OSOS – new radome type in SWEPOS

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Abstract

A new radome type (OSOS) has been developed by Lantmäteriet. The upper part of OSOS is essentially the same as OSOD (Figure 1), which has been used for almost all stations in SWEPOS since 1996, including the EPN-stations KIR0, MAR6, ONSA, SKE0, SPT0, VIL0 and VIS0. The hemispherical radome is handmade by blowing a large bubble on a heated acrylic plate using compressed air. In case of OSOD, the thin hemispherical part is combined with a thicker skirt at the bottom which is attached to the monument. This has the advantage that not just the antenna but also the upper part of the monument is protected, but also the disadvantage that antenna + radome could not be calibrated as a package. OSOS is a short version of OSOD without the skirt. The radome is directly attached to the antenna. Three Javad chokering antennas (JAVRINGANT_DM) have been calibrated with chamber calibration with and without OSOS at the University of Bonn. One of the antennas was also calibrated with robot calibration at Geo++. Some first tests have been performed to estimate the impact of the OSOS radome.

Figure 1: OSOD-radome to the left and OSOS-radome to the right. Photo: Johan Löfgren, Onsala Space Observatory, April 2015.

CLOSE III Project

During winter and spring 2015 Lantmäteriet in collaboration with Chalmers University of Technology, SP and Onsala Space Observatory are running a project called CLOSE III. One of the goals with CLOSE III is to find out more information about how different kinds of installations affect the measurement uncertainty in the SWEPOS-network. Four copies of the masts that are used in SWEPOS have been established at Onsala Space Observatory close to Gothenburg in order to perform experiments with different types of installations. The stations are called OTT1, OTT2, OTT4 and OTT6 (Figure 2). One part of the experiments is to evaluate the impact of the new OSOS-radome using antennas calibrated with and without the radome.

Figure 2: The experiment area at Onsala Space Observatory. The four new masts and the IGS/EPN-station ONSA.

Method and results

One of the three Bonn-calibrated Javad chokering antennas were placed at the station OTT6. At OTT1 an antenna calibrated (also in Bonn) just with OSOS-radome is placed. These two masts were not changed during the experiment period and could be used as references to OTT2 and OTT4 where the experiments are going on. For the calculations of OTT6, OTT1 is used as reference station and vice versa. From OTT6, which have the radome untouched since the calibration, one week of data were used to analyze the impact of the radome. Daily L1-, L2-, L3- and L3-troposhere-solutions were computed with the Bernese GNSS Software (ver. 5.2) using the individual antenna model with the OSOS-radome. L3-trophosphere, ionosphere free linear combination with estimation of zenith troposphere delay parameters, is the standard solution type for EPN- and SWEPOS-processing. The same data set were also used to calculate coordinates using the antenna model without radome. Difference in calculated coordinates are an indication of the impact of the radome in standard type processing and shown in Figure 4.a.

Another Bonn-calibrated antenna is placed in Mårtsbo close to Gävle at the station called MAR8 (Figure 3). One week of data were calculated in the same way as for OTT6 (Figure 4.b). The IGS/EPN-station MAR6 was used as reference station.

Figure 3: The antennas at Mårtsbo. Archive photo: Kent Ohlsson, January 2015.

The last of the three Bonn-calibrated antennas with and without radome is also calibrated with the OSOS-radome at Geo++. This antenna was used at OTT2 from the beginning of May 2015. The same calculations as OTT6 and MAR8 were done with five days of data from this antenna (Figure 4.c). OTT1 was used as reference antenna for these calculations. The same data set from this antenna was also used with the antenna model from Geo++ and the difference between using the two antenna models are shown in Figure 4.d.

