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Geoscientific Model Development Discussions

Interactive comment on "IL-GLOBO (1.0) – integrated Lagrangian particle model and Eulerian general circulation model GLOBO: development of the vertical diffusion module" *by* D. Rossi and A. Maurizi

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We would like to thank both Referees who raised interesting points about the manuscript that helped us to improve it.

==General comments==

Referee#1 notice that 1) "The code is not [...] yet fully integrated with the NWP model" and that 2) Equation (11) is wrong.

Both issues are true but:

1. we already integrated the vertical diffusion module into the 3D model with only the limitation that vertical K profiles are kept uniform across a grid column. Although this is not the final version, it provides a first test for the fully 3D integrated model. We decided to add the results of this simulation to the present manuscript.

2. although Equation (11) is wrong in the text, it is correct in the numerical code. If the code were written to solve Equation (11) as reported in the manuscript, no matter how carefully we select time step and interpolation scheme, WMC cannot be verified.

==Specific comments==

1. A test with a preliminary version of the fully 3D model is reported in the revised manuscript. As already pointed out, it does not involve any horizontal interpolation of the vertical K profiles (of course we interpolate the velocity field on the particle position). To make the present work more complete, we added the result of this preliminary simulation which should be regarded as an ensemble of 1D simulations over all the possible K-profiles resulting from a 24 hour run.

Details on the programming language (fortran90) and about the availability of the code is added in the revised version of the paper as well.

2. As noticed by both Referees Equation (11) is wrong.

Equation (11) will be written properly in the revised paper. Though slightly different from the derivation of Referee#1, our derivation (partly reported in the revised version of the manuscript) lead to the same equation.

As the numerical code implements the correct equation, no extra simulations are required.

3. We refined the section dealing with the derivation of Thomson.

4. All the suggestions are incorporated into the revised version.

5. According to the new organization of the work, we only used one of the Akima

algorithm. Concerning the value al NLEV+1, the GLOBO model put this at the top of the roughness elements (zero of the logarithmic part of the surface layer profile). This is clarified in the revised paper. It is also explained better that the Akima (1991) spline ensures the linear approximation if three point are co-linear, ensuring the correct matching of the surface layer profile.

6. Equations (21) and (22) are actually the hydrostatic and perfect law approximation. This is made clear in the revised version.

7. We agree with the Referee#1 that presenting actual profiles is useful (and more strict as a numerical test). For this reason we added a test for a profile typical of strong convective conditions just after sunrise. This results in a peak with the maximum at the first level above the ground, described by only one point (two points are actually non-zero as a result of the vertical discretization of the region around the temperature inversion).

This experiment proved to be extremely useful because it actually revealed some weakness in the adaptive Dt selection and allowed us to refine it furhter.

We also tried, as suggested by the Referee, the more simple scheme for numerical integration that consider constants first-order derivatives jointly with linear interpolation of the K profile. We found that it is mostly equivalent to the Akima interpolation, except for the 3D simulation, where it fails.

It is worth noting that in (corrected) Equation 11 only second order derivative of sigma(z) appear which is monotone and smooth and does not cause any problem to the numerics. The paper have been updated adding the scheme suggested by the Referee and reconsidering the non-consistency of the one that uses linear interpolation of derivatives.

==Technical comments==

About the tecnical comments, we modified the text according to all of the suggestions

provided by the Referee.

Interactive comment on Geosci. Model Dev. Discuss., 7, 2797, 2014.