GRUAN / ICM-15

Modem M10 GDP progression and results overview

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ICM-14 conclusions for Modem M10

- **WHAT :** Perform assessment of the data quality issues highlighted in Payerne parallel flights and assess whether it is feasible that M10 sondes can be processed to GRUAN products

- **HOW** : Further assessment of Modem M10 characterization including various parallel flights including M10-M10 paired flights to understand more fully data repeatability

- **BY WHOM** : Modem, Meteo-France, IPSL, Lead Center, Meteoswiss

- **BY WHEN** : ICM-15

Outline of the presentation

M10 Temperature Reproducibility issues

- Observation and problem identification
- Coating effect for day/night & solution
- Bending effect for day/night & solution
- Conclusions

Status of M10 GRUAN Data Product

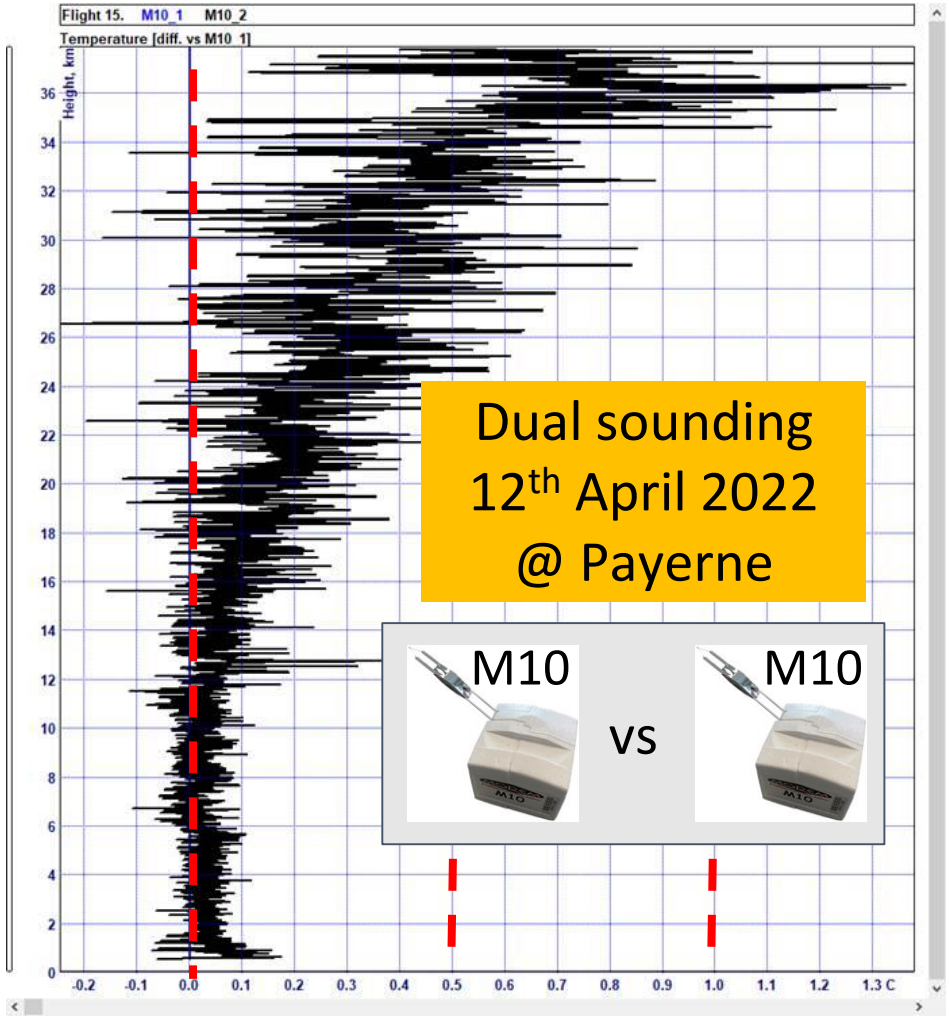
- Suggestion for M10 certification
- M10 dataflow

