GPM X-Cal Results for AMSR2

Special Meeting of X-Cal

Toulouse, France

May 24, 2013

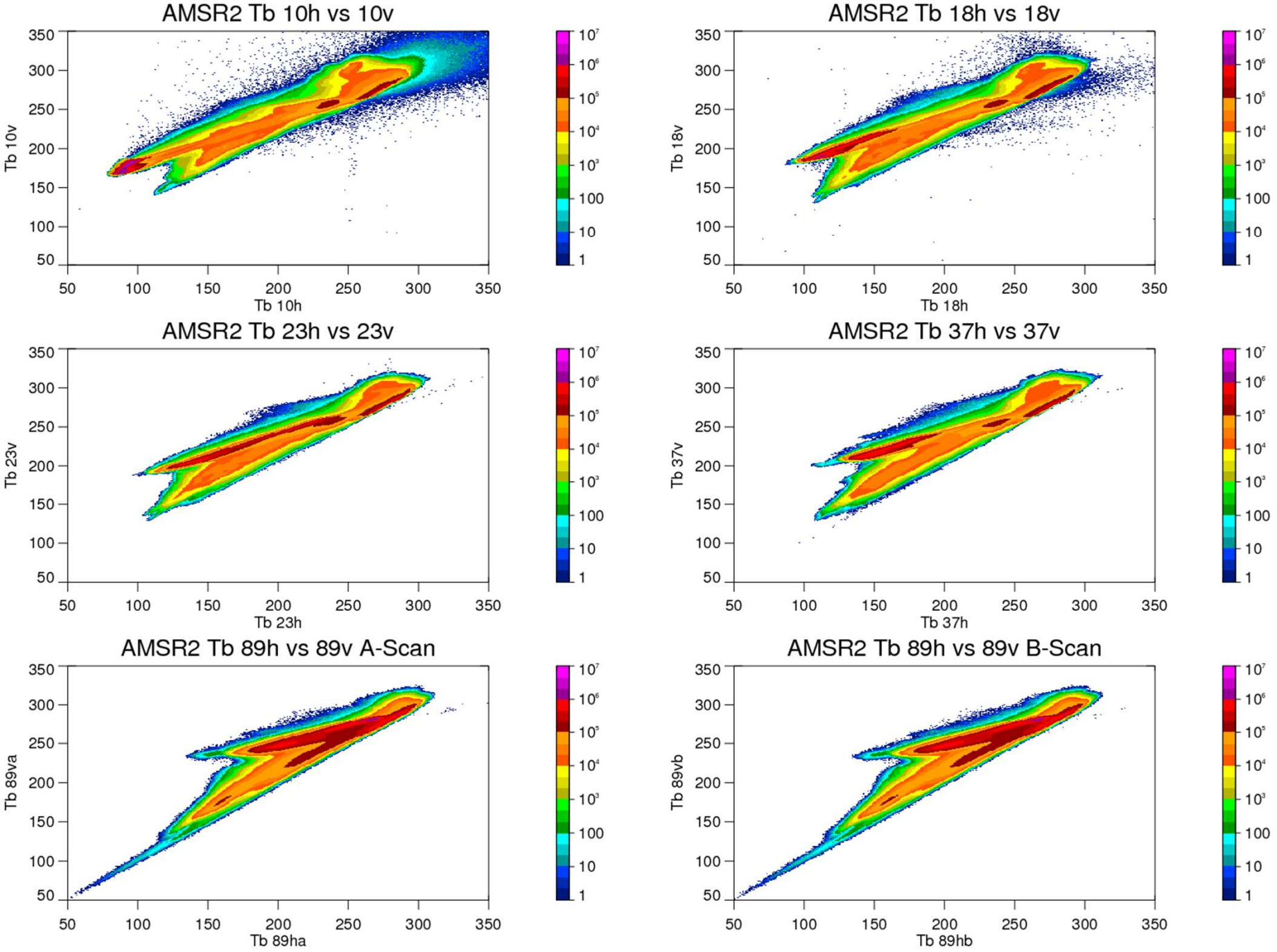
ATMOSPHERIC, OCEANIC AND SPACE SCIENCES

UNIVERSITY of MICHIGAN ■ COLLEGE of ENGINEERING

AMSR 2 Instrument

- Advanced Microwave Scanning Radiometer 2 (AMSR2) onboard Global Change Observation Mission Water (GCOM-W1)
  - Launched May 18th 2012 by Japan Aerospace Exploration Agency (JAXA) into afternoon A-Train orbit (13:30/1:30 asc/desc crossing times)

Center frequency [GHz]	NEDT [K]	Beam width [degree] (Ground resolution [km])
6.925 / 7.3	< 0.34/0.43	1.8(35 x 62)
10.65	< 0.70	1.2(24 x 42)
18.7	< 0.70	0.65(14 x 22)
23.8	< 0.60	0.75(15 x 26)
36.5	< 0.70	0.35(7 x 12)
89.0 A/B	< 1.20/1.40	0.15(3 x 5)


AMSR2 Tb 10h vs 10v
Tb 10v
Tb 10h
AMSR2 Tb 18h vs 18v
Tb 18v
Tb 18h
AMSR2 Tb 23h vs 23v
Tb 23v
Tb 23h
AMSR2 Tb 37h vs 37v
Tb 37v
Tb 37h
AMSR2 Tb 89h vs 89v A-Scan
Tb 89va
Tb 89ha
AMSR2 Tb 89h vs 89v B-Scan
Tb 89vb
Tb 89hb
50
100
150
200
250
300
350
1
10
100
10^3
10^4
10^5
10^6
10^7

