Multi-sites Calibration Tracking for FY-3A/MERSI Solar bands

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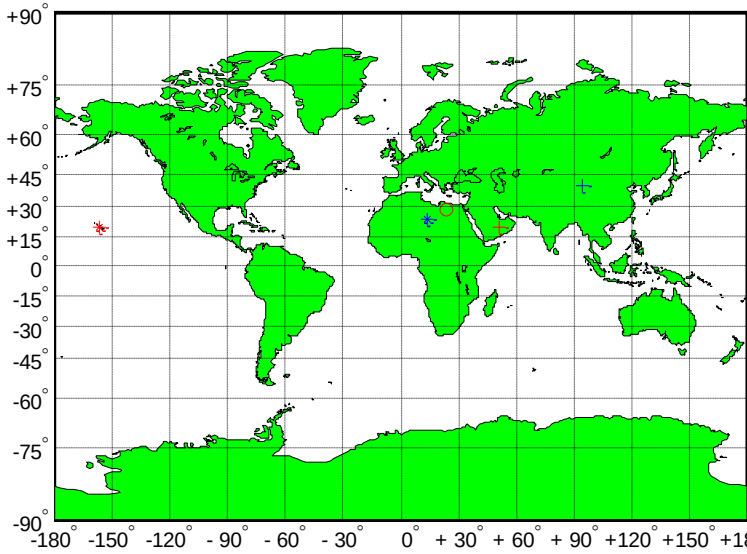
Outlines

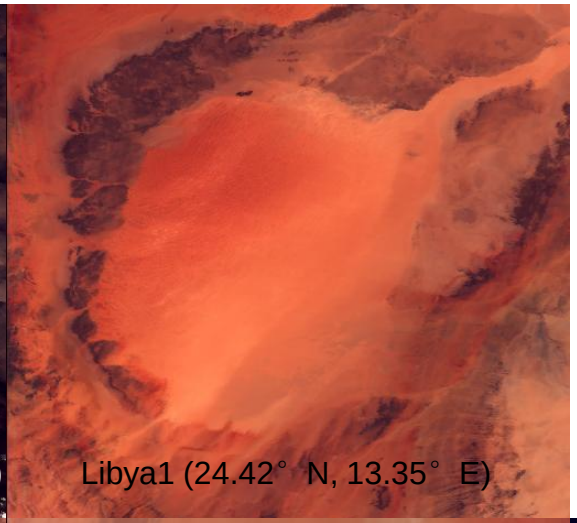
- **Method and Primary Result for FY-3A/MERSI**
- **TOA Radiation Estimation Test with Terra/MODIS**
- **FY-3A/MERSI Re-calibration Performance Analysis**

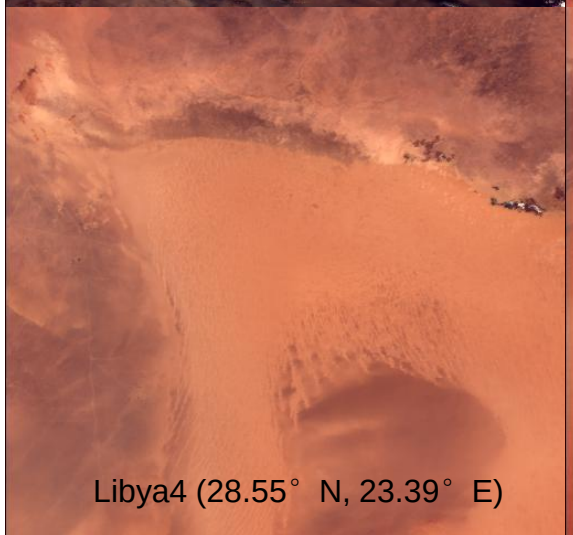
Method and Primary Results for MERSI

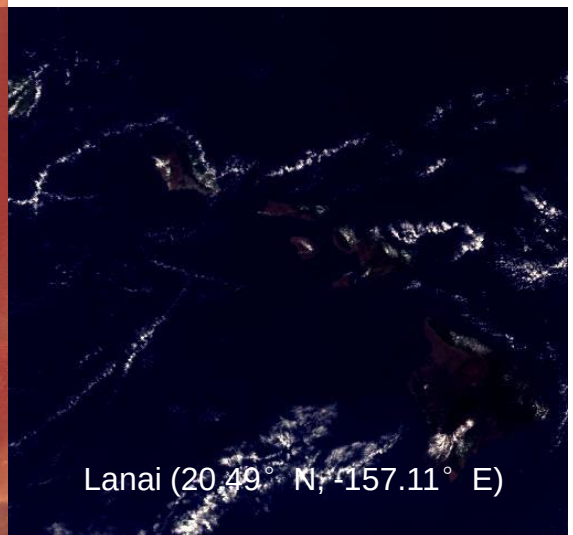
Multi-sites with stable surface properties :

Gobi and desert targets: Dunhuang, Libya1, Libya4 and Arabia2,
ocean site: Lanai (MOBY).









- TOA reflectance calculation

RTM：6SV

AOD@550nm：

MODIS monthly aerosol product

Aqua deep blue for land , Terra for ocean

Ozone amount:

climatological monthly mean from TOMS

Water vapor amount:

climatological monthly mean from NCEP

Surface directional reflectance:

MODIS BRDF products for land sites

MOBY measurements for ocean site

- **Calibration coefficient calculation**

  Data within certain days from 5 sites are used to get the calibration slope:

  $ARef_i = Ref_i\ (d0/d)^2 \cos(SolZ)$

  $= Slope_i\ (DN_i - DC_i)$

- **Calibration coefficient trend fitting**

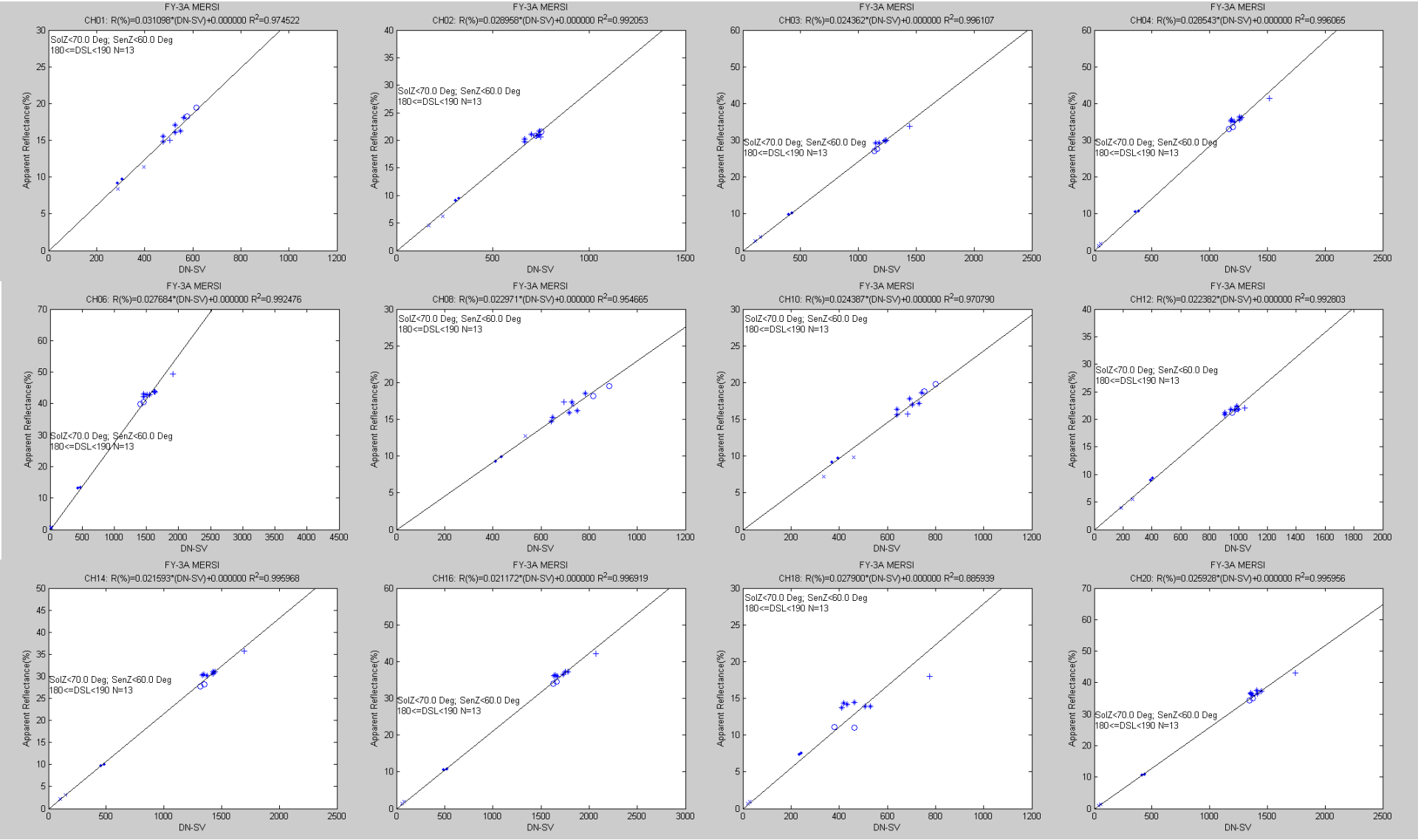
  Based on the calibration slope series, a linear model is used to describe the varying trend with DSL:

  $Slope_i = a_i DSL + b_i$

  DSL is the day number since launch (May 27, 2008)

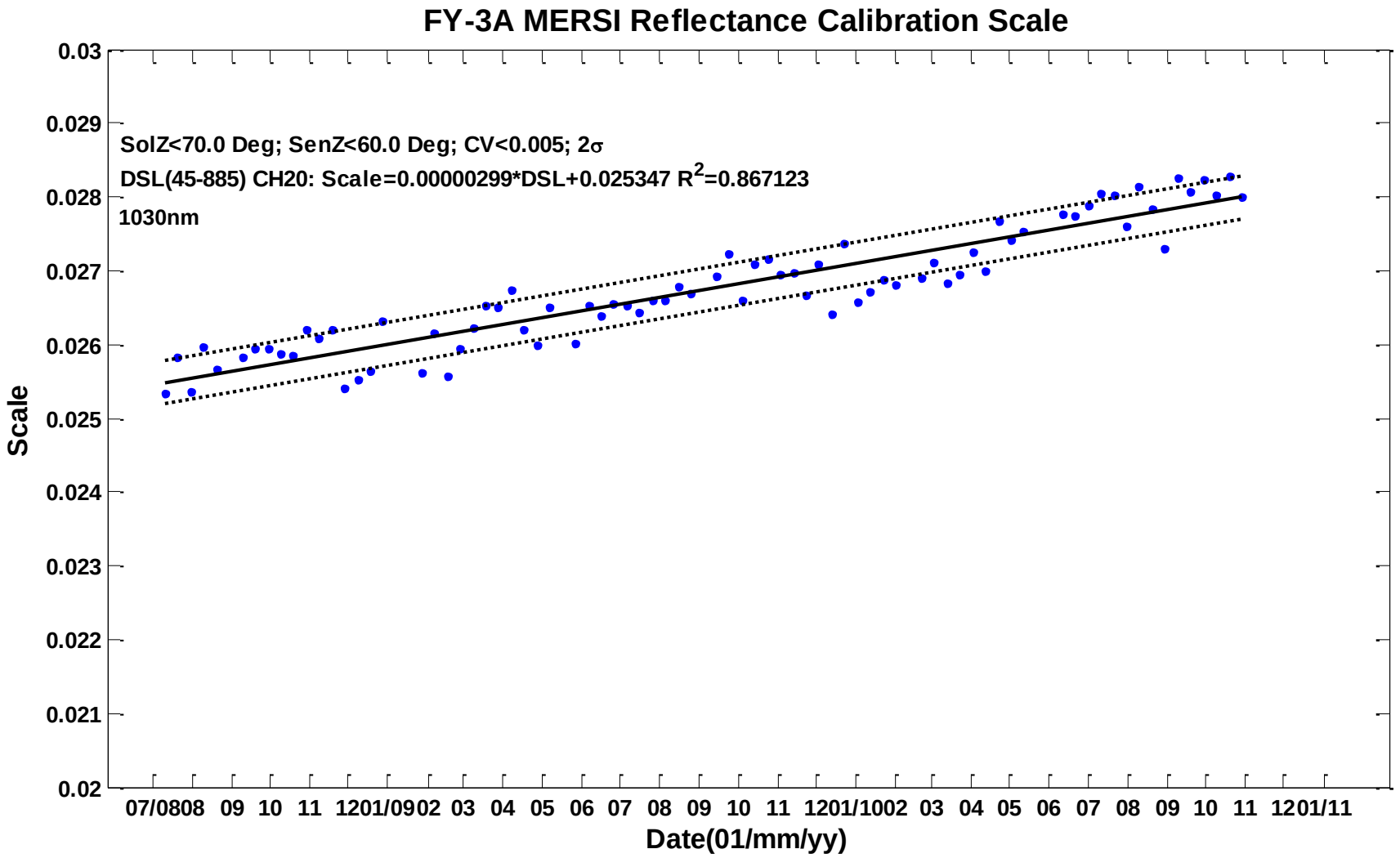
- **Annual decay rate**

  $AnnualDecayRate_i = a_i * 365 / b_i * 100.$



- Multi-sites with different brightness to cover the sensor dynamic range;
- Multi-sites and multi-days to decrease the random error.

Days=10



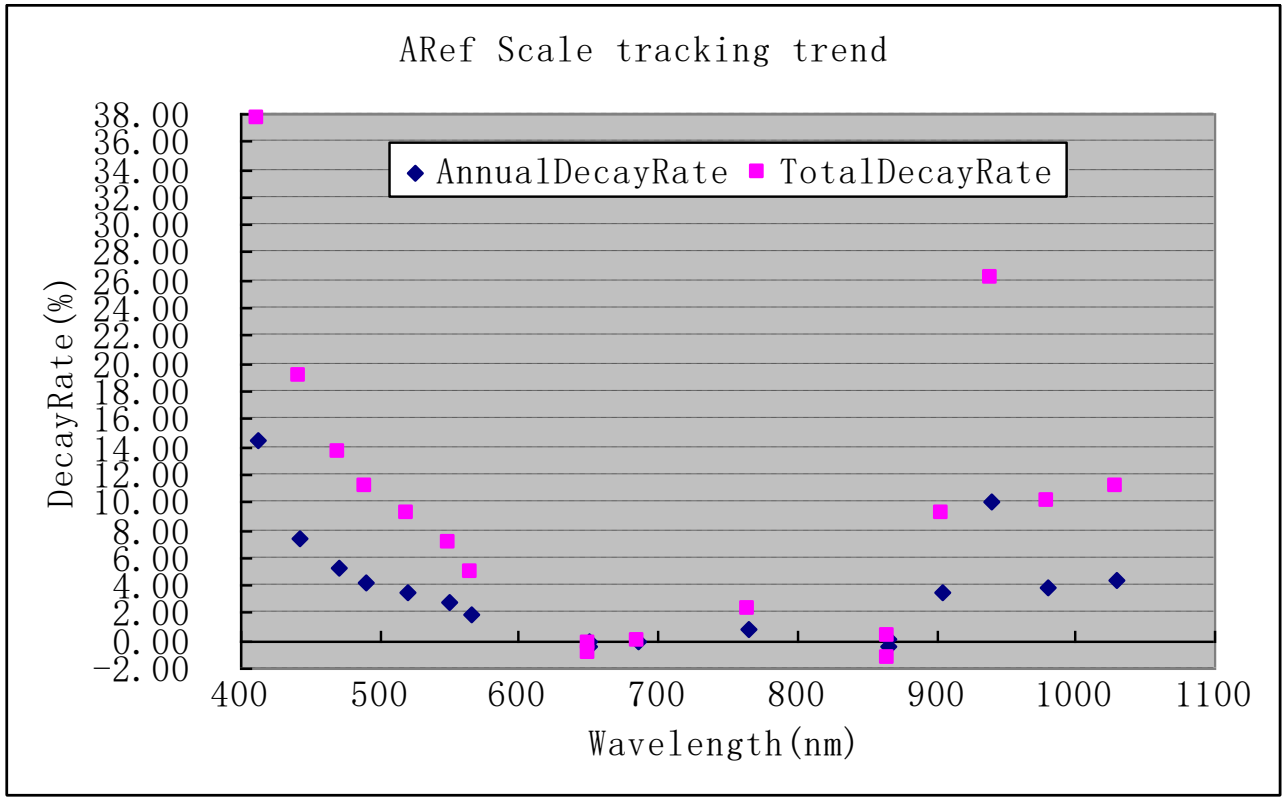
The calibration coefficients present a linear trend with DSL.

Annual periodicity exists especially in the short-wave and the water vapor channels.

