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M10 Gruan Data Product

JC. Dupont (IPSL), A. Farah (MODEM)

Outline

M10 GRUAN Data Product

- Organization
- Global status

Intensive Observational experiment at Payerne

- Multi-payload flights protocol
- Some statistics

Open issues currently under discussion

- New ground-check procedures / radiative correction
- Current open discussions

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Organization

Who? : Organization for the GRUAN GDP M10

1. **IPSL** (JC. Dupont, M. Haeffelin, MA. Drouin): Leader of the project, scientific relationship with GRUAN, algorithm development for M10 L1 and GDP + SIRTA site instruments
2. **Météo-France** (P. Jann) : Operationnal aspect for radiosondes at TRP and REU sites…. and Faa'a
3. **AERIS/ESPRI** (S. Cloché, C. Laplace) : Data flow at AERIS Data Center
4. **LACy, OSU** (S. Evan): M10 GDP validation and Maïdo site instruments
5. **MODEM** (A. Farah) : Corrections and uncertainties for M10 GDP & M20

Fruitfull collaboration with :

- MeteoSwiss (A. Haefele, F. Vogt, G. Martucci, G. Romanens) : technic & scientific discussions on M10 GDP
- Lead Center (R. Dirksen, M. Sommer, C. Von Rohden) : technic & scientific discussions on M10 GDP

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Global status of the GRUAN certification

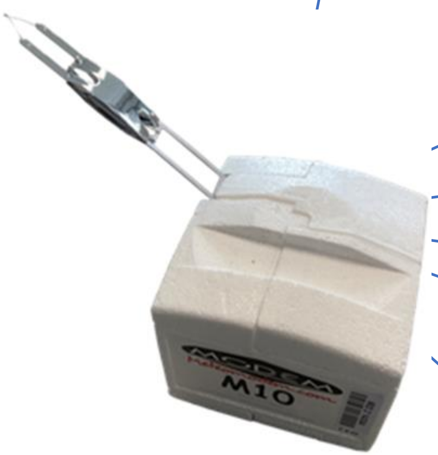
Technical Document (last TD-8), version 4 (280 pages) :
- submitted in April 20222
- LC review received on September

Scientific documents Dupont et al., 2020 and Madonna et al. 2020

Two operational sites (twice a day for TRP & REU)

New French operational site in South Pacific Ocean, FAA

Dataflow and datacenter: (https://www.gruan.org/data/measurements/sondelaunches) and AERIS datacenter



Discussions with the Lead Center to improve the quality of the TD

An established dataset for each site/sonde

Begining of M20

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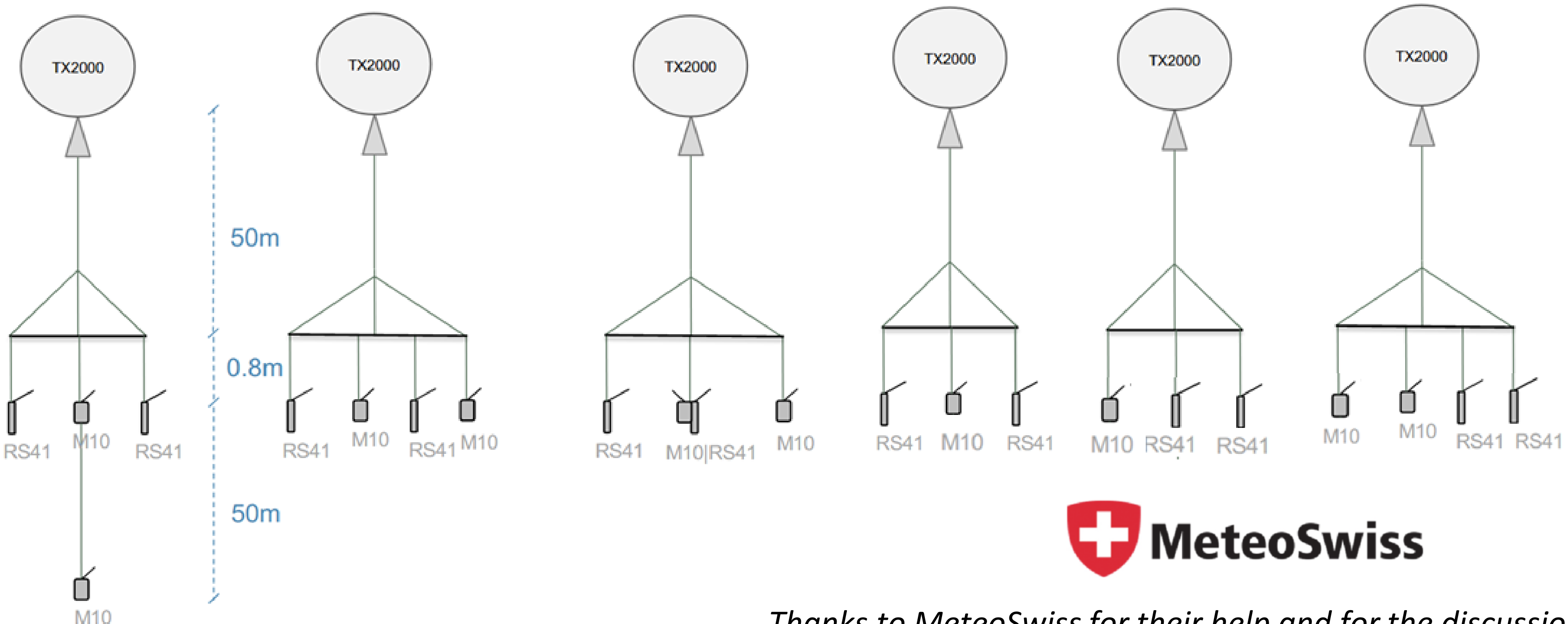
Multi-payload flights at Payerne



