Comparison of Cloud and Aerosol Detection between CERES Cloud Mask and CALIPSO Version 2 Data Products

Qing Z. Trepte, Zhaoyan Liu, Sunny Sun-Mack
Patrick Minnis, Chip Trepte

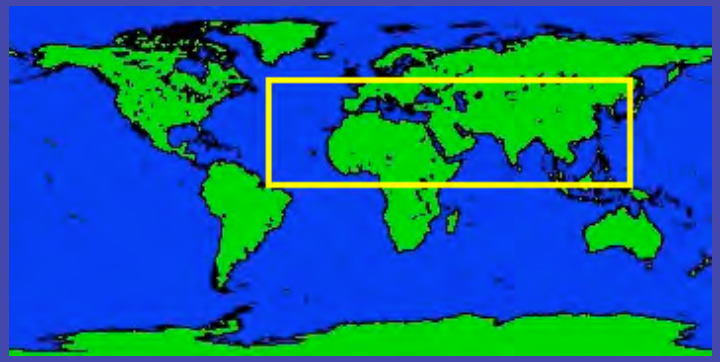
Cloud Working Group

10th CERES-II Science Team Meeting
New York City, NY, 27 - 29, October, 2008

Improvements of CERES cloud mask since last STM

1. New dust detection tests that apply to the “dust regions”

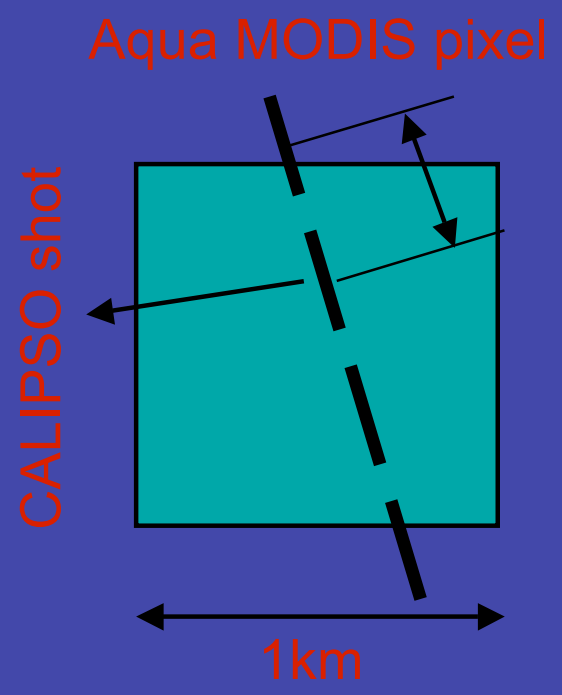
   - The dust region is defined below:



   - MODIS T_{11}-T_{12}, T_{85}-T_{11}, 0.65, ratios of 2.1 to 0.65, and 0.47 to 2.1 are used in land and ocean dust tests

1. Improved thin Cirrus tests.

Matching CALIPSO with Aqua MODIS using NEWS



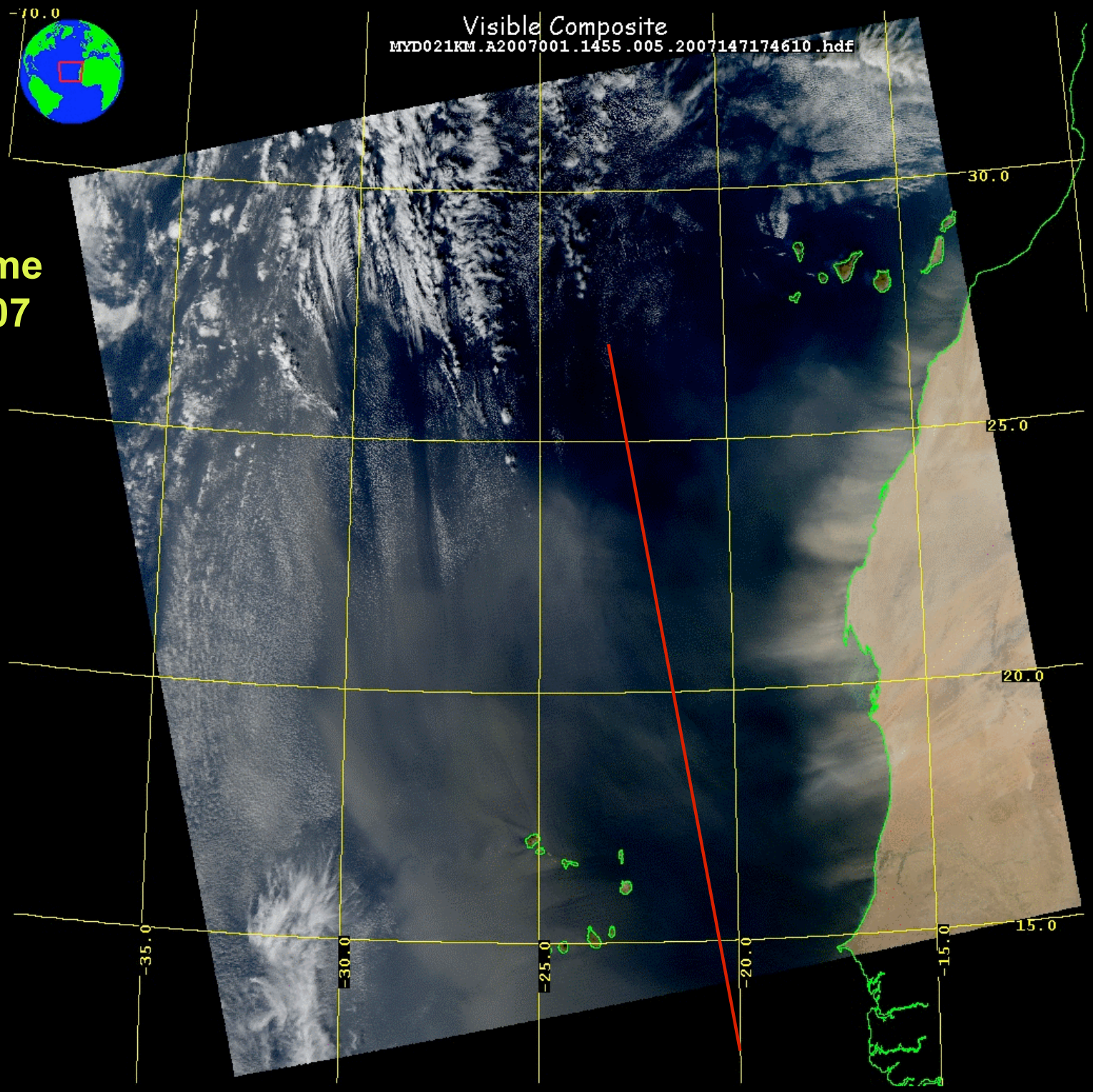
CALIPSO Version 2 Vertical Feature Mask (VFM)
(Released in January 2008)

