Re-calibration of FY-3 MWTS and Evaluation of FCDR data

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1. Introduction
2. Evaluation
3. Grid Data

1.Introduction

1) Time：2008-2020 FY-3 MWTS L0->L1 data
2) Channel：FY3-AB,ch1-4; FY3-CD,ch1\4\6\8;
3) RMSE: The accuracy of the dataset is less than 1K.
4) Re-calibration MODEL： nonlinear modeling, noise characteristic optimization and static parameter modification
5) Evaluation ：O-B，SNO(AMSU-A and ATMS)

Supported ：Calibration of Historical Chinese Earth Observation Satellite data

FY-3 MWTS FCDR

Sensor	Dataset coverage
FY-3A/MWTS	2008/07/01-2013/05/06
FY-3B/MWTS	2010/11/11-2014/02/21
FY-3C/MWTS	2013/09/30-2015/02/28
FY-3D/MWTS	2017/11/25-present

Version	Main efforts
V1	Apply FY-3D/MWTS algorithm to FY-3A/B/C MWTS
V2	Calibration algorithm improvement on static parameters, cold/hot target and nonlinear correction
V3	Data quality control

V2 (beta) dataset covers FY-3A/B/C/D from 2008 to 2020, applying new static parameters, data quality control , cold/hot target and nonlinear correction to FY-3A/B/C/D.

FY-3A/B/C/D MWTS

2.Evaluation

The calibration result evaluation method uses the Root-Mean-square Error of Cross calibration (SNO) , the SNO calculation is used as the precision estimation method, and the Root Mean-square Error is defined as follows:

$$RMSE = \frac{1}{n}\sum_{i=1}^{n}(x_i - m(x))^2$$

ch	T(K)	Mean of RMSE (K)		Std of RMSE (K)	
		conventional result	recalibrated result	conventional result	recalibrated result
FY-3A					
50.3GHz	214	1.4	0.52	0.29	0.24
53.596GHz	227	1.7	0.39	0.3	0.14
54.94GHz	222	1.45	0.99	0.55	0.59
57.29GHz	215	0.7	0.79	0.46	0.35
FY-3B					
50.3GHz	227	0.5	0.72	0.32	0.32
53.596GHz	233	1.3	1.0	0.25	0.17
54.94GHz	223	0.93	0.78	0.44	0.35
57.29GHz	217	1	1.6	0.78	0.88
FY-3C					
50.3GHz	223	5	0.89	0.67	0.22
53.596GHz	238	2.2	0.61	0.61	0.15
54.94GHz	222	2.2	0.3	0.56	0.07
57.29GHz	216	3.86	0.66	0.49	0.12
FY-3D					
50.3GHz	200	0.83	0.68	0.2	0.14
53.596GHz	222	0.65	0.45	0.21	0.1
54.94GHz	212	0.7	0.56	0.24	0.12
57.29GHz	198	0.6	0.46	0.41	0.11

50.3GHz

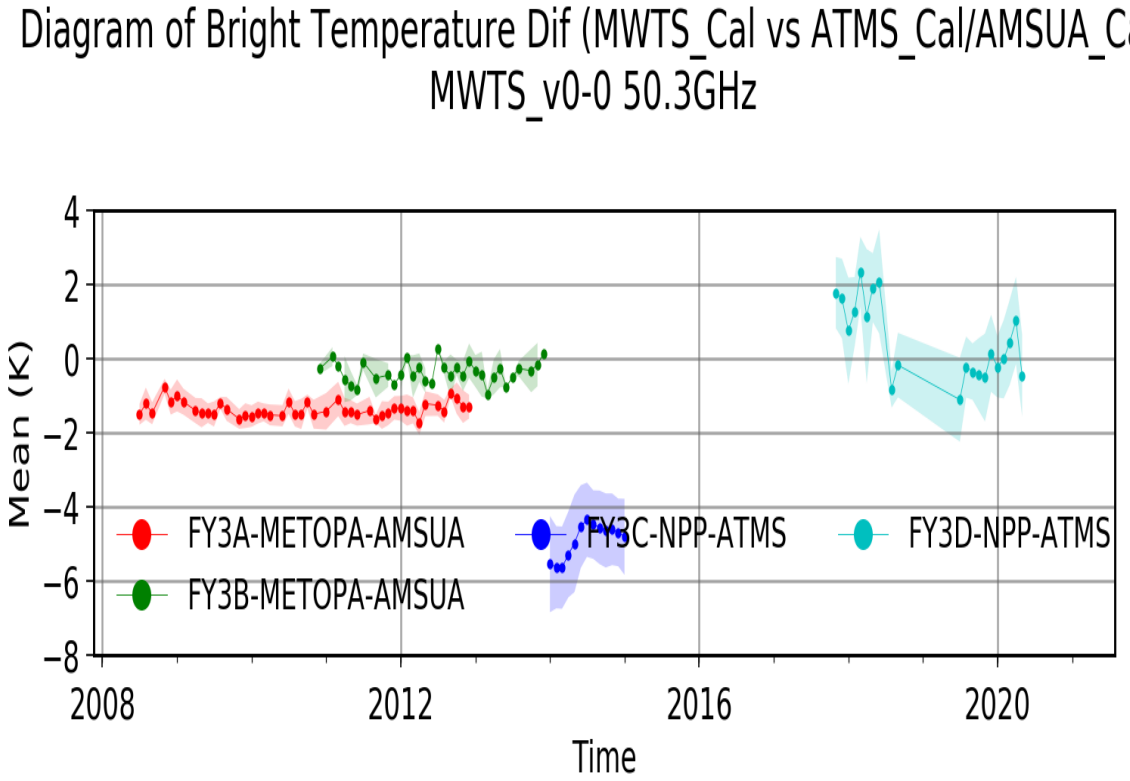


Diagram of Bright Temperature Dif (MWTS_Cal vs ATMS_Cal/AMSUA_Cal)
MWTS_v0-0 50.3GHz
Mean (K)
Time
FY3A-METOPA-AMSUA
FY3B-METOPA-AMSUA
FY3C-NPP-ATMS
FY3D-NPP-ATMS

