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 February , 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	77826	27747	14837
Sounder Uncertain	14525	4627	14717
Sounder Cloudy	5974	863	11247

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	73248	35426	11736
Sounder Uncertain	11809	9781	12279
Sounder Cloudy	4834	3131	10119

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	66461	40318	13631
Sounder Uncertain	10157	10380	13332
Sounder Cloudy	4339	3175	10570

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	45.15	16.10	8.61
Sounder Uncertain	8.43	2.68	8.54
Sounder Cloudy	3.47	0.50	6.53

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	42.50	20.55	6.81
Sounder Uncertain	6.85	5.67	7.12
Sounder Cloudy	2.80	1.82	5.87

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	38.56	23.39	7.91
Sounder Uncertain	5.89	6.02	7.73
Sounder Cloudy	2.52	1.84	6.13

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.35	0.86	0.38
Frequency Bias	1.22	1.02	0.44
Probability of Detection	0.79	0.14	0.28
False Alarm Rate	0.54	0.37	0.09

Overall Skill Score

Skill Score	Value
Proportion Correct	0.544
Kuiper Skill Score	0.142
Heidke Skill Score	0.153

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.39	0.71	0.44
Frequency Bias	1.34	0.70	0.53
Probability of Detection	0.81	0.20	0.30
False Alarm Rate	0.60	0.30	0.10

Overall Skill Score

Skill Score	Value
Proportion Correct	0.540
Kuiper Skill Score	0.164
Heidke Skill Score	0.179

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.45	0.69	0.42
Frequency Bias	1.49	0.63	0.48
Probability of Detection	0.82	0.19	0.28
False Alarm Rate	0.64	0.28	0.09

Overall Skill Score

Skill Score	Value
Proportion Correct	0.507
Kuiper Skill Score	0.149
Heidke Skill Score	0.161

INSAT-3D Sounder vs MODIS for February , 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	47469	11764	4973
Sounder Uncertain	8823	1638	3718
Sounder Cloudy	3920	511	7398

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	45464	15034	3708
Sounder Uncertain	7515	3841	2823
Sounder Cloudy	2963	2318	6548

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	40227	19623	4356
Sounder Uncertain	6488	4539	3152
Sounder Cloudy	2567	2395	6867

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	52.62	13.04	5.51
Sounder Uncertain	9.78	1.82	4.12
Sounder Cloudy	4.35	0.57	8.20

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	50.40	16.66	4.11
Sounder Uncertain	8.33	4.26	3.13
Sounder Cloudy	3.28	2.57	7.26

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	44.59	21.75	4.83
Sounder Uncertain	7.19	5.03	3.49
Sounder Cloudy	2.85	2.65	7.61

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.26	0.88	0.37
Frequency Bias	1.07	1.02	0.74
Probability of Detection	0.79	0.12	0.46
False Alarm Rate	0.50	0.37	0.13

Overall Skill Score

Skill Score	Value
Proportion Correct	0.626
Kuiper Skill Score	0.208
Heidke Skill Score	0.217

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.29	0.73	0.45
Frequency Bias	1.15	0.67	0.90
Probability of Detection	0.81	0.18	0.50
False Alarm Rate	0.55	0.30	0.15

Overall Skill Score

Skill Score	Value
Proportion Correct	0.619
Kuiper Skill Score	0.226
Heidke Skill Score	0.242

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.37	0.68	0.42
Frequency Bias	1.30	0.53	0.82
Probability of Detection	0.82	0.17	0.48
False Alarm Rate	0.62	0.25	0.13

Overall Skill Score

Skill Score	Value

Proportion Correct	0.572
Kuiper Skill Score	0.197
Heidke Skill Score	0.214

INSAT-3D Sounder vs MODIS for February , 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	30357	15983	9864
Sounder Uncertain	5702	2989	10999
Sounder Cloudy	2054	352	3849

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	27784	20392	8028
Sounder Uncertain	4294	5940	9456
Sounder Cloudy	1871	813	3571

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	26234	20695	9275
Sounder Uncertain	3669	5841	10180
Sounder Cloudy	1772	780	3703

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	36.95	19.46	12.01
Sounder Uncertain	6.94	3.64	13.39
Sounder Cloudy	2.50	0.43	4.69

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	33.82	24.82	9.77
Sounder Uncertain	5.23	7.23	11.51
Sounder Cloudy	2.28	0.99	4.35

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	31.93	25.19	11.29
Sounder Uncertain	4.47	7.11	12.39
Sounder Cloudy	2.16	0.95	4.51

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.46	0.85	0.38
Frequency Bias	1.47	1.02	0.25
Probability of Detection	0.80	0.15	0.16
False Alarm Rate	0.57	0.37	0.05

Overall Skill Score

Skill Score	Value
Proportion Correct	0.453
Kuiper Skill Score	0.088
Heidke Skill Score	0.093

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy

False Alarm Ratio	0.51	0.70	0.43
Frequency Bias	1.66	0.73	0.30
Probability of Detection	0.82	0.22	0.17
False Alarm Rate	0.63	0.31	0.06

Overall Skill Score

Skill Score	Value
Proportion Correct	0.454
Kuiper Skill Score	0.111
Heidke Skill Score	0.117

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.53	0.70	0.41
Frequency Bias	1.77	0.72	0.27
Probability of Detection	0.83	0.21	0.16
False Alarm Rate	0.65	0.30	0.06