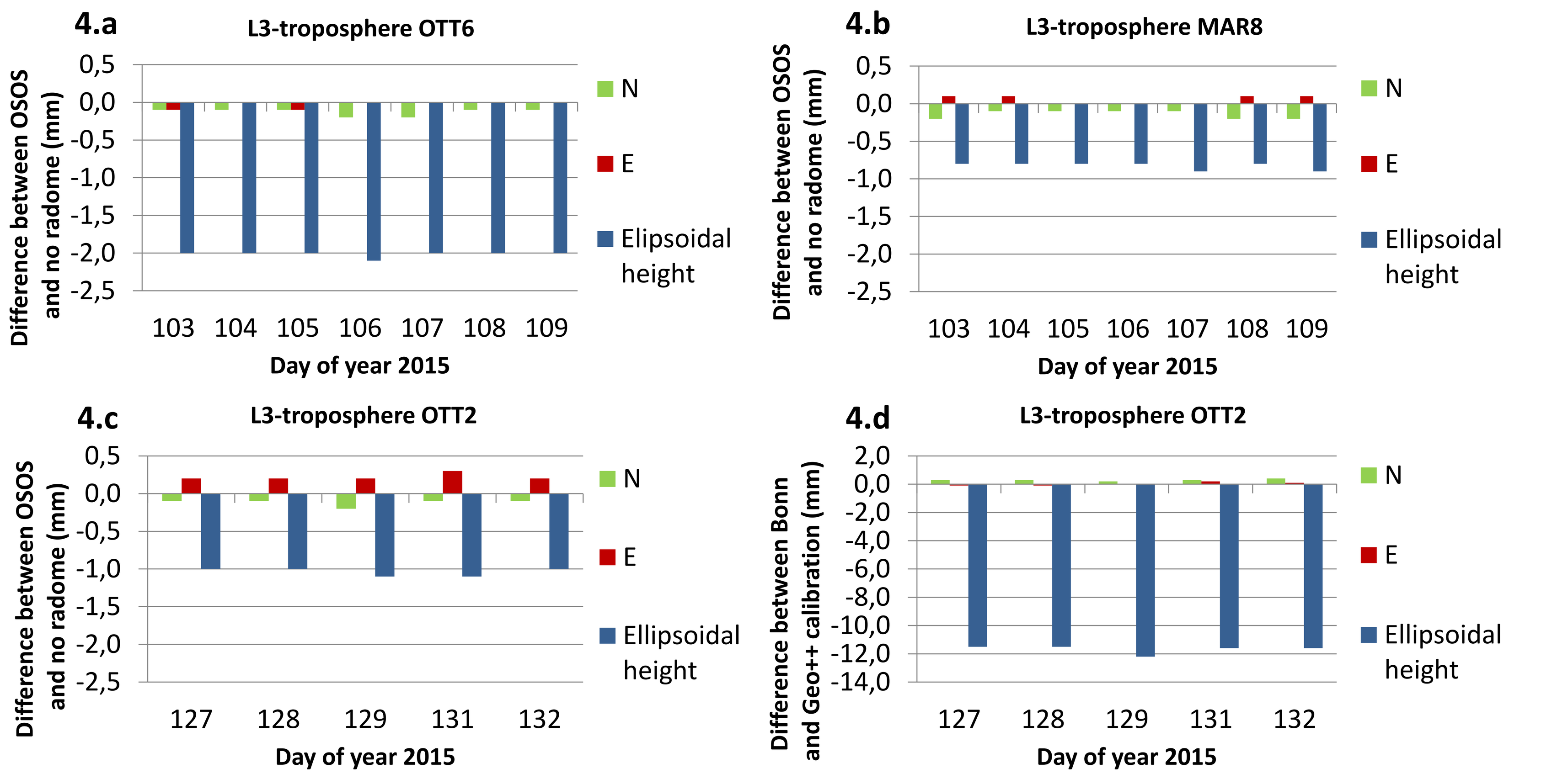

Figure 4: The difference between using antenna model from University of Bonn with and without OSOS-radome for three stations (**4.a-4.c**). Difference between using antenna model from University of Bonn and Geo++ at OTT2, respectively (**4.d**).

At the experiment station OTT2 an antenna calibrated in Bonn just with the OSOS-radome was used before the antenna that was installed in May. One experiment with this antenna was to take off the OSOS-radome, everything else unchanged, for one week and compare the computed coordinates with and without the radome. OTT1 was used as reference antenna. The same antenna model (with the OSOS-radome) was used for both weeks and the daily variations from the mean-value are shown in Figure 5.a.

Finally, at OTT4 there were some experiments done with the OSOD-radome. In three weeks first the OSOD-radome was used, then no radome and the last week an OSOS-radome was mounted on the antenna. This antenna was not calibrated individually so for all three weeks a type calibrated antenna model without radome from Geo++ was used. At this station it should also be noted that there is a different top monument of the mast (with arms to be able to mount the OSOD-radome (Figure 1)). A time series of the three weeks are shown in Figure 5.b.

