



Chemistry of small torrent catchments

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Runoff measurement and sampling

Runoff volume (Q):

- sporadic measurement of Q with dissolution of NaCl (automatic triggering) if necessary
- continuous recording of level (P) and electrical conductivity (EC)
- P/Q relationship

Instantaneous runoff sampling:

→ solute dynamics

- Weekly, 1970 - 1996

Flow proportional sampling (Fig. 1):

→ solute fluxes

- Subsample every 0.1 mm
- Storage of mixed subsamples
- Weekly collection of sample, since 1982

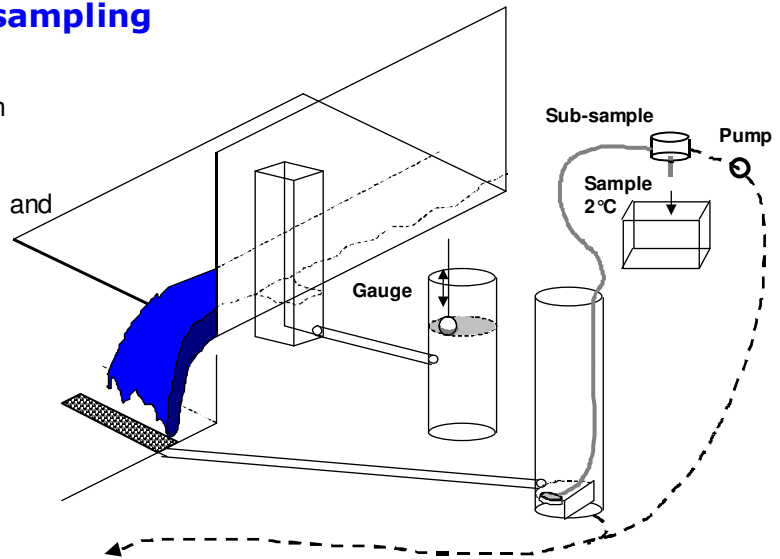


Fig. 1: Schematic of the upper runoff station on Erlenbach.

Operation during extreme conditions

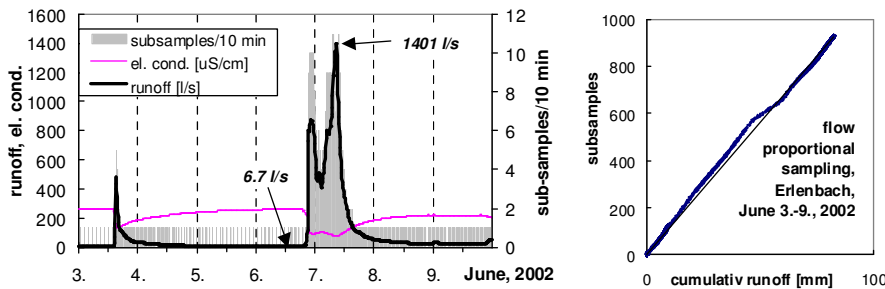


Fig. 2: An extremely large range of runoff values, has to be considered for the design of the automatic sampling in small torrents.

Fluctuations

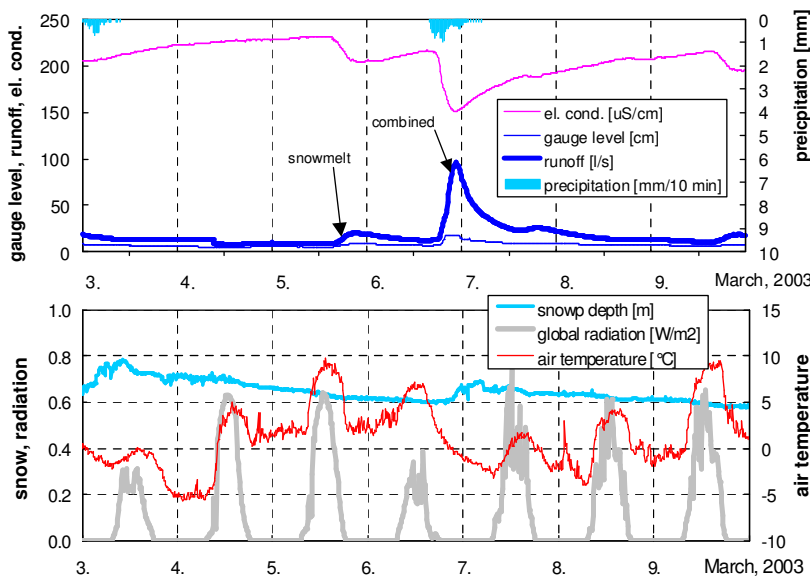


Fig. 2: Electrical conductivity reflects the fluctuations of runoff for both, snowmelt and precipitation runoff.



Chemical analyses of water samples

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Sample preparation, storage

After collection from the field, the samples are filtered (0.45 µm) and stored at 2°C (IC, ICP) and -20°C (FIA).