Overall Skill Score

Skill Score	Value
Proportion Correct	0.436
Kuiper Skill Score	0.107
Heidke Skill Score	0.111

INSAT-3D Sounder vs MODIS for February , 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

MODIS/Sounder			
Sounder Clear	56418	8012	6013
Sounder Uncertain	8943	1936	6543
Sounder Cloudy	2384	414	4471

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	53645	12962	3836
Sounder Uncertain	7525	4507	5390
Sounder Cloudy	1938	1327	4004

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	48001	17846	4596
Sounder Uncertain	6438	5182	5802
Sounder Cloudy	1729	1336	4204

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	59.30	8.42	6.32
Sounder Uncertain	9.40	2.04	6.88
Sounder Cloudy	2.51	0.44	4.70

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	56.39	13.62	4.03
Sounder Uncertain	7.91	4.74	5.67
Sounder Cloudy	2.04	1.39	4.21

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	50.46	18.76	4.83

Sounder Uncertain	6.77	5.45	6.10
Sounder Cloudy	1.82	1.40	4.42

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.20	0.89	0.38
Frequency Bias	1.04	1.68	0.43
Probability of Detection	0.83	0.19	0.26
False Alarm Rate	0.43	0.48	0.09

Overall Skill Score

Skill Score	Value
Proportion Correct	0.660
Kuiper Skill Score	0.222
Heidke Skill Score	0.227

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.24	0.74	0.45
Frequency Bias	1.12	0.93	0.55
Probability of Detection	0.85	0.24	0.30
False Alarm Rate	0.51	0.39	0.10

Overall Skill Score

Skill Score	Value
Proportion Correct	0.653
Kuiper Skill Score	0.230
Heidke Skill Score	0.250

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.32	0.70	0.42

Frequency Bias	1.25	0.72	0.50
Probability of Detection	0.85	0.21	0.29
False Alarm Rate	0.59	0.32	0.08

Overall Skill Score

Skill Score	Value
Proportion Correct	0.603
Kuiper Skill Score	0.191
Heidke Skill Score	0.213

INSAT-3D Sounder vs MODIS for February , 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	29689	6751	2287
Sounder Uncertain	5317	1313	1534
Sounder Cloudy	977	377	2664

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	28476	8908	1343
Sounder Uncertain	4632	2463	1069
Sounder Cloudy	587	1178	2253

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	23908	13061	1758

Sounder Uncertain	3833	3088	1243
Sounder Cloudy	433	1148	2437

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	58.32	13.26	4.49
Sounder Uncertain	10.44	2.58	3.01
Sounder Cloudy	1.92	0.74	5.23

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	55.94	17.50	2.64
Sounder Uncertain	9.10	4.84	2.10
Sounder Cloudy	1.15	2.31	4.43

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	46.96	25.66	3.45
Sounder Uncertain	7.53	6.07	2.44
Sounder Cloudy	0.85	2.26	4.79

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.23	0.84	0.34
Frequency Bias	1.08	0.97	0.62
Probability of Detection	0.83	0.16	0.41
False Alarm Rate	0.52	0.40	0.08

Overall Skill Score

Skill Score	Value
Proportion Correct	0.661
Kuiper Skill Score	0.190
Heidke Skill Score	0.204

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.26	0.70	0.44
Frequency Bias	1.15	0.65	0.86
Probability of Detection	0.85	0.20	0.48
False Alarm Rate	0.58	0.32	0.10

Overall Skill Score

Skill Score	Value
Proportion Correct	0.652
Kuiper Skill Score	0.206
Heidke Skill Score	0.226

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.38	0.62	0.39
Frequency Bias	1.37	0.47	0.74
Probability of Detection	0.85	0.18	0.45
False Alarm Rate	0.69	0.24	0.07

Overall Skill Score

Skill Score	Value
Proportion Correct	0.578
Kuiper Skill Score	0.166
Heidke Skill Score	0.183

INSAT-3D Sounder vs MODIS for February , 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	26729	1261	3726
Sounder Uncertain	3626	623	5009
Sounder Cloudy	1407	37	1807

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	25169	4054	2493
Sounder Uncertain	2893	2044	4321
Sounder Cloudy	1351	149	1751

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	24093	4785	2838
Sounder Uncertain	2605	2094	4559
Sounder Cloudy	1296	188	1767

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	60.44	2.85	8.43
Sounder Uncertain	8.20	1.41	11.33
Sounder Cloudy	3.18	0.08	4.09

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	56.91	9.17	5.64
Sounder Uncertain	6.54	4.62	9.77
Sounder Cloudy	3.05	0.34	3.96

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	54.48	10.82	6.42
Sounder Uncertain	5.89	4.73	10.31
Sounder Cloudy	2.93	0.43	4.00

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.16	0.93	0.44
Frequency Bias	1.00	4.82	0.31
Probability of Detection	0.84	0.32	0.17
False Alarm Rate	0.33	0.57	0.10

Overall Skill Score

Skill Score	Value
Proportion Correct	0.659
Kuiper Skill Score	0.277
Heidke Skill Score	0.257

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.21	0.78	0.46
Frequency Bias	1.08	1.48	0.38
Probability of Detection	0.86	0.33	0.20
False Alarm Rate	0.43	0.47	0.10

Overall Skill Score

Skill Score	Value
Proportion Correct	0.655
Kuiper Skill Score	0.268
Heidke Skill Score	0.280

