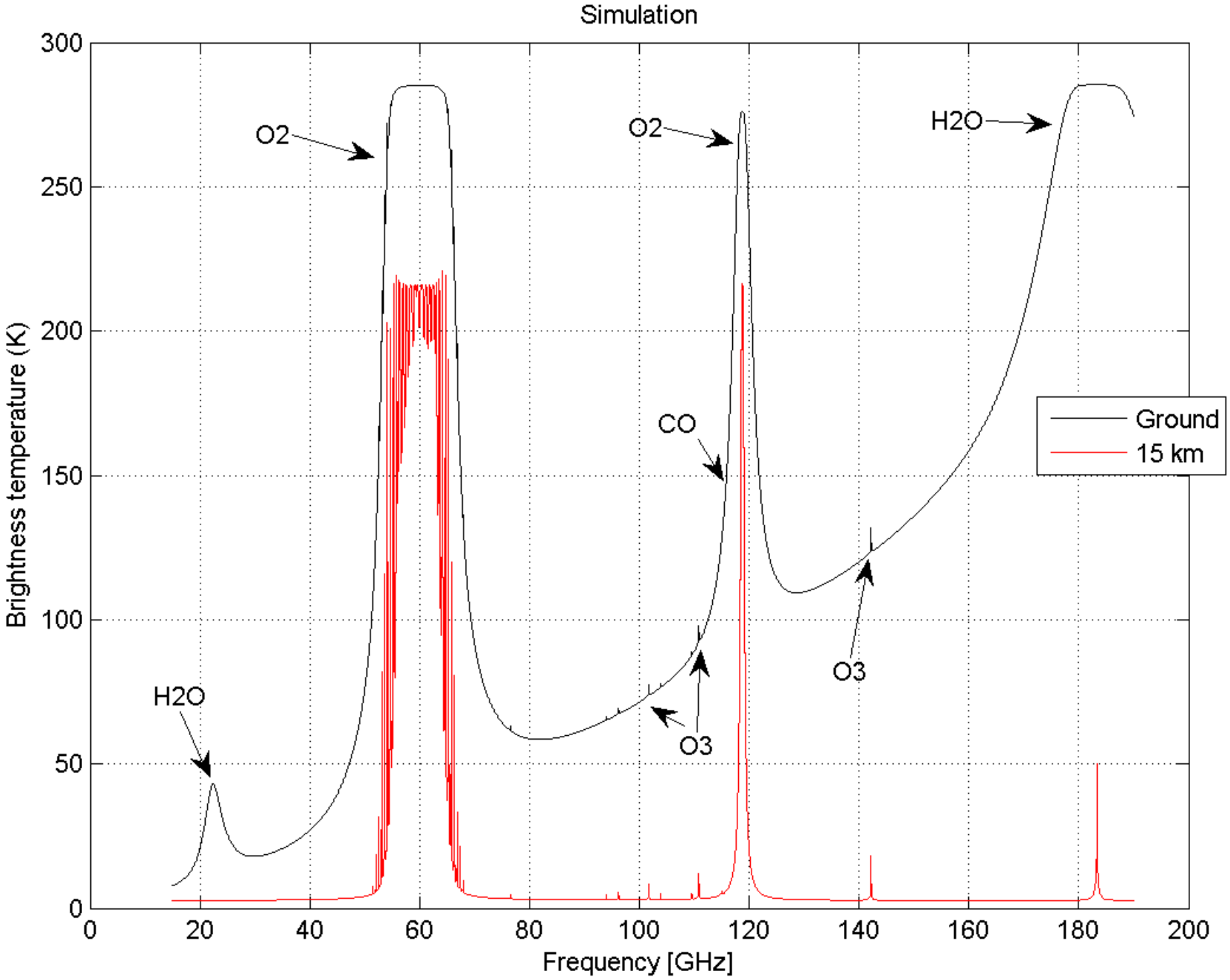
Ground-based measurements of mesospheric CO, H_2O and O_3 using microwave radiometry at Onsala Space Observatory

ARTS workshop June 9 2014

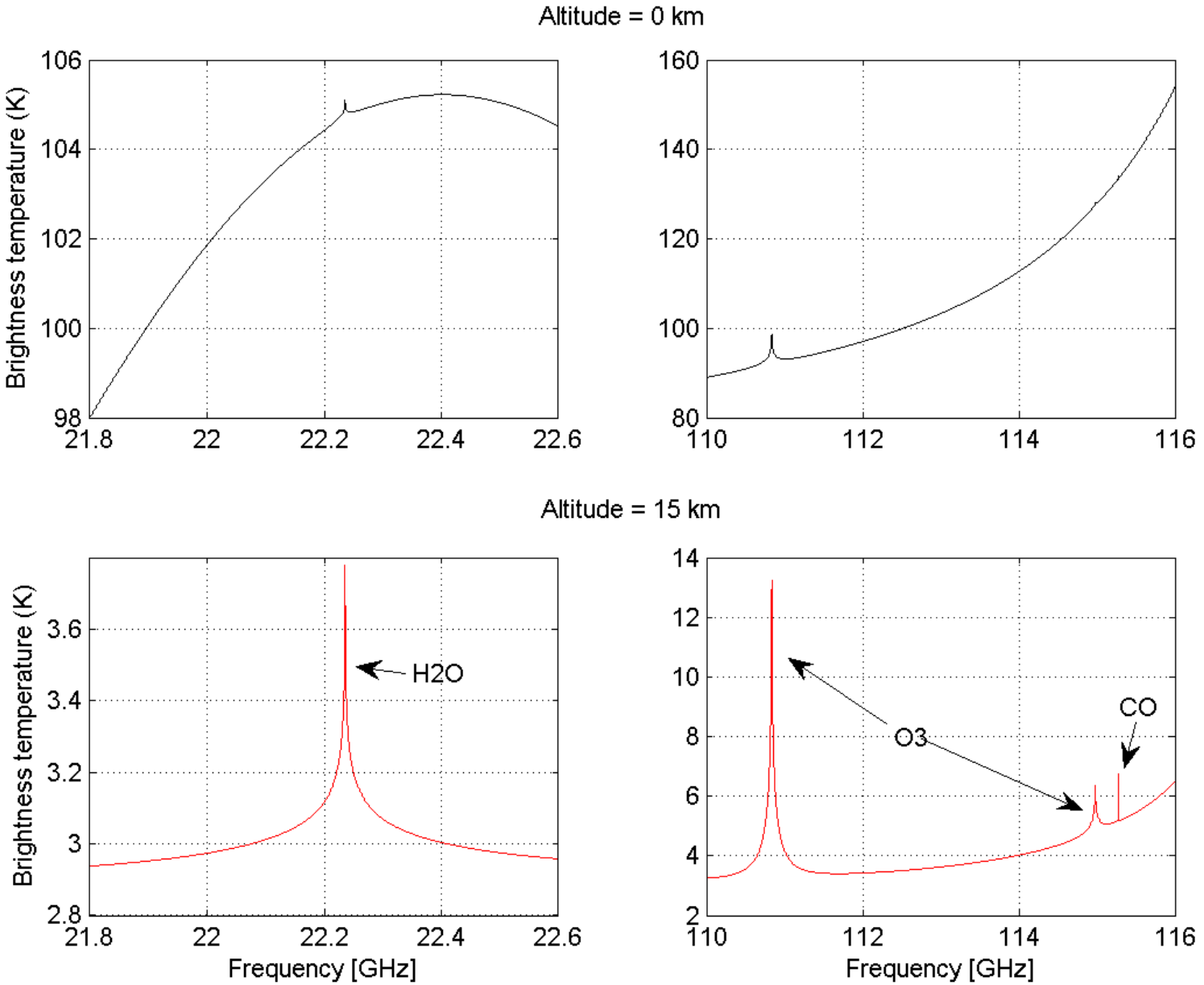
Peter Forkman
Global Environmental Measurements and Modeling
Department of Earth and Space Science

