The GRUAN Observing Station Payerne- Switzerland

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GRUAN Activities

- **Swiss Radiosonde**
- **GRUAN – Reference Multi-Soundings**
- **Uncertainty on upper-air Temperature**

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Swiss Radiosonde Meteolabor SRS-C34

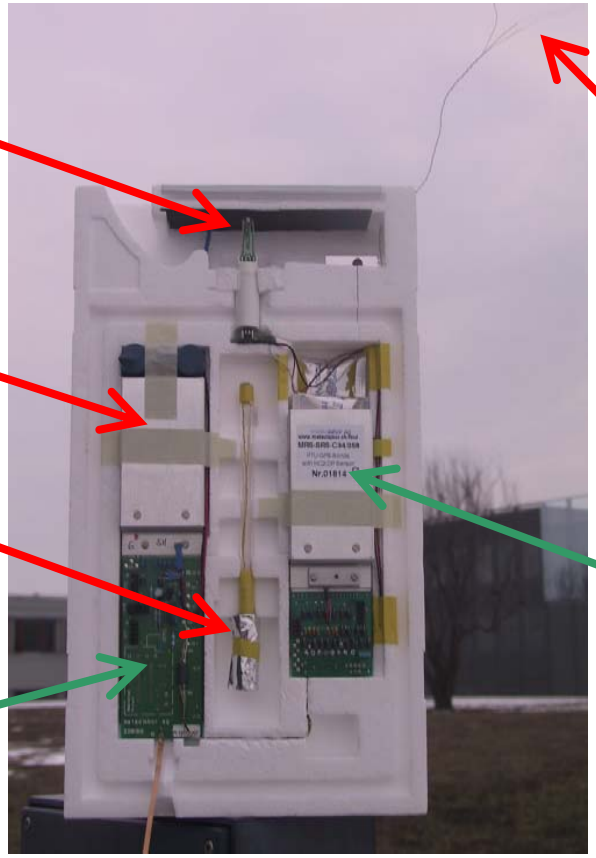
Operation:	**daily UT 00 – UT 12**
Temperature:	**Thermocouple**
Humidity:	**Rotronic HC2 capacitive**
Altitude/Pressure:	**GPS (Hypsometer)**
Wind Speed/Dir.:	**GPS**

Rotronic HC2 capacitive sensor

GPS

Water Hypsometer

Transmitter 400 Mhz



Thermocouple (Copper - Constantan) (wire ø 0.05 mm)

Electronique Interface

Telemetry

MeteoSwiss

GRUAN Reference Multi-Soundings

Biweekly Daytime UT 12:00 (Tuesday or Thursday)

Double sounding:

- Meteolabor SRS-C34 (operational)
- Vaisala RS92 (DigiCORA MW31) submitted to GRUAN lead center

Biweekly Nighttime UT 00:00 (Wednesday or Friday)

Triple sounding:

- Meteolabor SRS-C34 (operational)
- Vaisala RS92 (DigiCORA MW31) submitted to GRUAN lead center
- Meteolabor SnowWhite dew/frost point hygrometer

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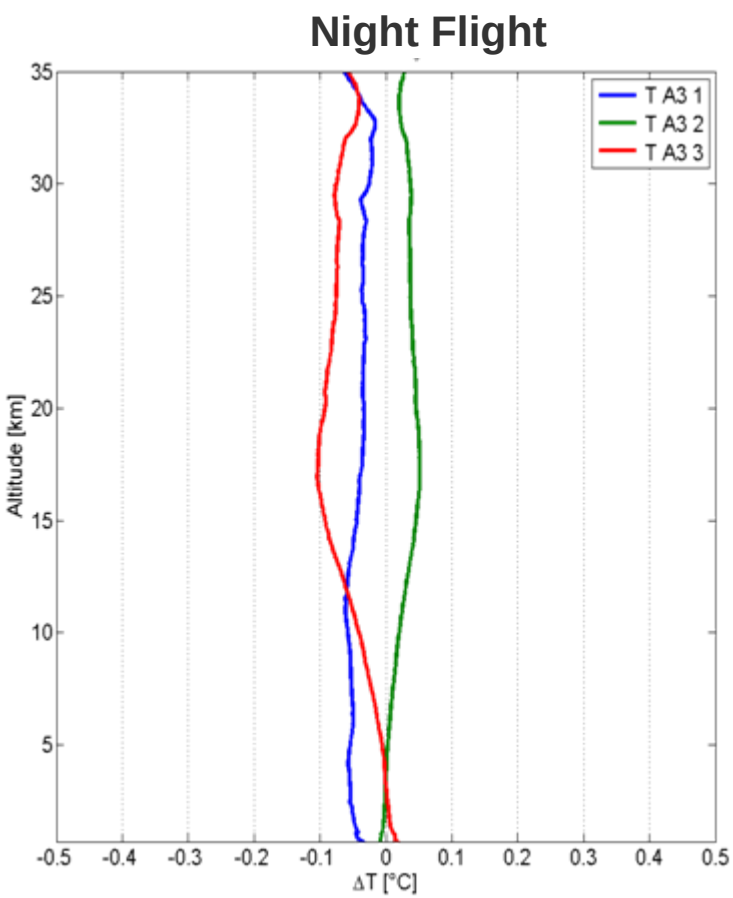
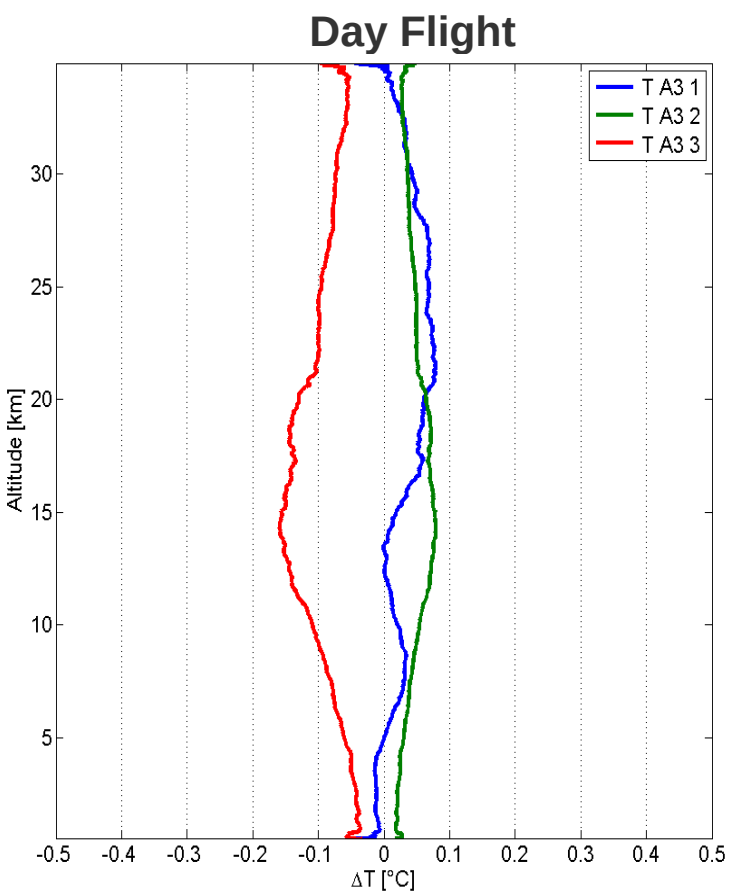
Uncertainty on Temperature

Triple sounding SRS-C34

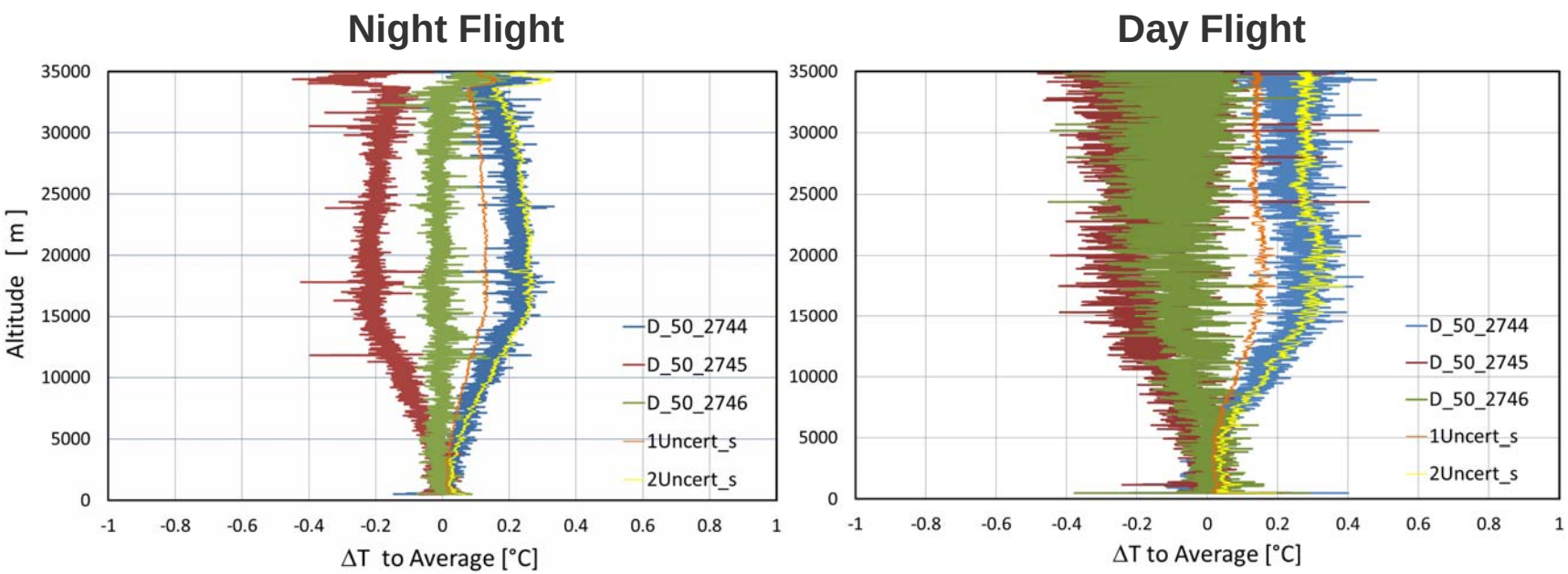
to test reproducibility





Uncertainty on Temperature

Triple sounding SRS-C34



Reproducibility Night ± 0.2 K

Reproducibility Day ± 0.3 K

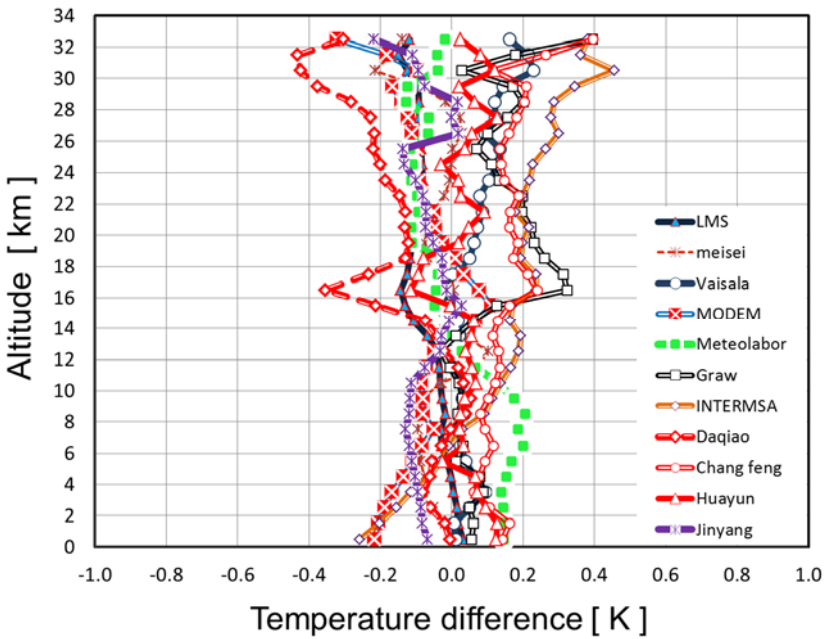
Uncertainty calculated according to *Immler et al. AMT 2010*

