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 December , 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	69966	18931	27360
Sounder Uncertain	13593	3229	17984
Sounder Cloudy	5317	571	15100

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	63150	31271	21836
Sounder Uncertain	10301	9359	15146
Sounder Cloudy	3918	3312	13758

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	55431	36638	24188
Sounder Uncertain	8491	10180	16135
Sounder Cloudy	3473	3279	14236

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	40.67	11.00	15.90
Sounder Uncertain	7.90	1.88	10.45
Sounder Cloudy	3.09	0.33	8.78

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	36.70	18.18	12.69
Sounder Uncertain	5.99	5.44	8.80
Sounder Cloudy	2.28	1.93	8.00

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	32.22	21.29	14.06
Sounder Uncertain	4.94	5.92	9.38
Sounder Cloudy	2.02	1.91	8.27

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.40	0.91	0.28
Frequency Bias	1.31	1.53	0.35
Probability of Detection	0.79	0.14	0.25
False Alarm Rate	0.55	0.38	0.07

Overall Skill Score

Skill Score	Value
Proportion Correct	0.513
Kuiper Skill Score	0.160
Heidke Skill Score	0.163

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.46	0.73	0.34
Frequency Bias	1.50	0.79	0.41
Probability of Detection	0.82	0.21	0.27
False Alarm Rate	0.62	0.30	0.08

Overall Skill Score

Skill Score	Value
Proportion Correct	0.501
Kuiper Skill Score	0.170
Heidke Skill Score	0.181

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.52	0.71	0.32
Frequency Bias	1.73	0.69	0.38
Probability of Detection	0.82	0.20	0.26
False Alarm Rate	0.66	0.27	0.07

Overall Skill Score

Skill Score	Value
Proportion Correct	0.464
Kuiper Skill Score	0.154
Heidke Skill Score	0.160

INSAT-3D Sounder vs MODIS for December , 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	34538	14915	15195
Sounder Uncertain	9256	2497	9976
Sounder Cloudy	3209	362	12092

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	30937	21048	12663
Sounder Uncertain	6939	6544	8246
Sounder Cloudy	2089	2515	11059

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	25121	25472	14055
Sounder Uncertain	5513	7343	8873
Sounder Cloudy	1766	2462	11435

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	33.85	14.62	14.89
Sounder Uncertain	9.07	2.45	9.78
Sounder Cloudy	3.14	0.35	11.85

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	30.32	20.63	12.41
Sounder Uncertain	6.80	6.41	8.08
Sounder Cloudy	2.05	2.46	10.84

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	24.62	24.96	13.77
Sounder Uncertain	5.40	7.20	8.70
Sounder Cloudy	1.73	2.41	11.21

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.47	0.89	0.23
Frequency Bias	1.38	1.22	0.42
Probability of Detection	0.73	0.14	0.32
False Alarm Rate	0.57	0.36	0.07

Overall Skill Score

Skill Score	Value
Proportion Correct	0.481
Kuiper Skill Score	0.155
Heidke Skill Score	0.157

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.52	0.70	0.29
Frequency Bias	1.62	0.72	0.49
Probability of Detection	0.77	0.22	0.35
False Alarm Rate	0.63	0.28	0.09

Overall Skill Score

Skill Score	Value
Proportion Correct	0.476
Kuiper Skill Score	0.176
Heidke Skill Score	0.182

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.61	0.66	0.27
Frequency Bias	2.00	0.62	0.46
Probability of Detection	0.78	0.21	0.33
False Alarm Rate	0.68	0.25	0.07

Overall Skill Score

Skill Score	Value

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Proportion Correct	0.430
Kuiper Skill Score	0.156
Heidke Skill Score	0.154

INSAT-3D Sounder vs MODIS for December , 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	35428	4016	12165
Sounder Uncertain	4337	732	8008
Sounder Cloudy	2108	209	3008

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	32213	10223	9173
Sounder Uncertain	3362	2815	6900
Sounder Cloudy	1829	797	2699

