delayed groundwater flow the runoff in the receiving stream also shows a delayed increase.

2. <u>Influence of the antecedent soil moisture on runoff processes</u>

The influence of the antecedent soil moisture is quantified by the multivariate-statistical analysis of 137 rainfall-runoff events. By using the hierarchical cluster analysis six soil moisture clusters can be distinguished which represent different moisture conditions of a convergent hillslope “husten”. Based on this distinction a linear regression function was calculated for estimating the peak flow in every cluster. During wet conditions the independent variables total rainfall amount of an event and the initial runoff have a strong influence on the peak runoff. In case of more dry conditions, the total rainfall amount and the rain intensity have a strong influence on the peak runoff. The variance of the independent variables marks the transition of the dominating influence of the rainfall characteristics (e.g. rainfall amount, rainfall-intensity) to the dominating influence of the catchment characteristics (e.g. soil, relief).

Key references for the basin

1. Chifflard, P. (2006): Der Einfluss des Reliefs, der Hangsedimente und der Bodenvorfeuchte auf die Abflussbildung im Mittelgebirge. Experimentelle Prozess-Studien im Sauerland. – Bochumer Geographische Arbeiten 76, 162 S.
2. Chifflard, P. & Zepp, H. (2008a): Erfassung der zeitlichen Variabilität der Abflussbereitschaft eines Einzugsgebietes auf Grundlage von Bodenfeuchtemessungen. – Hydrologie und Wasserbewirtschaftung 3:98-109
3. Rezzoug, A., Schumann, A., Chifflard, P. & Zepp, H. (2005): Field Measurement of soil moisture dynamics and numerical simulation using kinematic wave approximation. – Advances in Water Resources 28:917-926

Contact

Dr. Peter Chifflard
Institute of Hydraulic Engineering and Water Resources Management
Vienna University of Technology
Karslplatz 13/222, 1040 Vienna, AUSTRIA
e-mail: chifflard@hydro.tuwien.ac.at
http://www.hydrologie.at

Prof. Dr. Harald Zepp
Institute of Applied Physical Geography
Geography Department
Ruhr-University of Bochum
Universiätsstr. 150, 44801 Bochum, Germany
e-mail: harald.zepp@rub.de
http://www.geographie.rub.de/ag/apg/index.html