WMO Intercomparison 2010

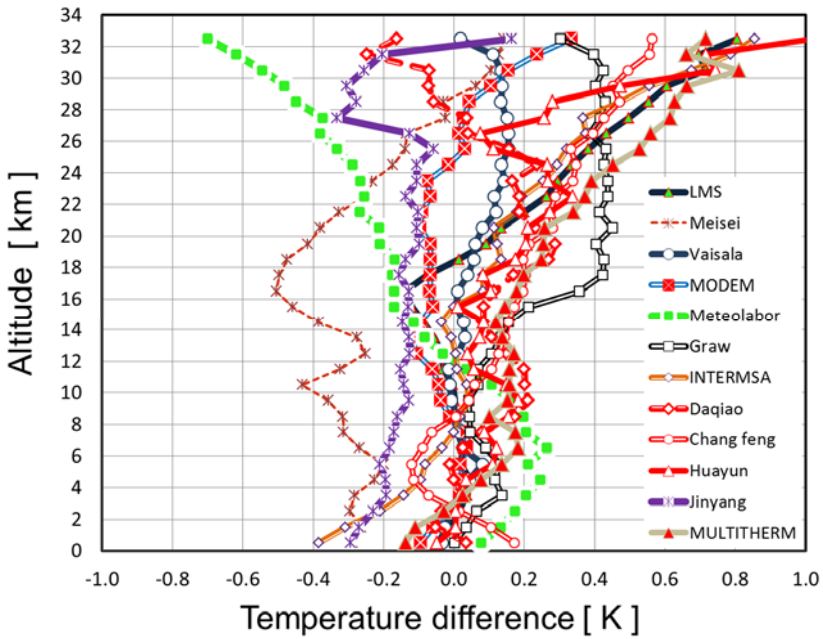
Results from the:

WMO Intercomparison of High Quality Radiosonde Systems
Yangjiang, China, 12 July - 3 August 2010

Night



Day



J. Nash, T. Oakley, H. Vömel, LI Wei, WMO/TD-No. 1580, 2011

Reinvestigation of Meteolabor radiation correction

Experiments: Atmosphere / Laboratory

1 **Measurements of the radiation error on unshaded and shaded temperature sensors in flight**

2 **Measurements of solar and thermal radiation flux profiles through the atmosphere**

3 **Measurements of the radiation error on temperature sensors of different diameters in a vacuum chamber**

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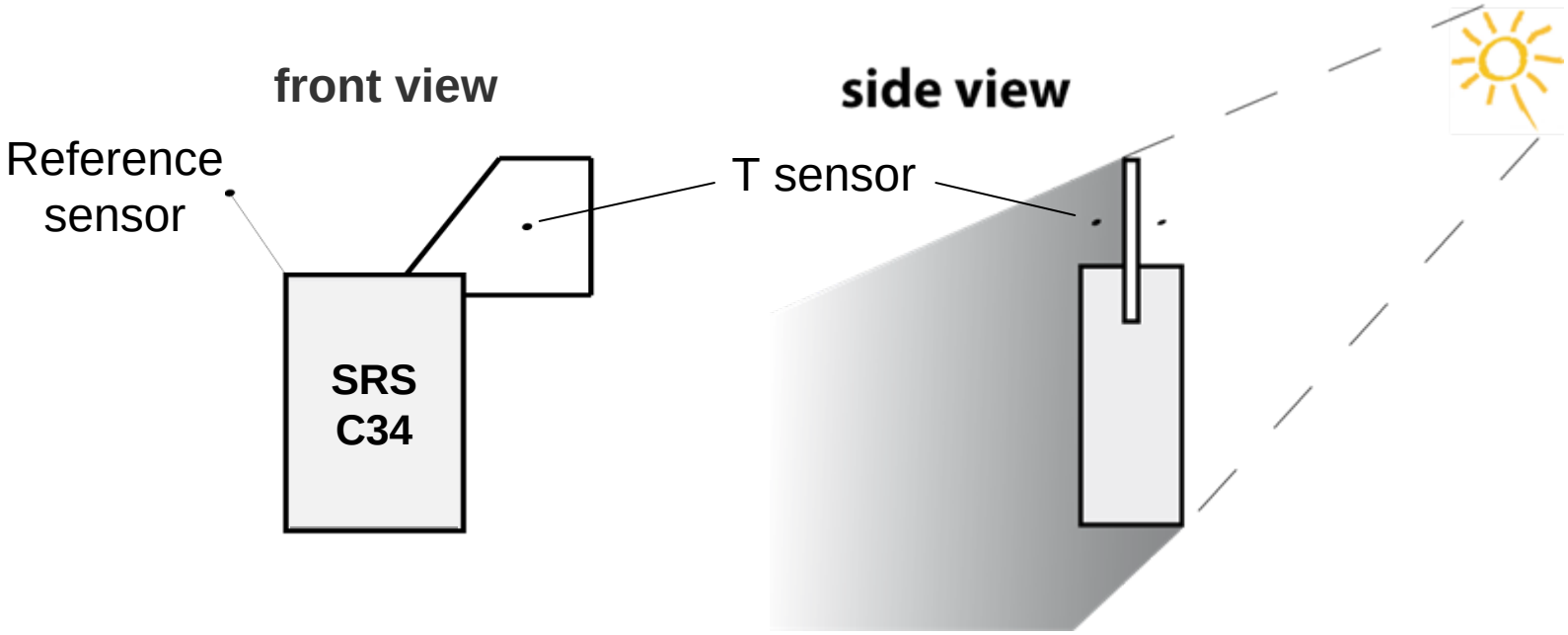
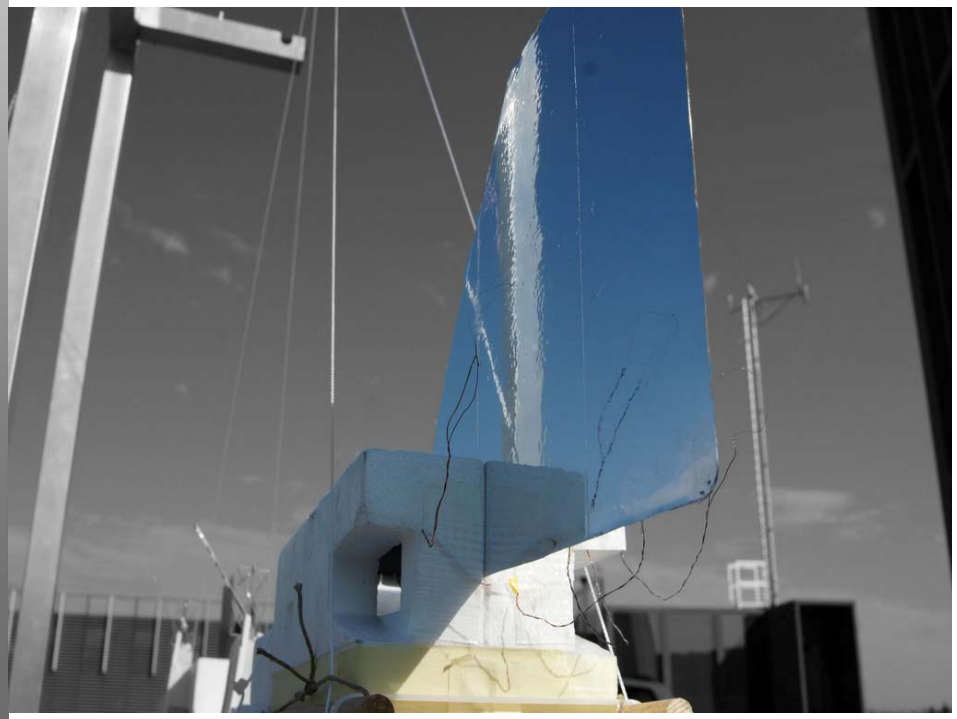
Shaded / Unshaded Temperature Measurement

- **Aluminium plate (brilliant / black) attached to Meteolabor sonde**
- **Temperature sensors on both sides (5cm distance)**
- **Alternately one sensor is exposed to the sun**



Shaded / Unshaded Temperature Measurement

50 micron thermocouple temperature sensors unshaded and shaded



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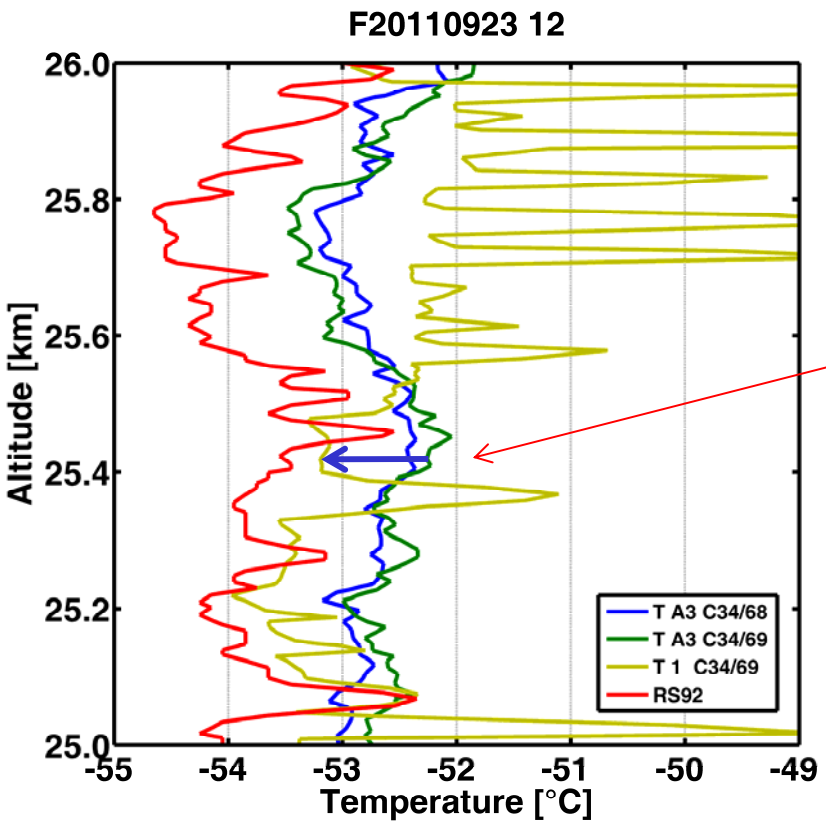
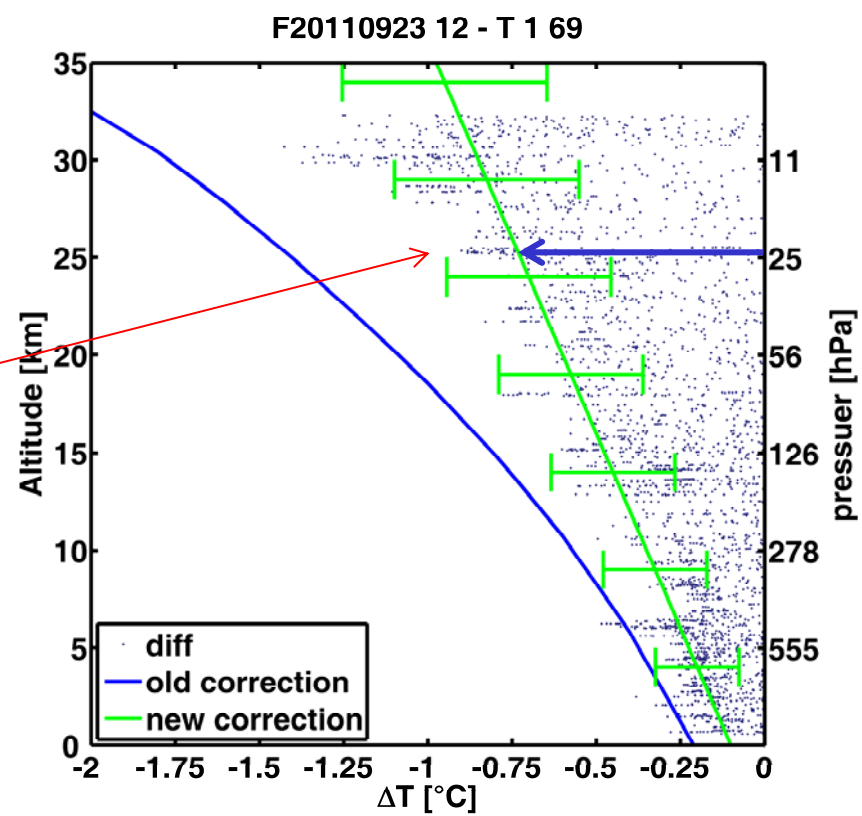
Shaded / Unshaded Temperature Measurement





