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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Rarity of upper-tropospheric low O_3 concentration events during MOZAIC flights" *by* W. A. H. Asman et al.

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General Comments

This paper is a methodical study of the incidence of low ozone events in the upper troposphere, and with some more work might give interesting conclusions. However the authors do not follow up the study with a rigorous scientific analysis of the results. It is not obvious whether the questions that motivated it were answered.

Specific comments

Page 1632, lines 22-24: The mixing lifetimes for parcels of low ozone air with their surroundings are probably more relevant here than the photochemical lifetimes. Can the authors give some estimates of these?

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Page 1632, lines 24-25: Mixing may be even more important in convective situations. Are convective processes likely to lift low ozone air without entraining environmental air?

Page 1633, lines 1-8: The possible explanations given here should be referred to again in the conclusions to see which are the most likely.

Page 1636, lines 24-25: Back trajectories of longer than 5 days, while not as accurate, can still be useful e.g. Stohl et al. (2001) JGR 106 27757-27768; Stohl and Trickl (1999) JGR 104 30445-30462.

Page 1637, lines 2-7: Were satellite images not available for the other case studies? They would be invaluable for assessing the impact of convection.

Sections 3.1-3.11: These descriptions are very dry to read and would be much better condensed into tables and figures. Most of the numerical detail could be removed and added to table 1. The descriptions of the back trajectories were difficult to follow and might be better shown as plots. Table 1 would benefit from adding the dimensions of the events. The concentration vs time plots in figure 2, are not very illuminating to non-experts. I would suggest showing colour-coded lat/long plots superimposed onto maps. They need dates as well as times. Specific humidity information would be useful, as O1D+H2O is the major ozone sink in these regions.

Page 1638, lines 3-4: How likely is it? Longer back trajectories should be run to support this statement.

Page 1641, lines 5-10: This revisiting of the same event is very interesting and the implications (persistence, movement, extent) should be commented on in the discussion section.

Discussion and conclusions: More work is needed here. Are the 'source regions' for the air parcels expected to have ozone below 8 ppb? Probably if it's the tropical MBL. There is no discussion of the atmospheric chemistry. Is the standard NOx/HOx chemistry

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likely to lead to ozone production or destruction along the trajectories? Does this imply a need for extra destruction terms (halogen or heterogeneous chemistry)? What is the characteristic size of the events, what does this imply for mixing, or lack of, along the trajectories?

Page 1642, lines 5-8: This is a rather negative conclusion. Does this mean that the aircraft was not a suitable tool for this study? The problem is slightly of the authors' own making since the criteria were deliberately chosen to select only a handful of events. Would different measurement systems (sondes or lidar) be better tools? The conclusion is not strictly true anyway, as some general conclusions can be made, and are made later in the text.

Page 1642, lines 9-10: If some the of the flights encountered the same air masses, there might only be 7 distinct low-ozone air masses, rather than 11.

Page 1642, lines 16-19: This is a very interesting point and could be explored more. What other characteristics do these low ozone trajectories have that differentiates them from high ozone ones?

Page 1642, lines 19-20: The authors should look at satellite images to determine whether convection was important along the trajectories.

Page 1643, lines 1-6: The coincidence of these 4 flights could be useful. How far apart were the events measured? Were they isolated or could they be part of the same event? What does this imply about the scale of the transport? Is the source region generally expected to have low ozone values, are there any other measurements to support this?

Page 1643, lines 7-10: An estimate of the maximum relative humidity encountered could be obtained by using the measured humidity and the minimum temperature along the trajectory.

Page 1643, lines 11-16: Given this data, can the authors estimate what fraction of

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the flight segments that were influenced by tropical sea areas encountered low ozone events?

Page 1643, lines 16-21: Are there any physical/chemical reasons why the events might occur more often at higher altitudes. Generally ozone concentrations increase with hight. Would taller cumulonimbi be more efficient at transporting intact low ozone air parcels? Or would the weaker mixing in the upper troposphere give the humid air parcels more time to destroy ozone?

Interactive comment on Atmos. Chem. Phys. Discuss., 3, 1631, 2003.