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Comment

## ***Interactive comment on “Variability of the Brewer-Dobson circulation’s meridional and vertical branch using Aura/MLS water vapor” by T. Flury et al.***

**Anonymous Referee #1**

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An analysis of upward and meridional transport of water vapor from just above the tropical tropopause is presented based on Aura/MLS data. The authors employ a lag-correlation method to extract the (apparent) upward and meridional transport velocities and analyze their interannual variability. A strong QBO signal in these velocities is found which manifests itself in an out-of-phase signal between the vertical and meridional velocities. The authors interpret these relations in terms of the secondary meridional circulation induced by the descending shear zones within the QBO.

The analysis and results presented are interesting, especially in light of Brewer’s original work which was concerned with water vapor transport. However, I find the implied

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interpretation of the inferred tracer transport velocities conceptually problematic in the following ways.

1) The vertical transport velocity is related to the tape recorder signal due to slow cross-isentropic (diabatic) ascent. The meridional transport velocity, on the other hand, is related to along-isentropic dispersion / mixing between the tropics and mid-latitudes. The former transport is advective in nature (justifying the term 'tape recorder'), the latter is diffusive in nature. The net transport of the quasi-horizontal dispersion is poleward, but mixing by definition is bi-directional. That is, some mid-latitude air is mixed into the tropics at the same time that tropical air is mixed into mid-latitudes. This process will have a tendency to homogenize background gradients in tracer fields with corresponding changes in local tracer mixing ratios. An important consequence of the above is that the here inferred (apparent) vertical velocity needs to be interpreted very differently from the inferred (apparent) meridional velocity. I feel that a discussion of these conceptual differences needs to be included in the manuscript.

2) The diffusive nature of the meridional transport leads to dilution of the tape recorder signal (see the discussion in Mote et al. 1998, JGR). As such the vertical and meridional transport velocities as diagnosed by the authors appear to be naturally coupled. Obviously, the same does not necessarily hold for the actual transport velocities. This may offer a more fundamental explanation of the anti-correlation between the two inferred velocities observed by the authors. That said, the QBO effect may still be manifested in the way discussed by the authors, but may not constitute the ultimate cause of the anti-correlation.

3) Meridional transport from the tropical tropopause is not the only way for air to reach the 100 hPa level in mid-latitudes. Vertical (diabatic, advective) transport from above as well as meridional transport from further poleward (quasi-adiabatic, diffusive) both influence the tracer mixing ratio at 100 hPa in mid-latitudes. It is not clear to me how the inferred meridional transport velocity should be interpreted given this issue. If the authors feel that  $v$  can still be inferred in the way they propose then at the least, this

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issue should be reflected in the uncertainties of  $v$ .

The above points need to be addressed and require adequate discussion in the manuscript.

Minor Comments:

page 21293:

L9: (also at other places) I don't understand why the meridional transport should be expected to be symmetric - wouldn't you generally expect asymmetry in the wave-driving between the hemispheres?

L27: the observations go back to 1960, the BDC itself has varied before that

page 21294:

L1/2: as far as I understand different modeling groups present different reasons for the BDC enhancement

L7: the actual statement in Engel et al. is that no significant trend could be identified (even though the trend value was positive)

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Interactive comment on Atmos. Chem. Phys. Discuss., 12, 21291, 2012.

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