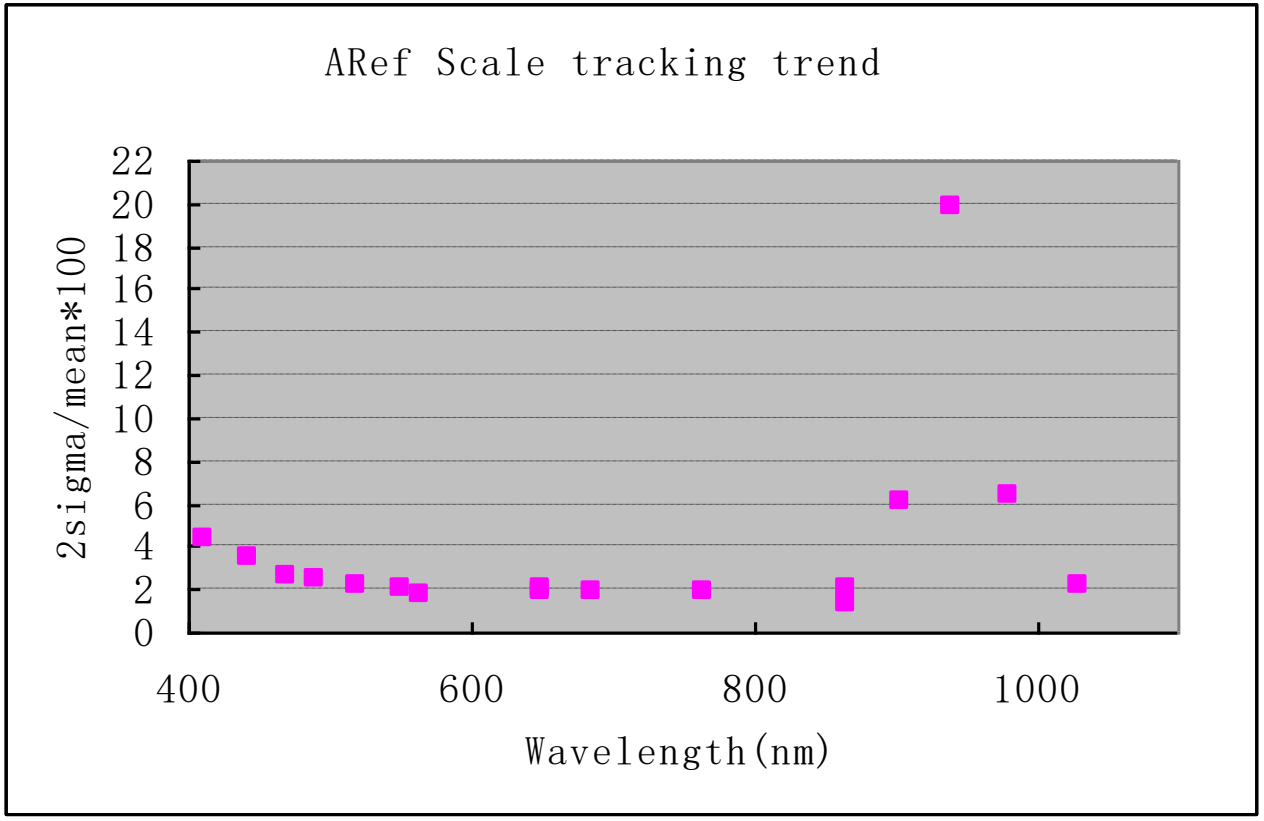
Apparent Reflectance = Scale * (DN_EarthView - DN_SpaceView) (%)							
Scale = d + c * Days = d*(1 + RatePerDay/100 * Days) (%/DN)							
Band	b (%/DN)	a (%/DN/Days)	Sigma	2Sigma/M (%)	Degrading rate per day (%)	Degrading rate per year (%)	Degrading rate(%)
Band1 (470nm)	0.031023	4.47E-06	4.41E-04	2.6694	0.0144	5.2561	13.6514
Band2 (550nm)	0.028936	2.14E-06	3.05E-04	2.0388	0.007383	2.6947	6.9988
Band3 (650nm)	0.024411	-2.19E-07	2.24E-04	1.8415	-0.000899	-0.3282	-0.8524
Band4 (865nm)	0.028568	-3.83E-07	2.79E-04	1.9638	-0.001341	-0.4895	-1.2714
Band8 (412nm)	0.021734	8.61E-06	5.61E-04	4.3801	0.039623	14.4623	37.5623
Band9 (443nm)	0.02372	4.78E-06	4.44E-04	3.4290	0.020132	7.3481	19.0849
Band10 (490nm)	0.02451	2.87E-06	3.19E-04	2.4686	0.011699	4.2702	11.0908
Band11 (520nm)	0.01987	1.91E-06	2.29E-04	2.2112	0.009608	3.5070	9.1087
Band12 (565nm)	0.022484	1.16E-06	2.03E-04	1.7599	0.005177	1.8896	4.9079
Band13 (650nm)	0.022257	-5.91E-08	2.22E-04	1.9964	-0.000266	-0.0970	-0.2519
Band14 (685nm)	0.021673	-2.39E-08	1.98E-04	1.8287	-0.00011	-0.0402	-0.1045
Band15 (765nm)	0.027623	6.73E-07	2.69E-04	1.9260	0.002435	0.8887	2.3081
Band16 (865nm)	0.021147	5.12E-08	1.45E-04	1.3659	0.000242	0.0884	0.2296
Band17 (905nm)	0.024272	2.36E-06	7.78E-04	6.1333	0.009707	3.5431	9.2025
Band18 (940nm)	0.026224	7.25E-06	2.93E-03	19.7859	0.027642	10.0894	26.2048
Band19 (980nm)	0.023307	2.48E-06	7.74E-04	6.3302	0.01064	3.8836	10.0867
Band20 (1030nm)	0.025347	2.99E-06	2.91E-04	2.1729	0.011789	4.3028	11.1756

* Days = Day Count since FY-3A Launched @ 2008-05-27

Degrading rate: Count from launch to 2010-12-31



- **The short-wave channels have large degradation, especially channel 8 with the annual decay rate up to 14%.**
- **In the red and near-infrared bands (600 ~ 900nm), e.g. channel 3,4,13,14,15 and 16, the calibration coefficients almost have no change with the annual decay rate below 1%.**



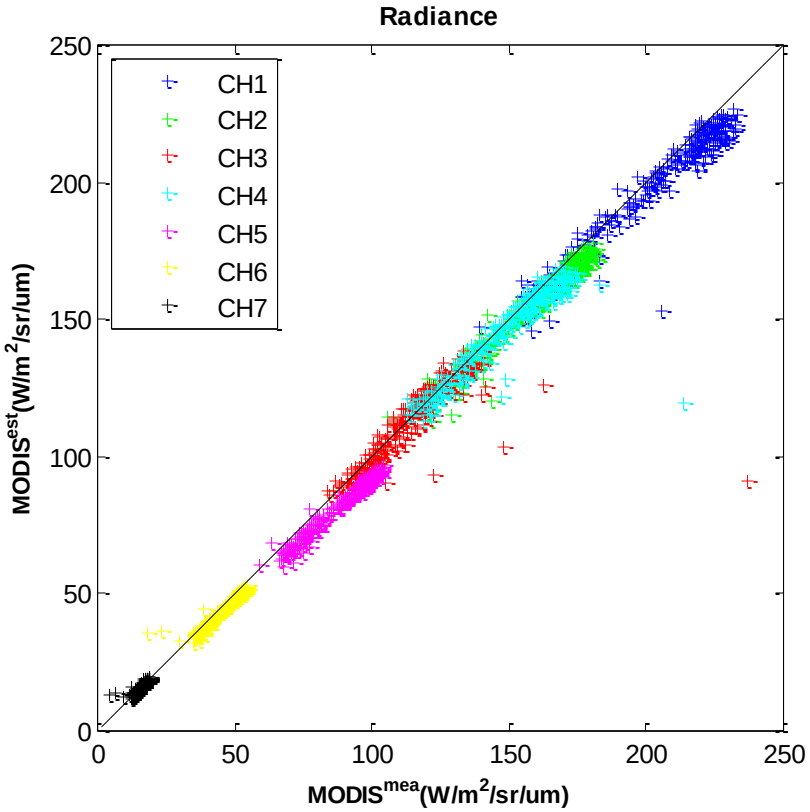
- **The uncertainty (2σ/mean) for the trend analysis is nearly below 4% except for water vapor channels (17, 18 and 19).**

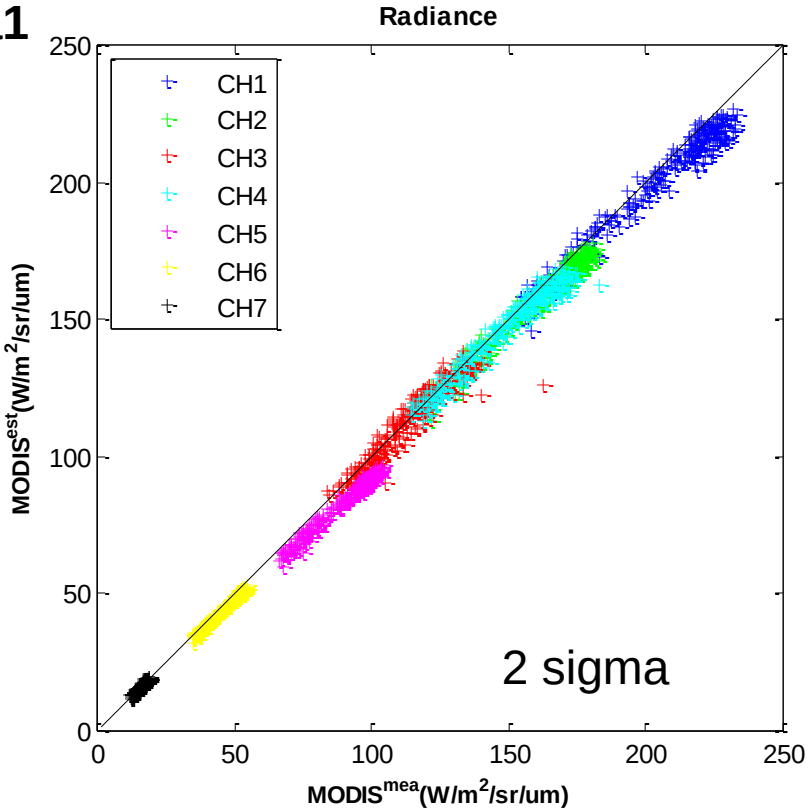
TOA Radiation Estimation Test with Terra/MODIS

Among the 4 land sites,

- **The performance is good for Libya1 and Libya4, relatively good for Arabia2, poor for Dunhuang.**

Libya1

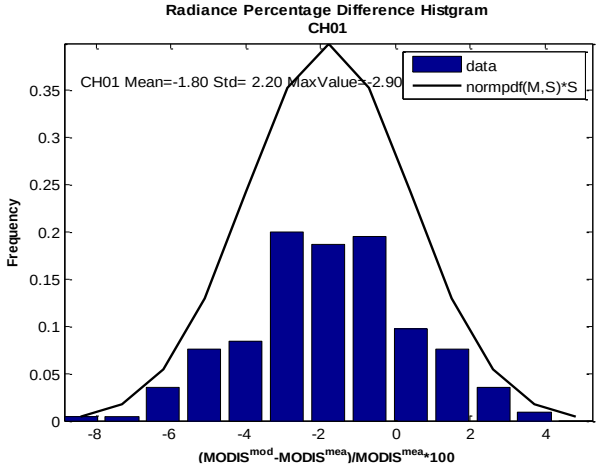


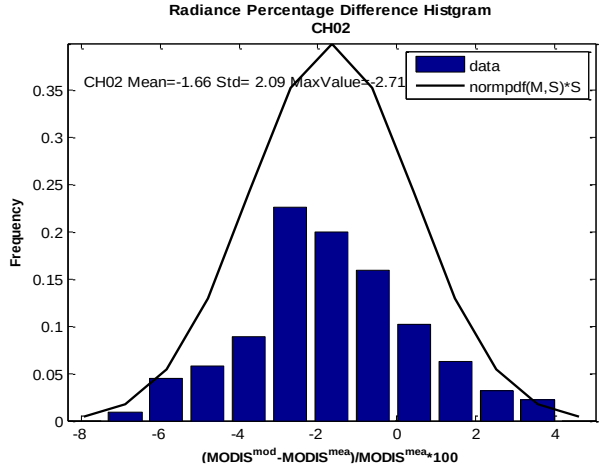


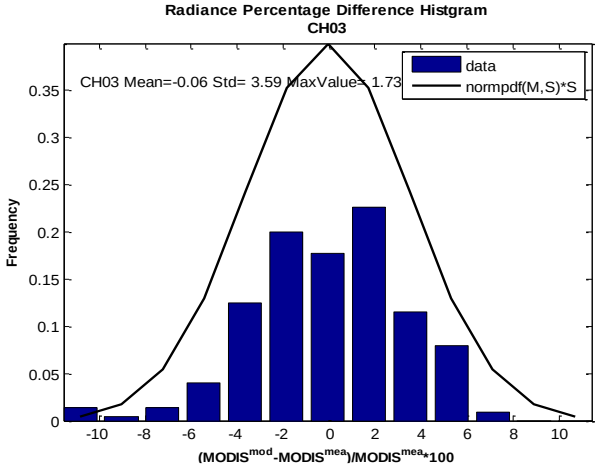
Linear fit:

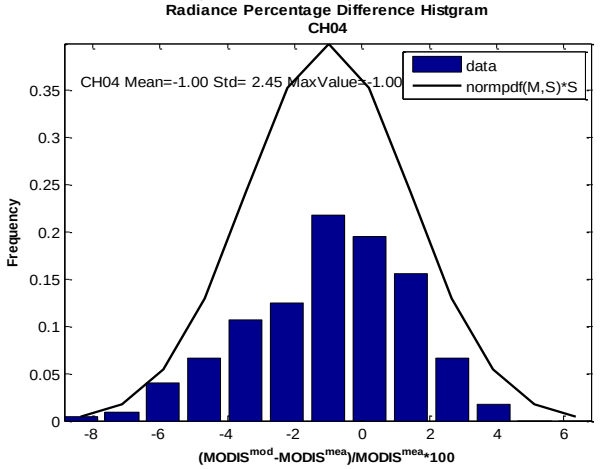
CH1(645nm): Y=0.91*X+15.20 R^2=0.97 RMS=3.96 RMSRE=2.05% MARE=1.65% N=226
CH2(858nm): Y=0.92*X+10.35 R^2=0.97 RMS=2.88 RMSRE=1.93% MARE=1.53% N=226
CH3(469nm): Y=0.93*X+7.66 R^2=0.89 RMS=4.40 RMSRE=3.60% MARE=2.68% N=226
CH4(555nm): Y=0.90*X+13.39 R^2=0.95 RMS=3.42 RMSRE=2.30% MARE=1.86% N=226
CH5(1.24um):Y=0.88*X+4.69 R^2=0.98 RMS=1.43 RMSRE=1.82% MARE=1.43% N=226
CH6(1.64um) Y=0.93*X+1.74 R^2=0.99 RMS=0.64 RMSRE=1.49% MARE=1.14% N=226
CH7(2.13um):Y=0.98*X+0.72 R^2=0.97 RMS=0.33 RMSRE=2.05% MARE=1.60% N=226

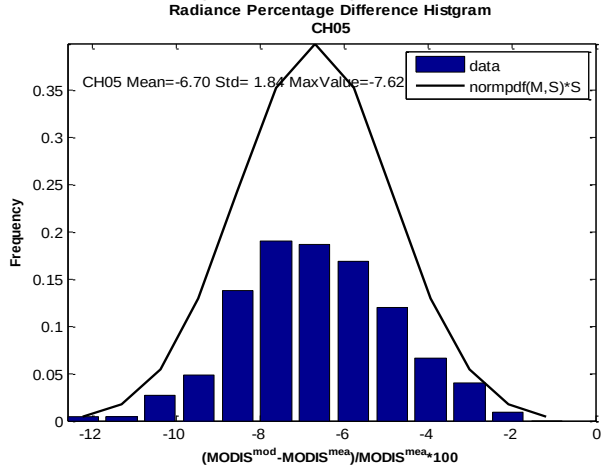
- Relatively good linear fitting result.
- Short wave channel(CH3,4,1) has more abnormal points.
- CH5,6 is underestimated.

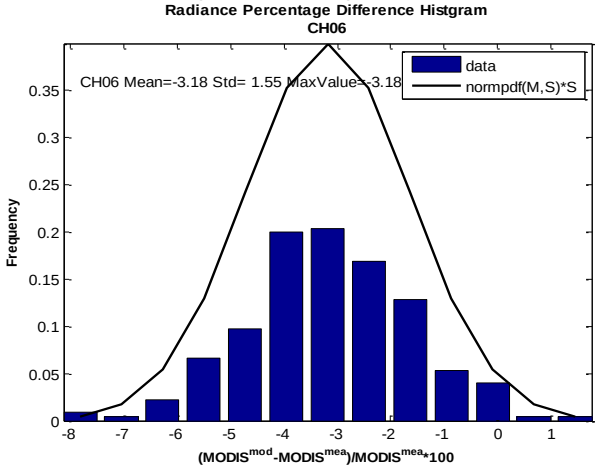


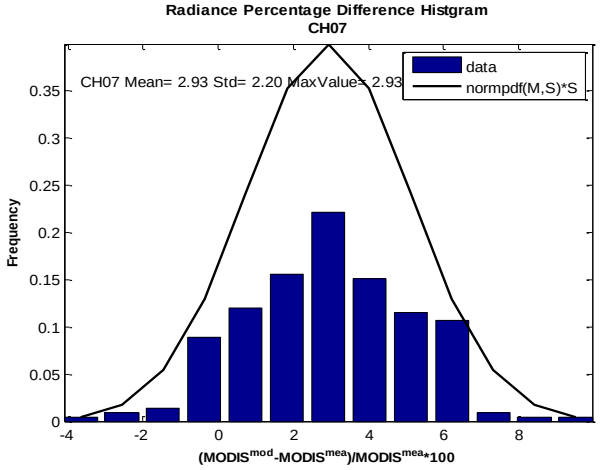










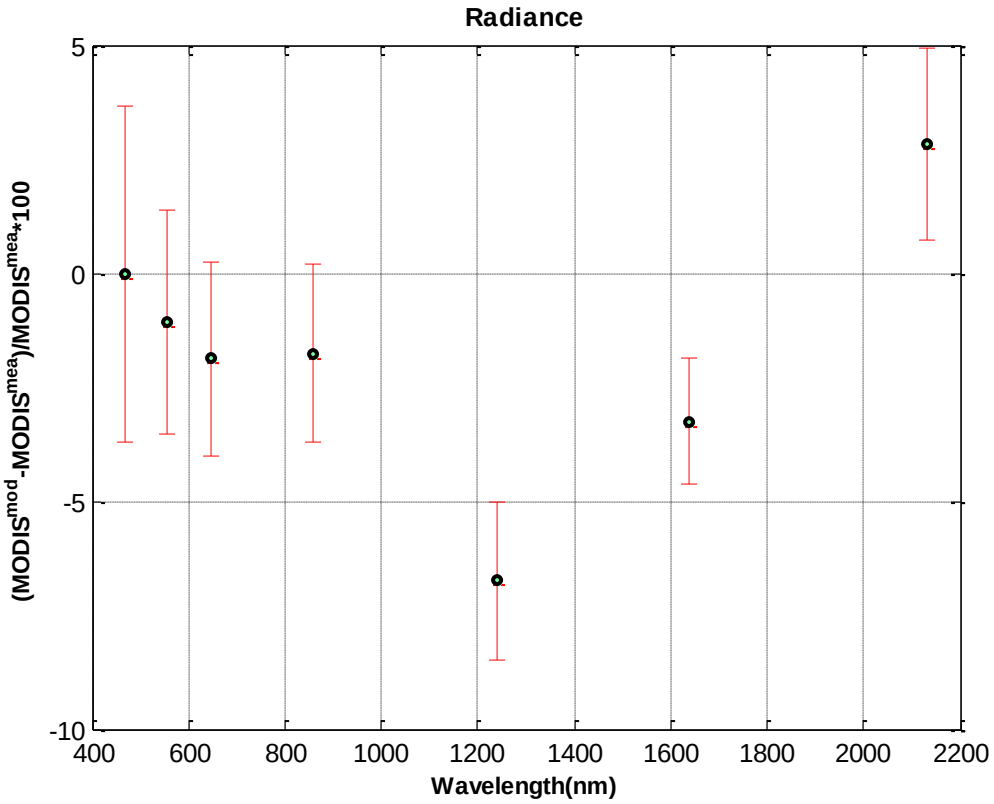


Dif(%):

CH1 M=-1.80 S= 2.20 MaxValue=-2.90, RMS= 2.84
CH2 M=-1.66 S= 2.09 MaxValue=-2.71, RMS= 2.67
CH3 M=-0.06 S= 3.59 MaxValue= 1.73, RMS= 3.58
CH4 M=-1.00 S= 2.45 MaxValue=-1.00, RMS= 2.65
CH5 M=-6.70 S= 1.84 MaxValue=-7.62, RMS= 6.95
CH6 M=-3.18 S= 1.55 MaxValue=-3.18, RMS= 3.54
CH7 M= 2.93 S= 2.20 MaxValue= 2.93, RMS= 3.66

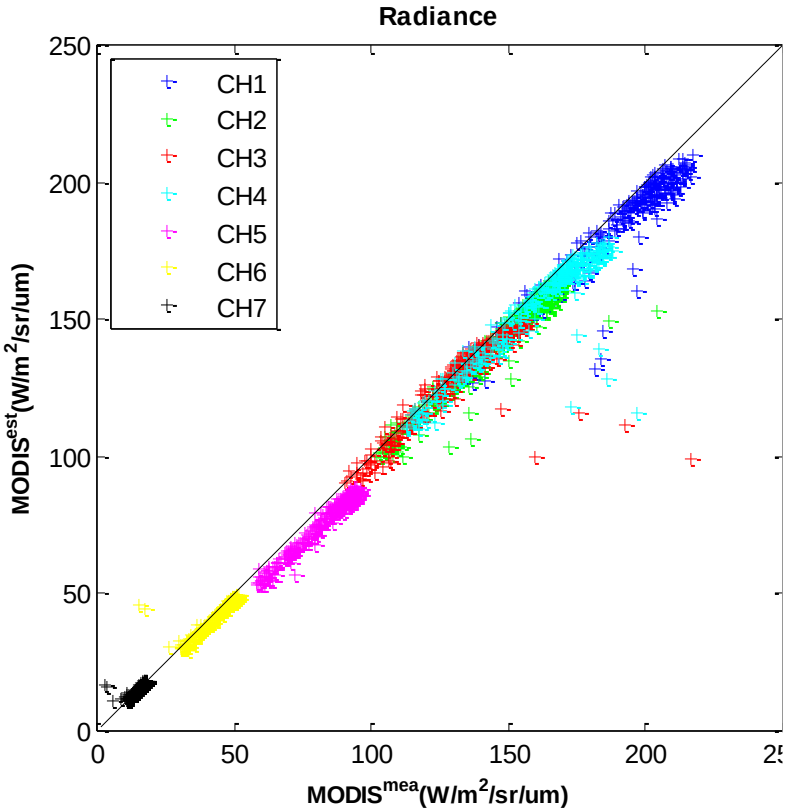
- CH1,2,4 are mostly underestimated.
- CH3 is unbiased.
- CH5,6 are almost all underestimated.
- CH7 is mostly overestimated.

