

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 around 40-60 pixels 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 cloudy 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 probability 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 statistics are presented in following 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 August , 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	2686	2771	15944
Sounder Uncertain	534	909	13426
Sounder Cloudy	2588	1784	121991

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	2094	3955	15352
Sounder Uncertain	303	1352	13214
Sounder Cloudy	2192	2850	121321

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1782	3721	15898
Sounder Uncertain	227	1172	13470
Sounder Cloudy	1805	2768	121790

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1.65	1.70	9.80
Sounder Uncertain	0.33	0.56	8.26
Sounder Cloudy	1.59	1.10	75.01

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1.29	2.43	9.44
Sounder Uncertain	0.19	0.83	8.13
Sounder Cloudy	1.35	1.75	74.60

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1.10	2.29	9.78
Sounder Uncertain	0.14	0.72	8.28
Sounder Cloudy	1.11	1.70	74.89

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.87	0.94	0.03
Frequency Bias	3.68	2.72	0.83
Probability of Detection	0.46	0.17	0.81
False Alarm Rate	0.51	0.38	0.12

Overall Skill Score

Skill Score	Value
Proportion Correct	0.772
Kuiper Skill Score	0.314
Heidke Skill Score	0.153

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.90	0.91	0.04
Frequency Bias	4.66	1.82	0.84
Probability of Detection	0.46	0.17	0.81
False Alarm Rate	0.51	0.36	0.13

Overall Skill Score

Skill Score	Value
Proportion Correct	0.767
Kuiper Skill Score	0.290
Heidke Skill Score	0.155

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.92	0.92	0.04
Frequency Bias	5.61	1.94	0.84
Probability of Detection	0.47	0.15	0.81
False Alarm Rate	0.52	0.36	0.12

Overall Skill Score

Skill Score	Value
Proportion Correct	0.767
Kuiper Skill Score	0.281
Heidke Skill Score	0.139

INSAT-3D Sounder vs MODIS for August , 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	2198	2607	11654
Sounder Uncertain	427	814	9108
Sounder Cloudy	2540	1764	83121

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1740	3536	11183
Sounder Uncertain	255	1121	8973
Sounder Cloudy	2171	2752	82502

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1474	3321	11664
Sounder Uncertain	191	971	9187
Sounder Cloudy	1789	2691	82945

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1.92	2.28	10.20
Sounder Uncertain	0.37	0.71	7.97
Sounder Cloudy	2.22	1.54	72.76

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1.52	3.10	9.79
Sounder Uncertain	0.22	0.98	7.85
Sounder Cloudy	1.90	2.41	72.22

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1.29	2.91	10.21
Sounder Uncertain	0.17	0.85	8.04
Sounder Cloudy	1.57	2.36	72.61

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.87	0.92	0.05
Frequency Bias	3.19	2.00	0.84
Probability of Detection	0.43	0.16	0.80
False Alarm Rate	0.51	0.34	0.15

Overall Skill Score

Skill Score	Value
Proportion Correct	0.754
Kuiper Skill Score	0.281
Heidke Skill Score	0.162

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.89	0.89	0.06
Frequency Bias	3.95	1.40	0.85
Probability of Detection	0.42	0.15	0.80
False Alarm Rate	0.51	0.32	0.17

Overall Skill Score

Skill Score	Value
Proportion Correct	0.747
Kuiper Skill Score	0.259
Heidke Skill Score	0.161

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.91	0.91	0.05
Frequency Bias	4.77	1.48	0.84
Probability of Detection	0.43	0.14	0.80
False Alarm Rate	0.52	0.33	0.16

Overall Skill Score

Skill Score	Value
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Proportion Correct	0.748
Kuiper Skill Score	0.249
Heidke Skill Score	0.143

INSAT-3D Sounder vs MODIS for August , 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	488	164	4290
Sounder Uncertain	107	95	4318
Sounder Cloudy	48	20	38870

