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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Variability of temperature and ozone in the upper troposphere and lower stratosphere from multi-satellite observations and reanalysis data" *by* Ming Shangguan et al.

Anonymous Referee #1

Received and published: 8 January 2019

Review of : Variability of temperature and ozone in the upper troposphere and lower stratosphere from multi-satellite observations and reanalysis data. Thank you for the pleasure of reviewing this paper. It is well written (with only a couple of English corrections), well laid out and has very good graphics. I very much like the usage of various satellite data, reanalysis data and comparisons with models to show if/how/where/when reanalysis data could be problematic for trend detection. The usage of a model with and without real time SST shows the role of dynamics and radiation upon the temperature and ozone variations over this albeit short period of 2002-2017. The great thing about GNSS-RO data is that it is unbiased and has been shown by several authors how its assimilation harmonizes the temperatures of the various reanaly-

ses from ∼2004 forward. Unfortunately, as the reanalyses migrate their temperatures toward the GNSS-RO values, any previous bias impacts the temperature trends from before to after the usage of GNSS-RO data. This word of caution is presented by the authors and can't be over emphasized.

I thought the authors do a great job presenting how the ozone and temperatures are interdependent and the roles of dynamics and radiation upon them. The ozone data sets used have both pros and cons. The conversion of number density to ozone mixing ratio is dependent upon the temperatures used. An erroneous trend in temperatures could impart an unwanted trend in ozone mixing ratio values. But that is a separate issue unrelated to the purpose of this paper.

Here are my line-by-line comments:

It is my understanding that GPS-RO is a particular type of radio occultation and that the more general Global Navigation Satellite System (GNSS-RO) should be used to cover all types of RO satellite systems.

Page 3, Line 7: Replace 'get' with 'be'.

Page 3, Line 14: Replace 'continues' with 'continuous'

Page 3, Line 21: Remove the 'a' in the phrase 'found decreasing ozone'

Page 3, Line 25: Is 'LS' defined earlier in the paper, otherwise use 'lower stratosphere'

Page 3, Line 26: Use 'increasing or declining'

Page 3, Line 30: Replace 'Although might be stil problematic' with 'Although it might still be problematic'

Page 4, Line 6: Replace 'recorded' with 'record'

Page 4, Line 12: 'In Sect. 3 we compare'

Page 4, Line 17: Replace 'Around one decade CHAMP' with 'Nearly one decade of

CHAMP'

Page 4, Line 19: Replace 'provides more than 10 times of' with 'providing more than then 10 times the number of'

Page 4, Line 27: Replace 'can be already captured by single satellite' with 'has already been captured by a single satellite'

Page 6, Line 12: 'qulaity' is misspelled 'quality'

Page 6, Line 15: Replace 'since' with 'beginning in'

Page 7, Line 3: Replace 'has been proved for a better representation to the detailed' with 'has been proved to better represent the detailed'

Page 7, Line 19: 'QBO coefficients'

Page 7, Line 20: 'a4' is the QBO30 coefficient, is there a missing solar term in equation 1 with a coefficient a5?

Page 7, Line 30: 'between reanalyses and from the GPS-RO data.'

Page 9, Paragraph beginning at line 3: Does the transition and use of MLS temps affect the MERRA2 trends? How does MERRA2 perform after vs before the use of CHAMP in 2004?

Page 9, Line 31: 'MERRA2', Do you have a reason why ERA-I trends are 'flat'?

Page 10, Line 29: 'estimated'

Page 10, Line 31: 'MERRA2'

Page 11, Line 1: 'At 10 hPa all the data sets'

Page 11, Line 11: 'confirmed by Table 1'

Page 11, Line 28: 'it does not assimilate as many ozone'

Page 12, Line 20: 'which is the reason of the positive'

Page 12, Line 32: 'SST's (Figures 15b-c).'

Page 13, Line 3: 'less ozone in the tropical lower'

Page 13, Line 7: 'SST increases are asymmetric in the two'

Page 13, Line 22: 'shows obvious improvements in reference to ERA-I'

Page 13, Line 23:'well known that are related to'

Page 13, Line 31: 'In contrast to the troposphere'

Page 14, Line 6: 'can be found for the two hemispheres'

Page 14, Line 13: 'supports'

Page 14, Line 17: Remove 'neither'

Figure 1: Label every other year on the X-axis; in the caption: 'between three reanalyses'

Figure 2+: Referring to previous figures should be capitalized: 'Same as Figure 1'

Figure 4: 'The two missions obtained'

Figures 1,2,3,13. It is hard to distinguish the black lines from the blue lines. Could another color or a lighter shade of blue be used?

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