CALIPSO_cloudy: two or three shots that detect clouds at any level.
CALIPSO_clear: none or one shot detects clouds.

Saharan dust plume on January 1, 2007 1455 UTC

Aqua MODIS

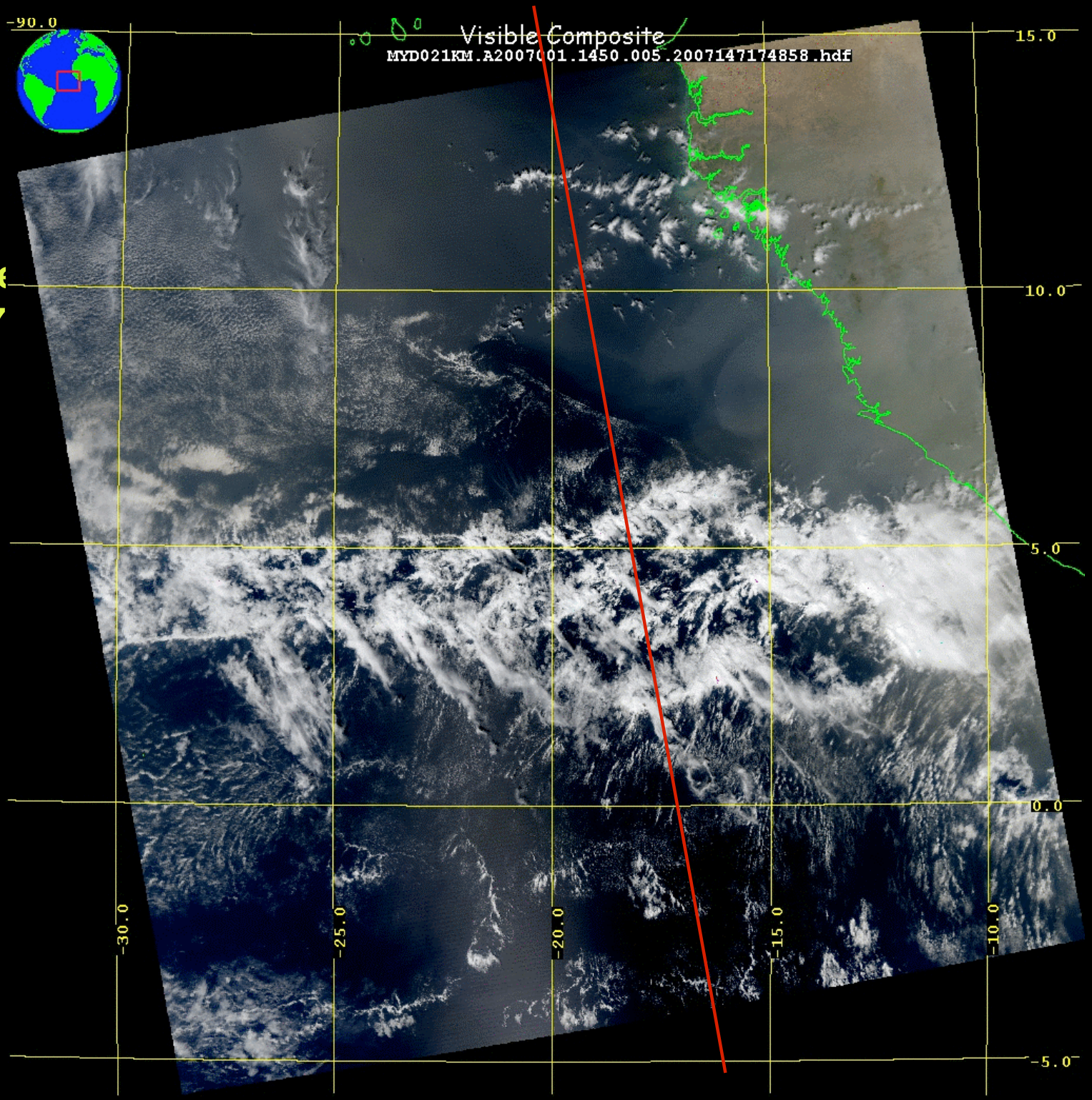
True color Image (Band 1-4-3)

