INSAT-3D Sounder Cloud Mask Validation Report

Validation Criteria :

1. Spatial Collocation : 10km (nominal resolution of INSAT-3D Sounder)

2. Temporal Collocation : 5 minutes

INSAT-3D sounder operational cloud mask product is available at 10km resolution at nadir. MODIS cloud mask product is available at 1 km resolution at nadir. Hence there will be approximately 100 pixels of Modis inside one Sounder Pixels provided both are looking at nadir. In general, there is arround 40-60 pixles of MODIS per sounder pixel.

Furthermore operational MODIS cloud mask has 4 flags : Confident clear, probably clear, probably cloudy and cloudy, while operational sounder cloud mask has only 3 flags : Clear, Cloudy and Uncertain. For validation we follow these steps :

1. Spatial and Temporal Collocation

2. Resampling of MODIS cloud Mask on sounder observation area

3. Conversion of 4 cloud flags of MODIS into 3 cloud flags of sounder

The following methodology is adopted for conversion of MODIS cloud flag to sounder cloud flag

(i) A probability value is assigned to each of the modis cloud flag. Here we have assigned the values of 0.125,0.25,0.5,1 for confident clear, probably clear, probably clouly and cloudy respectively.

(ii) For each collocated sounder pixel , a single probability value for MODIS is obtained using the following 3 methods of averaging :

a) Taking mode of modis pixel probability value

b) Taking weighted average of probability values

c) Taking weighted products of the odds and subtracting the final results from 1

(iii)Based on probabilty value (p) obtained from above mentioned methods, the cloud mask flag for modis is decided for each method as follows :

p < 0.35 : Cloudy

p = 0.35-0.75 : Uncertain

p > 0.75 : Clear

Based on this flag , confusion matrix and skill scores were computed for each of the 3 methods.

The validation satatistics are presented in follwing order :

1. All Surface

2. Land

3. Ocean

4. Coast

5. Highland (surface height > 2000 m)

For each of the 5 surface types , results are further categorised according to time of the day

1. All times

2. Daytime (0-12 UTC i.e. 05:30-17:30 IST)

3. Nighttime (12-24 UTC i.e. 17:30-05:30 IST)

For each of these cases following statistics are shown :

1. 3X3 Confusion matrices for clear, cloudy and uncertain conditions

2. Following skill scores based on confusion matrices :-

i). False Alarm Ratio (FAR)

ii). Frequency Bias (FB)

iii). Probability of Detection (POD)

iv). False Alarm Rate (F)

v). Proportion Correct (PCr)

vi). Kuiper Skill Score (KSS)

vii). Heidke Skill Score (HSS)

Following plots are also shown :

1. Time series of Total number of collocations obtained for each of the 5 categories

2. Time series of percentage correct pixels (100 * PCr)

3. Sample spatial plot of operational cloud products and collocations on Land and Ocean

INSAT-3D Sounder vs MODIS for January , 2018 (All times (day and night)) on all surface types

1. Confusion matrix of Total number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	73592	16241	18545
Sounder Uncertain	10628	1763	5967
Sounder Cloudy	5096	362	8880

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	69828	23036	15514
Sounder Uncertain	9119	4579	4660
Sounder Cloudy	4097	2216	8025

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	62674	28904	16800
Sounder Uncertain	8021	5166	5171
Sounder Cloudy	3649	2388	8301

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	52.17	11.51	13.15
Sounder Uncertain	7.53	1.25	4.23
Sounder Cloudy	3.61	0.26	6.29

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	49.50	16.33	11.00
Sounder Uncertain	6.46	3.25	3.30
Sounder Cloudy	2.90	1.57	5.69

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	44.43	20.49	11.91
Sounder Uncertain	5.69	3.66	3.67
Sounder Cloudy	2.59	1.69	5.88

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.32	0.90	0.38
Frequency Bias	1.21	1.00	0.43
Probability of Detection	0.82	0.10	0.27
False Alarm Rate	0.61	0.29	0.10

Overall Skill Score

Skill Score	Value
Proportion Correct	0.597
Kuiper Skill Score	0.132
Heidke Skill Score	0.148

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.36	0.75	0.44
Frequency Bias	1.31	0.62	0.51
Probability of Detection	0.84	0.15	0.28
False Alarm Rate	0.66	0.23	0.11

Overall Skill Score

Skill Score	Value
Proportion Correct	0.584
Kuiper Skill Score	0.148
Heidke Skill Score	0.169

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.42	0.72	0.42
Frequency Bias	1.46	0.50	0.47
Probability of Detection	0.84	0.14	0.27
False Alarm Rate	0.70	0.20	0.09

Overall Skill Score

Skill Score	Value
Proportion Correct	0.540
Kuiper Skill Score	0.130
Heidke Skill Score	0.147

INSAT-3D Sounder vs MODIS for January , 2018 (Day) on all surface types

1. Confusion matrix of Total number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	45732	11516	7593
Sounder Uncertain	7480	694	3237
Sounder Cloudy	3165	184	6308

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	43749	15011	6081
Sounder Uncertain	6530	2338	2543
Sounder Cloudy	2376	1657	5624

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	38013	20076	6752
Sounder Uncertain	5816	2823	2772
Sounder Cloudy	2034	1775	5848

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	53.23	13.40	8.84
Sounder Uncertain	8.71	0.81	3.77
Sounder Cloudy	3.68	0.21	7.34

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	50.92	17.47	7.08
Sounder Uncertain	7.60	2.72	2.96
Sounder Cloudy	2.77	1.93	6.55

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	44.25	23.37	7.86
Sounder Uncertain	6.77	3.29	3.23
Sounder Cloudy	2.37	2.07	6.81

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.29	0.94	0.35
Frequency Bias	1.15	0.92	0.56
Probability of Detection	0.81	0.06	0.37
False Alarm Rate	0.58	0.32	0.10

