

Interactive comment on “Snow specific surface area simulation using the one-layer snow model in the Canadian LAnd Surface Scheme (CLASS)” by A. Roy et al.

Anonymous Referee #2

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Summary: This paper presents the development of a model for snow surface area (SSA) implemented within the one-layer Canadian Land Surface Scheme (CLASS). The new model (called CLASS-SSA) is then used to simulate the temporal evolution of SSA at five sites with different climatic and snow regimes (alpine, Arctic and sub-Arctic). CLASS-SSA generally reproduces accurately the SSA in dry snow conditions (RMSE of 4.9 m² kg⁻¹ for the average SSA) but shows limitations in wet snow conditions. The paper concludes that CLASS-SSA may be used to validate satellite microwave brightness temperature assimilations along with other aspects or processes associated with snowpacks. The paper is generally well-written and scientifically sound although some aspects of the methodology are unclear. I recommend publication following some

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major revisions as outlined in my report:

General Comments:

- 1) Some aspects of the CLASS-SSA model development remain unclear. For instance, the approach of adding a new snow layer every time snowfall occurs remains ambiguous. At what time interval are snowfalls and hence new snow layers established in CLASS-SSA? Is there a minimum depth of snow required to establish a new snow layer? What is the maximum number of snow layers possible in the model? If a multi-layered structure for snow is used in CLASS-SSA, why not simulate the prognostic variables (snow water equivalent or SWE, snow depth, density and temperature) for each layer in the snowpack? Is the heat content of the snowpack also simulated in CLASS?
- 2) Further information on the simulations needs to be provided in the paper. For instance, what variables from the North American Regional Reanalysis (NARR) are used to force the CLASS simulations? Are the NARR data interpolated to each site of interest? What are the specific periods for which the model is run? What timestep is used in the simulations? What in situ meteorological variables at Col de Porte are used in the application of the model there?
- 3) Are there time series of automated in situ snowpack properties (e.g., snow depth measurements) available for any of the five sites to validate the CLASS snowpack simulations?
- 4) The discussion focuses on aspects of the CLASS-SSA model that may lead to errors in the simulation of SSA. Have the authors performed any sensitivity tests with CLASS-SSA to test the impacts on the simulations of, for example, a vertical gradient of temperature in snow or the use of an alternative forcing dataset? If the NARR data are used to drive the CLASS-SSA model at Col de Porte, how different are the SSA results?

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Specific Comments:

- p. 5256, line 22: Insert “GHz” after “19”.
- p. 5259, line 7: Delete the space in “account ,”
- p. 5259, line 9: Delete one of the two words “grain”.
- p. 5259, line 26: “Northern” does not need to be capitalized.
- p. 5260, line 25: Rephrase the repetitive text “model SWE with the SWE simulated”.
- p. 5261, line 2: Why is the maximal snow density set to 300 kg m⁻³? This seems somewhat low, particularly for late season, wet snow or for possible ice layers within the snowpack.
- p. 5263, line 21: Replace “in the rest” with “to the rest”.
- p. 5264, line 2: A map identifying all of the study sites would be useful for readers unfamiliar with the regions of interest. In addition, providing a general climatology (e.g., for winter air temperature, snowfall, maximum snow accumulation, etc.) for each site would provide useful context to the reader.
- p. 5265, line 7: Delete “re-analysis”.
- p. 5266, line 2: Should this be “and measured SWE”?
- p. 5267, line 6: Insert units after “10”.
- p. 5270, line 5: The statement “(if LWC > 0 LWC = 10%)” is unclear – perhaps insert “then” after “0”.
- p. 5273, line 9: Replace “analyses” with “analyzes”.
- p. 5279, line 11: Insert “Sensing” after “Remote”.
- p. 5284, Figure 3: For which year are the comparisons valid?

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pp. 5286/5287, Figures 5/6: Same comment.

Interactive comment on The Cryosphere Discuss., 6, 5255, 2012.

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