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The impact of the electromagnetic environment of the antenna on GPS measurements of atmospheric water vapour

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Based on the timing of radio waves propagating through the atmosphere, the Global Positioning System (GPS) is used to determine the amount of atmospheric water vapour. Currently in Sweden there are over 100 GPS stations under the operation of the Swedish Nationwide Multipurpose Network SWEPOS, where 24 of them are used for geodetic purposes. All antennas of the geodetic stations are mounted on concrete pillars and are protected from snow and rain by radomes.

The effects introduced by the geometry of the installation of the geodetic GPS antennas on the estimated time series of atmospheric water vapour is of fundamental importance. This is especially true when the application of the estimated times series of water vapour is climate monitoring. A special GPS station has been designed where the antenna is mounted on an x-y-z positioning platform in order to investigate these effects. This means that the antenna can be moved in different directions with respect to the radome as well as relative to the concrete pillar. Additionally, an arrangement has been implemented in order to move the radome along the vertical coordinate relative to the pillar. The data from the permanent SWEPOS GPS station at Onsala is used to provide a reference time series of water vapour to be compared to the corresponding estimates from the experimental station.

For simplicity we compare the estimates of the Zenith Total Delay (ZTD) obtained

from the GIPSY-OASIS II software, using the Precise Point Positioning (PPP) processing strategy. The ground pressure and the effective temperature of the wet refractivity in the atmosphere—needed for the conversion of the ZTD to the water vapour content—can be assumed to be identical at the two sites since the distance between them is only 12 m.

We present a first assessment of the impacts from a changing geometry of the nearby antenna environment. The long term goal is to be able to quantify the specifications on the geometric stability needed in order to detect variations in the water vapour content of the order of 0,01 mm/yr.