Toward Absolution Calibration of Suomi NPP ATMS

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NOAA/NESDIS/STAR

Outline

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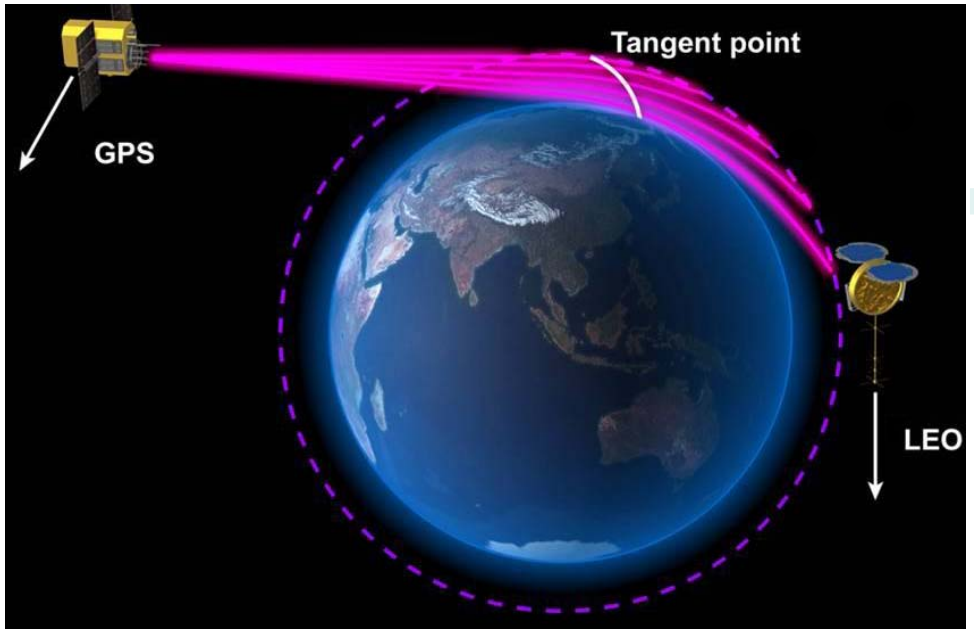
GPS RO Temperature Profiles

1. High vertical resolution
2. No contamination from clouds
3. No system calibration required
4. High accuracy and precision:



The global mean differences between COSMIC and high-quality reanalyses is ~0.65K between 8 and 30km (Kishore et al. 2008)

The precision of COSMIC GPS RO soundings is ~0.05K in the upper troposphere and lower stratosphere (Anthes et al. 2008)

Collocation Data Selection

- **Time period of data search:**

  January, 2012

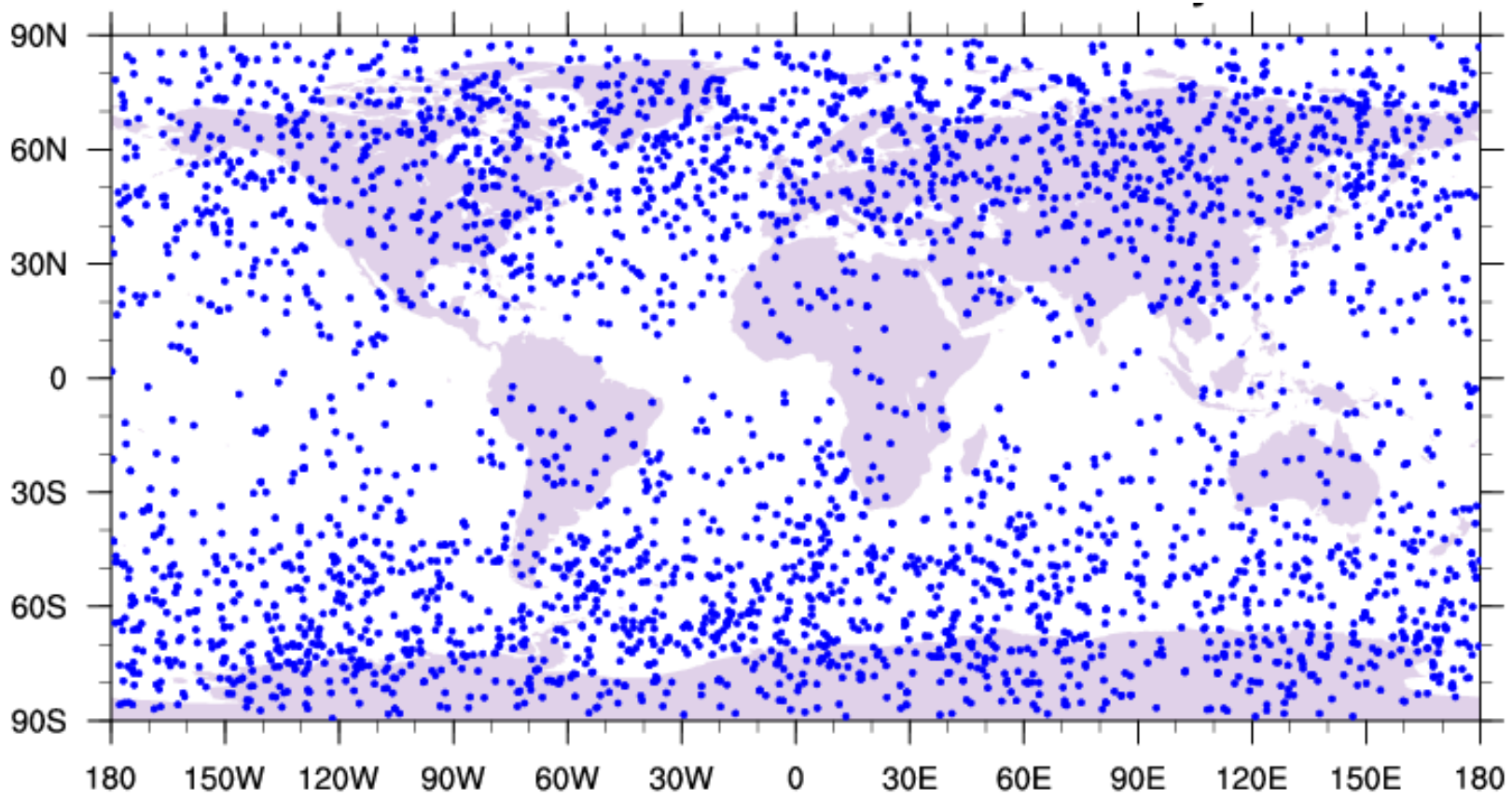
- **Collocation of CloudSat and COSMIC data:**