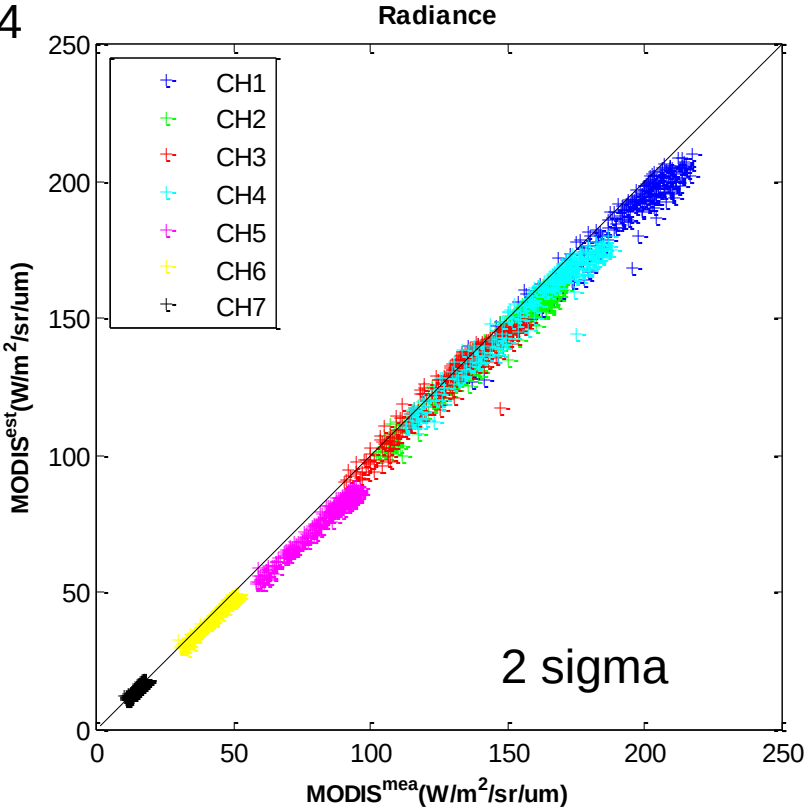
- Standard deviation decrease with increasing wavelength except for CH7.
- RMS of Dif(%) is 2.65~3.66% except for CH5.



•The calibration precision (Mean+-Std) is within 5% except for CH5.

Libya4

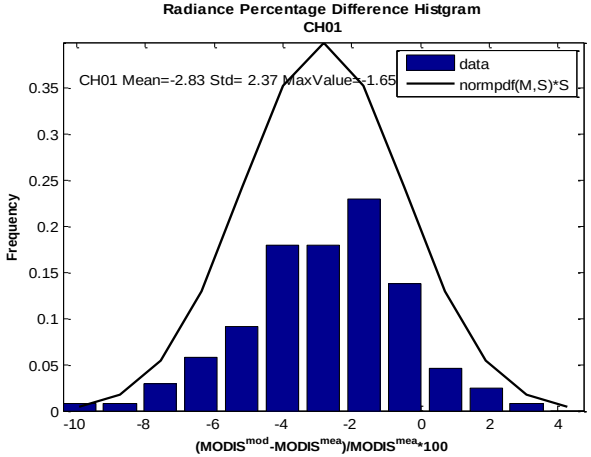


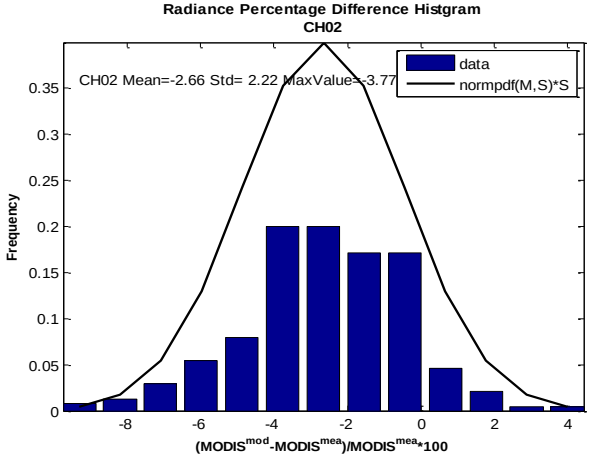


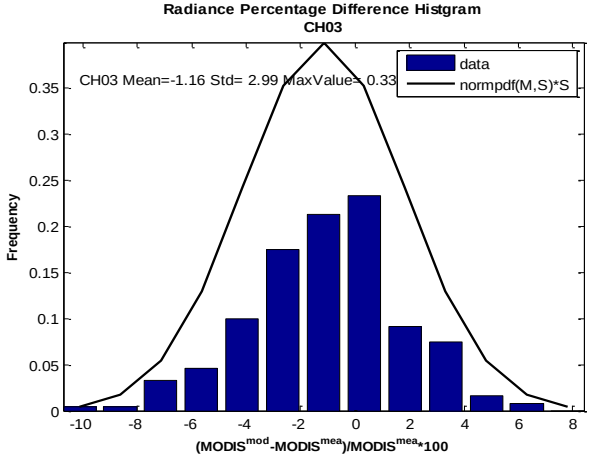
Linear fit:

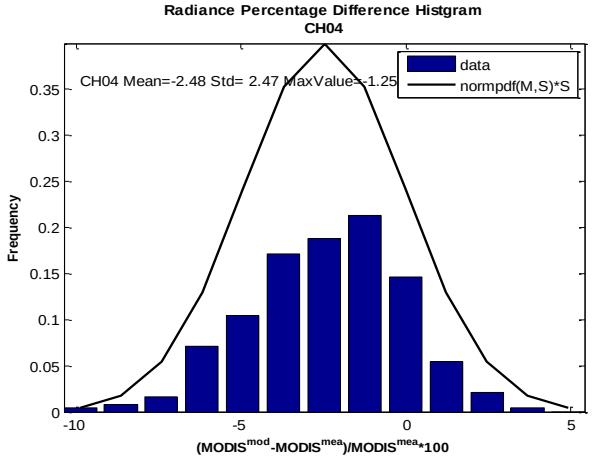
CH1(645nm): Y=0.93*X+6.90 R^2=0.97 RMS=4.20 RMSRE=2.38% MARE=1.87% N=240
CH2(858nm): Y=0.94*X+4.07 R^2=0.97 RMS=3.05 RMSRE=2.23% MARE=1.74% N=240
CH3(469nm): Y=0.93*X+7.96 R^2=0.94 RMS=3.74 RMSRE=2.98% MARE=2.23% N=240
CH4(555nm): Y=0.92*X+9.02 R^2=0.96 RMS=3.76 RMSRE=2.44% MARE=1.90% N=240
CH5(1.24um):Y=0.93*X- 0.56 R^2=0.98 RMS=1.50 RMSRE=2.03% MARE=1.55% N=240
CH6(1.64um) Y=0.95*X+0.47 R^2=0.99 RMS=0.70 RMSRE=1.88% MARE=1.28% N=240
CH7(2.13um):Y=0.99*X+0.42 R^2=0.97 RMS=0.39 RMSRE=2.77% MARE=2.00% N=240

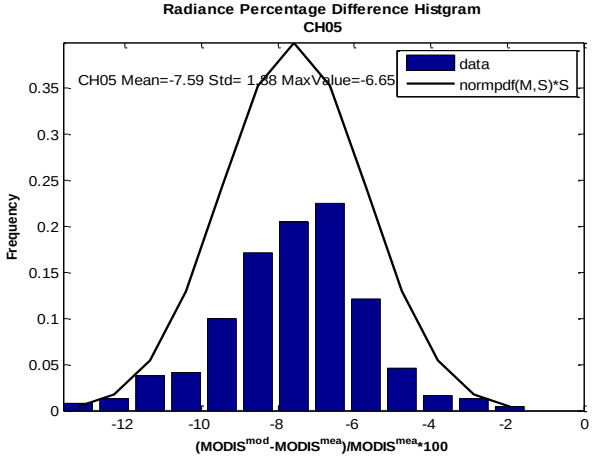
- Similarly result as Libya1.

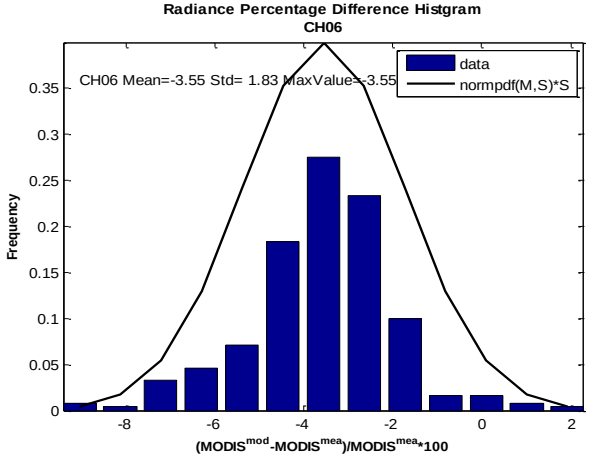


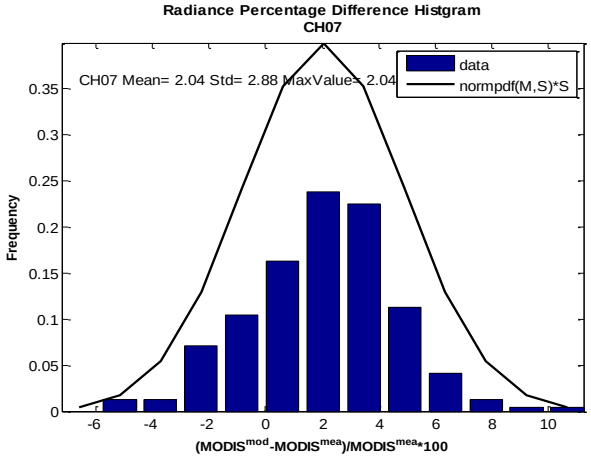










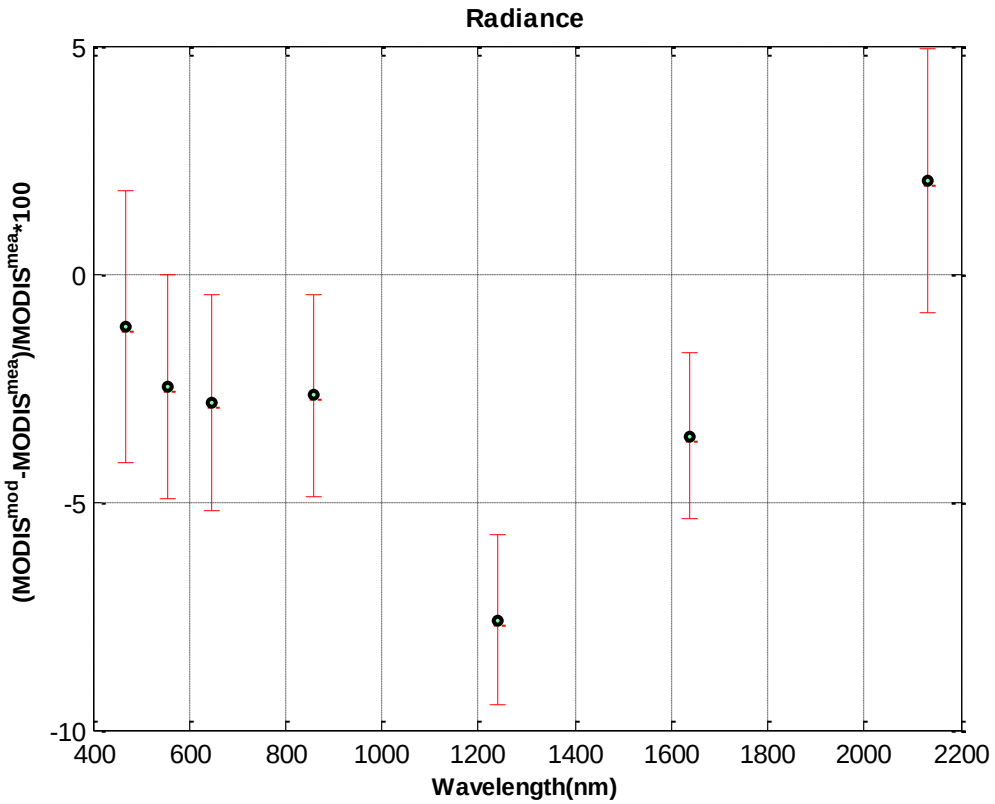


Dif(%):

CH1 M=-2.83 S= 2.37 MaxValue=-1.65 RMS= 3.69
CH2 M=-2.66 S= 2.22 MaxValue=-3.77 RMS= 3.46
CH3 M=-1.16 S= 2.99 MaxValue= 0.33 RMS= 3.20
CH4 M=-2.48 S= 2.47 MaxValue=-1.25 RMS= 3.49
CH5 M=-7.59 S= 1.88 MaxValue=-6.65 RMS= 7.82
CH6 M=-3.55 S= 1.83 MaxValue=-3.55 RMS= 4.00
CH7 M= 2.04 S= 2.88 MaxValue= 2.04 RMS= 3.53

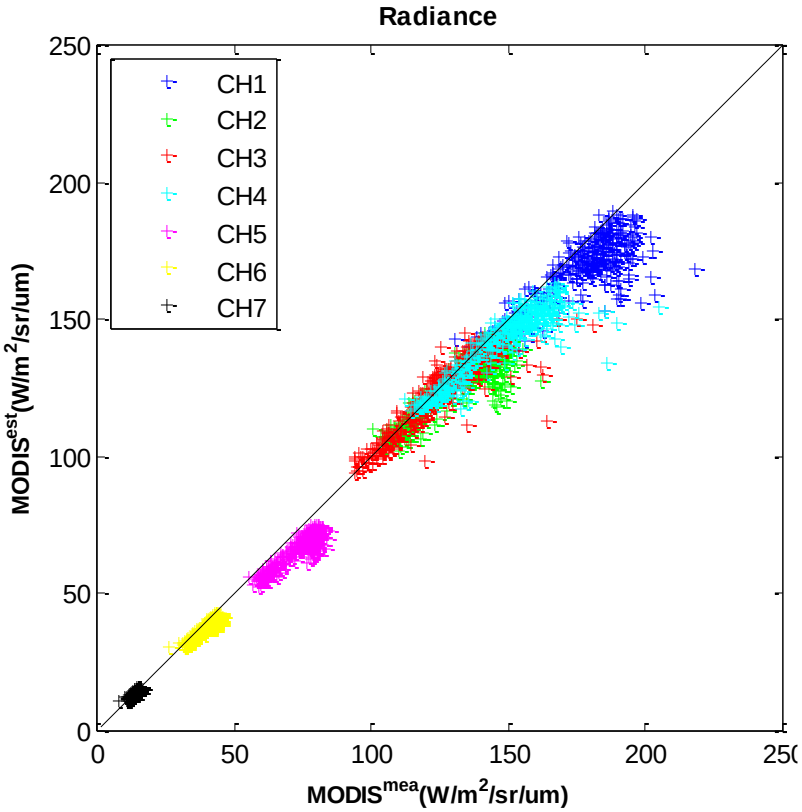
- CH1,2,4 are mostly underestimated.
- CH3 is nearly unbiased.
- CH5,6 are almost all underestimated.
- CH7 is mostly overestimated.

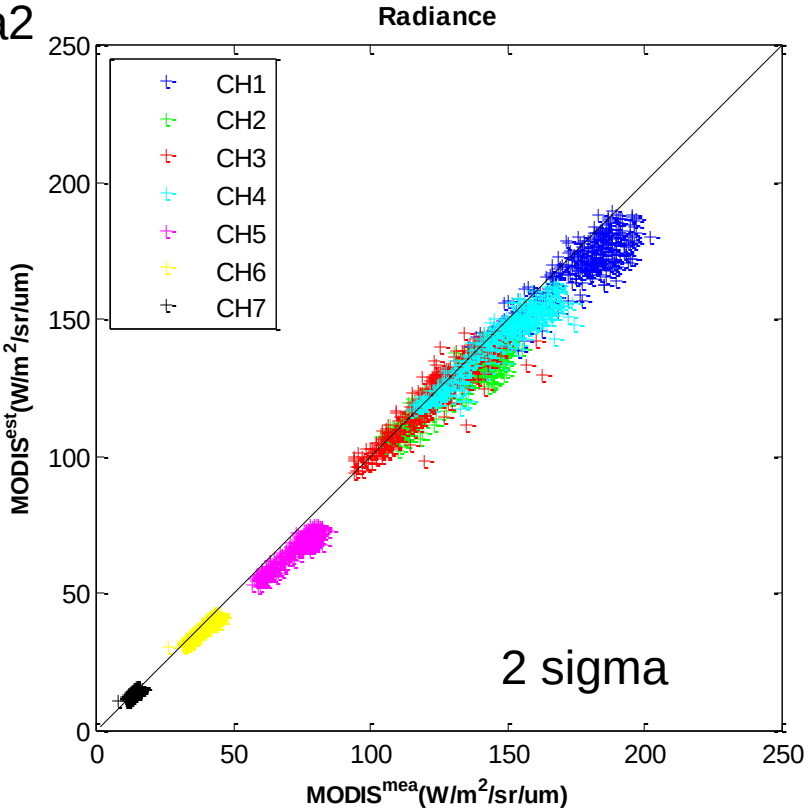
- RMS of Dif(%) is 3.20~4.00% except for CH5.



•The calibration precision is almost within 5% except for CH5.

