Status CIMO radiosonde intercomparison campaign

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Singapore
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Previous campaigns

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- 1984 Bracknell
- 1985 Wallops
- 1989 Dzhambul
- 1993 Tsukuba
- 1995-1997 Moscow & Wallops
- 2001 Alcantara
- 2005 Mauritius
- 2010 Yangjiang

Participants 2010

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Manufacturers
- Changfeng
- Daqiao
- Graw
- Huayun
- Intermet
- Jinyang
- Lockheed-Martin Sippican
- Meisei
- Meteolabor
- Meteomodem
- Vaisala

Research instruments

Humidity
CFH, Snowwhite, RD100

Temperature
Meisei MTR, LMS Multi-thermistor

Payerne 20-22 February 2019

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Campaign goals

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- To bring all the major radiosonde manufacturers of all the different regions of the world together.
- To characterize the individual radiosondes with respect to their Reproducibility and to determine the Uncertainty of the different measured parameters.
- To compare the different radiosonde systems to a “Radiosonde Reference” (mean of three chosen Traveling Standard Systems).
- To include remote sensing instruments for the benefit of upper air measurements as a whole.

	Working standards	Reference Sonde	Uncertainty/ traceability	parameters
Basic requirements	Goal: 3 GDP	scientific sondes	GRUAN expertise	P, T, q, u, gph

Campaign set-up

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- Laboratory campaign
  - Prior to radiosounding campaign
- GRUAN-philosophy
  - Laboratory characterisation, SHC ground check, reference instruments
- Traveling reference based on 3 GRUAN data products
  - Reference instrument: CFH (RH)
- Independent operators
  - Capacity building, evaluate user-friendliness of the radiosounding system
  - Independent comparison of radiosounding systems
- Synergies: Lindenberg remote sensing instrumentation
  - NWP, Satellite, AMDAR

Characterisation - Laboratory measurements

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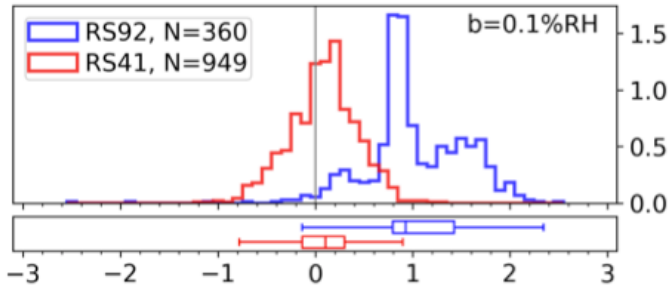
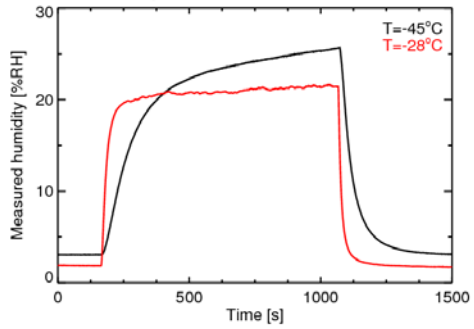
Length measurement program: 6 days

