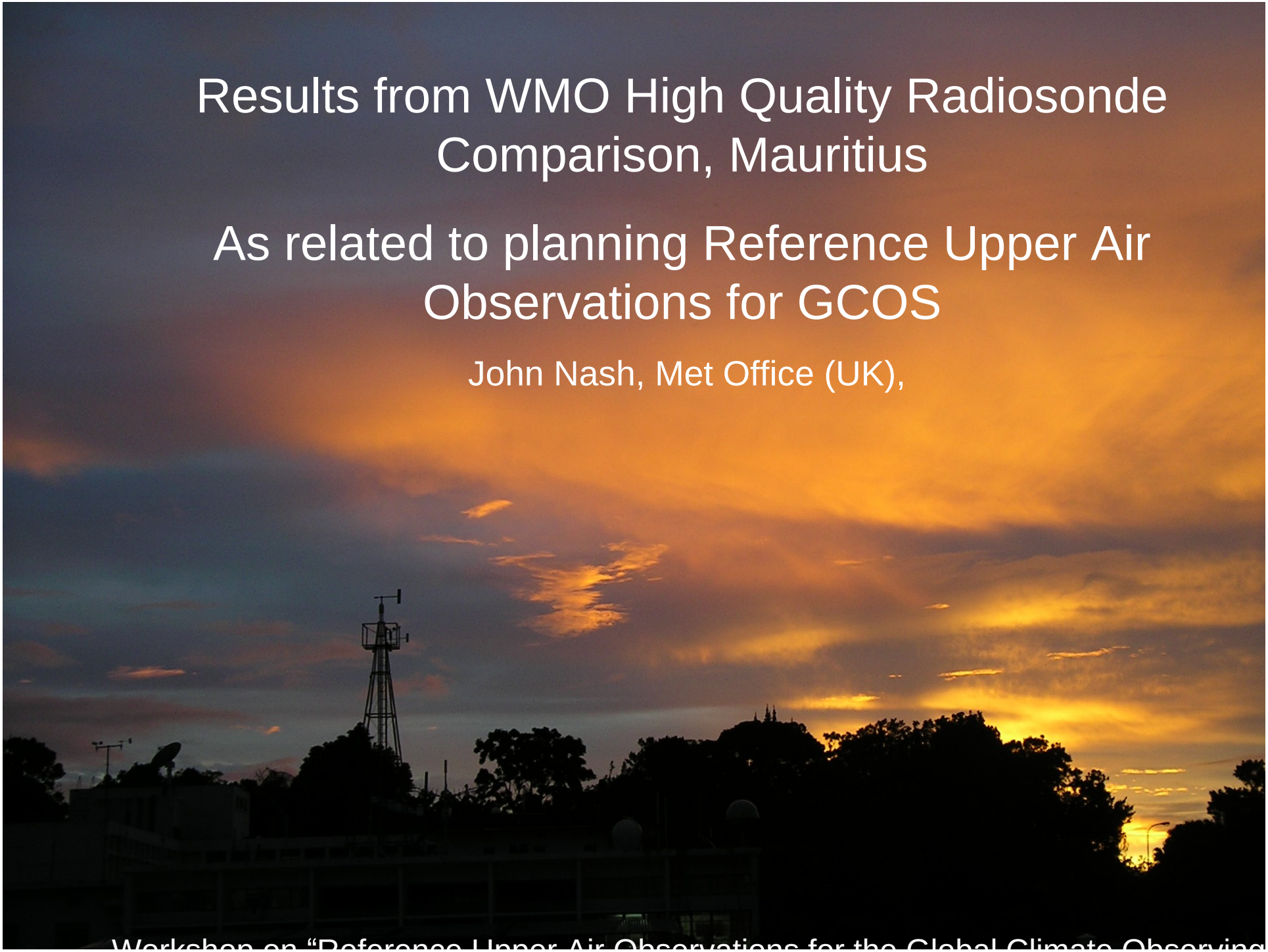
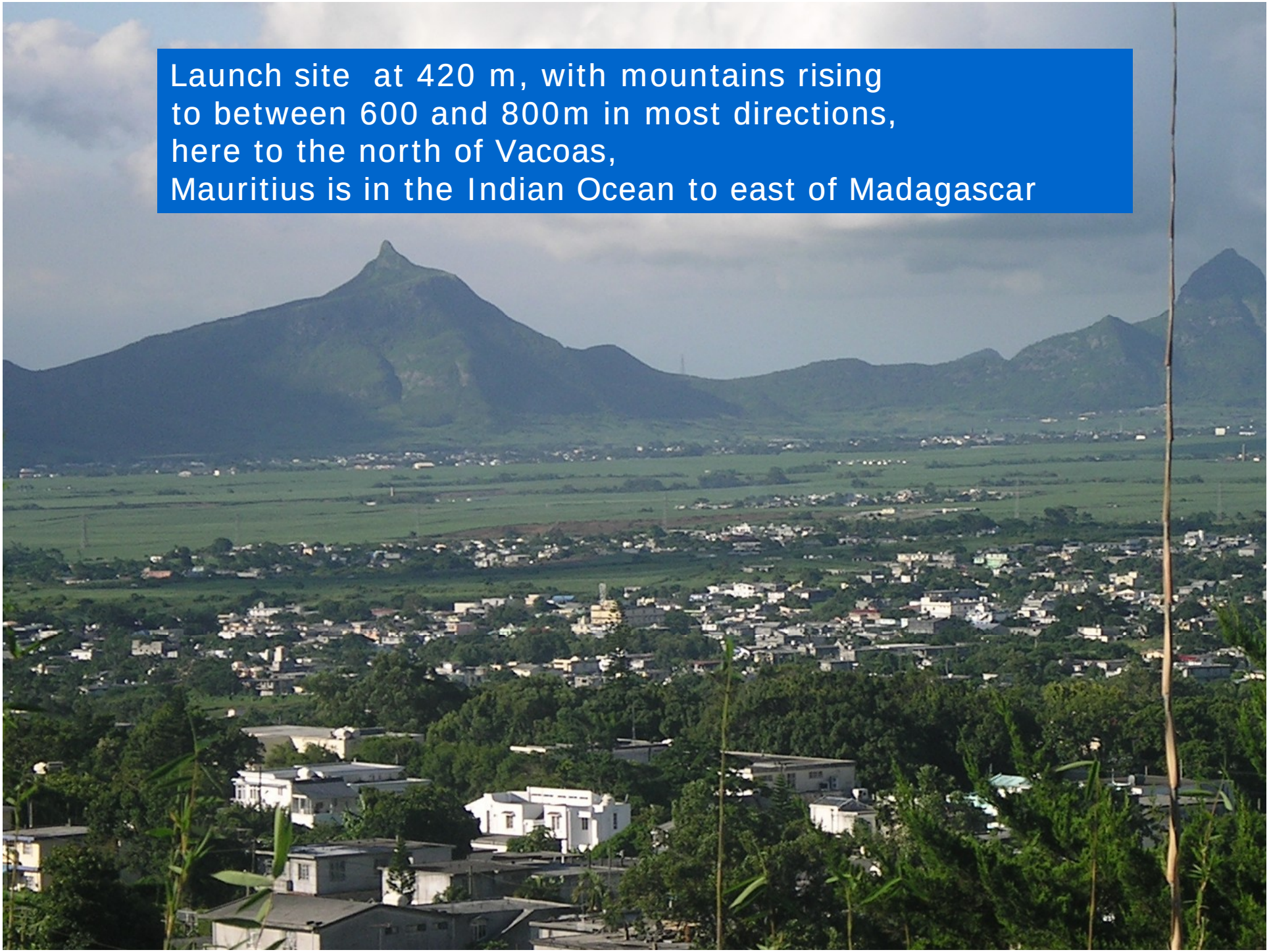


