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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Correction of erroneous intercalibration slopes/offsets
in the version on March 12, 2014

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.

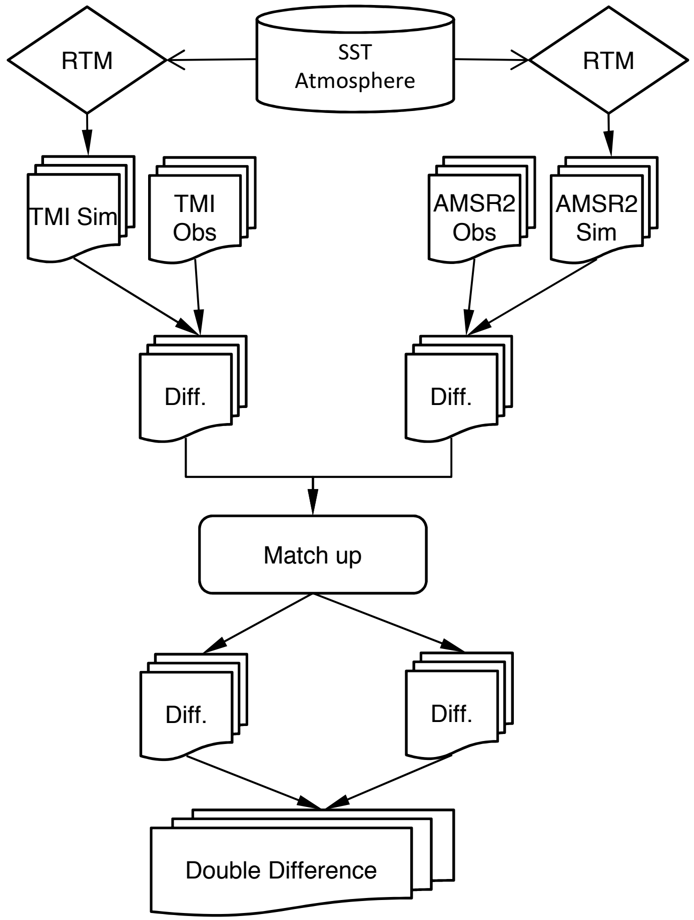
- Investigation of the causes of the calibration differences are underway.
- Further intercalibrations are in progress, including comparison with polar orbiting radiometers through TMI or by polar region match-ups. GMI data will also be used for further intercalibration.

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.

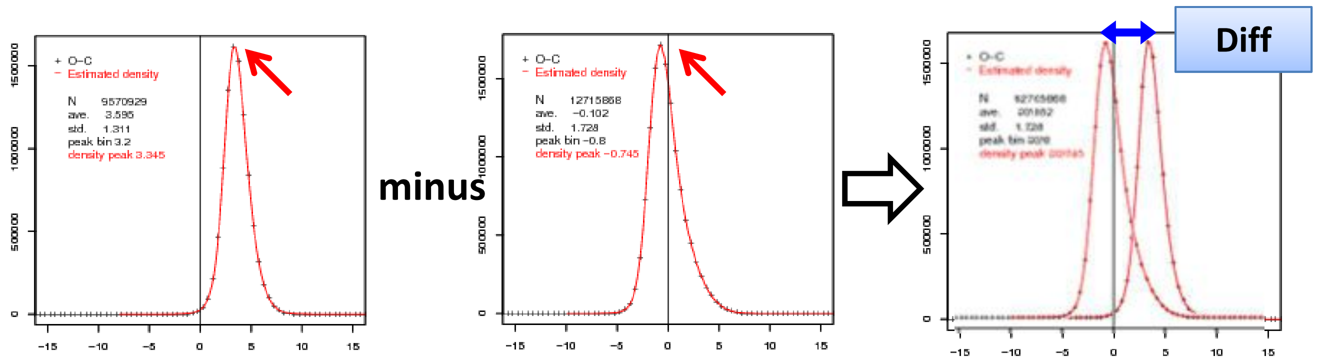
Methodology

- 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.

