

Interactive comment on “The role of radiation penetration in the energy budget of the snowpack at Summit, Greenland” by P. Kuipers Munneke et al.

Anonymous Referee #1

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General Comments

A thoroughly-researched manuscript that takes a new approach to assessing the effect of SW penetration into the snowpack on internal snowpack temperature gradients. The use of an energy-balance model with high spatiotemporal resolution in combination with a quality short-term dataset allows for detailed investigation of this process. The paper would benefit from some reorganization and a clearer statement of the significance of the results. Excellent scientific significance and quality, good presentation quality.

Specific Comments

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1. Abstract – Total energy values for each energy balance component (i.e., over the diurnal cycle) should be given in MJ m⁻², since energy flux densities (in W m⁻²) are being integrated over a specific period.
2. p. 279 ln 1 – is meltwater percolation expected to occur at Summit within the next decade given increasing melt extent?
3. Data collection – here it would be helpful to specify instrumentation at the beginning, for example windspeed is mentioned on ln 16 but the sonic anemometer measuring wind speed is not mentioned until p 281 ln 22.
4. How were thermistor strings installed to minimize snowpack disturbance/preferential melting/possible advection of warm(er) air into the pack via the string?
5. p 281 ln 1 – rime accretion on the upward-looking pyranometers – was this not also a problem on the pyregeometer and potentially the sonic anemometer? Presumably some quality control was applied to all instruments as more than one would be affected by rime.
6. p 281 on 7 – was the snowpack surface between the BSRN and the Greenland Environmental Observatory comparable in terms of roughness, emissivity, etc.?
7. p 284 ln 15-16 – the assumption of a constant snow density and effective snow grain radius can be problematic depending on observed changes in the snowpack during the measurement period. Can you comment on the likely effect of this assumption on model output, and how it relates to the 0.45°C difference between observed and modelled surface temperatures?
8. Following from 7, on p. 285 ln 10 you note that the subsurface flux is decoupled from the constant density required for the radiation penetration calculations – how does this decoupling affect model output given that results from the radiation penetration grid are interpolated onto the subsurface flux grid?
9. p 285 ln 9-11 – how often was a density profile collected? How much error is

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involved in interpolating the field measurements from 0.02 m resolution to the 0.01 m subsurface grid?

10. Section 4.0 – might fit better in the Methods section under 3.4 – Assessment of Model Performance. Section 4.2 (Sensitivity experiments) would also fit better under this new section (3.4)

11. p 288 kb 7 – why summarize only eight sensitivity tests? What were the criteria for selecting these tests to discuss?

12. Section 4.4 (Radiative transfer...) – much of this section should be introduced in the background/methods. While interesting, it comes as a bit of a surprise to the reader and seems somewhat 'tacked on' to the overall study. Need some sense previously of how this fits into the bigger picture of the overall study.

Interactive comment on The Cryosphere Discuss., 3, 277, 2009.