Results from WMO High Quality Radiosonde Comparison, Mauritius

As related to planning Reference Upper Air Observations for GCOS

John Nash, Met Office (UK),


Launch site at 420 m, with mountains rising
to between 600 and 800m in most directions,
here to the north of Vacoas,
Mauritius is in the Indian Ocean to east of Madagascar

Vacoas market,
Climate of Mauritius in the rainy season is similar to near the equator.

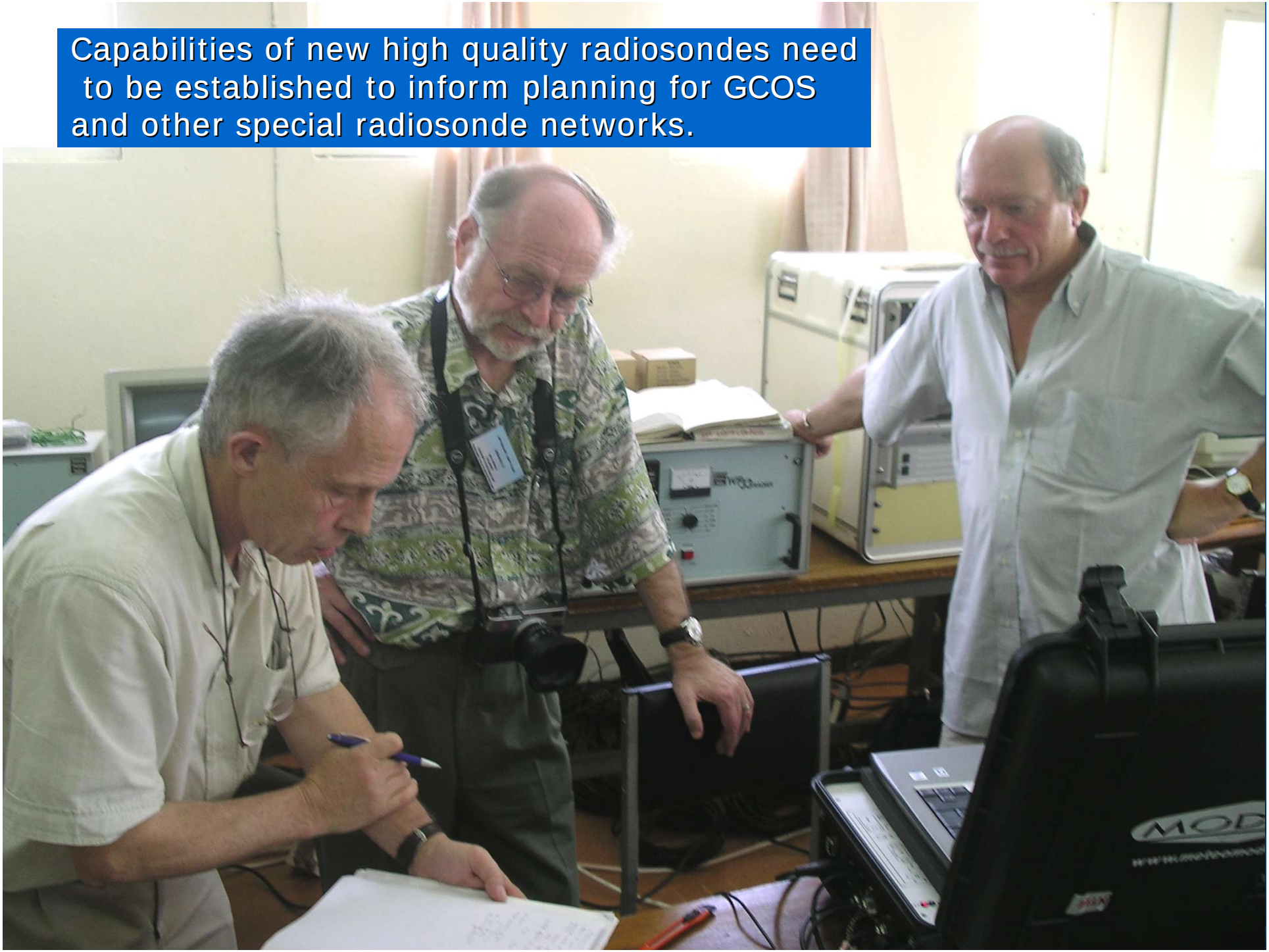
Test held at Mauritius Meteorological Services Headquarters,Vacoas 7 - 26 February 2005

Background to Mauritius test

- Solutions to GPS windfinding problems tested in Brazil in the previous comparison have now been implemented on most commercially available designs of radiosondes

- New generation of radiosondes will change characteristics of GOS radiosonde network

Capabilities of new high quality radiosondes need to be established to inform planning for GCOS and other special radiosonde networks.



Testing in the tropics to ensure radiosondes function in the more extreme environments required for GCOS.


Errors in new radiosonde designs need to be detected and corrected before widespread use of radiosondes starts.

Radiosondes used

- Vaisala RS92, pressure sensor + GPS height
- Graw DFM 97, pressure sensor + GPS height
- Modem M2K2, GPS height
- Lockheed Martin Sippican LMS -5 GPS height
- Meisei RS-01G GPS height
- Meteolabor, SRS-C34, pressure sensor
- +Snow White chilled mirror hygrometer [special]
- Sippican MKII, 3 thermistor radiosonde [special]


Up to 20 local staff supporting operations by day


and by night

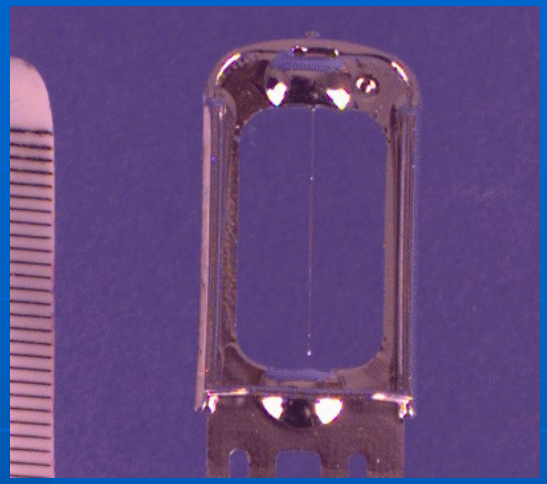
Management team + Met Service Technicians worked together to develop Balloon filling and Launch techniques suitable to local conditions

