

This paper presents a novel study diagnosing stratospheric aerosol processes in a GCM using circulation and temperature perturbations associated with the QBO. Results show coherent variability among aerosol parameters (mixing ratio, area and number densities, effective radius), along with microphysical processes and precursor gases. I like the methodology of compositing variability relative to the QBO, and the physical explanation of associated processes throughout the paper. This is a useful study for diagnosing and understanding the complicated processes influencing stratospheric aerosols in the model (and in the atmosphere). Overall the methodology is clearly explained and the paper is well written, and I recommend publication. I have several comments / suggestions for the authors to consider in revision:

More important:

- 1) It is often difficult to interpret the magnitude of variations in the (color) height vs. time lag plots with small labels (Figs. 4-11), and it is too much work for readers to determine if the variability is large or small. The authors might consider making these plots in % of the respective background values.
- 2) I had difficulty in understanding the take-home message of the CCMI data results in Fig. 6. Both the climatological mean and the composited QBO variability are substantially different from the model results in Fig. 5. I do not worry about the statistical significance of the model results because the QBO is the dominant variability, but I am less convinced about the observed data, where the patterns look confusing and noisy. Can the authors evaluate the statistical significance of the QBO variations in Fig. 6b, and critically assess the ability of these data to constrain the model results?
- 3) The overall results are probably intuitive to experts on stratospheric aerosols, but less so to the general reader. It might help to complement the Discussion section with a summary figure or cartoon highlighting the important aerosol processes and their physical links identified in this study. What are the explicit 'non-linear relationships' mentioned in the Abstract and Discussion section?

Minor suggestions:

- 4) p. 16255, lines 1-2: it is not easy to identify the 5 km height difference in aerosol mixing ratio in Fig. 3. One suggestion might be to add a figure simply comparing the vertical profiles of mixing ratio for snapshots of QBO east and west phases.
- 5) Regarding the ozone QBO above 20 hPa: because the ozone photochemical lifetime is short above this level, ozone chemistry is important or dominant in this region, rather than the direct effects of transport (transport influences species such as NO_y, which in turn influence ozone).
- 6) p. 16261, line 2: 'interfere' rather than 'infer'?
- 7) In addition to Fig. 8, it might be useful to show the aerosol size distributions for extreme QBO phases (perhaps at one or two altitudes where the changes are large).
- 8) I could not find any reference or discussion of the DMS results in Figs. 11 e-f.