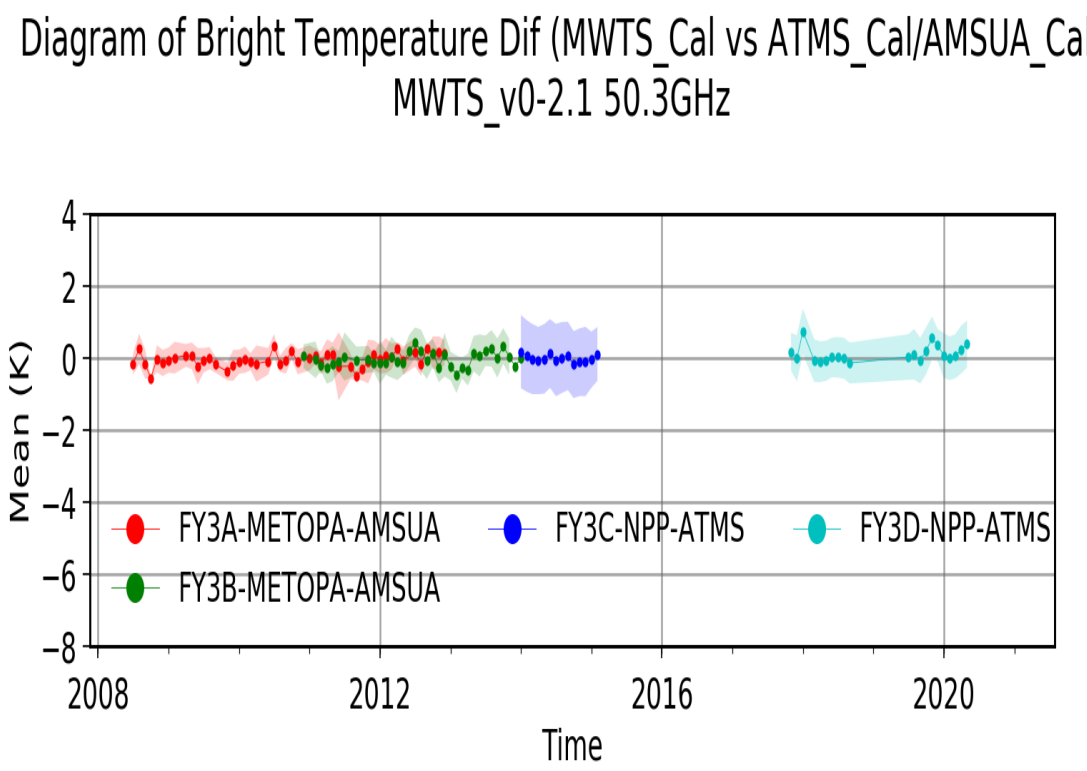
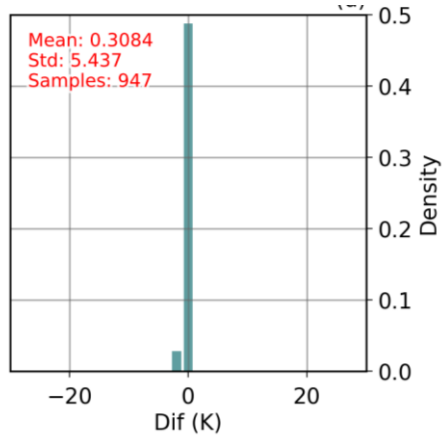
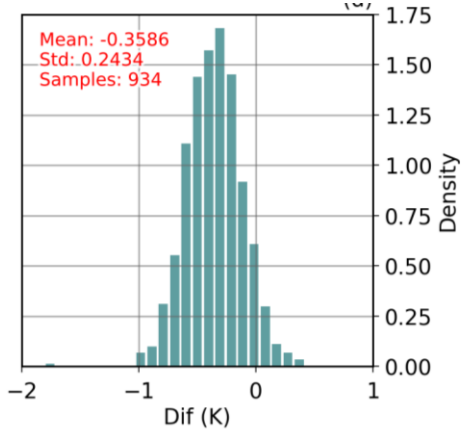


Diagram of Bright Temperature Dif (MWTS_Cal vs ATMS_Cal/AMSUA_Cal)
MWTS_v0-2.1 50.3GHz
Mean (K)
Time
FY3A-METOPA-AMSUA
FY3B-METOPA-AMSUA
FY3C-NPP-ATMS
FY3D-NPP-ATMS

