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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

Anonymous Referee #2

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General comment

This is an interesting manuscript. It describes a 1-D Lagrangian Stochastic model for the vertical position of particles in the native coordinate system of the model GLOBO. The model is derived from the equation for the concentration of a dispersing scalar presented in Thomson (1995), which includes the effects of the air density gradient. A careful and instructive work has been done to evaluate the accuracy of the interpolation schemes. However, as already noted by the reviewer n.1, there are errors in the fundamental equation (11) and these errors (and the possible consequences) must be

fixed before the manuscript may be considered for publication. Moreover, in the revised version of the manuscript, the authors should include all the details/steps of the derivation of the equation (11), adding an appendix if needed.

Other comments

1) I think that the authors should make clearer in the abstract that all the numerical experiments were performed off-line.
2) In the derivation/presentation of equation (8) I think it would be useful to include the original equation reported in Thomson (1995, eq. 2).
3) It seems to me that equation (11) does not follow from equation (8) using the 1-D Itô formula. As also noted by reviewer n.1 the terms in the equation are dimensionally inconsistent. In addition, it seems to me that, even if one consider the diffusion coefficient to be $K\sigma(= K(\partial\sigma/\partial z)^2)$ in all the terms except that containing the second derivative (the last term in square brackets), so that the equation becomes dimensionally correct, the equation would not be correct anyway (with some algebra, the term with the second derivative comes to be with negative sign in this case). If the density is also transformed according to $\rho_\sigma = \rho(\partial z/\partial\sigma)$ the result of the referee n.1 is obtained.
4) Page 2804, line 12, "the Itô-Taylor expansion"
5) The authors use the Milstein scheme for the time integration of the SDE. It would be interesting to show what is the difference in the results with respect to the use of the simpler Euler-Maruyama scheme (with the time step resulting from $C_T = 0.01$ and standard grid configuration).
6) Page 2809. The authors use averaged profiles from GLOBO to obtain the analytical fit functions (21), (22) and (23). However, in the on-line version of the model I assume that the instantaneous profiles will be used and they could not be as smooth as the averaged profiles.
7) Page 2810. The authors discuss the possibility of a peaked K profile in GLOBO. To "simulate" this peaked profile they select values for the constants B and C in eq. (24). However, they should include examples of the actual peaked profiles from the model

GLOBO and discuss the expected possible range of values, to support their choice for this test.

8) Page 2811. The optimal value of C_T is set to ensure that the RMSE is comparable with the statistical error. However, the statistical error can be made smaller by increasing the number of particles. Will $C_T = 0.01$ be used as the standard model setting in general? Or is this limited to the present simulations?

9) It would be valuable to include a figure showing the normalized concentration profiles obtained by using the two Akima functions in the case of coarse resolution and peaked diffusivity.

10) The use of the fitted analytical functions is a good choice to evaluate the correctness of the model formulation and the use of these functions sampled at discrete interval is a useful comparison to evaluate the interpolation. However, as also mentioned by the reviewer n.1, the results obtained using the standard model setting, but with the actual vertical profiles extracted from the model GLOBO (possibly the instantaneous profiles, see point 6 above), should also be discussed in the manuscript.

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