INSAT-3D Sounder Cloud Mask Validation Report

Validation Criteria :

1. Spatial Collocation : 10km (nominal resolution of INSAT-3D Sounder)

2. Temporal Collocation : 5 minutes

INSAT-3D sounder operational cloud mask product is available at 10km resolution at nadir. MODIS cloud mask product is available at 1 km resolution at nadir. Hence there will be approximately 100 pixels of Modis inside one Sounder Pixels provided both are looking at nadir. In general, there is arround 40-60 pixles of MODIS per sounder pixel.

Furthermore operational MODIS cloud mask has 4 flags : Confident clear, probably clear, probably cloudy and cloudy, while operational sounder cloud mask has only 3 flags : Clear, Cloudy and Uncertain. For validation we follow these steps :

1. Spatial and Temporal Collocation

2. Resampling of MODIS cloud Mask on sounder observation area

3. Conversion of 4 cloud flags of MODIS into 3 cloud flags of sounder

The following methodology is adopted for conversion of MODIS cloud flag to sounder cloud flag

(i) A probability value is assigned to each of the modis cloud flag. Here we have assigned the values of 0.125,0.25,0.5,1 for confident clear, probably clear, probably clouly and cloudy respectively.

(ii) For each collocated sounder pixel , a single probability value for MODIS is obtained using the following 3 methods of averaging :

a) Taking mode of modis pixel probability value

b) Taking weighted average of probability values

c) Taking weighted products of the odds and subtracting the final results from 1

(iii)Based on probabilty value (p) obtained from above mentioned methods, the cloud mask flag for modis is decided for each method as follows :

$p < 0.35$: Cloudy

$p = 0.35$-0.75 : Uncertain

$p > 0.75$: Clear

Based on this flag , confusion matrix and skill scores were computed for each of the 3 methods.

The validation satatistics are presented in follwing order :

1. All Surface

2. Land

3. Ocean

4. Coast

5. Highland (surface height > 2000 m)

For each of the 5 surface types , results are further categorised according to time of the day

1. All times

2. Daytime (0-12 UTC i.e. 05:30-17:30 IST)

3. Nighttime (12-24 UTC i.e. 17:30-05:30 IST)

For each of these cases following statistics are shown :

1. 3X3 Confusion matrices for clear, cloudy and uncertain conditions

2. Following skill scores based on confusion matrices :-

i). False Alarm Ratio (FAR)

ii). Frequency Bias (FB)

iii). Probability of Detection (POD)

iv). False Alarm Rate (F)

v). Proportion Correct (PCr)

vi). Kuiper Skill Score (KSS)

vii). Heidke Skill Score (HSS)

Following plots are also shown :

1. Time series of Total number of collocations obtained for each of the 5 categories

2. Time series of percentage correct pixels (100 * PCr)

3. Sample spatial plot of operational cloud products and collocations on Land and Ocean

INSAT-3D Sounder vs MODIS for October , 2018 (All times (day and night)) on all surface types

1. Confusion matrix of Total number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	63839	16592	13578
Sounder Uncertain	11881	3124	12431
Sounder Cloudy	3946	1200	14355

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	58132	25577	10300
Sounder Uncertain	8843	8665	9928
Sounder Cloudy	2424	4404	12673

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	50917	31308	11784
Sounder Uncertain	7054	9564	10818
Sounder Cloudy	1795	4442	13264

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	45.29	11.77	9.63
Sounder Uncertain	8.43	2.22	8.82
Sounder Cloudy	2.80	0.85	10.18

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	41.24	18.15	7.31
Sounder Uncertain	6.27	6.15	7.04
Sounder Cloudy	1.72	3.12	8.99

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	36.13	22.21	8.36
Sounder Uncertain	5.00	6.79	7.68
Sounder Cloudy	1.27	3.15	9.41

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.32	0.89	0.26
Frequency Bias	1.18	1.31	0.48
Probability of Detection	0.80	0.15	0.36
False Alarm Rate	0.51	0.41	0.09

