RS41GDP / RS92GDP
First comparison results

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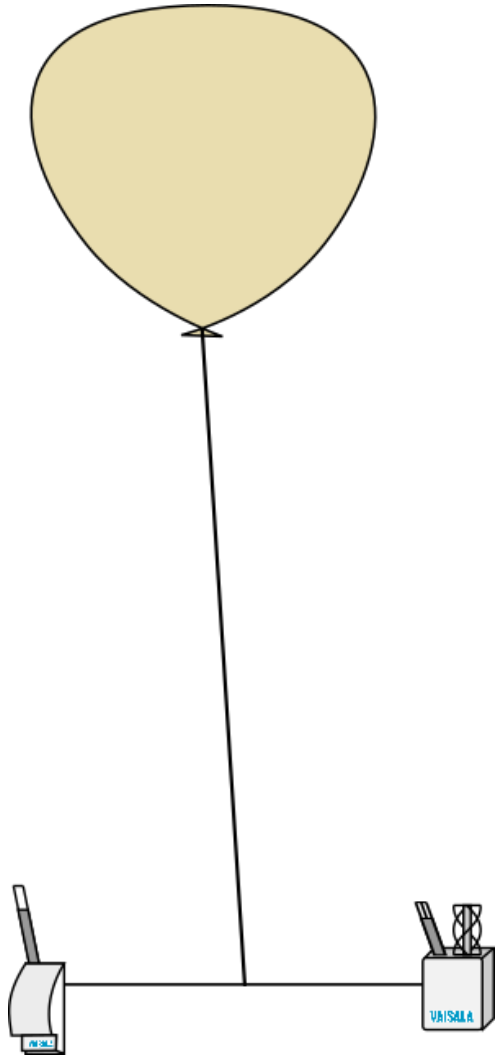
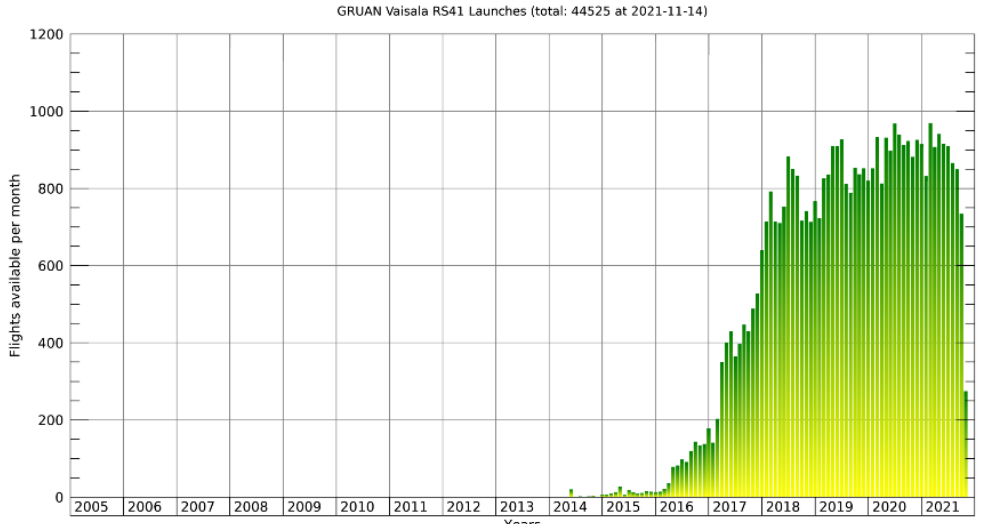
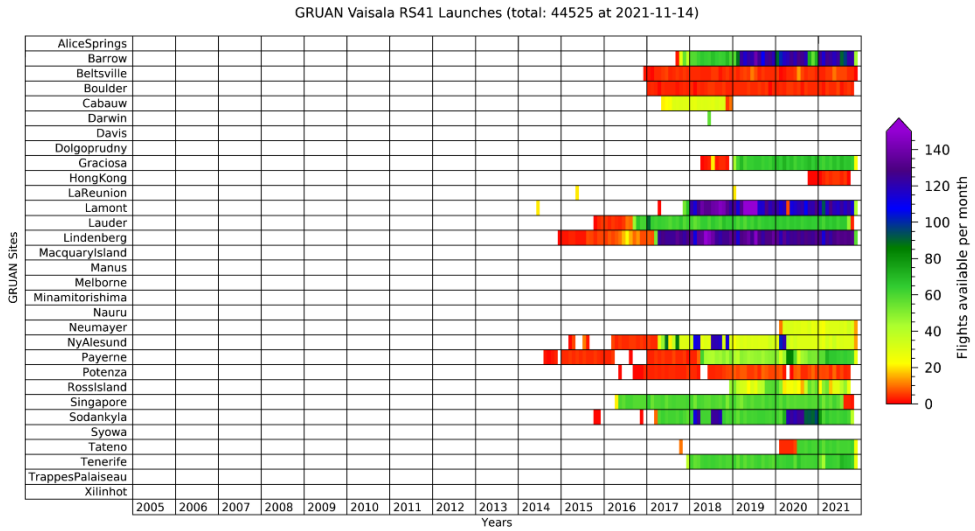


Why RS41 and RS92?

- RS41 is the follow-up radiosonde to the RS92
- RS92 used in 18/31 GRUAN sites
- RS41 used in 19/31 GRUAN sites
- For both sondes manufacturer created EDT products are available
- For both sondes GRUAN GDP's are created
- GDP's contain all measurements + estimated uncertainty budgets

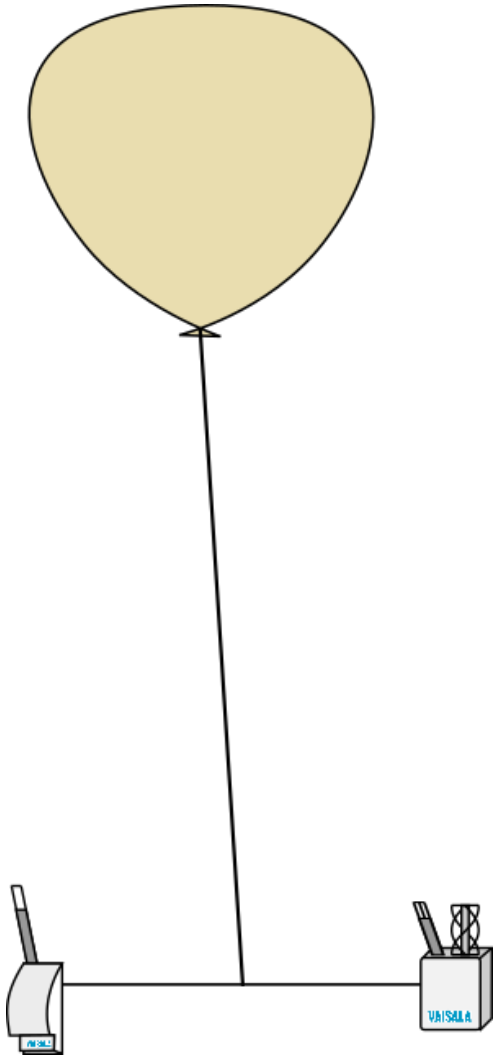




Available data and handling

- Each profile divided into layers 1km thick*
- Values averaged in each layer in each profile
- Values for all profiles for each station averaged for each layer
- Estimated uncertainties from GDP's

Station	N of flights
Lindenberg	276
Payerne	136
NyAlesund	112
Darwin	52
Neumayer	26
Lamont	9
Tateno	8



Simple scheme of uncertainties

	Point in profile	Layer in profile	All profiles
• uncorrelated (random)	u_{ucorr}	$u_{ucorr} = \sqrt{\sum u_{ucorr}^2}$	$u_{ucorr} = \sqrt{\sum u_{ucorr}^2}$
• correlated (systematic)	u_{corr}	$u_{corr} = \frac{1}{n}\sum_n u_{corr}$	$u_{corr} = \frac{1}{n}\sum_n u_{corr}$
• full	$u = \sqrt{u_{ucorr}^2 + u_{corr}^2}$	$u = \sqrt{u_{ucorr}^2 + u_{corr}^2}$	$u = \sqrt{u_{ucorr}^2 + u_{corr}^2}$