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.24	0.77	0.46
Frequency Bias	1.13	1.31	0.35
Probability of Detection	0.86	0.30	0.19
False Alarm Rate	0.47	0.44	0.09

Overall Skill Score

Skill Score	Value
Proportion Correct	0.632
Kuiper Skill Score	0.244
Heidke Skill Score	0.260

INSAT-3D Sounder vs MODIS for February , 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	16102	17553	5945
Sounder Uncertain	1424	1148	4380
Sounder Cloudy	171	88	1262

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	14947	18966	5687
Sounder Uncertain	954	2109	3889
Sounder Cloudy	147	128	1246

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	14353	18825	6422
Sounder Uncertain	845	1959	4148
Sounder Cloudy	137	127	1257

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	33.49	36.51	12.37
Sounder Uncertain	2.96	2.39	9.11
Sounder Cloudy	0.36	0.18	2.63

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	31.09	39.45	11.83
Sounder Uncertain	1.98	4.39	8.09
Sounder Cloudy	0.31	0.27	2.59

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	29.86	39.16	13.36
Sounder Uncertain	1.76	4.08	8.63
Sounder Cloudy	0.28	0.26	2.61

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.59	0.83	0.17
Frequency Bias	2.24	0.37	0.13
Probability of Detection	0.91	0.06	0.11
False Alarm Rate	0.79	0.20	0.01

Overall Skill Score

Skill Score	Value
Proportion Correct	0.385
Kuiper Skill Score	0.027
Heidke Skill Score	0.028

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.62	0.70	0.18
Frequency Bias	2.47	0.33	0.14
Probability of Detection	0.93	0.10	0.12
False Alarm Rate	0.83	0.16	0.01

Overall Skill Score

Skill Score	Value
Proportion Correct	0.381
Kuiper Skill Score	0.054
Heidke Skill Score	0.053

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.64	0.72	0.17
Frequency Bias	2.58	0.33	0.13
Probability of Detection	0.94	0.09	0.11
False Alarm Rate	0.83	0.16	0.01

Overall Skill Score

Skill Score	Value

Proportion Correct	0.365
Kuiper Skill Score	0.049
Heidke Skill Score	0.048

INSAT-3D Sounder vs MODIS for February , 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	14626	4759	2363
Sounder Uncertain	1043	183	1368
Sounder Cloudy	167	15	625

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	14067	5528	2153
Sounder Uncertain	809	598	1187
Sounder Cloudy	145	57	605

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	13596	5794	2358
Sounder Uncertain	727	601	1266
Sounder Cloudy	135	59	613

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	58.16	18.92	9.40
Sounder Uncertain	4.15	0.73	5.44
Sounder Cloudy	0.66	0.06	2.49

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	55.93	21.98	8.56
Sounder Uncertain	3.22	2.38	4.72
Sounder Cloudy	0.58	0.23	2.41

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	54.06	23.04	9.38
Sounder Uncertain	2.89	2.39	5.03
Sounder Cloudy	0.54	0.23	2.44

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.33	0.93	0.23
Frequency Bias	1.37	0.52	0.19
Probability of Detection	0.92	0.04	0.14
False Alarm Rate	0.73	0.25	0.02

Overall Skill Score

Skill Score	Value
Proportion Correct	0.614
Kuiper Skill Score	0.081
Heidke Skill Score	0.101

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy

False Alarm Ratio	0.35	0.77	0.25
Frequency Bias	1.45	0.42	0.20
Probability of Detection	0.94	0.10	0.15
False Alarm Rate	0.78	0.20	0.02

Overall Skill Score

Skill Score	Value
Proportion Correct	0.607
Kuiper Skill Score	0.108
Heidke Skill Score	0.133

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.37	0.77	0.24
Frequency Bias	1.50	0.40	0.19
Probability of Detection	0.94	0.09	0.14
False Alarm Rate	0.79	0.19	0.02

Overall Skill Score

Skill Score	Value
Proportion Correct	0.589
Kuiper Skill Score	0.104
Heidke Skill Score	0.127

INSAT-3D Sounder vs MODIS for February , 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	1476	12794	3582
Sounder Uncertain	381	965	3012
Sounder Cloudy	4	73	637

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	880	13438	3534
Sounder Uncertain	145	1511	2702
Sounder Cloudy	2	71	641

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	757	13031	4064
Sounder Uncertain	118	1358	2882
Sounder Cloudy	2	68	644

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	6.44	55.81	15.63
Sounder Uncertain	1.66	4.21	13.14
Sounder Cloudy	0.02	0.32	2.78

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	3.84	58.62	15.42
Sounder Uncertain	0.63	6.59	11.79
Sounder Cloudy	0.01	0.31	2.80

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	3.30	56.84	17.73

Sounder Uncertain	0.51	5.92	12.57
Sounder Cloudy	0.01	0.30	2.81

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.92	0.78	0.11
Frequency Bias	9.59	0.32	0.10
Probability of Detection	0.79	0.07	0.09
False Alarm Rate	0.83	0.17	0.00

Overall Skill Score

Skill Score	Value
Proportion Correct	0.134
Kuiper Skill Score	-0.101
Heidke Skill Score	-0.066

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.95	0.65	0.10
Frequency Bias	17.38	0.29	0.10
Probability of Detection	0.86	0.10	0.09
False Alarm Rate	0.85	0.14	0.00

