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Evaluation of Snow Water Equivalent Hindcasts in the Canadian Seasonal to Interannual Prediction System

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We present a preliminary evaluation of snow water equivalent (SWE) hindcasts from the Canadian Seasonal to Interannual Prediction System (CanSIPS). This is the prediction system in operational use at Environment Canada's Canadian Meteorological Centre (CMC) and the hindcasts are a contribution to the second phase of the Coupled Historical Forecast Project (CHFP2). SWE is an important variable to validate against observations since it represents a source of potential predictability on intraseasonal time scales. In addition, the timing of terrestrial snow melt, and subsequent snow cover onset in the fall, has important implications for the energy budget through changes to surface albedo, for the water cycle through the release of stored water, and for biogeochemical cycles by influencing the ground thermal regime and the length of the growing season.

The CanSIPS SWE hindcasts are somewhat unusual in that land surface initial conditions for each prediction period are determined entirely from the land model based on assimilated atmospheric variables rather than by direct assimilation of observed land variables. Such a setup means that biases may arise from the land-surface scheme alone, irrespective of how well temperature and precipitation forcing fields have been assimilated.

We present a comparison of SWE hindcasts over the 1981–2010 time period with a multi-data product average of observed SWE (including results from the satellite-derived GlobSnow product [Takala et al., 2011], MERRA reanalysis [Rienecker et al., 2011], ERA-Land reanalysis [Balsamo et al., 2012], and GLDAS Noah land surface simulation [Rodell et al., 2004]). CanSIPS initial conditions show reasonable agreement with observations during winter (DJF), but regions of extensive positive bias in spring (AMJ). These initial SWE biases may persist for 1-2 months. These results suggest that future plans to initialize land variables with assimilated observations may result in improved SWE predictability. We also quantify the drift present between assimilation and forecast runs and determine how errors in surface temperature forecasts (relative to observations) are spatially related to uncertainties in initial conditions for SWE. Finally we present correlation skill scores as a function of lead time which quantify the performance of the hindcasts on predicting SWE anomalies and represent a baseline for future changes to the forecast system.