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	30310	11166	10133
Sounder Uncertain	2978	2837	7262
Sounder Cloudy	1707	817	2801

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	50.60	5.74	17.38
Sounder Uncertain	6.19	1.05	11.44
Sounder Cloudy	3.01	0.30	4.30

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	46.01	14.60	13.10
Sounder Uncertain	4.80	4.02	9.86
Sounder Cloudy	2.61	1.14	3.86

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	43.29	15.95	14.47
Sounder Uncertain	4.25	4.05	10.37
Sounder Cloudy	2.44	1.17	4.00

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.31	0.94	0.44
Frequency Bias	1.23	2.64	0.23
Probability of Detection	0.85	0.15	0.13
False Alarm Rate	0.52	0.40	0.08

Overall Skill Score

Skill Score	Value
Proportion Correct	0.559
Kuiper Skill Score	0.152
Heidke Skill Score	0.154

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.38	0.78	0.49
Frequency Bias	1.38	0.95	0.28
Probability of Detection	0.86	0.20	0.14
False Alarm Rate	0.60	0.32	0.08

Overall Skill Score

Skill Score	Value
Proportion Correct	0.539
Kuiper Skill Score	0.145
Heidke Skill Score	0.160

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.41	0.78	0.47
Frequency Bias	1.47	0.88	0.26
Probability of Detection	0.87	0.19	0.14
False Alarm Rate	0.63	0.30	0.07

Overall Skill Score

Skill Score	Value
Proportion Correct	0.513
Kuiper Skill Score	0.134
Heidke Skill Score	0.147

INSAT-3D Sounder vs MODIS for December , 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

MODIS/Sounder			
Sounder Clear	55750	10417	15367
Sounder Uncertain	7476	1978	9313
Sounder Cloudy	1453	255	6651

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	50734	19585	11215
Sounder Uncertain	5810	5068	7889
Sounder Cloudy	1180	837	6342

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	44211	24547	12776
Sounder Uncertain	4573	5797	8397
Sounder Cloudy	1044	844	6471

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	51.31	9.59	14.14
Sounder Uncertain	6.88	1.82	8.57
Sounder Cloudy	1.34	0.23	6.12

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	46.69	18.02	10.32
Sounder Uncertain	5.35	4.66	7.26
Sounder Cloudy	1.09	0.77	5.84

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	40.69	22.59	11.76

Sounder Uncertain	4.21	5.33	7.73
Sounder Cloudy	0.96	0.78	5.96

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.32	0.89	0.20
Frequency Bias	1.26	1.48	0.27
Probability of Detection	0.86	0.16	0.21
False Alarm Rate	0.58	0.38	0.04

Overall Skill Score

Skill Score	Value
Proportion Correct	0.592
Kuiper Skill Score	0.189
Heidke Skill Score	0.203

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.38	0.73	0.24
Frequency Bias	1.41	0.74	0.33
Probability of Detection	0.88	0.20	0.25
False Alarm Rate	0.66	0.29	0.04

Overall Skill Score

Skill Score	Value
Proportion Correct	0.572
Kuiper Skill Score	0.189
Heidke Skill Score	0.211

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.46	0.69	0.23

Frequency Bias	1.64	0.60	0.30
Probability of Detection	0.89	0.19	0.23
False Alarm Rate	0.72	0.25	0.04

Overall Skill Score

Skill Score	Value
Proportion Correct	0.520
Kuiper Skill Score	0.166
Heidke Skill Score	0.182

INSAT-3D Sounder vs MODIS for December , 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	25847	9701	8195
Sounder Uncertain	5402	1849	4682
Sounder Cloudy	652	216	5241

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	23171	14454	6118
Sounder Uncertain	4224	3929	3780
Sounder Cloudy	467	636	5006

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	17928	18668	7147

Sounder Uncertain	3172	4619	4142
Sounder Cloudy	379	620	5110

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	41.83	15.70	13.26
Sounder Uncertain	8.74	2.99	7.58
Sounder Cloudy	1.06	0.35	8.48

