

VIIRS CLOUD PHASE AND TYPE STATUS

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VIIRS Cloud Phase/Type Products in NDE - Requirements

Timeliness	Refresh Rate	Data Latency	Mismt. Accuracy	Mismt. Range	Horiz. Res.	Vertical Res.	Geographic Coverage	User & Priority	Name
≤ 3 hours	90 minutes	30 minutes after granule is available	80% correct classification	Liquid/solid/super cooled/mixed (6 categories)	0.75 km	Cloud Top	Global	JPSS	Cloud Top Phase

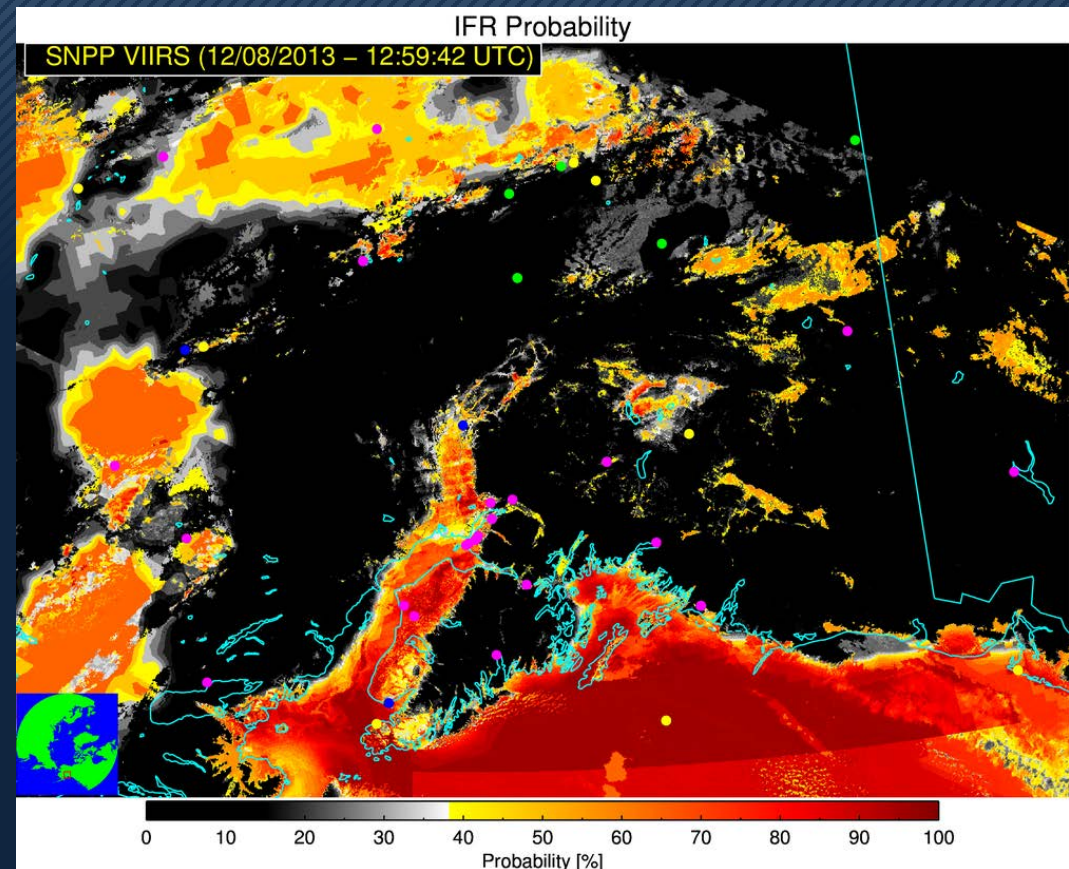
Timeliness	Refresh Rate	Data Latency	Mismt. Accuracy	Mismt. Range	Horiz. Res.	Vertical Res.	Geographic Coverage	User & Priority	Name
≤ 3 hours	90 minutes	30 minutes after granule is available	60% correct classification	7 categories	0.75 km	Cloud Top	Global	JPSS	Cloud Type

Algorithm: Pavlonis (2010) and Enterprise Cloud Phase and Type ATBD

VIIRS Cloud Phase/Type Products in NDE - Applications

Fog/low stratus threat assessment for aviation

- Downstream cloud algorithms (cloud height and optical properties)
- Aircraft icing
- Fog/low stratus (FLS)
- Precipitation type
- Cloud microphysical studies



False Color Imagery

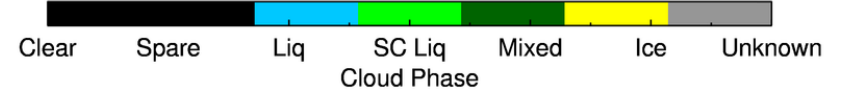
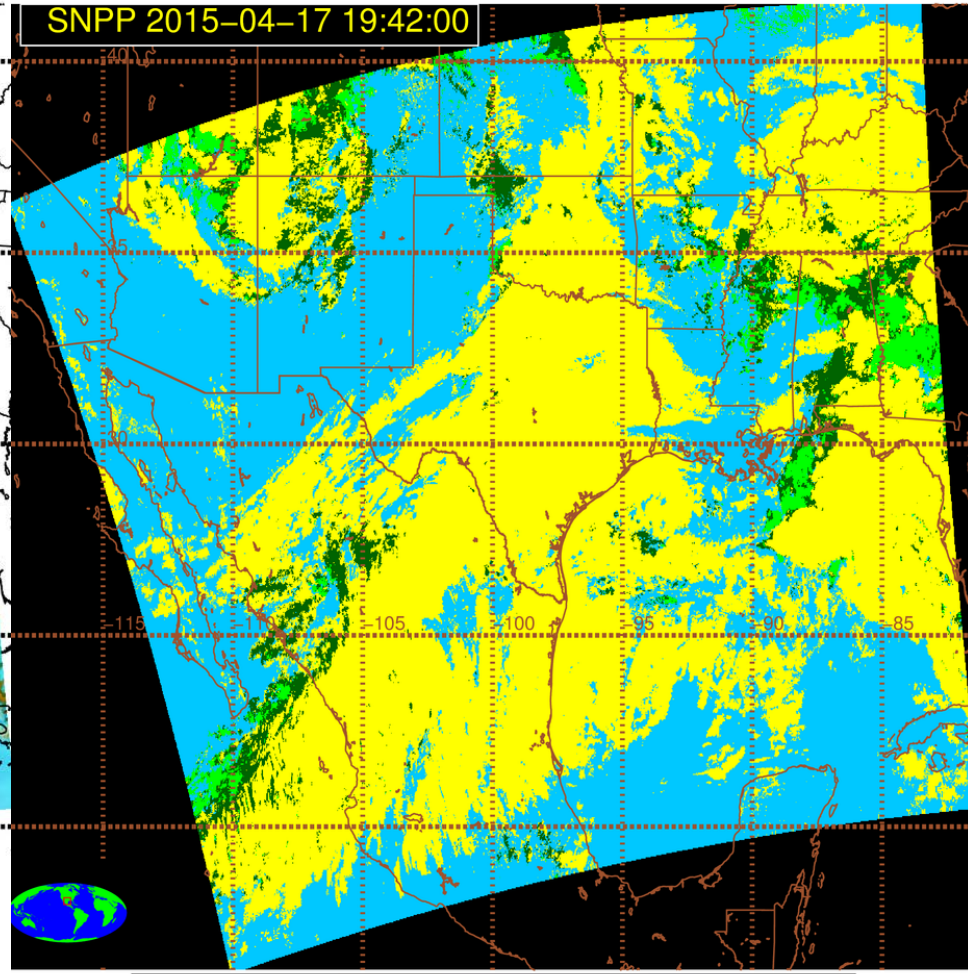
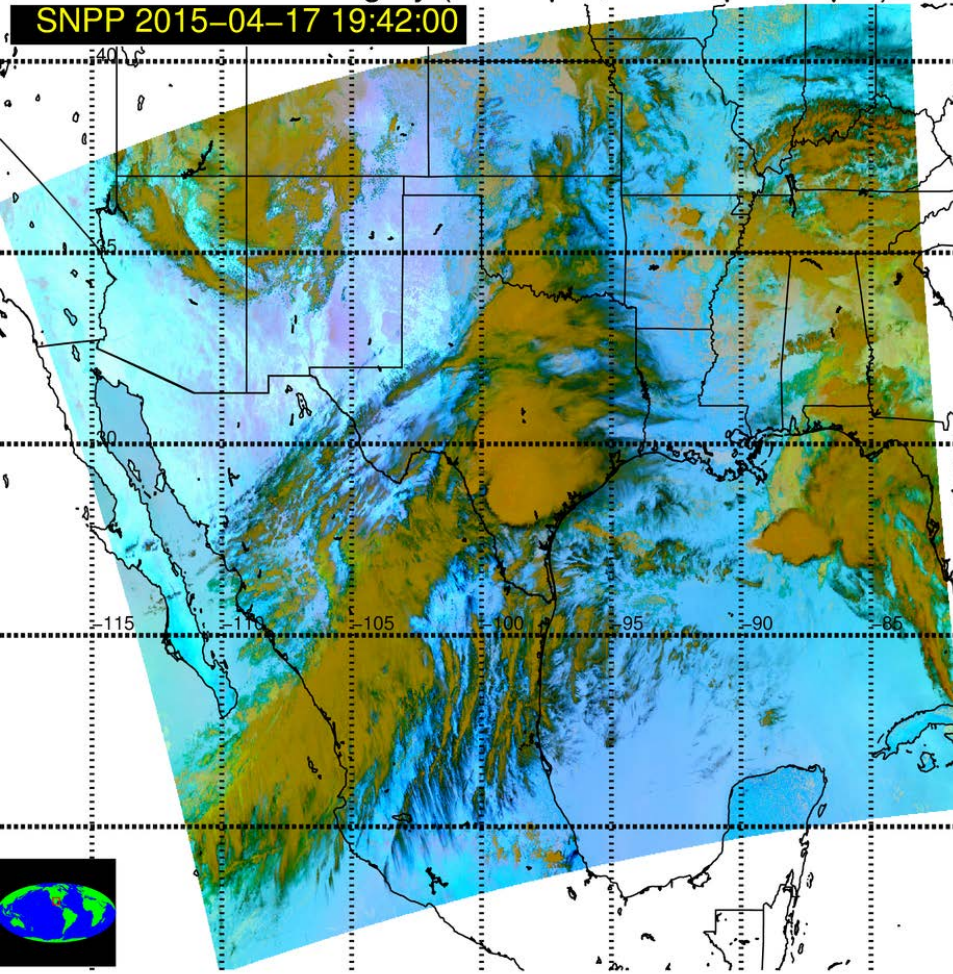
VIIRS NDE Cloud Phase

False Color Imagery (12–11 μ m, 11–8.5 μ m, 11 μ m)

