

## ***Interactive comment on “The Half-order Energy Balance Equation, Part 2: The inhomogeneous HEBE and 2D energy balance models” by Shaun Lovejoy***

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Interactive comment on “The Half-order Energy Balance Equation, Part 2: The inhomogeneous HEBE and 2D energy balance models”

Anonymous Referee #2

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This second part reviewed here extends the approach of Part 1 to higher spatial dimension and inhomogeneous thermal models of the earth’s response to radiative forcing. There is an appropriate summary of Part 1 that puts the new contribution into con-

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text. The full model considered here includes varying horizontal and vertical thermal diffusivities, thermal capacities, sensitivities and spatio-temporal forcing. By a heuristic method of Babenko, the author expands the inhomogeneous operator to give 2D energy balance equations that will be useful for studying spatio-temporal responses to forcing. The manuscript includes a number of appendices that examine horizontal structures, cross-correlations, space-time factorization of quantities such as autocorrelation and that extends the results from flat space to the sphere. The analysis seems to be carefully done, and care is taken to distinguish cases where there may not be a rigorous justification.

Au: I thank the referee for the very positive review!

I would be interested to see a bit more discussion of the “bottom boundary condition”  $T=0$  at  $z=-\infty$ . I think it would also be useful to include some discussion of how atmosphere/ocean convection is/is not represented in the model.

Au: The role of the bottom boundary condition was addressed in part I where (just after eq. 29) it is shown that the influence of the bottom BC decays exponentially quickly with depth so that below a few diffusion depths it is essentially irrelevant. In oceans this would likely imply depths of hundreds of meters. In part I we will add some new material clarifying the nature of the surface.

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