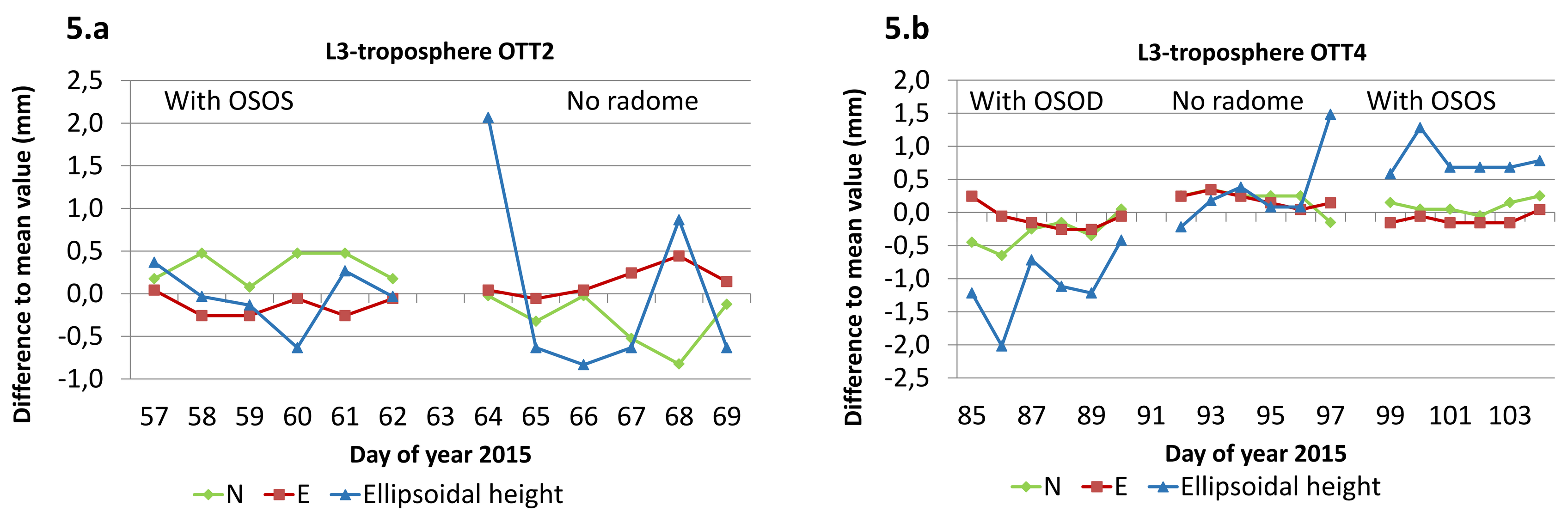

Figure 5: Time series with and without radome at the antennas. The coordinates have been computed with the same antenna model (calibrated model with OSOS for OTT2 and type model without radome for OTT4).

Discussion

The first tests of the OSOS-radome show that the impact of the radome seems to be small (Table 1). The height differences from the antenna at OTT6 were slightly larger than from the other two antennas. For all solutions and all antennas the antenna model with the OSOS-radome gives the lower height value. The L3-troposhere solution, which is most interesting according to the use for EPN, shows an impact of the radome of 1-2 mm in height estimations. For the horizontal coordinates the differences are just a few tenths of a millimeter.

In the fourth column of Table 1 the differences between using antenna model from the University of Bonn and Geo++ are presented. The difference in height is small for the L1-, L2- and L3-solution but the L3-troposphere solution differs almost 12 mm with the different antenna models! Using the antenna model from Geo++ gives higher height values than using the model from Bonn for the L3-troposphere solution. This need to be studied further.

Table 1: Mean value (mm) of the height difference of about one week of daily calculated coordinates using antenna models with and without OSOS for the three calibrated antennas at University of Bonn. The last column shows the difference at OTT2 when using either Bonn or Geo++-antenna model.

(mm)	OTT6	MAR8	OTT2	Bonn-Geo++
L1	-0,9	-0,5	-0,6	0,4
L2	-1,0	-0,7	-0,7	1,9
L3	-0,9	-0,2	-0,4	-2,1
L3t	-2,0	-0,8	-1,0	-11,7

From the test where the radome physically have been taken off there is no big difference between the calculated coordinates with OSOS-radome and without radome. Maybe the OSOS-radome gives some tenths of a mm higher values than if no radome is used. The OSOD-radome also seems to give slightly lower heights than if no radome or the OSOS-radome is mounted on the antenna. But it should also be noted that different days are compared so the external conditions like the ionosphere and troposphere could vary between different days.

Conclusion

The impact of the OSOS-radome in standard type processing is small, probably less than a few mm in the height and less than 1 mm for horizontal coordinates.

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