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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Unusually low ozone, HCl, and HNO_3 column measurements at Eureka, Canada during winter/spring 2011" *by* R. Lindenmaier et al.

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Anonymous Referee #3 Received and published: 27 February 2012

We thank the referee for his/her comments, which have helped improve the manuscript. In our reply below, the referee's comments are also included.

General comments

This paper is nicely written corresponding to a large data set. It summarizes several other work regarding stratosperic ozone depletion, providing a good scientific context. I think the paper can be published with only minor modifications, if any. .

I however have some diffiulty in understanding the main objective of the paper. I guess it is to show that 2011 was an unusally cold year above Eureka (what about elswhere?), with chlorine activation, denitrification and ozone depletion , as shown qualitatively from the FTIR data, and quantitively from the slimcat data.

The main objective of our paper is to show that unusually low ozone, HCl, and HNO3 total columns were measured at Eureka in spring 2011 compared to the previous 14 years, and that this resulted primarily from chemical ozone depletion. It is a case study that complements the results published by Manney et al. (2011) and other studies of the 2011 Arctic winter. The chemical ozone depletion is quantified using SLIMCAT and the passive subtraction method.

Personally I think the paper is a little long on the FTIR side, since most of the data is used only qualitatively. Can the same information could be given in a shorter manner or can more quantiatibe data be retrieved from the FTIR data?

The primary measurements were made using two FTIRs, the 125HR and the DA8, therefore we focused our discussion on these results. The total column time series show the evolution of each trace gas during the spring period and during the past 15 years. Since the dynamical effects are as important as the chemical ones during the Arctic spring, we normalized by the HF total columns to eliminate most of the dynamical effects, hence Fig. 6. All of the trace gases need to be shown in this figure to confirm the chemical origin of the low ozone, HCl, and HNO3 total columns measured in 2011. Inclusion of all 14 years is necessary to shows that the values in 2011 were the lowest on record.

I also miss some discussion around the slimcat data, over how long time period the passive tracer can be used in a good manner. In the past I have been involved in similar studies with older versions of slimcat showing a drift between the passive and active ozone after the end of the season. This is not the case here, but I would have liked some critical disccuion since it is the highlights of the paper.

We used SLIMCAT data beginning January 1, 2011. The passive and active runs are very close at this time. The difference between the two time series becomes more visible in February and large in March and April. The difference between the two runs can be used with confidence when we sample inside the vortex, which persisted into late April in 2011, past the end of our campaign. In our paper, this was demonstrated by comparing the measured ozone total columns to those from the active run of the model. Since these agreed well, we could expect to accurately estimate chemical ozone loss by calculating the percentage difference between the measured total columns and the passive run, considering only the measurements inside the vortex. A study of the evolution of the two model runs after the end of our campaign when the vortex breaks up is beyond the scope of this paper. Changes in the paper made in response to reviewer #2 also reinforce the validity of the way we have used the SLIMCAT model.

In the conclusion the authors claim a 35% ozone depletion being the highest in 15 years. I can not find that they refer how the depletion was measured the other years, also slimcat?

This statement is based on the results shown in Fig. 6, where it is clear that ozone depletion reached the largest value in 2011. The result is in very good agreement with Manney et al. (2011), other published results, and other results presented at the American Geophysical Union Fall Meeting.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 1053, 2012.