Overall Skill Score

Skill Score	Value
Proportion Correct	0.132
Kuiper Skill Score	-0.076
Heidke Skill Score	-0.044

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.96	0.69	0.10

Frequency Bias	20.36	0.30	0.09
Probability of Detection	0.86	0.09	0.08
False Alarm Rate	0.85	0.15	0.00

Overall Skill Score

Skill Score	Value
Proportion Correct	0.120
Kuiper Skill Score	-0.081
Heidke Skill Score	-0.047

INSAT-3D Sounder vs MODIS for February , 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	381	91	84
Sounder Uncertain	171	19	63
Sounder Cloudy	46	3	82

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	327	177	52
Sounder Uncertain	143	68	42
Sounder Cloudy	42	13	76

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	287	207	62

Sounder Uncertain	132	77	44
Sounder Cloudy	33	19	79

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	40.53	9.68	8.94
Sounder Uncertain	18.19	2.02	6.70
Sounder Cloudy	4.89	0.32	8.72

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	34.79	18.83	5.53
Sounder Uncertain	15.21	7.23	4.47
Sounder Cloudy	4.47	1.38	8.09

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	30.53	22.02	6.60
Sounder Uncertain	14.04	8.19	4.68
Sounder Cloudy	3.51	2.02	8.40

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.31	0.92	0.37
Frequency Bias	0.93	2.24	0.57
Probability of Detection	0.64	0.17	0.36
False Alarm Rate	0.38	0.51	0.11

Overall Skill Score

Skill Score	Value
Proportion Correct	0.513
Kuiper Skill Score	0.135
Heidke Skill Score	0.126

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.41	0.73	0.42
Frequency Bias	1.09	0.98	0.77
Probability of Detection	0.64	0.26	0.45
False Alarm Rate	0.49	0.39	0.12

Overall Skill Score

Skill Score	Value
Proportion Correct	0.501
Kuiper Skill Score	0.134
Heidke Skill Score	0.138

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.48	0.70	0.40
Frequency Bias	1.23	0.83	0.71
Probability of Detection	0.63	0.25	0.43
False Alarm Rate	0.54	0.35	0.10

Overall Skill Score

Skill Score	Value
Proportion Correct	0.471
Kuiper Skill Score	0.116
Heidke Skill Score	0.121

INSAT-3D Sounder vs MODIS for February , 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	271	42	42
Sounder Uncertain	138	11	31
Sounder Cloudy	43	1	42

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	245	83	27
Sounder Uncertain	121	40	19
Sounder Cloudy	40	9	37

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	220	102	33
Sounder Uncertain	111	49	20
Sounder Cloudy	33	14	39

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	43.64	6.76	6.76
Sounder Uncertain	22.22	1.77	4.99
Sounder Cloudy	6.92	0.16	6.76

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	39.45	13.37	4.35
Sounder Uncertain	19.48	6.44	3.06
Sounder Cloudy	6.44	1.45	5.96

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	35.43	16.43	5.31
Sounder Uncertain	17.87	7.89	3.22
Sounder Cloudy	5.31	2.25	6.28

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.24	0.94	0.51
Frequency Bias	0.79	3.33	0.75
Probability of Detection	0.60	0.20	0.37
False Alarm Rate	0.28	0.57	0.15

Overall Skill Score

Skill Score	Value
Proportion Correct	0.522
Kuiper Skill Score	0.128
Heidke Skill Score	0.103

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.31	0.78	0.57
Frequency Bias	0.87	1.36	1.04
Probability of Detection	0.60	0.30	0.45
False Alarm Rate	0.37	0.47	0.16

Overall Skill Score

Skill Score	Value
Proportion Correct	0.519
Kuiper Skill Score	0.127
Heidke Skill Score	0.118

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.38	0.73	0.55
Frequency Bias	0.98	1.09	0.93
Probability of Detection	0.60	0.30	0.42
False Alarm Rate	0.43	0.42	0.15

Overall Skill Score

Skill Score	Value
Proportion Correct	0.496
Kuiper Skill Score	0.112
Heidke Skill Score	0.112

INSAT-3D Sounder vs MODIS for February , 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	110	49	42
Sounder Uncertain	33	8	32
Sounder Cloudy	3	2	40

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	82	94	25
Sounder Uncertain	22	28	23
Sounder Cloudy	2	4	39

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	67	105	29
Sounder Uncertain	21	28	24
Sounder Cloudy	0	5	40

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	34.48	15.36	13.17
Sounder Uncertain	10.34	2.51	10.03
Sounder Cloudy	0.94	0.63	12.54

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	25.71	29.47	7.84
Sounder Uncertain	6.90	8.78	7.21
Sounder Cloudy	0.63	1.25	12.23

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	21.00	32.92	9.09
Sounder Uncertain	6.58	8.78	7.52
Sounder Cloudy	0.00	1.57	12.54

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.45	0.89	0.11
Frequency Bias	1.38	1.24	0.39
Probability of Detection	0.75	0.14	0.35
False Alarm Rate	0.57	0.40	0.03

Overall Skill Score

Skill Score	Value
Proportion Correct	0.495
Kuiper Skill Score	0.182
Heidke Skill Score	0.184

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.59	0.62	0.13
Frequency Bias	1.90	0.58	0.52
Probability of Detection	0.77	0.22	0.45
False Alarm Rate	0.70	0.26	0.04