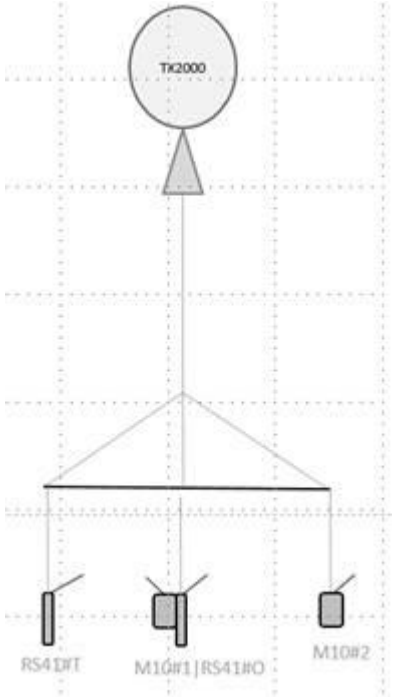
Metrics at Faa'a site

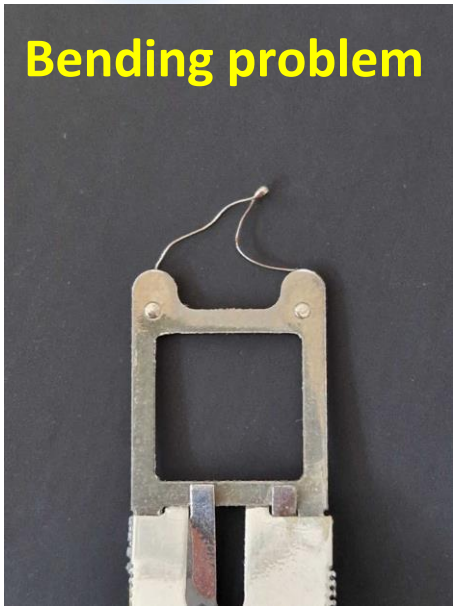
Conclusions and Perspectives

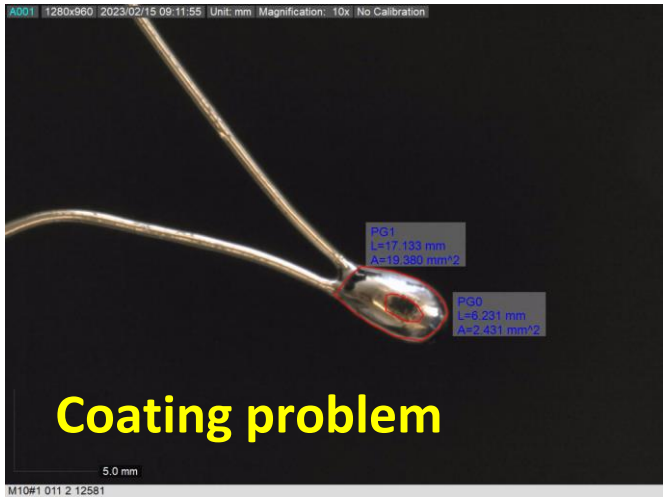
M10 Temperature Reproducibility Issues

1- Observations and problem





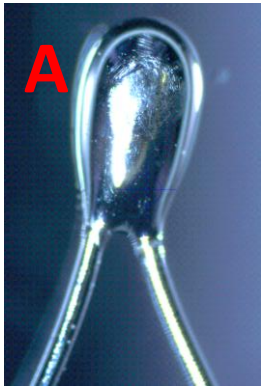


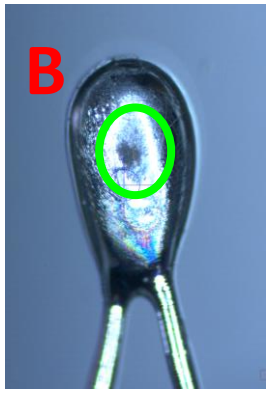


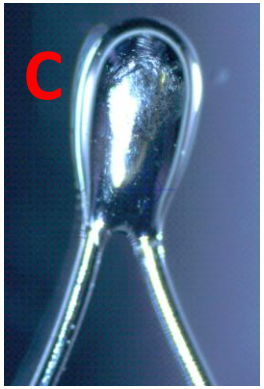
M10 Temperature Reproducibility Issues

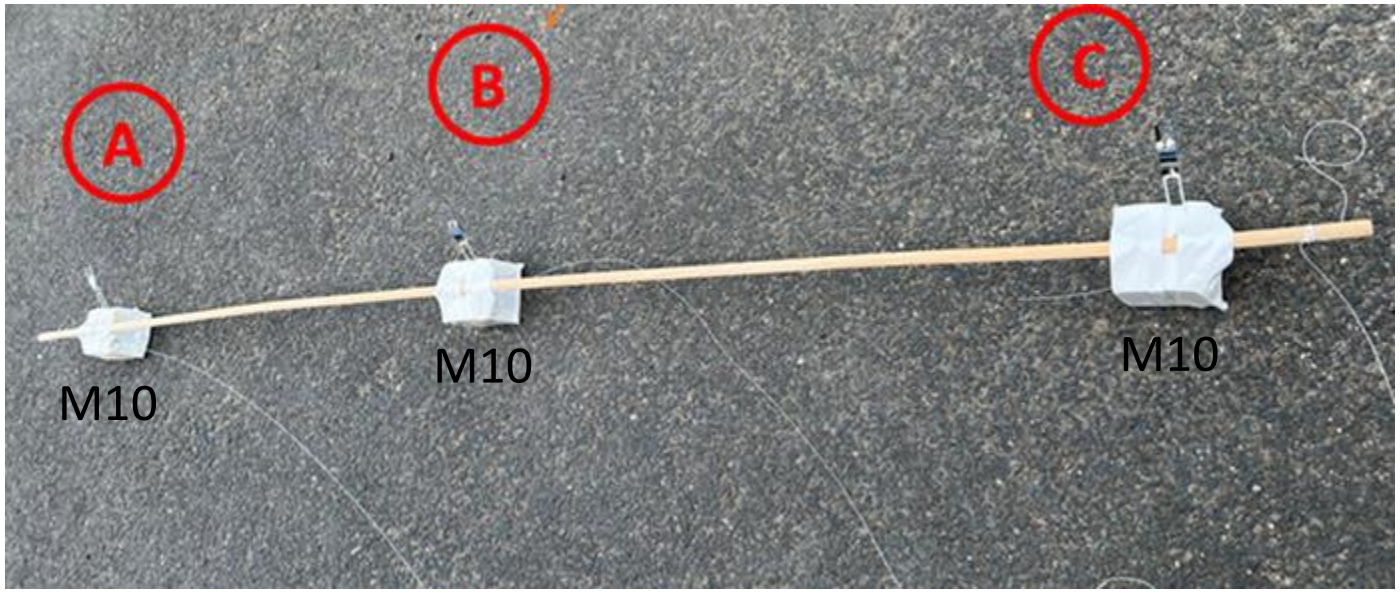
2- Coating Effect - M10 vs M10 flights

Set-up









M10 Temperature Reproducibility Issues

2- Coating Effect - M10 vs M10 flights

Flight & Config & Day

Flight #	Date (dd/mm/yyyy)	# of M10	Fixing	Configuration
1	16/05/2023	3	Scotch	OK-**KO**-OK
2	30/05/2023	3	Scotch	OK-**KO**-OK
3	01/03/2023	3	Rope	OK-**KO**-OK
4	03/03/2023	3	Scotch	**KO**-OK-OK
5	07/04/2023	3	Scotch	OK-OK-**KO**

OK: un-damaged T-sensor
KO: damaged T-sensor

M10 Temperature Reproducibility Issues

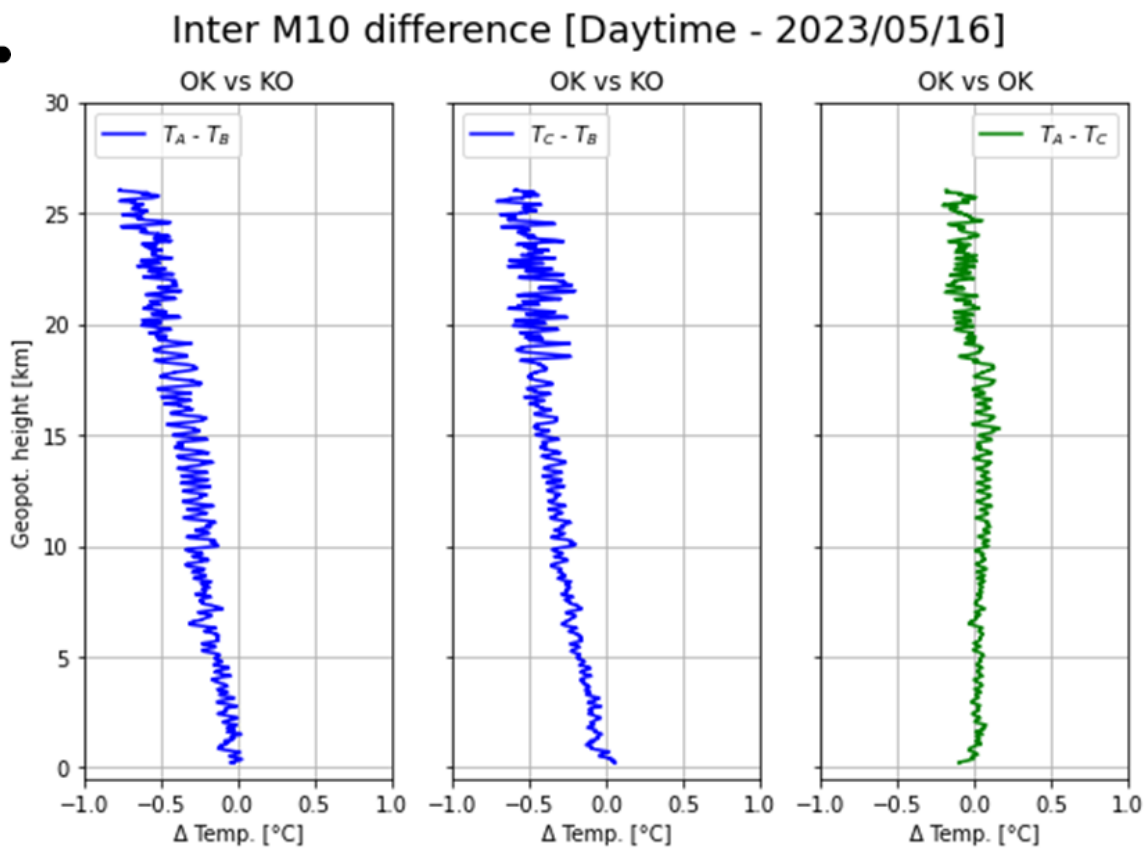
2- Coating Effect - M10 vs M10 flights

Results, day

Ex: Flight #1

OK vs OK: There is a strong temperature correlation between two M10.

OK vs KO: A linear increase in temperature difference with altitude is seen, peaking at δ=0.7k at 26 km.



