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

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April 5, 2013

Summary

- 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.

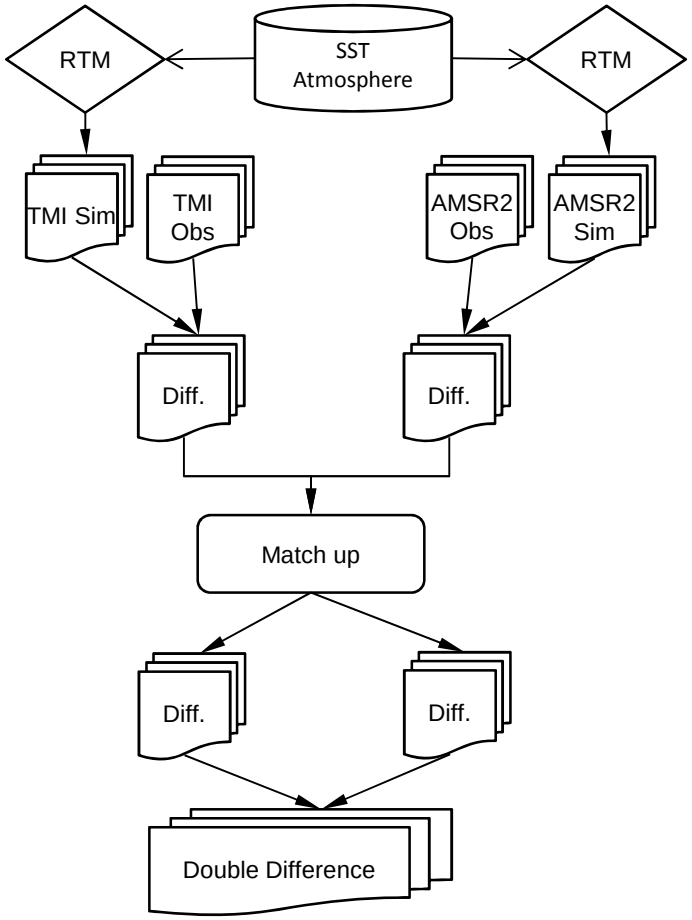
  * Note that these coefficients are just to cancel out calibration differences. Differences originated from instrument's characteristics (e.g., center frequency and incidence angle) should be handled by users.
- Investigation of the causes of the calibration differences are underway.
- Further intercalibrations are in progress, including comparison with polar orbiting radiometers through TMI or by polar region match-ups, and direct comparison with AMSR-E Tbs obtained by slow rotation observation (from December 2012).

Data and Models

- Tb products for intercalibration
  - AMSR2: Level-1B (Version 1.1)
  - TMI: 1B11 (Version 7)
  - AMSR-E: Level-1B (Version 3)
- 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.

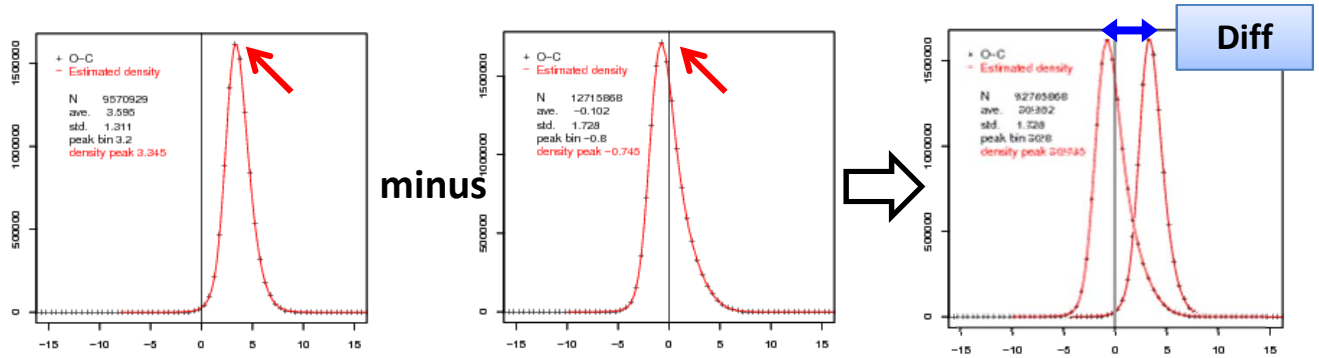
Methodology

- 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
  - 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 from July to September in this report.
  - Obtain peak values from O-C histogram.
  - Follow the same steps for 2011 AMSR-E data in the same period.
  - Differences between O-Cs indicate calibration differences within the limits of accuracy of global analysis.