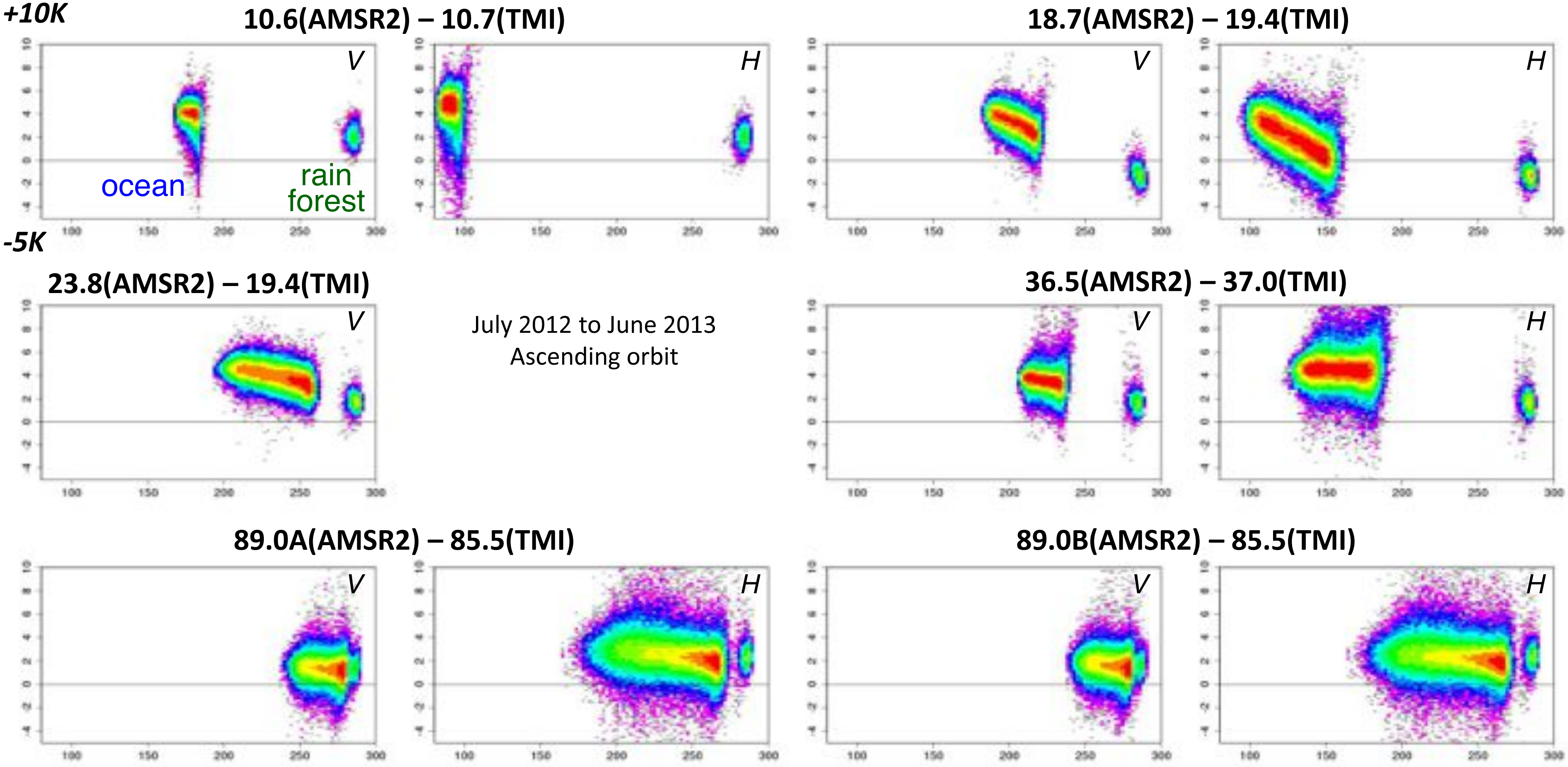
Asc+Dsc	AMSR2 - TMI		ocean		rainforest	
	Slope	Intercept	TB (K)	ΔT (K)	TB (K)	ΔT (K)
10V	-0.01980	7.69586	180	+4.1	284	+2.1
10H	-0.01432	6.13417	92	+4.8	283	+2.1
18V	-0.05644	15.08917	206	+3.4	285	-1.0
18H	-0.02025	4.66061	132	+2.0	283	-1.1
23V	-0.04399	14.59829	238	+4.1	287	+2.0
23H	-	-	-	-	-	-
36V	-0.03239	10.98683	225	+3.7	283	+1.8
36H	-0.02387	8.45525	161	+4.6	283	+1.7
89AV	0.00325	0.42602	271	+1.3	286	+1.4
89AH	-0.00614	3.92848	243	+2.4	286	+2.2
89BV	-0.00409	2.78984	270	+1.7	286	+1.6
89BH	0.00372	1.35592	243	+2.3	286	+2.4