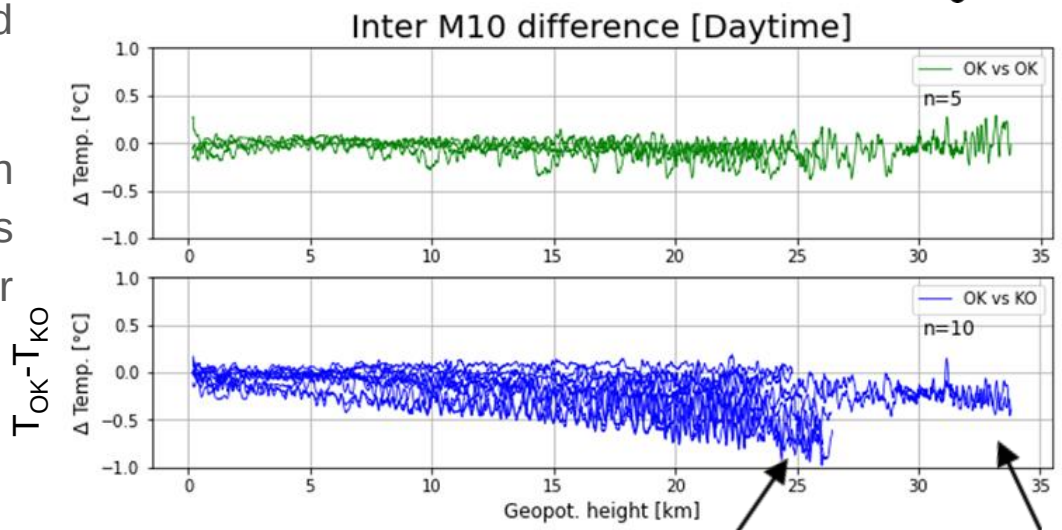
M10 Temperature Reproducibility Issues

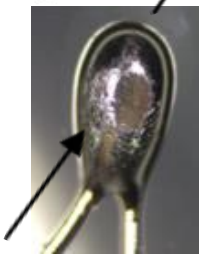
2- Coating Effect - M10 vs M10 flights

Results, day

OK vs OK: There is a very good agreement between the two M10.

OK vs KO: A linear increase in temperature difference with altitude is seen, peaking at Δ=0.8k at 26 km (for certain soundings).





Big stain on the temperature sensor

Small stain on the temperature sensor

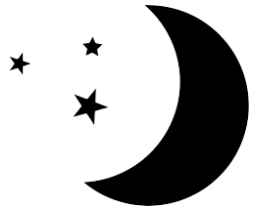
Summary:

Coating problem

- black stain on T sensor
  - more solar absorption
    - higher temperature for T_{KO}

M10 Temperature Reproducibility Issues

2- Coating Effect - M10 vs M10 flights



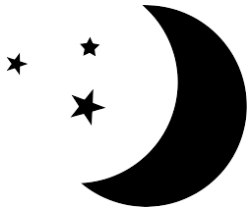
Flight & Config & Night

Flight #	Date (dd/mm/yyyy)	# of M10	Fixing	Configuration
1	20/02/2024	3	Rope	A: [OK + 0°] B: [OK + 90°] C: [KO + 0°]
2	28/02/2024	3	Rope	A: [OK + 0°] B: [OK + 90°] C: [KO + 0°]

***OK**: un-damaged T-sensor*
***KO**: damaged T-sensor*

M10 Temperature Reproducibility Issues

2- Coating Effect - M10 vs M10 flights

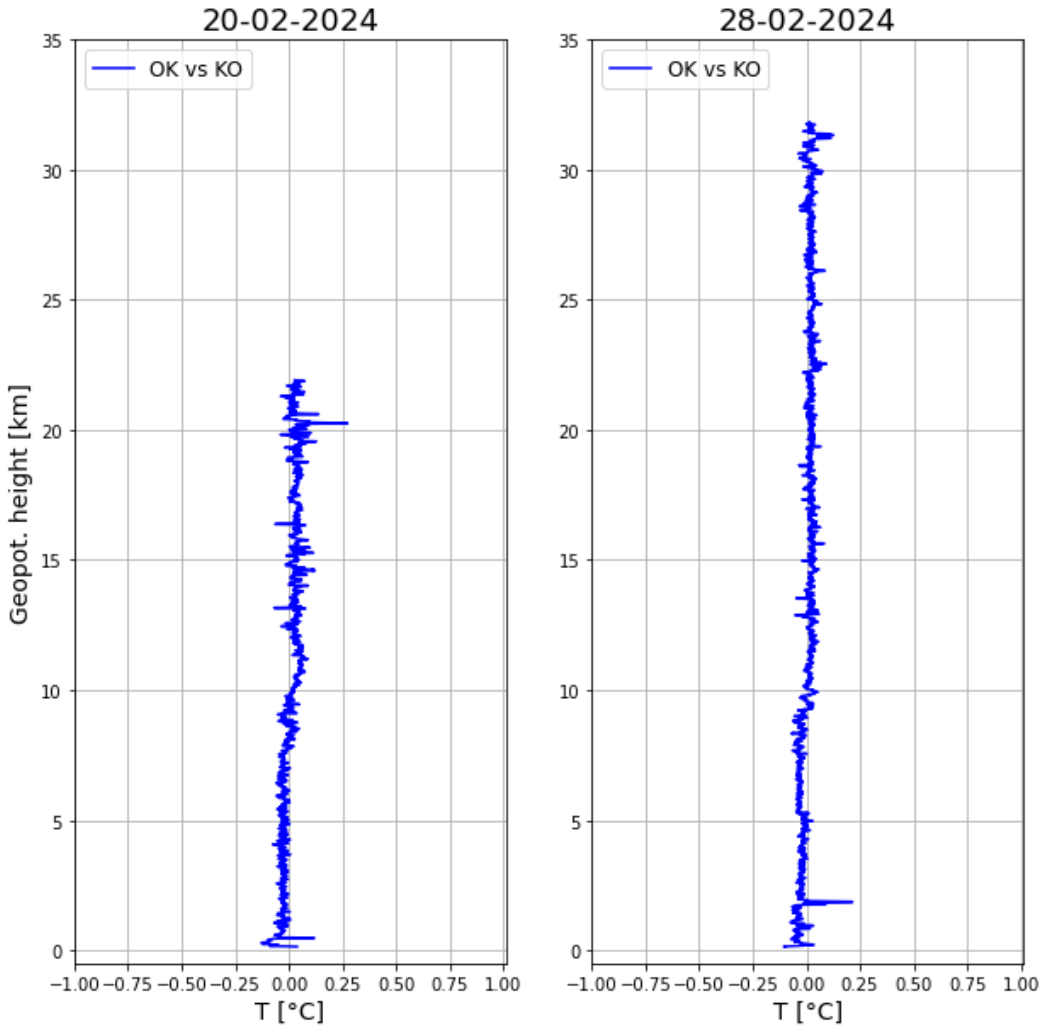


Results, Night

OK vs KO: No bias, no tendency between two M10.

Summary:

The issue with the temperature sensor coating has no impact on temperature measurements.



