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Interactive comment on "Technical note: The Lagrangian particle dispersion model FLEXPART version 6.2" *by* A. Stohl et al.

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We thank reviewer 1 for the careful reading of our manuscript.

1. Response to comments

1. Yes, the reviewer is right that vertical velocities are also transformed. We added the following text to give the details of the transformation:

   The conversion of vertical wind speeds from the eta coordinate system into the

terrain-following co-ordinate system follows as

$$\tilde{w} = \dot{\tilde{z}} = \dot{\tilde{\eta}} \left(\frac{\partial p}{\partial z} \right)^{-1} + \left. \frac{\partial \tilde{z}}{\partial t} \right|_{\eta} + \vec{v}_h \cdot \nabla_\eta \tilde{z} \quad (1)$$

where $\dot{\tilde{\eta}} = \dot{\eta} \partial p / \partial \eta$. The second term on the right hand side is missing in the FLEXPART transformation because it is much smaller than the others. One colleague has implemented this term in his version of FLEXPART and found virtually no differences (B. Legras, personal communication).

2. Total cloud cover is used in the wet deposition parameterization (eq. 39), solar radiation is indeed read in but not used at the moment. We will not mention solar radiation anymore in the revised version of the paper.

3. The factor 100 in eq. 7 is an empirical term taken from Vogelezang and Holtslag (1996). They determined it using different methods, e.g., large eddy simulations.

4. Yes, in the numerical literature this is normally referred to as a "Euler-step" scheme. Details on the various numerical schemes used for Lagrangian models can be found in Seibert (1993). We have implemented the Petterssen scheme – a standard scheme for trajectory calculations – for better numerical accuracy but a comparison with the Euler-step scheme has shown very little improvement at the short time steps normally used in FLEXPART.

5. Yes, the evaluation of the exponential function is quite costly and the approximation is sufficiently accurate in most cases. We will mention this reason in the revised manuscript and reverse the presentation of the two equations.

6. The reviewer has a point here. The parameterization was introduced because FLEXPART-simulated plumes were almost always too narrow in comparison with measurements (e.g., satellite and aircraft measurements of plumes transported

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over intercontinental distances, tracer experiment data). This may be due to the relatively coarse resolution available in some of the older simulations (but note that 0.3 degree resolution also does not cover the full variability of the wind). Partly, this parameterization may also compensate for other errors, such as the fact that a convection scheme was missing in older versions of FLEXPART. FLEXPART is now in the process of being validated again using the tracer experiments already used by Stohl et al. (1998), plus additional tracer experiment data on the mesoscale. We will test the sensitivity of the results to the mesoscale velocity fluctuation scheme and see whether it is still needed.

7. Yes, thank you for finding this error. It is correctly coded in FLEXPART but was wrong in the paper. This will be corrected in the revised version.

8. The dry deposition scheme has been taken from the literature and is perhaps the most widely used scheme in chemistry transport modeling. We have not validated this scheme (other than that it gives reasonable deposition velocities) and cannot say whether the level of complexity is warranted, or not. Instead, the user can also choose a constant deposition velocity if (s)he thinks that the Wesely scheme is too complex.

2. References

P. Seibert, Convergence and accuracy of numerical methods for trajectory calculations, J. Appl. Meteor., 32, 558-566, 1993.

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