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 March , 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	63039	15296	6716
Sounder Uncertain	9316	2312	6499
Sounder Cloudy	11272	2451	14024

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	59969	19891	5191
Sounder Uncertain	7913	4787	5427
Sounder Cloudy	9368	6028	12351

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	54061	25030	5960
Sounder Uncertain	6740	5467	5920
Sounder Cloudy	7757	7065	12925

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	48.15	11.68	5.13
Sounder Uncertain	7.12	1.77	4.96
Sounder Cloudy	8.61	1.87	10.71

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	45.80	15.19	3.96
Sounder Uncertain	6.04	3.66	4.15
Sounder Cloudy	7.16	4.60	9.43

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	41.29	19.12	4.55
Sounder Uncertain	5.15	4.18	4.52
Sounder Cloudy	5.92	5.40	9.87

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.26	0.87	0.49
Frequency Bias	1.02	0.90	1.02
Probability of Detection	0.75	0.12	0.51
False Alarm Rate	0.43	0.31	0.27

Overall Skill Score

Skill Score	Value
Proportion Correct	0.606
Kuiper Skill Score	0.240
Heidke Skill Score	0.242

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.29	0.74	0.55
Frequency Bias	1.10	0.59	1.21
Probability of Detection	0.78	0.16	0.54
False Alarm Rate	0.47	0.25	0.29

Overall Skill Score

Skill Score	Value
Proportion Correct	0.589
Kuiper Skill Score	0.240
Heidke Skill Score	0.249

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.36	0.70	0.53
Frequency Bias	1.24	0.48	1.12
Probability of Detection	0.79	0.15	0.52
False Alarm Rate	0.53	0.22	0.25

Overall Skill Score

Skill Score	Value
Proportion Correct	0.553
Kuiper Skill Score	0.219
Heidke Skill Score	0.230

INSAT-3D Sounder vs MODIS for March , 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	39529	11939	3742
Sounder Uncertain	7429	1551	2757
Sounder Cloudy	8831	1879	11120

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	37955	14326	2929
Sounder Uncertain	6443	3220	2074
Sounder Cloudy	7247	4852	9731

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	33647	18201	3362
Sounder Uncertain	5469	3948	2320
Sounder Cloudy	5889	5758	10183

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	44.53	13.45	4.22
Sounder Uncertain	8.37	1.75	3.11
Sounder Cloudy	9.95	2.12	12.53

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	42.75	16.14	3.30
Sounder Uncertain	7.26	3.63	2.34
Sounder Cloudy	8.16	5.47	10.96

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	37.90	20.50	3.79
Sounder Uncertain	6.16	4.45	2.61
Sounder Cloudy	6.63	6.49	11.47

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.28	0.87	0.49
Frequency Bias	0.99	0.76	1.24
Probability of Detection	0.71	0.10	0.63
False Alarm Rate	0.43	0.28	0.29

Overall Skill Score

Skill Score	Value
Proportion Correct	0.588
Kuiper Skill Score	0.234
Heidke Skill Score	0.233

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.31	0.73	0.55
Frequency Bias	1.07	0.52	1.48
Probability of Detection	0.73	0.14	0.66
False Alarm Rate	0.46	0.22	0.32

Overall Skill Score

Skill Score	Value
Proportion Correct	0.573
Kuiper Skill Score	0.241
Heidke Skill Score	0.244

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.39	0.66	0.53
Frequency Bias	1.23	0.42	1.38
Probability of Detection	0.75	0.14	0.64
False Alarm Rate	0.53	0.19	0.28

Overall Skill Score

Skill Score	Value

Proportion Correct	0.538
Kuiper Skill Score	0.224
Heidke Skill Score	0.229

INSAT-3D Sounder vs MODIS for March , 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	23510	3357	2974
Sounder Uncertain	1887	761	3742
Sounder Cloudy	2441	572	2904

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	22014	5565	2262
Sounder Uncertain	1470	1567	3353
Sounder Cloudy	2121	1176	2620

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	20414	6829	2598
Sounder Uncertain	1271	1519	3600
Sounder Cloudy	1868	1307	2742

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	55.78	7.96	7.06
Sounder Uncertain	4.48	1.81	8.88
Sounder Cloudy	5.79	1.36	6.89

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	52.23	13.20	5.37
Sounder Uncertain	3.49	3.72	7.96
Sounder Cloudy	5.03	2.79	6.22

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	48.43	16.20	6.16
Sounder Uncertain	3.02	3.60	8.54
Sounder Cloudy	4.43	3.10	6.51

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.21	0.88	0.51
Frequency Bias	1.07	1.36	0.62
Probability of Detection	0.84	0.16	0.30
False Alarm Rate	0.42	0.38	0.20

Overall Skill Score

Skill Score	Value
Proportion Correct	0.645
Kuiper Skill Score	0.257
Heidke Skill Score	0.265

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy

False Alarm Ratio	0.26	0.75	0.56
Frequency Bias	1.17	0.77	0.72
Probability of Detection	0.86	0.19	0.32
False Alarm Rate	0.49	0.30	0.21

Overall Skill Score

Skill Score	Value
Proportion Correct	0.622
Kuiper Skill Score	0.242
Heidke Skill Score	0.262

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.32	0.76	0.54
Frequency Bias	1.27	0.66	0.66
Probability of Detection	0.87	0.16	0.31
False Alarm Rate	0.54	0.28	0.18

Overall Skill Score

Skill Score	Value
Proportion Correct	0.585
Kuiper Skill Score	0.212
Heidke Skill Score	0.232

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

1. Confusion matrix of Total number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy

Sounder Clear	47662	6591	2690
Sounder Uncertain	6862	1509	2792
Sounder Cloudy	7879	1716	3969

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	46091	8993	1859
Sounder Uncertain	6004	2990	2169
Sounder Cloudy	6871	3507	3186

