Results of intercalibration between AMSR2 and TMI/AMSR-E
(AMSR2 Version 1.1)

Earth Observation Research Center
Japan Aerospace Exploration Agency

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Summary

- This material provides some updates from the one on April 5, 2013, in terms of used data period and AMSR-E slow rotation mode data.
- Brightness temperatures (Tbs) of AMSR2 (Version 1.1) were intercalibrated with those of TMI and AMSR-E.
- Differences were found between the calibration of AMSR2 and TMI/AMSR-E. The differences seem to be Tb-dependent.
- Intercalibration coefficients (slope and intercept) were derived to compensate the calibration differences.

  * Note that these coefficients are just to cancel out calibration differences. Differences originated from instrument's characteristics (e.g., center frequency and incidence angle) should be handled by users.

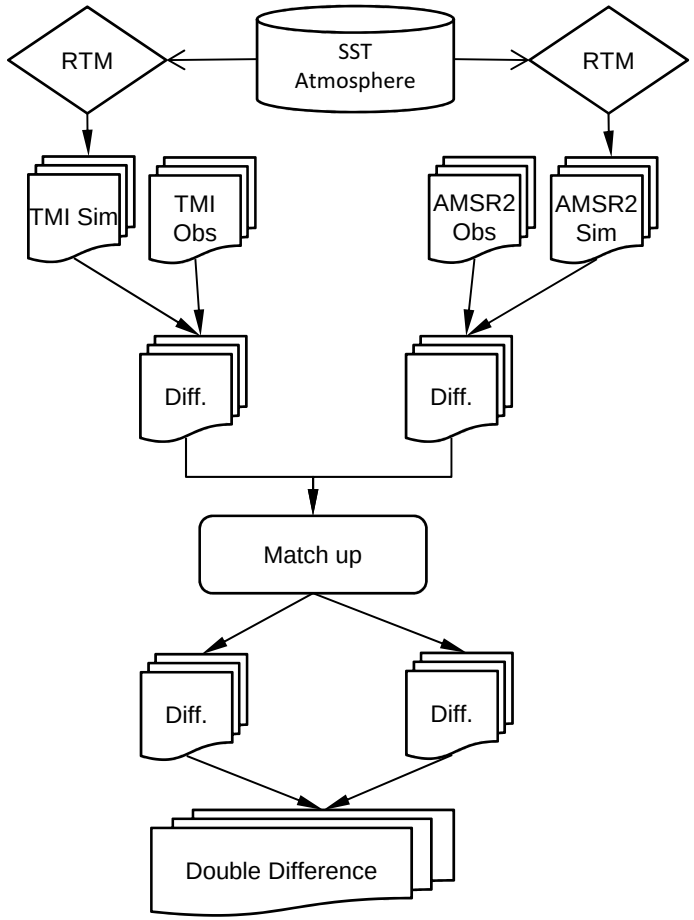
- Investigation of the causes of the calibration differences are underway.
- Further intercalibrations are in progress, including comparison with polar orbiting radiometers through TMI or by polar region match-ups. GMI data will also be used for further intercalibration.

Data and Models

- Tb products for intercalibration
  - AMSR2: Level-1B (Version 1.1)
  - AMSR-E: Level-1B (Version 3)
    - AMSR2 and AMSR-E Level-1B products are available from GCOM-W1 Data Providing Service at https://gcom-w1.jaxa.jp
  - TMI: 1B11 (Version 7)
  - AMSR-E: Level-1S
    - Research product observed in slow rotation mode. It is currently used just for consistency check.
    - http://sharaku.eorc.jaxa.jp/AMSR/products/amsre_slowdata.html
- Radiative transfer model (RTM)
  - RTTOV 10.2 distributed by NWP SAF.
  - Used surface emissivity model/atlas built-in RTTOV 10.2: FASTEM 5 for ocean and TELSEM for land surface emissivity.
- Global analysis data
  - ECMWF ERA-Interim analysis and JMA Merged satellite and in situ data Global Daily Sea Surface Temperatures (MGDSST) are used as atmospheric profile and SST, respectively.

