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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Airborne lidar measurements of surface ozone depletion over Arctic sea ice" *by* J. A. Seabrook et al.

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Response to Major comment:

The reference of McElroy et al. (1999) was not intended to be controversial. The McElroy (1999) paper concerns the interpretation of measurements of column BrO and does not provide measurements within the free troposphere of ozone-depleted air. In its conclusion, this paper poses the question "How much ozone loss might be expected from the observed amounts of BrO?" before discussing the possibility of ozone loss in the free troposphere. We thus don't understand the reviewer's sensitivity to our use of the word "suggested" in associating the McElroy (1999) paper with ozone depletion in the free troposphere. We are simply providing a context for the results of our study. The reference to McElroy et al (1999) in the Introduction of our paper is simply a mention

that the very interesting discussion in the McElroy paper provided part of the motivation for carrying out the project. As we are unable to understand why the reviewer detects an unfortunate tone, we have decided it is best not to include the reference to the McElroy (1999) paper in the Conclusion section, since the description of our results remains true either way.

In response to the reviewer, we have reworded the second half of the conclusion so that the intended meaning is more clearly stated. The main point is that we do not observe layers of significant ozone depletion where the lower boundary is not in contact with the surface. The second half of the conclusion is now as follows

" The observed ozone depletion event occurred in a layer in which the lower boundary was in contact with the surface of the Arctic Ocean. There were no observations of layers of ozone depleted air that were elevated such that the lower boundary was not in contact with the surface. This was also the case in two other flights during the May 2011 flight campaign, and the previous DIAL measurements on board the Amundsen Icebreaker during the entire month of March 2008 (Seabrook et al. 2011). All of the air that was measured to be depleted in ozone was found to have a recent history of being within 300 m of the surface for substantial periods of time. The ozone depletions occurred only in air that had been within the surface layer where turbulent mixing would result in contact with the surface. This is consistent with the findings of a previous study in which the same DIAL instrument provided measurements of ozone from the surface on board the Amundsen Coast Guard Icebreaker ship (Seabrook et al. 2011). The result is also consistent with previous studies using back-trajectory analysis (Bottenheim et al., 2009; Frieß et al., 2004) that have found a correlation between Arctic ozone depletion events and the length of time prior to being sampled that an air mass was within the surface layer over the sea ice."

Response to minor comments

p1443 line 13 We decided to show one case study rather than be repetitive. We feel it is not necessary to include extra figures to illustrate that a feature does not exist in the figures. In the reworded conclusion we also refer to the DIAL measurements from the Amundsen Icebreaker in which there were continuous measurements for a period of one month (Seabrook et al 2011) in which we did not observe layers of ozone depletion that were not connected to the surface.

p1437 line7 The conclusion has been reworded so that it is more clearly stated that we do not observe layers of ozone-depleted air in which the lower boundary is not in contact with the surface

p1439 The backscatter signal from the surface does not saturate the PMTs. Even if this were the case, at 20 Hz there is more than sufficient time between laser pulses for the subsequent measurement to be unaffected. As this is not a problem, and it is not part of the analysis, we do not see that it would add value to discuss it within the manuscript.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 1435, 2013.