

# Lessons from Mauritius WMO intercomparison and Results of temperature measurement of the aluminized boom sensor of Modem's radiosonde

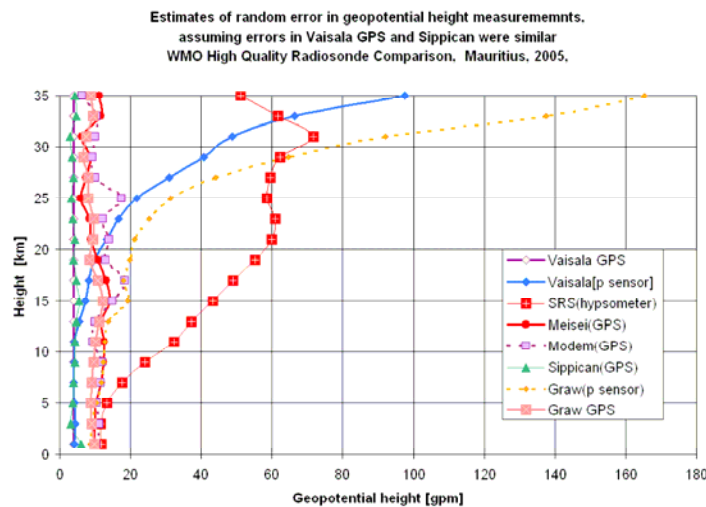
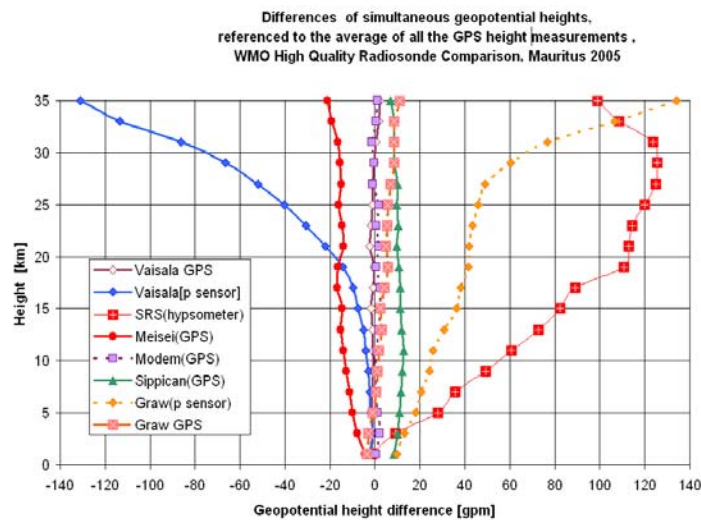
Modem participated to the most recent WMO intercomparison of High Quality GPS radiosondes held at Mauritius in February 2005.

M2K2 radiosonde was judged to merit the designation of High Quality radiosonde, outlining some remarkable performances and accuracy detailed below:

- **Geopotential height measurement**

“The simultaneous height intercomparisons demonstrated that GPS height measurements gave geopotential heights that were more accurate than the best pressure sensors at all heights above 16 km and were of similar accuracy to pressure sensor measurements at heights below 16 km.”

Note: MODEM has been using this method, as a pioneer, since 1997.



