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Atmospheric Measurement Techniques Discussions

Interactive comment on "Open-loop GPS signal tracking at low elevation angles from a ground-based observation site" *by* Georg Beyerle and Florian Zus

Anonymous Referee #2

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In this paper, the authors discuss the tracking performance of ground GPS observations at low elevation angles using their implementation of the OpenGPS receiver and suggest that the ground-based measurements provide a useful test bed for spaceborne radio occultation. I appreciate the concept and think that this can be a worthwhile approach. However, a better experimental design and perhaps better site selection are needed to produce more impactful results. The main conclusions of this paper are not really new, at least qualitatively. In addition, one issue I have is with the implementation of its O/L tracking (see comment 3 below) and how this would affect the results quantitatively and how this would translate to the spaceborne case. Overall, I think the paper can be suitable for publication, provided that the comments are adequately addressed

and that the paper is viewed as a "pathfinder" for future experiments.

(1) The paper should be made more succinct. In particular, the detailed description of the OpenGPS receiver does not offer much insight into understanding the data. The readers have to wade through too much background materials before getting to the results. I suggest significant shortening of Section 2.2 and Section 2.3. Another option is to move the materials to an Appendix.

(2) L15: it states that "vertical refractivity gradients... correlate moderately well with observed signal amplitude fluctuations..." However, Figure 16 shows that only 3 out of 9 cases "yield significant correlations". I suggest changing the wording of "correlate moderately well" to better represent the results.

(3) L245-255: the O/L tracking models are extrapolated from the C/L tracking data at higher elevation angles. Thus one can argue that this is more similar to the "flywheeling" algorithm implemented on CHAMP and SAC-C and might not work well under some conditions (which the authors recognized, see L267-270). Please explain/justify why it is done this way. Is it possible to use an a priori O/L model as was done in COSMIC and Metop/GRAS?

(4) Eqs (6)-(8): is there a reference for calculating C/N0 this way? I am confused with Eq. (8) since this apparently yields a noise floor of 17 dB Hz that depends only on the integration time. Shouldn't this depend on the antenna gain, cable loss, etc.?

(5) Table 1: PRN28 yields anomalously low ($\sim$ 35%) O/L enhancement. Any idea why?

(6) Fig. 15: I suggest more distinct colors for the light blue and dark blue lines. I have a hard time distinguishing them. It is also hard to tell the actual values of frequency offsets from these plots. I think it would be useful to have a summary table of mean and standard deviation of \Delta f_{obs} as a function of C/N0 that average over all 9 PRNs.

(7) L522: Is the refractivity based on ECMWF at a grid point closest to the receiver?

How about temporal differences? How does the refractivity vary along the ray paths? Besides vertical refractivity, horizontal inhomogeneity and small-scale irregularities (turbulence) can also lead to strong signal fluctuations. These effects could perhaps explain the lack of correlations for many of the PRNs.

(8) Do you expect local environmental effects (e.g., local multipath) and ionospheric conditions to have significant impact on the measurements?

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