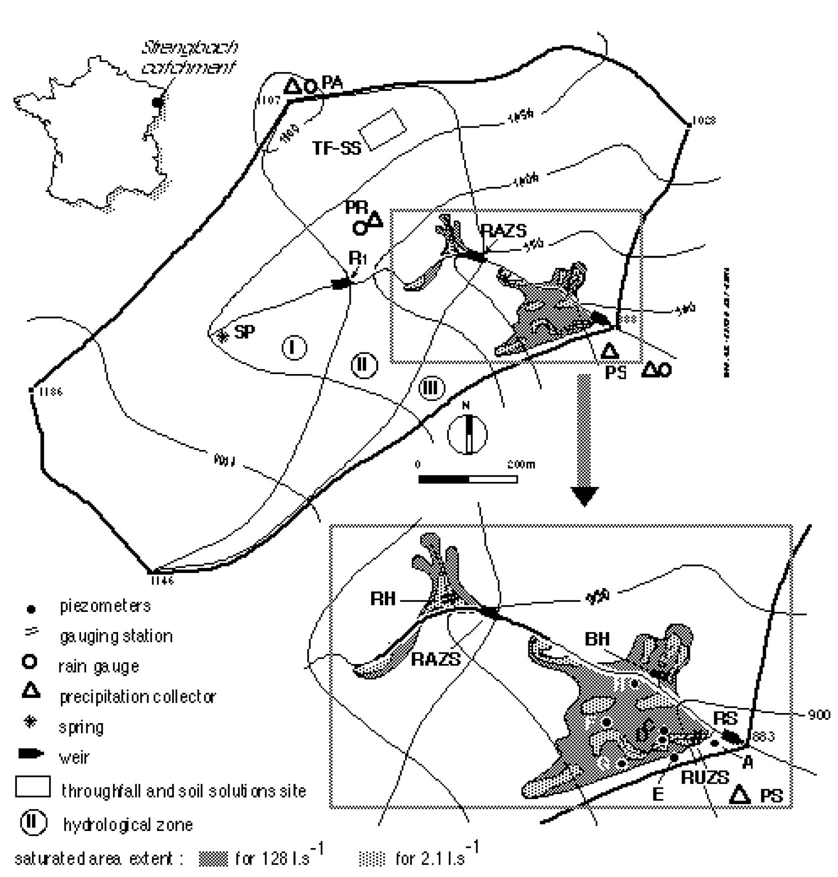
Strengbach

Strengbach basin, France

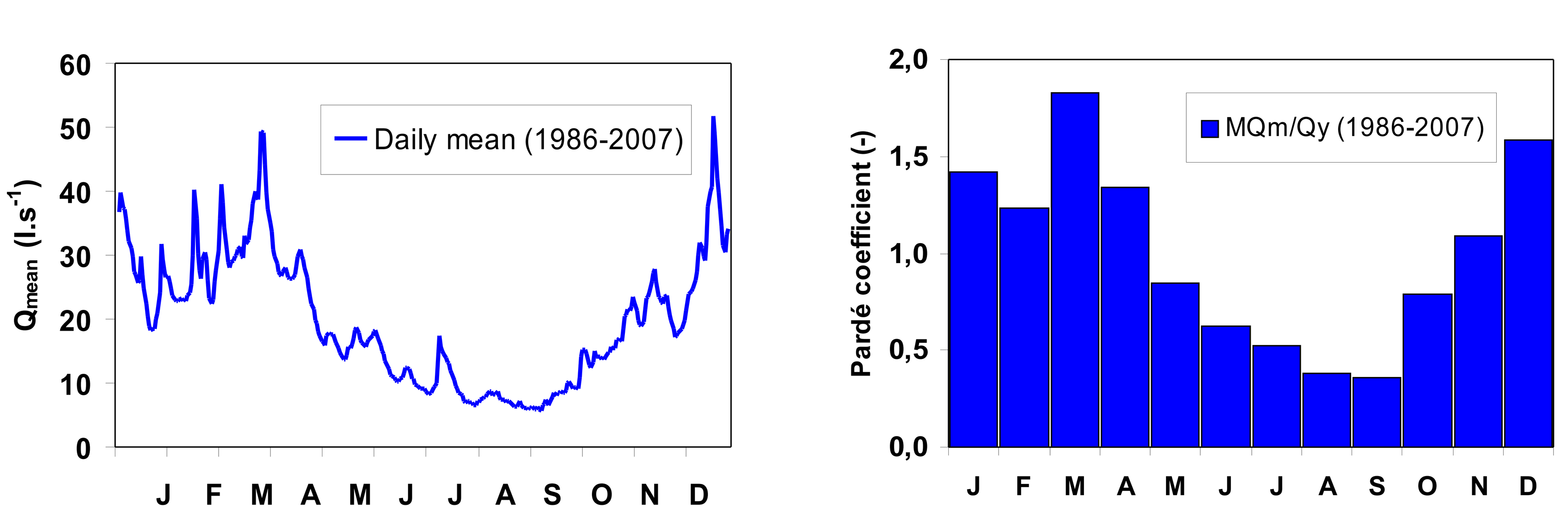
Basin characteristics

River Basin / River Basin (according EU-WFD)	Ill river basin / Rhine river basin
Operation (from… to…)	Since 1986, still in operation
Gauge coordinates / Gauge datum:	7°12'E; 48°12'N / 883 m a.m.s.l.
Catchment area:	0.8 km²
Elevation range:	883 – 1146 m a.m.s.l.
Basin type: (alpine, mountainous, lowland)	Mountainous
Climatic parameters: (mean precipitation, temperature and others)	1369 mm (1986-2007), 6°C (1986-2007)
Land use:	57% Norwegian spruce, 15% beech, 15% mixed forest
