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Earth System Dynamics
Discussions

Interactive comment on "A new moisture tagging capability in the Weather Research and Forecasting Model: formulation, validation and application to the 2014 Great Lake-effect snowstorm" *by* Damián Insua-Costa and Gonzalo Miguez-Macho

Anonymous Referee #1

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Dear Editor,

I have read and assessed the manuscript, which describes the implementation of online moisture tracking in the WRF atmospheric model and an application of this model to winter snowfall over the US Great Lakes area. The subject of the manuscript is very relevant as indicated by the many alternative methods to track atmospheric moisture. Moreover, the manuscript is well written.

The scientific quality of the work is good. However, my main issue with is that a validation has been performed in terms of the internal moisture budget of the method. I am happy that the errors in this budget are close to zero, but would really be interested how this new model performs compared to alternative methods, although I realize this would be a substantial effort.

Specific comments:

- In the Introduction, the author give an overview of different moisture tracking models (Eulerian, Lagrangian, on-line and off-line) and the assumptions that are associated with some of the current implementations of these models. In P2L25 it is stated that "Lagrangian models include, ..." as if this is true for the entire class of Lagrangian models, whereas I think it is only true of the implementations mentioned. That is, it is perfectly possible to create an off-line Lagrangian model that does not have these drawbacks. Therefore, I would encourage the authors to rewrite this section and to state clearly whether the assumptions are a limitation of the method or of the implementation.

- P2, L33-P3,L2: Here the authors state that the sub-grid variability in vertical motion is a drawback of Lagrangian models. Is this not true for all off-line simulation, so also for Eulerian models?

- P2L27, "simplifications that each author assumes". Again not clear whether these are method specific or implementation specific. Maybe this is a good place for a table of moisture tracking methods?

- P7L8-9: "but not all are equally treated". Can you state in which way the forms are simplified? And how does this relate to the validation later on?

- P8L12: This is really an internal validation of the system, in the sense that the budgets should match. Therefore, maybe "Moisture tracers budget validation" is a title?

- I had really hoped for a comparison between the offline moisture tracking schemes

and the model in this paper. How does the new technique relate to the moisture recycling estimates from offline schemes? Without this comparison, the reader does not really know whether to switch to an online tracking scheme, or use the offline scheme, which is much easier to run. See for example van der Ent et al(2013) for such a comparison.

Reference: Van der Ent, R. J., Tuinenburg, O. A., Knoche, H. R., Savenije, H. H. G., & Kunstmann, H. (2013). Should we use a simple or complex model for moisture recycling and atmospheric moisture tracking?. Hydrology and Earth System Sciences Discussions, 10 (5), 2013.

- P15L1-6: So, where do these errors come from? Numerical stability issues? Precision (rounding) issues?

- Related to that the budget errors: how do these errors compare to the moisture budget of the model? Is that zero, or is moisture missing there as well?

- The shading in Figure 10b looks very strange, with very large temperature gradients. What data is used for this, how is it interpolated and on what resolution?

- P19L32-33: "the pattern ... correlation": unclear, please rephrase.

- P21L8-10: "This means ... source": unclear, please rephrase.

- P21L31: "important contribution of evaporative fluxes": How can you be certain that it is the evaporation? Is this effect isolated from any temperature effects? If so, how is it determined?

- P21L35: "further diagnostics": Can you state what kind of diagnostics? Any ideas?

Minor comments: - P1L6: "monthly" –> "a one month"

- P7L8: could –> cloud

- P19L1: "first ... region": Unclear what is meant with this sentence, maybe rephrase it

so it is clearer.

- P19L8-9: "flow of moisture from the surface" –> evaporation?

- P21L24: "18th" –> "18th of November"

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