

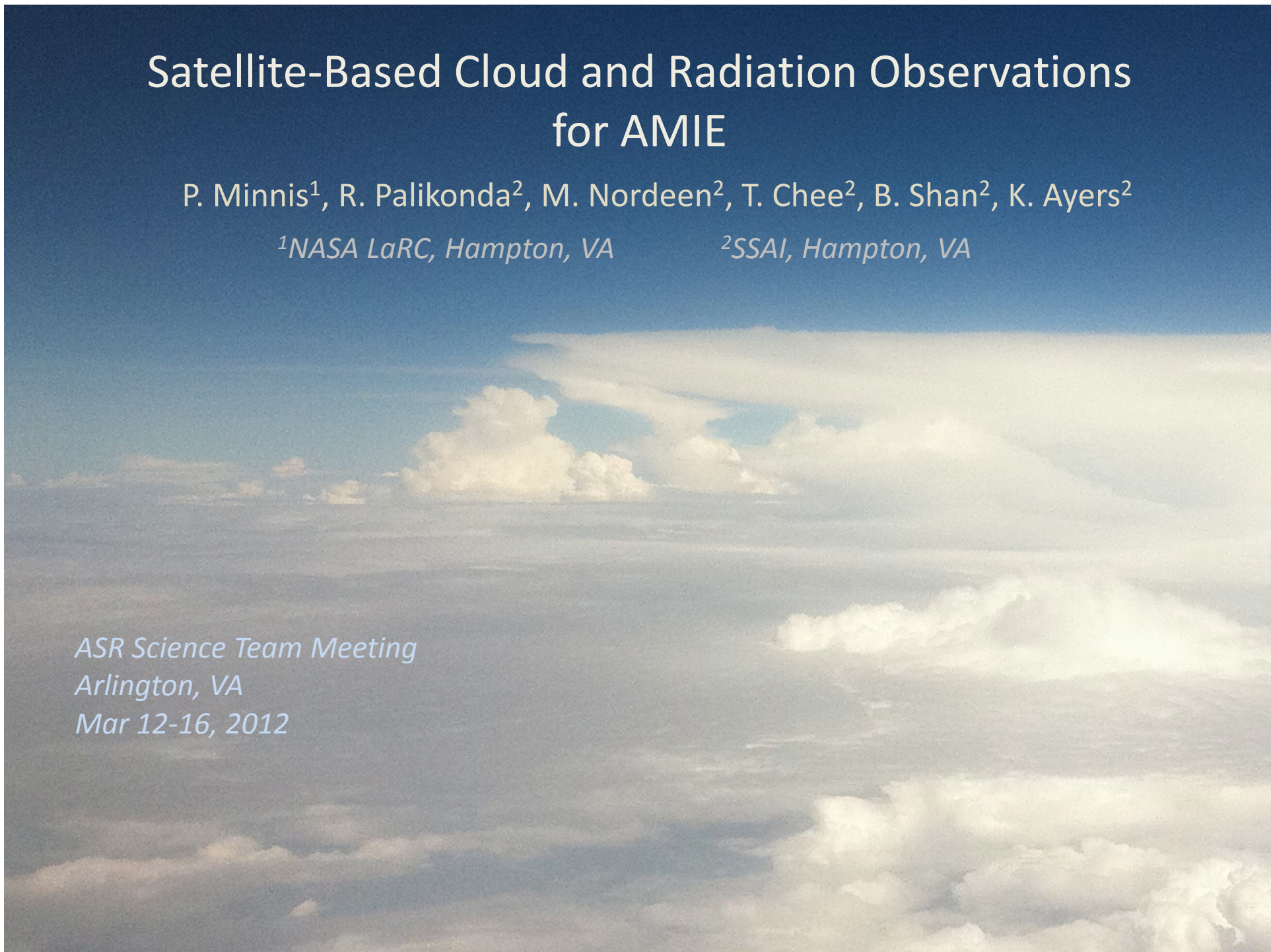
Satellite-Based Cloud and Radiation Observations for AMIE

P. Minnis¹, R. Palikonda², M. Nordeen², T. Chee², B. Shan², K. Ayers²

¹NASA LaRC, Hampton, VA

²SSAI, Hampton, VA

*ASR Science Team Meeting
Arlington, VA
Mar 12-16, 2012*



OBJECTIVES

- Provide large-scale cloud & radiation context for AMIE surface observations
- Generate a useful cloud property and flux dataset for
 - studies of MJO events
 - providing boundary conditions & validation for model studies
 - quantifying large-scale variations at seasonal and diurnal scales
- Use surface observations to validate marine tropical satellite retrievals