MeteoSwiss

Thanks to MeteoSwiss for their help and for the discussions

Goals:

- **Perform Daytime and Nighttime radiosoundings with M10/RS41 at the same hitch, around 20 flights.**
- **Check the effect of Multi-payload flights on data quality and interference between 2 M10 signals.**

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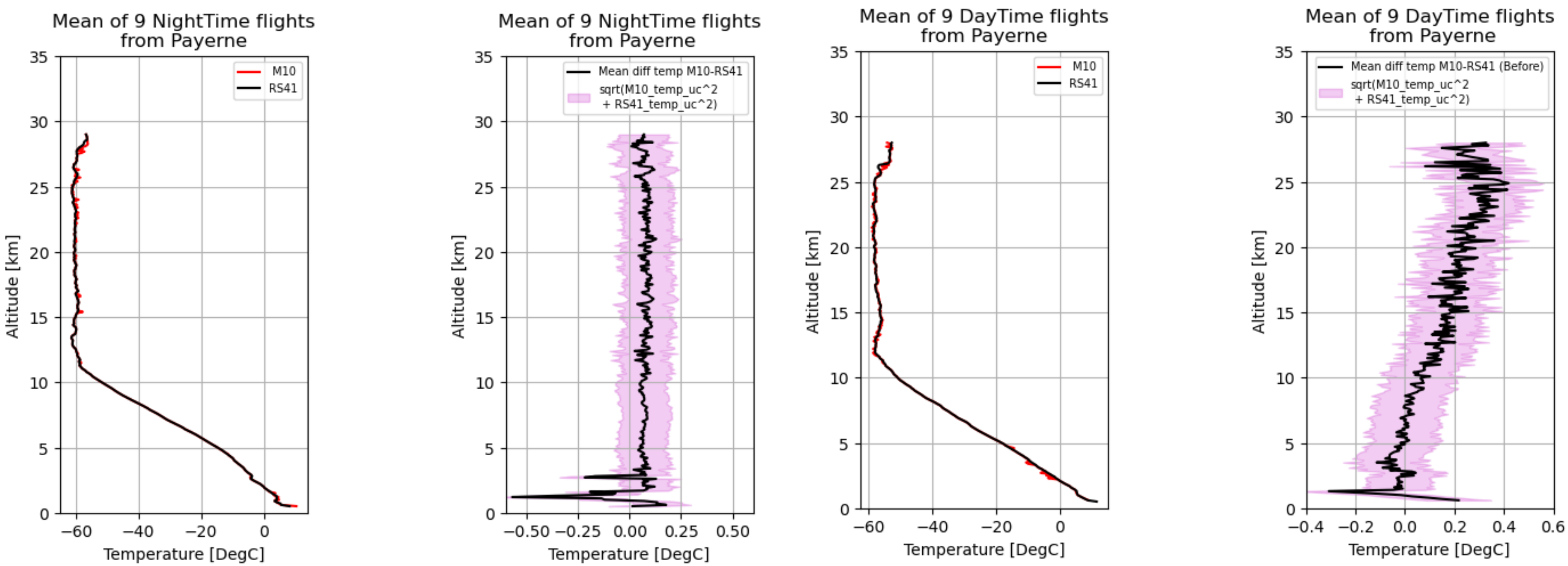
Multi-payload flights at Payerne

M10 GDP vs RS41 GDP [Temperature]



=> Difference M10 - RS41, ~ 0.1°C during nighttime for the whole profile.

