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Detection and attribution of Spring Snow Water Equivalent (SWE) Changes over the Northern Hemisphere

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Snow is an important component of the cryosphere and it has a direct and important influence on water storage and supply in snowmelt-dominated regions. This study evaluates the temporal evolution of snow water equivalent (SWE) for the February to April spring period using the GlobSnow observation dataset for the 1980-2012 period. The analysis is performed for different regions of hemispherical to sub-continental scales for the Northern Hemisphere. The detection-attribution (D-A) analysis is then performed to demonstrate anthropogenic and natural effects on spring SWE changes for different regions, by comparing observations with six CMIP5 model simulations for three different external forcings: all major anthropogenic and natural (ALL) forcings, greenhouse gas (GHG) forcing only, and natural forcing only. The observed spring SWE generally displays a decreasing trend, due to increasing spring temperatures. However, it exhibits a remarkable increasing trend for the southern parts of East Eurasia. The six CMIP5 models with ALL forcings reproduce well the observed spring SWE decreases at the hemispherical scale and continental scales, whereas important differences are noted for smaller regions such as southern and northern parts of East Eurasia and northern part of North America. The effects of ALL and GHG forcings are clearly detected for the spring SWE decline at the hemispherical scale, based on multi-model ensemble signals. The effects of ALL and GHG forcings, however, are less clear for the smaller regions or with single-model signals, indicating the large uncertainty in regional SWE changes, possibly due to stronger influence of natural climate variability.