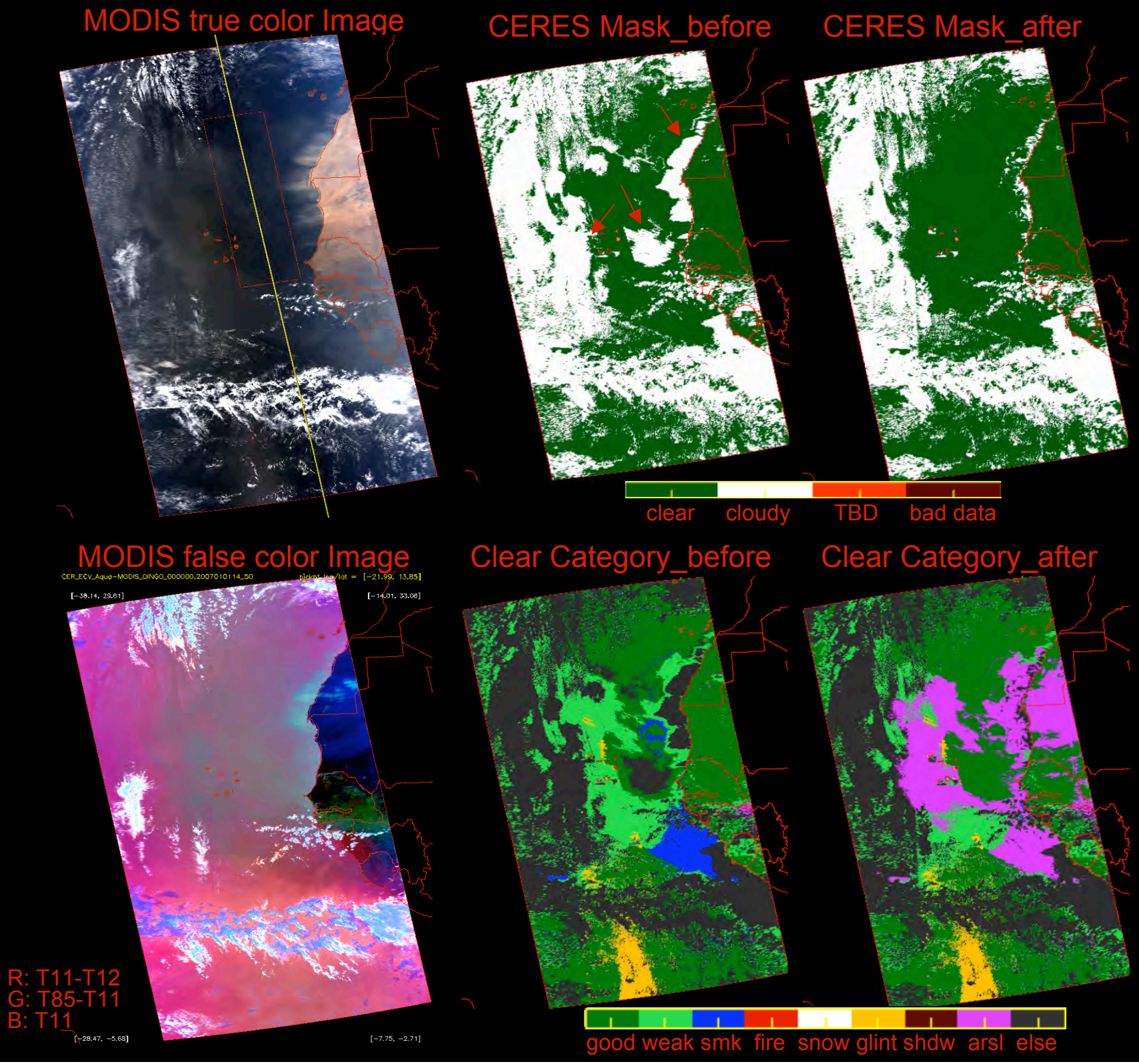


Saharan dust plume on January 1, 2007 1450 UTC

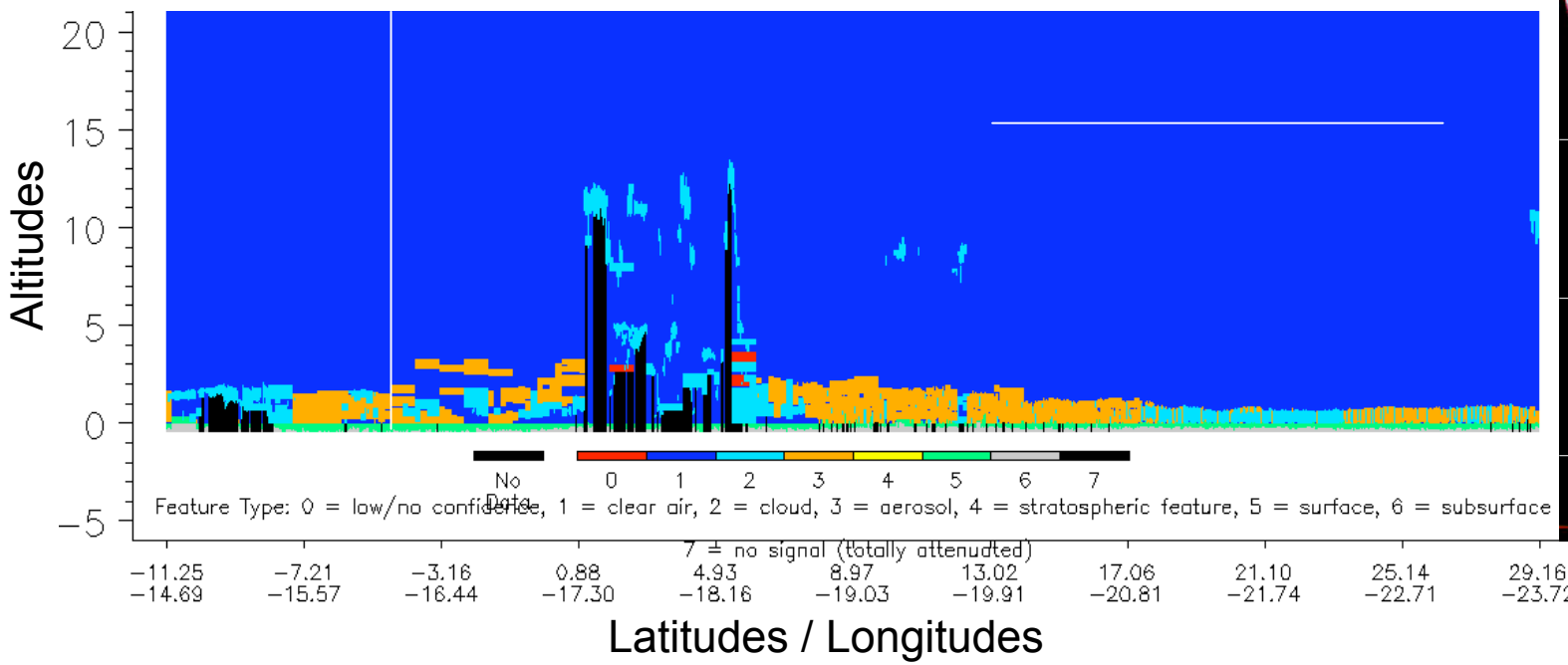
Aqua MODIS

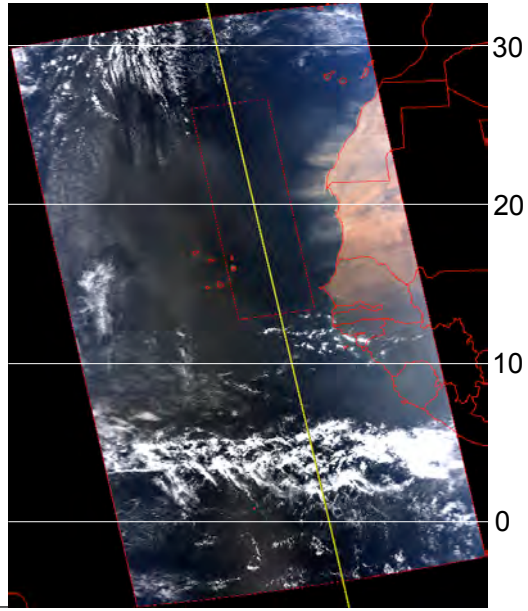
True color Image (Band 1-4-3)




MODIS true color Image
CERES Mask_before
CERES Mask_after
clear
cloudy
TBD
bad data
MODIS false color Image
CER_ECV_Aqua-MODIS_DINGO_000000.20070101 14_50