Only full uncertainties shown on plots

All profiles for Lindenberg

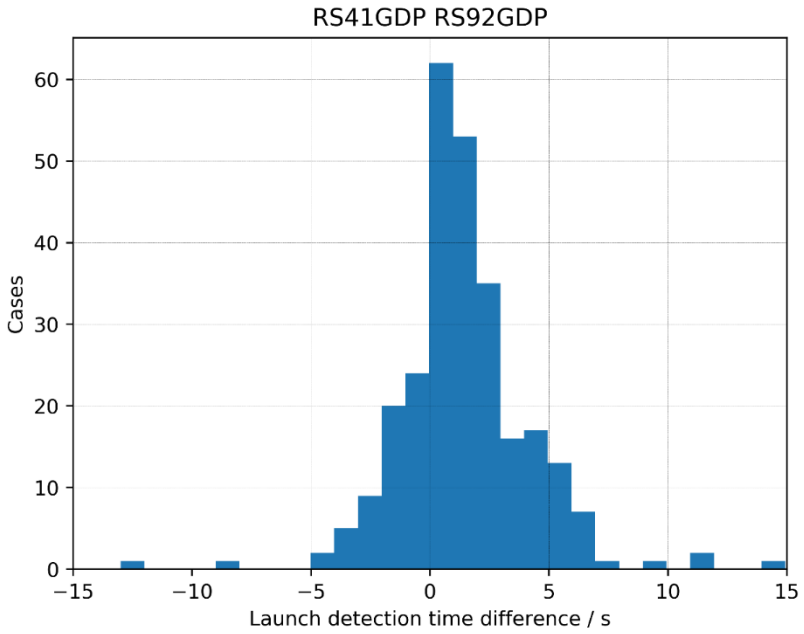
Blue points and blue uncertainties from GDP comparison!

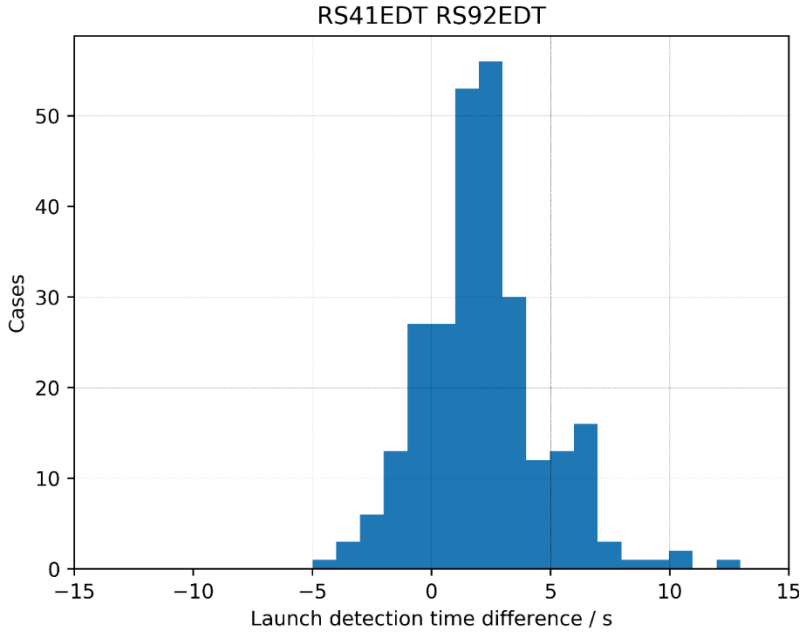
Red points from EDT comparison.

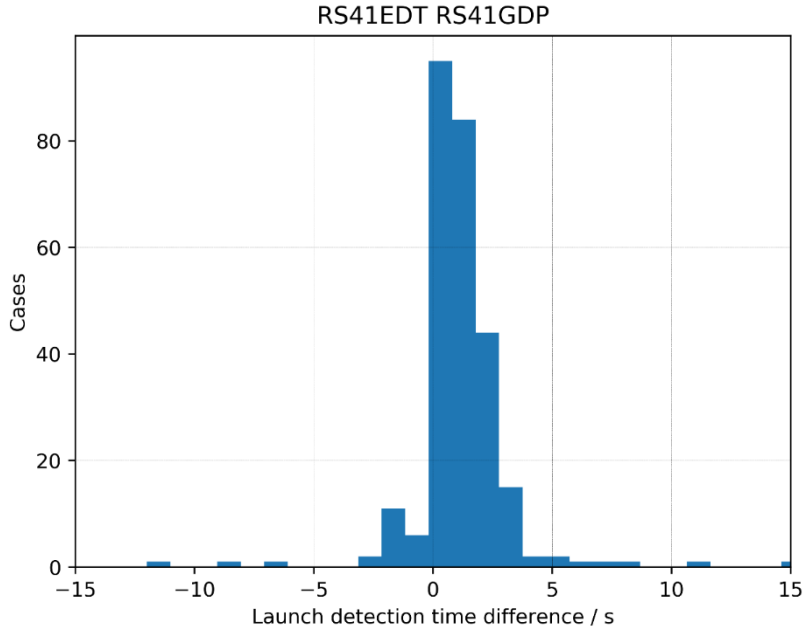
Launch point detection

Independent launch detection for RS41GDP from RS41EDT. RS92GDP uses RS92EDT launch detection.

- Gaussian distribution – figures from 276 flights from Lindenberg
- Differences up to 150s (!)
- Dependent on station – when RS41SGP is used, launch detection is from pressure sensor
- EDT's at 2s resolution (!)



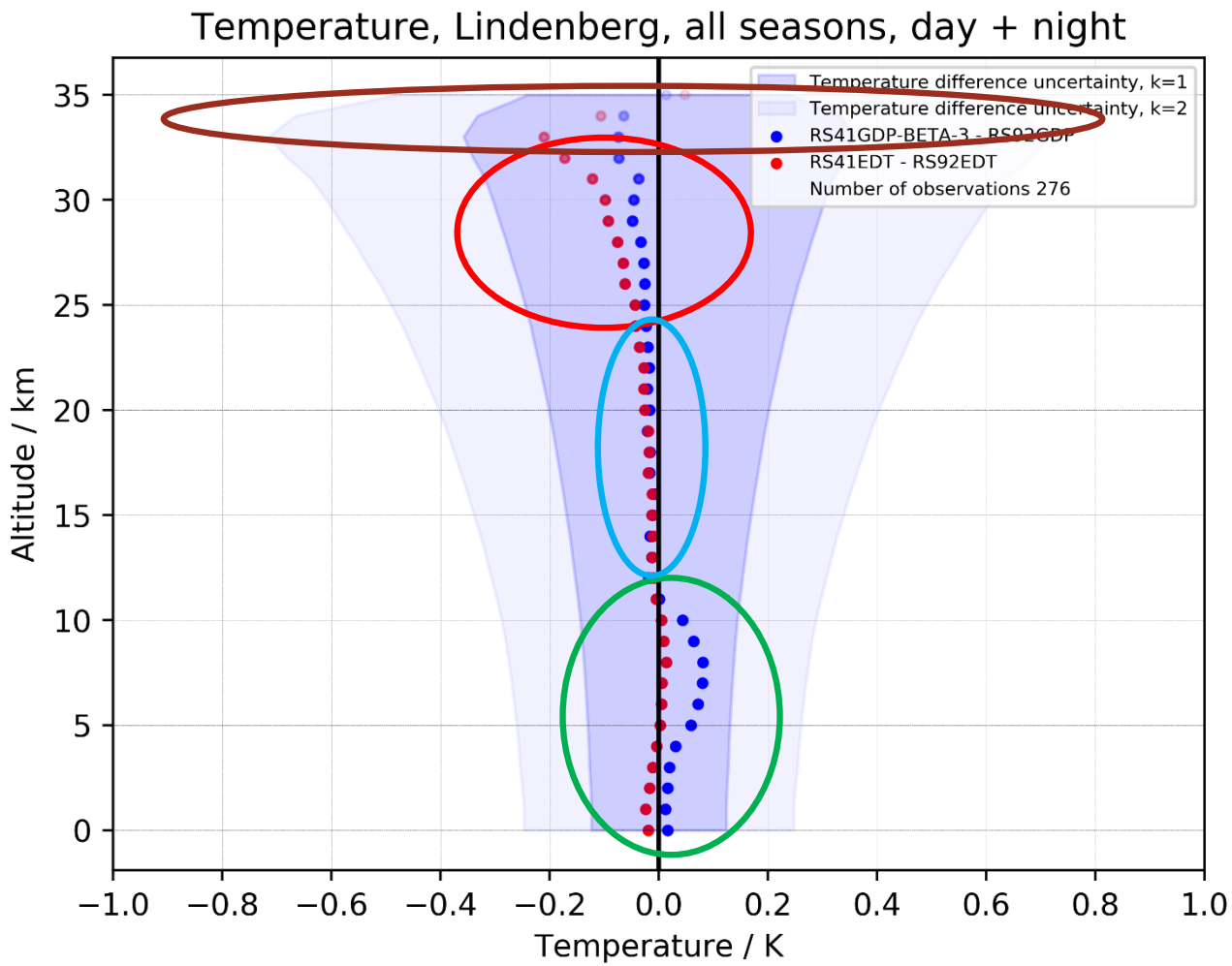




Effects on temperature

Observed features in the comparison:

