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

$p = 0.35\text{-}0.75$: 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 , 2017 (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	95728	38722	20485
Sounder Uncertain	11651	2266	12036
Sounder Cloudy	8579	2785	28452

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	88803	48487	17645
Sounder Uncertain	8935	7134	9884
Sounder Cloudy	6586	6834	26396

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	80636	54615	19684
Sounder Uncertain	7467	7848	10638
Sounder Cloudy	5680	7055	27081

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	43.37	17.54	9.28
Sounder Uncertain	5.28	1.03	5.45
Sounder Cloudy	3.89	1.26	12.89

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	40.24	21.97	7.99
Sounder Uncertain	4.05	3.23	4.48
Sounder Cloudy	2.98	3.10	11.96

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	36.54	24.75	8.92
Sounder Uncertain	3.38	3.56	4.82
Sounder Cloudy	2.57	3.20	12.27

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.38	0.91	0.29
Frequency Bias	1.34	0.59	0.65
Probability of Detection	0.83	0.05	0.47
False Alarm Rate	0.63	0.25	0.12

Overall Skill Score

Skill Score	Value
Proportion Correct	0.573
Kuiper Skill Score	0.215
Heidke Skill Score	0.235

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.43	0.73	0.34
Frequency Bias	1.49	0.42	0.74
Probability of Detection	0.85	0.11	0.49
False Alarm Rate	0.67	0.19	0.14

Overall Skill Score

Skill Score	Value
Proportion Correct	0.554
Kuiper Skill Score	0.228
Heidke Skill Score	0.246

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.48	0.70	0.32
Frequency Bias	1.65	0.37	0.69
Probability of Detection	0.86	0.11	0.47
False Alarm Rate	0.71	0.17	0.12

Overall Skill Score

Skill Score	Value
Proportion Correct	0.524
Kuiper Skill Score	0.217
Heidke Skill Score	0.229

INSAT-3D Sounder vs MODIS for March , 2017 (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	49882	19574	9412
Sounder Uncertain	8377	1884	6373
Sounder Cloudy	4867	1121	24512

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	46831	23420	8617
Sounder Uncertain	6276	5505	4853
Sounder Cloudy	3288	4485	22727

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	41094	27910	9864
Sounder Uncertain	5031	6173	5430
Sounder Cloudy	2645	4520	23335

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	39.59	15.53	7.47
Sounder Uncertain	6.65	1.50	5.06
Sounder Cloudy	3.86	0.89	19.45

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	37.17	18.59	6.84
Sounder Uncertain	4.98	4.37	3.85
Sounder Cloudy	2.61	3.56	18.04

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	32.61	22.15	7.83
Sounder Uncertain	3.99	4.90	4.31
Sounder Cloudy	2.10	3.59	18.52

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.37	0.89	0.20
Frequency Bias	1.25	0.74	0.76
Probability of Detection	0.79	0.08	0.61
False Alarm Rate	0.58	0.30	0.12

Overall Skill Score

Skill Score	Value
Proportion Correct	0.605
Kuiper Skill Score	0.310
Heidke Skill Score	0.326

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.41	0.67	0.25
Frequency Bias	1.40	0.50	0.84
Probability of Detection	0.83	0.16	0.63
False Alarm Rate	0.63	0.22	0.15

Overall Skill Score

Skill Score	Value
Proportion Correct	0.596
Kuiper Skill Score	0.326
Heidke Skill Score	0.343

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.48	0.63	0.23
Frequency Bias	1.62	0.43	0.79
Probability of Detection	0.84	0.16	0.60
False Alarm Rate	0.68	0.19	0.13

Overall Skill Score

Skill Score	Value

Proportion Correct	0.560
Kuiper Skill Score	0.307
Heidke Skill Score	0.316

INSAT-3D Sounder vs MODIS for March , 2017 (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	45846	19148	11073
Sounder Uncertain	3274	382	5663
Sounder Cloudy	3712	1664	3940

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	41972	25067	9028
Sounder Uncertain	2659	1629	5031
Sounder Cloudy	3298	2349	3669

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	39542	26705	9820
Sounder Uncertain	2436	1675	5208
Sounder Cloudy	3035	2535	3746

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	48.41	20.22	11.69
Sounder Uncertain	3.46	0.40	5.98
Sounder Cloudy	3.92	1.76	4.16

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	44.32	26.47	9.53
Sounder Uncertain	2.81	1.72	5.31
Sounder Cloudy	3.48	2.48	3.87

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	41.75	28.20	10.37
Sounder Uncertain	2.57	1.77	5.50
Sounder Cloudy	3.20	2.68	3.96

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.40	0.96	0.58
Frequency Bias	1.44	0.44	0.45
Probability of Detection	0.87	0.02	0.19
False Alarm Rate	0.68	0.20	0.12

Overall Skill Score

Skill Score	Value
Proportion Correct	0.530
Kuiper Skill Score	0.065
Heidke Skill Score	0.075

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy

False Alarm Ratio	0.45	0.83	0.61
Frequency Bias	1.59	0.32	0.53
Probability of Detection	0.88	0.06	0.21
False Alarm Rate	0.72	0.16	0.12

Overall Skill Score

Skill Score	Value
Proportion Correct	0.499
Kuiper Skill Score	0.072
Heidke Skill Score	0.081

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.48	0.82	0.60
Frequency Bias	1.69	0.30	0.50
Probability of Detection	0.88	0.05	0.20
False Alarm Rate	0.73	0.15	0.11

Overall Skill Score

Skill Score	Value
Proportion Correct	0.475
Kuiper Skill Score	0.066
Heidke Skill Score	0.073

