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ORIGINAL ARTICLE

Influence of different GPS receiver antenna calibration models on geodetic positioning

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Abstract To better understand how receiver antenna calibration models contribute to GPS positioning error budget, we compare station positions estimated with different calibration models: igs05.atx, igs08.atx and individual antenna calibrations. First, the impact of switching from the igs05.atx antenna calibration model to the igs08.atx antenna calibration model is investigated using the EUREF Permanent Network historical data set from 1996 until April 2011. It is confirmed that these position offsets can be effectively represented by the igs05.atx to igs08.atx latitude-dependent model. Then, we demonstrate that the position offsets resulting from the use of individual calibrations instead of type mean igs08.atx calibrations can reach up to 1 cm in the up component, while in the horizontal, the offsets generally stay below 4 mm. Finally, using six antennas individually calibrated by a robot as well as in an anechoic chamber, we observe a position agreement of 2 mm in the horizontal component and a bias of 5 mm in the up component. Larger position offsets, dependent on the antenna/radome type, are, however, found when these individual calibrations are compared to type mean calibrations of two tested antennas.

Keywords GNSS · IGS · EPN · Antenna phase center calibration

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Introduction

GNSS antennas do not have a well-defined phase center, but have a phase transfer function that varies over azimuth and elevation in a much more complex way than a simple first degree spherical function. This direction-dependent phase transfer function is referred to as the phase center correction (PCC) and is generally determined during a calibration measurement prior to installation. The PCCs exist for both satellite and station antennas. This study will focus on the effect of the PCCs of station antennas on the station positions. The impact of the PCC on the estimated station position and its accuracy is of particular importance when evaluating the agreement between local ties obtained with GPS and terrestrial measurements (Altamimi et al. 2011).

Absolute elevation and azimuth-dependent PCCs obtained using anechoic chambers (Görres et al. 2006) or a robot rotating and tilting the antenna (Wübenna et al. 1997) were introduced in November 2006 to replace pure elevation-dependent receiver antenna PCCs based on field calibrations relative to the Alan Osborne AOAD/M_T reference antenna (Rothacher 2001). Today, absolute PCCs are routinely used (IGSMAIL-5438 by Gendt, 2006) in both the International GNSS Service (IGS, Dow et al. 2009) and the EPN (Bruyninx et al. 2012).

The absolute receiver antenna calibrations presently used within the IGS are means of the available individual robot calibrations for a specific antenna type, indicated as antenna type mean calibrations. This implicitly assumes that the PCCs of antennas of the same type can all be represented with sufficient accuracy by these type mean calibrations. In addition to the type mean calibrations, the EPN uses the original individual antenna calibrations which are linked to a specific antenna/radome type and