AMSR2 (2012)
O(obs) – C(RTTOV)

AMSR-E (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.

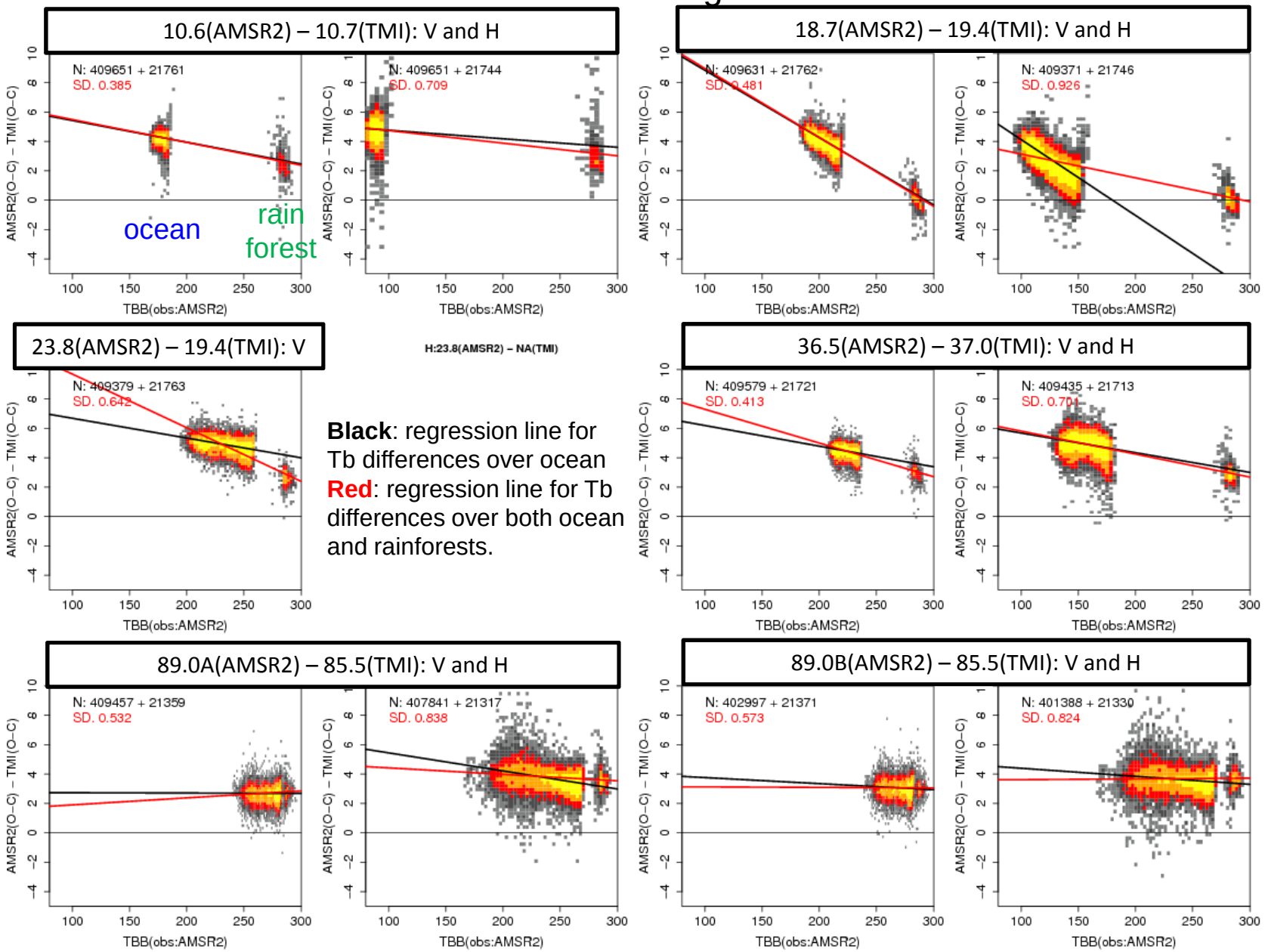
Asc+Dsc	slope	intercept	TB@ocean	ΔT@ocean	TB@land	ΔT@land
10V	-0.01662	6.99952	179	+4.0	285	+2.3
10H	-0.00975	5.61573	91	+4.7	283	+2.9
18V	-0.05124	13.80014	205	+3.3	286	-0.8
18H	-0.01944	4.62348	131	+2.1	284	-0.9
23V	-0.03970	13.47956	237	+4.1	288	+2.0
23H	-	-	-	-	-	-
36V	-0.02711	9.66059	224	+3.6	285	+1.9
36H	-0.02108	7.84445	160	+4.5	284	+1.9
89AV	-0.00141	1.75392	270	+1.4	287	+1.3
89AH	-0.00975	4.97772	242	+2.6	287	+2.2
89BV	-0.00618	3.37024	269	+1.7	287	+1.6
89BH	-0.00545	3.80564	241	+2.5	287	+2.2