INSAT-3D Sounder vs MODIS for March , 2017 (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	59942	6097	8760
Sounder Uncertain	7826	1294	6293
Sounder Cloudy	3215	959	17897

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	57340	10618	6841
Sounder Uncertain	6205	4143	5065
Sounder Cloudy	2455	2720	16896

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	51656	15725	7418
Sounder Uncertain	5122	4844	5447
Sounder Cloudy	1997	2823	17251

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	53.38	5.43	7.80
Sounder Uncertain	6.97	1.15	5.60
Sounder Cloudy	2.86	0.85	15.94

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	51.07	9.46	6.09
Sounder Uncertain	5.53	3.69	4.51
Sounder Cloudy	2.19	2.42	15.05

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	46.01	14.00	6.61

Sounder Uncertain	4.56	4.31	4.85
Sounder Cloudy	1.78	2.51	15.36

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.20	0.92	0.19
Frequency Bias	1.05	1.85	0.67
Probability of Detection	0.84	0.15	0.54
False Alarm Rate	0.45	0.43	0.13

Overall Skill Score

Skill Score	Value
Proportion Correct	0.705
Kuiper Skill Score	0.424
Heidke Skill Score	0.422

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.23	0.73	0.23
Frequency Bias	1.13	0.88	0.77
Probability of Detection	0.87	0.24	0.59
False Alarm Rate	0.51	0.33	0.15

Overall Skill Score

Skill Score	Value
Proportion Correct	0.698
Kuiper Skill Score	0.416
Heidke Skill Score	0.437

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.31	0.69	0.22

Frequency Bias	1.27	0.66	0.73
Probability of Detection	0.88	0.21	0.57
False Alarm Rate	0.60	0.27	0.13

Overall Skill Score

Skill Score	Value
Proportion Correct	0.657
Kuiper Skill Score	0.371
Heidke Skill Score	0.398

INSAT-3D Sounder vs MODIS for March , 2017 (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	32535	4961	1724
Sounder Uncertain	6033	1173	2415
Sounder Cloudy	2177	749	14992

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	31090	7081	1049
Sounder Uncertain	4734	3360	1527
Sounder Cloudy	1474	2380	14064

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	26561	11384	1275

Sounder Uncertain	3768	4045	1808
Sounder Cloudy	1117	2407	14394

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	48.74	7.43	2.58
Sounder Uncertain	9.04	1.76	3.62
Sounder Cloudy	3.26	1.12	22.46

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	46.57	10.61	1.57
Sounder Uncertain	7.09	5.03	2.29
Sounder Cloudy	2.21	3.57	21.07

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	39.79	17.05	1.91
Sounder Uncertain	5.64	6.06	2.71
Sounder Cloudy	1.67	3.61	21.56

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.17	0.88	0.16
Frequency Bias	0.96	1.40	0.94
Probability of Detection	0.80	0.17	0.78
False Alarm Rate	0.37	0.47	0.16

Overall Skill Score

Skill Score	Value
Proportion Correct	0.729
Kuiper Skill Score	0.522
Heidke Skill Score	0.508

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.21	0.65	0.22
Frequency Bias	1.05	0.75	1.08
Probability of Detection	0.83	0.26	0.85
False Alarm Rate	0.45	0.34	0.21

Overall Skill Score

Skill Score	Value
Proportion Correct	0.727
Kuiper Skill Score	0.516
Heidke Skill Score	0.527

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.32	0.58	0.20
Frequency Bias	1.25	0.54	1.03
Probability of Detection	0.84	0.23	0.82
False Alarm Rate	0.58	0.26	0.16

Overall Skill Score

Skill Score	Value
Proportion Correct	0.674
Kuiper Skill Score	0.452
Heidke Skill Score	0.470

INSAT-3D Sounder vs MODIS for March , 2017 (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	27407	1136	7036
Sounder Uncertain	1793	121	3878
Sounder Cloudy	1038	210	2905

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	26250	3537	5792
Sounder Uncertain	1471	783	3538
Sounder Cloudy	981	340	2832

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	25095	4341	6143
Sounder Uncertain	1354	799	3639
Sounder Cloudy	880	416	2857

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	60.20	2.50	15.46
Sounder Uncertain	3.94	0.27	8.52
Sounder Cloudy	2.28	0.46	6.38

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	57.66	7.77	12.72
Sounder Uncertain	3.23	1.72	7.77
Sounder Cloudy	2.15	0.75	6.22

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	55.12	9.54	13.49
Sounder Uncertain	2.97	1.76	7.99
Sounder Cloudy	1.93	0.91	6.28

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.23	0.98	0.30
Frequency Bias	1.18	3.95	0.30
Probability of Detection	0.91	0.08	0.21
False Alarm Rate	0.54	0.38	0.08

Overall Skill Score

Skill Score	Value
Proportion Correct	0.669
Kuiper Skill Score	0.253
Heidke Skill Score	0.262

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.26	0.86	0.32
Frequency Bias	1.24	1.24	0.34
Probability of Detection	0.91	0.17	0.23
False Alarm Rate	0.60	0.32	0.08

Overall Skill Score

Skill Score	Value
Proportion Correct	0.656
Kuiper Skill Score	0.242
Heidke Skill Score	0.268

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.29	0.86	0.31
Frequency Bias	1.30	1.04	0.33
Probability of Detection	0.92	0.14	0.23
False Alarm Rate	0.63	0.30	0.08

Overall Skill Score

Skill Score	Value
Proportion Correct	0.632
Kuiper Skill Score	0.222
Heidke Skill Score	0.248

