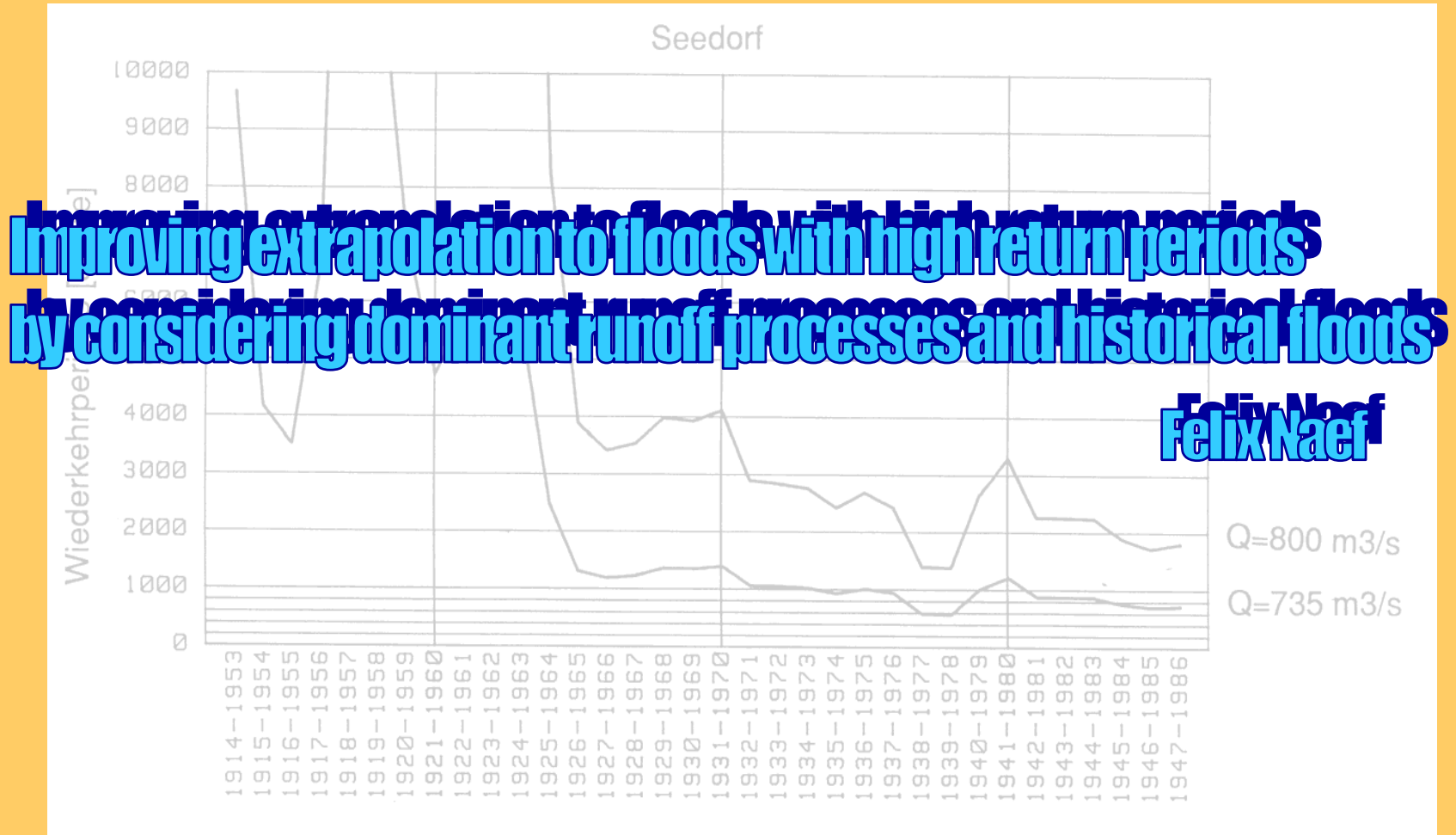
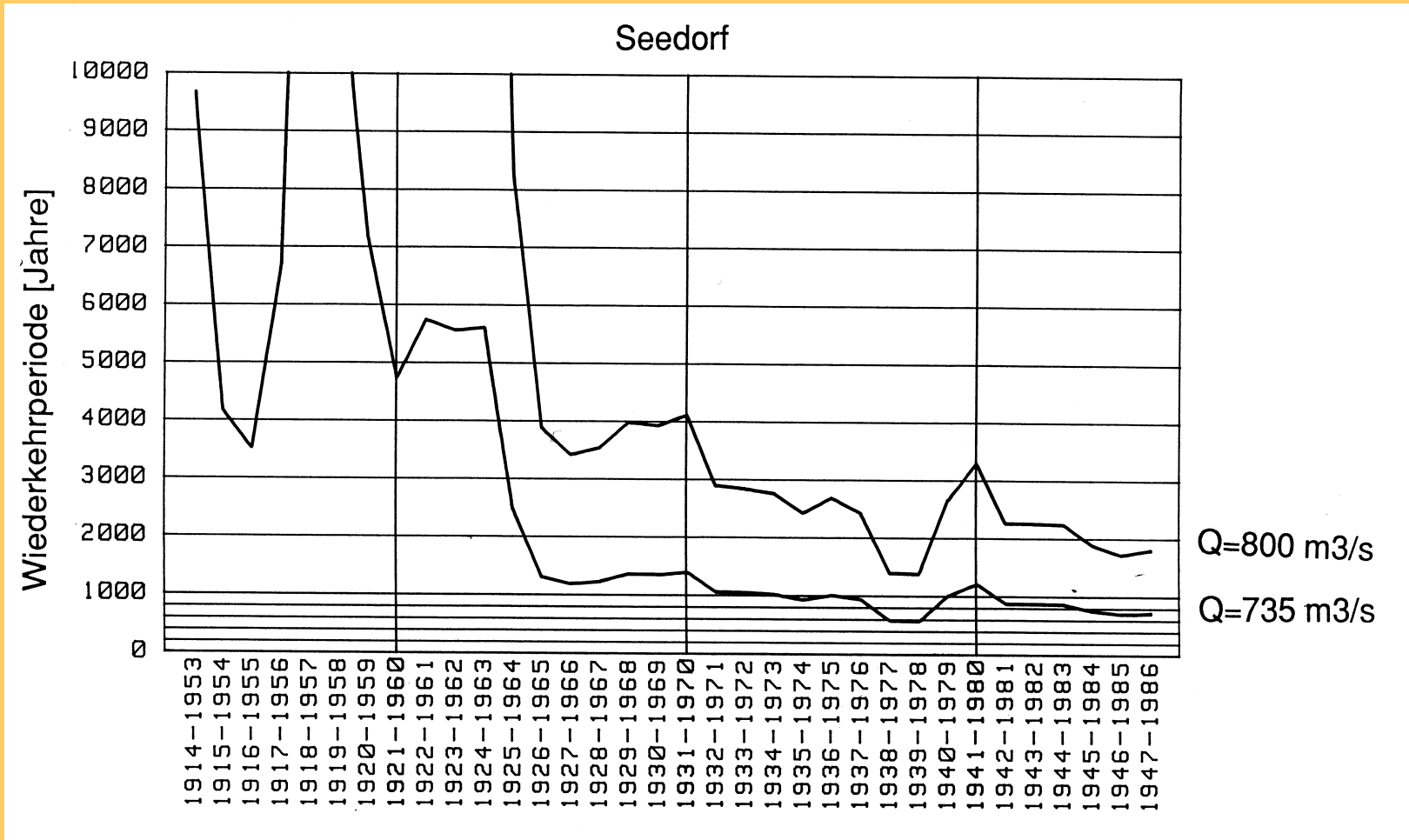