Introduction
Our instruments
Results

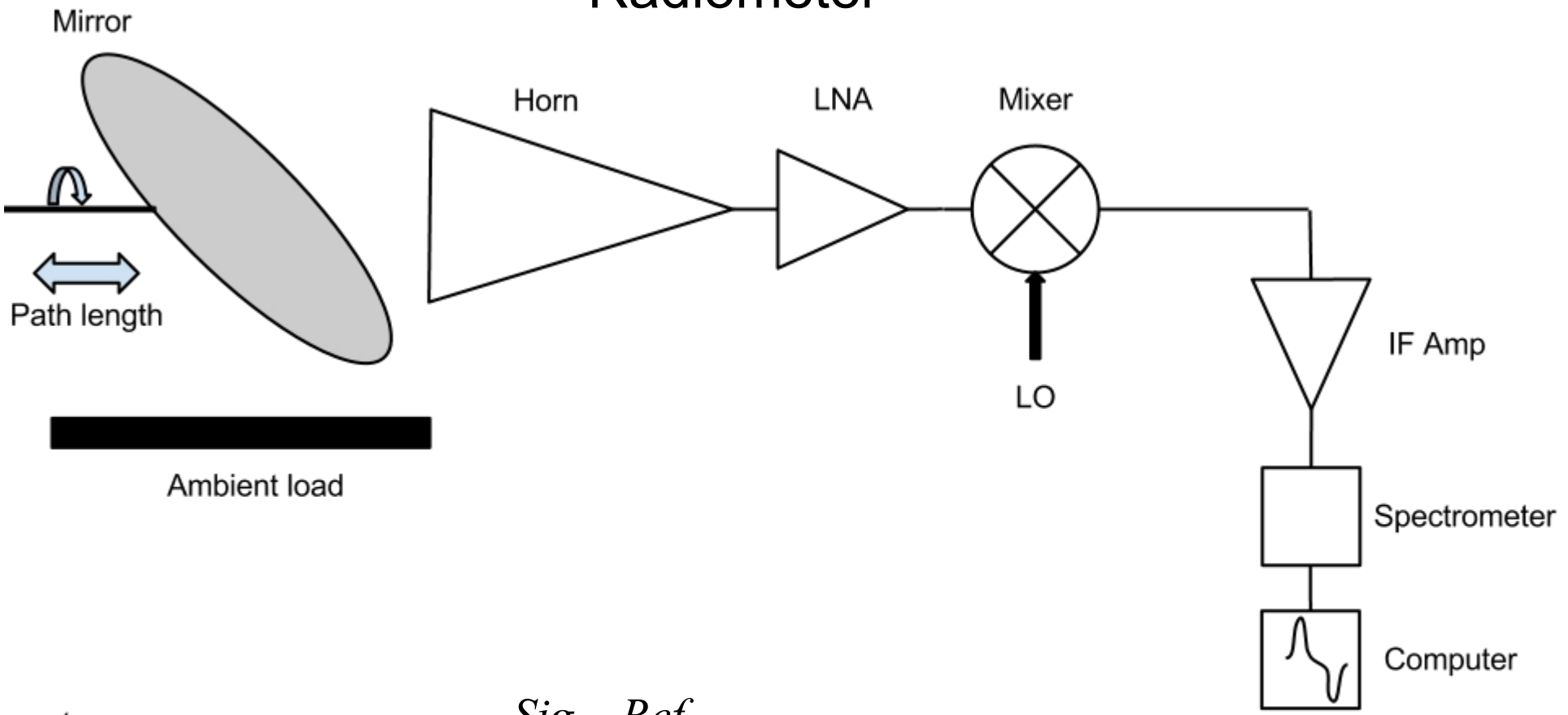
Atmospheric emission 20-180 GHz



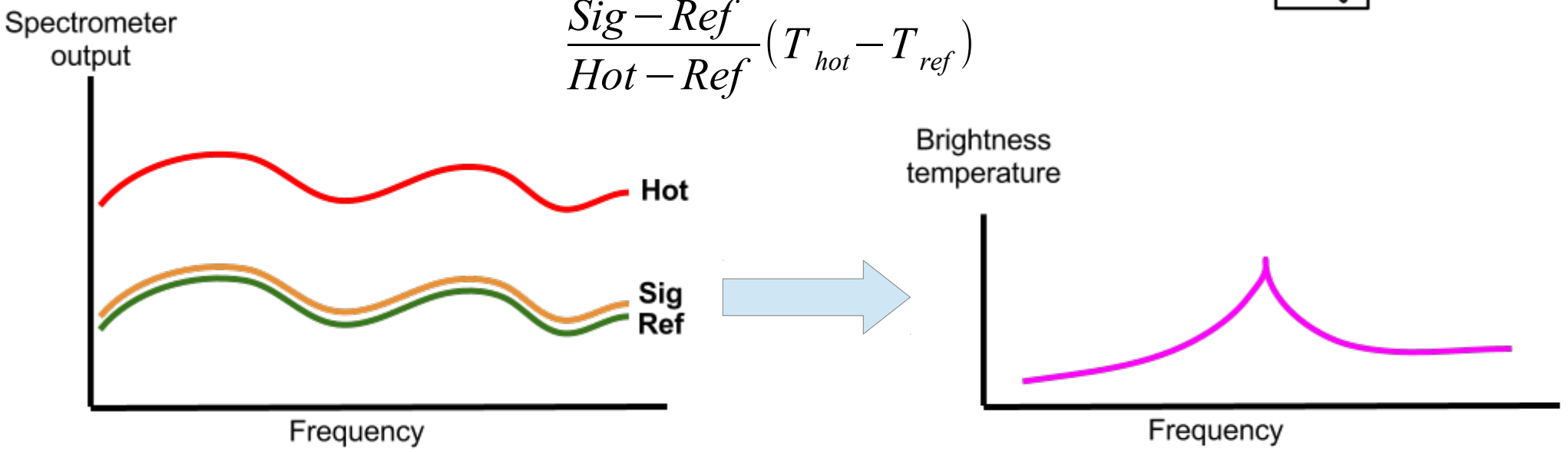
H_2O at 22.2 GHz, O_3 at 110.8 GHz and CO at 115.2 GHz



