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 September , 2016 (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	32768	16616	28105
Sounder Uncertain	4676	2372	19605
Sounder Cloudy	3246	1528	58065

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	25920	27033	24536
Sounder Uncertain	3055	5356	18242
Sounder Cloudy	2415	3235	57189

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	22135	28738	26616
Sounder Uncertain	2474	5212	18967
Sounder Cloudy	1950	3261	57628

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	19.62	9.95	16.83
Sounder Uncertain	2.80	1.42	11.74
Sounder Cloudy	1.94	0.92	34.77

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	15.52	16.19	14.69
Sounder Uncertain	1.83	3.21	10.92
Sounder Cloudy	1.45	1.94	34.25

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	13.26	17.21	15.94
Sounder Uncertain	1.48	3.12	11.36
Sounder Cloudy	1.17	1.95	34.51

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.58	0.91	0.08
Frequency Bias	1.90	1.30	0.59
Probability of Detection	0.81	0.12	0.55
False Alarm Rate	0.61	0.33	0.06

Overall Skill Score

Skill Score	Value
Proportion Correct	0.558
Kuiper Skill Score	0.357
Heidke Skill Score	0.297

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.67	0.80	0.09
Frequency Bias	2.47	0.75	0.63
Probability of Detection	0.83	0.15	0.57
False Alarm Rate	0.66	0.27	0.07

Overall Skill Score

Skill Score	Value
Proportion Correct	0.530
Kuiper Skill Score	0.327
Heidke Skill Score	0.280

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.71	0.80	0.08
Frequency Bias	2.92	0.72	0.61
Probability of Detection	0.83	0.14	0.56
False Alarm Rate	0.67	0.26	0.06

Overall Skill Score

Skill Score	Value
Proportion Correct	0.509
Kuiper Skill Score	0.307
Heidke Skill Score	0.254

INSAT-3D Sounder vs MODIS for September , 2016 (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	11642	9196	13670
Sounder Uncertain	2319	1386	10905
Sounder Cloudy	2886	1342	32614

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	8562	13829	12117
Sounder Uncertain	1415	3044	10151
Sounder Cloudy	2220	2732	31890

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	6767	14249	13492
Sounder Uncertain	1082	2909	10619
Sounder Cloudy	1792	2801	32249

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	13.54	10.70	15.90
Sounder Uncertain	2.70	1.61	12.69
Sounder Cloudy	3.36	1.56	37.94

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	9.96	16.09	14.10
Sounder Uncertain	1.65	3.54	11.81
Sounder Cloudy	2.58	3.18	37.10

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	7.87	16.58	15.70
Sounder Uncertain	1.26	3.38	12.35
Sounder Cloudy	2.08	3.26	37.52

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.66	0.91	0.11
Frequency Bias	2.05	1.23	0.64
Probability of Detection	0.69	0.12	0.57
False Alarm Rate	0.57	0.33	0.10

Overall Skill Score

Skill Score	Value
Proportion Correct	0.531
Kuiper Skill Score	0.287
Heidke Skill Score	0.234

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.75	0.79	0.13
Frequency Bias	2.83	0.75	0.68
Probability of Detection	0.70	0.16	0.59
False Alarm Rate	0.61	0.27	0.12

Overall Skill Score

Skill Score	Value
Proportion Correct	0.506
Kuiper Skill Score	0.264
Heidke Skill Score	0.221

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.80	0.80	0.12
Frequency Bias	3.58	0.73	0.65
Probability of Detection	0.70	0.15	0.57
False Alarm Rate	0.63	0.27	0.10

Overall Skill Score

Skill Score	Value

Proportion Correct	0.488
Kuiper Skill Score	0.243
Heidke Skill Score	0.193

INSAT-3D Sounder vs MODIS for September , 2016 (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	21126	7420	14435
Sounder Uncertain	2357	986	8700
Sounder Cloudy	360	186	25451

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	17358	13204	12419
Sounder Uncertain	1640	2312	8091
Sounder Cloudy	195	503	25299

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	15368	14489	13124
Sounder Uncertain	1392	2303	8348
Sounder Cloudy	158	460	25379

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	26.07	9.16	17.82
Sounder Uncertain	2.91	1.22	10.74
Sounder Cloudy	0.44	0.23	31.41

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	21.42	16.30	15.33
Sounder Uncertain	2.02	2.85	9.99
Sounder Cloudy	0.24	0.62	31.23

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	18.97	17.88	16.20
Sounder Uncertain	1.72	2.84	10.30
Sounder Cloudy	0.20	0.57	31.32

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.51	0.92	0.02
Frequency Bias	1.80	1.40	0.54
Probability of Detection	0.89	0.11	0.52
False Alarm Rate	0.65	0.33	0.02

Overall Skill Score

Skill Score	Value
Proportion Correct	0.587
Kuiper Skill Score	0.411
Heidke Skill Score	0.350

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy

False Alarm Ratio	0.60	0.81	0.03
Frequency Bias	2.24	0.75	0.57
Probability of Detection	0.90	0.14	0.55
False Alarm Rate	0.71	0.27	0.02

Overall Skill Score

Skill Score	Value
Proportion Correct	0.555
Kuiper Skill Score	0.374
Heidke Skill Score	0.329

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.64	0.81	0.02
Frequency Bias	2.54	0.70	0.55
Probability of Detection	0.91	0.13	0.54
False Alarm Rate	0.73	0.26	0.02

Overall Skill Score

Skill Score	Value
Proportion Correct	0.531
Kuiper Skill Score	0.353
Heidke Skill Score	0.303

INSAT-3D Sounder vs MODIS for September , 2016 (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	16282	5930	9373
Sounder Uncertain	1918	816	6815
Sounder Cloudy	2429	1103	25983

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	13734	10814	7037
Sounder Uncertain	1337	2098	6114
Sounder Cloudy	1991	1981	25543