KHR Workshop: expert discussion on extreme discharges

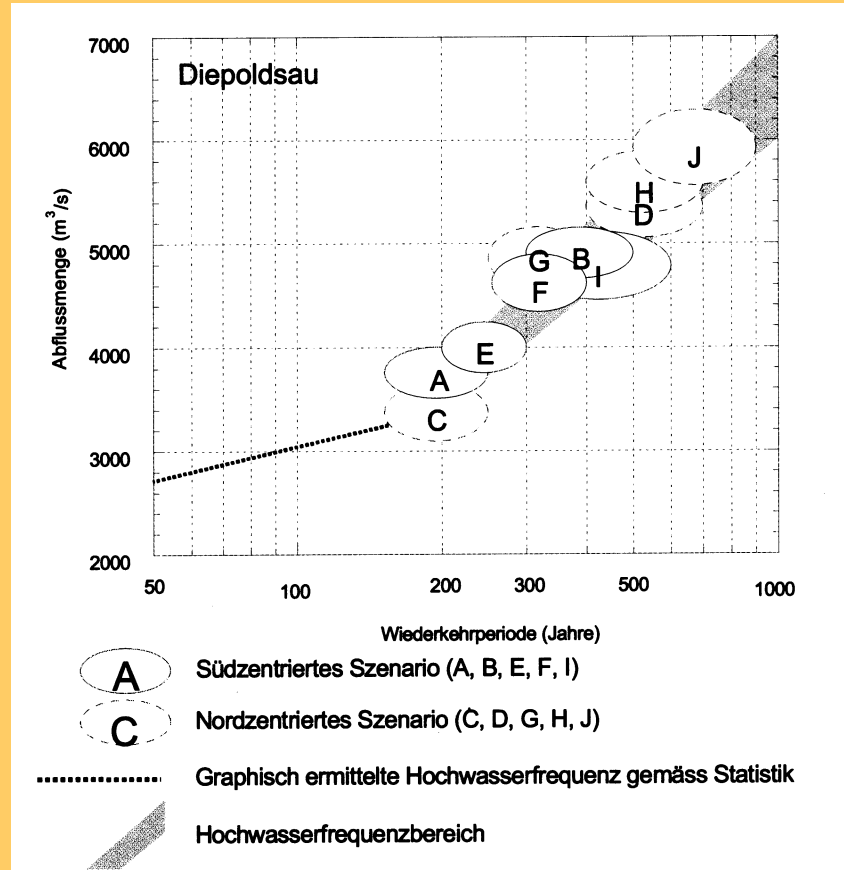


Challenge 1: estimation of the return period of an exceptional flood



Return period of the 1987 Reuss flood, estimated for moving 40 year periods

Challenge 2: extrapolation to extreme events

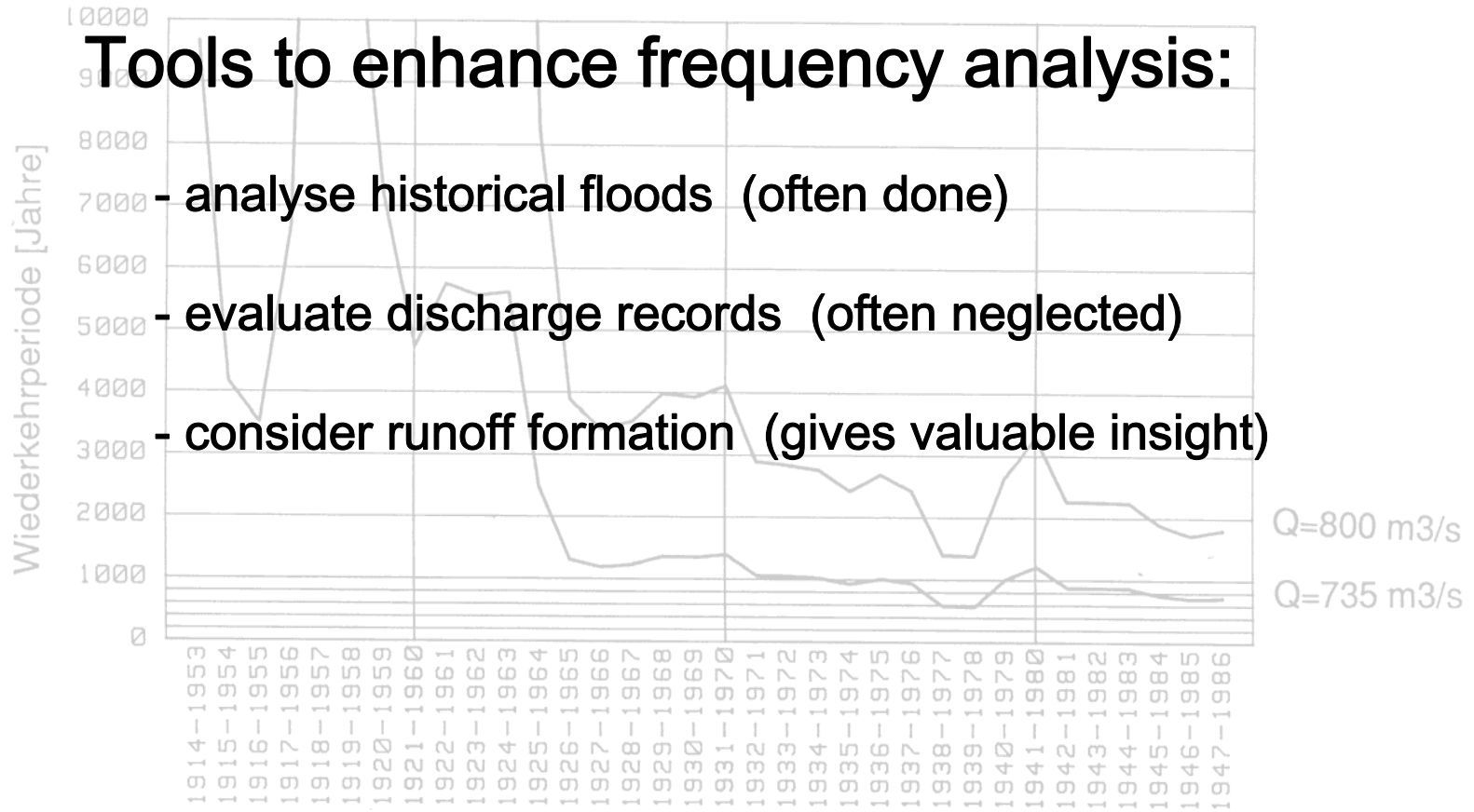


Is it real or fiction ?

