

Interactive comment on “Atmospheric diurnal and semi-diurnal variations observed with GPS radio occultation soundings” by F. Xie et al.

Anonymous Referee #2

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General comments:

This manuscript presents an investigation of GPS radio occultation data on migrating diurnal and semi-diurnal variations. The authors use two years (2007 to 2008) of high-resolution refractivities and temperatures from the COSMIC constellation to analyze global characteristics of atmospheric tides in the troposphere and stratosphere on a monthly time scale. The scientific results (in particular atmospheric tides at low and mid latitudes) are interesting and important. However, I have serious concerns about the discussion of high-latitude results (including the Arctic and Antarctic region). Please consider the following comments.

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Specific comments:

1. My main concern is the interpretation about diurnal and semi-diurnal variations at high latitudes. The authors extensively discuss results at polar latitudes in Sections 4, 5, and 6.

The authors note that the average number of profiles in a monthly, 2-hour 5° latitude bin at 75°N amounts to 37. Since this number is the average number of profiles and COSMIC local-time sampling is irregular within one month at high latitudes, I conclude that there are some local-time bins with significantly less profiles available. Furthermore, the number of profiles beyond 75° latitude further decreases. I think that data sampling is too low to perform reasonable linear harmonic analysis.

2. It would be useful to provide the uncertainty of the derived amplitudes and phases at all latitudes and altitudes, since to my knowledge the highest quality of radio occultation measurements is obtained in the upper troposphere and lower stratosphere region. Furthermore, a discussion of the errors magnitude associated with uneven local time sampling at high latitudes is essential for the interpretation of tidal signals.

Technical corrections:

1. page 25410, line 4: insert a comma after Meteorology
2. page 25410, line 18: “solar” instead of “solor”
3. page 25410, line 20: “Polar regions show” instead of “Polar regions shows”
4. page 25411, line 4: “satellite radiance measurements”

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5. page 25411, line 6: please insert a comma after cloudiness
6. page 25411, line 10: "Chapman and Lindzen" instead of "Chapman and Linzen"
7. page 25412, lines 6/7: Kursinski et al. (1997) specify a vertical resolution of 1.4 km in the middle atmosphere (rather than 1 km)
8. page 25412, line 11: Pirscher et al. (2007) and Zeng et al. (2008) specify that the orbit configuration of CHAMP allows a complete 24 h local time coverage within 130 days. Zeng et al. (2008) further explain that due to the limb sounding measurement principle, the effective repeat period is obtained every 108 days at the equator. These numbers only refer to low latitudes.
9. page 25413, lines 6/7: As shown by Pirscher et al. (2009) local time sampling at high latitudes is insufficient and irregular within one month. This is because at high latitudes the ascending and descending branch of the orbit move closer together in terms of local time sampling.
10. page 25413, line 23: You describe occultation geometry for "setting" events (as the LEO receiver "sets" behind the horizon...), but COSMIC is also able to perform "rising" measurements
11. page 25414, line 9: "Schreiner" instead of "Shreiner"
12. page 25414, line 13: to be consistent with the units of b_1 and b_2 , you should specify atmospheric pressure in hPa, not in mbar
13. page 25414, line 20: "Kursinski et al., 1997" instead of "Kursinski, et al, 1997"
14. page 25415, line 11: I guess that "Poli and Kursinski 2002" should be "Poli et al., 2002"
15. page 25416, line 8: "Ho et al., 2009" instead of "Ho et al., JGR, 2009"

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16. page 25416, line 8: You write: "A total of 641134 valid profiles over the two-year span (2007–2008) have been used in this study." But you also write on page 25418, lines 16/17 "2007: a total of 361051 profiles" and page 25418, line 21 "2008: 284227 profiles". $361051 + 284227 = 645278$, not 641134. Which numbers are correct?
17. page 25418, line 3: "additional errors" instead of "additional error"
18. page 25418, line 16: I do not understand how you derived diurnal variations between 10°S and 10°N: On page 25416, line 25 you write that your data are binned in every 5° latitude band and on page 25416, line 28, you write that your 5° latitude bands are centered at, e.g., 5°N. I conclude that your zonal bands reach e.g., from 2.5°N to 7.5°N. Did you average diurnal variations over 5 zonal bands (12.5°S–7.5°S, 7.5°S–2.5°S, 2.5°S–2.5°N, 2.5°N–7.5°N, 7.5°N–12.5°N) or did they average over 4 zonal bands (10°S–5°S, 5°S–0°, 0°–5°N, 5°N–10°N) or did you derive diurnal variations using all data between 10°S and 10°N?
19. page 25418, line 20: diurnal variations of refractivity are given in percent—what does the percentage refer to?
20. page 25418, line 23: "vertical structures" instead of "vertical structure"
21. page 25419, line 26: In my opinion, the variability at 140 hPa (14 km) is so small, that it is hardly possible to distinguish between different seasons.
22. page 25419, line 27: "winter and autumn seasons show larger diurnal amplitudes" instead of "winter and autumn season shows larger diurnal amplitude"
23. page 25420, line 5: "higher altitudes" instead of "higher altitude"
24. page 25420, line 6: "Lindzen" instead of "Linzen"

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25. page 25420, line 10: “the temperature tides is”—please use singular or plural form
26. page 25420, line 24: Equation (2) is specified in Section 2.1.
27. page 25421, line 12: “at all pressure levels” instead of “at all pressures”
28. page 25421, line 13: Does Figure 3 illustrate the time series of the diurnal amplitude at 30 hPa or at 30 km (compare text and figure caption)
29. page 25421, line 23/24: please specify “upper atmosphere”.
30. page 25421, line 25: “at pressure levels from” instead of “at pressures from”.
31. page 25422, line 12: “to be observed” instead of “to observe”.
32. page 25428, line 22: “the COSMIC RO constellation has greatly improved” instead of “the COSMIC RO constellation have greatly improved”
33. page 25433: Lieberman and Leovy (1995) and Lieberman et al. (2003) have never been cited in the text but are listed in the reference list.
34. page 25439, caption of Figure 3: please check consistency with the text (30 km/30 hPa)
35. page 25439, caption of Figure 3: “30°S–30°N” instead of “30S–30N”
36. page 25440, Figure 4: There is too much information for the limited space. Probably, contour intervals of, e.g., 0.25 %, or the use of colors could facilitate the interpretation of the figures.
37. generally: you often write, e.g., 12~1.3 hPa. In this case “~” should be replaced by “–” (or more precisely: 12 hPa to 1.3 hPa).

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Interactive comment on Atmos. Chem. Phys. Discuss., 9, 25409, 2009.