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Atmospheric Chemistry and Physics Discussions

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Interactive Comment

Interactive comment on "The effects of springtime mid-latitude storms on trace gas composition determined from the MACC reanalysis" *by* K. E. Knowland et al.

Anonymous Referee #2

Received and published: 25 November 2014

Knowland et al. present an analysis of trace gas composition within intense North Pacific and North Atlantic mid-latitude cyclones. The authors apply two compositing methods to the MACC reanalysis CO and O_3 fields, along with meteorological parameters. The aistreams within a mid-latitude cyclone are clearly identified, despite being hidden behind some background gradients in CO/O_3, and changes in CO/O_3 are quantified. The analysis is straightforward and of interest to the community, even if the results are not terribly novel.

The manuscript is very well written and I suggest that it be accepted for publication in ACP after the authors address the minor issues listed below.

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Interactive Discussion
Discussion Paper

General Comments

- The storm composites are adequately described, but not straightforward for the reader unaccustomed to their use. I recommend a figure showing the use of each composite method on a specific storm, which would much more clearly indicate the procedure used.

- More explanation and defense of the definition of the background "average conditions" is necessary. There is the potential for significant year-to-year variability in background values of both CO and O_3 in these regions and apparent signals could simply arise from a long-term trend in precursors, distant exceptional sources (biomass burning/lightning), or atypical transport pathways. An alternative would be to have a threshold relative vorticity value signaling the absence of a storm.

The latter figures (4-13) clearly show that the background definition is likely acceptable and I am ready to accept that these concerns regarding the background conditions are misguided, but evidence to this end is needed. While the difference between the storm and the background state is clear in Figures 4-13, this is not the case in Figures 2-3. In addition, the definition of the background state is essential to properly quantify anomalous CO and O_3.

- The figures are well constructed when viewed on the computer screen, but much harder to interpret when printed. Please make sure that the printed final versions of these figures are large enough to do them justice.

- Section 3.2 describes the change in ozone and CO within during an intense storm and in the background composite. Many of the features are the same: an increase in ozone and decrease in CO at altitude with minimal changes near the surface. Perhaps

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the discussion of the upper atmosphere (pressures lower than 400hPa) should be dropped? The effect of the DI is clear on this data, it makes the upper changes in CO/ozone stronger, but it also hides near-surface changes. In my opinion, it is the 1000-500hPa airflows that are of greatest interest.

The latter figures (4-13) are much more convincing.

- The airstream analysis is very interesting. I wonder if it can be expanded to provide an estimate of a strat-trop flux? This would be of great interest to the community and add a novel result to this manuscript.

Specific Comments

Page 27094, Line 26 – When is the area-averaged ozone higher? During the passing of the storm? After it passes? This sentence is unclear.

Page 27100, Line 13 – “due too low NO_x” should be “due to low NO_x”

Figure 7 – The negative values should have a different dashed pattern than that used for the axis; the contours are easily lost.

A relevant publication to include: Polvani and Esler (2007), Transport and mixing of chemical air masses in idealized baroclinic life cycles, J. Geophys. Res., 112, D23102, doi: 10.1029/2007JD008555.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 27093, 2014.