

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 July , 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	3264	3173	12505
Sounder Uncertain	965	1112	12008
Sounder Cloudy	617	769	130396

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	2454	4259	12229
Sounder Uncertain	522	1874	11689
Sounder Cloudy	290	1669	129823

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	2198	3999	12745
Sounder Uncertain	434	1703	11948
Sounder Cloudy	191	1479	130112

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1.98	1.93	7.59
Sounder Uncertain	0.59	0.67	7.29
Sounder Cloudy	0.37	0.47	79.12

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1.49	2.58	7.42
Sounder Uncertain	0.32	1.14	7.09
Sounder Cloudy	0.18	1.01	78.77

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1.33	2.43	7.73
Sounder Uncertain	0.26	1.03	7.25
Sounder Cloudy	0.12	0.90	78.95

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.83	0.92	0.01
Frequency Bias	3.91	2.79	0.85
Probability of Detection	0.67	0.22	0.84
False Alarm Rate	0.52	0.43	0.05

Overall Skill Score

Skill Score	Value
Proportion Correct	0.818
Kuiper Skill Score	0.525
Heidke Skill Score	0.248

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.87	0.87	0.01
Frequency Bias	5.80	1.81	0.86
Probability of Detection	0.75	0.24	0.84
False Alarm Rate	0.54	0.40	0.06

Overall Skill Score

Skill Score	Value
Proportion Correct	0.814
Kuiper Skill Score	0.486
Heidke Skill Score	0.249

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.88	0.88	0.01
Frequency Bias	6.71	1.96	0.85
Probability of Detection	0.78	0.24	0.84
False Alarm Rate	0.54	0.40	0.05

Overall Skill Score

Skill Score	Value
Proportion Correct	0.813
Kuiper Skill Score	0.488
Heidke Skill Score	0.232

INSAT-3D Sounder vs MODIS for July , 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	1657	2691	6573
Sounder Uncertain	487	861	6725
Sounder Cloudy	511	625	81843

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1221	3077	6623
Sounder Uncertain	252	1176	6645
Sounder Cloudy	234	1417	81328

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1042	2887	6992
Sounder Uncertain	198	1063	6812
Sounder Cloudy	149	1269	81561

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1.62	2.64	6.45
Sounder Uncertain	0.48	0.84	6.59
Sounder Cloudy	0.50	0.61	80.26

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1.20	3.02	6.49
Sounder Uncertain	0.25	1.15	6.52
Sounder Cloudy	0.23	1.39	79.75

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1.02	2.83	6.86
Sounder Uncertain	0.19	1.04	6.68
Sounder Cloudy	0.15	1.24	79.98

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.85	0.89	0.01
Frequency Bias	4.11	1.93	0.87
Probability of Detection	0.62	0.21	0.86
False Alarm Rate	0.53	0.41	0.06

Overall Skill Score

Skill Score	Value
Proportion Correct	0.827
Kuiper Skill Score	0.488
Heidke Skill Score	0.264

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.89	0.85	0.02
Frequency Bias	6.40	1.42	0.88
Probability of Detection	0.72	0.21	0.86
False Alarm Rate	0.53	0.38	0.09

Overall Skill Score

Skill Score	Value
Proportion Correct	0.821
Kuiper Skill Score	0.441
Heidke Skill Score	0.251

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.90	0.87	0.02
Frequency Bias	7.86	1.55	0.87
Probability of Detection	0.75	0.20	0.86
False Alarm Rate	0.54	0.38	0.08

Overall Skill Score

Skill Score	Value
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Proportion Correct	0.820
Kuiper Skill Score	0.440
Heidke Skill Score	0.231

INSAT-3D Sounder vs MODIS for July , 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	1607	482	5932
Sounder Uncertain	478	251	5283
Sounder Cloudy	106	144	48553

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1233	1182	5606
Sounder Uncertain	270	698	5044
Sounder Cloudy	56	252	48495