Estimated random error of M2K2 is less than 10 m at most heights

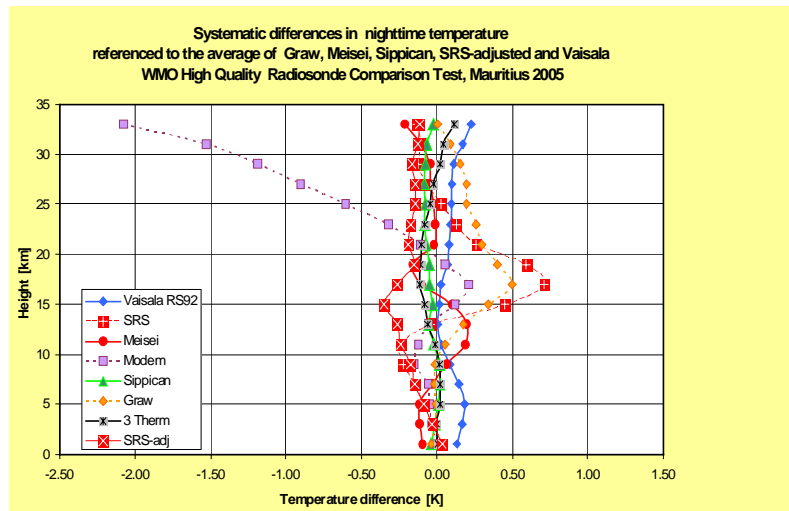
- **Data Availability**

During Mauritius comparison, M2K2 data availability percentage was around 98%. Météo-France reporting on acceptance tests performed on each delivery of radiosondes, regularly shows 100% data availability.

- **Temperature measurement**

Data from Mauritius experimentation have shown a cold bias ( $-1.0^{\circ}\text{C}$ ) of temperature measurement from M2K2 radiosonde when the following conditions were met simultaneously:

- At Night
- Above 25 km



This issue has been deeply discussed with CIMO expert, and it has been concluded that it was due to infrared absorption of the white paint coating of M2K2 sensor boom.

Since we discovered this problem, MODEM has been working hard on this issue. We have tested a lot of different coatings and solutions.

In fact we have to reduce infrared radiation at night without losing the good performance of solar radiation protection provided by the white paint during the day.

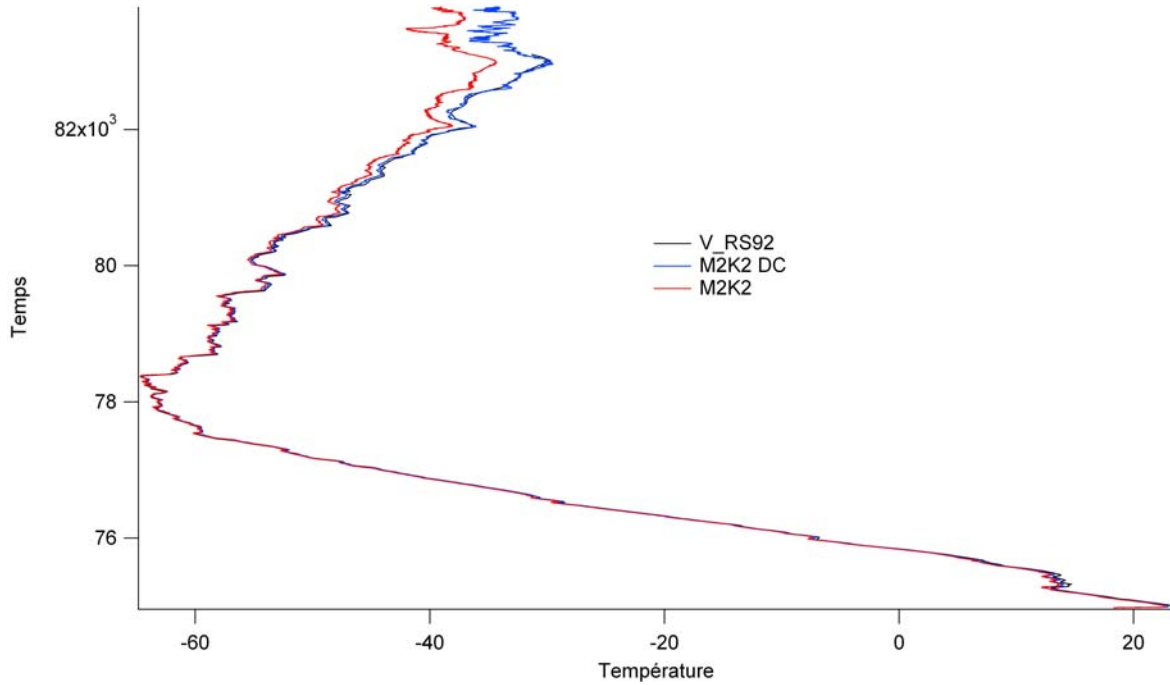
Finally, we have designed a new sensor boom with the following improvements:

- Replacement of the white paint by a varnish coating and vacuum metallization of the boom end
- Modification of the boom end shape in order to reduce solar radiation influence close to the temperature sensor

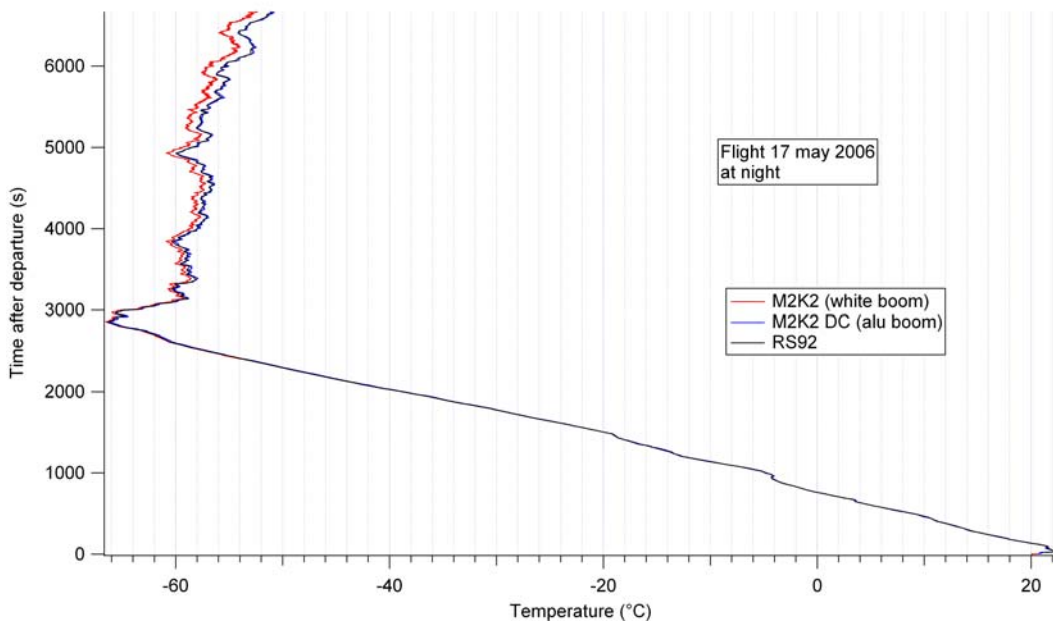


Above improvements give the results presented below:

**At night**

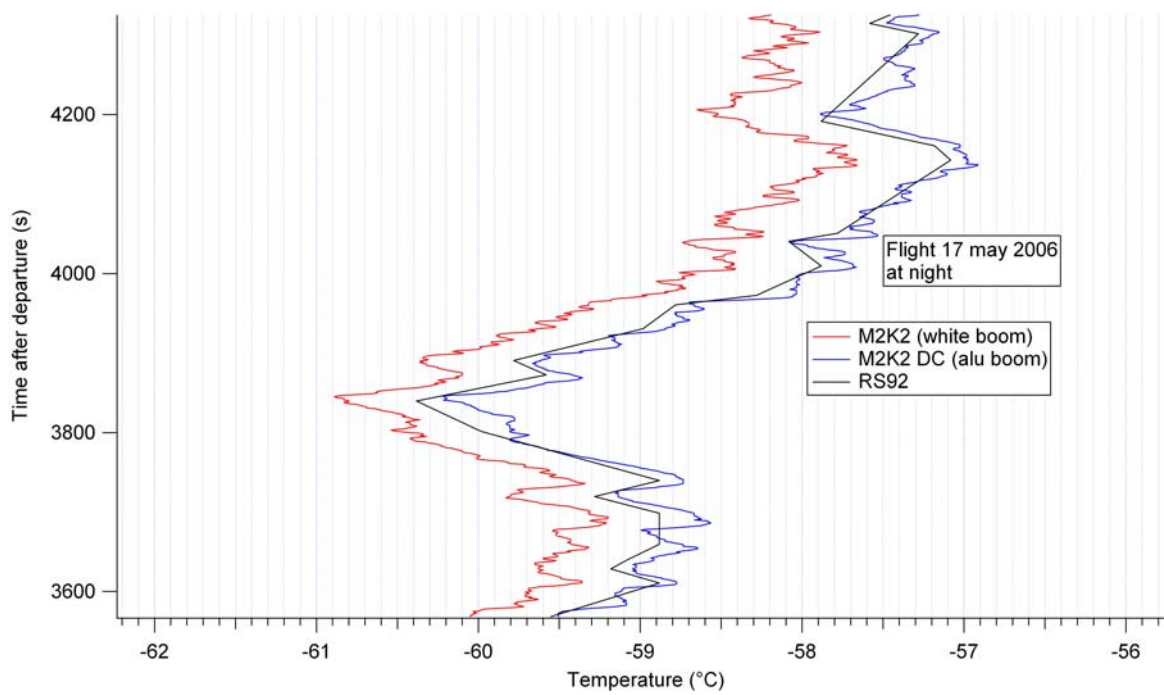


Night flight on September 5th 2006 - Chevannes, France : Cold bias between RS92 and M2K2 is shown while M2K2-DC and RS92 are very close.

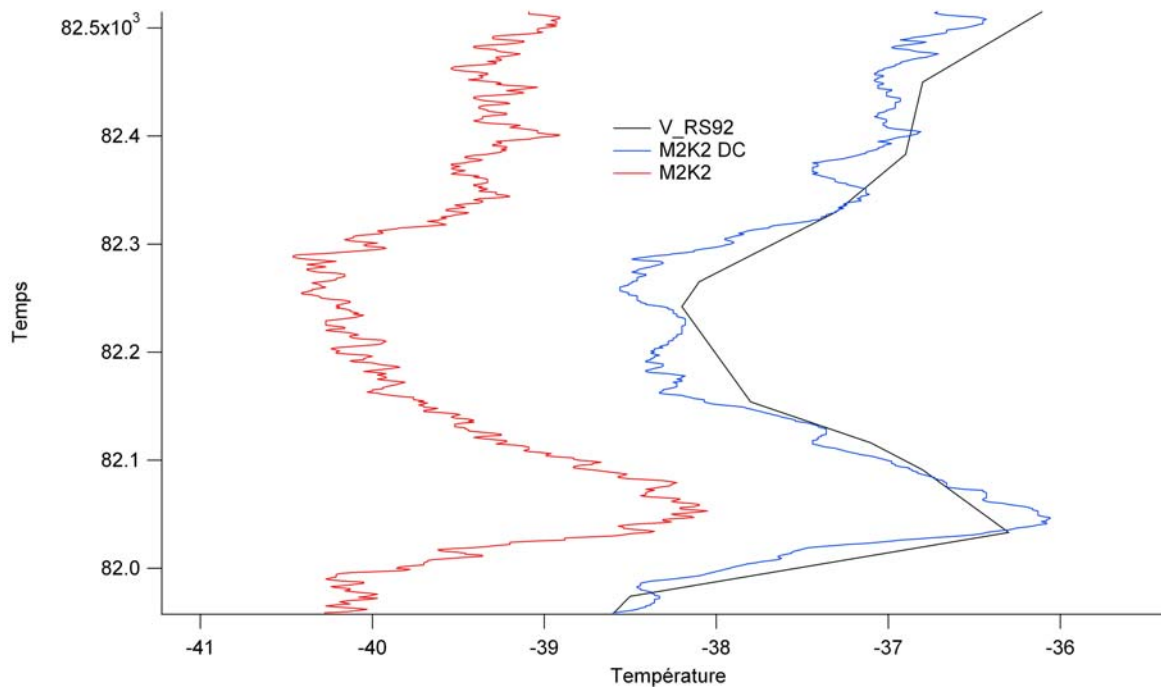


Similar situation for this night flight on May 17<sup>th</sup> 2006 – Chevannes , France

We can also see on the graphs below that noise due to the balloon pendulum and turbulence around the sensor are better than with the previous boom end shape of the M2K2