Overall Skill Score

Skill Score	Value
Proportion Correct	0.577
Kuiper Skill Score	0.228
Heidke Skill Score	0.237

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.38	0.68	0.35
Frequency Bias	1.35	0.71	0.59
Probability of Detection	0.84	0.22	0.39
False Alarm Rate	0.58	0.31	0.11

Overall Skill Score

Skill Score	Value
Proportion Correct	0.564
Kuiper Skill Score	0.239
Heidke Skill Score	0.256

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.46	0.65	0.32
Frequency Bias	1.57	0.61	0.54
Probability of Detection	0.85	0.21	0.37
False Alarm Rate	0.64	0.27	0.09

Overall Skill Score

Skill Score	Value
Proportion Correct	0.523
Kuiper Skill Score	0.219
Heidke Skill Score	0.230

INSAT-3D Sounder vs MODIS for October , 2018 (Day) on all surface types

1. Confusion matrix of Total number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	38952	14004	8078
Sounder Uncertain	9716	2188	6651
Sounder Cloudy	3664	1118	12650

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	34237	20850	5947
Sounder Uncertain	7193	6435	4927
Sounder Cloudy	2223	4139	11070

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	28371	25725	6938
Sounder Uncertain	5751	7312	5492
Sounder Cloudy	1648	4160	11624

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	40.15	14.43	8.33
Sounder Uncertain	10.01	2.26	6.86
Sounder Cloudy	3.78	1.15	13.04

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	35.29	21.49	6.13
Sounder Uncertain	7.41	6.63	5.08
Sounder Cloudy	2.29	4.27	11.41

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	29.24	26.51	7.15
Sounder Uncertain	5.93	7.54	5.66
Sounder Cloudy	1.70	4.29	11.98

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.36	0.88	0.27
Frequency Bias	1.17	1.07	0.64
Probability of Detection	0.74	0.13	0.46
False Alarm Rate	0.51	0.38	0.11

Overall Skill Score

Skill Score	Value
Proportion Correct	0.554
Kuiper Skill Score	0.218
Heidke Skill Score	0.226

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.44	0.65	0.36
Frequency Bias	1.40	0.59	0.79
Probability of Detection	0.78	0.20	0.50
False Alarm Rate	0.59	0.27	0.14

Overall Skill Score

Skill Score	Value
Proportion Correct	0.533
Kuiper Skill Score	0.230
Heidke Skill Score	0.240

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.54	0.61	0.33
Frequency Bias	1.71	0.50	0.72
Probability of Detection	0.79	0.20	0.48
False Alarm Rate	0.66	0.23	0.12

Overall Skill Score

Skill Score	Value

Proportion Correct	0.488
Kuiper Skill Score	0.210
Heidke Skill Score	0.212

INSAT-3D Sounder vs MODIS for October , 2018 (Night) on all surface types

1. Confusion matrix of Total number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	24887	2588	5500
Sounder Uncertain	2165	936	5780
Sounder Cloudy	282	82	1705

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	23895	4727	4353
Sounder Uncertain	1650	2230	5001
Sounder Cloudy	201	265	1603

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	22546	5583	4846
Sounder Uncertain	1303	2252	5326
Sounder Cloudy	147	282	1640

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	56.66	5.89	12.52
Sounder Uncertain	4.93	2.13	13.16
Sounder Cloudy	0.64	0.19	3.88

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	54.40	10.76	9.91
Sounder Uncertain	3.76	5.08	11.39
Sounder Cloudy	0.46	0.60	3.65

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	51.33	12.71	11.03
Sounder Uncertain	2.97	5.13	12.13
Sounder Cloudy	0.33	0.64	3.73

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.25	0.89	0.18
Frequency Bias	1.21	2.46	0.16
Probability of Detection	0.91	0.26	0.13
False Alarm Rate	0.49	0.48	0.02

