OPERATIONAL IMPLEMENTATION of the ISBA LAND SURFACE SCHEME in the CANADIAN REGIONAL FORECAST MODEL

Stéphane Bélair[*], Jocelyn Mailhot[*], Yves Delage[*], Ross Brown[*], Louis−Philippe Crevier[**], and Bernard Bilodeau[*]

[*]*Meteorological Research Branch, Meteorological Service of Canada*

[**]*Canadian Meteorological Centre, Meteorological Service of Canada*

In September 2001, a new surface modeling and assimilation strategy was operationally implemented into the Canadian regional weather forecasting system. The surface processes over land are evaluated in this system using the ISBA landsurface scheme (Noilhan and Planton 1989). Surface variables, including soil moisture, are initialized using a sequential assimilation technique in which model errors on low−level air temperature and relative humidity are used to determine innovations on surface variables.

It was found, for summertime results (see Bélair et al. 2002a), that the magnitude and nature of the corrections applied to the surface variables depend on the surface and meteorological conditions observed in each region. For regions with less meteorological activity, model errors on low−level air characteristics were more likely to be related to incorrect representation of surface processes due to either erroneous initial conditions or inaccurate parameterizations in the landsurface scheme. For other regions with more frequent and more intense precipitation events, surface corrections were mainly associated with inacurrate atmospheric forcing.

Objective evaluation against observations from radiosondes and surface stations showed that the amplitude of the diurnal cycle of near−surface air temperature and humidity is larger with the new surface system, in better agreement with observations. This type of improvement was found to extend higher−up in the boundary layer (up to 700 hPa) where cold and humid biases were significantly reduced by introducing the new surface system (e.g., see Fig. 1). The model precipitation was also found to be significantly improved by the new representation of surface fluxes (i.e., decrease of a positive bias)

The performance of a modified version ISBA's snow scheme, was also examined (see Bélair et al. 2002b). The stand−alone verification tests that were conducted prior to the operational implementation show that ISBA's new snow package was able to realistically reproduce the main characteristics of snow, such as snow water equivalent and density, for 5 winter datasets taken at Col−de−Porte, France, and at Goose Bay, Canada (e.g., see Fig. 2). The results further revealed the manner in which each of the modification that was included into ISBA's snow model (i.e., new liquid water reservoir in the snow pack, new formulation of snow density, and melting effect of incident rainfall on the snow pack) contributed in improving the numerical representation of snow's characteristics. This type of improvement was not found for liquid water runoff under the snow pack and for snow's superficial temperature.

Objective scores for the fully−interactive pre−implementation tests that were done with the Canadian regional weather forecast model indicated that using ISBA's new snow scheme instead of the highly−parameterized snow model that was previously used operationally at CMC only had minor impacts on the model's ability to predict atmospheric circulations. The objective scores revealed that only a thin atmospheric layer above snow−covered surfaces was influenced by the change of landsurface scheme, and that over these regions the essential behavior of the atmospheric model was not significantly altered by the change of landsurface scheme.

Bélair, S., L−P. Crevier, J. Mailhot, B. Bilodeau, and Y. Delage, 2002a: Operational implementation of the ISBA surface scheme in the Canadian regional weather forecast model: Warm season results. To be submitted to *J. Hydromet*.

Bélair, S., R. Brown, J. Mailhot, L.−P. Crevier, and B. Bilodeau, 2002b: Operational implementation of the ISBA surface scheme in the Canadian regional weather forecast model: Cold season results. To be submitted to *J. Hydromet*.

Noilhan, J., and S. Planton, 1989: A simple parameterization of land surface processes for meteorological models. *Mon. Wea. Rev*., **117**, 536−549.

