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 January , 2019 (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	68170	12742	14103
Sounder Uncertain	12125	1993	12007
Sounder Cloudy	5991	566	18565

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	63915	20981	10119
Sounder Uncertain	9631	6787	9707
Sounder Cloudy	4541	3440	17141

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	58293	24949	11773
Sounder Uncertain	8250	7363	10512
Sounder Cloudy	4016	3513	17593

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	46.61	8.71	9.64
Sounder Uncertain	8.29	1.36	8.21
Sounder Cloudy	4.10	0.39	12.69

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	43.70	14.34	6.92
Sounder Uncertain	6.58	4.64	6.64
Sounder Cloudy	3.10	2.35	11.72

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	39.86	17.06	8.05
Sounder Uncertain	5.64	5.03	7.19
Sounder Cloudy	2.75	2.40	12.03

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.28	0.92	0.26
Frequency Bias	1.10	1.71	0.56
Probability of Detection	0.79	0.13	0.42
False Alarm Rate	0.47	0.42	0.11

Overall Skill Score

Skill Score	Value
Proportion Correct	0.607
Kuiper Skill Score	0.278
Heidke Skill Score	0.279

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.33	0.74	0.32
Frequency Bias	1.22	0.84	0.68
Probability of Detection	0.82	0.22	0.46
False Alarm Rate	0.53	0.33	0.14

Overall Skill Score

Skill Score	Value
Proportion Correct	0.601
Kuiper Skill Score	0.284
Heidke Skill Score	0.301

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.39	0.72	0.30
Frequency Bias	1.35	0.73	0.63
Probability of Detection	0.83	0.21	0.44
False Alarm Rate	0.58	0.30	0.12

Overall Skill Score

Skill Score	Value
Proportion Correct	0.569
Kuiper Skill Score	0.261
Heidke Skill Score	0.277

INSAT-3D Sounder vs MODIS for January , 2019 (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	34813	8103	6560
Sounder Uncertain	7778	1244	5705
Sounder Cloudy	2814	367	15608

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	32652	12354	4470
Sounder Uncertain	6153	4165	4409
Sounder Cloudy	1692	2623	14474

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	28283	15831	5362
Sounder Uncertain	5157	4743	4827
Sounder Cloudy	1356	2597	14836

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	41.95	9.76	7.90
Sounder Uncertain	9.37	1.50	6.87
Sounder Cloudy	3.39	0.44	18.81

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	39.34	14.89	5.39
Sounder Uncertain	7.41	5.02	5.31
Sounder Cloudy	2.04	3.16	17.44

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	34.08	19.08	6.46
Sounder Uncertain	6.21	5.72	5.82
Sounder Cloudy	1.63	3.13	17.88

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.30	0.92	0.17
Frequency Bias	1.09	1.52	0.67
Probability of Detection	0.77	0.13	0.56
False Alarm Rate	0.47	0.43	0.10

Overall Skill Score

Skill Score	Value
Proportion Correct	0.623
Kuiper Skill Score	0.348
Heidke Skill Score	0.346

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.34	0.72	0.23
Frequency Bias	1.22	0.77	0.80
Probability of Detection	0.81	0.22	0.62
False Alarm Rate	0.53	0.33	0.14

Overall Skill Score

Skill Score	Value
Proportion Correct	0.618
Kuiper Skill Score	0.353
Heidke Skill Score	0.368

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.43	0.68	0.21
Frequency Bias	1.42	0.64	0.75
Probability of Detection	0.81	0.20	0.59
False Alarm Rate	0.60	0.28	0.11

Overall Skill Score

Skill Score	Value

Proportion Correct	0.577
Kuiper Skill Score	0.319
Heidke Skill Score	0.330

INSAT-3D Sounder vs MODIS for January , 2019 (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	33357	4639	7543
Sounder Uncertain	4347	749	6302
Sounder Cloudy	3177	199	2957

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	31263	8627	5649
Sounder Uncertain	3478	2622	5298
Sounder Cloudy	2849	817	2667