M10 Temperature Reproducibility Issues

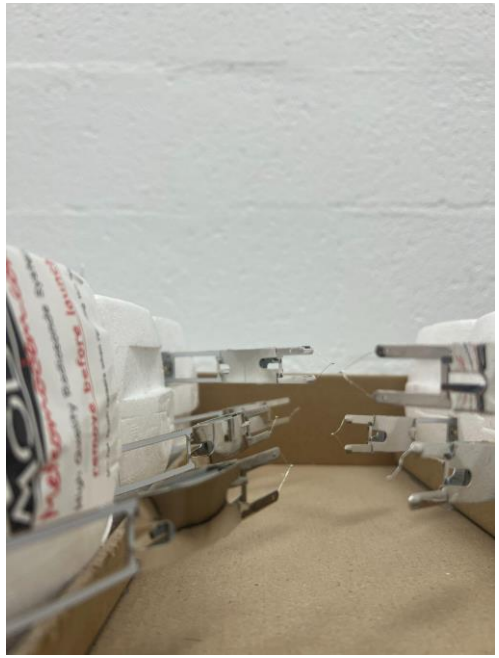
3- Coating problem - origine

Packaging Before June 2023

M10 Temperature Reproducibility Issues

3- Coating problem - solution

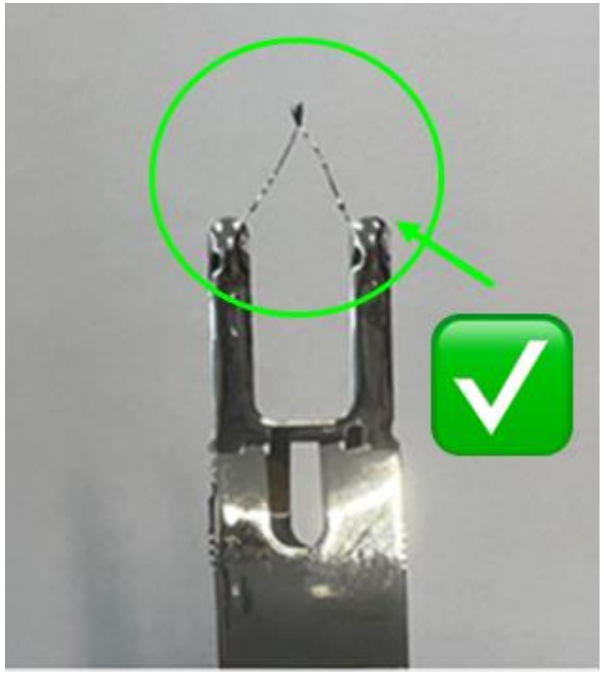
Packaging After June 2023



There is no contact between the temperature sensors

M10 Temperature Reproducibility Issues

4- Bending problem ?!