  Time difference < 0.5 hour

  Spatial distance < 30 km

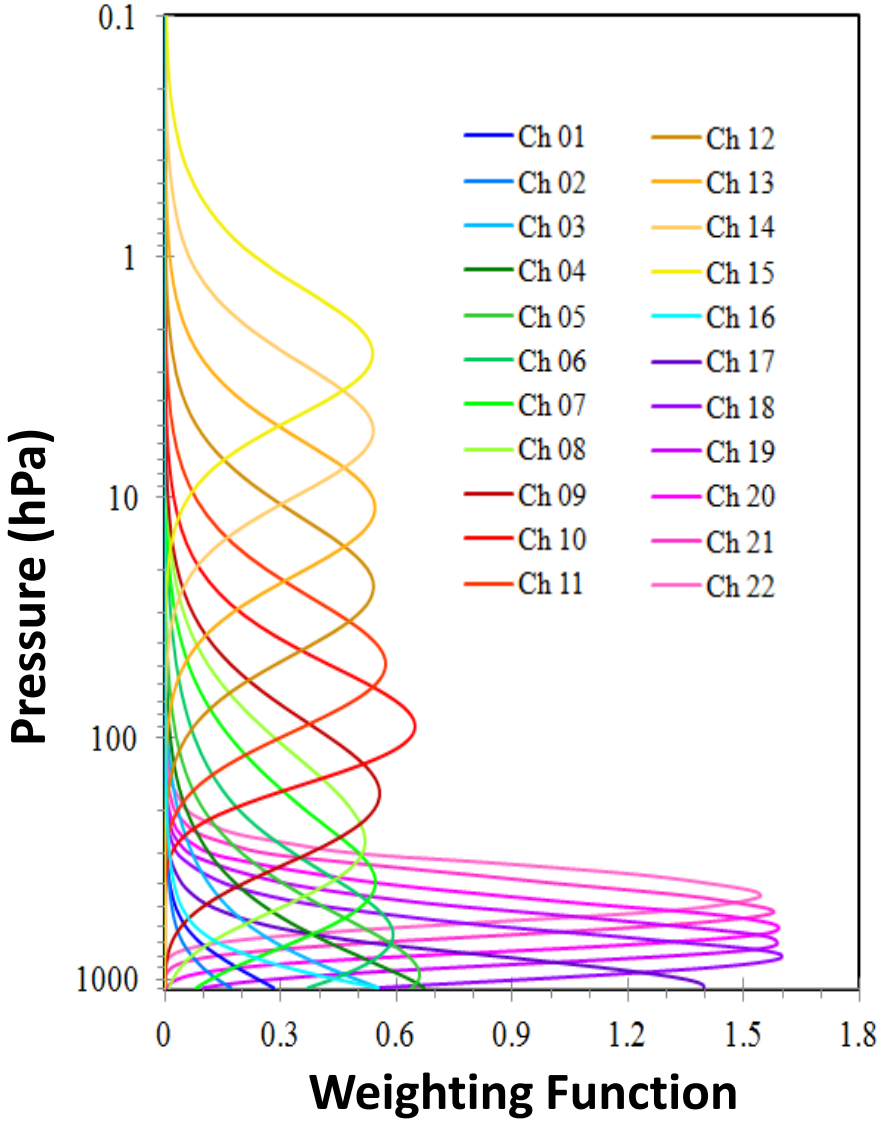
(GPS geolocation at 10km altitude is used for spatial collocation)

Distribution of Collocated ATMS in January 2012

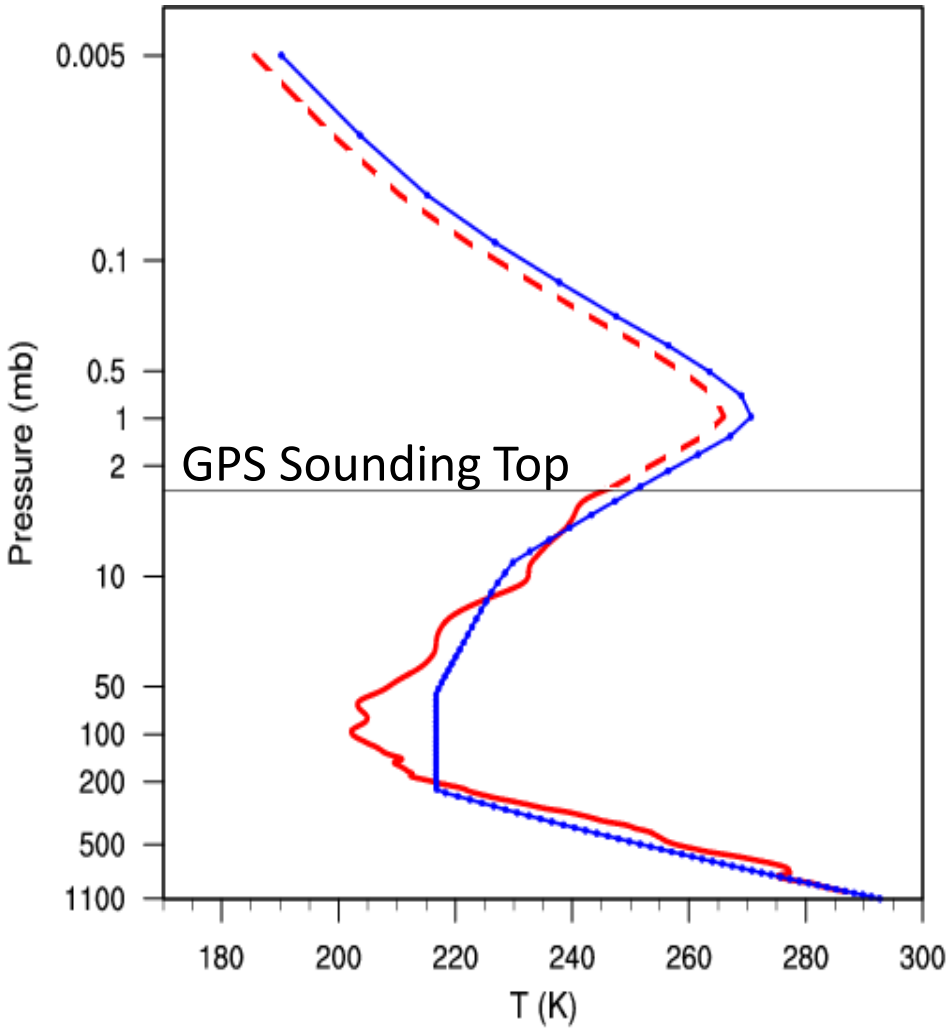


3056 collocated measurements

ATMS WF (U.S. Standard Atmosphere)