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	30010	9118	6411
Sounder Uncertain	3093	2620	5685
Sounder Cloudy	2660	916	2757

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

8

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	52.72	7.33	11.92
Sounder Uncertain	6.87	1.18	9.96
Sounder Cloudy	5.02	0.31	4.67

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	49.41	13.64	8.93
Sounder Uncertain	5.50	4.14	8.37
Sounder Cloudy	4.50	1.29	4.22

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	47.43	14.41	10.13
Sounder Uncertain	4.89	4.14	8.99
Sounder Cloudy	4.20	1.45	4.36

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.27	0.93	0.53
Frequency Bias	1.11	2.04	0.38
Probability of Detection	0.82	0.13	0.18
False Alarm Rate	0.46	0.41	0.13

Overall Skill Score

Skill Score	Value
Proportion Correct	0.586
Kuiper Skill Score	0.155
Heidke Skill Score	0.159

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy

Skill Score			
False Alarm Ratio	0.31	0.77	0.58
Frequency Bias	1.21	0.94	0.47
Probability of Detection	0.83	0.22	0.20
False Alarm Rate	0.53	0.33	0.14

Overall Skill Score

Skill Score	Value
Proportion Correct	0.578
Kuiper Skill Score	0.167
Heidke Skill Score	0.182

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.34	0.77	0.56
Frequency Bias	1.27	0.90	0.43
Probability of Detection	0.84	0.21	0.19
False Alarm Rate	0.56	0.31	0.13

Overall Skill Score

Skill Score	Value
Proportion Correct	0.559
Kuiper Skill Score	0.159
Heidke Skill Score	0.174

INSAT-3D Sounder vs MODIS for January , 2019 (All times (day and night)) on Land

1. Confusion matrix of Total number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy

Sounder Clear	53314	6431	8553
Sounder Uncertain	7224	1183	6438
Sounder Cloudy	1845	163	10342

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	50258	12181	5859
Sounder Uncertain	5981	3498	5366
Sounder Cloudy	1624	645	10081

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	45432	16033	6833
Sounder Uncertain	5078	4032	5735
Sounder Cloudy	1517	644	10189

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	55.83	6.73	8.96
Sounder Uncertain	7.56	1.24	6.74
Sounder Cloudy	1.93	0.17	10.83

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	52.63	12.76	6.14
Sounder Uncertain	6.26	3.66	5.62
Sounder Cloudy	1.70	0.68	10.56

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	47.58	16.79	7.16

Sounder Uncertain	5.32	4.22	6.01
Sounder Cloudy	1.59	0.67	10.67

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.22	0.92	0.16
Frequency Bias	1.09	1.91	0.49
Probability of Detection	0.85	0.15	0.41
False Alarm Rate	0.49	0.45	0.07

Overall Skill Score

Skill Score	Value
Proportion Correct	0.679
Kuiper Skill Score	0.332
Heidke Skill Score	0.339

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.26	0.76	0.18
Frequency Bias	1.18	0.91	0.58
Probability of Detection	0.87	0.21	0.47
False Alarm Rate	0.57	0.36	0.07

Overall Skill Score

Skill Score	Value
Proportion Correct	0.668
Kuiper Skill Score	0.324
Heidke Skill Score	0.352

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.33	0.73	0.17

Frequency Bias	1.31	0.72	0.54
Probability of Detection	0.87	0.19	0.45
False Alarm Rate	0.64	0.30	0.06

Overall Skill Score

Skill Score	Value
Proportion Correct	0.625
Kuiper Skill Score	0.284
Heidke Skill Score	0.312

INSAT-3D Sounder vs MODIS for January , 2019 (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	24517	5766	5098
Sounder Uncertain	4951	1030	3368
Sounder Cloudy	432	107	8592

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	22885	9165	3331
Sounder Uncertain	4135	2574	2640
Sounder Cloudy	285	464	8382