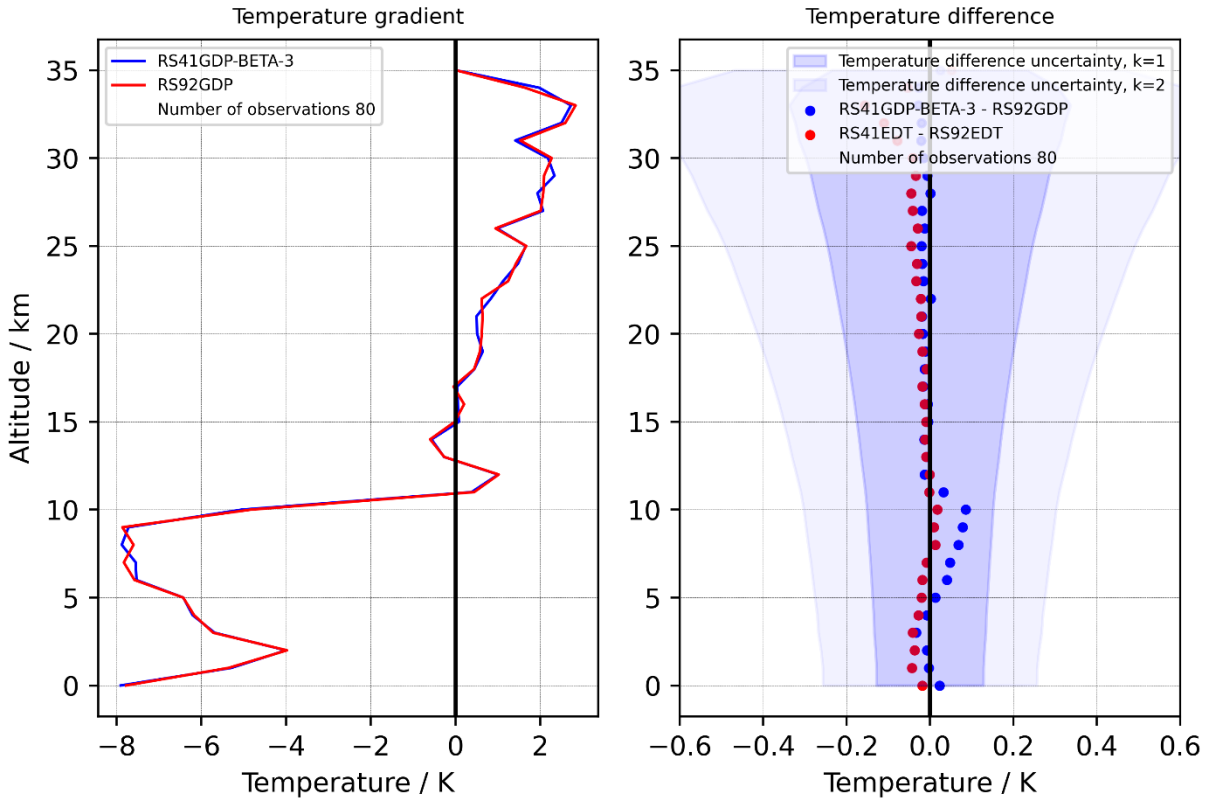
- Top of profiles – night flights reach higher altitudes more often, which decreases overall uncertainty
- Middle stratosphere – differences in radiation corrections
- Lower stratosphere – little to no bias between RS41 and RS92
- Troposphere – time lag difference between RS41 and RS92 temperature sensors



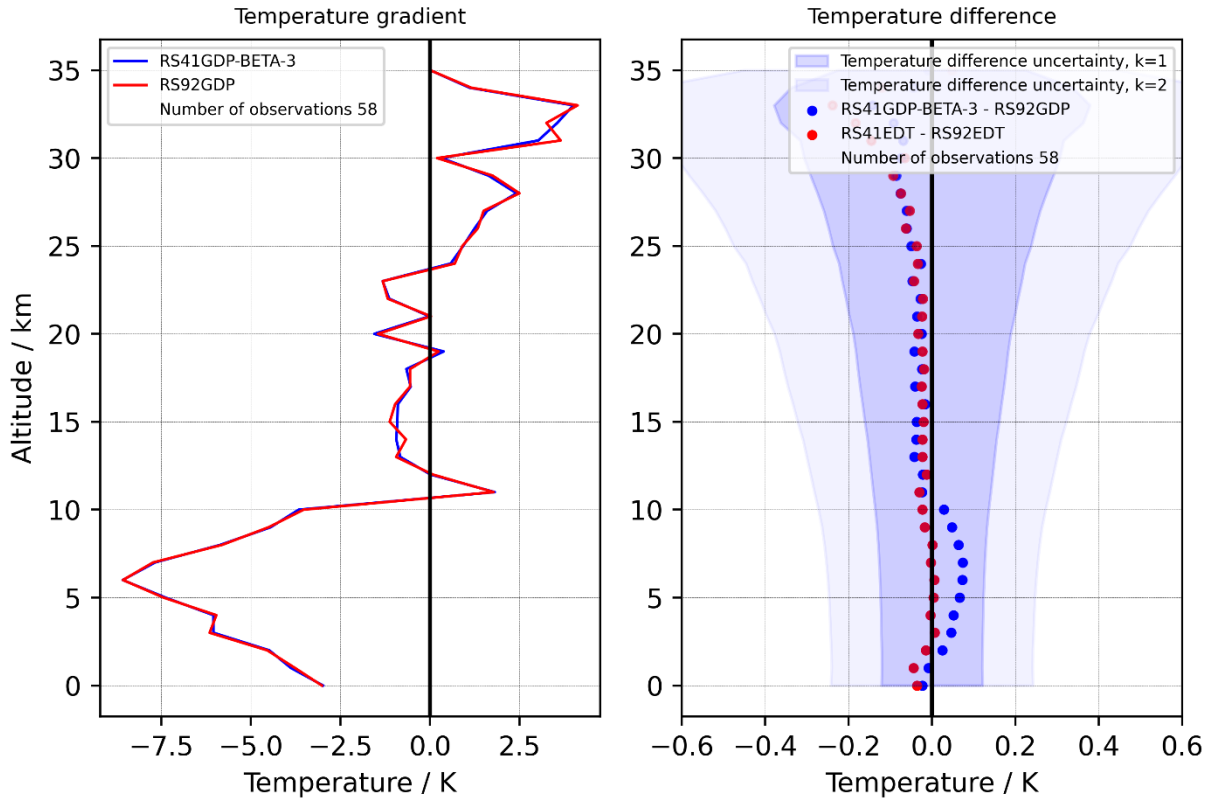
Time lag in the troposphere

- Time lag dependent on the gradient in the Troposphere
- The effect disappears at the Tropopause, which is dependent on the season

