Climate Modeling Applications of the ESA GlobSnow Data Record

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The European Space Agency (ESA) GlobSnow snow water equivalent (SWE) data record, produced from a combination of climate station snow depth observations, satellite passive microwave measurements and forward microwave emission model simulations, is an excellent resource for climate modeling applications. GlobSnow data are presently being used at Environment Canada to evaluate (1) coupled climate model simulations of historical climate as a baseline for multi-decadal climate projections, and (2) performance of the coupled modeling system used for seasonal predictions. This presentation will focus on evaluation of snow initial conditions in the Canadian Seasonal to Interannual Prediction System (CanSIPS), which is the operational seasonal forecasting system at Environment Canada. CanSIPS combines ensemble forecasts from two versions of the Canadian Centre for Climate Modeling and Analysis (CCCma) Coupled Climate Model – CanCM3 and CanCM4. Land surface initial conditions in CanSIPS, including snow, are determined from a land model (Canadian Land Surface Scheme 2.7) based on assimilated atmospheric variables (independent of surface observations). Biases in the assimilation temperature and precipitation fields combined with uncertainties in the performance of the land surface scheme will therefore produce biases in snow initial conditions.

CanCM3 and CanCM4 monthly mean snow water equivalent (SWE) were compared to observational data over the 1981-2010 time period in order to characterize uncertainty in CanSIPS initial conditions relative to observations. The observational datasets included the ESA GlobSnow v1.3 data record, the Canadian Meteorological Centre daily global snow analysis, and output from the Modern Era Retrospective Analysis for Research and Applications (MERRA). Agreement with observations during winter (DJF) was within the range of observational products, but there were regions of extensive positive bias in spring (AMJ) SWE in both the CanCM3 and CanCM4 models. The AMJ SWE bias is reduced (but not removed) in CanCM4 consistent with a reduction in the cold surface temperature bias between the models. The drift between assimilation and forecast model runs identified a tendency for the simulated snow mass to quickly shift towards the model climatology, particularly in the spring period. Ongoing work is addressing how errors in surface temperature forecasts (relative to observations) are spatially related to uncertainties in snow initial conditions.