Overall Skill Score

Skill Score	Value
Proportion Correct	0.614
Kuiper Skill Score	0.151
Heidke Skill Score	0.166

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.33	0.80	0.42
Frequency Bias	1.23	0.60	0.68
Probability of Detection	0.83	0.12	0.39
False Alarm Rate	0.62	0.27	0.12

Overall Skill Score

Skill Score	Value
Proportion Correct	0.602
Kuiper Skill Score	0.167
Heidke Skill Score	0.187

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.41	0.75	0.39
Frequency Bias	1.41	0.46	0.63
Probability of Detection	0.83	0.11	0.38
False Alarm Rate	0.68	0.22	0.10

Overall Skill Score

Skill Score	Value

Proportion Correct	0.543
Kuiper Skill Score	0.137
Heidke Skill Score	0.153

INSAT-3D Sounder vs MODIS for January , 2018 (Night) on all surface types

1. Confusion matrix of Total number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	27860	4725	10952
Sounder Uncertain	3148	1069	2730
Sounder Cloudy	1931	178	2572

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	26079	8025	9433
Sounder Uncertain	2589	2241	2117
Sounder Cloudy	1721	559	2401

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	24661	8828	10048
Sounder Uncertain	2205	2343	2399
Sounder Cloudy	1615	613	2453

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	50.50	8.57	19.85
Sounder Uncertain	5.71	1.94	4.95
Sounder Cloudy	3.50	0.32	4.66

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	47.27	14.55	17.10
Sounder Uncertain	4.69	4.06	3.84
Sounder Cloudy	3.12	1.01	4.35

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	44.70	16.00	18.21
Sounder Uncertain	4.00	4.25	4.35
Sounder Cloudy	2.93	1.11	4.45

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.36	0.85	0.45
Frequency Bias	1.32	1.16	0.29
Probability of Detection	0.85	0.18	0.16
False Alarm Rate	0.66	0.25	0.09

Overall Skill Score

Skill Score	Value
Proportion Correct	0.571
Kuiper Skill Score	0.112
Heidke Skill Score	0.125

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy

False Alarm Ratio	0.40	0.68	0.49
Frequency Bias	1.43	0.64	0.34
Probability of Detection	0.86	0.21	0.17
False Alarm Rate	0.71	0.19	0.09

Overall Skill Score

Skill Score	Value
Proportion Correct	0.557
Kuiper Skill Score	0.128
Heidke Skill Score	0.146

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.43	0.66	0.48
Frequency Bias	1.53	0.59	0.31
Probability of Detection	0.87	0.20	0.16
False Alarm Rate	0.73	0.18	0.09

Overall Skill Score

Skill Score	Value
Proportion Correct	0.534
Kuiper Skill Score	0.125
Heidke Skill Score	0.141

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

1. Confusion matrix of Total number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy

Sounder Clear	54592	7542	12371
Sounder Uncertain	4188	669	2605
Sounder Cloudy	1248	95	4194

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	52129	11993	10383
Sounder Uncertain	3683	1702	2077
Sounder Cloudy	1160	298	4079

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	46224	17244	11037
Sounder Uncertain	3135	2072	2255
Sounder Cloudy	1072	345	4120

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	62.39	8.62	14.14
Sounder Uncertain	4.79	0.76	2.98
Sounder Cloudy	1.43	0.11	4.79

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	59.57	13.71	11.87
Sounder Uncertain	4.21	1.95	2.37
Sounder Cloudy	1.33	0.34	4.66

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	52.83	19.71	12.61

Sounder Uncertain	3.58	2.37	2.58
Sounder Cloudy	1.23	0.39	4.71

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.27	0.91	0.24
Frequency Bias	1.24	0.90	0.29
Probability of Detection	0.91	0.08	0.22
False Alarm Rate	0.71	0.24	0.05

Overall Skill Score

Skill Score	Value
Proportion Correct	0.679
Kuiper Skill Score	0.155
Heidke Skill Score	0.186

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.30	0.77	0.26
Frequency Bias	1.31	0.53	0.33
Probability of Detection	0.91	0.12	0.25
False Alarm Rate	0.76	0.19	0.05

Overall Skill Score

Skill Score	Value
Proportion Correct	0.662
Kuiper Skill Score	0.159
Heidke Skill Score	0.195

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.38	0.72	0.26

Frequency Bias	1.48	0.38	0.32
Probability of Detection	0.92	0.11	0.24
False Alarm Rate	0.81	0.15	0.04

Overall Skill Score

Skill Score	Value
Proportion Correct	0.599
Kuiper Skill Score	0.132
Heidke Skill Score	0.160

INSAT-3D Sounder vs MODIS for January , 2018 (Day) on Land

1. Confusion matrix of Total number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	33078	7028	4475
Sounder Uncertain	3172	585	1828
Sounder Cloudy	299	67	2103

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	31639	9731	3211
Sounder Uncertain	2798	1358	1429
Sounder Cloudy	256	188	2025

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	26476	14400	3705

Sounder Uncertain	2319	1695	1571
Sounder Cloudy	197	215	2057

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	62.84	13.35	8.50
Sounder Uncertain	6.03	1.11	3.47
Sounder Cloudy	0.57	0.13	4.00

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	60.11	18.49	6.10
Sounder Uncertain	5.32	2.58	2.71
Sounder Cloudy	0.49	0.36	3.85

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	50.30	27.36	7.04
Sounder Uncertain	4.41	3.22	2.98
Sounder Cloudy	0.37	0.41	3.91

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.26	0.90	0.15
Frequency Bias	1.22	0.73	0.29
Probability of Detection	0.91	0.08	0.25
False Alarm Rate	0.68	0.30	0.02

Overall Skill Score

Skill Score	Value
Proportion Correct	0.680
Kuiper Skill Score	0.145
Heidke Skill Score	0.176

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.29	0.76	0.18
Frequency Bias	1.29	0.50	0.37
Probability of Detection	0.91	0.12	0.30
False Alarm Rate	0.73	0.24	0.03