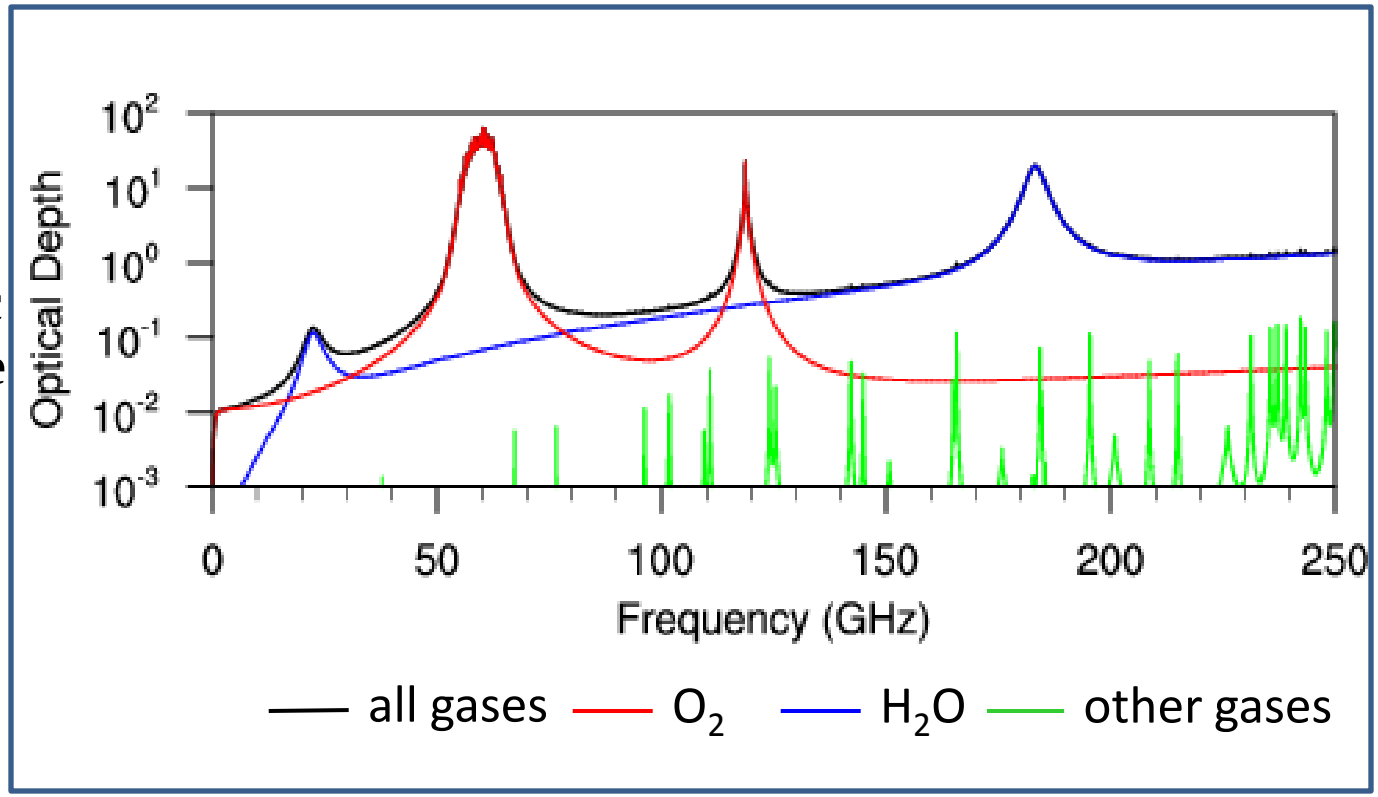
Add 1976 U.S. Standard Atmosphere State to GPS Soundings