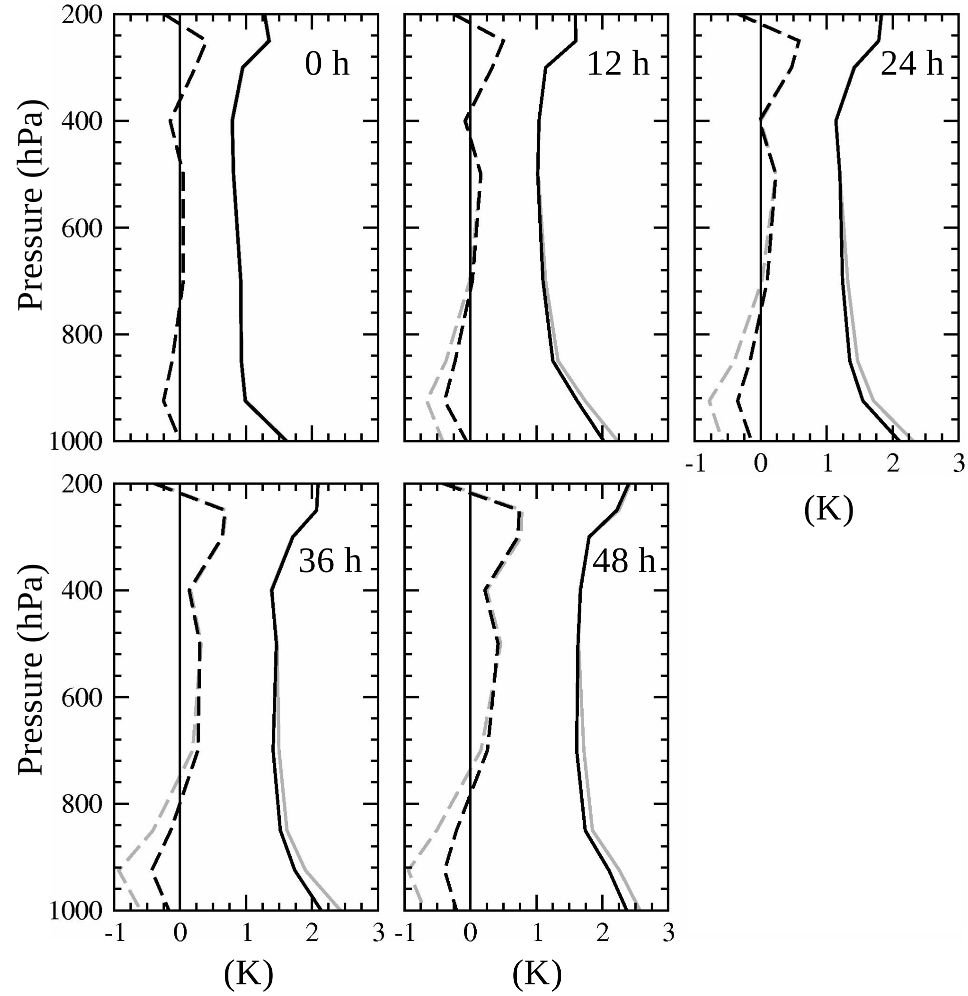

Fig. 1. Objective evaluation of upper−air temperature for 18 cases of August 2000. Root−mean−square (K, full lines) and bias (K, dashed lines) errors are shown for 0−h, 12−h, 24−h, 36−h, and 48−h forecasts from the operational (grey lines) and parallel (black lines) cycles.

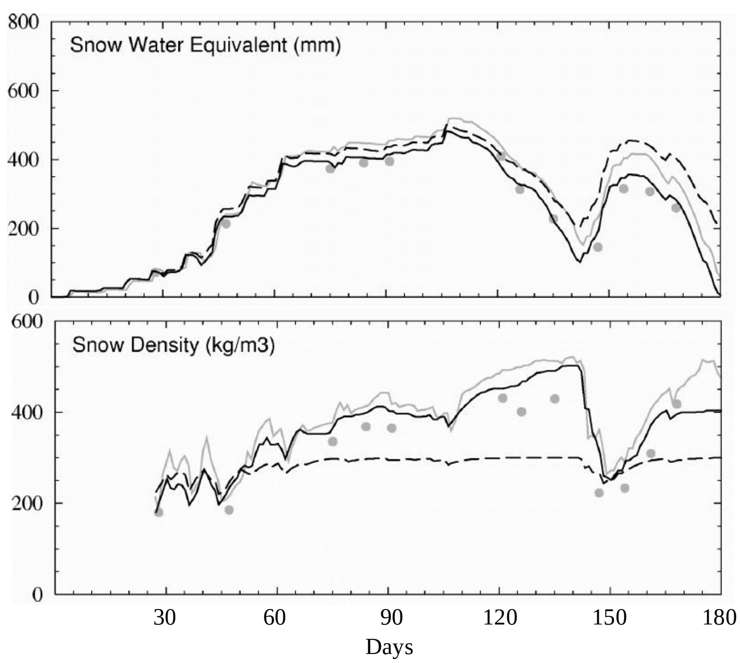

Fig. 2. Comparison between simulated and observed snow characteristics for winter 1993/94 at Col−de−Porte, France. Results from new and original ISBA snow models (full and dashed black lines, respectively) and CROCUS (full grey lines) are shown. The large grey dots represent observations.