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The Cryosphere Discussions

Interactive comment on "Using 3D turbulence-resolving simulations to understand the impact of surface properties on the energy balance of a debris-covered glacier" *by* Pleun Bonekamp et al.

Anonymous Referee #1

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This paper conducted a comprehensive study of energy balance for a debris-covered glacier using turbulence-resolving numerical simulations. The paper is well organized and written, and the conclusion is supported by the results. I am generally favorable to publication. However, I feel that the following point needs to be addressed before publication.

My major concern is that the one-meter spatial resolution used in the paper is way beyond the dissipation range, so I would be very hesitated to call it a DNS. I would like to be clear that I am not questioning the validity of the numerical results and the corre-

sponding conclusion in this paper. I agree that a one-meter resolution, constant eddy viscosity model should outperform a 10-meter resolution LES-SGS model. However, instead of calling it a DNS, I would suggest calling it a different name, e.g., a constant eddy viscosity LES, a high-resolution LES, or a quasi-DNS? The authors did show that doubling the spatial resolution (and the Reynolds number) had a small impact on the simulation results. In my opinion, this only indicates that, numerically, increasing the grid resolution has a limited impact on the simulation results. However, whether a one-meter resolution simulation can explicitly capture the right physics (small-scale turbulence behavior) in the atmosphere is still not quite clear. I suggest the authors conduct a validation that compares the quasi-DNS results with field experiments. I am also curious to see how a LES model behavior, compared with the quasi-DNS runs. Without such a comparison, it is hard to justify the one-meter resolution DNS configuration.

Some minor comments:

Line 97, page 3. "using a novel DNS mode", please be more specific in terms of what novel algorithms or techniques are used in the DNS solver?

Page 8. I suggest the authors add a schematic to illustrate the boundary conditions and especially, the immersed boundary method used to represent the DEM. Also, please be more specific why did the authors use 0.2 mˆ2 sˆ-1 as the eddy viscosity, as opposed to other possible values?

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