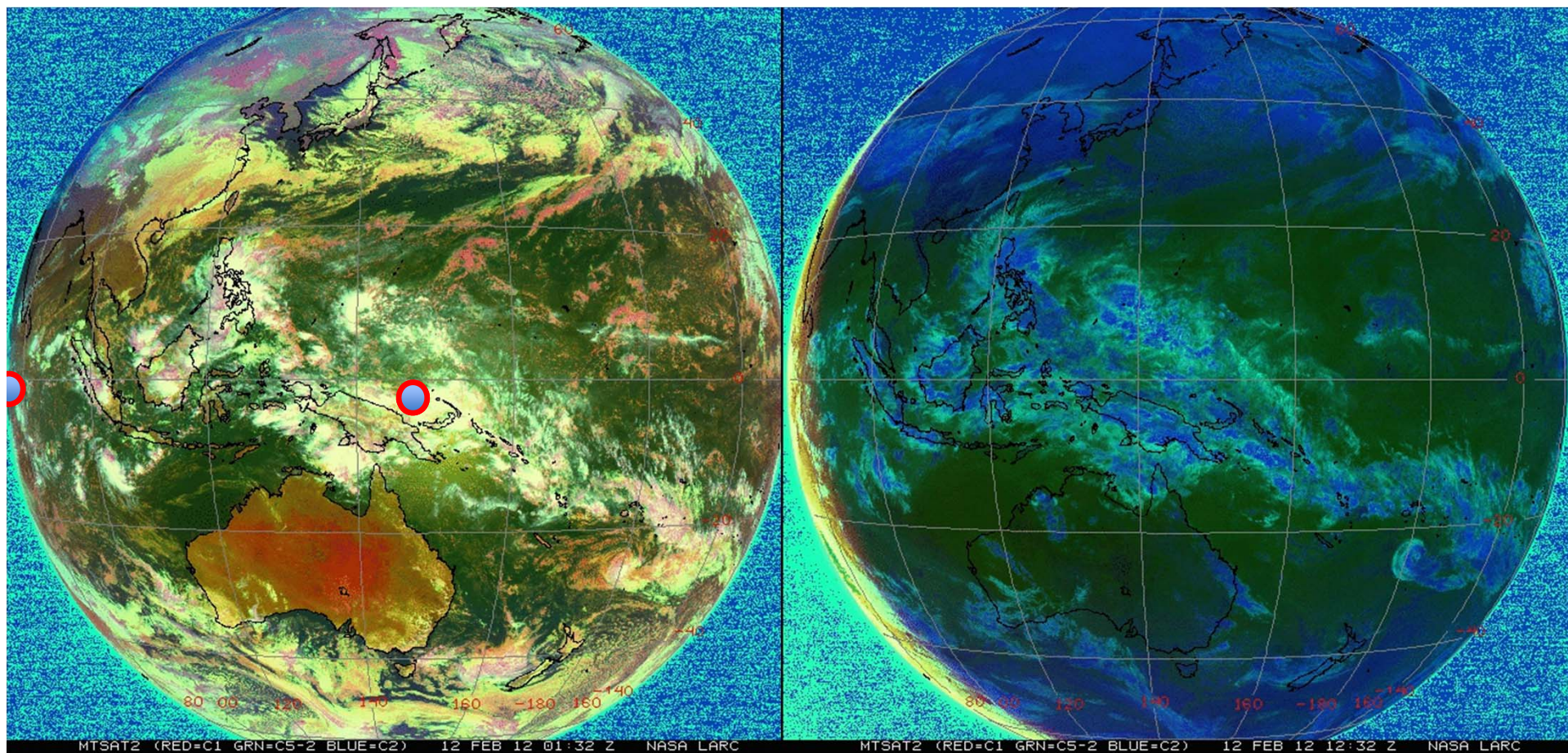
APPROACH

- Apply consistent set of algorithms to “calibrated” satellite data: GEO & LEO
 - use algorithms applied to MODIS for CERES, GOES, Meteosat
- Compute averages
- Provide access to the data
 - on LaRC website
 - ARM Data Center

MTSAT-2 Geostationary Satellite RGB Images, 29 February 2012

0130 UTC

1230 UTC



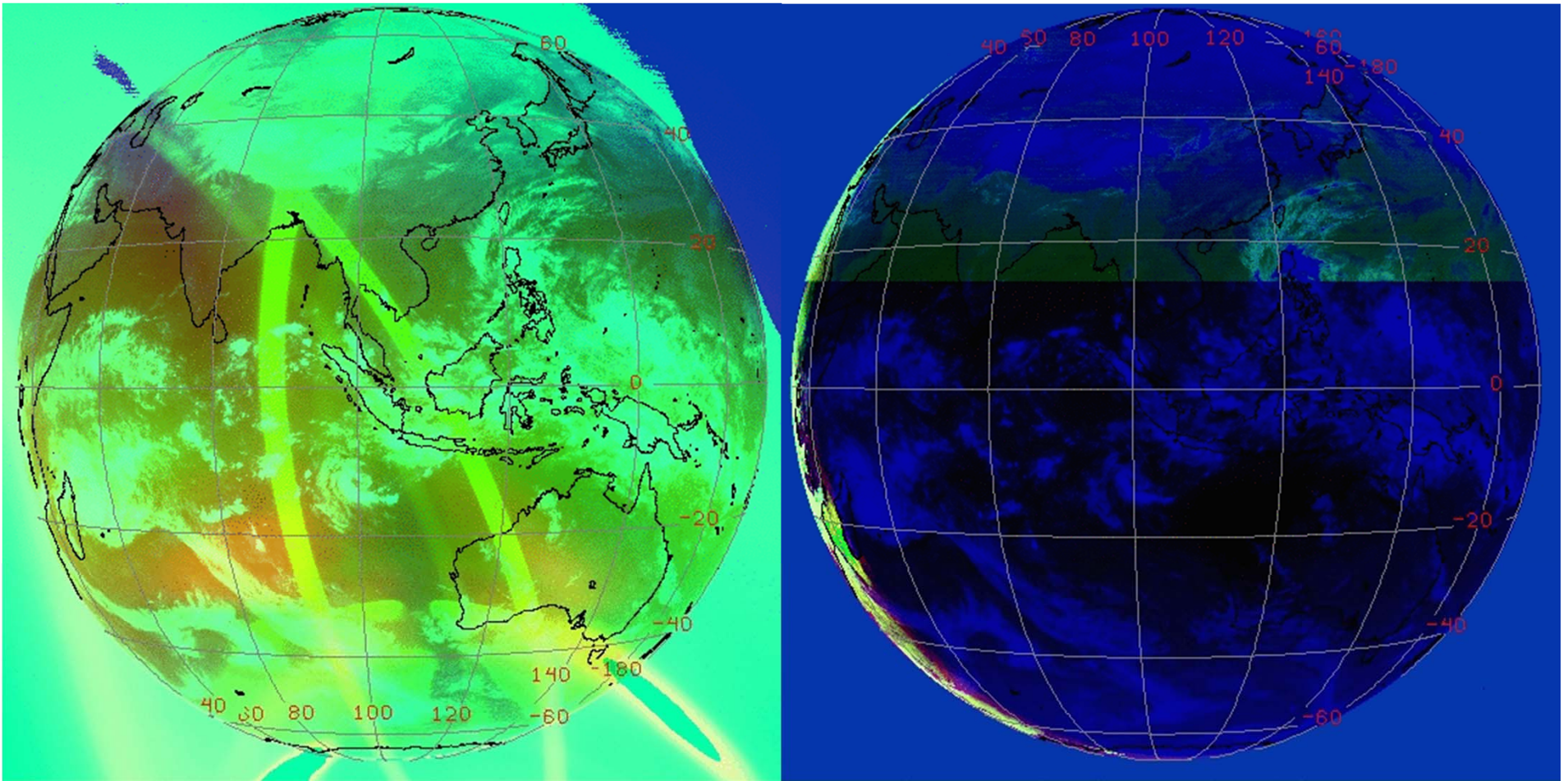
- Both MTSAT-2 and FY-2E: 1-hr, 4-km resolution; 0.65, 3.8, 6.7, 11.0, & 12.0 μm
- MTSAT-2 cannot view Gan Island, so FY-2E is used

FY-2E Geostationary Satellite RGB Images, 12 February 2012

Calibration Stability Issues: Night

0300 UTC 1701 UTC

1530 UTC



FY2E (RED=C1 GRN=C5-2 BLUE=C2) 12 FEB 12 17:01 Z NASA LAR FY2E (RED=C1 GRN=C5-2 BLUE=C2) 12 FEB 12 15:01 Z NASA LAR

What planet is this?