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1156	1112	5753
Sounder Uncertain	236	640	5136
Sounder Cloudy	42	210	48551

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	2.56	0.77	9.44
Sounder Uncertain	0.76	0.40	8.41
Sounder Cloudy	0.17	0.23	77.27

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1.96	1.88	8.92
Sounder Uncertain	0.43	1.11	8.03
Sounder Cloudy	0.09	0.40	77.18

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1.84	1.77	9.16
Sounder Uncertain	0.38	1.02	8.17
Sounder Cloudy	0.07	0.33	77.27

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.80	0.96	0.01
Frequency Bias	3.66	6.86	0.82
Probability of Detection	0.73	0.29	0.81
False Alarm Rate	0.52	0.46	0.02

Overall Skill Score

Skill Score	Value
Proportion Correct	0.802
Kuiper Skill Score	0.615
Heidke Skill Score	0.226

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
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False Alarm Ratio	0.85	0.88	0.01
Frequency Bias	5.14	2.82	0.83
Probability of Detection	0.79	0.33	0.82
False Alarm Rate	0.55	0.43	0.02

Overall Skill Score

Skill Score	Value
Proportion Correct	0.803
Kuiper Skill Score	0.579
Heidke Skill Score	0.248

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.86	0.89	0.01
Frequency Bias	5.59	3.06	0.82
Probability of Detection	0.81	0.33	0.82
False Alarm Rate	0.55	0.43	0.02

Overall Skill Score

Skill Score	Value
Proportion Correct	0.801
Kuiper Skill Score	0.585
Heidke Skill Score	0.234

INSAT-3D Sounder vs MODIS for July , 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	456	323	5313
Sounder Uncertain	119	102	4036
Sounder Cloudy	309	639	82396

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	263	690	5139
Sounder Uncertain	62	203	3992
Sounder Cloudy	157	1010	82177

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	189	662	5241
Sounder Uncertain	49	186	4022
Sounder Cloudy	98	892	82354

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.49	0.34	5.67
Sounder Uncertain	0.13	0.11	4.31
Sounder Cloudy	0.33	0.68	87.94

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.28	0.74	5.48
Sounder Uncertain	0.07	0.22	4.26
Sounder Cloudy	0.17	1.08	87.71

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.20	0.71	5.59

Sounder Uncertain	0.05	0.20	4.29
Sounder Cloudy	0.10	0.95	87.90

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.93	0.98	0.01
Frequency Bias	6.89	4.00	0.91
Probability of Detection	0.52	0.10	0.90
False Alarm Rate	0.52	0.39	0.09

Overall Skill Score

Skill Score	Value
Proportion Correct	0.885
Kuiper Skill Score	0.323
Heidke Skill Score	0.103

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.96	0.95	0.01
Frequency Bias	12.64	2.24	0.91
Probability of Detection	0.55	0.11	0.90
False Alarm Rate	0.53	0.37	0.11

Overall Skill Score

Skill Score	Value
Proportion Correct	0.882
Kuiper Skill Score	0.279
Heidke Skill Score	0.105

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.97	0.96	0.01

Frequency Bias	18.13	2.45	0.91
Probability of Detection	0.56	0.11	0.90
False Alarm Rate	0.54	0.37	0.09

Overall Skill Score

Skill Score	Value
Proportion Correct	0.883
Kuiper Skill Score	0.278
Heidke Skill Score	0.093

INSAT-3D Sounder vs MODIS for July , 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	438	92	1629
Sounder Uncertain	113	38	1387
Sounder Cloudy	303	540	53720

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	253	410	1496
Sounder Uncertain	59	134	1345
Sounder Cloudy	156	914	53493

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	182	433	1544

Sounder Uncertain	46	125	1367
Sounder Cloudy	98	823	53642

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.75	0.16	2.80
Sounder Uncertain	0.19	0.07	2.38
Sounder Cloudy	0.52	0.93	92.21