Soils:	Podzolic and brown acidic
Geology:	Leucogranite.
Hydrogeology: (Type of aquifers, hydraulic conductivity)	Fractured rock aquifer
Characteristic water discharges: (Q_{min}, Q_{max}, Q_{mean})	1.15 l/s, 469 l/s, 19.7 l/s (1986-2007)

Map of the research basin

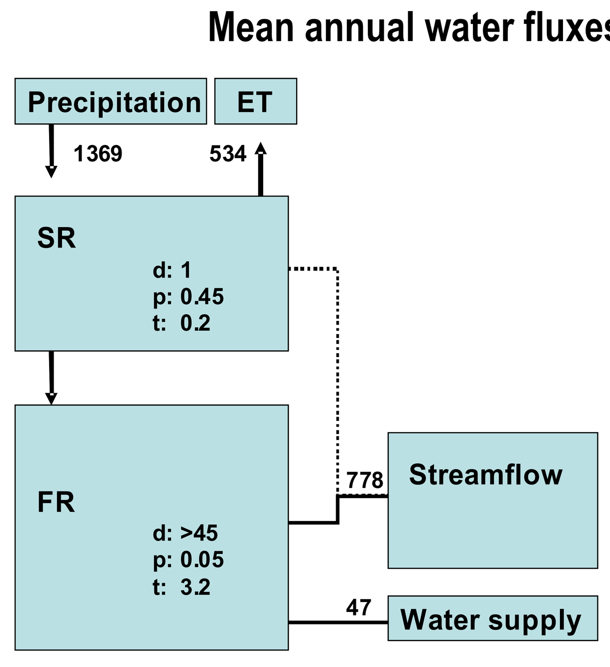


Mean hydrograph / Pardé flow regime



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

Mean annual water fluxes (mm) and hydraulic reservoirs features



SR: Soil water reservoir
FR: Fractured rock groundwater reservoir
Water fluxes (mm.y^{-1})
d: thickness of the reservoir (m)
p: porosity (m^3.m^{-3})
t: mean water transit time (year)