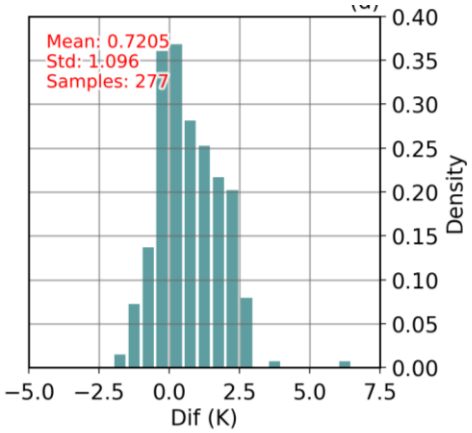
FY3-A/B/C/D time series histogram



FY3-A



FY3-B



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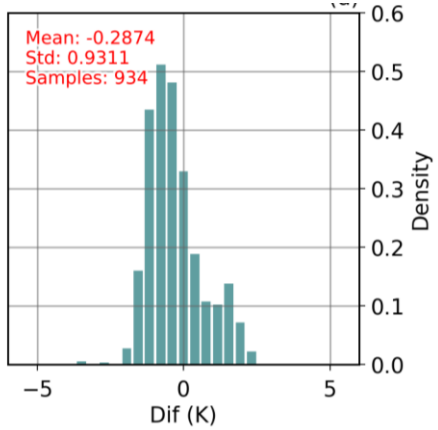
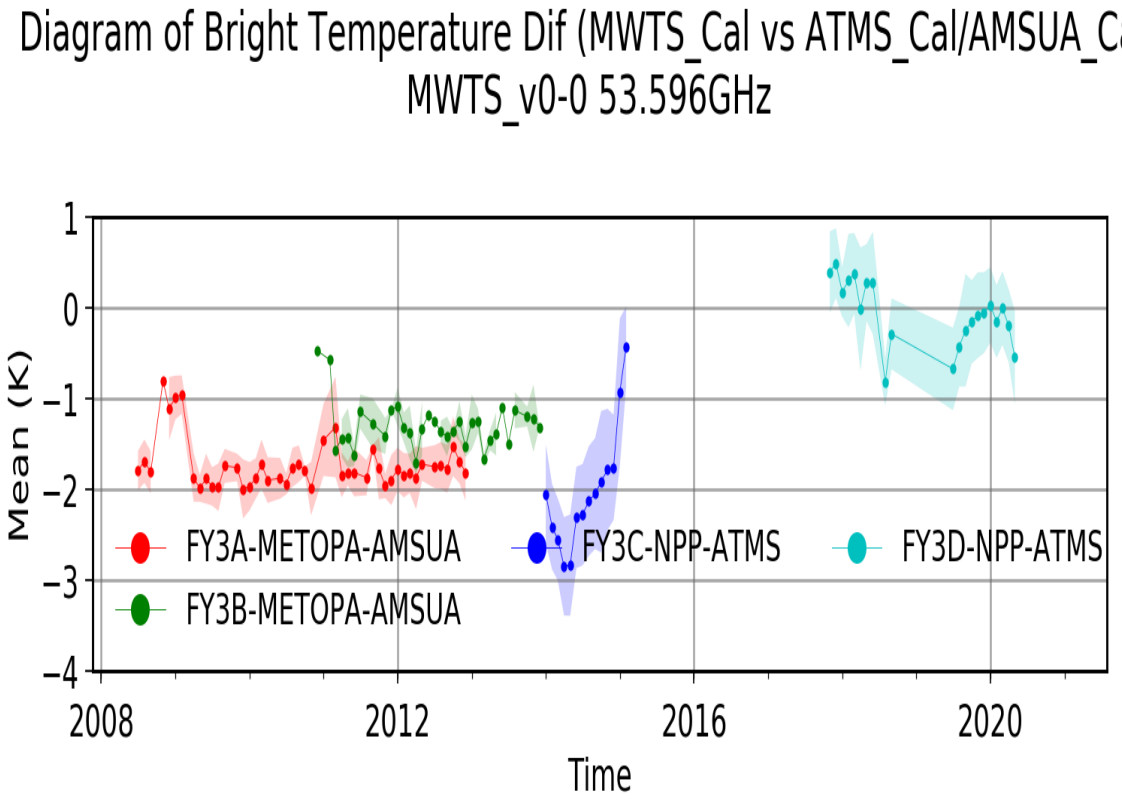