Bending problem A

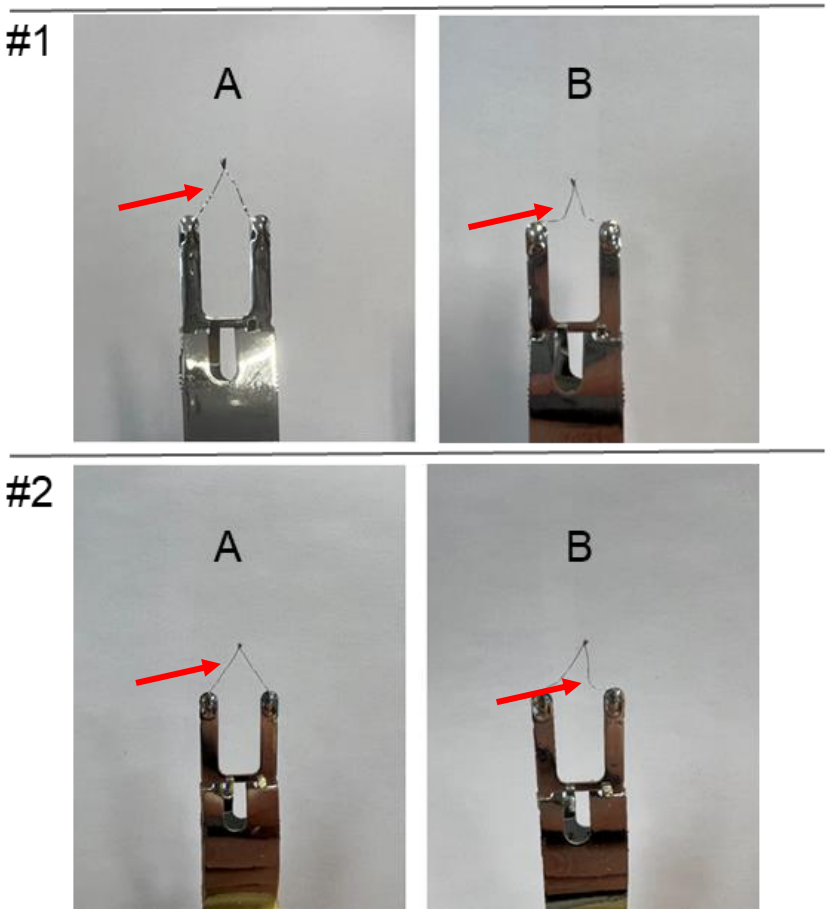
Bending problem B

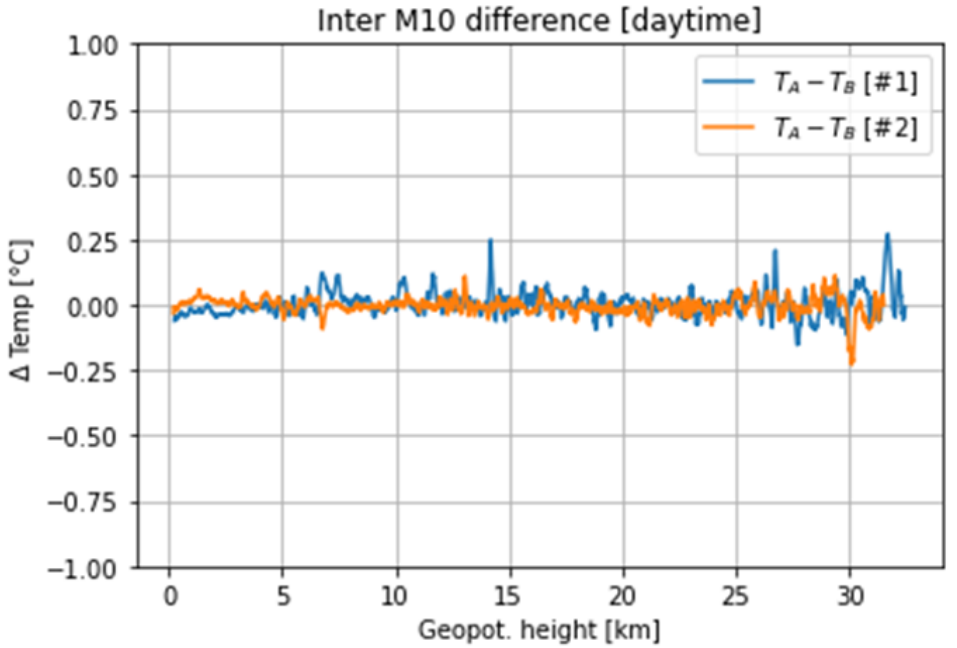
M10 Temperature Reproducibility Issues

4- Bending Effect A

Flights :
#1 : 03/09/2022
#2 : 06/09/2022

Set-up



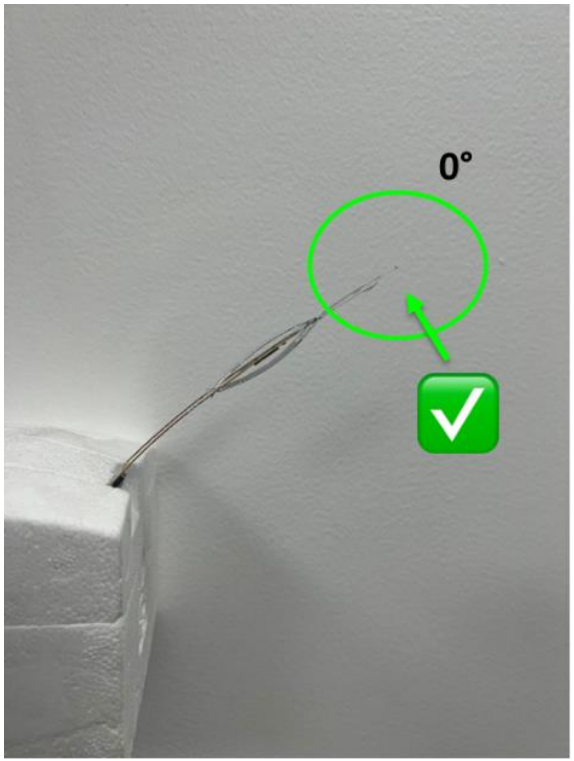


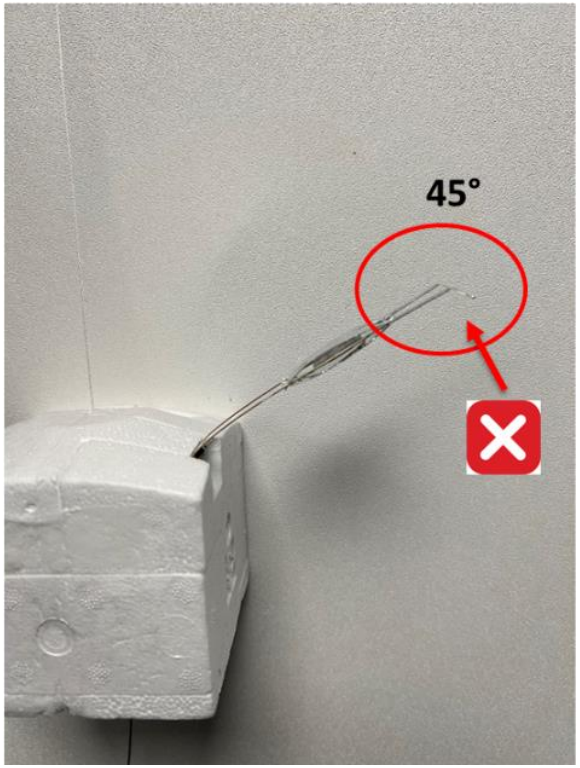
Summary:
The temperature variances exhibit symmetry around zero in both setups (#1 and #2). This implies that this bending shape of the temperature sensor wire has no impact on temperature measurements.

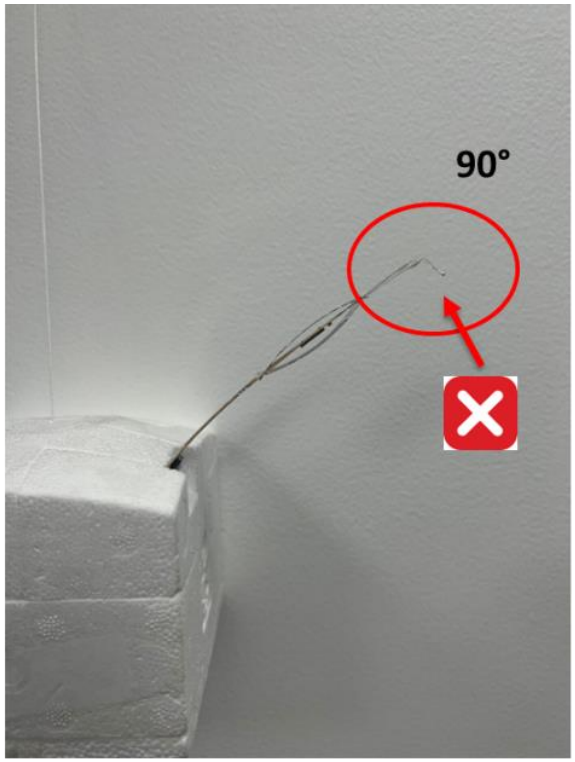
M10 Temperature Reproducibility Issues

5- Bending Effect B

Set-up : Tilt compared to the sensor boom

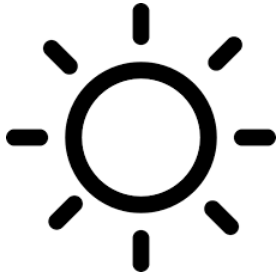






M10 Temperature Reproducibility Issues

5- Bending Effect B - M10 vs M10 flights

Flight & Config & Day 

Flight #	Date (dd/mm/yyyy)	# of M10	Fixing	Configuration (°)
1	21/12/2022	3	rope	0-0-90
2	26/01/2023	3	rope	0-0-45
3	27/01/2023	4	rope	0-0-45-90
4	26/07/2023	3	scotch	0-45-90
5	07/08/2023	3	scotch	0-45-90

M10 Temperature Reproducibility Issues

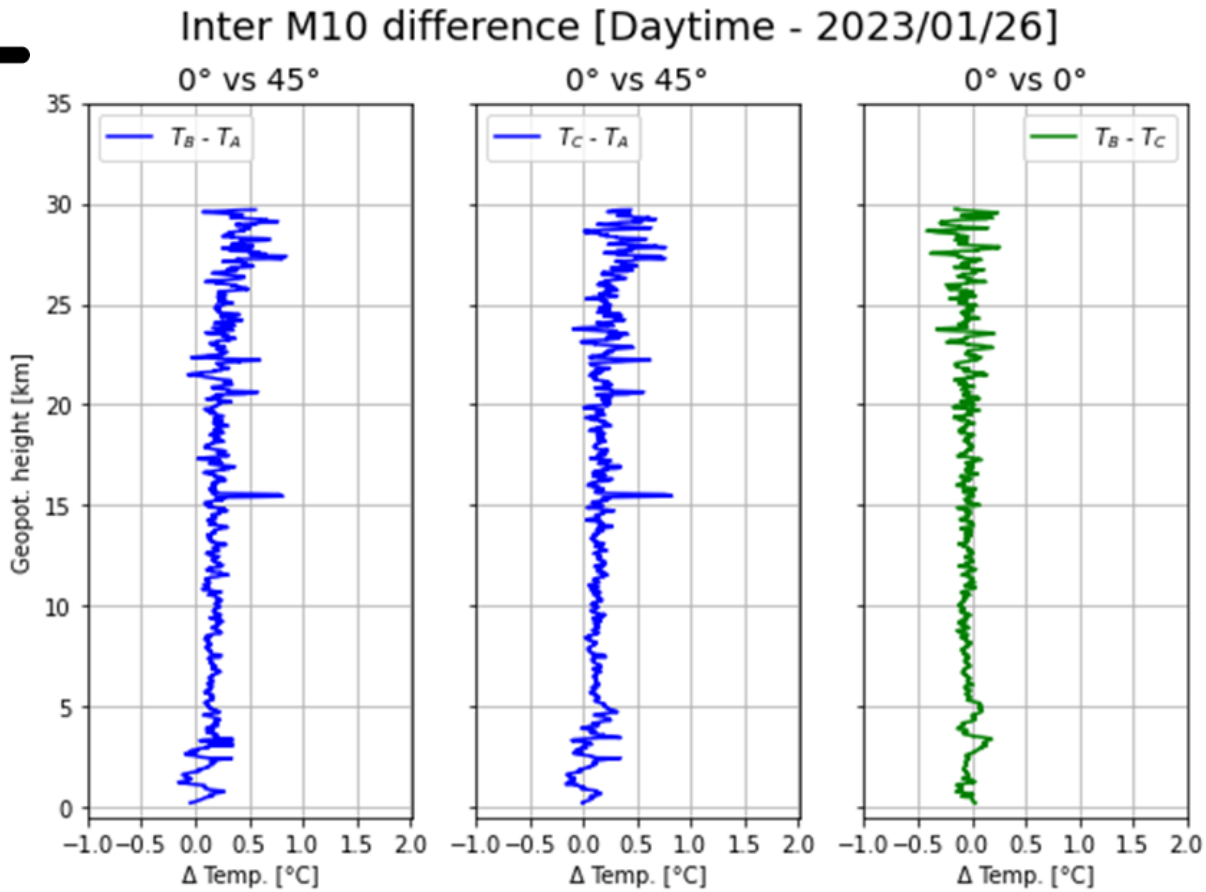
5- Bending Effect B - M10 vs M10 flights

Results, day

Ex: Flight #1

0° vs 0°: There is a strong temperature correlation between two M10.

0° vs 45°: A linear increase in temperature difference with altitude is observed.



