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Atmospheric Chemistry and Physics Discussions

Interactive comment on "CARIBIC DOAS observations of nitrous acid and formaldehyde in a large convective cloud" *by* K.-P. Heue et al.

Anonymous Referee #2

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The paper "CARIBIC DOAS observations of nitrous acid and formaldehyde in a large convective cloud" by Heue et al., describes airborne measurements of various trace gases and aerosol properties during transect of a deep convective cloud at 11.6 km altitude. Remote sensing spectroscopic measurements of HONO, NO2 and HCHO are converted into mixing ratios based on extensive radiative transfer simulations of the transected cloud. Additional in-situ observations of NO, O3, CO, CO2, H2O, and other species are used as input for chemical box model studies to explain the observed amounts of HONO and HCHO. Free tropospheric observations inside convective systems are very rare, and flying through a deep convective cloud with such a comprehensive observatory as the CARIBIC system presents a unique opportunity to study the local chemistry. Heue et al. make very good use of available measurements and

auxiliary data to analyze the chemical composition of the transected cloud top, which is influenced by lightning activity and updraft of clean marine boundary layer air. This article is very well suited for ACP and I recommend publication after the following issues are addressed.

General comments: The article presents the summary of a very comprehensive effort to explain the observed chemical state inside the deep convective cloud, including radiative transfer and chemical simulations. However its conclusions stop short in explaining or at least trying to estimate potential global effects, e.g. the potential importance of deep convective systems on OH chemistry. While realizing that the article describes a case study, the fact that similar events have been observed before, though rarely, speaks in my opinion for a more general pattern that deserves attention. Section 1 introduces HONO and its relevance to OH production. Adding a short paragraph that places the examined case study in a broader context would make this paper well rounded and increase its significance towards a broader audience.

Specific comments: p.24344, ln. 12ff: DOAS and its relationship to light paths needs explanation, e.g. move some parts of Section 2.3 further up or include references to Section 2.3.

p.24346, ln.23: Is it "on top of high reaching clouds" or in(side) the upper parts of high reaching clouds?

p.24348, ln. 12ff: introduction of importance and use of O4 is missing here.

p.24354, ln. 27ff: the choice of simulated cloud dimensions is not obvious to me - why not even smaller and save more modeling time?

p.24355, ln.3-4: Please explain focus on CE and CTH.

p.24369, ln.18: rare opportunity to do what?

p.24370ff: Please change Appendix text so that it only contains additional information and remove copied text from the main sections.

p.24371, ln. 2: "model's uncertainty" - which uncertainty specifically? Proof reading by a native speaker would be a bonus.

Technical comments: p.24344, ln. 4: "... 4 consecutive commercial airline flights operated by Lufthansa" instead of "Lufthansa flights".

p.24346, ln.18: replace "... reach up to 10" with "it can be as high as 10"

p.24346, ln.20: replace "...by a factor up to" with "by up to factor of"

p.24348, ln.3: replace "...the second only" with "only the second"

p.24348, ln.16 delete "the"

p.24350, ln.24: "paths" instead of "path"

p.24355, ln:18: placement of "(CTH and CE) confusing here

p.24355, ln:26: replace "...cloud top height (CTH)" with "CTH".

p.24357, ln:27: "on artificial spectra"

p.24358, ln:11: "estimate the influence"

p.24358, ln:23: "leads" instead of "lead"

p.24358, ln.18: "ratio"

p.24359, ln.21: replace "aware" with "cautious"

p.24360, ln.12: Sentence on wind speed is unclear; "the" instead of "The"

p.24364, ln.23: "is found to be too weak"

p.24365, ln.11: remove comma after "that"

p.24394, caption Fig.2: "Overview of" instead of "in"

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 24343, 2013.