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The Sperbelgraben - Rappengraben experiment: New insights on old interpretations

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In 1903 hydrologic measurements were initiated in two catchments of the Swiss Emmental to investigate forest influence on runoff processes. For this purpose, the data collected from the fully forested Sperbelgraben and scarcely forested Rappengraben were compared. The analysis showed important differences in the hydrologic behaviour of the two catchments mostly related to flood runoff generation. The differences were attributed to the differences in forest coverage. These results were the first scientific evidence for the importance of forests and forest management for flood protection.

Recently, the Sperbelgraben-catchment has anew become a site of experimental investigation. After the destructive wind storm Lothar of December 1999 a nested approach was applied in the Sperbelgraben to evaluate the runoff behaviour at various scales ranging from plots of 1 m^2 to the whole Sperbelgraben with an area of 0.5 km^2 and to estimate to what extent it is affected by deforestation. The analysis showed that forests in general do have an important influence on the water balance but only to a very limited extent on flood runoff generation. In the Sperbelgraben gleyic soils or permeable Cambisols dominate. On the Gleysols the storage capacities are too small to have an important influence on storm runoff generation. The permeability of the Cambisols is in most cases that high, that the water infiltrates into deep soils layers even if the soil is still far from being saturated. Under such conditions forests cannot considerably improve the hydrologic behaviour of a site.

Furthermore, the analysis showed that the Sperbelgraben is loosing water to the underground. The degree of this leakage varies with the scale of the analysis. Whilst in two sub-catchments the leakage is in the same order of magnitude as annual evaporation, it

is reduced to about one third of the evaporation in the entire Sperbelgraben catchment. This can be attributed to the prevailing geological conditions.

In both the Sperbelgraben and the Rappengraben bedrock consists of alternating layers of marls, sandstones and conglomerates. As the sandstones and the conglomerates are not completely impermeable, the hydrological behaviour is mainly determined by the succession of the marl layers. Several indicators (e.g. geological and topographic survey) lead to the conclusion that marl layers are more frequent in the Rappengraben than in the Sperbelgraben. Conceptual analysis shows that this difference could be the reason for the differences in the hydrologic behaviour of the two catchments.

This shows how important it is to fully account for the whole complexity of a catchment when interpreting measurements. The conceptual tracing of the flow of water in the Sperbelgraben and Rappengraben leads to a new hypothesis about the reason for observed differences. To prove one or the other concept, the water pathways should be traced physically.