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

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

Tb-dependent calibration differences

AMSR2 Ascending Passes



Black: regression line for Tb differences over ocean

Red: regression line for Tb differences over both ocean and rainforests.

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.

Asc+Dsc	AMSR-E(O-C)		AMSR-2(O-C)		AMSR(2-E)		Ocean		Land	
	Ocean	Land	Ocean	Land	Slope	Intercept	TB	ΔT	TB	ΔT
06V	-1.8	-2.6	-0.3	-2.7	-0.01412	3.89494	167	+1.5	282	-0.1
06H	+0.3	-3.3	+2.3	-3.3	-0.00982	2.83897	82	+2.0	281	+0.1
07V	NA	NA	-0.1	-1.1	-0.00203	2.08485	168	+1.7	284	+1.5
07H	NA	NA	+2.8	-2.3	-0.00805	3.30649	83	+2.6	282	+1.0
10V	-1.6	-3.9	+2.6	-1.1	-0.01351	6.70216	175	+4.3	284	+2.9
10H	+0.3	-4.0	+3.4	-1.5	-0.00293	3.42724	87	+3.2	282	+2.6
18V	+0.7	-1.5	+4.4	-2.1	-0.04960	13.49461	195	+3.8	284	-0.6
18H	+3.1	-1.5	+3.8	-2.3	-0.00945	1.82686	113	+0.8	283	-0.8
23V	+1.5	-1.6	+4.0	+0.1	-0.01237	5.29143	217	+2.6	287	+1.7
23H	+3.9	-1.6	+6.5	-0.4	-0.01114	4.49098	155	+2.8	286	+1.3
36V	-0.5	-1.5	+2.9	+1.1	-0.01103	5.78519	216	+3.4	283	+2.7
36H	+2.1	-1.2	+5.1	+1.3	-0.00440	3.78759	144	+3.2	283	+2.5
89AV	NA	NA	+3.1	+0.2	-0.01578	5.71765	257	+1.7	286	+1.2
89AH	NA	NA	+7.1	+0.2	-0.01738	5.61016	213	+1.9	286	+0.6
89BV	+1.6	-0.9	+3.4	+0.6	-0.01304	5.33198	257	+2.0	286	+1.6
89BH	+5.4	-0.4	+6.9	+0.3	-0.01133	4.04361	213	+1.6	286	+0.8

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

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

Appendix

Summary of TMI intercalibration

- Ascending and Descending -

Ascending	slope	intercept	TB@ocean	ΔT@ocean	TB@land	ΔT@land
10V	-0.01919	7.43988	179	+4.0	287	+1.9
10H	-0.01074	5.79105	91	+4.8	285	+2.7
18V	-0.05379	14.12539	204	+3.2	287	-1.3
18H	-0.02127	4.85403	129	+2.1	286	-1.2
23V	-0.04087	13.47508	235	+3.9	289	+1.7
23H						
36V	-0.02910	9.95147	223	+3.5	286	+1.6
36H	-0.02182	7.90710	158	+4.5	285	+1.7
89AV	-0.00165	1.79027	269	+1.4	288	+1.3
89AH	-0.00929	4.86461	239	+2.6	287	+2.2
89BV	-0.00528	3.04011	268	+1.6	288	+1.5
89BH	-0.00585	3.81577	238	+2.4	287	+2.1