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	18934	12369	4078

Sounder Uncertain	3407	3036	2906
Sounder Cloudy	233	423	8475

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	45.52	10.71	9.47
Sounder Uncertain	9.19	1.91	6.25
Sounder Cloudy	0.80	0.20	15.95

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	42.49	17.02	6.18
Sounder Uncertain	7.68	4.78	4.90
Sounder Cloudy	0.53	0.86	15.56

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	35.15	22.96	7.57
Sounder Uncertain	6.33	5.64	5.40
Sounder Cloudy	0.43	0.79	15.73

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.31	0.89	0.06
Frequency Bias	1.18	1.35	0.54
Probability of Detection	0.82	0.15	0.50
False Alarm Rate	0.55	0.42	0.03

Overall Skill Score

Skill Score	Value
Proportion Correct	0.634
Kuiper Skill Score	0.336
Heidke Skill Score	0.345

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.35	0.72	0.08
Frequency Bias	1.30	0.77	0.64
Probability of Detection	0.84	0.21	0.58
False Alarm Rate	0.62	0.34	0.04

Overall Skill Score

Skill Score	Value
Proportion Correct	0.628
Kuiper Skill Score	0.340
Heidke Skill Score	0.362

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.46	0.68	0.07
Frequency Bias	1.57	0.59	0.59
Probability of Detection	0.84	0.19	0.55
False Alarm Rate	0.70	0.27	0.03

Overall Skill Score

Skill Score	Value
Proportion Correct	0.565
Kuiper Skill Score	0.290
Heidke Skill Score	0.304

INSAT-3D Sounder vs MODIS for January , 2019 (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	28797	665	3455
Sounder Uncertain	2273	153	3070
Sounder Cloudy	1413	56	1750

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	27373	3016	2528
Sounder Uncertain	1846	924	2726
Sounder Cloudy	1339	181	1699

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	26498	3664	2755
Sounder Uncertain	1671	996	2829
Sounder Cloudy	1284	221	1714

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	69.17	1.60	8.30
Sounder Uncertain	5.46	0.37	7.37
Sounder Cloudy	3.39	0.13	4.20

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	65.75	7.24	6.07
Sounder Uncertain	4.43	2.22	6.55
Sounder Cloudy	3.22	0.43	4.08

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	63.65	8.80	6.62
Sounder Uncertain	4.01	2.39	6.80
Sounder Cloudy	3.08	0.53	4.12

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.13	0.97	0.46
Frequency Bias	1.01	6.29	0.39
Probability of Detection	0.89	0.18	0.21
False Alarm Rate	0.38	0.49	0.13

Overall Skill Score

Skill Score	Value
Proportion Correct	0.737
Kuiper Skill Score	0.291
Heidke Skill Score	0.280

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.17	0.83	0.47
Frequency Bias	1.08	1.33	0.46
Probability of Detection	0.90	0.22	0.24
False Alarm Rate	0.48	0.39	0.13

Overall Skill Score

Skill Score	Value
Proportion Correct	0.721
Kuiper Skill Score	0.270
Heidke Skill Score	0.290

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.20	0.82	0.47
Frequency Bias	1.12	1.13	0.44
Probability of Detection	0.90	0.20	0.23
False Alarm Rate	0.52	0.36	0.12

Overall Skill Score

Skill Score	Value
Proportion Correct	0.702
Kuiper Skill Score	0.249
Heidke Skill Score	0.275

INSAT-3D Sounder vs MODIS for January , 2019 (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	9372	4709	974
Sounder Uncertain	496	235	421
Sounder Cloudy	79	31	312

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	9114	5073	868
Sounder Uncertain	431	337	384
Sounder Cloudy	75	45	302

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	8784	5260	1011
Sounder Uncertain	411	334	407
Sounder Cloudy	74	45	303

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	56.36	28.32	5.86
Sounder Uncertain	2.98	1.41	2.53
Sounder Cloudy	0.48	0.19	1.88

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	54.81	30.51	5.22
Sounder Uncertain	2.59	2.03	2.31
Sounder Cloudy	0.45	0.27	1.82