INSAT-3D Sounder vs MODIS for March , 2017 (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	31026	31624	9501
Sounder Uncertain	1067	757	2773
Sounder Cloudy	2197	1426	3090

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	27402	35549	9200
Sounder Uncertain	817	1143	2637
Sounder Cloudy	1878	1862	2973

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	25431	36257	10463
Sounder Uncertain	717	1125	2755
Sounder Cloudy	1783	1915	3015

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	37.17	37.89	11.38
Sounder Uncertain	1.28	0.91	3.32
Sounder Cloudy	2.63	1.71	3.70

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	32.83	42.59	11.02
Sounder Uncertain	0.98	1.37	3.16
Sounder Cloudy	2.25	2.23	3.56

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	30.47	43.44	12.54
Sounder Uncertain	0.86	1.35	3.30
Sounder Cloudy	2.14	2.29	3.61

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.57	0.84	0.54
Frequency Bias	2.10	0.14	0.44
Probability of Detection	0.90	0.02	0.20
False Alarm Rate	0.85	0.08	0.07

Overall Skill Score

Skill Score	Value
Proportion Correct	0.418
Kuiper Skill Score	0.040
Heidke Skill Score	0.042

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.62	0.75	0.56
Frequency Bias	2.40	0.12	0.45
Probability of Detection	0.91	0.03	0.20
False Alarm Rate	0.86	0.07	0.07

Overall Skill Score

Skill Score	Value
Proportion Correct	0.378
Kuiper Skill Score	0.042
Heidke Skill Score	0.040

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.65	0.76	0.55
Frequency Bias	2.58	0.12	0.41
Probability of Detection	0.91	0.03	0.19
False Alarm Rate	0.87	0.06	0.07

Overall Skill Score

Skill Score	Value

Proportion Correct	0.354
Kuiper Skill Score	0.037
Heidke Skill Score	0.035

INSAT-3D Sounder vs MODIS for March , 2017 (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	14980	14285	6876
Sounder Uncertain	578	578	2148
Sounder Cloudy	224	152	2611

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	13737	15357	7047
Sounder Uncertain	448	758	2098
Sounder Cloudy	170	232	2585

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	12748	15426	7967
Sounder Uncertain	381	724	2199
Sounder Cloudy	148	229	2610

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	35.30	33.67	16.20
Sounder Uncertain	1.36	1.36	5.06
Sounder Cloudy	0.53	0.36	6.15

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	32.37	36.19	16.61
Sounder Uncertain	1.06	1.79	4.94
Sounder Cloudy	0.40	0.55	6.09

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	30.04	36.35	18.78
Sounder Uncertain	0.90	1.71	5.18
Sounder Cloudy	0.35	0.54	6.15

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.59	0.83	0.13
Frequency Bias	2.29	0.22	0.26
Probability of Detection	0.95	0.04	0.22
False Alarm Rate	0.87	0.11	0.02

Overall Skill Score

Skill Score	Value
Proportion Correct	0.428
Kuiper Skill Score	0.098
Heidke Skill Score	0.101

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy

False Alarm Ratio	0.62	0.77	0.13
Frequency Bias	2.52	0.20	0.25
Probability of Detection	0.96	0.05	0.22
False Alarm Rate	0.88	0.10	0.02

Overall Skill Score

Skill Score	Value
Proportion Correct	0.403
Kuiper Skill Score	0.098
Heidke Skill Score	0.098

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.65	0.78	0.13
Frequency Bias	2.72	0.20	0.23
Probability of Detection	0.96	0.04	0.20
False Alarm Rate	0.89	0.10	0.01

Overall Skill Score

Skill Score	Value
Proportion Correct	0.379
Kuiper Skill Score	0.092
Heidke Skill Score	0.090

INSAT-3D Sounder vs MODIS for March , 2017 (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	16046	17339	2625
Sounder Uncertain	489	179	625
Sounder Cloudy	1973	1274	479

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	13665	20192	2153
Sounder Uncertain	369	385	539
Sounder Cloudy	1708	1630	388

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	12683	20831	2496
Sounder Uncertain	336	401	556
Sounder Cloudy	1635	1686	405

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	39.11	42.26	6.40
Sounder Uncertain	1.19	0.44	1.52
Sounder Cloudy	4.81	3.11	1.17

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	33.31	49.21	5.25
Sounder Uncertain	0.90	0.94	1.31
Sounder Cloudy	4.16	3.97	0.95

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	30.91	50.77	6.08

Sounder Uncertain	0.82	0.98	1.36
Sounder Cloudy	3.98	4.11	0.99

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.55	0.86	0.87
Frequency Bias	1.95	0.07	1.00
Probability of Detection	0.87	0.01	0.13
False Alarm Rate	0.82	0.05	0.13

Overall Skill Score

Skill Score	Value
Proportion Correct	0.407
Kuiper Skill Score	-0.020
Heidke Skill Score	-0.020

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.62	0.70	0.90
Frequency Bias	2.29	0.06	1.21
Probability of Detection	0.87	0.02	0.13
False Alarm Rate	0.84	0.03	0.13

Overall Skill Score

Skill Score	Value
Proportion Correct	0.352
Kuiper Skill Score	-0.016
Heidke Skill Score	-0.014

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.65	0.69	0.89

Frequency Bias	2.46	0.06	1.08
Probability of Detection	0.87	0.02	0.12
False Alarm Rate	0.85	0.03	0.12

Overall Skill Score

Skill Score	Value
Proportion Correct	0.329
Kuiper Skill Score	-0.018
Heidke Skill Score	-0.015

