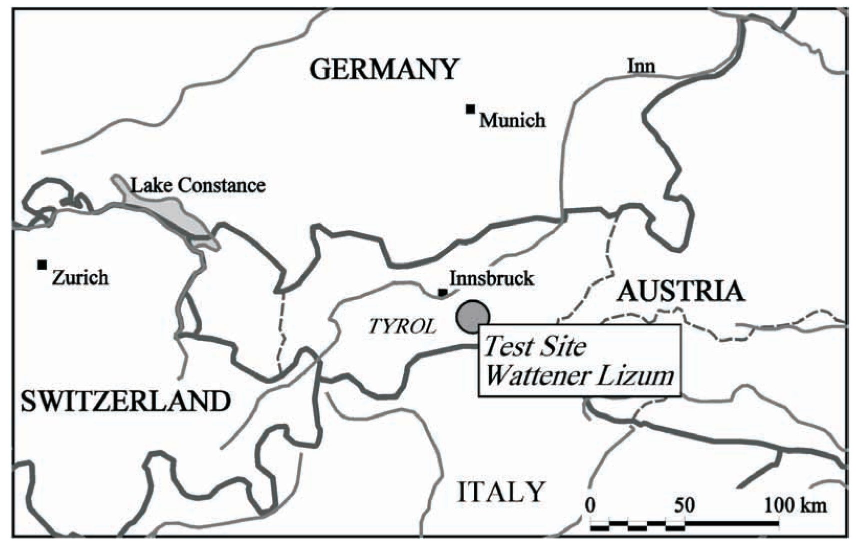
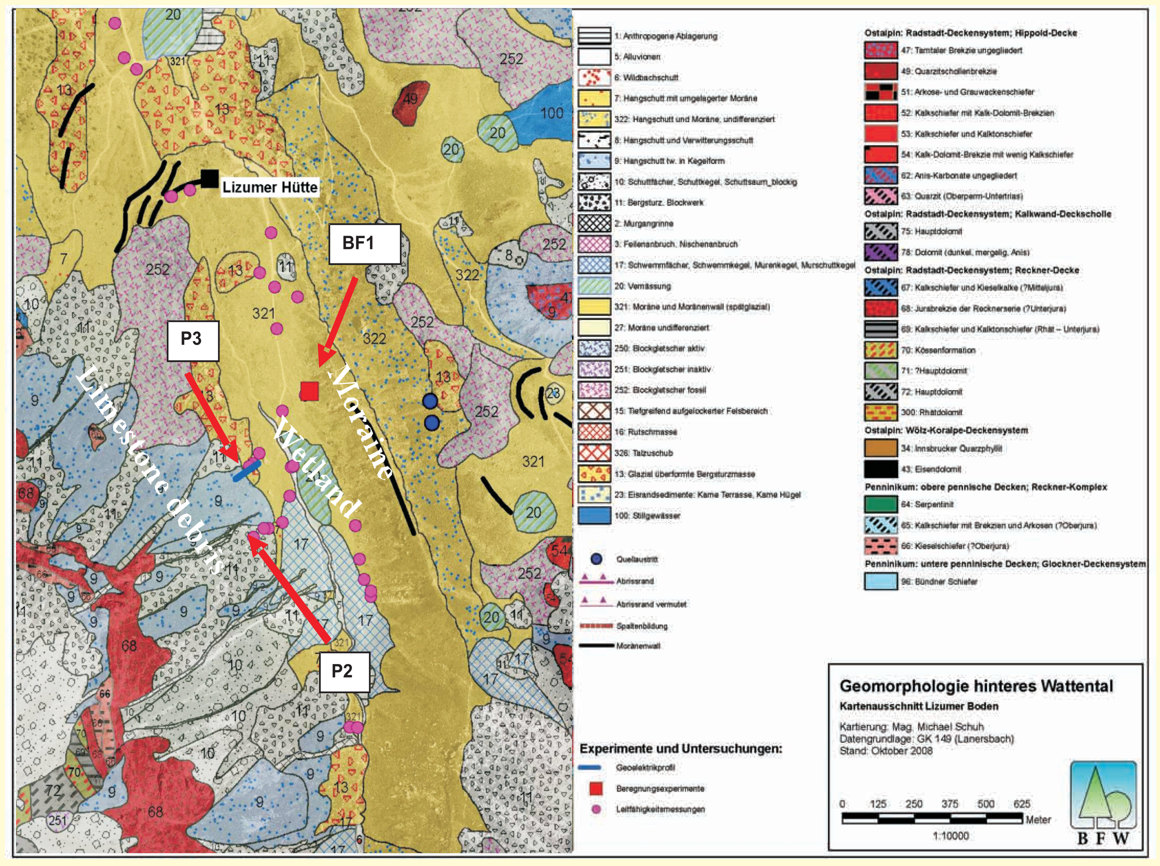
Geoelectrical Monitoring for the characterisation of the near surface interflow in small alpine catchment areas during continuous rain