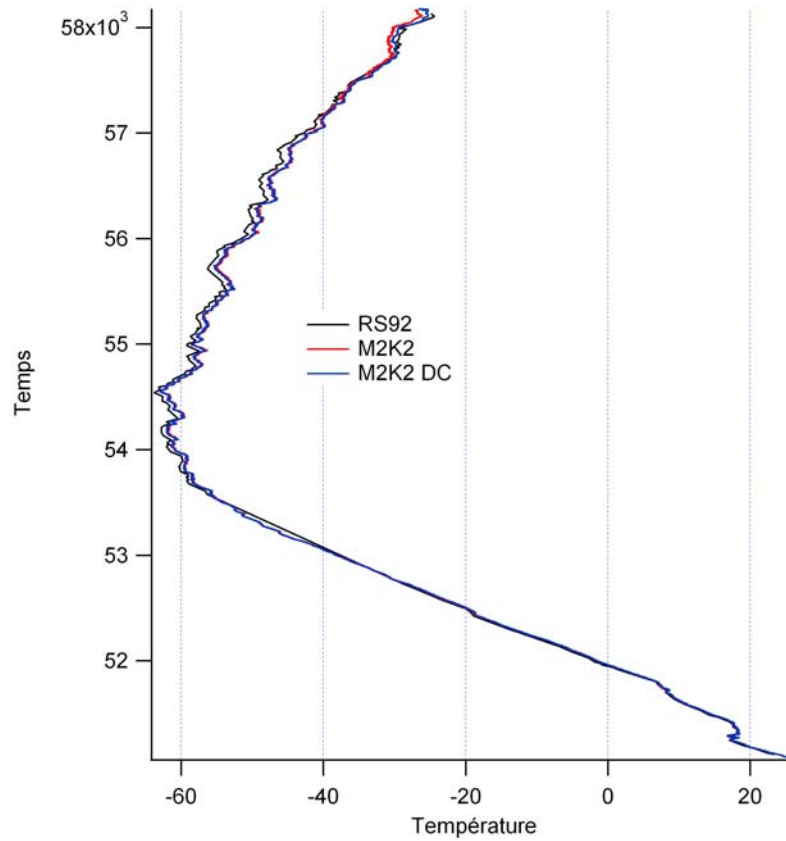


Night flight on May 17<sup>th</sup> 2006 – Chevannes , France

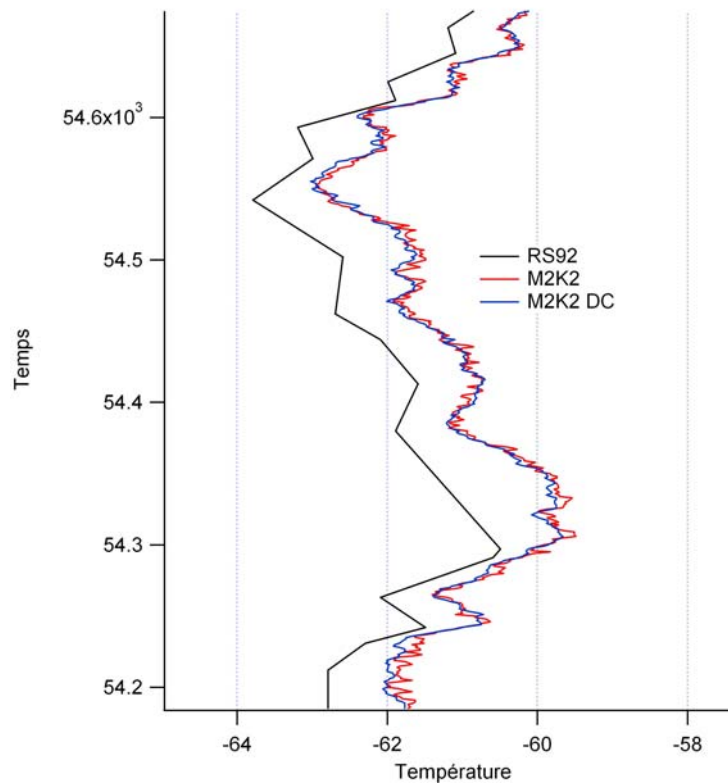


Night flight on September 5th 2006 - Chevannes, France

## During the day



Day flight on September 5th 2006 - Chevannes, France



Details – Day flight on September 5th 2006 - Chevannes, France