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	52.82	31.63	6.08
Sounder Uncertain	2.47	2.01	2.45
Sounder Cloudy	0.45	0.27	1.82

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.38	0.80	0.26
Frequency Bias	1.51	0.23	0.25
Probability of Detection	0.94	0.05	0.18
False Alarm Rate	0.85	0.14	0.02

Overall Skill Score

Skill Score	Value
Proportion Correct	0.596
Kuiper Skill Score	0.058
Heidke Skill Score	0.073

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.39	0.71	0.28
Frequency Bias	1.56	0.21	0.27
Probability of Detection	0.95	0.06	0.19
False Alarm Rate	0.86	0.12	0.02

Overall Skill Score

Skill Score	Value
Proportion Correct	0.587
Kuiper Skill Score	0.069
Heidke Skill Score	0.083

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.42	0.71	0.28
Frequency Bias	1.62	0.20	0.25
Probability of Detection	0.95	0.06	0.18
False Alarm Rate	0.87	0.11	0.02

Overall Skill Score

Skill Score	Value

Proportion Correct	0.567
Kuiper Skill Score	0.063
Heidke Skill Score	0.076

INSAT-3D Sounder vs MODIS for January , 2019 (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	7640	2111	631
Sounder Uncertain	383	89	124
Sounder Cloudy	26	4	187

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	7507	2303	572
Sounder Uncertain	364	122	110
Sounder Cloudy	24	12	181

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	7291	2465	626
Sounder Uncertain	351	131	114
Sounder Cloudy	24	12	181

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	68.24	18.86	5.64
Sounder Uncertain	3.42	0.79	1.11
Sounder Cloudy	0.23	0.04	1.67

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	67.06	20.57	5.11
Sounder Uncertain	3.25	1.09	0.98
Sounder Cloudy	0.21	0.11	1.62

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	65.13	22.02	5.59
Sounder Uncertain	3.14	1.17	1.02
Sounder Cloudy	0.21	0.11	1.62

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.26	0.85	0.14
Frequency Bias	1.29	0.27	0.23
Probability of Detection	0.95	0.04	0.20
False Alarm Rate	0.84	0.15	0.01

Overall Skill Score

Skill Score	Value
Proportion Correct	0.707
Kuiper Skill Score	0.065
Heidke Skill Score	0.088

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy

False Alarm Ratio	0.28	0.80	0.17
Frequency Bias	1.32	0.24	0.25
Probability of Detection	0.95	0.05	0.21
False Alarm Rate	0.85	0.14	0.01

Overall Skill Score

Skill Score	Value
Proportion Correct	0.698
Kuiper Skill Score	0.068
Heidke Skill Score	0.092

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.30	0.78	0.17
Frequency Bias	1.35	0.23	0.24
Probability of Detection	0.95	0.05	0.20
False Alarm Rate	0.86	0.13	0.01

Overall Skill Score

Skill Score	Value
Proportion Correct	0.679
Kuiper Skill Score	0.064
Heidke Skill Score	0.086

INSAT-3D Sounder vs MODIS for January , 2019 (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

MODIS/Sounder			
Sounder Clear	1732	2598	343
Sounder Uncertain	113	146	297
Sounder Cloudy	53	27	125

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1607	2770	296
Sounder Uncertain	67	215	274
Sounder Cloudy	51	33	121

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1493	2795	385
Sounder Uncertain	60	203	293
Sounder Cloudy	50	33	122

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	31.87	47.81	6.31
Sounder Uncertain	2.08	2.69	5.47
Sounder Cloudy	0.98	0.50	2.30

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	29.57	50.98	5.45
Sounder Uncertain	1.23	3.96	5.04
Sounder Cloudy	0.94	0.61	2.23

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	27.48	51.44	7.09

Sounder Uncertain	1.10	3.74	5.39
Sounder Cloudy	0.92	0.61	2.25

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.63	0.74	0.39
Frequency Bias	2.46	0.20	0.27
Probability of Detection	0.91	0.05	0.16
False Alarm Rate	0.86	0.12	0.02