INSAT-3D Sounder vs MODIS for March , 2017 (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	481	134	142
Sounder Uncertain	114	25	59
Sounder Cloudy	100	26	94

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	410	247	100
Sounder Uncertain	95	58	45
Sounder Cloudy	88	48	84

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	359	281	117

Sounder Uncertain	85	67	46
Sounder Cloudy	73	60	87

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	40.94	11.40	12.09
Sounder Uncertain	9.70	2.13	5.02
Sounder Cloudy	8.51	2.21	8.00

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	34.89	21.02	8.51
Sounder Uncertain	8.09	4.94	3.83
Sounder Cloudy	7.49	4.09	7.15

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	30.55	23.91	9.96
Sounder Uncertain	7.23	5.70	3.91
Sounder Cloudy	6.21	5.11	7.40

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.36	0.87	0.57
Frequency Bias	1.09	1.07	0.75
Probability of Detection	0.69	0.14	0.32
False Alarm Rate	0.48	0.30	0.22

Overall Skill Score

Skill Score	Value
Proportion Correct	0.511
Kuiper Skill Score	0.100
Heidke Skill Score	0.103

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.46	0.71	0.62
Frequency Bias	1.28	0.56	0.96
Probability of Detection	0.69	0.16	0.37
False Alarm Rate	0.56	0.22	0.22

Overall Skill Score

Skill Score	Value
Proportion Correct	0.470
Kuiper Skill Score	0.093
Heidke Skill Score	0.098

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.53	0.66	0.60
Frequency Bias	1.46	0.49	0.88
Probability of Detection	0.69	0.16	0.35
False Alarm Rate	0.60	0.20	0.20

Overall Skill Score

Skill Score	Value
Proportion Correct	0.437
Kuiper Skill Score	0.086
Heidke Skill Score	0.089

INSAT-3D Sounder vs MODIS for March , 2017 (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	296	37	69
Sounder Uncertain	105	13	35
Sounder Cloudy	72	9	78

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	269	81	52
Sounder Uncertain	87	42	24
Sounder Cloudy	61	30	68

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	252	90	60
Sounder Uncertain	78	50	25
Sounder Cloudy	56	33	70

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	41.46	5.18	9.66
Sounder Uncertain	14.71	1.82	4.90
Sounder Cloudy	10.08	1.26	10.92

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	37.68	11.34	7.28
Sounder Uncertain	12.18	5.88	3.36
Sounder Cloudy	8.54	4.20	9.52

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	35.29	12.61	8.40
Sounder Uncertain	10.92	7.00	3.50
Sounder Cloudy	7.84	4.62	9.80

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.26	0.92	0.51
Frequency Bias	0.85	2.59	0.87
Probability of Detection	0.63	0.22	0.43
False Alarm Rate	0.32	0.43	0.25

Overall Skill Score

Skill Score	Value
Proportion Correct	0.542
Kuiper Skill Score	0.193
Heidke Skill Score	0.171

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.33	0.73	0.57
Frequency Bias	0.96	1.00	1.10
Probability of Detection	0.65	0.27	0.47
False Alarm Rate	0.40	0.33	0.27

Overall Skill Score

Skill Score	Value
Proportion Correct	0.531
Kuiper Skill Score	0.194
Heidke Skill Score	0.192

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.37	0.67	0.56
Frequency Bias	1.04	0.88	1.03
Probability of Detection	0.65	0.29	0.45
False Alarm Rate	0.44	0.30	0.26

Overall Skill Score

Skill Score	Value
Proportion Correct	0.521
Kuiper Skill Score	0.193
Heidke Skill Score	0.195

INSAT-3D Sounder vs MODIS for March , 2017 (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	185	97	73
Sounder Uncertain	9	12	24
Sounder Cloudy	28	17	16

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	141	166	48
Sounder Uncertain	8	16	21
Sounder Cloudy	27	18	16

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	107	191	57
Sounder Uncertain	7	17	21
Sounder Cloudy	17	27	17

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	40.13	21.04	15.84
Sounder Uncertain	1.95	2.60	5.21
Sounder Cloudy	6.07	3.69	3.47

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	30.59	36.01	10.41
Sounder Uncertain	1.74	3.47	4.56
Sounder Cloudy	5.86	3.90	3.47

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	23.21	41.43	12.36
Sounder Uncertain	1.52	3.69	4.56
Sounder Cloudy	3.69	5.86	3.69

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.48	0.73	0.74
Frequency Bias	1.60	0.36	0.54
Probability of Detection	0.83	0.10	0.14
False Alarm Rate	0.69	0.13	0.18

Overall Skill Score

Skill Score	Value
Proportion Correct	0.462
Kuiper Skill Score	0.051
Heidke Skill Score	0.056

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.60	0.64	0.74
Frequency Bias	2.02	0.23	0.72
Probability of Detection	0.80	0.08	0.19
False Alarm Rate	0.74	0.10	0.16

Overall Skill Score

Skill Score	Value
Proportion Correct	0.375
Kuiper Skill Score	0.023
Heidke Skill Score	0.023

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.70	0.62	0.72
Frequency Bias	2.71	0.19	0.64
Probability of Detection	0.82	0.07	0.18
False Alarm Rate	0.78	0.09	0.14

Overall Skill Score

Skill Score	Value

Proportion Correct	0.306
Kuiper Skill Score	0.016
Heidke Skill Score	0.014

INSAT-3D Sounder vs MODIS for March , 2017 (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	1968	184	1439
Sounder Uncertain	2149	128	2636
Sounder Cloudy	2559	245	6884

