Geophysical Research Abstracts
Vol. 19, EGU2017-55, 2017
EGU General Assembly 2017


# Quantitative Drought Monitoring in a Typical Cold River Basin over Tibetan Plateau: an integration of meteorological, agricultural and hydrological droughts

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We have introduced a Rainfall, Snow and Glacier melt (RSG) standardized anomaly (SA) index to reflect water availability in cold river basins by taking into account snow and glacier melt that influence seasonal water availability. The study takes advantage of a high-resolution Water and Energy Budget-Based Hydrological Distributed Model with improved snow physics (WEB-DHM-S) at a grid size of 5 km to quantify hydrological regimes in a typical cold river basin in the Tibetan Plateau (Lhasa River basin as a demonstration site) from 1983 to 2012. Standardized anomaly index was utilized as drought Indicator whereby each meteo-hydrological parameter involved in drought quantification was fitted to a distribution pattern on a monthly basis. Akaike Information Criterion and Bayesian Information Criterion were used as selection criteria. Drought indices were computed from the model inputs and outputs, which included RSG for meteorological drought, soil moisture (surface and root-zone) for agricultural drought and discharge and groundwater level for hydrological drought. From spatial and temporal analyses, drought occurred in 1984, 1988, 1995, 1997, 2009 and 2010, with the highest severity in August, September, July, August, June and June, respectively. This study addresses the glacierized cold river basin's dryness by considering the contribution of snow and glacier in drought quantification, an integration of meteorological, agricultural and hydrological was performed to highlight drought hotspots in the Lhasa River Basin. To the best of our knowledge, this is the first drought study in Lhasa River Basin.