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	37.50	23.39	9.90
Sounder Uncertain	6.84	6.36	6.12
Sounder Cloudy	0.76	1.03	8.10

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	29.02	30.21	11.57
Sounder Uncertain	5.13	7.48	6.70
Sounder Cloudy	0.61	1.00	8.27

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.41	0.85	0.14
Frequency Bias	1.37	1.01	0.34
Probability of Detection	0.81	0.16	0.29
False Alarm Rate	0.62	0.35	0.03

Overall Skill Score

Skill Score	Value
Proportion Correct	0.533
Kuiper Skill Score	0.167
Heidke Skill Score	0.179

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.47	0.67	0.18
Frequency Bias	1.57	0.63	0.41
Probability of Detection	0.83	0.21	0.34
False Alarm Rate	0.69	0.27	0.04

Overall Skill Score

Skill Score	Value
Proportion Correct	0.520
Kuiper Skill Score	0.182
Heidke Skill Score	0.196

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.59	0.61	0.16
Frequency Bias	2.04	0.50	0.37
Probability of Detection	0.83	0.19	0.31
False Alarm Rate	0.76	0.21	0.03

Overall Skill Score

Skill Score	Value
Proportion Correct	0.448
Kuiper Skill Score	0.153
Heidke Skill Score	0.154

INSAT-3D Sounder vs MODIS for December , 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	29903	716	7172
Sounder Uncertain	2074	129	4631
Sounder Cloudy	801	39	1410

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	27563	5131	5097
Sounder Uncertain	1586	1139	4109
Sounder Cloudy	713	201	1336

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	26283	5879	5629
Sounder Uncertain	1401	1178	4255
Sounder Cloudy	665	224	1361

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	63.79	1.53	15.30
Sounder Uncertain	4.42	0.28	9.88
Sounder Cloudy	1.71	0.08	3.01

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	58.80	10.95	10.87
Sounder Uncertain	3.38	2.43	8.77
Sounder Cloudy	1.52	0.43	2.85

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	56.07	12.54	12.01
Sounder Uncertain	2.99	2.51	9.08
Sounder Cloudy	1.42	0.48	2.90

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.21	0.98	0.37
Frequency Bias	1.15	7.73	0.17
Probability of Detection	0.91	0.15	0.11
False Alarm Rate	0.51	0.43	0.05

Overall Skill Score

Skill Score	Value
Proportion Correct	0.671
Kuiper Skill Score	0.210
Heidke Skill Score	0.216

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.27	0.83	0.41
Frequency Bias	1.27	1.06	0.21
Probability of Detection	0.92	0.18	0.13
False Alarm Rate	0.61	0.34	0.05

Overall Skill Score

Skill Score	Value
Proportion Correct	0.641
Kuiper Skill Score	0.184
Heidke Skill Score	0.211

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.30	0.83	0.40
Frequency Bias	1.33	0.94	0.20
Probability of Detection	0.93	0.16	0.12
False Alarm Rate	0.64	0.31	0.05

Overall Skill Score

Skill Score	Value
Proportion Correct	0.615
Kuiper Skill Score	0.169
Heidke Skill Score	0.195

INSAT-3D Sounder vs MODIS for December , 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	6435	7082	6947
Sounder Uncertain	733	600	2908
Sounder Cloudy	42	38	2759

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	5889	7813	6762
Sounder Uncertain	595	825	2821
Sounder Cloudy	30	56	2753

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	5463	7927	7074
Sounder Uncertain	544	820	2877
Sounder Cloudy	28	56	2755

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	23.36	25.71	25.22
Sounder Uncertain	2.66	2.18	10.56
Sounder Cloudy	0.15	0.14	10.02

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	21.38	28.37	24.55
Sounder Uncertain	2.16	3.00	10.24
Sounder Cloudy	0.11	0.20	9.99

