

Interactive comment on “Nitrogen oxides and PAN in plumes from boreal fires during ARCTAS-B and their impact on ozone: an integrated analysis of aircraft and satellite observations” by M. J. Alvarado et al.

Anonymous Referee #1

Received and published: 19 August 2010

The paper interprets aircraft and satellite observations of trace gases during the ARCTAS-B campaign to improve understanding of chemistry in fresh, aged and old biomass burning plumes, with a particular focus on nitrogen oxides and PAN. It's a well written paper and should be accepted by ACP. Below, I list some minor comments and questions, which I would like the authors to address.

The authors use the ratio of CO to a range of hydrocarbons to determine the age of the plume. This is an approach that has been used in many previous studies but given that the plume aerosol might slow down the photochemistry, I wonder how robust this

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper



approach is. Did the DC8 measure aerosol optical depth? Have the authors looked at the model and observed OH?

My understanding of biomass burning plumes is that they can be remarkably thin in the vertical (100s m), making them difficult to intercept by plane and challenging to view them from space. Each plume is different, of course, and I'm wondering whether ARCTAS-B had a chance to assess the dimensions of the intercepted plumes. The vertical extent of the plume, in particular, will have implications for its detectability by satellite instruments that typically have sensitivity over relatively large altitude ranges. Can the authors comment on this issue regarding TES. It would be useful if the authors showed a "typical" TES averaging kernel for the observed scenes during ARCTAS-B.

The PAN chemistry will be dependent on the speed and height of the pyroconvection. The authors assume, based on Val Martin et al, 2010, that all fires are injected uniformly within the boundary layer. This is a reasonable prior assumption but I'm wondering how sensitive the results to injection 10% of the plumes above the boundary layer. I notice that none of the model calculations shown in this paper even capture the vertical distribution of CO (Figure 5) which is a relatively simple gas.

I question the approach taken to reduce emissions by adjusting the emission factors. Our understanding of the interplay between chemistry and plume dynamics is incomplete so comparing model and observed ratios between NO_y to CO is not necessarily a robust approach for determining emission factors. What about assumptions made about combustion completeness or the burned area? I am not suggesting that the emission factors are perfect but I am suggesting there are other variables that could be altered that would lead to the same emission reduction.

Have the authors a clear idea of the origin of each intercepted plume? If yes, can they relate the plume to vegetation type? Soja et al, (2008) suggest that crown fire inject smoke (and presumably gases alike) to altitudes of 5-7 km. This appears to be inconsistent with the authors' prior assumption about injection in the boundary layer.

[Full Screen / Esc](#)[Printer-friendly Version](#)[Interactive Discussion](#)[Discussion Paper](#)

The authors also note the role of storm updrafts as a mechanism for lifting emissions above the boundary. Is there an approach the authors could use with the DC8 data to separate the plumes lifted by pyroconvection versus storm updrafts?

Page 15341: Can the authors explain the approach taken to determine pseudo-emission factors that account for sub-grid processes.

From section 3.3.1. it appears no one sensitivity calculation addresses the discrepancy between the model and the DC8 measurements. Any suggestions for other avenues of research?

I remain unconvinced about the results shown in section 3.3.3. How much of the TES observed CO and TES, particularly in the lower troposphere, is due to the a priori used in the retrieval?

Figure 3: Can the authors provide some indication of the altitude for each intercepted plume? The colours could be used to denote the altitude and the symbols used to denote the two ratios.

Figure 5: This reader would find it useful if the plot also showed how many measurements were used at each altitude to determine the mean statistics. The legend needs to be larger.

Figures 11, 14 and 18. Suggest it might be better to show the differences between the model and TES.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 15325, 2010.

[Full Screen / Esc](#)[Printer-friendly Version](#)[Interactive Discussion](#)[Discussion Paper](#)