Overall Skill Score

Skill Score	Value
Proportion Correct	0.627
Kuiper Skill Score	0.249
Heidke Skill Score	0.257

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy

False Alarm Ratio	0.28	0.75	0.23
Frequency Bias	1.28	1.23	0.19
Probability of Detection	0.93	0.31	0.15
False Alarm Rate	0.56	0.41	0.03

Overall Skill Score

Skill Score	Value
Proportion Correct	0.631
Kuiper Skill Score	0.258
Heidke Skill Score	0.284

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.32	0.75	0.21
Frequency Bias	1.37	1.09	0.18
Probability of Detection	0.94	0.28	0.14
False Alarm Rate	0.60	0.38	0.02

Overall Skill Score

Skill Score	Value
Proportion Correct	0.602
Kuiper Skill Score	0.238
Heidke Skill Score	0.263

INSAT-3D Sounder vs MODIS for October , 2018 (All times (day and night)) on Land

1. Confusion matrix of Total number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy

Sounder Clear	51253	7600	6320
Sounder Uncertain	6155	1684	5678
Sounder Cloudy	1723	889	7009

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	47166	13995	4012
Sounder Uncertain	4680	4335	4502
Sounder Cloudy	1189	2086	6346

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	41266	19184	4723
Sounder Uncertain	3567	5073	4877
Sounder Cloudy	811	2196	6614

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	58.04	8.61	7.16
Sounder Uncertain	6.97	1.91	6.43
Sounder Cloudy	1.95	1.01	7.94

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	53.41	15.85	4.54
Sounder Uncertain	5.30	4.91	5.10
Sounder Cloudy	1.35	2.36	7.19

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	46.73	21.72	5.35

Sounder Uncertain	4.04	5.74	5.52
Sounder Cloudy	0.92	2.49	7.49

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.21	0.88	0.27
Frequency Bias	1.10	1.33	0.51
Probability of Detection	0.87	0.17	0.37
False Alarm Rate	0.49	0.42	0.09

Overall Skill Score

Skill Score	Value
Proportion Correct	0.679
Kuiper Skill Score	0.292
Heidke Skill Score	0.309

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.28	0.68	0.34
Frequency Bias	1.23	0.66	0.65
Probability of Detection	0.89	0.21	0.43
False Alarm Rate	0.59	0.30	0.11

Overall Skill Score

Skill Score	Value
Proportion Correct	0.655
Kuiper Skill Score	0.284
Heidke Skill Score	0.314

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.37	0.62	0.31

Frequency Bias	1.43	0.51	0.59
Probability of Detection	0.90	0.19	0.41
False Alarm Rate	0.68	0.24	0.09

Overall Skill Score

Skill Score	Value
Proportion Correct	0.600
Kuiper Skill Score	0.250
Heidke Skill Score	0.276

INSAT-3D Sounder vs MODIS for October , 2018 (Day) on Land

1. Confusion matrix of Total number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	28833	6707	4030
Sounder Uncertain	5264	1526	3144
Sounder Cloudy	1711	880	6280

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	25257	12079	2234
Sounder Uncertain	3926	3844	2164
Sounder Cloudy	1179	2077	5615

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	20225	16558	2787

Sounder Uncertain	2887	4577	2470
Sounder Cloudy	804	2185	5882

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	49.39	11.49	6.90
Sounder Uncertain	9.02	2.61	5.39
Sounder Cloudy	2.93	1.51	10.76

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	43.27	20.69	3.83
Sounder Uncertain	6.73	6.59	3.71
Sounder Cloudy	2.02	3.56	9.62

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	34.65	28.36	4.77
Sounder Uncertain	4.95	7.84	4.23
Sounder Cloudy	1.38	3.74	10.08

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.27	0.85	0.29
Frequency Bias	1.11	1.09	0.66
Probability of Detection	0.81	0.17	0.47
False Alarm Rate	0.49	0.39	0.12

Overall Skill Score

Skill Score	Value
Proportion Correct	0.628
Kuiper Skill Score	0.275
Heidke Skill Score	0.288