Overall Skill Score

Skill Score	Value
Proportion Correct	0.665
Kuiper Skill Score	0.156
Heidke Skill Score	0.190

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.41	0.70	0.17
Frequency Bias	1.54	0.34	0.34
Probability of Detection	0.91	0.10	0.28
False Alarm Rate	0.81	0.17	0.02

Overall Skill Score

Skill Score	Value
Proportion Correct	0.574
Kuiper Skill Score	0.118
Heidke Skill Score	0.138

INSAT-3D Sounder vs MODIS for January , 2018 (Night) on Land

1. Confusion matrix of Total number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	21514	514	7896
Sounder Uncertain	1016	84	777
Sounder Cloudy	949	28	2091

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	20490	2262	7172
Sounder Uncertain	885	344	648
Sounder Cloudy	904	110	2054

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	19748	2844	7332
Sounder Uncertain	816	377	684
Sounder Cloudy	875	130	2063

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	61.70	1.47	22.64
Sounder Uncertain	2.91	0.24	2.23
Sounder Cloudy	2.72	0.08	6.00

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	58.76	6.49	20.57
Sounder Uncertain	2.54	0.99	1.86
Sounder Cloudy	2.59	0.32	5.89

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	56.63	8.16	21.03
Sounder Uncertain	2.34	1.08	1.96
Sounder Cloudy	2.51	0.37	5.92

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.28	0.96	0.32
Frequency Bias	1.27	3.00	0.29
Probability of Detection	0.92	0.13	0.19
False Alarm Rate	0.75	0.16	0.09

Overall Skill Score

Skill Score	Value
Proportion Correct	0.679
Kuiper Skill Score	0.163
Heidke Skill Score	0.186

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.32	0.82	0.33
Frequency Bias	1.34	0.69	0.31
Probability of Detection	0.92	0.13	0.21
False Alarm Rate	0.79	0.13	0.08

Overall Skill Score

Skill Score	Value
Proportion Correct	0.656
Kuiper Skill Score	0.156
Heidke Skill Score	0.187

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.34	0.80	0.33
Frequency Bias	1.40	0.56	0.30
Probability of Detection	0.92	0.11	0.20
False Alarm Rate	0.80	0.12	0.08

Overall Skill Score

Skill Score	Value
Proportion Correct	0.636
Kuiper Skill Score	0.148
Heidke Skill Score	0.177

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

1. Confusion matrix of Total number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	8421	6401	2875
Sounder Uncertain	288	128	467
Sounder Cloudy	80	1	198

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	8130	6813	2754
Sounder Uncertain	254	192	437
Sounder Cloudy	73	13	193

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	7803	6975	2919
Sounder Uncertain	232	192	459
Sounder Cloudy	71	14	194

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	44.65	33.94	15.24
Sounder Uncertain	1.53	0.68	2.48
Sounder Cloudy	0.42	0.01	1.05

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	43.11	36.13	14.60
Sounder Uncertain	1.35	1.02	2.32
Sounder Cloudy	0.39	0.07	1.02

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	41.38	36.98	15.48
Sounder Uncertain	1.23	1.02	2.43
Sounder Cloudy	0.38	0.07	1.03

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.52	0.86	0.29
Frequency Bias	2.01	0.14	0.08
Probability of Detection	0.96	0.02	0.06
False Alarm Rate	0.92	0.07	0.01

Overall Skill Score

Skill Score	Value
Proportion Correct	0.464
Kuiper Skill Score	0.012
Heidke Skill Score	0.014

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.54	0.78	0.31
Frequency Bias	2.09	0.13	0.08
Probability of Detection	0.96	0.03	0.06
False Alarm Rate	0.92	0.07	0.01

Overall Skill Score

Skill Score	Value
Proportion Correct	0.452
Kuiper Skill Score	0.017
Heidke Skill Score	0.019

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.56	0.78	0.30
Frequency Bias	2.18	0.12	0.08
Probability of Detection	0.96	0.03	0.05
False Alarm Rate	0.93	0.06	0.01

Overall Skill Score

Skill Score	Value

Proportion Correct	0.434
Kuiper Skill Score	0.016
Heidke Skill Score	0.018

INSAT-3D Sounder vs MODIS for January , 2018 (Day) on Ocean

1. Confusion matrix of Total number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	6272	4267	2663
Sounder Uncertain	191	53	272
Sounder Cloudy	10	1	181

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	6057	4571	2574
Sounder Uncertain	183	63	270
Sounder Cloudy	10	3	179

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	5812	4686	2704
Sounder Uncertain	176	64	276
Sounder Cloudy	10	3	179

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	45.09	30.68	19.14
Sounder Uncertain	1.37	0.38	1.96
Sounder Cloudy	0.07	0.01	1.30

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	43.54	32.86	18.50
Sounder Uncertain	1.32	0.45	1.94
Sounder Cloudy	0.07	0.02	1.29

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	41.78	33.69	19.44
Sounder Uncertain	1.27	0.46	1.98
Sounder Cloudy	0.07	0.02	1.29

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.52	0.90	0.06
Frequency Bias	2.04	0.12	0.06
Probability of Detection	0.97	0.01	0.06
False Alarm Rate	0.94	0.06	0.00

Overall Skill Score

Skill Score	Value
Proportion Correct	0.468
Kuiper Skill Score	0.018
Heidke Skill Score	0.021

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy

	0.54	0.88	0.07
False Alarm Ratio	0.54	0.88	0.07
Frequency Bias	2.11	0.11	0.06
Probability of Detection	0.97	0.01	0.06
False Alarm Rate	0.94	0.06	0.00

Overall Skill Score

Skill Score	Value
Proportion Correct	0.453
Kuiper Skill Score	0.017
Heidke Skill Score	0.020

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.56	0.88	0.07
Frequency Bias	2.20	0.11	0.06
Probability of Detection	0.97	0.01	0.06
False Alarm Rate	0.94	0.06	0.00