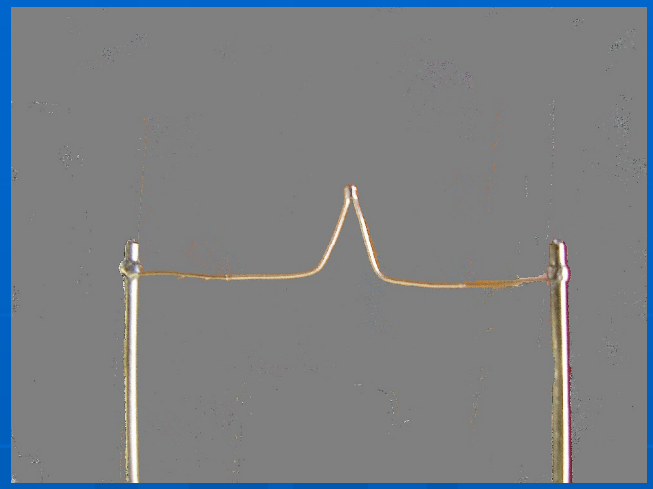
Hydrogen generator required supply of Purified water, Not always available At all locations??

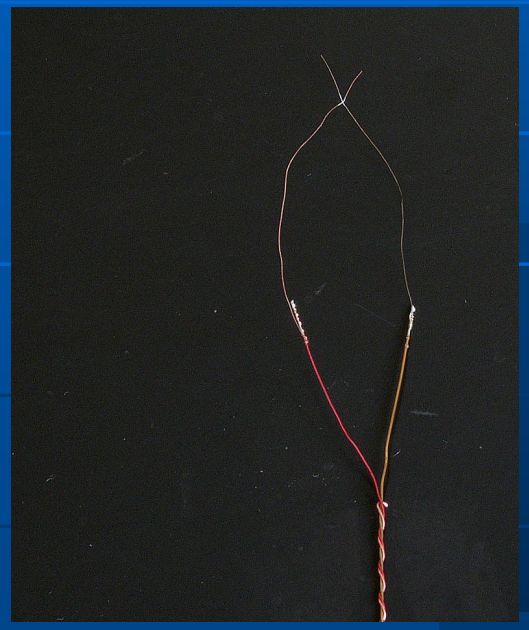
Temperature

A long-term stability of temperature measurement at night of ±0.1 K is potentially achievable.

The small differences between the temperature measurements of most of the radiosondes, see next slide ,indicates that many of the operational radiosondes were close to achieving the accuracy desired for long term climate monitoring.