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1628	895	1068
Sounder Uncertain	1385	1614	1914
Sounder Cloudy	1717	1979	5992

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1449	963	1179
Sounder Uncertain	1151	1612	2150
Sounder Cloudy	1428	1995	6265

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	10.82	1.01	7.91
Sounder Uncertain	11.81	0.70	14.49
Sounder Cloudy	14.07	1.35	37.84

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	8.95	4.92	5.87
Sounder Uncertain	7.61	8.87	10.52
Sounder Cloudy	9.44	10.88	32.94

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	7.97	5.29	6.48
Sounder Uncertain	6.33	8.86	11.82
Sounder Cloudy	7.85	10.97	34.44

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.45	0.97	0.29
Frequency Bias	0.54	8.82	0.88
Probability of Detection	0.29	0.23	0.63
False Alarm Rate	0.18	0.52	0.30

Overall Skill Score

Skill Score	Value
Proportion Correct	0.494
Kuiper Skill Score	0.184
Heidke Skill Score	0.154

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy

False Alarm Ratio	0.55	0.67	0.38
Frequency Bias	0.76	1.09	1.08
Probability of Detection	0.34	0.36	0.67
False Alarm Rate	0.22	0.37	0.41

Overall Skill Score

Skill Score	Value
Proportion Correct	0.508
Kuiper Skill Score	0.202
Heidke Skill Score	0.205

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.60	0.67	0.35
Frequency Bias	0.89	1.08	1.01
Probability of Detection	0.36	0.35	0.65
False Alarm Rate	0.24	0.37	0.39

Overall Skill Score

Skill Score	Value
Proportion Correct	0.513
Kuiper Skill Score	0.197
Heidke Skill Score	0.198

INSAT-3D Sounder vs MODIS for March , 2017 (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	593	42	407
Sounder Uncertain	1229	72	1632
Sounder Cloudy	2064	170	6408

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	401	407	234
Sounder Uncertain	620	1218	1095
Sounder Cloudy	1303	1721	5618

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	332	415	295
Sounder Uncertain	453	1201	1279
Sounder Cloudy	1068	1716	5858

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	4.70	0.33	3.23
Sounder Uncertain	9.74	0.57	12.93
Sounder Cloudy	16.36	1.35	50.79

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	3.18	3.23	1.85
Sounder Uncertain	4.91	9.65	8.68
Sounder Cloudy	10.33	13.64	44.53

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	2.63	3.29	2.34

Sounder Uncertain	3.59	9.52	10.14
Sounder Cloudy	8.46	13.60	46.43

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.43	0.98	0.26
Frequency Bias	0.27	10.33	1.02
Probability of Detection	0.15	0.25	0.76
False Alarm Rate	0.08	0.52	0.40

Overall Skill Score

Skill Score	Value
Proportion Correct	0.561
Kuiper Skill Score	0.156
Heidke Skill Score	0.140

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.62	0.58	0.35
Frequency Bias	0.45	0.88	1.24
Probability of Detection	0.17	0.36	0.81
False Alarm Rate	0.12	0.32	0.56

Overall Skill Score

Skill Score	Value
Proportion Correct	0.574
Kuiper Skill Score	0.202
Heidke Skill Score	0.219

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.68	0.59	0.32

Frequency Bias	0.56	0.88	1.16
Probability of Detection	0.18	0.36	0.79
False Alarm Rate	0.14	0.33	0.53

Overall Skill Score

Skill Score	Value
Proportion Correct	0.586
Kuiper Skill Score	0.194
Heidke Skill Score	0.208

INSAT-3D Sounder vs MODIS for March , 2017 (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	1375	142	1032
Sounder Uncertain	920	56	1004
Sounder Cloudy	495	75	476

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1227	488	834
Sounder Uncertain	765	396	819
Sounder Cloudy	414	258	374

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1117	548	884

Sounder Uncertain	698	411	871
Sounder Cloudy	360	279	407

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	24.66	2.55	18.51
Sounder Uncertain	16.50	1.00	18.01
Sounder Cloudy	8.88	1.35	8.54

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	22.01	8.75	14.96
Sounder Uncertain	13.72	7.10	14.69
Sounder Cloudy	7.43	4.63	6.71

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	20.04	9.83	15.86
Sounder Uncertain	12.52	7.37	15.62
Sounder Cloudy	6.46	5.00	7.30

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.46	0.97	0.54
Frequency Bias	0.91	7.25	0.42
Probability of Detection	0.49	0.21	0.19
False Alarm Rate	0.32	0.52	0.16

Overall Skill Score

Skill Score	Value
Proportion Correct	0.342
Kuiper Skill Score	0.021
Heidke Skill Score	0.017

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.52	0.80	0.64
Frequency Bias	1.06	1.73	0.52
Probability of Detection	0.51	0.35	0.18
False Alarm Rate	0.37	0.44	0.19

