

## ***Interactive comment on “Global mass fixer algorithms for conservative tracer transport in the ECMWF model” by M. Diamantakis and J. Flemming***

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General comments: The manuscript is well written and explores the effects of implementing mass conservation through global mass fixers in an operational model. The challenges of (inherent) mass conserving semi-Lagrangian methods are introduced and several global mass fixer algorithms (MFAs) are implemented and tested. The tests are carried out using both an operational setup as well as newly developed idealized tests for correlated tracers. The following comments are minor.

Minor comments/corrections (optional): The sharp increase in cloud water/ice content seen in Figure 1 (for the cubic solution), I assume is due to a truncation of negative

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values, which basically is the same as introducing a source term at those points. Has it been considered to redistribute this instead of truncating? In e.g. the HIRLAM model, cloud water/ice and humidity are linked so that negative values can be compensated in the other fields after advection (then truncated). This could potentially reduce the need for global redistributions with almost no additional computational cost.

In Section 4.3 (correlated tracers) it would have been nice if the mixing diagnostics ( $l_0$ ,  $l_u$  and  $l_r$ ) were shown, either in a table or in Figure 7. From Figure 7 it is difficult to visually estimate the filters individual differences. If it is possible to compute the diagnostics from the data available (without too much work), this would be beneficial for the filter comparison.

In Section 4.4 (volcanic plume) one might mention that for a single plume simulation a global MFA will work very well, but if multiple plumes (or the remnants of a previous plume) with different strengths and smoothness exist. Then the global redistribution will transfer mass from one plume to the other, since their interpolation errors are of different magnitude. It is, however, likely that some (or all) of the different weighted approaches used here can keep this to a minimum.

Technical corrections: I agree with the corrections mentioned by McGregor, and will not list them again.

Page: 781, L23: “the four top forecasts” should be “the forecasts”.

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