Overall Skill Score

Skill Score	Value
Proportion Correct	0.467
Kuiper Skill Score	0.195
Heidke Skill Score	0.195

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.67	0.62	0.11
Frequency Bias	2.28	0.53	0.48
Probability of Detection	0.76	0.20	0.43
False Alarm Rate	0.73	0.24	0.03

Overall Skill Score

Skill Score	Value

Proportion Correct	0.423
Kuiper Skill Score	0.168
Heidke Skill Score	0.159

INSAT-3D Sounder vs MODIS for February , 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	3052	1677	2352
Sounder Uncertain	3343	1421	3421
Sounder Cloudy	3107	309	5073

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	2672	2547	1862
Sounder Uncertain	2635	2837	2713
Sounder Cloudy	2480	1532	4477

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	2354	2516	2211
Sounder Uncertain	2234	2880	3071
Sounder Cloudy	2229	1561	4699

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	12.85	7.06	9.90
Sounder Uncertain	14.07	5.98	14.40
Sounder Cloudy	13.08	1.30	21.36

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	11.25	10.72	7.84
Sounder Uncertain	11.09	11.94	11.42
Sounder Cloudy	10.44	6.45	18.85

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	9.91	10.59	9.31
Sounder Uncertain	9.40	12.12	12.93
Sounder Cloudy	9.38	6.57	19.78

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.57	0.83	0.40
Frequency Bias	0.75	2.40	0.78
Probability of Detection	0.32	0.42	0.47
False Alarm Rate	0.28	0.48	0.24

Overall Skill Score

Skill Score	Value
Proportion Correct	0.402
Kuiper Skill Score	0.115
Heidke Skill Score	0.105

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy

False Alarm Ratio	0.62	0.65	0.47
Frequency Bias	0.91	1.18	0.94
Probability of Detection	0.34	0.41	0.49
False Alarm Rate	0.32	0.39	0.29

Overall Skill Score

Skill Score	Value
Proportion Correct	0.420
Kuiper Skill Score	0.130
Heidke Skill Score	0.129

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.67	0.65	0.45
Frequency Bias	1.04	1.18	0.85
Probability of Detection	0.35	0.41	0.47
False Alarm Rate	0.34	0.38	0.27

Overall Skill Score

Skill Score	Value
Proportion Correct	0.418
Kuiper Skill Score	0.124
Heidke Skill Score	0.123

INSAT-3D Sounder vs MODIS for February , 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

MODIS/Sounder			
Sounder Clear	1581	19	68
Sounder Uncertain	1811	66	670
Sounder Cloudy	2489	99	3834

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1490	136	42
Sounder Uncertain	1497	588	462
Sounder Cloudy	1983	976	3463

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1444	177	47
Sounder Uncertain	1390	632	525
Sounder Cloudy	1770	1077	3575

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	14.86	0.18	0.64
Sounder Uncertain	17.03	0.62	6.30
Sounder Cloudy	23.40	0.93	36.04

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	14.01	1.28	0.39
Sounder Uncertain	14.07	5.53	4.34
Sounder Cloudy	18.64	9.18	32.56

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	13.58	1.66	0.44

Sounder Uncertain	13.07	5.94	4.94
Sounder Cloudy	16.64	10.13	33.61

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.05	0.97	0.40
Frequency Bias	0.28	13.84	1.40
Probability of Detection	0.27	0.36	0.84
False Alarm Rate	0.02	0.48	0.50

Overall Skill Score

Skill Score	Value
Proportion Correct	0.515
Kuiper Skill Score	0.324
Heidke Skill Score	0.254

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.11	0.77	0.46
Frequency Bias	0.34	1.50	1.62
Probability of Detection	0.30	0.35	0.87
False Alarm Rate	0.03	0.38	0.58

Overall Skill Score

Skill Score	Value
Proportion Correct	0.521
Kuiper Skill Score	0.299
Heidke Skill Score	0.278

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.13	0.75	0.44

Frequency Bias	0.36	1.35	1.55
Probability of Detection	0.31	0.34	0.86
False Alarm Rate	0.04	0.38	0.57

Overall Skill Score

Skill Score	Value
Proportion Correct	0.531
Kuiper Skill Score	0.295
Heidke Skill Score	0.284

INSAT-3D Sounder vs MODIS for February , 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	1471	1658	2284
Sounder Uncertain	1532	1355	2751
Sounder Cloudy	618	210	1239

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1182	2411	1820
Sounder Uncertain	1138	2249	2251
Sounder Cloudy	497	556	1014

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	910	2339	2164

Sounder Uncertain	844	2248	2546
Sounder Cloudy	459	484	1124

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	11.21	12.64	17.41
Sounder Uncertain	11.68	10.33	20.97
Sounder Cloudy	4.71	1.60	9.45

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	9.01	18.38	13.87
Sounder Uncertain	8.68	17.14	17.16
Sounder Cloudy	3.79	4.24	7.73

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	6.94	17.83	16.50
Sounder Uncertain	6.43	17.14	19.41
Sounder Cloudy	3.50	3.69	8.57

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.73	0.76	0.40
Frequency Bias	1.49	1.75	0.33
Probability of Detection	0.41	0.42	0.20
False Alarm Rate	0.44	0.47	0.09

Overall Skill Score

Skill Score	Value
Proportion Correct	0.310
Kuiper Skill Score	0.024
Heidke Skill Score	0.021

