Impact of extreme events and changing environmental conditions on groundwater recharge

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Research field "Meteorology and hydrology: Groundwater resources in climate change"

Research question 2 | Cluster 1

Links to showcases Foelsche 1, Foelsche 2, Kirchengast 1, Kirchengast 2, Maraun 1, Steiner 2

Background: Current hydrological models frequently rely on simplifying approaches for calculating evapotranspiration such as correlations between evapotranspiration rates and air temperature. If the environmental conditions change strongly these approaches are subject to high uncertainty, first because of the impact of climate parameters other than temperature, and second because of changes in the soil-vegetation system. For instance, it has been suggested that the increasing carbon dioxide content of the air has reduced the transpiration by plants ("physiological forcing") and thus caused globally increasing continental runoff during the last decades despite the rising air temperatures (Gedney et al., 2006). This leads to the following research question: How is evapotranspiration and hence groundwater recharge affected by climate change taking into account changes in hydrological extremes and the responses of the soil-vegetation system to changing environmental conditions?

Goal: This thesis aims, first, to identify how groundwater level and discharge responded to extreme events in the past; second, to provide a quantitative understanding of the recharge mechanisms underlying the observed responses; and third, to assess potential impacts of future changes in the soil-vegetation system on evapotranspiration and groundwater recharge processes.

Methods and disciplinary background: Observed time series of groundwater level and spring discharge will be used to analyze (e.g., as in Healy and Cook, 2002; Geyer et al., 2008) how groundwater recharge responded to hydro-meteorological extreme conditions and to identify potential changes in these responses over the last decades. A process-based soil hydrological model will be employed to improve the understanding of the mechanisms controlling evapotranspiration and seepage flow in the soil under the observed extreme conditions as well as under future changing environmental conditions.

References:

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