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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Trans-Pacific transport of reactive nitrogen and ozone to Canada during spring" *by* T. W. Walker et al.

Anonymous Referee #1

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General Comments:

The study uses a global chemical transport model (GEOS-Chem) in combination with aircraft measurements during the INTEX-B campaign in spring 2006 to analyze source contributions of ozone in the free troposphere over the remote Pacific and identify transported pollution entering North America, with a focus on Canada. A model base simulation and a set of sensitivity runs are conducted to examine the roles of Asian anthropogenic and lightning emissions and chemical processing to the ozone background. The paper also describes a scaling method of using multi-year satellite retrievals of NO2 to create timely NOx emissions for the period of interest. The study addresses an important issue in atmospheric sciences, especially since transpacific pollution transport might become an even bigger concern in light of the rapid economical growth in

Asia. The work is well carried out and the methods generally sound. However, I have a few more specific comments that I would prefer if being addressed in more detail before publication.

Specific Comments:

Throughout the paper I find the way the results are presented often disconnected and hampering the flow of reading. For example, in the introduction it is talked about lightning emissions and their importance (page 8721), then the emissions modeling is discussed, then the focus gets back to discussing long-range transport, followed by stating a way for evaluating a model, and then the modeling part is discussed. Another example is Page 8730 (Line 3ff) where the model sensitivity simulations are discussed in Section "3.1 Estimates of Emissions" The emissions modeling itself, while a nice method, seems to me as being outside of the objectives of the paper, at least the way it is presented.

Abstract, line 19: Does the 2% global increase refer to a sensitivity study considering PAN from all sources or only sources in Asia?

Page 8728, Line 23: I am not following this scaling to 2003 emissions at all and suggest further explanations. Or, if this is standard practice in GEOS-CHEM, then it would help to, at least, include a reference.

Page 8729, Line 3: Is the trend calculated for entire Asia, or separately for China and East Asia? Can you comment if and how changes in other sources (biomass burning) might impact such a trend and the derived emissions?

Page 8731, Figure 5: Can you comment on the fact the model does not represent the low end of observed values?

Page 8731, Line 20 ff: Can you explain the different biases between the data sets, e.g. a large positive bias for C-130 and a large negative bias for Cessna data? Overall, I would not second what is described as a "good agreement". O3 compared to C-130

has a rather larger bias at all altitudes and PNs and NOx for DC-8 are significantly overestimated in the model. It is also disconcerting to me that, for C-130, the model agrees well with PNs and NOx but has a large bias in O3, while the model compared to DC-8 has a large bias in PNs and NOx, but agrees rather well with O3.

Page 8733, Figure 9: I am surprised by the high model bias compared to OMI. Compared to the aircraft and sonde data, the model seemed biased rather low and on page 8732, Line 18 you mention that other studies found that GEOS-Chem underestimates ozone of stratospheric origin. Can you comment on this?

Page 8734, Line 15: Because of the non-linear chemistry, it is not the "actual contribution" that is calculated by differencing model results with and without Asian emissions, but rather an estimate of how the ozone production is changed if there were no Asian emissions. Can you comment on how the derived estimate would differ from the "actual contribution"?

Page 8734, Figure 10: Do I understand that correctly that, at least in an average sense, net ozone production from Asian sources only occurs over Asia, meaning that ozone transported into North-America is ozone that was produced in Asia and then transported across the Pacific? Or is this only true for 800 hPa? How representative is the 800 hPa level for other altitudes?

Page 8737, Line 12: How do total O3 and PANs look along the flight track? Do they resemble the measurements?

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 8717, 2010.