NASA Langley Cloud Products

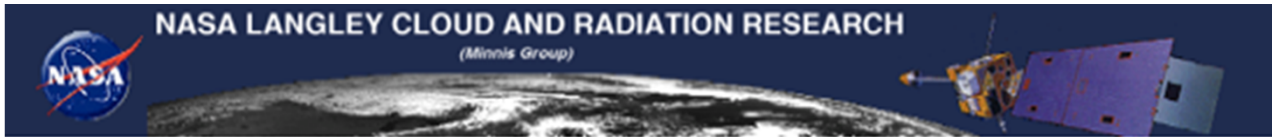
Standard, Single-Layer VISST/SIST

	<u>Cloud</u>
0.65, 1.6 μm Reflectances	
3.7, 6.7, 10.8 μm Temp	Mask, Phase
12 or 13.3 μm Temp	Optical Depth, IR emissivity
Broadband TOA Albedo	Cloud effective particle size
Broadband OLR	Liquid/Ice Water Path
Clear-sky Skin Temperature	Effective Temp, height, pressure
Icing Potential**	Top/ Bottom Pressure
	Top/ Bottom Height
	Overshooting tops (new)

Multi-Layer, CIRT, CO₂ channel only (GOES-12 & later)

*Upper &
lower cloud*

Multilayer ID (single or 2-layer)
effective temperature optical depth, thickness
effective particle size ice or liquid water path
height, top/base height pressure



- [User Warning, Please read!](#)
- [Minnis Group Homepage](#)
- [Real Time References](#)
- [Satellite Calibration:](#)
- [Langley Satellite Calibration](#)
- [Viewers/Tools:](#)
- [Contrail Forecast](#)
- [NOAA AVHRR Viewer](#)
- [MODIS Viewer](#)
- [Mid-Atlantic NEXRAD](#)
- [ARM-SGP NEXRAD](#)
- [Angles Viewer](#)
- [Plot RUC Sounding](#)
- [Gridded VISST Products](#)
- [Satellite Overpass Predictor](#)
- [Field Experiments:](#)
- [SEAC4RS](#)
- [MACPEX 2011](#)
- [CALWATER 2011](#)
- [STORMVEX 2010](#)
- [CALNEX 2010](#)
- [ARM SPARTICUS](#)
- [AMF-Azores](#)
- [FRAM-S](#)

Satellite Imagery And Cloud Products Page

Real-time and Historical Cloud Product Loops: The cloud products are derived with [VISST/SIST](#) algorithm. Select a domain from the table below to access the real-time (blue cells) and archived products.

FULL-DISK CLOUD PRODUCTS (Real Time)				
GOES-WEST	GOES-EAST	METEOSAT	FENG-YUN	MTSAT
New!! Merged Global Geostationary Gridded Cloud Products		New!!		

CLOUD PRODUCTS				
GOES WEST	GOES EAST	METEOSAT	TWP DOMAIN	NOAA 15/16/17 and TERRA/AQUA
North America (RR)		WEST EUROPE	MTSAT	ARM-SGP
West CONUS	East CONUS	EUROPE	MANUS	ARM-NSA
MERGED CONUS		ARM-NIAMEY	GOES-9	COVE
ARM-SGP	ARM-SGP		DARWIN	
ARM-NSA	MACPEX		NAURU	
STORMVEX-2010	COVE			
Monterey				

Real-time and Historical Satellite Imagery Loops: The links from the table below provide access to the real-time (blue cells) and historical image loops for various satellites.

SATELLITE IMAGERY				
Mid-West US (SGP)	Northeast US	Mid-Atlantic US	Southeast US	CONUS
E. Pacific G-12	Pacific/West	TWP DARWIN MTSAT	TWP DARWIN FY2C	TWP DARWIN MTSAT & FY2C
	Florida	TWP GOES-9	GMS-5 TWP	PACS EPIC

FULL-DISK SATELLITE IMAGERY						
GOES-W FD	GOES-E FD	MET-9/0E FD	MET-7/57E FD	FY2D/86E FD	FY2C,E/105E FD	MTSAT/140E FD

COMPOSITE SATELLITE IMAGERY		
Global Geostationary	North Pole MODIS	South Pole MODIS

Java Applets may not work correctly. Please check the [Java Applet Notes](#) from Tom Whittaker if you have difficulty viewing the images.

Langley Satellite Page

www-angler.larc.nasa.gov

To access Langley AMIE:

- 1) Langley satellite page
- 2) Find AMIE on sidebar
- 3) Click on AMIE

All results preliminary!



- Minnis Group Home

+ Cloud Products

+ Satellite Imagery

+ Field Experiments

+ Related References

- + NASA Home
- + NASA LaRC Home
- + Science Directorate
- + Minnis Group Home

AMIE

- + AMIE (dynamo & cindy2011) Official Home

Cloud Products

- + MTSAT-2 TWP domain
- + FY2E - AMIE- GAN
- + MTSAT-2 MANUS (AMIE-MANUS)

Ground Site Cloud Products

- + MANUS
- + GAN

SEARCH LANGLEY

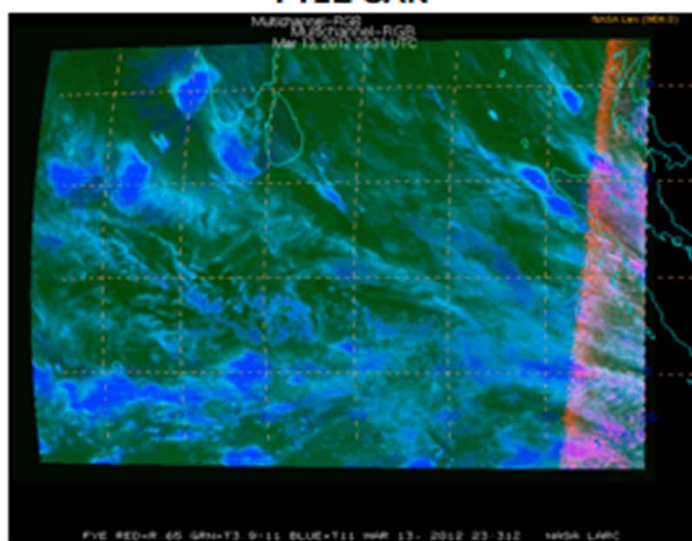
+ GO

NASA Langley AMIE 2011

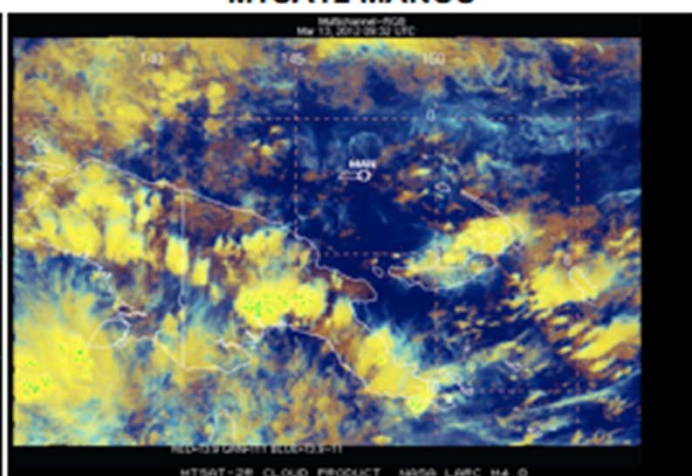
Latest Image Processed for AMIE Field Experiment

Click image to see latest products.

