

# ***Interactive comment on “MIPAS observations of longitudinal oscillations in the mesosphere and the lower thermosphere: Part 1. Climatology of odd-parity daily frequency modes” by Maya García-Comas et al.***

## **Anonymous Referee #1**

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This paper presents tidal proxies in MIPAS temperatures inferred as global ascending-descending node differences. The authors explain how these differences highlight diurnal and terdiurnal ("odd") harmonics, and present longitudinal spectral decompositions as a function of latitude, altitude and month. The novelty of the work lies in the presentations of MIPAS thermospheric temperatures, the first such results presented above 100 km. This paper is very pertinent to thermospheric dynamics and energetics, and should inform tidal modeling and studies of vertical coupling. I recommend publication after the comments below are addressed, and after a more thorough editing for English grammar.

1. Abstract, line 9-10: The data do not inform you of the QBO transmission process; only the facts should be reported. Change to "...4) a quasi-biennial oscillation of the migrating tide in the stratosphere and the MLT."

2. Lines 35-36: "Tidal inter-annual variability is thought to be correlated with the El Nino-Southern Oscillation (ENSO)"

The following paper demonstrated clearly how ENSO causes tidal variability.

Lieberman, R. S., D. M. Riggan, D. A. Ortland, S. W. Nesbitt, and R. A. Vincent (2007), Variability of mesospheric diurnal tides and tropospheric diurnal heating during 1997–1998, *J. Geophys. Res.*, 112, D20110, doi:10.1029/2007JD008578.

3. Lines 47-48: "The extent to which tides propagate from the lower atmosphere to the thermosphere or to which changes in lower altitude regions are transmitted by tides to the upper atmosphere or to other latitudes is not completely known."

The following papers should be cited in this section:

Talaat, E. R., and R. S. Lieberman (2010), Direct observations of nonmigrating diurnal tides in the equatorial thermosphere, *Geophys. Res. Lett.*, 37, L04803, doi:10.1029/2009GL041845.

Lieberman, R. S., J. Oberheide, and E. R. Talaat (2013), Nonmigrating diurnal tides observed in global thermospheric winds, *J. Geophys. Res. Space Physics*, 118, 7384–7397, doi:10.1002/2013JA018975.

Lieberman, R. S., D. M. Riggan, D. A. Ortland, J. Oberheide, and D. E. Siskind (2015), Global observations and modeling of nonmigrating diurnal tides generated by tide-planetary wave interactions, *J. Geophys. Res. Atmos.*, 120, doi:10.1002/2015JD023739.

4. Lines 58-70. This paragraph is extremely confusing, and should be deleted. The authors discuss sun-synchronous sampling before the MIPAS satellite and its orbit are

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even mentioned. Non-sun-synchronous sampling is not relevant here.

5. Lines 74-76: "Therefore, they provide a wealth of information on the tidal excitation mechanisms, the processes inducing tidal variability and the lower and upper atmosphere coupling through tides".

Delete this statement. The data cannot accomplish all of that on their own, only in combination with models.

6. Section 3, beginning. I suggest preceding line 34 with a BRIEF qualitative discussion of the consequences of sun-synchronous sampling. E. g., "Because MIPAS observations occur at 2 fixed local times, migrating tides (that depend only on local time) are seen as invariant features over the course of a day... We explore this and other ramifications of MIPAS sampling in the following discussion..."

7. Line 134: Sentence needs clarification:

"An atmospheric variable  $X$  consisting only of tides and a background state at altitude  $z$ , latitude, longitude and Universal Time (UT)  $t$  can be expressed as the sum of the background zonal mean value and the sum of all individual tidal components  $X_{s,n}$ , with zonal wavenumber  $s$  and wave frequency  $n$  at that position and time.."

8. Line 168: Delete "solution".

9. Lines 183-188: Delete.

10. Line 204-205. Change to "an oscillation tilting eastward with height..."

11. Lines 208-209: Change to "Fig. 1 exhibits wave features tilting westward with height (18 km vertical wavelength)..."

12. Lines 211-212: "This feature is difficult to notice..." Delete. In general, do not dwell on things that are not in the data.

13. Line 237: Delete "mainly".

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14. Lines 239-240: "including the information of the local time phase." This will confuse the reader, suggest deleting.

15. Line 254: Chapman and Lindzen predicted a vertical wavelength of 27 km for (1,1). Please specify where the observed vertical wavelength of "20-30 km" is smaller or larger than C & L's predictions.

16. Line 305: Change to "...and the zonal winds in the middle atmosphere.."

17. Line 330: Change to "They may originate..." and reference previously mentioned Lieberman et al., 2015. paper.

18. Lines 334-335: "The monotonical change in phase with altitude..." I suggest selecting 3 key latitudes -equatorial, and midlatitude northern and southern hemisphere - and generating line plots of the phase with altitude. That would make it much easier to see the phase tilt.

19. Lines 340-344: "Those features probably belong..." Delete.

20. Line 372: "MIPAS |nodd -s|=2 longitudinal oscillation embeds the diurnal DE1 and DW3 and the terdiurnal TW1 and TW2 components..."

No mention of TW2 is made in Table 1 for MIPAS wave 2, and the math I use (based on Salby's formulas) yields an alias of 1 for TW2.

21. Lines 373-374: "...both are most likely originated by non-linear interactions between their migrating counterpart (DW1 and TW3, respectively) and the s = 1 stationary planetary wave (SPW1)."

The verbiage here is very muddy. What do you mean by "both"? DE1 and DW3?

What are you proposing for the interactions? DW1 + SPW1, and TW3 + SPW1? Neither one of these produces DE1, DW3, TW1 or TW2.

22. Lines 375-376 ("Not many tidal analyses..."): Delete.

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23. Lines 406-407: "The phase dependence with altitude indicates contribution from an eastward propagating wave..." Again, show line plots at representative latitudes. It is actually quite difficult to determine phase tilt in contour plots. Also, the phase appears to be increasing with height in the southern hemisphere, and decreasing with height in the northern hemisphere.

Line 409: "Amplitudes from 115-150 km during December also exhibit eastward propagation." Do you mean to say here that the phases increase with altitude???

24. Line 432: Replace monotonically with "increasing".

25. Lines 437-438: "...phase moves westward as latitude increases... phase moves eastward..." Use phrases such as "phase increases/ decreases with latitude".

26. Lines 487-488: "The DE3 component should also present a QBO (Li et al., 2015) but small and it is not surprising that we could not detect it in MIPAS data." Delete.

27. Lines 520-524: "That suggest then that the effect on tides..." Delete these lines.

28. Figure 13: Convert to a line only at altitude of amplitude maximum.

29. Line 549: Delete "as expected".

30. Lines 576-577: "Comparison of tidal QBO and zonal wind stratospheric..." Delete.

In general the figures were much too small for a review copy.

1. Figure 1: Use monthname-day-year format rather than yyyyymmdd in the Figure titles.

2. I suggest either enlarging the latitude-altitude plots, or starting them at  $z = 60$  km. Since the amplitudes are very weak below 60 km, most of these plots are empty space, and they squish the more interesting behavior at high altitudes into too small of a space.

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