Review of "Spatial and temporal variation in long-term temperature and water vapor in the mesopause Region" (egusphere-2024-1144) by Gul *et al*.

General Comments

This paper presents an analysis of SABER temperature and water vapor profiles in the mesopause region (80-100 km). Selected months (solstices, equinoxes) and geographic regions (Equator, North and South polar) are examined throughout the 22-year data record covering 2002-2023. Extreme values are determined on annual and monthly basis for geographic and seasonal comparisons.

This paper provides relatively little new information. Numerous studies have examined the SABER data set previously. It is not clear that the authors have adequately addressed the changes in SABER sampling over its long data record. The trend analysis is too simplistic, and does not consider multiple periodic forcing functions that also affect the long-term variations of temperature and water vapor.

Definite need for grammar to be polished. Not trying to address all such items in this review.

Specific Comments

Page 1, lines 25-26: As discussed later, this statement does not take periodic forcing terms into account.

Page 3, lines 83-86: These are old references that only address a specific location and time, and discuss altitudes below the mesopause region. Why are they cited?

Page 3, lines 94-95: But there are certainly long data sets from ground-based microwave measurements and satellites (e.g. HALOE, SOFIE) that should be discussed.

Page 4, lines 111-112: 40% is a substantial amount of missing data. Does this represent frequent small gaps, or less frequent large gaps? What dimension is used for averaging? Altitude? Time? What is the weighting function?

Page 4, lines 120-122: This statement repeats the previous sentence. Since a 60-day yaw cycle is not an even fraction of a 365-day year, the latitude coverage in selected months will shift over 22 years. Are each of your months fully populated during the full data record?

Page 5, lines 133-135: Any comment on why the 2002 profile is such an outlier in the first 4 panels of Figure 2?

Pages 5-6, lines 138-143: There is a significant and well-known solar cycle signal in mesospheric temperature (noted on lines 242-249) that will greatly affect any calculated trends. Your results (which do not include any uncertainty estimate) cannot be compared to previous trends unless this contribution is addressed.

Page 6, lines 154-156: This statement seems very simplistic, given that your “global” average only includes small latitude bands near each pole and at the Equator. There is also significant altitude dependence that can vary between months and years.

Page 8, lines 201-204: The large variation in water vapor mixing ratio over this altitude range (as shown in Figures 2b and 2f) means that a simple average will be dominated by values from the lowest portion of the profile.

Pages 8-9, lines 204-206: Solar activity-induced variations will greatly affect any calculated trends in water vapor, as discussed previously for your temperature analysis.

Page 9, lines 224-225: Where is this result shown?

Pages 9-10, lines 237-238: But Figure 2 only shows global averages, not individual latitude ranges.

Page 10, lines 238-239: Again, Figure 2 only shows results averaged over 80-100 km, so what is the basis for this statement?

Page 10, lines 252-254: There are numerous studies during the last 30 years with more advanced models.

Page 10, line 257: Table 1 mixes different selections for latitude coverage, seasonal coverage, long-term temporal coverage, and data sources. It is hard to know what conclusions could (or should) be drawn.

Page 12, lines 280-283: This statement says that you have confirmed previous work. Any new information?

Page 15, lines 335-338: See previous questions about shift in yaw dates during SABER mission and impact on sampling. Note that the April data in Figure 5b only begin in 2017. Is the large trend in September temperature and water vapor affected by sampling changes?

Page 17, lines 350-354: Water vapor content at these low altitudes (81-83 km) will be affected by sublimation of PMC particles that settle from higher altitudes.

Page 17, lines 375-376: Note that January/December is summer in the Southern Hemisphere, not winter.

Page 27, line 586: It’s not clear why you say “performed the measurements” when the paper only analyzes SABER data.