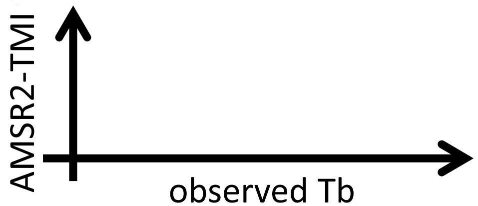
$$\Delta Cal_{AMSR2-TMI}[K] = Tb_{AMSR2}[K] * slope + intercept$$

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

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.

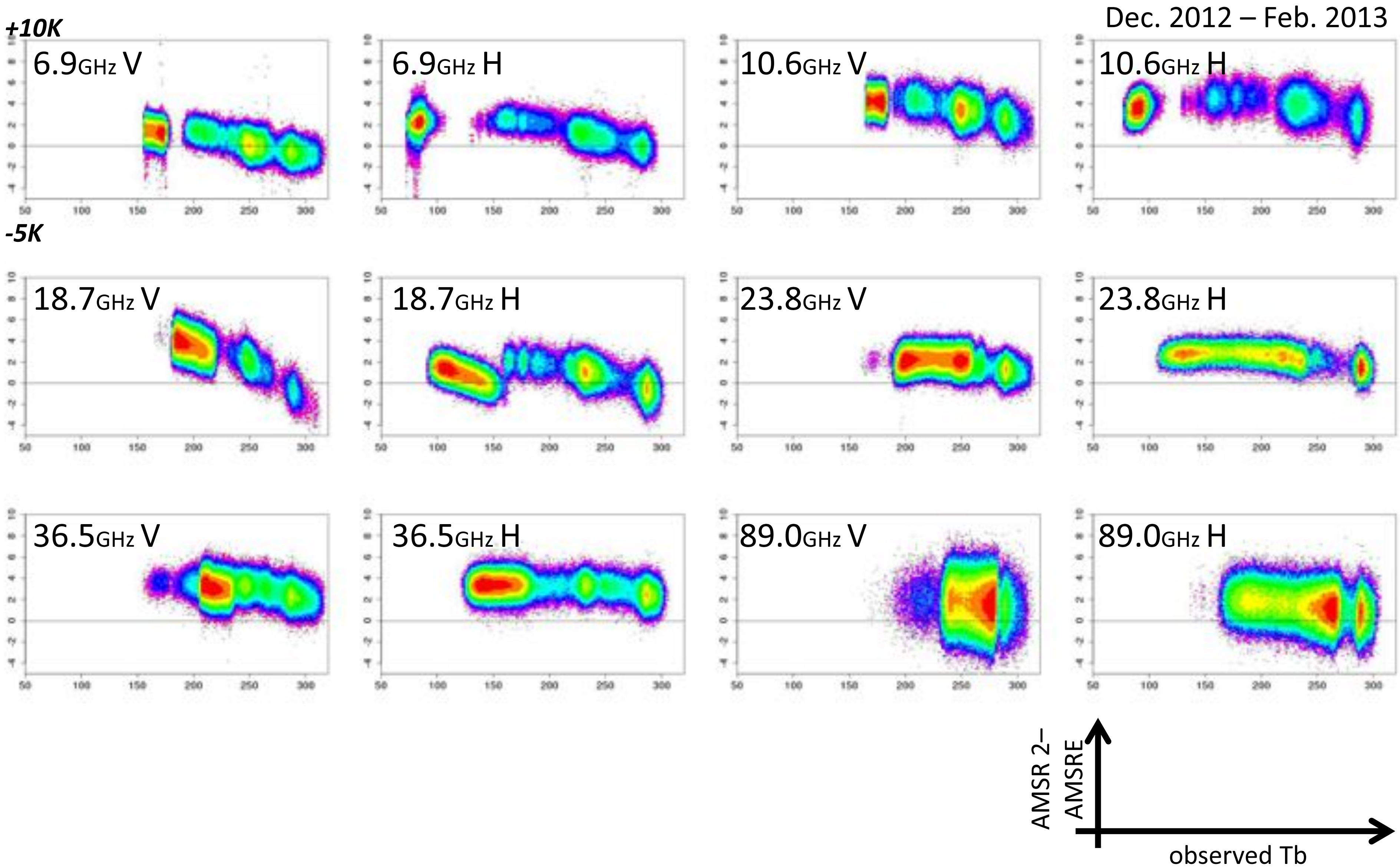
Asc+Dsc	AMSRE(O-C)		AMSR2(O-C)		AMSR(2-E)		ocean		rainforest	
	ocean	rainforest	ocean	rainforest	Slope	Intercept	TB (K)	ΔT (K)	TB (K)	ΔT (K)
6V	-1.8	-4.2	-0.3	-4.3	-0.01414	3.93780	170	1.5	283	-0.1
6H	0.1	-5.0	2.1	-4.8	-0.00950	2.82535	83	2.0	282	0.1
7V	-	-	-0.1	-3.1	-0.00533	2.59934	171	1.7	284	1.1
7H	-	-	2.7	-3.8	-0.00722	3.17482	84	2.6	283	1.1
10V	-1.8	-5.9	2.5	-3.2	-0.01440	6.84031	177	4.3	285	2.7
10H	-0.2	-6.0	3.1	-3.4	-0.00377	3.66738	89	3.3	283	2.6
18V	0.1	-3.3	3.8	-3.8	-0.05014	13.83082	201	3.8	285	-0.5
18H	1.5	-3.6	2.4	-4.4	-0.01020	2.09611	123	0.8	284	-0.8
23V	-0.2	-3.1	2.7	-1.4	-0.02015	7.52967	229	2.9	287	1.7
23H	1.3	-3.0	4.4	-1.8	-0.01730	6.22383	177	3.2	286	1.3
36V	-1.0	-3.3	2.5	-0.7	-0.01442	6.77155	221	3.6	284	2.7
36H	0.4	-3.1	4.1	-0.6	-0.00920	5.07333	154	3.7	283	2.5
89AV	-	-	2.0	-1.2	-0.01587	5.90429	265	1.7	287	1.3
89AH	-	-	4.8	-1.4	-0.03931	12.13781	233	3.0	287	0.9
89BV	0.3	-2.5	2.3	-1.1	-0.02590	8.86378	264	2.0	287	1.4
89BH	1.8	-2.2	4.2	-1.2	-0.02378	7.85141	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



