Barometer Calibration at the SLR Riga 1884, current status

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Abstract

The SLR Station Riga has operated a Vaisala WTX510 since 2007 as a primary meteorological unit. During the period 1897-2007 the aneroid barometer Paulin VBMM2 (Erickson) was used as a reference. A Vaisala pTU300 unit installed at the SLR Telescope room is used as an auxiliary unit.
During 2017-2018 both Vaisala Unit, WXT510 and PTU300, were calibrated against the GFZ Potsdam GE Druck141 DPI absolute barometer. Currently we are calibrating the aneroid barometers Paulin VBM2 and a 1978 Soviet model against the Vaisala units. We present the calibration results, and discuss future steps to be done.

1. Barometric sensors used at the SLR Riga 1884

In the period 1987-present (2022) the SLR station Riga had two reference barometric sensors in use:

1987/09/01 – 2007/03/30: Aneroid Barometer-Paulin VBM2. (Ericsson), with 0.2 mb accuracy installed on the main building at 50 cm height over the SLR telescope invariant point.

2007/03/30 – Present (2022): Vaisala WXT510, a Barocap pressure sensor, with 0.1 mb accuracy installed at a height of 200 cm over the SLR telescope invariant point (height measurement repeated in 2018). The Vaisala WXT510 is installed on the main building west facing outside wall. The position of the barometric sensor unit was measured and marked on the time service room inside wall. In this way any barometric sensor used for comparison with the WTX510 can be situated at the same height.

Additionally since 2016 the auxiliary Vaisala PTU300 unit is installed at the SLR telescope room at a height of 2 cm over the SLR telescope invariant point, with accuracy 0.1 mb.

During the period 2015-2018 we received several times from the Helmholtz Center GFZ-Potsdam the absolute barometer GE DPI 141 with accuracy 0.01 mb. It was used for comparison runs against the Vaisala WXT510 and PTU300 barometric sensors.

On Fig 1 it is shown a view of the SLR station with the barometric sensors positions.

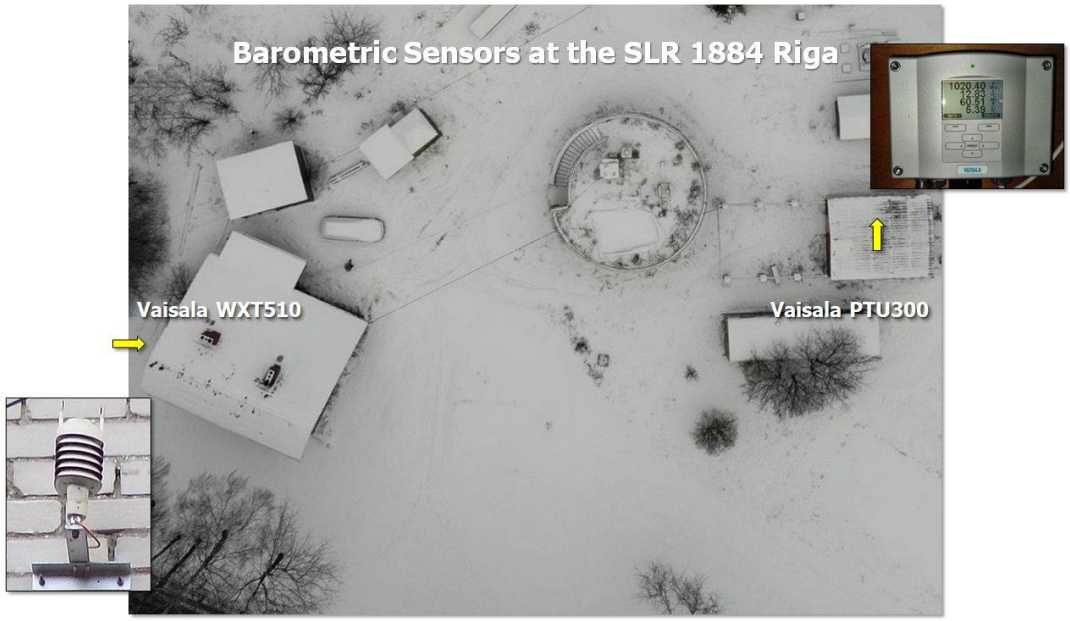

Fig 1, SLR station view and the barometric sensors position.