1051 UTC on January 1, 2012

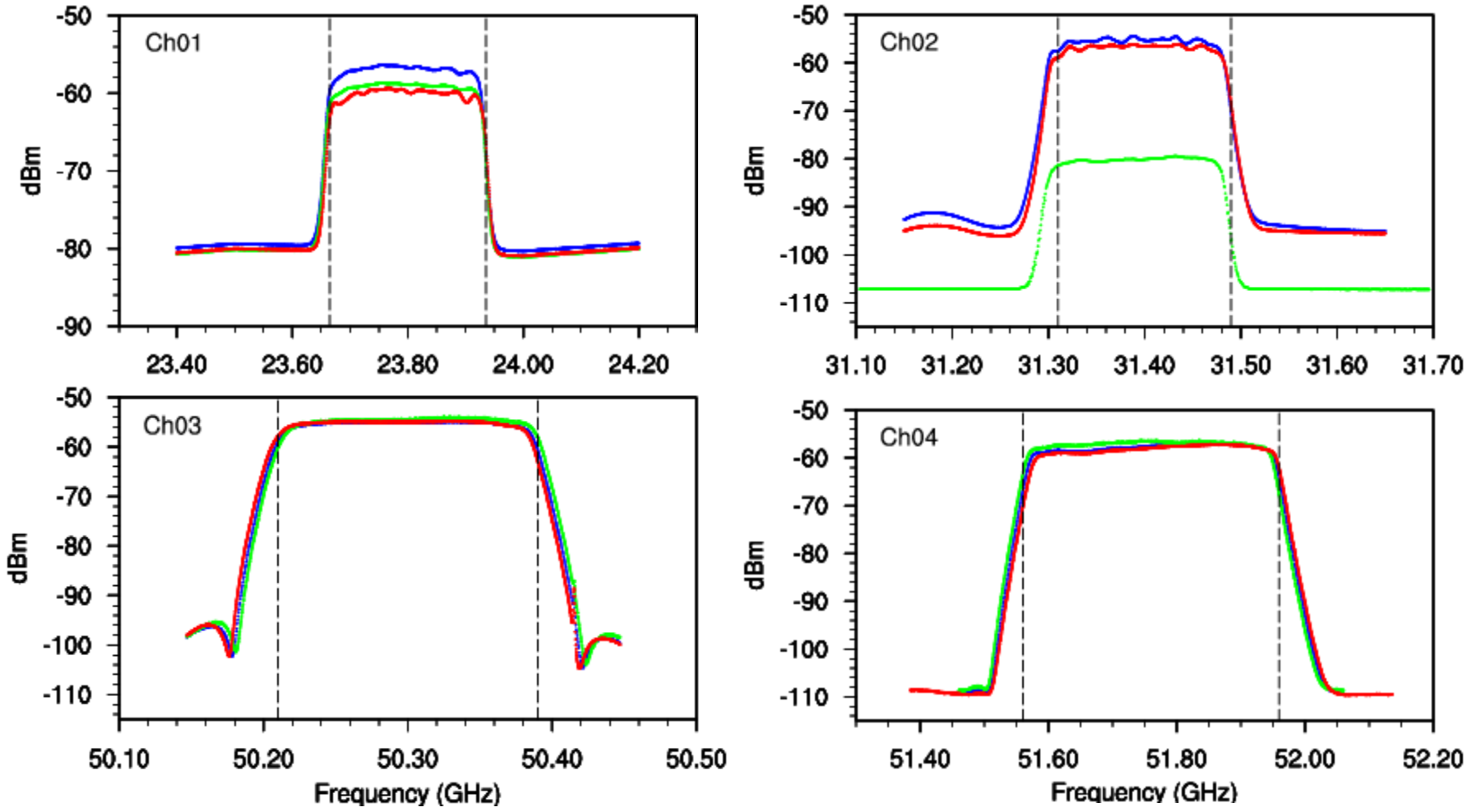
MonoRTM

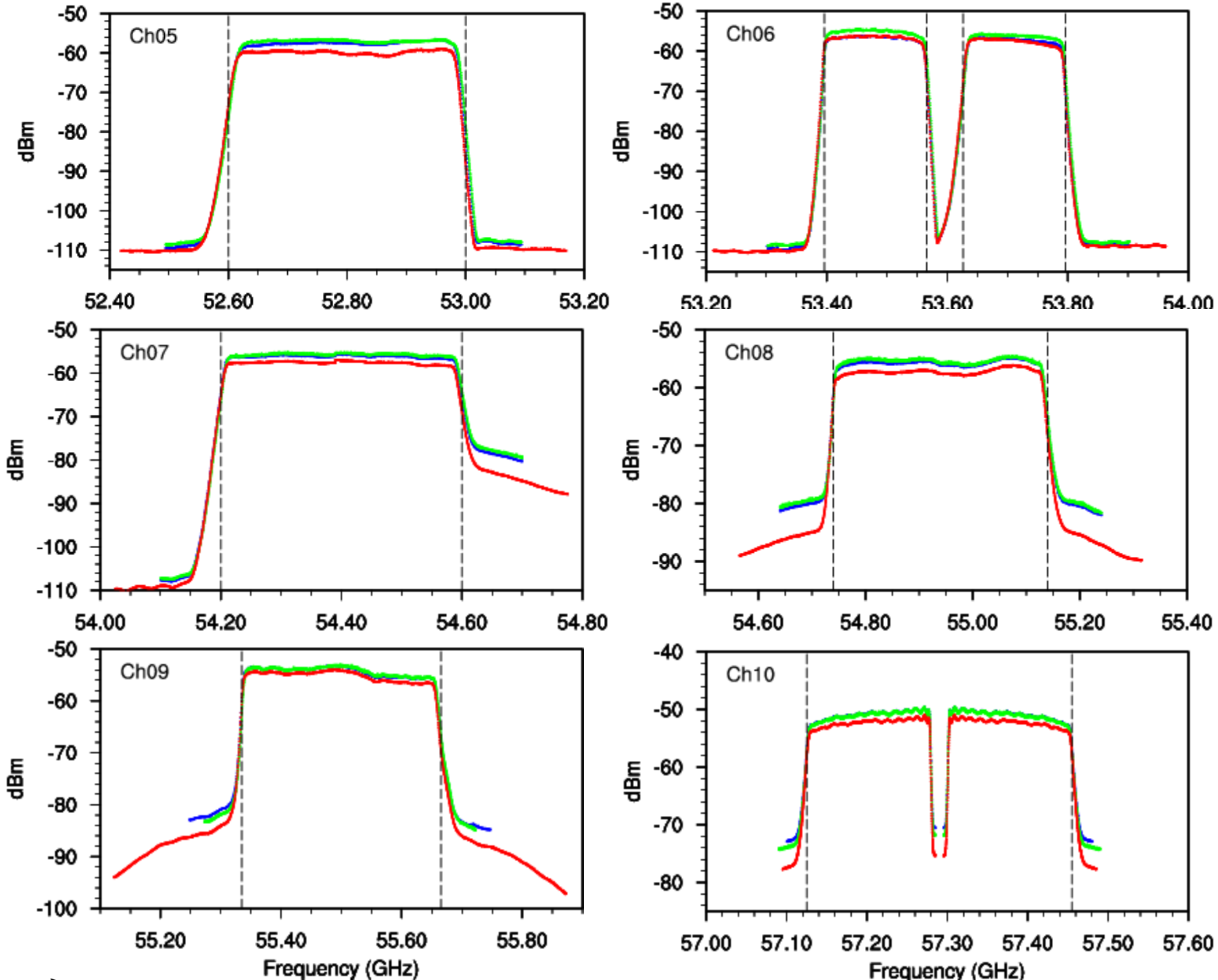
- Perform a line by line radiative transfer calculation
- Accurate atmospheric spectroscopy data base
- Only gaseous absorption
- Vertical stratification