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.36	0.61	0.37
Frequency Bias	1.30	0.55	0.89
Probability of Detection	0.83	0.21	0.56
False Alarm Rate	0.60	0.26	0.14

Overall Skill Score

Skill Score	Value
Proportion Correct	0.595
Kuiper Skill Score	0.270
Heidke Skill Score	0.288

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.49	0.54	0.34
Frequency Bias	1.65	0.43	0.80
Probability of Detection	0.85	0.20	0.53
False Alarm Rate	0.70	0.19	0.11

Overall Skill Score

Skill Score	Value
Proportion Correct	0.526
Kuiper Skill Score	0.237
Heidke Skill Score	0.241

INSAT-3D Sounder vs MODIS for October , 2018 (Night) on Land

1. Confusion matrix of Total number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	22420	893	2290
Sounder Uncertain	891	158	2534
Sounder Cloudy	12	9	729

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	21909	1916	1778
Sounder Uncertain	754	491	2338
Sounder Cloudy	10	9	731

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	21041	2626	1936
Sounder Uncertain	680	496	2407
Sounder Cloudy	7	11	732

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	74.89	2.98	7.65
Sounder Uncertain	2.98	0.53	8.46
Sounder Cloudy	0.04	0.03	2.44

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	73.19	6.40	5.94
Sounder Uncertain	2.52	1.64	7.81
Sounder Cloudy	0.03	0.03	2.44

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	70.29	8.77	6.47
Sounder Uncertain	2.27	1.66	8.04
Sounder Cloudy	0.02	0.04	2.45

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.12	0.96	0.03
Frequency Bias	1.10	3.38	0.14
Probability of Detection	0.96	0.15	0.13
False Alarm Rate	0.48	0.52	0.00

Overall Skill Score

Skill Score	Value
Proportion Correct	0.779
Kuiper Skill Score	0.289
Heidke Skill Score	0.318

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.14	0.86	0.03
Frequency Bias	1.13	1.48	0.15
Probability of Detection	0.97	0.20	0.15
False Alarm Rate	0.54	0.45	0.00

Overall Skill Score

Skill Score	Value
Proportion Correct	0.773
Kuiper Skill Score	0.283
Heidke Skill Score	0.329

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.18	0.86	0.02
Frequency Bias	1.18	1.14	0.15
Probability of Detection	0.97	0.16	0.14
False Alarm Rate	0.60	0.40	0.00

Overall Skill Score

Skill Score	Value
Proportion Correct	0.744
Kuiper Skill Score	0.245
Heidke Skill Score	0.293

INSAT-3D Sounder vs MODIS for October , 2018 (All times (day and night)) on Ocean

1. Confusion matrix of Total number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	7081	7136	3446
Sounder Uncertain	646	546	1559
Sounder Cloudy	71	93	1943

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	6375	7905	3383
Sounder Uncertain	490	769	1492
Sounder Cloudy	46	115	1946

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	5746	8169	3748
Sounder Uncertain	422	750	1579
Sounder Cloudy	42	112	1953

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	31.44	31.69	15.30
Sounder Uncertain	2.87	2.42	6.92
Sounder Cloudy	0.32	0.41	8.63

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	28.31	35.10	15.02
Sounder Uncertain	2.18	3.41	6.62
Sounder Cloudy	0.20	0.51	8.64

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	25.51	36.27	16.64
Sounder Uncertain	1.87	3.33	7.01
Sounder Cloudy	0.19	0.50	8.67

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.60	0.80	0.08
Frequency Bias	2.27	0.35	0.30
Probability of Detection	0.91	0.07	0.28
False Alarm Rate	0.82	0.17	0.01

Overall Skill Score

Skill Score	Value
Proportion Correct	0.425
Kuiper Skill Score	0.124
Heidke Skill Score	0.125

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.64	0.72	0.08
Frequency Bias	2.56	0.31	0.31
Probability of Detection	0.92	0.09	0.29
False Alarm Rate	0.84	0.15	0.01