Cloud Phase

SNPP 2015-04-17 19:42:00

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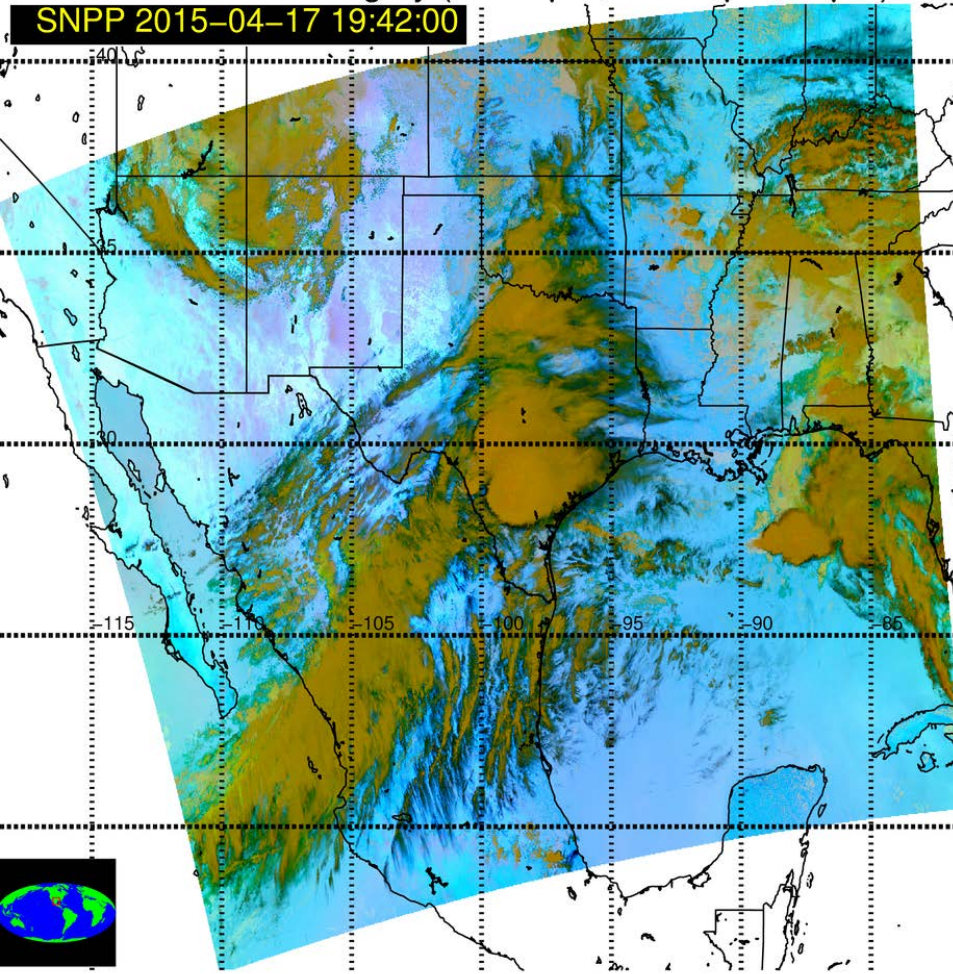


False Color Imagery

VIIRS NDE Cloud Type

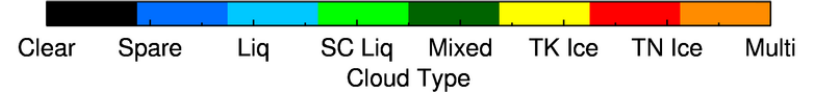
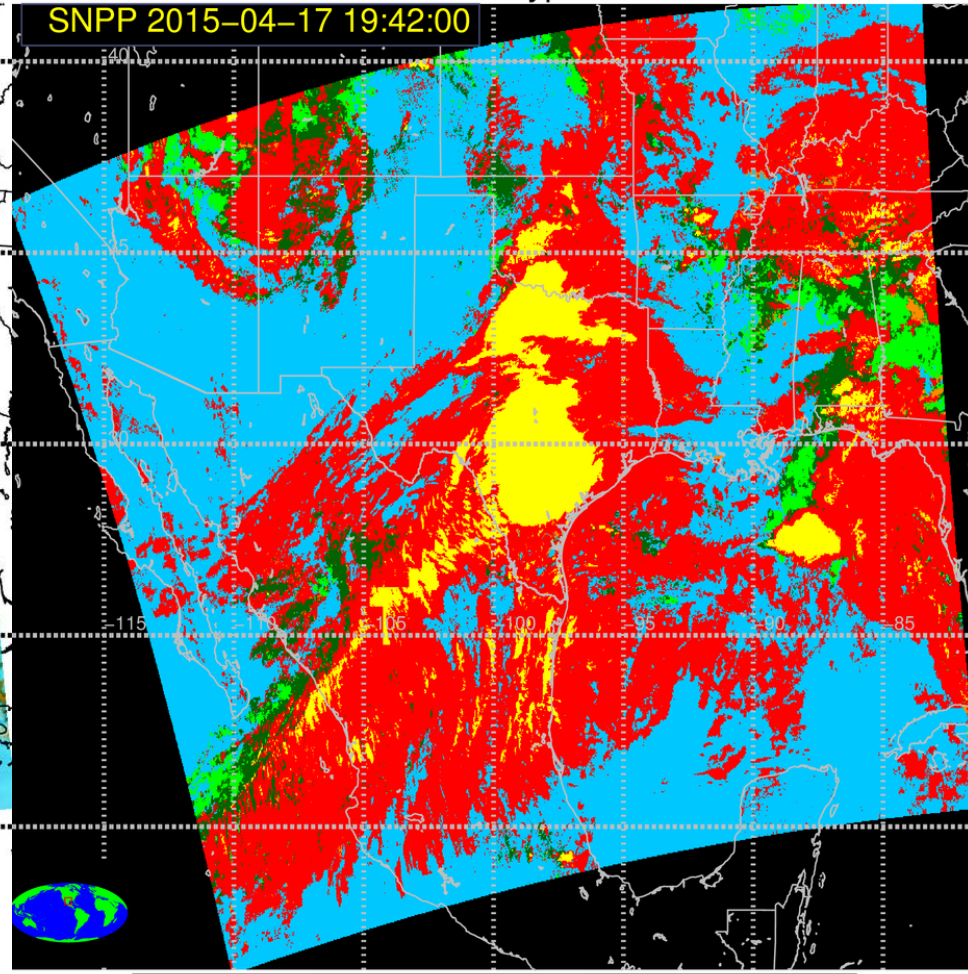
False Color Imagery (12–11 μ m, 11–8.5 μ m, 11 μ m)