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.43	0.70	2.57
Sounder Uncertain	0.10	0.23	2.31
Sounder Cloudy	0.27	1.57	91.82

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.31	0.74	2.65
Sounder Uncertain	0.08	0.21	2.35
Sounder Cloudy	0.17	1.41	92.07

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.80	0.98	0.02
Frequency Bias	2.53	2.30	0.96
Probability of Detection	0.51	0.06	0.95
False Alarm Rate	0.42	0.37	0.21

Overall Skill Score

Skill Score	Value
Proportion Correct	0.930
Kuiper Skill Score	0.338
Heidke Skill Score	0.199

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.88	0.91	0.02
Frequency Bias	4.61	1.05	0.97
Probability of Detection	0.54	0.09	0.95
False Alarm Rate	0.44	0.32	0.24

Overall Skill Score

Skill Score	Value
Proportion Correct	0.925
Kuiper Skill Score	0.284
Heidke Skill Score	0.196

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.92	0.92	0.02
Frequency Bias	6.62	1.11	0.96
Probability of Detection	0.56	0.09	0.95
False Alarm Rate	0.46	0.33	0.21

Overall Skill Score

Skill Score	Value
Proportion Correct	0.926
Kuiper Skill Score	0.281
Heidke Skill Score	0.178

INSAT-3D Sounder vs MODIS for July , 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	18	231	3684
Sounder Uncertain	6	64	2649
Sounder Cloudy	6	99	28676

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	10	280	3643
Sounder Uncertain	3	69	2647
Sounder Cloudy	1	96	28684

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	7	229	3697
Sounder Uncertain	3	61	2655
Sounder Cloudy	0	69	28712

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.05	0.65	10.40
Sounder Uncertain	0.02	0.18	7.48
Sounder Cloudy	0.02	0.28	80.93

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.03	0.79	10.28
Sounder Uncertain	0.01	0.19	7.47
Sounder Cloudy	0.00	0.27	80.95

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.02	0.65	10.43
Sounder Uncertain	0.01	0.17	7.49
Sounder Cloudy	0.00	0.19	81.03

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	1.00	0.98	0.00
Frequency Bias	131.10	6.90	0.82
Probability of Detection	0.60	0.16	0.82
False Alarm Rate	0.59	0.40	0.02

Overall Skill Score

Skill Score	Value
Proportion Correct	0.812
Kuiper Skill Score	0.343
Heidke Skill Score	0.041

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	1.00	0.97	0.00
Frequency Bias	280.93	6.11	0.82
Probability of Detection	0.71	0.16	0.82
False Alarm Rate	0.59	0.40	0.01

Overall Skill Score

Skill Score	Value
Proportion Correct	0.812
Kuiper Skill Score	0.352
Heidke Skill Score	0.046

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	1.00	0.98	0.00
Frequency Bias	393.30	7.57	0.82
Probability of Detection	0.70	0.17	0.82
False Alarm Rate	0.59	0.40	0.01

Overall Skill Score

Skill Score	Value
Proportion Correct	0.812
Kuiper Skill Score	0.370
Heidke Skill Score	0.039

INSAT-3D Sounder vs MODIS for July , 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	2644	2564	6178
Sounder Uncertain	722	813	6707
Sounder Cloudy	125	77	39440

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	2107	3097	6182
Sounder Uncertain	391	1332	6519
Sounder Cloudy	70	204	39368

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1949	2908	6529
Sounder Uncertain	343	1207	6692
Sounder Cloudy	54	189	39399

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	4.46	4.33	10.42
Sounder Uncertain	1.22	1.37	11.32
Sounder Cloudy	0.21	0.13	66.54

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	3.55	5.23	10.43
Sounder Uncertain	0.66	2.25	11.00
Sounder Cloudy	0.12	0.34	66.42

