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Hydrological connectivity and nutrient connectivity - coupled or not?

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This experimental catchment study is focussing on Phosphorus (P) losses in headwater catchments. Our interests where driven by the question if (and how) hydrological connectivity and nutrient connectivity are coupled.

The Schneckenbach river and its major tributary Rüttebach are located in the southernmost part of the Black Forest Mountains, Germany. Both rivers originate in humid climate conditions with non-calcareous organic and mineral soils and underlying gneiss and granite geology. Catchment characteristics are comparable in land use (extensive grassland, forest) but differ in topography, river morphology and runoff dynamics.

The objectives were (a) to assess P mobilisation and transport in and into the river system and (b) to explain the variability of non-point P sources contributing to river discharge due to connectivity for different events.

We investigated all major storm events ($>$ 20 mm) since Summer 2002 in combination with monitoring of agronomic impacts and anthropogenic point sources in high temporal resolution in a nested catchment approach (0.5, 0.7, 2.2, 3.2 km2). Additional weekly manual sampling and flow proportional auto sampling at the catchment outlet provided water quality data during base flow conditions.

Dominant runoff components and their generation processes where obtained from geochemical and stable isotope data (SiO2 and 18O) and tracer experiments (Uranin and Deuterium). Additional sediment sampling was carried out in 2003 and 2004, in order to take instream non-point P sinks and sources into account (see C. Katterfeld, HS 21).

P transportation into the river is generally assumed to be controlled by lateral connectivity, pre-event soil conditions (P fertilization) and storm charateristics. At our site

hydrological connectivity was generated by subsurface storm flow (SSF), saturation or hortonian overland flow (SOF or HOF) was not observed. The resulting lateral nutrient connectivity was considerably low (even for large events directly after manure application).

Water and nutrients that reach the river channel are generally considered to be transferred to the catchment outlet. Our data shows the opposite. We detected “transmission gains” in storm flow and “transmission losses” during base flow conditions within relatively short distances. Longitudinal connectivity (or its interruption in the river corridor) has a major influence on stream water chemistry, nutrient and sediment fluxes and highlights thereby the ecological function of river morphology on water quality.