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	41148	13561	2234
Sounder Uncertain	5083	3637	2443
Sounder Cloudy	5627	4470	3467

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	58.36	8.07	3.29
Sounder Uncertain	8.40	1.85	3.42
Sounder Cloudy	9.65	2.10	4.86

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	56.44	11.01	2.28
Sounder Uncertain	7.35	3.66	2.66
Sounder Cloudy	8.41	4.29	3.90

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	50.38	16.60	2.74

Sounder Uncertain	6.22	4.45	2.99
Sounder Cloudy	6.89	5.47	4.25

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.16	0.86	0.71
Frequency Bias	0.91	1.14	1.44
Probability of Detection	0.76	0.15	0.42
False Alarm Rate	0.33	0.34	0.34

Overall Skill Score

Skill Score	Value
Proportion Correct	0.651
Kuiper Skill Score	0.212
Heidke Skill Score	0.191

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.19	0.73	0.77
Frequency Bias	0.97	0.72	1.88
Probability of Detection	0.78	0.19	0.44
False Alarm Rate	0.37	0.28	0.35

Overall Skill Score

Skill Score	Value
Proportion Correct	0.640
Kuiper Skill Score	0.221
Heidke Skill Score	0.210

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.28	0.67	0.74

Frequency Bias	1.10	0.52	1.67
Probability of Detection	0.79	0.17	0.43
False Alarm Rate	0.47	0.23	0.30

Overall Skill Score

Skill Score	Value
Proportion Correct	0.591
Kuiper Skill Score	0.184
Heidke Skill Score	0.189

INSAT-3D Sounder vs MODIS for March , 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	29586	4113	1591
Sounder Uncertain	6105	1003	1340
Sounder Cloudy	6782	1531	3397

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	28477	5773	1040
Sounder Uncertain	5348	2289	811
Sounder Cloudy	5836	3213	2661

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	24750	9323	1217

Sounder Uncertain	4497	2981	970
Sounder Cloudy	4726	4072	2912

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	53.36	7.42	2.87
Sounder Uncertain	11.01	1.81	2.42
Sounder Cloudy	12.23	2.76	6.13

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	51.36	10.41	1.88
Sounder Uncertain	9.65	4.13	1.46
Sounder Cloudy	10.53	5.79	4.80

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	44.64	16.81	2.19
Sounder Uncertain	8.11	5.38	1.75
Sounder Cloudy	8.52	7.34	5.25

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.16	0.88	0.71
Frequency Bias	0.83	1.27	1.85
Probability of Detection	0.70	0.15	0.54
False Alarm Rate	0.27	0.35	0.39

Overall Skill Score

Skill Score	Value
Proportion Correct	0.613
Kuiper Skill Score	0.215
Heidke Skill Score	0.177

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.19	0.73	0.77
Frequency Bias	0.89	0.75	2.60
Probability of Detection	0.72	0.20	0.59
False Alarm Rate	0.31	0.28	0.41

Overall Skill Score

Skill Score	Value
Proportion Correct	0.603
Kuiper Skill Score	0.226
Heidke Skill Score	0.200

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.30	0.65	0.75
Frequency Bias	1.04	0.52	2.30
Probability of Detection	0.73	0.18	0.57
False Alarm Rate	0.42	0.22	0.35

Overall Skill Score

Skill Score	Value
Proportion Correct	0.553
Kuiper Skill Score	0.186
Heidke Skill Score	0.180

INSAT-3D Sounder vs MODIS for March , 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	18076	2478	1099
Sounder Uncertain	757	506	1452
Sounder Cloudy	1097	185	572

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	17614	3220	819
Sounder Uncertain	656	701	1358
Sounder Cloudy	1035	294	525

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	16398	4238	1017
Sounder Uncertain	586	656	1473
Sounder Cloudy	901	398	555

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	68.93	9.45	4.19
Sounder Uncertain	2.89	1.93	5.54
Sounder Cloudy	4.18	0.71	2.18

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	67.17	12.28	3.12
Sounder Uncertain	2.50	2.67	5.18
Sounder Cloudy	3.95	1.12	2.00

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	62.54	16.16	3.88
Sounder Uncertain	2.23	2.50	5.62
Sounder Cloudy	3.44	1.52	2.12

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.17	0.81	0.69
Frequency Bias	1.09	0.86	0.59
Probability of Detection	0.91	0.16	0.18
False Alarm Rate	0.51	0.31	0.18

Overall Skill Score

Skill Score	Value
Proportion Correct	0.730
Kuiper Skill Score	0.208
Heidke Skill Score	0.233

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.19	0.74	0.72
Frequency Bias	1.12	0.64	0.69
Probability of Detection	0.91	0.17	0.19
False Alarm Rate	0.55	0.27	0.18

Overall Skill Score

Skill Score	Value
Proportion Correct	0.718
Kuiper Skill Score	0.205
Heidke Skill Score	0.235

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.24	0.76	0.70
Frequency Bias	1.21	0.51	0.61
Probability of Detection	0.92	0.12	0.18
False Alarm Rate	0.61	0.24	0.15

Overall Skill Score

Skill Score	Value
Proportion Correct	0.672
Kuiper Skill Score	0.165
Heidke Skill Score	0.194

INSAT-3D Sounder vs MODIS for March , 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	12254	8073	2580
Sounder Uncertain	790	543	1461
Sounder Cloudy	928	323	1322

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	11077	9706	2124
Sounder Uncertain	631	827	1336
Sounder Cloudy	817	495	1261

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	10363	10135	2409
Sounder Uncertain	568	799	1427
Sounder Cloudy	755	523	1295

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	43.34	28.55	9.12
Sounder Uncertain	2.79	1.92	5.17
Sounder Cloudy	3.28	1.14	4.68

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	39.18	34.33	7.51
Sounder Uncertain	2.23	2.92	4.73
Sounder Cloudy	2.89	1.75	4.46

