Geophysical Research Abstracts,
Vol. 11, EGU2009-2058, 2009
EGU General Assembly 2009

Changes to North American Snowpacks from 1979-2004 based on the Snow Water Equivalent data of SMMR & SSM/I Passive Microwave and related Climatic Factors

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Abstract
Changes to the North American (NA) Snowpacks from 1979-2004 based on the Snow Water Equivalent (SWE) values retrieved from the SMMR and SSM/I Passive Microwave data were analyzed using the non-parametric Kendall's test. About 30 % of detected decreasing trends in SWE for 1979-2004 are statistically significant at /2 = 0.05, which is about 3 or more times more frequent than detected increasing trends in SWE. Significant decreasing trends in SWE are more extensive in Canada than in the US, where such decreasing trends are mainly found along the American Rockies. The overall mean trend magnitudes are about -0.4 to -0.5 mm/year which means an overall reduction of snow depth of about 10 to 13 cm (assuming a snowpack density of 0.1) which can have significant impact to regions relying on spring snowmelt for water supply. The PC1 of NA's SWE are found to be significantly correlated to the Pacific Decadal Oscillation (PDO) index, marginally correlated to the Pacific North American (PNA) pattern, but not much related to El Nino Southern Oscillation (ENSO). To assess the possible impact of climatic change to the snowpack of NA, the SWE-air temperature relationships are also analyzed. Trend analysis of both the gridded, 2-m air temperature data of the North American Regional Reanalysis (NARR) and that of the University of Delaware showed little agreement between areas of detected increasing temperature trends and decreasing SWE trends based on passive microwave data, but extensive areas of negative correlations between SWE and temperature exist both across the U.S. and Canada except in January, and the distribution of these areas of negative correlation closely follow the areas of the decreasing trends detected from the SWE data. More significant decreasing precipitation trends are detected from University of Delaware than NARR data but again there are limited agreements between areas of detected decreasing precipitation trends and decreasing SWE trends.