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Interactive comment on “The use of SMILES data to study ozone loss in the Arctic winter 2009/2010 and comparison with Odin/SMR data using assimilation techniques” by K. Sagi et al.

Anonymous Referee #1

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This paper presents SMILES and ODIN/SMR data and a study ozone loss in the winter 2009/2010. While the presented data and the derived model quantities seem to be in good shape, the interpretation of the results is not reflected well. The main point is that with the method of passive tracer subtraction, it is not possible to distinguish between different processes. Moreover no comparison is made with other published ozone depletion estimates based on different data. With a conclusive interpretation and a comparison with existing studies, it could be a good paper, but it needs a major revision.

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7890/6: The concept of “ozone loss due to the instability of the vortex” is not very clear. There could be chemical ozone loss by various processes but the instability of the vortex itself does not generate ozone loss. It may cause mixing between air masses with different ozone amounts or simply transport of air from mid-latitudes into the vortex.

7896: The choice of ω as a symbol for vertical velocity for different vertical coordinates is confusing, as it is typically used as the vertical velocity in pressure coordinates ($\omega = dp/dt$). It is further well known that slow vertical motions in the stratosphere as the tropical ascent in the Brewer Dobson Circulation but also the descent in the polar vortex can be described best using the heating rate and potential temperature as vertical coordinate. Therefore it would be better to leave out this discussion and refer to the literature.

7896, formula 3: This can only be a necessary condition and is not a sufficient condition. E.g. by increasing the $\Delta\Theta$ to a very large number you could fulfil this formula, but you may not be able to simulate vertical descent.

7897/17: The US-standard atmosphere profile does significantly differ from a polar ozone profile that should rather be used here

7900/4ff: I don't see how you can derive statements about equilibrium between processes from the shown quantity that is an integral of ozone loss rate since the beginning of the winter. Also, the photochemical production in polar spring is probably very low. With the shown method, you cannot discriminate changes between chemical ozone loss or transport of/mixing with air-masses from lower latitudes that did experience earlier Ozone loss (e.g. due to NO_x)

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7900/15ff: The process of polar ozone depletion by chlorine activation and subsequent polar ozone depletion is generally known and must not be repeated here. Especially it is not necessary to provide detailed information on PSC types or denitrification. Chlorine activation can be triggered by different PSC types, most important are the liquid particles. The only shown data for that are the SMR ClO data. From the SMR ClO nighttime data, the chlorine activation is best visible if temperatures rise and thermal decomposition of the night reservoir Cl_2O_2 becomes important. This cannot be verified as the chemistry is not simulated by the model. However, there are several papers that describe ozone depletion, denitrification of the winter 2009/2010.

Do you use equivalent latitude $>70^\circ\text{N}$ as definition vortex edge throughout the paper? Is this justified for all times and altitudes? Please give an indication of the breakdown time of the polar vortex in the different altitudes.

Classify the results with respect to other published ozone loss estimates.

Minor Issues

7890/11: Mention which data from ECMWF are used (operational analyses, re-analyses...)

7890/13: "cross-isentropic tracer transport": Do you mean vertical tracer transport or isentropic transport across the vortex edge?

7890/25: rather write "... release of active chlorine species (Cl, ClO)"

7891/1: The Arctic vortex is also stable. Write rather "less stable"

7891/5: As indicated also later, this is only true for the beginning of the winter (Dörnbrack et al., 2012)

7891/24: This latitude range cannot be true. It should be also in the Northern hemisphere

7892/5: rather write "SMILES does not measure inside the vortex..."

7892/17: remove "us"

7893/6: please re-phrase, as it could be mis-understood. The limb emission is neither coming from the ISS nor from the 340-360km range.

7895/25ff: This is a strange concept. The diabatic descent of the air masses in the polar night is caused by the radiation imbalance (no solar irradiance). This must be re-phrased.

7897/26: rather write "...vortices did reconnect by..."

7897/28: rather write "lowest temperatures"

7898/11: rather write "...would be perfectly simulated..."

7899/5: If there is a known bias, please mention the order of magnitude

7899/9: Probably you mean 65°N

Figs 3 and 6: The figures should be displayed larger such that the details can be visible

Fig. 8: Are the data displayed in Fig. 8 also averages for equivalent latitude $>70^{\circ}\text{N}$?

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 7889, 2014.

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