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.78	0.60	0.51
Frequency Bias	1.92	1.08	0.41
Probability of Detection	0.42	0.43	0.20
False Alarm Rate	0.49	0.39	0.12

Overall Skill Score

Skill Score	Value
Proportion Correct	0.339
Kuiper Skill Score	0.028
Heidke Skill Score	0.027

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.83	0.60	0.46
Frequency Bias	2.45	1.11	0.35
Probability of Detection	0.41	0.44	0.19
False Alarm Rate	0.51	0.38	0.11

Overall Skill Score

Skill Score	Value
Proportion Correct	0.326
Kuiper Skill Score	0.033
Heidke Skill Score	0.030

Number of Collocations for Feb-2016
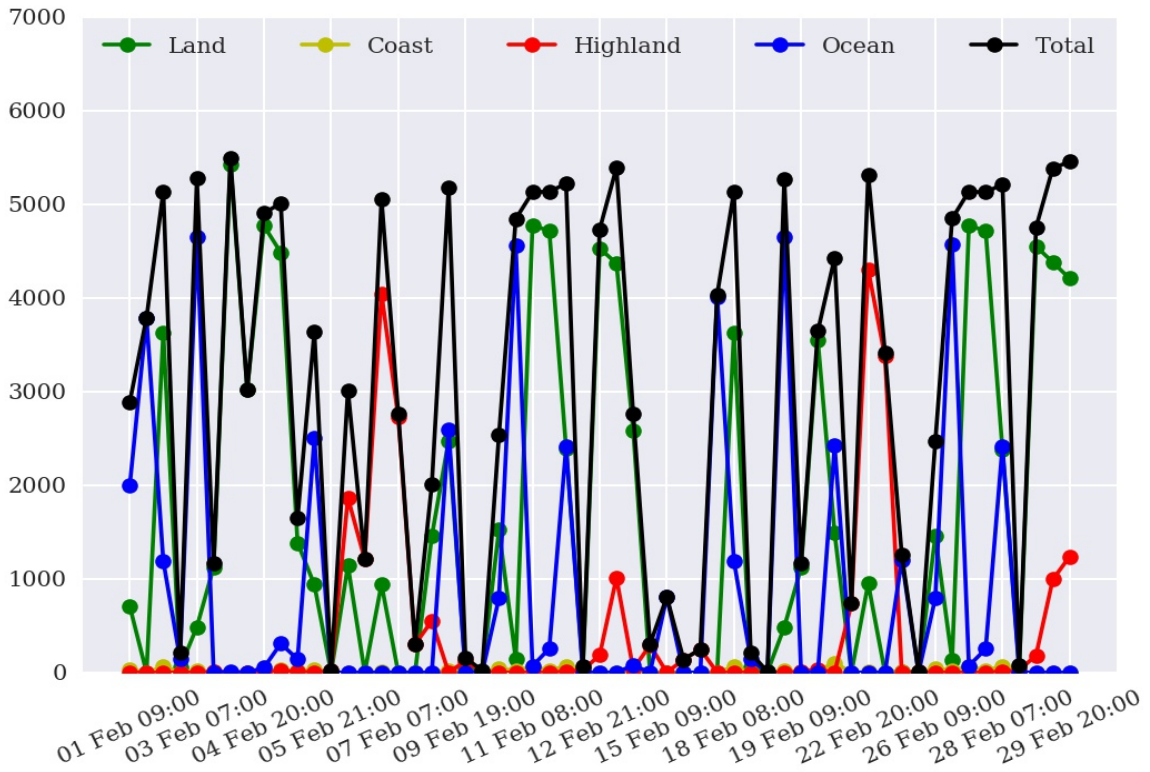
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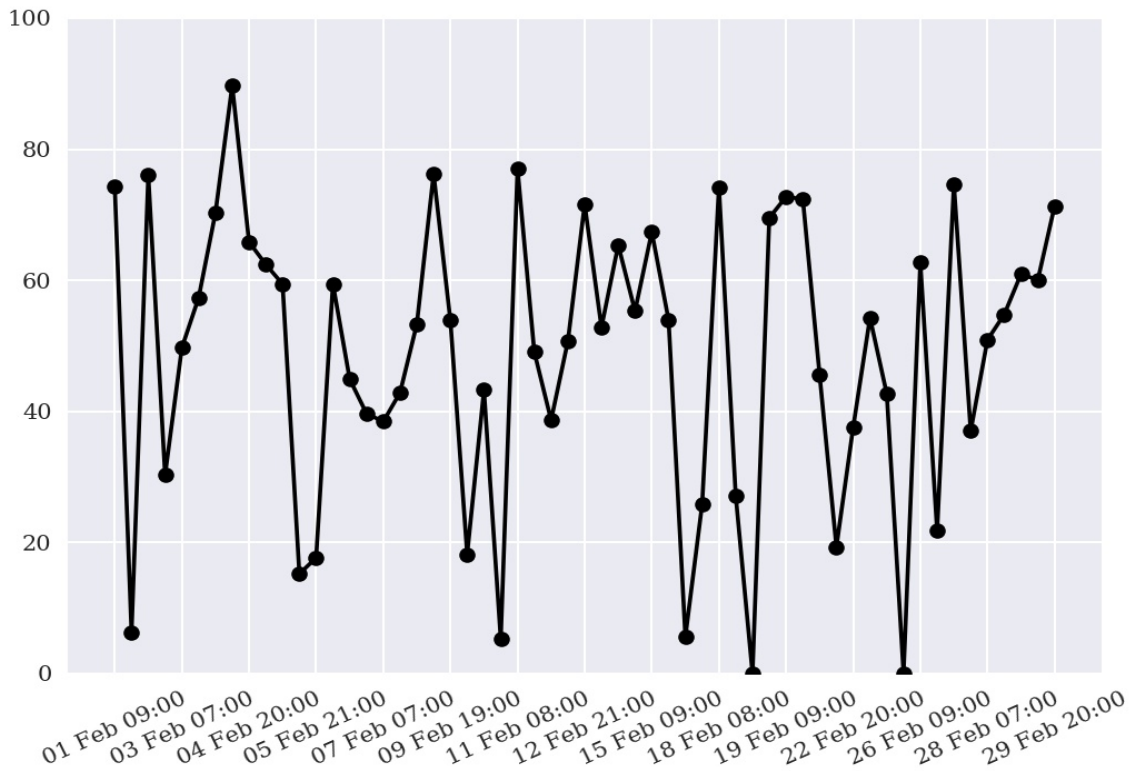
INSAT-3D Sounder Cloud Mask on