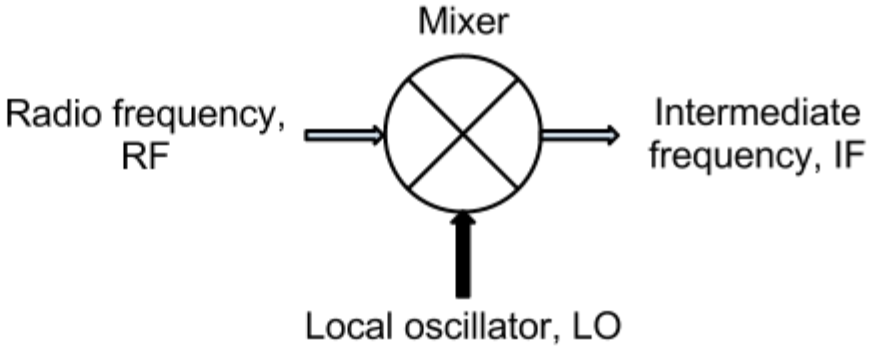
Radiometer

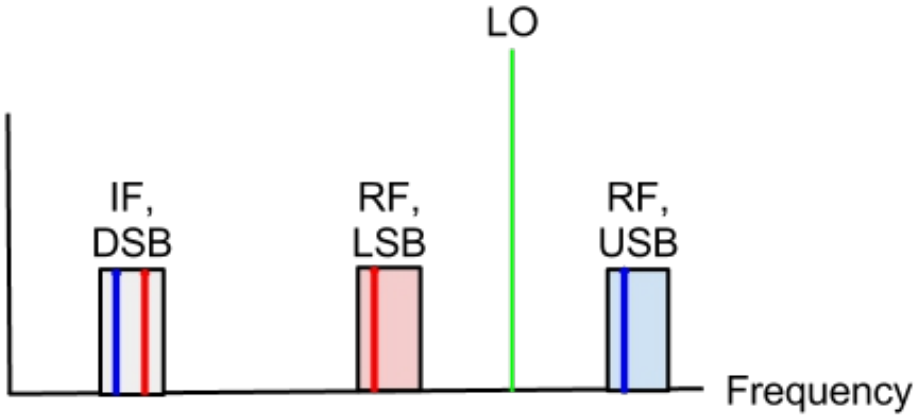


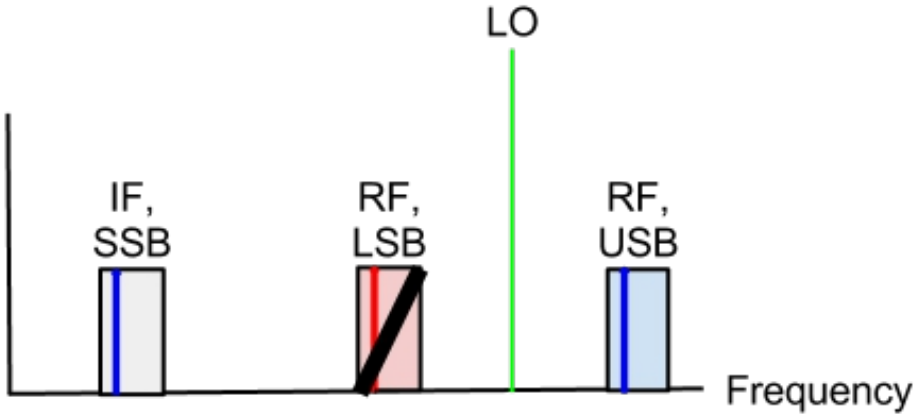
$$\frac{Sig - Ref}{Hot - Ref}\left(T_{hot} - T_{ref}\right)$$