SNPP 2015-04-17 19:42:00



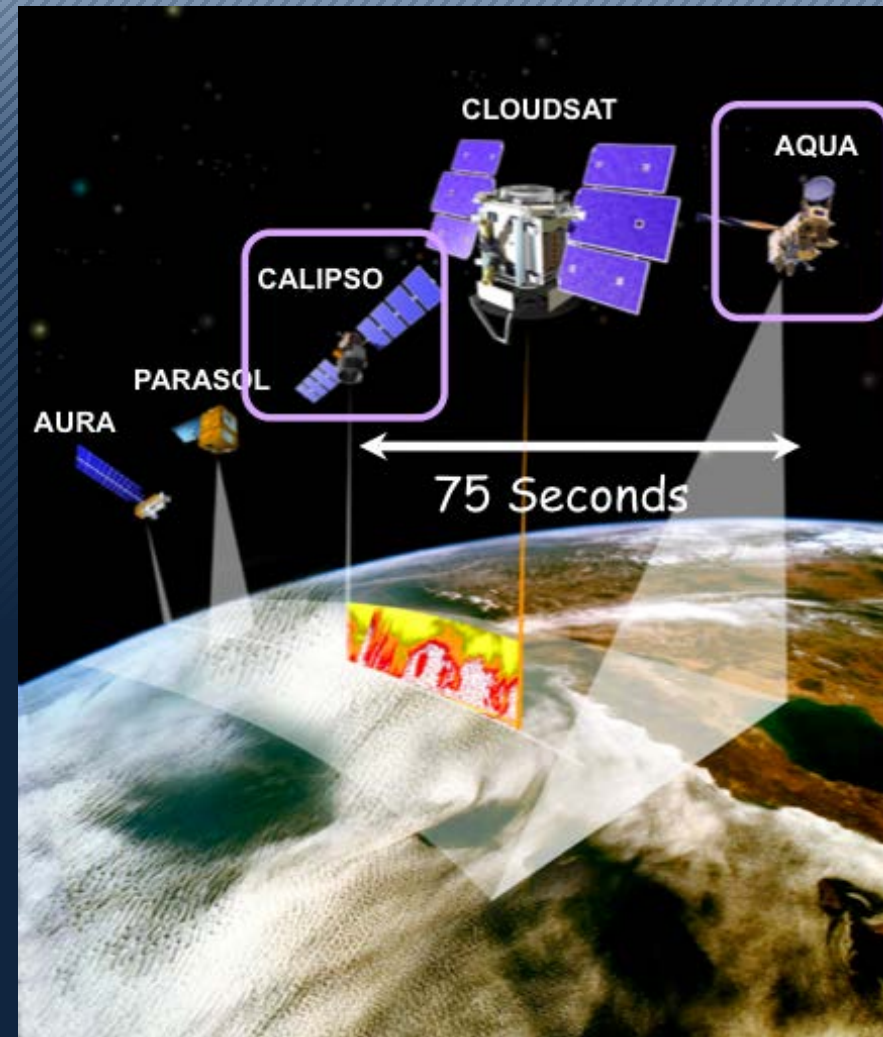
Cloud Type

SNPP 2015-04-17 19:42:00

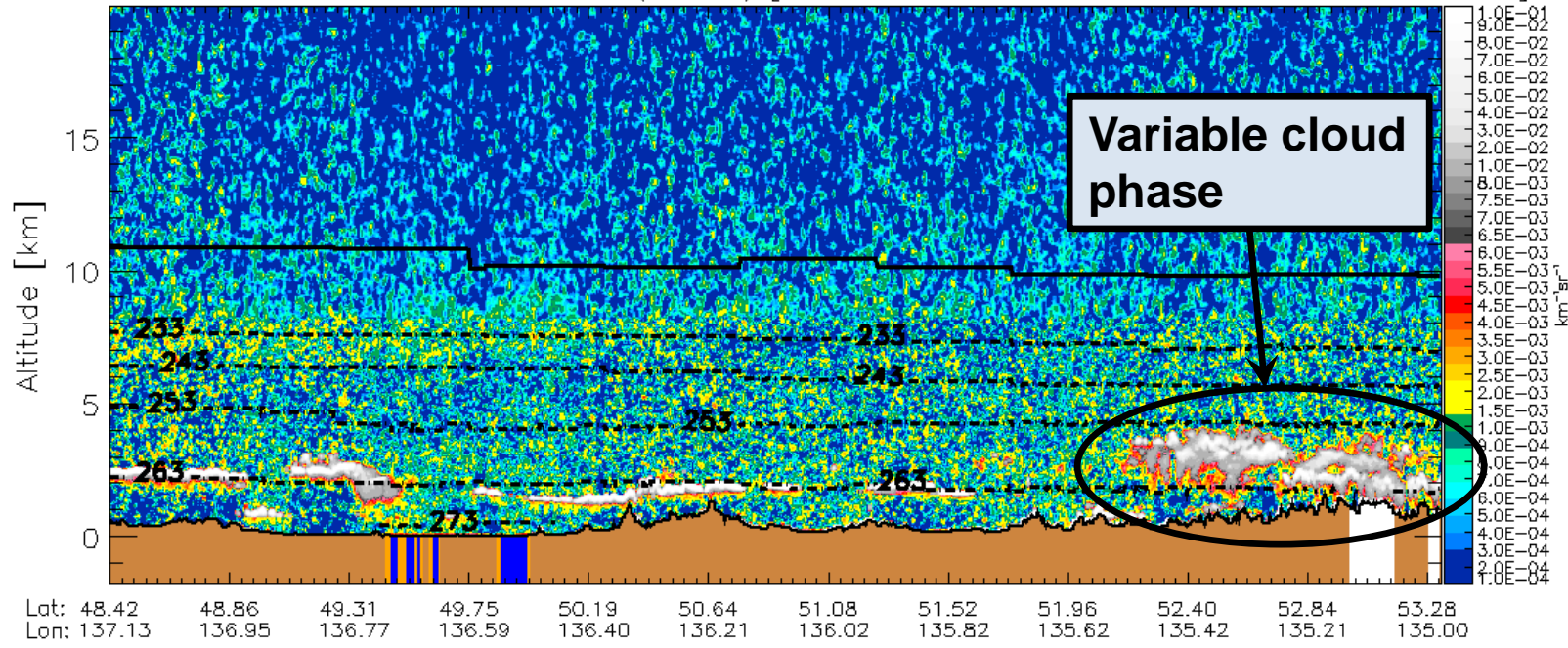


Validation

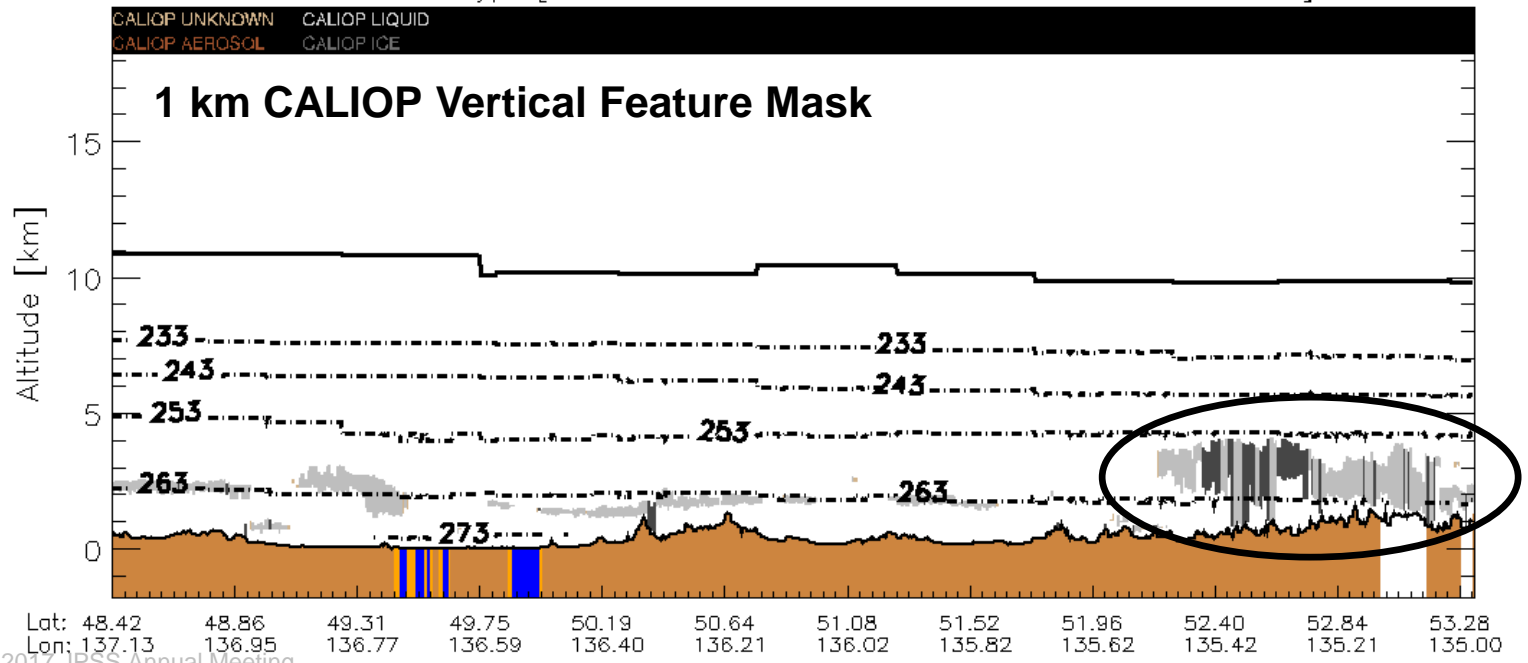
- CALIOP is a lidar, with depolarization, on board the CALIPSO satellite in the NASA A-Train.
- The CALIOP 1 and 5 km vertical feature mask products are merged to derive the cloud phase of the highest cloud layer with CALIOP 532 nm optical depth > 0.01
- Validation analysis is a function of the CALIOP 532 nm cloud optical depth

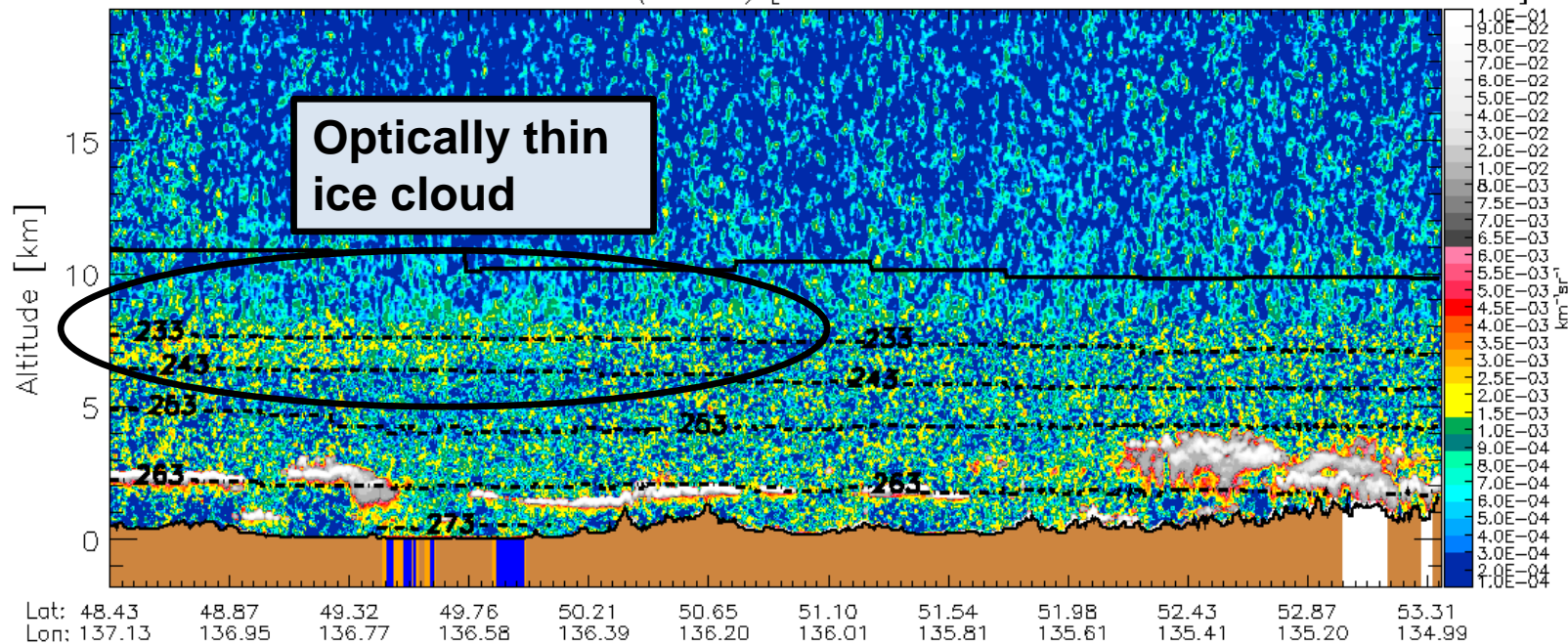


CALIOP 532 nm Total Attenuated Backscatter ($\text{km}^{-1}\text{sr}^{-1}$) [UTC: 2012-11-10 03:58:19 to 2012-11-10 03:59:43]

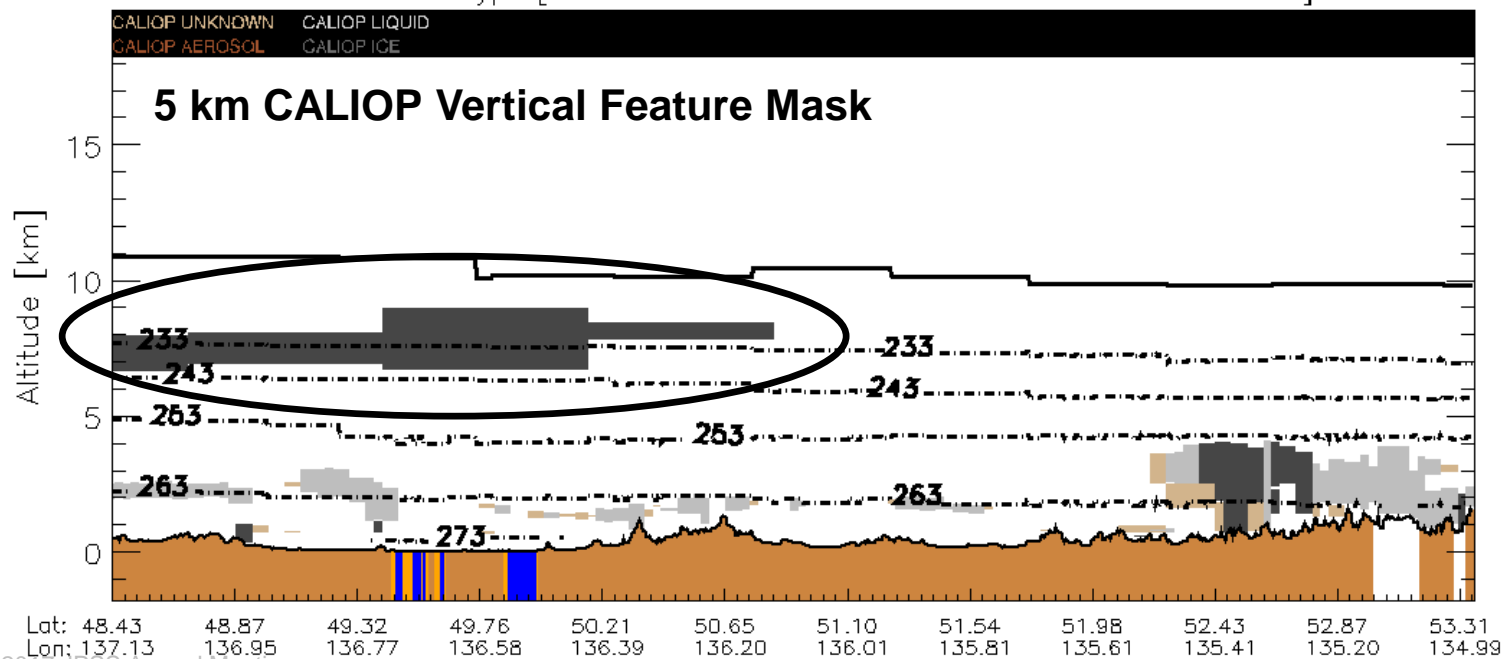


CALIOP Cloud Type [UTC: 2012-11-10 03:58:19 to 2012-11-10 03:59:43]





CALIOP Cloud Type [UTC: 2012-11-10 03:58:19 to 2012-11-10 03:59:43]



