

## **Changes in North American snow packs for 1979–2004 detected from the snow water equivalent data of SMMR and SSM/I passive microwave and related climatic factors**

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**Abstract** Changes to the North American (NA) snow packs for 1979–2004 were detected from snow water equivalent (SWE) retrieved from SMMR and SSM/I passive microwave data using the non-parametric Kendall's test. In NA, about 30% decreasing trends in SWE for 1979–2004 are statistically significant, or about three times more than significant increasing trends of SWE. Significant decreasing trends in SWE are more extensive in Canada than in the USA. The overall mean trend magnitudes are about  $-0.4$  to  $-0.5$  mm/year, which translates to an overall reduction of snow depth of about 5–6 cm in 26 years. From detected increasing (decreasing) trends of gridded temperature (precipitation) based on the North American Regional Reanalysis (NARR) and the University of Delaware data set for NA, and their respective correlations with SWE data, it seems that the extensive decreasing trends in SWE detected mainly in Canada are caused more by increasing temperatures than by decreasing precipitation.

**Key words** snow water equivalent; SMMR and SSM/I passive microwave data; North America; Kendall's non-parametric trend test; surface temperature; precipitation; climate anomalies