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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The January 2006 low ozone event over the UK" *by* M. Keil et al.

Anonymous Referee #1

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Summary:

This paper reports on a low-ozone event that occured over the UK in January 2006. The event is analysed and described from various perspectives and with a wide range of complementary methods, a very interesting case study. The scientific question that is approached is to determine the origins of the low-ozone air in the atmospheric column.

A weakness of this study is that it fails to point out, or follow through, the novel contributions to this topic. As it stands, it nicely confirms current theories of the dynamics of low-ozone events, and mentions/sets out the additional possibility for a chemical ozone destruction, but the latter notion is not followed up any further. If the authors see this paper as an exemplary case study, the paper could gain by restructuring it, to avoid repetitions. E.g. present the dynamical concept first before going on to evaluate/exemplify it with the specific case of January 2006.

Further, minor weaknesses include the lack of conciseness (some arguments are repeated), lack of clarity in some explanations and inconsistencies in the interpretation, esp conclusions should be revised for clarity (see specific comments below).

Therefore I recommend to accept the mansucript after major revision.

Remark:

The conceptual picture presented in Koch et al., 2005, A composite study of ozone miniholes and minihighs over Central Europe and their formation mechanisms, Geophysical Research Letters, 32, pp.L12810. doi:10.1029/2004GL022062 has been derived from a climatology of low-ozone events and could be of interest in the discussion/presentation of this case study (cf. their Fig. 6). There is also a special focus on the presence of anticyclonic vortex anomalies at the tropopause level for these events (their Fig. 5).

Specific comments:

p.8459, l.3-4: Change "This therefore suggests..for the ozone minima", since you are showing later on (in agreement with the literature), that both, the stratospheric and the tropospheric component are important.

—, l.12: change "via the polar vortex" into e.g. "originate from within the polar vortex"

p.8460, l.13: Allen and Nakamura (citation style)

—, l.14: "Here, ..." Specify more clearly hat the objectives are. What is the purpose of the trajectory calculations.

p.8461, l.8: "should", is there a reference?

—, l.10: "is likely" is a bit vague, also the reference (1980) is quite old. Is it still appropriate?

—, l.24-26: Something seems to be wrong with this sentence.

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Use Figure 1 a, b when discussing the Figure.

p.8462, l.9: You could mention specifically the model (wind fields) the transport model is using.

—, l.13: The sentence beginning with "Broadly speaking..." is unclear. Does this describe the whole sequence shown in Fig. 2? It is unclear to me which region you are speaking about.

—, l.17: give height of geopotential and isentrope (pressure?) for PV

—, l.20-22: This sentence is a bit unclear as well. Fig.2 clearly shows variations on the synoptic scale. What exactly is "the large low ozone region"? This is probably related to l.13-16?

It would add to the paper if the O3 description (Fig.2) would be more quantitative (since you are also quoting the accuracies of the instruments etc)

p.8463, l.12-13: Repetition, maybe change place of sentence? You already hinted at the role of the location of the polar vortex above?

—, l.17-22: Could be worthwhile to be more detailed/quantitative about this derivation?

p.8464, l4-6: "The January...average": Move this sentence after the next paragraph?

—, l.19: specify the threshold?

—, l.21-22: Is it known at which height the PSCs are observed? Is that in correspondance to the observed O3 profile?

—, l.29: "simply a result" Is that clear? There is still the possibility for a chemical impact? (cf. p.8464, l25, and p.8465, l.14-17).

—, l.29, and p.8465,l.3: Lerwick and Sodankyla are not "inside" the polar vortex, but below/underneath?

Fig.5: Would it be possible to add the PSC observations from the web-site to Fig. 5?

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p.8465, l.18: "another possible mechanism" is too weak? On p8463,l.19 you state that 2/3 of the depletion is from that altitude range?!

—, l.23: Fig.7 –> Fig.6

—, l.29: ...ozone minima (Fig.2)

p.8466, l.1: ...anticyclones (Fig.6)

p.8467, l.19: Do you mean 5-30km?

—, l.23-24: "reduce the amount of possible information for any given prediction" is unclear

—, l.28, and Fig.7: It is unclear from the text how the time-integrated air concentration is obtained, and what it represents. What are the units of "air concentration"? Can the result (Figs 7-10) be described more quantitatively?

Can this model provide an indication of the amount of ozone at the "receptor"? What is the assumption? There is no 3-dimensional Ozone information used here, so nothing is known about the start and end condition for the backward trajectories (in terms of O3).

p.8468, l.1: "ring between Iceland...", and later "ring is of stratospheric origin". Avoid "ring".

—, l.6-7: Do you mean that the air is between 15-30km at the receptor point? Or all along the trajectories, or at the origin? This is not so clear from the text. I suspect it is only at the receptor, then it still remains to be shown that the air *arriving* at 15-30km is of stratospheric *origin*. To do that, PV, height or pressure of the backward trajectories will have to be analysed.

—, l.8-12: There is some confusion about origin and arrival in this paragraph.

—, l.13: move "in the 10-15km layer" back to "...receptor location..." otherwise it might

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be misunderstood that the trajectories always stay on the 10-15km level.

—, l.15-16: "anticyclonic path": an alternative interpretation is that the trajectories follow the jet stream, and then the trough-ridge pattern over the Atlantic?

—, l.19: "anticyclonic path": again, a different interpretation is that these air parcels experience frontal lifting ahead of the trough?

—, l.25: "related to the passage of UTLS cyclones and anticyclones". Why UTLS? A lot of the transport is accomplished by the mean/jet flow (esp. in the 10-15km layer).

p.8469, l.14: change "British Isles was *within* vortex"

p.8470,l.6-7: Repetition. Remove sentence "Therefore, it appears..."

—, l.9-10: It has only been shown by qualitative arguments here that the trajectories originate from a region with minimum temperatures. Can this be made more quantifyable by analysing the temperatures of the trajectories?

—, l.14: "antiyclonic path" could be specified more clearly. Is it fair to say that the presence of a ridge over the UK, and the associated transport of subtropical (potentially low-ozone) air ahead of the upstream trough into the ridge both play important roles?

—, l.16 "clearly confirms": I don't agree. It is not clear from this analysis, that the ozone minimum visible in the WMO column can be attributed solely to the lifting of the tropopause. Also, the preceeding sentence (l.13-14) stresses the imporance of transport.

—, l.18: I don't find the terminology "UTLS anticyclone" convincing. I suspect that a ridge will also be present in the mid- and lower troposphere, and possibly at the surface.

—, l.19-29: This section is interesting general outlook, but rather long, given the fact that the January 2006 event presented no health hazard.

Figures:

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Figure 3: (a) Lerwick, (b) Sodankyla. Maybe consider a legend for the different colours in the figure, rather than a description in the caption?

Figure 5: Maybe possible to add obs PSCs?

Figure 7 is unnecessary if the 3 subsets are shown. Caption: Do you mean 5-30km?

Figures 8-10: Possibly change captions. And exchange "originating" by "arriving" which would be a bit more intuitive.

Figure 10: It is confusing to cahnge the projection. These trajectories could possibly be included in Fig.9 (e.g. use a different colour scale)?

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 8457, 2006.