Overall Skill Score

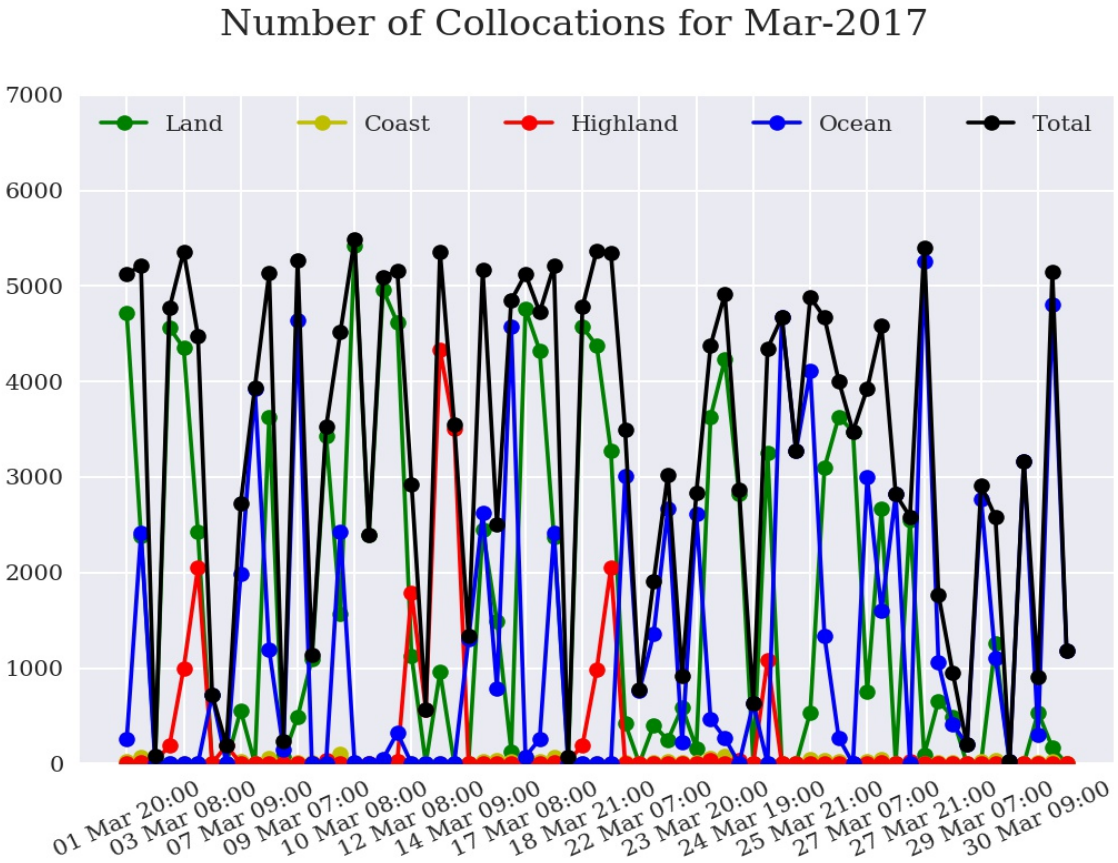
Skill Score	Value
Proportion Correct	0.358
Kuiper Skill Score	0.031
Heidke Skill Score	0.030

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.56	0.79	0.61
Frequency Bias	1.17	1.60	0.48
Probability of Detection	0.51	0.33	0.19
False Alarm Rate	0.39	0.43	0.18

Overall Skill Score

Skill Score	Value
Proportion Correct	0.347
Kuiper Skill Score	0.026
Heidke Skill Score	0.025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Highland
Ocean
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07 Mar 09:00
09 Mar 07:00
10 Mar 08:00
12 Mar 08:00
14 Mar 09:00
17 Mar 08:00
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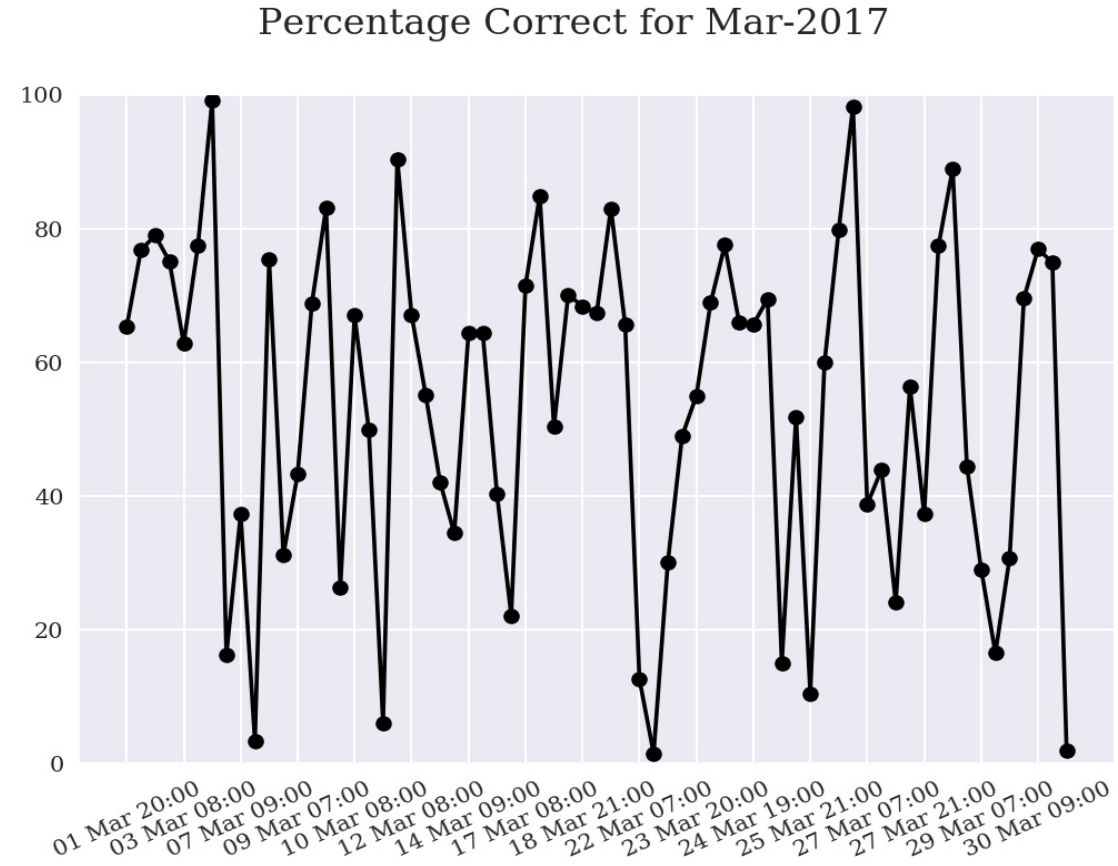
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18 Mar 21:00
22 Mar 07:00
23 Mar 20:00
24 Mar 19:00
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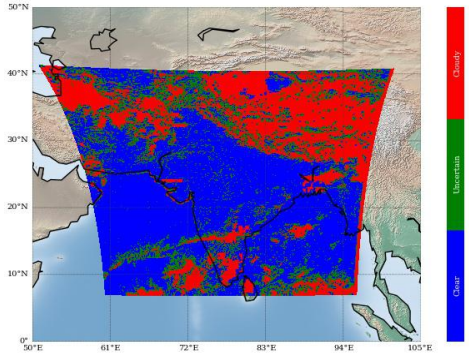
30 Mar 09:00

