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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Should we use a simple or complex model for moisture recycling and atmospheric moisture tracking?" *by* R. J. van der Ent et al.

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The manuscript describes well a comparison between 3 moisture tracking models, applied to the Lake Volta case study area. Some obvious shortcomings of the simpler methods are repaired, and even a very nice overview of the conditions under which these modifications are requires are given (figs 10 and 11). The reviews lead to an improved description of the methodology and considerations, and the overall scope and presentation of the latest version of the manuscript justify publication in HESS.

However, there is one consideration (also raised by Helge Goessling) that is not en-

tirely clear to me, and so could also be confusing to other readers. The "well-mixed" assumption (Eq 2) leads to the strategy to distribute evaporated water proportional to the vertical water vapor distribution. You state that at coarser resolution this assumption may hold, but is violated at finer resolution. I would have expected an explicit notion that the spatial dimension of the source area do play a vital role here. For evaporation to reach the upper atmosphere, time is needed, depending on turbulence and convection. I would expect that at typical vertical displacement heights of water the air parcels may have moved 100s of km horizontally before the water has reached the mid free troposphere at, say 5km height. Therefore, it does not come as a surprise that the original 3D-T method is improved a lot when implicitly taking the relationship between source area size and effective source height into account (by reducing the effective source height). I therefore recommend an explicit description of the relationship between source size and the required release height.

Apart from this comment, a number of textual suggestions are given:

- Introduction: it would be good to justify the choice of your case study domain already early: a wet area/season (monsoon) with a complex atmospheric flow structure (West Africa) and the presence of a clear water source (Lake Volta): this combination challenges your tracking methods nicely
- P2, right column, last para: "...in a moisture tracking model it can be desirable to add the water to higher levels...": this only applies to offline (a posteriori) tracking models
- P3, below Eq 5: "spatial resolution ... increase": I suggest to use "gets finer" instead of "increase", as "resolutions" is sometimes ambiguously interpreted as the size of the grid cells
- P3, right column, top: you may refer to vdHurk and v Meijgaard here as an example of a study that applies the tracking backward in time

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- section “RCM-tag”: is the “cumulus” parameterization in fact a “convection” parameterization? Or is it something else?
- P4, left column, top: “S = S_t in Eq 1”: there is no S_t in Eq 1
- same para: “the its simplicity” -> “to its simplicity”
- case description (section 3): a bit more “environmental” information on the case study could be given: the selected months are in the heart of the monsoon season; fig 1 could use a geographical referencing on which one can recognize West Africa
- 3.1, 2nd para: evaporation “clearly” being highest where precip is highest is not immediately obvious from fig 2a and b, who show quite different patterns
- Results in 3.2.1-3.2.2: I think it would be good to describe already in these sections that the patterns of tracked moisture follow the surface winds clearly in RCM-tag, while the upper winds dominate the results in WAM
- 3.2.1, 2nd para: insert “areas” between “also reached” and “south of Lake Volta”
- 3.3.2, 2nd para: to me it is not clear what you refer to with “peak intensity”
- same para: start a new sentence at “The parcel trajectories”
- 3.4.4: I would make explicit that you derive this conclusion from the implicit evidence that RCM-tag and the modified 3D-T methods give comparable results
- section 4, 2nd para: the relation between the size of source area and presence of vertical wind shear does need some specification of this size. From fig 11 it is clear that only for source areas of (sub) continental scale this compensation from different areas in the source area could be true.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 6723, 2013.