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	3.29	4.91	11.02
Sounder Uncertain	0.58	2.04	11.29
Sounder Cloudy	0.09	0.32	66.47

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.77	0.90	0.01
Frequency Bias	3.26	2.39	0.76
Probability of Detection	0.76	0.24	0.75
False Alarm Rate	0.53	0.45	0.01

Overall Skill Score

Skill Score	Value
Proportion Correct	0.724
Kuiper Skill Score	0.533
Heidke Skill Score	0.292

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.81	0.84	0.01
Frequency Bias	4.43	1.78	0.76
Probability of Detection	0.82	0.29	0.76
False Alarm Rate	0.56	0.42	0.02

Overall Skill Score

Skill Score	Value
Proportion Correct	0.722
Kuiper Skill Score	0.524
Heidke Skill Score	0.294

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.83	0.85	0.01
Frequency Bias	4.85	1.91	0.75
Probability of Detection	0.83	0.28	0.75
False Alarm Rate	0.56	0.42	0.01

Overall Skill Score

Skill Score	Value
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Proportion Correct	0.718
Kuiper Skill Score	0.520
Heidke Skill Score	0.274

INSAT-3D Sounder vs MODIS for July , 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	1083	2513	4628
Sounder Uncertain	276	789	4898
Sounder Cloudy	33	66	22440

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	901	2450	4873
Sounder Uncertain	138	919	4906
Sounder Cloudy	21	90	22428

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	810	2245	5169
Sounder Uncertain	116	812	5035
Sounder Cloudy	16	83	22440

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	2.95	6.84	12.60
Sounder Uncertain	0.75	2.15	13.34
Sounder Cloudy	0.09	0.18	61.10

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	2.45	6.67	13.27
Sounder Uncertain	0.38	2.50	13.36
Sounder Cloudy	0.06	0.25	61.07

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	2.21	6.11	14.07
Sounder Uncertain	0.32	2.21	13.71
Sounder Cloudy	0.04	0.23	61.10

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.87	0.87	0.00
Frequency Bias	5.91	1.77	0.71
Probability of Detection	0.78	0.23	0.70
False Alarm Rate	0.58	0.42	0.01

Overall Skill Score

Skill Score	Value
Proportion Correct	0.662
Kuiper Skill Score	0.449
Heidke Skill Score	0.236

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
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False Alarm Ratio	0.89	0.85	0.00
Frequency Bias	7.76	1.72	0.70
Probability of Detection	0.85	0.27	0.70
False Alarm Rate	0.59	0.40	0.01

Overall Skill Score

Skill Score	Value
Proportion Correct	0.660
Kuiper Skill Score	0.453
Heidke Skill Score	0.228

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.90	0.86	0.00
Frequency Bias	8.73	1.90	0.69
Probability of Detection	0.86	0.26	0.69
False Alarm Rate	0.59	0.41	0.01

Overall Skill Score

Skill Score	Value
Proportion Correct	0.655
Kuiper Skill Score	0.446
Heidke Skill Score	0.207

INSAT-3D Sounder vs MODIS for July , 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	1561	51	1550
Sounder Uncertain	446	24	1809
Sounder Cloudy	92	11	17000

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1206	647	1309
Sounder Uncertain	253	413	1613
Sounder Cloudy	49	114	16940

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1139	663	1360
Sounder Uncertain	227	395	1657
Sounder Cloudy	38	106	16959

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	6.92	0.23	6.88
Sounder Uncertain	1.98	0.11	8.02
Sounder Cloudy	0.41	0.05	75.41

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	5.35	2.87	5.81
Sounder Uncertain	1.12	1.83	7.15
Sounder Cloudy	0.22	0.51	75.14

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	5.05	2.94	6.03

Sounder Uncertain	1.01	1.75	7.35
Sounder Cloudy	0.17	0.47	75.23

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.51	0.99	0.01
Frequency Bias	1.51	26.50	0.84
Probability of Detection	0.74	0.28	0.84
False Alarm Rate	0.40	0.57	0.03

