Establishment of an Official Tide Gauge Station at the Onsala Space Observatory

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Introduction

The Onsala Space Observatory is a fundamental geodetic station. The main instrument is, since 1980, the 20 m radome enclosed telescope that is used for geodetic VLBI. A dedicated twin telescope for geodetic VLBI has been funded in 2012 and the installation is expected in early 2016. Thereafter all three telescopes will be part of the VGOS network.

The observatory operates also other instrumentation in support of space geodesy and the international terrestrial reference frame:

- several GNSS receivers
- a superconducting gravimeter
- a seismometer
- several microwave radiometers for estimation of the tropospheric water vapour content
- several tide gauges.

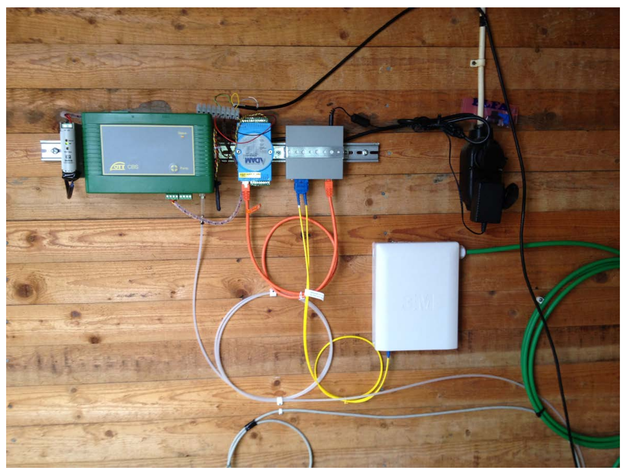
Tide gauge installations at the Onsala site

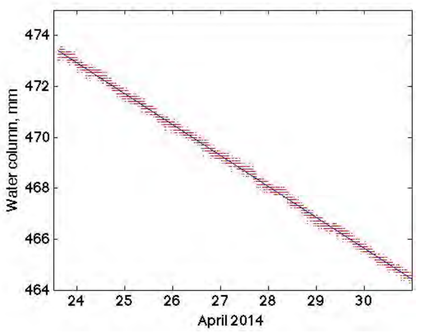
GNSS and pressure sensor tide gauge

Bubbler and radar sensor tide gauge

Sea level observations

Since 2010 we operate a so-called GNSS-R tide gauge that is utilizing reflected GNSS signals. It is complemented by three pressure-sensor based tide gauges at the same location. In the autumn of 2013 a pneumatic (bubbler) tide gauge was temporary installed at another location (see above). This new location will be operated together with the Swedish Hydrological and Meteorological Institute (SMHI) and will be an official site in the national sea level monitoring network. The final installation will have a radar-based sensor and one bubbler sensor in an ice free well, complemented by one additional bubbler sensor outside the well. The reason for the second bubbler is to have an independent check that the density (salinity) of the water in the well is not significantly different from that in the sea.





Time series of water level observed with the bubbler sensor during evaporation of water from the plastic tube.

The GNSS-R sensor

The system make use of two independently operating GNSS receivers, fed with a common external frequency. The observing geometry can be modified by changing the height of the antennas above the sea level in ten steps, where that largest distance is approximately 500 cm (top frame) above the mean sea level (MSL) and the lowest is approximately 250 cm (bottom frame) above the MSL. Ongoing research will determine if there is an optimum position in terms of the distance and size of the reflection area.

The bubbler sensor

The pneumatic sensor (CS471, Campbell Scientific) determines the sea level from differential pressure measurements. One value is the pressure of compressed air necessary in order to release bubbles from a tube at a fixed position, well below the sea level, and the other pressure value is that of the air at the sea level. The top photo shows the temporary installed bubbler compressor. The photo below shows a test installation of the second bubbler sensor to investigate its stability.

The radar sensor

The radar will be installed in the ice free well. The photo above shows a test installation to evaluate the accuracy, e.g. the linearity and the sensitivity to a misalignment of the system.

Construction of the ice free well

The four photos on the right show the construction of the ice-free well. Top-to-bottom: the identified construction area, the blasting of the rock, the installation of the inner well, and the concrete work, are shown. The present status, after adding the outer concrete rings is shown at the top of the poster. The well will be completed in the autumn of 2014 and equipped with the tide gauge sensors.