Lindenberg, summer, day + night

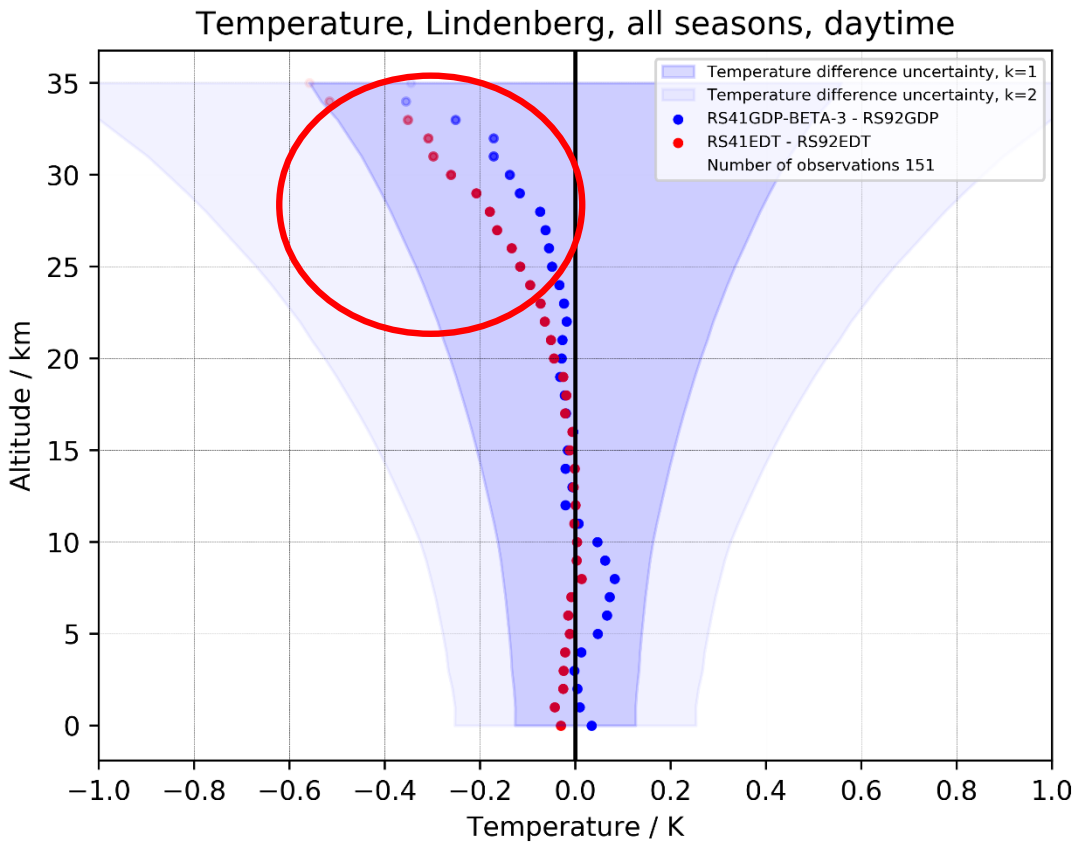


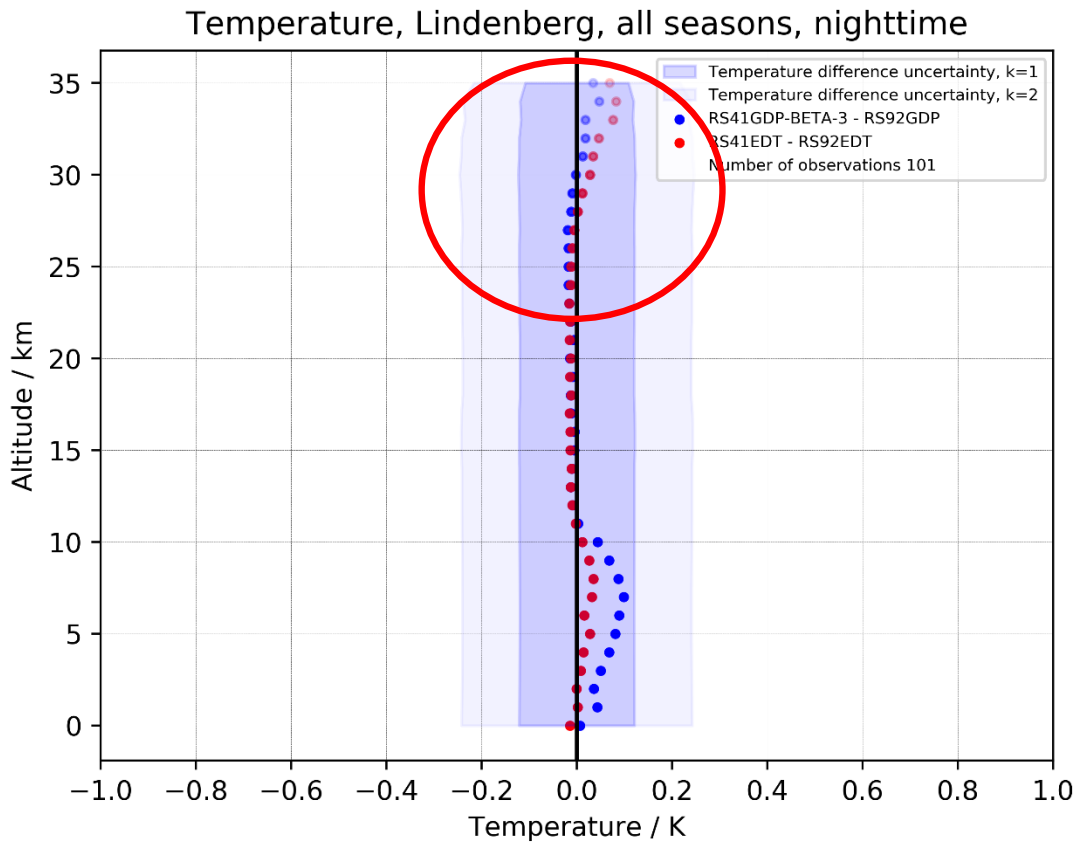
Lindenberg, winter, day + night



Radiation influence on temperature

- Larger radiation corrections for both RS92 products, compared to the RS41 data





Temperature processing differences

RS92GDP:

- Sensitivity estimated from experiments in radiation chamber at various ***p*** and ***v***
- Solar radiation from RTM, based on **solar elevation**
- Use of a look-up table with pre-computed (simulated) cases -- but only a few different cases

RS41GDP:

- Sensitivity of T-sensor to solar radiation measured with SISTER as function of ***p,v***, the combination of ***boom angle*** and **solar elevation**, and as averaged effect over a **rotating sonde**
- Solar radiation from RTM
- online simulation of each flight case (up to 100 simulations per flight because change of time and solar angles)

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Atmospheric Measurement Techniques Discussions

Laboratory characterisation of the radiation temperature error of radiosondes and its application to the GRUAN data processing for the Vaisala RS41