FY3-D

53.596GHz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Time
FY3A-METOPA-AMSUA
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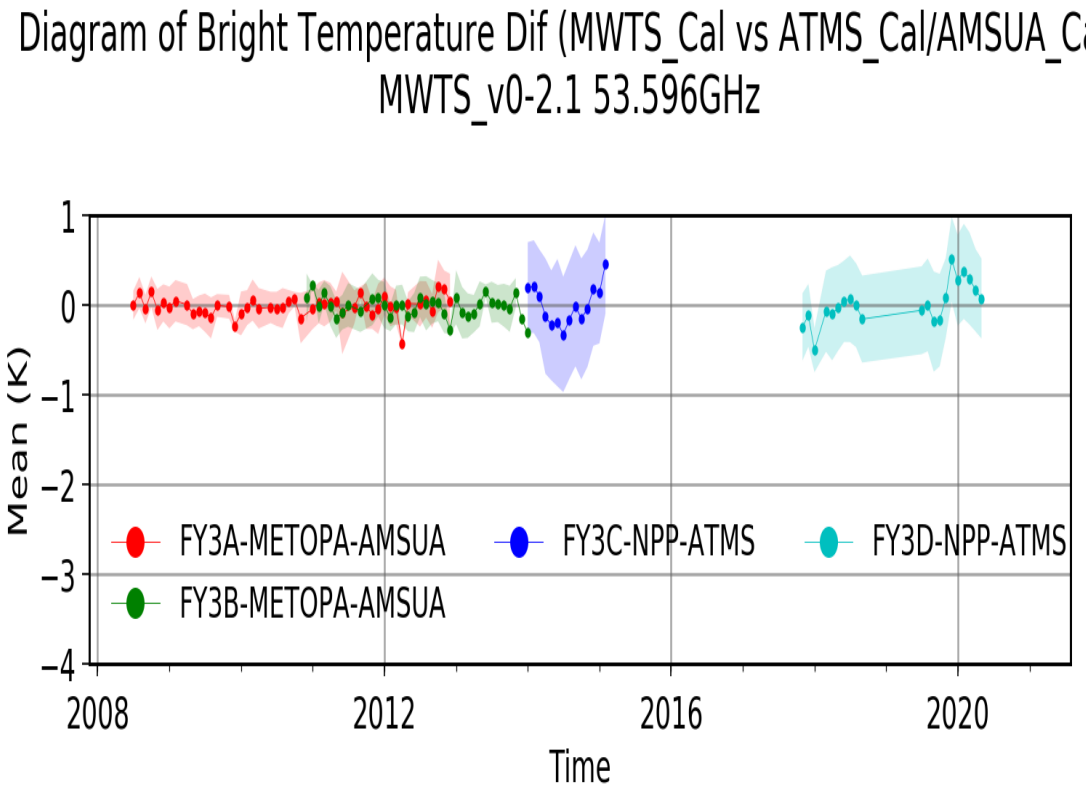
FY3D-NPP-ATMS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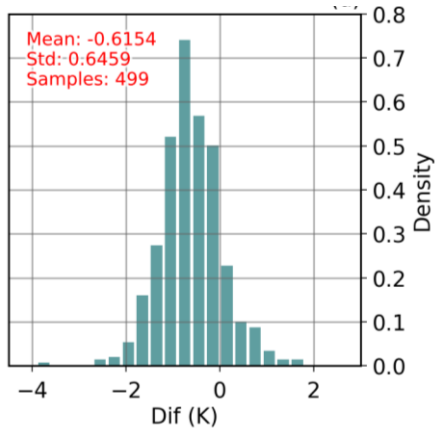
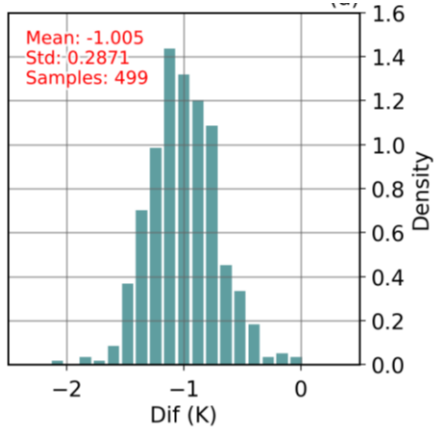
MWTS_v0-2.1 53.596GHz
Mean (K)
Time
FY3A-METOPA-AMSUA
FY3B-METOPA-AMSUA
FY3C-NPP-ATMS
FY3D-NPP-ATMS