=> Difference M10 - RS41, ~ 0 to 0.3°C during daytime.

=> Radiative correction has to be reviewed.

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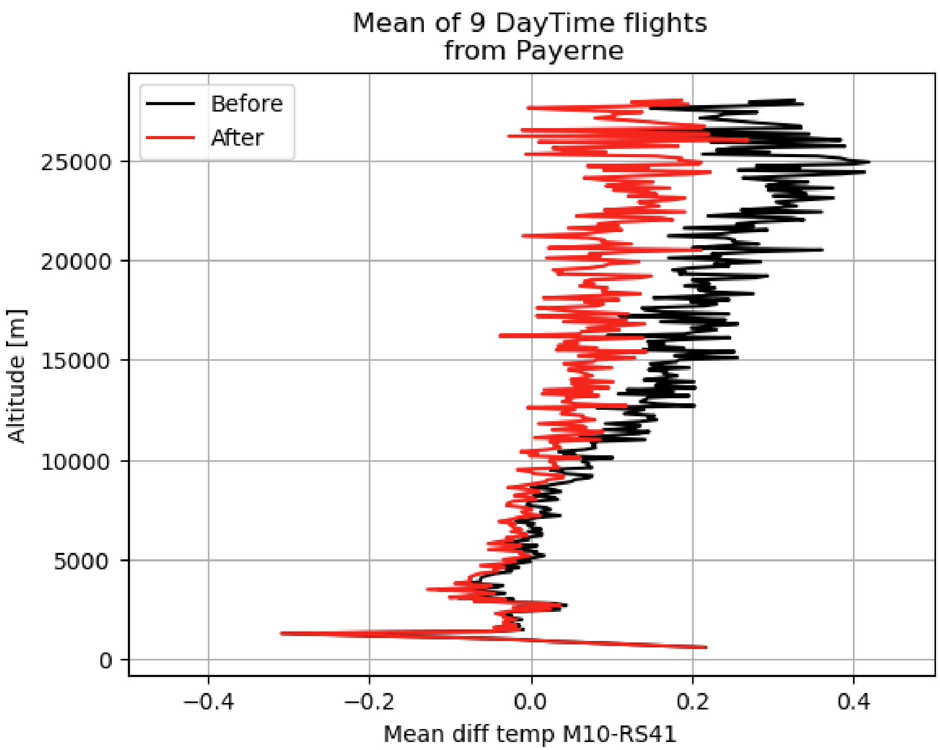
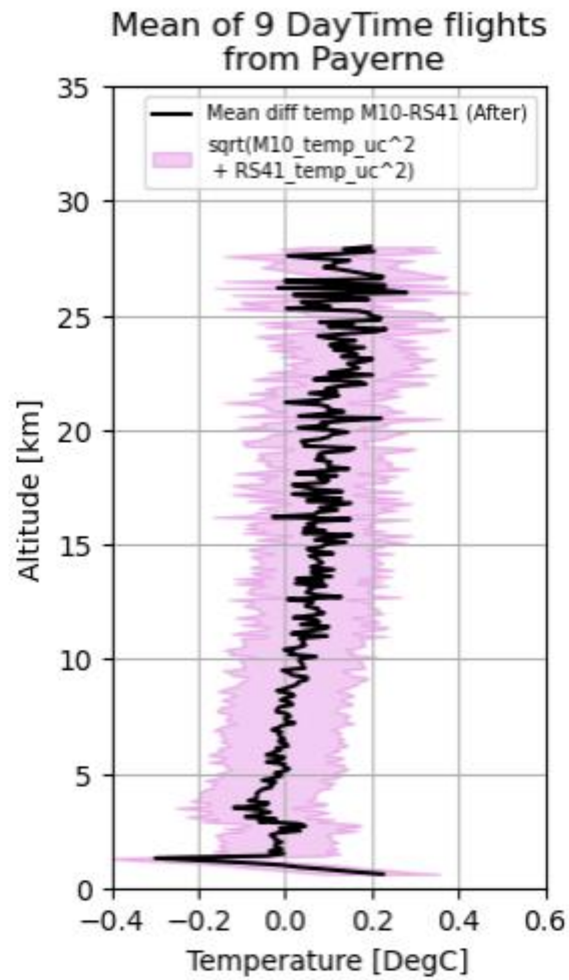
Recent improvement

- Change in the radiative correction on the temperature sensor





=> Statistic on 9 daytime flights at Payerne

=> Thanks to LC for the explanation and fruitfull discussions.

