Long Term Calibration of a Pure Rotational Raman Lidar for Temperature Measurements Using Radiosondes and Solar Background

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Motivation and Objectives

- The main goal of our project is to compute a long term relative humidity climatology and trend analysis in the free troposphere and the UTLS region over Payerne, Switzerland.

- For our project we will be using data obtained by the Raman Lidar for Meteorological Observations (RALMO) located at Payerne, Switzerland.

- Relative humidity can be retrieved directly from RALMO Raman-scattering backscatter measurements using an optimal estimation method (OEM)-based retrieval (Gamage et al., 2020*).

- Retrieving relative humidity directly from lidar requires the calibration of temperature using an external temperature measurement.

- Our goal is to improve the temperature calibration and to produce a continuous temperature calibration time series.

*Gamage, S. M., Sica, R., Martucci, G., and Haefele, A.: A 1D Var retrieval of relative humidity using the ERA5 dataset for the assimilation of Raman lidar measurements, Journal of Atmospheric and Oceanic Technology, 37, 2051-2064, 2020.

RALMO Temperature retrieval
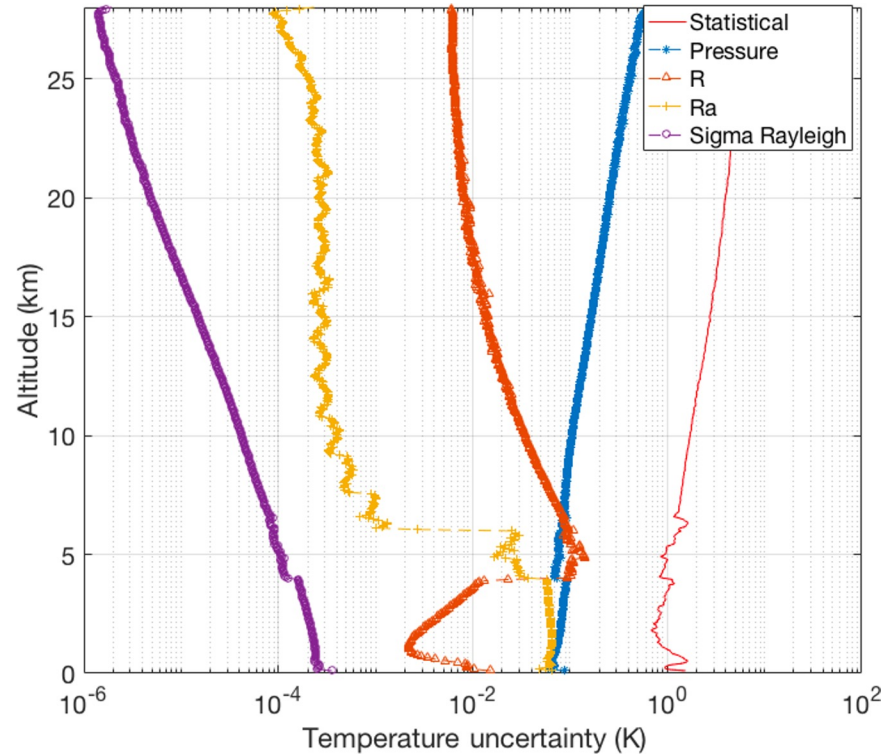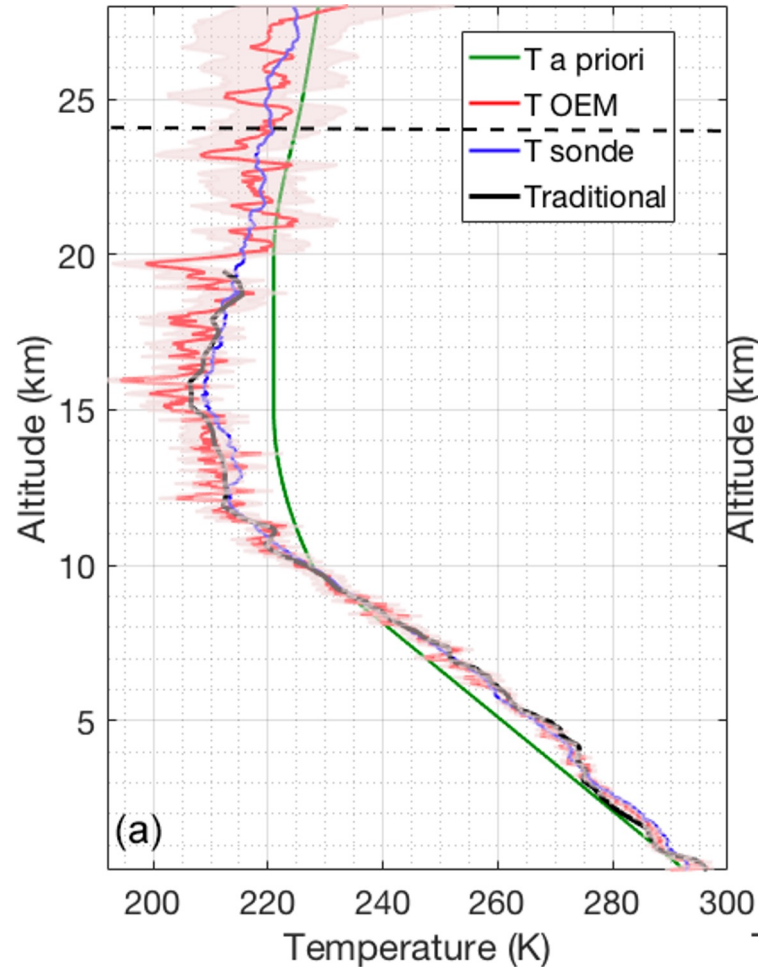
Temperature retrieval from RALMO measurements on 09 September 2011 along with the full uncertainty budget.