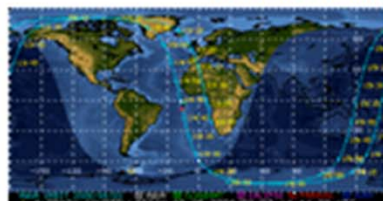
FY2E GAN



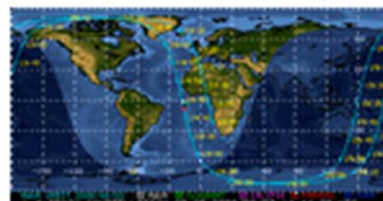
MTSAT2 MANUS



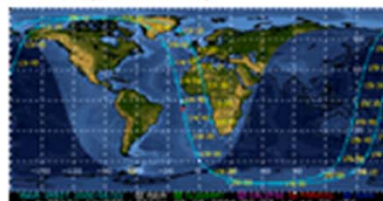
Current Location of A-Train Satellites (updated every 30 sec)



A-Train



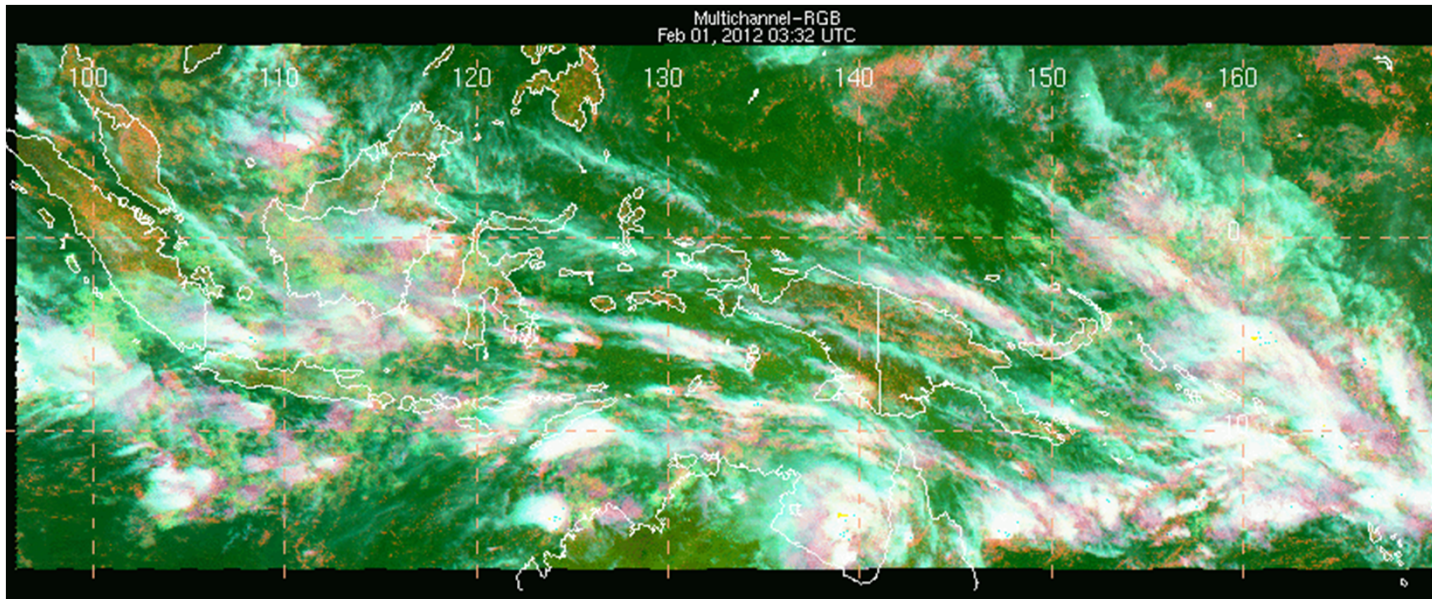
Calipso



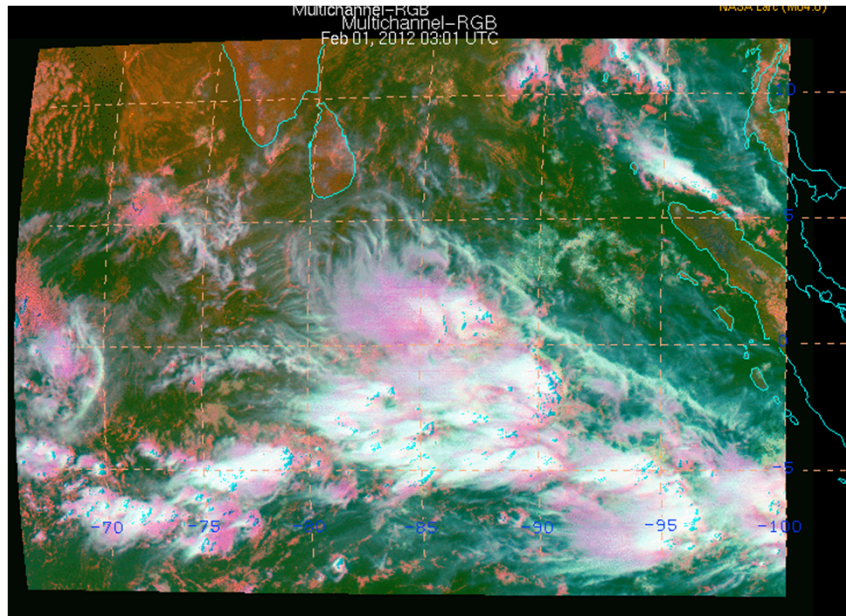
