Review of "A convervative reconstruction scheme for the interpolation of extensive quantities in the Lagrangian particle dispersion model FLEXPART" by Hittmeir et al.

The authors present a new interpolation scheme for extensive variables for future use with the LPDM FLEXPART. The interpolation algorithm relies on piecewise linear interpolation using two supporting points in each grid-cell. The most interesting property of the suggested algorithm is the ability to retain the conservation within each gridcell, which algorithm previously used in LPDM do not achieve.
The paper is largely well written, although some sections could be restructured to enhance the clearity of the manuscript. I propose to accept the manuscript pending modifications as suggested below.

1 General comments

1. section 1: It should be better motivated why the non-conservation in a specific time interval is problematic. An interesting example could be the spatio-temporal pattern of wet scavenging, something the authors have on mind here anyway.

2. section 3: There are plenty of very short sections and the overall structure does not become very clear. I would suggest remove sections 3.2 and 3.7 as these paragraphs have only a few lines, which would fit well within preceeding paragraphs (3.2) or are probably not needed (3.7). Also, the numbering of section 3.4 to 3.6 is missleading, as 3.5 and 3.6 should be subsections of section 3.4 (general case).

3. section 3.1: It should be made clear that the physical interpretation of g is the mean precipitation rate. If this is not the case, eq. (4) is not physically meaningful in the context of the discussion in the reminder of the paper.

4. section 3.1 and 3.2: I think you should at $f(t) \geq 0$ as third condition for the construction of the algorithm. Also, it would be good to reference Tab. 2 in this section already.

5. section 4.2.3: Instead of comparing the global maximum (which is only one data point), it would be interesting to investigate the statistics of the maximum value during all events.

2 Specific comments

1. p. 2., l. 10ff: It sould be made clearer from the start that any linear interpolation will conserve the total precipitation amount globally, but not with in each time interval. While

this becomes clear in the course of the discussion, clarifying this from the start will allow the reader to understand the problem more quickly.

2. Figure 1: Whue using supporting points shifted by half a grid-point? This is not reflective of the IFP algorithm as suggested by later plots.

3. p. 3, l. 7: You refer to the asymmetry of problem in the time coordinate. This has not been mentioned before and needs some more explanation.

4. p. 6, l. 10: Why four conditions of mass conservation?

5. p. 9, l. 18ff: T has not been defined.

6. p. 11, l. 5: Do you mean cases with either $g_i = 0 \& g_{i+1} > 0$ or $g_i > 0 \& g_{i+1} = 0$?

7. p. 12, l. 13: The derivation of Eq. (24) needs a bit more explanation, as it does not directly follow from Eq. (16). It would be good to explain that you use the conditions for the two intervals on which $\mathrm{f_{i+1}}$ borders.

8. Fig. 8b: It would be nice to have the original reconstructed precipitation curve plotted in the background to illustrate that also $f_i^{(1)}$ changes.

9. p. 14. l. 3: Add reference to left hand side of Table 1.

10. section 3.6.2: State explicitly that the main difference to IA1 is that the monotonicity filter is applied to all intervals not only does exhibiting a "M-" or "W-"shape. Als add a reference to the right hand side of Table 1.

11. p. 18, l. 7ff: Reorder the discussion in this paragraph so the requirements are discussed in the same order as listed in the Table.

12. p. 21, l. 9: Can you reformulate this sentence, it is not clear to me what you mean with " precipitation rate weakened within two 3-h intervals"?

13. p. 22, l. 1f.: Do you mean you are using the data from the operational deterministic forecasts? Please reformulate accordingly.

14. p. 22, l. 14: "Convective precipitation occurs less frequently". Presumably you refer to periods with only convective precipitation in the ECMWF forecast? Also, is this statement true globally?

15. p. 24, l. 18: This may also be due to the convection parameterisation used in the ECMWF global model. It is well known that parameterised convection is too weak and too frequent compared to either observations or convection-permitting model simulations.

16. p. 28, l. 1: This is not only true for the "light-blue region"! Frequency values are generally shifted towards higher IFP values in the first R1h bin compared to the second R1h bin.

3 Technical corrections

1. p. 2, l. 15: "... quantification of atmospheric **transport,** such ..."

2. p. 3, l. 22: remove "see" from figure reference

3. p. 5, l. 19: ... ones **(e.g., Hämmerlin and Hoffmann, 1994; Hermann, 2011).** The ...

4. p. 5, l. 21: ... out **for example by** White et al. (2009) ...
5. p. 5, l. 32: no comma after "problem"
6. p. 6, l. 26: "... presented in **section 1**, we ..."
7. p. 9, l. 10: "$g_i \cdot g_{i+1} > 0$" would be clearer
8. p. 10, l. 12 & l. 19: These sentences are slightly awkward, please reformulate.
9. p. 11, l. 9: "**With** Eq. (2) .."
10. p. 11, l. 20: Add "as discussed in the following paragraphs."
11. p. 11., l. 21: Remove "thereby"
12. p. 12., l. 4: "**The** preservation ... requirement, **as discussed above**. In ... for the **non-negativity** ..."
13. p. 12, l. 5: The sentence is somewhat awkward, could you reformulate just using the equations constiting the algorithm so far>?
14. p. 17, l. 11: "... requirements, as **formulated** in ..."
15. p. 18, l. 2: "... with **constant** precipitation ..." ?
16. p. 18, l. 6: "... with **the results from the reconstruction algorithms** ... "
17. p. 18, l. 10: "... as **the** input ..."
18. p. 18, l. 22: "... both algorithms (not shown). ..."
19. p. 19, l. 2: " ... in addition **requires** some ..."
20. p. 19, l. 10: Replace the phrase " go on". The current formulation is rather casual and unspecific.
21. p. 19, l. 17: "... the way, **in which the monoticity filter is applied.** In ..."
22. p. 21, l. 15ff.: "... retrieved **with 1-h and 3-h** time resolution. ... algorithms, **while the 1-h data are used to validate the reconstructed** ..."
23. p. 22, l. 13f.: "... one **dominated by large-scale** and another by **convective precipitation**."
24. p. 22, l. 17: Please reformulate this sentence, it is somewhat awkward.
25. p. 22, l. 18: "Characteristic" for what?
26. p. 22, l. 26 and 30f.: Please ensure you are using a consistent nomenclature for date-times througout the paper.
27. p. 22, l. 29: " ... last longer **(Fig. 14). This** ..."
28. p. 25, l. 14: "overall averages": The column labelled "mean"?
29. Table 5, caption: "Relative deviations **(δ_d and δ_w)** ..."

30. p. 27, l. 1: "... more **points** fall ..." ?

31. p. 28, l. 19: The nomenclature of IA1m is slightly confusing, as IA2m refers to the average of forward and backward execution of IA2.

32. p. 29, l. 28: "... integration of **the** method ... itself **for the** temporal ..."