Application of Dr. Zou's Approach on Inter-Calibration of AMSU-A Window Channels

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Background

- AMSU FCDR for hydrological products – Window channels
- One critical step toward stable CDR

SNO Overview

Sensitivity and Problem

- Sensitivity of heterogeneity
- Warm target contamination

Correction

- Dr. Zou's sequential adjusting process
- Major equations, important variables
- Iterative search and result coefficients
- Impacts of the correction
- Correction of N16 Ch3 drift

Ongoing Work

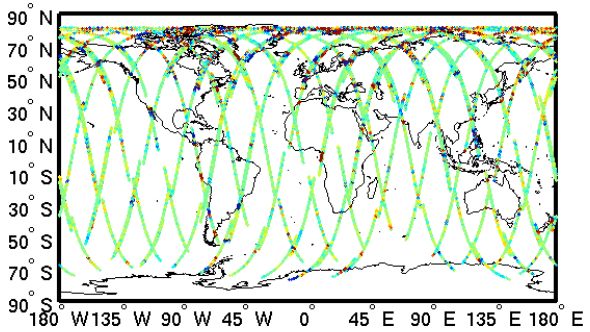
- Possible frequency shift of N15 Ch15
- Diurnal cycle

SNO Temporal Pattern

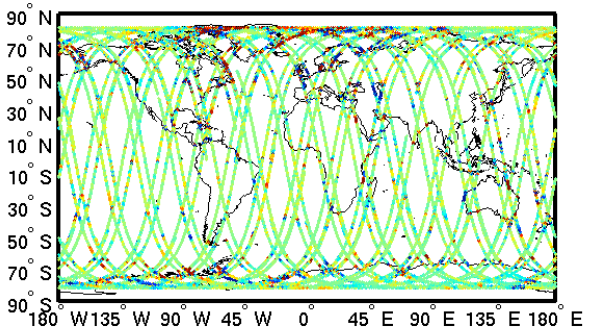
Overlap-Interval	N16	N17	N18	M02	N19
N15	1 – 8.14	4.5 – 104	1 – 7.31	1 – 31.7	1 – 7.14
N16		1 – 8.44	3 – 82	1 – 11.2	2 – 66
N17			1 – 7.66	2 – 40	1 – 7.52
N18				1 – 9.81	8 – 326
M02					1 – 9.62

