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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The sensitivity of CO and aerosol transport to the temporal and vertical distribution of North American boreal fire emissions" *by* Y. Chen et al.

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I would like to complement the authors on this interesting study that analyzes the effects of the choice of time resolution and injection height of biomass smoke emissions on the accuracy of model-predicted distributions of pyrogenic CO and aerosols. My comment refers to the discussion of smoke lofting and injection mechanisms in paragraph 4, beginning on line 10, page 11960.

The authors refer to the observations that smoke is often found to be injected well above the PBL, and state "Although the mechanisms are not entirely clear, this rising of smoke plumes is thought to be related to the dynamical heat flux from fires (Kahn et al., 2007) and the associated moist convective processes (Fromm et al., 2005)."

There is in fact considerable mechanistic understanding of the lofting process, which has been published in recent years (Trentmann et al., 2002; Luderer et al., 2006; Trentmann et al., 2006). The results of these studies show that both fire-related buoyancy and meteorological instability significantly contribute to the injection of biomass smoke into the upper troposphere. In these studies, a high-resolution non-hydrostatic atmospheric model, ATHAM, was used to investigate the transport processes in pyro-convection. The use of such a detailed model would not be possible in large-scale studies such as the one presented by Chen et al. However, in a recent study, Freitas et al. (2009) have shown that even a parameterized approach yields considerable improvements in model skill.

None of the present injection models take into account the effect that the modification of cloud microphysics by the smoke aerosols is likely to have on the scavenging efficiency for aerosol particles. It has been shown that the presence of high aerosol concentrations leads to a pronounced suppression of early rain formation processes in convective clouds and to the existence of a large fraction of interstitial aerosol. (Andreae et al., 2004; Rosenfeld et al., 2007). Both effects must be expected to strongly reduce aerosol scavenging and to increase the fraction of particles that escape from wet scavenging and are detrained at altitude, producing the visibly "smoking clouds" typical of pyro-convection. The inclusion of standard wet-scavenging parameterizations is therefore not appropriate in smoke injection models and should be replaced by more appropriate formulations.

References

Andreae, M. O., Rosenfeld, D., Artaxo, P., Costa, A. A., Frank, G. P., Longo, K. M., and Silva-Dias, M. A. F., Smoking rain clouds over the Amazon: Science, 303, 1337-1342, 2004.

Freitas, S. R., Longo, K. M., Silva-Dias, M. A. F., Chatfield, R., Silva-Dias, P., Artaxo,

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Discussion Paper

P., Andreae, M. O., Grell, G., Rodrigues, L. F., Fazenda, A., and Panetta, J., The Coupled Aerosol and Tracer Transport model to the Brazilian developments on the Regional Atmospheric Modeling System (CATT-BRAMS). Part 1: Model description and evaluation: Atmos. Chem. Phys., 9, 2843–2861, 2009.

Luderer, G., Trentmann, J., Winterrath, T., Textor, C., Herzog, M., Graf, H.-F., and Andreae, M. O., Modeling of biomass smoke injection into the lower stratosphere by a large forest fire (part II): Sensitivity studies: Atmos. Chem. Phys., 6, 5261-5277, 2006.

Rosenfeld, D., Fromm, M., Trentmann, J., Luderer, G., Andreae, M. O., and Servranckx, R., The Chisholm firestorm: Observed microstructure, precipitation and lightning activity of a pyro-cumulonimbus: Atmos. Chem. Phys., 7, 645-659, 2007.

Trentmann, J., Andreae, M. O., Graf, H.-F., Hobbs, P. V., Ottmar, R. D., and Trautmann, T., Simulation of a biomass burning plume: Comparison of model results with observations: J. Geophys. Res., 107, 4013, doi:10.1029/2001JD000410, 2002.

Trentmann, J., Luderer, G., Winterrath, T., Fromm, M., Servranckx, R., Textor, C., Herzog, M., Graf, H.-F., and Andreae, M. O., Modeling of biomass smoke injection into the lower stratosphere by a large forest fire (part I): Reference simulation: Atmos. Chem. Phys., 6, 5247-5260, 2006.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 11951, 2009.

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