Atmos. Chem. Phys. Discuss., 8, S6587–S6588, 2008
www.atmos-chem-phys-discuss.net/8/S6587/2008/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Hydration of the lower stratosphere by ice crystal geysers over land convective systems" *by* S. Khaykin et al.

Anonymous Referee #3

Received and published: 1 September 2008

Overall: The paper provides some nice evidence of convective overshooting moistening, and should be published. I have some issues with presentation, and interpretation.

1) Length : the paper is too long. The argument the paper is making is quite simple, and the size of the dataset is modest (mostly six profiles). The length of the paper undermines its impact.

2) Estimate of vertical velocity in Table 2: I would consider removing these estimates. They are, in some cases, extremely large. If the tropics had convective systems with this kinetic energy, hail would be common rather than rare. I am not familiar with the method of Vonnegut and Moore used to estimate an equilibrium level (assume level of neutral buoyancy), but it is important to keep in mind that no cloud can be

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characterized by a single LNB. Air parcels are entrained into convective clouds with a spectrum of temperatures, relative humidities, and equivalent potential temperatures. They under go various rates of mixing with background air parcels of varying properties. Presumably the air parcels that reach the highest altitudes are those with the highest initial starting equivalent potential temperature and/or undergo least mixing. I don't know how you would attempt to prove that the LNB of these air parcels was 14 km, or even that they were overshooting (i.e. experienced negative buoyancy) at all.

3) The labels in Figure 1 are microscopic. Each figure of a paper should be legible when printed out. This is figure is not even close to being legible.

4) "Remarkable also is the presence of dips in the ozone profile coincident with the water vapour and ice crystal layers, indicative of an injection of relatively ozone-poor tropospheric air into the lower stratosphere." (line 15-17, page 15476). I assume this is referring to Figure 5, though the paper is obscure here. However the dips in ozone that I think are being referred to are very modest, and to my mind, would appear more to support the idea that the ice was generated by in situ processes rather than convective injection.

5) lines 23-25, page 15477. It is a bit of stretch to extrapolate from six sondes the idea that the summer seasonal increase of water vapour in the lower stratosphere is due to overshooting convective injection. This conjecture should be removed.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 15463, 2008.

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