Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2020-1075-RC2, 2020

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Structure, dynamics, and trace gases variability within the Asian summer monsoon anticyclone in extreme El Niño of 2015–16" *by* Saginela Ravindra Babu et al.

Anonymous Referee #2

Received and published: 14 December 2020

General:
This a very interesting and well-structured paper that should be published by ACP. It shows how a strong boreal summer ENSO event like that in 2015 significantly weakens the strength of the Asian summer monsoon anticyclone (ASMA). Typically, ENSO events happen during the boreal winter, so summer events, which are rather rare, may be important in a changing climate. The paper shows how the composition of air within the ASMA around the UTLS is strongly influenced by such a summer El Nino, with less tropospheric (CO, WV) and more stratospheric (ozone) signatures (all these quantities are derived from the MLS observations). Also the warming of the tropopause (lapse

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Discussion paper

rate and cold point) within the ASMA as derived from the COSMIC data is very convincing. Thus, I would like to recommend this paper for publishing in ACP by taking into account the following critical points. There are also few important formulation issues listed in the minor comments.

Major points

- In Figs 6-9, I would recommend to show which differences are statistically significant by comparing the difference with the standard deviation σ of the calculated mean value. Typically, hatched areas (e.g. by black dots) are used to show which differences are larger than 2σ.

Minor comments:

- Abstract, P1 L13
  In your abstract, you talk about the extreme El Nino 2015-16 event, so my impression was that you will discuss the winter part of this event...however your topic is much more the unusual summer start of this event...maybe you should reformulate your abstract, maybe something like this:

  A weak 2014/15 El Nino developed in 2015 to a strong boreal summer event which continued and even enhanced during the following winter. In this work, the detailed changes in the structure, dynamics and trace gases within the Asian summer monsoon anticyclone (ASMA) is delineated by using Aura Microwave Limb Sounder (MLS) measurements, COSMIC Radio Occultation (RO) temperature, and NCEP reanalysis products. Our analysis concentrates only on the summer months of July and August 2015 when Nino3.4 index started to exceed

1.5 values. The results show that the ASMA structure was quite different in summer 2015 as compared....

- Abstract, P2 L29-31
  ...and further supports...

  During a “normal” El Nino which typically maximizes during the boreal winter, there is a shift of convection from the Western to the Eastern Pacific, so something similar has to be expected for the summer El Nino...so this is for me one of the main reasons for the warming of the tropopause in the ASM region. Of course, changes in ozone you recognized follow this shift in convective patterns and also influence the tropopause temperature...

- P2 L36
  boreal summer, centered at 25N and extending....

- P2 L42
  Santee et al., 2017).

- P2 64
  ....Das and Suneeth, 2020). Most of the water vapor enters the stratosphere through....

- P2 68-71
  ....about the causative mechanism...????

  ....is mainly controlled by the advection and tropopause altitude...

  I think that the cold point tropopause mainly dominates the WV concentrations in the lower stratosphere. I would recommend to reformulate all statements related to Das and Suneeth publication

- P4 L78-105, Tweedy et al., 2018 versus Yan et al., 2018
  Maybe you should make more clear, even in the introduction, how to classify the

2015-2016 El Nino event: In my understanding there was a weak El Nino during the 2014/15 boreal winter which developed to strong boreal summer ENSO event (following the definition discussed in Tweedy et al., 2018). This summer ENSO event continued and even enhanced until the winter 2015/16. Thus, following the definition given in Yan et al., 2018, it was a long-lasting El Niño event because it lasted over two consecutive winters.

- P8 L180
  In a similar manner, we....
- P10 L194-195
  ...in August if compared to July.
- P10 L195
  ...over the northwestern Pacific...(see also L406)
- P10 L206
  ...as well as at 150 hPa...
- P12 L232
  ...of the westerlies.
- P12 L242
  Western Pacific (use large letters for geographic names)
- P14 Figure 5, caption
  please write correctly the PV units.
- P15 L277
  ...penetration....has started

- Figure 6 and Figure 7, captions
  please mention that PV is from ERA-Interim in Figure 6 and ozone from MLS in Figure 7

- General
  Sometimes you write O3 and sometimes O_3....

- P16 L289
  Further, we quantify the change in O3, CO and WV concentration...within the ASM during 2015 caused by the dynamical effects....and we do not need the last sentence, I think.

- P16 L295
  It is well-documented that the ASMA contains low (high)...

- P16 L298
  Differences of the trace gases within and outside of the ASMA are attributed to...

- P16 L301
  two times “strongly”

- P16 L303
  ...(Yan et al., 2018...)

- P17-19 L314-351
  There are few repetition in the text...you should also explain the strong negative values in Fig 7 probably related to a stronger upwelling in the BD circulation during this summer El Nino (see also Diallo et al., 2018). The sentence in L346 does not contain any verb....The sentence in L349-351 is confusing...

- P20, Figure 8 + text
  There is also a considerable year-to-year variability of the CO sources (biamass

burning) which may be also the reason for the CO anomaly in 2015, see e.g. Santee et al.,JGR, 2017....maybe you would like to discuss this point.

- P21 Figure 9
  There is a significant enhancement of WV in the tropics, probably related to warmer tropical temperatures following EL Nino. For the typical winter El Nino a positive water anomaly is expected in the tropical tropopause region (see Randel et al. 2009 or Konopka et al., 2016), so something similar can be expected for a summer El Nino

- P22 L389
  ...we tried to...please reformulate

- P22 L395-96
  It is well-documented that...are occur (?) This sentence is confusing

- P22 L401
  Kindly noticed...please reformulate

- P22 L406
  Nortwestern Pacific

- P23 L415-416
  During winter El Nino, there is a shift of convection from the Western to the Eastern Pacific, something similar has to be expected for the summer El Nino...so this is for me one of the main reasons for the warming of the tropopause in the ASM region (less convection). Of course, changes in ozone you recognized follow this shift in convective patterns and also influence the tropopause temperature

- P24 438
  in the stratospheric tracer (O3) within the ASMA..

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