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	11586	12061	7938
Sounder Uncertain	1064	2055	6430
Sounder Cloudy	1612	2135	25768

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	23.05	8.39	13.27
Sounder Uncertain	2.71	1.16	9.65
Sounder Cloudy	3.44	1.56	36.78

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	19.44	15.31	9.96
Sounder Uncertain	1.89	2.97	8.65
Sounder Cloudy	2.82	2.80	36.15

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	16.40	17.07	11.24

Sounder Uncertain	1.51	2.91	9.10
Sounder Cloudy	2.28	3.02	36.47

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.48	0.91	0.12
Frequency Bias	1.53	1.22	0.70
Probability of Detection	0.79	0.10	0.62
False Alarm Rate	0.56	0.32	0.13

Overall Skill Score

Skill Score	Value
Proportion Correct	0.610
Kuiper Skill Score	0.393
Heidke Skill Score	0.355

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.57	0.78	0.13
Frequency Bias	1.85	0.64	0.76
Probability of Detection	0.80	0.14	0.66
False Alarm Rate	0.61	0.25	0.14

Overall Skill Score

Skill Score	Value
Proportion Correct	0.586
Kuiper Skill Score	0.369
Heidke Skill Score	0.347

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.63	0.78	0.13

Frequency Bias	2.21	0.59	0.74
Probability of Detection	0.81	0.13	0.64
False Alarm Rate	0.64	0.24	0.12

Overall Skill Score

Skill Score	Value
Proportion Correct	0.558
Kuiper Skill Score	0.341
Heidke Skill Score	0.311

INSAT-3D Sounder vs MODIS for September , 2016 (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	8224	1770	5896
Sounder Uncertain	1281	346	3591
Sounder Cloudy	2423	1087	17383

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	5875	6163	3852
Sounder Uncertain	766	1481	2971
Sounder Cloudy	1985	1960	16948

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	4619	6700	4571

Sounder Uncertain	571	1420	3227
Sounder Cloudy	1607	2117	17169

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	19.58	4.21	14.04
Sounder Uncertain	3.05	0.82	8.55
Sounder Cloudy	5.77	2.59	41.39

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	13.99	14.67	9.17
Sounder Uncertain	1.82	3.53	7.07
Sounder Cloudy	4.73	4.67	40.35

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	11.00	15.95	10.88
Sounder Uncertain	1.36	3.38	7.68
Sounder Cloudy	3.83	5.04	40.88

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.48	0.93	0.17
Frequency Bias	1.33	1.63	0.78
Probability of Detection	0.69	0.11	0.65
False Alarm Rate	0.48	0.30	0.22

Overall Skill Score

Skill Score	Value
Proportion Correct	0.618
Kuiper Skill Score	0.362
Heidke Skill Score	0.324

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.63	0.72	0.19
Frequency Bias	1.84	0.54	0.88
Probability of Detection	0.68	0.15	0.71
False Alarm Rate	0.57	0.21	0.22

Overall Skill Score

Skill Score	Value
Proportion Correct	0.579
Kuiper Skill Score	0.326
Heidke Skill Score	0.312

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.71	0.73	0.18
Frequency Bias	2.34	0.51	0.84
Probability of Detection	0.68	0.14	0.69
False Alarm Rate	0.60	0.20	0.20

Overall Skill Score

Skill Score	Value
Proportion Correct	0.553
Kuiper Skill Score	0.295
Heidke Skill Score	0.270

INSAT-3D Sounder vs MODIS for September , 2016 (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	8058	4160	3477
Sounder Uncertain	637	470	3224
Sounder Cloudy	6	16	8600

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	7859	4651	3185
Sounder Uncertain	571	617	3143
Sounder Cloudy	6	21	8595

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	6967	5361	3367
Sounder Uncertain	493	635	3203
Sounder Cloudy	5	18	8599

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	28.13	14.52	12.14
Sounder Uncertain	2.22	1.64	11.25
Sounder Cloudy	0.02	0.06	30.02

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	27.43	16.23	11.12
Sounder Uncertain	1.99	2.15	10.97
Sounder Cloudy	0.02	0.07	30.00

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	24.32	18.71	11.75
Sounder Uncertain	1.72	2.22	11.18
Sounder Cloudy	0.02	0.06	30.02

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.49	0.89	0.00
Frequency Bias	1.80	0.93	0.56
Probability of Detection	0.93	0.10	0.56
False Alarm Rate	0.66	0.34	0.00

Overall Skill Score

Skill Score	Value
Proportion Correct	0.598
Kuiper Skill Score	0.413
Heidke Skill Score	0.380

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.50	0.86	0.00
Frequency Bias	1.86	0.82	0.58
Probability of Detection	0.93	0.12	0.58
False Alarm Rate	0.68	0.32	0.00

Overall Skill Score

Skill Score	Value
Proportion Correct	0.596
Kuiper Skill Score	0.411
Heidke Skill Score	0.382

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.56	0.85	0.00
Frequency Bias	2.10	0.72	0.57
Probability of Detection	0.93	0.11	0.57
False Alarm Rate	0.70	0.30	0.00

Overall Skill Score

Skill Score	Value
Proportion Correct	0.566
Kuiper Skill Score	0.381
Heidke Skill Score	0.348

INSAT-3D Sounder vs MODIS for September , 2016 (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	14964	9851	17536
Sounder Uncertain	1975	1273	11372
Sounder Cloudy	399	318	26850

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	10953	14832	16566
Sounder Uncertain	1201	2446	10973
Sounder Cloudy	218	597	26752

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	9621	15108	17622
Sounder Uncertain	1028	2310	11282
Sounder Cloudy	183	531	26853

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	17.70	11.65	20.74
Sounder Uncertain	2.34	1.51	13.45
Sounder Cloudy	0.47	0.38	31.76