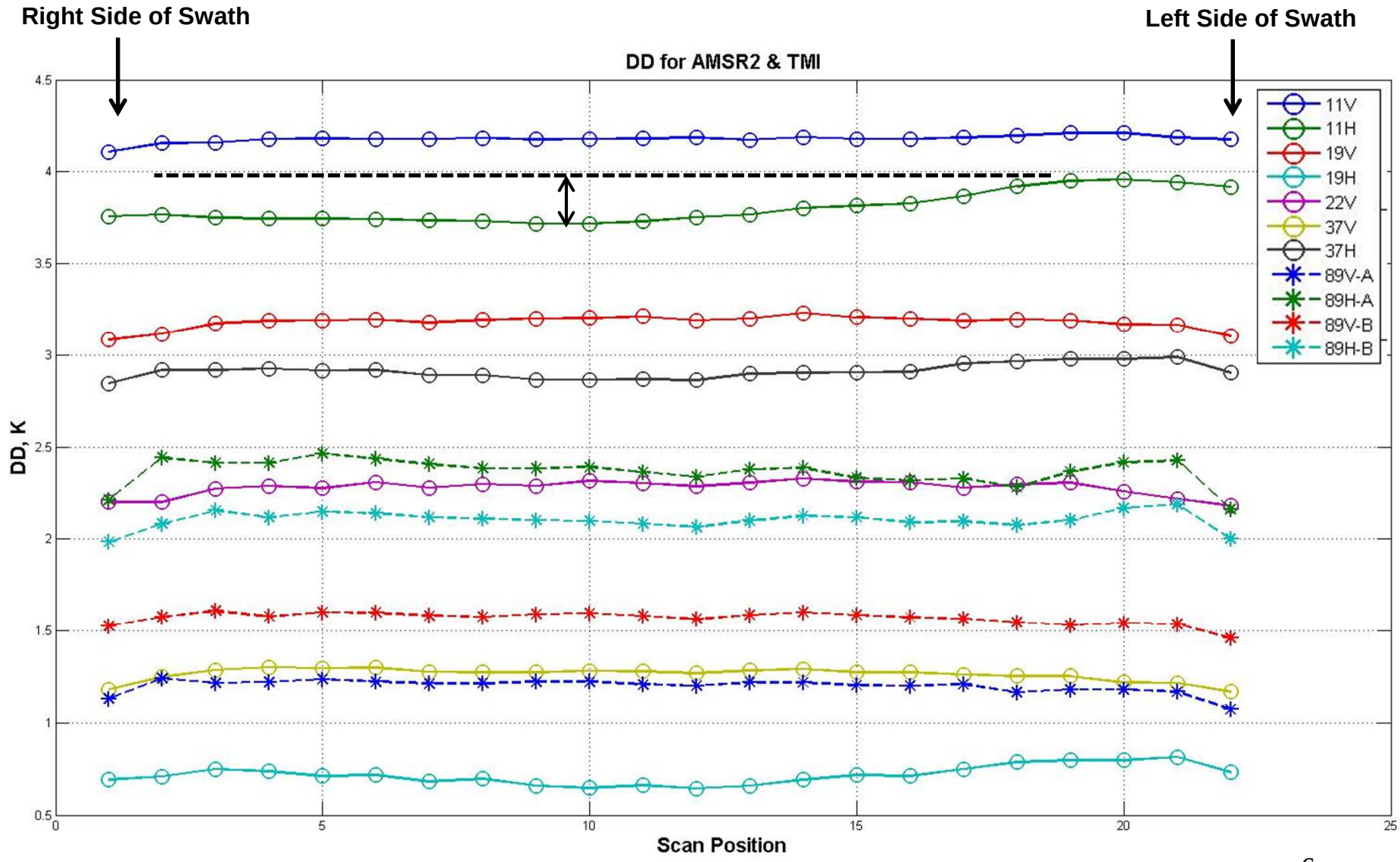
X-Cal Analysis

- Version 1.1 level 1b data from JAXA via PPS
  - Will also show results from previous Version 1.0 data
- Data from 2012/07 to 2013/04 have been analyzed by Xcal teams
  - TAMU: retrieval method + matchup with GDAS
  - CSU: retrieval method + matchup with multiple models
  - UCF: matchup with GDAS
  - UM: vicarious calibration, cold and warm