Overall Skill Score

Skill Score	Value
Proportion Correct	0.824
Kuiper Skill Score	0.716
Heidke Skill Score	0.417

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.62	0.82	0.01
Frequency Bias	2.10	1.94	0.86
Probability of Detection	0.80	0.35	0.85
False Alarm Rate	0.49	0.47	0.04

Overall Skill Score

Skill Score	Value
Proportion Correct	0.823
Kuiper Skill Score	0.647
Heidke Skill Score	0.442

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.64	0.83	0.01

Frequency Bias	2.25	1.96	0.86
Probability of Detection	0.81	0.34	0.85
False Alarm Rate	0.50	0.47	0.04

Overall Skill Score

Skill Score	Value
Proportion Correct	0.820
Kuiper Skill Score	0.644
Heidke Skill Score	0.427

INSAT-3D Sounder vs MODIS for July , 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	23	20	92
Sounder Uncertain	5	3	91
Sounder Cloudy	2	0	755

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	13	44	78
Sounder Uncertain	2	12	85
Sounder Cloudy	2	2	753

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	7	43	85

Sounder Uncertain	2	11	86
Sounder Cloudy	1	2	754

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	2.32	2.02	9.28
Sounder Uncertain	0.50	0.30	9.18
Sounder Cloudy	0.20	0.00	76.19

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1.31	4.44	7.87
Sounder Uncertain	0.20	1.21	8.58
Sounder Cloudy	0.20	0.20	75.98

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.71	4.34	8.58
Sounder Uncertain	0.20	1.11	8.68
Sounder Cloudy	0.10	0.20	76.08

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.83	0.97	0.00
Frequency Bias	4.50	4.30	0.81
Probability of Detection	0.77	0.13	0.80
False Alarm Rate	0.53	0.46	0.01

Overall Skill Score

Skill Score	Value
Proportion Correct	0.788
Kuiper Skill Score	0.571
Heidke Skill Score	0.217

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.90	0.88	0.01
Frequency Bias	7.94	1.71	0.83
Probability of Detection	0.76	0.21	0.82
False Alarm Rate	0.57	0.41	0.02

Overall Skill Score

Skill Score	Value
Proportion Correct	0.785
Kuiper Skill Score	0.499
Heidke Skill Score	0.248

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.95	0.89	0.00
Frequency Bias	13.50	1.77	0.82
Probability of Detection	0.70	0.20	0.82
False Alarm Rate	0.58	0.40	0.01

Overall Skill Score

Skill Score	Value
Proportion Correct	0.779
Kuiper Skill Score	0.470
Heidke Skill Score	0.211

INSAT-3D Sounder vs MODIS for July , 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	21	20	52
Sounder Uncertain	5	3	75
Sounder Cloudy	2	0	540

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	11	41	41
Sounder Uncertain	2	11	70
Sounder Cloudy	2	2	538

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	5	43	45
Sounder Uncertain	2	11	70
Sounder Cloudy	1	2	539

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	2.79	7.24
Sounder Uncertain	0.70	0.42	10.45
Sounder Cloudy	0.28	0.00	75.21

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1.53	5.71	5.71
Sounder Uncertain	0.28	1.53	9.75
Sounder Cloudy	0.28	0.28	74.93

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.70	5.99	6.27
Sounder Uncertain	0.28	1.53	9.75
Sounder Cloudy	0.14	0.28	75.07

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.77	0.96	0.00
Frequency Bias	3.32	3.61	0.81
Probability of Detection	0.75	0.13	0.81
False Alarm Rate	0.47	0.52	0.01

Overall Skill Score

Skill Score	Value
Proportion Correct	0.786
Kuiper Skill Score	0.562
Heidke Skill Score	0.260