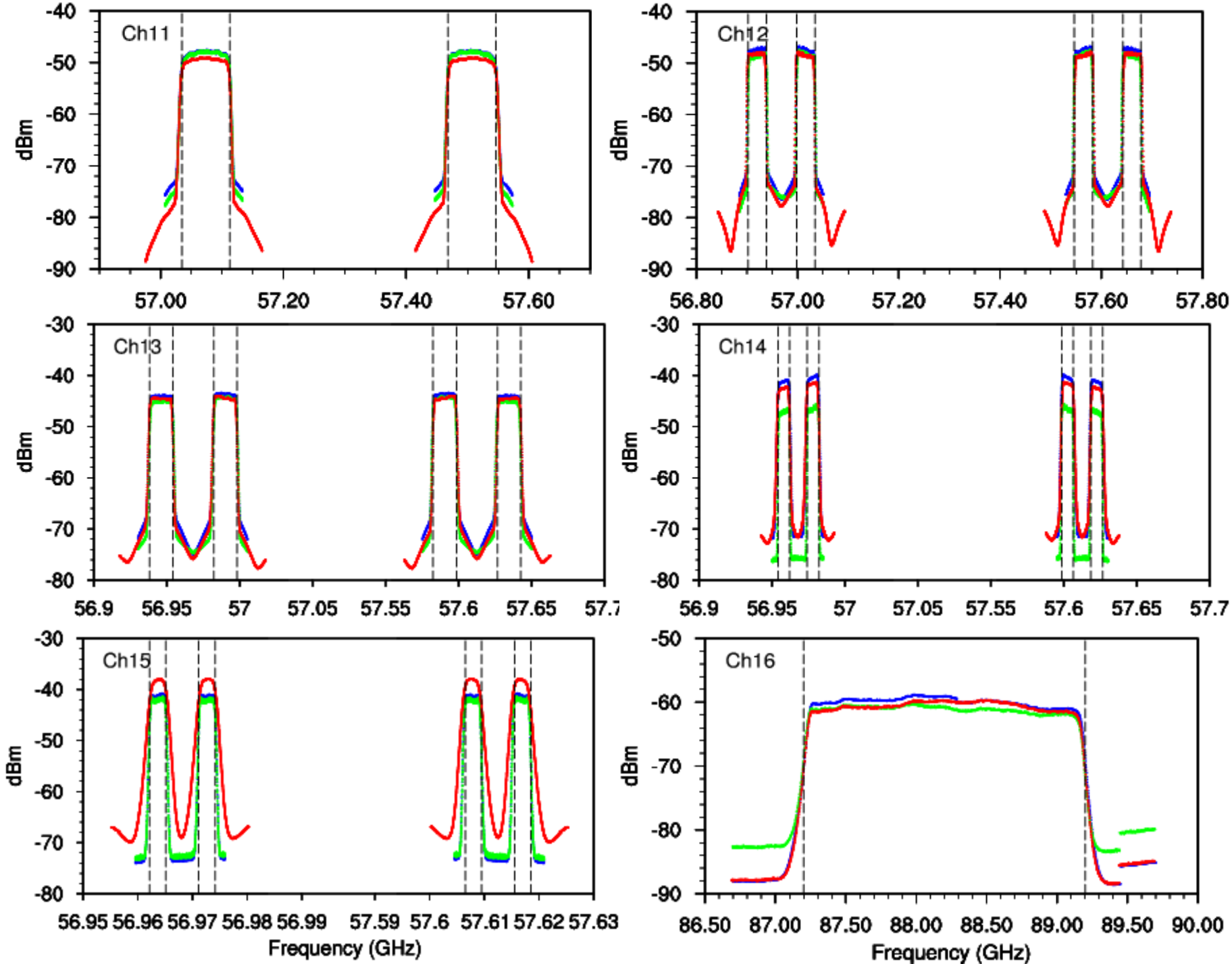


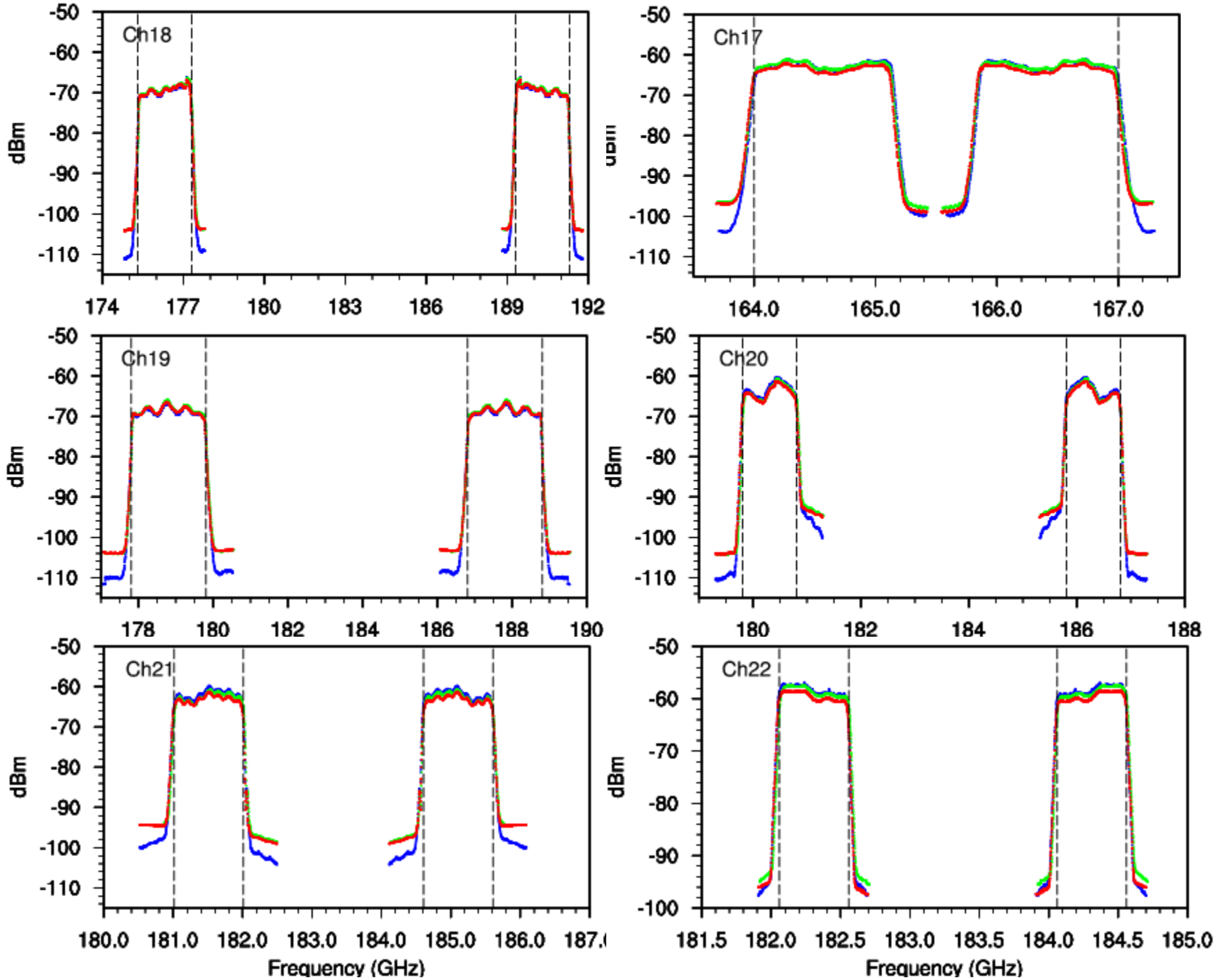
Microwave sounding channels at 50-60 GHz O_2 absorption band can be best simulated under a cloud-free atmosphere using line by line calculation

