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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Composition of the TTL over Darwin: local mixing or long-range transport?" *by* W. J. Heyes et al.

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General

Heyes et al. analyse measurements of O3 and CO over Darwin, Australia, in austral spring/summer 2005/2006 during the period of the ACTIVE campaign. Taking advantage of the specific lifetimes of O3 and CO, they seek to quantify the relative roles of local (convective) transport versus far-range transport. The manuscript addresses an important scientific question in a very straightforward way, arrives at important conclusions, and is generally well written. Therefore I recommend publication, but I would like the authors to carefully consider the following comments.

Specific comments

(i) The manuscript uses the terms "local", "far-range", "distant hot spot" and "background TTL" in a fairly carefree manner. These terms need proper definition. Most importantly, it seems that the manuscript uses the terms "far-range" and "background TTL" virtually as synonyms, with which I would disagree. For me, "background" implies the existence of a chemical composition where it is not possible to directly determine the origin of the air masses anymore, because "in-situ" (in-situ in the sense of a layer, not longitude/latitude; to avoid confusion with "local") processes (chemical, and mixing) in the layer of interest override whatever chemical signature the air had at entry into the layer of interest (in this case the TTL). Hence, the fact that you can show that tracer variations reflect different long-range transport histories argues against the existence of a "background TTL". Consequently, a statement like that in the abstract (L10ff): "Although ... no such signal was found in the background TTL, where ... correlated well with air mass origin ..." makes no sense to me. If the authors can make a convincing argument for their use of terminology I will accept it, but for now I urge the authors to re-think their terminology, and adjust it throughout the manuscript. Also, it would be helpful if the manuscript could indicate what spatial scale is considered "local" and what "long-range"; obviously, depending on perspective, the whole world may be perceived as "local" or "far-range".

(ii) The manuscript states that the TTL is ventilated by certain "hot spots". The obvious question then is: Is the Darwin region not also a "hot spot"? (After all, the motivation for the campaigns from Darwin were that at least the Tiwi Islands should be a hot spot, no?) Put another way: If you would measure in those locations identified as "hot spots", would you come to the same conclusions, namely that the air in the TTL in this region is fed by some distant "hot spot" - for the argument's sake e.g. the Darwin region? Such a paradoxical result (that you always have the impression

that long-range transport dominates, irrespective where you look) may arise if the sampling of observations may be such that the probability to see the effects of local events is low biased. (I.e. convection could have a diurnal cycle, and sondes could be launched predominantly "upstream" (both in time and location) of local events. Similarly, sondes launched after the local convection may simply be launched too late, such that advection has carried away the "local signature"). On the other hand, I could well imagine that Darwin is simply too peripheric to the Western Pacific warm pool and its massive convective fluxes (as e.g. seen in the analyses of source regions in the ECMWF-world shown by Fueglistaler et al. 2004/2005). It may not be possible for this work to give the final answer to these questions, but in any case, the revised version of the manuscript should at least discuss these issues.

(iii) A minor comment regarding the structuring of the document: In section 2, we are first given a hint as to why ozone is a tracer of interest (P7303, L20ff), but the discussion stops abruptly (what's missing is what happens to ozone (timescales) in the TTL), and no discussion of CO is given here (some information is given much later on P7311). This separation may has arisen as a consequence of the different platforms measuring the O3 and CO, respectively. However, I would suggest to combine the description of what can be learnt from O3 and CO, and to expand this section (scientific rationale), and integrate it with the description/definitions of "local", "long-range", and "background TTL".

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