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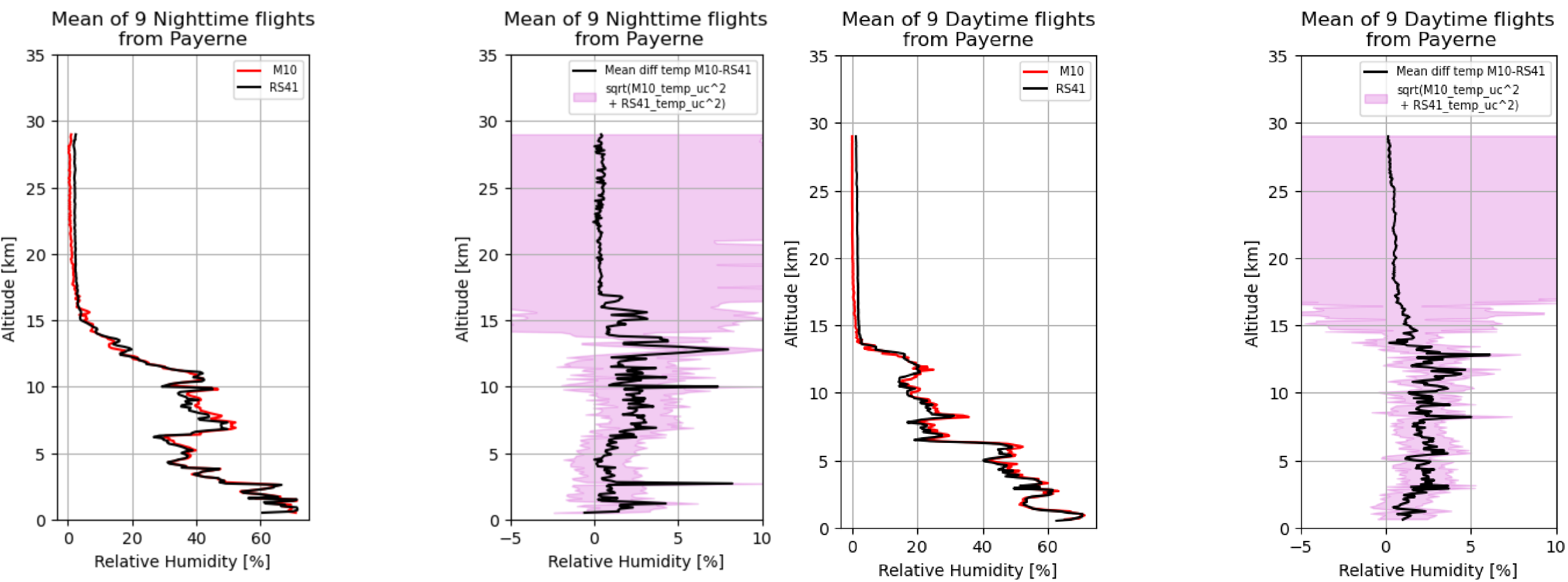
Multi-payload flights at Payerne

M10 GDP vs RS41 GDP [Relative Humidity]



=> Good correlation between M10 and RS41, with a wet biais of 3 %RH during daytime and nighttime