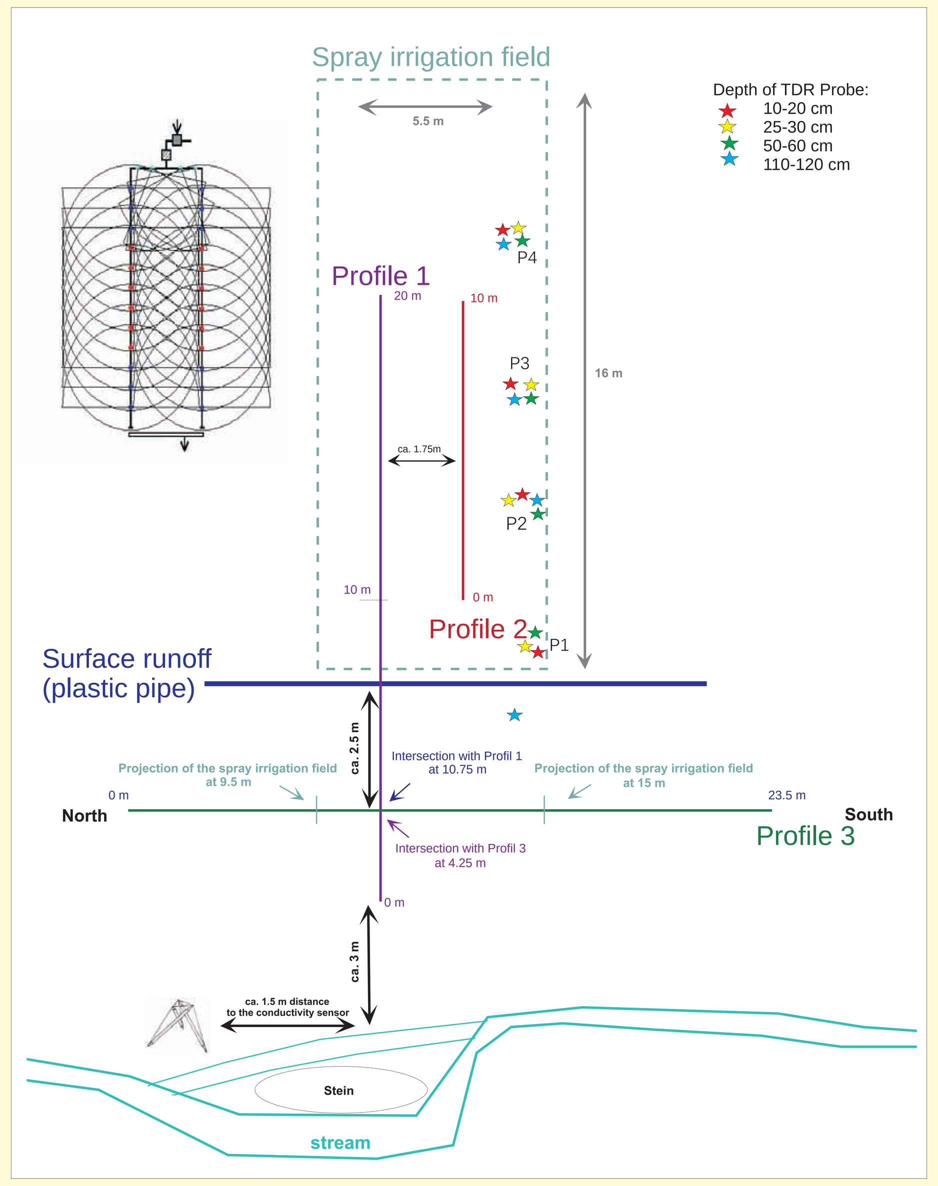
ITA A.[1], RÖMER A.[1], MARKART G.[2], KLEBINDER K.[2], BIEBER G.[1]