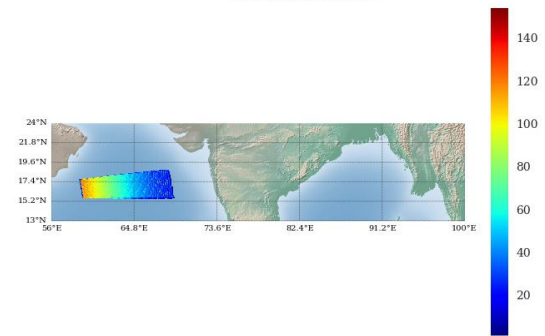04 February, 2016 20:00 UTC
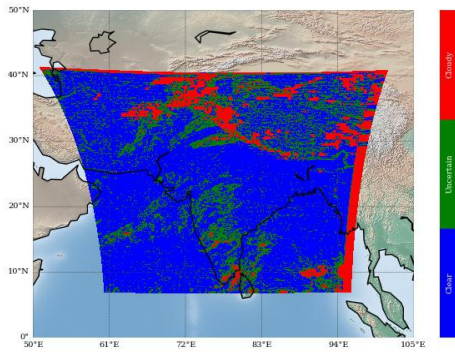
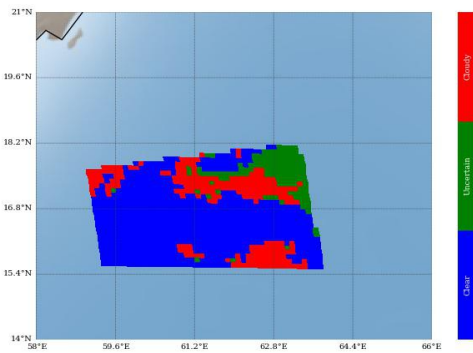Modis Cloud Mask on
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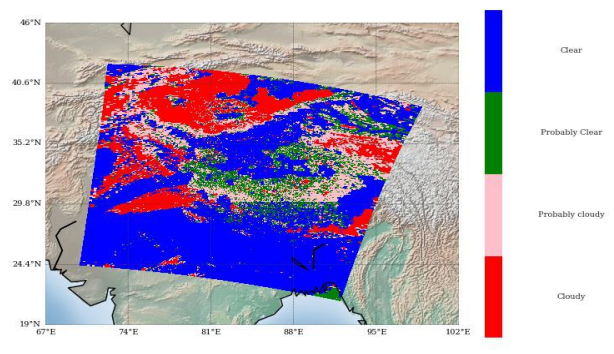
MODIS pass over INSAT-3D Sounder on
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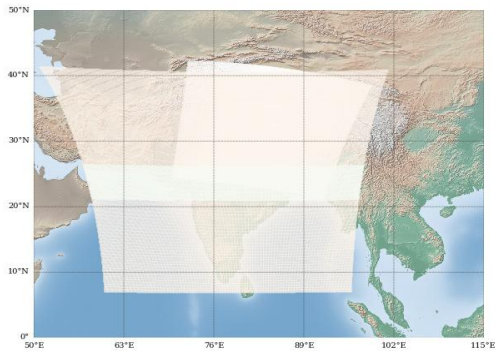
Number of Modis Pixels per Sounder Pixels on a
spatially and Temporally Collocated Domain on
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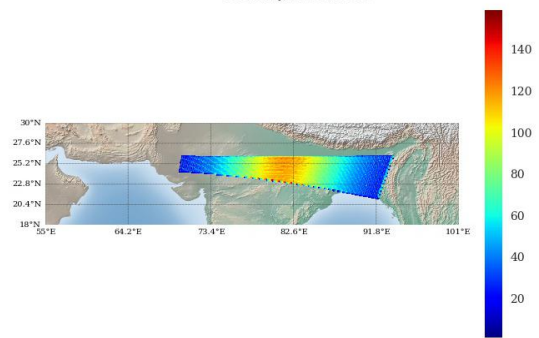
Modis Cloud Mask on Sounder Grid
Method 1 : Mode of Modis pixels
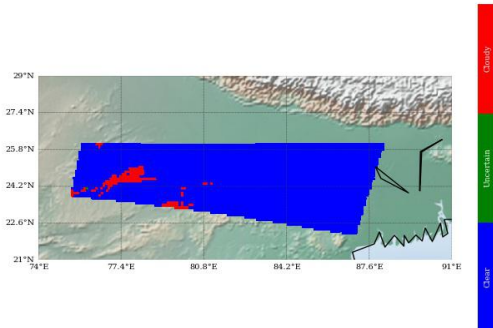
Modis Cloud Mask on Sounder Grid
Method 2 : Weighted Average