=> need further understanding on this difference

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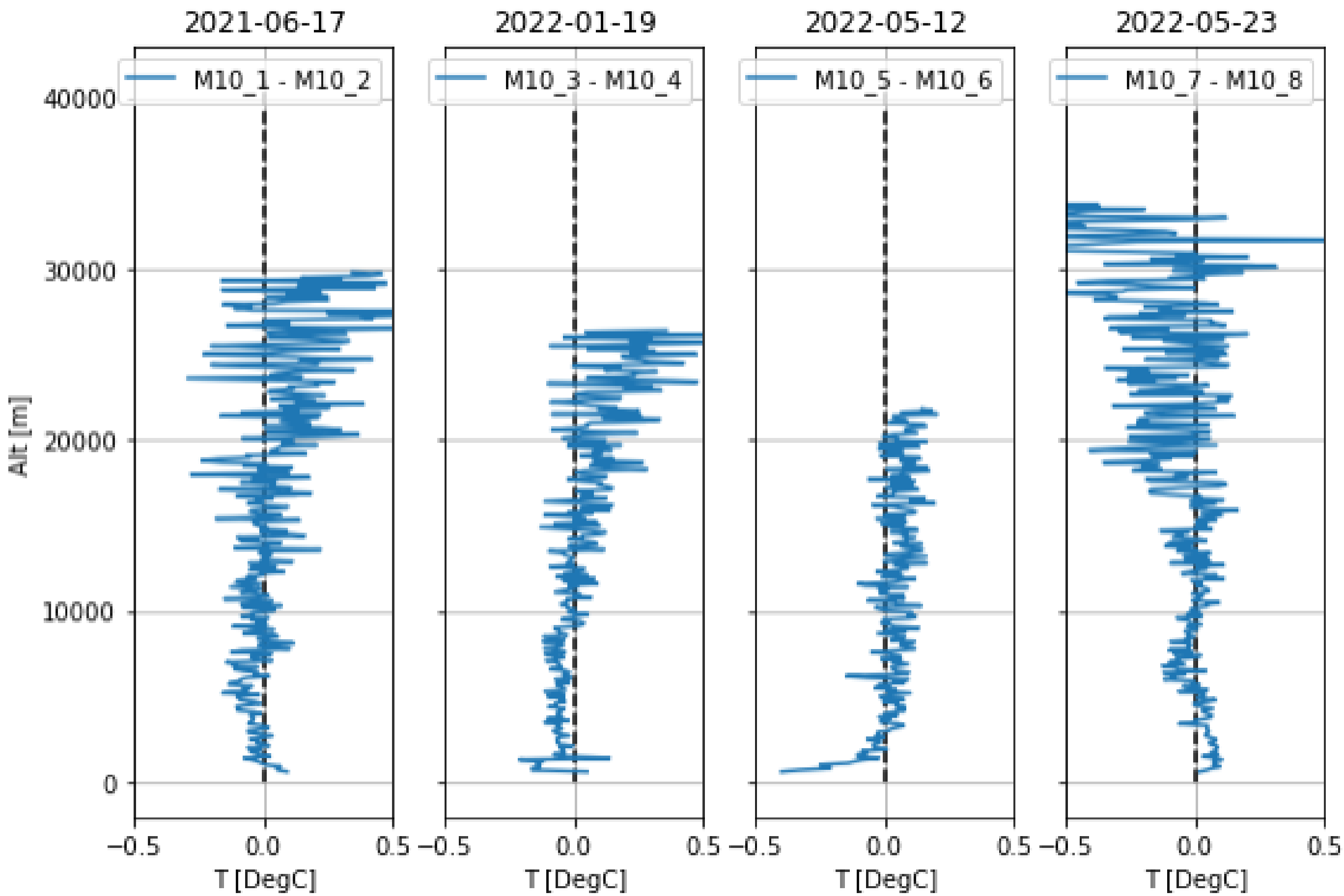
Multi-payload flights at Payerne

Inter M10-GDP difference (daytime T) [Temperature]



=> Unexplained inter M10-GDP difference (daytime T)

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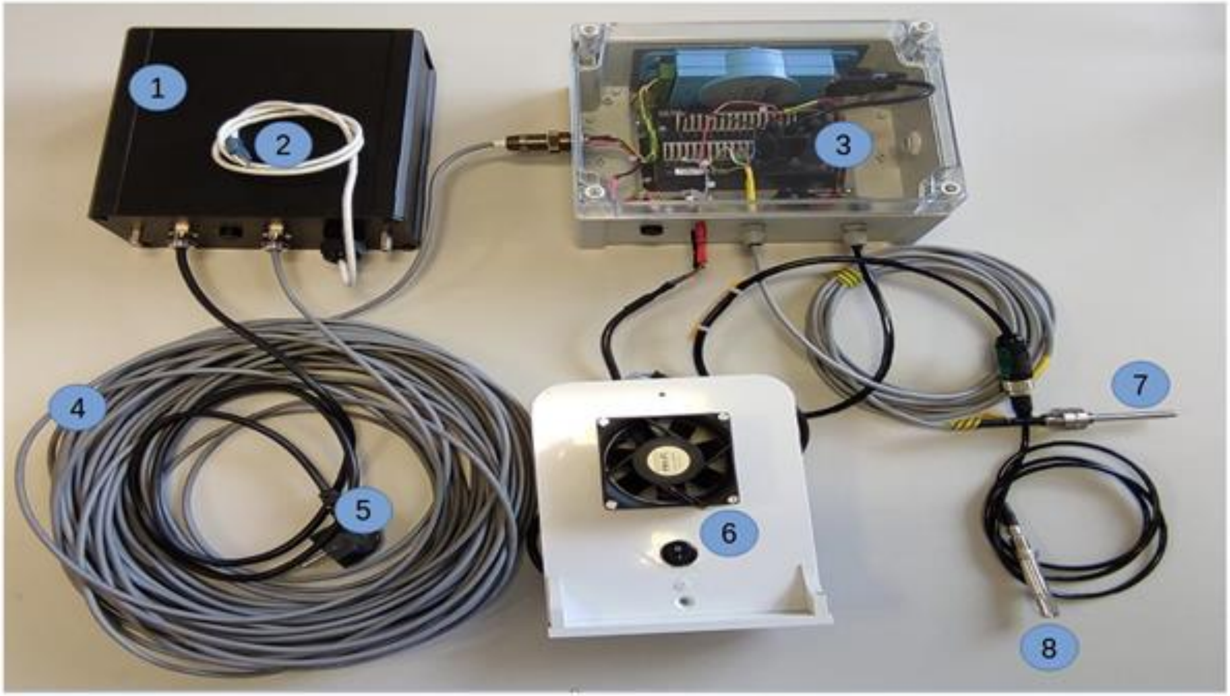
Recent improvement