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	19.83	28.78	25.68
Sounder Uncertain	1.98	2.98	10.45
Sounder Cloudy	0.10	0.20	10.00

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.69	0.86	0.03
Frequency Bias	2.84	0.55	0.23
Probability of Detection	0.89	0.08	0.22
False Alarm Rate	0.79	0.21	0.00

Overall Skill Score

Skill Score	Value
Proportion Correct	0.356
Kuiper Skill Score	0.110
Heidke Skill Score	0.099

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.71	0.81	0.03
Frequency Bias	3.14	0.49	0.23
Probability of Detection	0.90	0.09	0.22
False Alarm Rate	0.81	0.19	0.00

Overall Skill Score

Skill Score	Value
Proportion Correct	0.344
Kuiper Skill Score	0.114
Heidke Skill Score	0.100

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.73	0.81	0.03
Frequency Bias	3.39	0.48	0.22
Probability of Detection	0.91	0.09	0.22
False Alarm Rate	0.81	0.18	0.00

Overall Skill Score

Skill Score	Value

Proportion Correct	0.328
Kuiper Skill Score	0.108
Heidke Skill Score	0.093

INSAT-3D Sounder vs MODIS for December , 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	4936	5021	5662
Sounder Uncertain	654	510	2427
Sounder Cloudy	32	8	2297

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	4665	5343	5611
Sounder Uncertain	548	681	2362
Sounder Cloudy	25	21	2291

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	4441	5315	5863
Sounder Uncertain	510	667	2414
Sounder Cloudy	24	20	2293

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	22.91	23.30	26.28
Sounder Uncertain	3.04	2.37	11.26
Sounder Cloudy	0.15	0.04	10.66

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	21.65	24.80	26.04
Sounder Uncertain	2.54	3.16	10.96
Sounder Cloudy	0.12	0.10	10.63

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	20.61	24.67	27.21
Sounder Uncertain	2.37	3.10	11.20
Sounder Cloudy	0.11	0.09	10.64

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.68	0.86	0.02
Frequency Bias	2.78	0.65	0.23
Probability of Detection	0.88	0.09	0.22
False Alarm Rate	0.77	0.22	0.00

Overall Skill Score

Skill Score	Value
Proportion Correct	0.359
Kuiper Skill Score	0.119
Heidke Skill Score	0.105

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.70	0.81	0.02
Frequency Bias	2.98	0.59	0.23
Probability of Detection	0.89	0.11	0.22
False Alarm Rate	0.79	0.21	0.00

Overall Skill Score

Skill Score	Value
Proportion Correct	0.354
Kuiper Skill Score	0.126
Heidke Skill Score	0.110

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.72	0.81	0.02
Frequency Bias	3.14	0.60	0.22
Probability of Detection	0.89	0.11	0.22
False Alarm Rate	0.79	0.21	0.00

Overall Skill Score

Skill Score	Value
Proportion Correct	0.343
Kuiper Skill Score	0.122
Heidke Skill Score	0.104

INSAT-3D Sounder vs MODIS for December , 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	1499	2061	1285
Sounder Uncertain	79	90	481
Sounder Cloudy	10	30	462

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1224	2470	1151
Sounder Uncertain	47	144	459
Sounder Cloudy	5	35	462

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1022	2612	1211
Sounder Uncertain	34	153	463
Sounder Cloudy	4	36	462

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	25.00	34.37	21.43
Sounder Uncertain	1.32	1.50	8.02
Sounder Cloudy	0.17	0.50	7.70

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	20.41	41.19	19.19
Sounder Uncertain	0.78	2.40	7.65
Sounder Cloudy	0.08	0.58	7.70

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	17.04	43.56	20.19

Sounder Uncertain	0.57	2.55	7.72
Sounder Cloudy	0.07	0.60	7.70

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.69	0.86	0.08
Frequency Bias	3.05	0.30	0.23
Probability of Detection	0.94	0.04	0.21
False Alarm Rate	0.85	0.14	0.01