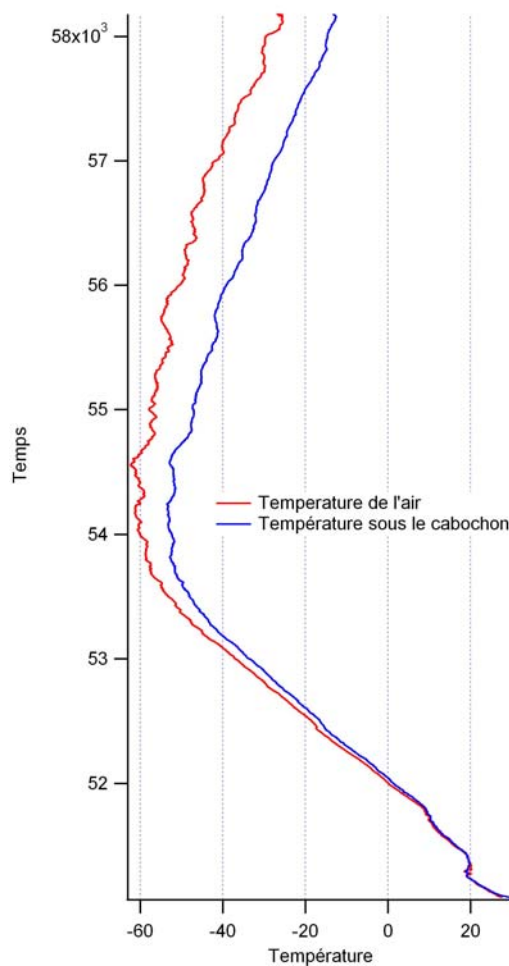
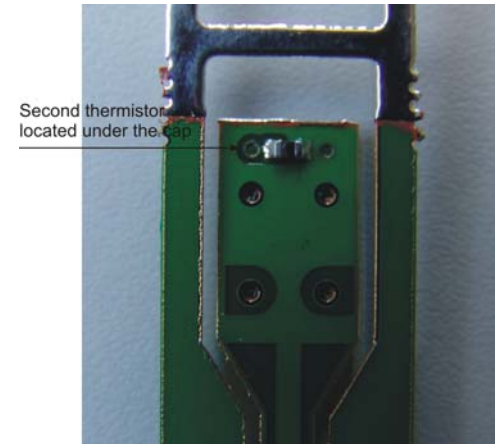
During the day, M2K2 et M2K2-DC measurements are similar (less noise with the new boom) and close to RS92

- **Relative humidity measurement**

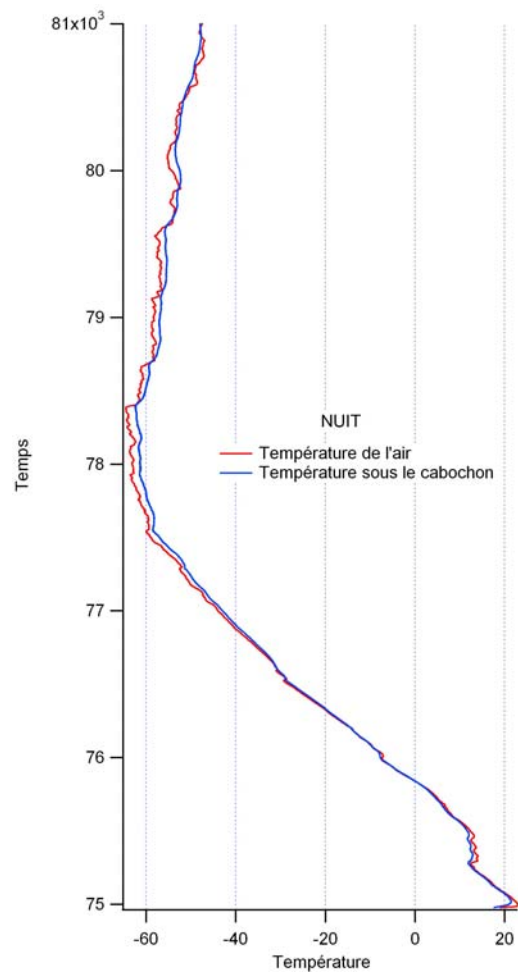
RH measurement from M2K2 were acceptable however there was still room to make improvement.