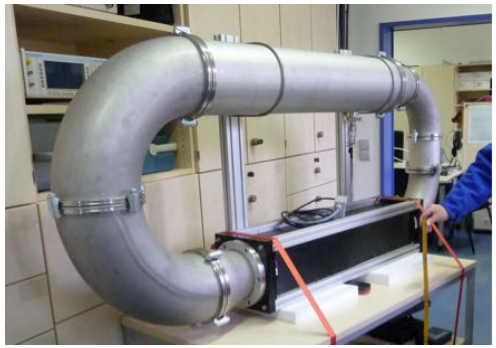
PTU

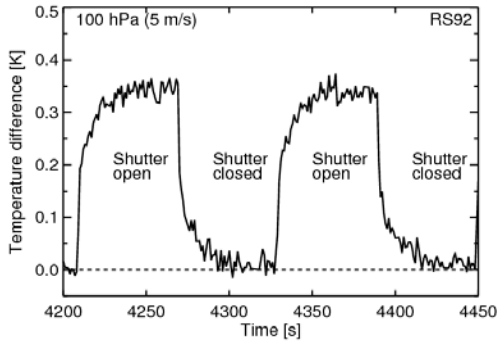


Climate chamber



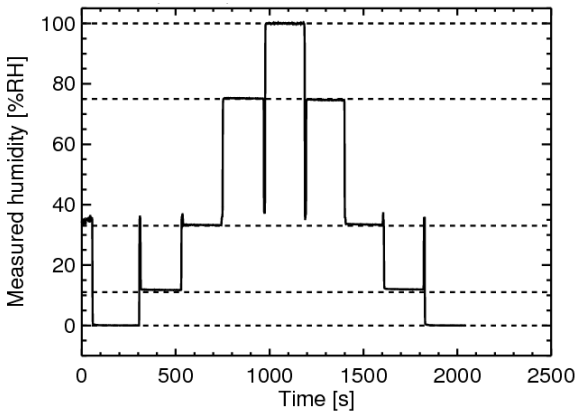
Radiation





Tests in SHC at room temperature

- Parameters: T, RH
- 0-100-0 %RH, via plateaus.
- Stabilize for 10 min (influence of sensor cover?)
  - 2 hours per radiosonde
- Test 5 radiosondes per type (statistical validity)
- 1 radiosonde: iterate test 5 times (repeatability)
- Operate 2 radiosondes simultaneously
- Time needed per radiosonde type: 1-2 days



Climate chamber

- Parameters: T, RH (timelag)
- Temperature plateaus (-80, -50, -20, 0° C)
- No active control of RH

- Potential alternative: liquid baths for temperature validation
  - Faster testing
- Time needed per radiosonde type: 1 day

Climate chamber

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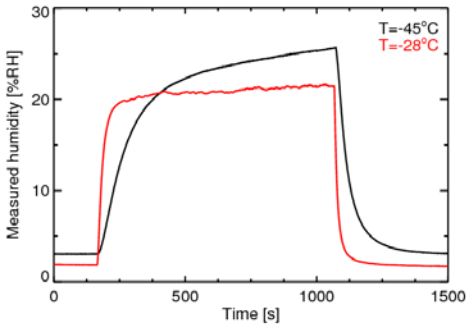
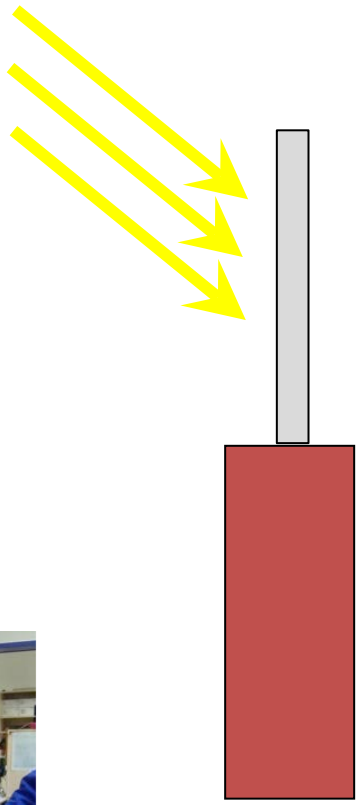
- Parameter: Timelag of RH sensor

- Temperature plateaus (-80, -60, -40° C)
- 2 radiosondes simultaneously
- Time needed per radiosonde type: 1 day

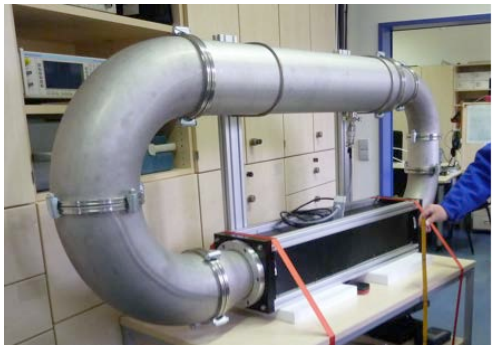


Radiation

- Rotation of radiosonde around longitudinal axis.
- Fixed irradiance
- Fixed azimuth angle
- Variation of pressure [3-1000 hPa]