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	36.65	35.85	8.52
Sounder Uncertain	2.01	2.83	5.05
Sounder Cloudy	2.67	1.85	4.58

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.47	0.81	0.49
Frequency Bias	1.64	0.31	0.48
Probability of Detection	0.88	0.06	0.25
False Alarm Rate	0.75	0.16	0.09

Overall Skill Score

Skill Score	Value
Proportion Correct	0.499
Kuiper Skill Score	0.081
Heidke Skill Score	0.092

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.52	0.70	0.51
Frequency Bias	1.83	0.25	0.55
Probability of Detection	0.88	0.07	0.27
False Alarm Rate	0.78	0.13	0.09

Overall Skill Score

Skill Score	Value
Proportion Correct	0.466
Kuiper Skill Score	0.085
Heidke Skill Score	0.090

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.55	0.71	0.50
Frequency Bias	1.96	0.24	0.50
Probability of Detection	0.89	0.07	0.25
False Alarm Rate	0.79	0.13	0.08

Overall Skill Score

Skill Score	Value

Proportion Correct	0.441
Kuiper Skill Score	0.078
Heidke Skill Score	0.081

INSAT-3D Sounder vs MODIS for March , 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	8287	7559	1936
Sounder Uncertain	502	489	918
Sounder Cloudy	273	123	532

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	7913	8139	1730
Sounder Uncertain	438	617	854
Sounder Cloudy	260	142	526

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	7444	8373	1965
Sounder Uncertain	398	595	916
Sounder Cloudy	227	170	531

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	40.19	36.66	9.39
Sounder Uncertain	2.43	2.37	4.45
Sounder Cloudy	1.32	0.60	2.58

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	38.38	39.47	8.39
Sounder Uncertain	2.12	2.99	4.14
Sounder Cloudy	1.26	0.69	2.55

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	36.10	40.61	9.53
Sounder Uncertain	1.93	2.89	4.44
Sounder Cloudy	1.10	0.82	2.58

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.53	0.74	0.43
Frequency Bias	1.96	0.23	0.27
Probability of Detection	0.91	0.06	0.16
False Alarm Rate	0.84	0.13	0.04

Overall Skill Score

Skill Score	Value
Proportion Correct	0.451
Kuiper Skill Score	0.045
Heidke Skill Score	0.049

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy

False Alarm Ratio	0.55	0.68	0.43
Frequency Bias	2.07	0.21	0.30
Probability of Detection	0.92	0.07	0.17
False Alarm Rate	0.85	0.11	0.03

Overall Skill Score

Skill Score	Value
Proportion Correct	0.439
Kuiper Skill Score	0.052
Heidke Skill Score	0.054

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.58	0.69	0.43
Frequency Bias	2.20	0.21	0.27
Probability of Detection	0.92	0.07	0.16
False Alarm Rate	0.86	0.11	0.03

Overall Skill Score

Skill Score	Value
Proportion Correct	0.416
Kuiper Skill Score	0.048
Heidke Skill Score	0.048

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

1. Confusion matrix of Total number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy

Sounder Clear	3967	514	644
Sounder Uncertain	288	54	543
Sounder Cloudy	655	200	790

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	3164	1567	394
Sounder Uncertain	193	210	482
Sounder Cloudy	557	353	735

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	2919	1762	444
Sounder Uncertain	170	204	511
Sounder Cloudy	528	353	764

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	51.82	6.71	8.41
Sounder Uncertain	3.76	0.71	7.09
Sounder Cloudy	8.56	2.61	10.32

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	41.33	20.47	5.15
Sounder Uncertain	2.52	2.74	6.30
Sounder Cloudy	7.28	4.61	9.60

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	38.13	23.02	5.80

Sounder Uncertain	2.22	2.66	6.68
Sounder Cloudy	6.90	4.61	9.98

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.23	0.94	0.52
Frequency Bias	1.04	1.15	0.83
Probability of Detection	0.81	0.07	0.40
False Alarm Rate	0.41	0.29	0.30

Overall Skill Score

Skill Score	Value
Proportion Correct	0.628
Kuiper Skill Score	0.258
Heidke Skill Score	0.262

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.38	0.76	0.55
Frequency Bias	1.31	0.42	1.02
Probability of Detection	0.81	0.10	0.46
False Alarm Rate	0.55	0.19	0.26

Overall Skill Score

Skill Score	Value
Proportion Correct	0.537
Kuiper Skill Score	0.190
Heidke Skill Score	0.202

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.43	0.77	0.54

Frequency Bias	1.42	0.38	0.96
Probability of Detection	0.81	0.09	0.44
False Alarm Rate	0.59	0.18	0.23

Overall Skill Score

Skill Score	Value
Proportion Correct	0.508
Kuiper Skill Score	0.170
Heidke Skill Score	0.180

INSAT-3D Sounder vs MODIS for March , 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	323	69	14
Sounder Uncertain	42	7	13
Sounder Cloudy	85	27	19

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	314	78	14
Sounder Uncertain	40	11	11
Sounder Cloudy	77	41	13

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	296	95	15

Sounder Uncertain	37	13	12
Sounder Cloudy	68	47	16

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	53.92	11.52	2.34
Sounder Uncertain	7.01	1.17	2.17
Sounder Cloudy	14.19	4.51	3.17

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	52.42	13.02	2.34
Sounder Uncertain	6.68	1.84	1.84
Sounder Cloudy	12.85	6.84	2.17

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	49.42	15.86	2.50
Sounder Uncertain	6.18	2.17	2.00
Sounder Cloudy	11.35	7.85	2.67

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.20	0.89	0.85
Frequency Bias	0.90	0.60	2.85
Probability of Detection	0.72	0.07	0.41
False Alarm Rate	0.33	0.22	0.45

Overall Skill Score

Skill Score	Value
Proportion Correct	0.583
Kuiper Skill Score	0.097
Heidke Skill Score	0.085