Cold Calibration Results

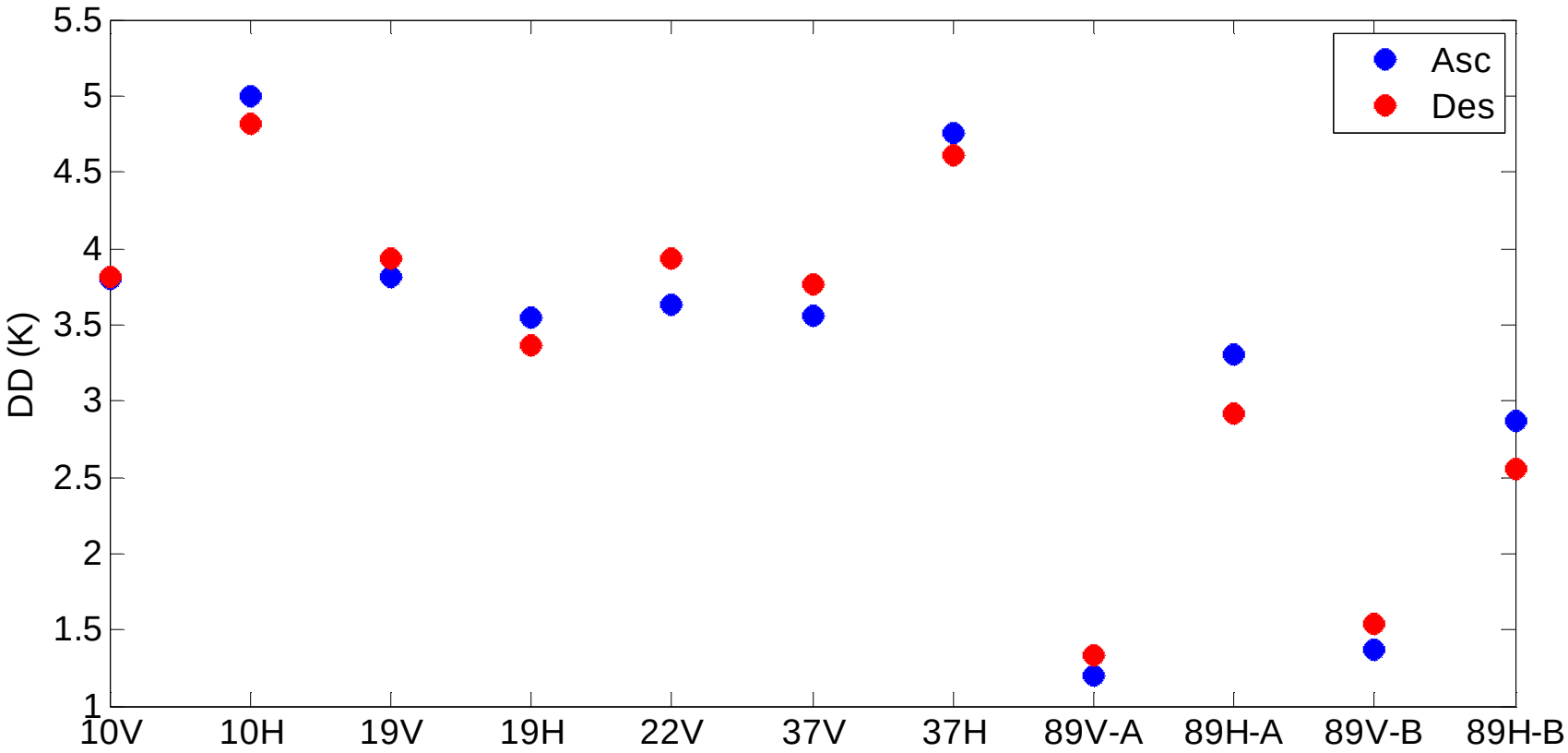
Results from Xcal teams over relatively cold ocean scenes