Arabia2

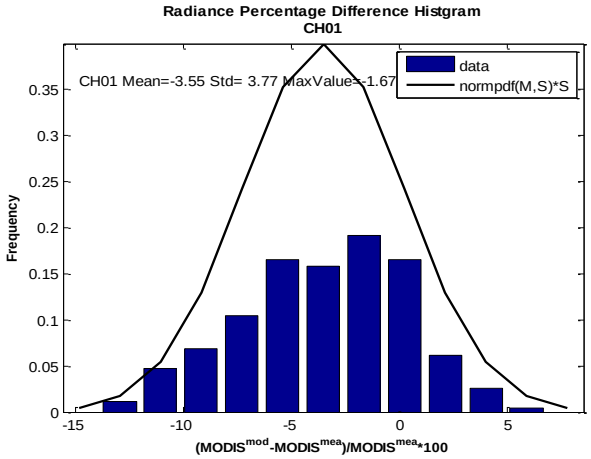


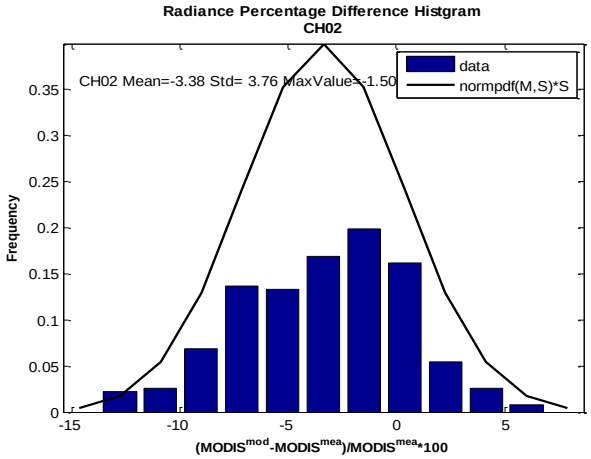


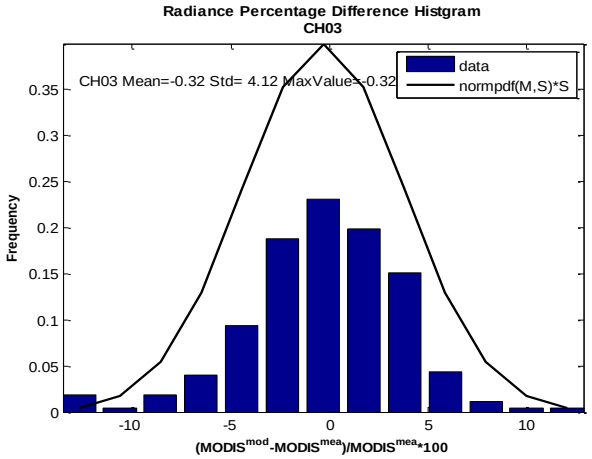
Linear fit:

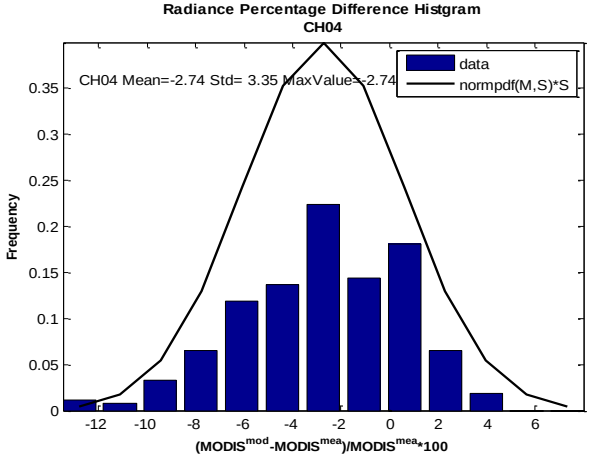
CH1(645nm): Y=0.77*X+32.89 R^2=0.84 RMS=5.63 RMSRE=3.36% MARE=2.67% N=278
CH2(858nm): Y=0.78*X+24.50 R^2=0.85 RMS=4.34 RMSRE=3.36% MARE=2.68% N=278
CH3(469nm): Y=0.86*X+17.05 R^2=0.86 RMS=5.02 RMSRE=3.94% MARE=2.93% N=278
CH4(555nm): Y=0.79*X+26.49 R^2=0.89 RMS=4.20 RMSRE=2.91% MARE=2.24% N=278
CH5(1.24um):Y=0.81*X+7.89 R^2=0.91 RMS=1.84 RMSRE=2.74% MARE=2.17% N=278
CH6(1.64um) Y=0.84*X+4.75 R^2=0.93 RMS=0.92 RMSRE=2.47% MARE=1.91% N=278
CH7(2.13um):Y=0.82*X+2.57 R^2=0.87 RMS=0.47 RMSRE=3.54% MARE=2.68% N=278

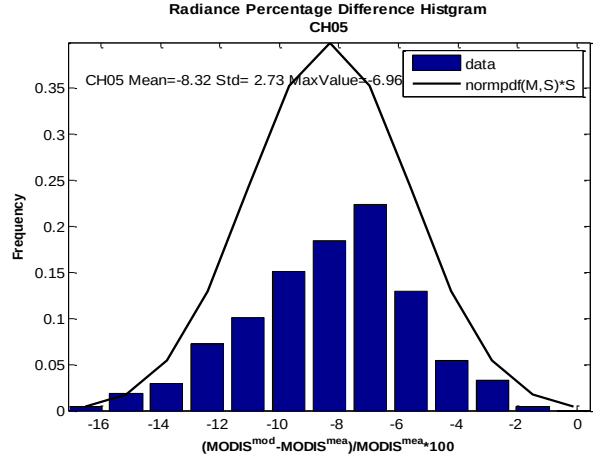
- Not as good as Libya.
- Short wave channel(CH3,4,1,2) has more abnormal points.
- CH5,6 is underestimated.

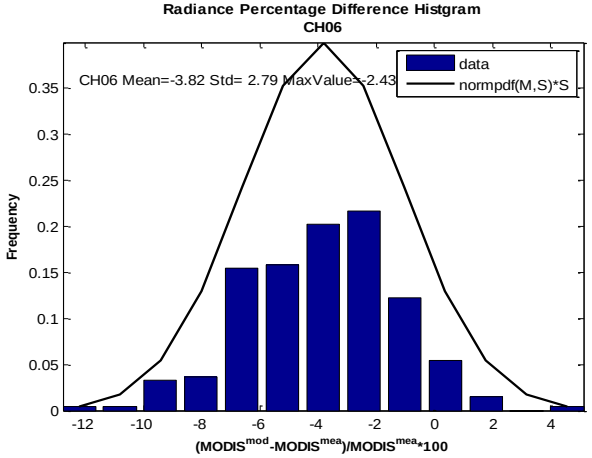


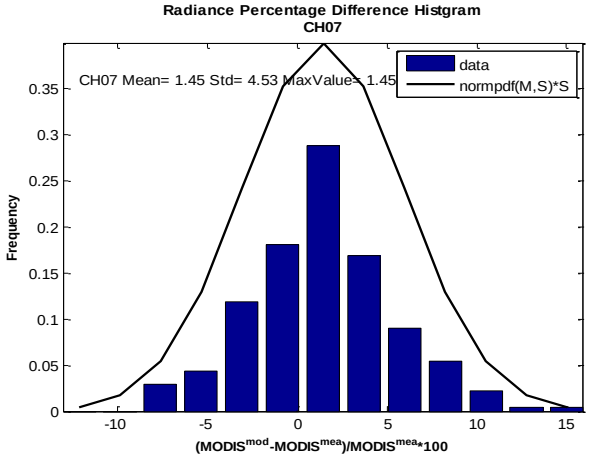










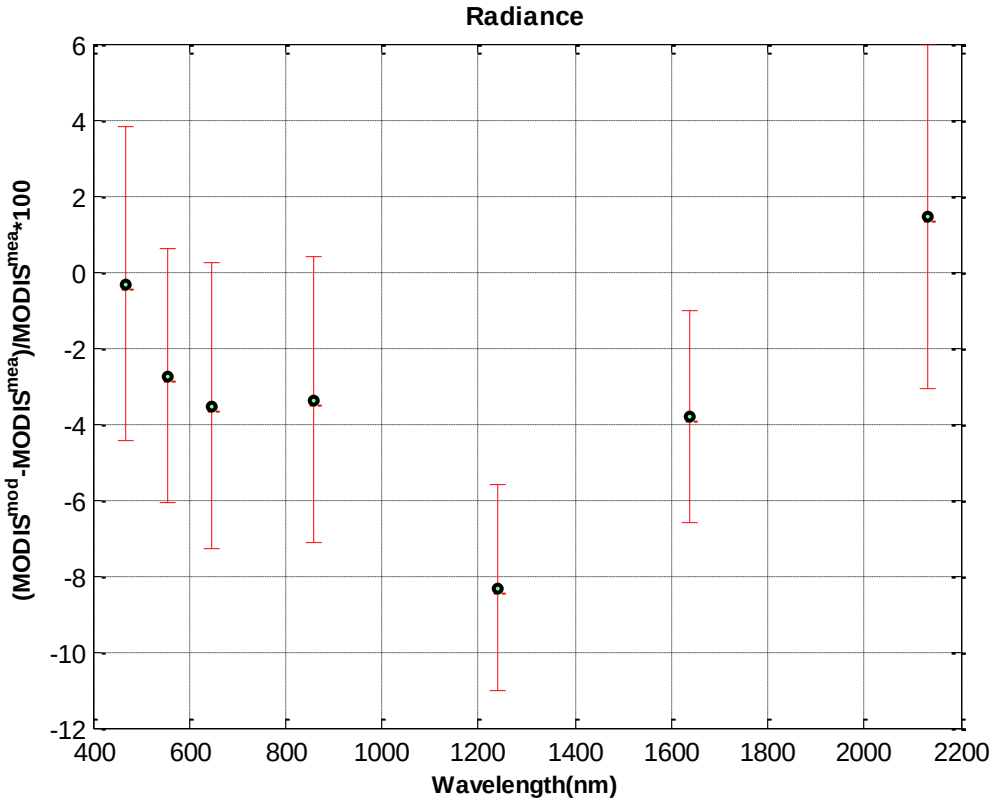


Dif(%):

CH1 M=-3.55 S= 3.77 MaxValue=-1.67 RMS= 5.17
CH2 M=-3.38 S= 3.76 MaxValue=-1.50 RMS= 5.05
CH3 M=-0.32 S= 4.12 MaxValue=-0.32 RMS= 4.13
CH4 M=-2.74 S= 3.35 MaxValue=-2.74 RMS= 4.33
CH5 M=-8.32 S= 2.73 MaxValue=-6.96 RMS= 8.76
CH6 M=-3.82 S= 2.79 MaxValue=-2.43 RMS= 4.73
CH7 M= 1.45 S= 4.53 MaxValue= 1.45 RMS= 4.75

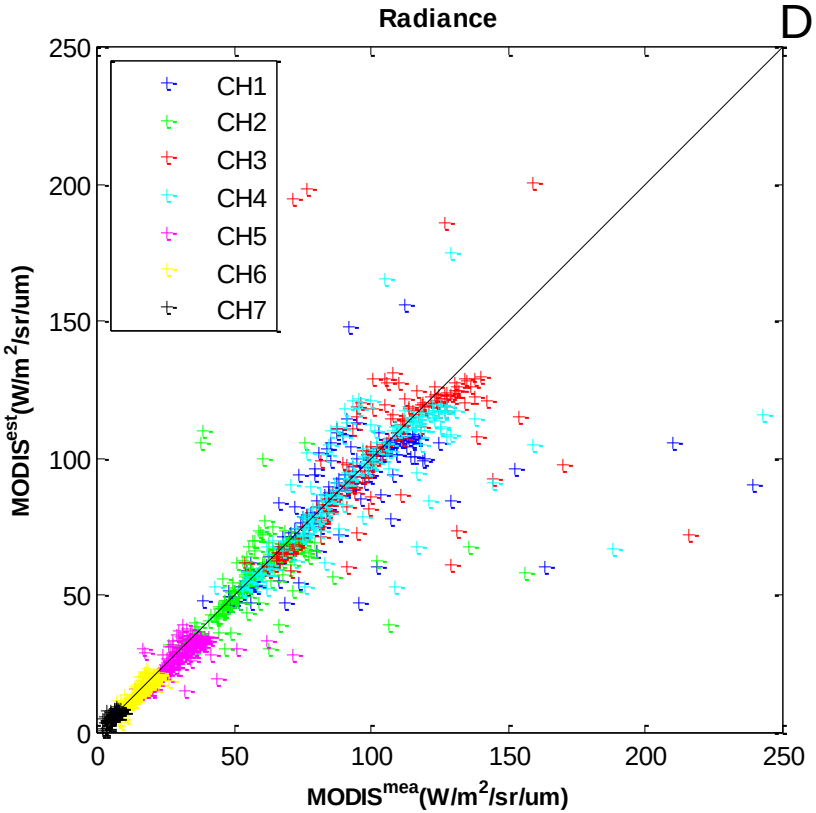
- CH1,2,4 are mostly underestimated.
- CH3 is nearly unbiased.
- CH5,6 are almost all underestimated.
- CH7 is mostly overestimated.

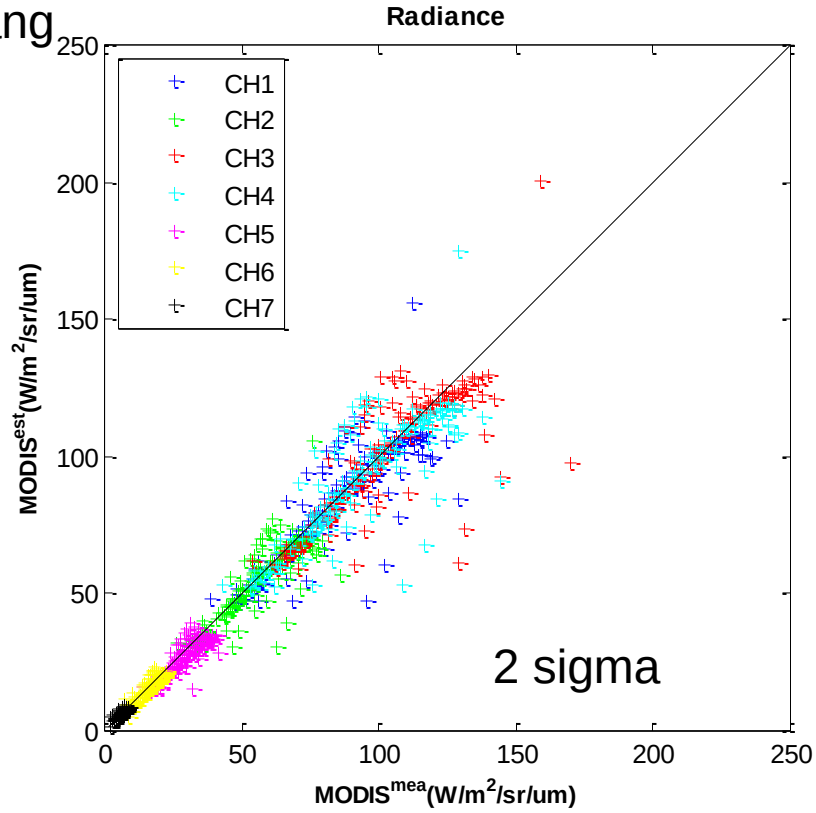
- RMS of Dif(%) is 4.13~5.17% except for CH5.



- The calibration precision (Mean+-Std) is within 5% in CH3(470nm).
- The mean calibration percentage error is -4~2% except for CH5.

Dunhuang

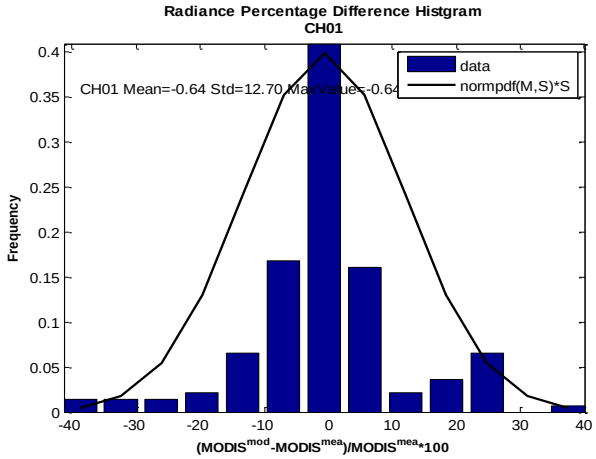


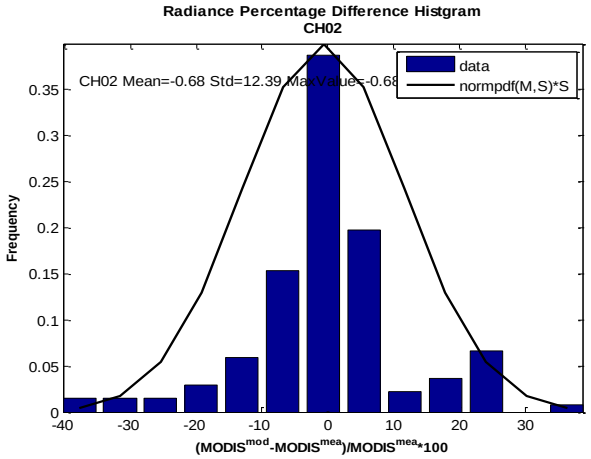


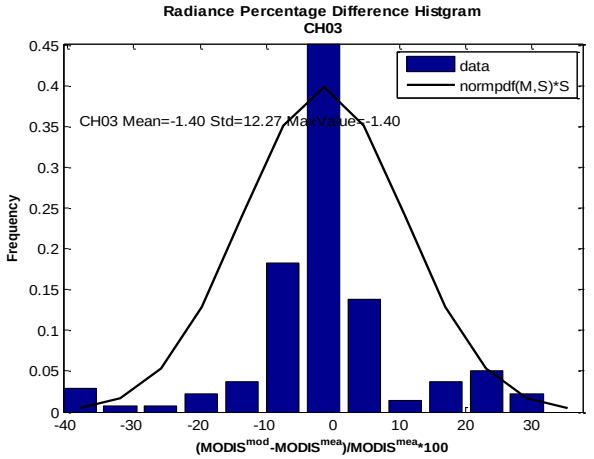
Linear fit:

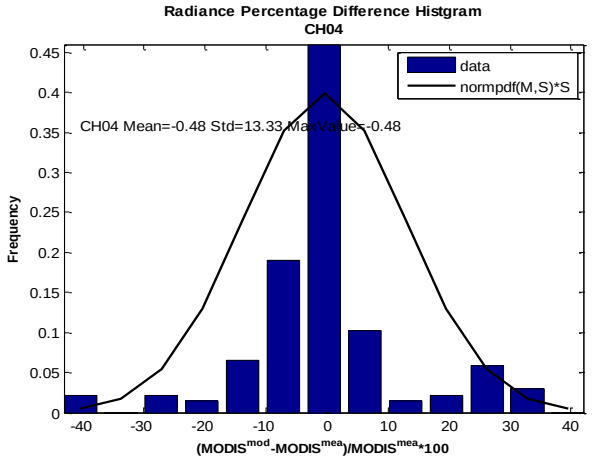
CH1(645nm): Y=0.85*X+11.43 R^2=0.71 RMS=11.35 RMSRE=12.80% MARE=8.60% N=137
CH2(858nm): Y=0.87*X+6.43 R^2=0.71 RMS=7.45 RMSRE=12.53% MARE=8.30% N=137
CH3(469nm): Y=0.82*X+16.57 R^2=0.64 RMS=14.08 RMSRE=12.65% MARE=8.44% N=137
CH4(555nm): Y=0.82*X+15.64 R^2=0.67 RMS=12.88 RMSRE=13.35% MARE=8.90% N=137
CH5(1.24um):Y=0.86*X+2.33 R^2=0.76 RMS=3.24 RMSRE=11.79% MARE=7.93% N=137
CH6(1.64um) Y=0.94*X+0.99 R^2=0.85 RMS=1.59 RMSRE=11.37% MARE=7.68% N=137
CH7(2.13um):Y=0.97*X+0.67 R^2=0.86 RMS=0.60 RMSRE=13.13% MARE=8.02% N=137

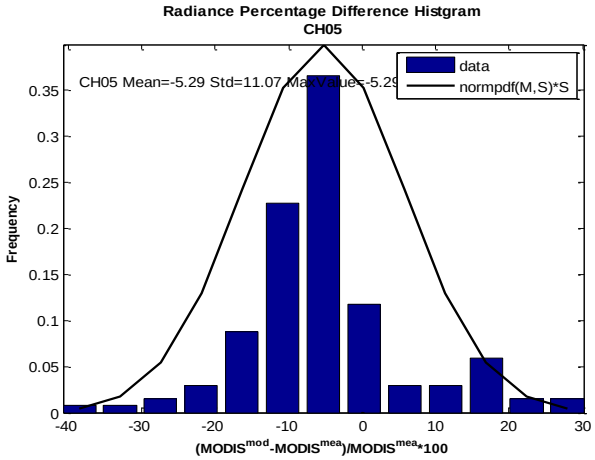
- Poorest result.
- Channels have more abnormal points, especially in CH1~5.

