Impact of Station GNSS Antenna Phase Centre Calibrations on Satellite Orbits and Station Coordinates: Preliminary Results

Abstract

The International GNSS Service has developed antenna phase centre corrections (PCC), which include models for mean PCCs have been generated and, for practical reasons, have been widely applied. However, due to these imperfections, the use of the latter mean PCCs are widely employed. However, due to these imperfections, the use of individual PCCs for two derived solutions compared to the IGS final solutions. We have shown that:

Introduction

Continuous efforts by the International GNSS Service (IGS) in refining the applied models and processing algorithms have resulted in outstanding quality of the produced GPS solutions. The latter are exploited in the construction of the International Terrestrial Reference Frame (ITRF), which is based on the IGS. Very-long baseline interferometry (VLBI), Satellite Laser Ranging (SLR) and DORIS (Doppler Orbitography Integrated by Satellite) (DORIS) observations are used to determine the ITRF. Although the IGS developed PCCs have some limitations and are not suitable for antenna phase centre calibrations to the original IGS orbit products, it is essential for establishing the links between the two techniques, e.g., to jointly analyze atmospheric and scale factors, extraterrestrial models, time and space coordinates in real-time processing centers, and re-compute these models. This is important to improve the quality of the orbit products and derived PPP solutions.

To validate our processing sequence we first produced a set of orbits and clocks using the IGS08 core products. To which degree this may have affected the results needs to be further investigated. Both biases may propagate into computed satellite orbits and derived PPP solutions either directly or indirectly. As the attenuation factor for draconitic frequencies can be made on contribution of antenna PCC errors to draconitic signals observed in the GPS orbital solutions. Although the quality of the orbits produced using the network of stations shown in Figure 3 may not be optimal, the analysis of the impact of antenna PCCs is still valid and can be used for potential improvements of the ITRF determination and consecutive PPP processing. We have shown that:

Discussion and conclusion

The developed PCCs are not necessarily adequate for use with all types of antennas, e.g., due to changes in the electronic and mechanical design of the antennas, as well as due to variations in the material the antennas are made of. The latter factors are important for the determination of the antenna phase centre and the reference frame, respectively.

Table 1: Summary of the results of the analysis of the impact of antenna PCCs on the computed satellite orbits and derived PPP solutions for the stations shown in Figure 3. The table provides the following information for each station: the station name, the antenna type, the number of observations, the number of epochs, and the root mean square (RMS) of the differences between the computed and the IGS final orbits for the radial, north, and east components, respectively.

<table>
<thead>
<tr>
<th>Station</th>
<th>Antenna Type</th>
<th>Observations</th>
<th>Epochs</th>
<th>RMS Radial (m)</th>
<th>RMS North (m)</th>
<th>RMS East (m)</th>
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<td>typ 1</td>
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<td>4.57</td>
<td>2.95</td>
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<td>4.85</td>
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</table>

Acknowledgments

The authors would like to thank the IGS, EUREF, Natural Resources Canada, the British Isles continuous GNSS Facility (BIGF) and Administration de cartografie et de topographie, Luxembourg, for providing data and products.

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