M10 Temperature Reproducibility Issues

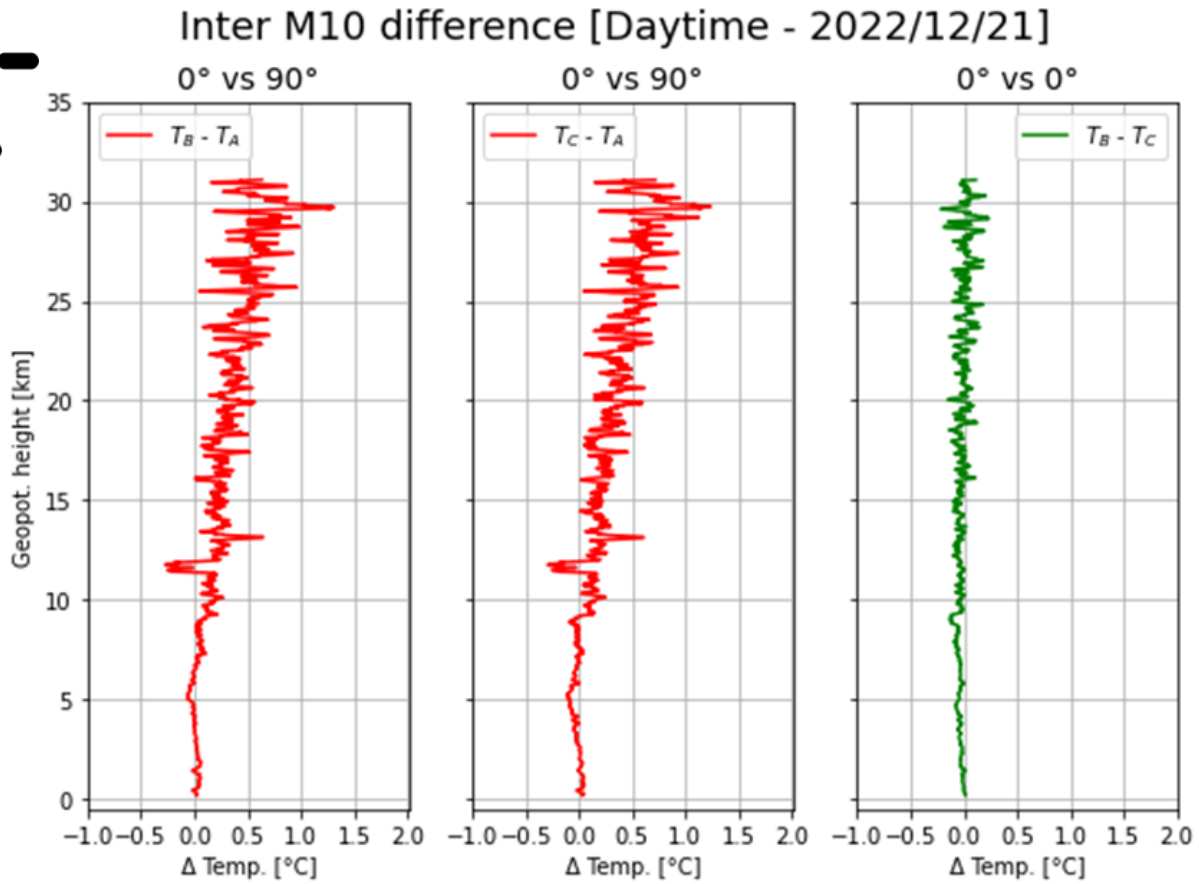
5- Bending Effect B - M10 vs M10 flights

Results, day

Ex: Flight #2

0° vs 0°: There is a strong temperature correlation between two M10,

0° vs 90°: A linear increase in temperature difference with altitude is observed, peaking at Δ=1.2k at 30 km.



M10 Temperature Reproducibility Issues

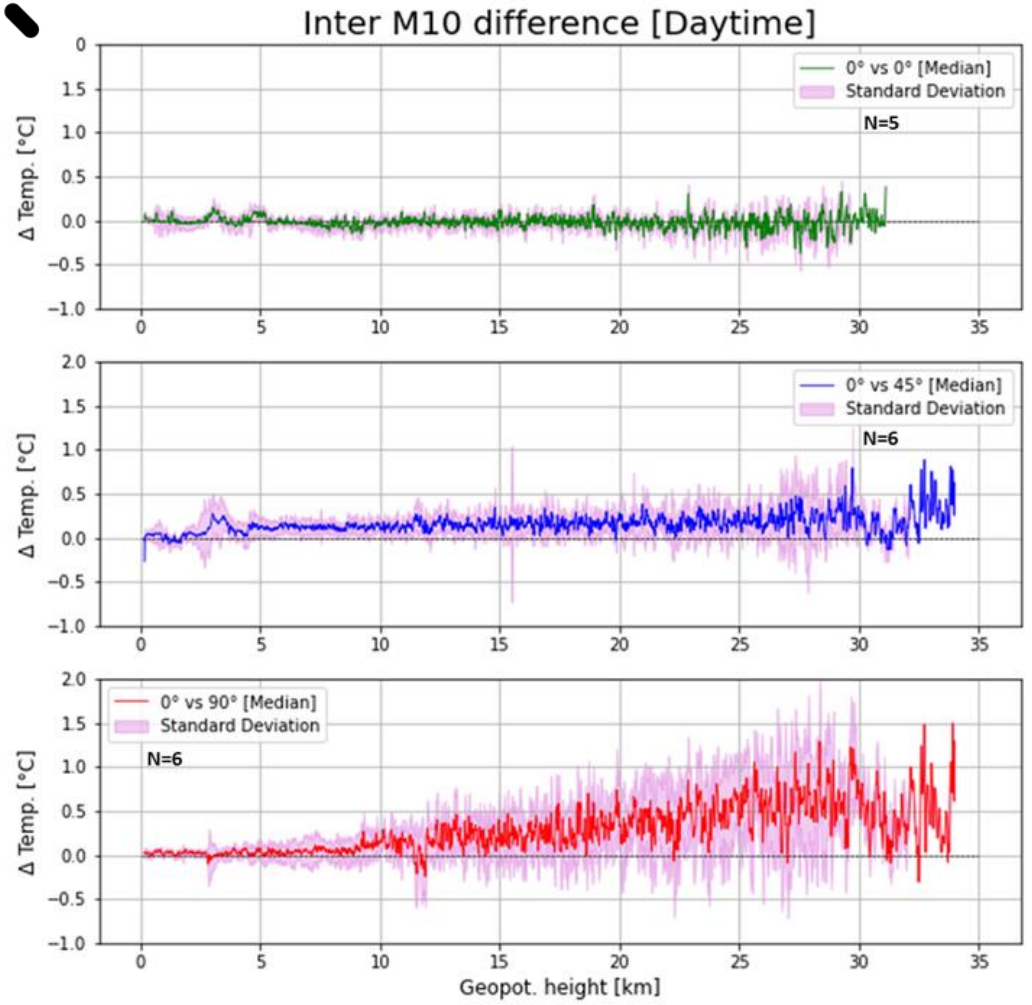
5- Bending Effect B

Results, day

0° vs 0°: There is a strong temperature correlation between two M10

0° vs 45°: A linear increase in temperature difference with altitude is observed, reaching Δ =0.7k at 33 km.

0° vs 90°: A linear increase in temperature difference with altitude is seen, peaking at Δ =1.5k at 33 km (for certain soundings).



Summary:

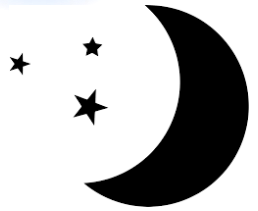
Bending problem B has a « cooling » impact on the temperature, much cooler for 90° compared to 45°.

Why ?

