

## ***Interactive comment on “The global overturning diabatic circulation of the stratosphere as a metric for the Brewer-Dobson Circulation” by Marianna Linz et al.***

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### **Interactive comment on "The global overturning diabatic circulation of the stratosphere as a metric for the Brewer-Dobson Circulation" by Linz et al. 2018**

This study uses the recently introduced new metric of the BDC, the global overturning diabatic circulation, and investigates its relationship to more traditionally used metrics of calculating the BDC (i.e. different TEM residual circulation metrics). The authors show this relationship for a state of the art climate chemistry model (WACCM) and also for three different reanalysis data sets (ERA-Interim, MERRA, JRA-55). Comparing the different TEM metrics to the global overturning diabatic circulation, they found mainly

C1

good agreement in the middle and higher stratosphere, while in the lower stratosphere the difference between the methods is substantial (with highest differences in the reanalysis products). Moreover this paper includes a very nice analysis about the correlation of the diabatic circulation with water vapor tape recorder and also with total column ozone. The results are well organized and described and the topic is appropriate certainly of interest for ACP. I recommend publication with consideration of the specific comments below.

#### **Specific comments**

Pg. 2, line 18: '... transport processes such as mixing'. Please include some literature here.

Pg. 2, line 25: You use different terms for 'global overturning diabatic circulation' in the text, e.g. total overturning circulation, total global diabatic circulation, diabatic overturning circulation, diabatic circulation, global average overturning circulation. Perhaps it is easier for the reader to use the same term in the entire text.

Pg. 4, line 4: What is the horizontal resolution of the model?

Pg. 4, line 26: I do not understand how the QBO influences the correlations between diabatic circulation and other TEM calculations? As I understand, the QBO should have the same influence on the interannual variability of all BDC metrics, and thus it should not influence the correlations, or?

Pg. 5, line 1: Tropical Leaky Pipe *Model*: Perhaps you could shortly explain the TLP model.

Pg. 5, line 6: It would be nice to have an additional sentence about the advantage that the global mean overturning circulation can be assessed from observational data (so you can refer to the statement made at Pg. 4, line 32).

Pg. 7, line 9: Reword to '... primary diagnostic of the stratosphere for models and observations'. And what do you mean with TEM diagnostic from observations?

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Pg. 8, line 6: Can you explain why you use 30N/S as latitude band? Do you know how sensitive the calculations are if you vary the latitude band to 20N/S or to turn around latitudes?

Pg. 8, line 22: Do you know the reason why it is important for the model and not for reanalysis?

Pg. 8, line 35: Could you mention how the radiative heating was calculated in Rosenlof (1995), e.g. with a radiative transfer model?

Pg. 9, line 16: Could you explain, why the correlation is worse when calculated with higher frequency data? What does the study of Ming et al. say about this issue?

Pg. 12, line 2: It would be easier for the reader, if you could repeat the time period for which the trends are calculated (i.e 1980-2014) here? It was only mentioned in section 2.

Pg. 12, line 4: Abalos et al. 2015 do not look exactly at the same time period (1979-2012) when looking at trends. Moreover QBO and ENSO variability were removed in Abalos et al. 2015. Is it possible that these facts could also explain the mentioned differences in the trends?

Pg. 12, line 9: You mention, that isentropic levels are changing their location over these decades. Did you check this for the data you are using?

Pg. 14, figure 6: Why was the correlation only done with  $w^*$ , and not with the other TEM residual circulation metrics?

Pg. 15, line 13: Can you explain, why you do not use ozone concentrations from the reanalysis? Correlations of reanalysis data (shown in Fig. 7a-c) would perhaps become better, when the data are more consistent.

Pg. 16, line 2: Perhaps you could add a sentence about, how correlation of ozone with the TEM calculations do look like? Or is there a reason why you didn't look at these correlations?

Pg. 16, figure 7: I am not sure, but perhaps an additional plot of the vertical profile of the diabatic circulation and the latitudinal distribution of the O3 column would be nice, to have an idea how they look like.

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Pg. 17, line 17: Could you define stratospheric entry levels?

Pg. 17, line 30: Can you explain why cooling leads to more ozone production? (Or is that clear to everyone?)

Pg.18, figure 9: Please give the correlation value within the plot (as done in figure 5)?

Pg. 20, line 3: '... *metrics for the strength of the BDC*. In particular, we have examined ..... and the total column ozone concentrations.' Ozone column is not a metric for strength of BDC. Please reword the sentence.

Pg. 20, line 19: '...., which can have complication with convergence.'. Can you explain?

Pg. 20, line 30: '... in observing systems.' Some more explanation would be nice, or give a relevant citation.

### Technical corrections

Pg. 2, line 1: Change 'gases' to 'trace gases'

Pg. 2, line 4: 'surface circulation' – Do you mean surface climate?

Pg. 2, line 11: Perhaps you can reword this sentence, I did have problems to understand it.

Pg. 2, line 20: Change to 'age of air'

Pg. 2, line 26: Perhaps change to '*stratospheric* circulation strength'

Pg. 2, line 31: 'TTL' – tropical tropopause layer (TTL)

Pg. 2, line 33: '10S-10N'

Pg. 3, line 5: *stratospheric* circulation

Pg. 3, line 6: Remove 'it'

Pg. 3, line 15: *stratospheric* circulation

Pg. 4, line 5: Spelling: 'prescribed *observed* sea surface temperature'

Pg. 4, line 7: Change to 'model *simulation*'.

Pg. 4, line 17: Change to 'heating *rates*'.

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Pg. 4, line 30: 'circulation *on* isentropes'. There was one 'on' too much.  
Pg. 5, line 1: Perhaps change to 'age *of* air tracer'  
Pg. 6, line 2: Change to '...is *outputted* differently'.  
Pg. 7, line 19: Change to '*zonal mean wind*'  
Pg. 8, line 7: Change to '...at *all* levels.'  
Pg. 9, line 2: 'Abalos et al.:' the year of the citation is missing  
Pg. 9, line 6: Replace 'plots' with *panels*.  
Pg. 9, line 21: Change to '...*is* weak'.  
Pg. 12, line 4: 'ERA-*Interim*'  
Pg. 12, line 8: Change to '...for the vertical *residual* velocity'  
Pg. 15, line 3: Change to '*before mentioned*'  
Pg. 17, line 2: Change to '...couple *of* individual ...'  
Pg. 17, line 24: Perhaps change to *Figure 9(a)* shows ...' This is optical easier to read.  
Pg. 17, line 25: Perhaps include '....weaker *negative* relationship'  
Pg. 19, line 8: Change to '... with *reanalysis and model data*'  
Pg. 20, line 6: Remove one 'on' in '....based on the ...'