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.23	0.82	0.90
Frequency Bias	0.94	0.48	3.45
Probability of Detection	0.73	0.08	0.34
False Alarm Rate	0.35	0.20	0.45

Overall Skill Score

Skill Score	Value
Proportion Correct	0.564
Kuiper Skill Score	0.093
Heidke Skill Score	0.085

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.27	0.79	0.88
Frequency Bias	1.01	0.40	3.05
Probability of Detection	0.74	0.08	0.37
False Alarm Rate	0.40	0.18	0.42

Overall Skill Score

Skill Score	Value
Proportion Correct	0.543
Kuiper Skill Score	0.097
Heidke Skill Score	0.092

INSAT-3D Sounder vs MODIS for March , 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	254	63	9
Sounder Uncertain	40	6	9
Sounder Cloudy	70	22	10

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	247	70	9
Sounder Uncertain	39	8	8
Sounder Cloudy	64	32	6

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	231	85	10
Sounder Uncertain	37	10	8
Sounder Cloudy	57	39	6

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	52.59	13.04	1.86
Sounder Uncertain	8.28	1.24	1.86
Sounder Cloudy	14.49	4.55	2.07

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	51.14	14.49	1.86
Sounder Uncertain	8.07	1.66	1.66
Sounder Cloudy	13.25	6.63	1.24

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	47.83	17.60	2.07
Sounder Uncertain	7.66	2.07	1.66
Sounder Cloudy	11.80	8.07	1.24

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.22	0.89	0.90
Frequency Bias	0.90	0.60	3.64
Probability of Detection	0.70	0.07	0.36
False Alarm Rate	0.34	0.23	0.43

Overall Skill Score

Skill Score	Value
Proportion Correct	0.559
Kuiper Skill Score	0.042
Heidke Skill Score	0.036

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.24	0.85	0.94
Frequency Bias	0.93	0.50	4.43
Probability of Detection	0.71	0.07	0.26
False Alarm Rate	0.36	0.21	0.43

Overall Skill Score

Skill Score	Value
Proportion Correct	0.540
Kuiper Skill Score	0.036
Heidke Skill Score	0.032

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.29	0.82	0.94
Frequency Bias	1.00	0.41	4.25
Probability of Detection	0.71	0.07	0.25
False Alarm Rate	0.40	0.19	0.41

Overall Skill Score

Skill Score	Value
Proportion Correct	0.511
Kuiper Skill Score	0.032
Heidke Skill Score	0.030

INSAT-3D Sounder vs MODIS for March , 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	69	6	5
Sounder Uncertain	2	1	4
Sounder Cloudy	15	5	9

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	67	8	5
Sounder Uncertain	1	3	3
Sounder Cloudy	13	9	7

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	65	10	5
Sounder Uncertain	0	3	4
Sounder Cloudy	11	8	10

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	59.48	5.17	4.31
Sounder Uncertain	1.72	0.86	3.45
Sounder Cloudy	12.93	4.31	7.76

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	57.76	6.90	4.31
Sounder Uncertain	0.86	2.59	2.59
Sounder Cloudy	11.21	7.76	6.03

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	56.03	8.62	4.31
Sounder Uncertain	0.00	2.59	3.45
Sounder Cloudy	9.48	6.90	8.62

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.14	0.86	0.69
Frequency Bias	0.93	0.58	1.61
Probability of Detection	0.80	0.08	0.50
False Alarm Rate	0.30	0.16	0.54

Overall Skill Score

Skill Score	Value
Proportion Correct	0.681
Kuiper Skill Score	0.300
Heidke Skill Score	0.281

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.16	0.57	0.76
Frequency Bias	0.99	0.35	1.93
Probability of Detection	0.83	0.15	0.47
False Alarm Rate	0.33	0.10	0.56

Overall Skill Score

Skill Score	Value
Proportion Correct	0.664
Kuiper Skill Score	0.299
Heidke Skill Score	0.293

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.19	0.57	0.66
Frequency Bias	1.05	0.33	1.53
Probability of Detection	0.86	0.14	0.53
False Alarm Rate	0.39	0.11	0.50

Overall Skill Score

Skill Score	Value

Proportion Correct	0.672
Kuiper Skill Score	0.330
Heidke Skill Score	0.340

INSAT-3D Sounder vs MODIS for March , 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	1256	328	1330
Sounder Uncertain	1451	221	2150
Sounder Cloudy	1942	245	8532

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	989	804	1121
Sounder Uncertain	1075	916	1831
Sounder Cloudy	1191	1797	7731

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	858	840	1216
Sounder Uncertain	902	967	1953
Sounder Cloudy	944	1797	7978

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	7.20	1.88	7.62
Sounder Uncertain	8.31	1.27	12.32
Sounder Cloudy	11.13	1.40	48.88

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	5.67	4.61	6.42
Sounder Uncertain	6.16	5.25	10.49
Sounder Cloudy	6.82	10.30	44.29

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	4.92	4.81	6.97
Sounder Uncertain	5.17	5.54	11.19
Sounder Cloudy	5.41	10.30	45.71

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.57	0.94	0.20
Frequency Bias	0.63	4.81	0.89
Probability of Detection	0.27	0.28	0.71
False Alarm Rate	0.22	0.48	0.29

Overall Skill Score

Skill Score	Value
Proportion Correct	0.573
Kuiper Skill Score	0.213
Heidke Skill Score	0.184

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy

False Alarm Ratio	0.66	0.76	0.28
Frequency Bias	0.90	1.09	1.00
Probability of Detection	0.30	0.26	0.72
False Alarm Rate	0.25	0.37	0.38

Overall Skill Score

Skill Score	Value
Proportion Correct	0.552
Kuiper Skill Score	0.184
Heidke Skill Score	0.184

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.71	0.75	0.26
Frequency Bias	1.08	1.06	0.96
Probability of Detection	0.32	0.27	0.72
False Alarm Rate	0.27	0.37	0.36