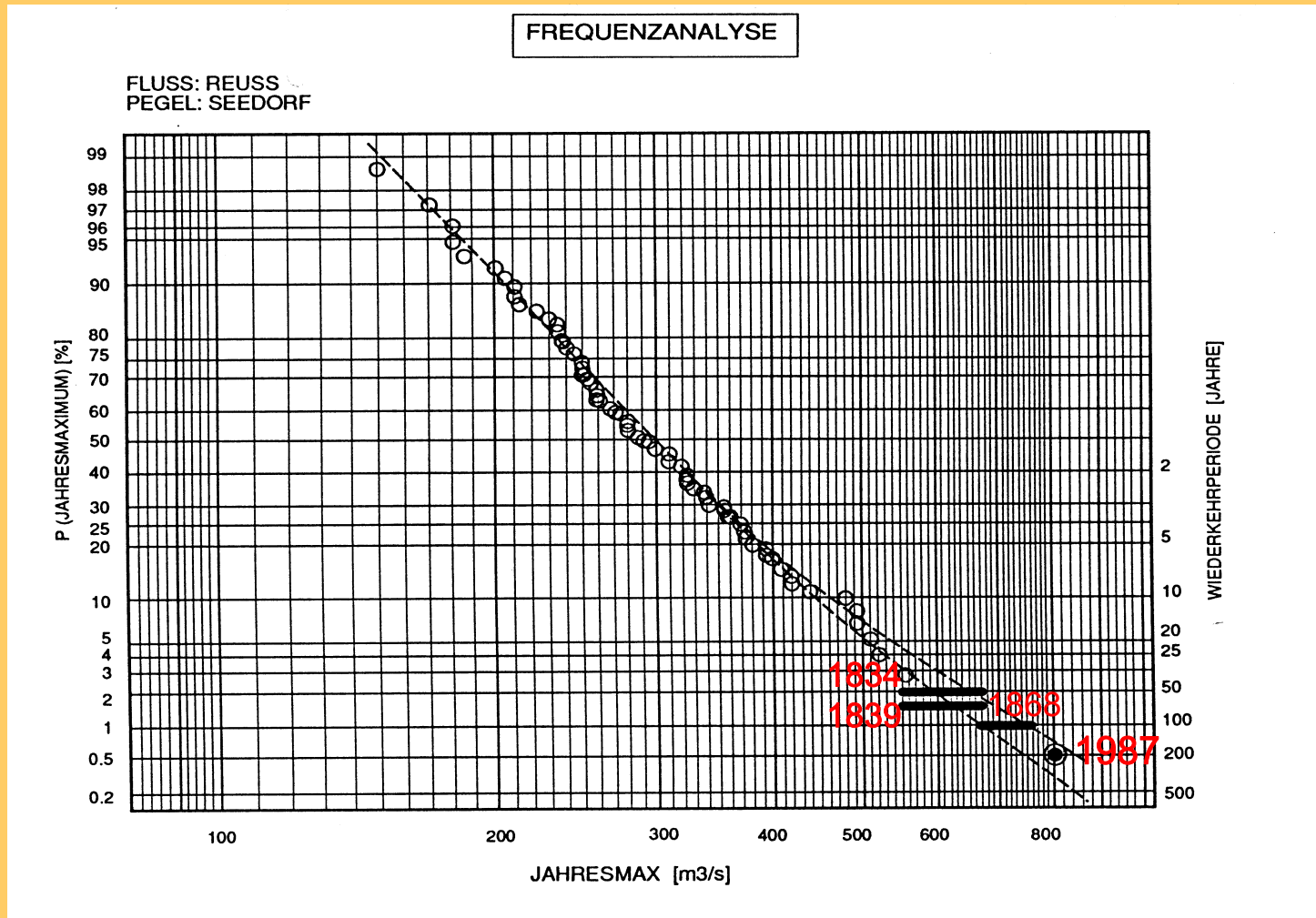
Seedorf

Tools to enhance frequency analysis:

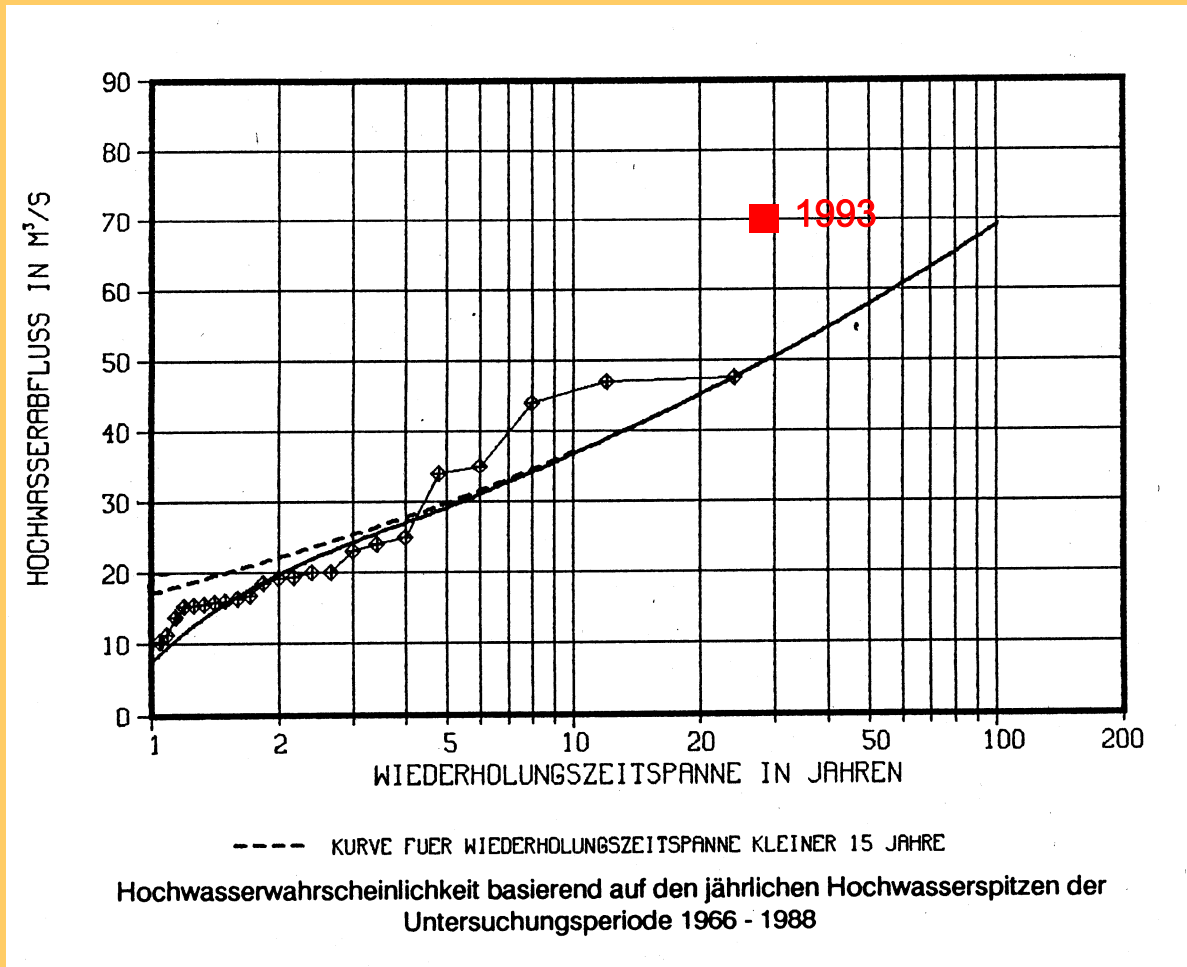
- analyse historical floods (often done)
- evaluate discharge records (often neglected)
- consider runoff formation (gives valuable insight)