- Time needed per radiosonde type: 1 Day



Radiosounding campaign

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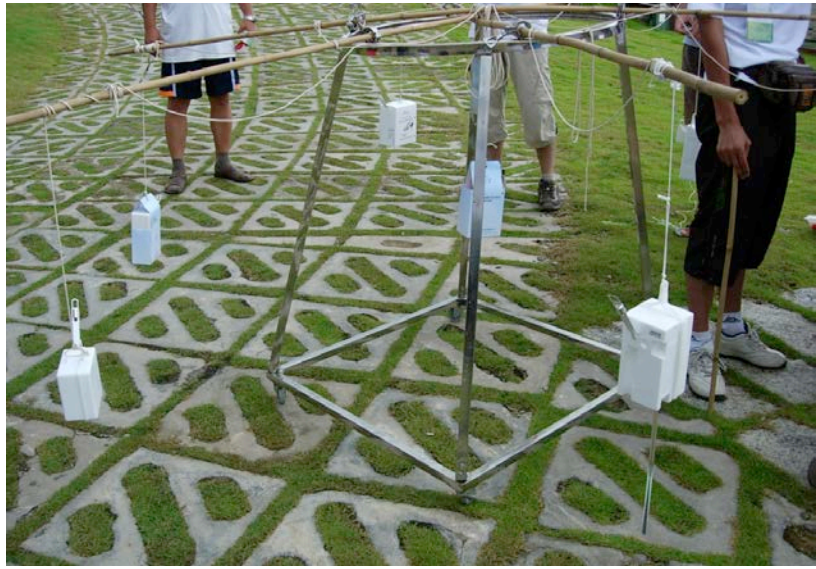