Project blanks and replications:

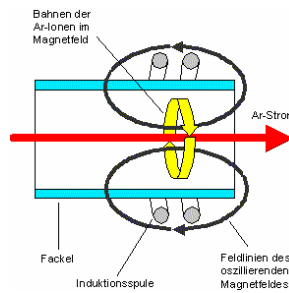
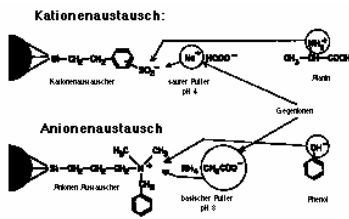
Blank samples are prepared with supra-pure water (Millipore Supra Q).

Every 4th week a sample of a duplicate precipitation collector and one duplicate runoff sample are prepared.

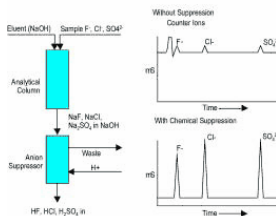
Cleaning procedures: Precipitation and runoff samplers are rinsed with deionised water after collection. Precipitation samplers are acid washed every 4 weeks and sample bottles after each usage.

Analyses in the analytical labor of the WSL

parameter	method	instrument
anions (NO ₃ ⁻ , Cl ⁻ , SO ₄ ²⁻ , Br ⁻ ..)	Ion chromatography (IC)	Dionex DX-120
elements (Ca, Mg, Na, K, P, S, ...)	Inductively coupled plasma-atomic emission spectrometry (ICP-AES)	Perkin-Elmer Optima 3000
NH ₄ ⁺	flow injected analyses (FIA)	Perkin-Elmer FIAS 300



The Role of Chemical Suppression



International Intercomparison:

AQUACON-MedBas Project - Subproject N° 6 - Acid Rain Analysis.

AQUACON-MedBas Project - Subproject N° 5 - Freshwater Analysis.

ICP Forests, Laboratory Intercomparison of Chemical Deposition Analyses 2002.



Solute concentrations and fluxes

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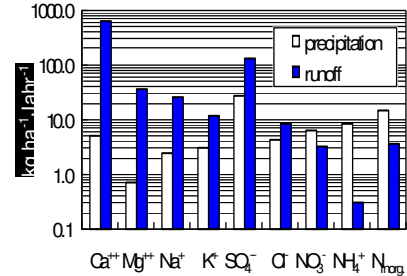
Mean concentrations

Tab. Mean concentration of selected solutes in fluxes and storage of the catchments.

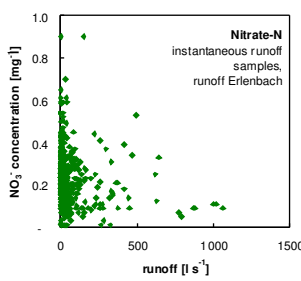
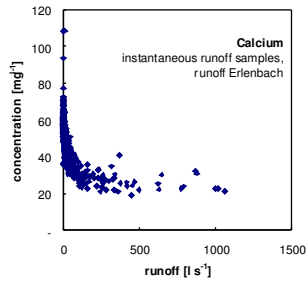
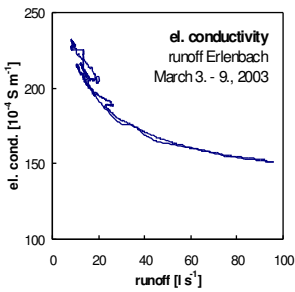
	n samples	concentrations, volume weighed means [mg l ⁻¹]				
		Ca	K	NO ₃ ⁻ -N	NH ₄ ⁺ -N	SO ₄ ²⁻
bulk precipitation	1542	0.32	0.11	0.31	0.34	0.95
canopy throughfall*	166	0.67	1.68	0.90	0.80	1.95
snow cover	694	0.34	0.21	0.23	0.16	0.34
runoff Vogelbach	708	32.00	0.53	0.40	0.04	5.19
runoff Lümpenen	778	42.75	0.75	0.35	0.02	5.97
runoff Erlenbach	897	34.21	0.68	0.19	0.02	7.19

*1991-1994

Annual fluxes



Fluctuations: dilution effect



dissolution of calcereous m.

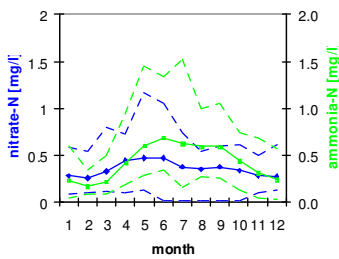


electrical conductivity (EC_{calc})

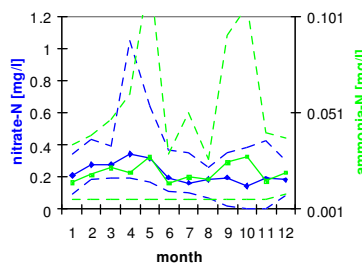
$$\text{EC}_{\text{calc}} = \sum_i \lambda_i C_i$$

Seasonal variations

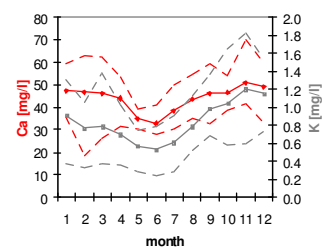
precipitation Erlenhöhe 1976-1995



runoff (Erlenbach), 1982-1995



runoff (Erlenbach), 1982-1995



Long-term variations of annual fluxes of inorg. nitrogen