Overall Skill Score

Skill Score	Value
Proportion Correct	0.435
Kuiper Skill Score	0.016
Heidke Skill Score	0.018

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

1. Confusion matrix of Total number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy

Sounder Clear	2149	2134	212
Sounder Uncertain	97	75	195
Sounder Cloudy	70	0	17

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	2073	2242	180
Sounder Uncertain	71	129	167
Sounder Cloudy	63	10	14

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	1991	2289	215
Sounder Uncertain	56	128	183
Sounder Cloudy	61	11	15

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	43.42	43.12	4.28
Sounder Uncertain	1.96	1.52	3.94
Sounder Cloudy	1.41	0.00	0.34

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	41.89	45.30	3.64
Sounder Uncertain	1.43	2.61	3.37
Sounder Cloudy	1.27	0.20	0.28

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	40.23	46.25	4.34

Sounder Uncertain	1.13	2.59	3.70
Sounder Cloudy	1.23	0.22	0.30

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.52	0.80	0.80
Frequency Bias	1.94	0.17	0.21
Probability of Detection	0.93	0.03	0.04
False Alarm Rate	0.87	0.11	0.03

Overall Skill Score

Skill Score	Value
Proportion Correct	0.453
Kuiper Skill Score	-0.012
Heidke Skill Score	-0.013

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.54	0.65	0.84
Frequency Bias	2.04	0.15	0.24
Probability of Detection	0.94	0.05	0.04
False Alarm Rate	0.89	0.09	0.03

Overall Skill Score

Skill Score	Value
Proportion Correct	0.448
Kuiper Skill Score	0.010
Heidke Skill Score	0.010

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.56	0.65	0.83

Frequency Bias	2.13	0.15	0.21
Probability of Detection	0.94	0.05	0.04
False Alarm Rate	0.89	0.08	0.03

Overall Skill Score

Skill Score	Value
Proportion Correct	0.431
Kuiper Skill Score	0.011
Heidke Skill Score	0.011

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

1. Confusion matrix of Total number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	374	53	42
Sounder Uncertain	40	4	7
Sounder Cloudy	7	3	6

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	358	87	24
Sounder Uncertain	38	8	5
Sounder Cloudy	7	4	5

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	328	111	30

Sounder Uncertain	35	10	6
Sounder Cloudy	6	5	5

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	69.78	9.89	7.84
Sounder Uncertain	7.46	0.75	1.31
Sounder Cloudy	1.31	0.56	1.12

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	66.79	16.23	4.48
Sounder Uncertain	7.09	1.49	0.93
Sounder Cloudy	1.31	0.75	0.93

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	61.19	20.71	5.60
Sounder Uncertain	6.53	1.87	1.12
Sounder Cloudy	1.12	0.93	0.93

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.20	0.92	0.62
Frequency Bias	1.11	0.85	0.29
Probability of Detection	0.89	0.07	0.11
False Alarm Rate	0.62	0.31	0.07

Overall Skill Score

Skill Score	Value
Proportion Correct	0.716
Kuiper Skill Score	0.043
Heidke Skill Score	0.052

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.24	0.84	0.69
Frequency Bias	1.16	0.52	0.47
Probability of Detection	0.89	0.08	0.15
False Alarm Rate	0.67	0.26	0.07

Overall Skill Score

Skill Score	Value
Proportion Correct	0.692
Kuiper Skill Score	0.037
Heidke Skill Score	0.046

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.30	0.80	0.69
Frequency Bias	1.27	0.40	0.39
Probability of Detection	0.89	0.08	0.12
False Alarm Rate	0.73	0.21	0.06

Overall Skill Score

Skill Score	Value
Proportion Correct	0.640
Kuiper Skill Score	0.028
Heidke Skill Score	0.035

INSAT-3D Sounder vs MODIS for January , 2018 (Day) on Coast

1. Confusion matrix of Total number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	306	22	22
Sounder Uncertain	32	4	2
Sounder Cloudy	4	2	6

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	293	45	12
Sounder Uncertain	31	5	2
Sounder Cloudy	4	3	5

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	270	66	14
Sounder Uncertain	29	7	2
Sounder Cloudy	3	4	5

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	76.50	5.50	5.50
Sounder Uncertain	8.00	1.00	0.50
Sounder Cloudy	1.00	0.50	1.50

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	73.25	11.25	3.00
Sounder Uncertain	7.75	1.25	0.50
Sounder Cloudy	1.00	0.75	1.25

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	67.50	16.50	3.50
Sounder Uncertain	7.25	1.75	0.50
Sounder Cloudy	0.75	1.00	1.25

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.13	0.89	0.50
Frequency Bias	1.02	1.36	0.40
Probability of Detection	0.89	0.14	0.20
False Alarm Rate	0.52	0.40	0.07

Overall Skill Score

Skill Score	Value
Proportion Correct	0.790
Kuiper Skill Score	0.128
Heidke Skill Score	0.136

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.16	0.87	0.58
Frequency Bias	1.07	0.72	0.63
Probability of Detection	0.89	0.09	0.26
False Alarm Rate	0.59	0.34	0.07

Overall Skill Score

Skill Score	Value
Proportion Correct	0.757
Kuiper Skill Score	0.084
Heidke Skill Score	0.097

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.23	0.82	0.58
Frequency Bias	1.16	0.49	0.57
Probability of Detection	0.89	0.09	0.24
False Alarm Rate	0.68	0.26	0.06

Overall Skill Score

Skill Score	Value
Proportion Correct	0.705
Kuiper Skill Score	0.063
Heidke Skill Score	0.077

INSAT-3D Sounder vs MODIS for January , 2018 (Night) on Coast

1. Confusion matrix of Total number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	68	31	20
Sounder Uncertain	8	0	5
Sounder Cloudy	3	1	0

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	65	42	12
Sounder Uncertain	7	3	3
Sounder Cloudy	3	1	0