ATMS Measured SRF at Baseplate Temperature of -10°C, 20°C, and 50°C

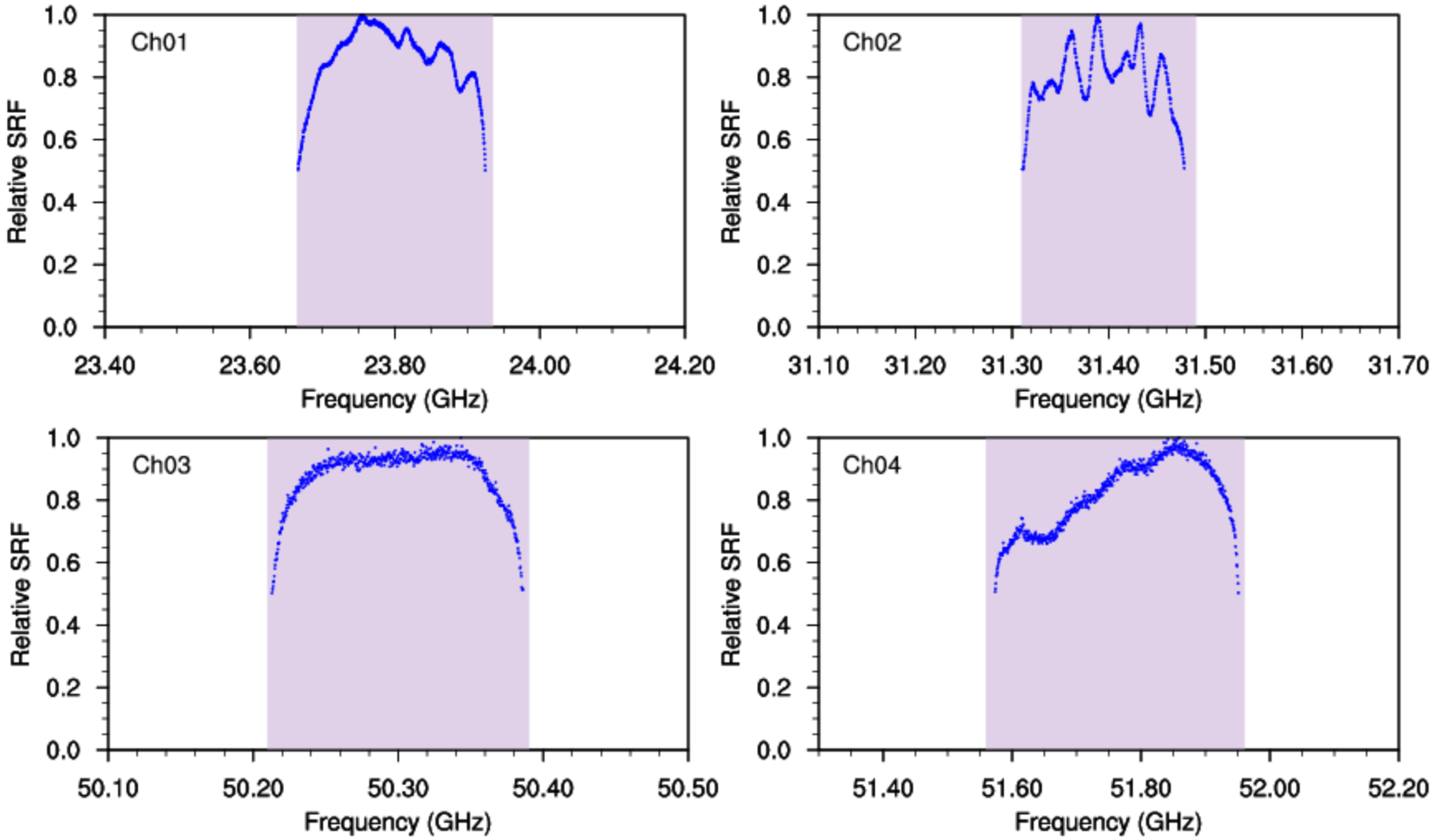


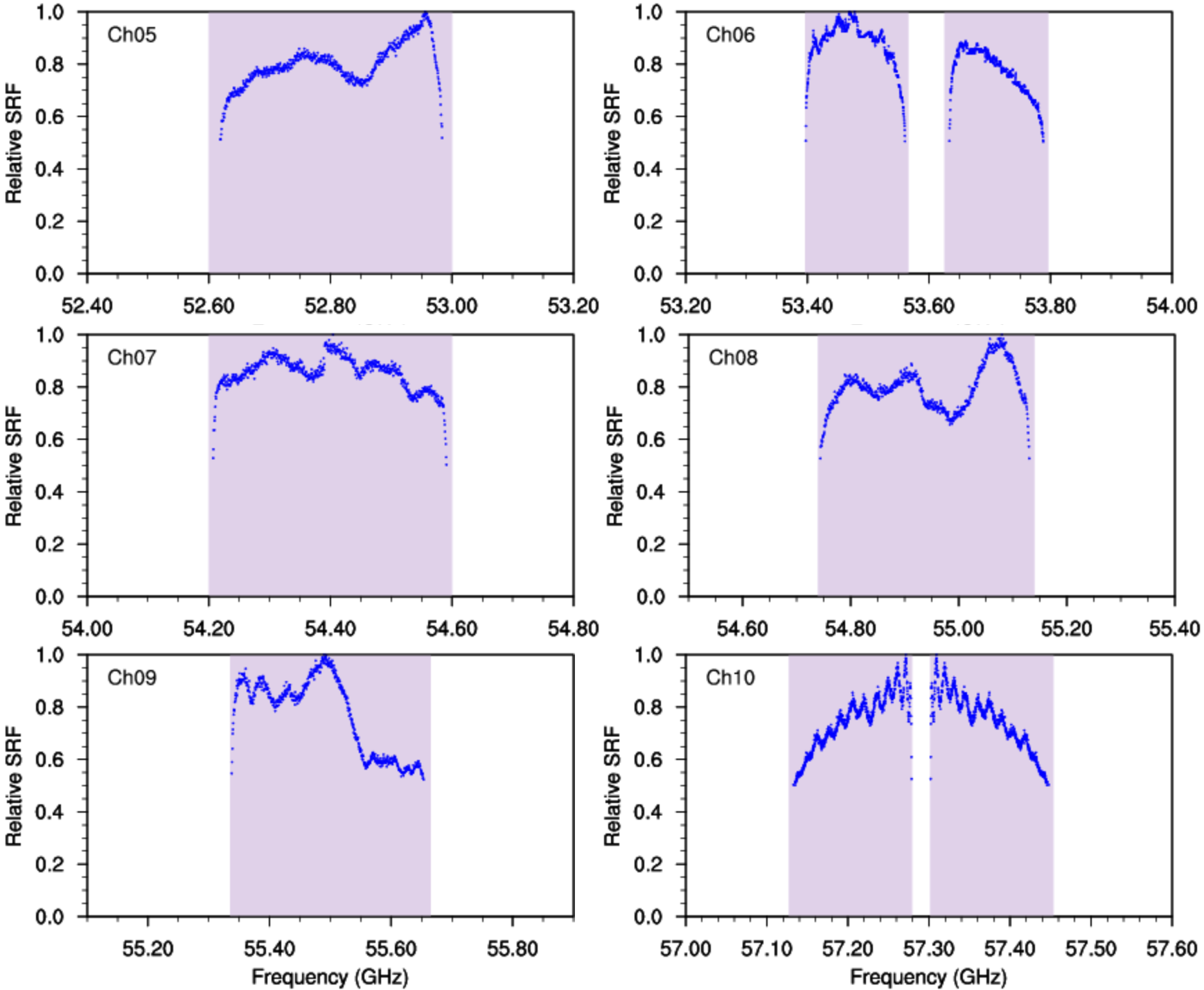

Ch05
Ch06
Ch07
Ch08
Ch09
Ch10
dBm
Frequency (GHz)

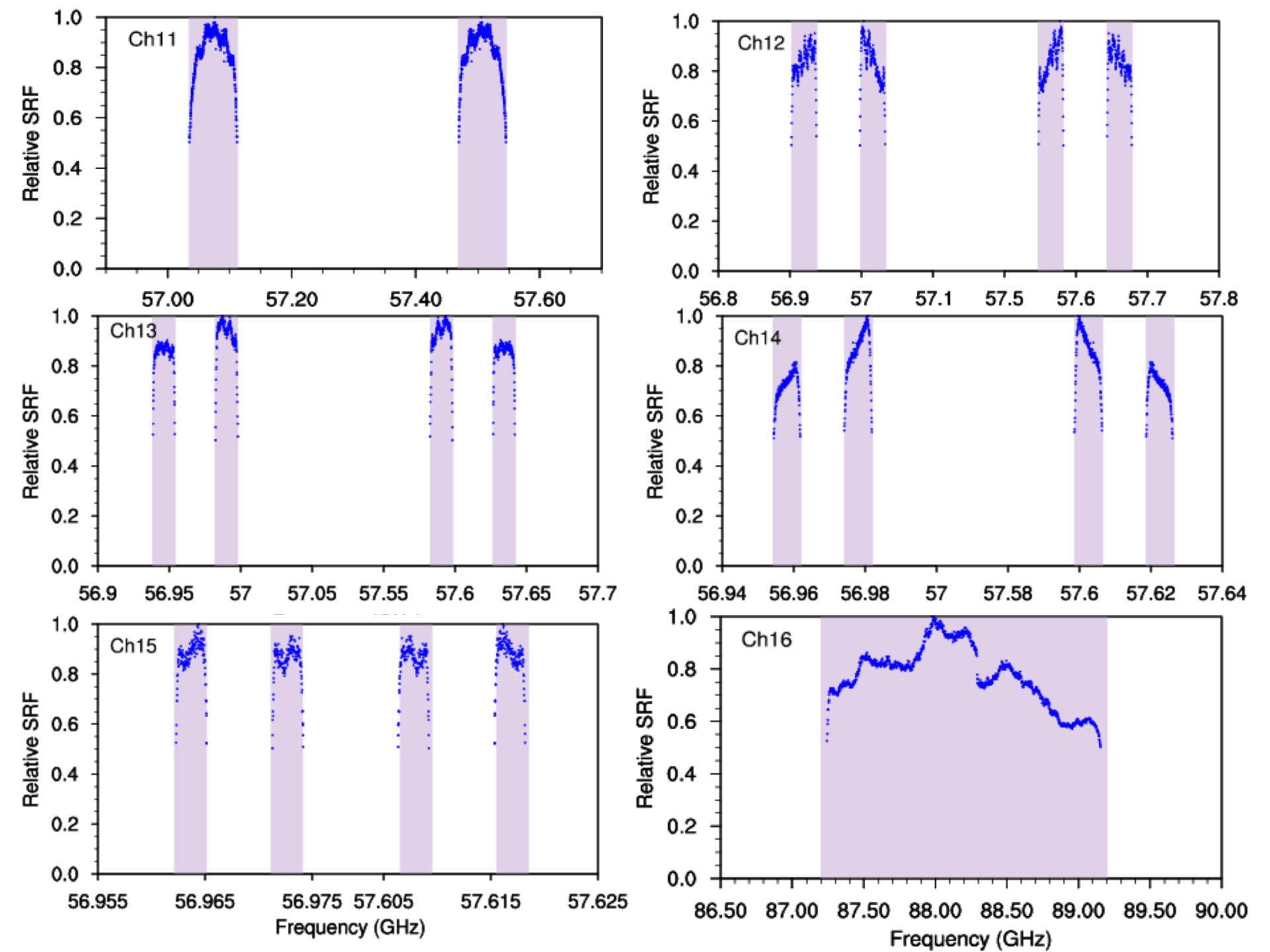

Ch11
Ch12
Ch13
Ch14
Ch15
Ch16
dBm
Frequency (GHz)