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	12.96	17.54	19.60
Sounder Uncertain	1.42	2.89	12.98
Sounder Cloudy	0.26	0.71	31.64

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	11.38	17.87	20.85
Sounder Uncertain	1.22	2.73	13.35
Sounder Cloudy	0.22	0.63	31.76

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.65	0.91	0.03
Frequency Bias	2.44	1.28	0.49
Probability of Detection	0.86	0.11	0.48
False Alarm Rate	0.66	0.32	0.02

Overall Skill Score

Skill Score	Value
Proportion Correct	0.510
Kuiper Skill Score	0.334
Heidke Skill Score	0.256

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.74	0.83	0.03
Frequency Bias	3.42	0.82	0.51
Probability of Detection	0.89	0.14	0.49
False Alarm Rate	0.71	0.27	0.02

Overall Skill Score

Skill Score	Value
Proportion Correct	0.475
Kuiper Skill Score	0.298
Heidke Skill Score	0.229

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.77	0.84	0.03
Frequency Bias	3.91	0.81	0.49
Probability of Detection	0.89	0.13	0.48
False Alarm Rate	0.72	0.27	0.02

Overall Skill Score

Skill Score	Value

Proportion Correct	0.459
Kuiper Skill Score	0.284
Heidke Skill Score	0.209

INSAT-3D Sounder vs MODIS for September , 2016 (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	2715	7260	7351
Sounder Uncertain	387	978	6622
Sounder Cloudy	57	160	10988

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	2157	7188	7981
Sounder Uncertain	236	1061	6690
Sounder Cloudy	36	147	11022

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1717	7021	8588
Sounder Uncertain	187	951	6849
Sounder Cloudy	33	122	11050

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	7.43	19.88	20.13
Sounder Uncertain	1.06	2.68	18.13
Sounder Cloudy	0.16	0.44	30.09

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	5.91	19.68	21.85
Sounder Uncertain	0.65	2.91	18.32
Sounder Cloudy	0.10	0.40	30.18

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	4.70	19.23	23.52
Sounder Uncertain	0.51	2.60	18.76
Sounder Cloudy	0.09	0.33	30.26

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.84	0.88	0.02
Frequency Bias	5.48	0.95	0.45
Probability of Detection	0.86	0.12	0.44
False Alarm Rate	0.67	0.32	0.01

Overall Skill Score

Skill Score	Value
Proportion Correct	0.402
Kuiper Skill Score	0.214
Heidke Skill Score	0.144

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy

False Alarm Ratio	0.88	0.87	0.02
Frequency Bias	7.13	0.95	0.44
Probability of Detection	0.89	0.13	0.43
False Alarm Rate	0.68	0.31	0.01

Overall Skill Score

Skill Score	Value
Proportion Correct	0.390
Kuiper Skill Score	0.206
Heidke Skill Score	0.131

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.90	0.88	0.01
Frequency Bias	8.94	0.99	0.42
Probability of Detection	0.89	0.12	0.42
False Alarm Rate	0.68	0.31	0.01

Overall Skill Score

Skill Score	Value
Proportion Correct	0.376
Kuiper Skill Score	0.188
Heidke Skill Score	0.113

INSAT-3D Sounder vs MODIS for September , 2016 (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	12249	2591	10185
Sounder Uncertain	1588	295	4750
Sounder Cloudy	342	158	15862

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	8796	7644	8585
Sounder Uncertain	965	1385	4283
Sounder Cloudy	182	450	15730

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	7904	8087	9034
Sounder Uncertain	841	1359	4433
Sounder Cloudy	150	409	15803

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	25.51	5.40	21.21
Sounder Uncertain	3.31	0.61	9.89
Sounder Cloudy	0.71	0.33	33.03

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	18.32	15.92	17.88
Sounder Uncertain	2.01	2.88	8.92
Sounder Cloudy	0.38	0.94	32.76

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	16.46	16.84	18.81

Sounder Uncertain	1.75	2.83	9.23
Sounder Cloudy	0.31	0.85	32.91

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.51	0.96	0.03
Frequency Bias	1.76	2.18	0.53
Probability of Detection	0.86	0.10	0.52
False Alarm Rate	0.65	0.32	0.03

Overall Skill Score

Skill Score	Value
Proportion Correct	0.592
Kuiper Skill Score	0.423
Heidke Skill Score	0.340

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.65	0.79	0.04
Frequency Bias	2.52	0.70	0.57
Probability of Detection	0.88	0.15	0.55
False Alarm Rate	0.73	0.24	0.03

Overall Skill Score

Skill Score	Value
Proportion Correct	0.540
Kuiper Skill Score	0.358
Heidke Skill Score	0.304

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.68	0.80	0.03

Frequency Bias	2.81	0.67	0.56
Probability of Detection	0.89	0.14	0.54
False Alarm Rate	0.75	0.23	0.02

Overall Skill Score

Skill Score	Value
Proportion Correct	0.522
Kuiper Skill Score	0.343
Heidke Skill Score	0.284

INSAT-3D Sounder vs MODIS for September , 2016 (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	211	129	175
Sounder Uncertain	35	10	91
Sounder Cloudy	32	16	240

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	163	222	130
Sounder Uncertain	22	34	80
Sounder Cloudy	20	37	231

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	119	250	146

Sounder Uncertain	10	41	85
Sounder Cloudy	16	38	234

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	22.47	13.74	18.64
Sounder Uncertain	3.73	1.06	9.69
Sounder Cloudy	3.41	1.70	25.56

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	17.36	23.64	13.84
Sounder Uncertain	2.34	3.62	8.52
Sounder Cloudy	2.13	3.94	24.60

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	12.67	26.62	15.55
Sounder Uncertain	1.06	4.37	9.05
Sounder Cloudy	1.70	4.05	24.92

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.59	0.93	0.17
Frequency Bias	1.85	0.88	0.57
Probability of Detection	0.76	0.06	0.47
False Alarm Rate	0.64	0.26	0.10