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	58	45	16
Sounder Uncertain	6	3	4
Sounder Cloudy	3	1	0

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	50.00	22.79	14.71
Sounder Uncertain	5.88	0.00	3.68
Sounder Cloudy	2.21	0.74	0.00

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	47.79	30.88	8.82
Sounder Uncertain	5.15	2.21	2.21
Sounder Cloudy	2.21	0.74	0.00

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	42.65	33.09	11.76
Sounder Uncertain	4.41	2.21	2.94
Sounder Cloudy	2.21	0.74	0.00

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.43	1.00	1.00
Frequency Bias	1.51	0.41	0.16
Probability of Detection	0.86	0.00	0.00
False Alarm Rate	0.75	0.19	0.06

Overall Skill Score

Skill Score	Value
Proportion Correct	0.500
Kuiper Skill Score	-0.063
Heidke Skill Score	-0.078

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.45	0.77	1.00
Frequency Bias	1.59	0.28	0.27
Probability of Detection	0.87	0.07	0.00
False Alarm Rate	0.79	0.15	0.06

Overall Skill Score

Skill Score	Value
Proportion Correct	0.500
Kuiper Skill Score	-0.032
Heidke Skill Score	-0.038

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.51	0.77	1.00
Frequency Bias	1.78	0.27	0.20
Probability of Detection	0.87	0.06	0.00
False Alarm Rate	0.81	0.13	0.05

Overall Skill Score

Skill Score	Value

Proportion Correct	0.449
Kuiper Skill Score	-0.035
Heidke Skill Score	-0.040

INSAT-3D Sounder vs MODIS for January , 2018 (All times (day and night)) on Highland (>2000 m)

1. Confusion matrix of Total number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	8443	1928	2988
Sounder Uncertain	5958	939	2829
Sounder Cloudy	3712	257	4429

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	7539	3645	2175
Sounder Uncertain	5004	2626	2096
Sounder Cloudy	2823	1874	3701

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	6774	3990	2595
Sounder Uncertain	4488	2843	2395
Sounder Cloudy	2468	1996	3934

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	26.82	6.12	9.49
Sounder Uncertain	18.92	2.98	8.99
Sounder Cloudy	11.79	0.82	14.07

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	23.95	11.58	6.91
Sounder Uncertain	15.89	8.34	6.66
Sounder Cloudy	8.97	5.95	11.76

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	21.52	12.67	8.24
Sounder Uncertain	14.26	9.03	7.61
Sounder Cloudy	7.84	6.34	12.50

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.37	0.90	0.47
Frequency Bias	0.74	3.11	0.82
Probability of Detection	0.47	0.30	0.43
False Alarm Rate	0.28	0.50	0.22

Overall Skill Score

Skill Score	Value
Proportion Correct	0.439
Kuiper Skill Score	0.139
Heidke Skill Score	0.121

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy

	0.44	0.73	0.56
False Alarm Ratio	0.44	0.73	0.56
Frequency Bias	0.87	1.19	1.05
Probability of Detection	0.49	0.32	0.46
False Alarm Rate	0.33	0.40	0.27

Overall Skill Score

Skill Score	Value
Proportion Correct	0.440
Kuiper Skill Score	0.136
Heidke Skill Score	0.133

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.49	0.71	0.53
Frequency Bias	0.97	1.10	0.94
Probability of Detection	0.49	0.32	0.44
False Alarm Rate	0.37	0.38	0.25

Overall Skill Score

Skill Score	Value
Proportion Correct	0.430
Kuiper Skill Score	0.128
Heidke Skill Score	0.127

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

1. Confusion matrix of Total number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy

Sounder Clear	4774	44	304
Sounder Uncertain	3955	41	1107
Sounder Cloudy	2822	109	3972

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	4513	403	206
Sounder Uncertain	3399	881	823
Sounder Cloudy	2089	1440	3374

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	4313	576	233
Sounder Uncertain	3179	1025	899
Sounder Cloudy	1809	1529	3565

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	27.87	0.26	1.77
Sounder Uncertain	23.09	0.24	6.46
Sounder Cloudy	16.48	0.64	23.19

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	26.35	2.35	1.20
Sounder Uncertain	19.84	5.14	4.80
Sounder Cloudy	12.20	8.41	19.70

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	25.18	3.36	1.36

Sounder Uncertain	18.56	5.98	5.25
Sounder Cloudy	10.56	8.93	20.81

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.07	0.99	0.42
Frequency Bias	0.44	26.30	1.28
Probability of Detection	0.41	0.21	0.74
False Alarm Rate	0.04	0.61	0.35

Overall Skill Score

Skill Score	Value
Proportion Correct	0.513
Kuiper Skill Score	0.406
Heidke Skill Score	0.271

Method2 :Taking Weighted Average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.12	0.83	0.51
Frequency Bias	0.51	1.87	1.57
Probability of Detection	0.45	0.32	0.77
False Alarm Rate	0.07	0.51	0.42

Overall Skill Score

Skill Score	Value
Proportion Correct	0.512
Kuiper Skill Score	0.328
Heidke Skill Score	0.276

Method3: Taking Weighted Product average of MODIS pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.16	0.80	0.48

Frequency Bias	0.55	1.63	1.47
Probability of Detection	0.46	0.33	0.76
False Alarm Rate	0.10	0.50	0.41

Overall Skill Score

Skill Score	Value
Proportion Correct	0.520
Kuiper Skill Score	0.323
Heidke Skill Score	0.286

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

1. Confusion matrix of Total number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	3669	1884	2684
Sounder Uncertain	2003	898	1722
Sounder Cloudy	890	148	457

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	3026	3242	1969
Sounder Uncertain	1605	1745	1273
Sounder Cloudy	734	434	327

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	2461	3414	2362

| Sounder Uncertain | 1309 | 1818 | 1496 |
| Sounder Cloudy | 659 | 467 | 369 |

2. Confusion matrix of percentage number of collocations

Method1 :Taking Mode of MODIS Pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	25.56	13.12	18.70
Sounder Uncertain	13.95	6.26	12.00
Sounder Cloudy	6.20	1.03	3.18

