Geophysical Research Abstracts
Vol. 19, EGU2017-2848, 2017
EGU General Assembly 2017

Spatiotemporal Trends in the Timing and Volume of Snowfall in High Mountain Asia

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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-E, SSMIS, AMSR2, and GPM, 1987-2016), to examine trends in the timing, volume, and spatial distribution of snowfall.

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 increased snow-water storage. Other regions, such as the Pamir and Karakorum, 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.