[-38.14, 29.61]
[-14.01, 33.06]
[-28.47, -5.68]
[-7.75, -2.71]
R: T11-T12
G: T85-T11
B: T11
Clear Category_before
Clear Category_after
good
weak smk
fire
snow
glint
shdw
arsl
else

CALIPSO V2 VFM

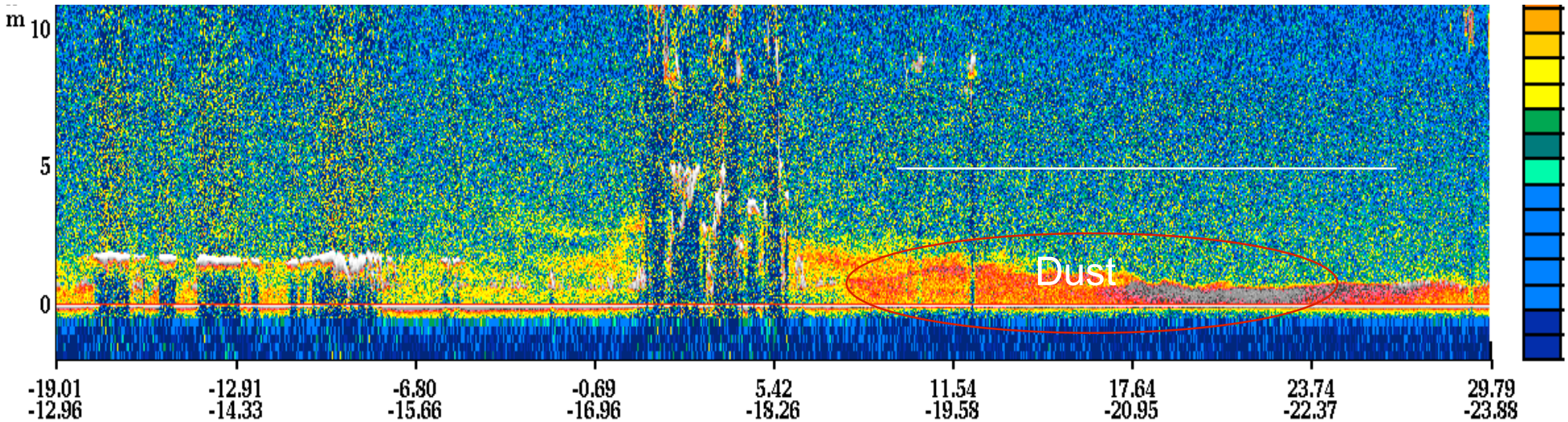




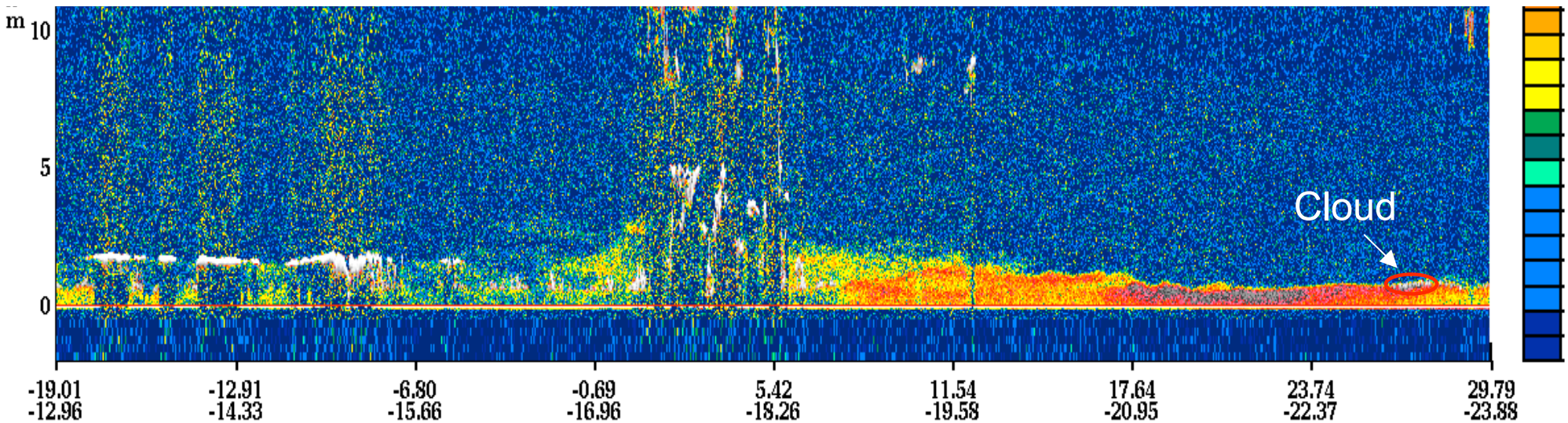
Cloud Fraction Comparison between CERES_MODIS and CALIPSO VFM