Overall Skill Score

Skill Score	Value
Proportion Correct	0.404
Kuiper Skill Score	0.131
Heidke Skill Score	0.127

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.67	0.73	0.07
Frequency Bias	2.84	0.30	0.29
Probability of Detection	0.93	0.08	0.27
False Alarm Rate	0.85	0.14	0.01

Overall Skill Score

Skill Score	Value

Proportion Correct	0.375
Kuiper Skill Score	0.121
Heidke Skill Score	0.113

INSAT-3D Sounder vs MODIS for October , 2018 (Day) on Ocean

1. Confusion matrix of Total number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	6733	7105	3276
Sounder Uncertain	636	546	1418
Sounder Cloudy	71	92	1679

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	6072	7808	3234
Sounder Uncertain	484	758	1358
Sounder Cloudy	46	115	1681

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	5469	8053	3592
Sounder Uncertain	417	738	1445
Sounder Cloudy	42	112	1688

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	31.23	32.96	15.20
Sounder Uncertain	2.95	2.53	6.58
Sounder Cloudy	0.33	0.43	7.79

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	28.17	36.22	15.00
Sounder Uncertain	2.25	3.52	6.30
Sounder Cloudy	0.21	0.53	7.80

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	25.37	37.36	16.66
Sounder Uncertain	1.93	3.42	6.70
Sounder Cloudy	0.19	0.52	7.83

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.61	0.79	0.09
Frequency Bias	2.30	0.34	0.29
Probability of Detection	0.90	0.07	0.26
False Alarm Rate	0.82	0.16	0.01

Overall Skill Score

Skill Score	Value
Proportion Correct	0.416
Kuiper Skill Score	0.110
Heidke Skill Score	0.111

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy

False Alarm Ratio	0.65	0.71	0.09
Frequency Bias	2.59	0.30	0.29
Probability of Detection	0.92	0.09	0.27
False Alarm Rate	0.85	0.14	0.01

Overall Skill Score

Skill Score	Value
Proportion Correct	0.395
Kuiper Skill Score	0.119
Heidke Skill Score	0.114

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.68	0.72	0.08
Frequency Bias	2.89	0.29	0.27
Probability of Detection	0.92	0.08	0.25
False Alarm Rate	0.85	0.14	0.01

Overall Skill Score

Skill Score	Value
Proportion Correct	0.366
Kuiper Skill Score	0.109
Heidke Skill Score	0.101

INSAT-3D Sounder vs MODIS for October , 2018 (Night) on Ocean

1. Confusion matrix of Total number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy

Sounder Clear	348	31	170
Sounder Uncertain	10	0	141
Sounder Cloudy	0	1	264

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	303	97	149
Sounder Uncertain	6	11	134
Sounder Cloudy	0	0	265

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	277	116	156
Sounder Uncertain	5	12	134
Sounder Cloudy	0	0	265

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	36.06	3.21	17.62
Sounder Uncertain	1.04	0.00	14.61
Sounder Cloudy	0.00	0.10	27.36

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	31.40	10.05	15.44
Sounder Uncertain	0.62	1.14	13.89
Sounder Cloudy	0.00	0.00	27.46

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	28.70	12.02	16.17

Sounder Uncertain	0.52	1.24	13.89
Sounder Cloudy	0.00	0.00	27.46

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.37	1.00	0.00
Frequency Bias	1.53	4.72	0.46
Probability of Detection	0.97	0.00	0.46
False Alarm Rate	0.57	0.43	0.00

Overall Skill Score

Skill Score	Value
Proportion Correct	0.634
Kuiper Skill Score	0.502
Heidke Skill Score	0.410

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.45	0.93	0.00
Frequency Bias	1.78	1.40	0.48
Probability of Detection	0.98	0.10	0.48
False Alarm Rate	0.64	0.36	0.00