- Modification of the ground-check procedure: add T/RH reference sensors for non-permanent M10 robotsonde sites (Payerne, Lindenberg).



1.power supply / communication with the pc and the acquisition box.
2.USB cable to connect to the GRUAN PC.
3.T/HU and fan power supply box.
4.12 VDC communication and power supply cable.
5. power supply cable of the system.
6. 12 V/0.2 A fan.
7. PT100 probe.
8. nalog HMP110 probe.

=> Effect of ground correction on T/RH profiles must be clarified.
=> Uncertainties in SHC-100 and ground-check not accounted for.

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Open discussions

Open issues currently under discussion

- Difference with RS41/iMS-100 GDPs for daytime T and RH wet bias.
- Unexplained inter M10-GDP difference (daytime T).
- Effect of ground correction on T/RH profiles must be clarified.
- Uncertainties in SHC-100 and ground-check not accounted for.
- NaN value for wdir_uc and press_uc.
- Differences to be investigated for REU and PAY sites concerning T profiles.
- Technical Document readability & quality must be improved.

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Preliminary results of M20

A. Farah (MODEM), JC. Dupont (IPSL)

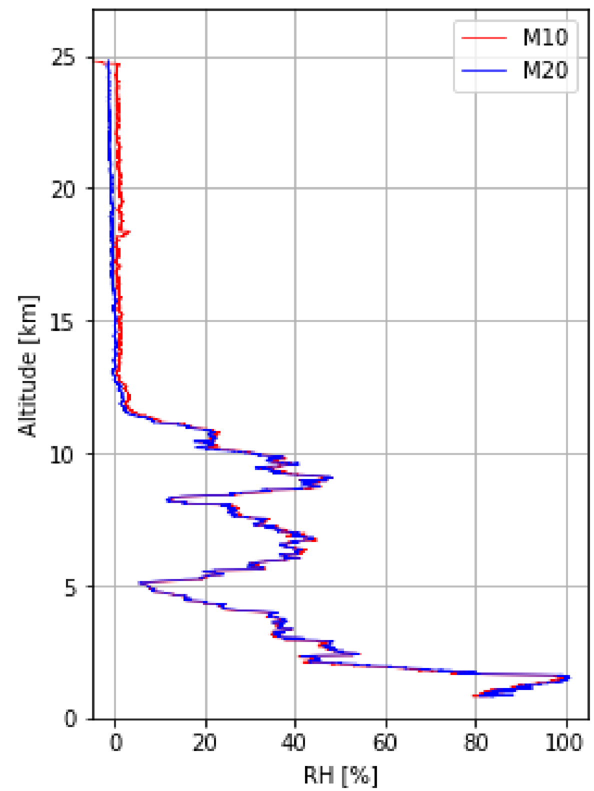
M20 Radiosonde (1/6)

M20 New generation of M10 radiosonde

M20 launched in Nimes Météo-France site (2 radiosoundings per day since July 2021, total of 960 radiosoundings)

Lightweight compact	• Ultra light radiosonde (36g). • Simplified storage.
Economic	• No parachute needed. • Save up to 20% of gas.
Heated Humidity sensor	• Humidity sensor fitted with a de-icing device.
Compatible Robotsonde	• Automatic balloon launcher system (up to 24 radiosondes).
Environment Friendly	• Reduced environmental impact (less batteries, less polluting surface, etc...).

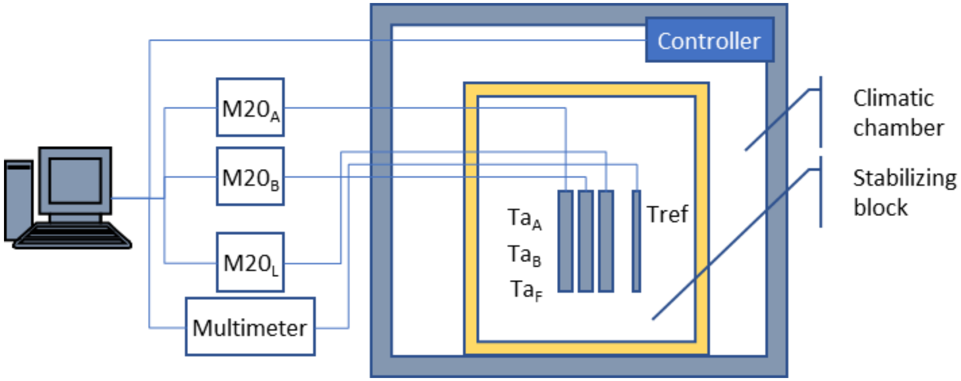
M10 VS M20



M20 Radiosonde (2/6)

