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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Small-scale mixing processes enhancing troposphere-to-stratosphere transport by pyro-cumulonimbus storms" *by* G. Luderer et al.

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This paper shows the importance of small-scale mixing processes occurring at the top of a fire-induced storm (pyroCb) via comparing the features of satellite visible and IR images and cloud top temperature structure extracted from a cloud resolving model simulation results of the Chisholm fire on 28 May 2001. Such mixing processes, especially those associated with the gravity wave processes, are important to the transport of trace species from the troposphere to the stratosphere and the paper sheds lights on the role played by pyroCbs in the cross-tropopause transport via these processes. The paper is clearly written and the analysis appears to be sound. Hence I support the

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Interactive Discussion

Discussion Paper

acceptance of this paper for publication.

I only have three comments and all are minor:

(1) In the middle of P. 10382, the authors mentioned that “the occurrence of the cold U/Warm center structure must have been due to dynamic effects at the cloud top rather than radiative effects”. This is exactly the same conclusion reached by Wang et al. (2002a, b) who used another cloud resolving model to simulate a regular severe US Midwest thunderstorm (but not a pyroCb). Thus the present paper enhances the plausibility further that the dynamic effect probably plays the dominant role in shaping the satellite observed IR features atop deep convective storms whether they were fire-induced or not. I think this point deserves some note in the paper. (2) While recognizing that the gravity waves may be largely responsible for the main features of the storm top thermal structure, it is also possible that storm top cirrus plumes, if thick enough, may also contribute to shaping the appearance of the cold-U structure as viewed from satellites, as pointed out in Setvak et al. (2007). For example, it may make the cold-U to look more like cold-V since the plume may cover part of the apex of the “U” and make the apex looked sharper. There are also mean flow-storm interactions that may contribute to the appearance. I understand that the authors have indicated that their conclusions are specific to this case. Nevertheless, it is worthwhile to point out that other processes may also contribute to the overall appearance. (3) Finally, about the term “cold-U (or V)”. In US it is now more customary to call it “enhanced-U (or V)”. Some readers may wonder whether the two are the same thing or not (they really are). I myself have not particular preference. Either the authors are willing to use the term “enhanced-U” or at least make a note that there is also another term in use that refers to the same phenomenon.

References

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Interactive Comment

other features atop some Midwest severe thunderstorms. Paper 1.2, Preprints of the 11th Conference on Cloud Physics, American Meteorological Society, 3-7 June 2002, Ogden, Utah, USA.

2. Wang, P. K., H. M. Lin, S. Natali, S, Bachmeier, and R. Rain, 2002b: Enhanced V's and other thunderstorm features. Bull. Amer. Meteor. Soc., 83, 843-844.

3. Setvak, M., R. M. Robin and P. K. Wang, 2007: Contribution of MODIS instrument to the observations of deep convective storms and stratospheric moisture detection in GOES and MSG imagery, Atmos. Res., 83, 505-518.

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 10371, 2007.