August 2021

- Set up systems by manufacturers
- Train operators & perform test soundings

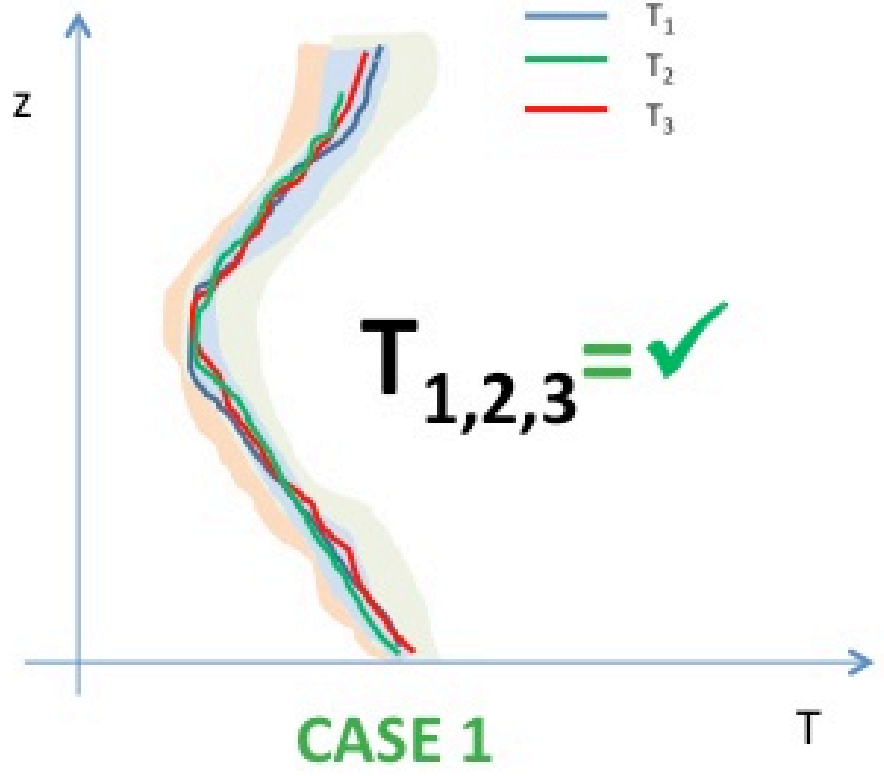
Mid August – September

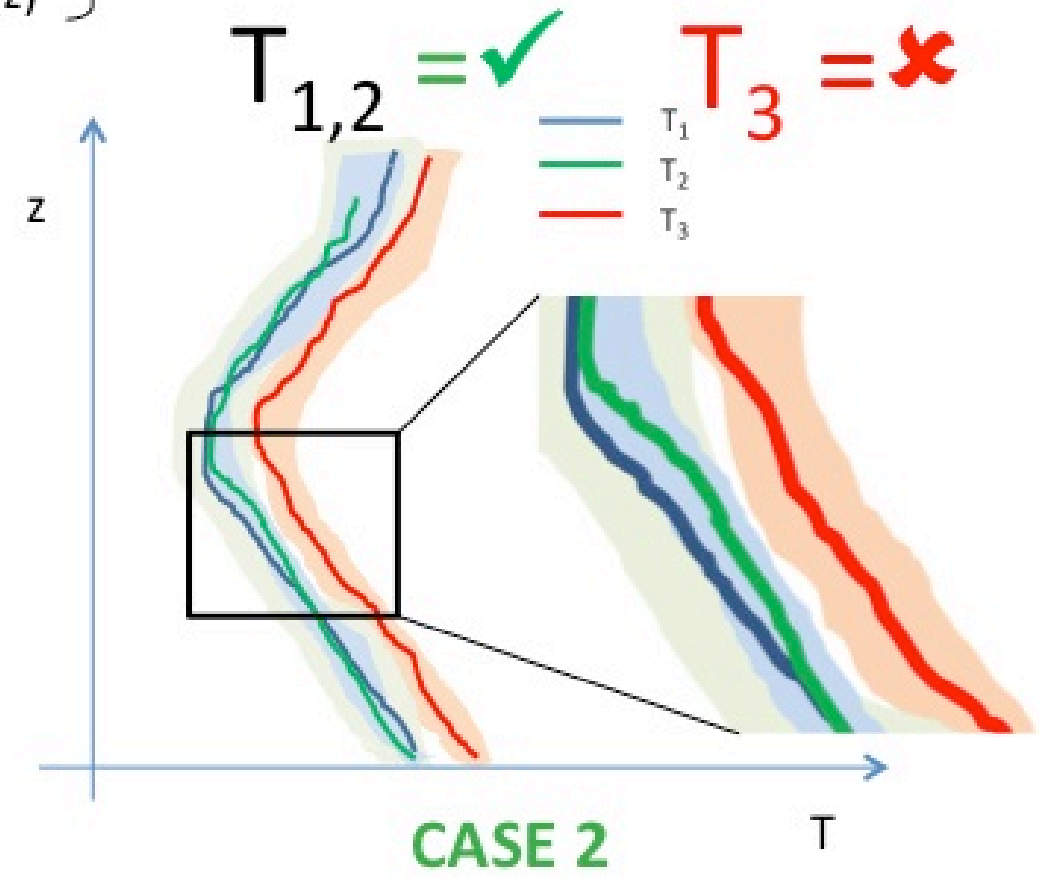
- Perform radiosoundings (by operators)
  - Background support available from manufacturers
- 30 radiosoundings per type (day/night)
- Selected soundings with 2 identical radiosondes to check reproducibility