Overall Skill Score

Skill Score	Value
Proportion Correct	0.600
Kuiper Skill Score	0.434
Heidke Skill Score	0.379

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.50	0.92	0.00

Frequency Bias	1.95	1.18	0.48
Probability of Detection	0.98	0.09	0.48
False Alarm Rate	0.66	0.34	0.00

Overall Skill Score

Skill Score	Value
Proportion Correct	0.574
Kuiper Skill Score	0.405
Heidke Skill Score	0.350

INSAT-3D Sounder vs MODIS for October , 2018 (All times (day and night)) on Coast

1. Confusion matrix of Total number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	316	40	79
Sounder Uncertain	54	4	32
Sounder Cloudy	16	5	53

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	293	95	47
Sounder Uncertain	39	26	25
Sounder Cloudy	12	14	48

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	266	111	58

Sounder Uncertain	31	32	27
Sounder Cloudy	11	14	49

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	52.75	6.68	13.19
Sounder Uncertain	9.02	0.67	5.34
Sounder Cloudy	2.67	0.83	8.85

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	48.91	15.86	7.85
Sounder Uncertain	6.51	4.34	4.17
Sounder Cloudy	2.00	2.34	8.01

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	44.41	18.53	9.68
Sounder Uncertain	5.18	5.34	4.51
Sounder Cloudy	1.84	2.34	8.18

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.27	0.96	0.28
Frequency Bias	1.13	1.84	0.45
Probability of Detection	0.82	0.08	0.32
False Alarm Rate	0.53	0.38	0.09

Overall Skill Score

Skill Score	Value
Proportion Correct	0.623
Kuiper Skill Score	0.216
Heidke Skill Score	0.224

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.33	0.71	0.35
Frequency Bias	1.26	0.67	0.62
Probability of Detection	0.85	0.19	0.40
False Alarm Rate	0.61	0.28	0.11

Overall Skill Score

Skill Score	Value
Proportion Correct	0.613
Kuiper Skill Score	0.237
Heidke Skill Score	0.261

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.39	0.64	0.34
Frequency Bias	1.41	0.57	0.55
Probability of Detection	0.86	0.20	0.37
False Alarm Rate	0.67	0.23	0.10

Overall Skill Score

Skill Score	Value
Proportion Correct	0.579
Kuiper Skill Score	0.225
Heidke Skill Score	0.248

INSAT-3D Sounder vs MODIS for October , 2018 (Day) on Coast

1. Confusion matrix of Total number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	274	32	59
Sounder Uncertain	54	2	21
Sounder Cloudy	16	5	48

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	252	84	29
Sounder Uncertain	39	23	15
Sounder Cloudy	12	14	43

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	227	99	39
Sounder Uncertain	31	30	16
Sounder Cloudy	11	14	44

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	53.62	6.26	11.55
Sounder Uncertain	10.57	0.39	4.11
Sounder Cloudy	3.13	0.98	9.39

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	49.32	16.44	5.68
Sounder Uncertain	7.63	4.50	2.94
Sounder Cloudy	2.35	2.74	8.41

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	44.42	19.37	7.63
Sounder Uncertain	6.07	5.87	3.13
Sounder Cloudy	2.15	2.74	8.61

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.25	0.97	0.30
Frequency Bias	1.06	1.97	0.54
Probability of Detection	0.80	0.05	0.38
False Alarm Rate	0.49	0.40	0.11

Overall Skill Score

Skill Score	Value
Proportion Correct	0.634
Kuiper Skill Score	0.226
Heidke Skill Score	0.228

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.31	0.70	0.38
Frequency Bias	1.20	0.64	0.79
Probability of Detection	0.83	0.19	0.49
False Alarm Rate	0.59	0.28	0.13

Overall Skill Score

Skill Score	Value
Proportion Correct	0.622
Kuiper Skill Score	0.249
Heidke Skill Score	0.271

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.38	0.61	0.36
Frequency Bias	1.36	0.54	0.70
Probability of Detection	0.84	0.21	0.44
False Alarm Rate	0.66	0.22	0.12

