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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Satellite observations of long range transport of a large BrO cloud in the Arctic" *by* M. Begoin et al.

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This review is by Owen Cooper, co-Editor of this manuscript. I am posting my comments now to stimulate the open review process. My review is written without the benefit of first reading the reviews by the anonymous referees and their opinions will have a major influence on my decision regarding publication in ACP. From my first reading of the paper there are 4 topics that in my opinion require additional attention and revision: 1) further description of the PFF methodology and validity; 2) elaboration on the new results of this study; 3) additional comparison and quantification of BrO from GOME-2 and FLEXPART; 4) corrections of writing style and grammar.

1) I don't find the description of the PFF calculation to be adequate and further discussion of the validity of the PFF maps is required. I read Kaleshcke et al (GRL 2004)

to learn more about the PFF technique and its verification but I still have questions. What is the resolution of the PFF maps? I assume the resolution is limited by either the meteorological fields and/or the SSM/I sea ice retrievals. Has the PFF product actually been verified by observations of frost flowers in the field? During March sea ice extent is at its maximum and with the exception of polynyas along the coast lines or a few leads that open up in the middle of the pack ice as the sea ice shifts, the Arctic is covered by ice that is at least 4-5 months old. Because frost flowers have a lifetime of just a few days the PFF maps indicate freshly formed frost flowers. This means that the regions with frost flowers must have had open water just a few days before. The PFF map for March 28 indicates that much of the region between Siberia and the North Pole had 10% or more of its area covered by frost flowers, which means that a few days before much of this region must have had extensive lead formation. I find it difficult to believe that such a broad region was so extensively fractured during March. Do the SSM/I retrievals show such heavy lead formation? What is the spatial resolution of the SSM/I retrievals? How wide do the leads have to be before the instrument can detect them? My impression of the PFF product is that it overestimates the regions with frost flowers. I would like to see SSM/I retrievals that show the extensive number of leads that could produce the large regions of PFF.

2) Please make a better case for how your work has advanced our understanding of BrO explosions. Does your simulation provide better insight into the long range transport of a BrO plume than previous studies? Is this a new method for tracking and simulating a BrO plume?

3) In the conclusions you state that BrO recycling must have occurred to maintain the near constant BrO levels. But I am not yet convinced this is the case. You need to actually add up the mass of BrO as seen by GOME-2 in the transport corridor to show that the mass remained constant. This can be done as follows: Because the FLEXPART BrO tracer is passive with no removal, the mass of tracer in the plume remains constant even as it disperses. For each daily GOME-2 map identify all grid

cells that contain FLEXPART tracer, then sum up the BrO detected by GOME-2 in the same grid cells. If the total quantity of GOME-2 BrO in this transport corridor remains constant (allowing for errors due to clouds, etc.), then you can argue that perhaps the BrO is recycled as it would be unlikely that fresh BrO would be released into the plume at the same rate at which it is removed. On the other hand if the GOME-2 BrO becomes significantly greater than the FLEXPART BrO then you would have to conclude that additional BrO was emitted into the plume. But this of course would only provide a lower estimate of the extra BrO released because it assumes that all of the initial BrO released on March 26 is recycled within the plume. If the original BrO was removed then the additional BrO releases would be much more.

4) Below are my suggestions for improving the paper's style and grammar. If no explanation for a comment is given, please insert/replace the suggested text into the appropriate place in the manuscript.

page 20408 line 11 to study an arctic BrO event

p20408 line 13 and throughout the paper Use "Hudson Bay" rather than "the Hudson Bay"

p20408 line 14-15 in the production and sustainment of aerosols that provided the surface

p20408 line 16 BrO plume was well reproduced by FLEXPART simulations of a passive tracer

p20408 line 19-20 but PFF calculations indicate the presence of frost flowers a few days before....

p20408 line 22 Strong depletion of tropospheric ozone in the Arctic polar boundary layer in spring was first reported in the 1980s at Barrow....

p20408 line 24 Later, measurements in the....

p20408 line 26 ...other Arctic and Antarctic stations, demonstrated that...

p20409 line 9 bromine is believed to be released...

p20410 line 11 from the surface as an air mass traverses the source region, or whether...

p20410 line 13 event observed by the GOME-2 instrument....

p20410 line 15 compared to transport simulations by the FLEXPART particle dispersion model.

p20410 line 25 1920 km, global coverage can be achieved within one day and several....

p 20411 line 12 As only the tropospheric component is of interest for this study..

p20411 line 24 FLEXPART is a Lagrangian particle dispersion model...

p20412 line 1 and throughout the paper BrO "clouds" is a little misleading. It would be better to refer to the BrO features as plumes.

p20412 line 2 with a horizontal resolution of 1 degree

p20412 line 2 What is the vertical resolution of the ECMWF wind fields?

p20412 Please provide some additional description of frost flowers. What do they look like and how large are they? Do they completely cover an ice surface or are they spaced a few centimeters apart?

Figures The figures in the text need to be mentioned sequentially. For example, Figure 2 is mentioned first instead of Figure 1. Then you mention Figure 4 before you mention Figure 3.

p20413 line 9 Please indicate the range of wind speeds.

p20423 lines 19-23 These lines aren't necessary as the FLEXPART simulation ad-

dresses this issue.

p20414 line 1 when you say “several overpasses” do you mean per day?

p20424 line 22 do you mean “collocated” rather than “allocated”?

Figure 1 please use arrows to indicate the locations of the Laptev, East Siberia, Beaufort, Barents, Chukchi and Kara seas.

Ridley et al. (2007) is missing from the reference list.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 20407, 2009.