

RC1 Comments

(1) 1.44-51: Suggestion for future work:

You should compare ACE LOS winds with the Japanese JAWARA reanalysis that was developed in the frame of the ICSOM project. Unlike MERRA2, JAWARA assimilates data even in the upper mesosphere and therefore provides quite realistic winds even at altitudes somewhat above 100km.

<https://jawara.nipr.ac.jp/home>

Sato, K., Tomikawa, Y., Kohma, M., Yasui, R., Koshin, D., Okui, H., et al. (2023), Interhemispheric Coupling Study by Observations and Modelling (ICSOM): Concept, Campaigns, and Initial Results, *Journal of Geophysical Research Atmospheres*, 128(11), e2022JD038249, doi:10.1029/2022JD038249.

Koshin, D., Sato, K., Watanabe, S., & Miyazaki, K. (2025), The JAGUAR-DAS whole neutral atmosphere reanalysis: JAWARA, *Progress in Earth and Planetary Science*, 12:1, <https://doi.org/10.1186/s40645-024-00674-3>.

Thank you for the recommendation. We will consider this as a possible future project.

(2) Is there a reason why you are not comparing to TIDI winds?

TIDI has a much longer dataset than MIGHTI.

We compared with MIGHTI instead of TIDI for a few reasons. The main reason, in this paper, is that we are comparing ACE v.5.3 winds with MIGHTI to show the improvement from v.5.2, which were previously compared by Johnson et al. (2024). The reason Johnson et al. chose MIGHTI was due to a higher number of coincidences with ACE measurements in the given time range compared with TIDI. This was also noted in Boone et al. (2021), but there is potential to compare with TIDI in the future.

(3) 1.59-66: You should specify whether data from a free WACCM run were used in your study, or whether WACCM was at least nudged to analysis/reanalysis at low altitudes. This information

is important because, depending on setup, WACCM data may be closer or less close to the real atmospheric state.

L297 in the preprint, now L310, states SD WACCM-X 2.2 was used. Added a sentence to clarify that this model is altered by observations. It now reads as “Specified Dynamics (SD) WACCM-X Version 2.2 provides global vector winds in 3 hour intervals. This SD version of WACCM-X uses observational data to produce wind speeds closer to the actual atmospheric state.”

(4) In L.119 you mention that after homogenization ACE altitude profiles are shifted as a whole to match an analysis of the Canadian weather model at Environment and Climate Change Canada.

Please provide some information how large these shifts typically are.

The magnitude of the wind calibration shift was not tracked, so we cannot provide a typical value; however, we added an explanation. Now reads as: “As with previous processing versions, the final wind profile is shifted such that the results between 18 and 24 km match the expectations from an analysis run of the Canadian weather model at Environment and Climate Change Canada (Buehner, 2015). This is needed to account for the motion of the satellite relative to the atmosphere. A rough calibration of the ACE-FTS wavenumber scale is accomplished using high altitude CO₂ lines, but because this process uses sampled peaks (which may not be sampled at line centers), the calibration could be off by a fraction of the width of the instrumental line shape 0.02 cm⁻¹. The accuracy of this calibration will vary from occultation to occultation, but the wind calibration shifts can be as high as a few hundred m/s to compensate for the resulting offsets.”

(5) 1.203: What do you think is the reason for the mentioned outliers?

Added sentence to explain. Now reads as: “Data Set 2 used only the coincidences where the average difference between ACE and MIGHTI wind speeds was less than 60 m/s, leaving us with 184 sunrises and 196 sunsets. The outliers removed are typically associated with a limited altitude window for the MIGHTI measurement.”

(6) 1.207: Where do you think the sunrise/sunset biases come from?

Could this be some thermal drift of the satellite, or an effect of stray light that would be different between sunrise/sunset?

We are unsure about the cause of the sunrise-sunset at this time. It is something we plan on trying to solve in future versions.

(7) Another bias becomes evident in Fig.6b. At 100km ACE sunset winds are offset by 40m/s with respect to the radars. As measurements are coincident, this should not be an effect of atmospheric tides.

Do you have any idea where this offset comes from?

Added clarity so it now reads as: “Unlike the comparison with MIGHTI, the number of coincidences here is small, so the entirety of the coincident data set is considered. This means, unlike in MIGHTI where we removed outliers created by measurements with small altitude windows, outliers persist towards the edges of the meteor radar altitudes. This is best seen at 100 km in Fig. 6b, where the difference in Meteor Radar versus ACE is nearly 40 m/s at the top of the window.”

(8) In Fig.7a ACE v5.3 shows a strong 50m/s jump at 50km, not seen in V5.2, or MERRA2. How often do such effects occur? Do you have any explanation for this effect?

This is already addressed in the text: “Near 52 km in Fig. 7(a), there is a sharp eastward increase in ACE v.5.3 wind speed. This shift occurs at the boundary of segments 2 and 3. There was probably an issue at the top of the segment 2 retrieval or at the bottom of the segment 3 retrieval for this occultation.”

For clarity, rewriting as: “Near 52 km in Fig. 7(a), there is a sharp eastward increase in ACE v.5.3 wind speed. This shift occurs at the boundary of segments 2 and 3 and is likely an issue with the retrieval at the top of segment 2 or bottom of segment 3 (see Fig. 1) for this particular occultation.”

(9) About Fig.10a:

It is quite encouraging how well ACE captures the general global circulation patterns!

You should also mention that in September/October the winds in the tropics at 50km (eastward) and 80km (westward) are opposite. This is as expected from the vertical structure of the semiannual oscillation (SAO). See, for example, Ern et al. (2021), their Figs. 2 and 3.

It is also notable that the westward winds at 80km in the tropics are much stronger than in

MERRA2. From Ern et al. (2021), Fig.2 it looks like MERRA2 winds are strongly damped above 65km.

Added note and citation: “ACE measures the polar vortex near 30 km altitude in September-October. As expected, the vortex is weak in March-April. In September-October, the mesosphere is characterized by strong positive zonal winds in the whole hemisphere. It is well known that winds of the thermosphere are variable with local time. Because of ACE observation geometry, the sampled local times for sunrises (March-April) are typically between 6:00-~~am~~ and 9:00-~~am~~ and the sampled local times for sunsets (September-October) are typically between 15:00-~~pm~~ and 18:00-~~pm~~. For sunrises in March-April, the thermosphere zonal winds are positive around 100 km altitude and negative above. At sunsets in September-October, strong negative zonal winds are observed at 60° S and altitude 130 km. Notably, the winds in the tropics are in opposite directions at 50 km (eastward) and 80 km (westward) in September-October. This is representative of the vertical structure of the semiannual oscillation (Ern et al, 2021).”

(10) Data availability section is missing.

Added section. Text reads as: “ACE v.5.2 and v.5.3 wind data can be found on the SCISAT webpage (<https://database.scisat.ca>) within the Level 2 Data.”

TECHNICAL COMMENTS:

1.26: atom oxygen -> atomic oxygen

Corrected.

1.228: able compare -> able to compare

Corrected.