NDE Cloud Phase Validation

Optical Depth Filter

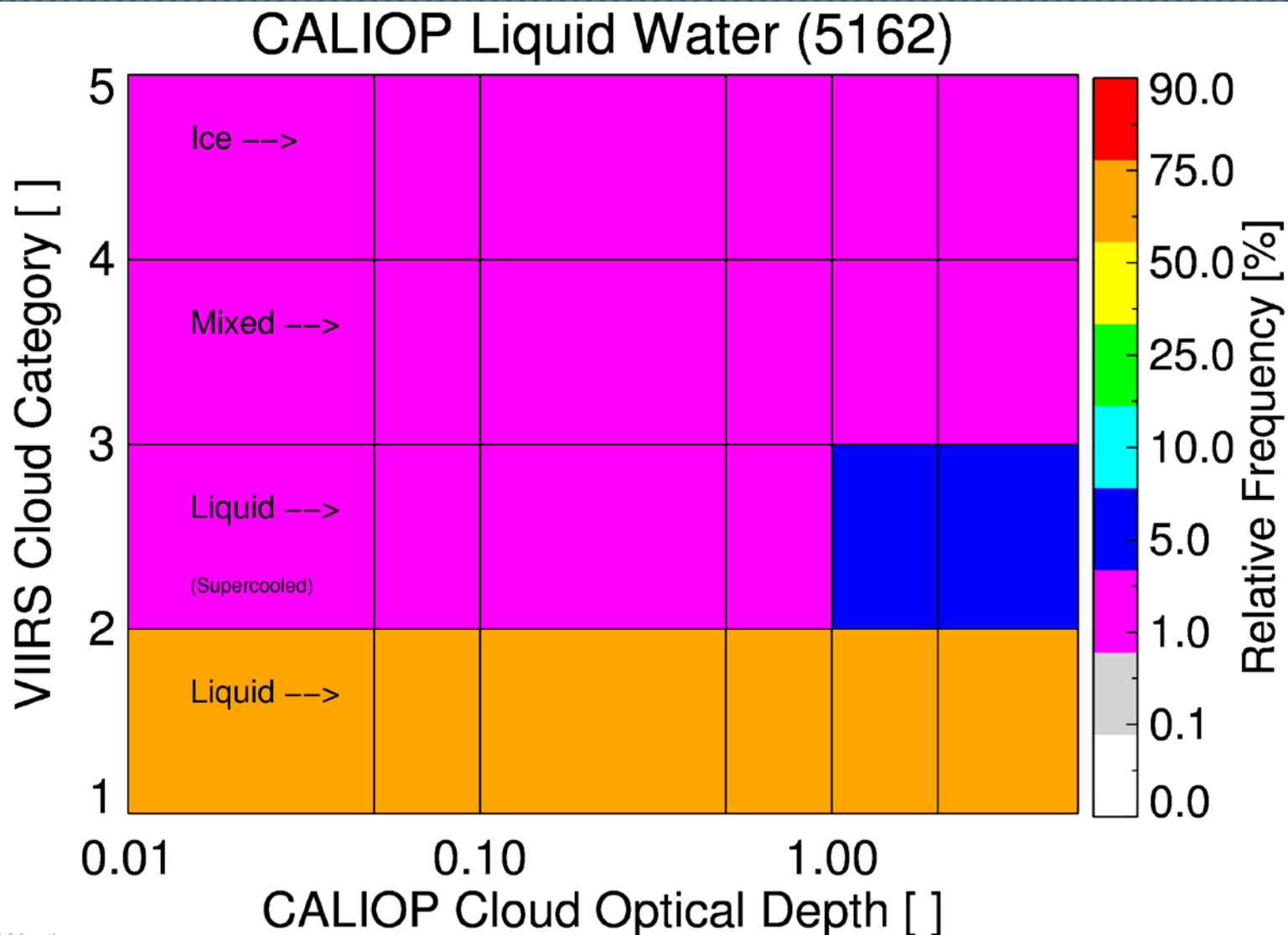
OD	>0.0	>0.1	>0.2	>0.3	>0.4	>0.5	>2.0
All data	0.826 (101144/ 122402)	0.876 (86632/ 98945)	0.882 (78632/ 89122)	0.885 (73889/ 83528)	0.885 (70792/ 79971)	0.885 (68246/ 77090)	0.849 (33375/ 39317)
Day time	0.822 (46123/ 56133)	0.875 (37517/ 42874)	0.881 (33982/ 38585)	0.880 (31653/ 35966)	0.880 (30307/ 34431)	0.880 (29267/ 33240)	0.822 (13703/ 16671)
Night time	0.830 (55021/ 66269)	0.876 (49115/ 56071)	0.884 (44650/ 50537)	0.888 (42236/ 47562)	0.889 (40485/ 45540)	0.889 (38979/ 43850)	0.869 (19672/ 22646)
Over land	0.862 (26242/ 30446)	0.897 (21655/ 24153)	0.904 (19429/ 21487)	0.907 (17766/ 19581)	0.909 (16888/ 18584)	0.910 (16193/ 17796)	0.868 (5999/ 6913)
Over water	0.815 (74902/ 91956)	0.869 (64977/ 74792)	0.875 (59203/ 67635)	0.878 (56123/ 63947)	0.878 (53904/ 61387)	0.878 (52053/ 59294)	0.845 (27376/ 32404)
Lat > 60 deg	0.860 (23218/ 26983)	0.870 (18754/ 21561)	0.873 (17127/ 19612)	0.873 (16046/ 18387)	0.873 (15407/ 17642)	0.872 (14772/ 16949)	0.782 (6264/ 8007)
Lat < 60 deg	0.817 (77926/ 95419)	0.877 (67878/ 77384)	0.885 (61505/ 69510)	0.888 (57843/ 65141)	0.889 (55385/ 62329)	0.889 (53474/ 60141)	0.866 (27111/ 31310)

NDE Cloud Type Validation

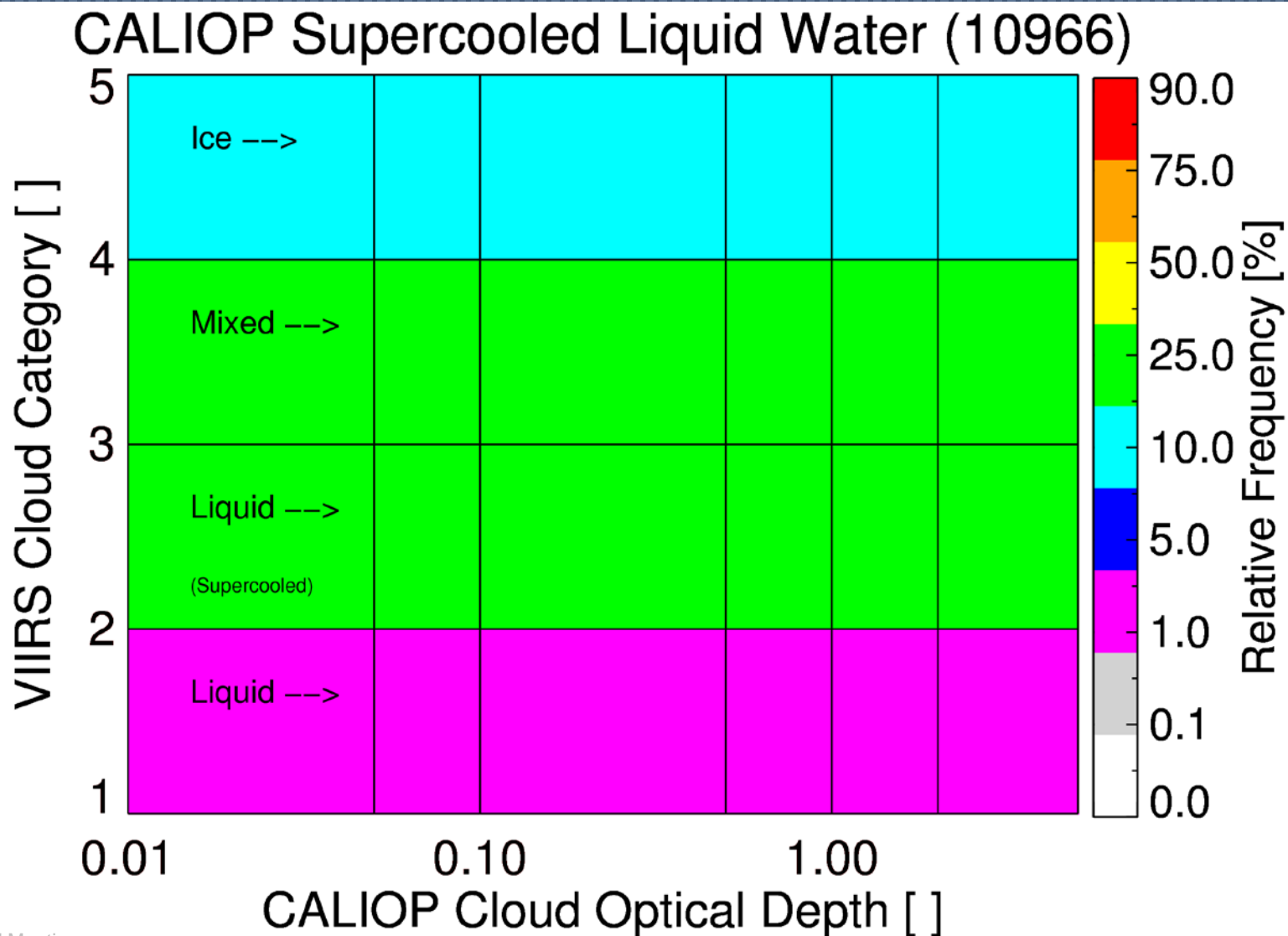
Optical Depth Filter

OD	> 0.0	>0.1	>0.2	>0.3	>0.4	>0.5	>2.0
All data	0.726 (82679/ 113807)	0.778 (71968/ 92555)	0.791 (65841/ 83244)	0.799 (62265/ 77943)	0.802 (59771/ 74539)	0.805 (57802/ 71847)	0.775 (28372/ 36601)
Day time	0.712 (35328/ 49614)	0.775 (29527/ 38104)	0.790 (27015/ 34180)	0.797 (25307/ 31770)	0.799 (24247/ 30357)	0.803 (23514/ 29293)	0.754 (11044/ 14642)
Night time	0.738 (47351/ 64193)	0.779 (42441/ 54451)	0.791 (38826/ 49064)	0.800 (36958/ 46173)	0.804 (35524/ 44182)	0.806 (34288/ 42554)	0.789 (17328/ 21959)
Over land	0.719 (19737/ 27445)	0.753 (16429/ 21819)	0.760 (14670/ 19315)	0.763 (13393/ 17547)	0.766 (12755/ 16656)	0.768 (12261/ 15965)	0.676 (4118/ 6095)
Over water	0.729 (62942/ 86362)	0.785 (55539/ 70736)	0.800 (51171/ 63929)	0.809 (48872/ 60396)	0.812 (47016/ 57883)	0.815 (45541/ 55882)	0.795 (24254/ 30506)
Lat > 60 deg	0.803 (15903/ 19805)	0.844 (13560/ 16063)	0.865 (12557/ 14514)	0.876 (11874/ 13556)	0.881 (11399/ 12945)	0.884 (10980/ 12426)	0.837 (4846/ 5789)
Lat < 60 deg	0.710 (66776/ 94002)	0.764 (58408/ 76492)	0.775 (53284/ 68730)	0.783 (50391/ 64387)	0.785 (48372/ 61594)	0.788 (46822/ 59421)	0.764 (23526/ 30812)

