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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Source-receptor relationships for airborne measurements of CO_2, CO and O_3 above Siberia: a cluster-based approach" *by* J.-D. Paris et al.

Anonymous Referee #1

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The manuscript describes and applies a cluster analysis to Lagrangian particle model output, specifically to surface influence associated with a series of airborne measurements. Using a time reversed Lagrangian particle dispersion model, the authors computed potential contributions from specific upstream regions to the measurements along the flight tracks, somewhat similar to Eulerian tagged tracer experiments. Those contributions are then used in a cluster analysis. The research flights were undertaken during a series of three airborne campaigns within the YAK experiment, characterizing the troposphere over Siberia. The last of the campaigns is described in this paper for the first time, the two earlier campaigns are described in a previous publication.

Although the focus of the paper may be on the cluster analysis of YAK data, it would be appropriate in the introduction to refer to some of the earlier measurement programs that provided atmospheric greenhouse gas data over Siberia, e.g. work by Lloyd et al., Tellus 2002, Levin et al., Tellus 2002, and others.

The main issue I see with this paper is that it remains quite unclear what the advantage over forward model sensitivity analysis is. For example, using tagged tracers in modeling experiments can provide quantitative contributions from specific processes (biomass burning emission, fossil fuel emissions) to observed chemical composition. In comparison, a simple "tagging by region" as done in this study will only give qualitative results. This might be appropriate if the processes causing the atmospheric variations in the measured trace gases were unknown, then such a method might provide new insight. In case of contributions from well known processes such as emissions from fossil fuel combustion, biomass burning, or biosphere-atmosphere exchange of CO2 it is not surprising to find general correlations between origin of an airmass and its chemical composition. Therefore I recommend the authors to put forward some ideas as to why this method is applied here, and what the expected additional information is that cannot be provided by classical forward (tagged tracers) or inverse modeling approaches. A new method should not be applied just before it is possible, but there should be a strong reason for developing and using it.

Minor comments

Throughout the manuscript, I suggest to replace the word "aircraft itinerary" by "flight track"

Pg 2, ln 20-26: This paragraph would fit better at the end of the introduction

Pg 2, ln 23: "tomography" suggests three-dimensional domain filling observations, which is certainly not the case for airborne profile measurements using in-situ techniques.

Pg 3, ln 16: sentence not complete

Pg 5, ln 22: When precision and accuracy are both 0.15ppm, there is no room for any short-term noise in the measurement

Pg 6, ln 6: “prior assessment of transport”: this remains unclear. What is the outcome of this assessment?

Pg 6, ln 16: It is unclear which particles are declared as having stratospheric origin. Those that have been in the stratosphere during part of the ten days, or only those that were in the stratosphere 10 days prior to measurement?

Pg 9, ln 3-6: Which of the 20 versions was used? Or how have those runs been combined?

Figures 5,7, and 9 do not contain a proper legend for the color scale. Is it the natural log or base 10? What units where used before applying the log?

Pg 14, ln 11: “. . . excluding data associated to residence time < 100 s/grid”: how does thios threshold compare to the range of residence times?

Pg 14, ln 26: replace “seem to has” with “seems to have”

Pg 15, ln 12: “excepted” –> “excect”?

Pg 15, ln 27: “. . . a novel application of clustering to Lagrangian particle dispersion model footprint” this should be reformulated

Fig. 12, legend: I would suggest to use month&year throughout the paper instead of campaign names (YAK1 etc).

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 6207, 2009.