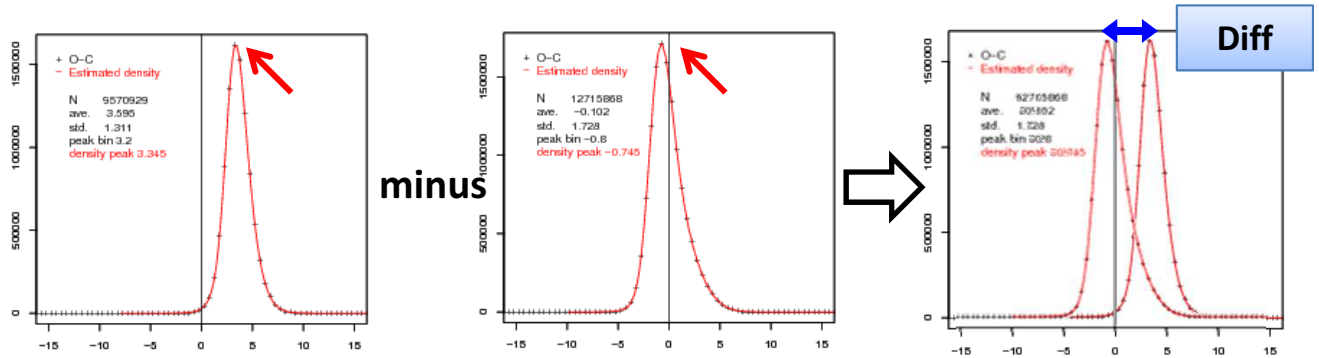
Methodology

- TMI intercalibration
  - Create collocation dataset from AMSR2 and TMI (15 minutes and 0.1 degrees grid).
  - Compute differences between observed- and calculated-Tb (O-C) for both AMSR2 and TMI, over rainforest and cloud-free/calm ocean areas. Global analysis data and RTM are used to derive calculated-Tbs.
  - Further create “double difference” to cancel out the differences in frequency and incidence angle: AMSR2(O-C) – TMI(O-C).



Methodology

- AMSR-E intercalibration (L1B, previous data)
  - Calculate differences between observed- and simulated-Tb (O-C) over rainforest and cloud-free/calm ocean areas for 2012 AMSR2 Tbs, by using global analysis data and RTM. Data period is one year, from July 2012 to June 2013, in this report.
  - Obtain peak values from O-C histogram.
  - Follow the same steps for AMSR-E one year data, from October 2010 to September 2011.
  - Differences between O-Cs indicate calibration differences within the limits of accuracy of global analysis (figures below).
- Consistency check with AMSR-E intercalibration (L1S)
  - Calculate differences between AMSR2 L1B and AMSR-E L1S observed Tbs (O-O). Data period in this report is from December 2012 to February 2013.
  - Obtain peak values from the O-O histogram.
  - Compare with the results from AMSR-E L1B intercalibration.



AMSR2 (2012-2013)
O(obs) – C(RTTOV)

AMSR-E (2010-2011)
O(obs) – C(RTTOV)

Summary of TMI intercalibration

- Intercalibration coefficients (slope/intercept) were derived by linear regression (no physical meaning of straight-line approximation). Calibration differences at typical Tbs are also shown in table below based on the intercalibration coefficients.
- Characteristics of the difference sometimes differ for ocean/land and ascending/descending (see next slide). Coefficients below were determined by using both ocean and rainforests values, and averaged over ascending and descending. Separated coefficients for ascending and descending are provided in Appendix.