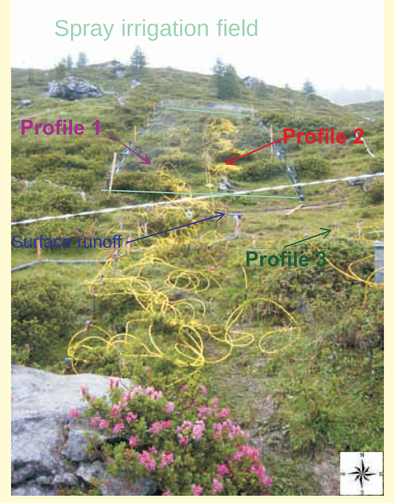
[1] Geological Survey of Austria, Neulinggasse 38, 1030 Vienna, Austria (anna.ita@geologie.ac.at)
[2] Federal Research and Training Center for Forests, Natural Hazards and Landscape, Rennweg 1 - Hofburg, 6020 Innsbruck, Austria (gerhard.markart@uibk.ac.at)

Location and Geology:



Outline of monitoring profiles:





Abstract:

OBJECTIVES:

In a pilot study the bandwidth of the near surface interflow and subsurface stormflow were investigated on a hill slope complex (see Location and Geology) at the military training centre Lizum/Walchen (approx. 2000m above sea level) in Tyrol.

METHODOLOGY:

High amounts of precipitation (about 250 mm) were applied within 2 days by use of a transportable spray irrigation installation. During the first day water from a creek was applied to the test site. On the following day the site was sprinkled with a salt tracer for an hour followed by creek water for the rest of the day. To characterise the runoff, different measurement techniques were used in the irrigation field. The subsurface runoff was registered in calibrated tanks. Changes in soil moisture were measured with buried TDR-waveguides – arranged in four profiles from 15 cm to 115 cm soil depth in maximum. In addition three geoelectrical profiles were measured (see Outline of monitoring profiles).

Two geoelectrical profiles were positioned orthogonal to the slope in the precipitation area, where one was reaching over the edge. The third profile was parallel to the slope overlapping with the second profile. Electrode distances were 0.25 cm and 0.50 cm respectively with 48 electrodes per profile. Geoelectrical measurements were done periodically before, during and after the rain simulation experiments. These have been carried out with the newly developed geoelectric instrument of the Geological survey of Austria, GEOMON4D (see Geoelectrics). The advantage of the instrument is that it can measure a resistivity section at high speed and in an automated, meaning monitoring mode. Therefore, it is possible to register small and fast changes in the soil conductivity caused by a tracer.

RESULTS/CONCLUSION:

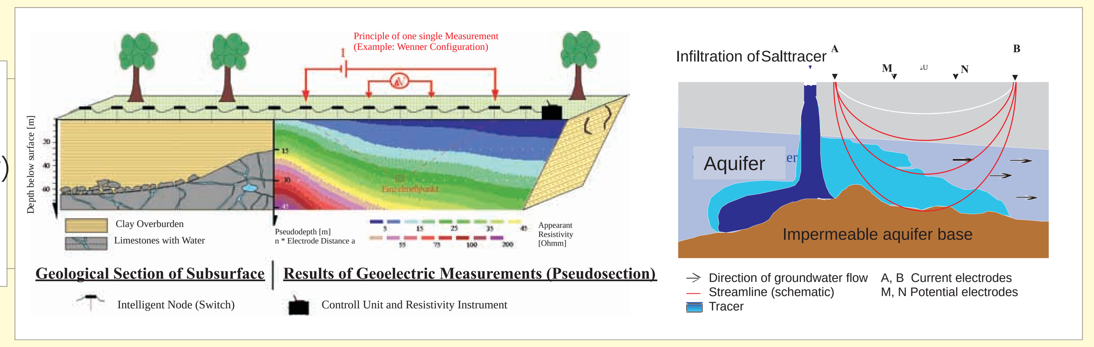
Summarising it can be said that the resistivity soundings give a detailed picture regarding the geological structure of the research area as well as explicit knowledge of how the near surface interflow spreads out in the subsurface. (see Geoelectrical results) The geoelectric measurements deliver precise information about the behaviour of the salt tracer, its lateral and vertical extend and the flow velocity in the subsurface.