Overall Skill Score

Skill Score	Value
Proportion Correct	0.342
Kuiper Skill Score	0.087
Heidke Skill Score	0.080

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.75	0.78	0.08
Frequency Bias	3.80	0.25	0.24
Probability of Detection	0.96	0.05	0.22
False Alarm Rate	0.87	0.12	0.01

Overall Skill Score

Skill Score	Value
Proportion Correct	0.305
Kuiper Skill Score	0.088
Heidke Skill Score	0.075

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.79	0.76	0.08

Frequency Bias	4.57	0.23	0.24
Probability of Detection	0.96	0.05	0.22
False Alarm Rate	0.88	0.11	0.01

Overall Skill Score

Skill Score	Value
Proportion Correct	0.273
Kuiper Skill Score	0.080
Heidke Skill Score	0.064

INSAT-3D Sounder vs MODIS for December , 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	334	59	115
Sounder Uncertain	53	10	49
Sounder Cloudy	9	9	80

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	306	106	96
Sounder Uncertain	48	22	42
Sounder Cloudy	6	12	80

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	272	129	107

Sounder Uncertain	36	29	47
Sounder Cloudy	5	12	81

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	46.52	8.22	16.02
Sounder Uncertain	7.38	1.39	6.82
Sounder Cloudy	1.25	1.25	11.14

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	42.62	14.76	13.37
Sounder Uncertain	6.69	3.06	5.85
Sounder Cloudy	0.84	1.67	11.14

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	37.88	17.97	14.90
Sounder Uncertain	5.01	4.04	6.55
Sounder Cloudy	0.70	1.67	11.28

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.34	0.91	0.18
Frequency Bias	1.28	1.44	0.40
Probability of Detection	0.84	0.13	0.33
False Alarm Rate	0.59	0.35	0.06

Overall Skill Score

Skill Score	Value
Proportion Correct	0.591
Kuiper Skill Score	0.241
Heidke Skill Score	0.251

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.40	0.80	0.18
Frequency Bias	1.41	0.80	0.45
Probability of Detection	0.85	0.16	0.37
False Alarm Rate	0.65	0.29	0.06

Overall Skill Score

Skill Score	Value
Proportion Correct	0.568
Kuiper Skill Score	0.229
Heidke Skill Score	0.247

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.46	0.74	0.17
Frequency Bias	1.62	0.66	0.42
Probability of Detection	0.87	0.17	0.34
False Alarm Rate	0.70	0.25	0.05

Overall Skill Score

Skill Score	Value
Proportion Correct	0.532
Kuiper Skill Score	0.220
Heidke Skill Score	0.233

INSAT-3D Sounder vs MODIS for December , 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	251	31	75
Sounder Uncertain	45	8	32
Sounder Cloudy	6	7	61

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	235	61	61
Sounder Uncertain	43	14	28
Sounder Cloudy	3	10	61

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	207	82	68
Sounder Uncertain	32	24	29
Sounder Cloudy	2	10	62

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	48.64	6.01	14.53
Sounder Uncertain	8.72	1.55	6.20
Sounder Cloudy	1.16	1.36	11.82

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	45.54	11.82	11.82
Sounder Uncertain	8.33	2.71	5.43
Sounder Cloudy	0.58	1.94	11.82

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	40.12	15.89	13.18
Sounder Uncertain	6.20	4.65	5.62
Sounder Cloudy	0.39	1.94	12.02

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.30	0.91	0.18
Frequency Bias	1.18	1.85	0.44
Probability of Detection	0.83	0.17	0.36
False Alarm Rate	0.54	0.39	0.07

Overall Skill Score

Skill Score	Value
Proportion Correct	0.620
Kuiper Skill Score	0.283
Heidke Skill Score	0.288

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.34	0.84	0.18
Frequency Bias	1.27	1.00	0.49
Probability of Detection	0.84	0.16	0.41
False Alarm Rate	0.59	0.34	0.06

