

Interactive comment on “The influence of mid-latitude cyclones on European background surface ozone” by K. Emma Knowland

Anonymous Referee #3

Received and published: 3 July 2017

General comments:

This manuscript investigates how passing mid-latitude cyclones influence the surface ozone levels at two stations in Western Europe (Mace Head and Monte Velho) by combining ozone observations and reanalysis data from ERA-Interim, MACC, and MERRA-2. Four case studies were presented to support the main results. The strong impact of the downward transport of O₃-rich air masses from the stratosphere on the surface ozone levels was pointed out.

The topic and the general length of the paper are relevant for publication in ACP. Generally the paper is compact and well-written, however Sect. 4.2.1-4.2.3 should be improved as suggested below. The structure of the paper is logical. The introductory discussion is adequate and the referencing is sufficient. In a few cases more details on

C1

the methods are needed. Some of the figures need improvement.

For the reasons mentioned above and below the paper is appropriate for publication in ACP after a major revision.

Specific comments:

- Shorten Sect. 4.2.1 and improve the text of this section (write more compact and structured). Perhaps add a table to shorten the text.
- Section 4.2.2 should be better weighted (better incorporate the amount of text compared to the number of figures).
- In comparison Section 4.2.3 is extremely brief and all information is shifted to the Supplement. → I get the general impression that Sect. 4.2.1-4.2.3 must be better weighted and the text must be improved and more compact written. Sometimes hard to follow for the reader.
- Sometimes the numbers for statistics are rather low (number of strong cyclones, see minor comments). Comment on this!
- Perhaps it would also be useful to show observed ozone time series for the whole months of your case studies?

Your results must be very sensitive to the vertical distribution of ozone in the tropopause layer (reanalysis data). Have you investigated this in detail? How accurate are the reanalysis data at these altitudes?

Minor comments and technical corrections:

Page 2, line 7: Add also the mean latitude for the Icelandic low, since you also give this for the Azores High (line 9).

Page 2: Add this reference to your discussion: Trickl, T., O. R. Cooper, H. Eisele, P. James, R. Mücke, and A. Stohl (2003), Intercontinental transport and its influence on

C2

the ozone concentrations over central Europe: Three case studies, *J. Geophys. Res.*, 108, 8530, doi:10.1029/2002JD002735, D12.

Page 3, line 25-30: What kind of instrument was used for the ozone measurements?

Page 3, line 29: Replace “pink” by “orange”.

Page 4, line 5: More clearly point out the difference between the present paper and Knowland et al., 2015.

Page 4, line 12-13: Add webpages for ERA-Interim, MACC, and MERRA-2 reanalysis.

Page 4, line 25: What does “cycle 31r2” mean?

Page 5, line 2: What does “cycle 36r1” mean?

Page 5, line 13: What is the explanation for the underestimate?

Page 6, line 2-5: Reorder the references in chronological order (and for same years in alphabetical order).

Page 6, line 11: Write out STFR.

Page 6, line 19: Reorder the references in chronological order.

Page 6, line 27: “<1000 km” in what time?

Page 8, Figure 1: The letter size of lat and lon numbers is too large compared to the track density numbers.

Page 9, Table 1: The number of strong cyclones used in the study is very low. Is this number high enough for your statistics?

Page 10, line 23: What does “SGF” mean?

Page 11, Table 2: Last column (right): “percent” → “Percent”

Page 11, Table 2: The number of years given in the brackets (SGF) is very low. Can

C3

you comment on this low number for your statistics?

Page 14, Figure 3 legend: Always mention latitude first and then longitude. Check this throughout the paper.

Page 15, Figure 4: It is very hard to recognize Ireland in the maps (especially in b and c).

Page 16, line 34: Not common to mention Fig. 6c before Fig. 6a.

Page 18, Figure 6: the letters “a”) and so on are too big in comparison to the numbers along the axes. Reduce this for all figures throughout the paper.

Page 18, Figure 6: In a) the white lines are very hard to see.

Page 19, line 27-29: This is a good example of the sentences that should be improved in this section (as mentioned in “Specific comments”).

Page 21, line 22: White contours are hard to recognize.

Page 21-26: In this section you present many figures, however very little text to the figures. Weight figures and text better.

Page 31, line 15-16: This sentence is somehow stand-alone. What is the message?

Page 31, line 18: “We have shown passing cyclones have” → “We have shown that passing cyclones have”

Page 31, line 26: For a better structure after “Specifically:” Add a “-“ to all small paragraphs that follow and use an insertion slide-in.

Supplement: Figs. S2c, S4c, and S6c are not very useful, since they are too dark.

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C4