Overall Skill Score

Skill Score	Value
Proportion Correct	0.589
Kuiper Skill Score	0.238
Heidke Skill Score	0.260

INSAT-3D Sounder vs MODIS for October , 2018 (Night) on Coast

1. Confusion matrix of Total number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	42	8	20
Sounder Uncertain	0	2	11
Sounder Cloudy	0	0	5

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	41	11	18
Sounder Uncertain	0	3	10
Sounder Cloudy	0	0	5

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	39	12	19
Sounder Uncertain	0	2	11
Sounder Cloudy	0	0	5

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	47.73	9.09	22.73
Sounder Uncertain	0.00	2.27	12.50
Sounder Cloudy	0.00	0.00	5.68

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	46.59	12.50	20.45
Sounder Uncertain	0.00	3.41	11.36
Sounder Cloudy	0.00	0.00	5.68

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	44.32	13.64	21.59
Sounder Uncertain	0.00	2.27	12.50
Sounder Cloudy	0.00	0.00	5.68

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.40	0.85	0.00
Frequency Bias	1.67	1.30	0.14
Probability of Detection	1.00	0.20	0.14
False Alarm Rate	0.72	0.28	0.00

Overall Skill Score

Skill Score	Value
Proportion Correct	0.557
Kuiper Skill Score	0.232
Heidke Skill Score	0.236

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.41	0.77	0.00
Frequency Bias	1.71	0.93	0.15
Probability of Detection	1.00	0.21	0.15
False Alarm Rate	0.74	0.26	0.00

Overall Skill Score

Skill Score	Value
Proportion Correct	0.557
Kuiper Skill Score	0.229
Heidke Skill Score	0.242

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.44	0.85	0.00
Frequency Bias	1.79	0.93	0.14
Probability of Detection	1.00	0.14	0.14
False Alarm Rate	0.74	0.26	0.00

Overall Skill Score

Skill Score	Value

Proportion Correct	0.523
Kuiper Skill Score	0.200
Heidke Skill Score	0.206

INSAT-3D Sounder vs MODIS for October , 2018 (All times (day and night)) on Highland (>2000 m)

1. Confusion matrix of Total number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	3672	1625	3325
Sounder Uncertain	4741	852	4900
Sounder Cloudy	2042	197	5096

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	2968	3087	2567
Sounder Uncertain	3427	3370	3696
Sounder Cloudy	1110	2129	4096

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	2443	3248	2931
Sounder Uncertain	2856	3536	4101
Sounder Cloudy	880	2048	4407

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	13.88	6.14	12.57
Sounder Uncertain	17.92	3.22	18.53
Sounder Cloudy	7.72	0.74	19.27

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	11.22	11.67	9.71
Sounder Uncertain	12.96	12.74	13.97
Sounder Cloudy	4.20	8.05	15.49

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	9.24	12.28	11.08
Sounder Uncertain	10.80	13.37	15.50
Sounder Cloudy	3.33	7.74	16.66

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.57	0.92	0.31
Frequency Bias	0.82	3.92	0.55
Probability of Detection	0.35	0.32	0.38
False Alarm Rate	0.29	0.57	0.13

Overall Skill Score

Skill Score	Value
Proportion Correct	0.364
Kuiper Skill Score	0.095
Heidke Skill Score	0.080

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy

Skill Score			
False Alarm Ratio	0.66	0.68	0.44
Frequency Bias	1.15	1.22	0.71
Probability of Detection	0.40	0.39	0.40
False Alarm Rate	0.35	0.44	0.20

Overall Skill Score

Skill Score	Value
Proportion Correct	0.394
Kuiper Skill Score	0.098
Heidke Skill Score	0.096

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.72	0.66	0.40
Frequency Bias	1.40	1.19	0.64
Probability of Detection	0.40	0.40	0.39
False Alarm Rate	0.38	0.43	0.18