CloudSat

AMIE Satellite Domains

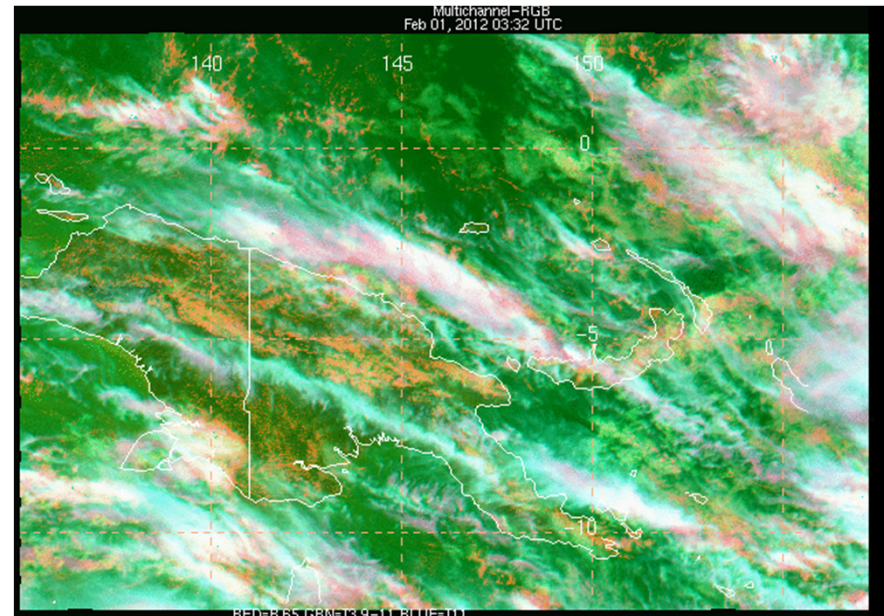
Greater TWP Domain, MTSAT-2, 8-km



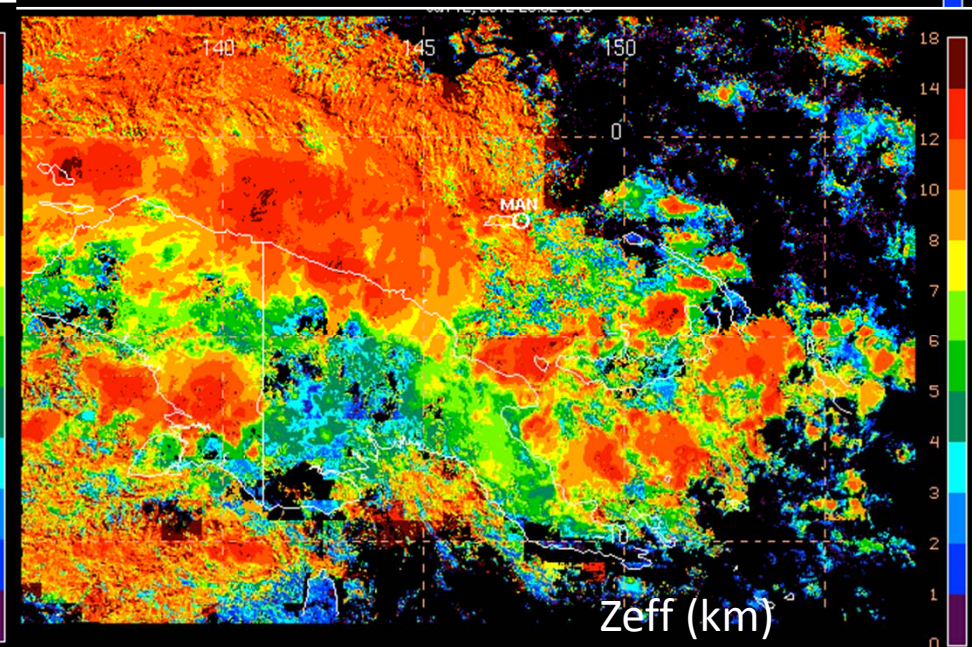
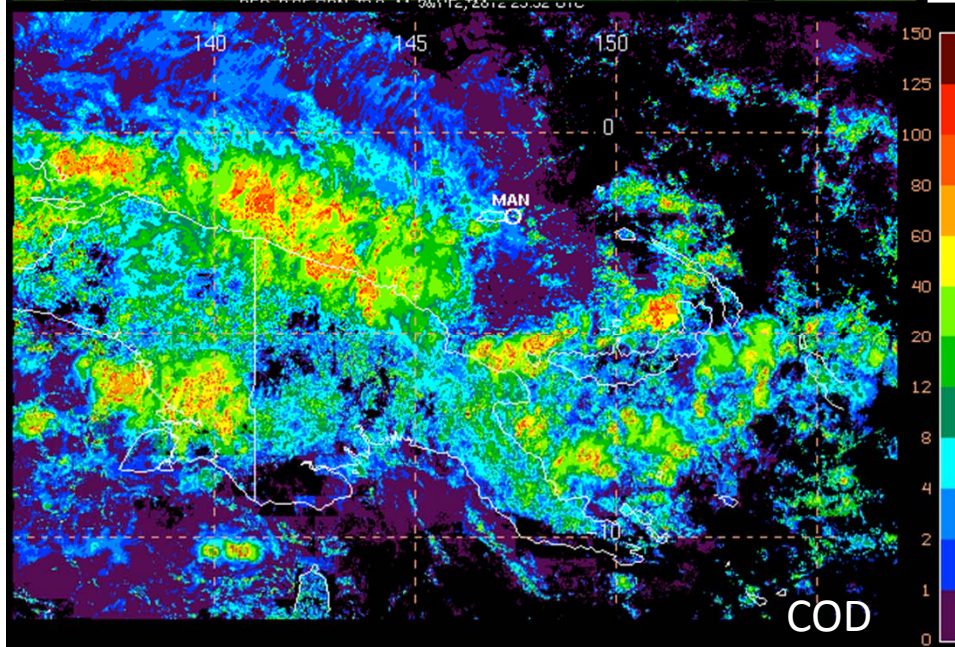
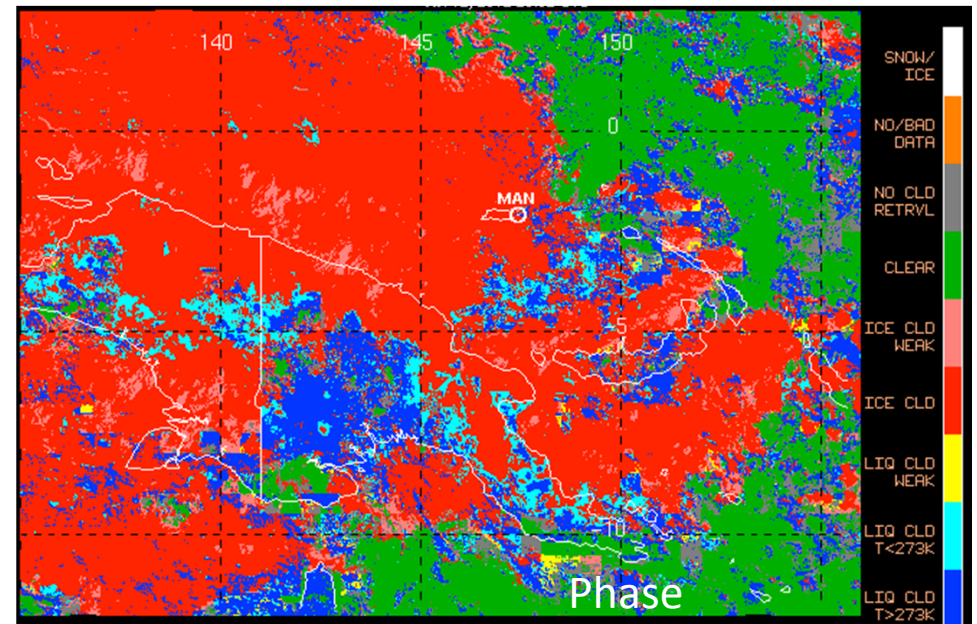
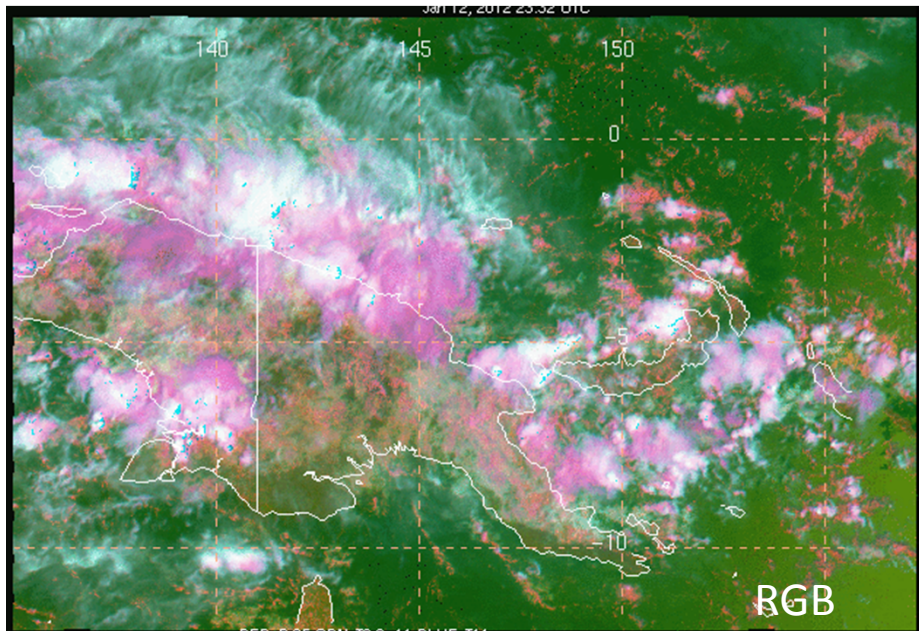
DYNAMO Domain, FY-2E, 4 km