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	354	419	4169
Sounder Uncertain	48	231	4241
Sounder Cloudy	21	98	38819

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	308	400	4234
Sounder Uncertain	36	201	4283
Sounder Cloudy	16	77	38845

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1.01	0.34	8.86
Sounder Uncertain	0.22	0.20	8.92
Sounder Cloudy	0.10	0.04	80.31

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.73	0.87	8.61
Sounder Uncertain	0.10	0.48	8.76
Sounder Cloudy	0.04	0.20	80.20

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.64	0.83	8.75
Sounder Uncertain	0.07	0.42	8.85
Sounder Cloudy	0.03	0.16	80.26

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.90	0.98	0.00
Frequency Bias	7.69	16.20	0.82
Probability of Detection	0.76	0.34	0.82
False Alarm Rate	0.50	0.49	0.01

Overall Skill Score

Skill Score	Value
Proportion Correct	0.815
Kuiper Skill Score	0.641
Heidke Skill Score	0.115

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
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False Alarm Ratio	0.93	0.95	0.00
Frequency Bias	11.68	6.04	0.82
Probability of Detection	0.84	0.31	0.82
False Alarm Rate	0.51	0.48	0.01

Overall Skill Score

Skill Score	Value
Proportion Correct	0.814
Kuiper Skill Score	0.563
Heidke Skill Score	0.126

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.94	0.96	0.00
Frequency Bias	13.73	6.67	0.82
Probability of Detection	0.86	0.30	0.82
False Alarm Rate	0.51	0.48	0.01

Overall Skill Score

Skill Score	Value
Proportion Correct	0.813
Kuiper Skill Score	0.564
Heidke Skill Score	0.113

INSAT-3D Sounder vs MODIS for August , 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
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Sounder Clear	834	630	8597
Sounder Uncertain	260	191	5313
Sounder Cloudy	2448	1708	74165

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	602	1299	8160
Sounder Uncertain	165	431	5168
Sounder Cloudy	2137	2532	73652

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	460	1154	8447
Sounder Uncertain	120	380	5264
Sounder Cloudy	1768	2506	74047

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.89	0.67	9.13
Sounder Uncertain	0.28	0.20	5.64
Sounder Cloudy	2.60	1.81	78.78

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.64	1.38	8.67
Sounder Uncertain	0.18	0.46	5.49
Sounder Cloudy	2.27	2.69	78.23

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.49	1.23	8.97

Sounder Uncertain	0.13	0.40	5.59
Sounder Cloudy	1.88	2.66	78.65

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.92	0.97	0.05
Frequency Bias	2.84	2.28	0.89
Probability of Detection	0.24	0.08	0.84
False Alarm Rate	0.49	0.29	0.22

Overall Skill Score

Skill Score	Value
Proportion Correct	0.799
Kuiper Skill Score	0.120
Heidke Skill Score	0.068

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.94	0.93	0.06
Frequency Bias	3.46	1.35	0.90
Probability of Detection	0.21	0.10	0.85
False Alarm Rate	0.49	0.27	0.24

Overall Skill Score

Skill Score	Value
Proportion Correct	0.793
Kuiper Skill Score	0.130
Heidke Skill Score	0.083

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.95	0.93	0.05

Frequency Bias	4.28	1.43	0.89
Probability of Detection	0.20	0.09	0.84
False Alarm Rate	0.50	0.28	0.22

Overall Skill Score

Skill Score	Value
Proportion Correct	0.795
Kuiper Skill Score	0.114
Heidke Skill Score	0.067

INSAT-3D Sounder vs MODIS for August , 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	834	612	5896
Sounder Uncertain	259	176	3163
Sounder Cloudy	2448	1706	52402

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	602	1274	5466
Sounder Uncertain	165	417	3016
Sounder Cloudy	2137	2528	51891