Global SNO Spatial Distribution with DTB

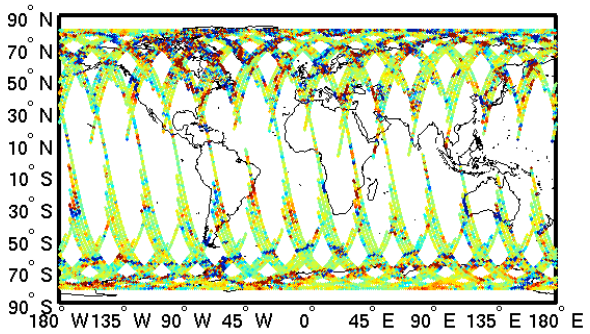
ΔTB: n15 vs. n16

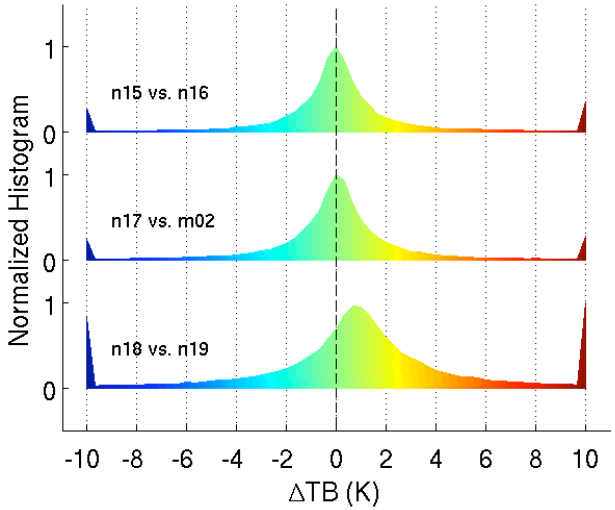


ΔTB: n17 vs. m02



ΔTB: n18 vs. n19

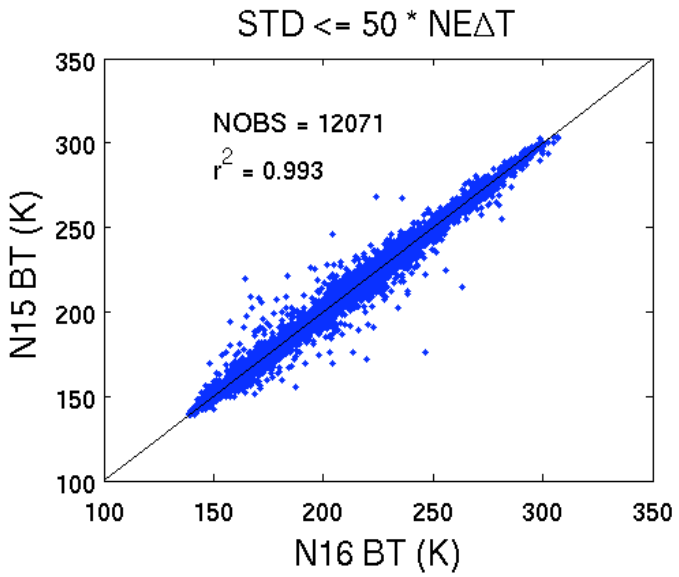


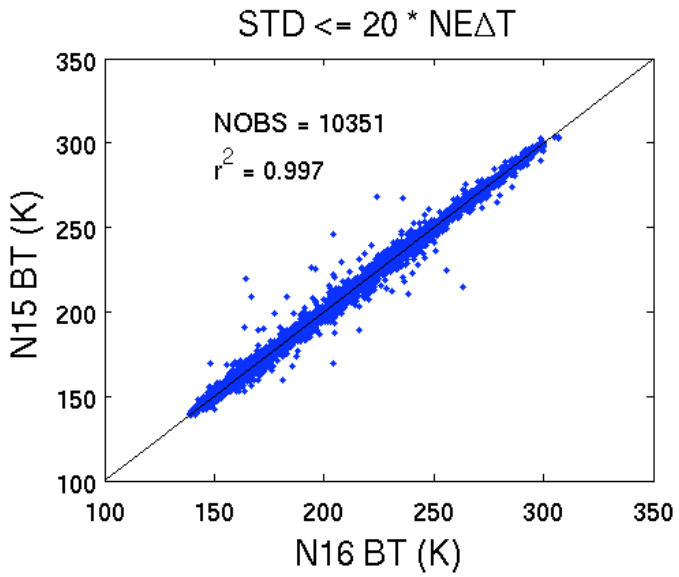


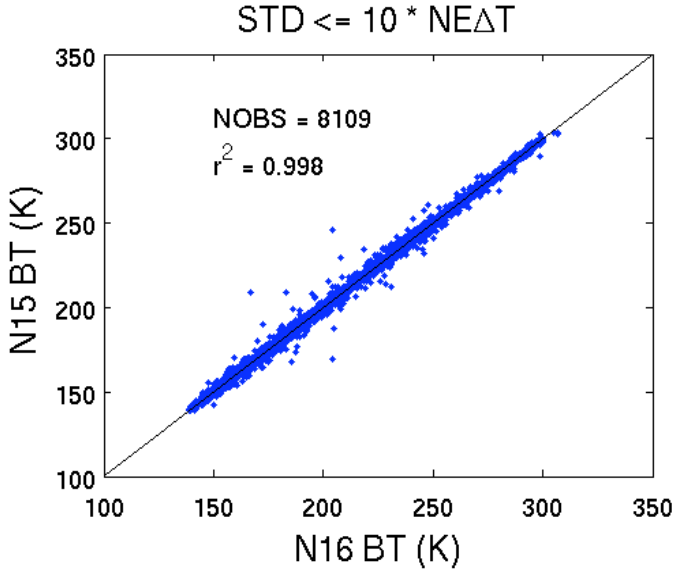
SNO DTB vs. Factors Correlation Coefficients

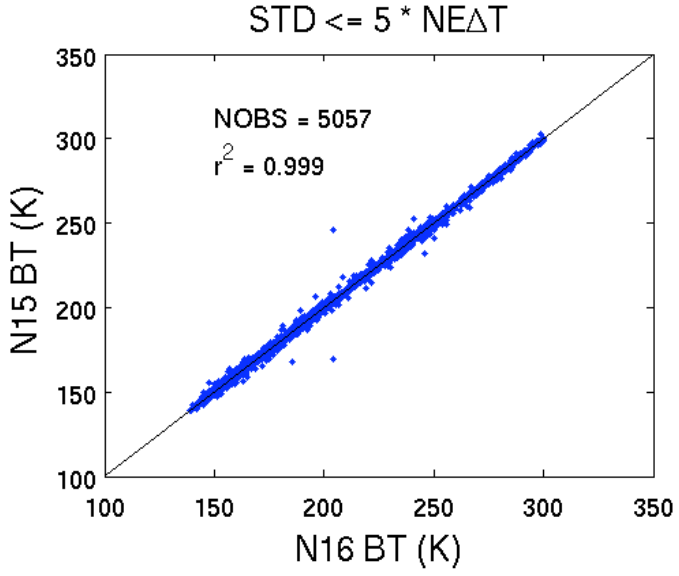
Correlation Coefficients	23.8 GHz	31.4 GHz	50.3 GHz	89 GHz
NOBS	53531	53531	53534	53506
Distance	0.19	0.18	0.15	0.18
P1 TB STD	0.53	0.53	0.47	0.43
P2 TB STD	0.55	0.55	0.50	0.44
Time Difference	-0.01	-0.01	-0.01	-0.01