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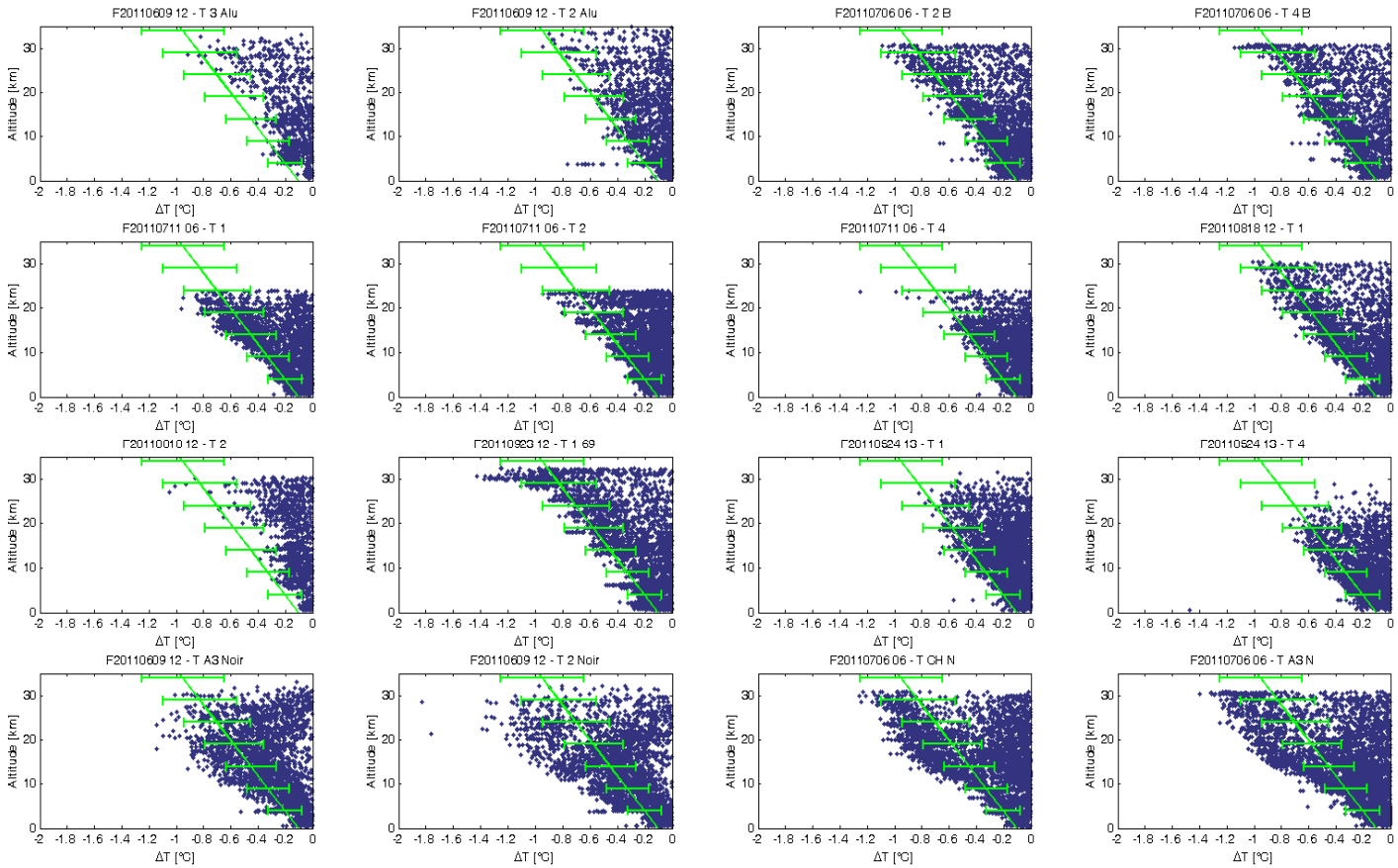
New Radiation Error on Temperature



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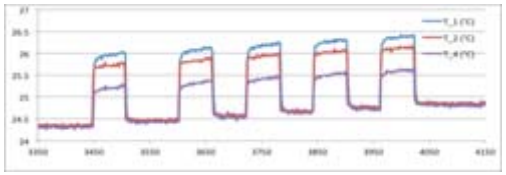
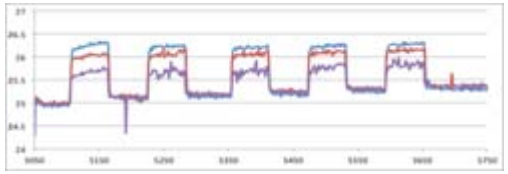
Radiation Error measured in Vacuum Chamber

Experiment with one Meteolabor sonde having three thermocouple sensors with wires of 20μ, 50μ, 100μ

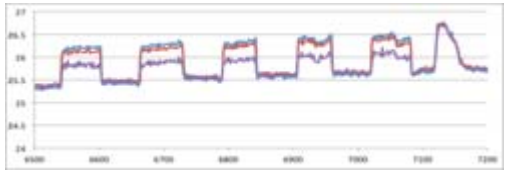
1 Minute on, 1 Minute off



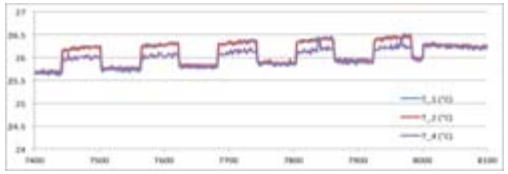
P = 5 hPa
v = 5 m/s



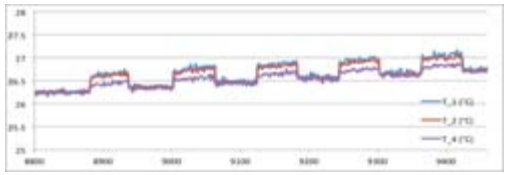
P = 10 hPa
v = 5 m/s



P = 30 hPa
v = 5 m/s

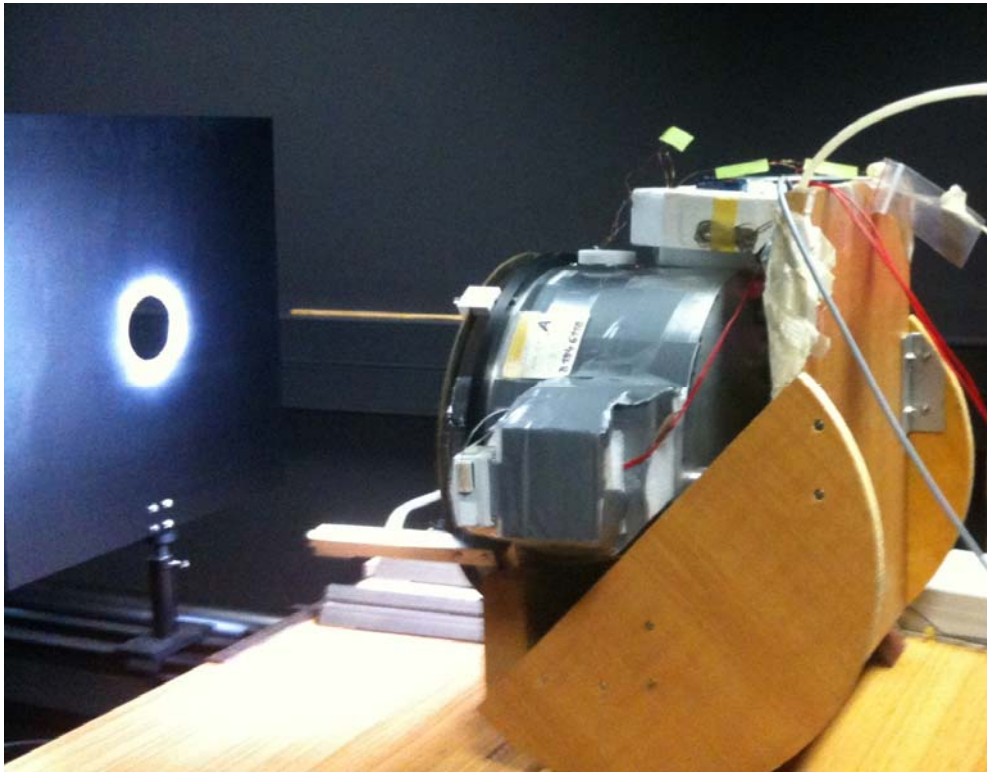


P = 100 hPa
v = 5 m/s

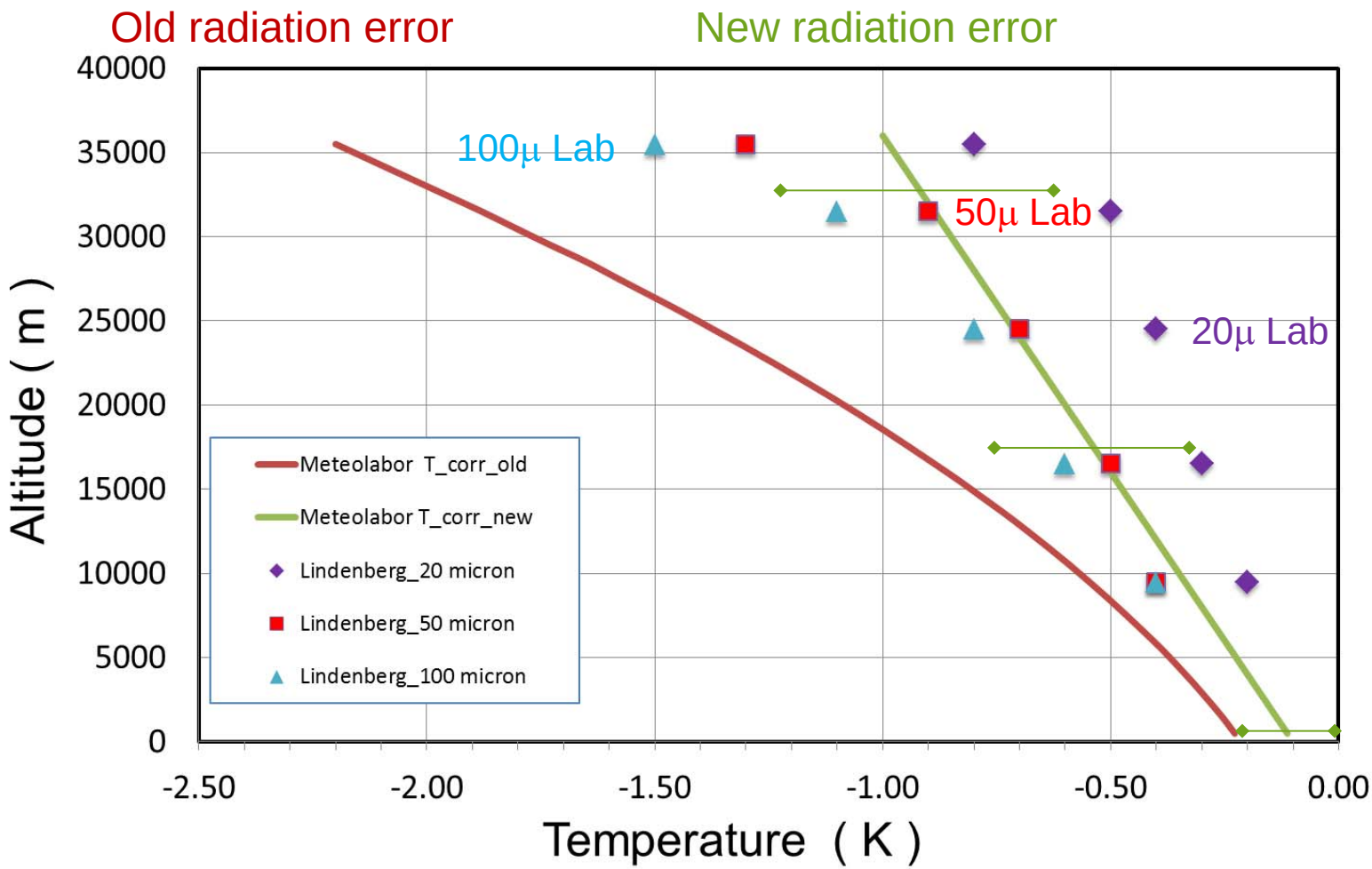


P = 300 hPa
v = 5 m/s

Observatory of Lindenberg Vacuum Chamber
Xenon Arc Lamp, Intensity: ~ **1650 Wm^{-2}**