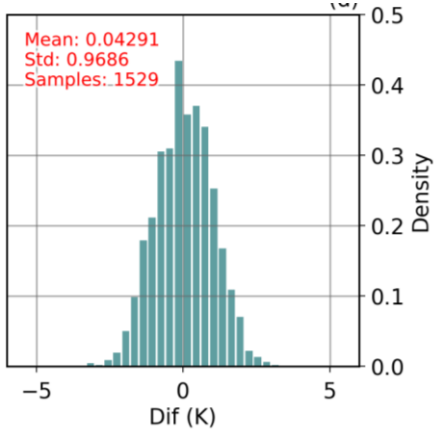
FY3-A/B/C/D time series histogram



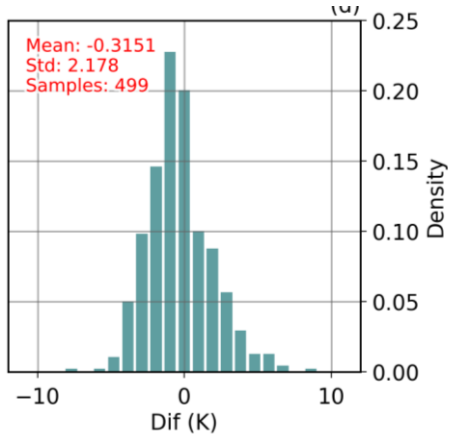
FY3-A



FY3-B

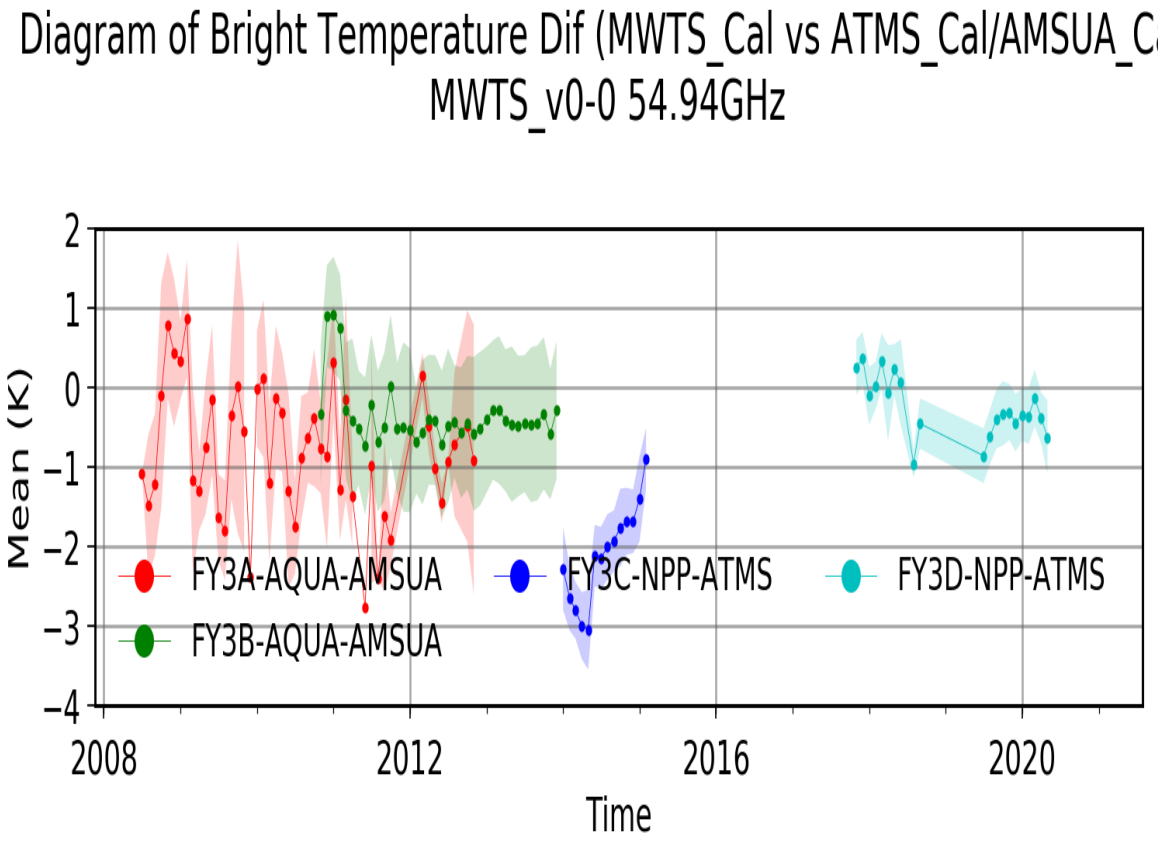


FY3-C



FY3-D

54.94GHz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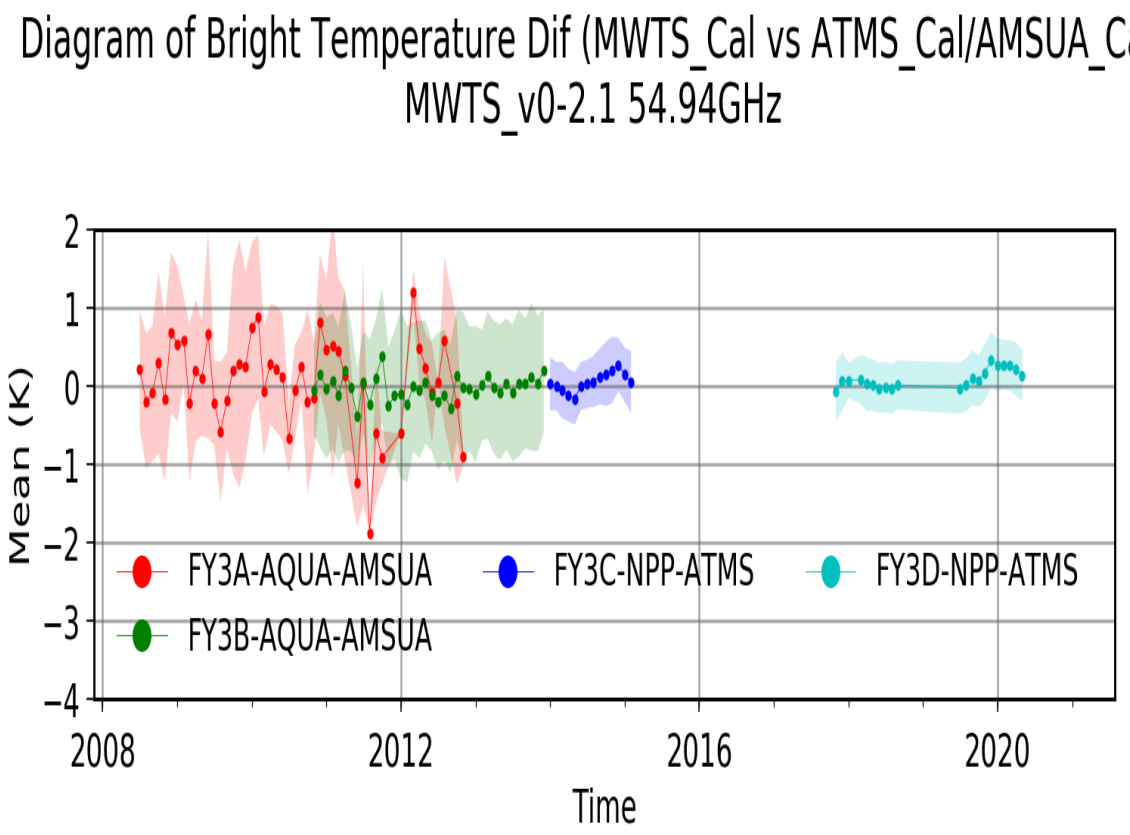
MWTS_v0-0 54.94GHz
Mean (K)
Time
FY3A-AQUA-AMSUA
FY3B-AQUA-AMSUA
FY3C-NPP-ATMS
FY3D-NPP-ATMS
2
1
0
−1
−2
−3
−4
2008
2012
2016
2020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MWTS_v0-2.1 54.94GHz
Mean (K)
Time
FY3A-AQUA-AMSUA
FY3B-AQUA-AMSUA
FY3C-NPP-ATMS
FY3D-NPP-ATMS
2
1
0
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−3
−4
2008
2012
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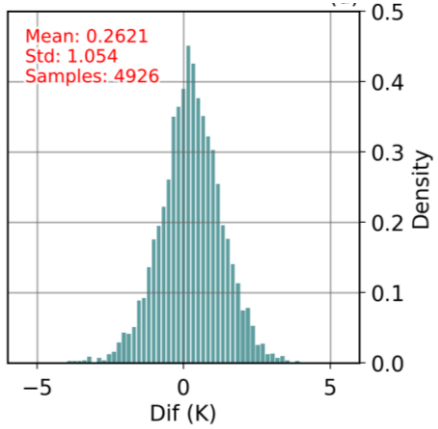
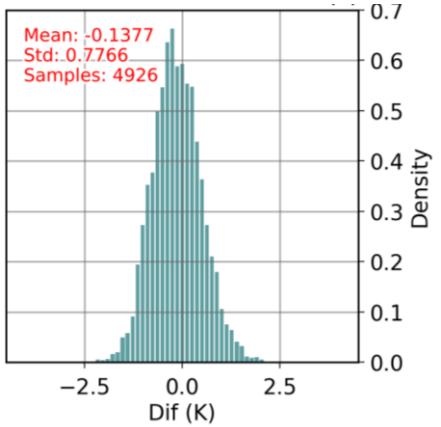
2020