2. Comparison data runs

The longest WXT510-DPI 141 comparison run was a sessions sets during April-August 2016 with a total of 27 observing days. The shorter sessions prior to this one were dedicated to fine tune the data acquisition parameters and processing strategies (i.e. optimizing the DPI sampling rate, sensor height positioning, etc.). A final 5 days campaign was done in February 2018.

The PTU-DPI 141 comparison run was done between 2018-07-08 and 2018-07-26.

3. WXT510 and PTU300 Calibration results

The calibration results are summarized on Table 1. and Fig 2. and 3.

Sensor	Mean Difference mb		Error mb
WTX510	+0.04	±	0.08
PTU300	+0.12	±	0.04

Table 1. Calibration Systematic offsets and errors for the barometric sensors in use.

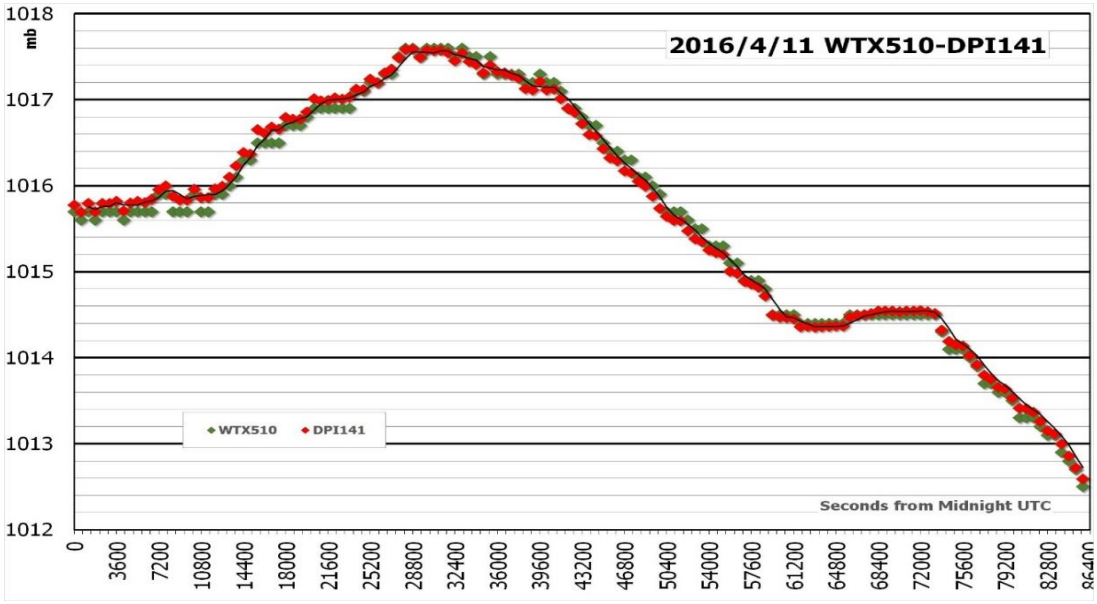

Fig 2. One day calibration run example for WTX510-DPI141.