Overall Skill Score

Skill Score	Value
Proportion Correct	0.601
Kuiper Skill Score	0.262
Heidke Skill Score	0.280

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.42	0.72	0.16
Frequency Bias	1.48	0.73	0.47
Probability of Detection	0.86	0.21	0.39
False Alarm Rate	0.67	0.27	0.05

Overall Skill Score

Skill Score	Value
Proportion Correct	0.568
Kuiper Skill Score	0.257
Heidke Skill Score	0.274

INSAT-3D Sounder vs MODIS for December , 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	83	28	40
Sounder Uncertain	8	2	17
Sounder Cloudy	3	2	19

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	71	45	35
Sounder Uncertain	5	8	14
Sounder Cloudy	3	2	19

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	65	47	39
Sounder Uncertain	4	5	18
Sounder Cloudy	3	2	19

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	41.09	13.86	19.80
Sounder Uncertain	3.96	0.99	8.42
Sounder Cloudy	1.49	0.99	9.41

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	35.15	22.28	17.33
Sounder Uncertain	2.48	3.96	6.93
Sounder Cloudy	1.49	0.99	9.41

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	32.18	23.27	19.31
Sounder Uncertain	1.98	2.48	8.91
Sounder Cloudy	1.49	0.99	9.41

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.45	0.93	0.21
Frequency Bias	1.61	0.84	0.32
Probability of Detection	0.88	0.06	0.25
False Alarm Rate	0.69	0.26	0.05

Overall Skill Score

Skill Score	Value
Proportion Correct	0.515
Kuiper Skill Score	0.164
Heidke Skill Score	0.172

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.53	0.70	0.21
Frequency Bias	1.91	0.49	0.35
Probability of Detection	0.90	0.15	0.28
False Alarm Rate	0.77	0.18	0.05

Overall Skill Score

Skill Score	Value
Proportion Correct	0.485
Kuiper Skill Score	0.176
Heidke Skill Score	0.184

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.57	0.81	0.21
Frequency Bias	2.10	0.50	0.32
Probability of Detection	0.90	0.09	0.25
False Alarm Rate	0.76	0.19	0.04

Overall Skill Score

Skill Score	Value

Proportion Correct	0.441
Kuiper Skill Score	0.142
Heidke Skill Score	0.143

INSAT-3D Sounder vs MODIS for December , 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	5767	1105	4385
Sounder Uncertain	5065	578	5414
Sounder Cloudy	3740	254	5119

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	4720	3194	3343
Sounder Uncertain	3634	3292	4131
Sounder Cloudy	2641	2365	4107

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	4136	3353	3768
Sounder Uncertain	3153	3374	4530
Sounder Cloudy	2338	2329	4446

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	18.35	3.52	13.95
Sounder Uncertain	16.12	1.84	17.23
Sounder Cloudy	11.90	0.81	16.29

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	15.02	10.16	10.64
Sounder Uncertain	11.56	10.48	13.14
Sounder Cloudy	8.40	7.53	13.07

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	13.16	10.67	11.99
Sounder Uncertain	10.03	10.74	14.41
Sounder Cloudy	7.44	7.41	14.15

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.49	0.95	0.44
Frequency Bias	0.77	5.71	0.61
Probability of Detection	0.40	0.30	0.34
False Alarm Rate	0.28	0.52	0.20

Overall Skill Score

Skill Score	Value
Proportion Correct	0.365
Kuiper Skill Score	0.071
Heidke Skill Score	0.058

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy

False Alarm Ratio	0.58	0.70	0.55
Frequency Bias	1.02	1.25	0.79
Probability of Detection	0.43	0.37	0.35
False Alarm Rate	0.34	0.40	0.26

Overall Skill Score

Skill Score	Value
Proportion Correct	0.386
Kuiper Skill Score	0.082
Heidke Skill Score	0.081