Following the experimentation and according to results, we have brought following changes:

- Addition of a second thermistor under the cap
- Different positioning of the cap allowing a better ventilation of the sensor



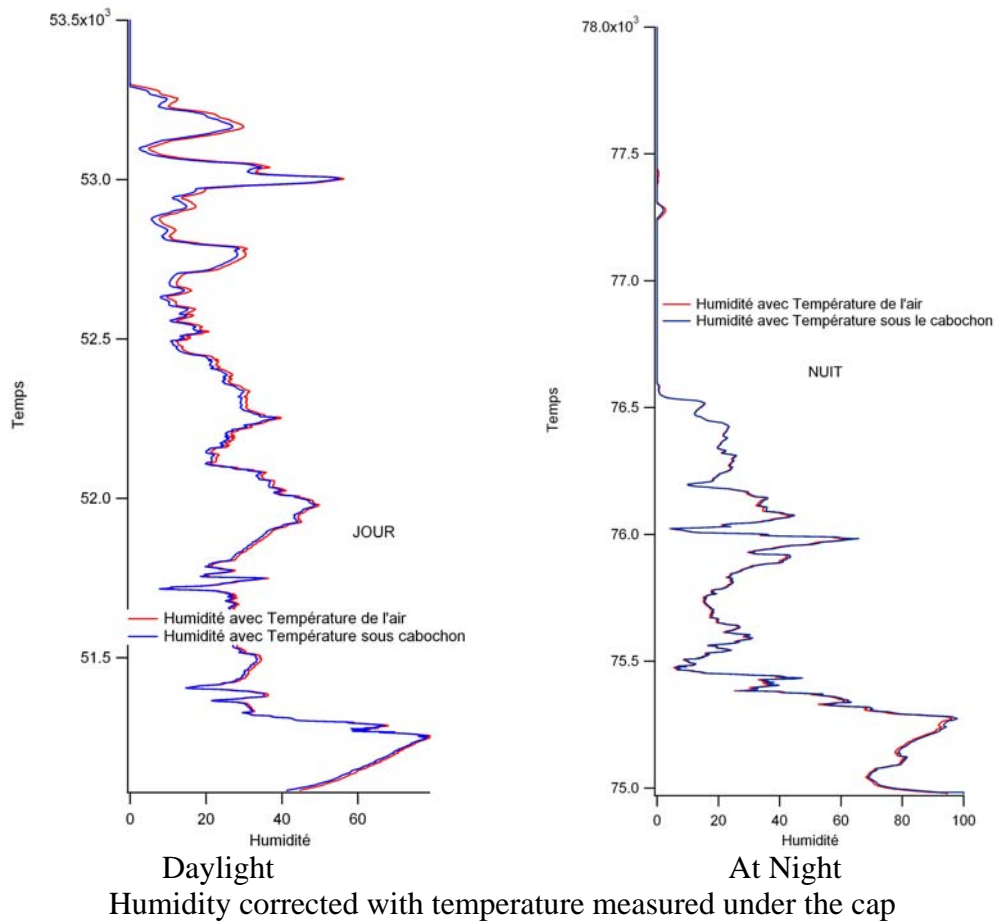
Daylight



At Night

Comparison of air temperature against temperature measured under the cap

During daylight flight, air temperature and temperature under the cap is significantly different. Thus, it is preferable to take into account the actual temperature close to the RH sensor (under the cap) in the calculation of relative humidity, even if this parameter has only a small influence on the result.



Humidity corrected with temperature measured under the cap

## **ADDITIONAL TESTS**

After our own tests, M2K2-DC is presently deeply tested by Meteo-France in the scope of an international tendering procedure. Results and official report would be available early 2007.

According to CIMO recommendation, it is also scheduled to evaluate the M2K2-DC at Camborne, the UK Met-Office's test station.