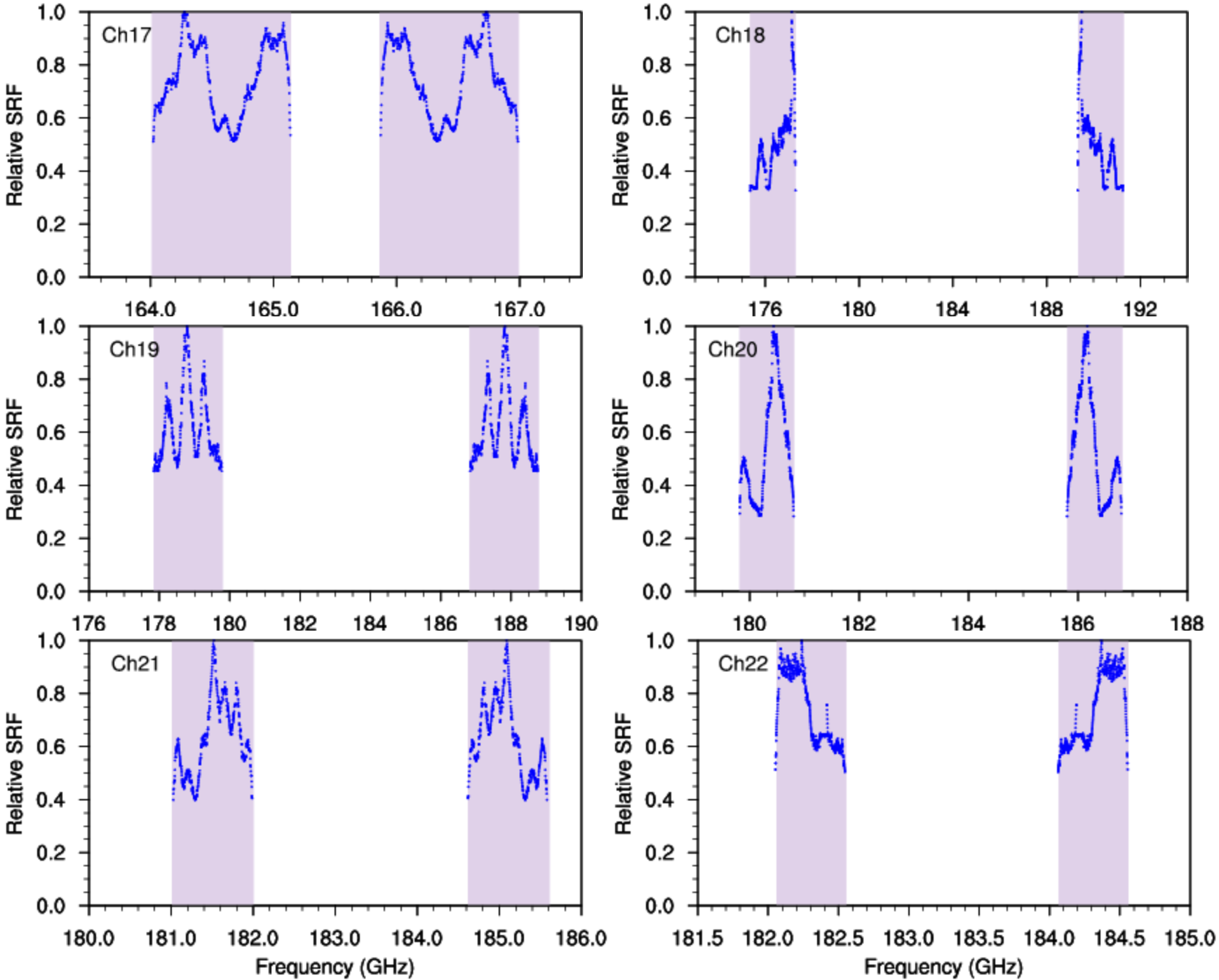

Ch18
Ch17
Ch19
Ch20
Ch21
Ch22
dBm
Frequency (GHz)

SRF after -3dB Truncation for Baseplate of 20°C




Ch05
Ch06
Ch07
Ch08
Ch09
Ch10
Relative SRF
Frequency (GHz)
1.0
0.8
0.6
0.4
0.2
0.0
52.40
52.60
52.80
53.00
53.20
53.40
53.60
53.80
54.00
54.20
54.40
54.60
54.80
55.00
55.20
55.40
55.60
55.80
57.00
57.10
57.20
57.30
57.40
57.50
57.60