Radiation Error: Atmosphere / Laboratory



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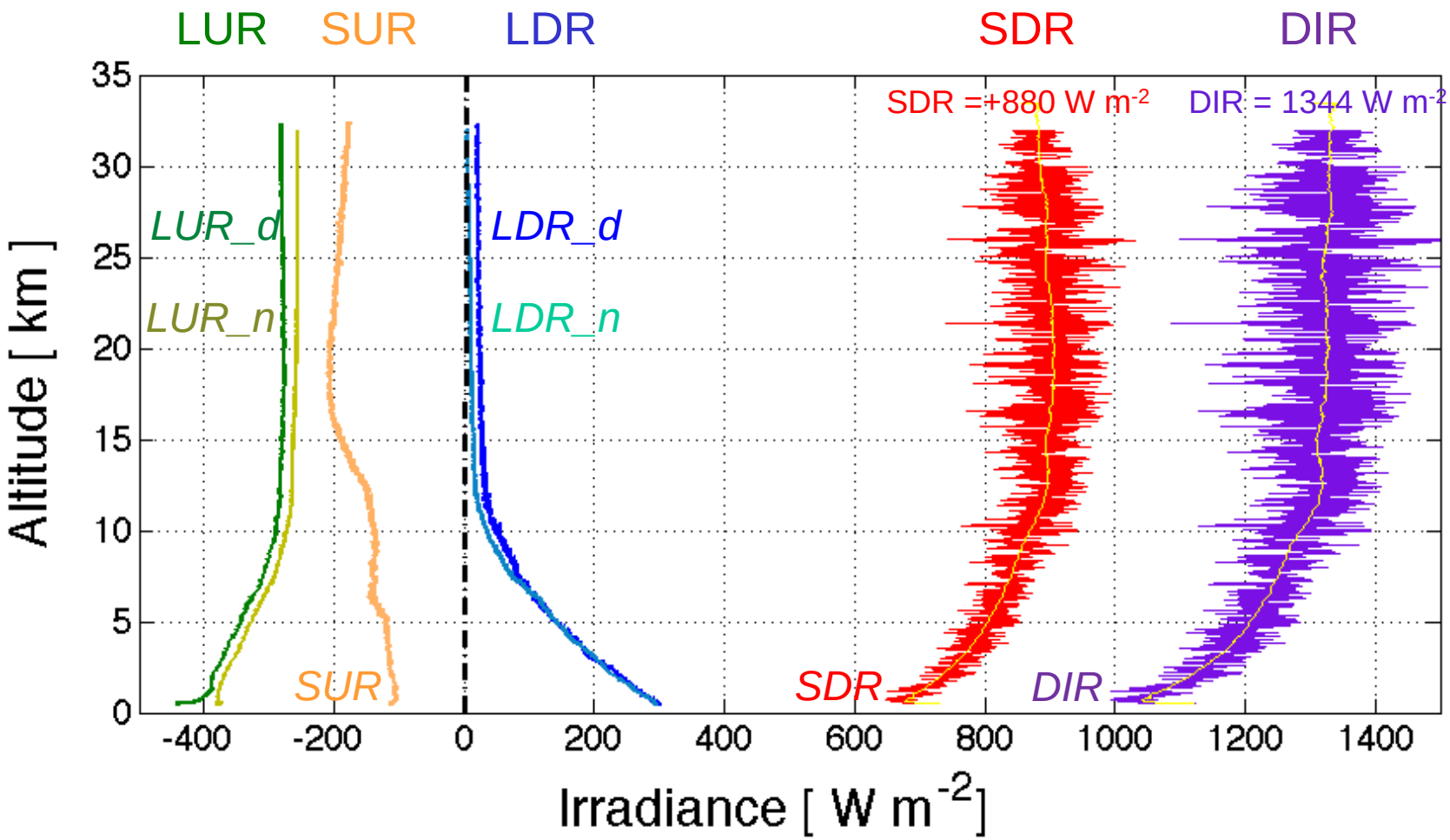
Radiation Measurements through the Atmosphere

SRS-C34 Radiosondes from Meteolabor and CNR 4 Net Radiometer from Kipp and Zonen

Shortwave and longwave Radiation Profiles

Night flight: 23 Sep 2011, UT21:20 **and** **Day flight: 23 Sep 2011, UT10:13**

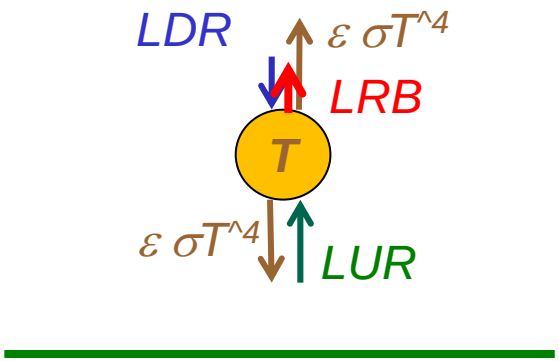


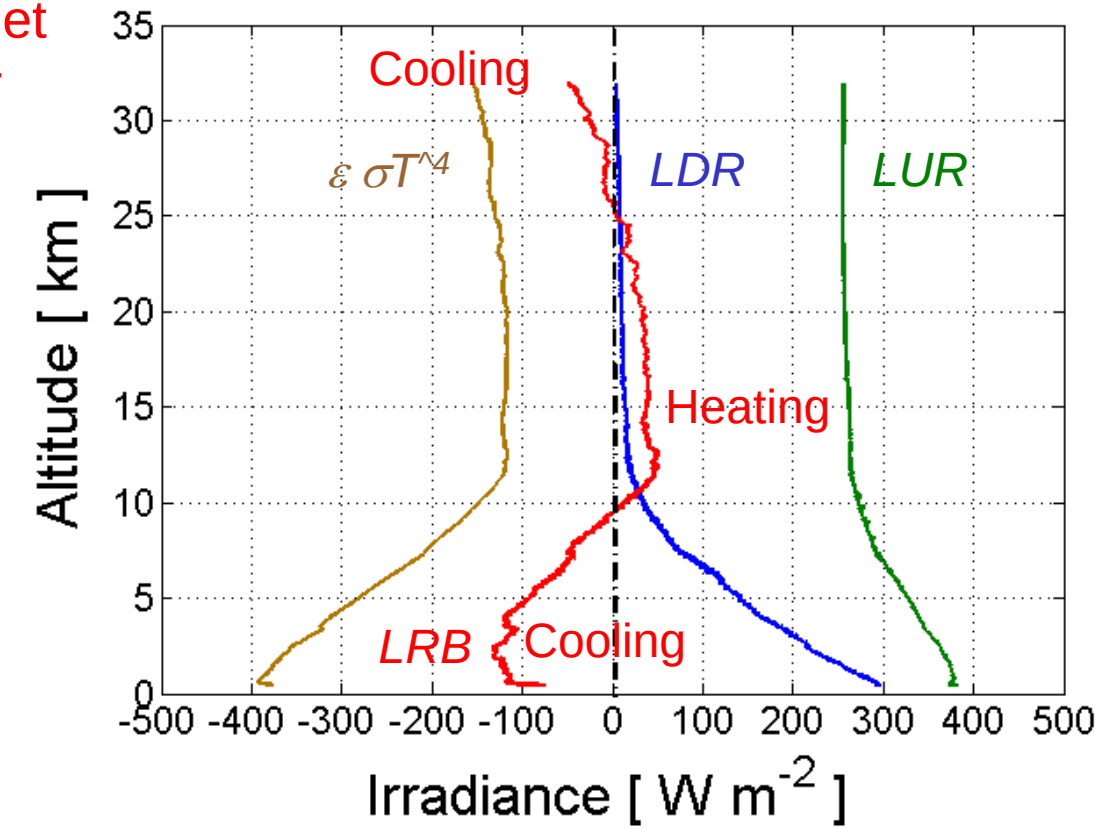
Philipona, Kräuchi, Brocard, GRL, 2012 doi:10.1029/2012GL052087

Longwave Radiation Error during the Night

Night flight: 23 Sep 2011, UT21:20

Longwave Radiation Budget on Temperature Sensor

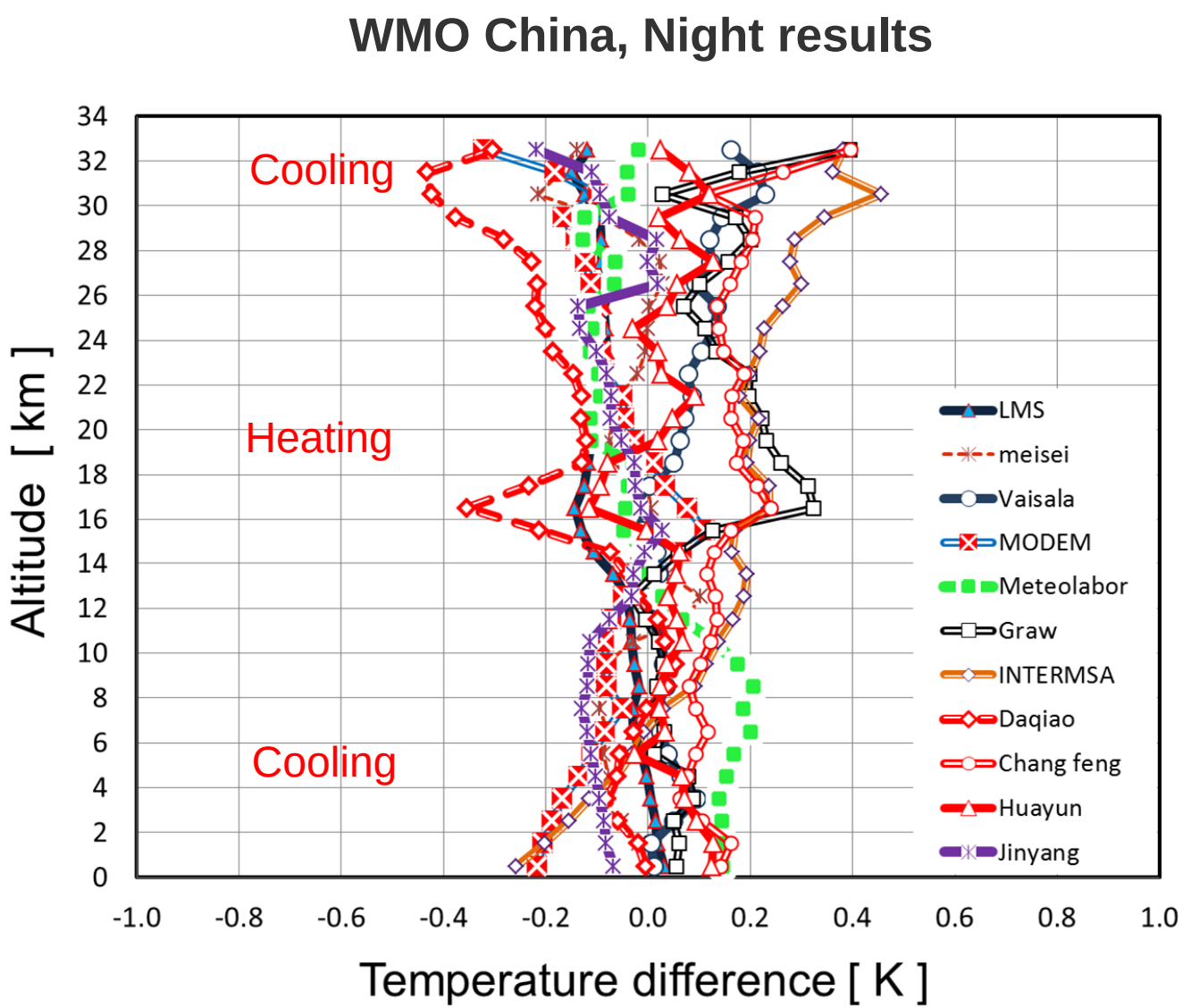




Glenn E. Daniels, JAM, 1968:

