

The authors have satisfactorily addressed my previous comments. This work is a valuable contribution to the community's understanding of water vapor anomalies above Northern Hemisphere summer monsoons. I have a few minor comments that the authors should address prior to publication.

~Stephen Bourguet

Minor comments:

-Line 9: "water vapor is predominantly controlled by local temperatures near the tropopause in the Asian Monsoon." Does this refer to water vapor across the tropics, or just water vapor near the Asian Monsoon?

-Line 14: "an underestimation of moistening due to convective ice injection may play a role in this region." Is there a reason to suggest that the link between convection and the reconstruction dry bias is specifically driven by ice injection? I would suggest making this statement more general if not.

-Line 43: "Our goal is to evaluate the role of the freeze-drying mechanism in the large-scale temperature and wind fields for the enhancement of stratospheric water vapor over the ASM and NAM regions from a Lagrangian perspective." This study explores water vapor anomalies throughout the UTLS, not just the stratosphere. I think the region of the study (i.e., the UTLS) should be made clear here to prevent readers from focusing only on results in the stratosphere.

-Line 55 and throughout the text: The term "deep tropics" is misused. This refers to the region within the tropics closest to the equator (e.g., 10S to 10N). It would be sufficient to just refer to the study region (35S to 35N) as the tropics.

-Line 65: "How well can stratospheric water vapor mixing ratios in the ASM and NAM as observed by SAGE III/ISS and MLS be reconstructed using a simplified Lagrangian modelling method...." Similar to a previous comment — does this study aim to focus on the stratosphere or the UTLS? This distinction matters for the analysis, especially given the emphasis on reconstructions at 16.5 km in Figures 1, 5, 6, and 8. (16.5 km is below the cold point tropopause across the tropics.) If the study is intended to focus on the stratosphere, then the analysis needs to be done above the cold point tropopause.

-Line 205: The term "tropical tropopause layer" is used incorrectly here and in the following discussion. The TTL spans 150 hPa to 70 hPa, or 14 km to 18.5 km. It is not the layer between the lapse rate and cold point tropopauses.

-Line 236: "whereas small-scale mixing appears to be a more dominant contributor." This is not part of the analysis and is speculative. Why the focus on small-scale mixing here? What about, e.g., ice injection?

-Lines 347–348: "The locations of LCPs for the tropics (Fig. 5a–b) resemble an ensemble of those found in the ASM and NAM, suggesting that dehydration predominantly occurs near the

monsoon regions.” Figure 5 shows that the LCPs are concentrated around southeast Asia for each ensemble. It does not show LCPs for the tropical ensemble centered around the monsoons. Instead, Fig. 5 shows that cold trap dehydration mechanism (Holton and Gettelman, 2001) dominates the tropical trajectories (as is correctly noted in the following sentence).

-Lines 365–366: “ $OLR \geq 1.5$ standard deviations” and “ $OLR \leq -1.5$ standard deviations” would be more clear if stated as “ $OLR \geq 1.5$ standard deviations above the mean” and “ $OLR \leq -1.5$ standard deviations below the mean.” (Assuming that the mean is used.)

-Lines 438–442: This paragraph implies that the Lagrangian method is effective across the tropics. This needs to be qualified to acknowledge the method’s ineffectiveness in capturing the NAM water vapor anomalies.

-Line 465–466: “Hence, it is likely the underestimated moistening effect of ice injection of convection in the western region of the Asian monsoon which controls the dry bias of Lagrangian reconstructions in the ASM.” Convective ice injection is not part of the analysis, so this statement is speculative. Why the focus on ice injection here? Is it known that convection over the western sector brings ice particles to the UTLS?

There are a handful of typographical errors that need to be addressed:

-Line 8: “The main dehydration, region ...” should be “The main dehydration region, ...”

-Line 13: “dry bias in reconstruction ...” would read better as “the dry bias in reconstructions ...”

-Lines 59–60: Citations need to be in parentheses.

-Line 260: comma before “thus” should be a semicolon.

-Line 407: “simulates the conversion of excess water vapor to ice, and setting parcels to saturation within convection zones” should be “simulates the conversion of excess water vapor to ice by setting parcels to saturation within convection zones.”