For a more elaborate interpretation the results of the measurements were put together to achieve the best information of the interflow processes. It was seen that there is a very good correlation between the used methods. The results of the interflow velocities are estimated from the results of the TDR measurements as well as the results of the geoelectrical measurements (see Conclusion).

Still, for future investigations the methodology has to be refined, as for example a rearrangement of the experimental setup.

Geoelectrics:

- Geological characterisation
- Measurement of the resistivity values of the earth (salt tracer=low resistivity)
- Monitoring temporal changes of the substratum (infiltration of salt tracer)



Geomon 4D:

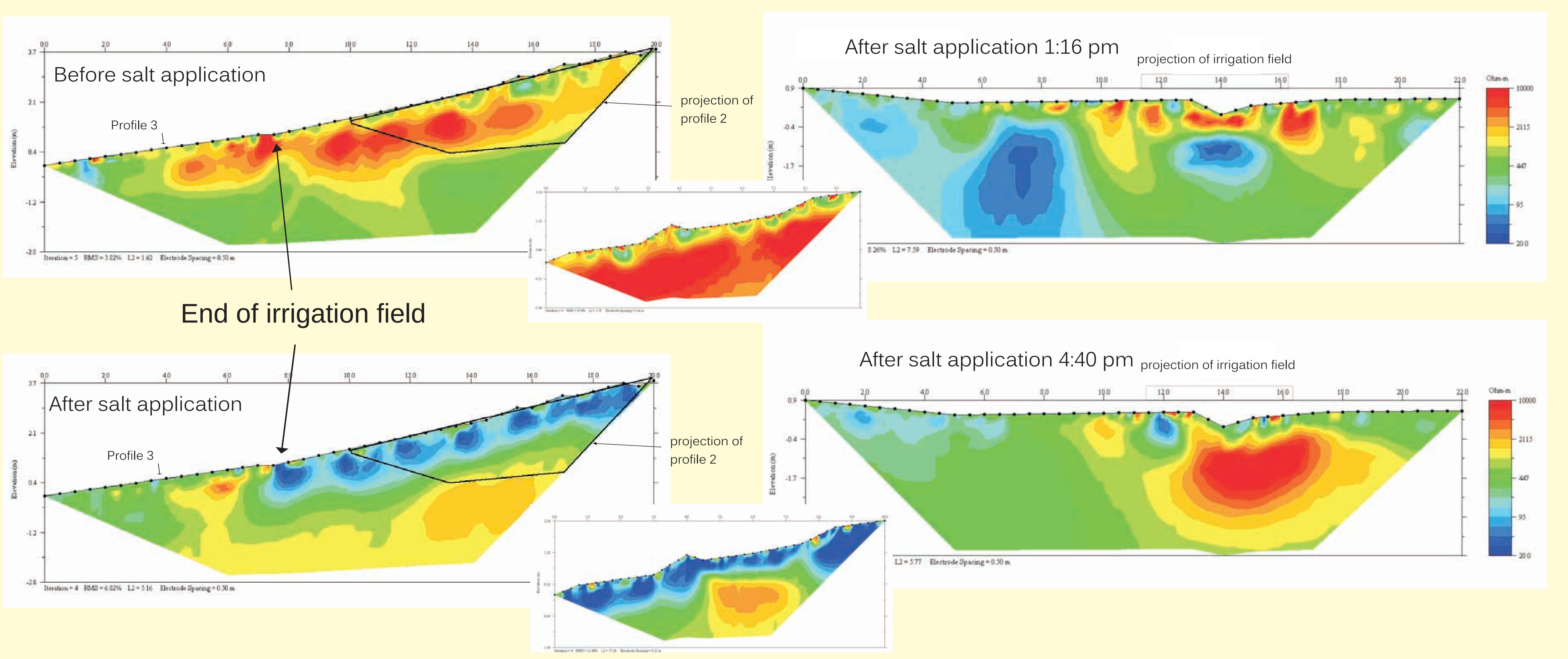
- In-house development
- 3000 data within 30 min
- surveillance of each single measurement
- GPRS access

