Behavior of 6 different GPS receivers at low latitude under moderate scintillation

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Abstract

The small scale irregularities of hundred of meters, associated with bubbles, cause scattering and diffraction of radio waves crossing the ionosphere and produces scintillation in amplitude and/or phase of the signal. The scintillation in GPS receiver signal can cause loss of lock of its code and/or carrier, affecting the positioning determination. The understanding of scintillation pattern and its statistical characterization can help designers to improve the GPS receiver robustness. In this work, scintillation data from six different GPS receivers, installed on September 2012 at São José dos Campos (23.1º S, 45.8º W, dip latitude 17.3º S), a station under the southern crest of the Equatorial Ionization Anomaly (EIA), were analyzed to study their behavior under moderate scintillation conditions. Amplitude scintillation index S4 and phase scintillation index σ_ϕ during this period were analyzed. We present the results for 2 levels of S4 amplitudes, which were from February 20, 2013 (F10.7 cm solar flux=111.0 sfu) for the PRN 19, when average S4 was not larger than 0.7 and from November 27, 2013 (F10.7 cm solar flux=125.6) for the PRN 25 when average S4 was about 0.8. The elevation mask of 10º was used.
When using data from different scintillation monitors for S4 mapping, modeling, statistical studies and scientific studies, which are located at different sites in a large territorial area like Brazil, it is important to evaluate their performance under scintillation conditions. We used GPS receivers data from the Cornell Scintillation Monitor, the ASTRA, the Novatel 4004B (Boston College), the Novatel GPStation 6 (Boston College), Septentrio PolaRxSpro (Boston College) and u-blox EVK-6T/GTEC 3 band front end (Stanford University).
Figure 1 shows S4 in function of time during the night 20/21 of February 2013 for the PRN 19 except for the Stanford University data and Figure 2 for the night of 27/28 of November 2013 for the PRN 25 for all six receivers described above.

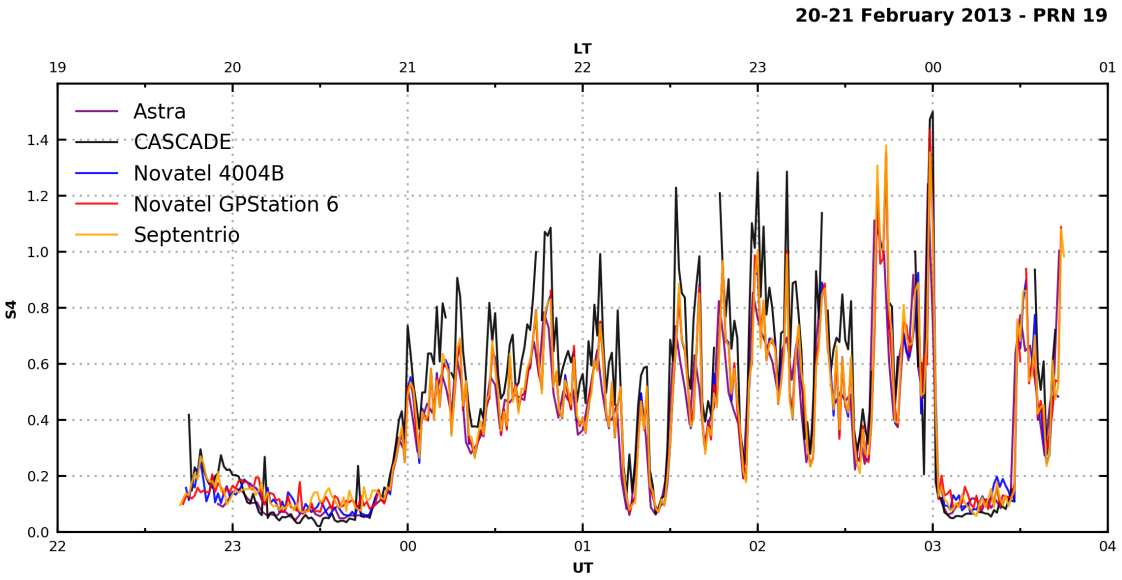

Figure 1: S4 data for the night 20-21 February 2013 and PRN 19 at São José dos Campos

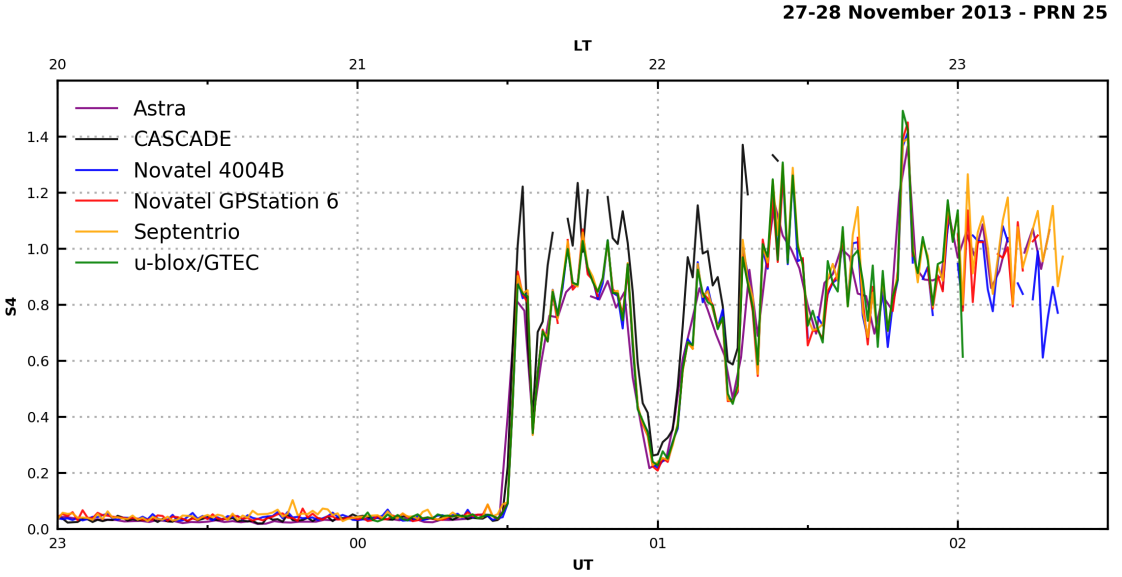

Figure 2: S4 data for the night 27-28 November 2013 and PRN 25 at São José dos Campos

These plots show a reasonable agreement between S4 measured by the different receivers. These results provide support to the possibility of using S4 data from these different receivers to develop a global S4 mapping or for scientific studies. The σ_ϕ analysis was performed for 4 different receivers during the 2 nights cited above, and some differences in this parameter were observed.

Acknowledgements

E. R. de Paula acknowledges the support from Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) under process number 310802/2015-6 and to INCT GNSS-NavAer grants 2014/465648/2014-2 CNPq and 2017/01150-0 FAPESP. A. R. F. Martinon is thankful to FAPESP support under grant 2018/23754-4.