1. Historical floods:



2. Evaluation of discharge records



Frequenzanalyse Saltina bei Brig



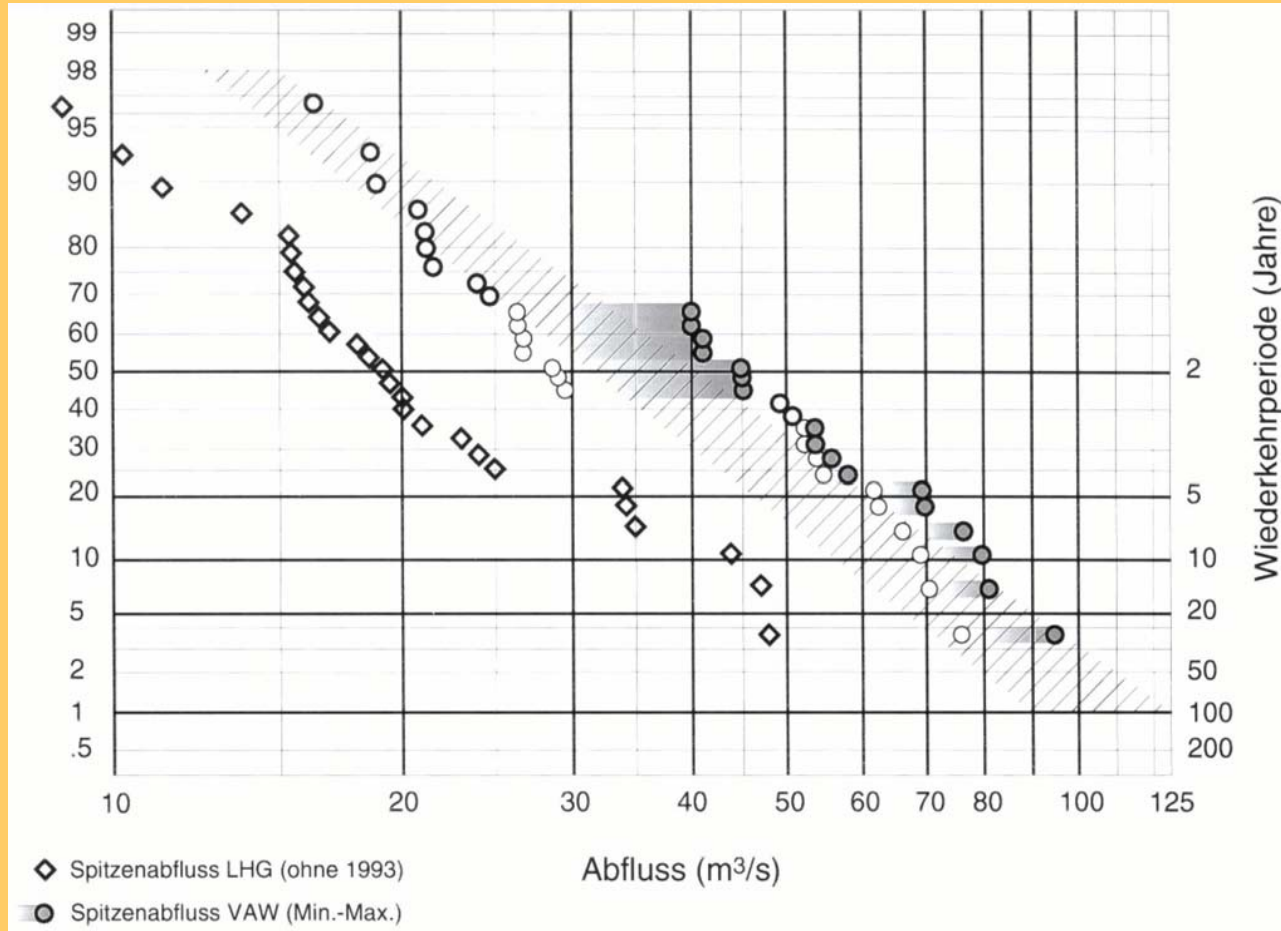
Pegel Saltina in Brig



$Q = 30 \text{ m}^3/\text{s}$



$Q = 70 \text{ m}^3/\text{s}$



Frequenzanalyse nach PQ_{Jahrbuch} und $PQ_{\text{Modellversuch}}$





5 m³/s in the Glatt River at gage site
(left without, right with „Verkrautung“)

3. Consideration of runoff formation:

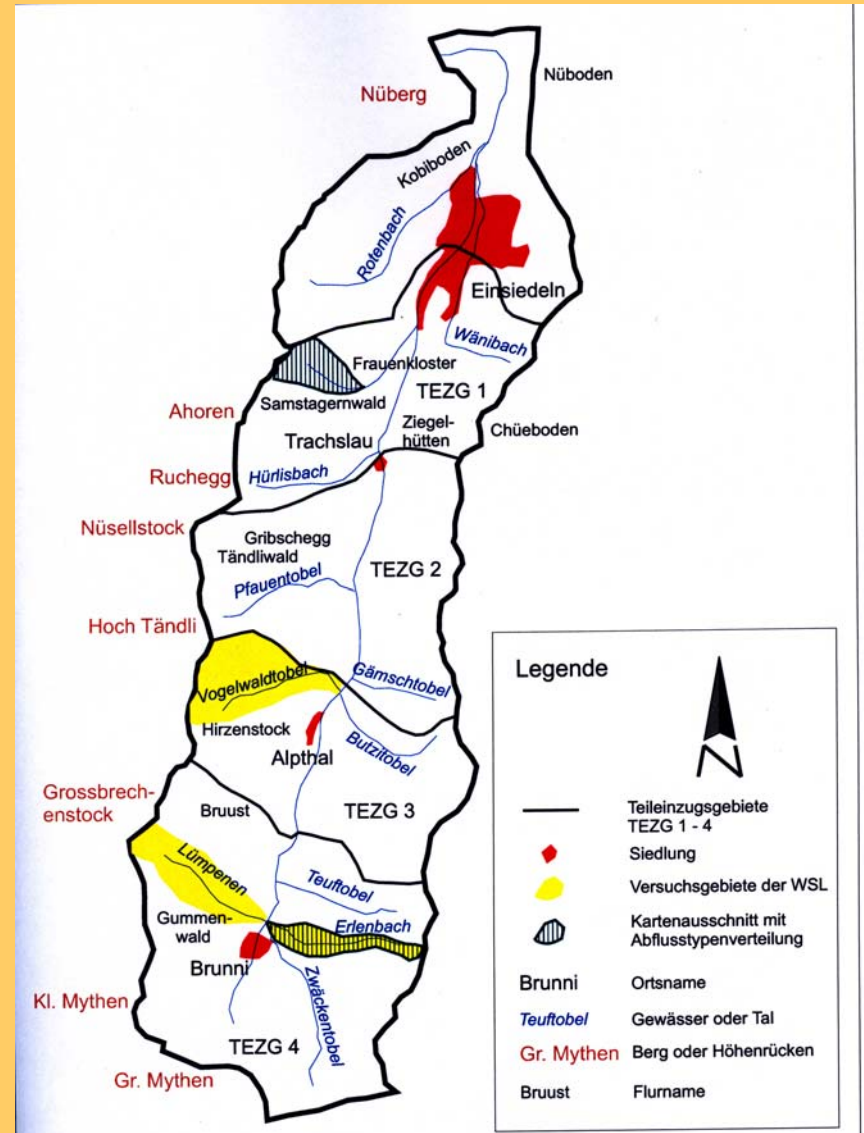
Example Alptal (38 km²)

different experimental catchments,
 river and raingages installed (WSL),

catchment predominantly Flysch,
 is fast reacting,

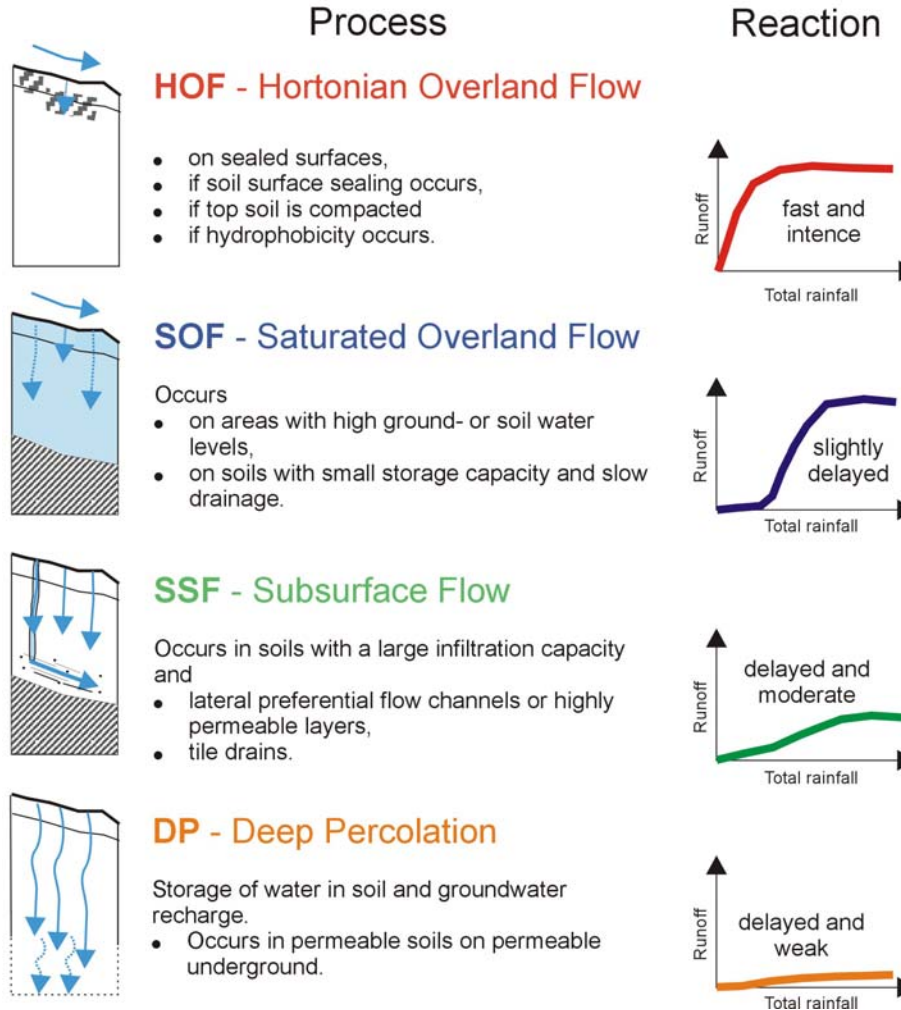
An extreme flood occurred on the
 25. 7. 1984.

