

## **Title: Atmospheric diurnal and semi-diurnal variations observed with GPS radio occultation soundings**

### **General comments:**

The paper presented the potential of COSMIC RO data to investigate the atmospheric diurnal and semidiurnal variations in the troposphere and stratosphere on continuous monthly scale. COSMIC RO data, as a novel data source, are definitely suitable to study the diurnal tides because of its spatial and temporal coverage and high resolution. This study could be useful for better understanding and modelling the atmospheric diurnal cycles. However, there are several concerns require more clarification.

### **Specific comments:**

1. The authors state that “the six satellites, with a 30° orbital plane spacing, give a full diurnal cycle sampling ... within about one month for higher latitudes” (Page25413, Line5-7). For high latitudes, the COSMIC constellation seems not able to sample all local times uniformly within a month. The results over the high latitudes therefore might be questionable. Even though the authors tried to use RO data processed by different centers to investigate the reliability of their results in the discussion part, still under-sampling problem of COSMIC data itself won't be accounted. If possible, a simple simulation study using synthetic data might be helpful for testing the effects of this under-sampling problem.
2. Since the temperature and refractivity are one-one correspondences at specific pressure level in the upper troposphere and stratosphere, it is ideal that if the author can more clearly address the motivation and meaning of studying the diurnal refractivity variations over other height ranges.
3. There's only one subsection 3.1 for Section 3. Also the term “migrating tides” is introduced suddenly in the beginning Section 3, which has no difference with “diurnal variations” widely used in the whole paper herein. I think it might be good to consistently use “diurnal variations” here unless the authors have other intention.
4. The semidiurnal amplitudes presented in this paper seem quite large for some seasons and altitudes, while their phases are rather irregular. The reader might question the reliability of these results. It might be useful if the authors can show the semidiurnal variations resolved from the models or global analysis data as references. Also since the presented seasonal variations of semidiurnal cycles are prominent (seen from Fig. 2), what would its seasonal variation look like (similar to Fig. 3)?
5. The authors mentioned several issues in the discussion section, some of them are not closely related (i.e. the last paragraph on Page 25428) or too general (i.e. ionospheric residual effects on diurnal variations. How big is it? Any references?) to the topic of this paper.

### **Technical corrections:**

1. P25410, L18: “solor” -> “solar”
2. P25410, L20: “shows” -> “show”

3. P25411, L10: "Linzen" -> "Lindzen"
4. P25413, L11-17: "Sect." -> "Section"
5. P25414, L9: "Shreiner" -> "Schreiner"
6. P25414, L13-16: Keep consistence with the unit of pressure, mbar or hPa
7. P25414, L20: "Kursinski, et al, 1997" -> "Kursinski et al., 1997"
8. P25418, L13: "some of the earlier studies" -> "some earlier studies"
9. P25420, L6: "Linzen" -> "Linden"
10. P25423, L29: "August~October" -> "August-October"