Geoelectrical results:

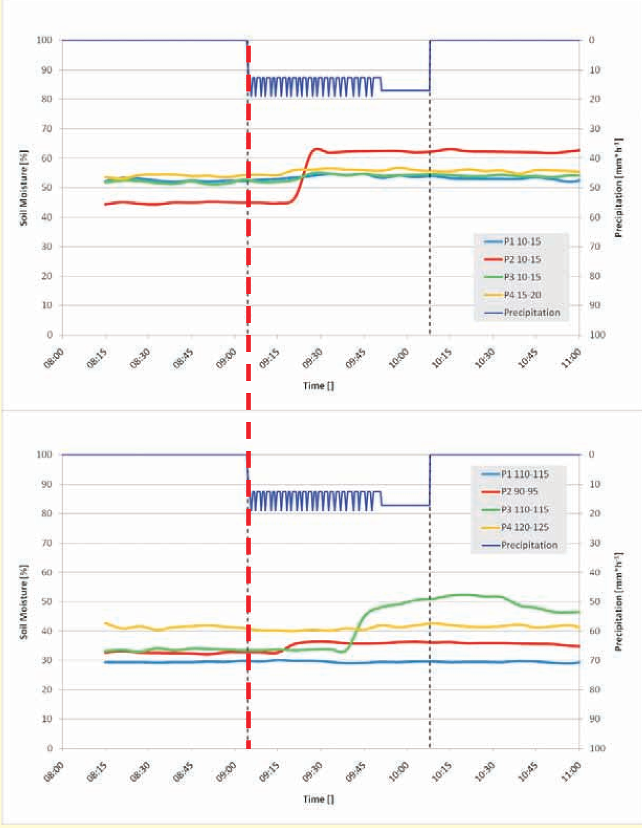
Profile 1
Electrode distance 0.5 m

Profile 2
Electrode distance 0.25 m

Profile 3
Electrode distance 0.5 m

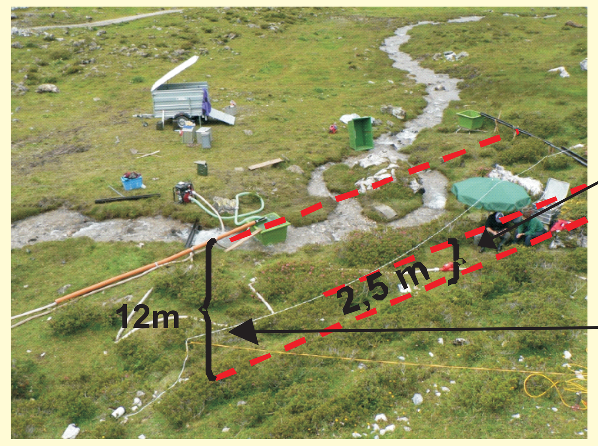


TDR Results:



TDR Changes in the soil moisture content (vertical flow)
$0.25\ mh^{-1} < k < 0.5\ mh^{-1}$

Conclusion:



- The interflow velocities were estimated by the results of the different measurement techniques:
- Geoelectrics:
  velocity estimated by profile 1&2 => $1mh^{-1}$
  Profile 3: the tracer passes 2.5 m in 2.8 h => $1mh^{-1}$
- Marginal changes of conductivity at gauging point
  salt tracer needs 6h to cross 12 m in the substratum => $2mh^{-1}$
- The mean vertical movement of the salt tracer approximated by the TDR-probes => $1\text{-}2\ mh^{-1}$

It can be seen that the different methods have a good correlation.

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Geological Survey of Austria

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