Temperature Calibration Experiment

Climate chamber @ LMD/Ecole Polytechnique

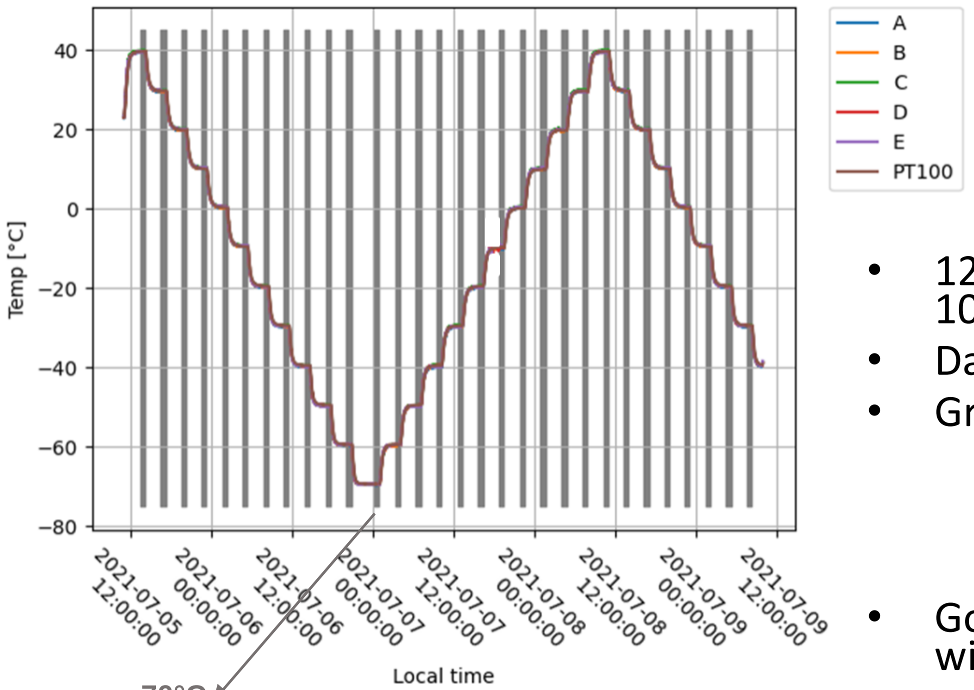


Schematization of climatic chamber, and stabilizing block

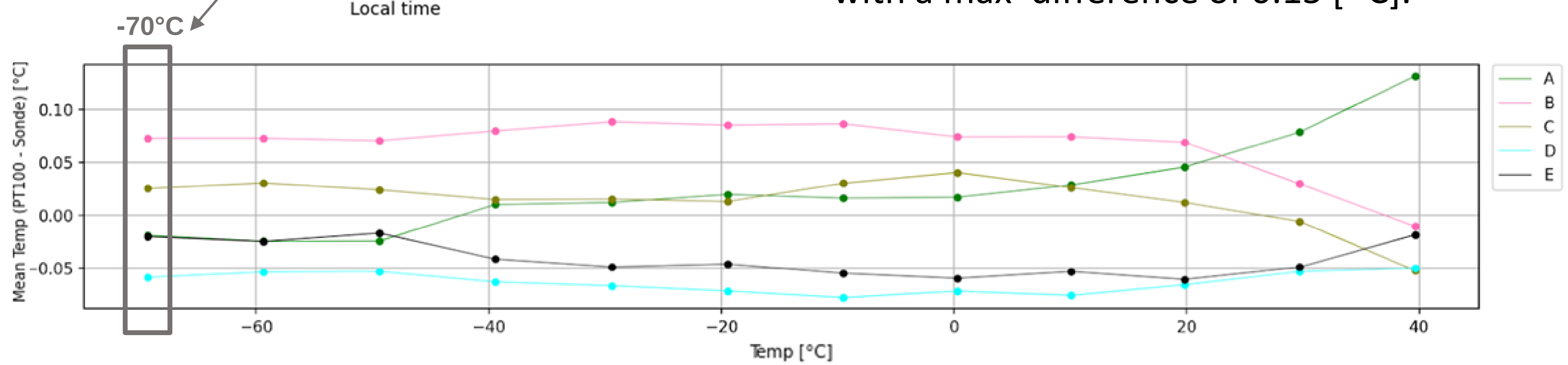
- Calibration tests made @LMD/Ecole Polytechnique (Same methodology as for M10).
- Five M20 are chosen as representative radiosondes.
- Reference PT100 [u_{ref} =0.03 K (k=1)].

