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Testing a Naive Snow Theory Against a Physically Based Model: Sensitivity of Global Mountain Snow Regimes to Increased Air Temperatures

Ross Woods[1], Juan Ignacio López Moreno[2], Esteban Alonso-Gonzalez[2], Jesus Revuelto[2], Joshua Larsen[3], and Bettina Schaefli[4]

[1]Dept of Civil Engineering, University of Bristol, Bristol, UK (ross.woods@bristol.ac.uk)
[2]IPE-CSIC, Zaragoza, Spain
[3]School of Geography, Earth and Environmental Sciences, University of Birmingham, UK
[4]Universität Bern, Geographisches Institut, Bern, Switzerland

Mountain snow regimes will be significantly altered by climate warming, resulting in shallower snowpacks whose duration is also reduced. The sensitivity of snowpacks to a unit of air temperature warming depends strongly on climate; in addition, for a given climate, the sensitivity also depends on the details of energy balance partitioning. A synthesis of these factors remains challenging. Here we evaluate to what extent a naïve theory of snowpack response to warming can reproduce the sensitivity which is calculated by a detailed physically based model of the snowpack (Snobal), applied to a diverse global set of mountain locations. Our hypothesis is that the naïve theory will adequately predict the range of snow sensitivity values across diverse climates, but not the additional impacts of inter-site differences in energy partitioning for a given climate. The potential benefits of the naïve theory are that it enables a significant reduction of the uncertainty of snowpack sensitivity, and an improved conceptual understanding of the impacts of climate parameters (e.g. the seasonality and fluctuations of temperature and precipitation) on snowpack accumulation and melt-sensitivity under warming climates.