Mahagammulla Gamage, S., Sica, R. J., Martucci, G., and Haefele, A.: Retrieval of temperature from a multiple channel pure rotational Raman backscatter lidar using an optimal estimation method, Atmospheric Measurement Techniques, 12, 5801-5816, 2019.

Calibration of Temperature Measurements

- External method: Uses an external reference instrument (i.e Radiosonde) for calibration.

- Internal method (background method): Uses the solar background taken through the lidar at a time corresponding to a 70º zenith angle.

- The trend derived from externally calibrated data is highly dependent on the trend of the external reference itself.

- Using the internal calibration method, the derived **trend** becomes independent from the external reference measurements.

External and Background Calibration
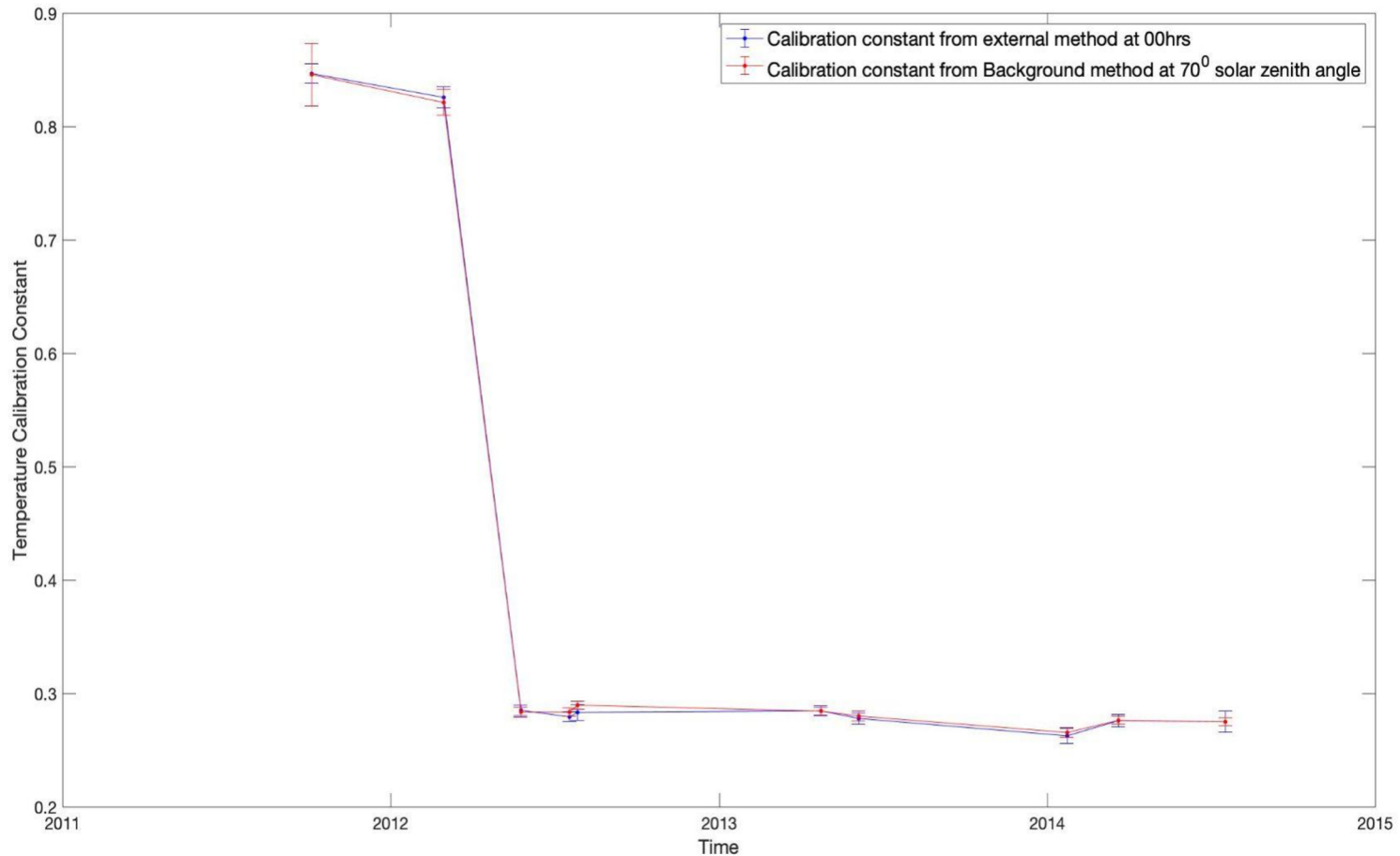
- Comparison between the temperature calibration time series obtained by the external method and the background calibration method.