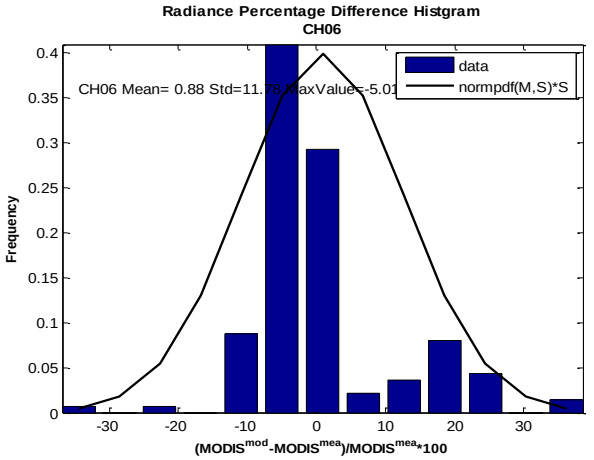


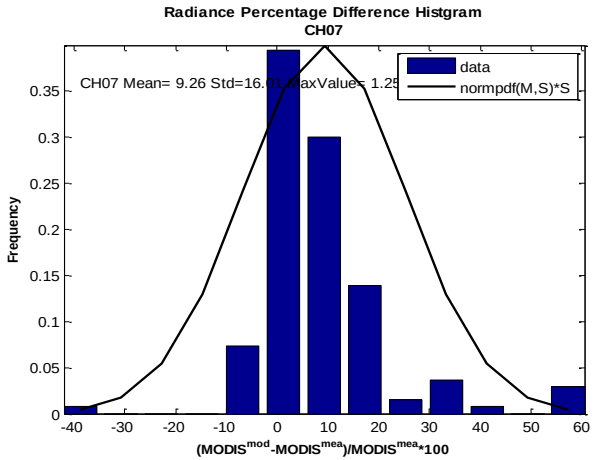










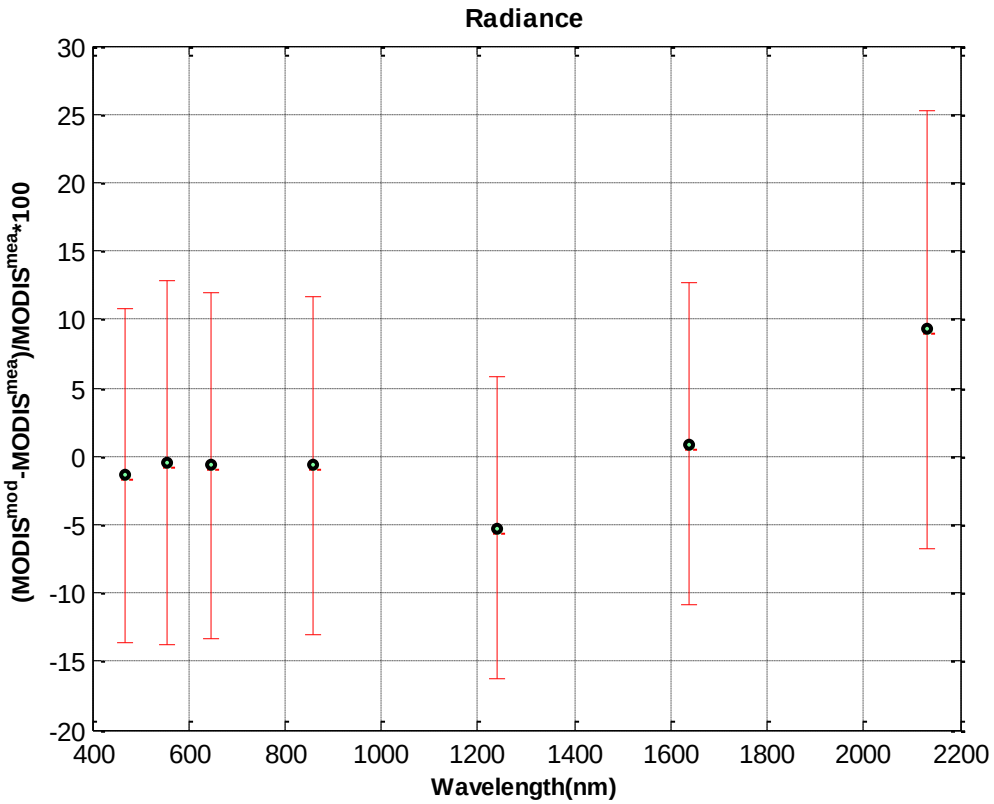


Dif(%):

CH1 M=-0.64 S=12.70 MaxValue=-0.64 RMS=12.67
CH2 M=-0.68 S=12.39 MaxValue=-0.68 RMS=12.36
CH3 M=-1.40 S=12.27 MaxValue=-1.40 RMS=12.30
CH4 M=-0.48 S=13.33 MaxValue=-0.48 RMS=13.29
CH5 M=-5.29 S=11.07 MaxValue=-5.29 RMS=12.24
CH6 M= 0.88 S=11.78 MaxValue=-5.01 RMS=11.77
CH7 M= 9.26 S=16.01 MaxValue= 1.25 RMS=18.44

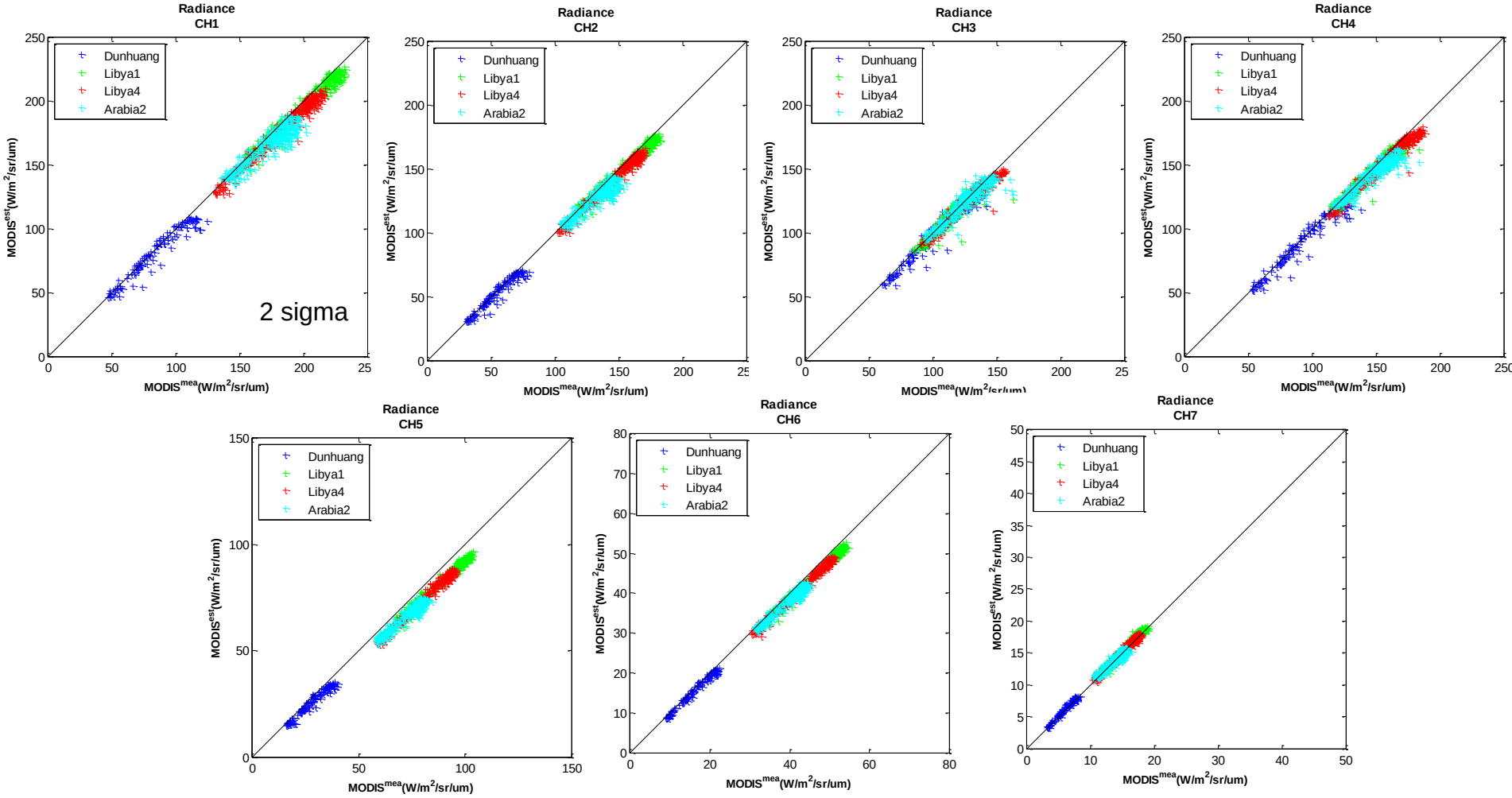
- CH1,2,3,4 are nearly unbiased.
- CH5,6 are mostly underestimated.
- CH7 is mostly overestimated.

RMS of Dif(%) is 11.77~13.29% except for CH7.



•The mean calibration percentage error is -1.4~1% for CH1,2,3,4,6; ~-5% for CH5, ~10% for CH7.

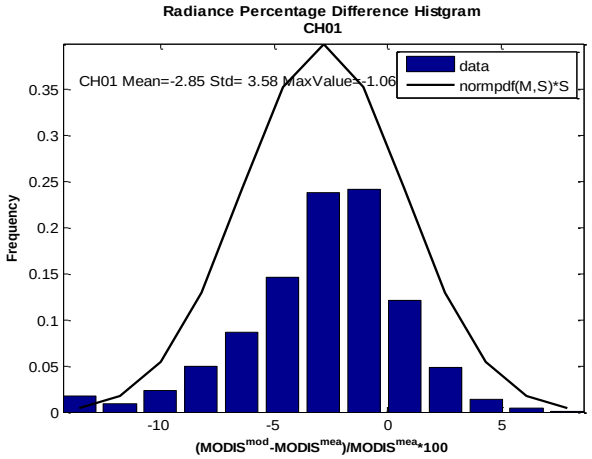
Libya1&Libya4&Arabia2&Dunhuang

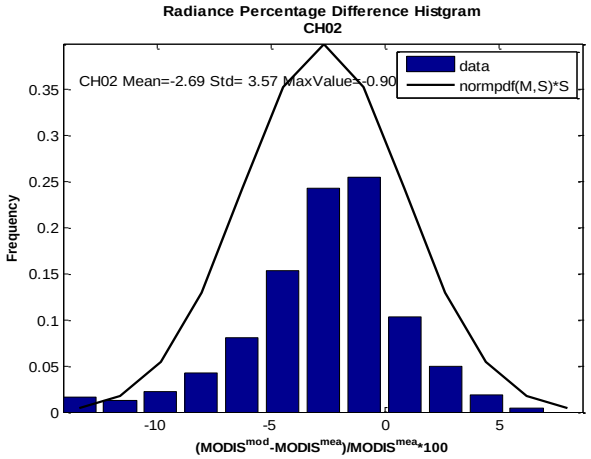


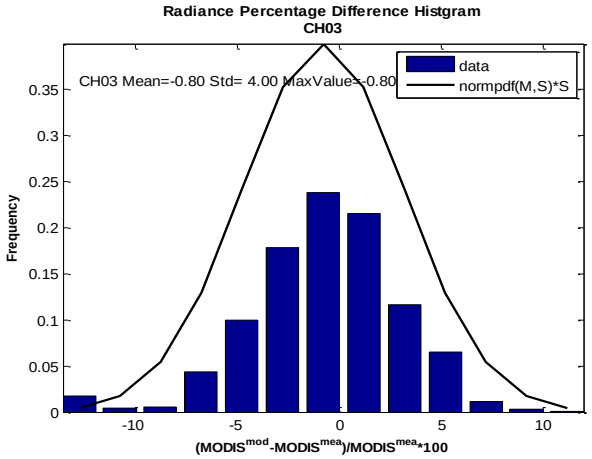
Linear fit:

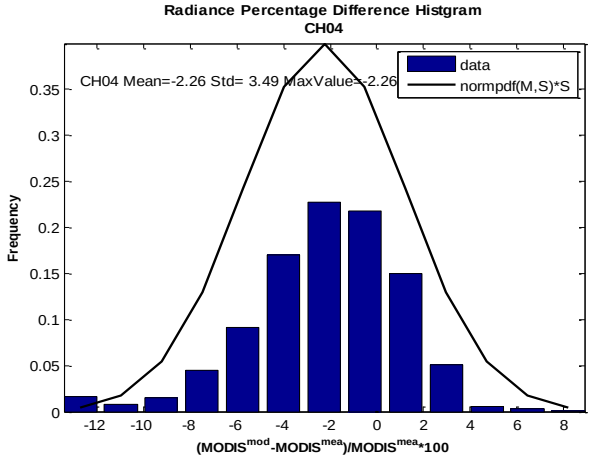
CH1: Y=0.96*X+2.08 R^2=0.98 RMS=5.52 RMSRE=3.66% MARE=2.70% N=850
CH2: Y=0.96*X+1.00 R^2=0.99 RMS=4.08 RMSRE=3.64% MARE=2.63% N=850
CH3: Y=0.94*X+6.48 R^2=0.93 RMS=4.85 RMSRE=4.08% MARE=2.92% N=850
CH4: Y=0.94*X+5.55 R^2=0.97 RMS=4.67 RMSRE=3.57% MARE=2.60% N=850
CH5: Y=0.93*X- 0.15 R^2=0.99 RMS=1.77 RMSRE=3.10% MARE=2.23% N=850
CH6: Y=0.96*X+0.25 R^2=0.99 RMS=0.80 RMSRE=2.32% MARE=1.73% N=850
CH7: Y=1.00*X+0.25 R^2=0.99 RMS=0.42 RMSRE=3.20% MARE=2.41% N=850

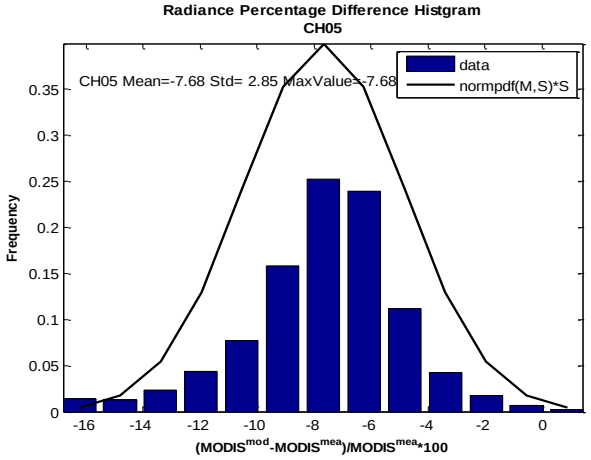
- Good linear relationship.
- Short wave channels (CH3,4,1)are more noisy.

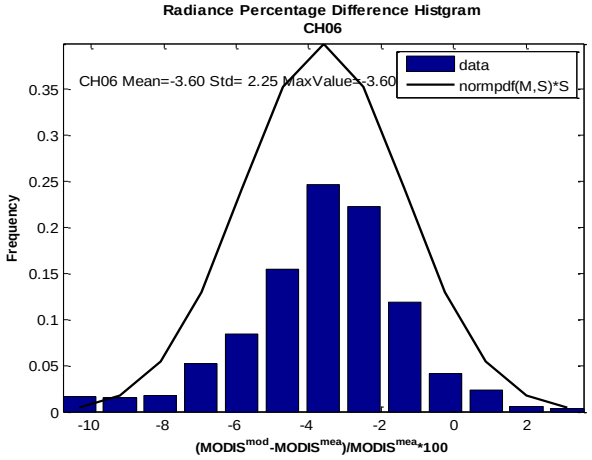


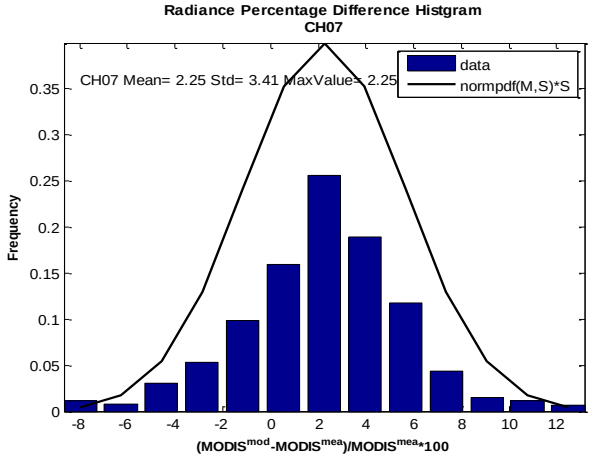










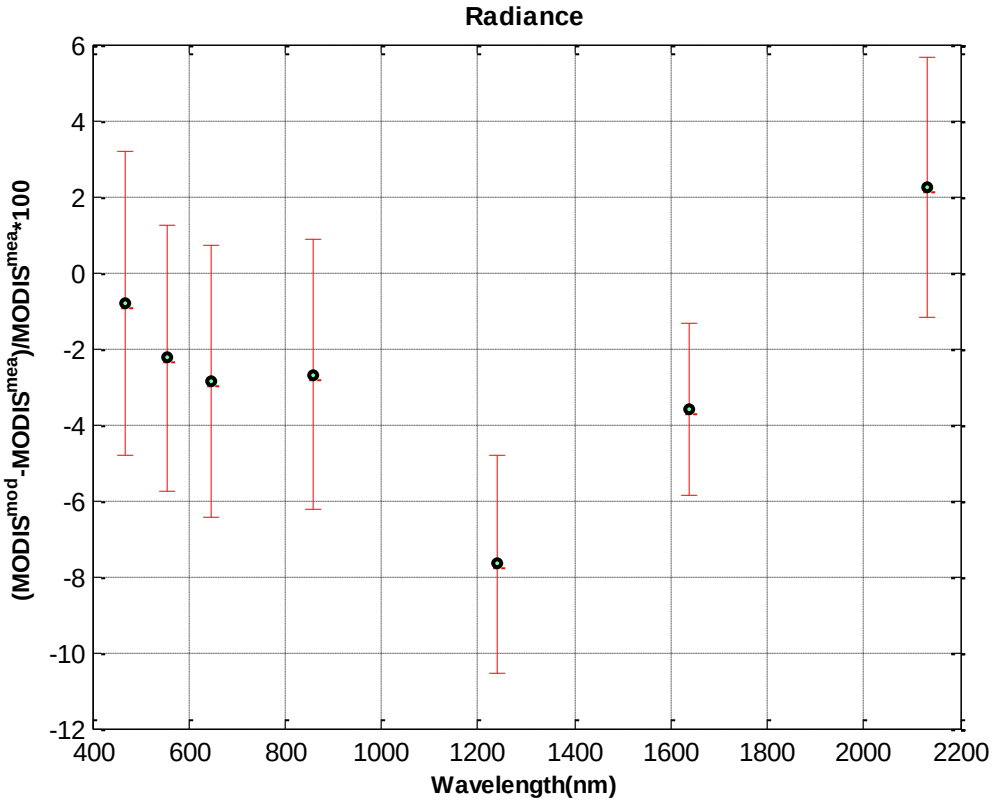


Dif(%):

CH1 M=-2.85 S= 3.58 MaxValue=-1.06 RMS= 4.58
CH2 M=-2.69 S= 3.57 MaxValue=-0.90 RMS= 4.47
CH3 M=-0.80 S= 4.00 MaxValue=-0.80 RMS= 4.07
CH4 M=-2.26 S= 3.49 MaxValue=-2.26 RMS= 4.15
CH5 M=-7.68 S= 2.85 MaxValue=-7.68 RMS= 8.19
CH6 M=-3.60 S= 2.25 MaxValue=-3.60 RMS= 4.24
CH7 M= 2.25 S= 3.41 MaxValue= 2.25 RMS= 4.08

- CH1,2,4 are mostly underestimated.
- CH3 is nearly unbiased.
- CH5,6 are almost all underestimated.
- CH7 is mostly overestimated.