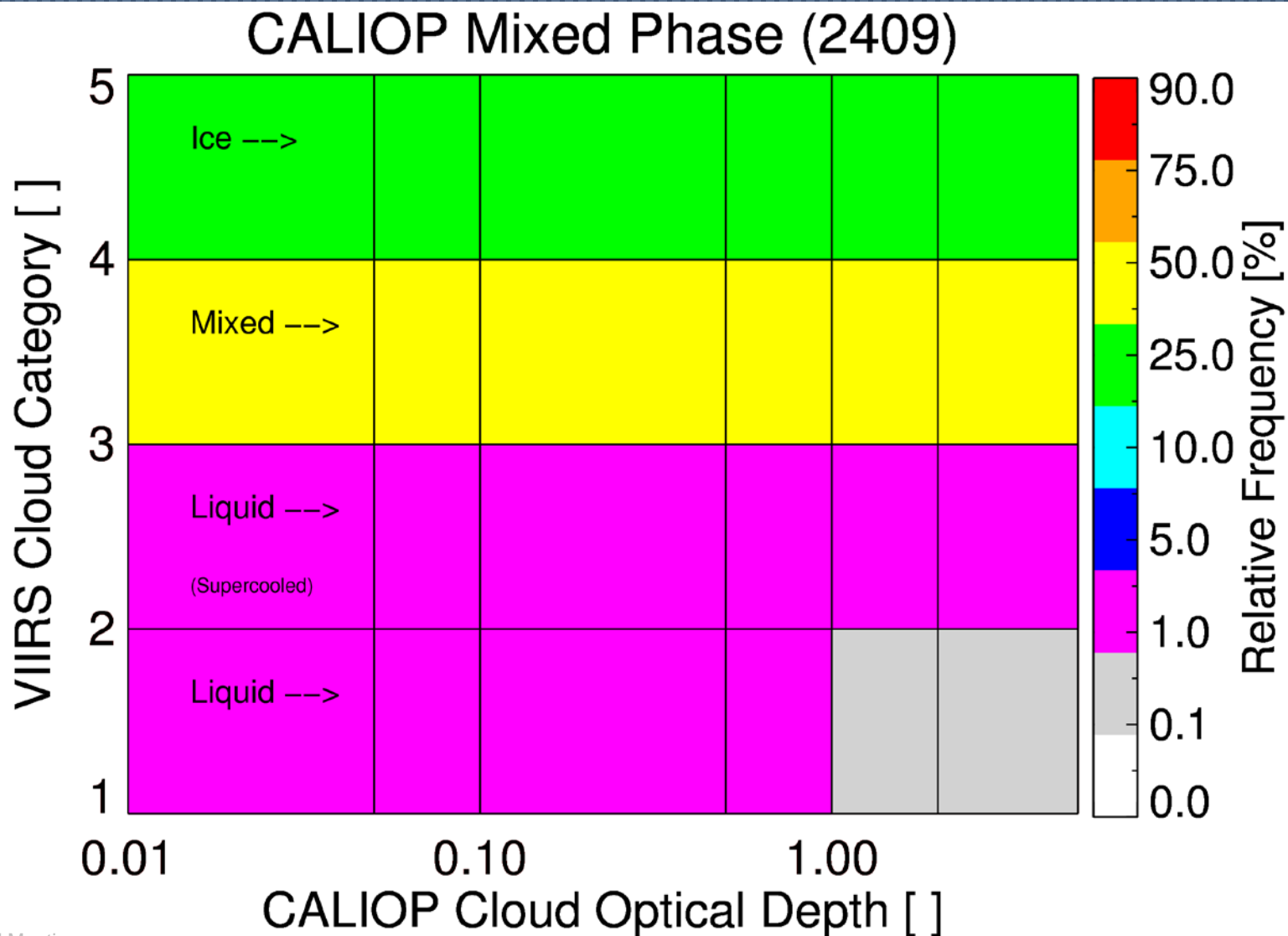
When CALIOP indicates warm liquid water, the VIIRS algorithm generally agrees (most disagreements fall into supercooled liquid water category)



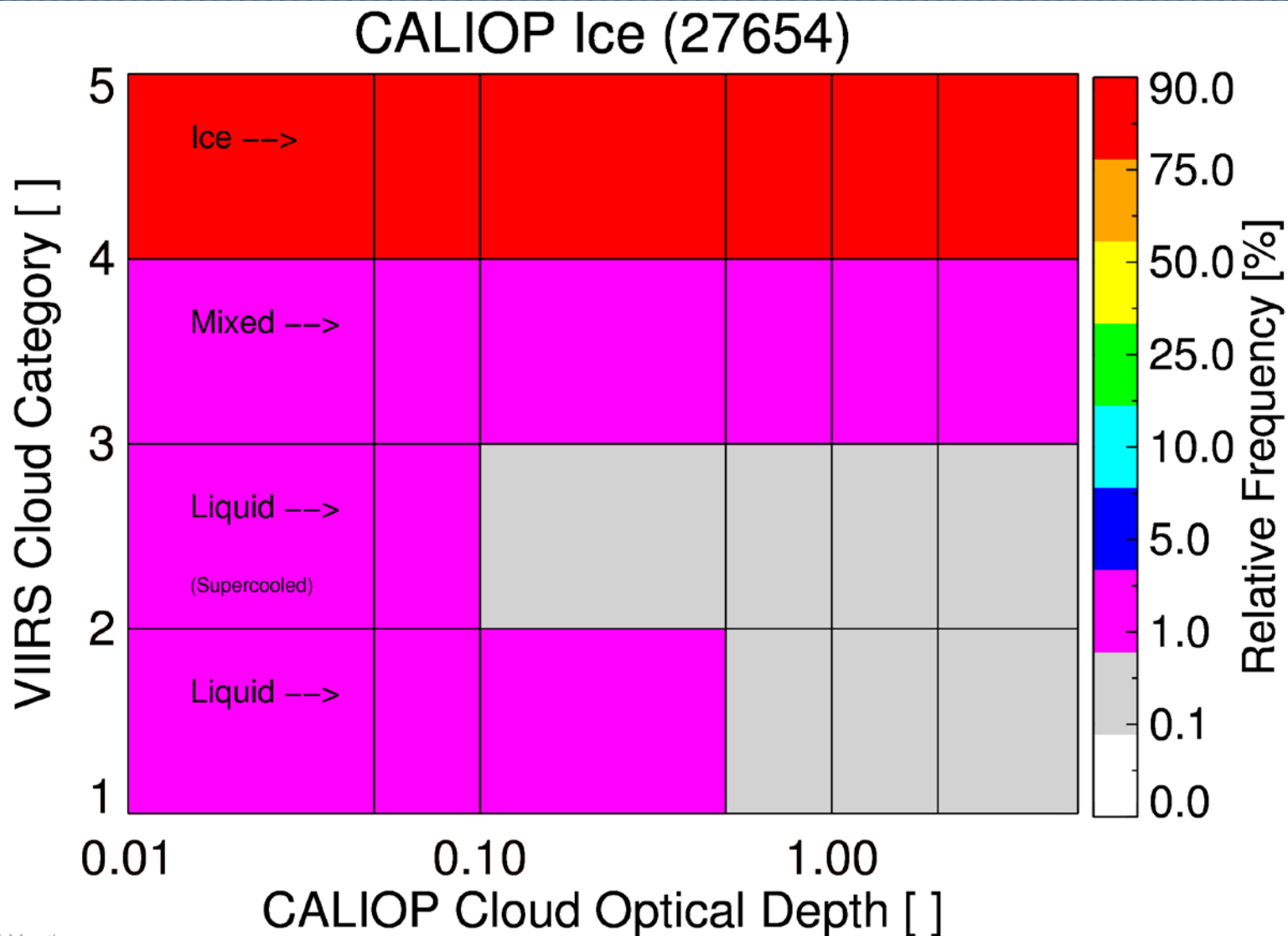
When CALIOP indicates supercooled liquid water, the VIIRS algorithm generally classifies clouds as supercooled liquid or mixed phase



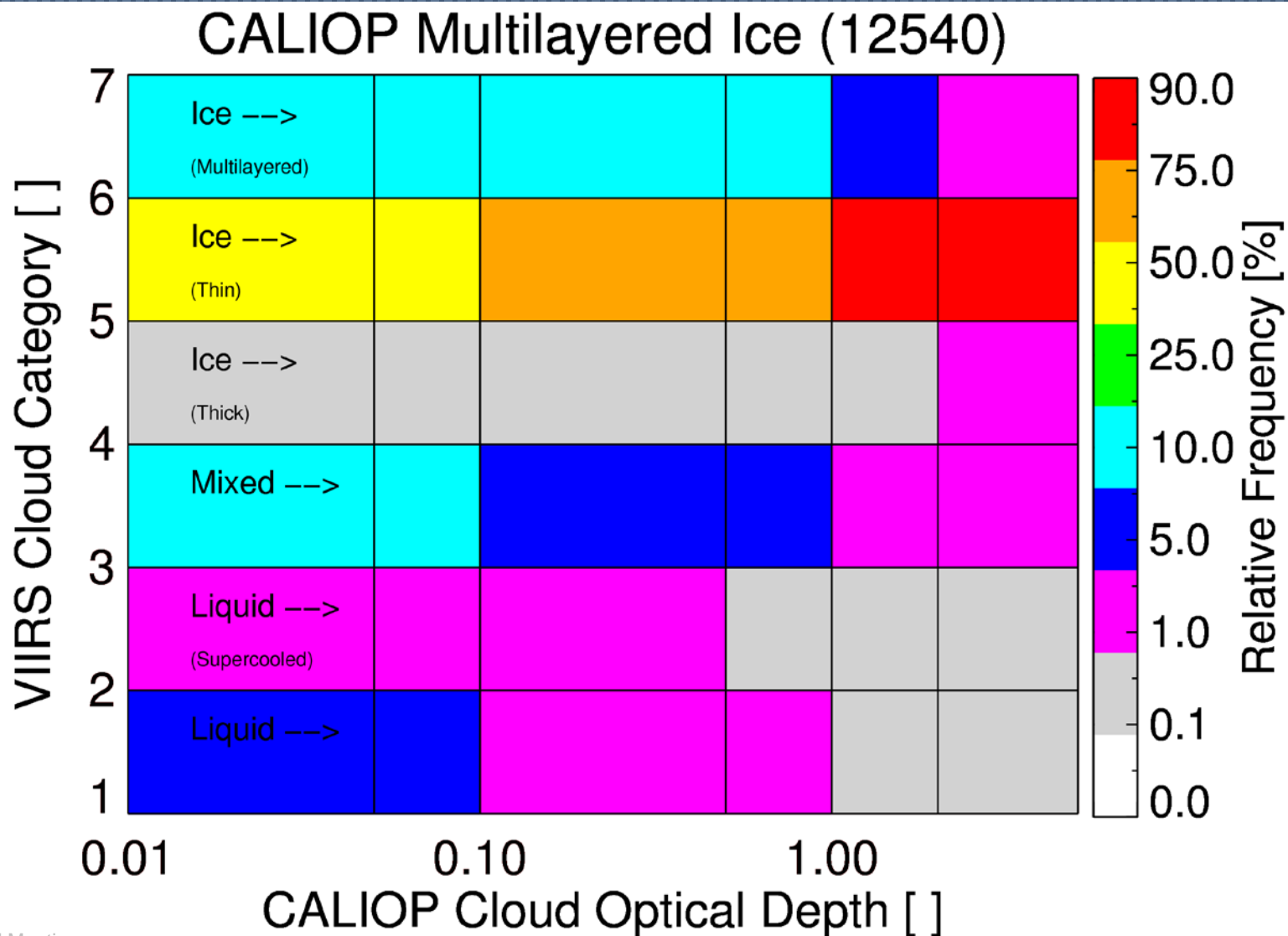
When CALIOP indicates mixed phase, the VIIRS algorithm generally agrees (most disagreements fall into ice phase category)