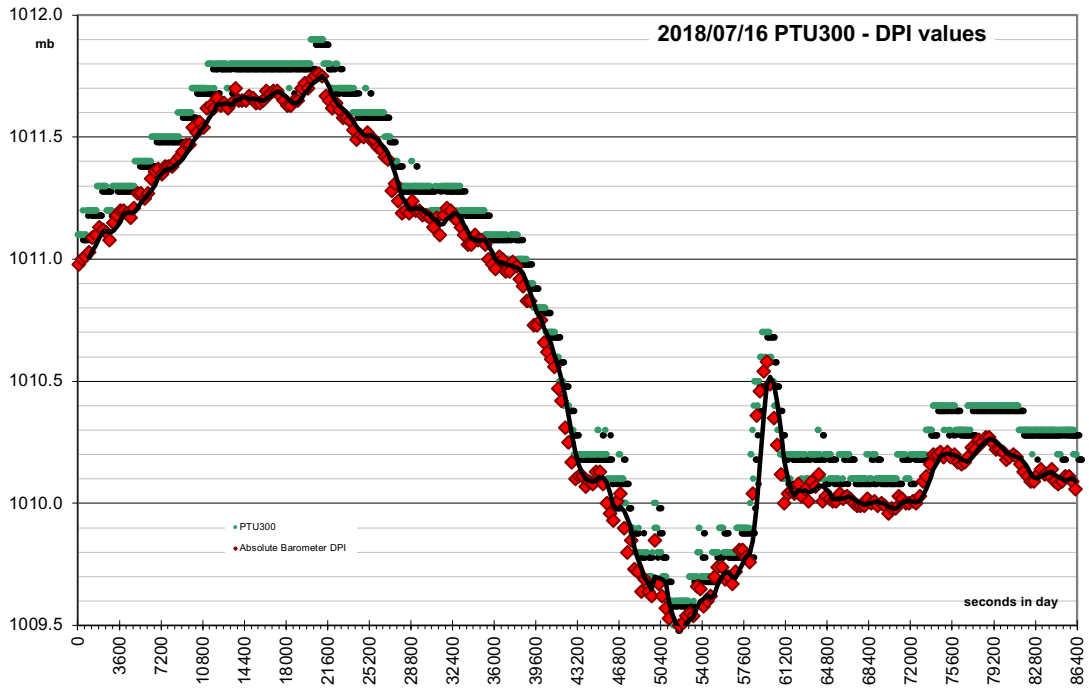

Fig 3. One day calibration run example for PTU-DPI141.

The most important result is that the WTX510 systematic difference value is within the tolerance limits as defined by the ILRS. That mean that the barometric pressure reported on the Riga data does not add additional systematic errors.

The uncorrected PTU300 barometric readouts has a systematic difference above the ILRS limits, but its error is half than on the WTX510. This systematic difference either can be introduced into the PTU300 firmware or applied during the PTU data processing.

4. Current calibration activities.

For completeness we are calibrating the aneroid barometer Paulin VBM2 and an old Soviet made aneroid against both WTX510 and PTU300. One data point is taken once per working day around 13h local time. We plan to run this calibration for at least one year until end of summer 2023.

We are running a long term comparison between the WTX510 and PTU300 data, applying the PTU300 systematic mean difference and a temperature dependent height correction in order to monitor the long term WTX510 mean difference value evolution.

5. Future Activities

- Repeat the barometric sensors calibrations against a reference barometer. Main goal is to detect and quantify any possible time drift.
- Install a new meteorological station following WMO recommendations and compare to the WXT510 data to obtain additional wind and precipitation measurements and determine other measurement biases e.g. temperature.
- Buy and use an absolute barometer as the main pressure measuring unit.

6. Conclusions

The barometric sensors currently in operation at the SLR Riga 1884 has been calibrated and the systematic error at the operational WTX510 sensor is within the ILRS values.

A long term calibration procedure for old aneroid sensors and for a relative evaluation of the sensors now in use has been implemented and is operational.

References

J. del Pino, A. Mejers, Redetermination of the Height Elevation Correction for the main Meteorological Sensor Vaisala WXT510 at the Satellite Tracking Observatory Riga 1884. Internal report, 2018.

R. Krautmann, J. del Pino, Calibration of the Meteorological Unit Vaisala PTU300 barometer sensor at the Satellite Tracking Observatory Riga, Internal Report, 1884.

The Druck DPI 141 description is available at:
http://www.met.reading.ac.uk/observatorymain/Druck_DPI140_manual.pdf

The Vaisala WTX510 description is available at:
https://www.vaisala.com/sites/default/files/documents/WXT510_User_Guide_in_English.pdf

The Vaisala PTU300 description is available at:
https://psl.noaa.gov/data/obs/instruments/VaisalaPTU300-Users-Guide.pdf