Method2 :Taking Weighted Average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	21.08	22.58	13.72
Sounder Uncertain	11.18	12.16	8.87
Sounder Cloudy	5.11	3.02	2.28

Method3: Taking Weighted Product average of MODIS pixels

MODIS/Sounder	MODIS Clear	MODIS Uncertain	MODIS Cloudy
Sounder Clear	17.14	23.78	16.45
Sounder Uncertain	9.12	12.66	10.42
Sounder Cloudy	4.59	3.25	2.57

3. Skill Scores

Method1 :Taking Mode of MODIS Pixels

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.55	0.81	0.69
Frequency Bias	1.26	1.58	0.31
Probability of Detection	0.56	0.31	0.09
False Alarm Rate	0.49	0.40	0.11

Overall Skill Score

Skill Score	Value
Proportion Correct	0.350
Kuiper Skill Score	-0.021
Heidke Skill Score	-0.021

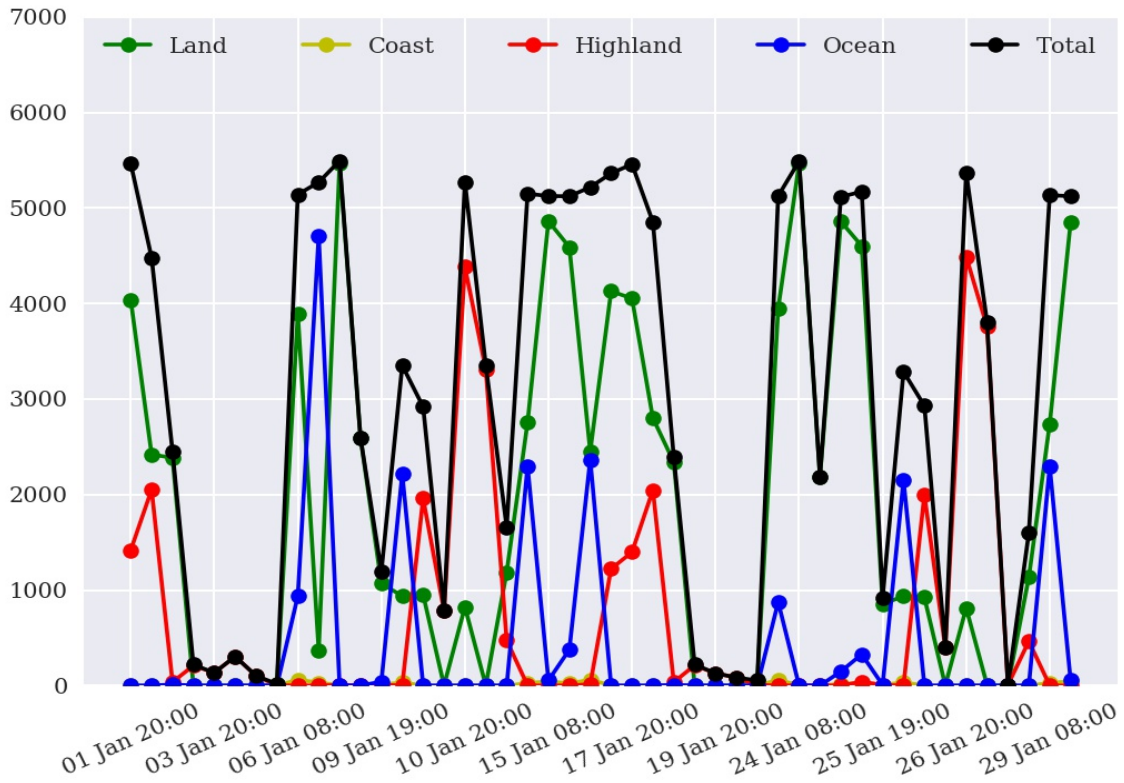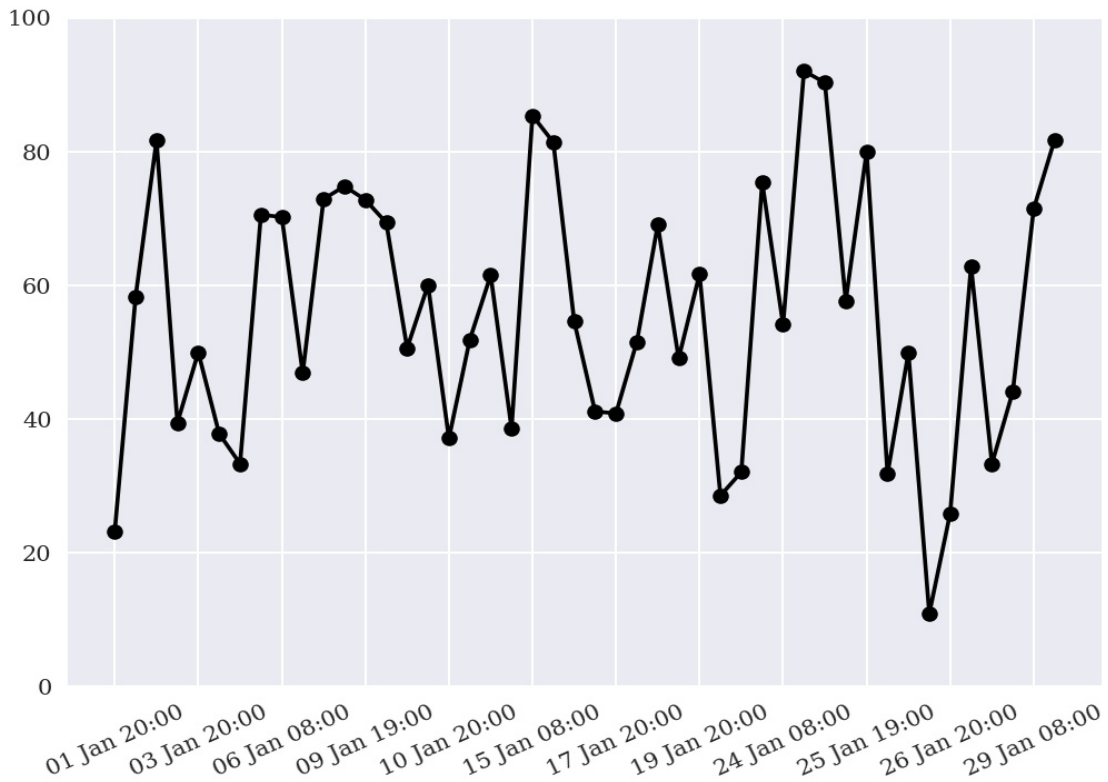*Method2 :Taking Weighted Average of MODIS pixels*

Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.63	0.62	0.78
Frequency Bias	1.54	0.85	0.42
Probability of Detection	0.56	0.32	0.09
False Alarm Rate	0.56	0.31	0.13

Overall Skill Score

Skill Score	Value
Proportion Correct	0.355
Kuiper Skill Score	-0.010
Heidke Skill Score	-0.011

Method3: Taking Weighted Product average of MODIS pixels

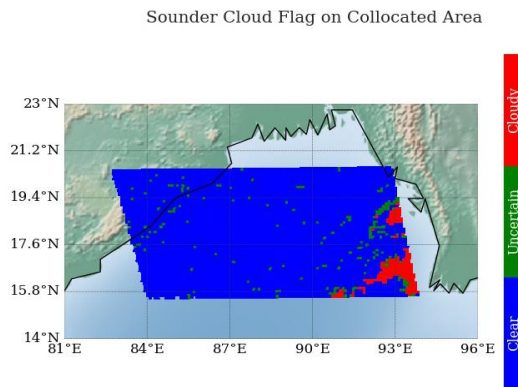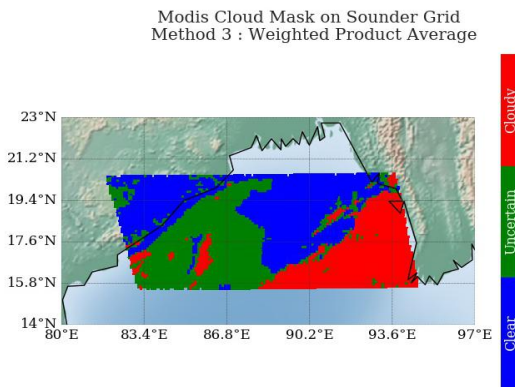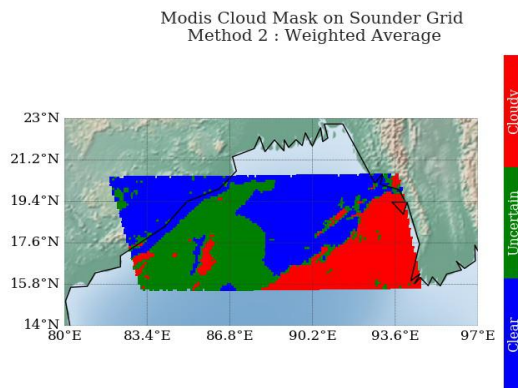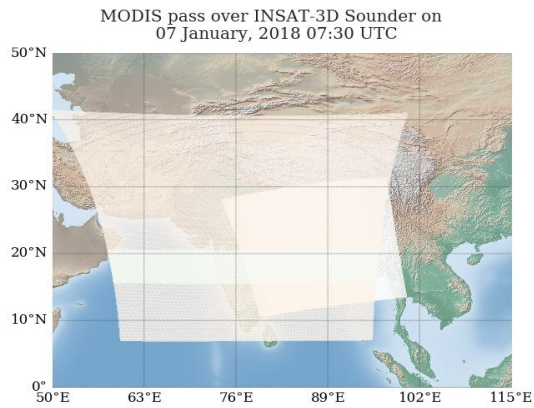| Skill Score	Clear	Uncertain	Cloudy
False Alarm Ratio	0.70	0.61	0.75
Frequency Bias	1.86	0.81	0.35
Probability of Detection	0.56	0.32	0.09
False Alarm Rate	0.60	0.29	0.12