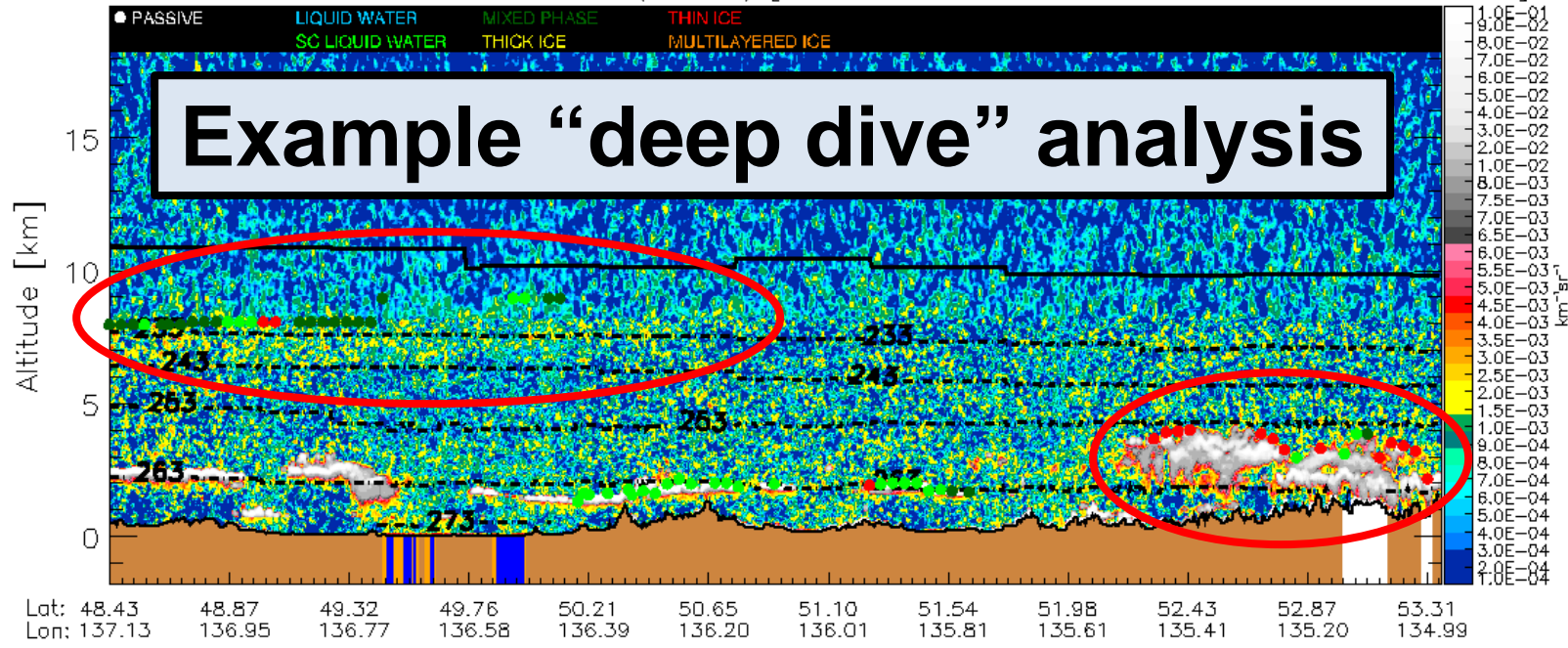


When CALIOP indicates ice phase, the VIIRS algorithm generally agrees (most disagreements fall into mixed phase category)

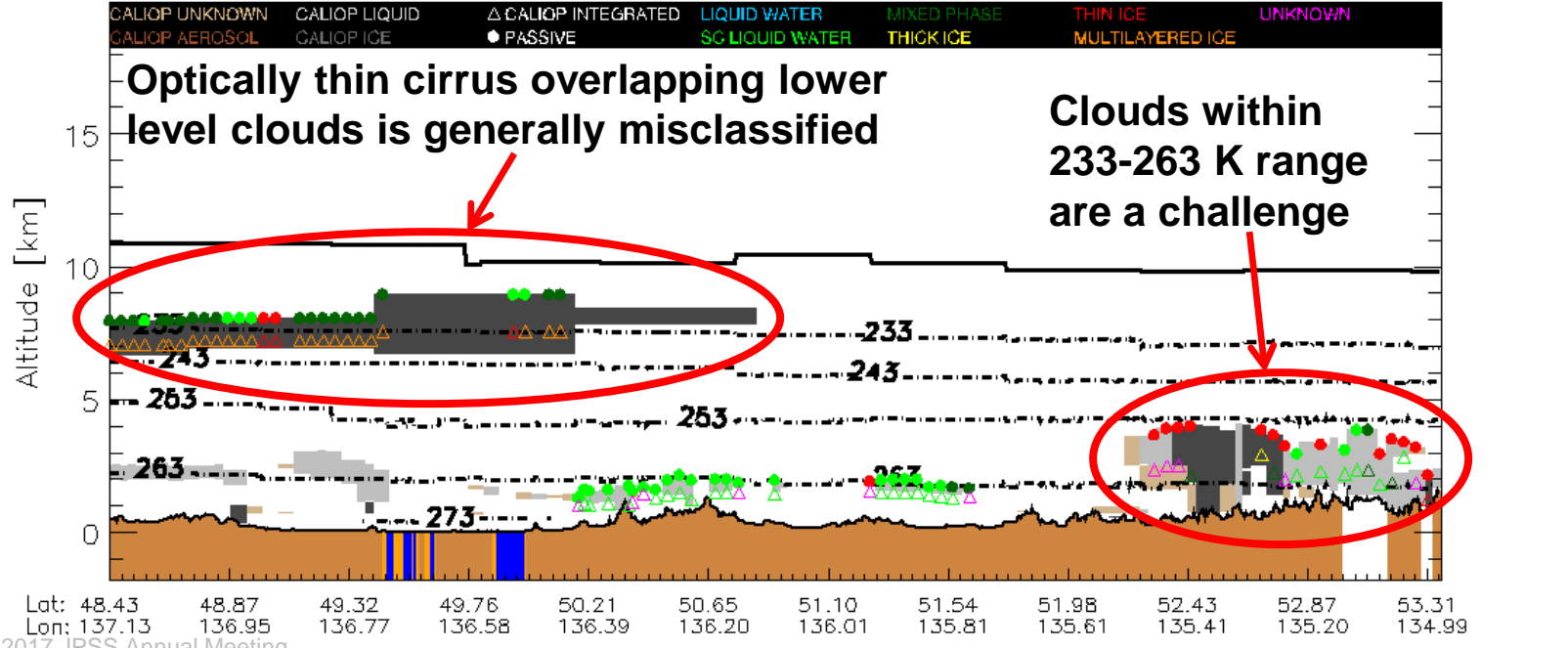


When CALIOP indicates multilayered ice, the VIIRS algorithm has a difficult time identifying the cloud as multilayered ice





CALiOP Cloud Type [UTC: 2012-11-10 03:58:19 to 2012-11-10 03:59:43]

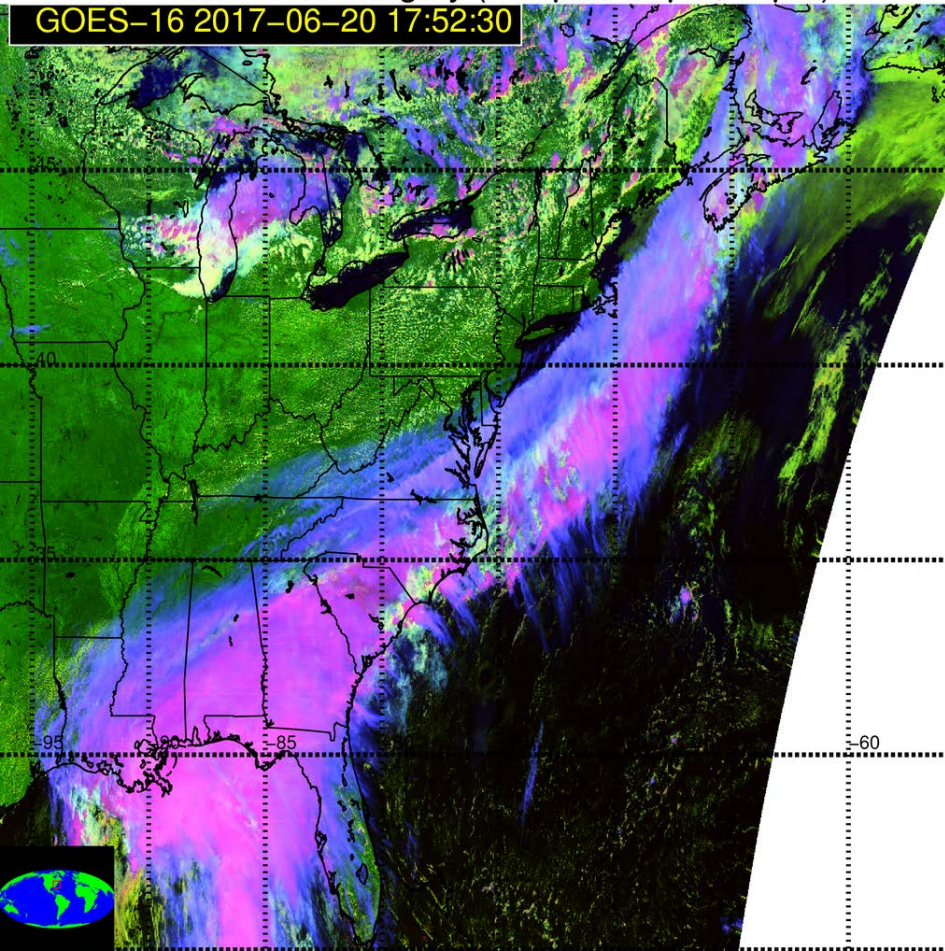


VIIRS NDE vs GOES-16 ABI from GS

False Color Imagery

False Color Imagery (0.65 μ m, 1.6 μ m, 11 μ m)