Overall Skill Score

Skill Score	Value
Proportion Correct	0.562
Kuiper Skill Score	0.187
Heidke Skill Score	0.183

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

1. Confusion matrix of Total number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy

Sounder Clear	241	23	154
Sounder Uncertain	617	23	450
Sounder Cloudy	1337	90	7070

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	188	113	117
Sounder Uncertain	460	267	363
Sounder Cloudy	740	1309	6448

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	165	124	129
Sounder Uncertain	392	314	384
Sounder Cloudy	570	1289	6638

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	2.41	0.23	1.54
Sounder Uncertain	6.17	0.23	4.50
Sounder Cloudy	13.36	0.90	70.66

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1.88	1.13	1.17
Sounder Uncertain	4.60	2.67	3.63
Sounder Cloudy	7.40	13.08	64.45

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1.65	1.24	1.29

Sounder Uncertain	3.92	3.14	3.84
Sounder Cloudy	5.70	12.88	66.35

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.42	0.98	0.17
Frequency Bias	0.19	8.01	1.11
Probability of Detection	0.11	0.17	0.92
False Alarm Rate	0.07	0.40	0.53

Overall Skill Score

Skill Score	Value
Proportion Correct	0.733
Kuiper Skill Score	0.195
Heidke Skill Score	0.210

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.55	0.76	0.24
Frequency Bias	0.30	0.65	1.23
Probability of Detection	0.14	0.16	0.93
False Alarm Rate	0.07	0.27	0.66

Overall Skill Score

Skill Score	Value
Proportion Correct	0.690
Kuiper Skill Score	0.164
Heidke Skill Score	0.200

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.61	0.71	0.22

Frequency Bias	0.37	0.63	1.19
Probability of Detection	0.15	0.18	0.93
False Alarm Rate	0.09	0.27	0.64

Overall Skill Score

Skill Score	Value
Proportion Correct	0.711
Kuiper Skill Score	0.181
Heidke Skill Score	0.219

INSAT-3D Sounder vs MODIS for March , 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	1015	305	1176
Sounder Uncertain	834	198	1700
Sounder Cloudy	605	155	1462

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	801	691	1004
Sounder Uncertain	615	649	1468
Sounder Cloudy	451	488	1283

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	693	716	1087

Sounder Uncertain	510	653	1569
Sounder Cloudy	374	508	1340

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	13.62	4.09	15.79
Sounder Uncertain	11.19	2.66	22.82
Sounder Cloudy	8.12	2.08	19.62

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	10.75	9.28	13.48
Sounder Uncertain	8.26	8.71	19.70
Sounder Cloudy	6.05	6.55	17.22

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	9.30	9.61	14.59
Sounder Uncertain	6.85	8.77	21.06
Sounder Cloudy	5.02	6.82	17.99

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.59	0.93	0.34
Frequency Bias	1.02	4.15	0.51
Probability of Detection	0.41	0.30	0.34
False Alarm Rate	0.31	0.53	0.16

Overall Skill Score

Skill Score	Value
Proportion Correct	0.359
Kuiper Skill Score	0.078
Heidke Skill Score	0.062

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.68	0.76	0.42
Frequency Bias	1.34	1.49	0.59
Probability of Detection	0.43	0.36	0.34
False Alarm Rate	0.36	0.44	0.20

Overall Skill Score

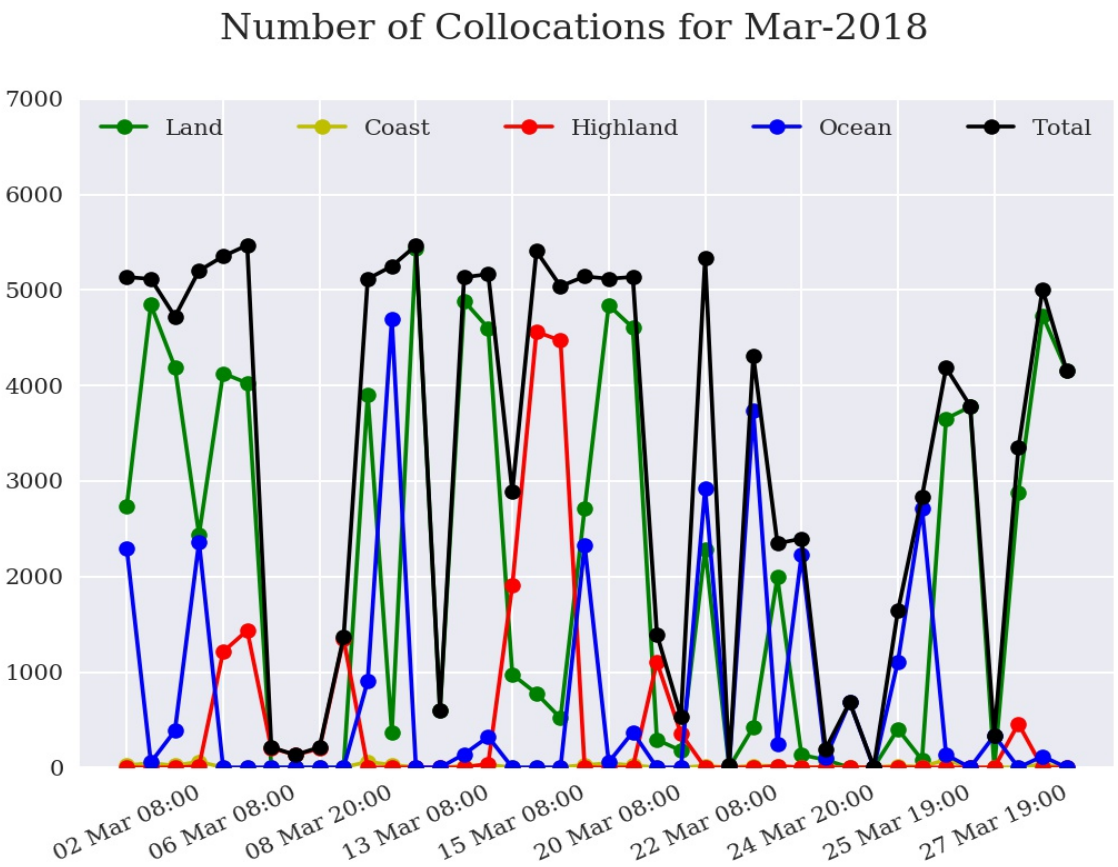
Skill Score	Value
Proportion Correct	0.367
Kuiper Skill Score	0.068
Heidke Skill Score	0.063