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	460	1140	5742

Sounder Uncertain	120	367	3111
Sounder Cloudy	1768	2504	52284

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1.24	0.91	8.74
Sounder Uncertain	0.38	0.26	4.69
Sounder Cloudy	3.63	2.53	77.64

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.89	1.89	8.10
Sounder Uncertain	0.24	0.62	4.47
Sounder Cloudy	3.17	3.75	76.88

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.68	1.69	8.51
Sounder Uncertain	0.18	0.54	4.61
Sounder Cloudy	2.62	3.71	77.46

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.89	0.95	0.07
Frequency Bias	2.07	1.44	0.92
Probability of Detection	0.24	0.07	0.85
False Alarm Rate	0.46	0.24	0.29

Overall Skill Score

Skill Score	Value
Proportion Correct	0.791
Kuiper Skill Score	0.124
Heidke Skill Score	0.090

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.92	0.88	0.08
Frequency Bias	2.53	0.85	0.94
Probability of Detection	0.21	0.10	0.86
False Alarm Rate	0.46	0.22	0.32

Overall Skill Score

Skill Score	Value
Proportion Correct	0.784
Kuiper Skill Score	0.136
Heidke Skill Score	0.109

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.94	0.90	0.08
Frequency Bias	3.13	0.90	0.93
Probability of Detection	0.20	0.09	0.86
False Alarm Rate	0.48	0.22	0.30

Overall Skill Score

Skill Score	Value
Proportion Correct	0.787
Kuiper Skill Score	0.120
Heidke Skill Score	0.090

INSAT-3D Sounder vs MODIS for August , 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	0	18	2701
Sounder Uncertain	1	15	2150
Sounder Cloudy	0	2	21763

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0	25	2694
Sounder Uncertain	0	14	2152
Sounder Cloudy	0	4	21761

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0	14	2705
Sounder Uncertain	0	13	2153
Sounder Cloudy	0	2	21763

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.00	0.07	10.14
Sounder Uncertain	0.00	0.06	8.07
Sounder Cloudy	0.00	0.01	81.66

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.00	0.09	10.11
Sounder Uncertain	0.00	0.05	8.08
Sounder Cloudy	0.00	0.02	81.65

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.00	0.05	10.15
Sounder Uncertain	0.00	0.05	8.08
Sounder Cloudy	0.00	0.01	81.66

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	1.00	0.99	0.00
Frequency Bias	2719.00	61.89	0.82
Probability of Detection	0.00	0.43	0.82
False Alarm Rate	0.56	0.44	0.00

Overall Skill Score

Skill Score	Value
Proportion Correct	0.817
Kuiper Skill Score	0.549
Heidke Skill Score	0.008

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	1.00	0.99	0.00
Frequency Bias	inf	50.37	0.82
Probability of Detection	nan	0.33	0.82
False Alarm Rate	0.56	0.44	0.00

Overall Skill Score

Skill Score	Value
Proportion Correct	0.817
Kuiper Skill Score	0.485
Heidke Skill Score	0.008

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	1.00	0.99	0.00
Frequency Bias	inf	74.69	0.82
Probability of Detection	nan	0.45	0.82
False Alarm Rate	0.56	0.44	0.00

Overall Skill Score

Skill Score	Value
Proportion Correct	0.817
Kuiper Skill Score	0.558
Heidke Skill Score	0.007

INSAT-3D Sounder vs MODIS for August , 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	1767	2028	6225
Sounder Uncertain	236	642	7299
Sounder Cloudy	68	45	42283

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1443	2420	6157
Sounder Uncertain	119	786	7272
Sounder Cloudy	28	153	42215

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1288	2368	6364
Sounder Uncertain	95	685	7397
Sounder Cloudy	21	130	42245

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	2.92	3.35	10.27
Sounder Uncertain	0.39	1.06	12.05
Sounder Cloudy	0.11	0.07	69.78

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	2.38	3.99	10.16
Sounder Uncertain	0.20	1.30	12.00
Sounder Cloudy	0.05	0.25	69.67