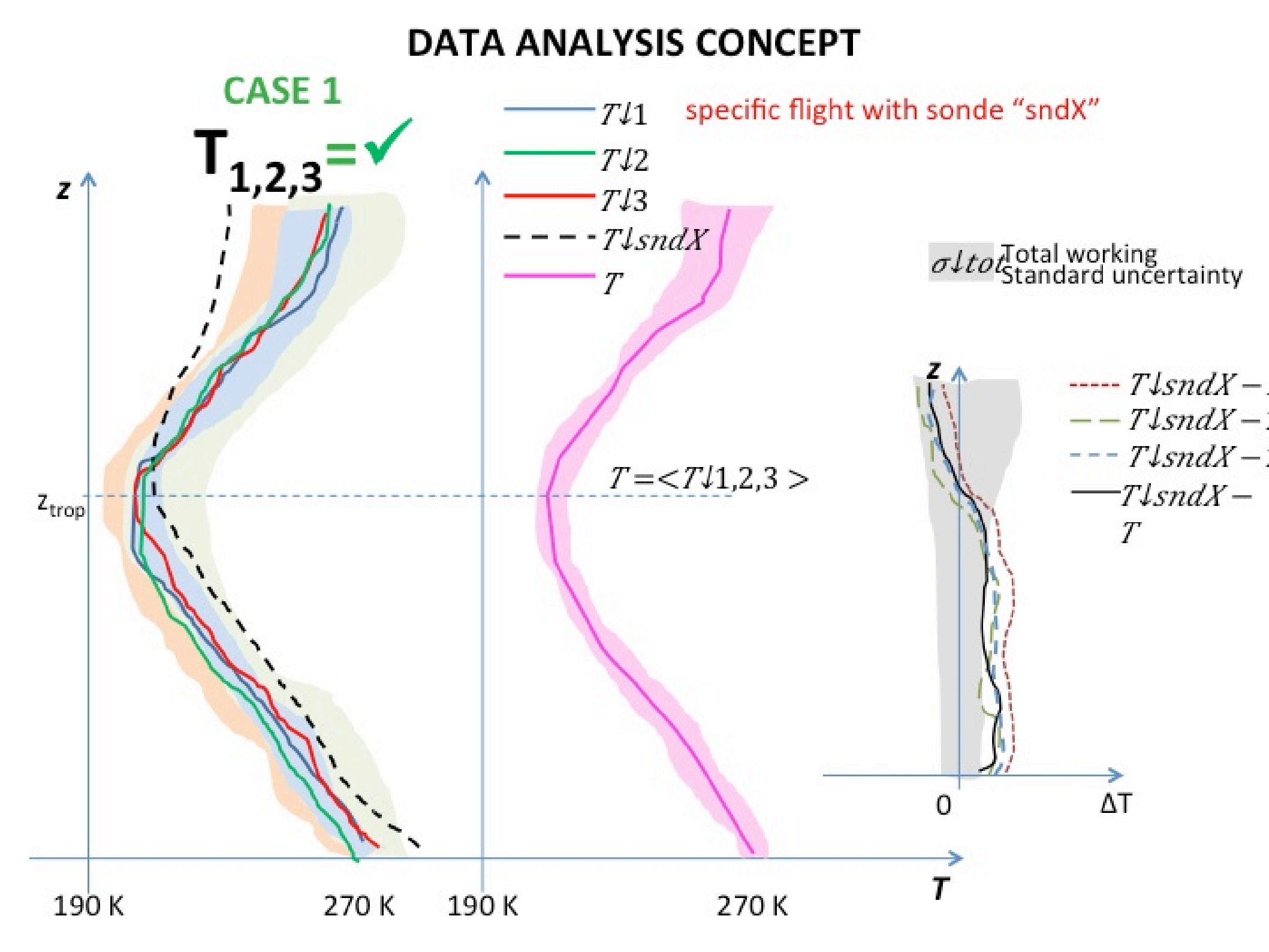
DATA ANALYSIS - GENERAL CONCEPT

- Selection of GRUAN-certified working standards radiosounding systems.
- The working standards are fully characterized in terms of uncertainty at each level *z*.
- The working standards must be consistent amongst each other, namely:
  - For each flight the sondes are tested for consistency for each parameter (p, T, q, u, gph) at each level *z*. For each measured parameter, e.g. *T*, the consistency can be expressed as:
    - $T_{2,3}(z)-\Delta T_{2,3}(z) \leq T_1(z) \leq T_{2,3}(z)-\Delta T_{2,3}(z)$
    - $T_{1,3}(z)-\Delta T_{1,3}(z) \leq T_2(z) \leq T_{1,3}(z)-\Delta T_{1,3}(z)$
    - $T_{1,2}(z)-\Delta T_{1,2}(z) \leq T_3(z) \leq T_{1,2}(z)-\Delta T_{1,2}(z)$

