Seasonal to interannual prediction methods for water availability at the catchment scale, including climate change

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Climate change: is the hydrological cycle speeding up? (2 hrs)
This part deals with two important questions related to the hydrological cycle and climate change: Does global warming lead to an intensification of the hydrological cycle? Can we observe this already? Starting with defining what is the intensification of the hydrological cycle (looking at residence times of flux magnitudes), the lecture focuses on possible consequences of global warming on evaporation and precipitation (considering also effects on changing net radiation and relative humidity).

Climate change: Sensitivity of runoff (2 hrs)
An important aspect of assessing possible impacts of climate change is to determine how runoff will change with changes in precipitation and temperature. A very useful instrument are runoff-climate elasticity maps that quantify empirically such changes. One can also follow a more conceptual approach to try to predict runoff changes in different climates. This lecture will review some recent studies on this topic.

Feedback mechanisms: Climate, soil moisture and groundwater (2 hrs)
Rainfall is strongly connected with the properties of the land surface, in particular soil wetness. After introducing the concept of rainfall recycling and recycling rate, soil moisture-rainfall feedback is treated, both at the seasonal and multi-year time scale. Additional feedback mechanisms related to vegetation response and albedo are treated. Brief attention is paid to the possible role of groundwater in these feedback systems.

Feedback mechanisms: vegetation water use efficiency (2 hrs)
It is generally understood that the vegetation water use efficiency decreases as the climate becomes more humid. This is a result of the fact that other than water resources become limiting for plant growth. Ecologists however have discovered that when biomes are experiencing local droughts they become as efficient in their water use as (semi-)arid biomes. In this lecture we will present empirical evidence that such ecosystem behaviour can be observed in the annual water balance of catchments, and we will discuss different biogeochemical hypotheses related to this observation.

Seasonal predictions: ocean-land surface connections (2 hrs)
The Earth's oceans have a vast storage of energy that helps drive global climatic variability. Sea surface temperatures (SSTs) are one manifestation of this energy storage. Given the oceanic mass and water's large specific heat, SST's effect on ocean-atmosphere heat and water vapor exchange can be on seasonal to annual time scales. Consequently, variability in SSTs can help provide predictive information about the hydroclimate in regions across the globe. In this lecture we will review recent studies that use ocean's SSTs to predict seasonal water availability at the catchment scale.