Manus Domain, MTSAT-2, 4 km



Manus Domain, 4-km MTSAT-2, 12 Jan 2012





- Minnis Group Home

+ Cloud Products

+ Satellite Imagery

+ Field Experiments

+ Related References

- + NASA Home
- + NASA LaRC Home
- + Science Directorate
- + Minnis Group Home

AMIE

+ AMIE (dynamo & cindy2011) Official Home

Cloud Products

- + MTSAT-2 TWP domain
- + FY2E - AMIE- GAN
- + MTSAT-2 MANUS (AMIE-MANUS)

Ground Site Cloud Products

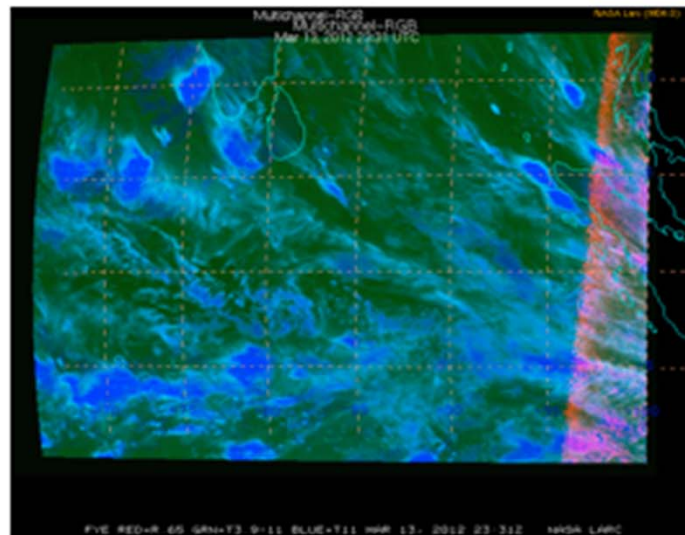
- + GAN

NASA Langley AMIE 2011

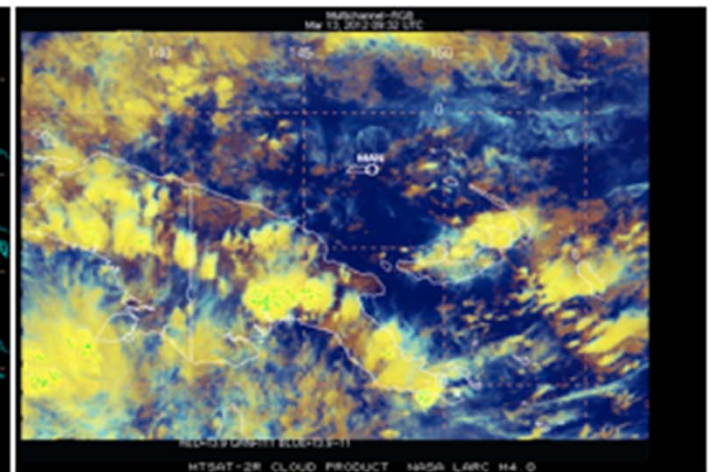
Latest Image Processed for AMIE Field Experiment

Click image to see latest products.

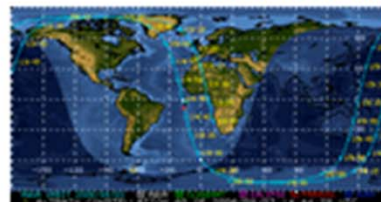
FY2E GAN



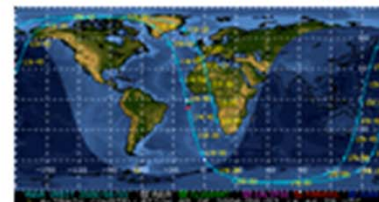
MTSAT2 MANUS



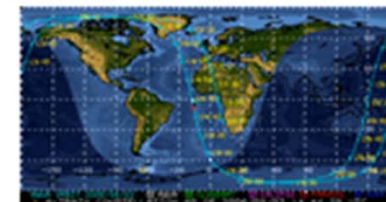
Current Location of A-Train Satellites (updated every 30 sec)