Overall Skill Score

Skill Score	Value
Proportion Correct	0.369
Kuiper Skill Score	0.018
Heidke Skill Score	0.017

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.66	0.61	0.41
Frequency Bias	2.71	0.18	0.30
Probability of Detection	0.93	0.07	0.18
False Alarm Rate	0.88	0.10	0.02

Overall Skill Score

Skill Score	Value
Proportion Correct	0.358
Kuiper Skill Score	0.040
Heidke Skill Score	0.034

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.68	0.63	0.40

Frequency Bias	2.92	0.18	0.26
Probability of Detection	0.93	0.07	0.15
False Alarm Rate	0.88	0.10	0.02

Overall Skill Score

Skill Score	Value
Proportion Correct	0.335
Kuiper Skill Score	0.031
Heidke Skill Score	0.027

INSAT-3D Sounder vs MODIS for January , 2019 (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	255	85	23
Sounder Uncertain	69	5	17
Sounder Cloudy	10	0	58

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	245	102	16
Sounder Uncertain	66	12	13
Sounder Cloudy	10	2	56

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	229	112	22

Sounder Uncertain	55	23	13
Sounder Cloudy	8	3	57

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	48.85	16.28	4.41
Sounder Uncertain	13.22	0.96	3.26
Sounder Cloudy	1.92	0.00	11.11

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	46.93	19.54	3.07
Sounder Uncertain	12.64	2.30	2.49
Sounder Cloudy	1.92	0.38	10.73

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	43.87	21.46	4.21
Sounder Uncertain	10.54	4.41	2.49
Sounder Cloudy	1.53	0.57	10.92

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.30	0.95	0.15
Frequency Bias	1.09	1.01	0.69
Probability of Detection	0.76	0.06	0.59
False Alarm Rate	0.53	0.42	0.05

Overall Skill Score

Skill Score	Value
Proportion Correct	0.609
Kuiper Skill Score	0.209
Heidke Skill Score	0.219

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.33	0.87	0.18
Frequency Bias	1.13	0.78	0.80
Probability of Detection	0.76	0.10	0.66
False Alarm Rate	0.56	0.38	0.06

Overall Skill Score

Skill Score	Value
Proportion Correct	0.600
Kuiper Skill Score	0.205
Heidke Skill Score	0.219

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.37	0.75	0.16
Frequency Bias	1.24	0.66	0.74
Probability of Detection	0.78	0.17	0.62
False Alarm Rate	0.63	0.32	0.05

Overall Skill Score

Skill Score	Value
Proportion Correct	0.592
Kuiper Skill Score	0.228
Heidke Skill Score	0.247

INSAT-3D Sounder vs MODIS for January , 2019 (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	201	30	13
Sounder Uncertain	59	4	6
Sounder Cloudy	7	0	31

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	197	40	7
Sounder Uncertain	58	7	4
Sounder Cloudy	7	2	29

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	183	50	11
Sounder Uncertain	48	17	4
Sounder Cloudy	5	3	30

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	57.26	8.55	3.70
Sounder Uncertain	16.81	1.14	1.71
Sounder Cloudy	1.99	0.00	8.83

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	56.13	11.40	1.99
Sounder Uncertain	16.52	1.99	1.14
Sounder Cloudy	1.99	0.57	8.26

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	52.14	14.25	3.13
Sounder Uncertain	13.68	4.84	1.14
Sounder Cloudy	1.42	0.85	8.55

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.18	0.94	0.18
Frequency Bias	0.91	2.03	0.76
Probability of Detection	0.75	0.12	0.62
False Alarm Rate	0.37	0.57	0.06

Overall Skill Score

Skill Score	Value
Proportion Correct	0.672
Kuiper Skill Score	0.279
Heidke Skill Score	0.250

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.19	0.90	0.24
Frequency Bias	0.93	1.41	0.95
Probability of Detection	0.75	0.14	0.72
False Alarm Rate	0.40	0.53	0.08