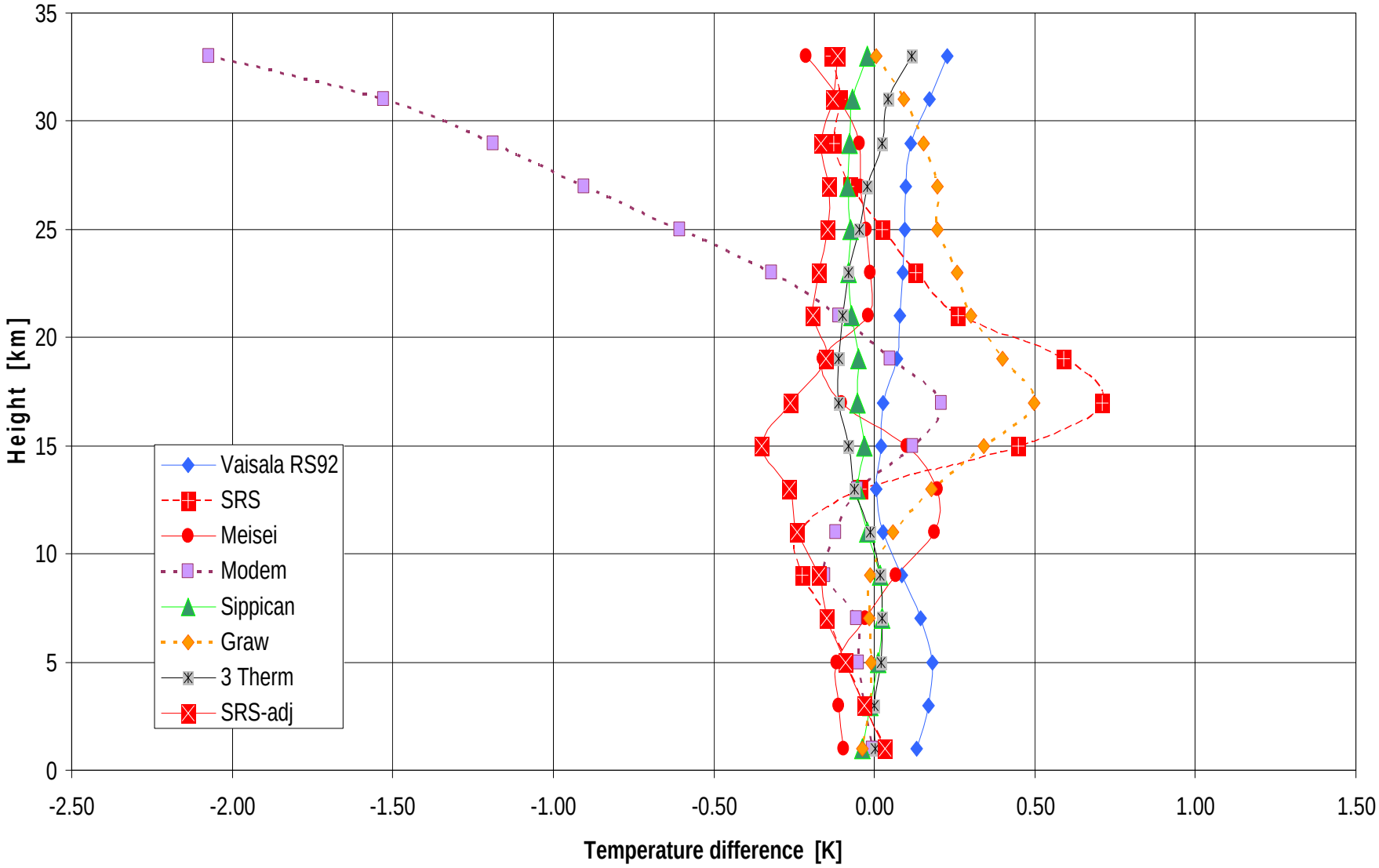
Temperature sensors in Mauritius

Daytime Temperature

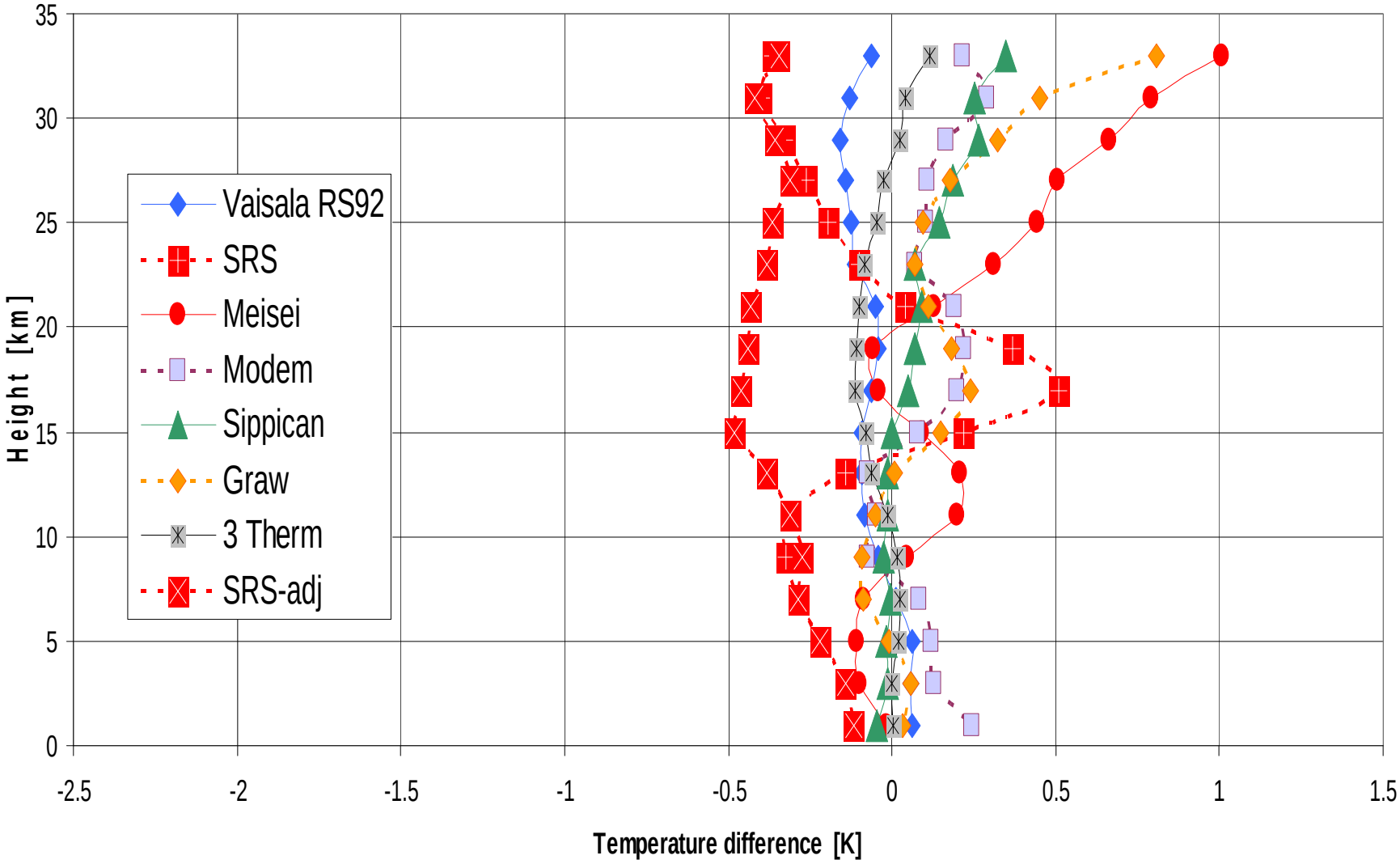
However, only one radiosonde design had temperature sensor exposure in the daytime that should ensure the best accuracy for daytime measurements at the highest altitudes in the stratosphere.

There is still further room for improvement in daytime measurement quality for nearly all the daytime temperature measurements

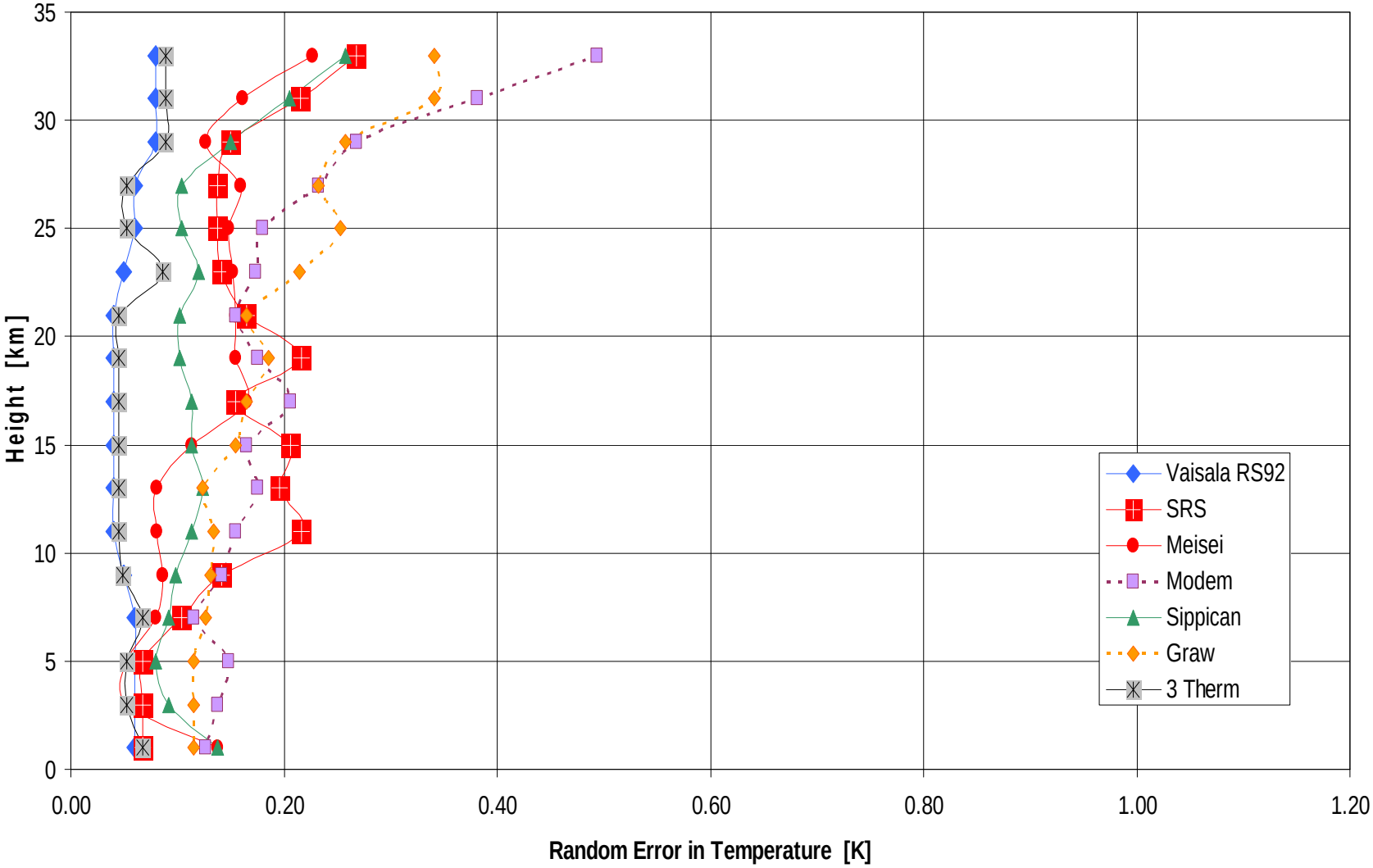
Systematic differences in nighttime temperature
referenced to the average of Graw, Meisei, Sippican, SRS-adjusted and Vaisala
WMO High Quality Radiosonde Comparison Test, Mauritius 2005