- Reduce sensor Size
- Reduce sensor Emissivity
- Increase sensor Speed

Longwave Radiation Error during the Night



Meteolabor

50µ
T sensor

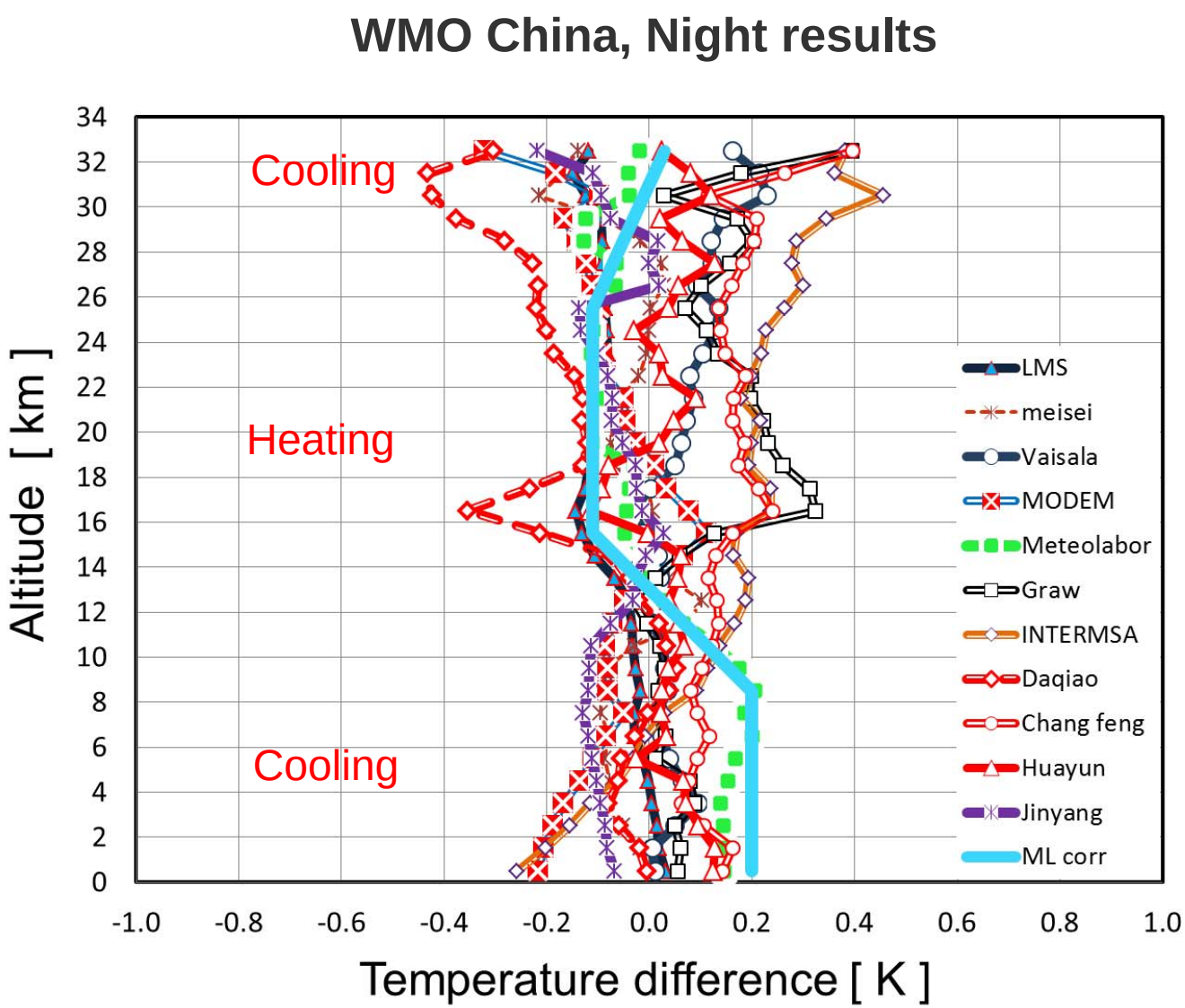
smallest Size

uncertain Emissivity

same Speed

MeteoSwiss

Longwave Radiation Error during the Night

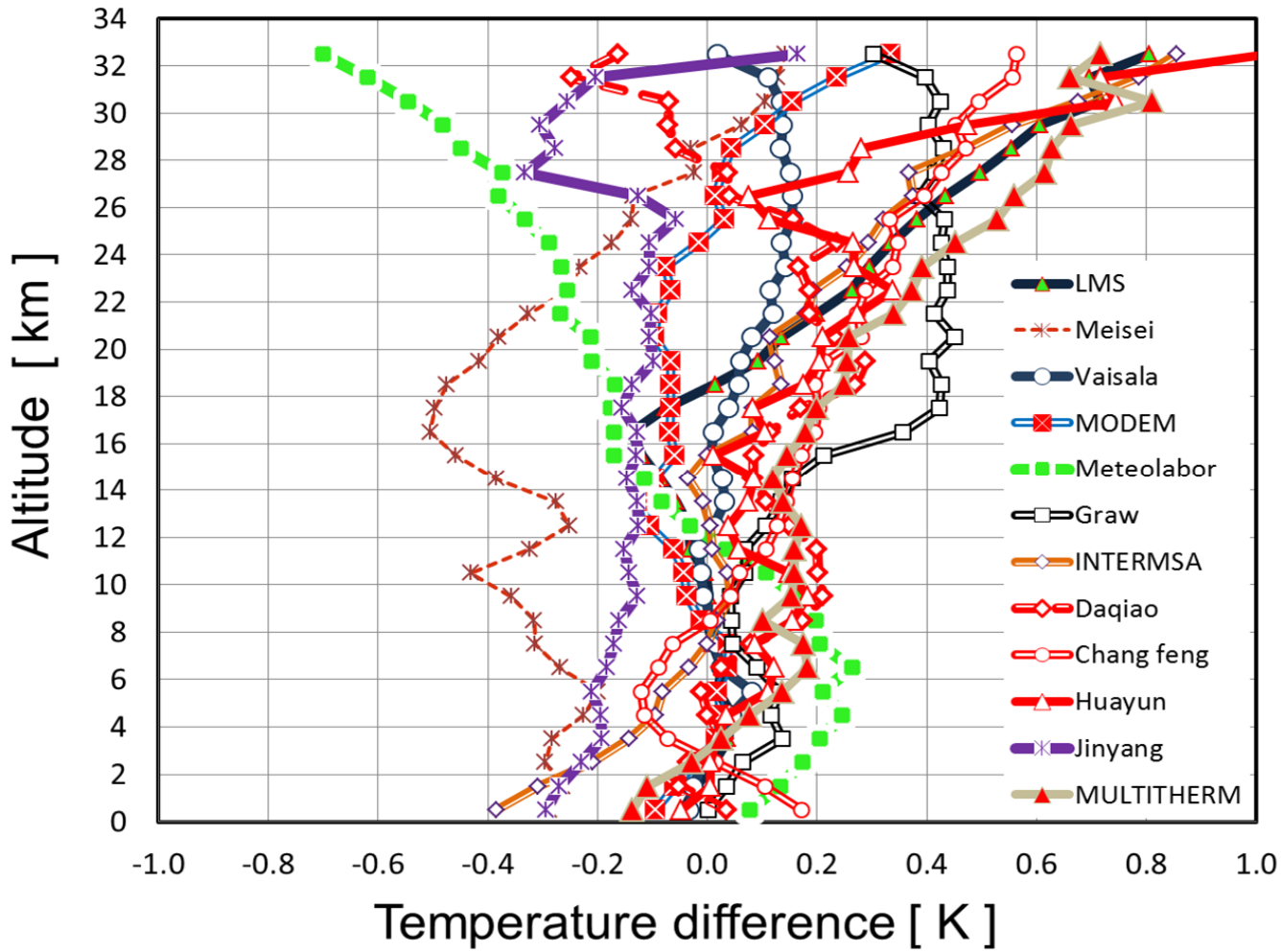


All sensors are too warm

All sensors are too cold

Solar Radiation Error during the Day

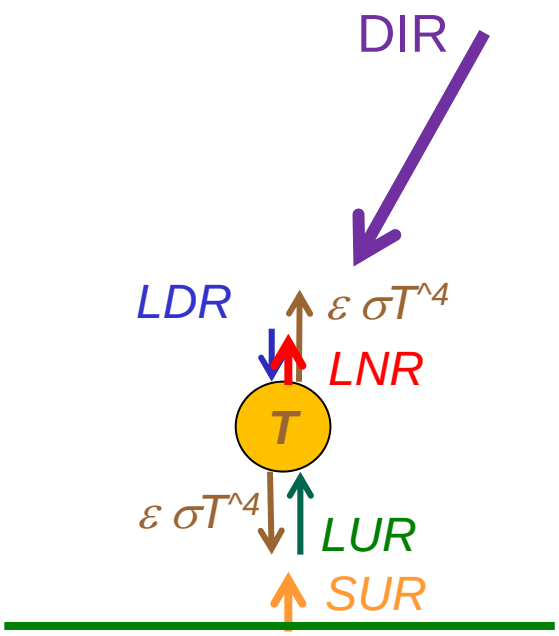
WMO China, Day results

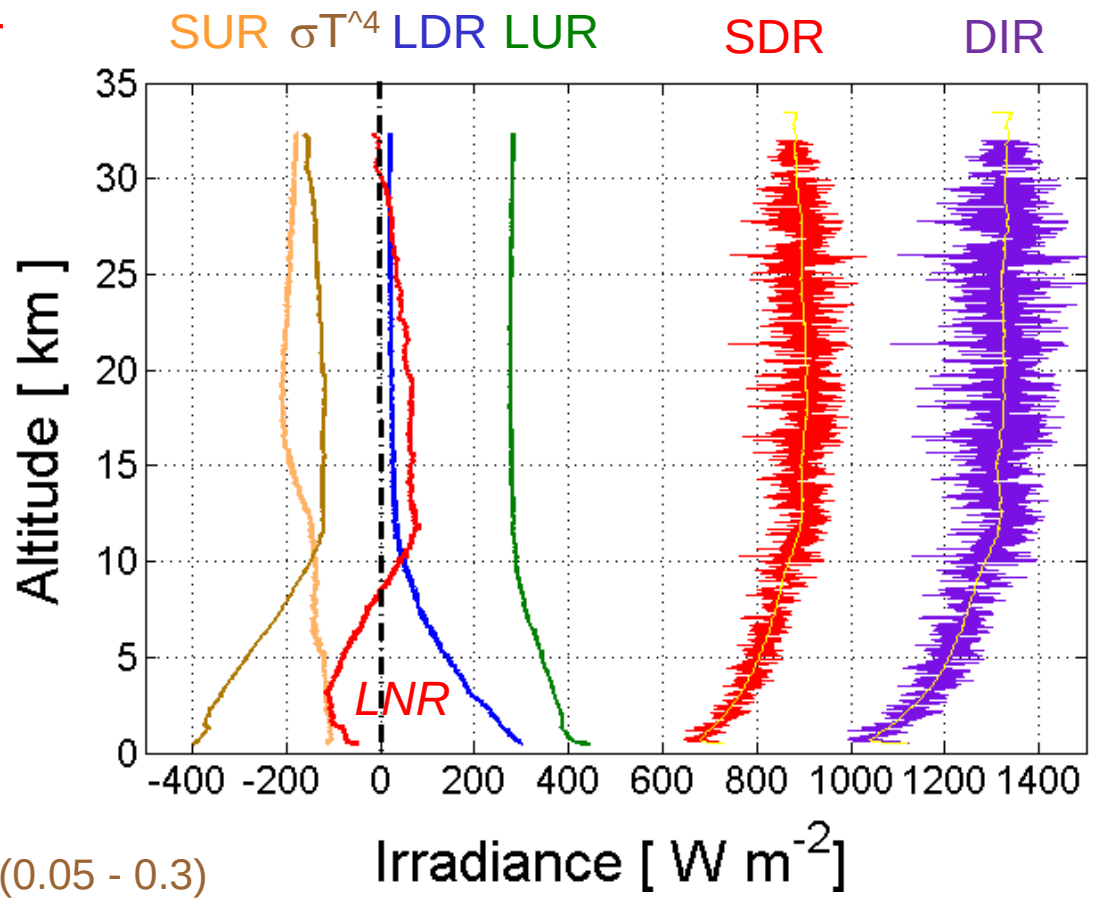


Radiation Error during the Day

Day flight: 23 Sep 2011, UT10:13

Total Net Radiation
on Temperature Sensor

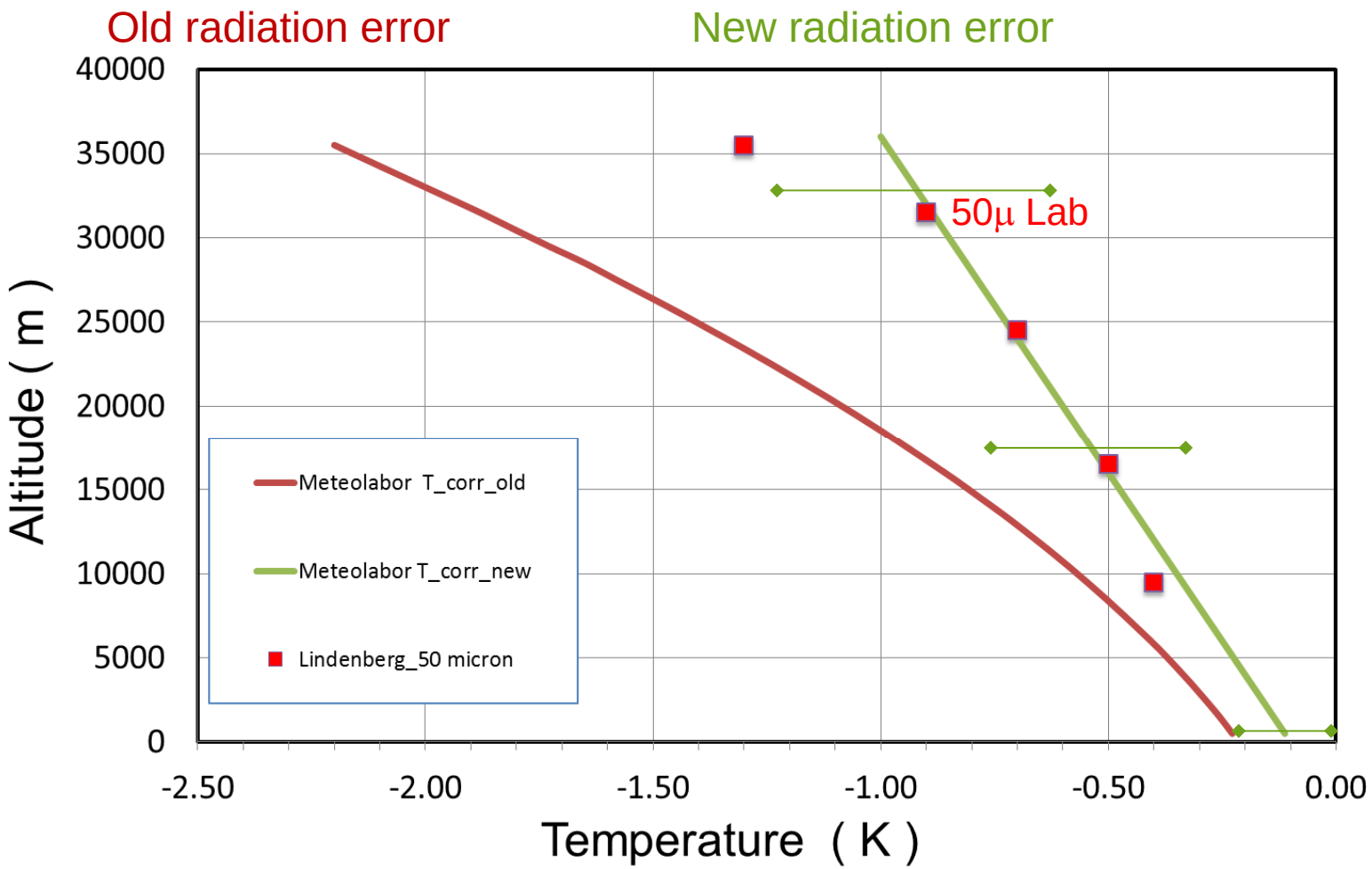




Longwave Emission ε: (0.05 - 0.3)