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.72	0.76	0.40
Frequency Bias	1.58	1.46	0.56
Probability of Detection	0.44	0.35	0.34
False Alarm Rate	0.38	0.44	0.19

Overall Skill Score

Skill Score	Value
Proportion Correct	0.361
Kuiper Skill Score	0.062
Heidke Skill Score	0.055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Coast
Highland
Ocean
Total
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6000
5000
4000
3000
2000
1000
0
02 Mar 08:00
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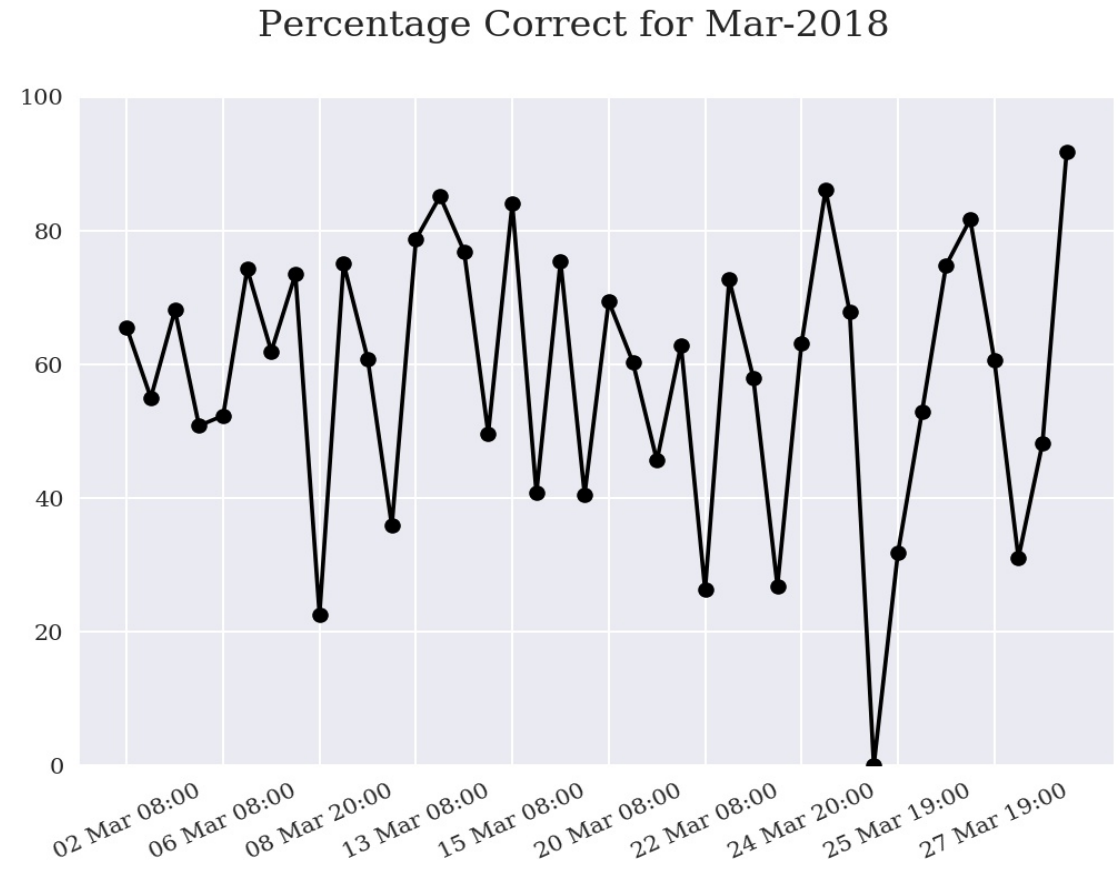
27 Mar 19:00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80
60
40
20
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13 Mar 08:00
15 Mar 08:00
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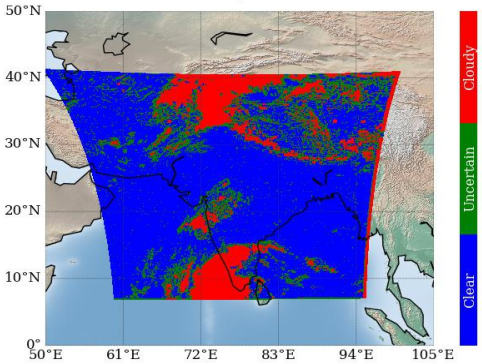
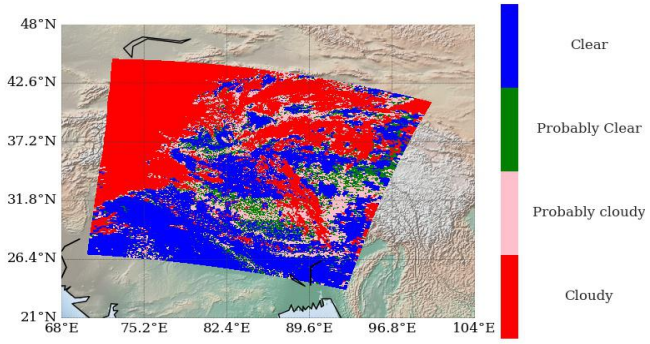
25 Mar 19:00
27 Mar 19:00