Overall Skill Score

Skill Score	Value
Proportion Correct	0.664
Kuiper Skill Score	0.256
Heidke Skill Score	0.238

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.25	0.75	0.21
Frequency Bias	1.03	0.99	0.84
Probability of Detection	0.78	0.24	0.67
False Alarm Rate	0.50	0.43	0.07

Overall Skill Score

Skill Score	Value
Proportion Correct	0.655
Kuiper Skill Score	0.274
Heidke Skill Score	0.281

INSAT-3D Sounder vs MODIS for January , 2019 (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	54	55	10
Sounder Uncertain	10	1	11
Sounder Cloudy	3	0	27

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	48	62	9
Sounder Uncertain	8	5	9
Sounder Cloudy	3	0	27

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	46	62	11
Sounder Uncertain	7	6	9
Sounder Cloudy	3	0	27

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	31.58	32.16	5.85
Sounder Uncertain	5.85	0.58	6.43
Sounder Cloudy	1.75	0.00	15.79

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	28.07	36.26	5.26
Sounder Uncertain	4.68	2.92	5.26
Sounder Cloudy	1.75	0.00	15.79

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	26.90	36.26	6.43
Sounder Uncertain	4.09	3.51	5.26
Sounder Cloudy	1.75	0.00	15.79

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.55	0.95	0.10
Frequency Bias	1.78	0.39	0.62
Probability of Detection	0.81	0.02	0.56
False Alarm Rate	0.73	0.24	0.03

Overall Skill Score

Skill Score	Value
Proportion Correct	0.480
Kuiper Skill Score	0.175
Heidke Skill Score	0.182

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.60	0.77	0.10
Frequency Bias	2.02	0.33	0.67
Probability of Detection	0.81	0.07	0.60
False Alarm Rate	0.78	0.19	0.03

Overall Skill Score

Skill Score	Value
Proportion Correct	0.468
Kuiper Skill Score	0.199
Heidke Skill Score	0.198

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.61	0.73	0.10
Frequency Bias	2.12	0.32	0.64
Probability of Detection	0.82	0.09	0.57
False Alarm Rate	0.79	0.17	0.03

Overall Skill Score

Skill Score	Value

Proportion Correct	0.462
Kuiper Skill Score	0.204
Heidke Skill Score	0.200

INSAT-3D Sounder vs MODIS for January , 2019 (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	3914	1143	4351
Sounder Uncertain	4093	524	4992
Sounder Cloudy	3991	364	7476

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	3055	3127	3226
Sounder Uncertain	2932	2837	3840
Sounder Cloudy	2780	2713	6338

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	2677	2998	3733
Sounder Uncertain	2509	2865	4235
Sounder Cloudy	2367	2789	6675

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	12.69	3.71	14.10
Sounder Uncertain	13.27	1.70	16.18
Sounder Cloudy	12.94	1.18	24.23

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	9.90	10.14	10.46
Sounder Uncertain	9.50	9.20	12.45
Sounder Cloudy	9.01	8.79	20.55

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	8.68	9.72	12.10
Sounder Uncertain	8.13	9.29	13.73
Sounder Cloudy	7.67	9.04	21.64

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.58	0.95	0.37
Frequency Bias	0.78	4.73	0.70
Probability of Detection	0.33	0.26	0.44
False Alarm Rate	0.29	0.48	0.23

Overall Skill Score

Skill Score	Value
Proportion Correct	0.386
Kuiper Skill Score	0.069
Heidke Skill Score	0.058

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy

False Alarm Ratio	0.68	0.70	0.46
Frequency Bias	1.07	1.11	0.88
Probability of Detection	0.35	0.33	0.47
False Alarm Rate	0.34	0.36	0.30

Overall Skill Score

Skill Score	Value
Proportion Correct	0.396
Kuiper Skill Score	0.085
Heidke Skill Score	0.084

