

## ***Interactive comment on “Inter-comparison and improvement of 2-stream shortwave radiative transfer models for unified treatment of cryospheric surfaces in ESMs” by Cheng Dang et al.***

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I have read the manuscript: "Inter-comparison and improvement of 2-stream shortwave radiative transfer models for a unified treatment of cryospheric surfaces in ESMs" by Dang et al. Overall, the article is interesting and may be of interest to the readers of the Cryosphere. I believe it needs some substantial revision before it would be acceptable however. There are a lot of model acronyms thrown around here and the text should be expanded to help clarify in some sections. Also, I feel it is lacking a bit in motivation. I understand from the title, the idea is to unify the radiative transfer schemes for snow

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on land, ice sheets, and sea ice, but a bit more here would be good. For example: Is it easier to maintain? Is there performance benefits? Does the accurate simulation of surface albedo matter for climate given the small differences between the algorithms here? The text also needs some significant grammar checking. Here are some more specific suggestions:

1. It is very confusing when the delta-Eddington radiative transfer scheme of Breigleb and Light (2007) is interchangeably referred to as CICE, Icepack, delta-Eddington, adding-doubling delta-Eddington, etc. I suggest you just refer to it as dEdd everywhere and clearly explain that you are talking about the default implementation of Briegleb and Light (2007) and not some modified version?
2. The first sentence of the abstract should say something more quantitative than "large parts of the Earth".
3. The first two paragraphs should mention melt ponds and meltwater in the snow. These are critical for the seasonal cycle evolution of albedo.
4. Line 116: "This method has carried into the sea-ice ..." This is not proper usage.
5. The discussion of large solar Zenith angles is an interesting part. I think some suggestions of ways to improve how the models do this is needed.
6. Some mention of how the methods handle aerosols (black carbon and dust) would be good. For example, see Holland et al. 2012.
7. In the caption for Figure 1, I think you should spell out SWNB2. You refer to Figure 1 in the text before you define the acronym.
8. Figures 3-5 feel like they have a bunch of empty space (light red). You could almost cut off the panel axes below angles of 50 degrees.
9. The caption for Figure 4 is not grammatically correct and should be expanded.
10. The caption for Figure 5 is not correct. These panels are not the same as Figure

C2

3. This caption should be expanded appropriately.

11. The caption for Figure 6 is not grammatically correct and should be expanded.

12. In general, I would prefer "two-stream" rather than "2-stream".

Holland et al. 2012: <https://journals.ametsoc.org/doi/10.1175/JCLI-D-11-00078.1>

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