A-Train



Calipso

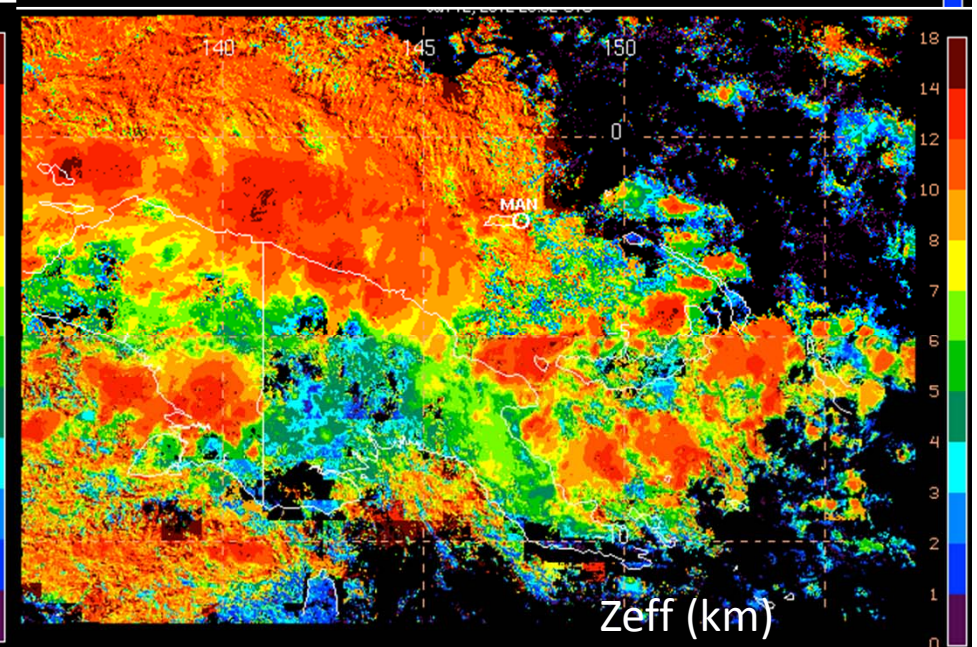
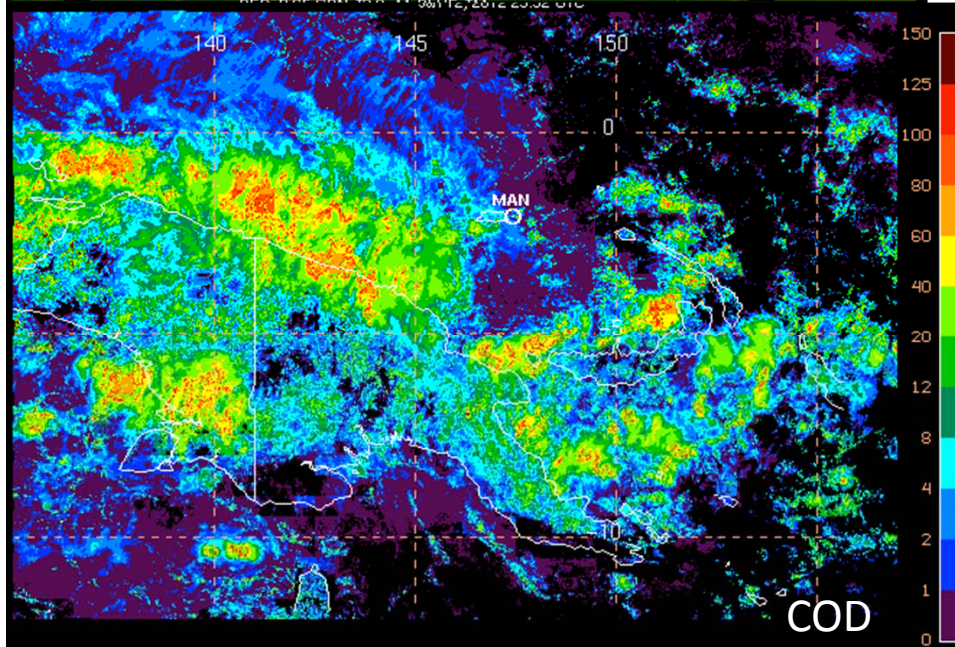
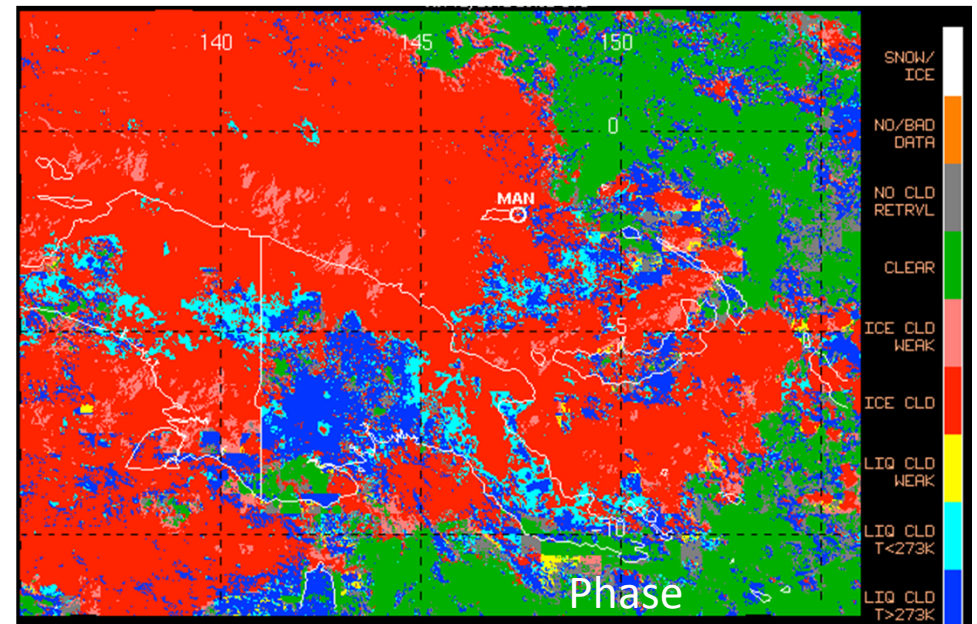
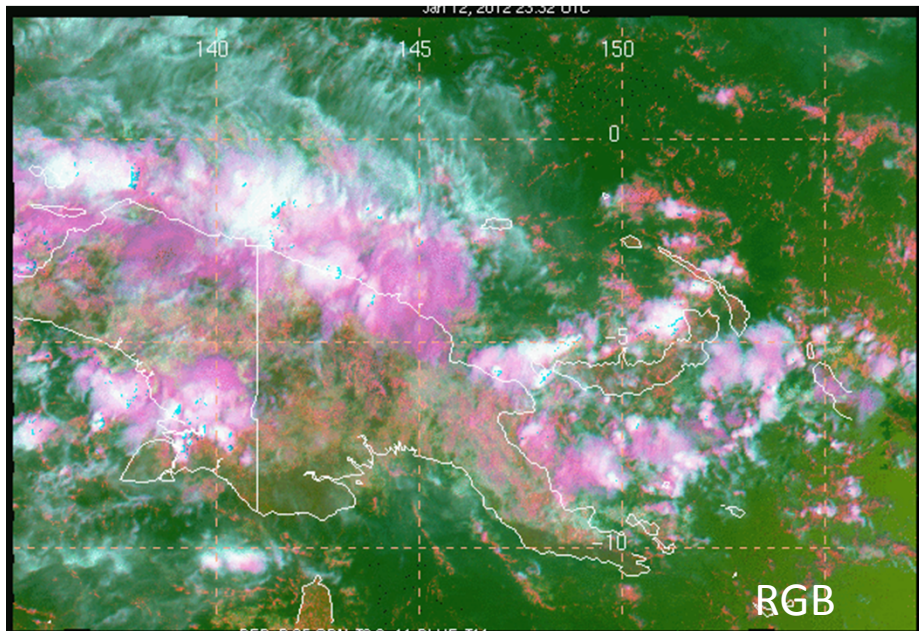