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	2.13	3.91	10.50
Sounder Uncertain	0.16	1.13	12.21
Sounder Cloudy	0.03	0.21	69.72

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.82	0.92	0.00
Frequency Bias	4.84	3.01	0.76
Probability of Detection	0.85	0.24	0.76
False Alarm Rate	0.52	0.47	0.01

Overall Skill Score

Skill Score	Value
Proportion Correct	0.738
Kuiper Skill Score	0.548
Heidke Skill Score	0.237

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.86	0.90	0.00
Frequency Bias	6.30	2.43	0.76
Probability of Detection	0.91	0.23	0.76
False Alarm Rate	0.53	0.46	0.01

Overall Skill Score

Skill Score	Value
Proportion Correct	0.733
Kuiper Skill Score	0.517
Heidke Skill Score	0.229

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.87	0.92	0.00
Frequency Bias	7.14	2.57	0.76
Probability of Detection	0.92	0.22	0.75
False Alarm Rate	0.53	0.46	0.01

Overall Skill Score

Skill Score	Value
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Proportion Correct	0.730
Kuiper Skill Score	0.507
Heidke Skill Score	0.211

INSAT-3D Sounder vs MODIS for August , 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	1281	1910	4865
Sounder Uncertain	133	593	5467
Sounder Cloudy	20	38	26406

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1090	2062	4904
Sounder Uncertain	73	612	5508
Sounder Cloudy	7	79	26378

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	980	2011	5065
Sounder Uncertain	59	530	5604
Sounder Cloudy	5	64	26395

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	3.15	4.69	11.95
Sounder Uncertain	0.33	1.46	13.43
Sounder Cloudy	0.05	0.09	64.86

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	2.68	5.06	12.05
Sounder Uncertain	0.18	1.50	13.53
Sounder Cloudy	0.02	0.19	64.79

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	2.41	4.94	12.44
Sounder Uncertain	0.14	1.30	13.76
Sounder Cloudy	0.01	0.16	64.83

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.84	0.90	0.00
Frequency Bias	5.62	2.44	0.72
Probability of Detection	0.89	0.23	0.72
False Alarm Rate	0.54	0.45	0.00

Overall Skill Score

Skill Score	Value
Proportion Correct	0.695
Kuiper Skill Score	0.507
Heidke Skill Score	0.231

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
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False Alarm Ratio	0.86	0.90	0.00
Frequency Bias	6.89	2.25	0.72
Probability of Detection	0.93	0.22	0.72
False Alarm Rate	0.55	0.44	0.01

Overall Skill Score

Skill Score	Value
Proportion Correct	0.690
Kuiper Skill Score	0.485
Heidke Skill Score	0.218

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.88	0.91	0.00
Frequency Bias	7.72	2.38	0.71
Probability of Detection	0.94	0.20	0.71
False Alarm Rate	0.55	0.44	0.01

Overall Skill Score

Skill Score	Value
Proportion Correct	0.685
Kuiper Skill Score	0.474
Heidke Skill Score	0.200

INSAT-3D Sounder vs MODIS for August , 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
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Sounder Clear	486	118	1360
Sounder Uncertain	103	49	1832
Sounder Cloudy	48	7	15877

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	353	358	1253
Sounder Uncertain	46	174	1764
Sounder Cloudy	21	74	15837

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	308	357	1299
Sounder Uncertain	36	155	1793
Sounder Cloudy	16	66	15850

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	2.44	0.59	6.84
Sounder Uncertain	0.52	0.25	9.22
Sounder Cloudy	0.24	0.04	79.86

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1.78	1.80	6.30
Sounder Uncertain	0.23	0.88	8.87
Sounder Cloudy	0.11	0.37	79.66

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1.55	1.80	6.53

Sounder Uncertain	0.18	0.78	9.02
Sounder Cloudy	0.08	0.33	79.73

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.75	0.98	0.00
Frequency Bias	3.08	11.40	0.84
Probability of Detection	0.76	0.28	0.83
False Alarm Rate	0.43	0.56	0.02