- RMS of Dif(%) is 4.07~4.58% except for CH5.

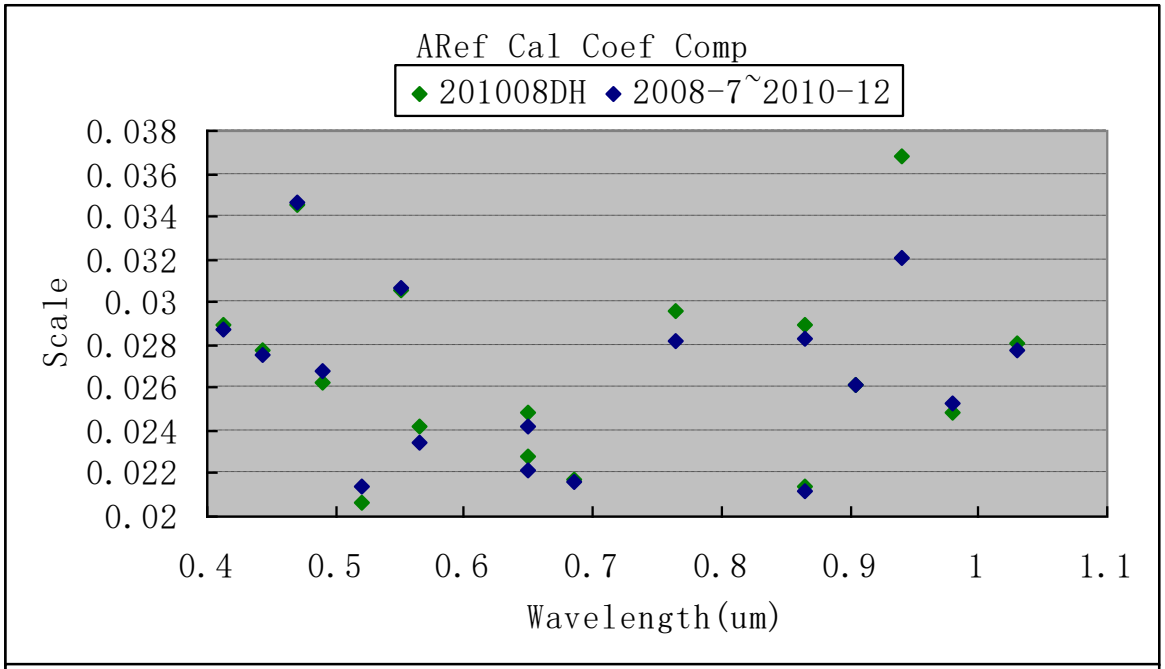


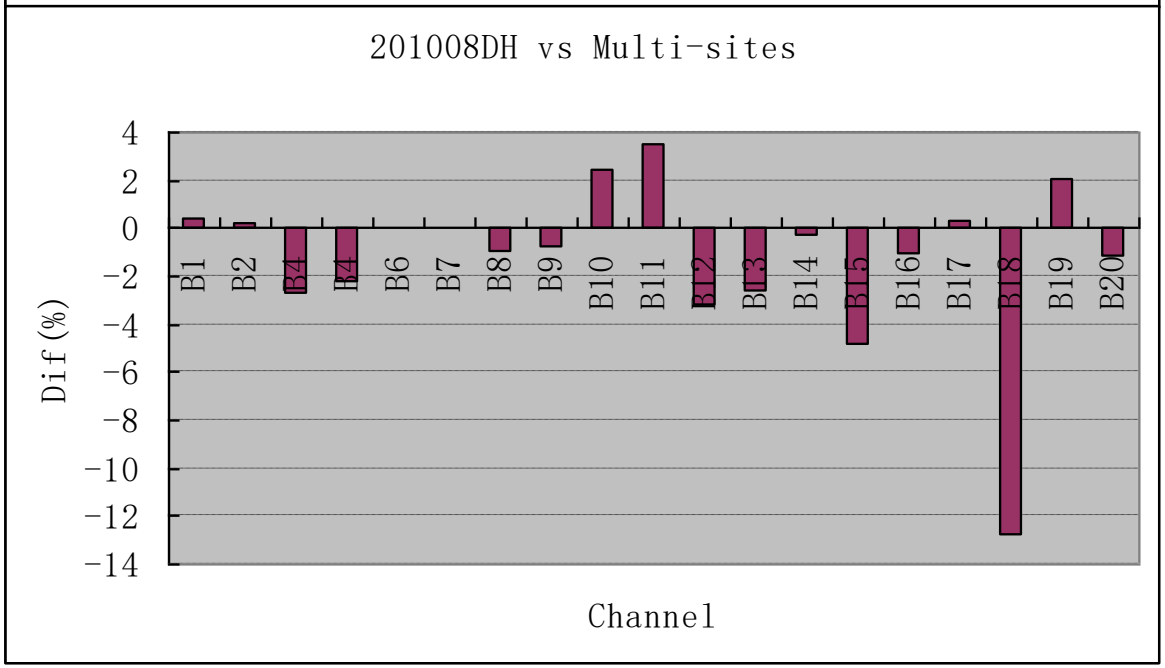
- The calibration precision (Mean+-Std) is almost within 6% except for CH5.
- The mean calibration percentage error is ~8% for CH5.

MERSI Re-calibration Performance Analysis

- Test with Dunhuang calibration experiment @ 2010-8
- Difference Analysis with Model Estimation
- Double Difference Analysis with MODIS

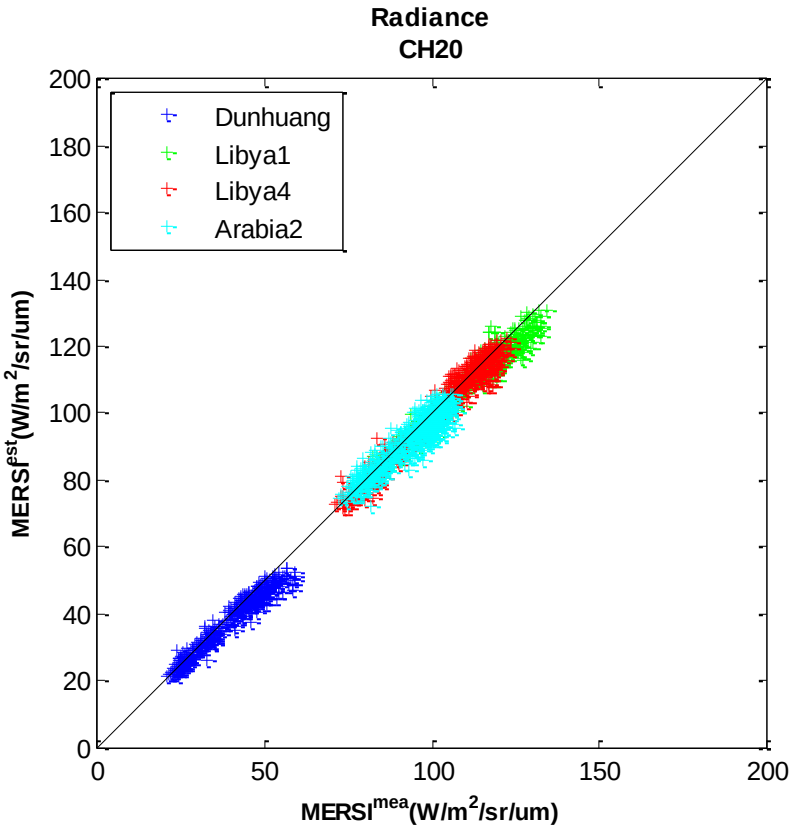
Test with Dunhuang calibration experiment @ 2010-8

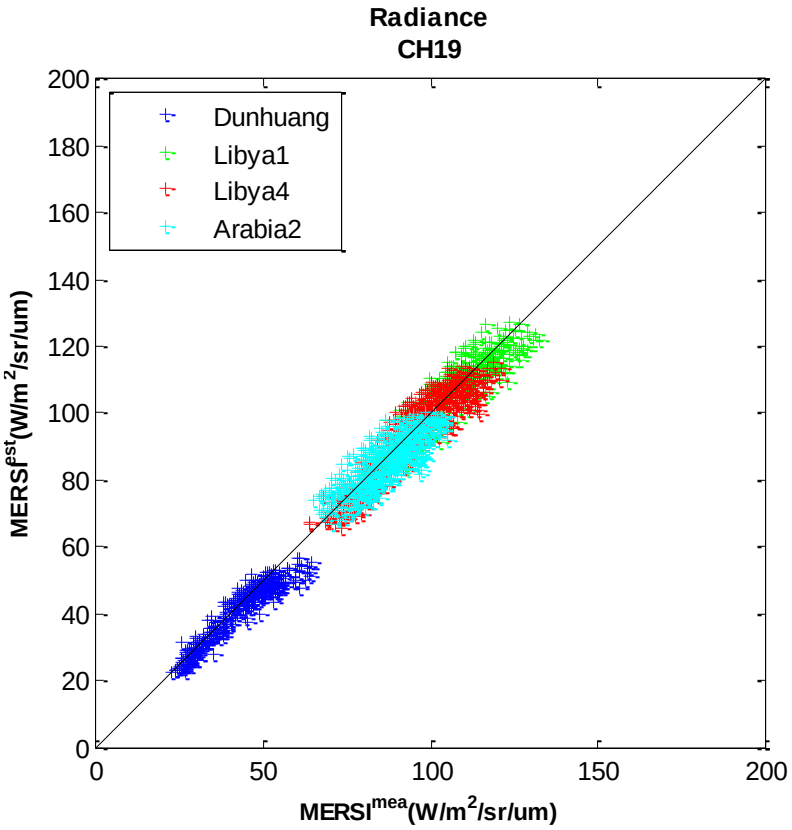




- Calibration coefficients during annual field campaign at Dunhuang in Aug. 2010 were estimated using the formula from multi-sites tracking analysis.
- The percent difference between estimated coefficients and vicarious calibration with in-situ data are below 5%(exept for CH18).

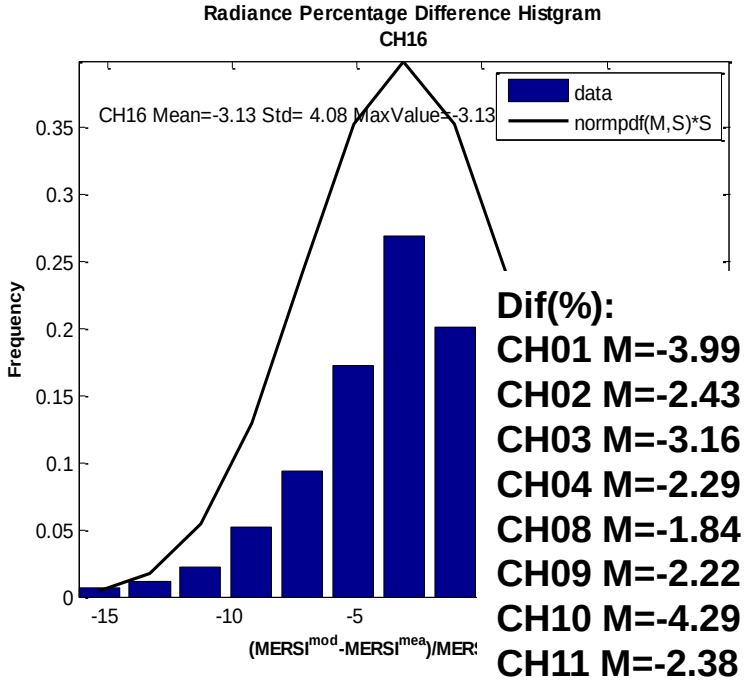
Difference Analysis with Model Estimation

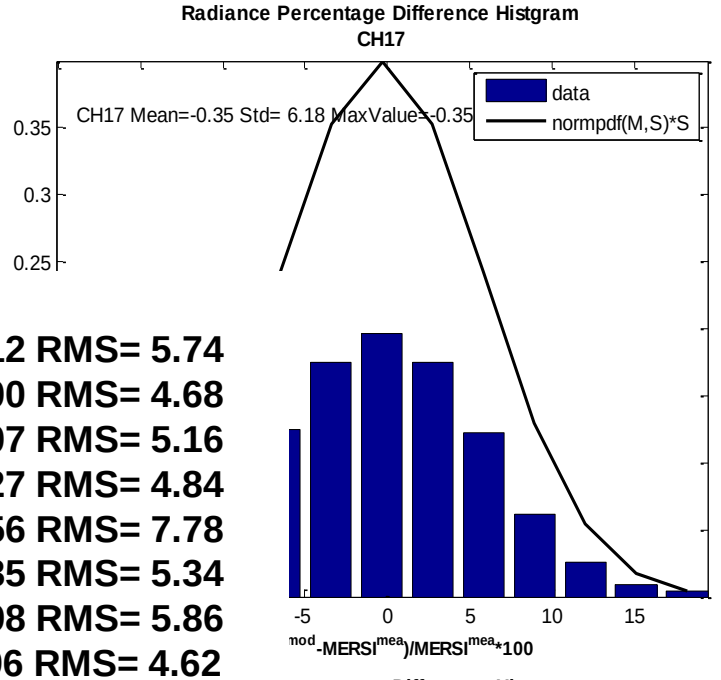




CH01: Y=0.867225*X+10.925230 R^2=0.94 N=1566
CH02: Y=0.903934*X+8.684667 R^2=0.97
CH03: Y=0.936878*X+4.430178 R^2=0.98
CH04: Y=0.950942*X+2.582312 R^2=0.99
CH08: Y=0.933389*X+4.963085 R^2=0.82
CH09: Y=0.906054*X+7.824815 R^2=0.91
CH10: Y=0.871630*X+10.132691 R^2=0.95
CH11: Y=0.901565*X+8.515229 R^2=0.96
CH12: Y=0.921335*X+8.345866 R^2=0.98

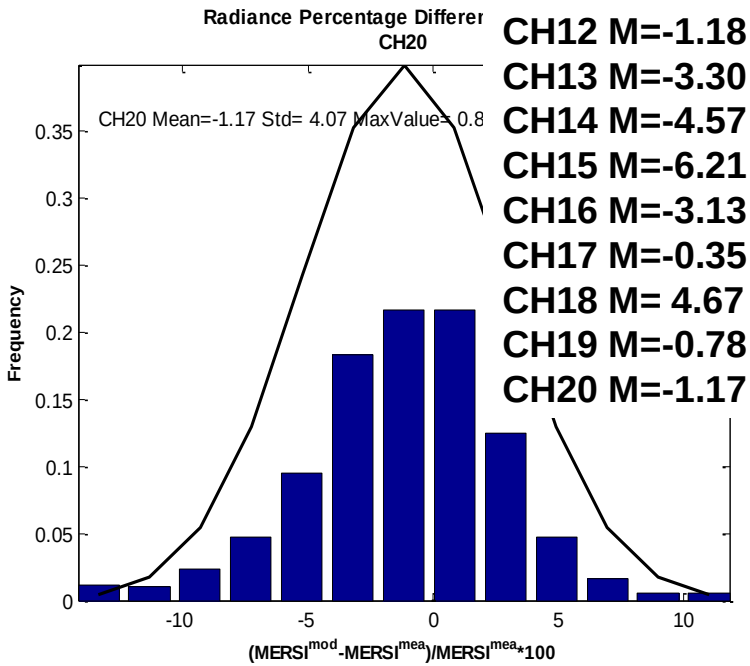
CH13: Y=0.945468*X+3.029687 R^2=0.98
CH14: Y=0.953996*X+0.013269 R^2=0.98
CH15: Y=0.943419*X+-0.580752 R^2=0.98
CH16: Y=0.951738*X+1.697367 R^2=0.99
CH17: Y=0.966486*X+2.369436 R^2=0.96
CH18: Y=0.705127*X+12.725681 R^2=0.70
CH19: Y=0.990320*X+0.181439 R^2=0.97
CH20: Y=0.991121*X+-0.191652 R^2=0.99

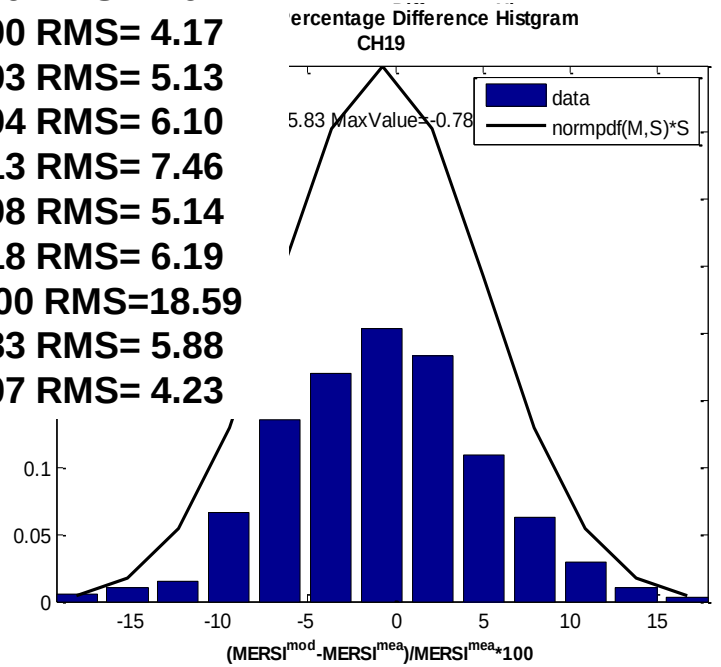




Dif(%):