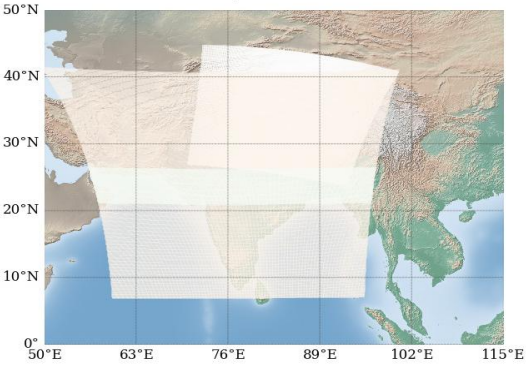
INSAT-3D Sounder Cloud Mask on
13 March, 2018 20:00 UTC



Modis Cloud Mask on
13 March, 2018 20:20 UTC

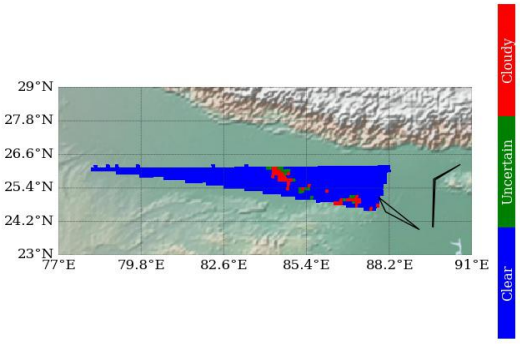


MODIS pass over INSAT-3D Sounder on
13 March, 2018 20:20 UTC

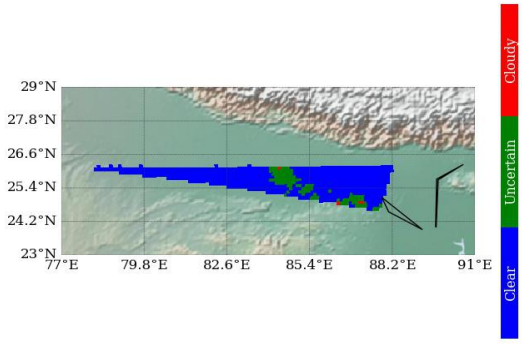


Number of Modis Pixels per Sounder Pixels on a
spatially and Temporally Collocated Domain on
13 March, 2018 20:20 UTC

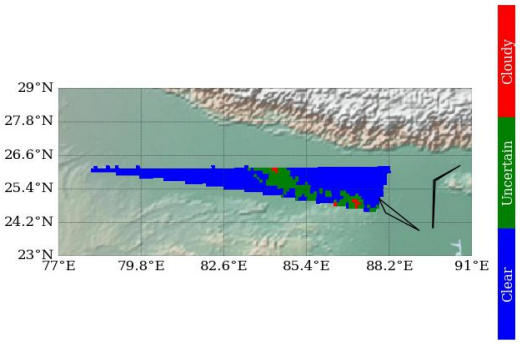
Modis Cloud Mask on Sounder Grid
Method 1 : Mode of Modis pixels



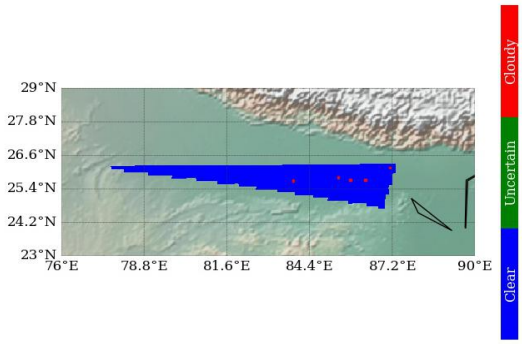
Modis Cloud Mask on Sounder Grid
Method 2 : Weighted Average

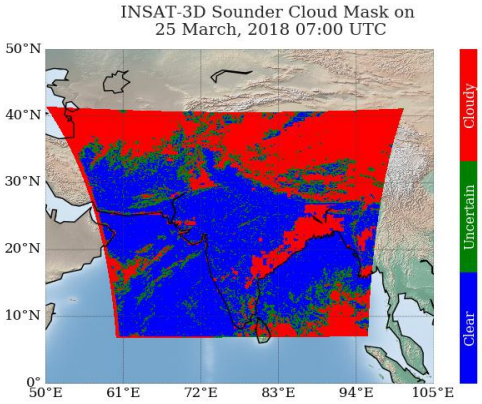


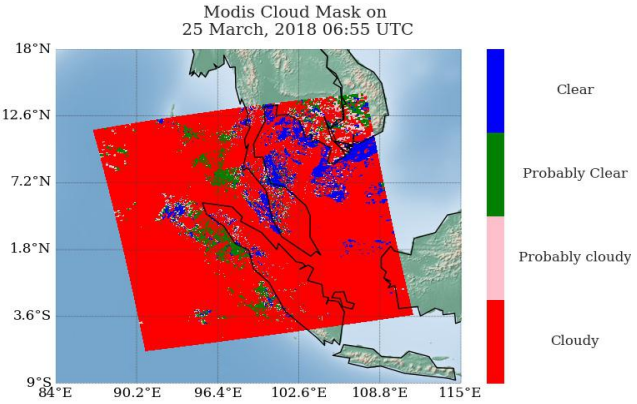
Modis Cloud Mask on Sounder Grid
Method 3 : Weighted Product Average