Comparison of temperature profiles
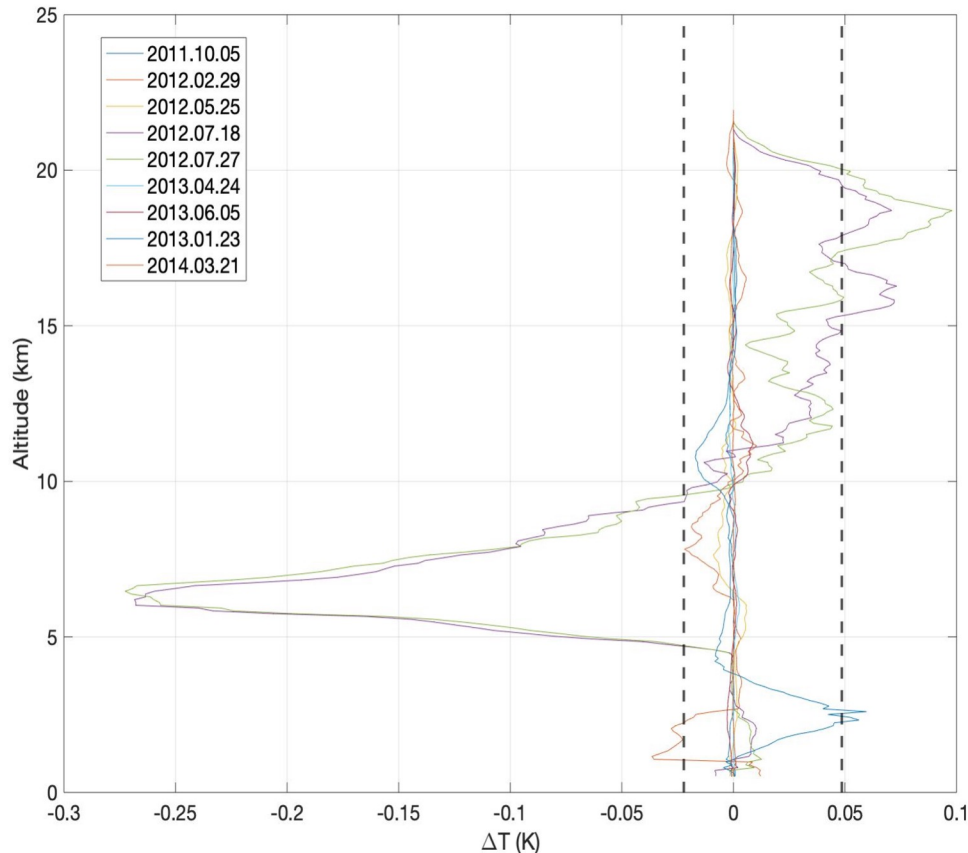
- Figure shows the difference between the temperature profiles obtained using the calibration constant from external and background calibration methods.

- The agreement between the external and background calibration methods to the 2σ level is about 0.07 K, with a bias of 0.01 K.

- Comparison suggests that we will be able to use the background calibration technique as an alternative to the external calibration method.