Overall Skill Score

Skill Score	Value
Proportion Correct	0.826
Kuiper Skill Score	0.670
Heidke Skill Score	0.232

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.82	0.91	0.01
Frequency Bias	4.68	3.27	0.85
Probability of Detection	0.84	0.29	0.84
False Alarm Rate	0.46	0.51	0.03

Overall Skill Score

Skill Score	Value
Proportion Correct	0.823
Kuiper Skill Score	0.584
Heidke Skill Score	0.247

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.84	0.92	0.01

Frequency Bias	5.46	3.43	0.84
Probability of Detection	0.86	0.27	0.84
False Alarm Rate	0.46	0.51	0.02

Overall Skill Score

Skill Score	Value
Proportion Correct	0.821
Kuiper Skill Score	0.575
Heidke Skill Score	0.226

INSAT-3D Sounder vs MODIS for August , 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	16	17	153
Sounder Uncertain	6	10	91
Sounder Cloudy	3	3	651

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	11	32	143
Sounder Uncertain	3	19	85
Sounder Cloudy	3	5	649

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	9	28	149

Sounder Uncertain	2	14	91
Sounder Cloudy	3	4	650

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1.68	1.79	16.11
Sounder Uncertain	0.63	1.05	9.58
Sounder Cloudy	0.32	0.32	68.53

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1.16	3.37	15.05
Sounder Uncertain	0.32	2.00	8.95
Sounder Cloudy	0.32	0.53	68.32

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.95	2.95	15.68
Sounder Uncertain	0.21	1.47	9.58
Sounder Cloudy	0.32	0.42	68.42

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.91	0.91	0.01
Frequency Bias	7.44	3.57	0.73
Probability of Detection	0.64	0.33	0.73
False Alarm Rate	0.62	0.36	0.02

Overall Skill Score

Skill Score	Value
Proportion Correct	0.713
Kuiper Skill Score	0.473
Heidke Skill Score	0.154

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.94	0.82	0.01
Frequency Bias	10.94	1.91	0.75
Probability of Detection	0.65	0.34	0.74
False Alarm Rate	0.65	0.32	0.03

Overall Skill Score

Skill Score	Value
Proportion Correct	0.715
Kuiper Skill Score	0.459
Heidke Skill Score	0.188

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.95	0.87	0.01
Frequency Bias	13.29	2.33	0.74
Probability of Detection	0.64	0.30	0.73
False Alarm Rate	0.64	0.34	0.03

Overall Skill Score

Skill Score	Value
Proportion Correct	0.708
Kuiper Skill Score	0.436
Heidke Skill Score	0.152

INSAT-3D Sounder vs MODIS for August , 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	16	17	143
Sounder Uncertain	6	10	74
Sounder Cloudy	3	3	550

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	11	32	133
Sounder Uncertain	3	19	68
Sounder Cloudy	3	5	548

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	9	28	139
Sounder Uncertain	2	14	74
Sounder Cloudy	3	4	549

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1.95	2.07	17.40
Sounder Uncertain	0.73	1.22	9.00
Sounder Cloudy	0.36	0.36	66.91

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1.34	3.89	16.18
Sounder Uncertain	0.36	2.31	8.27
Sounder Cloudy	0.36	0.61	66.67

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1.09	3.41	16.91
Sounder Uncertain	0.24	1.70	9.00
Sounder Cloudy	0.36	0.49	66.79

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.91	0.89	0.01
Frequency Bias	7.04	3.00	0.72
Probability of Detection	0.64	0.33	0.72
False Alarm Rate	0.65	0.33	0.02

Overall Skill Score

Skill Score	Value
Proportion Correct	0.701
Kuiper Skill Score	0.465
Heidke Skill Score	0.165