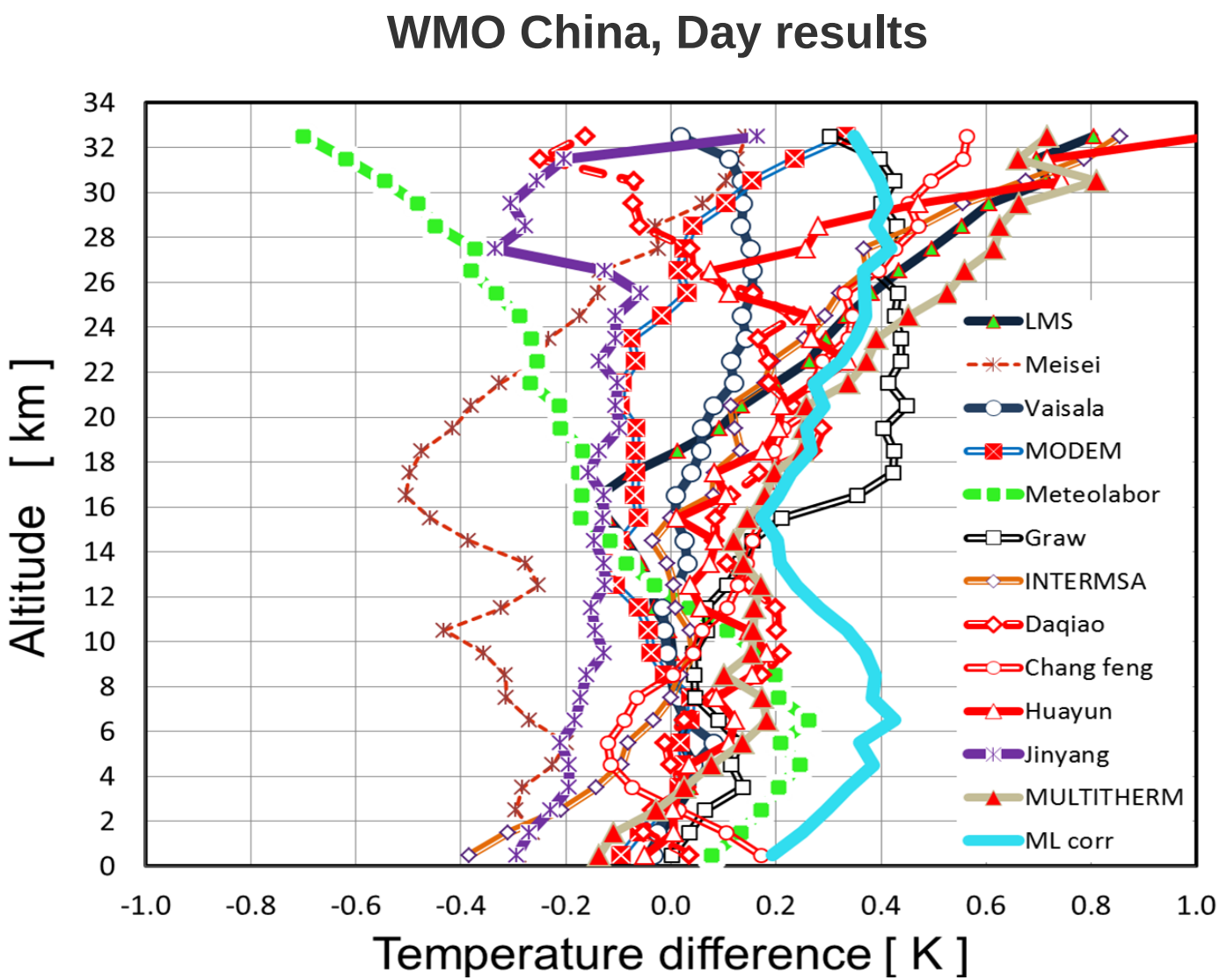
Shortwave Absorption α: (0.01 - 0.2)