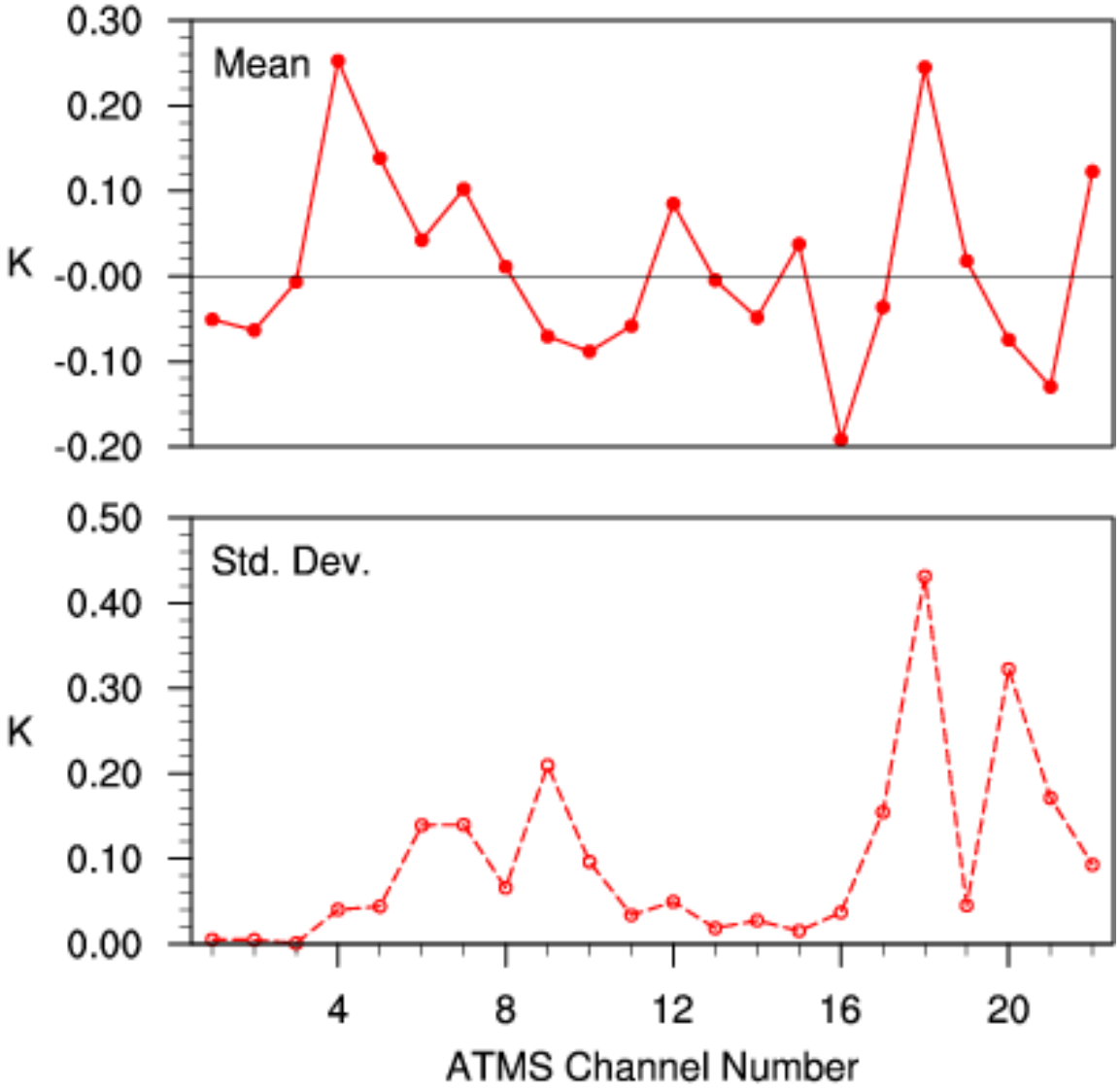

Ch11
Ch12
Ch13
Ch14
Ch15
Ch16
Relative SRF
Frequency (GHz)
1.0
0.8
0.6
0.4
0.2
0.0
57.00
57.20
57.40
57.60
56.8
56.9
57
57.1
57.5
57.6
57.7
57.8
56.9
56.95
57
57.05
57.55
57.6
57.65
57.7
56.94
56.96
56.98
57
57.58
57.6
57.62
57.64
56.955
56.965
56.975
57.605
57.615
57.625
86.50
87.00
87.50
88.00
88.50
89.00
89.50
90.00


Ch17
Ch18
Ch19
Ch20
Ch21
Ch22
Relative SRF
Frequency (GHz)
1.0
0.8
0.6
0.4
0.2
0.0
164.0
165.0
166.0
167.0
176
180
184
188
192
178
182
186
190
180.0
181.0
182.0
183.0
184.0
185.0
186.0
181.5
182.5
183.5
184.5

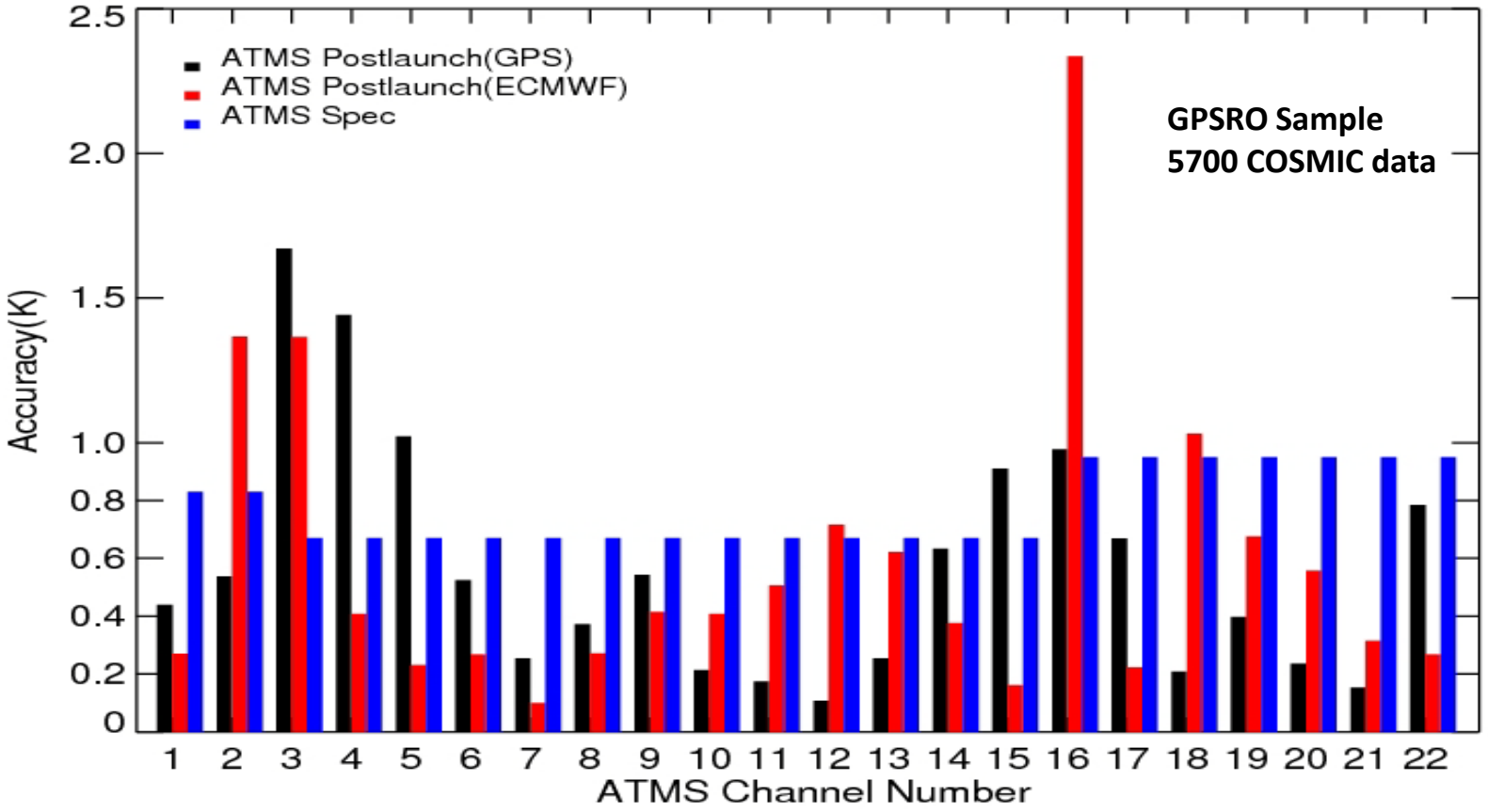
Channel Number	Number of Line		Frequency Resolution (mHz)	Channel Number	Number of Line		Frequency Resolution (mHz)
	Original	-3dB			Original	-3dB	
01	2501	808	0.32	**12**	2002	844	0.165
02	1601	536	0.3125	**13**	2002	822	0.075
03	1001	577	0.3	**14**	2002	864	0.035
04	1001	630	0.6	**15**	2002	702	0.016
05	1001	609	0.6	**16**	1600	1020	1.88
06	2002	1061	0.3	**17**	2002	1308	1.7
07	1001	641	0.6	**18**	2002	1296	2.97
08	1001	645	0.6	**19**	2002	1112	3.46
09	1001	632	0.5	**20**	2002	976	1.98
10	2002	1558	0.185	**21**	2002	978	1.97
11	2002	1214	0.126	**22**	2002	1250	0.79

MonoRTM simulation for January, 2012

$M^{SRF} - M^{Boxcar}$



ATMS Calibration Accuracy Derived Using COSMIC Data



On-orbit ATMS calibration accuracy is quantified using GPSRO data as input to LBLRT model and is better than specification for most of sounding channels

Summary

Difference between simulations using Boxcar SRF and measured SRF is within 0.3K.

For NWP radiance assimilation, forward models need to consider the measured SRF.