Overall Skill Score

Skill Score	Value
Proportion Correct	0.491
Kuiper Skill Score	0.234
Heidke Skill Score	0.215

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.68	0.75	0.20
Frequency Bias	2.51	0.46	0.65
Probability of Detection	0.80	0.12	0.52
False Alarm Rate	0.69	0.20	0.11

Overall Skill Score

Skill Score	Value
Proportion Correct	0.456
Kuiper Skill Score	0.231
Heidke Skill Score	0.212

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.77	0.70	0.19
Frequency Bias	3.55	0.41	0.62
Probability of Detection	0.82	0.12	0.50
False Alarm Rate	0.73	0.17	0.10

Overall Skill Score

Skill Score	Value
Proportion Correct	0.420
Kuiper Skill Score	0.217
Heidke Skill Score	0.186

INSAT-3D Sounder vs MODIS for September , 2016 (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	90	25	58
Sounder Uncertain	21	4	34
Sounder Cloudy	32	16	152

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	60	76	37
Sounder Uncertain	11	17	31
Sounder Cloudy	20	37	143

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	47	86	40
Sounder Uncertain	8	19	32
Sounder Cloudy	16	38	146

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	20.83	5.79	13.43
Sounder Uncertain	4.86	0.93	7.87
Sounder Cloudy	7.41	3.70	35.19

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	13.89	17.59	8.56
Sounder Uncertain	2.55	3.94	7.18
Sounder Cloudy	4.63	8.56	33.10

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	10.88	19.91	9.26
Sounder Uncertain	1.85	4.40	7.41
Sounder Cloudy	3.70	8.80	33.80

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.48	0.93	0.24
Frequency Bias	1.21	1.31	0.82
Probability of Detection	0.63	0.09	0.62
False Alarm Rate	0.45	0.30	0.26

Overall Skill Score

Skill Score	Value
Proportion Correct	0.569
Kuiper Skill Score	0.288
Heidke Skill Score	0.272

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.65	0.71	0.28
Frequency Bias	1.90	0.45	0.95
Probability of Detection	0.66	0.13	0.68
False Alarm Rate	0.53	0.20	0.27

Overall Skill Score

Skill Score	Value
Proportion Correct	0.509
Kuiper Skill Score	0.252
Heidke Skill Score	0.243

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.73	0.68	0.27
Frequency Bias	2.44	0.41	0.92
Probability of Detection	0.66	0.13	0.67
False Alarm Rate	0.57	0.18	0.25

Overall Skill Score

Skill Score	Value
Proportion Correct	0.491
Kuiper Skill Score	0.240
Heidke Skill Score	0.223

INSAT-3D Sounder vs MODIS for September , 2016 (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	121	104	117
Sounder Uncertain	14	6	57
Sounder Cloudy	0	0	88

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	103	146	93
Sounder Uncertain	11	17	49
Sounder Cloudy	0	0	88

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	72	164	106
Sounder Uncertain	2	22	53
Sounder Cloudy	0	0	88

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	23.87	20.51	23.08
Sounder Uncertain	2.76	1.18	11.24
Sounder Cloudy	0.00	0.00	17.36

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	20.32	28.80	18.34
Sounder Uncertain	2.17	3.35	9.66
Sounder Cloudy	0.00	0.00	17.36

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	14.20	32.35	20.91
Sounder Uncertain	0.39	4.34	10.45
Sounder Cloudy	0.00	0.00	17.36

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.65	0.92	0.00
Frequency Bias	2.53	0.70	0.34
Probability of Detection	0.90	0.05	0.34
False Alarm Rate	0.76	0.24	0.00

Overall Skill Score

Skill Score	Value
Proportion Correct	0.424
Kuiper Skill Score	0.198
Heidke Skill Score	0.175

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.70	0.78	0.00
Frequency Bias	3.00	0.47	0.38
Probability of Detection	0.90	0.10	0.38
False Alarm Rate	0.80	0.20	0.00

Overall Skill Score

Skill Score	Value
Proportion Correct	0.410
Kuiper Skill Score	0.205
Heidke Skill Score	0.182

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.79	0.71	0.00
Frequency Bias	4.62	0.41	0.36
Probability of Detection	0.97	0.12	0.36
False Alarm Rate	0.83	0.17	0.00

Overall Skill Score

Skill Score	Value

Proportion Correct	0.359
Kuiper Skill Score	0.198
Heidke Skill Score	0.158

INSAT-3D Sounder vs MODIS for September , 2016 (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	336	184	273
Sounder Uncertain	627	167	893
Sounder Cloudy	252	30	3674

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	276	303	214
Sounder Uncertain	397	618	672
Sounder Cloudy	81	508	3367

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	231	310	252
Sounder Uncertain	296	637	754
Sounder Cloudy	54	440	3462

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	5.22	2.86	4.24
Sounder Uncertain	9.74	2.59	13.88
Sounder Cloudy	3.92	0.47	57.09

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	4.29	4.71	3.33
Sounder Uncertain	6.17	9.60	10.44
Sounder Cloudy	1.26	7.89	52.32

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	3.59	4.82	3.92
Sounder Uncertain	4.60	9.90	11.72
Sounder Cloudy	0.84	6.84	53.79

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.58	0.90	0.07
Frequency Bias	0.65	4.43	0.82
Probability of Detection	0.28	0.44	0.76
False Alarm Rate	0.20	0.67	0.12

Overall Skill Score

Skill Score	Value
Proportion Correct	0.649
Kuiper Skill Score	0.374
Heidke Skill Score	0.297

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy

False Alarm Ratio	0.65	0.63	0.15
Frequency Bias	1.05	1.18	0.93
Probability of Detection	0.37	0.43	0.79
False Alarm Rate	0.24	0.49	0.27

