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## ***Interactive comment on “The latitudinal structure of recent changes in the boreal Brewer–Dobson circulation” by C. Shi et al.***

### **Anonymous Referee #2**

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Review for “The latitudinal structure of recent changes in the boreal Brewer–Dobson circulation” By Shi et al.,

General Comments In this study authors try to explain anonymous changes stratospheric HCl and H<sub>2</sub>O over last few years. Authors use observation-based GOZCARDS data and ERA-interim dynamical fields to argue that there are significant changes in the stratospheric circulation (or Brewer–Dobson (BDC) circulation). They argue that weakening on tropical upwelling caused by TTL warming (hence increasing trend in the stratospheric H<sub>2</sub>O) but enhanced downwelling caused increase in mid-latitude stratospheric HCl.

Some aspects of this study are quite good but overall authors fail to explain their results

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more clear way. There is no limit on number of figures or words. So authors should include detailed analysis of each aspect of their results. Most of the sections/sentences seem to combination of different ideas and there is no clear flow in their arguments. Presenting all the analysis in just couple of figures also does not help. Some references are cited just for sake of it and some are cited only after reading the abstract. Results presented in Mahieu et al (2014), clearly show increase in mid-latitude age of air throughout the NH stratosphere. Their analysis does not show any differences between the shallow branch and the deep branch circulation. Can you please explain why your results differ as you are also using ERA-interim data. Authors also forgot to include careful analysis of H2O trends presented in Hegglin et al., 2014. Overall I think this manuscript needs major revision before it is accepted to ACP.

#### Minor Comments

Page 24404 1. Line 5-6 Confusing sentence: "Climatologically, a symmetric weakening BDC indicates increasing tropical lower stratospheric WV and decreasing extratropical middle-lower stratospheric HCl" 2. Line 14-15: enhancing polar vortex? Do you mean strength of polar vortex? But when? early winter/mid-winter or late winter? 3. Line 16: What is regressive temperature increase? Where is your regression model. What terms are included? 4. Line 23: aren't you contradicting yourself with Solomon et al., 2010?

Page 24405 5. line 21: Do you know why? Page 24406: 6. line 2 and 3: Confusing link between Waugh et al., (2007) and deep BDC. Please revise 7. line 16-21: Can you please comment on various biases in GOZCARDS data. For careful and detailed analysis WV trend using satellite data, please see Hegglin et al., 2014 (Nature Geoscience) 8. line 24-26: Using monthly mean data to calculate EPF and TEM is pointless. You should use daily fields and then calculate monthly mean values

page 24407 9. line 5: Which data are you using? NCEP or ERA-interim?

page 24408: 10. line 3: Linear regression is used to calculate correlation? why not

simple rank-correlation. Give detailed expression for regression model.

11. line 8: BDC increase in 1993 to 1999: This is not correct. We have some of the coldest winters during this period e.g. 1996, 1997. Overall scientific understanding is that ozone losses increased tropics-to-pole temperature gradient, hence Arctic vortex got stronger. Only two years 1998 and 1999 showed enhanced wave activity. Do you have any reference to support your argument?

Page 24410 12. line 10-15: WV trends? Do you think Randel et al., 2006 or Dhomse et al., 2008 are incorrect to show increase BDC caused decrease in stratospheric water vapour after 2001?

Figures

13. Figure 1a: For which years linear lines are fitted?

14. Figure 1b: Why 25 month smoothing?

15. Why do you want to have all the analysis in two figures. Please separate EP flux analysis as a new Figure

16. Can you please explain if the EP flux analysis shown in Figure 1 are from NCEP or ERA-interim. Do you use daily fluxes or just use monthly mean fields. Also I think better to use anomalies, not the absolute values.

17. Plot U winds anomalies and EP flux anomalies separately.

18. Figure 1f and 1h- 3 and 5 year running means. I assume you are using earlier years from ERA-interim for pre-2001 time period but how are you truncation last 5 years. Those end points must be skewing the time series

19. Figure 2a: Can you please comment on quality of H<sub>2</sub>O data from GOZCARDS. As it is combination of SAGE/HALOE and MLS. But as soon as you add/remove satellite data, GOZCARDS seems to show strange behaviour. I think authors should carefully read GOZCARDS related document and should comment on those biases?

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20. What residuals are almost similar to absolute values. Your regression model seems to have some problem.

21. Why do you use only solar term?

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