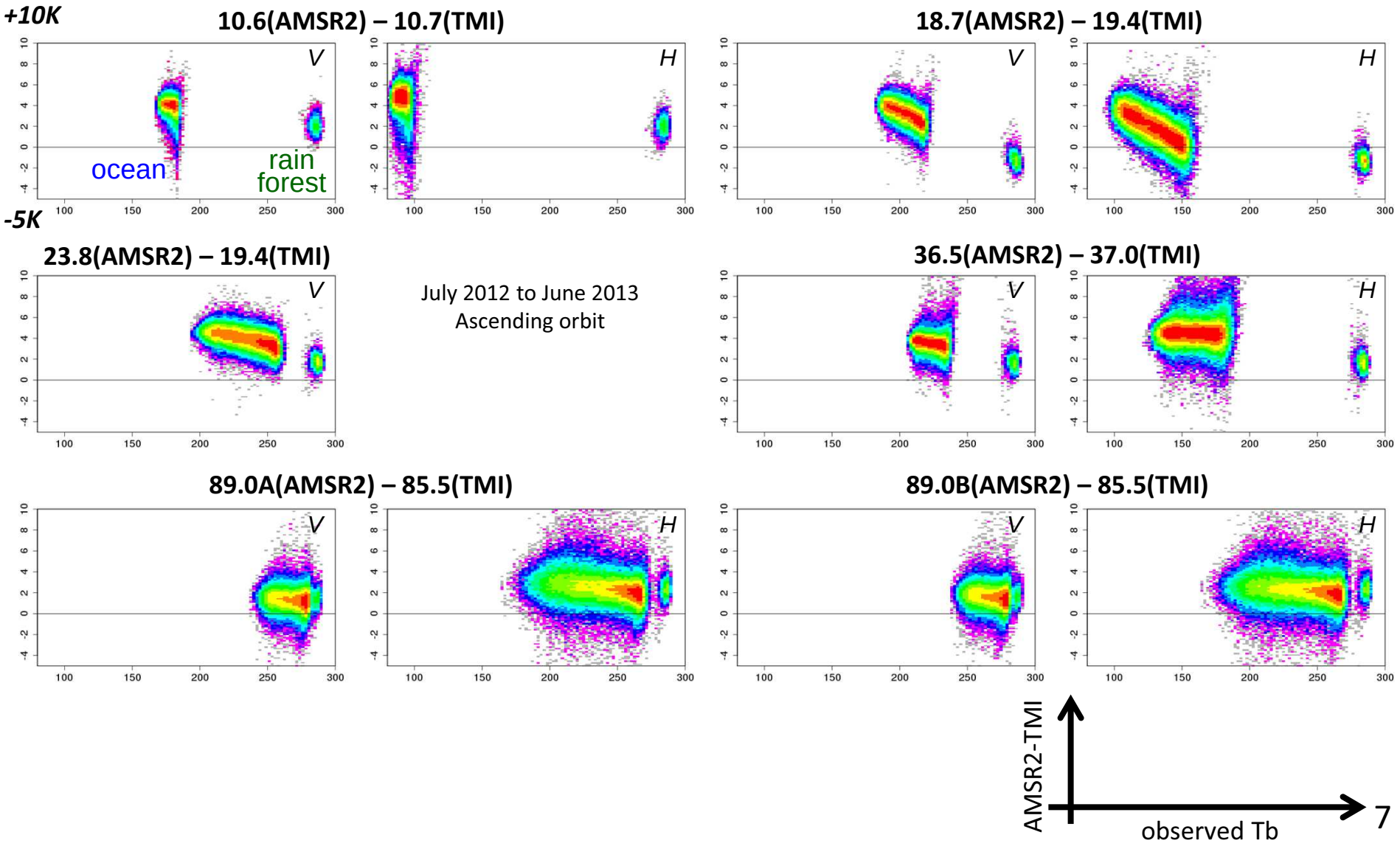
Asc+Dsc	AMSR(2-E)		ocean		rainforest	
	Slope	Intercept	TB	ΔT	TB	ΔT
10V	-0.01980	3.56086	180	+4.1	284	+2.1
10H	-0.01432	1.31417	92	+4.8	283	+2.1
18V	-0.05644	11.64917	206	+3.4	285	-1.0
18H	-0.02025	2.67061	132	+2.0	283	-1.1
23V	-0.04399	10.47329	238	+4.1	287	+2.0
23H	-	-	-	-	-	-
36V	-0.03239	7.28683	225	+3.7	283	+1.8
36H	-0.02387	3.84525	161	+4.6	283	+1.7
89AV	0.00325	-0.87898	271	+1.3	286	+1.4
89AH	-0.00614	1.49348	243	+2.4	286	+2.2
89BV	-0.00409	1.10484	270	+1.7	286	+1.6
89BH	0.00372	-0.90408	243	+2.3	286	+2.4

$$\Delta Cal_{AMSR2-TMI}[K] = Tb_{AMSR2}[K] * slope + intercept$$

$$\Delta Cal_{TMI-AMSR2}[K] = -(Tb_{AMSR2}[K] * slope + intercept)$$

Tb-dependent calibration differences with TMI

AMSR2 Ascending Passes



Summary of AMSR-E intercalibration

- Intercalibration coefficients (slope and intercept) provided below are those of lines passing through two O-C values over ocean and rainforest (no physical meaning for straight-line approximation). Calibration differences at typical Tbs are shown based on the coefficients.
- Averaged over ascending and descending passes. Separated coefficients for ascending and descending orbits are provided in Appendix.
- The calibration differences have good agreement in the consistency check by using the AMSR-E L1S data within 0.5K at most.

