

Replies to the comments:

We thank the reviewer for the comments. In the following, the comments are included in black while our replies are given in blue.

General comments:

Based on both observations and simulation, this work highlights an isolated enhanced annual variation of stratospheric water vapor in the middle and upper stratosphere. The authors have clearly explained the mechanism of AO maximum primarily by the variation of deep BD circulation. This annual variation signature and its hemispheric asymmetry feature can be a useful diagnostic tool to validate models. The paper is well written and the materials sufficiently support the conclusions. I suggest publication only with a few minor revisions.

Specific comments:

Comment #1: One concern is whether the location of the enhanced annual variation has some shifts from year to year based on MIPAS observation and EMAC? Although the author pointed out the averaged peak location is slightly lower in EMAC simulation than MIPAS, do they have similarity of inter-annual location shifts (or amplitude)?

Response #1: So far we have not performed any investigations beyond the climatological view. As responded to reviewer #1 there is a genuine interest to look into inter-annual variation and longer-term variability more in detail, in particular from the satellite point of view. The assumption is that with the anticipated changes of the Brewer-Dobson circulation also the enhanced annual variation will change (shift in latitude and/or altitude, size of the amplitude).

Comment #2: As pointed out by the first reviewer, Figure 12 should be consistent with Figure 8 where the negative winds used dashed white lines.

Response #2: Thanks for pointing this out. This has been fixed.

Comment #3: In the last schematic figure, I am confused by the grey oval showing the NH enhanced AO. I suppose it should not be symmetric with SH one (black oval) like Fig. 1 or Fig. 7. Or, the authors just intend to show the corresponding NH location to SH enhanced AO?

Response #3: The intention was to show the inter-hemispheric differences at 15° latitude. The caption has been rewritten to make this more obvious.