Overall Skill Score
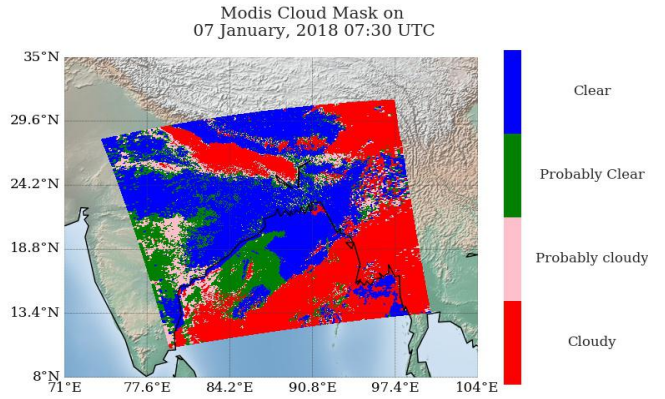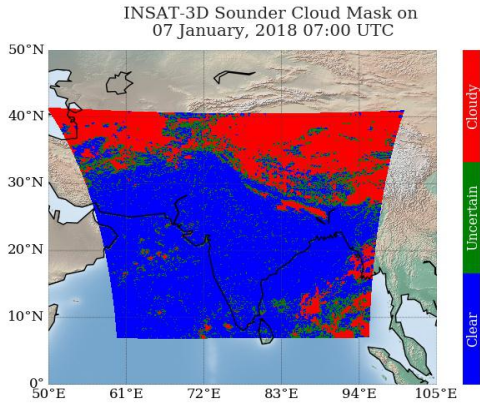
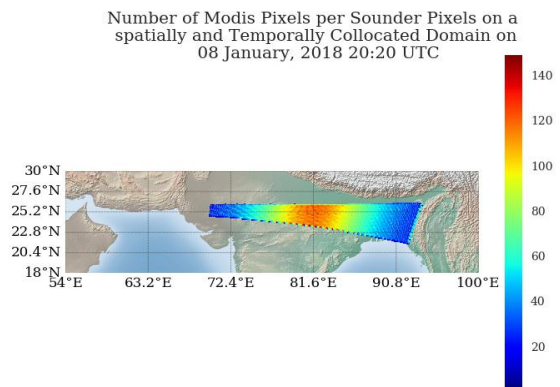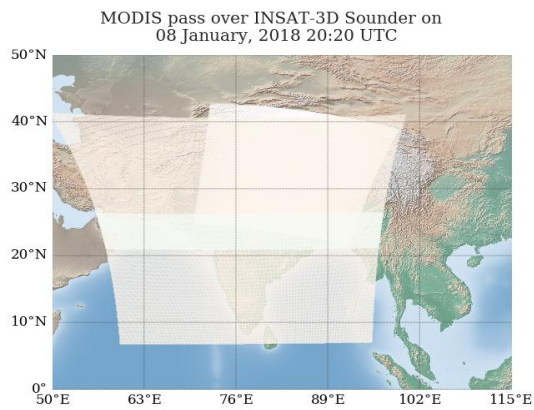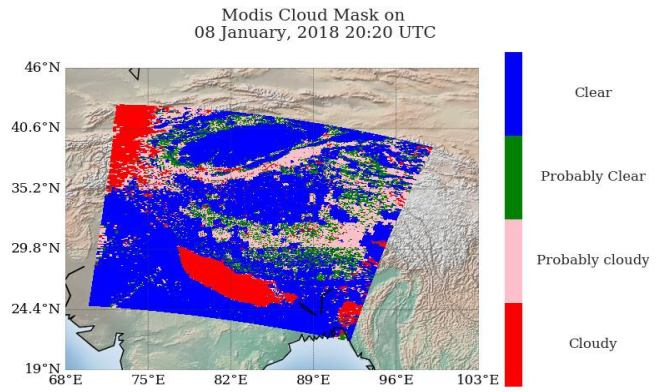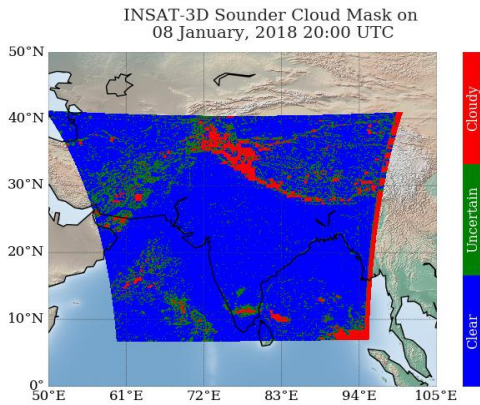| Skill Score	Value
Proportion Correct	0.324
Kuiper Skill Score	-0.018
Heidke Skill Score	-0.018

Number of Collocations for Jan-2018

Percentage Correct for Jan-2018

INSAT-3D Sounder Cloud Mask on
07 January, 2018 07:00 UTC

Modis Cloud Mask on
07 January, 2018 07:30 UTC

MODIS pass over INSAT-3D Sounder on
07 January, 2018 07:30 UTC

Number of Modis Pixels per Sounder Pixels on a
spatially and Temporally Collocated Domain on
07 January, 2018 07:30 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
08 January, 2018 20:00 UTC

Modis Cloud Mask on
08 January, 2018 20:20 UTC

MODIS pass over INSAT-3D Sounder on
08 January, 2018 20:20 UTC

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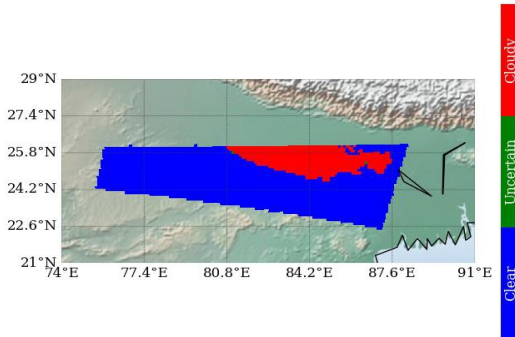spatially and Temporally Collocated Domain on
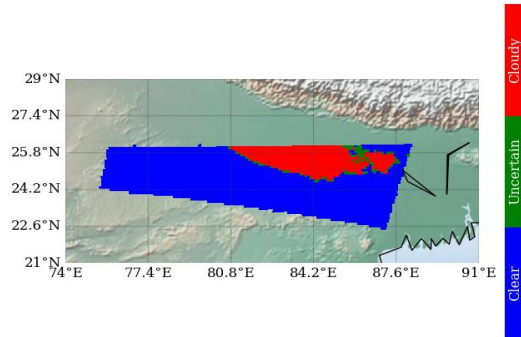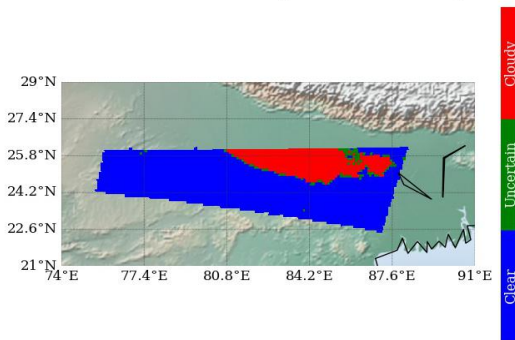08 January, 2018 20:20 UTC

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

Modis Cloud Mask on Sounder Grid
Method 2 : Weighted Average

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

Sounder Cloud Flag on Collocated Area