Radiation Error: Atmosphere / Laboratory



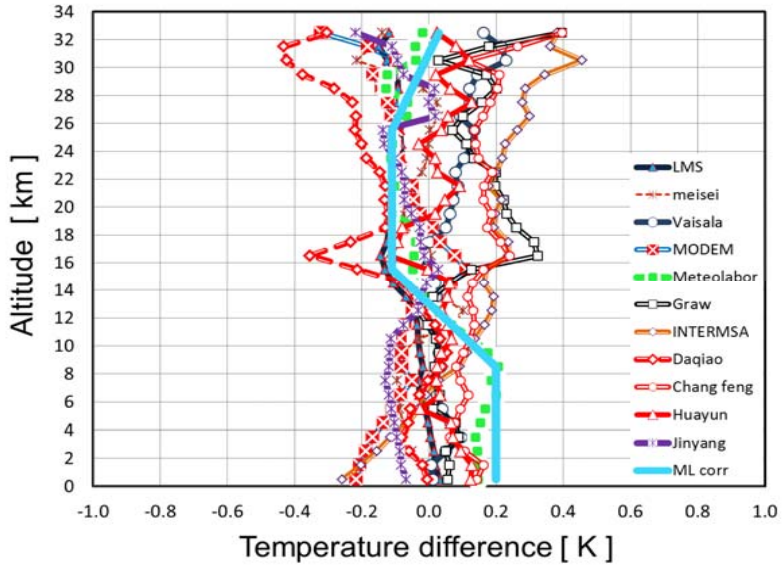
MeteoSwiss

Radiation Error Correction during Day

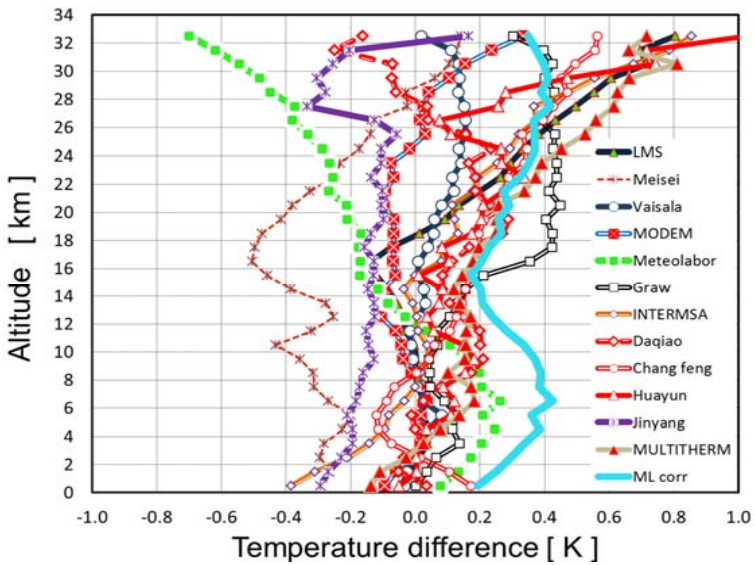


Summary: Radiation Error Night and Day

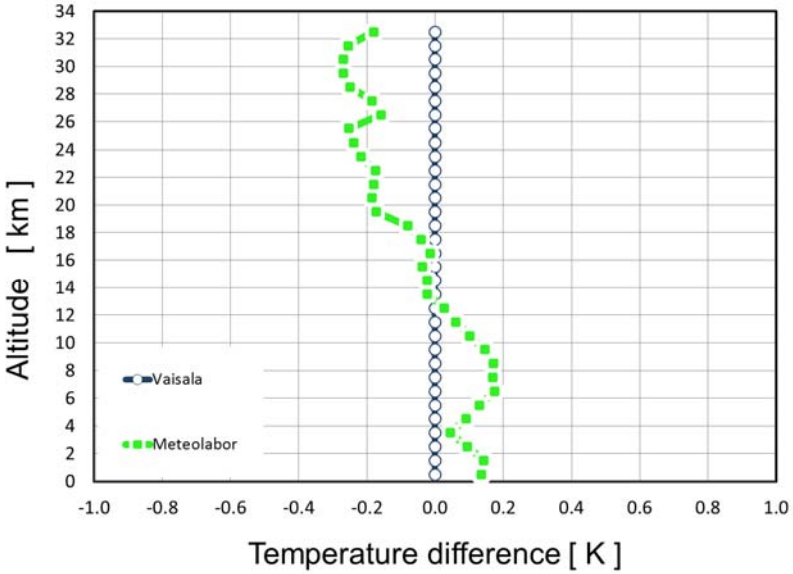
Night

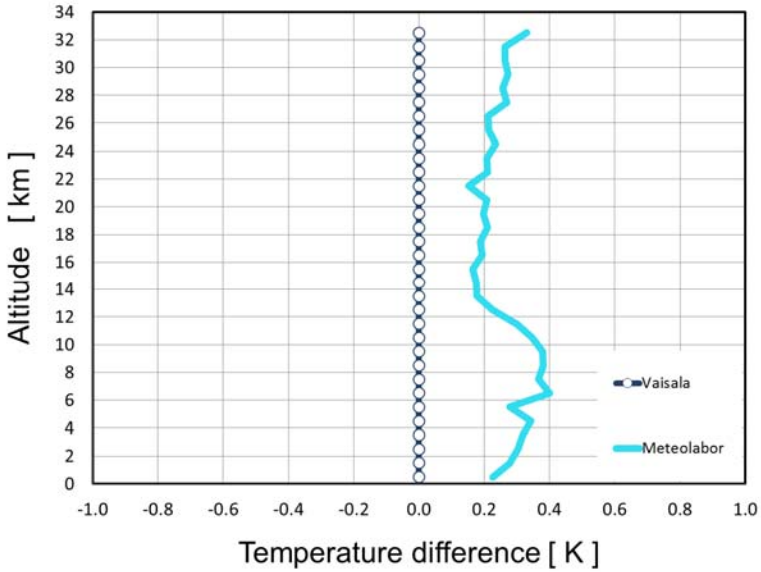


Day



WMO China 2010



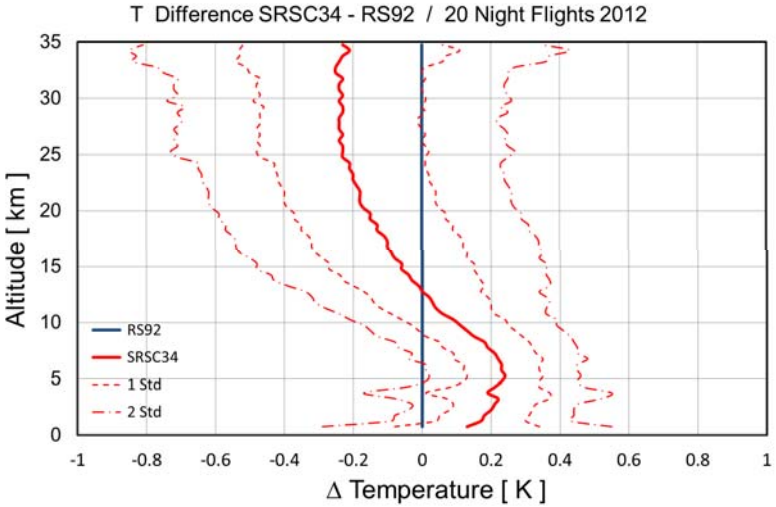


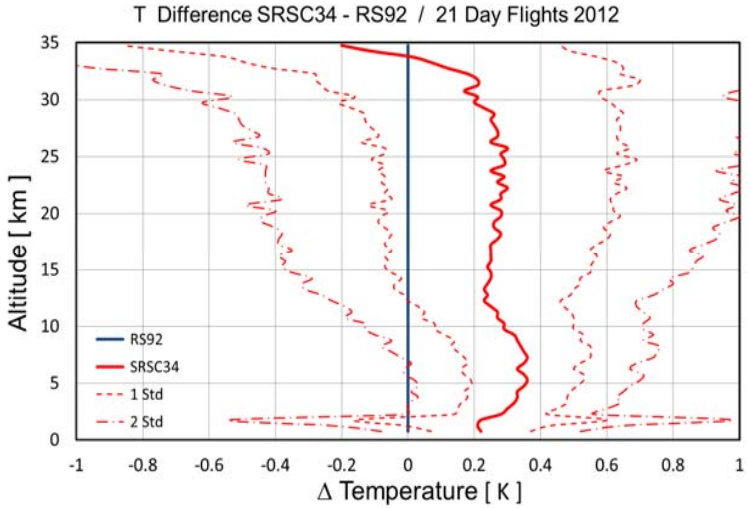
MeteoSwiss

Summary: Radiation Error Night and Day

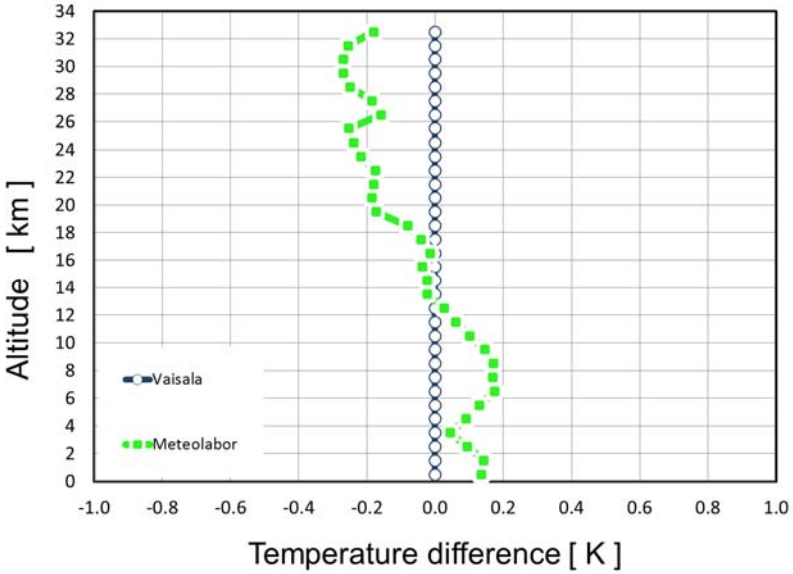
Night **Day**

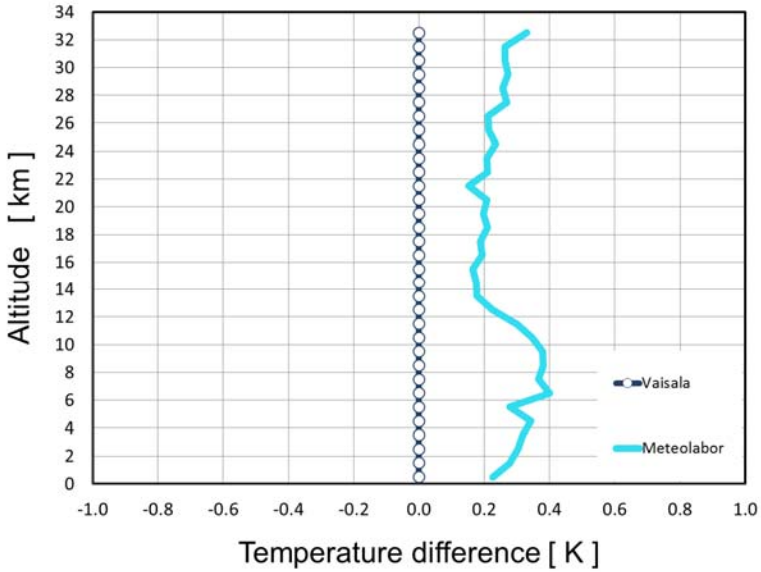
MCH Payerne 2012





WMO China 2010

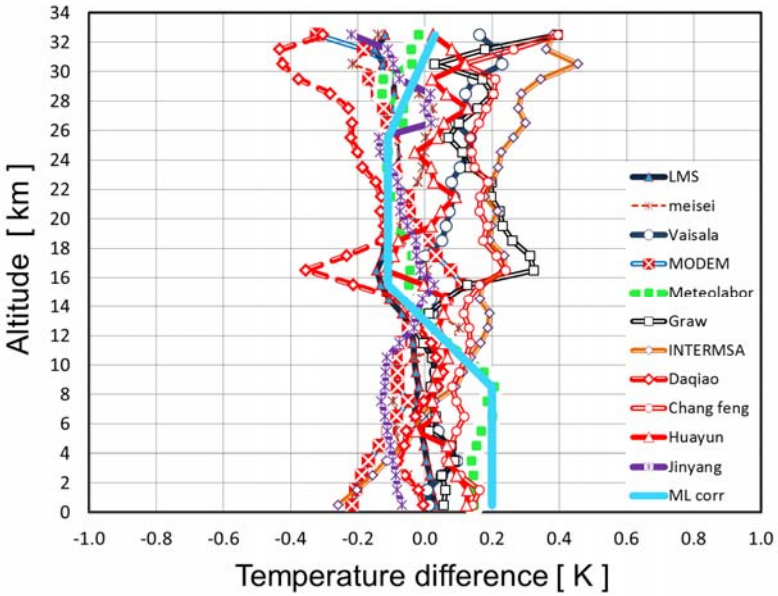




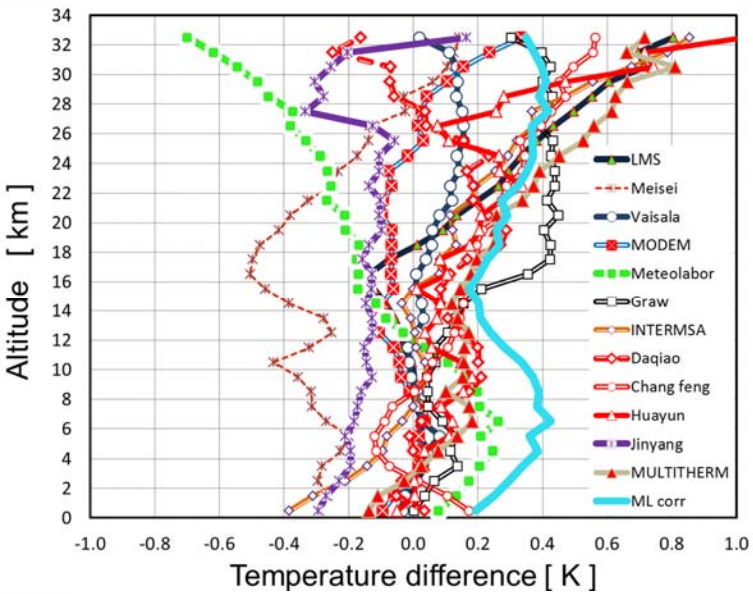
MeteoSwiss

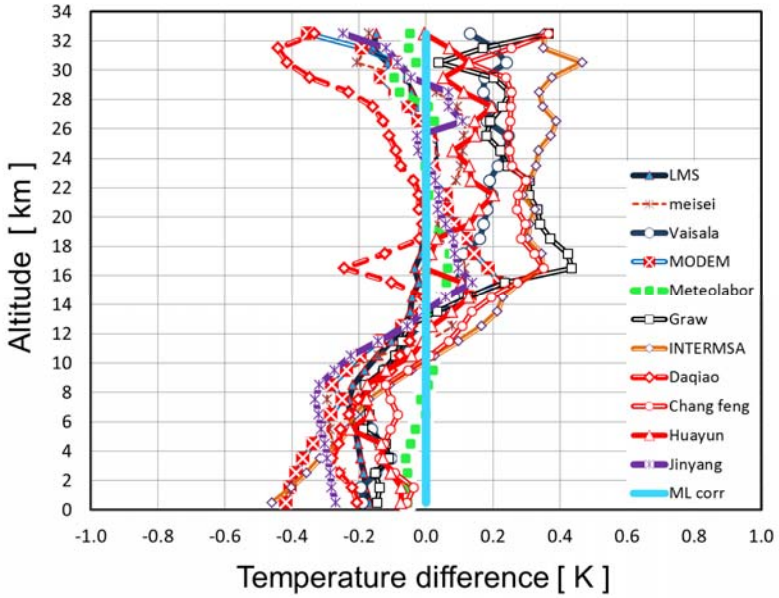
Summary: Radiation Error Night and Day

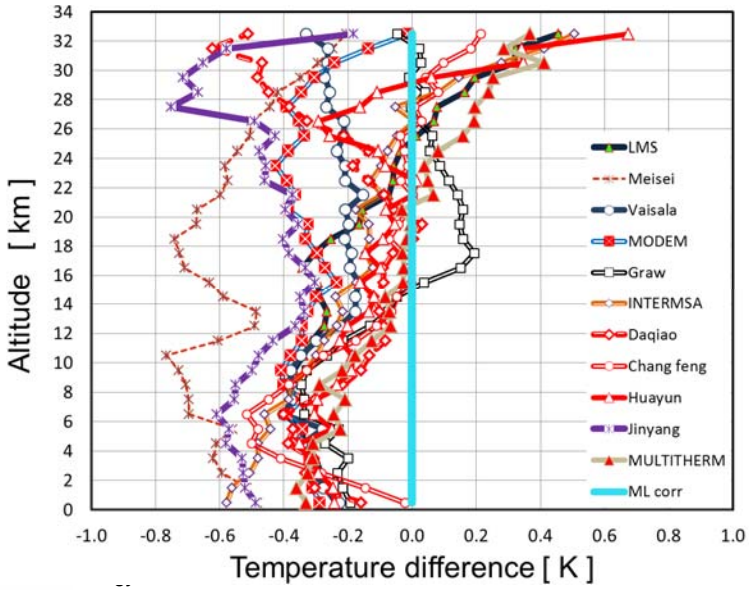
Night



Day







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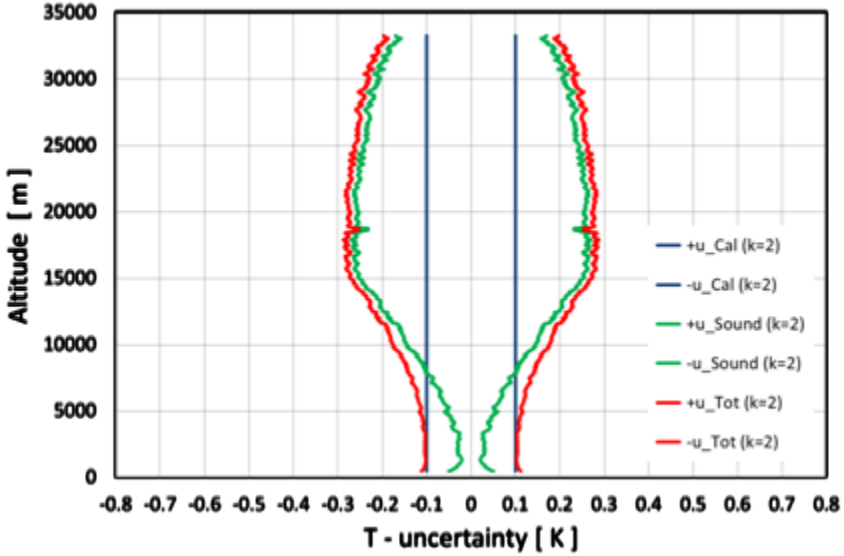
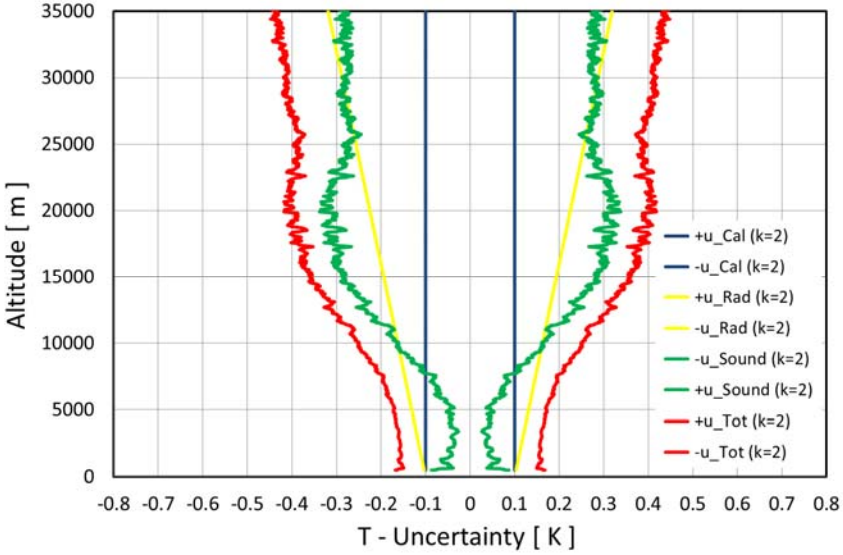
Uncertainty on SRS-C34 Temperature