Probability of larger floods?

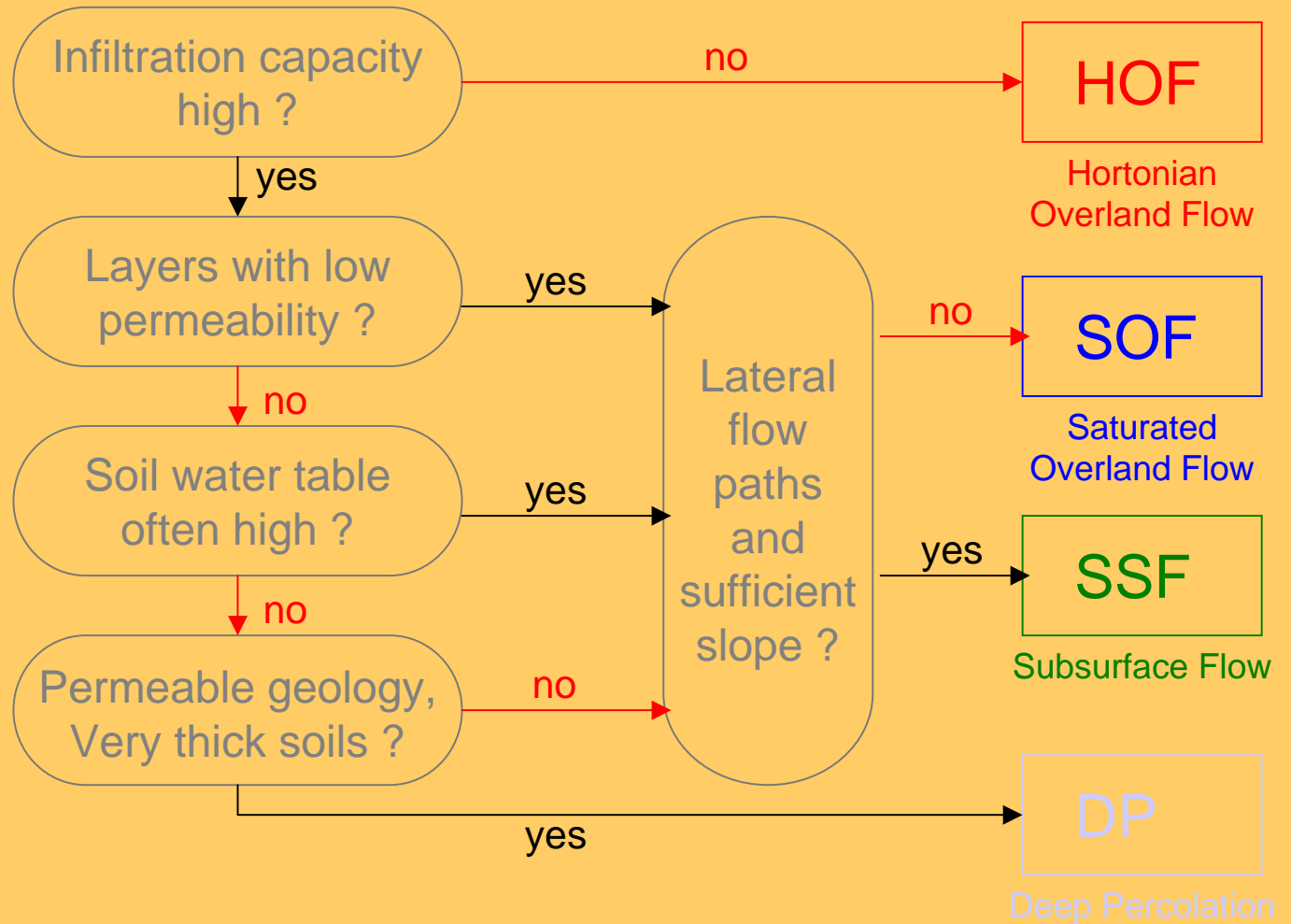


Runoff Processes

Four runoff processes in different intensities (fast (1), retarded (2), slow (3) reacting) can be distinguished.