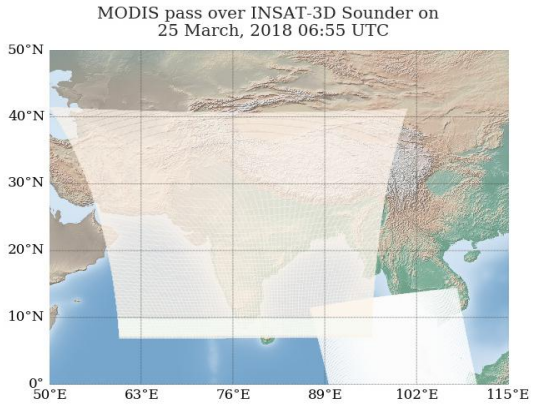


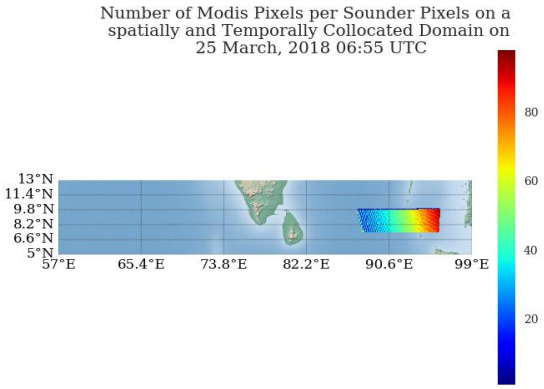
Sounder Cloud Flag on Collocated Area

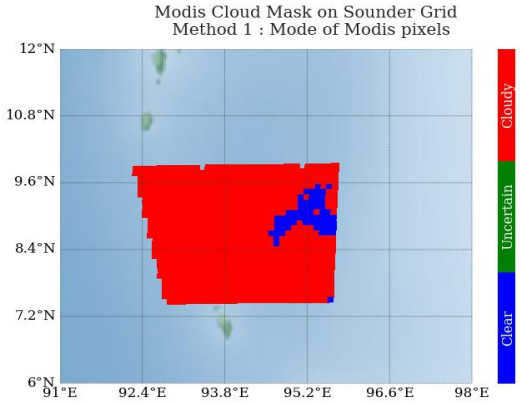


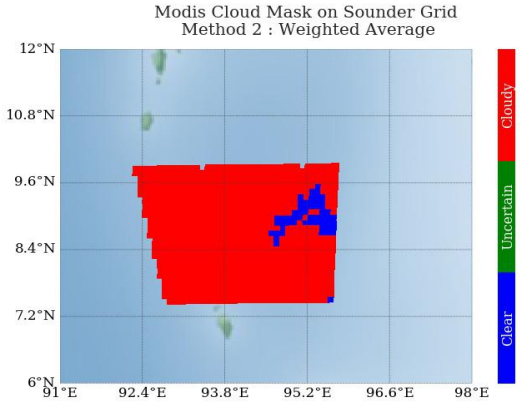

INSAT-3D Sounder Cloud Mask on
25 March, 2018 07:00 UTC
50°N
40°N
30°N
20°N
10°N
0°
50°E
61°E
72°E
83°E
94°E
105°E
Cloudy
Uncertain
Clear

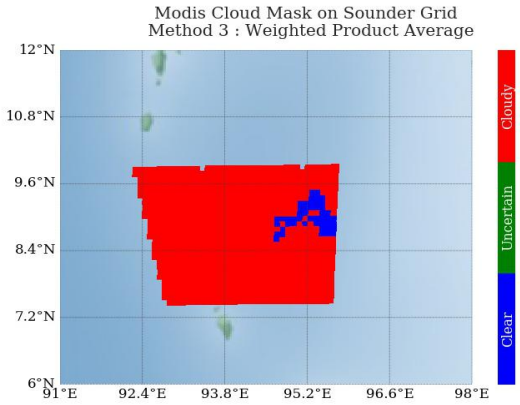

Modis Cloud Mask on
25 March, 2018 06:55 UTC
18°N
12.6°N
7.2°N
1.8°N
3.6°S
9°S
84°E
90.2°E
96.4°E
102.6°E
108.8°E
115°E
Clear
Probably Clear
Probably cloudy
Cloudy

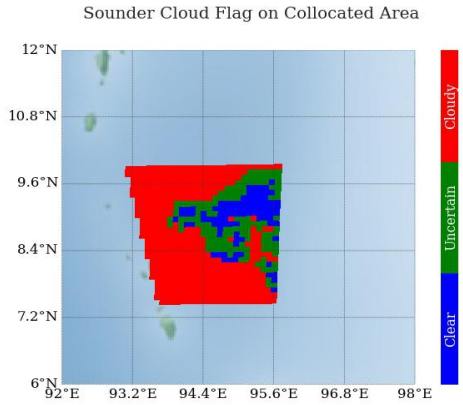

MODIS pass over INSAT-3D Sounder on
25 March, 2018 06:55 UTC
50°N
40°N
30°N
20°N
10°N
0°
50°E
63°E
76°E
89°E
102°E
115°E


Number of Modis Pixels per Sounder Pixels on a
spatially and Temporally Collocated Domain on
25 March, 2018 06:55 UTC
13°N
11.4°N
9.8°N
8.2°N
6.6°N
5°N
57°E
65.4°E
73.8°E
82.2°E
90.6°E
99°E
80
60
40
20


Modis Cloud Mask on Sounder Grid
Method 1 : Mode of Modis pixels
12°N
10.8°N
9.6°N
8.4°N
7.2°N
6°N
91°E
92.4°E
93.8°E
95.2°E
96.6°E
98°E
Cloudy
Uncertain
Clear


Modis Cloud Mask on Sounder Grid
Method 2 : Weighted Average
12°N
10.8°N
9.6°N
8.4°N
7.2°N
6°N
91°E
92.4°E
93.8°E
95.2°E
96.6°E
98°E
Cloudy
Uncertain
Clear


Modis Cloud Mask on Sounder Grid
Method 3 : Weighted Product Average
12°N
10.8°N
9.6°N
8.4°N
7.2°N
6°N
91°E
92.4°E
93.8°E
95.2°E
96.6°E
98°E
Cloudy
Uncertain
Clear


Sounder Cloud Flag on Collocated Area
12°N
10.8°N
9.6°N
8.4°N
7.2°N
6°N
92°E
93.2°E
94.4°E
95.6°E
96.8°E
98°E
Cloudy
Uncertain
Clear