- ✓ Sensor boom shadow on the T sensor ?
- ✓ Different reflexion between T sensor and M10 box

M10 Temperature Reproducibility Issues

5- Bending Effect B - M10 vs M10 flights

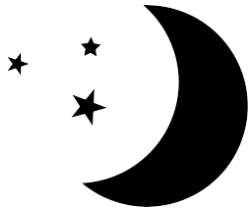


Flight & Config & Night

Flight #	Date (dd/mm/yyyy)	# of M10	Fixing	Configuration (°)
1	20/02/2024	3	Rope	A: [OK + 0°] B: [OK + 90°] C: [KO + 0°]
2	28/02/2024	3	Rope	A: [OK + 0°] B: [OK + 90°] C: [KO + 0°]

M10 Temperature Reproducibility Issues

5- Bending Effect B - M10 vs M10 flights

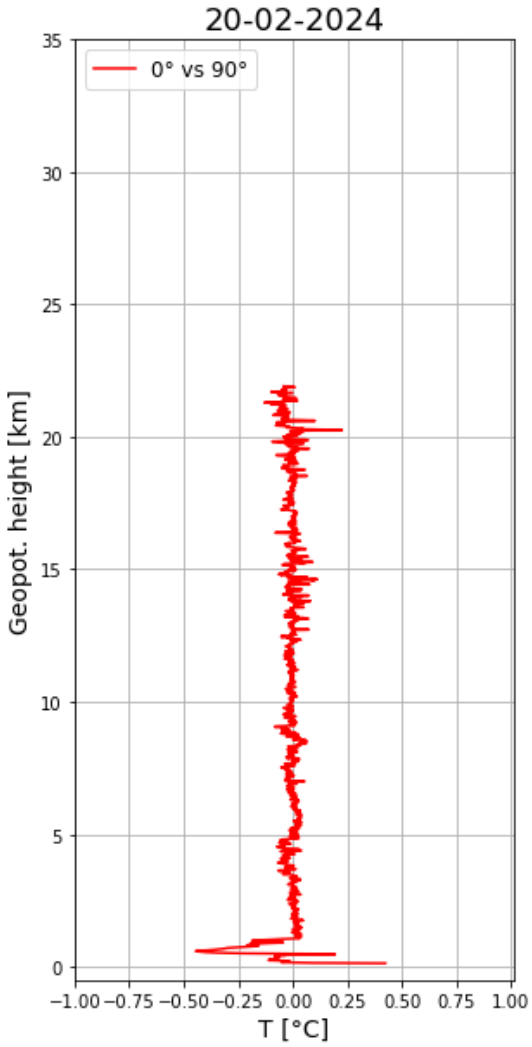


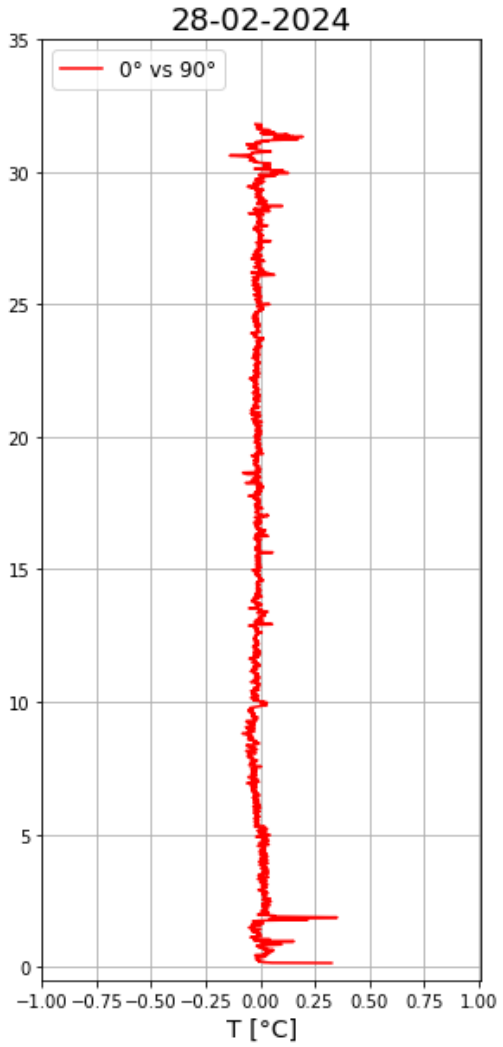
Results, night

0° vs 90°: There is a strong temperature correlation between two M10

Summary:

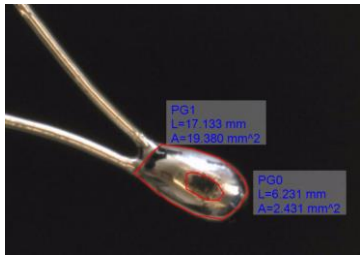
The orientation of the temperature sensor has no influence on temperature measurements.





M10 Temperature Reproducibility Issues

	Bending effect A	Bending effect B	Coating effect
☀	✓ ~ 0	✗ **Colder** max 0.7k @ 33km for 45° max 1.5k @ 33km for 90°	✗ **Warmer** max 0.8k @ 26km
☾	✓ ~ 0	✓ ~ 0	✓ ~ 0



Status of M10 GRUAN Data Product

- Suggestion for M10 certification

Period	Before June 2023		After June 2023	
Day/night / Variables	☀	☾	☀	☾
Pressure	✓	✓	✓	✓
Wind	✓	✓	✓	✓
Relative humidity	✓	✓	✓	✓
Temperature	✗	✓	✓	✓

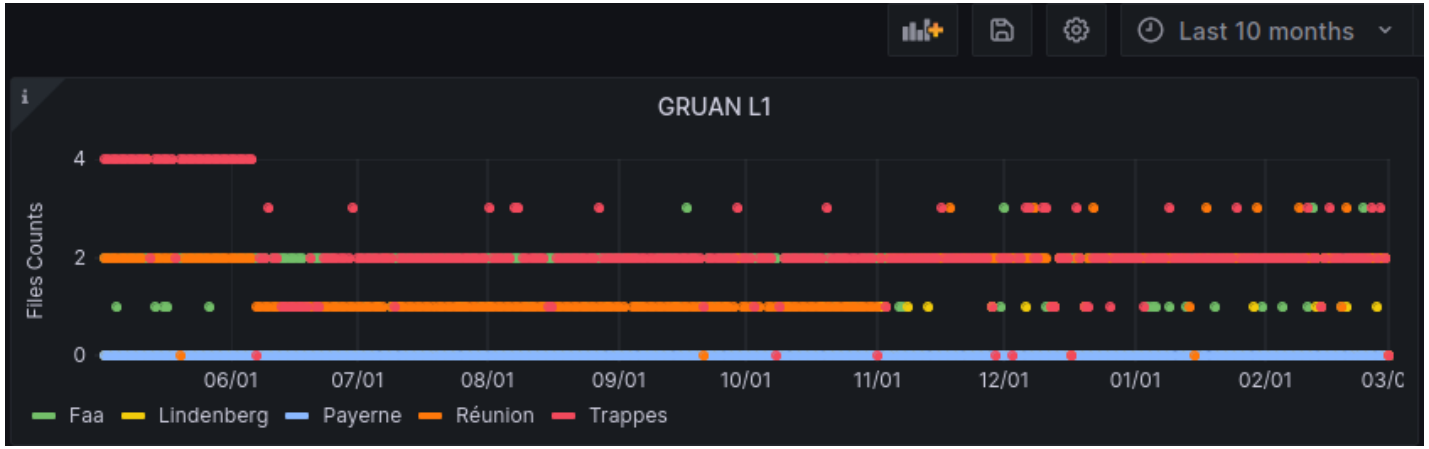
For the M10 certification, we would like to send the technical document (1) for all the variables, (2) for day and night sounding, and (3) for the whole period ; **except for** temperature where we recommand not to use the daytime launch before June 2023 (new packaging technic), due to possible bias reaching max value around 2°C.