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.88	0.87	0.01
Frequency Bias	6.20	1.54	0.84
Probability of Detection	0.73	0.20	0.83
False Alarm Rate	0.52	0.46	0.03

Overall Skill Score

Skill Score	Value
Proportion Correct	0.780
Kuiper Skill Score	0.487
Heidke Skill Score	0.281

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.95	0.87	0.01
Frequency Bias	11.62	1.48	0.83
Probability of Detection	0.62	0.20	0.82
False Alarm Rate	0.54	0.44	0.02

Overall Skill Score

Skill Score	Value
Proportion Correct	0.773
Kuiper Skill Score	0.457
Heidke Skill Score	0.248

INSAT-3D Sounder vs MODIS for July , 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	2	0	40
Sounder Uncertain	0	0	16
Sounder Cloudy	0	0	215

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	2	3	37
Sounder Uncertain	0	1	15
Sounder Cloudy	0	0	215

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	2	0	40
Sounder Uncertain	0	0	16
Sounder Cloudy	0	0	215

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.73	0.00	14.65
Sounder Uncertain	0.00	0.00	5.86
Sounder Cloudy	0.00	0.00	78.75

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.73	1.10	13.55
Sounder Uncertain	0.00	0.37	5.49
Sounder Cloudy	0.00	0.00	78.75

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.73	0.00	14.65
Sounder Uncertain	0.00	0.00	5.86
Sounder Cloudy	0.00	0.00	78.75

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.95	1.00	0.00
Frequency Bias	21.00	inf	0.79
Probability of Detection	1.00	nan	0.79
False Alarm Rate	0.71	0.29	0.00

Overall Skill Score

Skill Score	Value
Proportion Correct	0.795
Kuiper Skill Score	0.823
Heidke Skill Score	0.055

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.95	0.94	0.00
Frequency Bias	21.00	4.00	0.81
Probability of Detection	1.00	0.25	0.81
False Alarm Rate	0.73	0.27	0.00

Overall Skill Score

Skill Score	Value
Proportion Correct	0.799
Kuiper Skill Score	0.609
Heidke Skill Score	0.116

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.95	1.00	0.00
Frequency Bias	21.00	inf	0.79
Probability of Detection	1.00	nan	0.79
False Alarm Rate	0.71	0.29	0.00

Overall Skill Score

Skill Score	Value
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Proportion Correct	0.795
Kuiper Skill Score	0.823
Heidke Skill Score	0.055

INSAT-3D Sounder vs MODIS for July , 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	36	197	547
Sounder Uncertain	97	164	852
Sounder Cloudy	162	45	3867

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	19	263	498
Sounder Uncertain	55	276	782
Sounder Cloudy	49	407	3618

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	11	231	538
Sounder Uncertain	34	255	824
Sounder Cloudy	32	353	3689

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.60	3.30	9.17
Sounder Uncertain	1.63	2.75	14.28
Sounder Cloudy	2.71	0.75	64.81

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.32	4.41	8.35
Sounder Uncertain	0.92	4.63	13.11
Sounder Cloudy	0.82	6.82	60.63

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.18	3.87	9.02
Sounder Uncertain	0.57	4.27	13.81
Sounder Cloudy	0.54	5.92	61.82

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.95	0.85	0.05
Frequency Bias	2.64	2.74	0.77
Probability of Detection	0.12	0.40	0.73
False Alarm Rate	0.39	0.50	0.11

Overall Skill Score

Skill Score	Value
Proportion Correct	0.682
Kuiper Skill Score	0.280
Heidke Skill Score	0.158

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
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False Alarm Ratio	0.98	0.75	0.11
Frequency Bias	6.34	1.18	0.83
Probability of Detection	0.15	0.29	0.74
False Alarm Rate	0.37	0.41	0.22

Overall Skill Score

Skill Score	Value
Proportion Correct	0.656
Kuiper Skill Score	0.210
Heidke Skill Score	0.155