Overall Skill Score

Skill Score	Value
Proportion Correct	0.662
Kuiper Skill Score	0.366
Heidke Skill Score	0.352

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.71	0.62	0.12
Frequency Bias	1.36	1.22	0.89
Probability of Detection	0.40	0.46	0.77
False Alarm Rate	0.27	0.50	0.23

Overall Skill Score

Skill Score	Value
Proportion Correct	0.673
Kuiper Skill Score	0.385
Heidke Skill Score	0.353

INSAT-3D Sounder vs MODIS for September , 2016 (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	205	11	77
Sounder Uncertain	554	12	483
Sounder Cloudy	241	22	3237

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	155	95	43
Sounder Uncertain	341	411	297
Sounder Cloudy	74	481	2945

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	135	106	52
Sounder Uncertain	265	440	344
Sounder Cloudy	51	412	3037

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	4.23	0.23	1.59
Sounder Uncertain	11.44	0.25	9.98
Sounder Cloudy	4.98	0.45	66.85

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	3.20	1.96	0.89
Sounder Uncertain	7.04	8.49	6.13
Sounder Cloudy	1.53	9.93	60.82

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	2.79	2.19	1.07

Sounder Uncertain	5.47	9.09	7.10
Sounder Cloudy	1.05	8.51	62.72

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.30	0.99	0.08
Frequency Bias	0.29	23.31	0.92
Probability of Detection	0.20	0.27	0.85
False Alarm Rate	0.06	0.75	0.19

Overall Skill Score

Skill Score	Value
Proportion Correct	0.713
Kuiper Skill Score	0.386
Heidke Skill Score	0.315

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.47	0.61	0.16
Frequency Bias	0.51	1.06	1.07
Probability of Detection	0.27	0.42	0.90
False Alarm Rate	0.10	0.48	0.42

Overall Skill Score

Skill Score	Value
Proportion Correct	0.725
Kuiper Skill Score	0.379
Heidke Skill Score	0.400

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.54	0.58	0.13

Frequency Bias	0.65	1.09	1.02
Probability of Detection	0.30	0.46	0.88
False Alarm Rate	0.13	0.50	0.38

Overall Skill Score

Skill Score	Value
Proportion Correct	0.746
Kuiper Skill Score	0.412
Heidke Skill Score	0.421

INSAT-3D Sounder vs MODIS for September , 2016 (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	131	173	196
Sounder Uncertain	73	155	410
Sounder Cloudy	11	8	437

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	121	208	171
Sounder Uncertain	56	207	375
Sounder Cloudy	7	27	422

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	96	204	200

Sounder Uncertain	31	197	410
Sounder Cloudy	3	28	425

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	8.22	10.85	12.30
Sounder Uncertain	4.58	9.72	25.72
Sounder Cloudy	0.69	0.50	27.42

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	7.59	13.05	10.73
Sounder Uncertain	3.51	12.99	23.53
Sounder Cloudy	0.44	1.69	26.47

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	6.02	12.80	12.55
Sounder Uncertain	1.94	12.36	25.72
Sounder Cloudy	0.19	1.76	26.66

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.74	0.76	0.04
Frequency Bias	2.33	1.90	0.44
Probability of Detection	0.61	0.46	0.42
False Alarm Rate	0.42	0.55	0.02

Overall Skill Score

Skill Score	Value
Proportion Correct	0.454
Kuiper Skill Score	0.274
Heidke Skill Score	0.204

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.76	0.68	0.07
Frequency Bias	2.72	1.44	0.47
Probability of Detection	0.66	0.47	0.44
False Alarm Rate	0.45	0.51	0.04

Overall Skill Score

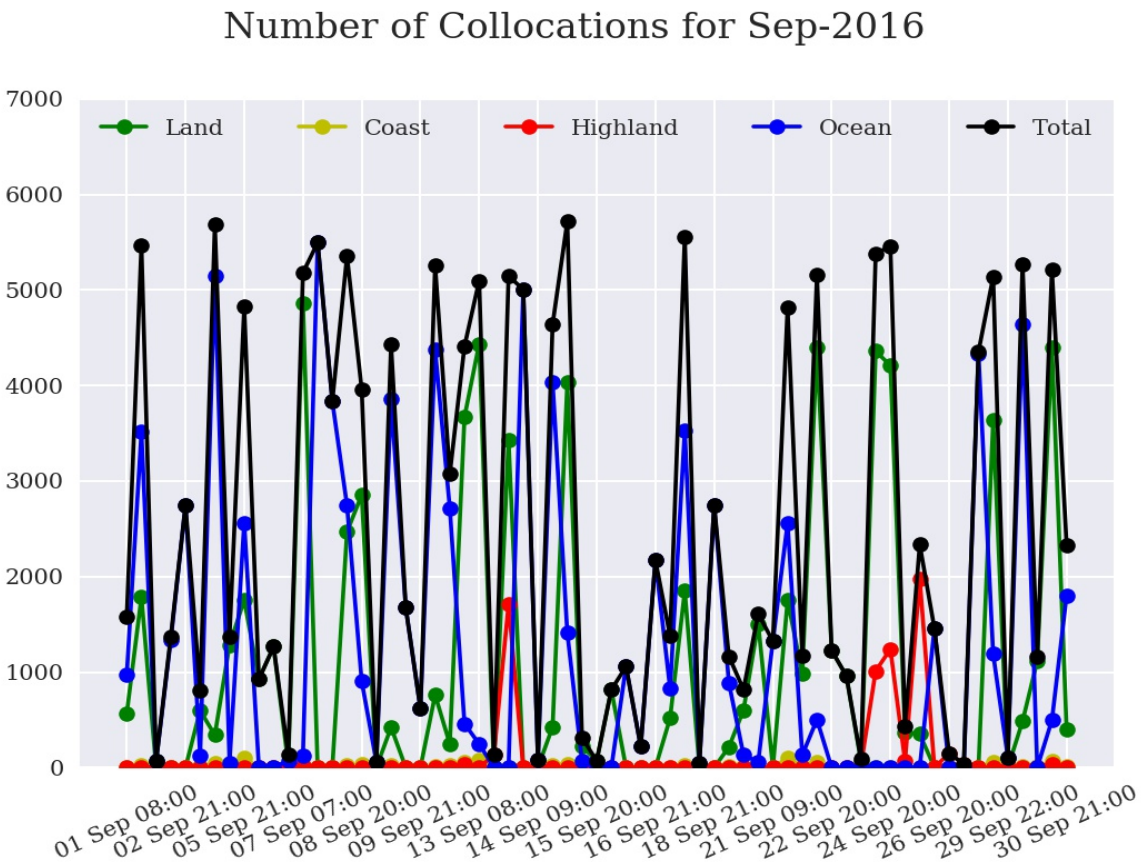
Skill Score	Value
Proportion Correct	0.471
Kuiper Skill Score	0.277
Heidke Skill Score	0.220