Test STD Threshold using Brightness Temperature Scatter Plot, Chan 1, 2008

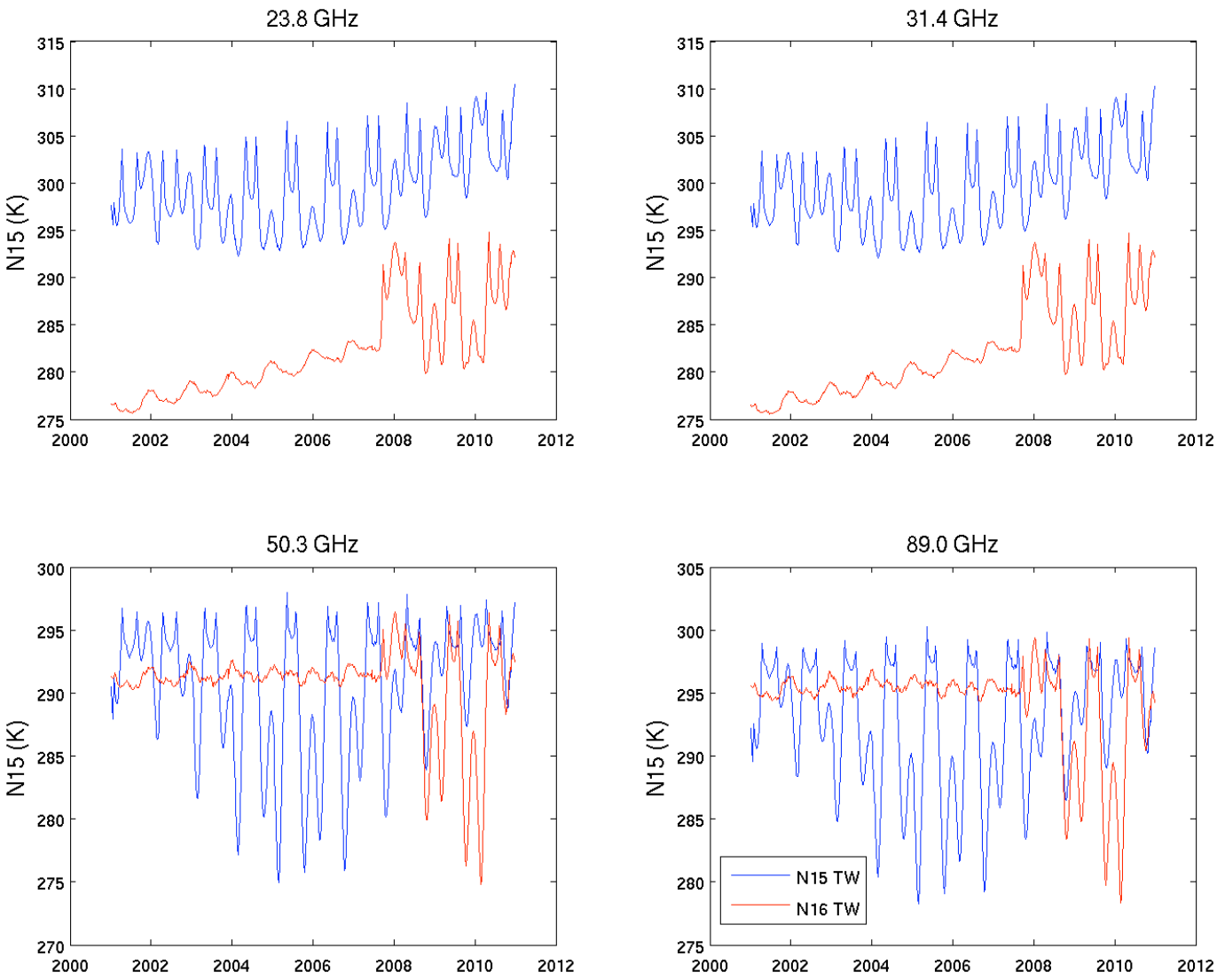








Warm Target Contamination



Correction Process

Focusing on Dr. Cheng-Zhi Zou's sequential adjusting process

1. Generate intermediate SNO data set
   Increase from 30 variables to 142 for each SNO events
2. Calculate SNO coefficients (α, β, a0, a1)
3. Set $\delta R_{N15} = 0$, and μ_{N15}, calculate δR_k, μ_k, k = 1 to 5
4. Generate level-1c radiances for all six satellites using recalibration coeffiicients
5. Compute tropical ocean mean time series of ΔTb for available overlaps between pairs
6. Change the value of μ_{N15} and repeat steps 3, 4, and 5
7. Stop when summation of root mean square of ΔTb is minimum