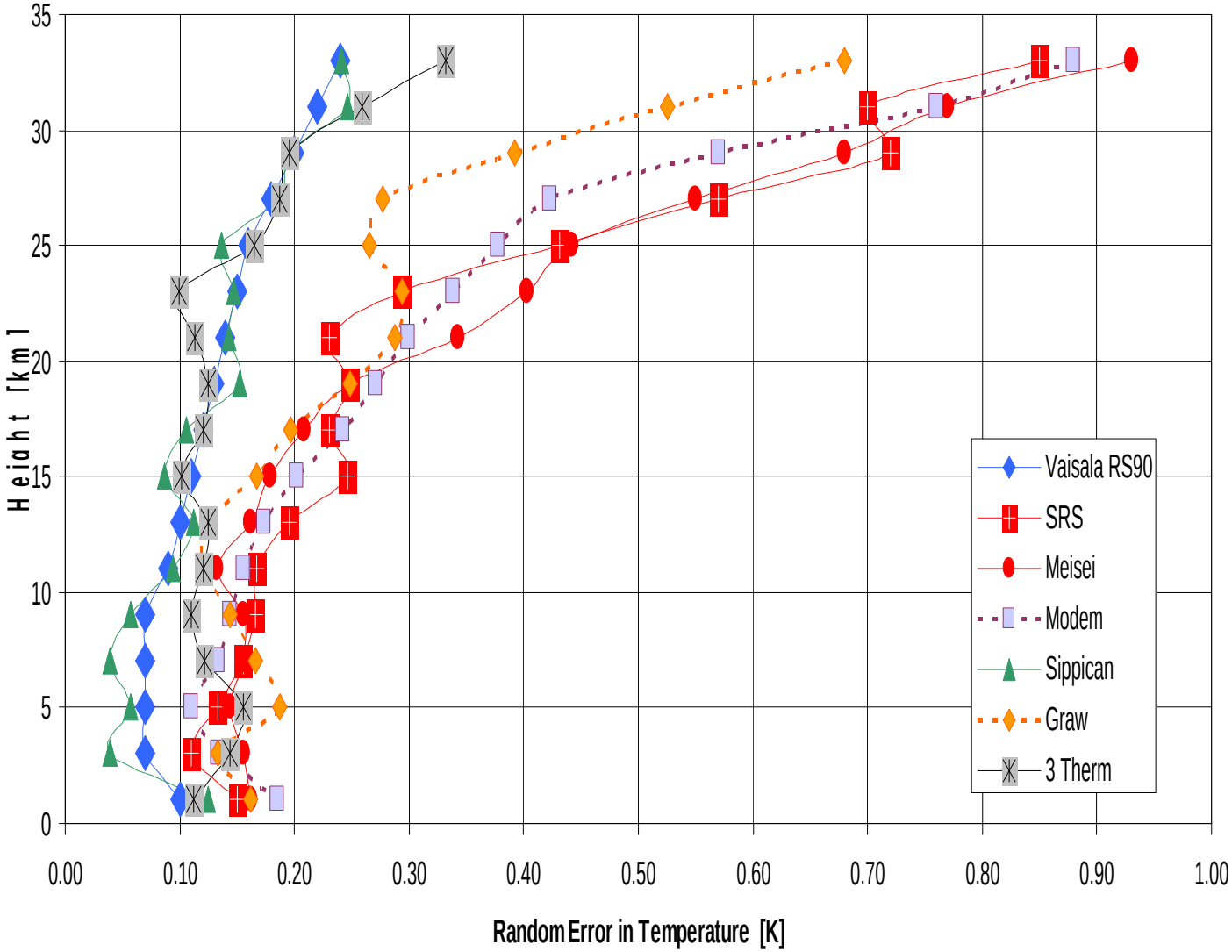
Systematic differences in daytime temperature referenced to the nighttime reference using 3 thermistor measurements,
WMO High Quality Radiosonde Comparison Test, Mauritius, 2005



Estimated random errors in nighttime temperature measurements, WMO High Quality Radiosonde Comparison, Mauritius 2005, assuming Vaisala random errors were as shown



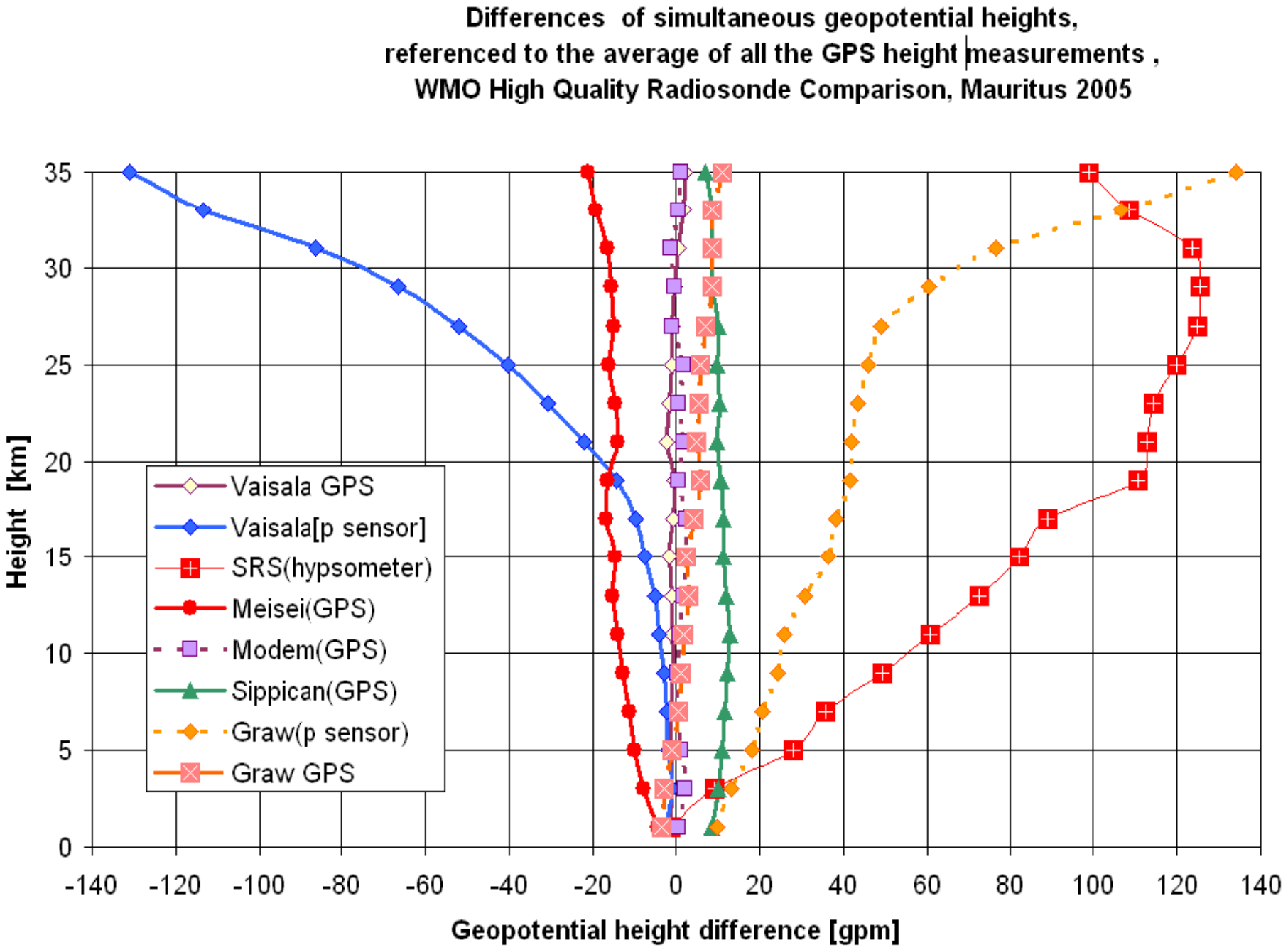
Estimated random errors in daytime temperature measurements, WMO High Quality Radiosonde Comparison, Mauritius, 2005 assuming Vaisala errors were as shown