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.94	0.79	0.01
Frequency Bias	10.35	1.61	0.74
Probability of Detection	0.65	0.34	0.73
False Alarm Rate	0.68	0.29	0.03

Overall Skill Score

Skill Score	Value
Proportion Correct	0.703
Kuiper Skill Score	0.455
Heidke Skill Score	0.202

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.95	0.84	0.01
Frequency Bias	12.57	1.96	0.73
Probability of Detection	0.64	0.30	0.72
False Alarm Rate	0.67	0.30	0.03

Overall Skill Score

Skill Score	Value
Proportion Correct	0.696
Kuiper Skill Score	0.430
Heidke Skill Score	0.163

INSAT-3D Sounder vs MODIS for August , 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	0	0	10
Sounder Uncertain	0	0	17
Sounder Cloudy	0	0	101

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0	0	10
Sounder Uncertain	0	0	17
Sounder Cloudy	0	0	101

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0	0	10
Sounder Uncertain	0	0	17
Sounder Cloudy	0	0	101

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.00	0.00	7.81
Sounder Uncertain	0.00	0.00	13.28
Sounder Cloudy	0.00	0.00	78.91

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.00	0.00	7.81
Sounder Uncertain	0.00	0.00	13.28
Sounder Cloudy	0.00	0.00	78.91

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.00	0.00	7.81
Sounder Uncertain	0.00	0.00	13.28
Sounder Cloudy	0.00	0.00	78.91

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	1.00	1.00	0.00
Frequency Bias	inf	inf	0.79
Probability of Detection	nan	nan	0.79
False Alarm Rate	0.37	0.63	0.00

Overall Skill Score

Skill Score	Value
Proportion Correct	0.789
Kuiper Skill Score	nan
Heidke Skill Score	0.000

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	1.00	1.00	0.00
Frequency Bias	inf	inf	0.79
Probability of Detection	nan	nan	0.79
False Alarm Rate	0.37	0.63	0.00

Overall Skill Score

Skill Score	Value
Proportion Correct	0.789
Kuiper Skill Score	nan
Heidke Skill Score	0.000

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	1.00	1.00	0.00
Frequency Bias	inf	inf	0.79
Probability of Detection	nan	nan	0.79
False Alarm Rate	0.37	0.63	0.00

Overall Skill Score

Skill Score	Value
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Proportion Correct	0.789
Kuiper Skill Score	nan
Heidke Skill Score	0.000

INSAT-3D Sounder vs MODIS for August , 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	15	29	217
Sounder Uncertain	25	34	365
Sounder Cloudy	42	16	1624

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	8	56	197
Sounder Uncertain	14	69	341
Sounder Cloudy	15	102	1565

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	6	48	207
Sounder Uncertain	8	57	359
Sounder Cloudy	5	83	1594

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.63	1.23	9.17
Sounder Uncertain	1.06	1.44	15.42
Sounder Cloudy	1.77	0.68	68.61

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.34	2.37	8.32
Sounder Uncertain	0.59	2.92	14.41
Sounder Cloudy	0.63	4.31	66.12

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.25	2.03	8.75
Sounder Uncertain	0.34	2.41	15.17
Sounder Cloudy	0.21	3.51	67.34

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.94	0.92	0.03
Frequency Bias	3.18	5.37	0.76
Probability of Detection	0.18	0.43	0.74
False Alarm Rate	0.35	0.56	0.08

Overall Skill Score

Skill Score	Value
Proportion Correct	0.707
Kuiper Skill Score	0.269
Heidke Skill Score	0.106

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
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False Alarm Ratio	0.97	0.84	0.07
Frequency Bias	7.05	1.87	0.80
Probability of Detection	0.22	0.30	0.74
False Alarm Rate	0.35	0.49	0.16

Overall Skill Score

Skill Score	Value
Proportion Correct	0.694
Kuiper Skill Score	0.216
Heidke Skill Score	0.124

