

Interactive comment on “Highly resolved observations of trace gases in the lowermost stratosphere and upper troposphere from the Spurt project: an overview” by A. Engel et al.

Anonymous Referee #1

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GENERAL

This paper is the result of a great deal of good quality effort and has provided an extremely important set of data of trace species near the midlatitude tropopause. The paper clearly merits publication in ACP.

However, there are some overall comments which need to be raised here but which are described in detail in the SPECIFIC section below at the appropriate points. [1] While recognizing the virtues of PV/eq. lat. coordinates, there is value in also plotting the data in $\Delta(z)$ from tropopause versus latitude where possible. The reason is that a

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model-based PV definition of the tropopause necessarily imposes a continuity on the tropopause that is inappropriate in the light of vertical observations. These indicate that at least 15% of all profiles have ambiguous tropopauses. These very cases are often the ones that will tell you about cross-tropopause transport, but an observed tropopause is required. [2] Some statements imply discovery of phenomena that have been in the literature for years to decades, albeit not with the range of tracers reported here. References are specified below to support this contention.

SPECIFIC

Coordinates: {xxxx=page, yy-zz=line(s)} {5084, 9-26}: The overworld starts at about 460 K in the tropics, JGR 102, 13213 [1997]; JGR 108, Art. No. 4734, doi:10.1029/2003JD003399 [2003]; QJRMS 123, 1 [1997]. For the value of observed tropopauses see QJRMS 122, 929 [1996]. The presence of partially tropospheric air above the tropopause was evident in Brewer's 1949 paper and to others in the 1960s, 1970s, 1980s and 1990s. {5086, 17}: 'variability' includes all scales, not just the ones at lower frequencies than the low-pass filter inherent in a PV tropopause. See the MTP website <http://reductionism.net.seanic.net/bgary.mtp2/isentrop/mfa.htm>. Both the lapse rate and the isentropes have small scale structure. {5087, 3}: 'irreversible' appears to be a prejudice elevated to the level of an assumption. There is a great deal of evidence to the contrary, e.g. JAS 37, 994 [1980]. {5087, 15}: 'mixing' is a word that means different things to different people. At the very least, its use has to be accompanied by a minimum scale and at least two air mass origins. {5095, 17-21}: The facts reported here surely permit addressing of the virtues of an observed tropopause. {5099, 5-6}: Was this evident in the PV analyses, or is it an example of the virtues of a directly observed tropopause? {5099, 15-25}: I suggest plotting in geometric coordinates as well as PV/EL. See for example J Atmos Chem 1, 27 [1983] or JGR 105, 12169 [2000]. {5100, 5-18}: What was the surface mixing ratio from the CMDL data base? The occurrence of tropopause folds implies that it should be detectably greater; evidence exists in the literature that this is so. {5101, 4-18}: Nitrous oxide is widely be-

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lieved and observationally known to be a tracer in the LS. This is not so for ozone, and the discussion needs to reflect the difference. {5103, 16-27}: Again, it would be important here to plot relative to the observed tropopause. {5104, 10-22}: For gas-gas correlations as a function of lifetime, see JGR 109, D05310, doi:10.1029/2003JD003942 (2004) figure 6 - and your observations give you a lot of scope! {5104, 20-23}: As remarked above, there is a case here for not exclusively convoluting high resolution observations with analysed PV, particularly when accompanied by large scale modellers' orthodoxy. Instrumentalists should also offer their own direct interpretation and perspective based, for example, upon observed variability which is above the random error of the instruments. {5105, 4-22}: Brewer knew this, as did others cited above.

TECHNICAL

{5088, 11}: 'horizontal' {5090, 3}: 'anisokinetic' {5093, 28}: 'these ... data' {5096, 5}: 'denotes' {5097, 10}: replace 'close' by 'the' {5098, 5}: northbound 'leg'...

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