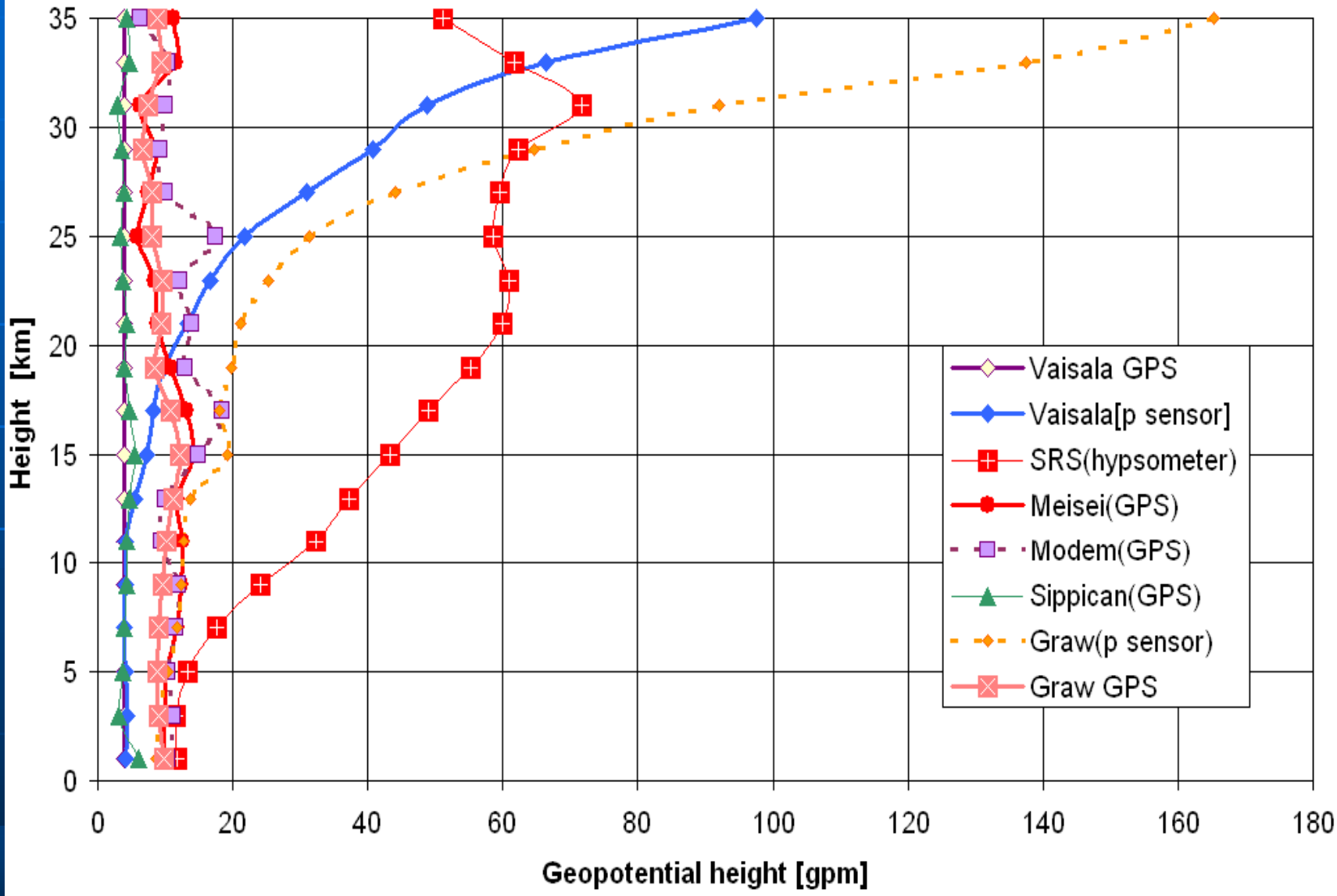
Pressure sensor errors have always limited the heights to which very stable temperatures could be reported.

In this test, the GPS radiosondes have demonstrated that height assignment no longer needs to be a limitation on the heights to which radiosondes can usefully be used.