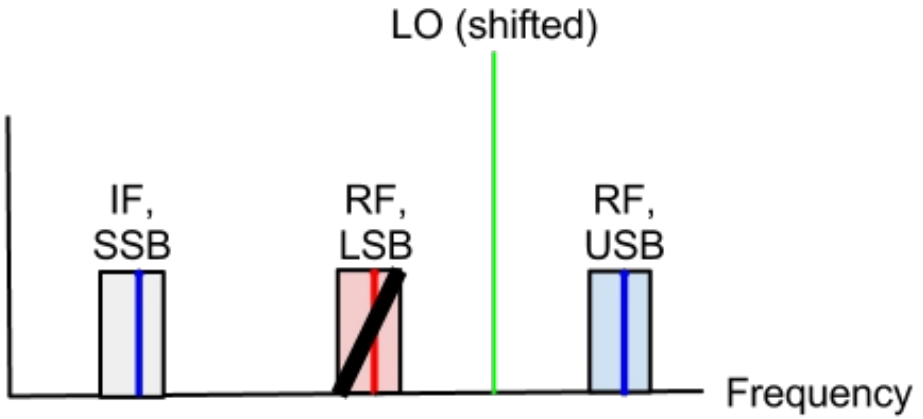


The heterodyne receiver

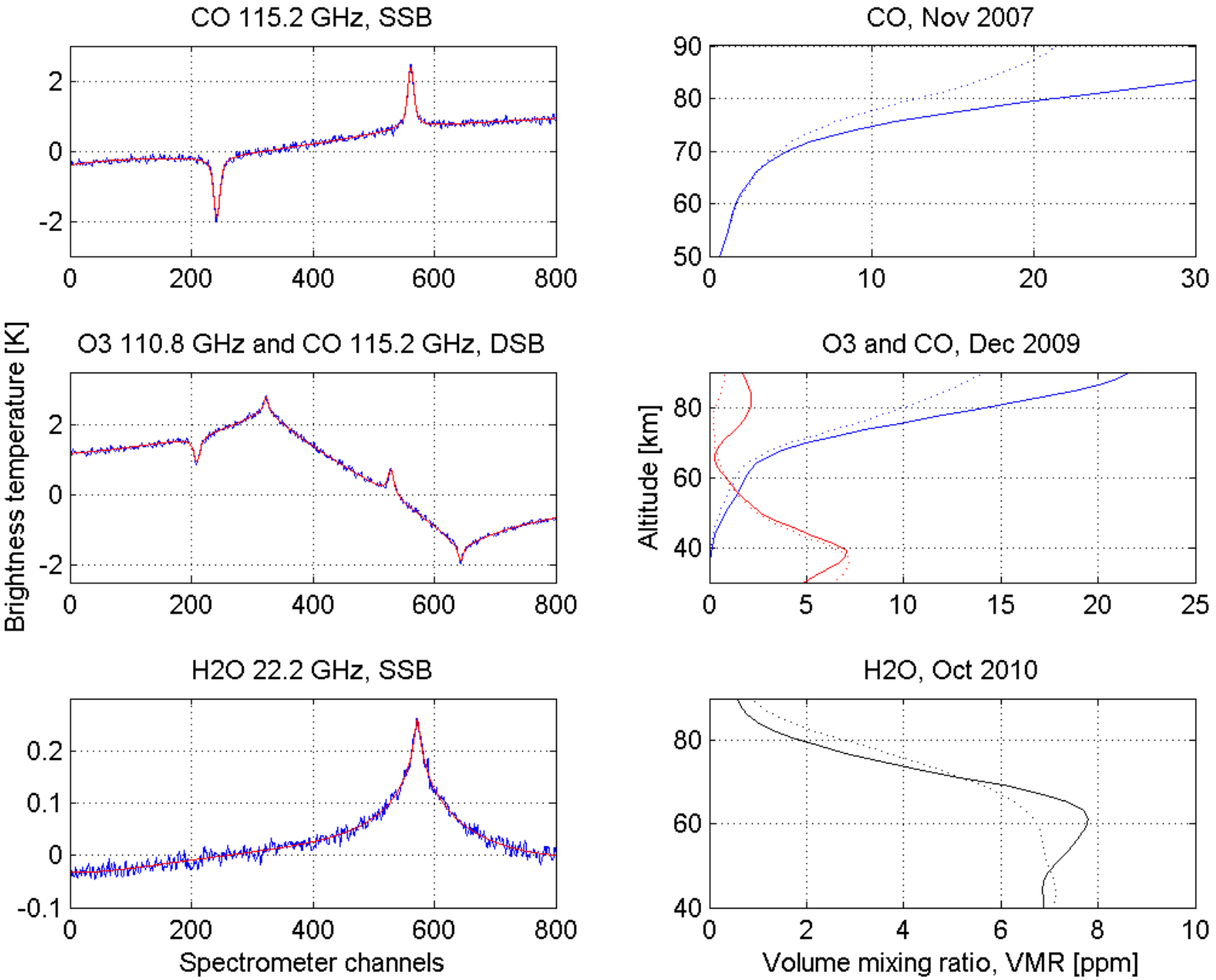








Observed spectra and retrieved vertical profiles



ORMA, Onsala Radiometers for Microwave sensing of the Atmosphere

Astrid and Konrad

Total power 21 and 31.4 GHz
Tropospheric liquid and gaseous water

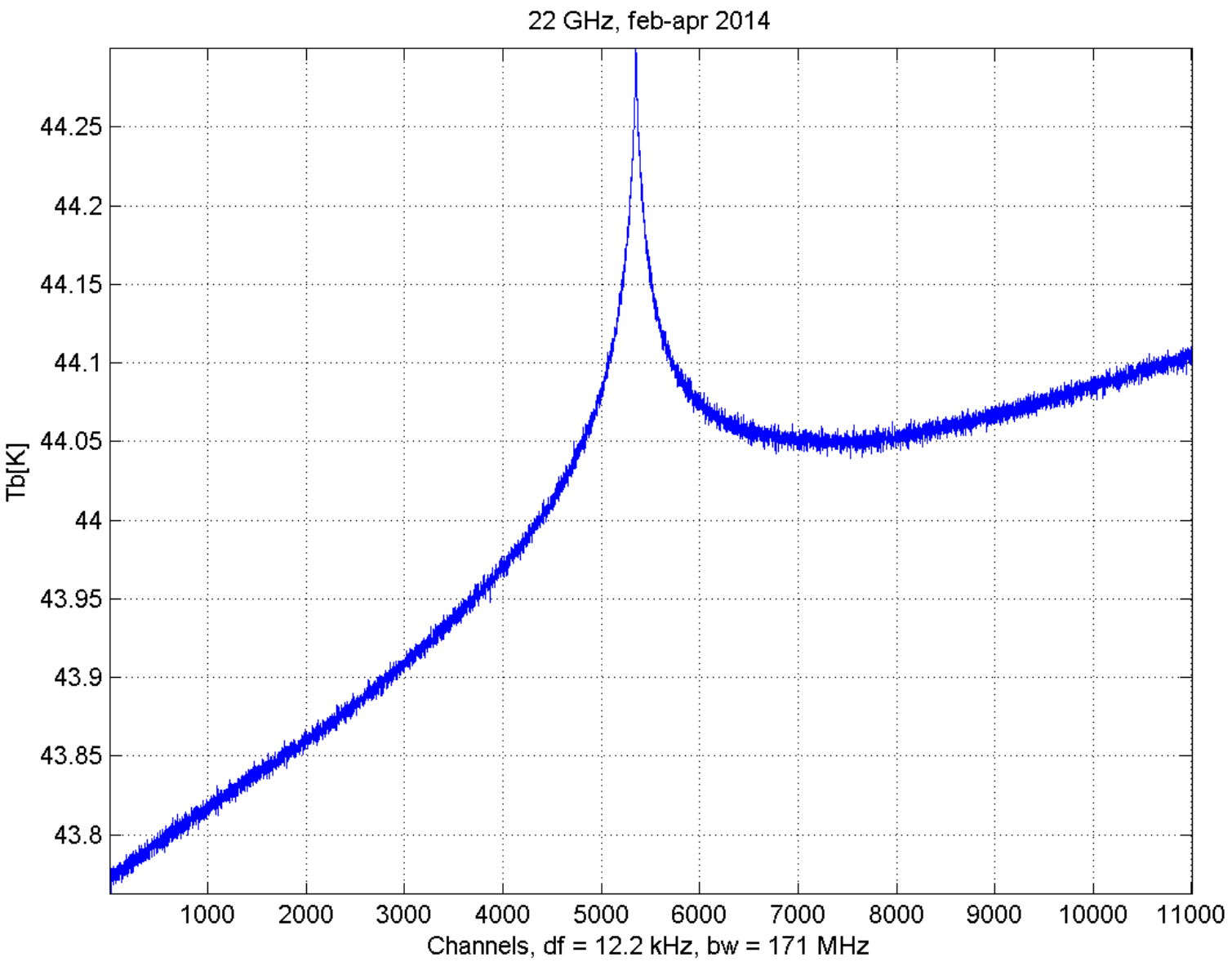
22 GHz radiometer

first generation

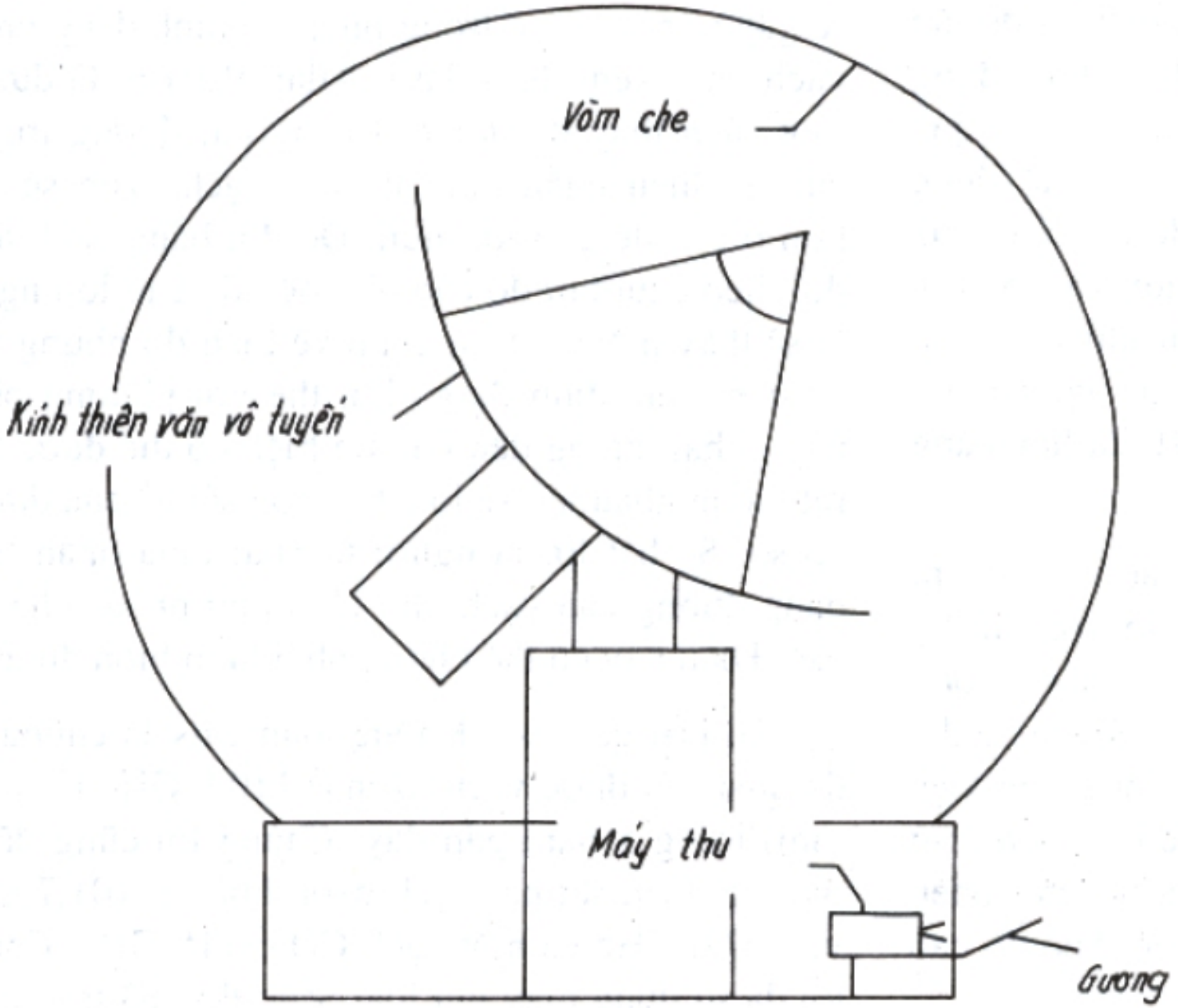
second generation

third generation

New cabin,
modified mirror control


22 GHz, feb-apr 2014
Tb[K]
44.25
44.2
44.15
44.1
44.05
44
43.95
43.9
43.85
43.8
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
Channels, df = 12.2 kHz, bw = 171 MHz

