

Interactive comment on “Identification of gravity wave sources using reverse ray tracing over Indian region” by M. Pramitha et al.

M. Pramitha et al.

vratnam@narl.gov.in

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To identify the sources of gravity waves observed by optical airglow measurements over Gadanki (13.50 N) and Hyderabad (17.50 N) at altitudes of about 97 km, reverse ray tracing methods based on the equations described by Marks and Eckermann (1995) are successfully applied. In 9 of 14 investigated events the authors could identify that these waves are launched in the upper troposphere (10 – 12 km) at regions with large vertical shears of horizontal winds. In all cases studies investigated here, tropical deep convection has been excluded as possible sources for the upward propagating gravity waves. To get confidence to the results, the backward ray tracing estimations have been done by considering a realistic variability of winds and temperatures caused by

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tidal waves. The derived results are very interesting. Before publication in ACP the authors should extend their discussion, consider the following remarks:

Reply: First of all we wish to thank the reviewer for going through the manuscript carefully, appreciating the actual content of the work and for providing potential solutions for further improvement. We have taken care most of the issues suggested.

1. A broader discussion in connection with previous results is recommended. Reply: As also suggested by other reviewer we have included discussion related to wind shear generated waves while quoting relevant references in the revised manuscript.

2. As an example: Preusse et al., (2008) used GROGRAT to discuss the propagation properties of high frequency waves with short horizontal wavelengths and questioned whether these could possibly reach the mesopause region. In their Figure 2 they show that most GW with horizontal wavelengths smaller than 50 km propagating upward from the troposphere (5 km) or stratosphere (20 km), respectively, are evanescent at the sources or are reflected by wind shears and hence cannot reach altitudes of 80 km or higher during summer. How are their results related to the findings during these case studies?

Reply: We have compared our findings with that reported by Preusse et al., (2008) as suggested. Preusse et al. discussed the transparency of the waves to the atmosphere in different seasons. They reported that during equinox times atmosphere is more transparent to the high phase speed and shorter horizontal wavelength waves than that in the solstices. Further, horizontal wavelength less than 10 km and slow phase speed waves are less likely to reach MLT regions. However, the number of rays penetrating to the MLT peaks at the tropical latitude where wind speed is low in comparison to the mid and high latitudes. In our case, whenever phase speed is low for short horizontal wavelength waves, ray didn't reach up to the troposphere and it got stopped at mesospheric altitude itself. This has been discussed in revised manuscript.

3. Five of the total 14 wave events are restricted to mesospheric altitudes. A stronger

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discussion on the origin of these waves, e.g. as secondary waves, is recommended.

Reply: Thanks for this suggestion. We have included discussion related to secondary waves while quoting relevant references in the revised manuscript.

4. Following the suggestions given by the first interactive comment, it is recommended to delete Section 3 (which follows the appendix of Marks and Eckermann, 1995) and substitute it by an explanation and evaluation of the used program packet.

Reply: As also suggested by other reviewer, we have reduced the content of section 3 and tried to explain the used code to the maximum possible extent.

5. The English needs a revision.

Reply: We tried our level best to reduce the errors in the English usage in the revised manuscript.

6. P19592 L3 : The zonal, meridional and vertical wavelength are not provided in table 1 but can be derived using the values provided in table 1

Reply: Modified.

7. P 19593 Sect 2.3 To improve the readability it is recommended to explain that the OLR values are later shown in Fig 8.

Reply: Explained.

8. Page 19599 line 25 Runge-Kutta

Reply: Modified.

9. Page 19600 line 28 is nearly identical to page 19598 line 16

Reply: Deleted the repeated sentences.

10. Page 19606 line 18 Rayleigh

Reply: Modified.

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11. Figure 5c and f please add "at 97 km" Reply: Added.

References: Preusse, P., S. D. Eckermann, and M. Ern (2008), Transparency of the atmosphere to short horizontal wave-length gravity waves, *J. Geophys. Res.*, 113,D24104, doi:10.1029/2007JD009682. Interactive comment on *Atmos. Chem. Phys. Discuss.*, 14, 19587, 2014.

Reply: We have included this reference in the revised manuscript.

We once again thank the reviewer for going through the manuscript carefully as providing constructive comments which made us to improve the manuscript content further.

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Interactive comment on *Atmos. Chem. Phys. Discuss.*, 14, 19587, 2014.

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