Simplified decision scheme

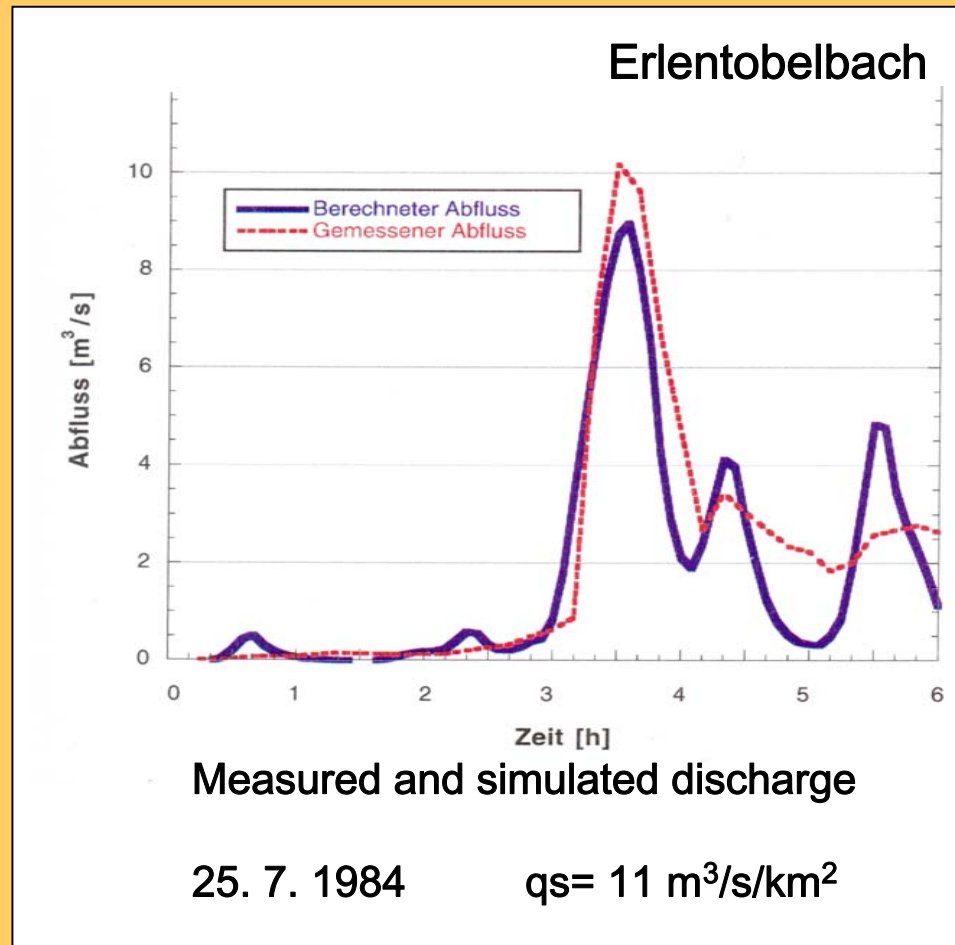


runoff process map

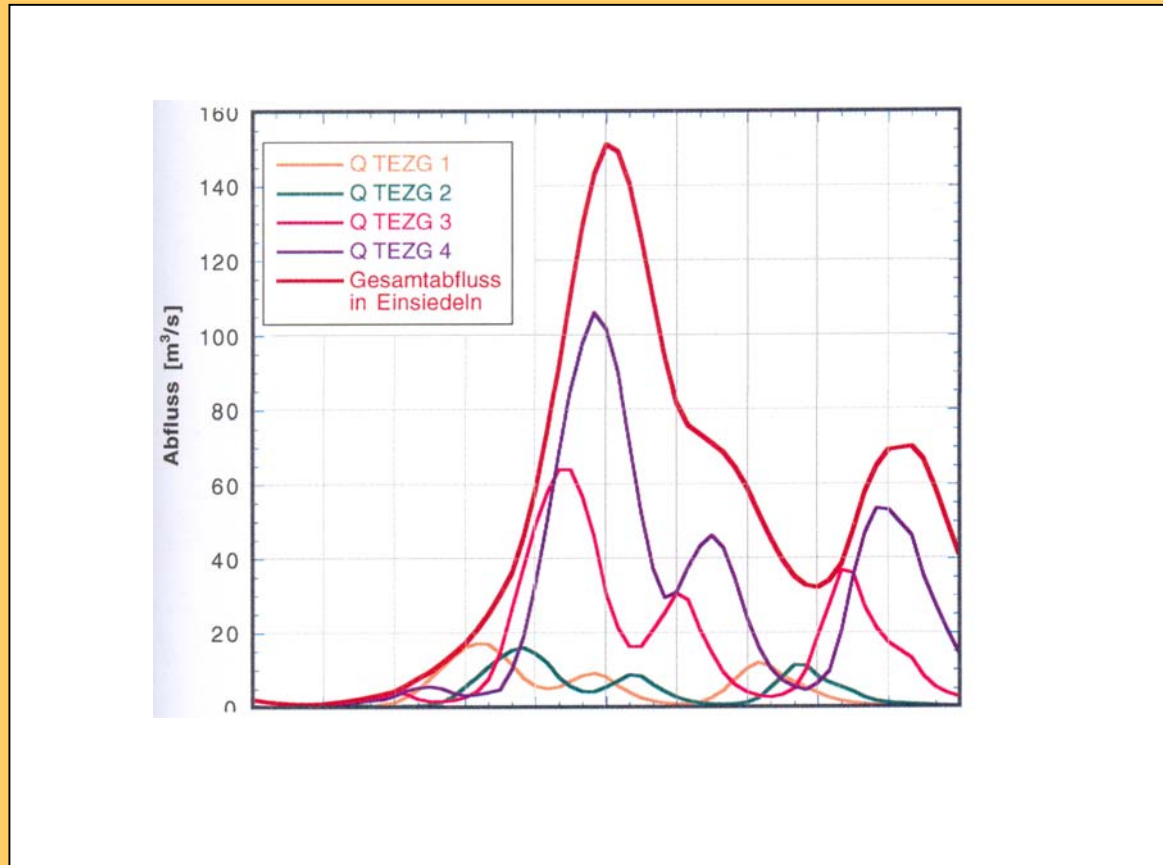
Erlentobelbach 0.8 km²

Alp River tributary

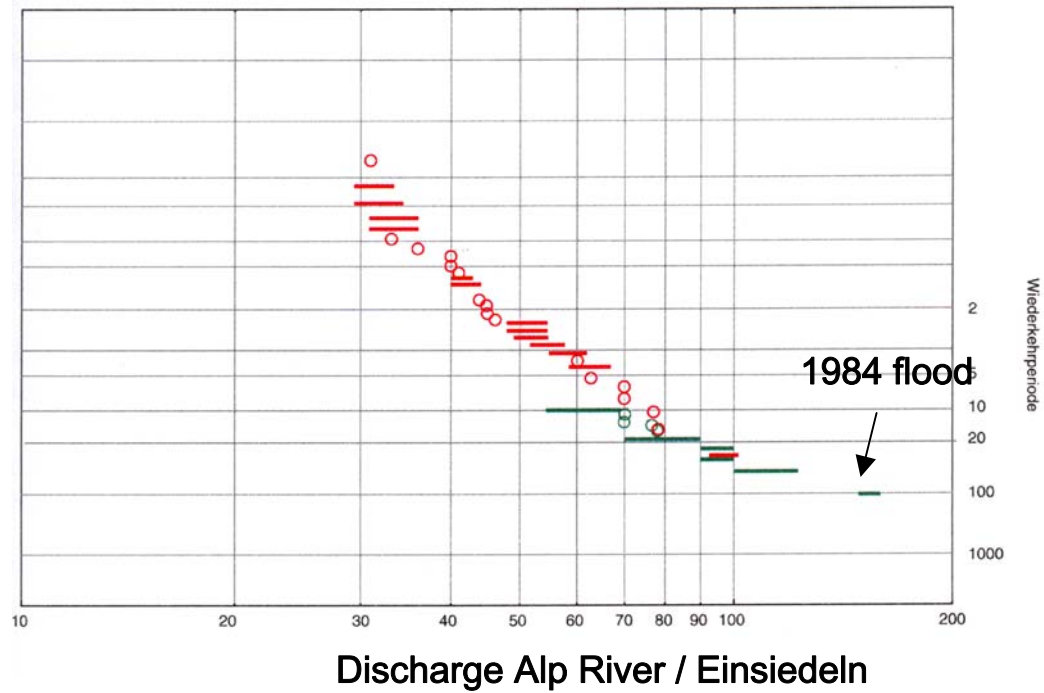




Discharge of the Alp river and its tributaries on the 25. 7. 1984

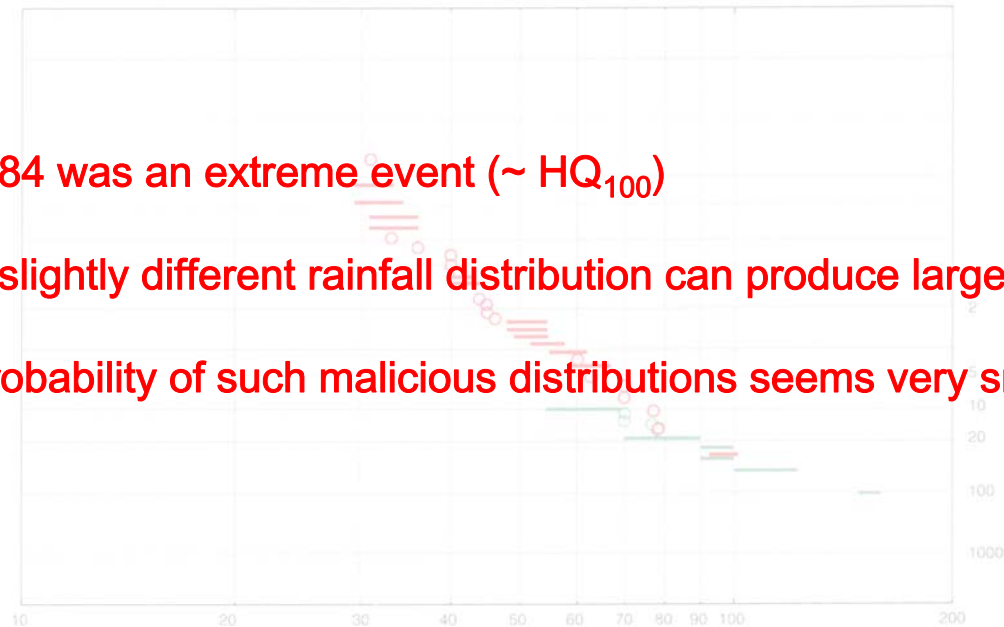


Frequency Analysis Alp River, based on all available sources



Frequency Analysis Alp River, based on all available sources

- 1984 was an extreme event ($\sim HQ_{100}$)
- a slightly different rainfall distribution can produce larger floods
- probability of such malicious distributions seems very small



