Trend and Design of Annual Maximum Snowmelt Events over the Conterminous United States (CONUS)

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ABSTRACT

Snow impacts on human activity across the U.S. In the north-central and north-eastern U.S., snow meltwater is a dominant driver of severe spring flooding. Recent snowmelt floods in 1997, 2009, 2011, and 2019 resulted in large societal and economic impacts on communities in the north-central and north-eastern U.S. Due to the lack of reliable long-term gridded SWE, the current engineering design precipitation U.S. maps are based solely on rainfall (point interpolation or gridded) data (e.g. NOAA Atlas 14). In this study, we quantify the trends in annual maximum snow water equivalent (SWE) and snowmelt events over the CONUS using observation-based long term 4-km gridded SWE data developed by University of Arizona (UA SWE) from 1981 to 2017. In most mountain regions in western U.S., annual maximum SWE decreased significantly ($p < 0.05$) while there are no significant changes but general increases at a non-significant level, in the north-central and eastern U.S. However, annual maximum 7-day snowmelt increased significantly in north-central U.S. (North Dakota and Minnesota) and parts of Michigan and Maine (7 - 10 mm per decade). Based on the accuracies of the UA SWE products without systematic biases (Cho *et al*., 2019), engineering design snowmelt maps (25- and 100-year) were firstly generated over the CONUS. We expect that the design maps will help infrastructure design regarding flood risk management in snowmelt dominant regions.

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