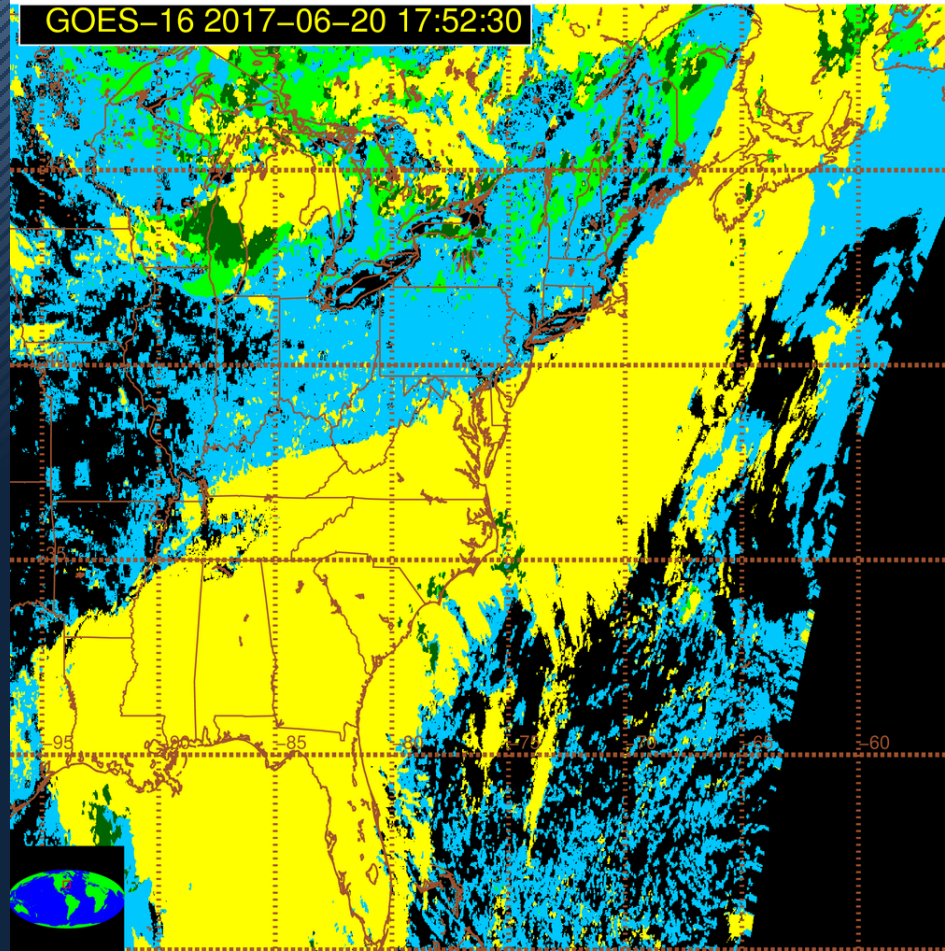
GOES-16 2017-06-20 17:52:30



GOES-16 ABI GS Cloud Phase

Cloud Phase

GOES-16 2017-06-20 17:52:30



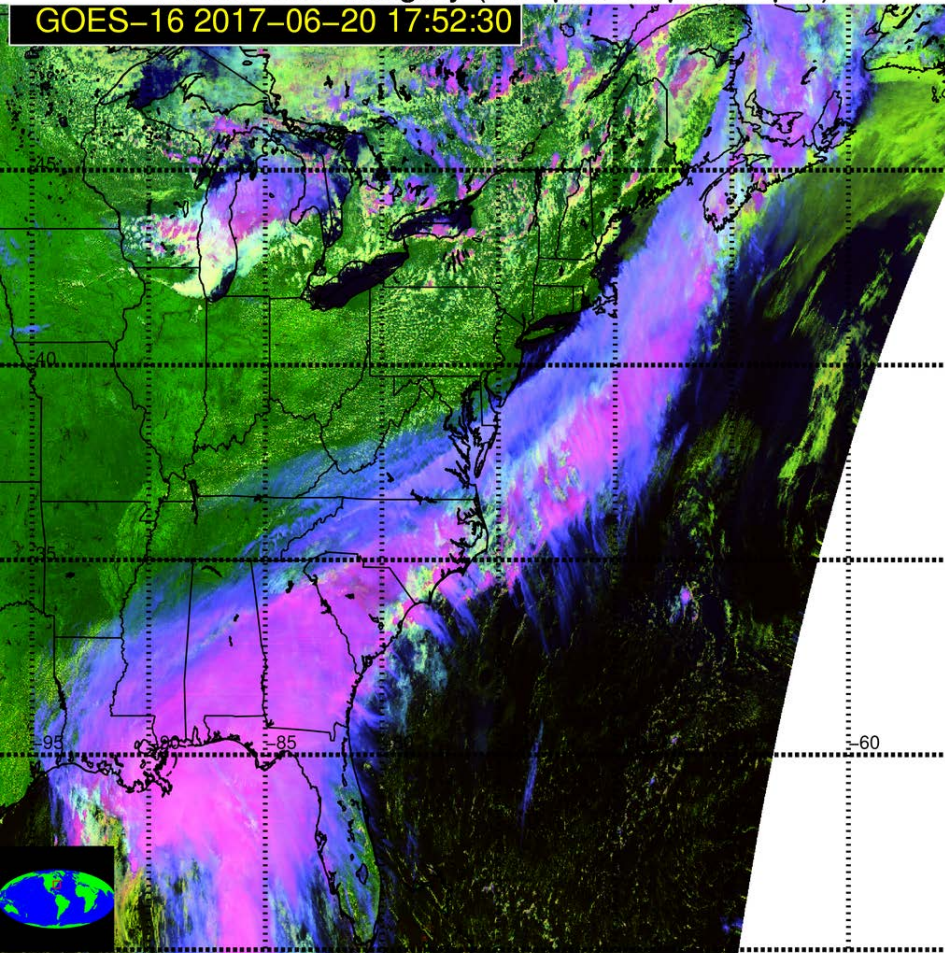
Clear Spare Liq SC Liq Mixed Ice Unknown
Cloud Phase

VIIRS NDE vs GOES-16 ABI from GS

False Color Imagery

False Color Imagery (0.65 μ m, 1.6 μ m, 11 μ m)

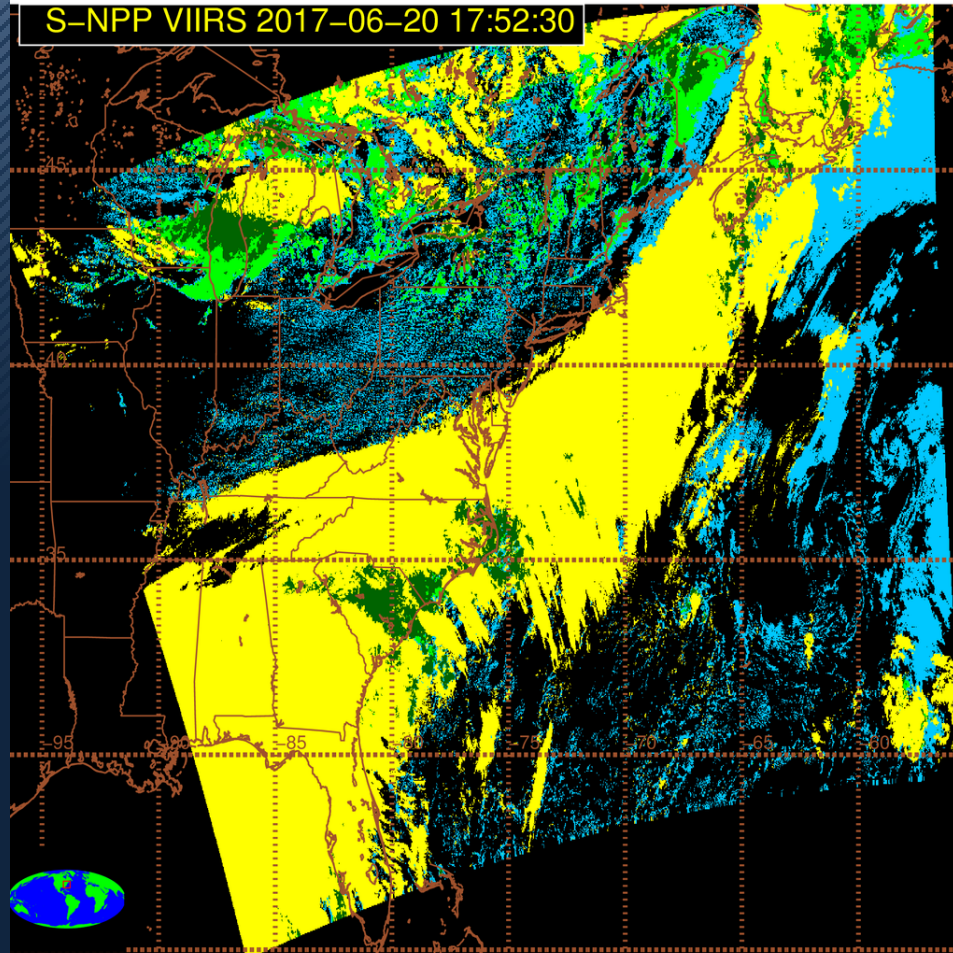
GOES-16 2017-06-20 17:52:30



VIIRS NDE Cloud Phase

Cloud Phase

S-NPP VIIRS 2017-06-20 17:52:30



Clear Spare Liq SC Liq Mixed Ice Unknown
Cloud Phase

VIIRS NDE vs GOES-16 ABI from GS

VIIRS \ ABI	Liquid	Supercooled	Mixed	Ice	Total
Liquid	924996 (17.20%)	43766 (0.81%)	12167 (0.23%)	141531 (2.63%)	1122460 (20.87%)
Supercooled	74126 (1.38%)	187852 (3.49%)	33211 (0.62%)	50590 (0.94%)	345779 (6.43%)
Mixed	18056 (0.34%)	41011 (0.76%)	100420 (1.87%)	236750 (4.40%)	396237 (7.37%)
Ice	117529 (2.19%)	15822 (0.29%)	35629 (0.66%)	3344144 (62.19%)	3513124 (65.33%)
Total	1134707 (21.10%)	288451 (5.36%)	181427 (3.37%)	3773015 (70.17%)	5377600 (100%)

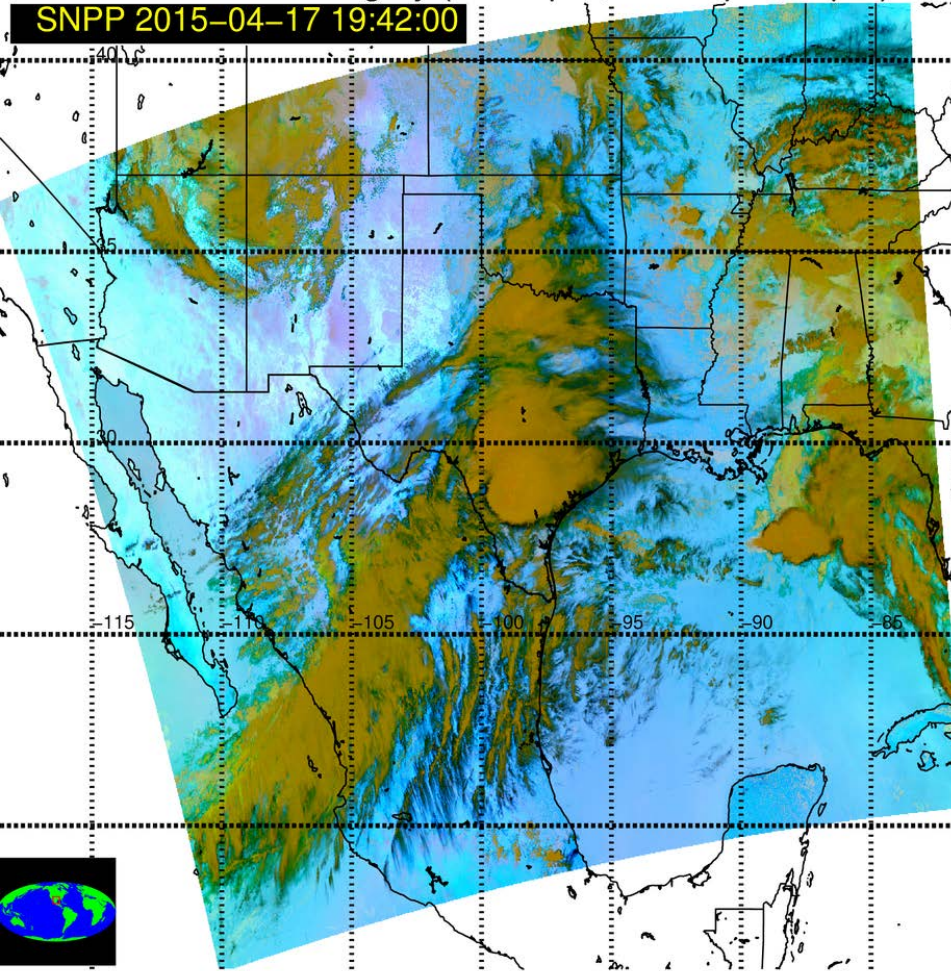
The GOES-16 ABI product detects about 5% more ice clouds. Most are thin cirrus that are difficult to detect without infrared absorption channels, which VIIRS lacks.

Planned Improvements

7.3 μm pseudo-channel

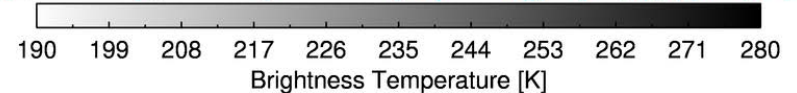
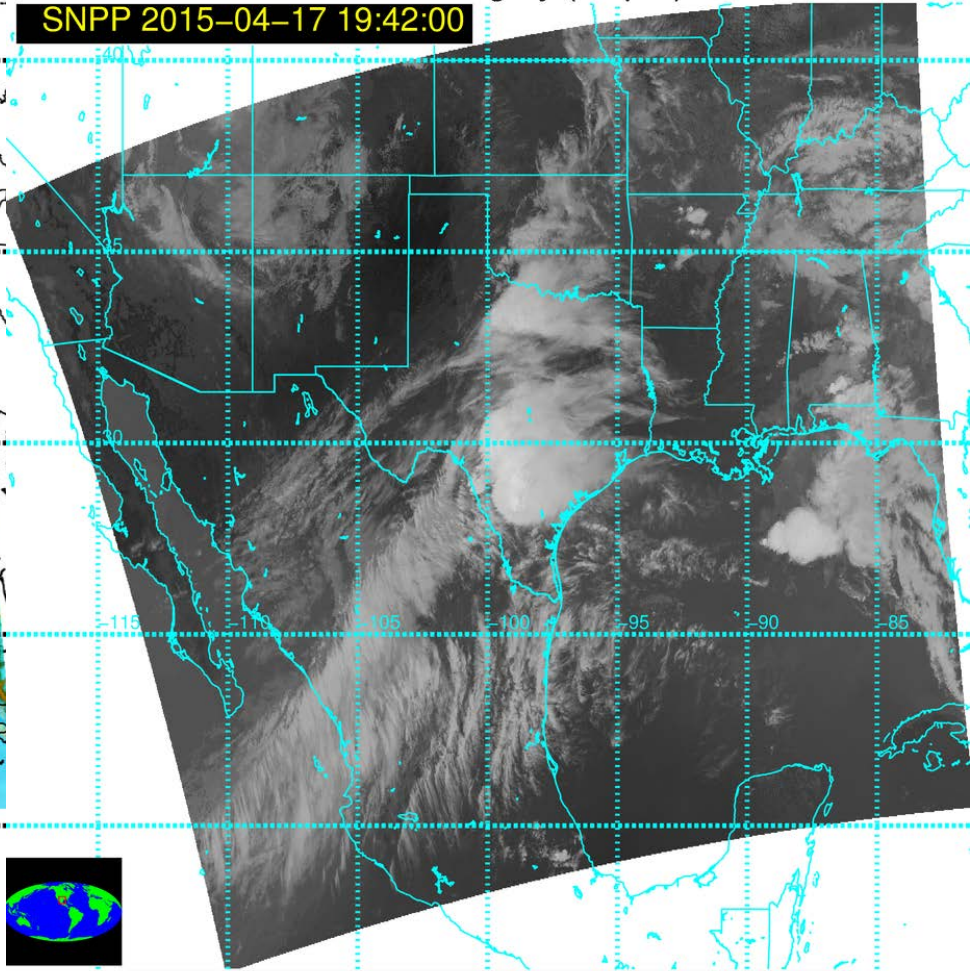
False Color Imagery (12–11 μm , 11–8.5 μm , 11 μm)