Major Inter-Calibration Equations

$$I.\quad Z_j = \beta Z_k + \alpha + \zeta$$

$$II.\begin{cases} \sum_{i=1}^{N} \Delta R_{L,i} = a_0 + a_1 \sum_{i=1}^{N} Z_{k,i} \\ \sum_{i=1}^{N} Z_{k,i} \Delta R_{L,i} = a_0 \sum_{i=1}^{N} Z_{k,i} + a_1 \sum_{i=1}^{N} Z_{k,i}^2 \end{cases}$$

$$III.\begin{cases} a_0 = \Delta\delta R + \alpha\mu_j \\ a_1 = -\mu_k + \beta\mu_j \end{cases}$$

$$Other:$$

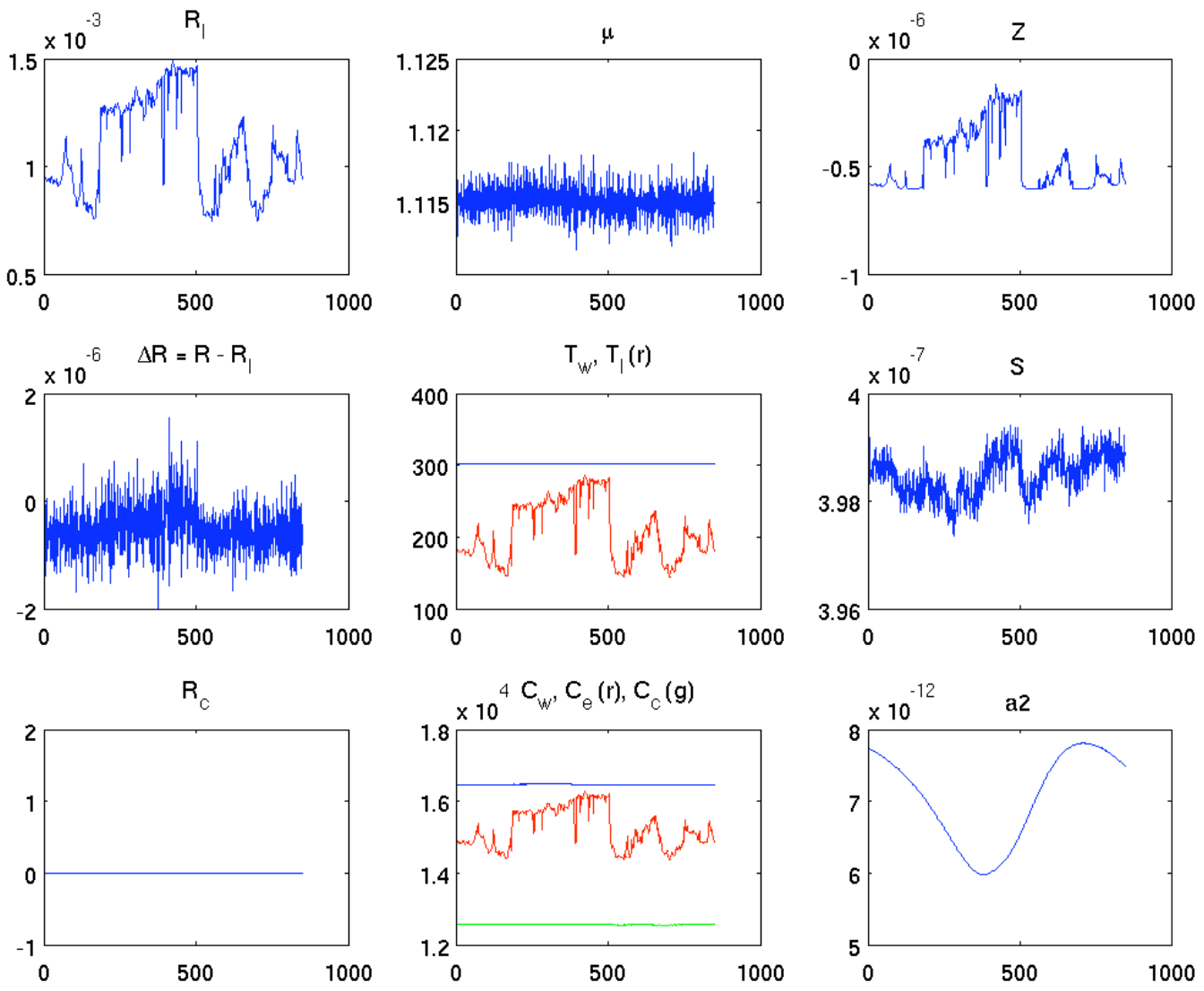
$$R = R_L - \delta R + \mu Z$$

$$R_L = R_c + S(C_e - C_c)$$

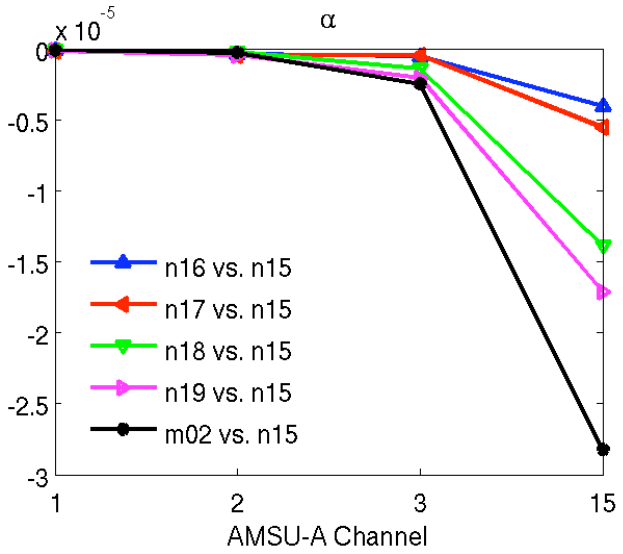
$$S = \frac{R_w - R_c}{C_w - C_c}$$

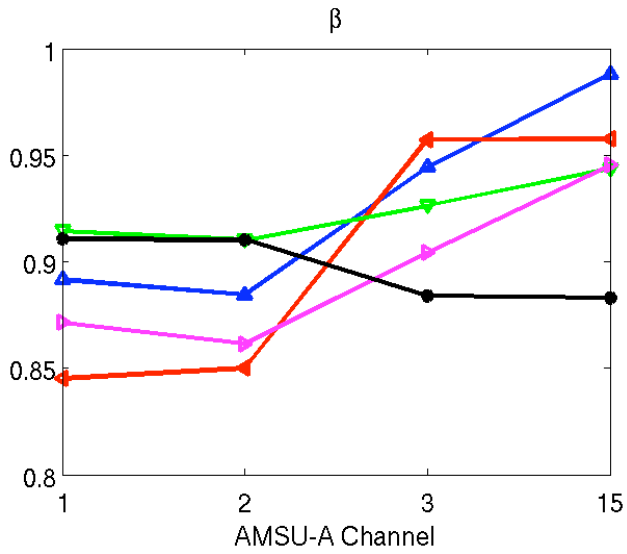
$$Z = S^2(C_e - C_c)(C_e - C_c)$$

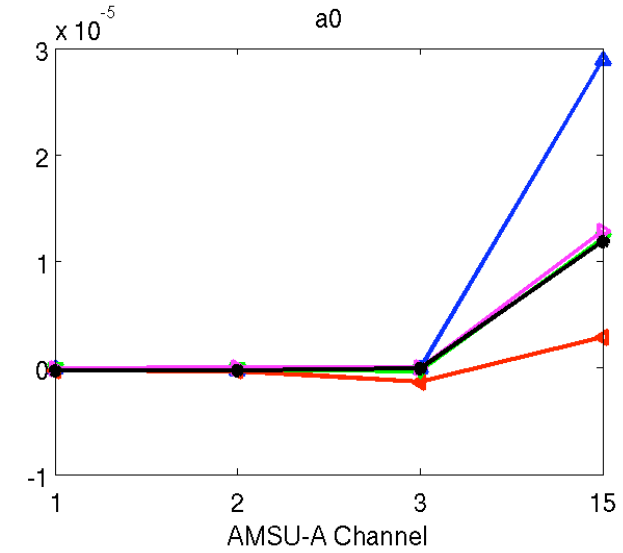
Relative Variables in a Swath, N15, Channel 1, Beam Position 15

