Tropospheric Zenith Delays for Trafelberg at Extreme Conditions

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The height differences at the GNSS station Trafelberg at certain dates have led to the thesis that this phenomenon is triggered by heavy snowfall or rain and the insufficient estimation of the sudden changes in the troposphere. Therefore the estimated values of the zenith delay are checked against those from the nearest meteorological stations. While the values of the stations are consistent, they are not conform with GNSS estimation.

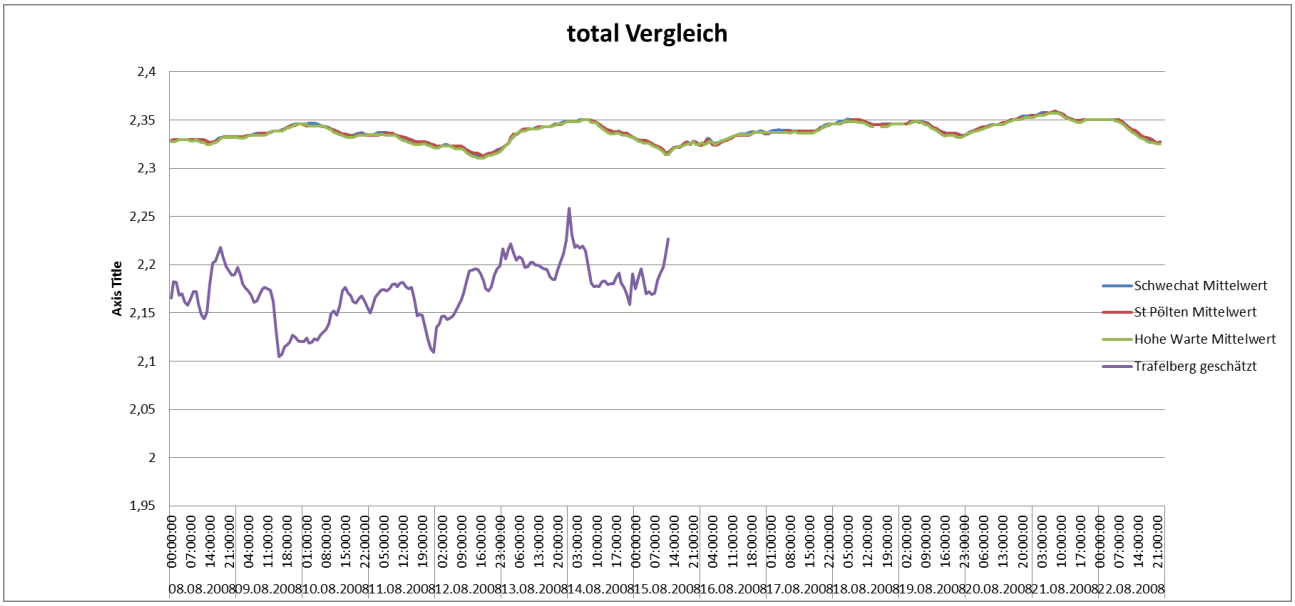

Figure 1: Comparison of total zenith delays, derived from meteorological stations, against GNSS estimations.

The time series of the GNSS station TRF2 (Trafelberg) shows some outliers in height at certain dates. The outliers (20-30mm) remain for one or more days. When investigating such events it turned out that they go hand in hand with extreme weather conditions, e.g. heavy snowfall or heavy rain. The hypothesis was that the estimation of the troposphere was not sufficient and a part of the wrong estimation affects the up coordinate because both are closely related.

Therefore, meteorological parameters (pressure, temperature, and humidity) of the surrounding meteorological stations are compared to the GNSS estimations at the basis of the TZD (total zenith delay). See Figure 1 when it rained heavily. As can be seen there is a bias of about 15cm which can be explained by the fact that when the meteorological stations reduces the pressure to a certain level, a zero height is suggested. More interesting is the behaviour of these days. While all 4 stations are very consistent at the mm-level the estimated TZDs show some erratic jumps up to 5cm which are not realistic.

One reason for the jumps is that the TZDs are estimated day by day without any boundary condition at midnight. The absolute mean value of the day has a big statistical freedom of moving well at the 5cm level varies by 5cm. Thus, when combining TZDs with a time series, boundary conditions should be introduced to reduce the daily jumps. As the figure shows this is unfortunately not enough, because there are still unrealistic short-term (hourly) peaks. More realistic is the time lag by which GNSS estimates the humidity in the clouds before the meteorological stations can detect it. Some peaks could also point to a more complicated structure of the troposphere than the meteorological stations could detect (e.g. inversion layers of the temperature). It would be helpful if a radiosonde could be used to check this.

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