The first ozone observations

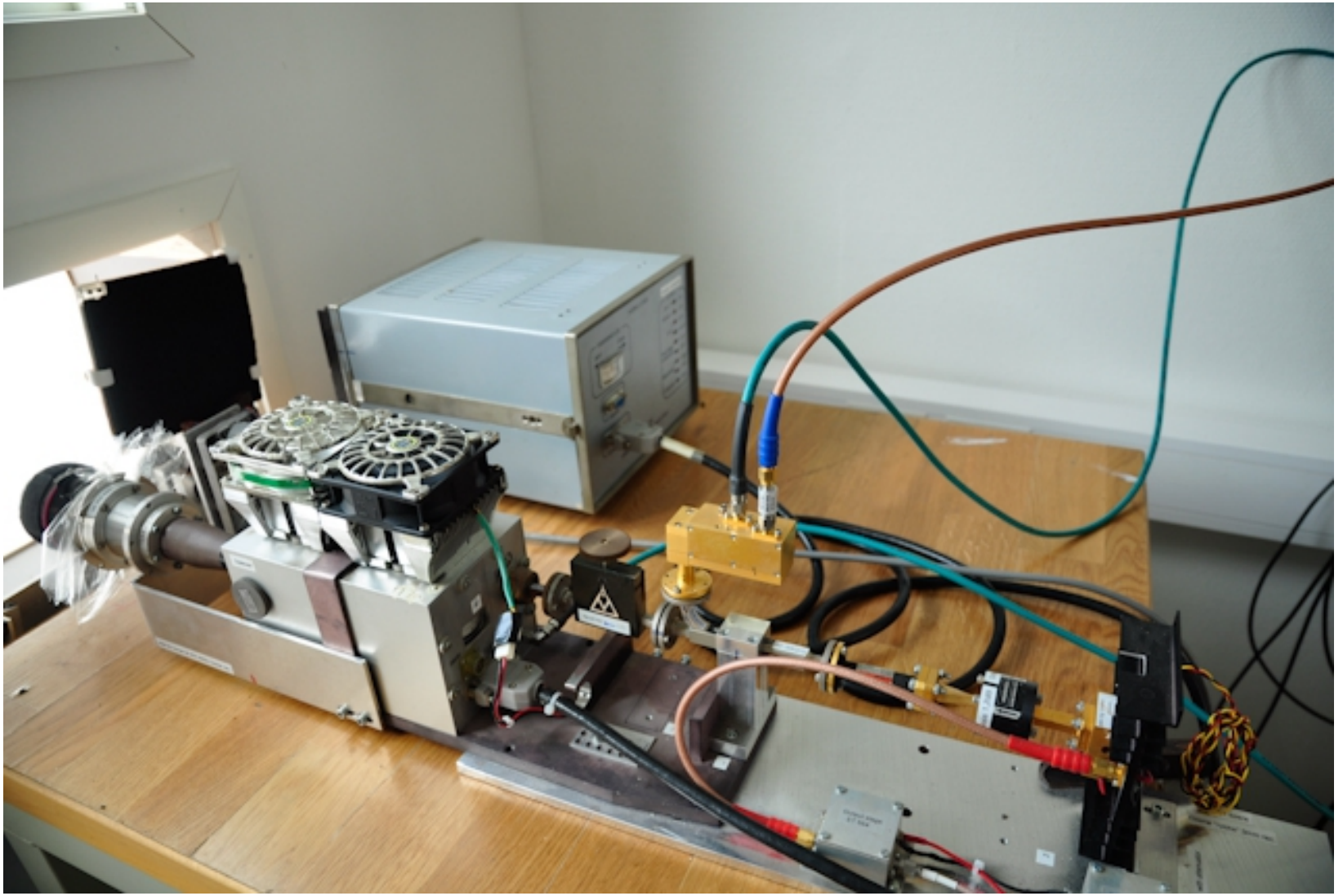


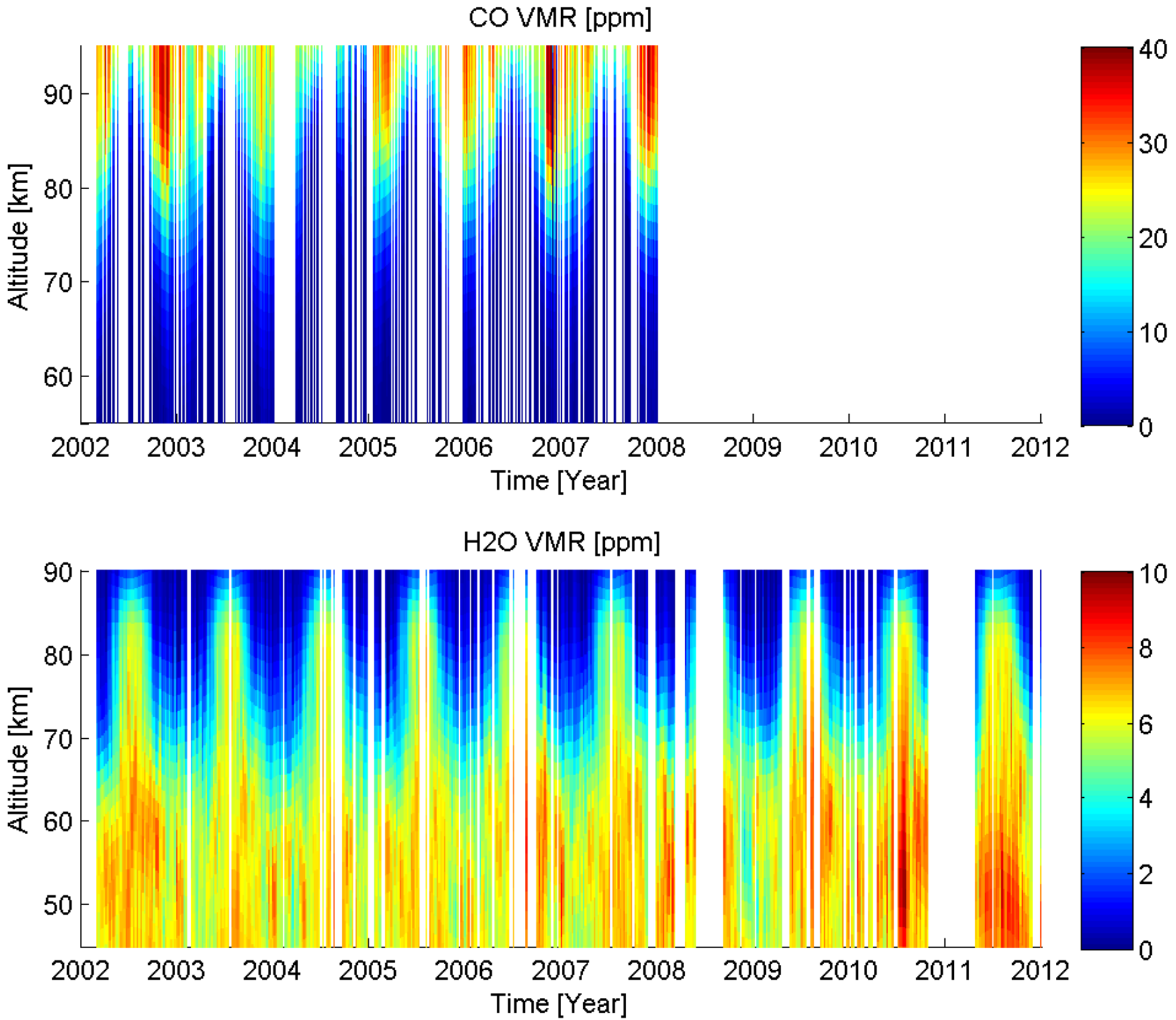
The first cabin

90-120 GHz cooled Shottky SSB mixer

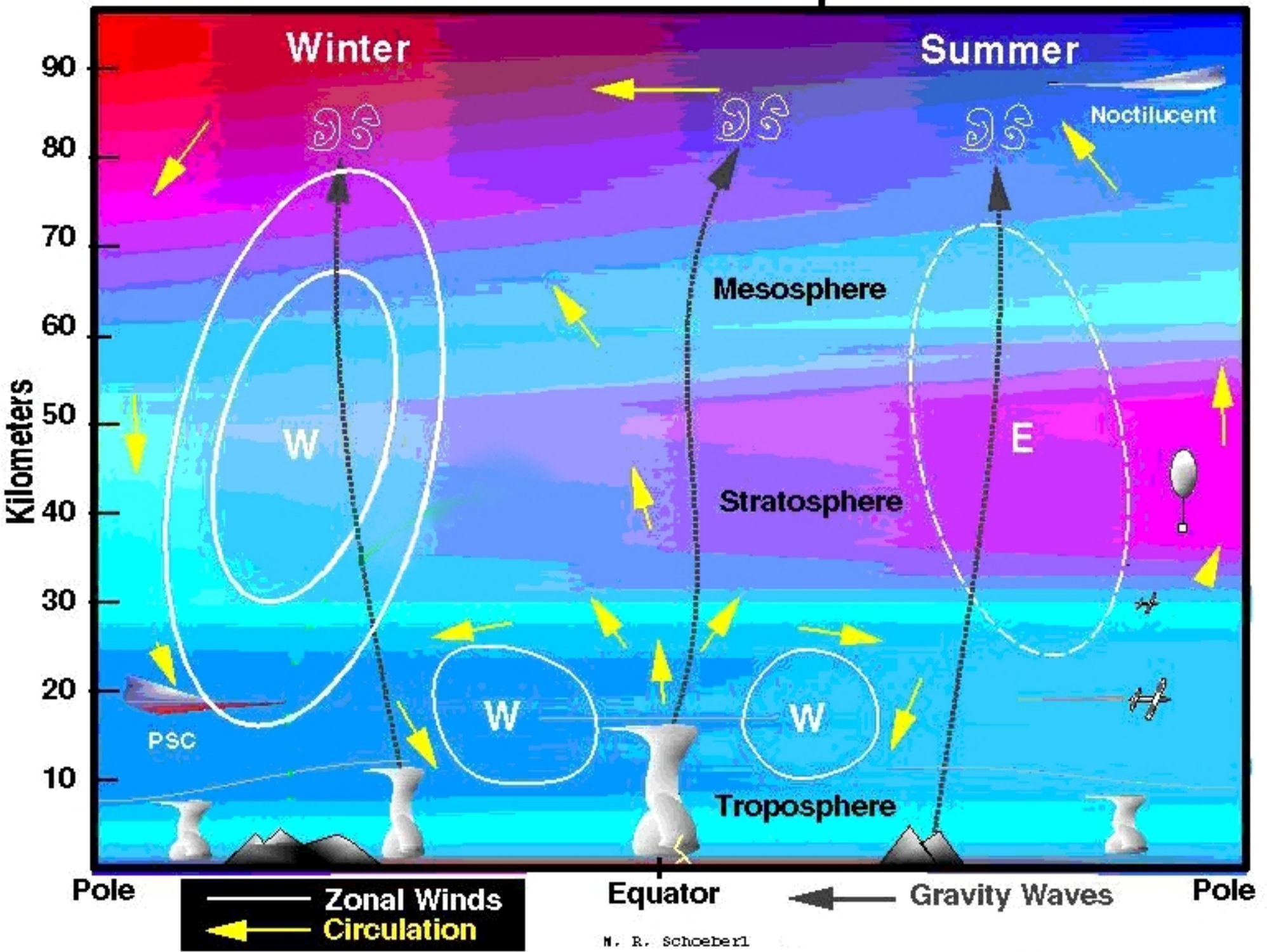
The Geo cabin

The first 111/115 GHz DSB radiometer

