Authors Response

Review: Review Report

This paper proposes a new Volume Velocity Processing method in spherical coordinates to improve the wind retrieval in MLT. Its performance is compared against the conventional VVP method in plane geometry and the 3DVAR+DIV method, which result shows that the proposed SVVP method generally resolves more variability than the conventional VVP, and provides a more robust framework than 3DVAR+DIV for the study of MLT dynamics in terms of longer time series. The manuscript is generally well written. My main concerns are as follows:

General Reply: *We thank the reviewer for the review of the submitted manuscript. The major contribution of the manuscript is the implementation of the VVP in spherical coordinates as SVVP, addressing geometric limitations of the conventional planar VVP approach for wind retrieval in the MLT region. We have revised the manuscript, addressing the concerns in detail below. We have added a figure presenting the error distribution for VVP and SVVP, which demonstrates the improvement in retrieval error achieved by SVVP. Furthermore, we revised the 3DVAR+DIV section concerning the vertical wind to emphasize the difference between instantaneous spatially resolved vertical winds and climatological patterns inferred from SVVP and VVP.*

Comments:

Review: Major Comments

Reviewer Comment: The caption of Table 1 should appear on top of the table. Moreover, it would be nice to see the relevant parameters of the radar antenna beam as well.

Response: *We thank the reviewer for pointing this out. We have moved the caption to the top of the table. All systems use circularly polarized Yagi antennas. We also added a column for the baseline of the Jones cross in λ.*

Reviewer Comment: The authors demonstrate the difference between SVVP and VVP clearly, notably for the retrieval of the vertical wind component. However, their superiority cannot be intuitively judged due to the lack of comparison with the 'actual' wind field.

Response: *We have submitted a companion paper in which the SVVP retrievals are validated against the Japanese Meteorological reanalysis (JAWARA) and a free run of SE-WACCM-X. The present manuscript instead focuses on geometry imple-*

mentation in the SVVP and VVP differences, and on comparing SVVP with VVP and the potential to improve the 3DVAR+DIV. We only argue that the vertical climatology appears to be more reasonable compare to the VVP.

Reviewer Comment: The comparison against 3DVAR+DIV is not straightforward, since they are two different frameworks. The advantages/disadvantages of SVVP w.r.t. 3DVAR+DIV should be highlighted.

Response: *We thank the reviewer for the comment. We have stated the underlying differences in the 3DVAR+DIV and SVVP frameworks. We revised the manuscript to clarify the advantages and disadvantages of each approach, which has been included in the revised manuscript. Furthermore, we used the opportunity to add analysis for the 3DVAR+DIv data to avoid too much misinterpretation.*

Reviewer Comment: The authors demonstrate the importance of geometric effects. The contribution of geometric effects to wind retrieval errors is not well addressed.

Response: *We thank the reviewer for raising this point. We have added figure 1 to show the contribution of geometric effects to the wind retrieval errors. It compares the per-fit error distributions of VVP and SVVP for both the zonal and meridional wind components. Both algorithms achieve almost similar error distributions after 8 iterations. Zonal winds tend to show smaller errors in the SVVP, while meridional winds show smaller errors in the VVP. However, the distributions exhibit only marginal deviations. This is understandable, as the quality of the fitted model coefficients does not depend on the geometry, but their physical values do.*

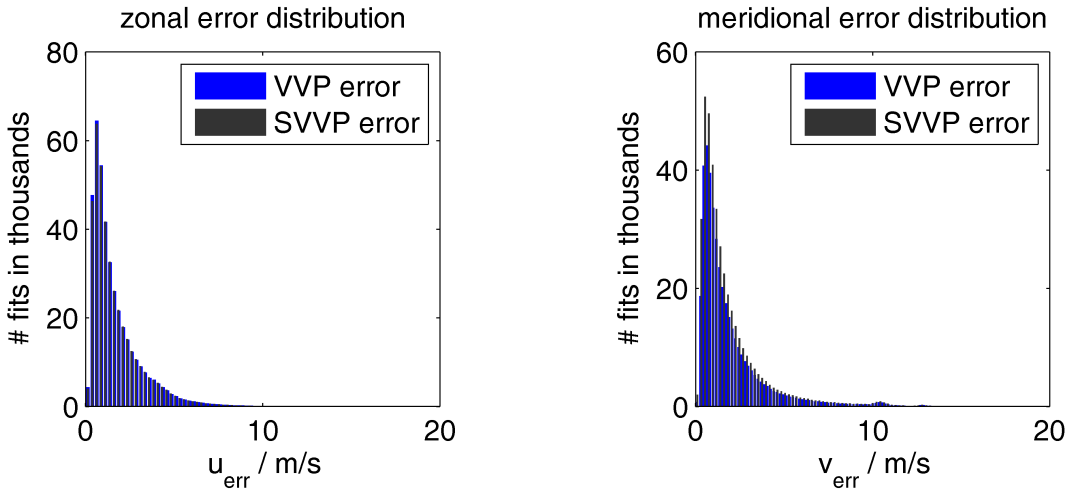

Figure 1. Comparison of fit-error for the zonal (left) and meridional (right) wind components retrieved by SVVP and VVP. The top row shows scatter plots of per-fit error for SVVP and VVP, while the bottom row shows histograms of the corresponding error distributions: VVP (blue) and SVVP (gray).