Analysis on AMSR2 Scan Position

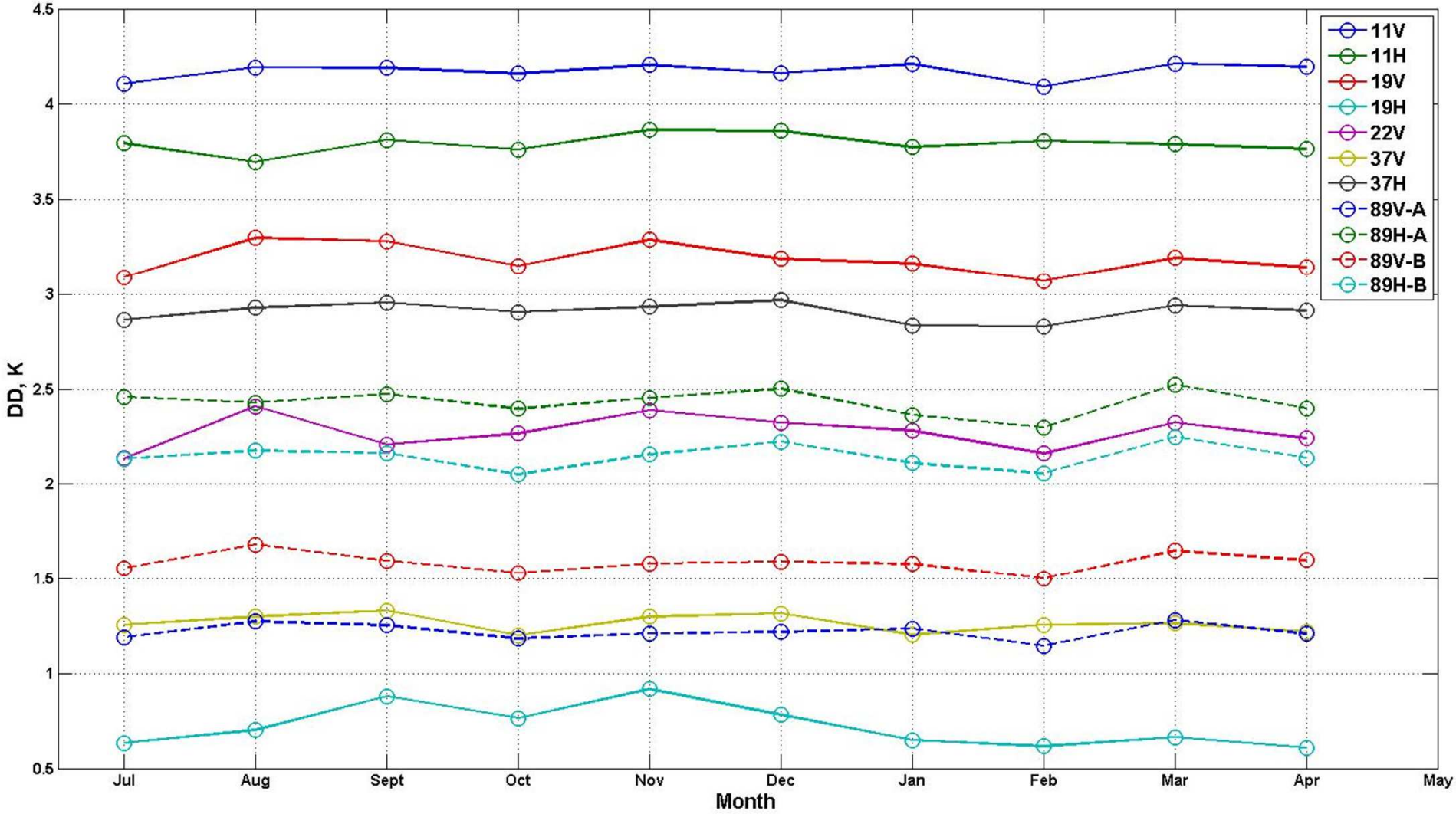


Bin Size: 11 scan positions for Low Res
22 scan positions for High Res

AMSR2 Double Difference Asc/Des



Analysis on Months

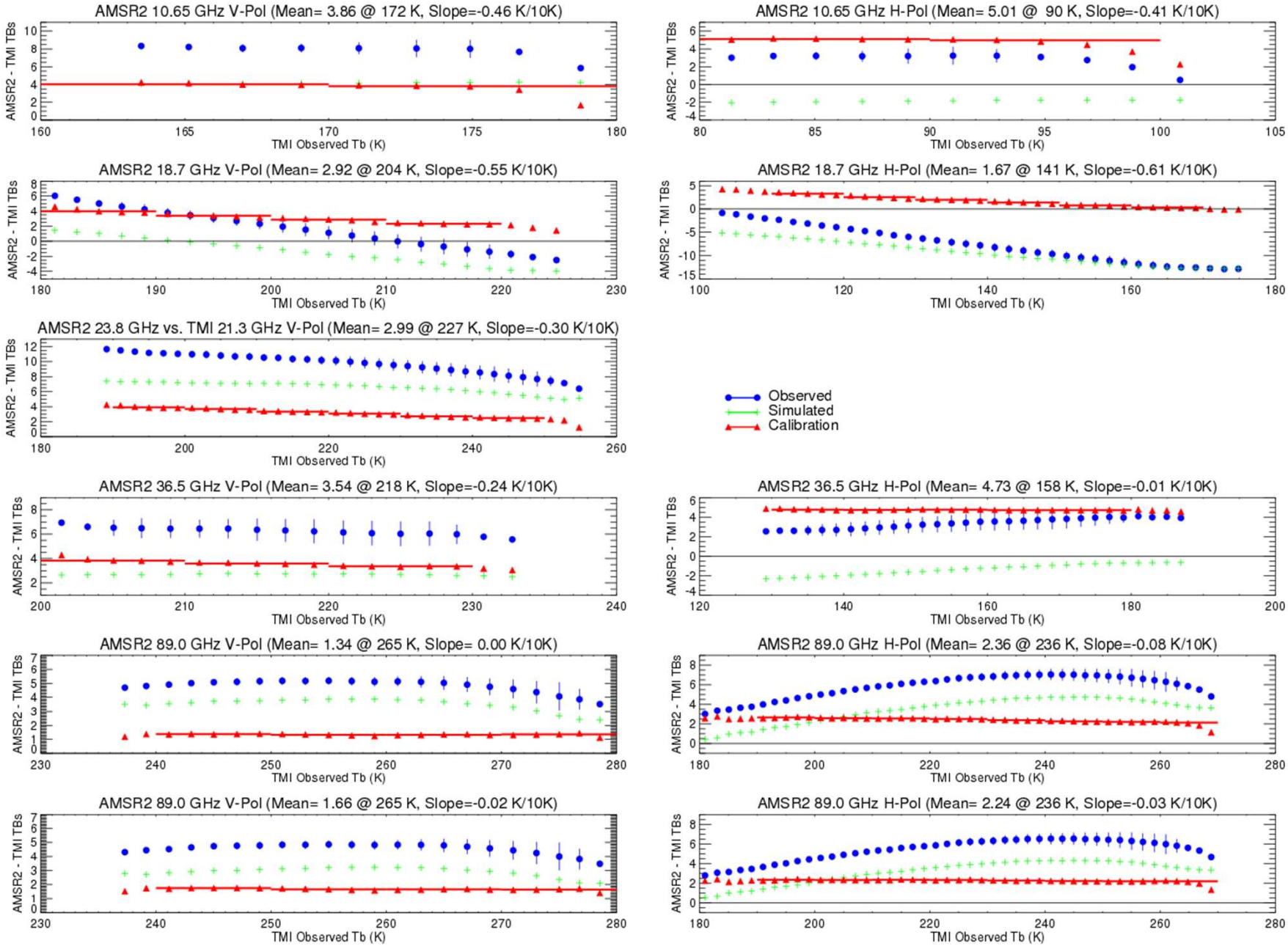


Combined Cold Double Differences/BTs AMSR2 V1.1* -TMI V7

Channel	TAMU GDAS (K/K)	CSU ERA-I (K/K)	UCF (K/K)	UM (K/K)	JAXA (K) Prelim (V1.0)
10V	3.9/179	3.9/172	4.0/167	3.8/164	4.3
10H	5.1/92	5.0/90	5.0/89	4.9/82	5.0
19V	3.2/204	3.9/204	3.7/194	3.9/183	3.5
19H	2.2/130	1.7/141	3.0/114	3.5/106	2.7
22V	3.3/234	3.0/227	3.8/215	3.8/193	5.5
37V	3.6/223	3.5/215	3.7/214	3.7/204	3.9
37H	4.8/159	4.7/158	4.7/144	4.7/131	4.5
85V-A	1.5/268	1.3/265	1.2/255	1.3/241	1.9
85H-A	2.5/239	2.4/236	2.4/211	3.1/182	2.8
85V-B	1.8/268	1.7/265	1.6/255	1.5/241	1.9
85H-B	2.4/239	2.2/236	2.1/211	2.7/182	2.3

*JAXA results are V1.0

CSU Results Vs. T_b



Warm Calibration Results

Results for relatively warm rainforest scenes

Warm Calibration Technique

- Want to find a stable calibration point at relatively high T_bs
  - Want point on warm end to use with relatively cold over ocean calibration
    - Get both gain and offset for radiometer calibration with a two point calibration similar to what is done on-orbit
      - Independent of on-board cal load issues
      - Calibration through the main antenna (end-to-end)
  - Look for warm, (near) black-body (= unpolarized) target