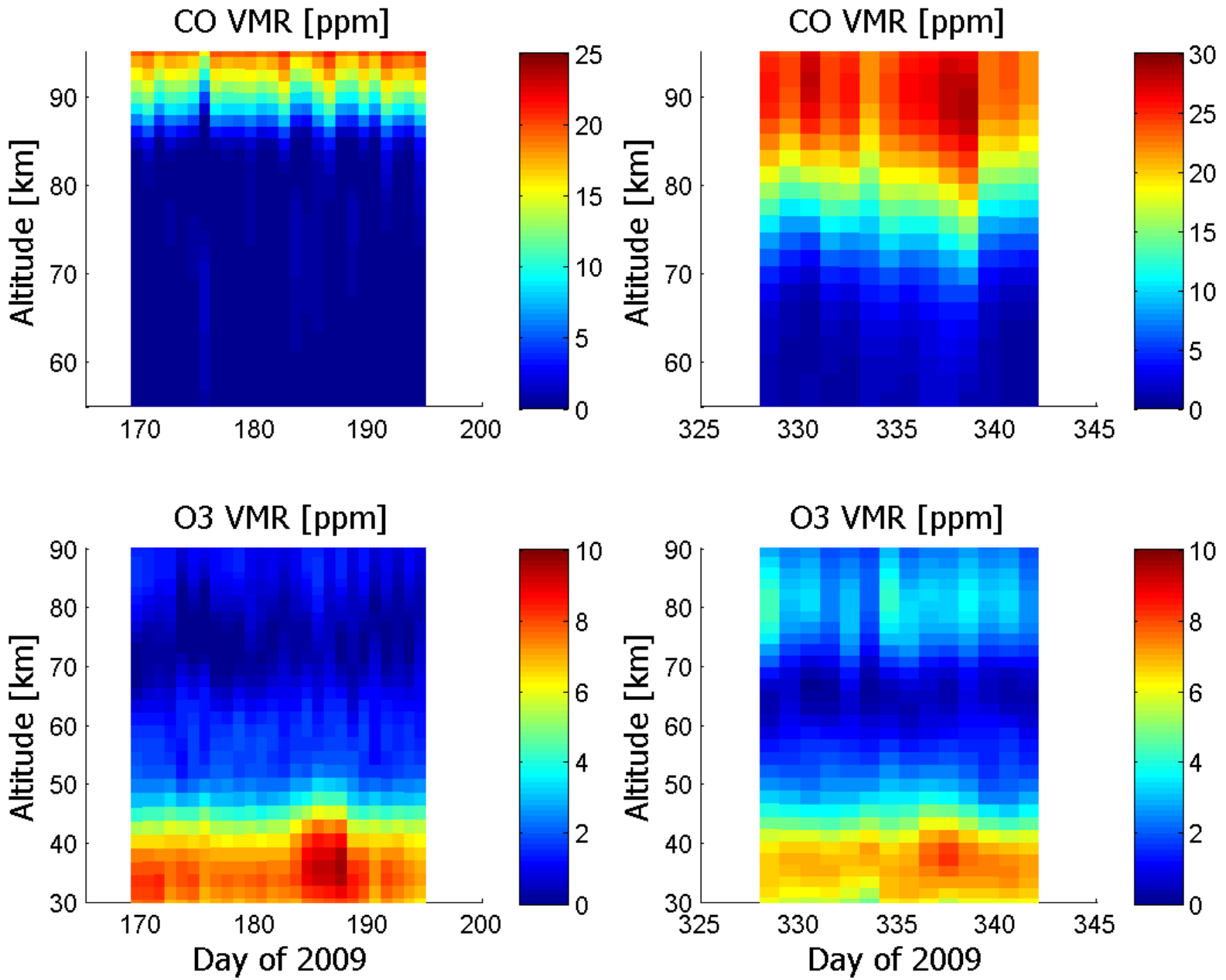



CO VMR [ppm]
Altitude [km]
90
80
70
60
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
Time [Year]
40
30
20
10
0
H2O VMR [ppm]
Altitude [km]
90
80
70
60
50
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
Time [Year]
10
8
6
4
2
0