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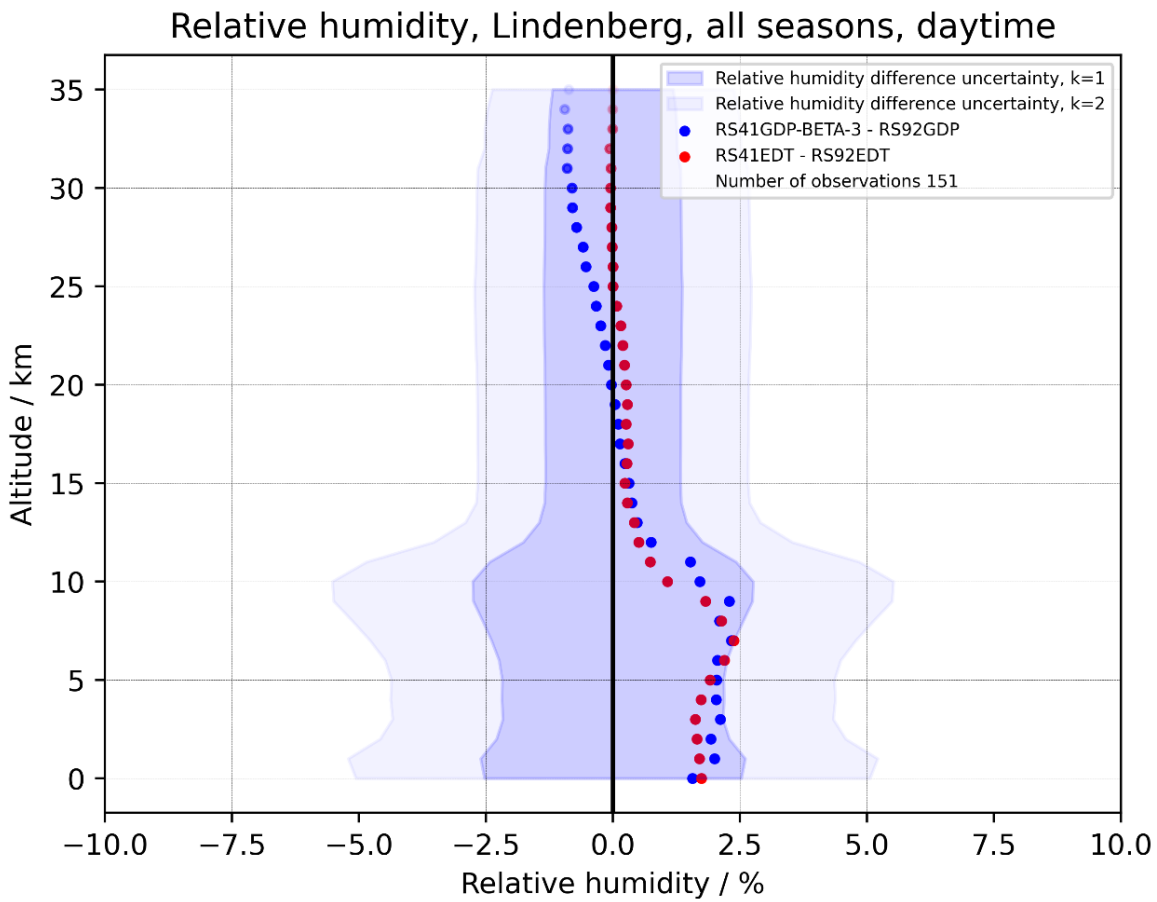
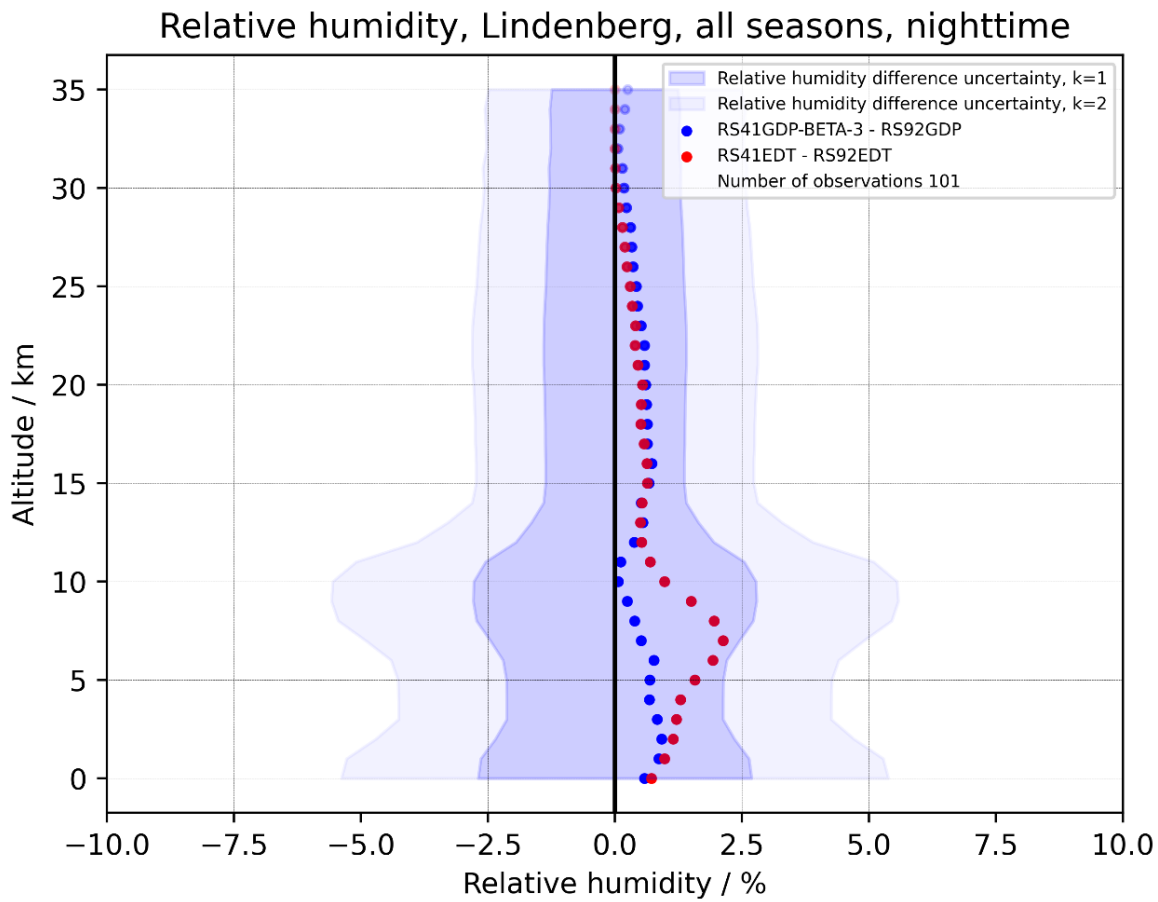
Abstract.

The paper presents the Simulator for Investigation of Solar Temperature Error of Radiosondes (SISTER), a setup that was developed to quantify the solar heating of the temperature sensor of radiosondes under laboratory conditions by recreating as closely as possible the atmospheric and illumination conditions that are encountered during a daytime radiosounding ascent. SISTER controls the pressure (3 hPa to 1020 hPa) and ventilation speed of the air inside the windtunnel-like setup to simulate the conditions between the surface and 35 km altitude, to determine the dependence of the radiation temperature error on the irradiance and the convective cooling. The radiosonde is mounted inside a quartz tube, while the complete sensor boom is illuminated by an external light source to include the conductive heat transfer between sensor and boom. A special feature of SISTER is that the radiosonde is rotated around its axis to imitate the spinning of the radiosonde in flight. The characterisation of the radiation temperature error is performed for various pressures, ventilation speeds and illumination angles, yielding a 2D-parameterisation of the radiation error for each illumination angle, with an uncertainty smaller than 0.2 K ($k = 2$) for typical ascend speeds. This parameterisation is applied in the GRUAN processing for radiosonde data, which relies on the extensive characterisation of the sensor properties to produce a traceable reference data product which is free of manufacturer

Relative humidity comparisons

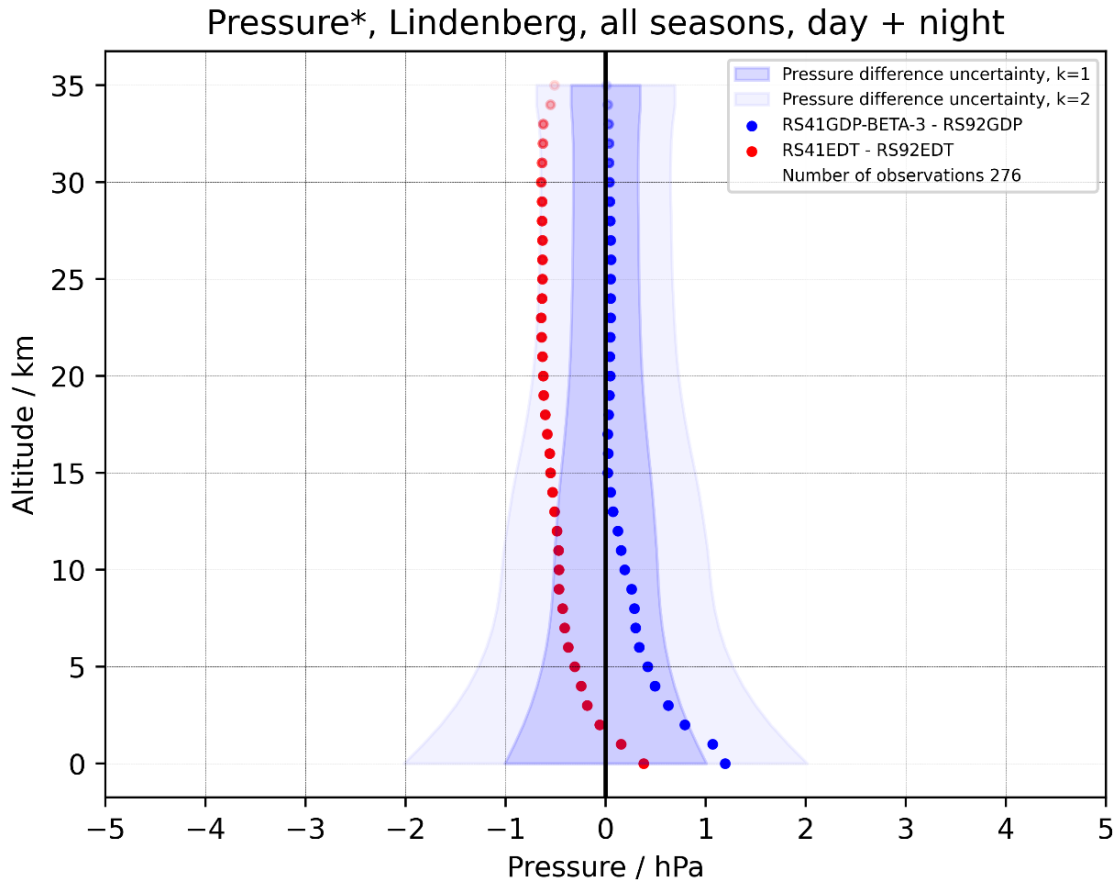
- Influence of time lag in the Troposphere