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.98	0.87	0.05
Frequency Bias	13.74	2.26	0.78
Probability of Detection	0.32	0.30	0.74
False Alarm Rate	0.36	0.52	0.12

Overall Skill Score

Skill Score	Value
Proportion Correct	0.700
Kuiper Skill Score	0.227
Heidke Skill Score	0.108

INSAT-3D Sounder vs MODIS for August , 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
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Sounder Clear	13	1	74
Sounder Uncertain	22	3	134
Sounder Cloudy	42	6	995

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	7	20	61
Sounder Uncertain	12	26	121
Sounder Cloudy	15	83	945

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	6	19	63
Sounder Uncertain	8	24	127
Sounder Cloudy	5	75	963

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1.01	0.08	5.74
Sounder Uncertain	1.71	0.23	10.39
Sounder Cloudy	3.26	0.47	77.13

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.54	1.55	4.73
Sounder Uncertain	0.93	2.02	9.38
Sounder Cloudy	1.16	6.43	73.26

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.47	1.47	4.88

Sounder Uncertain	0.62	1.86	9.84
Sounder Cloudy	0.39	5.81	74.65

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.85	0.98	0.05
Frequency Bias	1.14	15.90	0.87
Probability of Detection	0.17	0.30	0.83
False Alarm Rate	0.27	0.56	0.17

Overall Skill Score

Skill Score	Value
Proportion Correct	0.784
Kuiper Skill Score	0.195
Heidke Skill Score	0.102

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.92	0.84	0.09
Frequency Bias	2.59	1.23	0.93
Probability of Detection	0.21	0.20	0.84
False Alarm Rate	0.26	0.43	0.31

Overall Skill Score

Skill Score	Value
Proportion Correct	0.758
Kuiper Skill Score	0.167
Heidke Skill Score	0.135

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.93	0.85	0.08

Frequency Bias	4.63	1.35	0.90
Probability of Detection	0.32	0.20	0.84
False Alarm Rate	0.28	0.45	0.27

Overall Skill Score

Skill Score	Value
Proportion Correct	0.770
Kuiper Skill Score	0.181
Heidke Skill Score	0.131

INSAT-3D Sounder vs MODIS for August , 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	2	28	143
Sounder Uncertain	3	31	231
Sounder Cloudy	0	10	629

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1	36	136
Sounder Uncertain	2	43	220
Sounder Cloudy	0	19	620

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0	29	144

Sounder Uncertain	0	33	232
Sounder Cloudy	0	8	631

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.19	2.60	13.28
Sounder Uncertain	0.28	2.88	21.45
Sounder Cloudy	0.00	0.93	58.40

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.09	3.34	12.63
Sounder Uncertain	0.19	3.99	20.43
Sounder Cloudy	0.00	1.76	57.57

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.00	2.69	13.37
Sounder Uncertain	0.00	3.06	21.54
Sounder Cloudy	0.00	0.74	58.59

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.99	0.88	0.02
Frequency Bias	34.60	3.84	0.64
Probability of Detection	0.40	0.45	0.63
False Alarm Rate	0.41	0.56	0.02

Overall Skill Score

Skill Score	Value
Proportion Correct	0.615
Kuiper Skill Score	0.355
Heidke Skill Score	0.106

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.99	0.84	0.03
Frequency Bias	57.67	2.70	0.65
Probability of Detection	0.33	0.44	0.64
False Alarm Rate	0.42	0.54	0.05

Overall Skill Score

Skill Score	Value
Proportion Correct	0.617
Kuiper Skill Score	0.329
Heidke Skill Score	0.127

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	1.00	0.88	0.01
Frequency Bias	inf	3.79	0.63
Probability of Detection	nan	0.47	0.63
False Alarm Rate	0.42	0.56	0.02

Overall Skill Score

Skill Score	Value
Proportion Correct	0.617
Kuiper Skill Score	0.377
Heidke Skill Score	0.107