Total Aqua Pixel (4061) (1459)	CERES-Cloudy	CERES-Clear	
CALIPSO-Cloudy	23.44% (0%)	41.15% (56%)	64.59%
CALIPSO-Clear	0.394% (0%)	34.99% (44%)	
	23.8%		

532 nm Total Attenuated Backscatter



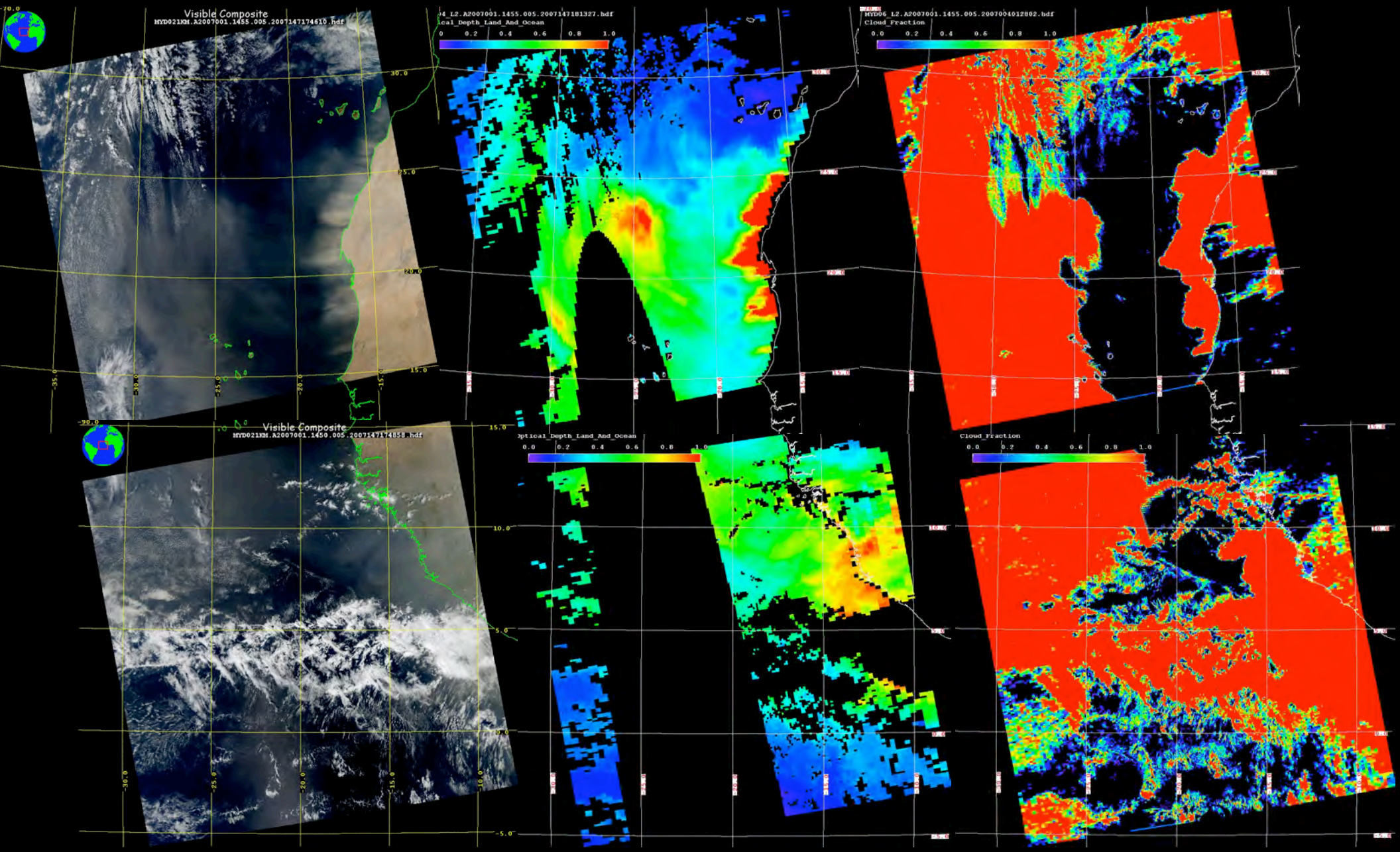
1064 nm Total Attenuated Backscatter



Aqua MODIS Image (Band 1-4-3)

MODIS Aerosol Optical Depth (MYD04)

MODIS Cloud Fraction (MYD06)