INSAT-3D Sounder Cloud Mask on
05 March, 2017 09:00 UTC



Modis Cloud Mask on
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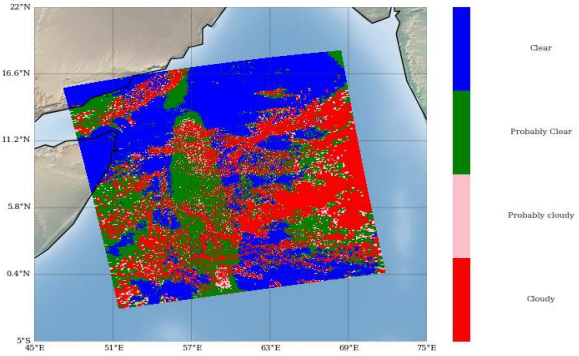
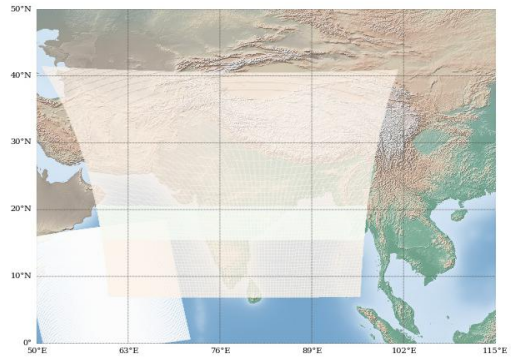
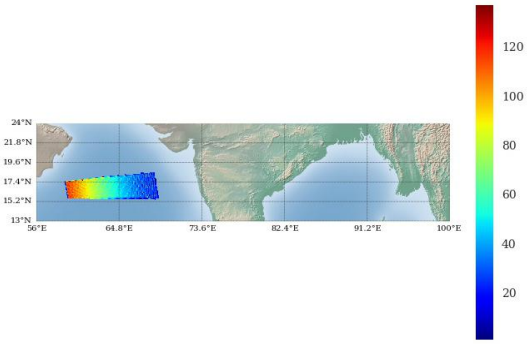


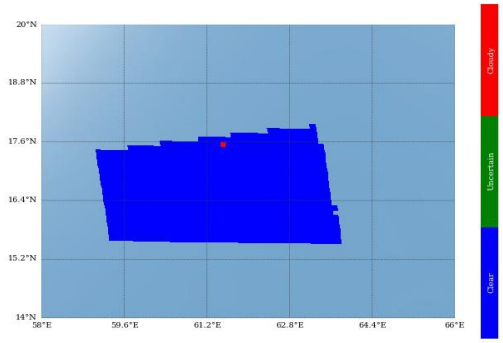
MODIS pass over INSAT-3D Sounder on
05 March, 2017 09:30 UTC



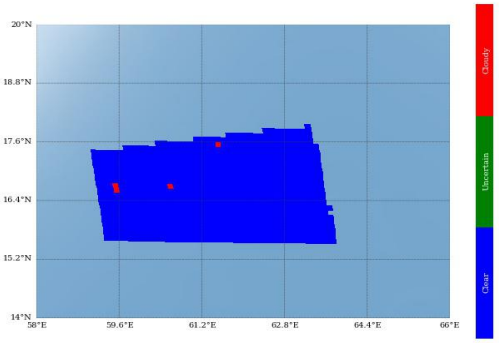
Number of Modis Pixels per Sounder Pixels on a
spatially and Temporally Collocated Domain on
05 March, 2017 09:30 UTC



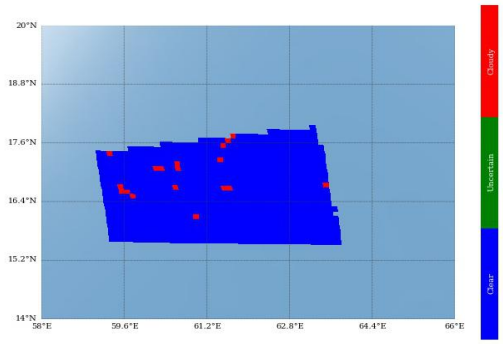
Modis Cloud Mask on Sounder Grid
Method 1 : Mode of Modis pixels