Discharge Alp River / Einsiedeln



Schwarzenburg flood, 4. 7. 1985

Dorfbach in Schwarzenburg

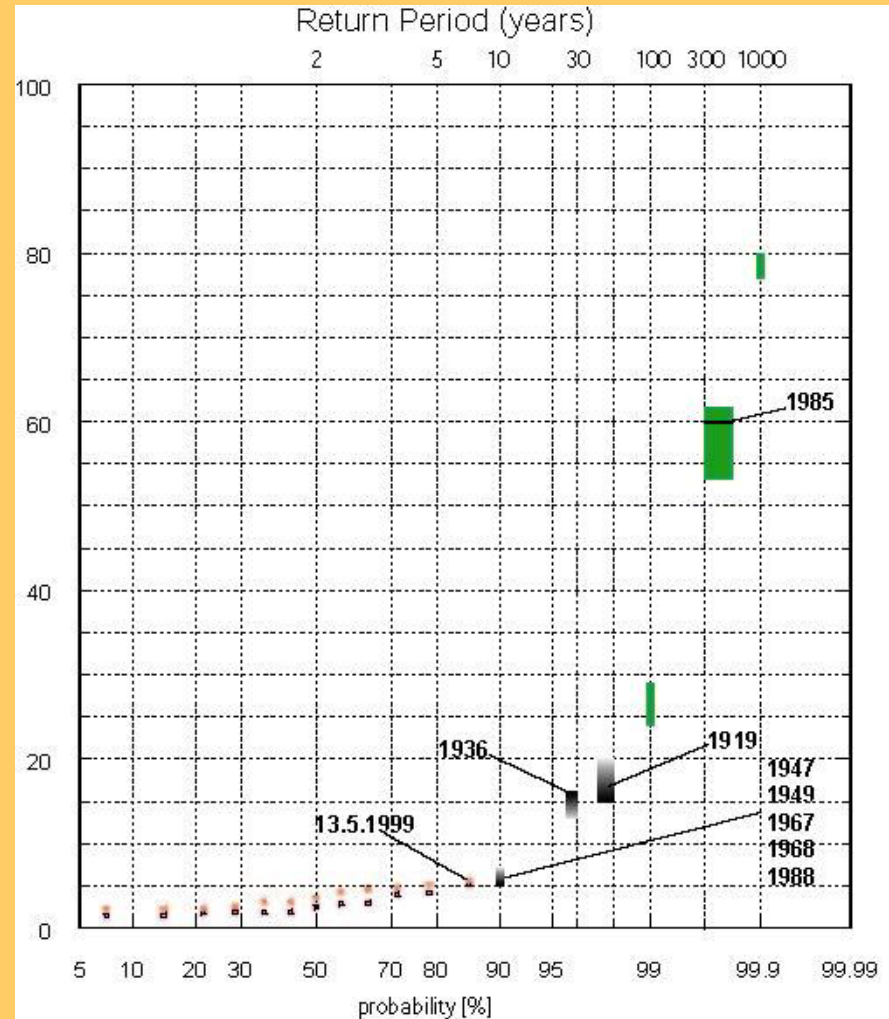
11 km²

Mostly pervious sandstones

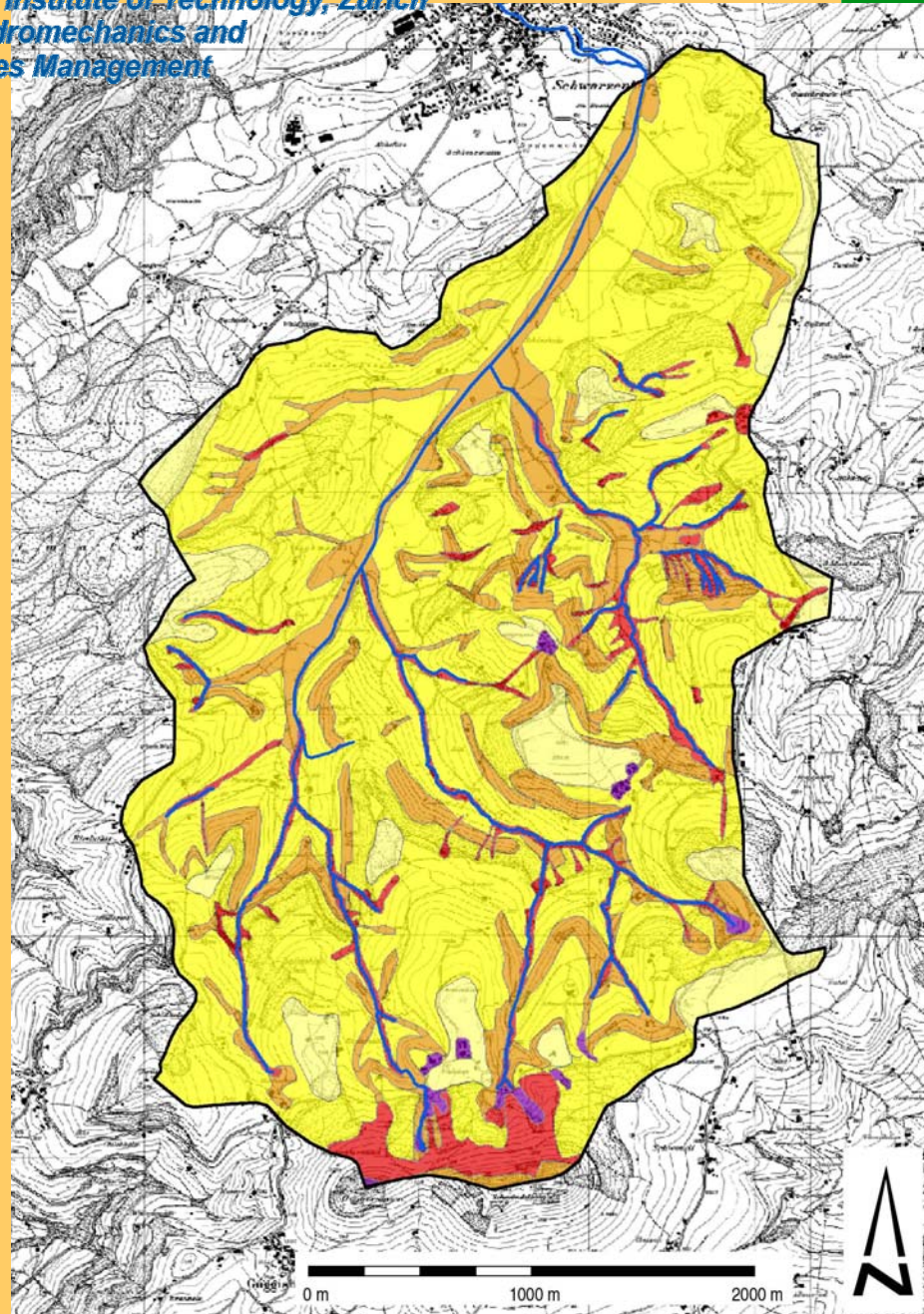
extreme flood on the 4. 7. 1985

(170 mm in less than 1 h)

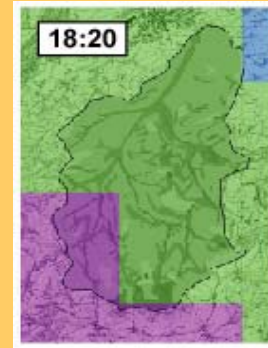
Return period?