    ➔Heavy vegetation like the Amazon rainforest; method of Brown and Ruf

Warm Cal Reference Retrieved for Two Regions

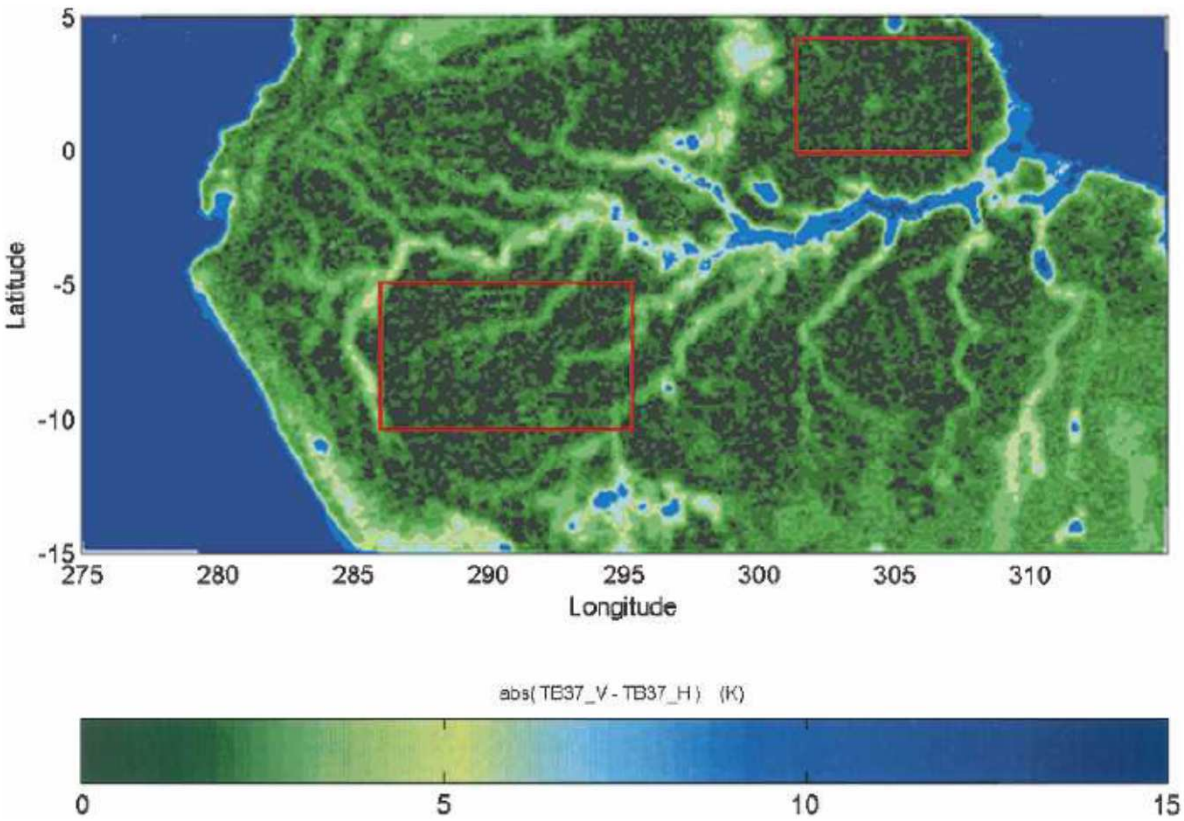


FIG. 1. Magnitude of the difference between vertically and horizontally polarized brightness temperature at 37 GHz, 53° incidence angle over the Amazon basin as measured by SSM/I. The red boxes denote regions of high depolarization, which have properties especially amenable to modeling as blackbody hot calibration reference sites.