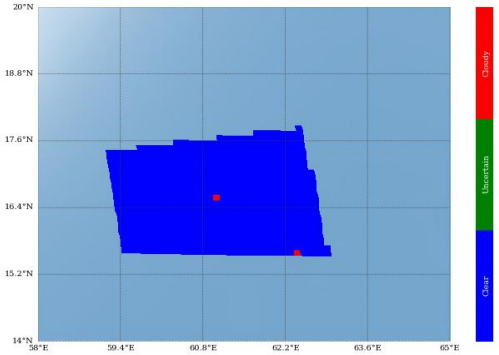
Modis Cloud Mask on Sounder Grid
Method 2 : Weighted Average



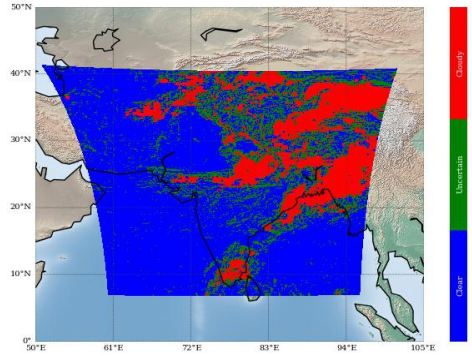
Modis Cloud Mask on Sounder Grid
Method 3 : Weighted Product Average



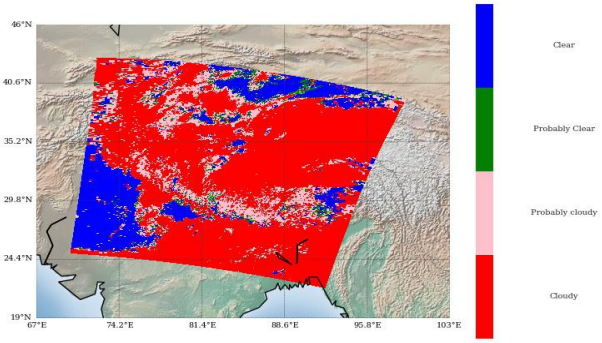
Sounder Cloud Flag on Collocated Area



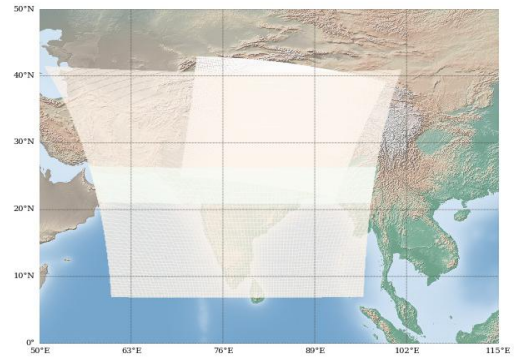
INSAT-3D Sounder Cloud Mask on
10 March, 2017 20:00 UTC



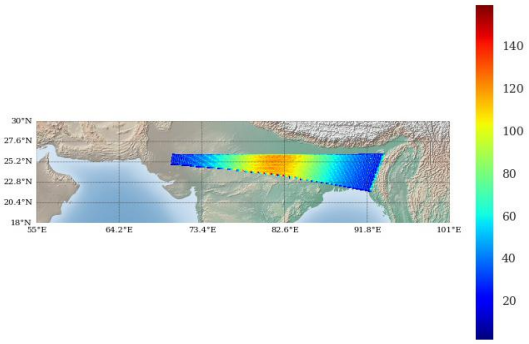
Modis Cloud Mask on
10 March, 2017 20:20 UTC



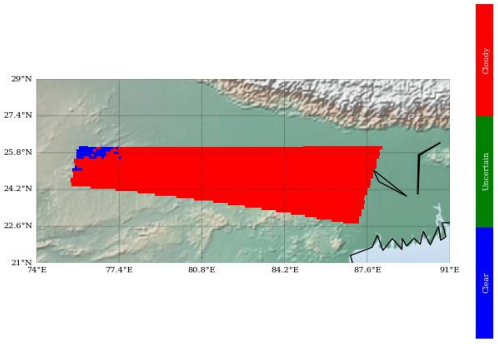
MODIS pass over INSAT-3D Sounder on
10 March, 2017 20:20 UTC



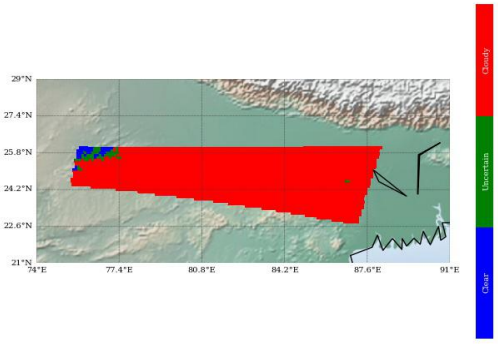
Number of Modis Pixels per Sounder Pixels on a
spatially and Temporally Collocated Domain on
10 March, 2017 20:20 UTC



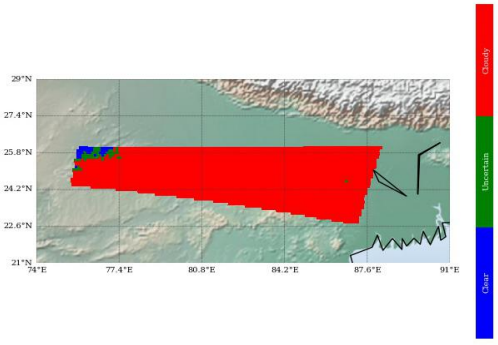
Modis Cloud Mask on Sounder Grid
Method 1 : Mode of Modis pixels



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