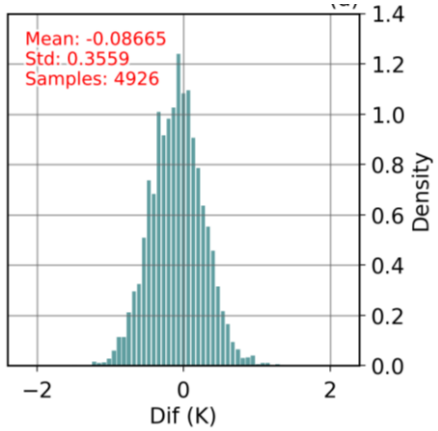
FY3-A/B/C/D time series histogram



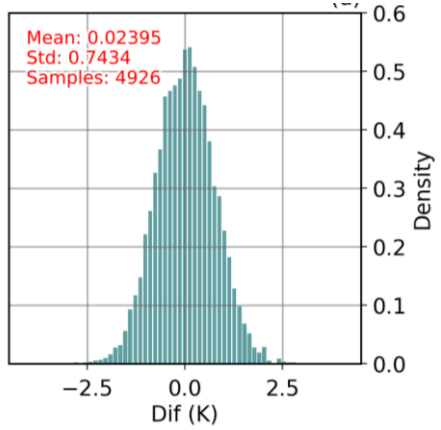
FY3-A



FY3-B

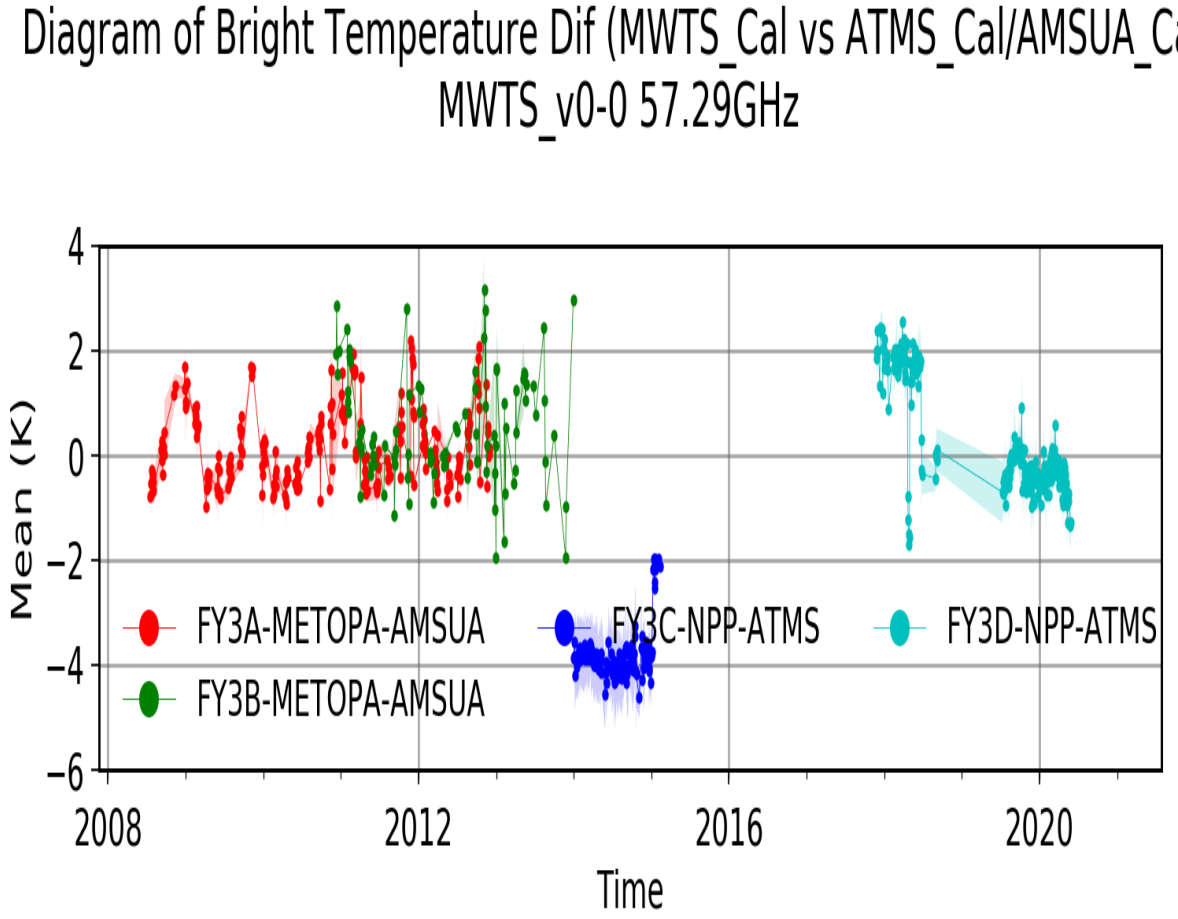


FY3-C



FY3-D

57.29GHz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MWTS_v0-0 57.29GHz