} Consistency condition

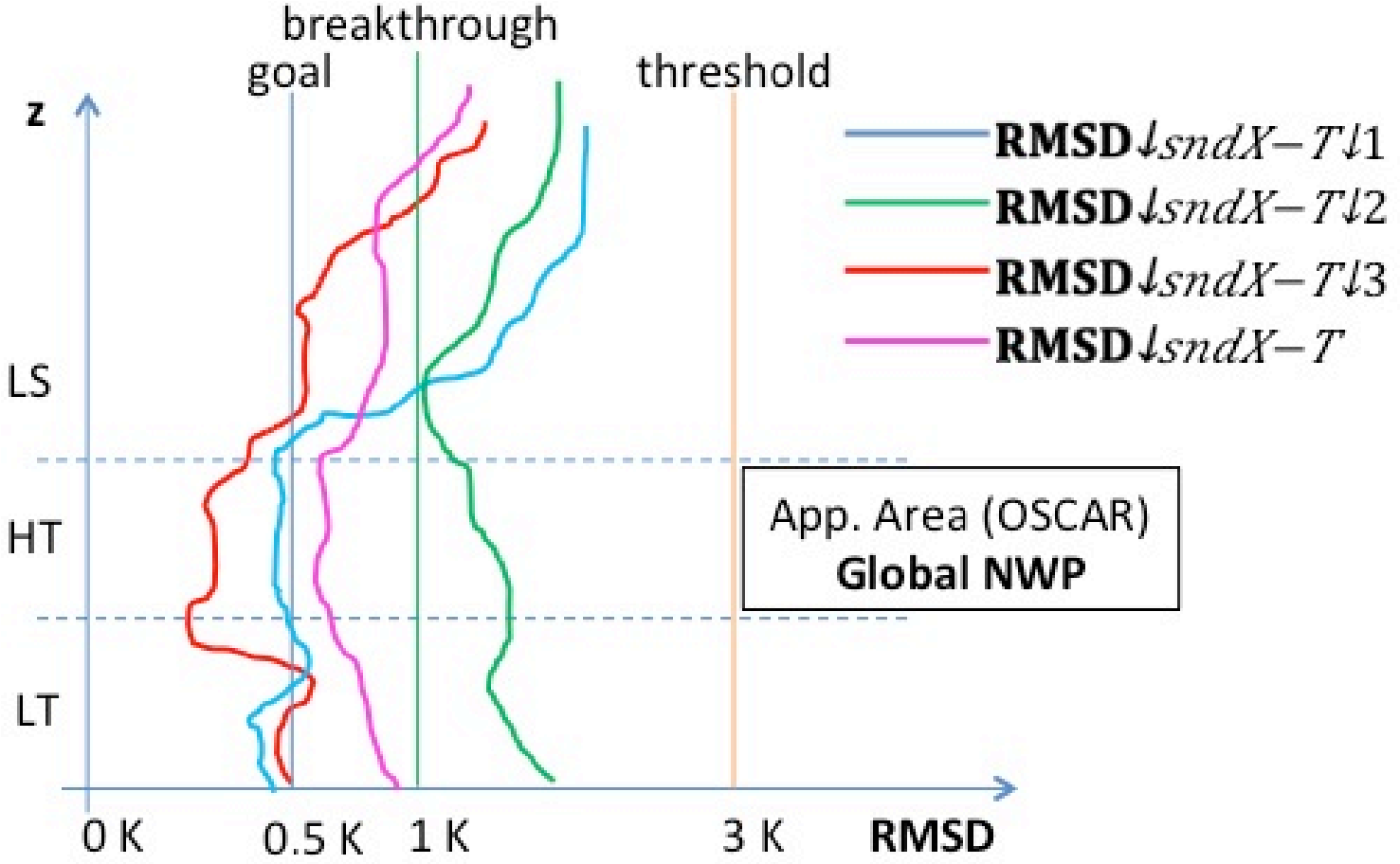





DATA ANALYSIS CONCEPT
CASE 1
$T_{1,2,3}$ =
z
z_{trop}
190 K
270 K
$T\downarrow 1$
$T\downarrow 2$
$T\downarrow 3$
$T\downarrow sndX$
T
specific flight with sonde "sndX"
$T = <T\downarrow 1,2,3>$
190 K
270 K
T
$\sigma\downarrow tot$ Total working Standard uncertainty
z
$T\downarrow sndX -$
$T\downarrow sndX -$
$T\downarrow sndX -$
$T\downarrow sndX -$
T
0
ΔT

ASSESSMENT vs OSCAR REQUIREMENTS

- At the end of the intercomparison, after ***N*** flights, the total root mean square deviation (RMSD) of each sonde versus each working standard is calculated for all levels.
- The OSCAR table is used to define the fit-for-purpose requirements for specific application areas and atmospheric regions



Road ahead

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- Meet with manufacturers June 5 Geneva
- Write project plan
- Meeting IOC Lindenberg Nov 2019
- Prepare
  - analysis software, logistics, laboratory, planning schedule etc
- Start laboratory campaign Jan 2021
- Radiosounding campaign August-September 2021
- September 2021 – September 2022
  - Analysis, write report