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.99	0.77	0.09
Frequency Bias	10.13	1.33	0.81
Probability of Detection	0.14	0.30	0.73
False Alarm Rate	0.38	0.43	0.19

Overall Skill Score

Skill Score	Value
Proportion Correct	0.663
Kuiper Skill Score	0.216
Heidke Skill Score	0.145

INSAT-3D Sounder vs MODIS for July , 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	20	1	43
Sounder Uncertain	71	2	147
Sounder Cloudy	154	11	2423

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	12	19	33
Sounder Uncertain	41	65	114
Sounder Cloudy	43	365	2180

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	11	19	34
Sounder Uncertain	28	72	120
Sounder Cloudy	28	318	2242

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.70	0.03	1.50
Sounder Uncertain	2.47	0.07	5.12
Sounder Cloudy	5.36	0.38	84.37

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.42	0.66	1.15
Sounder Uncertain	1.43	2.26	3.97
Sounder Cloudy	1.50	12.71	75.91

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.38	0.66	1.18

Sounder Uncertain	0.97	2.51	4.18
Sounder Cloudy	0.97	11.07	78.06

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.69	0.99	0.06
Frequency Bias	0.26	15.71	0.99
Probability of Detection	0.08	0.14	0.93
False Alarm Rate	0.10	0.51	0.39

Overall Skill Score

Skill Score	Value
Proportion Correct	0.851
Kuiper Skill Score	0.177
Heidke Skill Score	0.164

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.81	0.70	0.16
Frequency Bias	0.67	0.49	1.11
Probability of Detection	0.12	0.14	0.94
False Alarm Rate	0.08	0.25	0.66

Overall Skill Score

Skill Score	Value
Proportion Correct	0.786
Kuiper Skill Score	0.135
Heidke Skill Score	0.167

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.83	0.67	0.13

Frequency Bias	0.96	0.54	1.08
Probability of Detection	0.16	0.18	0.94
False Alarm Rate	0.10	0.27	0.63

Overall Skill Score

Skill Score	Value
Proportion Correct	0.810
Kuiper Skill Score	0.164
Heidke Skill Score	0.196

INSAT-3D Sounder vs MODIS for July , 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	16	196	504
Sounder Uncertain	26	162	705
Sounder Cloudy	8	34	1444

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	7	244	465
Sounder Uncertain	14	211	668
Sounder Cloudy	6	42	1438

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0	212	504

Sounder Uncertain	6	183	704
Sounder Cloudy	4	35	1447

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.52	6.33	16.28
Sounder Uncertain	0.84	5.23	22.78
Sounder Cloudy	0.26	1.10	46.66

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.23	7.88	15.02
Sounder Uncertain	0.45	6.82	21.58
Sounder Cloudy	0.19	1.36	46.46

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	0.00	6.85	16.28
Sounder Uncertain	0.19	5.91	22.75
Sounder Cloudy	0.13	1.13	46.75

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.98	0.82	0.03
Frequency Bias	14.32	2.28	0.56
Probability of Detection	0.32	0.41	0.54
False Alarm Rate	0.48	0.50	0.03

Overall Skill Score

Skill Score	Value
Proportion Correct	0.524
Kuiper Skill Score	0.290
Heidke Skill Score	0.132

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.99	0.76	0.03
Frequency Bias	26.52	1.80	0.58
Probability of Detection	0.26	0.42	0.56
False Alarm Rate	0.49	0.47	0.03

Overall Skill Score

Skill Score	Value
Proportion Correct	0.535
Kuiper Skill Score	0.309
Heidke Skill Score	0.159

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	1.00	0.80	0.03
Frequency Bias	71.60	2.08	0.56
Probability of Detection	0.00	0.43	0.55
False Alarm Rate	0.49	0.48	0.03

Overall Skill Score

Skill Score	Value
Proportion Correct	0.527
Kuiper Skill Score	0.302
Heidke Skill Score	0.135