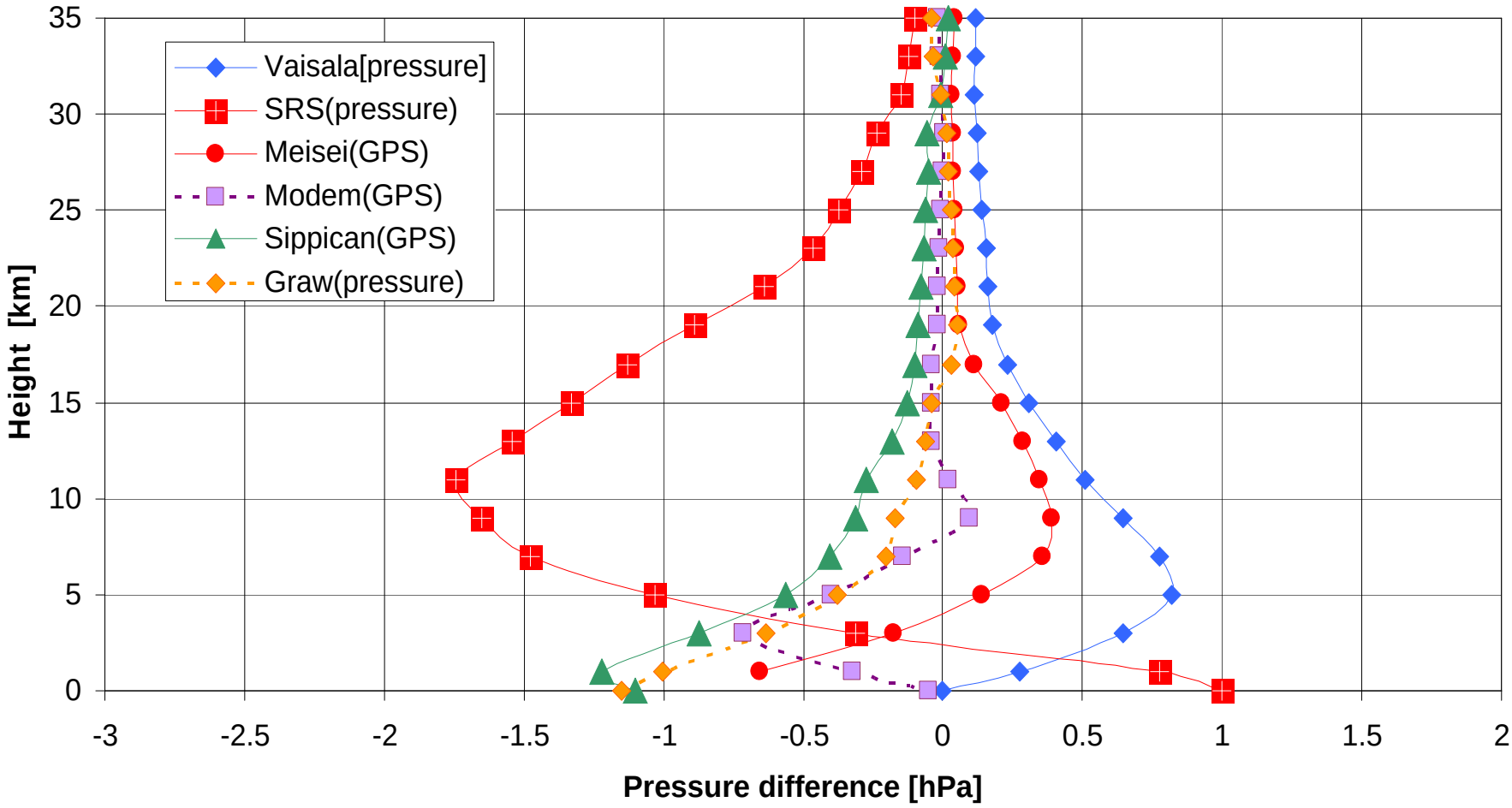
Thus, reproducible heights with good long term stability should be possible with GPS radiosondes up to at least 40 km, given that the radiosonde batteries can sustain the longer flight duration.


Differences of simultaneous geopotential heights,
referenced to the average of all the GPS height measurements ,
WMO High Quality Radiosonde Comparison, Mauritus 2005
Height [km]
35
30
25
20
15
10
5
0
-140
-120
-100
-80
-60
-40
-20
0
20
40
60
80
100
120
140
Geopotential height difference [gpm]
Vaisala GPS
Vaisala[p sensor]
SRS(hypsometer)
Meisei(GPS)
Modem(GPS)
Sippican(GPS)
Graw(p sensor)
Graw GPS

Estimates of random error in geopotential height measurememnts,
assuming errors in Vaisala GPS and Sippican were similar
WMO High Quality Radiosonde Comparison, Mauritius, 2005,



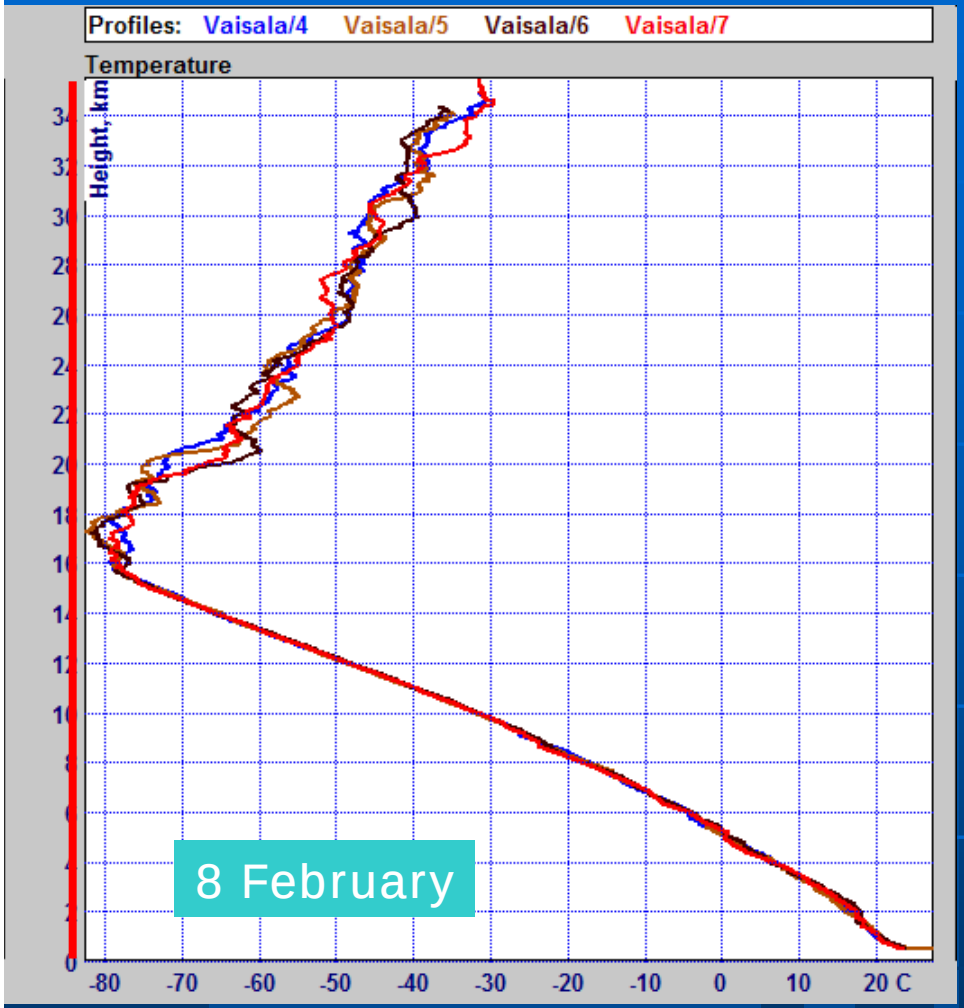
Systematic differences in pressure sensor measurements referenced to the average of the GPS radiosondes at upper levels and the correct fit to surface pressure near the surface, WMO High Quality Radiosonde Comparison, Mauritius