Instrumentation and data

Measured hydrological parameters	Measuring period	Temporal resolution	Number of stations
Stream flow	Sept 1986 – Sept 1988 Sept 1988 – cont.	1h 1 min	1
Precipitation	Sept 1986 – cont. Sept 1988 – cont.	Daily 10 min.	2
Air temp., humidit,	Sept 1986 – cont. Sept 1988 – cont.	1h / 10 min.	1
Glo. Radiation, Wind speed	Jan. 1989 – 2002	1h / 10 min.	1
Water table	Apr 1996 – Sept 2005 Oct 2005 – cont	Weekly, Fortnightly	4
Chemical elements	Dec 1985 – Sept 2005 Oct 2005 – cont	Weekly, Fortnightly	6
Environ. isotopes ^{2}H, ^{18}O	Dec 1989 – Aug 1995	Weekly	3

Applied models

1. FlowPC **2. Biljou** **3. Topmodel** **4. GR4**

Main scientific results

Water residence time

The lumped-parameter model (FlowPC) developed by Maloszewski and Zuber (1994) was applied to the 1989–95 environmental isotopic tracer (^{18}O) data set of the catchment in order to determine the water transit time. An exponential piston version of the model applied to spring water indicates a 38,5 month mean transit time, which suggests that the volume in the aquifer, expressed in water depth, is 2,4 m. A considerable thickness (>45 m) of fractured bedrock may be involved for such a volume of water to be stored in the aquifer.

Stormflow components analysis

Complementary approaches associating chemical (trace and major elements), isotopic tracers and hydrological measurements have been performed to identify the origin of water pathways in various hydrological conditions

DOC associated to Si allow to identify the different contributing areas (upper layers of the saturated areas, deep layers of the hillslope and rainwater).

During the first stage of a long duration and less intensive rainfall event (40 mm in 20 hours), a significant part of the runoff (30±39%) comes from the small extended saturated areas located down part of the basin (overland runoff then groundwater ridging). During the second stage, the contribution of waters from the deep layers of the hillslope in the upper subcatchment becomes more significant. The final state is characterised by a balanced contribution between aquifers.

During an intensive 30 mm rainfall of a summer storm event, the infiltration in the soil via macropores provokes a sharp rising of the water table by groundwater ridging, then, an increasing extent of the water saturated area. The processes involved are saturation excess surface runoff and return flow.

Long term hydrochemical trends

The long term observation of this ecoystem indicates, for example, that the spring SO_4 concentration (also Ca and Mg) continuously decreases in a reason to a reduction of the atmospheric inputs of these elements and also -as there is less H^+ in the atmosphere and therefore in the soils- to a decreasing weathering in the soils. The increasing NO_3 concentration is due to the declining spruce stand which consumes little nitrogen

Key references for the basin

1. Viville, D., Ladouche, B., Bariac, T. (2006). Isotope hydrological study of mean transit time in the granitic Strengbach catchment (Vosges Massif, France). Application of the FlowPC model with modified input function. *Hydrological Processes;* 20, (8), 1737-1751.
2. Stille, P., Steinmann, M., Pierret, M.-C., Gauthier-Lafaye, F., Chabaux, F., Viville, D., Pourcelot, L., Matera, V., Aouad, G., Aubert, D. (2006). The impact of vegetation on REE fractionation in stream waters of a small forested catchment (the Strengbach case). *Geochimica et Cosmochimica Acta*, 70, 3217-3230.
3. Ladouche, B., Probst, A., Viville, D., Idir, S., Loubet, M., Probst, J.L., Bariac, T. (2001). Hydrograph separation of stormflow components using isotopic, chemical and hydrological approaches: application to the Strengbach catchment (Vosges mountains -France). *Journal of Hydrology*, 242, 255-274.
4. Probst, A., Dambrine, E., Viville, D., Fritz, B. (1990). Influence of acid atmospheric inputs on surface water chemistry and mineral fluxes in a declining spruce stand within a small catchment (Vosges massif, France*). J. of Hydrology*, 116, 101-124.

Contact

Viville D., Pierret-Neuboit M.C.
EOST- Laboratoire d'Hydrologie et de Géochimie de Strasbourg (UMR 7517-CNRS/U.Strasbourg), 1, rue Blessig, F-67084 Strasbourg Cedex, France (daniel.viville@eost.u-strasbg.fr)
http//ohge.u-strasbg.fr