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.72	0.70	0.44
Frequency Bias	1.25	1.11	0.81
Probability of Detection	0.35	0.33	0.46
False Alarm Rate	0.36	0.36	0.28

Overall Skill Score

Skill Score	Value
Proportion Correct	0.396
Kuiper Skill Score	0.082
Heidke Skill Score	0.079

INSAT-3D Sounder vs MODIS for January , 2019 (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	1496	60	715
Sounder Uncertain	2192	88	2144
Sounder Cloudy	2318	253	6577

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1150	633	488
Sounder Uncertain	1414	1404	1606
Sounder Cloudy	1357	2116	5675

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1022	688	561
Sounder Uncertain	1189	1486	1749
Sounder Cloudy	1077	2133	5938

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	9.44	0.38	4.51
Sounder Uncertain	13.84	0.56	13.53
Sounder Cloudy	14.63	1.60	41.51

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	7.26	4.00	3.08
Sounder Uncertain	8.93	8.86	10.14
Sounder Cloudy	8.57	13.36	35.82

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	6.45	4.34	3.54

Sounder Uncertain	7.50	9.38	11.04
Sounder Cloudy	6.80	13.46	37.48

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.34	0.98	0.28
Frequency Bias	0.38	11.03	0.97
Probability of Detection	0.25	0.22	0.70
False Alarm Rate	0.10	0.56	0.33

Overall Skill Score

Skill Score	Value
Proportion Correct	0.515
Kuiper Skill Score	0.219
Heidke Skill Score	0.185

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.49	0.68	0.38
Frequency Bias	0.58	1.07	1.18
Probability of Detection	0.29	0.34	0.73
False Alarm Rate	0.15	0.40	0.46

Overall Skill Score

Skill Score	Value
Proportion Correct	0.519
Kuiper Skill Score	0.203
Heidke Skill Score	0.210

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.55	0.66	0.35

Frequency Bias	0.69	1.03	1.11
Probability of Detection	0.31	0.35	0.72
False Alarm Rate	0.17	0.40	0.43

Overall Skill Score

Skill Score	Value
Proportion Correct	0.533
Kuiper Skill Score	0.207
Heidke Skill Score	0.214

INSAT-3D Sounder vs MODIS for January , 2019 (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	2418	1083	3636
Sounder Uncertain	1901	436	2848
Sounder Cloudy	1673	111	899

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1905	2494	2738
Sounder Uncertain	1518	1433	2234
Sounder Cloudy	1423	597	663

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1655	2310	3172

Sounder Uncertain	1320	1379	2486
Sounder Cloudy	1290	656	737

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	16.11	7.22	24.23
Sounder Uncertain	12.67	2.91	18.98
Sounder Cloudy	11.15	0.74	5.99

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	12.70	16.62	18.25
Sounder Uncertain	10.12	9.55	14.89
Sounder Cloudy	9.48	3.98	4.42

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	11.03	15.39	21.14
Sounder Uncertain	8.80	9.19	16.57
Sounder Cloudy	8.60	4.37	4.91

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.66	0.92	0.66
Frequency Bias	1.19	3.18	0.36
Probability of Detection	0.40	0.27	0.12
False Alarm Rate	0.42	0.42	0.16

Overall Skill Score

Skill Score	Value
Proportion Correct	0.250
Kuiper Skill Score	-0.111
Heidke Skill Score	-0.095

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.73	0.72	0.75
Frequency Bias	1.47	1.15	0.48
Probability of Detection	0.39	0.32	0.12
False Alarm Rate	0.48	0.34	0.18

Overall Skill Score

Skill Score	Value
Proportion Correct	0.267
Kuiper Skill Score	-0.088
Heidke Skill Score	-0.086

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.77	0.73	0.73
Frequency Bias	1.67	1.19	0.42
Probability of Detection	0.39	0.32	0.12
False Alarm Rate	0.49	0.34	0.17

Overall Skill Score

Skill Score	Value
Proportion Correct	0.251
Kuiper Skill Score	-0.092
Heidke Skill Score	-0.087