Night



Day

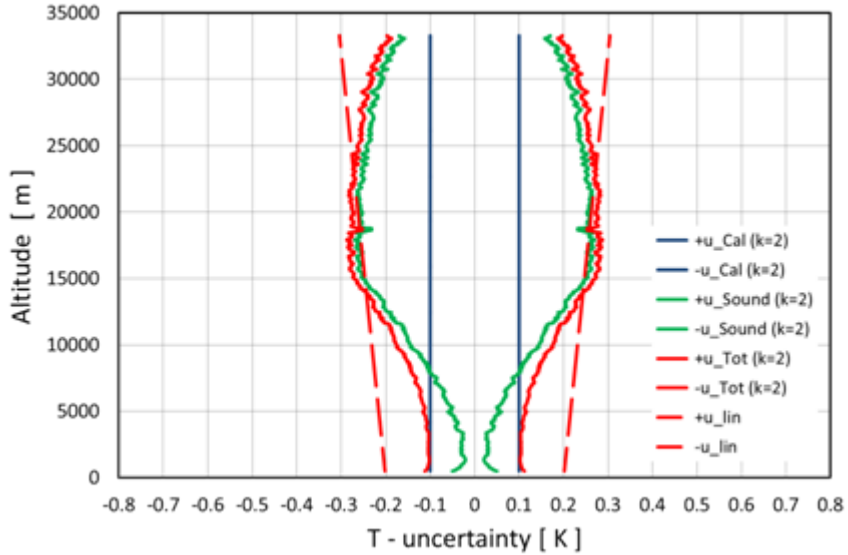


- Standard deviation in repeatability of calibration (k=2)
- Standard deviation in reproducibility in sounding (k=2)
- Standard deviation on daytime radiation error (k=2)
- Total uncertainty in sounding (k=2)

MeteoSwiss

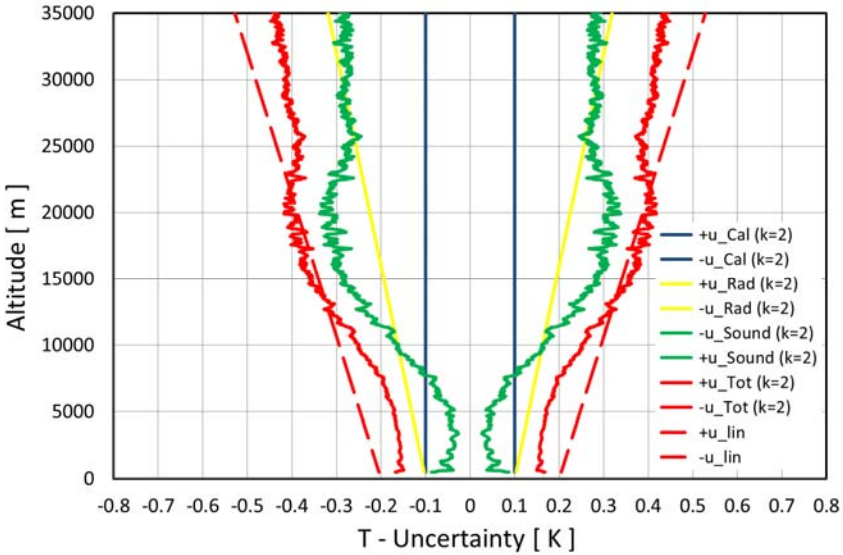
Uncertainty on SRS-C34 Temperature

Night



± 0.2 - 0.3 K

Day



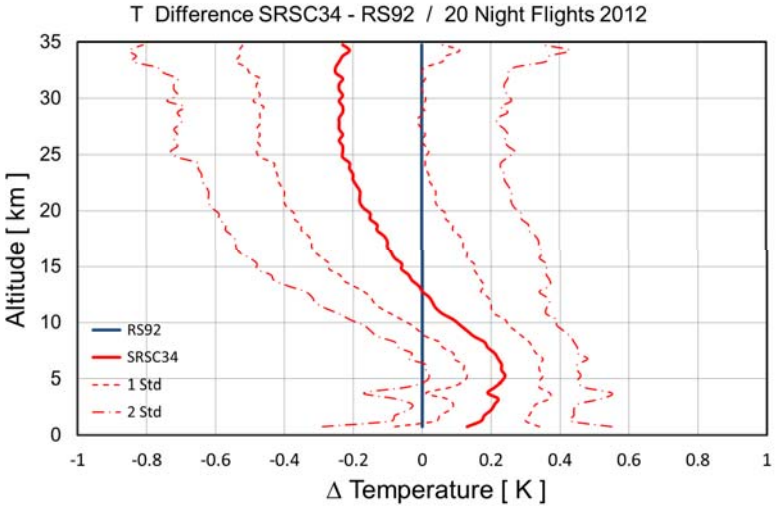
± 0.2 - 0.5 K

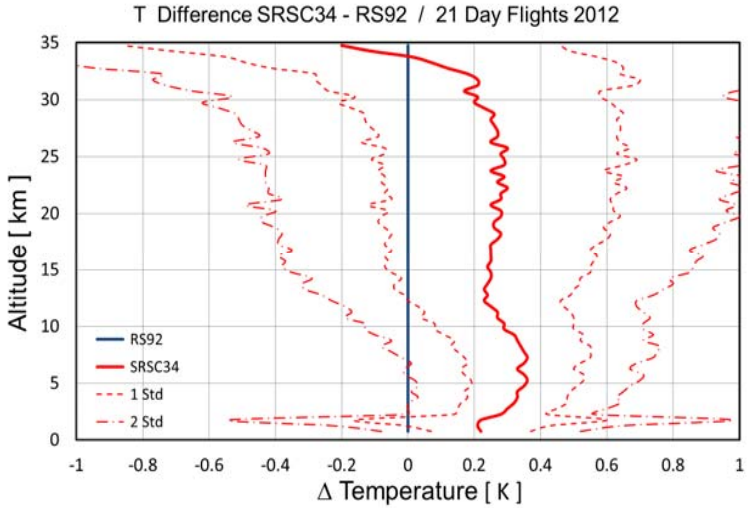
- Standard deviation in repeatability of calibration (k=2)
- Standard deviation in reproducibility in sounding (k=2)
- Standard deviation on daytime radiation error (k=2)
- Total uncertainty in sounding (k=2)
- Total uncertainty in sounding (linear relation)

Summary: Radiation Error Night and Day

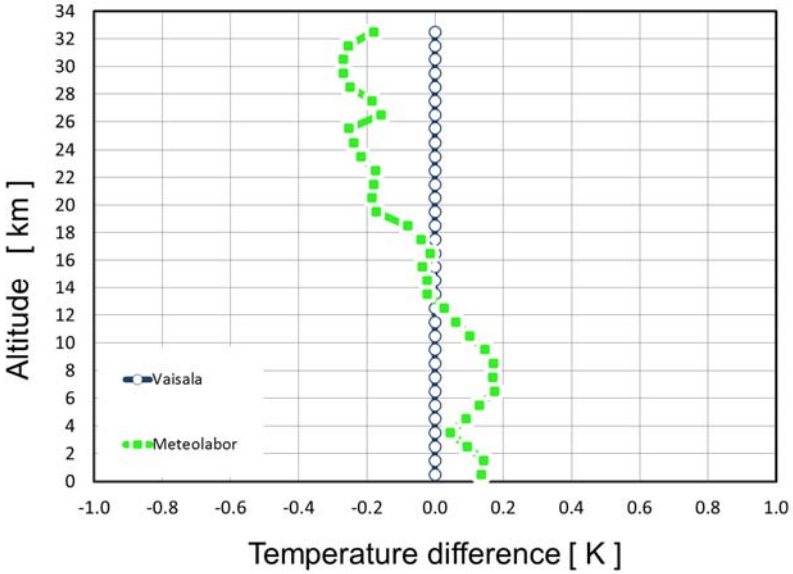
Night **Day**

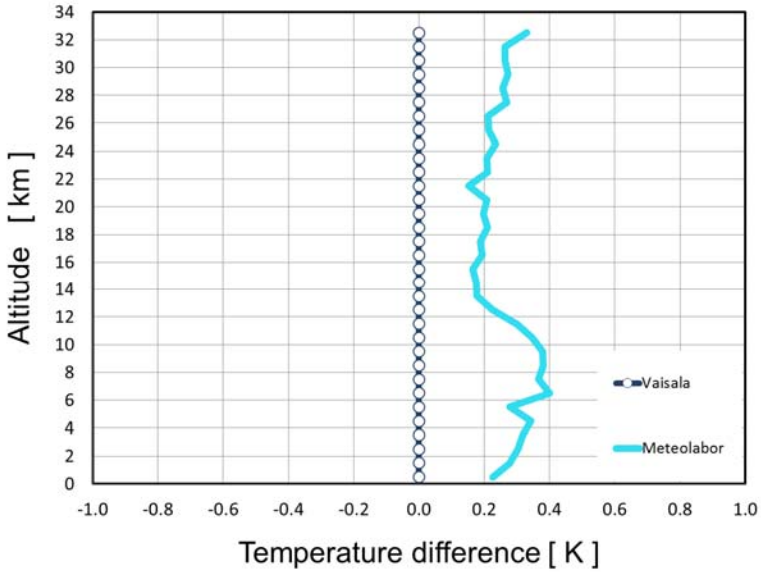
MCH Payerne 2012





WMO China 2010

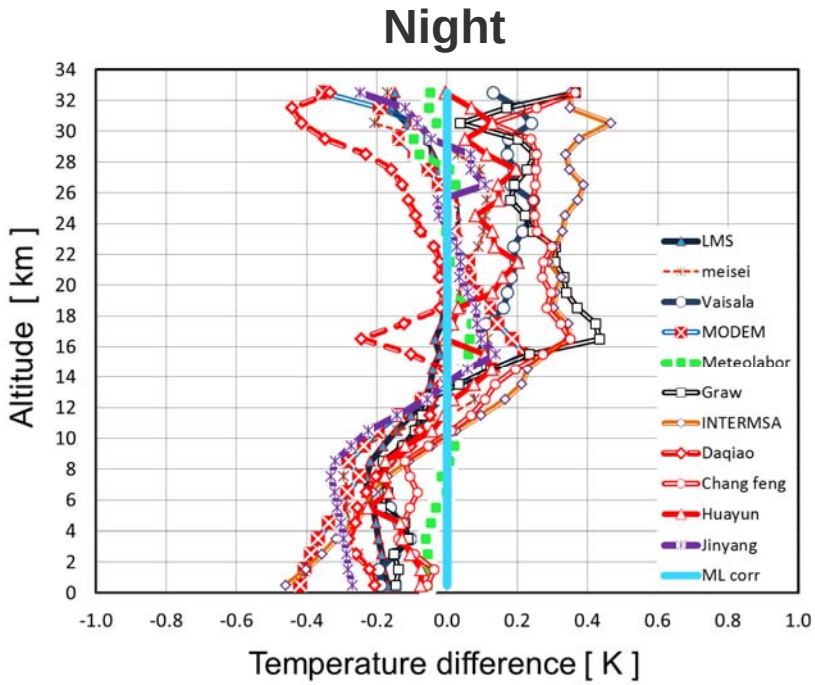


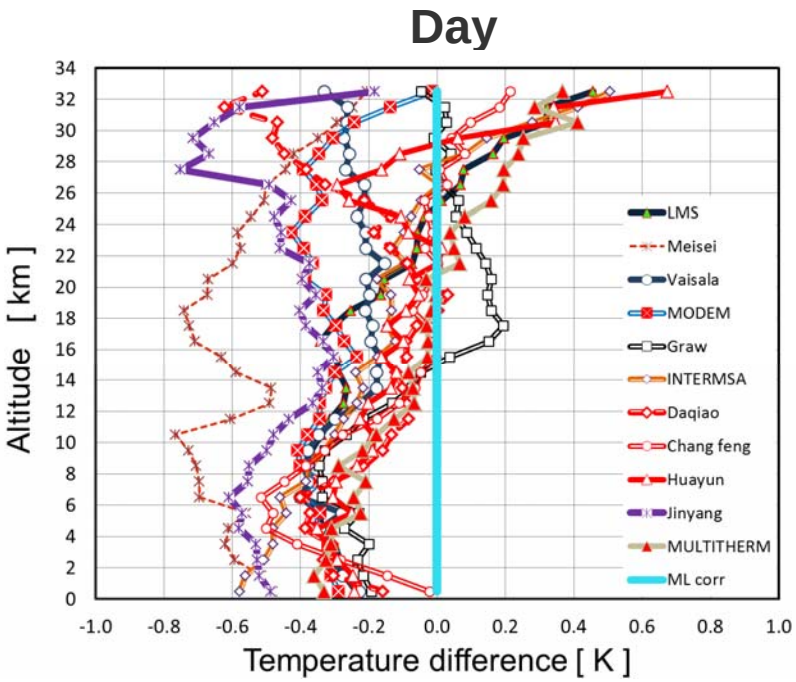


MeteoSwiss

Summary and Conclusions

WMO China results referenced to new Meteolabor T-correction





- More night experiments are needed to clarify thermal effects
- Future WMO intercomparisons are needed to help improving radiosonde measurements

Thank you for your attention !