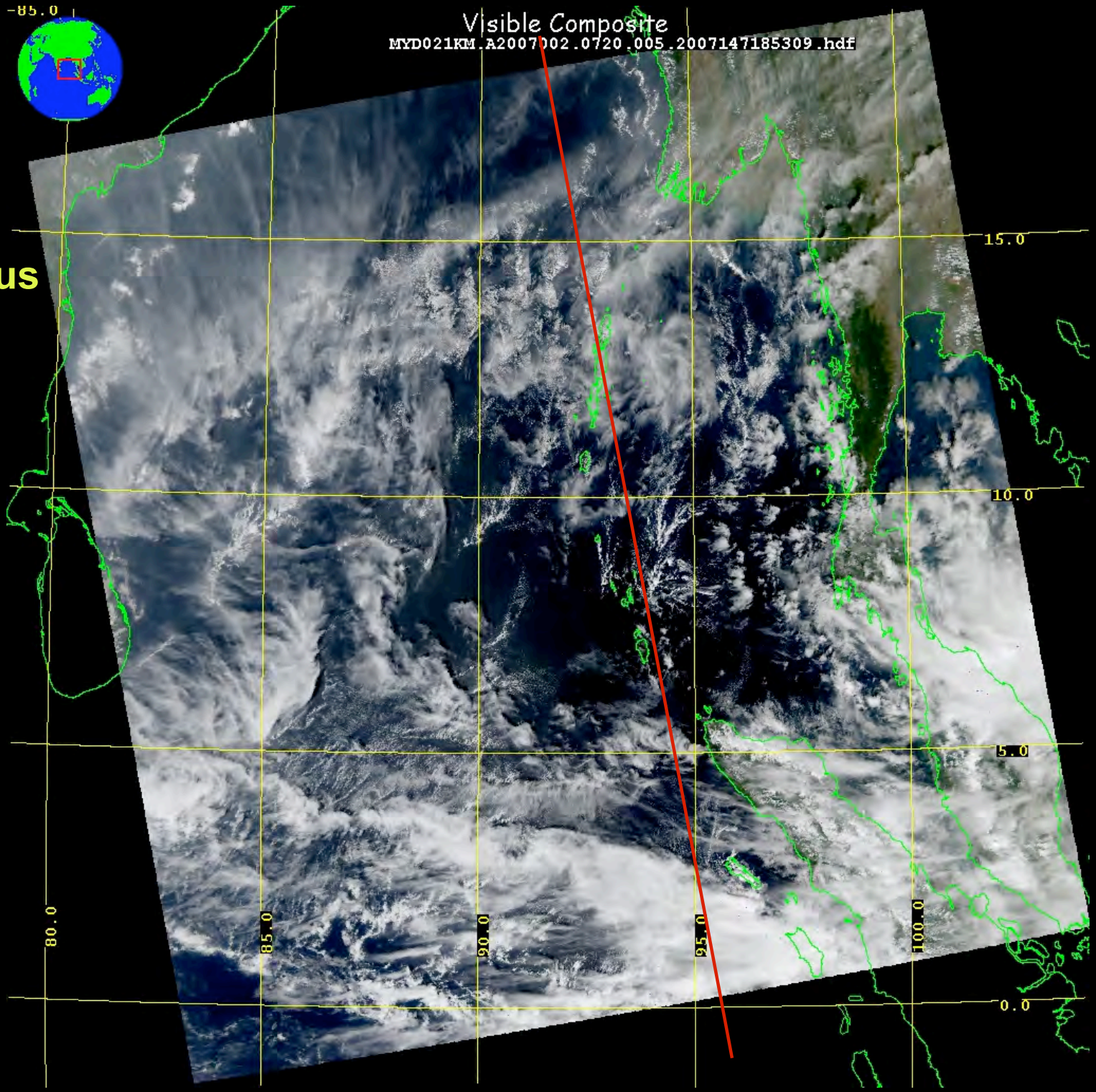


MODIS cloud mask can be safely used when AOT < 0.6. (*J. Brennan et. al. IEEE, 2005*)

Tropical Thin Cirrus
January 2, 2007
0720 UTC

Aqua MODIS

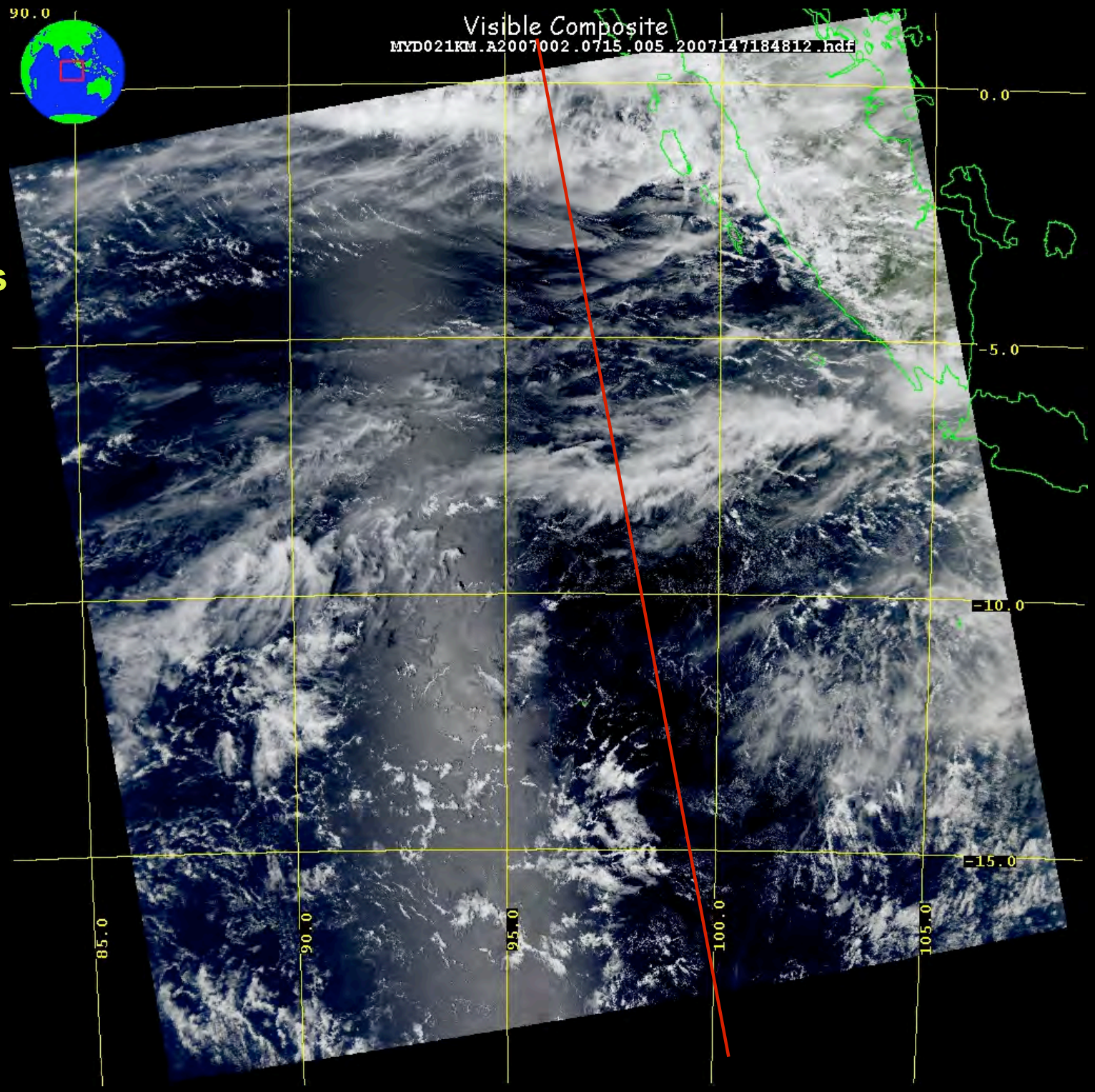
True color Image
(Band 1-4-3)

