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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Comparison of Eulerian and Lagrangian moisture source diagnostics – the flood event in eastern Europe in May 2010" *by* A. Winschall et al.

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1 General comments

The authors determine the evaporative source regions contributing to a heavy precipitation event using two different methods: Eulerian (online) water vapor tracers and Lagrangian (offline) backward trajectories, where in the former case two alternative formulations are used. They find that the methods yield qualitatively similar results, but with considerable quantitative differences. The results are complemented with an analysis based on individual parcel trajectories.

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Overall I find the manuscript well-written and -structured, and also the scientific substance appropriate for publication in ACP. Below I make a number of suggestions how to further clarify and improve some aspects of the manuscript. My suggestions do not ask for additional simulations or substantial changes, and can thus be categorized as "minor revisions".

2 Specific comments

P4L1–3 and P4L: If I am not mistaken, Stohl and James (2004) applied their particle dispersion model forward in time. The methodological difference is subtle, but because elsewhere you are talking explicitly about backward trajectories (e.g. P2L6) I suggest to state this explicitly.

P4L23–24: The term "numerical model simulations" seems a bit imprecise here: also the Lagrangian method involves "numerical model simulations". The involvement of a full general circulation model is seemingly meant. However, there are also offline methods using Eulerian coordinates, such as those applied in Goessling and Reick (2011) and van der Ent et al. (2010), which largely share the disadvantages described here for the Lagrangian methods. The categories "Eulerian" and "Lagrangian" as discussed here seem to correspond rather to "online" and "offline" methods.

P5L23: I suggest to replace "convective transport" by "advective transport", because as I understand it in atmospheric science terminology the former includes (or even means only) turbulent (vertical) mixing due to dry and moist "convection".

P6L4: The primitive equations imply the use of the hydrostatic approximation, which is not used in COSMO. I would therefore remove the word "primitive".

P7Eq3: I think it would help the reader to mention that $q^t_{sfc} = q_{sfc}$ for the tracer associated with the current location and $q^t_{sfc} = 0$ for the other tracers. Or is that incorrect?

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P8L2: “mixing of tracers close to the surface”. I think that “mixing of tracers between the atmosphere and the (sub-)surface” or the like would be more accurate.

P8L3–4: “The strength of mixing in reality can be assumed to be intermediate between the two approaches” - I do not agree with this statement. My point of view is rather that the two methods provide different information. The Evap_tag method tells where the water molecules actually come from, whereas the Evap_tot method tells where a considered air parcel has been fuelled by net evaporation. I think that it is an interesting open question which of these flavours is more relevant when it comes to quantifying the dependence of precipitation somewhere to evaporation elsewhere. A short discussion of this issue is given in Goessling (2013), pp. 95–97.

First paragraph of Sect. 4 and first paragraph of Sect. 5: Do these paragraphs not fit better in the methods section?

P11L10: To me it is unclear what the term “statistical” shall imply here.

P11L23: “... its impact on the event is negligible”. I would generally avoid this kind of phrasing where a causal link is implied. This touches upon the discussion brought up in Goessling and Reick (2011): it is unclear to what extent the source-sink relations of atmospheric moisture tell something about the sensitivity of precipitation somewhere to evaporation elsewhere. In this case I suggest something along the lines “its contribution to the precipitation associated with the considered event is negligible”. The subtle difference is important.

P13L11–14: This is an interesting remark that points to the fact that the causal link between evaporation and precipitation is more complex than could be accounted for by determining source-sink relations.

P13L17–18: Please clarify that “close” is meant with respect to time rather than space (right?).

P14L1: Please state whether the backward trajectories are isentropic or at constant

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pressure (or ...).

P14L3–4: I would be interested to know which fraction of all trajectories fulfills this condition.

P14L19–21: Again I think that a clearer distinction should be made between the quantification of source-sink relations and the causal link between evaporation and precipitation.

P15L1–3: How are the starting points distributed horizontally in the (25x25)km cell? Regularly? Randomly? But more importantly, why are they distributed vertically using equal pressure intervals rather than moisture mass intervals (i.e. weighted according to the profile of specific humidity as e.g. in Dirmeyer and Brubaker (1999))? Does the use of equal pressure intervals not introduce a bias towards higher-level moisture as only a small fraction of the moisture resides there?

P15L17–18: Is it not astonishing that the magnitude of uptakes is almost as large above the ABL compared to within the ABL? Could this be a hint that there is indeed a bias as suggested in the previous comment, or is there a different explanation?

P17L24–25: What is meant by “completely independent”? After all, the same thing shall be quantified, and the methods work on the same physical fields.

P17L27–29: Can you explain why the results of the Lagrangian method tend to be between the two Eulerian variants? I would have expected that the Lagrangian approach yields results closer to Evap_tot because the Lagrangian approach diagnoses net rather than gross surface fluxes, right?

P21L1–5: For my taste the sentence starting with “Between” and the subsequent one do not belong into the conclusion and could be omitted.

Tab1: I think this table can be omitted as it conveys the same information as Fig. (10) but in a less beautiful way.

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Fig1: “atmospheric tracer”. I think it would help to state again in the caption that the atmospheric tracer is the one initially contained in the atmosphere.

Fig2: The right column has “RH” (relative humidity) in the title which should be “q” (specific humidity).

Fig8: Here I suggest to add a box that indicates where the target region is located.

3 Technical corrections

P4L29: With “Validating such ...” I recommend to start a new paragraph.

P7L5: “A positive values ...” - remove “A”.

P15L19: Replace “too” by “two”.

P17L11: “... between 14% ...”. Something seems to be missing here.

P19L3: “area source”. Should these words be swapped?

P19L6: Please remove “s” from “concepts”.

P23L20: “Scḧar” has its umlaut points in the wrong place.

References

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