M20 Radiosonde (3/6)

Temperature Calibration Experiment



- 12 stabilized temperatures from 40 to -70°C per 10°C steps, stabilized for 3 hours.
- Data resolution: 10s.
- Grey shaded block: last 10% of the stabilized time.
- Good correlation between Temp M20 and PT100, with a max difference of 0.15 [° C].



M20 Radiosonde (4/6)

Temperature Calibration uncertainties

- 4 uncertainties related to the M20: linearity, repeatability, reproducibility, and resolution.
- 3 uncertainties related to Ref PT100: calibration, repeatability and resolution.

- **Results**= **0.107 °C (K=1)**

  $\neq$

  0.114 °C (k=1) (M10)

Duvernoy et al. 2015 WMO Report n°119 (Same methodology as for M10)

Parameter	Name	Description	Standard uncertainty [°C] k=1
$u(T_{a\text{-}lin})$	Uncertainty of temp_raw linearity	Maximum bias from reference	0.150/√(3)
$u(T_{a\text{-}repe})$	Uncertainty of temp_raw repeatability	Standard deviation of mean stabilized values	0.045
$u(T_{a\text{-}repro})$	Uncertainty of temp_raw reproducibility	Maximum standard deviation along all stabilized values	0.075/√(3)
$u(T_{a\text{-}reso})$	Uncertainty of temp_raw resolution	Minimum difference between two indications	0.020/√(12)
$u(T_{ref\text{-}cal})$	Uncertainty of Tref calibration	Calibration certificate including the PT100 and the acquisition system	0.045
$u(T_{ref\text{-}repe})$	Uncertainty of Tref repeatability	Standard deviation of mean stabilized values	0.016
$u(T_{ref\text{-}reso})$	Uncertainty of Tref resolution	Minimum difference between two indications	<0.003/√(12)
$u(T_{a\text{-}cal})$	Uncertainty of Ta_raw calibration	Composition of $u(T_{a\text{-}lin})$, $u(T_{a\text{-}repe})$, $u(T_{a\text{-}repro})$, $u(T_{a\text{-}reso})$, $u(T_{ref\text{-}cal})$, $u(T_{ref\text{-}repe})$, $u(T_{ref\text{-}reso})$	0.107

M20 Radiosonde (5/6)

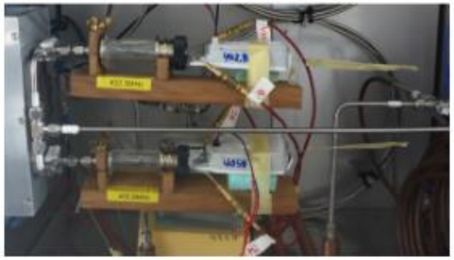
M20 at the UAII2022 (Lindenberg, Germany)

Labratory campaign (28/03 until 08/04)

SHC
(Standard Humidity Chamber)

- 0-100-0 %RH, via plateau.
- Stabilisation time: 10 min.

Climate chamber



- Timelag of Humidity sensor.
- Temperature: -70, -50, -30, -10°C.

Radiation

- Solar radiation correction:
  - Irradiance 1100 W/m^2.
  - Pressure: 5, 20, 100, 950 hPa.
  - Ventilation speed: 1, 3, 5 m/s.

M20 Radiosonde (6/6)

M20 at the UAII2022

Radiosounding campaign (August - September 2022)

- Capacity: 10 radiosondes.
- 80 launches (4 per day).
- Perform daytime and Nighttime soundings.

Perspectives

- Validate GRUAN certification of M10 radiosonde.
- Design a campaign to calculate ARL M10 uncertainties in collaboration with Météo-France and Ecole Polytechnique.
- Launching of the next French Météo-France operational site with M20 in the south of the pacific ocean, FAA, Polynésie (**Session 6-5 presented by Patrick Jann on Wednesday at 10:20 am**).
- Data analysis of the UAII2022 experimental campaign in Lindenberg lead center:
    - Radiation correction in the wind channel.
    - Timelag uncertainty in the climate chamber.
    - RH uncertainties in the SHC.

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Questions?

Thank you for your attention

IPSL SIRTA

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AERIS

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