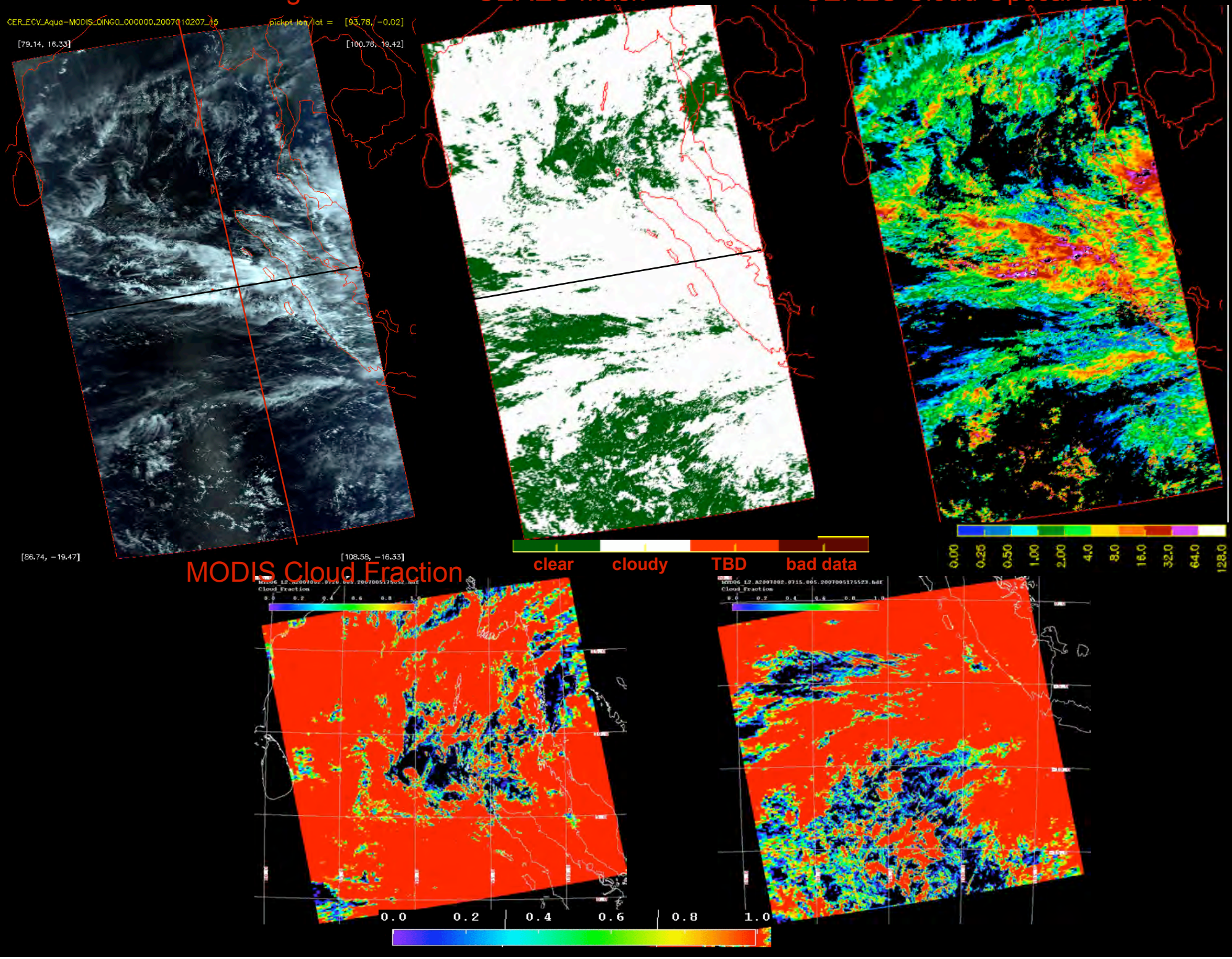


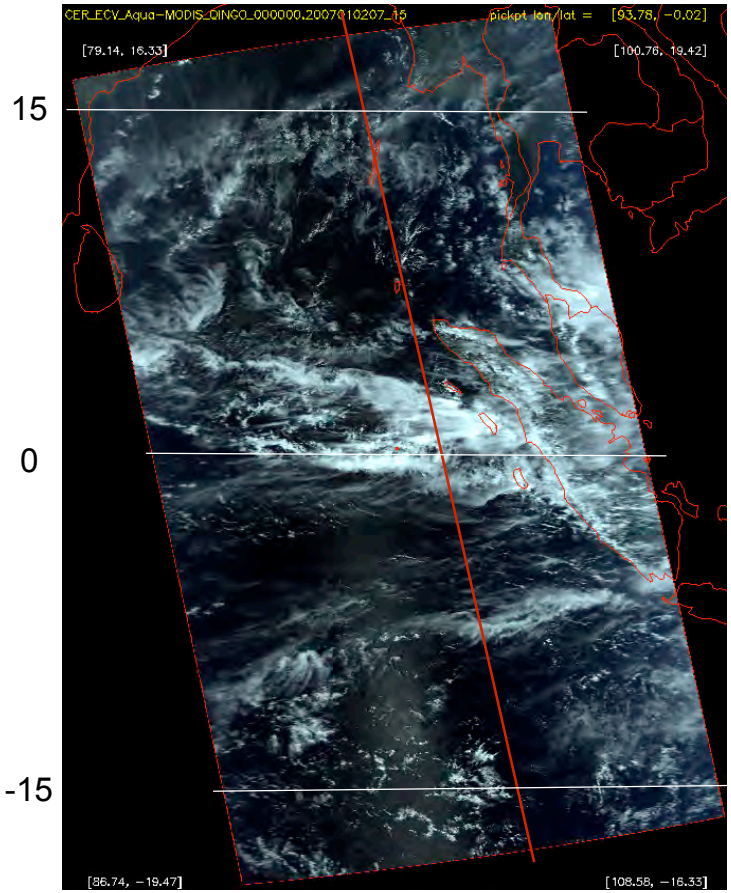
Tropical Thin Cirrus
January 2, 2007
0715 UTC

