Spatiotemporal Trends in Snow-Water Storage and the Timing of Snowmelt in High Mountain Asia

Taylor Smith, Bodo Bookhagen, and Aljoscha Rheinwalt
Institute of Earth and Environmental Science, Universitat Potsdam, Potsdam-Golm, Germany

High Mountain Asia, which encompasses the Himalaya, Karakoram, Pamir, Tien Shan, and the Tibetan Plateau, is the primary ‘water tower’ for much of Asia, serving more than a billion downstream users. Many catchments receive the majority of their yearly water budget in the form of snow – the vast majority of which is not monitored by sparse weather networks in the region. We leverage passive microwave data, flown on five sensors (SSMI, AMSR, SSMIS, AMSR2, and GPM, 1987-2016), to examine trends in the timing, volume, and spatial distribution of snowmelt and snow-water equivalent.

While the total volume of water stored in snowpack has decreased over the study period, this large-scale water-storage loss hides small-scale and seasonal complexities. Some regions, such as the high Tien Shan and Kunlun Shan, have seen annually increasing snow-water storage. Other regions, such as the Pamir and Karakoram, have seen increases in winter snow-water storage, coupled with decreases in summer snow-water storage, implying an intensification of winter storms alongside more rapid spring and summer snowmelt. We also note a non-linear elevation trend, where the mid-elevation zones show the largest negative snow-water storage trends, implying that these areas are the most strongly impacted by increasing temperatures in the region. Our study provides a first-order examination of snow-water trends in High Mountain Asia, and highlights that both small and large-scale snow trends must be considered for effective water planning.