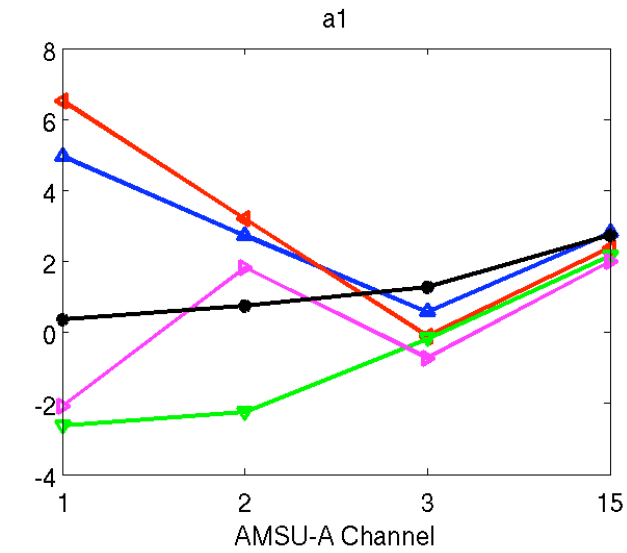


Coefficients of Alpha, Beta, A0 and A1

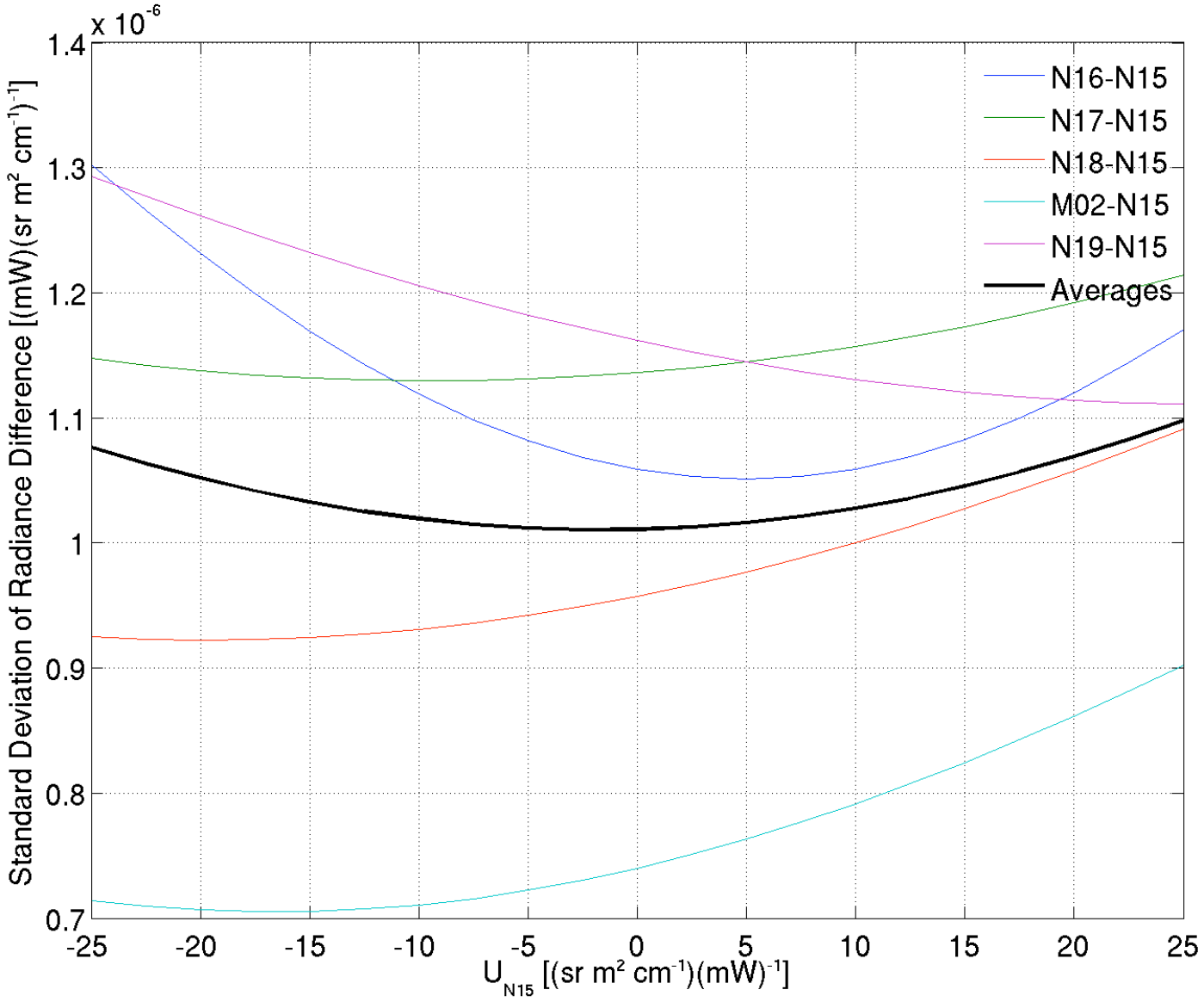








Iterative Search for Mu of N15, Channel 1



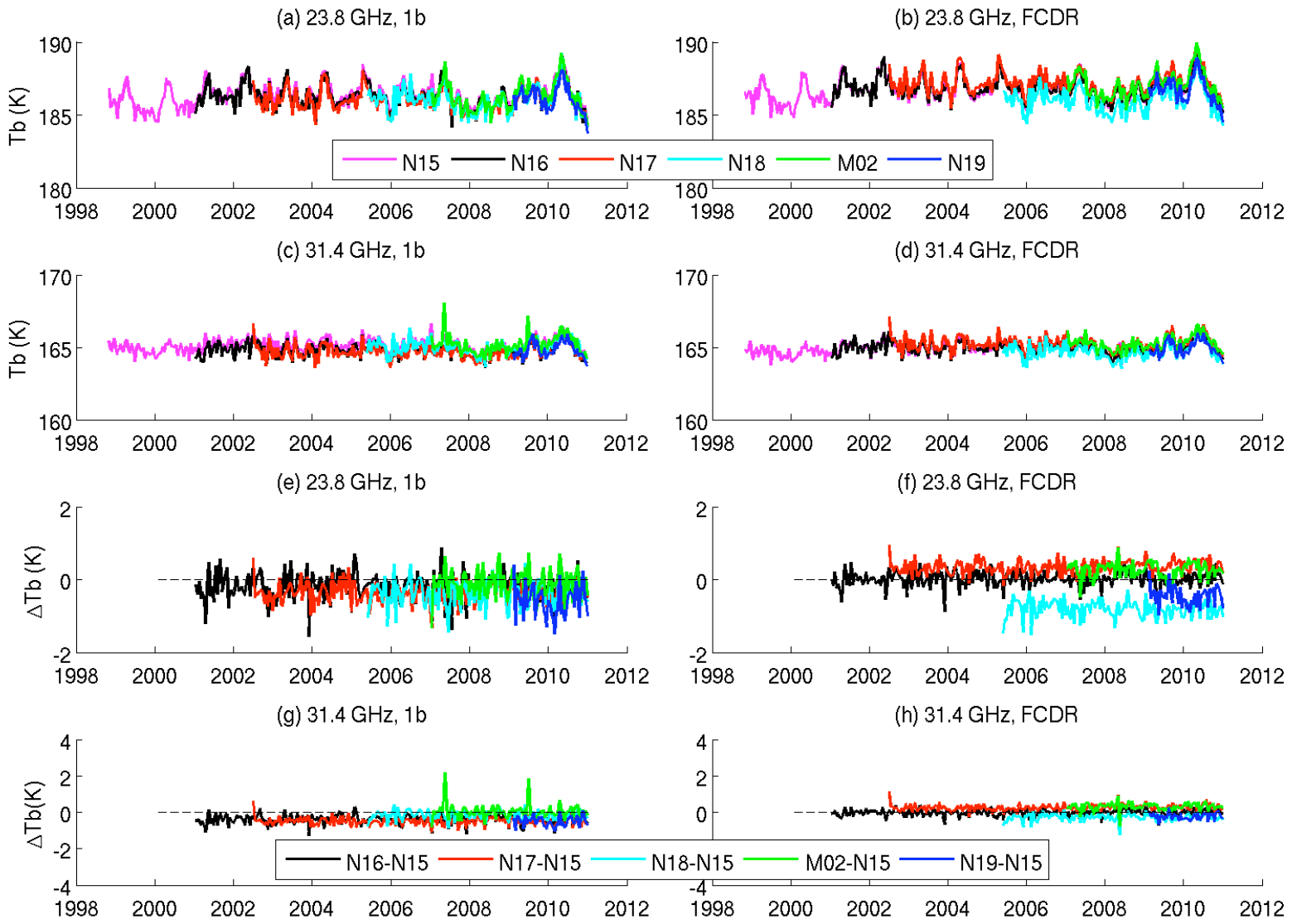
Comparison of Optional and Prelaunch μ_{N15}

	Ch1	Ch2	Ch3	Ch15
Optional Mu_N15	-2.9086	1.0531	-1.9849	-3.9801
Prelaunch Mu_N15	0.9802	-0.0723	0.0555	-0.0016
	1.1284	0.3094	0.0806	-0.0404
	1.1098	-0.0502	0.0484	0.2949
Reference Temperature	266.55	266.55	270.56	270.54
for Prelaunch Mu_N15	284.65	284.65	291.18	291.18
	302.85	302.85	311.91	311.24