Appendix

Summary of TMI intercalibration

- Ascending and Descending -

Ascending	AMSR2 - TMI		ocean		rainforest	
	Slope	Intercept	TB (K)	ΔT (K)	TB (K)	ΔT (K)
10V	-0.01966	7.69762	180	+4.2	287	+2.1
10H	-0.01510	6.27705	92	+4.9	285	+2.0
18V	-0.05782	15.29030	206	+3.4	287	-1.3
18H	-0.02127	4.77219	132	+2.0	285	-1.3
23V	-0.04217	13.97110	238	+3.9	288	+1.8
23H	-	-	-	-	-	-
36V	-0.03339	11.17763	225	+3.7	285	+1.7
36H	-0.02332	8.42756	161	+4.7	285	+1.8
89AV	0.00060	1.24825	270	+1.4	287	+1.4
89AH	-0.00635	4.04286	243	+2.5	287	+2.2
89BV	-0.00463	2.92160	270	+1.7	287	+1.6
89BH	0.00403	1.30380	242	+2.3	287	+2.5

Descending	AMSR2 - TMI		ocean		rainforest	
	Slope	Intercept	TB (K)	ΔT (K)	TB (K)	ΔT (K)
10V	-0.01995	7.69521	180	+4.1	282	+2.1
10H	-0.01351	5.98959	92	+4.8	280	+2.2
18V	-0.05498	14.87137	206	+3.5	283	-0.7
18H	-0.01919	4.54442	132	+2.0	281	-0.9
23V	-0.04595	15.25850	238	+4.3	285	+2.2
23H	-	-	-	-	-	-
36V	-0.03130	10.77845	225	+3.7	281	+2.0
36H	-0.02445	8.48671	161	+4.5	281	+1.6
89AV	0.00640	-0.53247	271	+1.2	285	+1.3
89AH	-0.00590	3.80947	244	+2.4	285	+2.1
89BV	-0.00344	2.63019	271	+1.7	285	+1.7
89BH	0.00339	1.41451	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	AMSRE(O-C)		AMSR2(O-C)		AMSR(2-E)		ocean		rainforest	
	ocean	rainforest	ocean	rainforest	Slope	Intercept	TB (K)	ΔT (K)	TB (K)	ΔT (K)
6V	-1.8	-4.0	-0.2	-4.3	-0.01589	4.26274	171	+1.6	287	-0.3
6H	0.1	-4.7	2.2	-4.8	-0.01084	2.94563	83	+2.0	286	-0.2
7V	-	-	-0.1	-3.1	-0.00643	2.77795	171	+1.7	289	+0.9
7H	-	-	2.7	-3.8	-0.00825	3.23788	84	+2.5	287	+0.9
10V	-1.8	-5.4	2.5	-2.9	-0.01704	7.40349	178	+4.4	289	+2.5
10H	-0.2	-5.5	3.2	-3.0	-0.00424	3.73465	90	+3.4	288	+2.5
18V	0.2	-2.6	3.9	-3.6	-0.05413	14.64512	202	+3.7	289	-1.0
18H	1.3	-3.2	2.4	-4.0	-0.01079	2.38433	125	+1.0	288	-0.7
23V	0.1	-2.6	2.8	-1.4	-0.02327	8.06181	231	+2.7	291	+1.3
23H	1.3	-2.8	4.5	-1.7	-0.01926	6.65809	180	+3.2	290	+1.1
36V	-1.0	-2.9	2.5	-0.3	-0.01469	6.74016	221	+3.5	288	+2.5
36H	0.1	-2.8	4.0	-0.2	-0.01017	5.50737	155	+3.9	287	+2.6
89AV	-	-	2.0	-1.2	-0.02526	8.40045	266	+1.7	290	+1.1
89AH	-	-	4.7	-1.4	-0.04225	12.86375	235	+3.0	289	+0.6
89BV	0.3	-2.3	2.2	-1.0	-0.02910	9.68392	266	+2.0	290	+1.2
89BH	1.7	-2.0	3.7	-1.3	-0.02354	7.53100	234	+2.0	289	+0.7

Descending	AMSRE(O-C)		AMSR2(O-C)		AMSR(2-E)		ocean		rainforest	
	ocean	rainforest	ocean	rainforest	Slope	Intercept	TB (K)	ΔT (K)	TB (K)	ΔT (K)
6V	-1.9	-4.4	-0.4	-4.2	-0.01229	3.59611	169	+1.5	279	+0.2
6H	0.1	-5.3	2.1	-4.8	-0.00811	2.70154	83	+2.0	278	+0.5
7V	-	-	-0.2	-3.2	-0.00417	2.40981	170	+1.7	280	+1.2
7H	-	-	2.7	-3.9	-0.00615	3.10883	84	+2.6	279	+1.4
10V	-1.8	-6.5	2.4	-3.5	-0.01157	6.24584	177	+4.2	280	+3.0
10H	-0.2	-6.4	3.1	-3.7	-0.00328	3.59859	89	+3.3	279	+2.7
18V	0.0	-4.0	3.8	-3.9	-0.04585	12.96276	200	+3.8	281	+0.1
18H	1.7	-3.9	2.4	-4.8	-0.00959	1.80690	122	+0.6	279	-0.9
23V	-0.5	-3.6	2.6	-1.4	-0.01686	6.97062	227	+3.1	284	+2.2
23H	1.3	-3.3	4.4	-1.8	-0.01533	5.80057	173	+3.1	283	+1.5
36V	-1.1	-3.8	2.6	-1.0	-0.01411	6.79681	220	+3.7	280	+2.8
36H	0.8	-3.3	4.2	-1.0	-0.00819	4.63400	153	+3.4	279	+2.3
89AV	-	-	2.0	-1.1	-0.00527	3.11548	263	+1.7	284	+1.6
89AH	-	-	5.0	-1.4	-0.03629	11.40389	231	+3.0	284	+1.1
89BV	0.3	-2.8	2.3	-1.2	-0.02228	7.94346	263	+2.1	285	+1.6
89BH	2.0	-2.5	4.6	-1.1	-0.02404	8.17265	231	+2.6	284	+1.3

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

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