Evaluation of Environmental Effects on GPS Signals by Submitting Rinex Files to Online PPP Software

Luiz Vicente Gomes Tarelho[1], Guilherme de Andrade Garcia[1], Antonio Carlos Baratto[1],

Elizabeth Vilcañaupa Raymundo[2], Selma Junqueira[2], Rodolfo Saboia Lima de Souza[1],

[1]Dmtic, Inmetro, Duque de Caxias, Rio de Janeiro/Brazil
[2]DSHO, ON, Rio de Janeiro, Rio de Janeiro/Brazil

Email: gagarcia@inmetro.gov.br

This paper describes the determination of ionospheric and tropospheric effects on satellite communications between Inmetro ground station and GPS constellation satellites with the use of a geodesic receiver to collect data and with post processing softwares for Precise Point Positioning (PPP) implementation. The satellite communication is used for time and frequency maintenance of local Local Time Scale UTC (INXE) and for key comparison promoted by BIPM. Relative differences of plasma density of ionosphere and atmosphere conditions can be inferred from the different delays imposed to the propagating signal. There are some highlighted effect differences during daytime and nighttime signal behavior, for instance, ionosphere disturbances, scintillations and plasma bubbles that are very common in Brazil, because we are located near Ionospheric Equatorial Anomaly. These effects are not evaluated completely in time and frequency transfer using satellite links. Inmetro ground station is composed by an atomic cesium clock connected to a multi frequency GNSS receiver which allows data to be collected and recorded in a Receiver Independent Exchange Format (Rinex). Furthermore, these data can be used to investigate some environmental effects present in the satellite communication, such as space environment and atmosphere conditions. The PPP method is a post-processing approach, where correction data calculated from networks of globally distributed GPS receivers are combined with the measurement data. There are several software concepts which use different solution algorithms and different correction models developed independently by several organisms. In this work four major servers for online free PPP services were used to perform data treatment: CSRS-PPP developed by Natural Resources Canada (NRCan) [1]., GPS Analysis and Positioning Software (GAPS) developed by University of New Brunswick (UNB) [2], Automatic Precise Positioning Service (APPS) developed by Jet Propulsion Laboratory (JPL) using GNSS-Inferred Positioning System (GIPSY) [3] and MagicGNSS developed by GMV [4].

There are several possible comparisons to be made from the software solutions and some of them are: final Cartesian coordinates, tropospheric zenith delay and vertical ionospheric delay. At Inmetro the results for Cartesian coordinates increased the reliability and coherence of the four different implementations and demonstrate that is possible to use a common geodesic receiver to obtain results about ionospheric and tropospheric behavior by only submitting the files to online services.

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[1] http://www.geod.nrcan.gc.ca/online_data_e.php

[2] http://gaps.gge.unb.ca/

[3] http://apps.gdgps.net/

[4] http://magicgnss.gmv.com/ppp