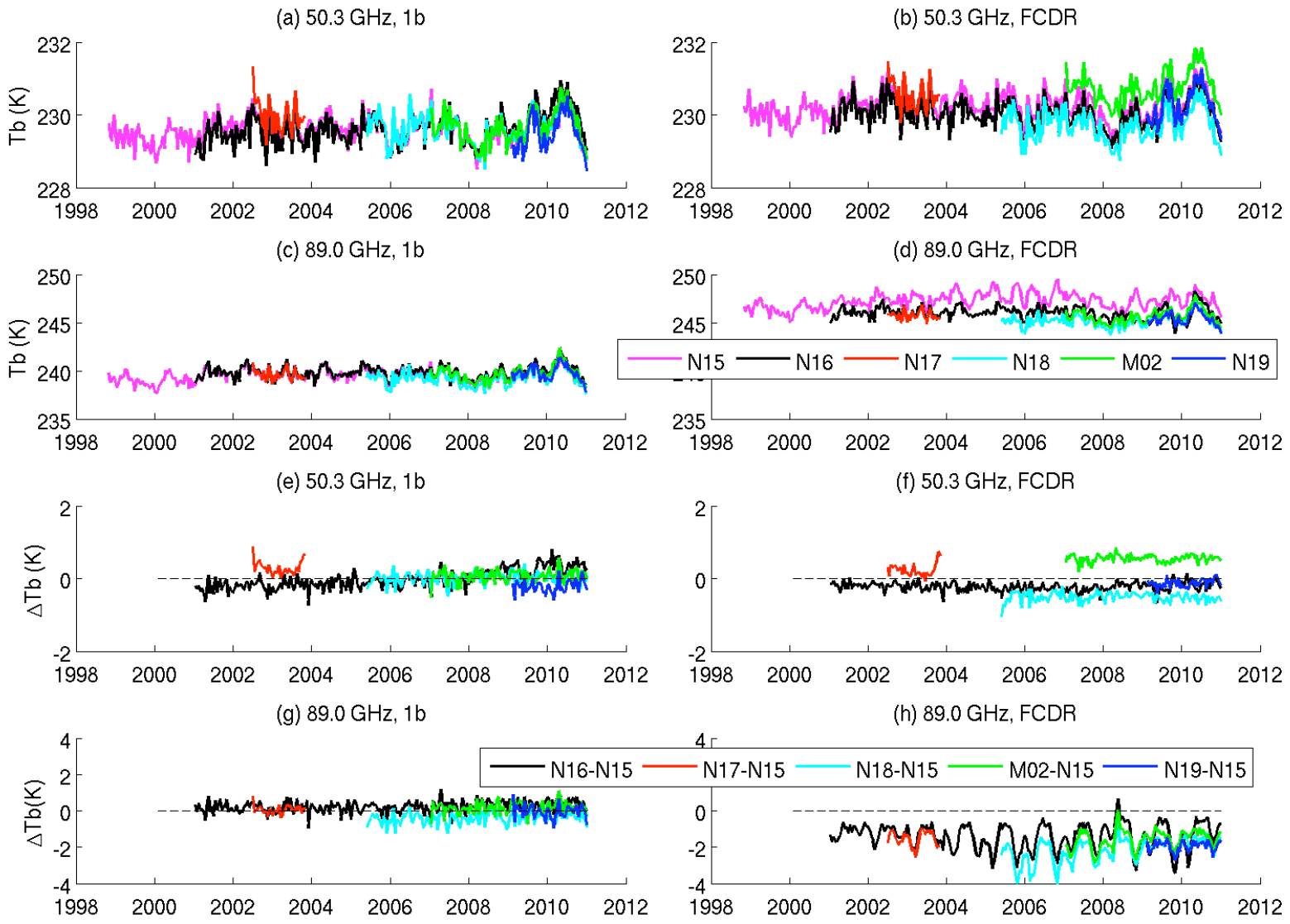
Optimal μ and δR

		N15	N16	N17	N18	M02	N19
Mu	Ch1	-2.90860	-7.75889	-10.30357	0.54319	-3.12837	0.09178
	Ch2	1.05310	-2.15364	-3.06236	3.79401	-4.42838	-0.79372
	Ch3	-1.98488	-2.46439	-1.69333	-1.77138	-3.13583	-1.12520
	Ch15	-3.98007	-6.70802	-6.35800	-5.85813	-6.16404	-5.65483
dR	Ch1	0.000E+00	-4.505E-07	-7.846E-07	1.389E-06	-6.149E-07	-4.975E-07
	Ch2	0.000E+00	1.064E-07	6.151E-08	2.861E-07	-1.104E-07	3.753E-07
	Ch3	0.000E+00	-1.311E-06	-2.104E-06	9.705E-06	-5.078E-06	-4.291E-06
	Ch15	0.000E+00	1.191E-05	-1.983E-06	-4.071E-05	-1.029E-04	-5.833E-05

Tropical Ocean Mean Tb/DTb, Ch 1 & 2



Tropical Ocean Mean Tb/DTb, Ch 3 & 15



Tropical Ocean STD of Delta Tb

	Before				After			
Channel	23.8	31.4	50.3	89.0	23.8	31.4	50.3	89.0
N16-N15	0.374	0.263	0.267	0.315	0.217	0.193	0.125	0.716
N17-N15	0.285	0.217	0.191	0.225	0.190	0.191	0.171	0.411
N18-N15	0.386	0.259	0.168	0.337	0.238	0.196	0.129	0.647
M02-N15	0.370	0.384	0.167	0.328	0.215	0.207	0.107	0.518
N19-N15	0.424	0.276	0.174	0.374	0.262	0.186	0.115	0.296

Conclusion and Ongoing Work

1. We explored SNO characteristics among specified NOAA and MetOP satellites
2. Heterogeneity problem has been identified and threshold has been tested
3. The sequential adjusting process has been applied to correct warm target contamination
4. Our ongoing work relates to frequency shift and diurnal cycle