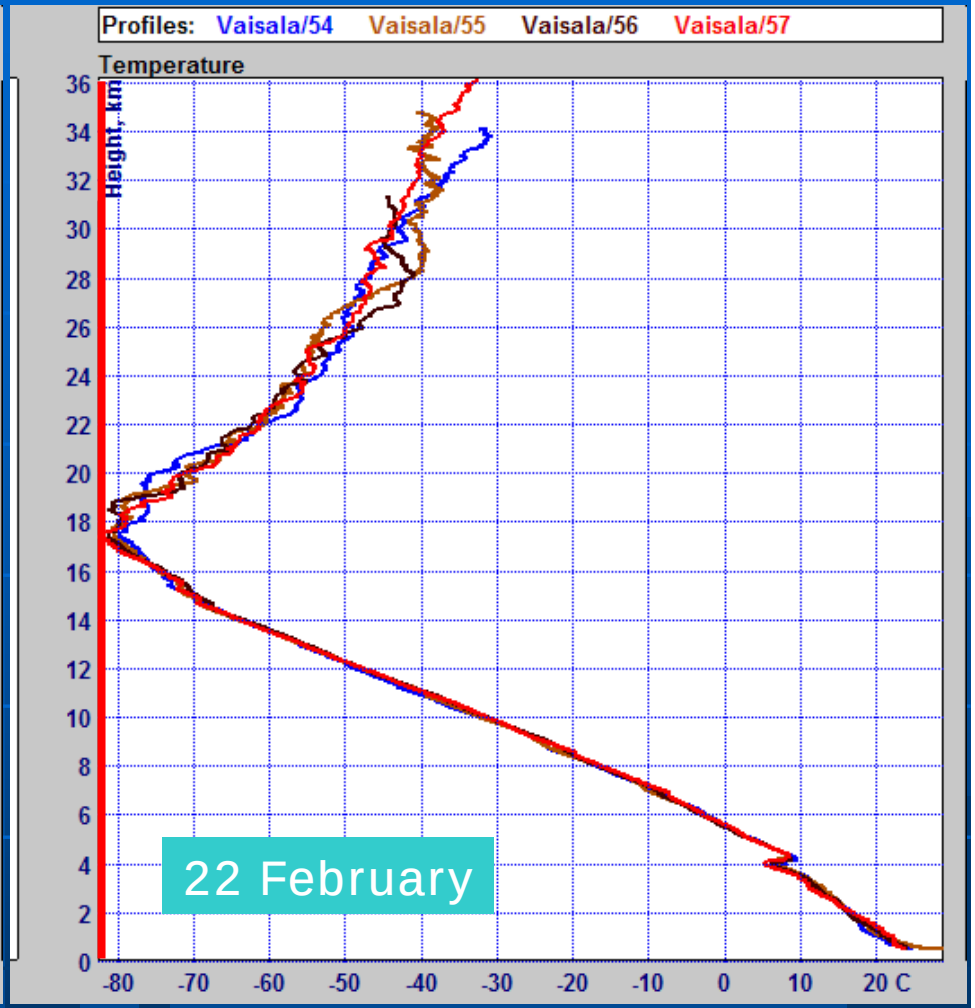


The limitations imposed on each radiosonde sample by small-scale motions in the tropics can be illustrated by plotting all the temperature and humidity observations for one day as a function of height.

Results for Vaisala measurements
on February 8 2005
and February 22 2005
are shown for temperature in the next slide.

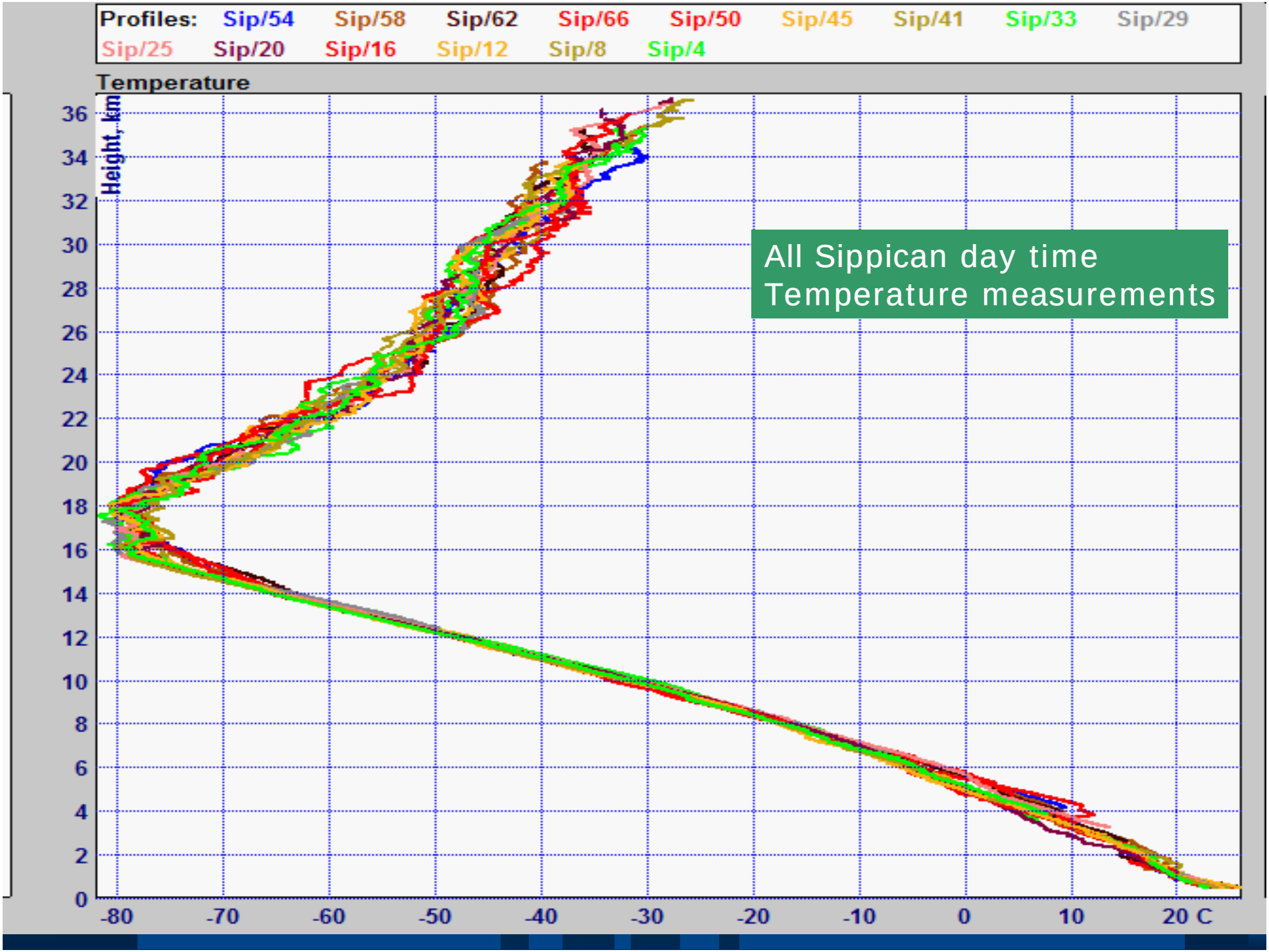
There were no significant synoptic changes near Mauritius on 8 February and some small changes in tropospheric winds on 22 February





Comparison of four radiosonde temperature measurements within 14 hours, demonstrating the influence of small scale atmospheric motions in the stratosphere.

The influence of atmospheric variability on averages over longer time scales can be seen in the following example from the different radiosonde types in Mauritius:


Profiles: Sip/54 Sip/58 Sip/62 Sip/66 Sip/50 Sip/45 Sip/41 Sip/33 Sip/29
Sip/25 Sip/20 Sip/16 Sip/12 Sip/8 Sip/4
Temperature
Height, km
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
-80 -70 -60 -50 -40 -30 -20 -10 0 10 20 C
All Sippican day time
Temperature measurements