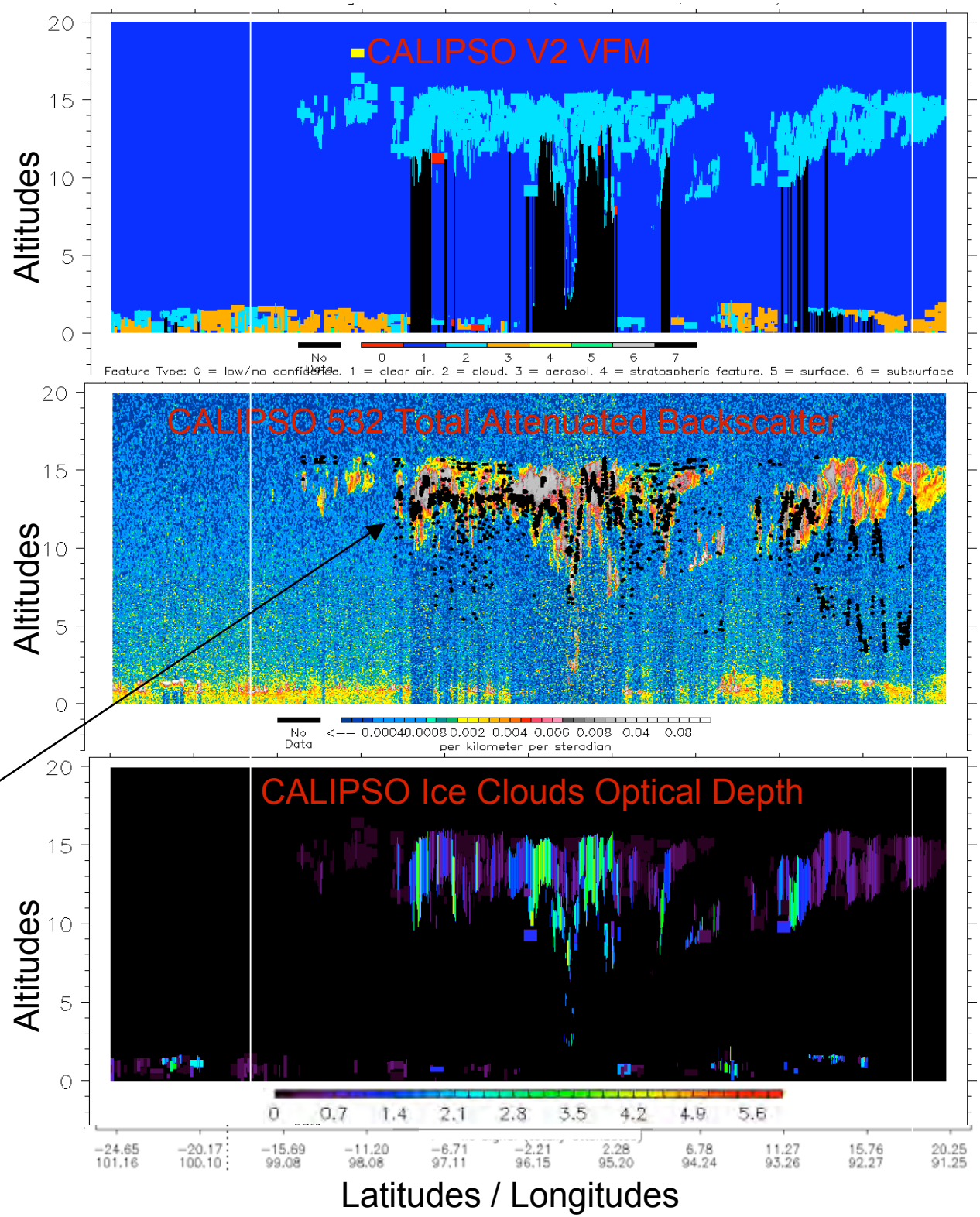
Aqua MODIS

True color Image
(Band 1-4-3)




MODIS true color Image
CERES Mask
CERES Cloud Optical Depth
CER_ECV_Aqua-MODIS_CINGO_000000.20070102.07_15
pickpt lon/lat = [93.78, -0.02]
[79.14, 16.33]
[100.76, 19.42]
[86.74, -19.47]
[108.58, -16.33]
clear
cloudy
TBD
bad data
0.00
0.25
0.50
1.00
2.00
4.0
8.0
16.0
32.0
64.0
128.0
MODIS Cloud Fraction
Cloud_Fraction
0.0
0.2
0.4
0.6
0.8
1.0





Black dots are CERES-MODIS retrieved ice clouds heights.

Cloud Fraction Comparison between CERES_MODIS and CALIPSO VFM

Total Aqua Pixel 4070	CERES - Cloudy	CERES - Clear	
CALIPSO - Cloudy	78%	14.2%	92.2%
CALIPSO - Clear	0.57%	7.3%	
	78.57%		

CERES - Clear and CALIPSO - Cloudy

	percentage	Averaged height
High Clouds (> 5 km)	53.6%	14 km
Low Clouds (< 5 km)	46.4%	1.30 km

CONCLUSIONS

- CERES_MODIS cloud and aerosol detection algorithms are compared with CALIPSO Version 2 VFM.

- CERES thin Cirrus cloud and low clouds detection still need improvement. Hopefully 250m-algorithm will help pick up sub-scale low clouds.

- CALIPSO VFM detects more clouds than CERES mask also due to higher sensitivity from lidar measurements.

- Occasional CALIPSO V2 VFM misclassifications of strong dust layers as clouds. These will be improved in V3 release early next year.