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Geoscientific Model Development Discussions
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Interactive comment on "An axisymmetric non-hydrostatic model for double-diffusive water systems" *by* Koen Hilgersom et al.

Anonymous Referee #3

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The paper presents a new code capable of simulating nonhydrostacy due to salt and heat double diffusion, providing the numerical methods and example test cases. Existing challenges due to small time steps are circumvented by the model formulation. The paper is clearly written and model development appears to be sound, although additional support for the paper could demonstrate numerical robustness via convergence studies as well as demonstrated applicability to the real world via comparison with laboratory study data.

General comments:

* It would be good to elaborate on use of SWASH vs a completely new model. Was the primary reason to take advantage of computational infrastructure? It seems like this may have been more work than starting fresh and it would be nice to include

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further details for this design choice. * Please justify this choice of method as opposed to alternative methods, e.g., advanced mesh refinement * Please provide additional discussion of applications and uses for this code.

Specific comments:

line 146: may be nice to state briefly why staggered grid is used for this case (especially the connection to nonhydrostatic pressure and avoidance of pressure modes) line 150-175: potentially include in appendix and summarize here for brevity line 181: please justify use of poor time accuracy Euler explicit method line 198: please remove dots from equations because this makes it harder to read (this is true for other places too) Figure 4: variable line type widths would make this figure clearer Colorbars throughout: please do not use jet. Please use an alternative color bar that is not artificially misleading, e.g., gray or viridis. * Demonstration of model convergence would be very helpful in providing confidence in results * Please discuss in more detail the simpliciations resulting from the axisymmetric assumption used in this paper because it is not too hard to believe that the problem may not be axissymtetric. Additional justification will clarify the paper, e.g., in the results section. * Conclusions would benefit by returning to the question of how this model could be used to better understand double diffusion or real world problems.

Technical corrections:

line 64: axisymmetric equation 6: please place on two separate lines for clarity line 140: in the tangential direction

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