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Future runoff from glacierized catchments in the Central Andes could substantially decrease

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In Peru, about 50% of the energy is produced from hydropower plants. An important amount of this energy is produced with water from glaciated catchments. In these catchments river streamflow is furthermore needed for other socio-economic activities such as agriculture. However, the amount and seasonality of water from glacial melt is expected to undergo strong changes. As glaciers are projected to further decline with continued warming, runoff will become more and more sensitive to possible changes in precipitation patterns. Moreover, as stated by a recent study (Neukom et al., 2015), wet season precipitation sums in the Central Andes could decrease up to 19-33 % by the end of the 21st century compared to present-day conditions.
Here, we investigate future runoff availability for selected glacierized catchments in the Peruvian Andes. In a first step, we apply a simplified energy balance and runoff model (ITGG-2.0-R) for current conditions. Thereafter, we model future runoff for different climate scenarios, including the possibility of strongly reduced precipitation. Preliminary findings indicate (i) changes in the seasonal distribution of runoff and (ii) significant reductions of the annual runoff in future for the mentioned scenario with significant precipitation decreases. During early phases of glacier recession, melt leads to increased runoff - respectively compensates for the precipitation reduction in the corresponding scenario - depending on the fraction of catchment glaciation. Glaciers are acting as natural water reservoirs and may buffer the decreasing precipitation in glacierized catchments for a limited period. However, strongly reduced precipitation will have noticeable consequences on runoff, particularly when glacier melt contribution gets smaller and finally is completely missing. This will have consequences on the water availability for hydropower production, agriculture, mining and other water uses. Critical conditions may emerge in particular during the dry season when glacier melt water used to represent substantial amounts of total runoff in high Andean catchments. Seasonal shifts of water availability may be mitigated by artificial reservoirs, but possible reductions of annual runoff cannot be compensated by such constructions. Furthermore, these possible water shortages may interact with other climatic and non-climatic stressors as well as socioeconomic drivers such as agroindustrial development leading to an increased need of comprehensive adaptation strategies.