SNPP 2015-04-17 19:42:00



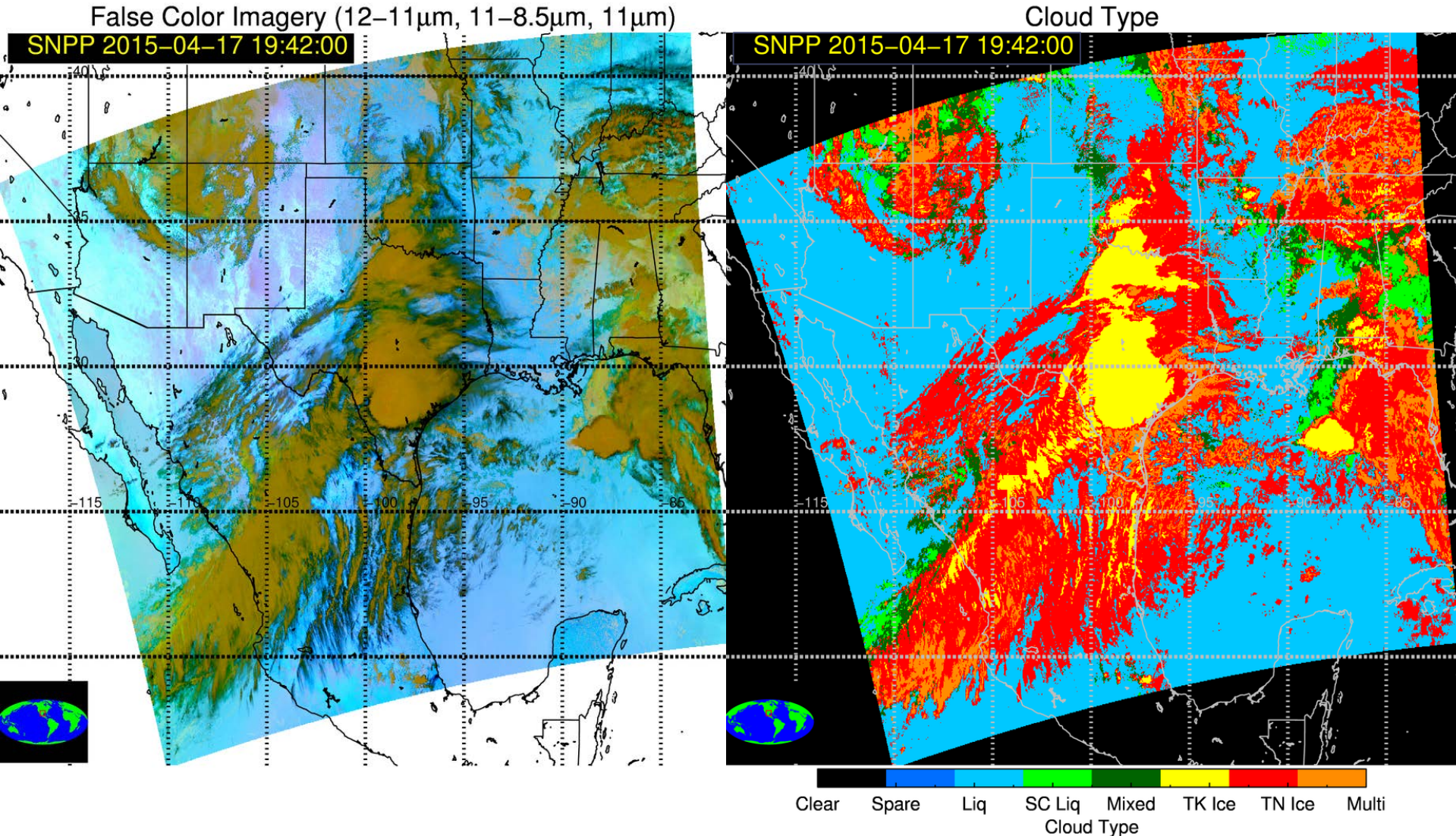
Infrared Imagery (7.3 μm)

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Planned Improvements

With 7.3 μm pseudo-channel

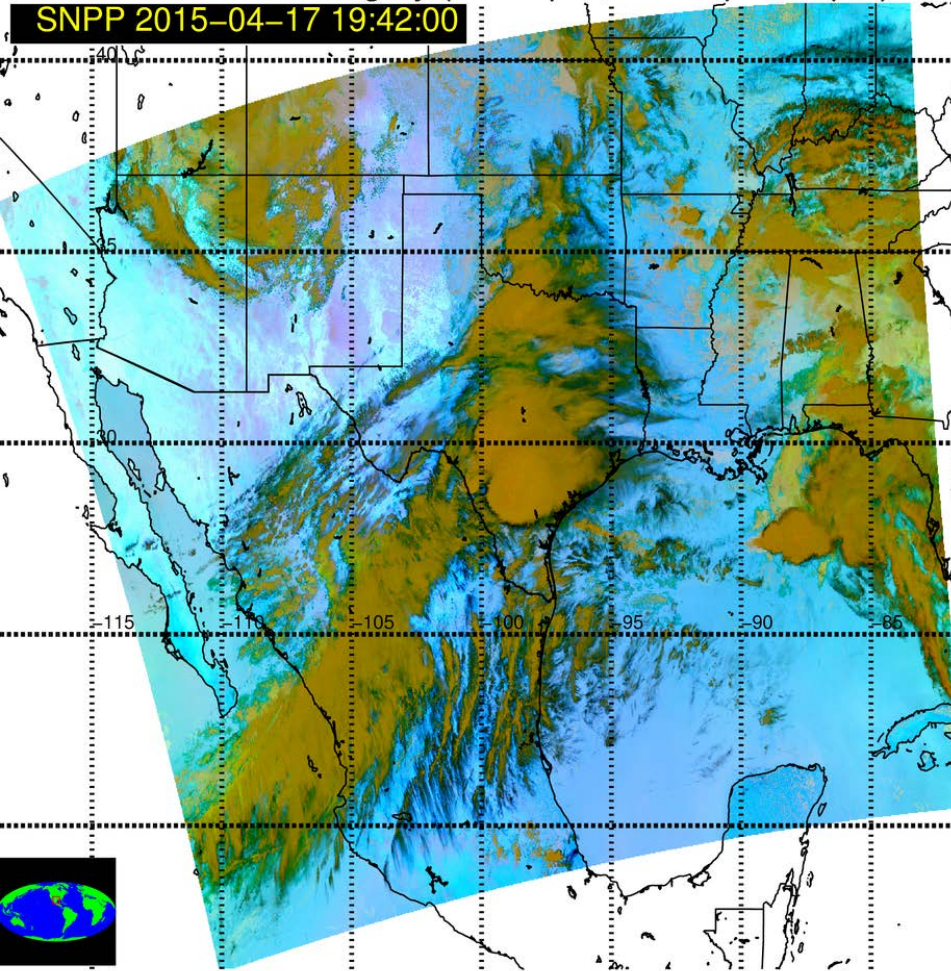


Planned Improvements

Without 7.3 μm pseudo-channel

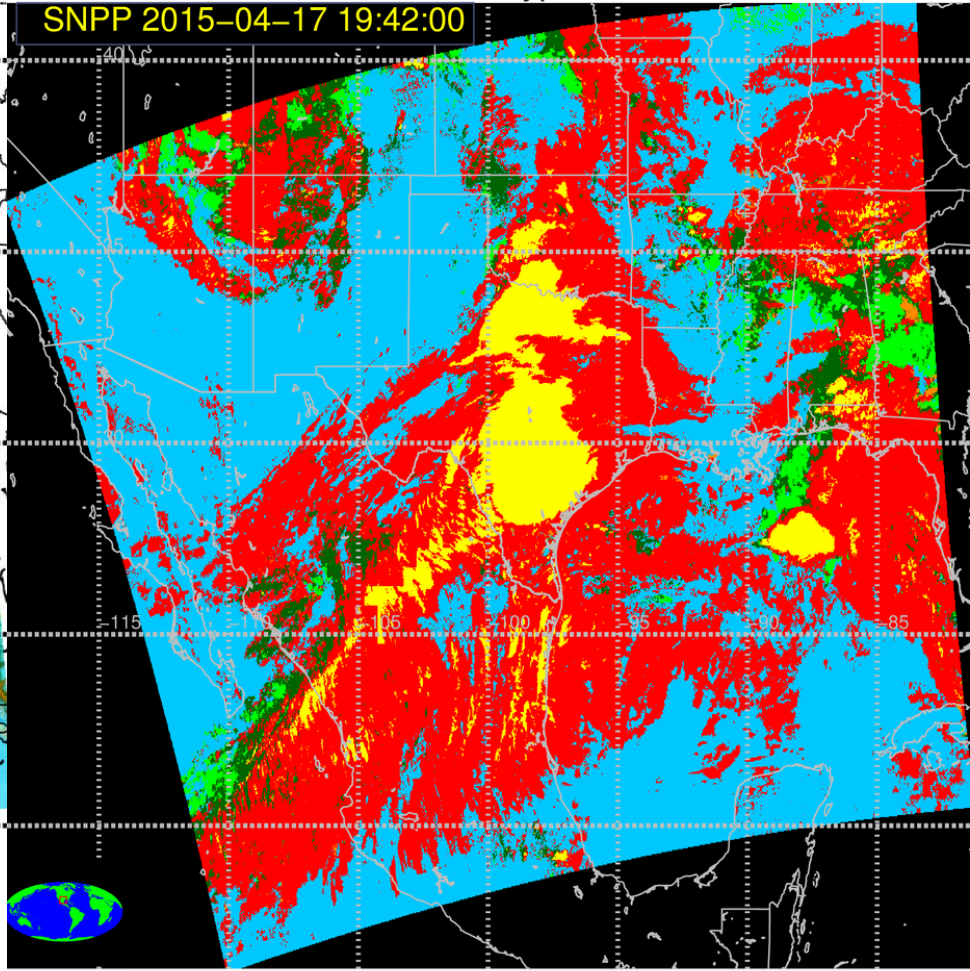
False Color Imagery (12–11 μm , 11–8.5 μm , 11 μm)

SNPP 2015-04-17 19:42:00



Cloud Type

SNPP 2015-04-17 19:42:00



Clear Spare Liq SC Liq Mixed TK Ice TN Ice Multi
Cloud Type

Future Plans

- Optimize thresholds for on-orbit JPSS-1 data
- Continue to explore use of CrIS measurements, including pseudo-channels
- Integration of near-infrared measurements (produce IR-only and IR + NIR products?)