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.81	0.69	0.07
Frequency Bias	3.85	1.49	0.44
Probability of Detection	0.74	0.46	0.41
False Alarm Rate	0.46	0.50	0.04

Overall Skill Score

Skill Score	Value
Proportion Correct	0.450
Kuiper Skill Score	0.263
Heidke Skill Score	0.193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Coast
Highland
Ocean
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1000
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05 Sep 21:00
07 Sep 07:00
08 Sep 20:00
09 Sep 21:00
13 Sep 08:00
14 Sep 09:00
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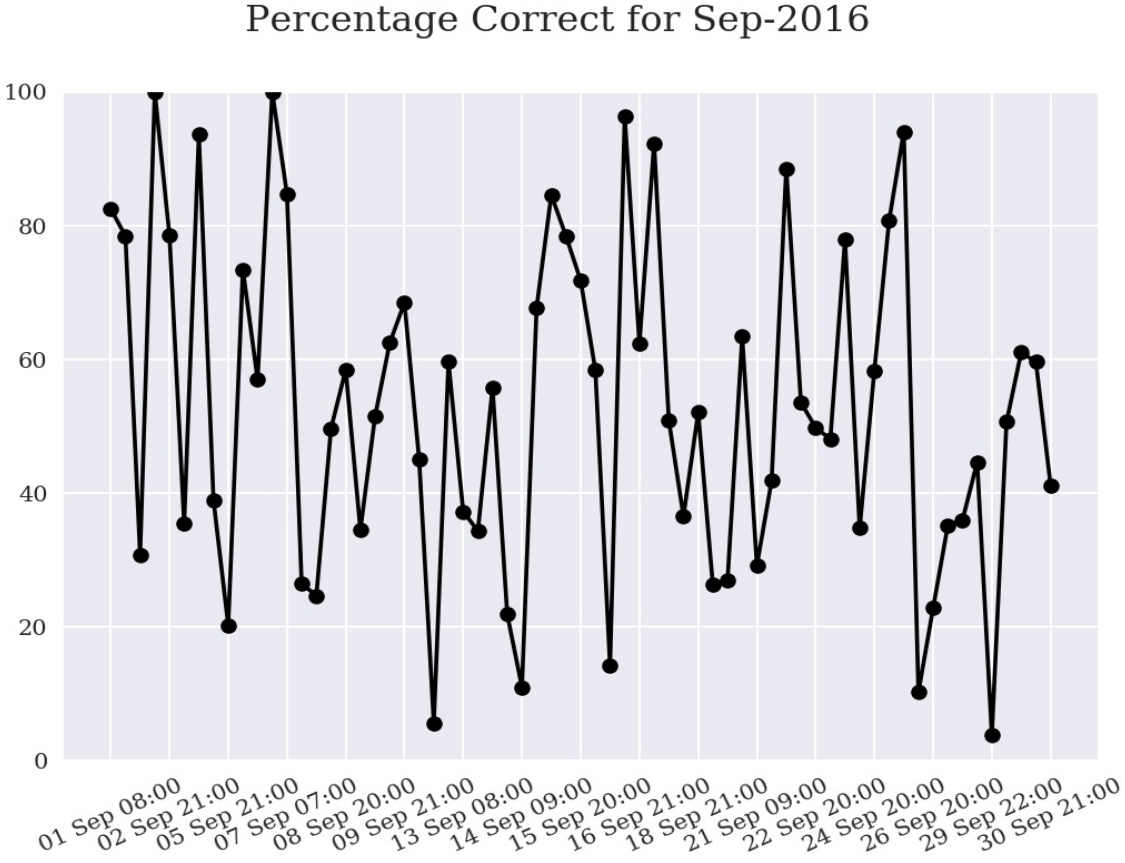
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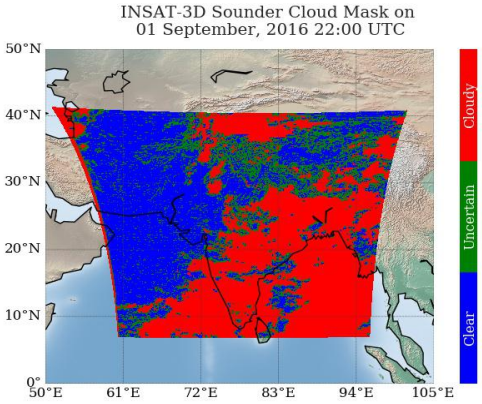
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83°E
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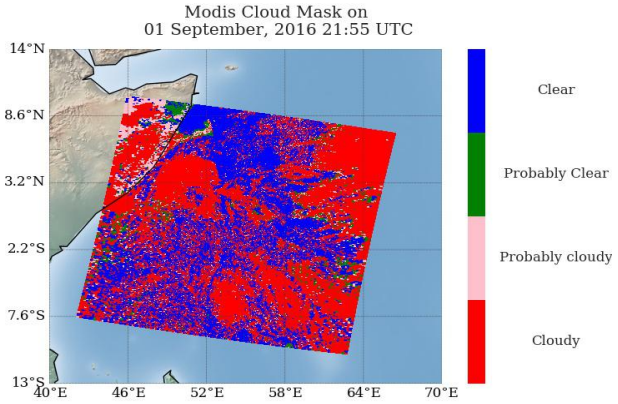
105°E
Cloudy
Uncertain
Clear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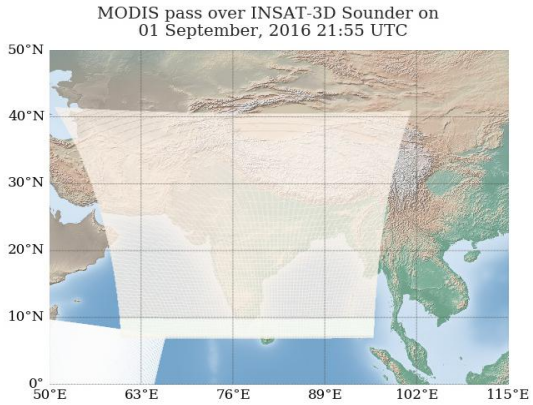
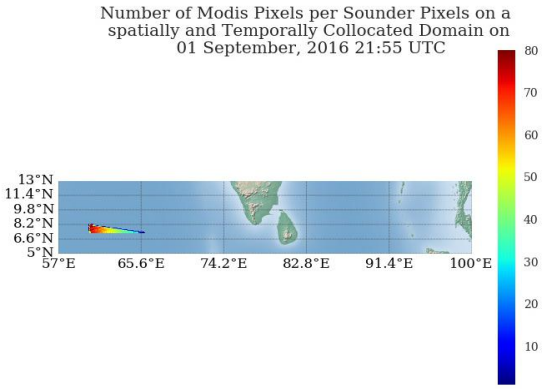
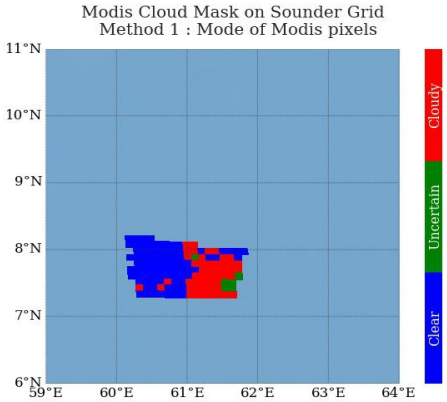
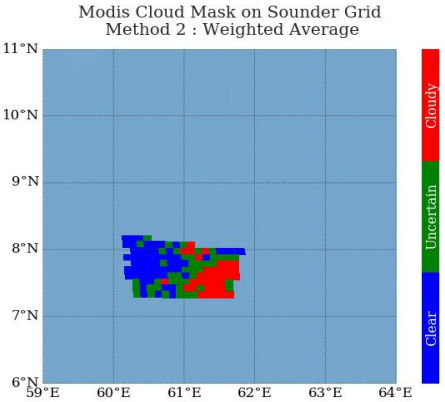
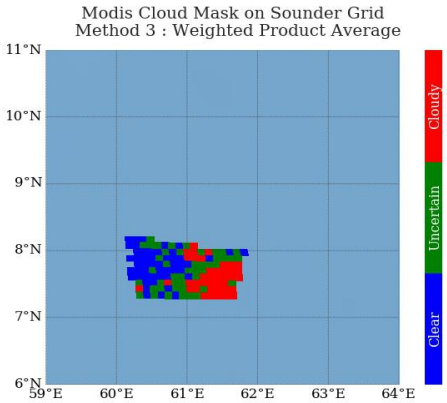
46°E
52°E
58°E
64°E
70°E
Clear
Probably Clear
Probably cloudy
Cloudy