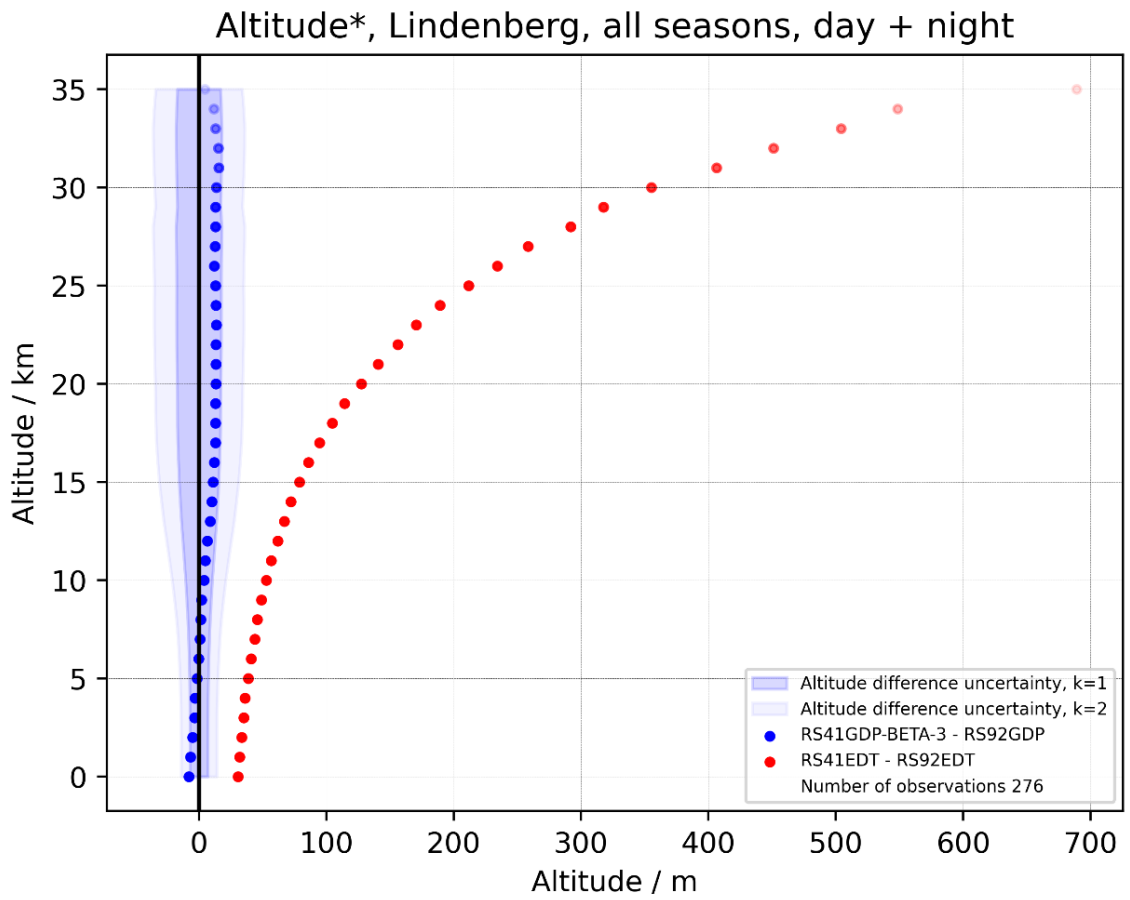


Altitude and Pressure differences

- RS41GDP uses EGM2008 geoid
- RS92GDP uses EGM96 geoid



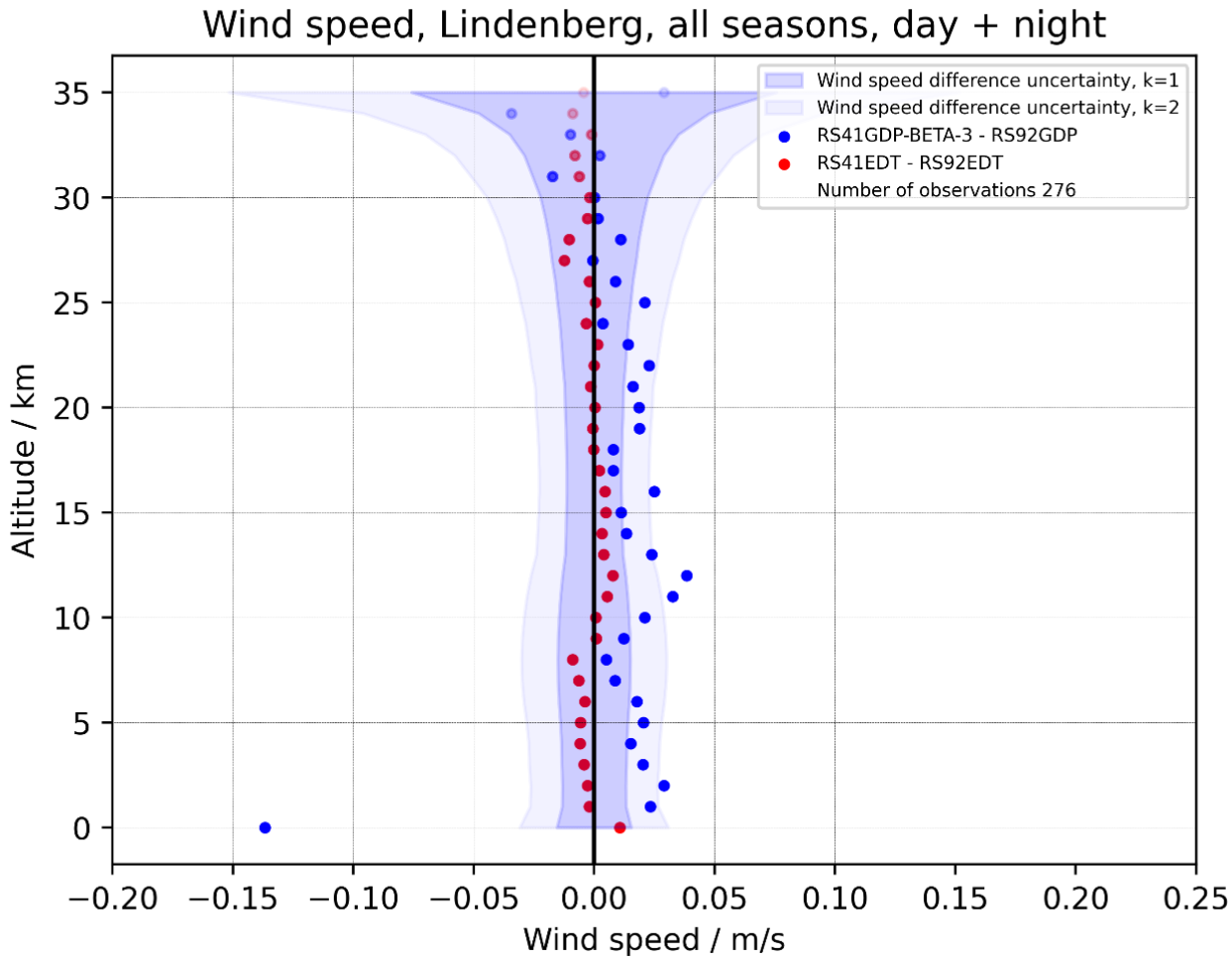
- RS41EDT uses EGM96 geoid (?)
- RS92EDT uses WGS84 ellipsoid (?)



Wind speed comparisons

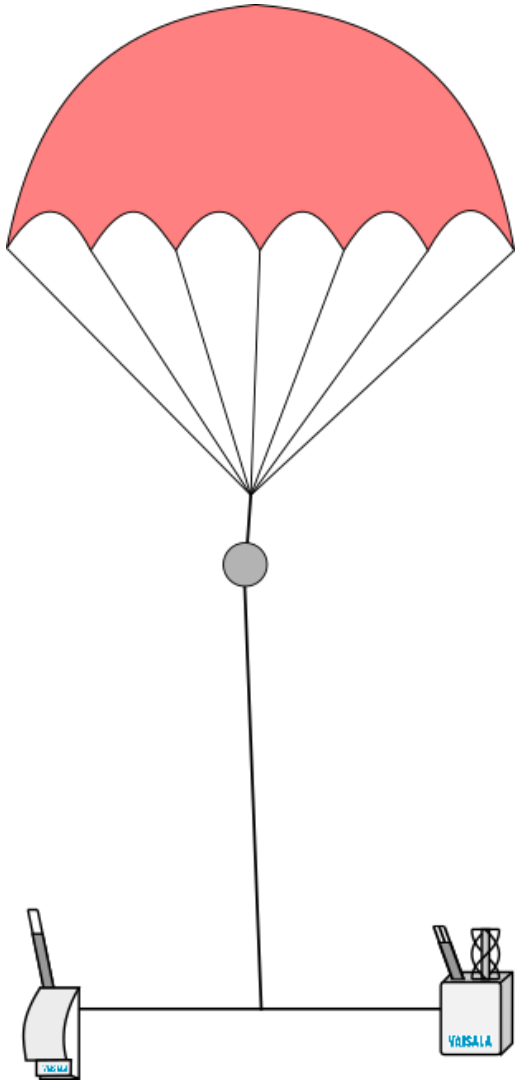
Observed features in the comparison:

- Small uncertainties, since all uncertainties are uncorrelated
- Both EDT wind speed calculated from Doppler GPS observations
- Both GDP wind speed calculated from differences between absolute positions
- Small differences in results for all sites and all seasons



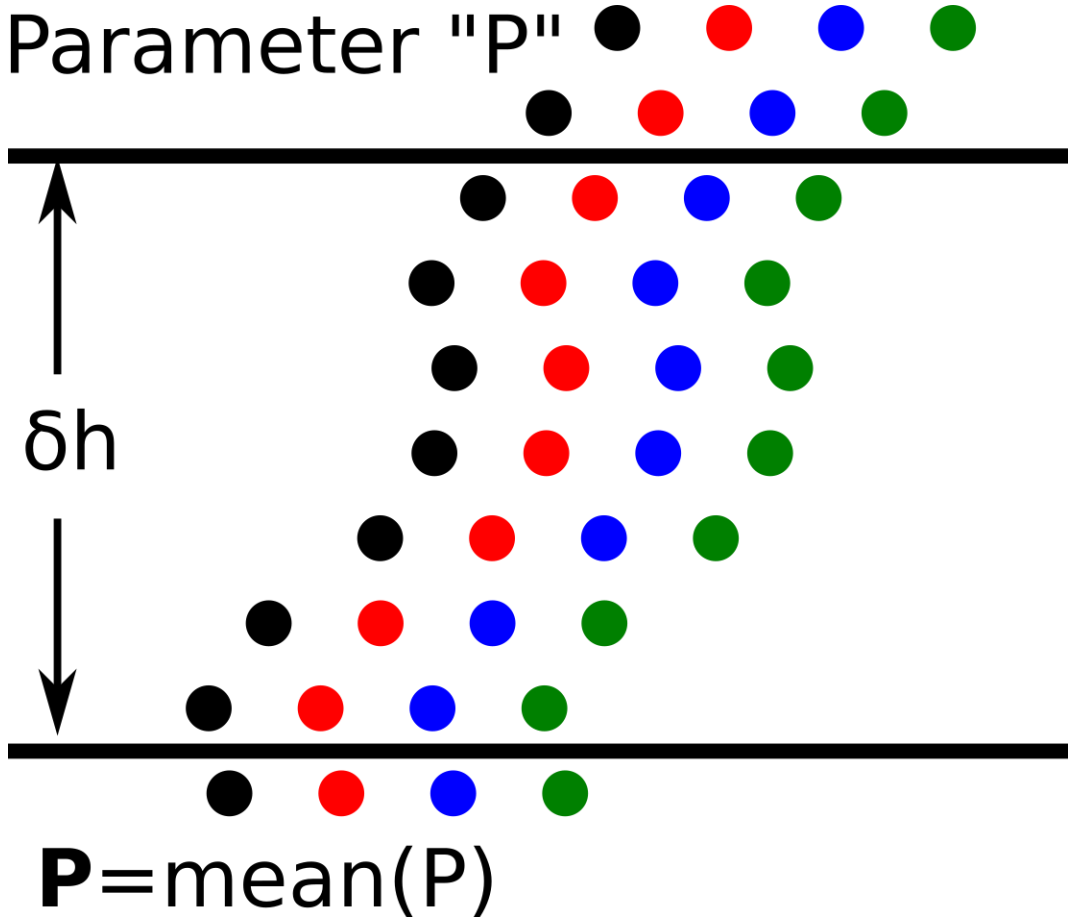
Summary and outlook

- First results from comparison from all GRUAN sites
- Temperature and relative humidity comparisons to be published in paper for the RS41GDP certification
- Further paper on pressure, coordinates and wind to follow

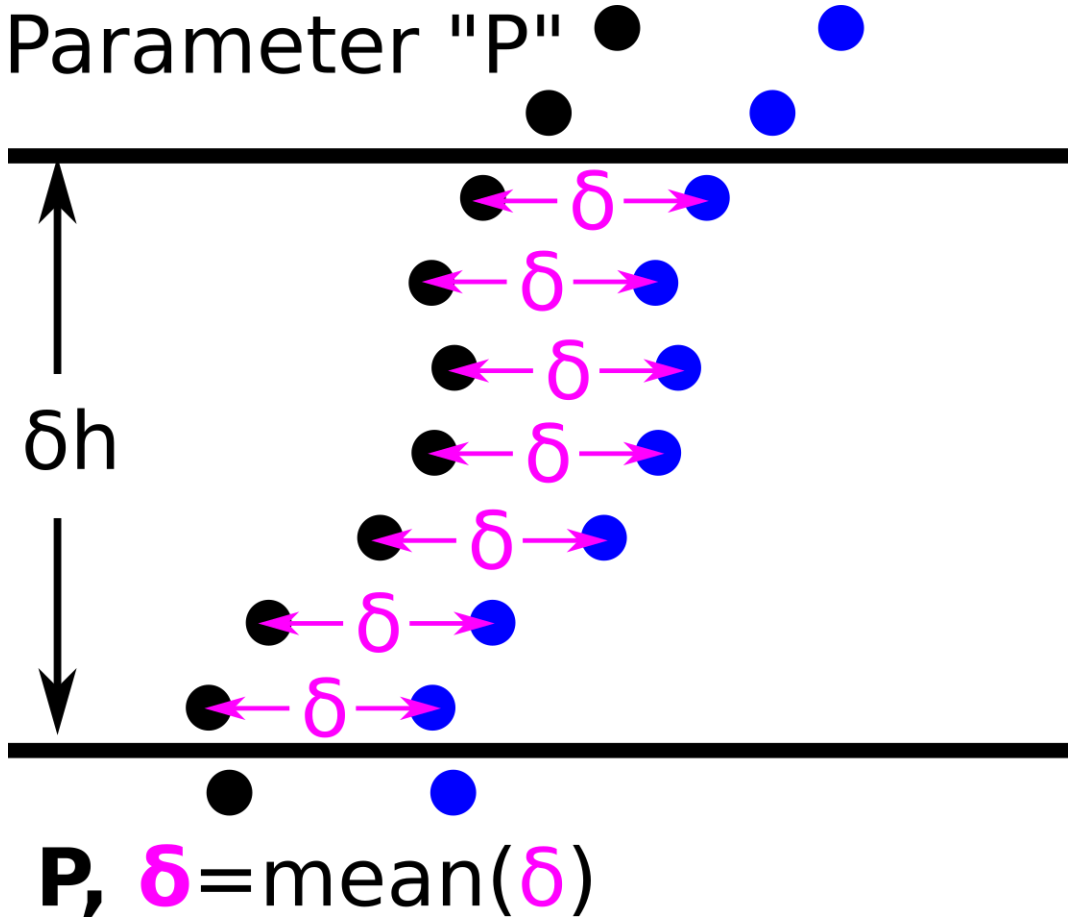


Thank you for your attention !