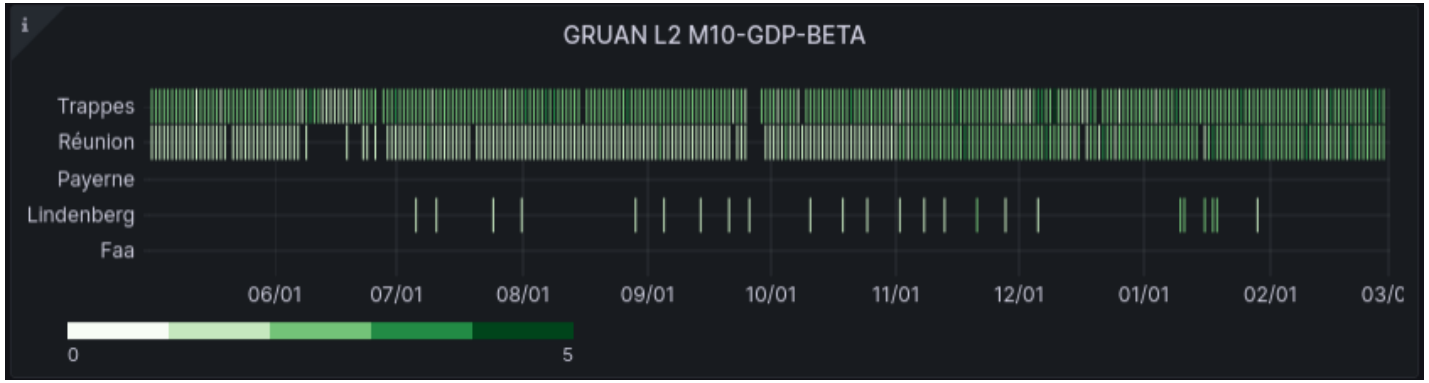
Take home message : if T-sensor is non-damaged and align with the sensor boom, reproducibility is perfect for day & night !

Status of M10 GRUAN Data Product

- M10 dataflow

- M10 GDP production is ensured by AERIS Data Center
- M10 GDP data flow is monitoring with GRAFANA software
- Since more than 2 years, M10-GDP processing is automatic for TRP and REU operationnal sites
- Since October 2022, M10 L1 Product processing is automatic for FAA operationnal site
- Since last week, M10-GDP processing is automatic for specific sites like Payerne or Lindenberg

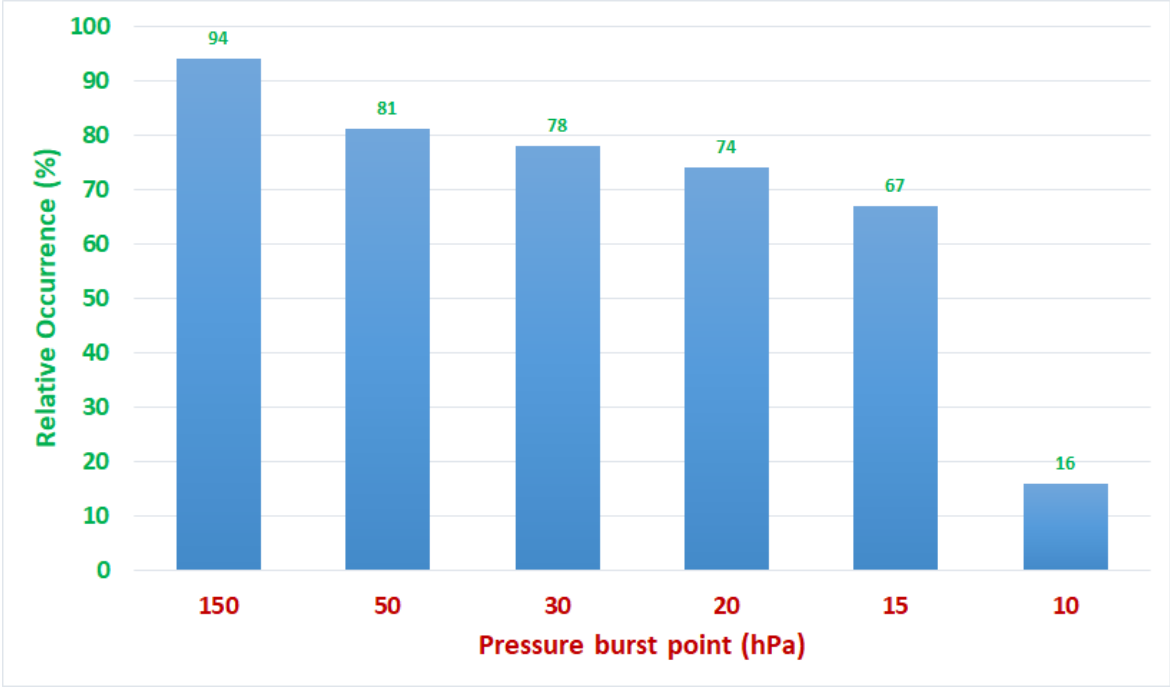




Faa'a statistics since Oct. 2022

MODEM robotsonde since october 2018

… with GRUAN procedures (GC) since october 2022



In 2023 : 703 M20 profiles (raw data availability L1)

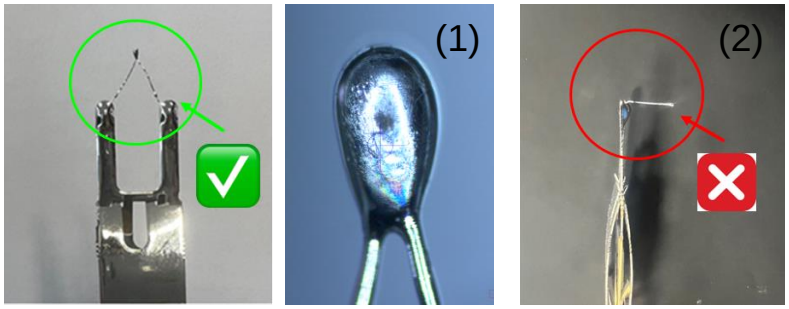
Conclusions

Take Home Message

Reproducibility issue has been identified :

(1) Coating problem

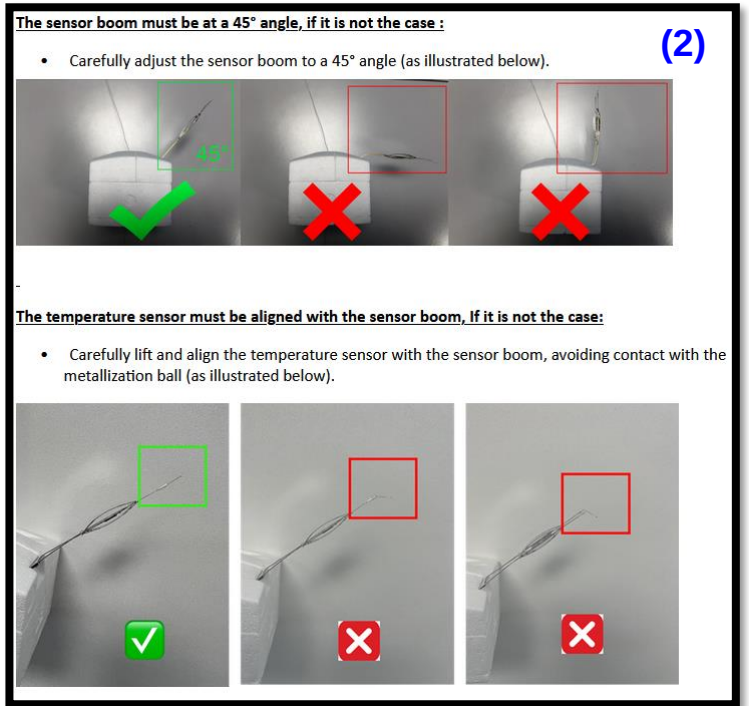
(2) Bending problem



AND solutions have been implemented :

(1) new packaging

(2) revised set-up before launch



Perspectives

- **Step 1**. Find an optimal solution for MODEM M10 GDP certification. We have to take some decisions on :
  - Variables (P, T, U, V)
  - Period (before/after June 2023)
  - Day/Night (solar effect)

  ⇒ **M10 GDP submission before mid of 2024 !**

- **Step 2**. Start the certification for MODEM M20

- Ensure/Monitor the M10 GDP data flow for operationnal sites (TRP, REU, ?).
- Ensure/Monitor the M20 L1 data flow for non-operationnal sites (LIN, PAY, ?).

Questions?

Thank you for your attention