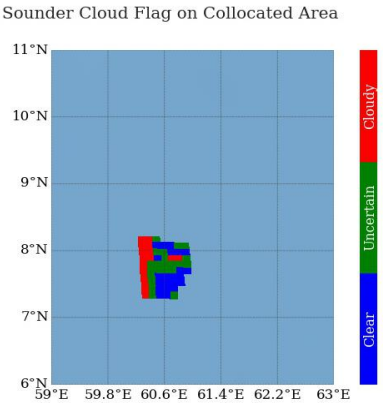

MODIS pass over INSAT-3D Sounder on
01 September, 2016 21:55 UTC
50°N
40°N
30°N
20°N
10°N
0°
50°E
63°E
76°E
89°E
102°E
115°E


Number of Modis Pixels per Sounder Pixels on a
spatially and Temporally Collocated Domain on
01 September, 2016 21:55 UTC
13°N
11.4°N
9.8°N
8.2°N
6.6°N
5°N
57°E
65.6°E
74.2°E
82.8°E
91.4°E
100°E
80
70
60
50
40
30
20
10

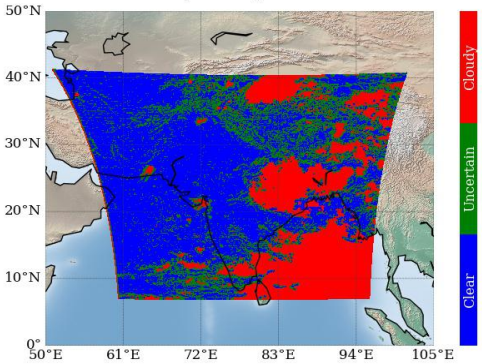

Modis Cloud Mask on Sounder Grid
Method 1 : Mode of Modis pixels
11°N
10°N
9°N
8°N
7°N
6°N
59°E
60°E
61°E
62°E
63°E
64°E
Cloudy
Uncertain
Clear