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.63	0.69	0.51
Frequency Bias	1.17	1.22	0.72
Probability of Detection	0.43	0.37	0.35
False Alarm Rate	0.37	0.39	0.24

Overall Skill Score

Skill Score	Value
Proportion Correct	0.380
Kuiper Skill Score	0.079
Heidke Skill Score	0.077

INSAT-3D Sounder vs MODIS for December , 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	2315	38	935
Sounder Uncertain	2920	91	2650
Sounder Cloudy	2468	123	4120

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1796	862	630
Sounder Uncertain	1932	1808	1921
Sounder Cloudy	1554	1814	3343

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1596	979	713
Sounder Uncertain	1633	1908	2120
Sounder Cloudy	1324	1781	3606

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	14.78	0.24	5.97
Sounder Uncertain	18.65	0.58	16.92
Sounder Cloudy	15.76	0.79	26.31

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	11.47	5.50	4.02
Sounder Uncertain	12.34	11.55	12.27
Sounder Cloudy	9.92	11.58	21.35

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	10.19	6.25	4.55

Sounder Uncertain	10.43	12.18	13.54
Sounder Cloudy	8.45	11.37	23.03

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.30	0.98	0.39
Frequency Bias	0.43	22.46	0.87
Probability of Detection	0.30	0.36	0.53
False Alarm Rate	0.11	0.61	0.28

Overall Skill Score

Skill Score	Value
Proportion Correct	0.417
Kuiper Skill Score	0.188
Heidke Skill Score	0.142

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.45	0.68	0.50
Frequency Bias	0.62	1.26	1.14
Probability of Detection	0.34	0.40	0.57
False Alarm Rate	0.17	0.44	0.39

Overall Skill Score

Skill Score	Value
Proportion Correct	0.444
Kuiper Skill Score	0.163
Heidke Skill Score	0.163

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.51	0.66	0.46

Frequency Bias	0.72	1.21	1.04
Probability of Detection	0.35	0.41	0.56
False Alarm Rate	0.20	0.44	0.36

Overall Skill Score

Skill Score	Value
Proportion Correct	0.454
Kuiper Skill Score	0.166
Heidke Skill Score	0.166

INSAT-3D Sounder vs MODIS for December , 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	3452	1067	3450
Sounder Uncertain	2145	487	2764
Sounder Cloudy	1272	131	999

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	2924	2332	2713
Sounder Uncertain	1702	1484	2210
Sounder Cloudy	1087	551	764

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	2540	2374	3055

Sounder Uncertain	1520	1466	2410
Sounder Cloudy	1014	548	840

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	21.89	6.77	21.88
Sounder Uncertain	13.60	3.09	17.53
Sounder Cloudy	8.07	0.83	6.34

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	18.55	14.79	17.21
Sounder Uncertain	10.79	9.41	14.02
Sounder Cloudy	6.89	3.49	4.85

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	16.11	15.06	19.38
Sounder Uncertain	9.64	9.30	15.29
Sounder Cloudy	6.43	3.48	5.33

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.57	0.91	0.58
Frequency Bias	1.16	3.20	0.33
Probability of Detection	0.50	0.29	0.14
False Alarm Rate	0.42	0.45	0.13

Overall Skill Score

Skill Score	Value
Proportion Correct	0.313
Kuiper Skill Score	-0.023
Heidke Skill Score	-0.020

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.63	0.72	0.68
Frequency Bias	1.39	1.24	0.42
Probability of Detection	0.51	0.34	0.13
False Alarm Rate	0.48	0.37	0.15

Overall Skill Score

Skill Score	Value
Proportion Correct	0.328
Kuiper Skill Score	-0.007
Heidke Skill Score	-0.007

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.68	0.73	0.65
Frequency Bias	1.57	1.23	0.38
Probability of Detection	0.50	0.33	0.13
False Alarm Rate	0.50	0.36	0.14

Overall Skill Score

Skill Score	Value
Proportion Correct	0.307
Kuiper Skill Score	-0.017
Heidke Skill Score	-0.017