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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Turbulence dissipation rate derivation for meandering occurrences in a stable planetary boundary layer" *by* G. A. Degrazia et al.

Anonymous Referee #3

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There are a few unclear points in the paper, which should be clarified:

1) The new model is tested using experimental data from the INEL. Sagedorf and Dickson (1974) reported on an oil plume, which was simultaneously released with SF6 and which gave some evidence that the plume raised up to about 3 m above ground level although the initial height of release was 1.5 m. Due to the small roughness length and the low wind speeds during the experiments, quite strong vertical concentration gradients should occur in the vicinity of the release point. For instance, Sharan and Yadav (1998) and Brusasca et al. (1992) used an effective release height of 3m in their simulations. As on the one hand the determination of the effective release height by

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means of visual inspection of an oil plume is relatively inexact and on the other hand it can be expected that the release height has a strong impact on results, it is not possible to judge the performance for the new parameterisation of the dissipation. A comparison of the model with and without (setting m=0) meandering should be made. 2) Reviewer 2 (comment from 8.Nov.07) stated that the lateral diffusion of a plume in low wind speed conditions is reduced for long distances. A reduction of the plume after some time when applying Frenkiels (1953) form of the autocorrelation function has been presented in the paper of Anfossi et al. (2005). As already stated in the comment by the authors (posted on 15.Nov.07) this is in contradiction with classical diffusion theory. I would like to ask whether the application of Taylors equation, which relates the plume spread from a point source with the autocorrelation function, is applicable at all in the case of meandering flows? Taylors equation (eq. 11 in the paper) is based on the assumption of stationary turbulence. As the meandering periods are in the range of 1000 s and more (see Anfossi et al. 2005) and the averaging time in model simulations is usually half an hour or an hour, stationary conditions are hardly conceivable. In other words, meandering is probably more likely a property of the mean flow rather than turbulence. Taylors equation is also only valid for isotropic turbulence. This restriction is needed to be able to use observed variances of velocity fluctuations. In other words Eulerian and Lagrangian variances are assumed to be the same (ergodicity). As we know that the lateral variances of wind fluctuations in low wind speed conditions are dominated by the low frequency part of the energy spectrum (meandering) it is questionable, if ergodicity also holds for meandering flows. If equation 11 in the paper is not applicable at all, then one would never observe a decrease in plume spreads after some distance as predicted by equation 13.

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Brusasca, G., G. Tinarelli, and D. Anfossi, 1992: Particle model simulation of diffusion in low wind speed stable conditions. Atm. Env., 4, 707-723.

Frenkiel F.N. (1953) : Turbulent diffusion: mean concentration distribution in a flow field of homogeneous turbulence. Adv. Appl. Mech. 3, 61-107.

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Interactive comment on Atmos. Chem. Phys. Discuss., 7, 15251, 2007.