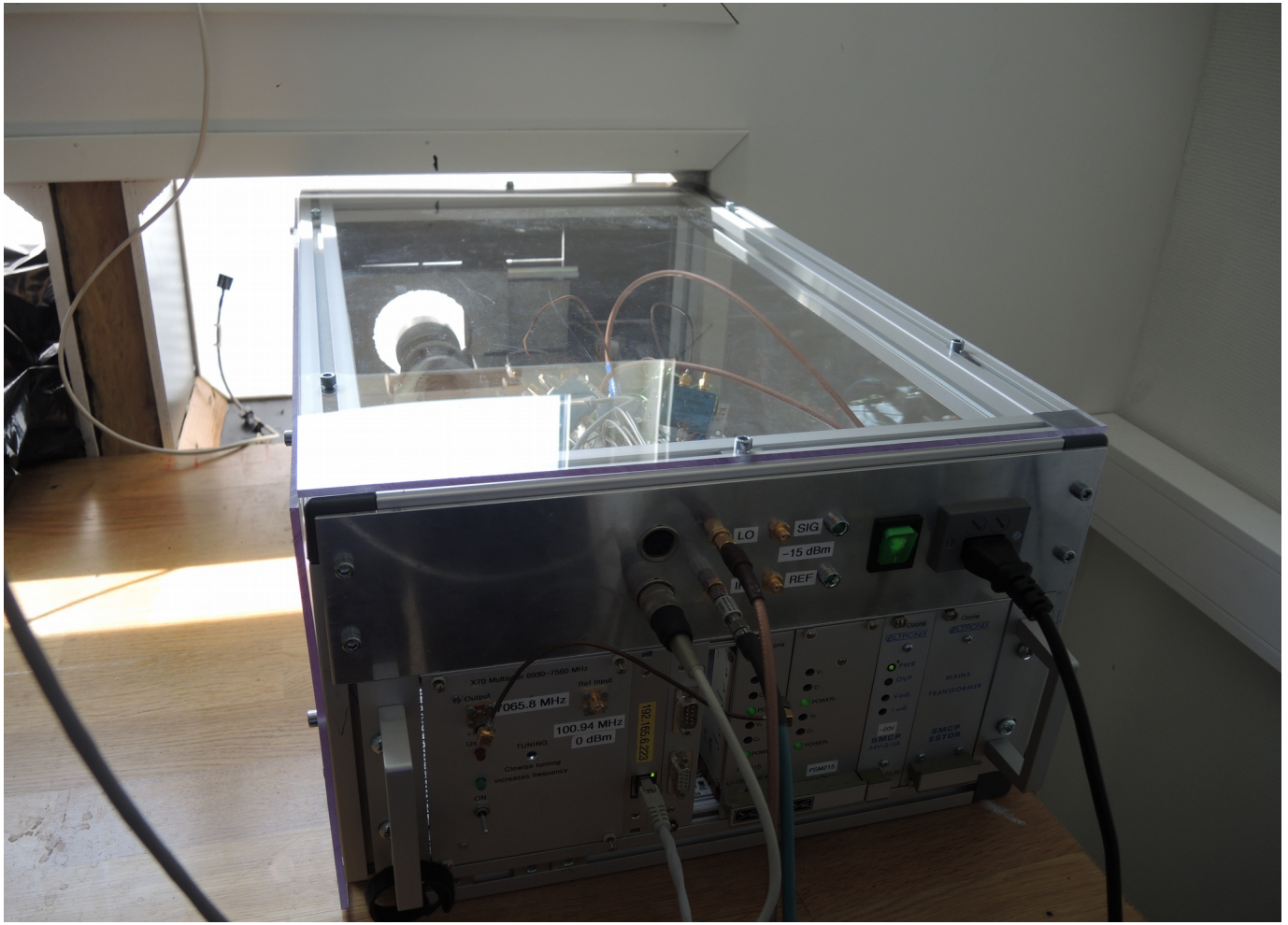
The Middle Atmosphere



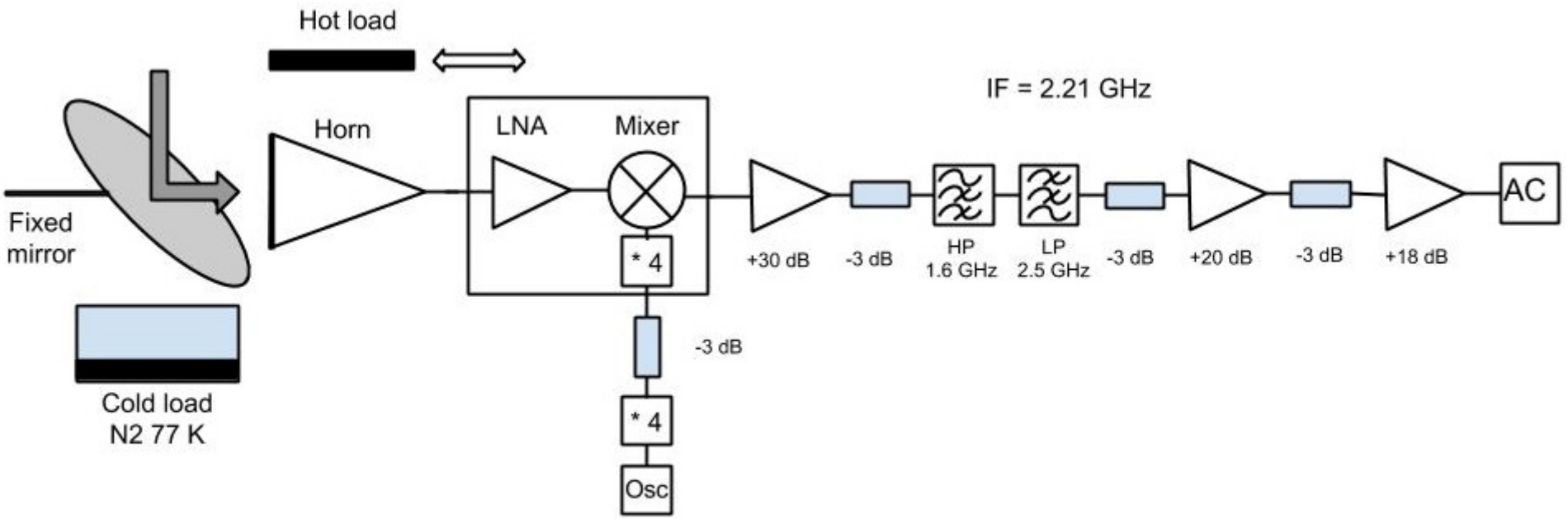
Some results from the first DSB 111/115 GHz radiometer