Modis Cloud Mask on Sounder Grid
Method 2 : Weighted Average
11°N
10°N
9°N
8°N
7°N
6°N
59°E
60°E
61°E
62°E
63°E
64°E
Cloudy
Uncertain
Clear

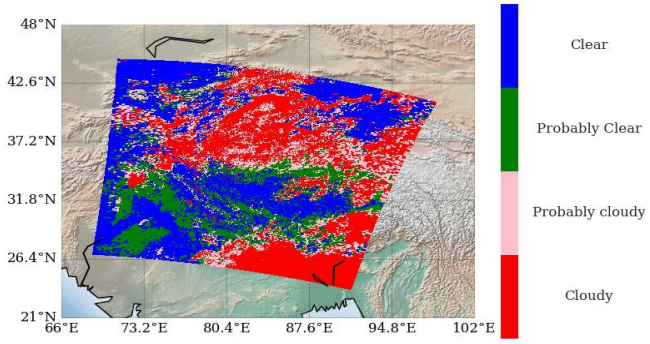

Modis Cloud Mask on Sounder Grid
Method 3 : Weighted Product Average
11°N
10°N
9°N
8°N
7°N
6°N
59°E
60°E
61°E
62°E
63°E
64°E
Cloudy
Uncertain
Clear


Sounder Cloud Flag on Collocated Area
11°N
10°N
9°N
8°N
7°N
6°N
59°E
59.8°E
60.6°E
61.4°E
62.2°E
63°E
Cloudy
Uncertain
Clear

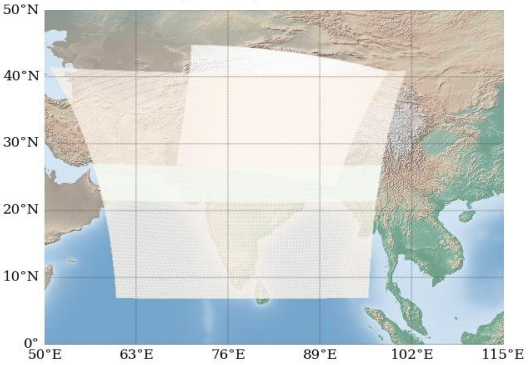
INSAT-3D Sounder Cloud Mask on
06 September, 2016 20:00 UTC



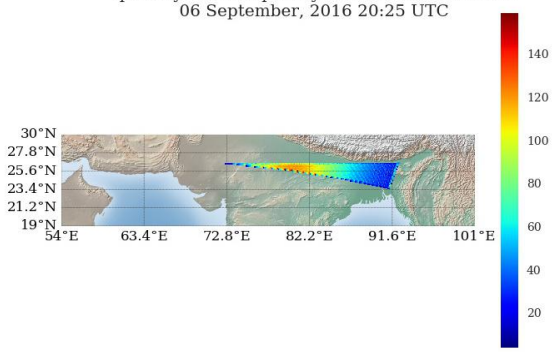
Modis Cloud Mask on
06 September, 2016 20:25 UTC



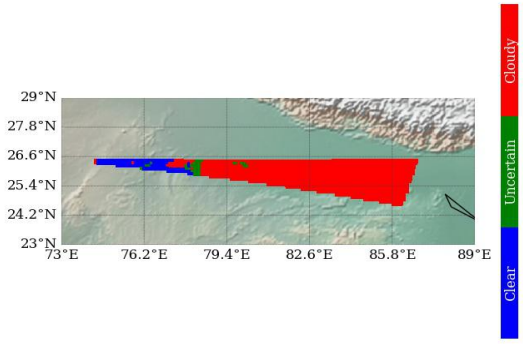
MODIS pass over INSAT-3D Sounder on
06 September, 2016 20:25 UTC



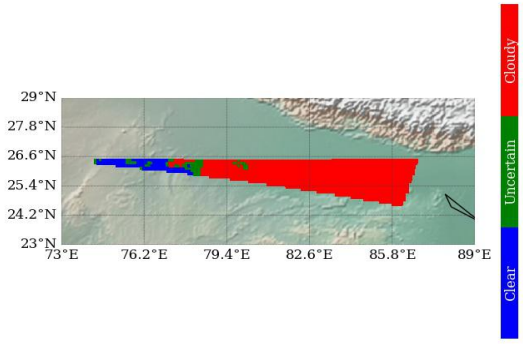
Number of Modis Pixels per Sounder Pixels on a
spatially and Temporally Collocated Domain on
06 September, 2016 20:25 UTC



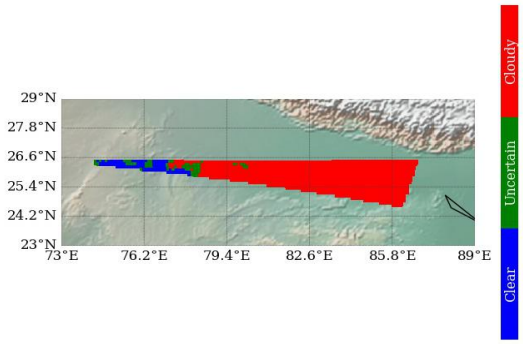
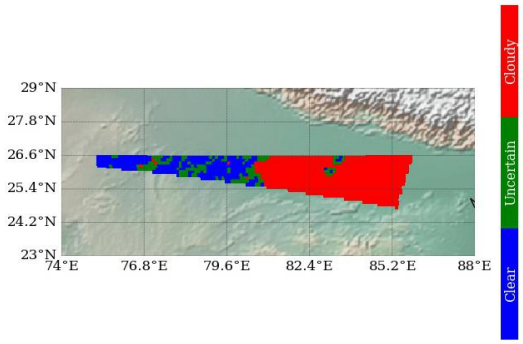
Modis Cloud Mask on Sounder Grid
Method 1 : Mode of Modis pixels



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