Overall Skill Score

Skill Score	Value
Proportion Correct	0.393
Kuiper Skill Score	0.099
Heidke Skill Score	0.095

INSAT-3D Sounder vs MODIS for October , 2018 (Day) on Highland (>2000 m)

1. Confusion matrix of Total number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy

Sounder Clear	1814	28	438
Sounder Uncertain	3488	84	1919
Sounder Cloudy	1774	126	4414

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1536	466	278
Sounder Uncertain	2543	1673	1275
Sounder Cloudy	920	1876	3518

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1445	514	321
Sounder Uncertain	2244	1813	1434
Sounder Cloudy	741	1779	3794

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	12.88	0.20	3.11
Sounder Uncertain	24.76	0.60	13.62
Sounder Cloudy	12.59	0.89	31.34

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	10.91	3.31	1.97
Sounder Uncertain	18.05	11.88	9.05
Sounder Cloudy	6.53	13.32	24.98

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	10.26	3.65	2.28

Sounder Uncertain	15.93	12.87	10.18
Sounder Cloudy	5.26	12.63	26.94

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.20	0.98	0.30
Frequency Bias	0.32	23.07	0.93
Probability of Detection	0.26	0.35	0.65
False Alarm Rate	0.06	0.70	0.24

Overall Skill Score

Skill Score	Value
Proportion Correct	0.448
Kuiper Skill Score	0.280
Heidke Skill Score	0.208

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.33	0.70	0.44
Frequency Bias	0.46	1.37	1.25
Probability of Detection	0.31	0.42	0.69
False Alarm Rate	0.10	0.52	0.38

Overall Skill Score

Skill Score	Value
Proportion Correct	0.478
Kuiper Skill Score	0.223
Heidke Skill Score	0.220

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.37	0.67	0.40

Frequency Bias	0.51	1.34	1.14
Probability of Detection	0.33	0.44	0.68
False Alarm Rate	0.12	0.52	0.36

Overall Skill Score

Skill Score	Value
Proportion Correct	0.501
Kuiper Skill Score	0.241
Heidke Skill Score	0.242

INSAT-3D Sounder vs MODIS for October , 2018 (Night) on Highland (>2000 m)

1. Confusion matrix of Total number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1858	1597	2887
Sounder Uncertain	1253	768	2981
Sounder Cloudy	268	71	682

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1432	2621	2289
Sounder Uncertain	884	1697	2421
Sounder Cloudy	190	253	578

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	998	2734	2610

Sounder Uncertain	612	1723	2667
Sounder Cloudy	139	269	613

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	15.03	12.92	23.35
Sounder Uncertain	10.13	6.21	24.11
Sounder Cloudy	2.17	0.57	5.52

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	11.58	21.20	18.51
Sounder Uncertain	7.15	13.72	19.58
Sounder Cloudy	1.54	2.05	4.67

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	8.07	22.11	21.11
Sounder Uncertain	4.95	13.93	21.57
Sounder Cloudy	1.12	2.18	4.96

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.71	0.85	0.33
Frequency Bias	1.88	2.05	0.16
Probability of Detection	0.55	0.32	0.10
False Alarm Rate	0.50	0.47	0.04

Overall Skill Score

Skill Score	Value
Proportion Correct	0.268
Kuiper Skill Score	0.006
Heidke Skill Score	0.005

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.77	0.66	0.43
Frequency Bias	2.53	1.09	0.19
Probability of Detection	0.57	0.37	0.11
False Alarm Rate	0.57	0.38	0.05

Overall Skill Score

Skill Score	Value
Proportion Correct	0.300
Kuiper Skill Score	0.017
Heidke Skill Score	0.015

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.84	0.66	0.40
Frequency Bias	3.63	1.06	0.17
Probability of Detection	0.57	0.36	0.10
False Alarm Rate	0.59	0.36	0.05

Overall Skill Score

Skill Score	Value
Proportion Correct	0.270
Kuiper Skill Score	0.005
Heidke Skill Score	0.004