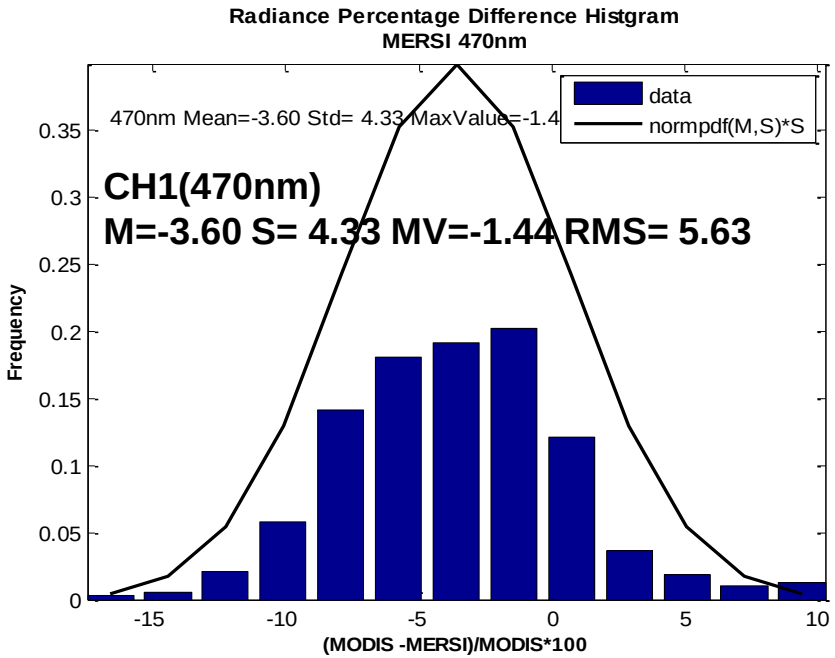
CH01 M=-3.99 S= 4.12 RMS= 5.74
CH02 M=-2.43 S= 4.00 RMS= 4.68
CH03 M=-3.16 S= 4.07 RMS= 5.16
CH04 M=-2.29 S= 4.27 RMS= 4.84
CH08 M=-1.84 S= 7.56 RMS= 7.78
CH09 M=-2.22 S= 4.85 RMS= 5.34
CH10 M=-4.29 S= 3.98 RMS= 5.86
CH11 M=-2.38 S= 3.96 RMS= 4.62
CH12 M=-1.18 S= 4.00 RMS= 4.17
CH13 M=-3.30 S= 3.93 RMS= 5.13
CH14 M=-4.57 S= 4.04 RMS= 6.10
CH15 M=-6.21 S= 4.13 RMS= 7.46
CH16 M=-3.13 S= 4.08 RMS= 5.14
CH17 M=-0.35 S= 6.18 RMS= 6.19
CH18 M= 4.67 S=18.00 RMS=18.59
CH19 M=-0.78 S= 5.83 RMS= 5.88
CH20 M=-1.17 S= 4.07 RMS= 4.23

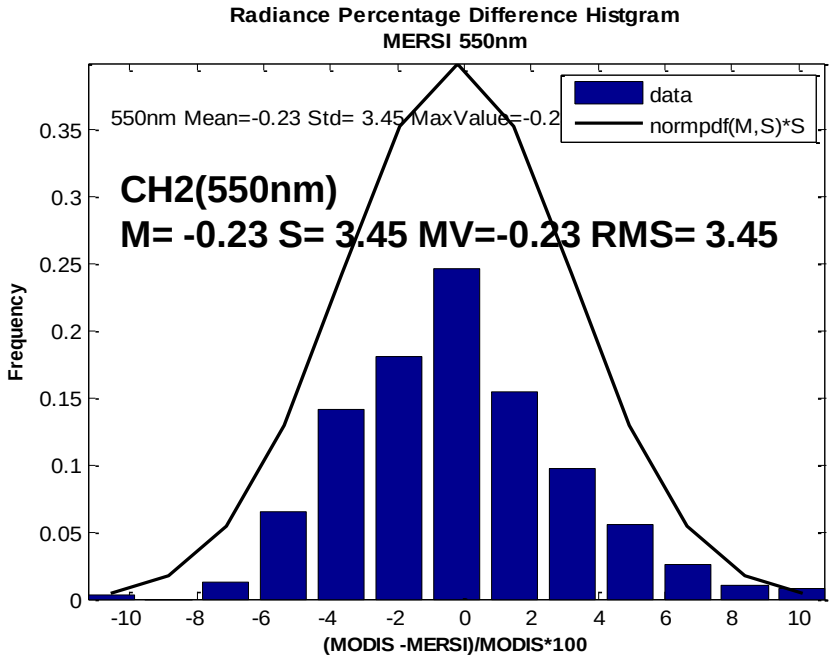


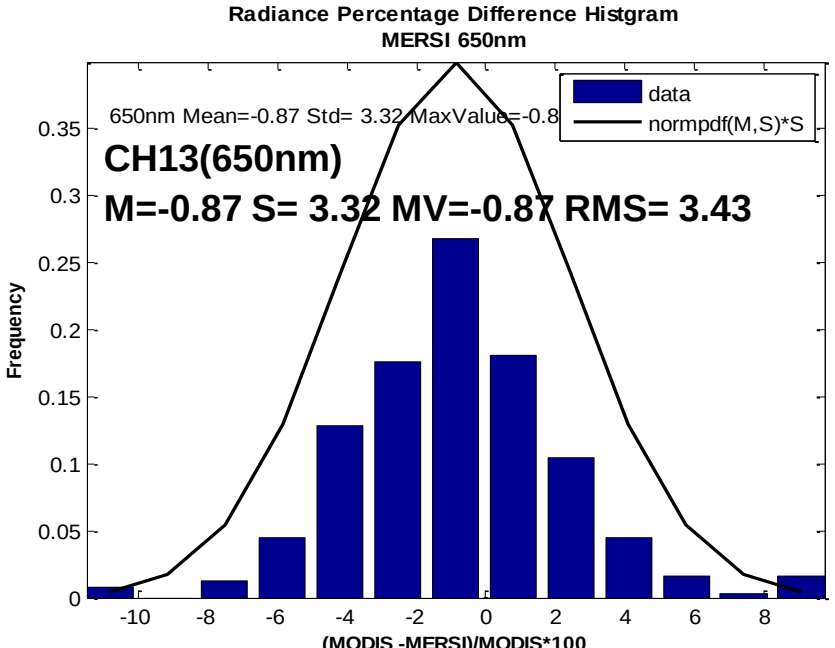


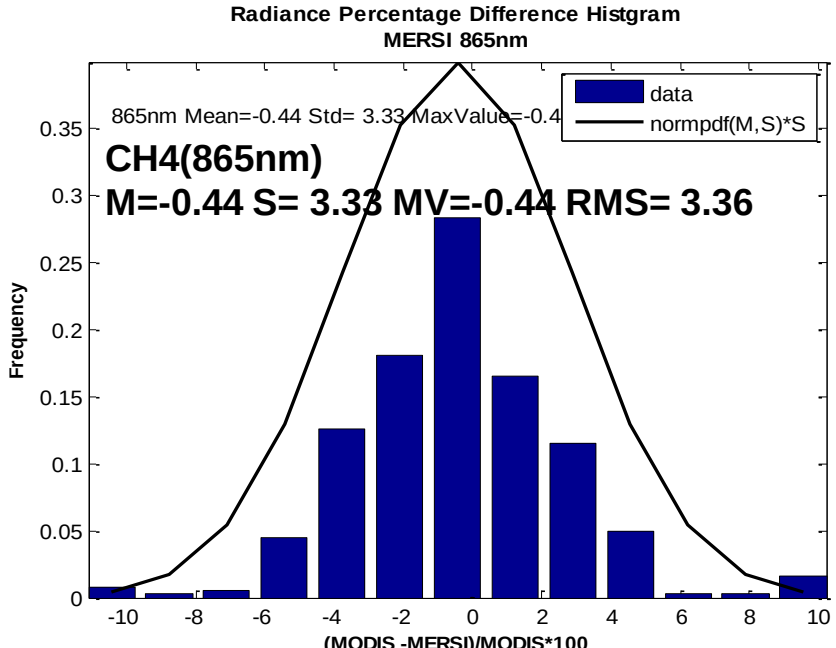
Double Difference Analysis with MODIS

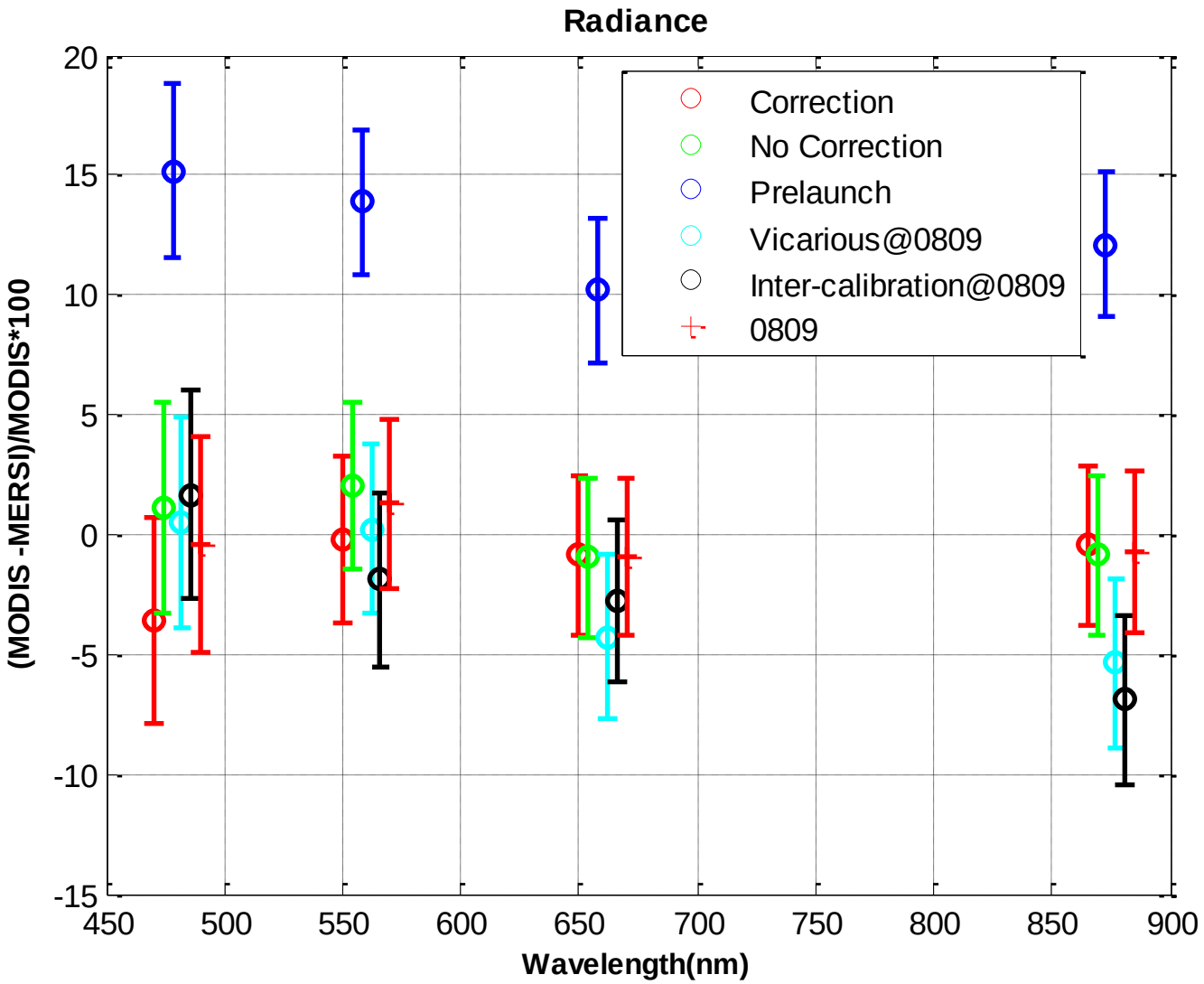
4 sites;2008-7~2009-12 N=382







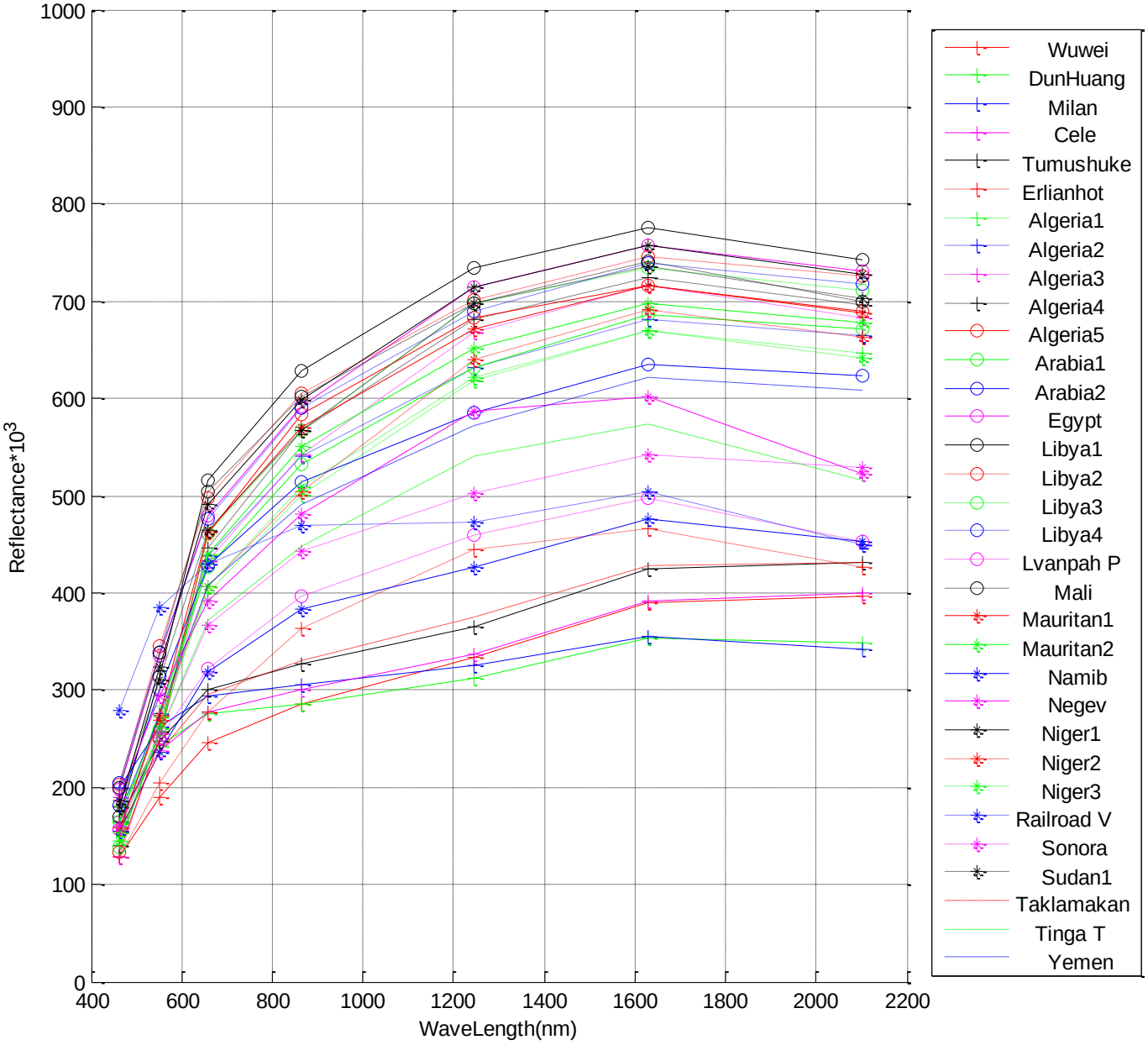



Radiance
(MODIS -MERSI)/MODIS*100
Wavelength(nm)
Correction
No Correction
Prelaunch
Vicarious@0809
Inter-calibration@0809
0809
20
15
10
5
0
-5
-10
-15
450
500
550
600
650
700
750
800
850
900

Conclusion

- The multi-sites radiometric calibration tracking method could provide the re-calibration coefficients for MERSI.
- This current method is not good for water absorption channels. Near real-time humidity profiles may be helpful to improve.
- Primary re-calibration performance shows that the RMS percentage difference with MODIS is 5.6, 3.5, 3.4 and 3.4% for MERSI bands at 470, 550, 650 and 865 nm by double differencing, but MERSI is systematically larger at 470nm .

Thank you!