Asc+Dsc	AMSR-E(O-C)		AMSR-2(O-C)		AMSR(2-E)		ocean		rainforest	
	ocean	rainforest	ocean	rainforest	Slope	Intercept	TB	ΔT	TB	ΔT
6V	-1.8	-4.2	-0.3	-4.3	-0.01414	2.40305	170	+1.5	283	-0.1
6H	+0.1	-5.0	+2.1	-4.8	-0.00950	0.78967	83	+2.0	282	+0.1
7V	-	-	-0.1	-3.1	-0.00533	0.90961	171	+1.7	284	+1.1
7H	-	-	+2.7	-3.8	-0.00722	0.60737	84	+2.6	283	+1.1
10V	-1.8	-5.9	+2.5	-3.2	-0.01440	2.55318	177	+4.3	285	+2.7
10H	-0.2	-6.0	+3.1	-3.4	-0.00377	0.33740	89	+3.3	283	+2.6
18V	+0.1	-3.3	+3.8	-3.8	-0.05014	10.07842	201	+3.8	285	-0.5
18H	+1.5	-3.6	+2.4	-4.4	-0.01020	1.25821	123	+0.8	284	-0.8
23V	-0.2	-3.1	+2.7	-1.4	-0.02015	4.61315	229	+2.9	287	+1.7
23H	+1.3	-3.0	+4.4	-1.8	-0.01730	3.05393	177	+3.2	286	+1.3
36V	-1.0	-3.3	+2.5	-0.7	-0.01442	3.18150	221	+3.6	284	+2.7
36H	+0.4	-3.1	+4.1	-0.6	-0.00920	1.41439	154	+3.7	283	+2.5
89AV	-	-	+2.0	-1.2	-0.01587	4.20000	265	+1.7	287	+1.3
89AH	-	-	+4.8	-1.4	-0.03931	9.14565	233	+3.0	287	+0.9
89BV	+0.3	-2.5	+2.3	-1.1	-0.02590	6.84920	264	+2.0	287	+1.4
89BH	+1.8	-2.2	+4.2	-1.2	-0.02378	5.52598	232	+2.3	287	+1.0

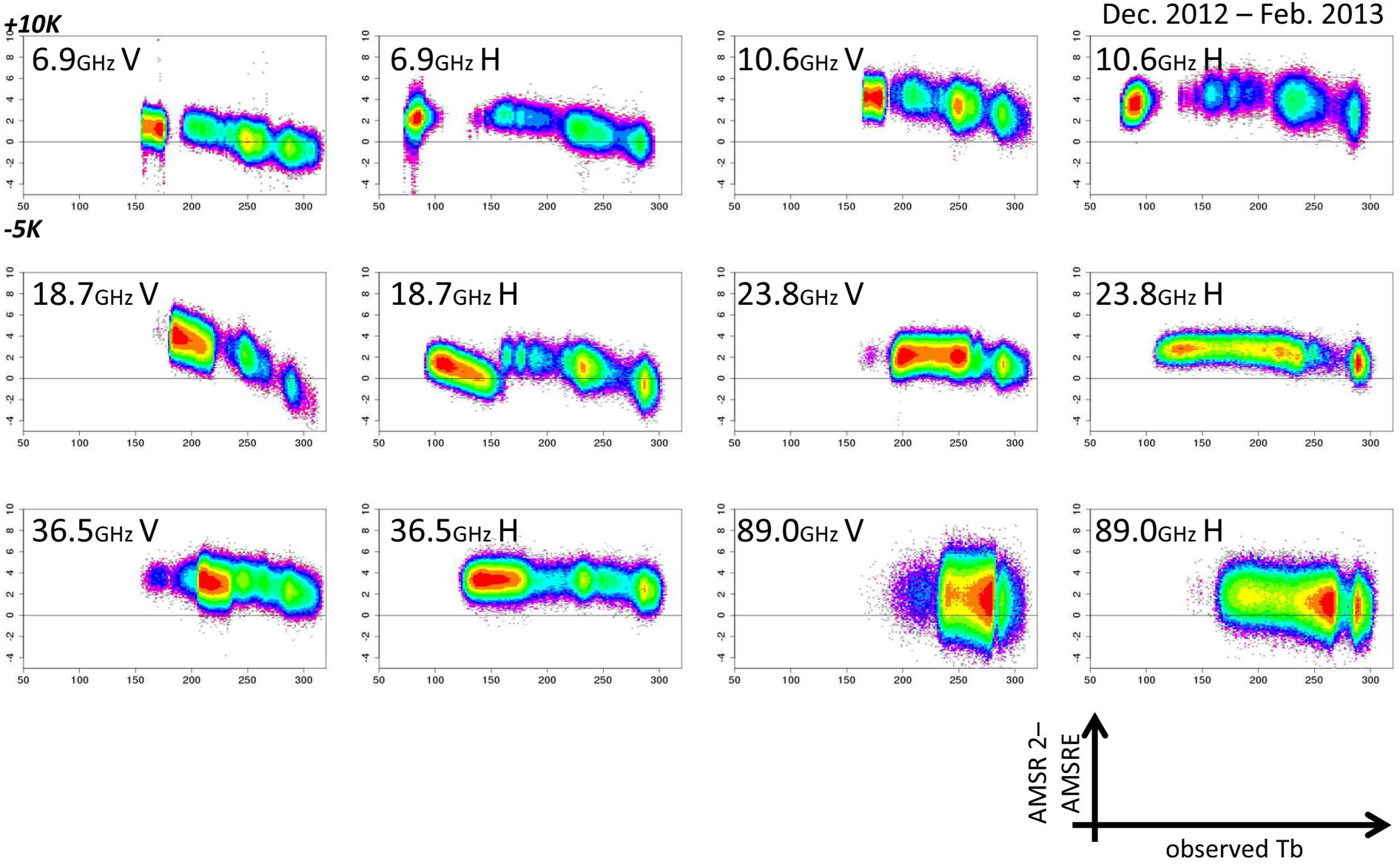
$$\Delta Cal_{AMSR2-AMSRE}[K] = Tb_{AMSR2}[K] * slope + intercept$$

