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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Rapid convective outflow from the U.S. to the upper troposphere over the North Atlantic during the NASA INTEX-NA airborne campaign: flight 13 case study" *by* S. Y. Kim et al.

Anonymous Referee #3

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This manuscript provides a good description of the chemical data collected by the NASA DC-8 aircraft on Flight 13 of the INTEX-NA mission in July 2004. This flight encountered enhanced upper tropospheric pollution, which the authors show to be the result of rapid outflow from convection over the southeastern USA. The analysis is strengthened by inclusion of data from a MOZAIC flight in the same region. The manuscript is reasonably well written, but there are a number of improvements that can be made, which are outlined below. For example, the description of the meteorological situation could use some improvement, as could the comparison of time since

convection using trajectories and chemical clocks. The manuscript should be published following attention to the items listed below.

Specific Comments: p. 17370, latter part of Section 1: some references from the SONEX field experiment from 1997 should be included. Convective transport was active over the eastern US and Gulf Stream during this experiment.

p. 17371, line 13: is the CO lifetime really as long as 2 months in summer? I have always thought it was more like 1 month.

p. 17373, first paragraph of Section 3: Is the text beginning with "According to the...." relevant?

p. 17373, 2nd paragraph of Section 3: Is the stationary front referred to here the same front that was called a cold front in the previous paragraph? Did the cold front become stationary? If so, please say this in the text. Later in the paragraph a cold front is again mentioned. Did the stationary front evolve into a cold front as the small cyclone developed? Please clarify.

p. 17374, line 9: There are both upward and downward motions associated with a jet stream (upward on one side and downward on the other). Please clarify.

p. 17374, line 14: The paper would be enhanced if the height to which the convection over the southeastern US could be determined. Here GOES IR imagery is mentioned. Could you get cloud top temperatures from this imagery to yield some idea of how deep the convection was? This information could also be used to strengthen the trajectory analysis.

p. 17374, line 24: The soundings on the skew-T diagrams do not verify the "occurrence" of convection. The stability indices provide an idea of the "likelihood" of convection. Please change "occurrence" to "likelihood".

p. 17374, line 28: change "instable" to "unstable".

ACPD

7, S8599–S8602, 2008

p. 17375, first paragraph: With regard to WCB transport, the Kiley et al. (2006, JGR) paper should be referenced. This paper details the effects of WCB transport during INTEX-NA. Can you sort out the contribution of the WCB vs. that of deep convection to the rapid upward transport in the Flight 13 case?

p. 17375, last paragraph: Explain why CO2 and COS have opposite trends with altitude compared with the other trace gases. I think this was mentioned later in the paper, but it should probably be placed here instead.

p. 17377-17378; The discussion of the time since convection from the trajectories and from the chemical aging should be made more precise. For region 1 the trajectories indicate 20 hours and the aging suggests 36 hours (1.5 days). For region 2 the trajectories say 1 day, but the aging says 2 days. For region 3 the aging suggests 1.7 days, but the results from the trajectories are not clearly given. Please clarify. At line 21 of p. 17378, the text says that photochemical aging gives transport times "reasonably similar" to those from the back trajectories. Is a factor of 2 reasonably similar. I guess it is better than if one method yielded 1 day and the other five days! Can any possible reasons be provided for the discrepancies?

p. 17380, line 3: From the figure, it looks like the ozone ranges up to 120 ppb, not 110 ppbv.

p. 17380, last paragraph of Section 4: Doesn't the existence of Halon 1211 at levels similar to Asian boundary layer values definitely indicate an Asian influence since there is no other source for this compound? The paragraph as it stands seems to suggest that there is conflicting evidence. Perhaps the air had Asian origins much further back in time than the 5 days transport shown on the trajectories given in the figure. Please clarify.

p. 17383, line 27: Please provide a reference for the AIRMAP data during INTEX-NA. Define TF and AI. I know they are Thompson Farm and Appledore Island, but not all readers would.

ACPD

7, S8599–S8602, 2008

Figure 2: Need better sea-level-pressure maps! The ones here are not very readable.

Figure 3: The best indicator of the extent of convection is the manually-digitized radar plots. It would improve the paper if the full temporal extent of this convection was documented. Could a series of MDR plots be shown (maybe every 6 hours) from 0000 UT 26 July to 0000 UT 27 July? Does any of the convection between 0000 UT 27 July and 0000 UT 28 July also contribute to the measured outflow? If so, then these MDR maps should also be shown.

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 17367, 2007.