Descending	slope	intercept	TB@ocean	ΔT@ocean	TB@land	ΔT@land
10V	-0.01405	6.55917	179	+4.0	283	+2.6
10H	-0.00876	5.44041	91	+4.6	281	+3.0
18V	-0.04869	13.47488	206	+3.4	284	-0.4
18H	-0.01760	4.39293	132	+2.1	282	-0.6
23V	-0.03852	13.48404	238	+4.3	287	+2.4
23H						
36V	-0.02511	9.36971	225	+3.7	283	+2.3
36H	-0.02035	7.78179	161	+4.5	282	+2.0
89AV	-0.00117	1.71757	270	+1.4	286	+1.4
89AH	-0.01021	5.09084	244	+2.6	286	+2.2
89BV	-0.00708	3.70037	270	+1.8	286	+1.7
89BH	-0.00506	3.79552	243	+2.6	286	+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		Land	
	Ocean	Land	Ocean	Land	Slope	Intercept	TB	ΔT	TB	ΔT
06V	-1.8	-3.5	-0.2	-4.0	-0.01721	4.48848	168	+1.6	288	-0.5
06H	+0.3	-4.4	+2.3	-4.5	-0.01060	2.92763	82	+2.1	287	-0.1
07V	NA	NA	+0.0	-2.4	-0.00492	2.66166	168	+1.8	291	+1.2
07H	NA	NA	+2.9	-3.6	-0.00891	3.39916	83	+2.7	288	+0.8
10V	-1.8	-4.7	+2.7	-2.1	-0.01734	7.63511	175	+4.6	290	+2.6
10H	+0.1	-4.8	+3.4	-2.6	-0.00537	3.83960	87	+3.4	289	+2.3
18V	+0.6	-2.1	+4.5	-3.2	-0.05307	14.31457	195	+4.0	290	-1.1
18H	+3.1	-2.6	+3.8	-3.2	-0.00826	1.72220	114	+0.8	289	-0.7
23V	+1.7	-1.9	+4.1	-0.7	-0.01686	6.25463	217	+2.6	291	+1.3
23H	+3.8	-2.3	+6.4	-0.8	-0.00956	4.27756	156	+2.8	290	+1.5
36V	-0.7	-2.0	+2.8	+0.4	-0.01534	6.88561	215	+3.6	288	+2.5
36H	+1.9	-2.0	+5.1	+0.3	-0.00618	4.16480	144	+3.3	287	+2.4
89AV	NA	NA	+3.2	-0.4	-0.01671	6.10373	257	+1.8	289	+1.3
89AH	NA	NA	+7.3	-0.2	-0.01846	6.26630	214	+2.3	289	+0.9
89BV	+1.7	-1.5	+3.5	+0.1	-0.01106	4.93692	257	+2.1	289	+1.7
89BH	+5.2	-1.0	+6.9	-0.2	-0.01304	4.62759	213	+1.8	289	+0.9

Descending	AMSR-E(O-C)		AMSR-2(O-C)		AMSR(2-E)		Ocean		Land	
	Ocean	Land	Ocean	Land	Slope	Intercept	TB	ΔT	TB	ΔT
06V	-1.8	-1.7	-0.3	-1.4	-0.01018	3.15977	167	+1.5	282	+0.3
06H	+0.2	-2.3	+2.2	-2.1	-0.00874	2.73023	82	+2.0	281	+0.3
07V	NA	NA	-0.1	+0.1	0.00112	1.46345	168	+1.7	284	+1.8
07H	NA	NA	+2.8	-1.1	-0.00693	3.19522	83	+2.6	282	+1.2
10V	-1.5	-3.2	+2.5	-0.2	-0.00872	5.60089	175	+4.1	284	+3.1
10H	+0.4	-3.2	+3.3	-0.4	-0.00032	3.00164	87	+3.0	282	+2.9
18V	+0.7	-0.9	+4.4	-1.0	-0.04296	12.05713	195	+3.7	284	-0.2
18H	+3.1	-0.5	+3.8	-1.5	-0.01039	1.90624	113	+0.7	283	-1.0
23V	+1.4	-1.3	+3.9	+0.8	-0.00688	4.11310	217	+2.6	287	+2.1
23H	+4.0	-0.9	+6.6	+0.1	-0.01245	4.66638	155	+2.7	286	+1.1
36V	-0.3	-1.0	+2.9	+1.9	-0.00552	4.42327	216	+3.2	283	+2.9
36H	+2.2	-0.4	+5.2	+2.2	-0.00241	3.38051	144	+3.0	283	+2.7
89AV	NA	NA	+2.9	+0.8	-0.01299	4.85400	257	+1.5	286	+1.1
89AH	NA	NA	+7.0	+0.5	-0.01555	4.79854	213	+1.5	286	+0.4
89BV	+1.5	-0.2	+3.2	+1.1	-0.01379	5.41121	257	+1.9	286	+1.5
89BH	+5.7	+0.2	+6.9	+0.9	-0.00907	3.34063	213	+1.4	286	+0.7

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

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