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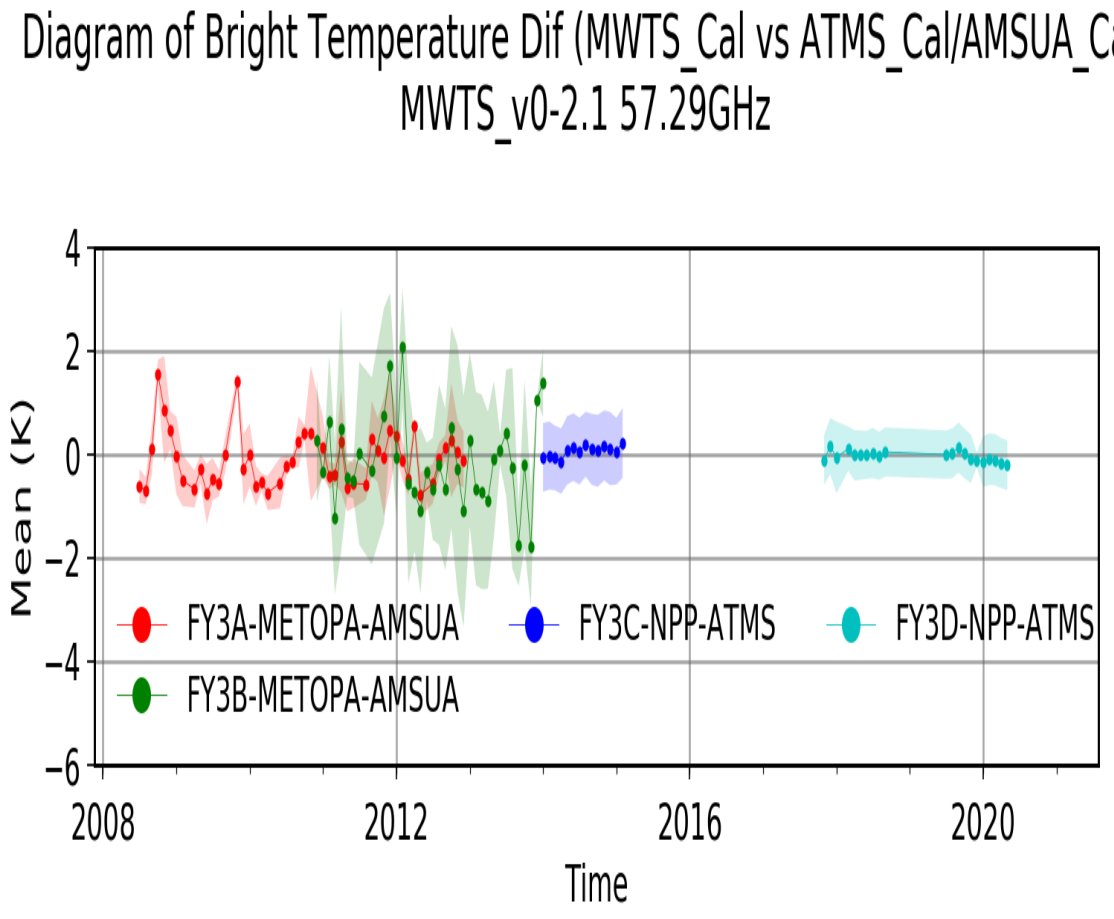
FY3D-NPP-ATMS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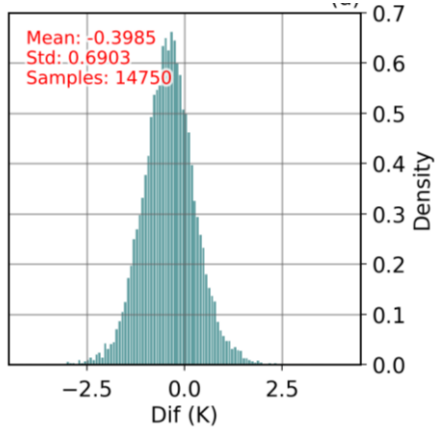
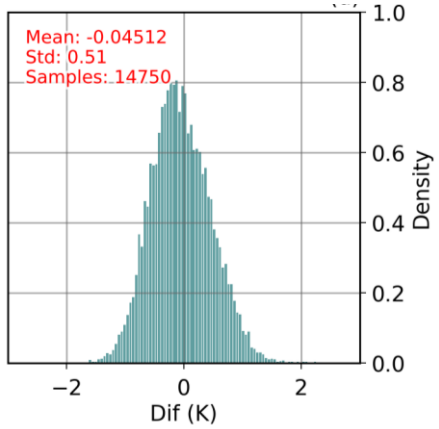
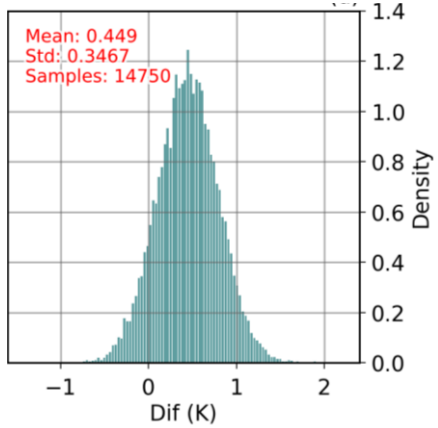
FY3-A/B/C/D time series histogram