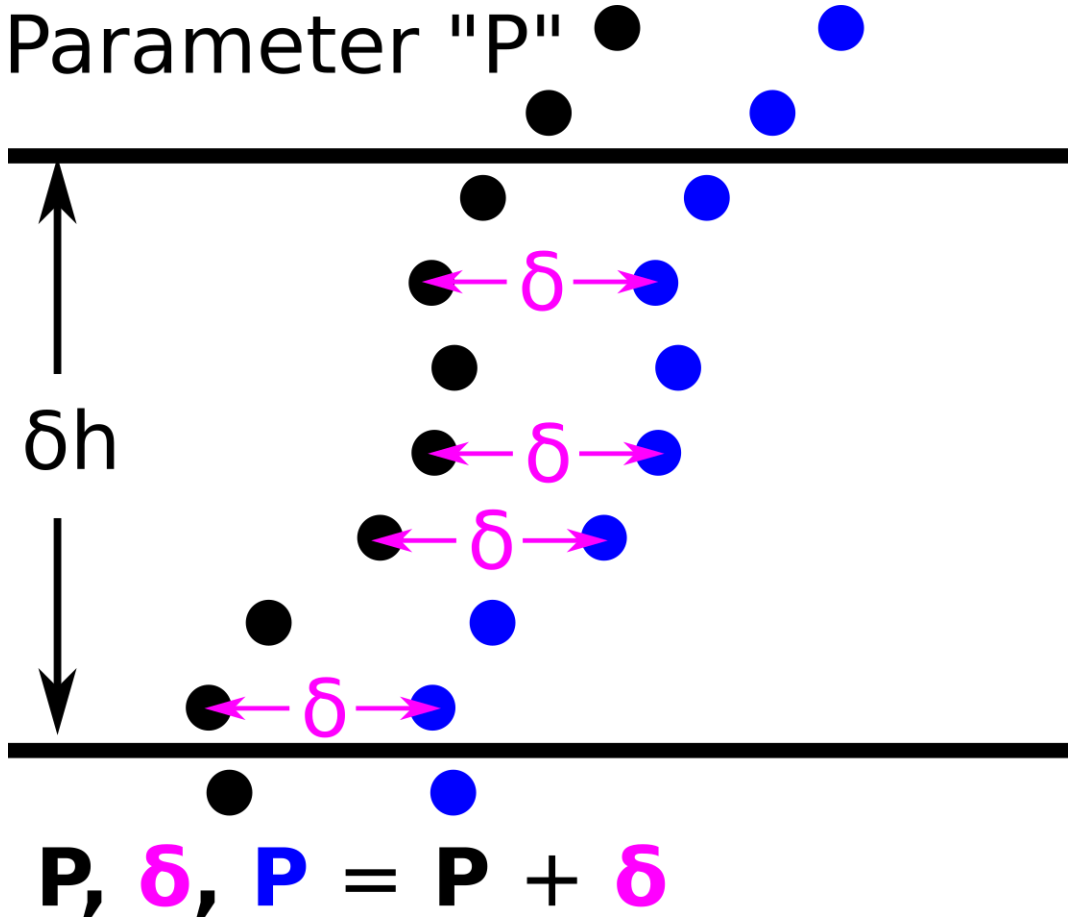
Profile synchronization



Profile synchronization



Profile synchronization



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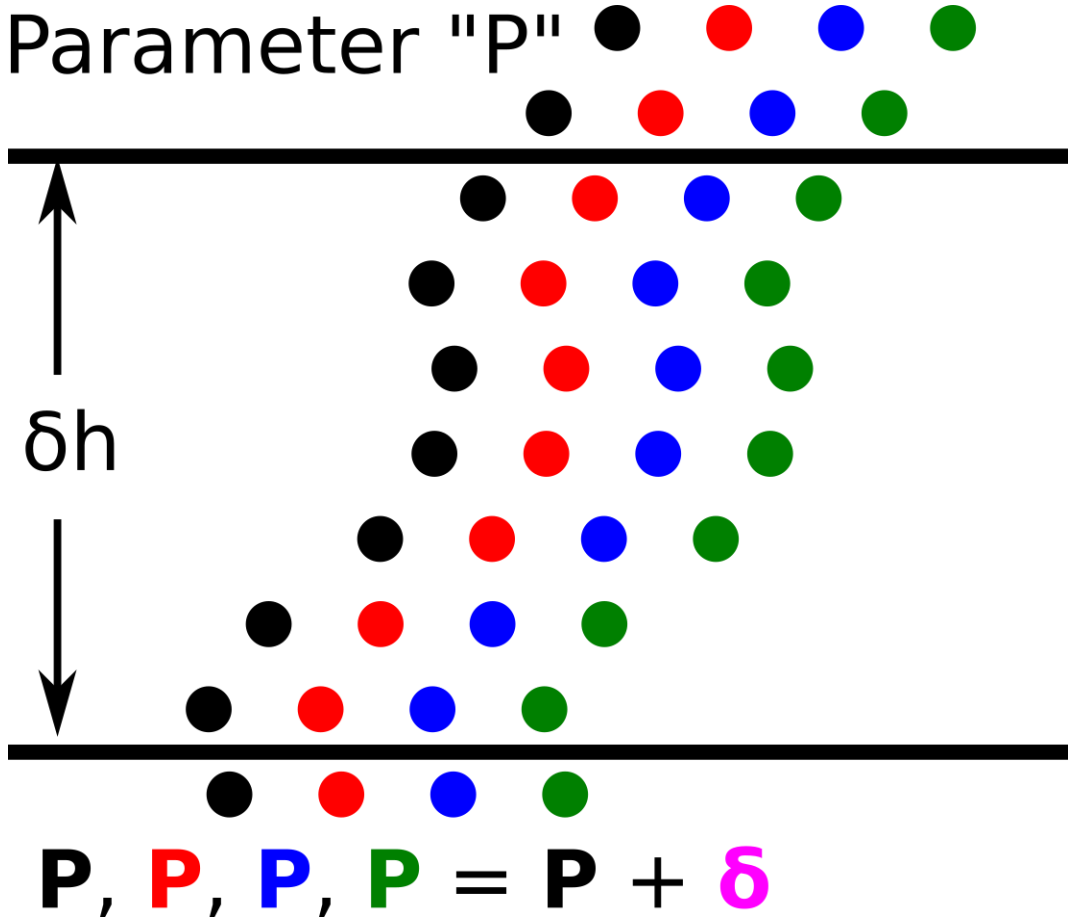

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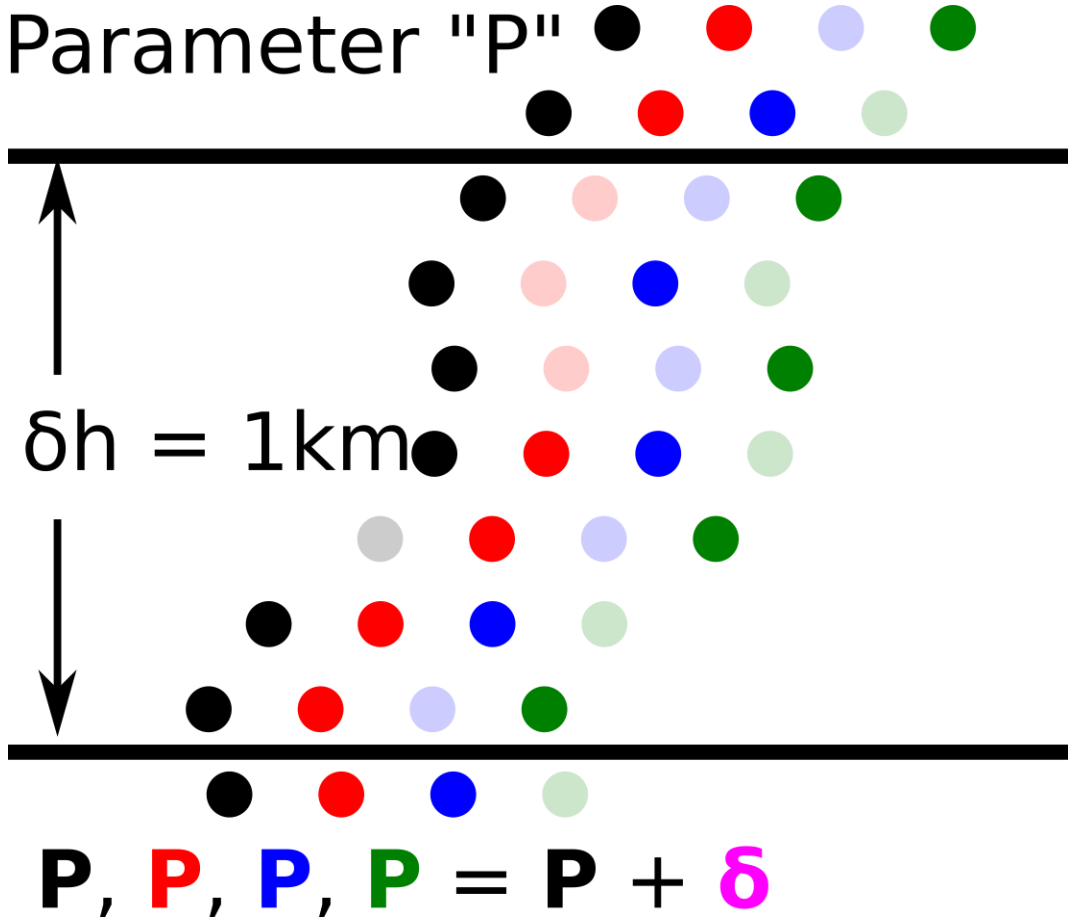

Profile synchronization