Hot Vicarious Calibration Method

- Basic Steps:
  - Using simplified forward model and non-linear least squares fit, retrieve parameters of the rainforest surface and atmosphere from reference observations
    - Surface: temperature and emissivity
    - Atmosphere: water vapor and cloud liquid water
    - WindSat center of scan used as reference as with cold cal
  - Use forward model to translate target T_b for variations in frequency and incidence angle
  - Compute bias of observations at new frequency, incidence angle relative to target reference
    - Includes comparing T_bs as a function of scan position

Warm Double Differences
AMSR2 V2 -TMI V7

Channel	UM DD (K)	JAXA Preliminary DD (K)	Reported Temp (K)
10V	2.7	2.5	287
10H	4.1	3.1	287
19V	0.6	0.1	288
19H	1.2	0.1	288
22V	2.6	2.8	290
37V	3.3	3.0	287
37H	3.6	2.9	287
89V	2.9	2.9	288
89H	3.9	3.5	288

Additional Results

Break-down of results by group including
AMSR2 V1.0 vs V1.1

TAMU Cold Double Differences
AMSR2 – TMI V7

AMSR2 Channel	7ch	9ch	GDAS	JAXA Prelim
10V	4.1/3.9@179	4.1/4.0	4.1/3.9	4.3
10H	5.2/5.1@92	5.1/5.1	5.2/5.1	5.0
18V	4.1/3.4@204	4.1/3.4	4.0/3.2	3.5
18H	2.9/2.4@130	2.7/2.3	2.7/2.2	2.7
23V	4.1/3.2@234	4.1/3.2	4.2/3.3	5.5
23H *	5.8/5.3@187	6.0/5.5	6.7/6.3	
36V	4.3/3.6@223	4.4/3.6	4.3/3.6	3.9
36H	5.2/4.8@159	5.3/4.8	5.2/4.8	4.5
89AV	2.5/1.2@268	2.5/1.2	2.7/1.5	1.9
89AH	3.3/2.2@239	3.3/2.2	3.6/2.5	2.8
89BV	2.8/1.5@268	2.8/1.5	3.1/1.8	1.9
89BH	3.2/2.1@239	3.2/2.1	3.5/2.4	2.3

*23H Very Uncertain. Orlando Numbers/ Toulouse Numbers

CSU Cold Double Differences
AMSR2-TMI V7

Channel	DD (K) AMSR2 V 1.1 Optimal Est.	DD (K) AMSR2 V 1.1 ERA-I	Reported Temp (K)
10V	3.9	3.9	172
10H	5.1	5.0	90
19V	3.3	3.9	204
19H	2.3	1.7	141
22V	4.0	3.0	227
37V	3.6	3.5	215
37H	4.7	4.7	158
85V-A	1.3	1.3	265
85H-A	2.5	2.4	236
85V-B	1.7	1.7	265
85H-B	2.3	2.2	236

UM Cold Double Differences
AMSR2 – TMI V7

Channel	DD (K) AMSR2 V 1.0	DD (K) AMSR2 V 1.1	Reported Temp (K)
10V	4.3	3.8	163.9
10H	5.3	4.9	82.2
19V	4.6	3.9	182.6
19H	4.3	3.5	106.2
22V	4.3	3.8	192.8
37V	4.3	3.7	204.1
37H	5.4	4.7	131.3
85V-A	2.6	1.3	241.2
85H-A	2.6	3.1	182.2
85V-B	2.9	1.5	241.2
85H-B	2.2	2.7	182.2

UCF Cold Double Differences
AMSR2 – TMI V7

Channel	DD(K)	Reported Temp (K)
11V	3.97	167
11H	5.04	89
19V	3.65	194
19H	3.04	114
24V	3.76	215
37V	3.69	214
37H	4.74	144
89V–A	1.22	255
89H–A	2.43	211
89V–B	1.59	255
89H–B	2.15	211

Example of Combined Cold/Hot UM Results