Frequency analysis Dorfbach

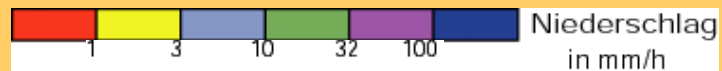
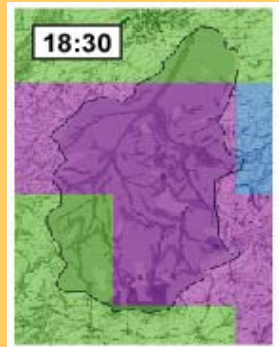


Process map
 Dorfbach



Radar measurements
4. 7. 1985

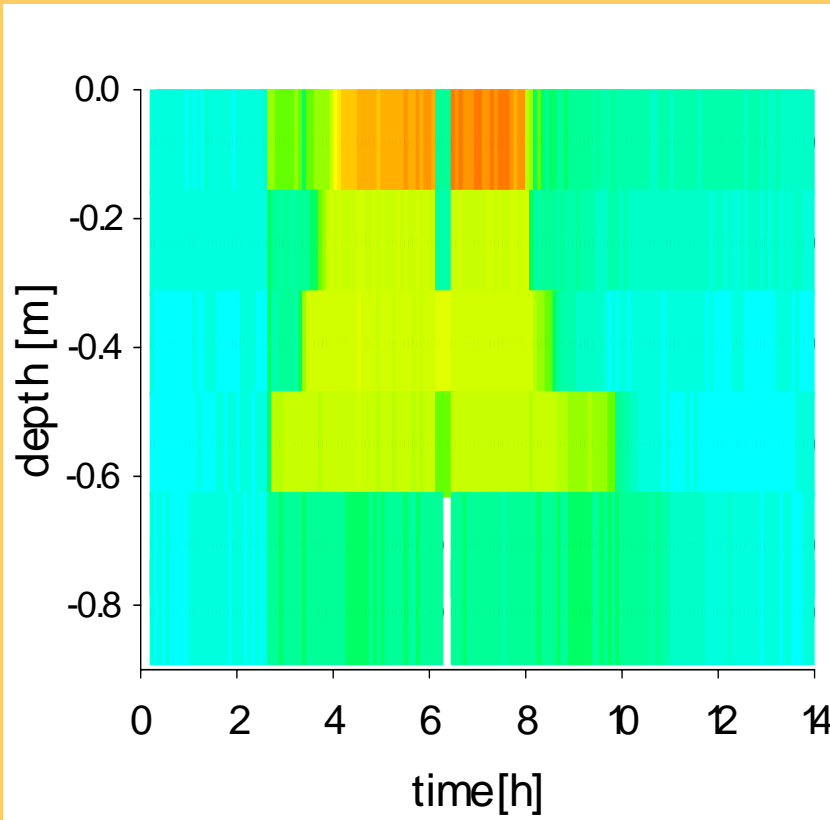
Rainfall was extreme, but not sufficient to explain the observed discharge!



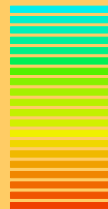
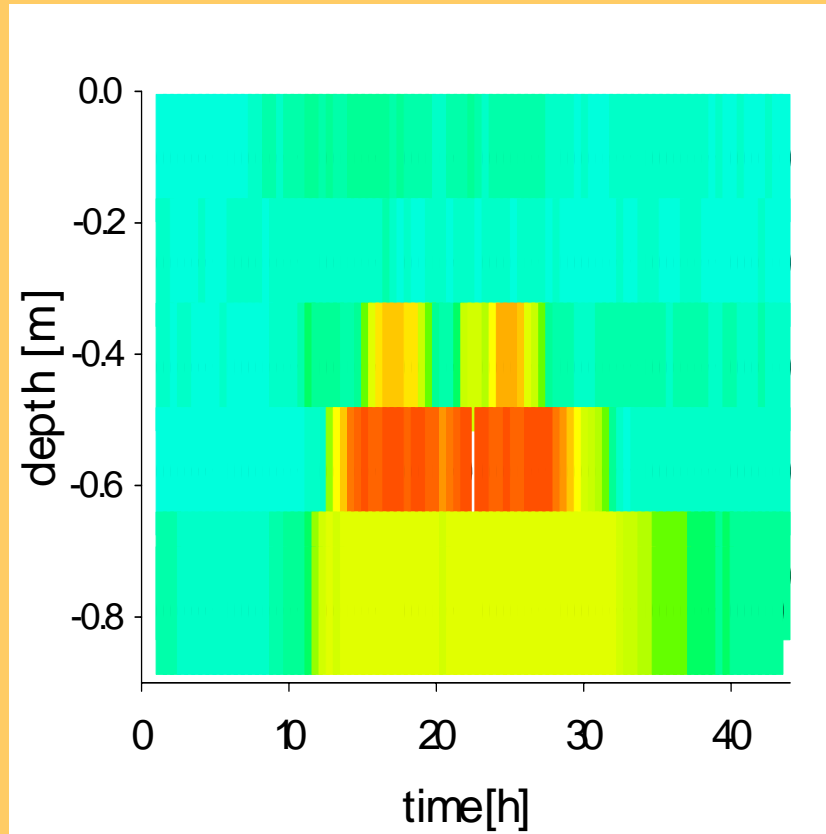
high precipitation intensity sprinkling experiments

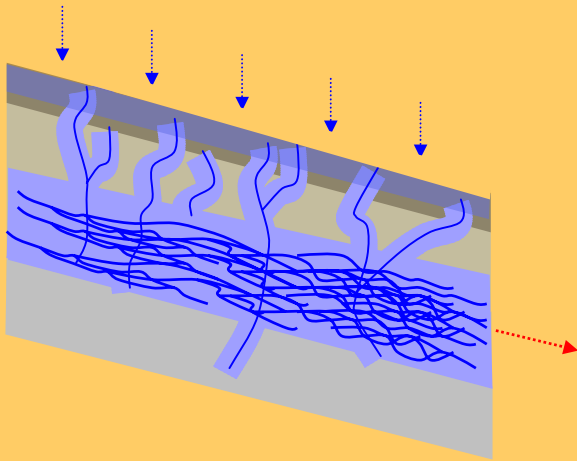


high precipitation intensity sprinkling experiment



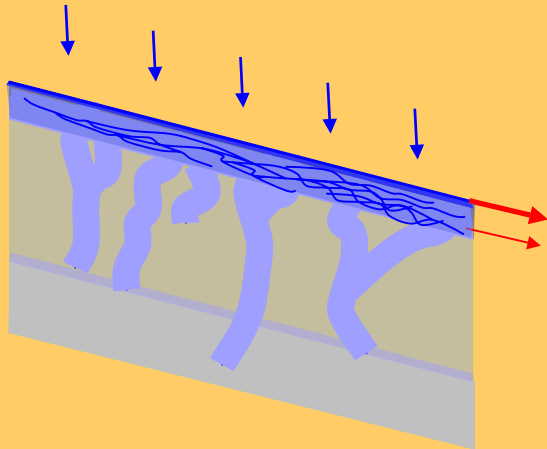
low precipitation intensity event january, 13th/14th





Process change:

during medium and high intensity rains:
no surface runoff



during extreme intensities:
surface runoff due to a saturated layer

- with the presented tools, events up to 200 years can be handled,
- Schwarzenburg was a super event (return period 200 to 300 years)
- an opportunity to learn!