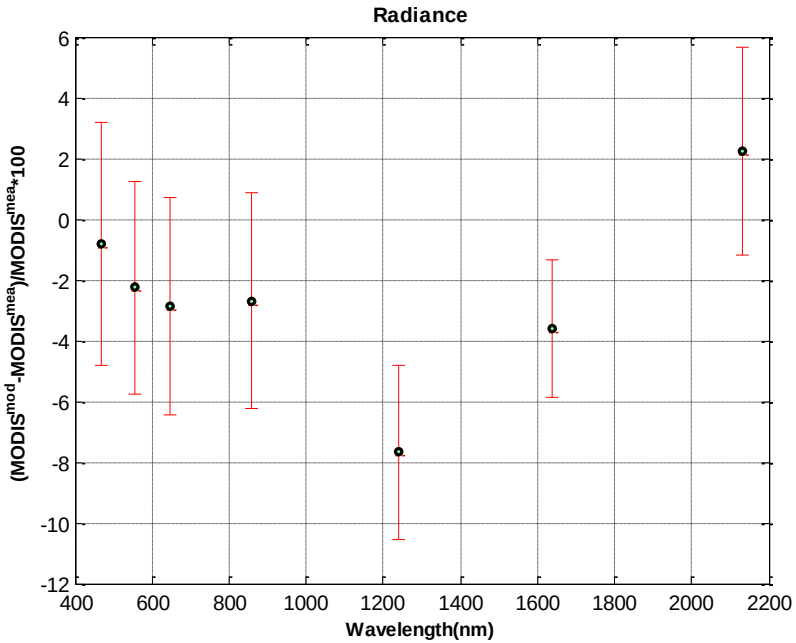

Reflectance*10^3
WaveLength(nm)
0
100
200
300
400
500
600
700
800
900
1000
400
600
800
1000
1200
1400
1600
1800
2000
2200
Wuwei
DunHuang
Milan
Cele
Tumushuke
Erlianhot
Algeria1
Algeria2
Algeria3
Algeria4
Algeria5
Arabia1
Arabia2
Egypt
Libya1
Libya2
Libya3
Libya4
Lvanpah P
Mali
Mauritan1
Mauritan2
Namib
Negev
Niger1
Niger2
Niger3
Railroad V
Sonora
Sudan1
Taklamakan
Tinga T
Yemen

Apparent Reflectance = Scale * (DN_EarthView - DN_SpaceView) (%)							
Scale = d + c * Days = d*(1 + RatePerDay/100 * Days) (%/DN)							
Band	d (%/DN)	c (%/DN/Days)	Sigma	2*Sigma/ M (%)	Degrading rate per day (%)	Degrading rate per year (%)	Degrading rate(%)
Band1 (470nm)	0.03102	4.10E-06	3.76E-04	2.2871	0.013224	4.8266	12.5360
Band2 (550nm)	0.028943	1.98E-06	3.07E-04	2.0541	0.006834	2.4943	6.4784
Band3 (650nm)	0.024436	-3.57E-07	2.09E-04	1.7265	-0.001462	-0.5335	-1.3855
Band4 (865nm)	0.028536	-3.80E-07	2.61E-04	1.8388	-0.001331	-0.4857	-1.2614
Band8 (412nm)	0.021779	8.63E-06	5.63E-04	4.3683	0.039615	14.4596	37.5554
Band9 (443nm)	0.023745	4.60E-06	4.23E-04	3.2638	0.019372	7.0709	18.3651
Band10 (490nm)	0.024547	2.58E-06	2.94E-04	2.2851	0.010496	3.8309	9.9499
Band11 (520nm)	0.019928	1.70E-06	2.41E-04	2.3265	0.008551	3.1212	8.1066
Band12 (565nm)	0.022491	1.03E-06	1.88E-04	1.6366	0.004571	1.6685	4.3335
Band13 (650nm)	0.022279	-1.44E-07	2.23E-04	2.0114	-0.000645	-0.2355	-0.6117
Band14 (685nm)	0.021689	-6.72E-08	1.89E-04	1.7439	-0.00031	-0.1131	-0.2938
Band15 (765nm)	0.027703	5.94E-07	2.49E-04	1.7805	0.002146	0.7831	2.0340
Band16 (865nm)	0.021174	-1.66E-08	1.38E-04	1.3041	-0.000078	-0.0286	-0.0742
Band17 (905nm)	0.024235	2.53E-06	6.71E-04	5.2813	0.010433	3.8079	9.8901
Band18 (940nm)	0.026011	7.27E-06	2.33E-03	15.8592	0.02795	10.2018	26.4966
Band19 (980nm)	0.023308	2.75E-06	7.26E-04	5.9051	0.011805	4.3089	11.1914
Band20 (1030nm)	0.025393	2.98E-06	2.84E-04	2.1155	0.011742	4.2857	11.1310

* Days = Day Count since FY-3A Launched @ 2008-05-27

Degrading rate: Count from launch to 2010-12-31

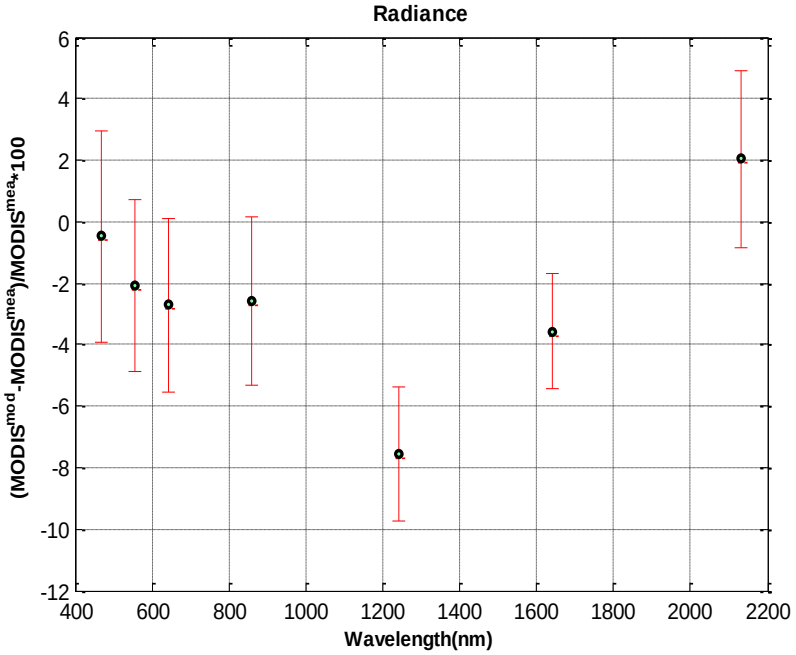
Libya1&Libya4&Arabia2&Dunhuang



Dif(%):
CH1 M=-2.85 S= 3.58 MaxValue=-1.06 RMS= 4.58
CH2 M=-2.69 S= 3.57 MaxValue=-0.90 RMS= 4.47
CH3 M=-0.80 S= 4.00 MaxValue=-0.80 RMS= 4.07
CH4 M=-2.26 S= 3.49 MaxValue=-2.26 RMS= 4.15
CH5 M=-7.68 S= 2.85 MaxValue=-7.68 RMS= 8.19
CH6 M=-3.60 S= 2.25 MaxValue=-3.60 RMS= 4.24
CH7 M= 2.25 S= 3.41 MaxValue= 2.25 RMS= 4.08

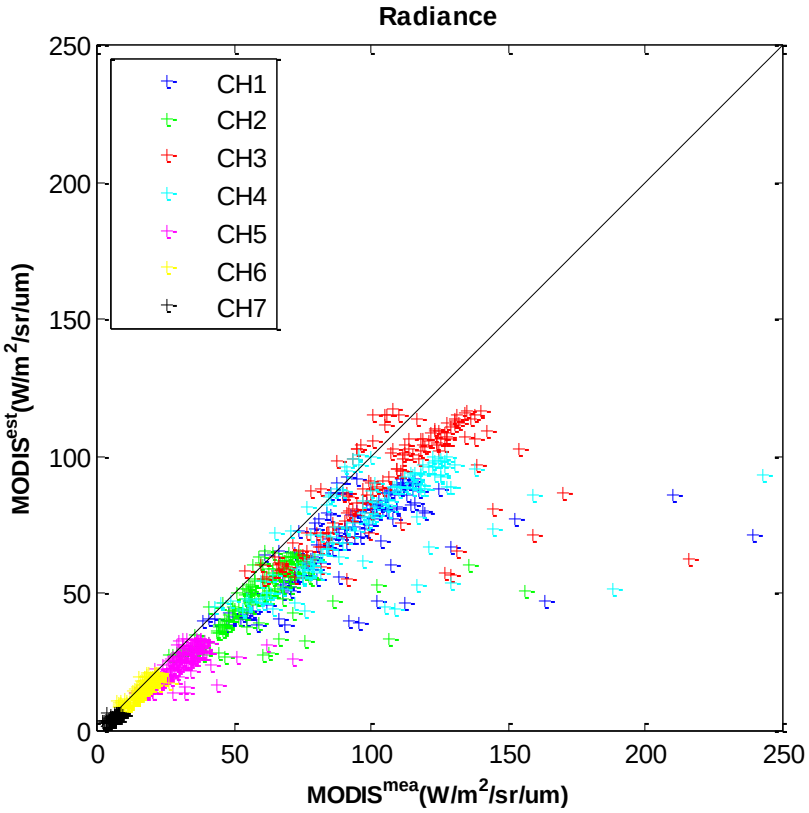
- **RMS of Dif(%) is 4.07~4.58% except for CH5.**
- **The calibration precision (M+-S) is almost within 6% except for CH5.**
- **The mean calibration percentage error is ~8% for CH5.**

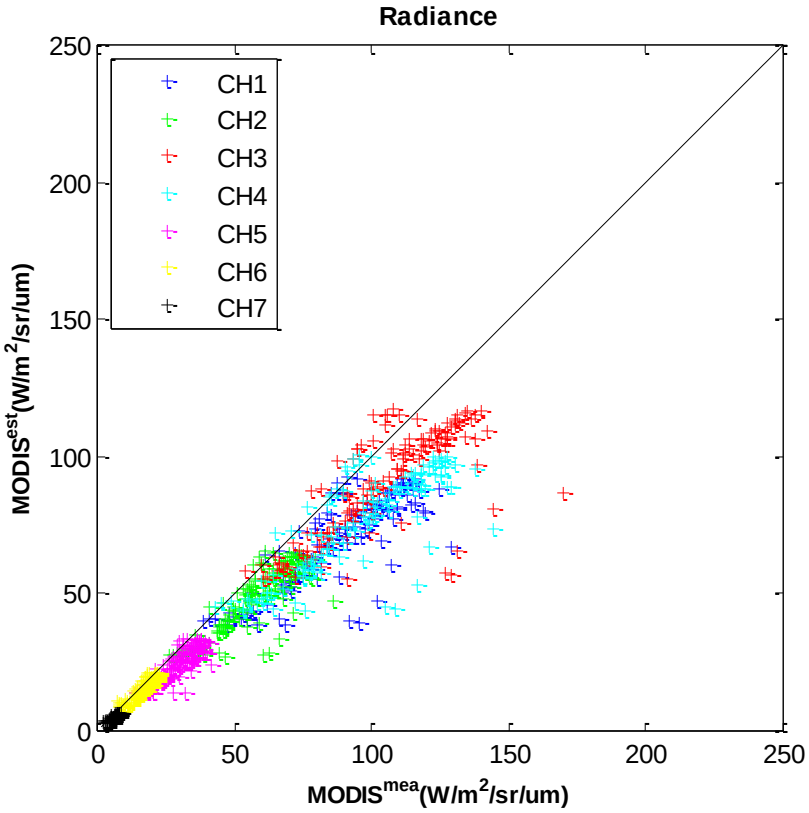
Libya1&Libya4&Arabia2



Dif(%):
CH1 M=-2.72 S= 2.82 MaxValue=-1.31 RMS= 3.91
CH2 M=-2.57 S= 2.74 MaxValue=-1.20 RMS= 3.75
CH3 M=-0.47 S= 3.44 MaxValue=-0.47 RMS= 3.47
CH4 M=-2.06 S= 2.79 MaxValue=-2.06 RMS= 3.47
CH5 M=-7.56 S= 2.18 MaxValue=-6.47 RMS= 7.86
CH6 M=-3.57 S= 1.88 MaxValue=-3.57 RMS= 4.03
CH7 M= 2.04 S= 2.89 MaxValue= 2.04 RMS= 3.53

- **RMS of Dif(%) is 3.47~4.03% except for CH5.**
- **The calibration precision is almost within 5% except for CH5.**
- **The mean calibration percentage error is ~8% for CH5.**

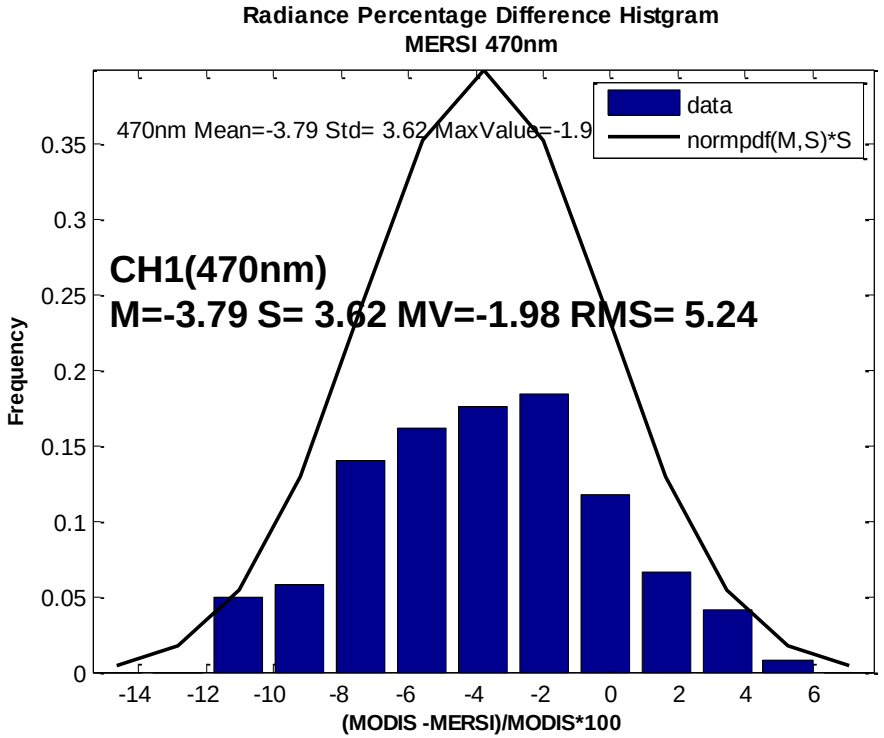


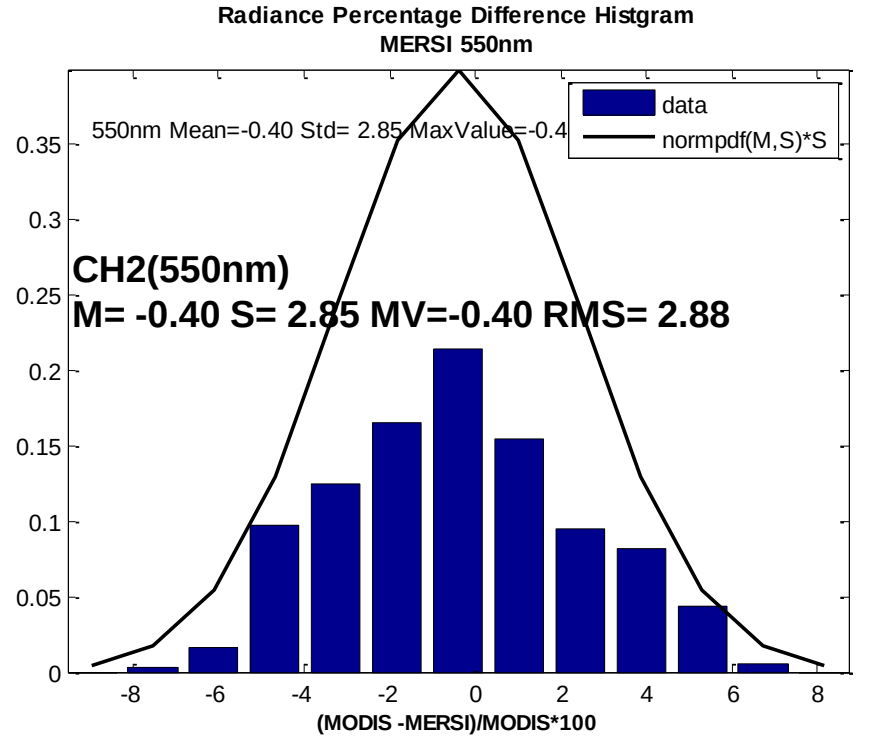


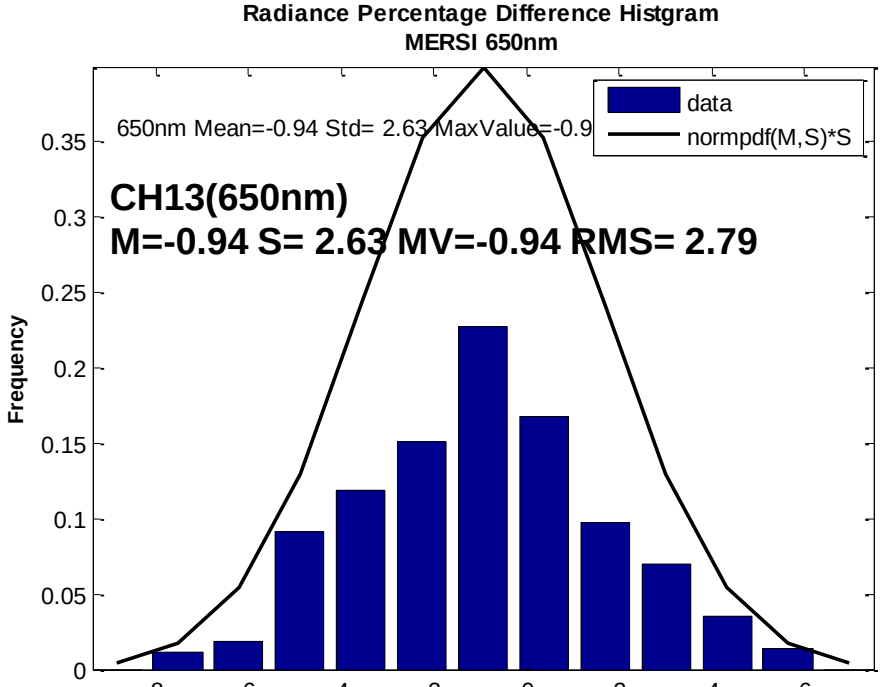
2 sigma

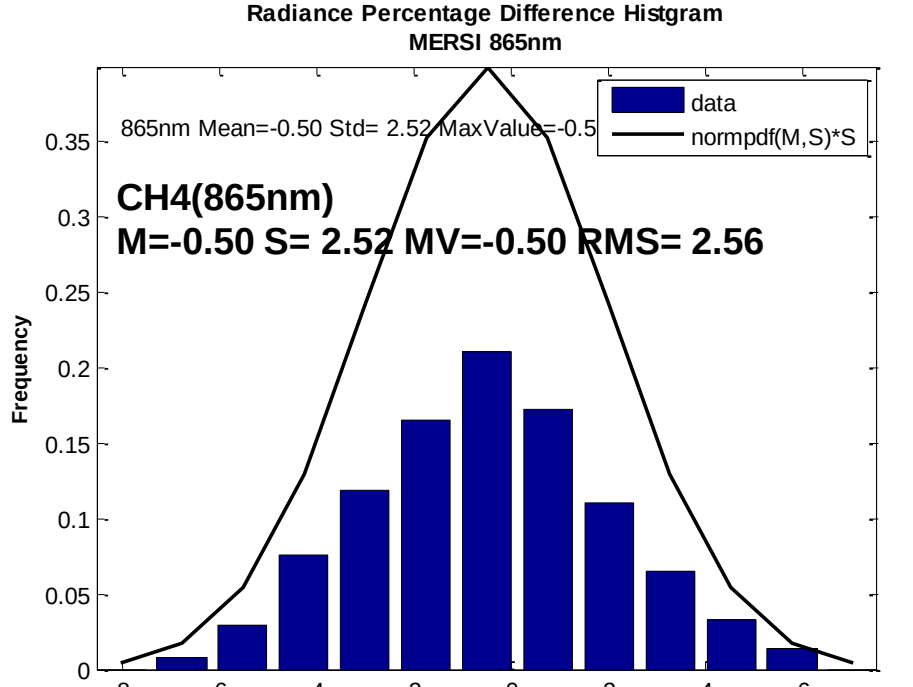
Using Dunhuang in-situ BRDF model of Sept. 2008, the simulated radiance tends to be underestimated.

Dunhuang Insitu BRDF Model


Radiance Percentage Difference Histgram
MERSI 470nm
470nm Mean=-3.79 Std= 3.62 MaxValue=-1.9
data
normpdf(M,S)*S
CH1(470nm)
M=-3.79 S= 3.62 MV=-1.98 RMS= 5.24
Frequency
(MODIS -MERSI)/MODIS*100


Radiance Percentage Difference Histgram
MERSI 550nm
550nm Mean=-0.40 Std= 2.85 MaxValue=-0.4
data
normpdf(M,S)*S
CH2(550nm)
M= -0.40 S= 2.85 MV=-0.40 RMS= 2.88
(MODIS -MERSI)/MODIS*100


Radiance Percentage Difference Histgram
MERSI 650nm
650nm Mean=-0.94 Std= 2.63 MaxValue=-0.9
data
normpdf(M,S)*S
CH13(650nm)
M=-0.94 S= 2.63 MV=-0.94 RMS= 2.79
Frequency


Radiance Percentage Difference Histgram
MERSI 865nm
865nm Mean=-0.50 Std= 2.52 MaxValue=-0.5
data
normpdf(M,S)*S
CH4(865nm)
M=-0.50 S= 2.52 MV=-0.50 RMS= 2.56
Frequency