$$\Delta Cal_{AMSRE-AMSR2}[K] = -(Tb_{AMSR2}[K] * slope + intercept)$$

Intercalibration results with AMSR-E (L1S)

AMSR2 Ascending Passes

Dec. 2012 – Feb. 2013



Appendix

Summary of TMI intercalibration

- Ascending and Descending -

Ascending	AMSR(2-E)		ocean		rainforest	
	Slope	Intercept	TB	ΔT	TB	ΔT
10V	-0.01966	3.53762	180	+4.2	287	+2.1
10H	-0.01510	1.38705	92	+4.9	285	+2.0
18V	-0.05782	11.93030	206	+3.4	287	-1.3
18H	-0.02127	2.80219	132	+2.0	285	-1.3
23V	-0.04217	10.03110	238	+3.9	288	+1.8
23H	-	-	-	-	-	-
36V	-0.03339	7.50763	225	+3.7	285	+1.7
36H	-0.02332	3.74756	161	+4.7	285	+1.8
89AV	0.00060	-0.16175	270	+1.4	287	+1.4
89AH	-0.00635	1.54286	243	+2.5	287	+2.2
89BV	-0.00463	1.25160	270	+1.7	287	+1.6
89BH	0.00403	-0.97620	242	+2.3	287	+2.5

Descending	AMSR(2-E)		ocean		rainforest	
	Slope	Intercept	TB	ΔT	TB	ΔT
10V	-0.01995	3.58521	180	+4.1	282	+2.1
10H	-0.01351	1.23959	92	+4.8	280	+2.2
18V	-0.05498	11.35137	206	+3.5	283	-0.7
18H	-0.01919	2.53442	132	+2.0	281	-0.9
23V	-0.04595	10.94850	238	+4.3	285	+2.2
23H	-	-	-	-	-	-
36V	-0.03130	7.04845	225	+3.7	281	+2.0
36H	-0.02445	3.94671	161	+4.5	281	+1.6
89AV	0.00640	-1.73247	271	+1.2	285	+1.3
89AH	-0.00590	1.43947	244	+2.4	285	+2.1
89BV	-0.00344	0.93019	271	+1.7	285	+1.7
89BH	0.00339	-0.82549	243	+2.2	285	+2.4