The second 111/115 GHz DSB radiometer

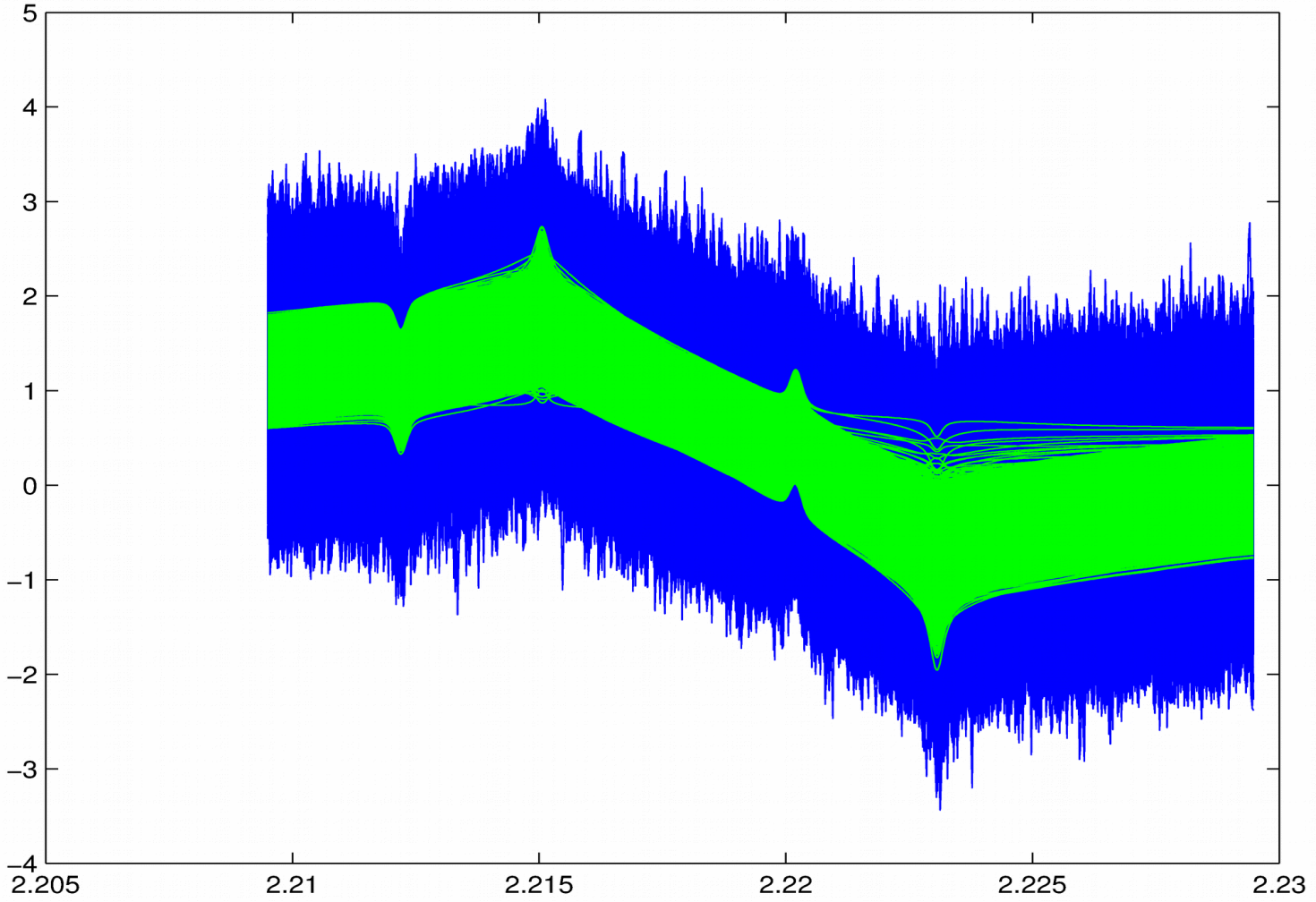


Block scheme DSB 111 / 115 GHz radiometer



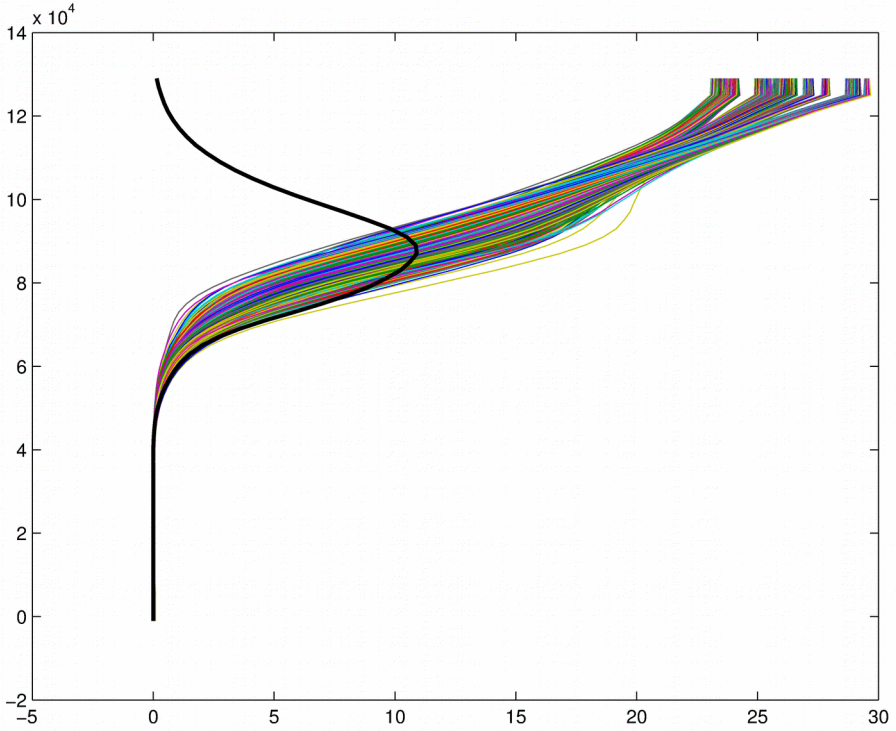
7.066 GHz +/- 0.25 MHz

Measured and fitted CO/O3 spectra

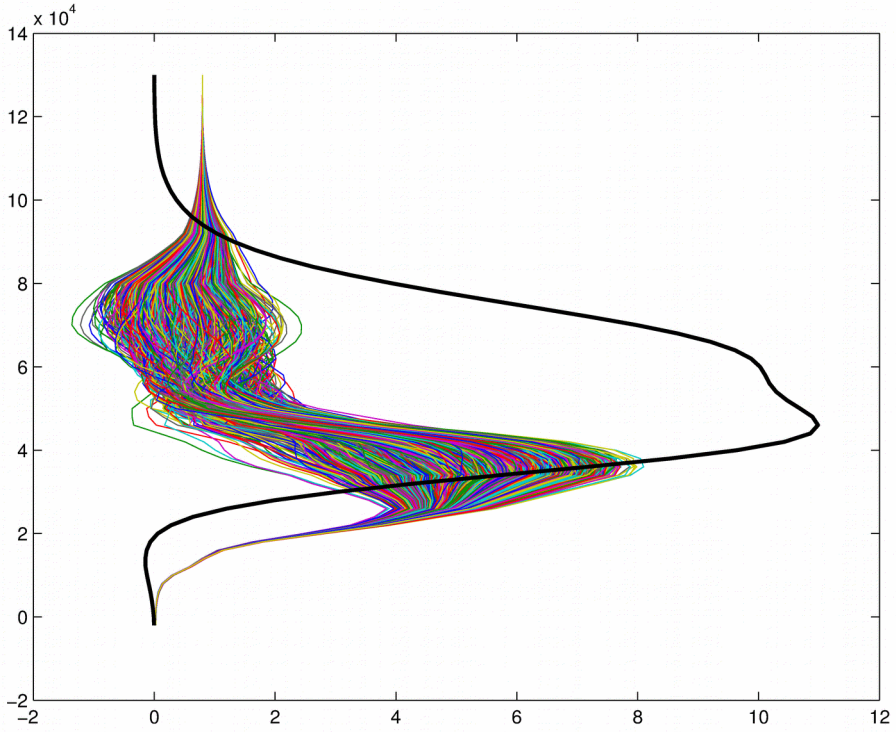


Tb [K] vs Frequency [GHz]

Vertical profiles of CO and O3



CO VMR [ppm] vs altitude [m]



O3 VMR [ppm] vs altitude [m]

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