

Interactive comment on “Simulating the climatic mass balance of Svalbard glaciers from 2003 to 2013 with a high-resolution coupled atmosphere-glacier model” by K. S. Aas et al.

Anonymous Referee #1

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General Comments:

This paper uses WRF regional atmospheric model coupled with the CMB climatic mass balance model to simulate the climatic mass balance of Svalbard glaciers over a ten-year period. The paper provides an extensive but concise evaluation of the simulations through comparison with AWS data, stake data, GPR data and satellite altimetry data and demonstrates that the modelling scheme has good skill (in most regions) in calculating the climatological mass balance. The paper also investigates the impact of WRF horizontal resolution using both the 9 km outer grid, the 3 km inner grid and a special 1 km grid for a one-month test. The paper is clearly written and concise.

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Specific Comments:

1. Abstract and elsewhere. I suggest keeping the same units when reporting mass balances. At the moment mm w.e. y⁻¹ and m w.e. y⁻¹ are both used.
2. I would like to see more details on the WRF model set up.
 - a. More information on how the ERA –Interim is used for lateral BCs. Is there a nudging or relaxation scheme used at the edges of the 9 km domain? If so, how is this applied? What is the time frequency of the ERA Interim dataset.
 - b. What is the vertical resolution? Is it the same on the 9/3/1 km domains?
3. At the end of section 2.2 the authors point out an issue with some grid cells giving unrealistic sub-surface melting in the climatic mass balance (CMB) model, but do not provide any reasons for this. This is problematic and casts doubt on the integrity of the CMB simulation. I suggest that the authors do some debugging and testing to determine why this error is occurring. (I would not insist that they redo their entire simulation – just that they provide an explanation of the error and demonstrate that it is not impacting their simulation in a significant way.
4. The authors use a modified version of the CMB model from Molg et al (2008,2009). It would be helpful if they could briefly describe how CMB differs from the land surface schemes that are part of the normal WRF model.
5. Section 3.1 compares the simulation output with weather station data. Many atmospheric parameters, like temperature, depend strongly on altitude, but the WRF surface elevation and actual (AWS) surface elevations were not reported. Was there any difference between the WRF surface elevation and the actual surface elevation at the AWS locations? Was any adjustment made to account for this difference?
6. Page 5787 line 22: change “(Fig. 5b)” to “(Fig. 5c)” (I think this is a typographical error)

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7. Section 3.4 – comparison with Satellite altimetry. You note that geodetic mass balance does not include glacier dynamics, however in Table 4 you only include mean elevation changes for whole glaciers. Is it possible that glacier dynamics “cancels out” at this scale of analysis (in other words emergence in some areas offsets submergence in others)?
8. Figure 7 should include a scale indicating the correspondence between colours and topography.
9. Blowing snow is not accounted for. How important is this likely to be? Only at Hansbreen?
10. In Figure 8, comparing October precipitation at the three model resolutions, are observational data available for comparison too? If so, it would be interesting to include that as a fourth profile line. . .
11. In Figure 10 – define all the terms in the energy balance and mass fluxes.

Interactive comment on The Cryosphere Discuss., 9, 5775, 2015.