$$\Delta Cal_{AMSR2-TMI}[K] = Tb_{AMSR2}[K] * slope + intercept$$

$$\Delta Cal_{TMI-AMSR2}[K] = -(Tb_{AMSR2}[K] * slope + intercept)$$

Summary of AMSR-E intercalibration

- Ascending and Descending -

Ascending	AMSR-E(O-C)		AMSR-2(O-C)		AMSR(2-E)		ocean		rainforest	
	ocean	rainforest	ocean	rainforest	Slope	Intercept	TB	ΔT	TB	ΔT
6V	-1.8	-4.0	-0.2	-4.3	-0.01589	2.70907	171	+1.6	287	-0.3
6H	+0.1	-4.7	+2.2	-4.8	-0.01084	0.90408	83	+2.0	286	-0.2
7V	-	-	-0.1	-3.1	-0.00643	1.10021	171	+1.7	289	+0.9
7H	-	-	+2.7	-3.8	-0.00825	0.69634	84	+2.5	287	+0.9
10V	-1.8	-5.4	+2.5	-2.9	-0.01704	3.03079	178	+4.4	289	+2.5
10H	-0.2	-5.5	+3.2	-3.0	-0.00424	0.38061	90	+3.4	288	+2.5
18V	+0.2	-2.6	+3.9	-3.6	-0.05413	10.93266	202	+3.7	289	-1.0
18H	+1.3	-3.2	+2.4	-4.0	-0.01079	1.34553	125	+1.0	288	-0.7
23V	+0.1	-2.6	+2.8	-1.4	-0.02327	5.36885	231	+2.7	291	+1.3
23H	+1.3	-2.8	+4.5	-1.7	-0.01926	3.46134	180	+3.2	290	+1.1
36V	-1.0	-2.9	+2.5	-0.3	-0.01469	3.25158	221	+3.5	288	+2.5
36H	+0.1	-2.8	+4.0	-0.2	-0.01017	1.57216	155	+3.9	287	+2.6
89AV	-	-	+2.0	-1.2	-0.02526	6.71946	266	+1.7	290	+1.1
89AH	-	-	+4.7	-1.4	-0.04225	9.90878	235	+3.0	289	+0.6
89BV	+0.3	-2.3	+2.2	-1.0	-0.02910	7.73206	266	+2.0	290	+1.2
89BH	+1.7	-2.0	+3.7	-1.3	-0.02354	5.50958	234	+2.0	289	+0.7

Descending	AMSR-E(O-C)		AMSR-2(O-C)		AMSR(2-E)		ocean		rainforest	
	ocean	rainforest	ocean	rainforest	Slope	Intercept	TB	ΔT	TB	ΔT
6V	-1.9	-4.4	-0.4	-4.2	-0.01229	2.08028	169	+1.5	279	+0.2
6H	+0.1	-5.3	+2.1	-4.8	-0.00811	0.67174	83	+2.0	278	+0.5
7V	-	-	-0.2	-3.2	-0.00417	0.70808	170	+1.7	280	+1.2
7H	-	-	+2.7	-3.9	-0.00615	0.51548	84	+2.6	279	+1.4
10V	-1.8	-6.5	+2.4	-3.5	-0.01157	2.04428	177	+4.2	280	+3.0
10H	-0.2	-6.4	+3.1	-3.7	-0.00328	0.29269	89	+3.3	279	+2.7
18V	-0.0	-4.0	+3.8	-3.9	-0.04585	9.17044	200	+3.8	281	+0.1
18H	+1.7	-3.9	+2.4	-4.8	-0.00959	1.16990	122	+0.6	279	-0.9
23V	-0.5	-3.6	+2.6	-1.4	-0.01686	3.83053	227	+3.1	284	+2.2
23H	+1.3	-3.3	+4.4	-1.8	-0.01533	2.65752	173	+3.1	283	+1.5
36V	-1.1	-3.8	+2.6	-1.0	-0.01411	3.10529	220	+3.7	280	+2.8
36H	+0.8	-3.3	+4.2	-1.0	-0.00819	1.25134	153	+3.4	279	+2.3
89AV	-	-	+2.0	-1.1	-0.00527	1.38789	263	+1.7	284	+1.6
89AH	-	-	+5.0	-1.4	-0.03629	8.37453	231	+3.0	284	+1.1
89BV	+0.3	-2.8	+2.3	-1.2	-0.02228	5.86617	263	+2.1	285	+1.6
89BH	+2.0	-2.5	+4.6	-1.1	-0.02404	5.54322	231	+2.6	284	+1.3

$$\Delta Cal_{AMSR2-AMSRE}[K] = Tb_{AMSR2}[K] * slope + intercept$$

$$\Delta Cal_{AMSRE-AMSR2}[K] = -(Tb_{AMSR2}[K] * slope + intercept)$$