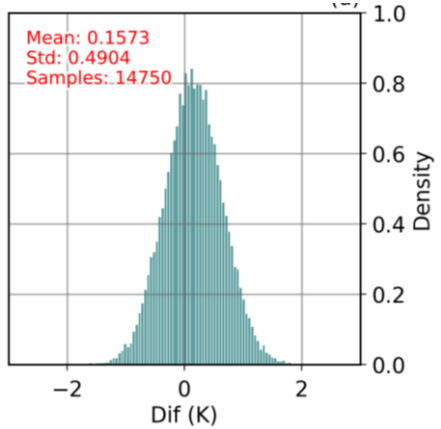
FY3-A



FY3-B



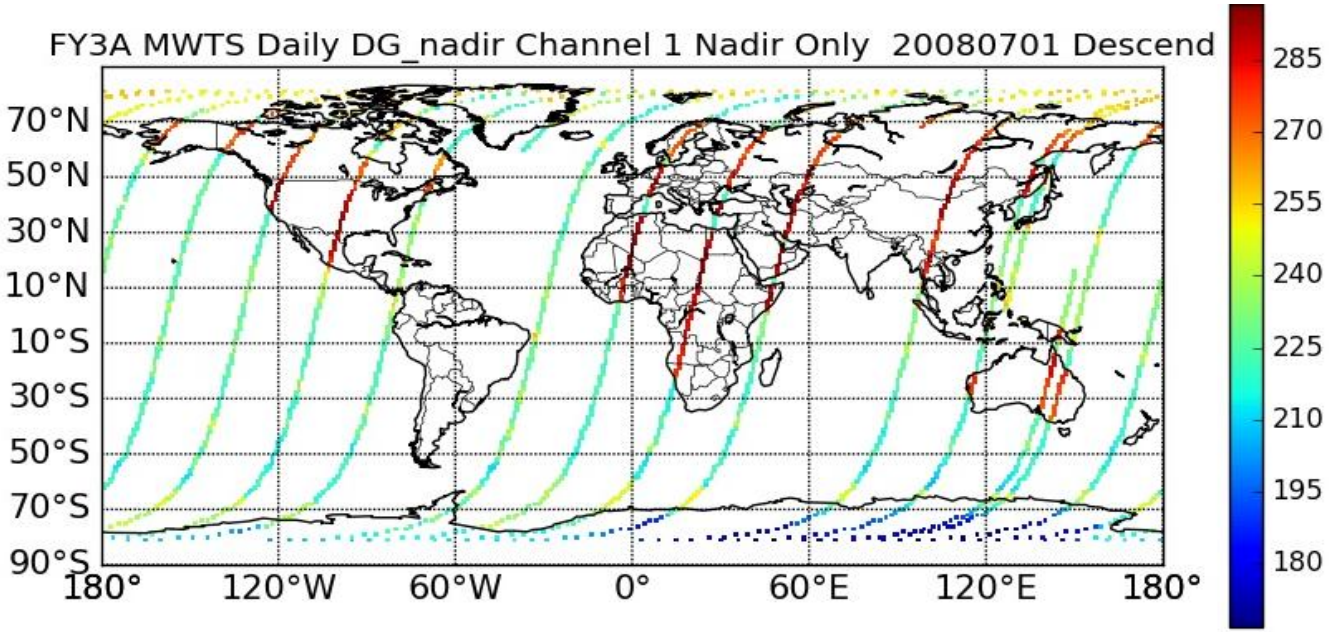
FY3-C



FY3-D

3. Grid data

1) Brightness temperatures of near-nadir FOVs only: Only near-nadir pixels (scan positions 15 and 16 in FY-3A/B; 45 and 46 in FY-3C/D) from FCDR products are used to compose daily products.
2) In case more than one near-nadir pixels are accumulated in one grid cell, their average is used to represent the daily brightness temperatures for the grid cell.
3) The gridded datasets have spatial resolution of 1°x1°, and cover the time period from Oct. 2008 to present for ascending and descending orbits, respectively.



Summary

1) The overall calibration accuracy of the FCDR data RMSE is better than 1K from 2008 to 2020.
2) Channel 54.94 and 57.29GHz in FY-3A/B MWTS instability due to a faulty Gunn Tube in local oscillator.So the accuracy improvement is limited, especially Channel 57.29GHz.

Thank you!