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

Sounder Cloud Flag on Collocated Area

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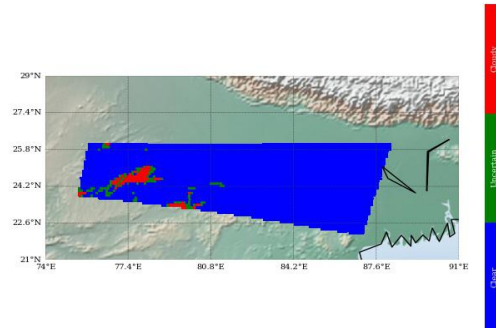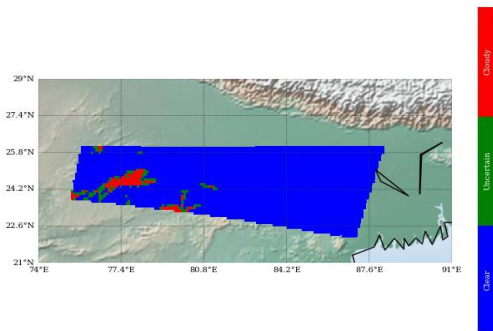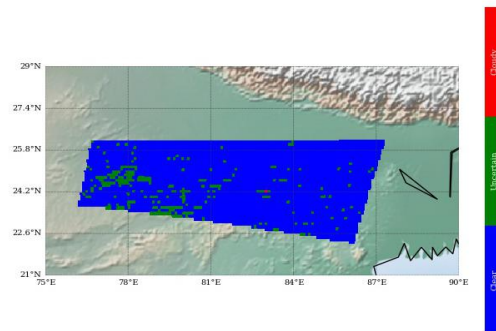
INSAT-3D Sounder Cloud Mask on
15 February, 2016 09:00 UTC
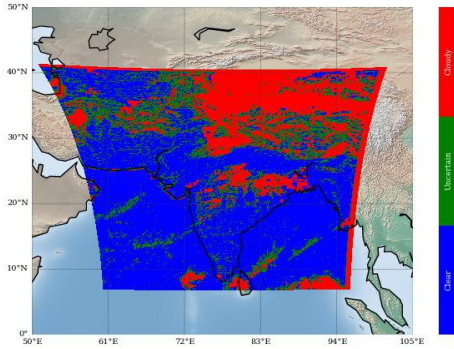
Modis Cloud Mask on
15 February, 2016 09:30 UTC
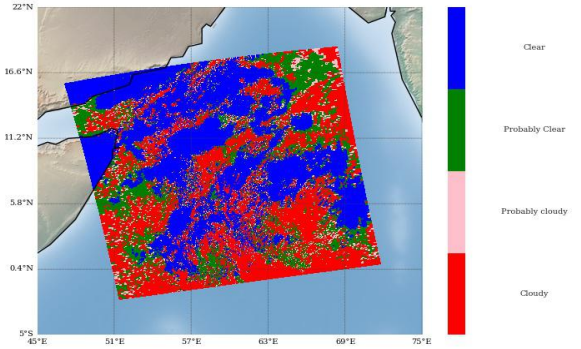
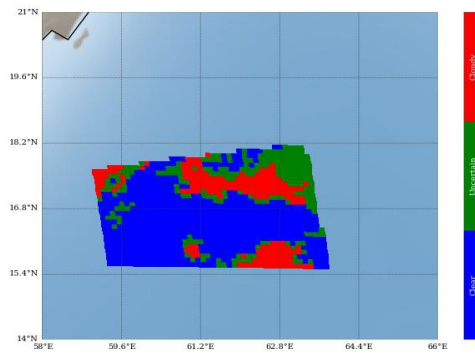MODIS pass over INSAT-3D Sounder on
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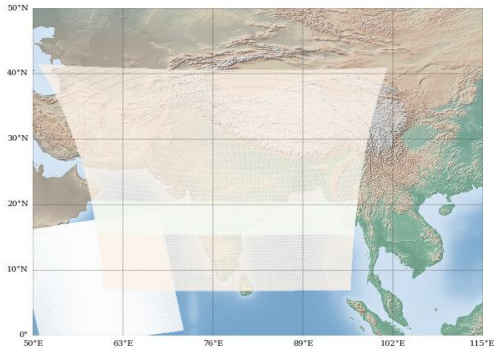
Number of Modis Pixels per Sounder Pixels on a
spatially and Temporally Collocated Domain on
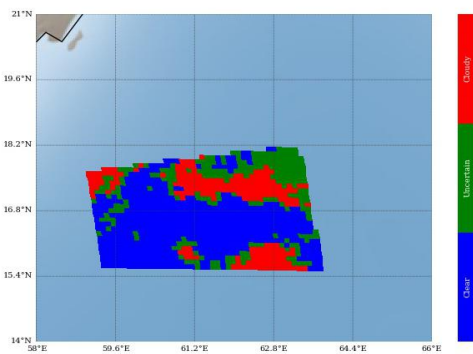15 February, 2016 09:30 UTC

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