CloudSat

SEARCH LANGLEY

+ GO

Manus Domain, 4-km MTSAT-2, 12 Jan 2012



Ground Site Pixel Interactive Pixel Averaging Web Page



**NATIONAL AERONAUTICS
AND SPACE ADMINISTRATION**

+ NASA Portal
+ Preferences

Search:

- Minnis Group Home
- + Cloud Products
- + Satellite Imagery
- + Field Experiments
- + Related References

- + NASA Home
- + NASA LaRC Home
- + Science Directorate
- + Minnis Group Home

- + About Us
- + Cloud Products
- + Satellite Imagery
- + Projects
- + Field Experiments
- + Viewers / Tools
- + Satellite Calibration
- + Contrails
- + Related References
- + User Warning !

VISST Derived Cloud Products for ARM-TWP, MANUS

VISST Derived Cloud Products for the MANUS Site, ARM-TWP

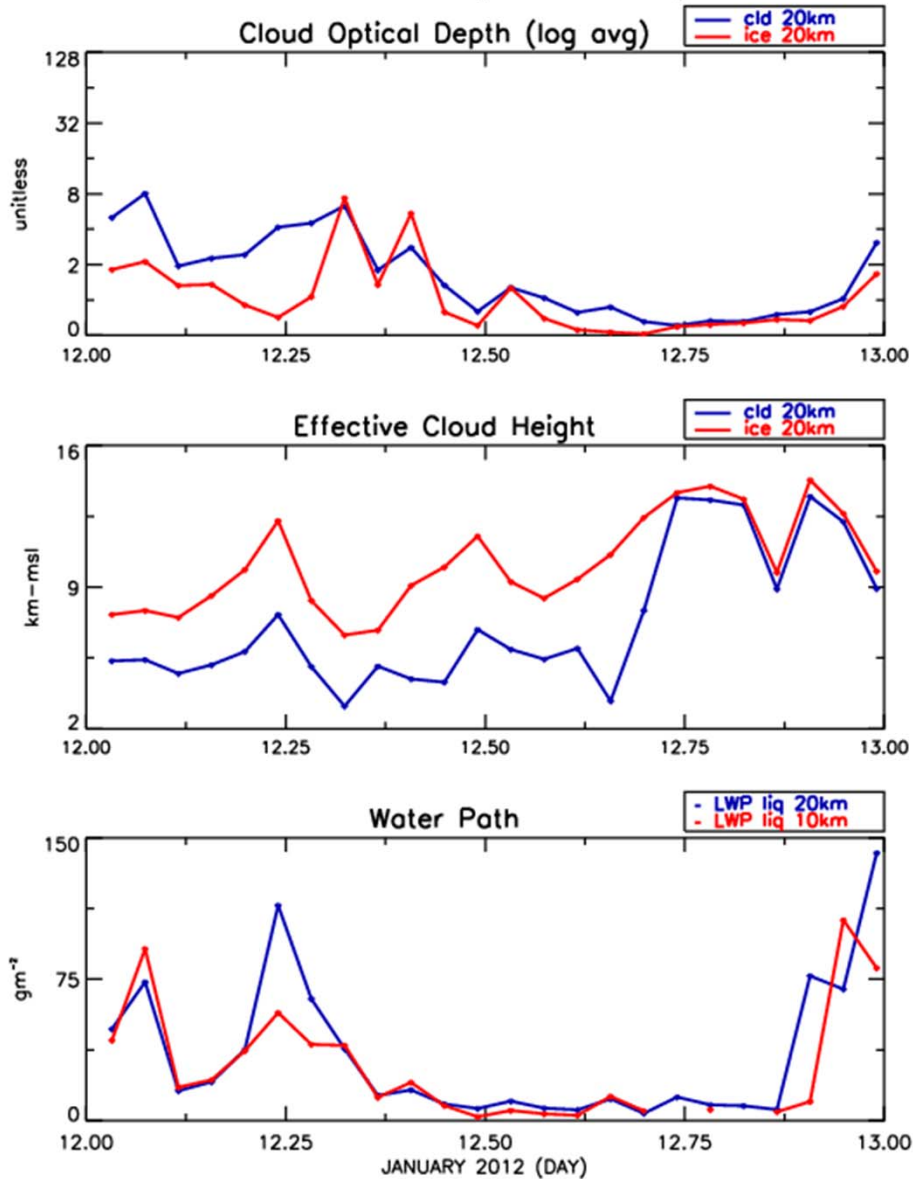
VISST derived Cloud Products are computed from the individual pixel retrievals from hourly images. The cloud product means and standard deviations are computed from the pixels within both a 10 km and 20 km radius centered on the MANUS site.

Select up to 4 Cloud Products	Line 1 Select type / Radius	Line 2 (optional) Select type / Radius
<input style="width: 90%;" type="text" value="Cloud Optical Depth"/>	<input style="width: 40%;" type="text" value="Total"/> <input style="width: 40%;" type="text" value="20 km"/>	<input style="width: 40%;" type="text" value="Ice"/> <input style="width: 40%;" type="text" value="20 km"/>
<input style="width: 90%;" type="text" value="Cloud Effective Height"/>	<input style="width: 40%;" type="text" value="Total"/> <input style="width: 40%;" type="text" value="20 km"/>	<input style="width: 40%;" type="text" value="Ice"/> <input style="width: 40%;" type="text" value="20 km"/>
<input style="width: 90%;" type="text" value="Liquid Water Path"/>	<input style="width: 40%;" type="text" value="Liquid"/> <input style="width: 40%;" type="text" value="20 km"/>	<input style="width: 40%;" type="text" value="Liquid"/> <input style="width: 40%;" type="text" value="10 km"/>
<input style="width: 90%;" type="text" value="Cloud Product 4"/>	<input style="width: 40%;" type="text" value="Type"/> <input style="width: 40%;" type="text" value="20 km"/>	<input style="width: 40%;" type="text" value="Type"/> <input style="width: 40%;" type="text" value="20 km"/>
<input style="width: 20%;" type="text" value="Jan"/> <input style="width: 20%;" type="text" value="2012"/>	Start day: <input style="width: 20%;" type="text" value="12"/> End Day: <input style="width: 20%;" type="text" value="12"/>	<input style="width: 80px;" type="button" value="Plot"/>

You can also view the following: [Image plot \(.gif format\)](#) • [Postscript Image plot](#) • [IDL Data File](#)

Or, Search [again](#).

NASA-Langley MTSAT-1R VISST Derived Cloud Products for MANUS over the ARM-TWP, MANUS SITE, JANUARY 2012

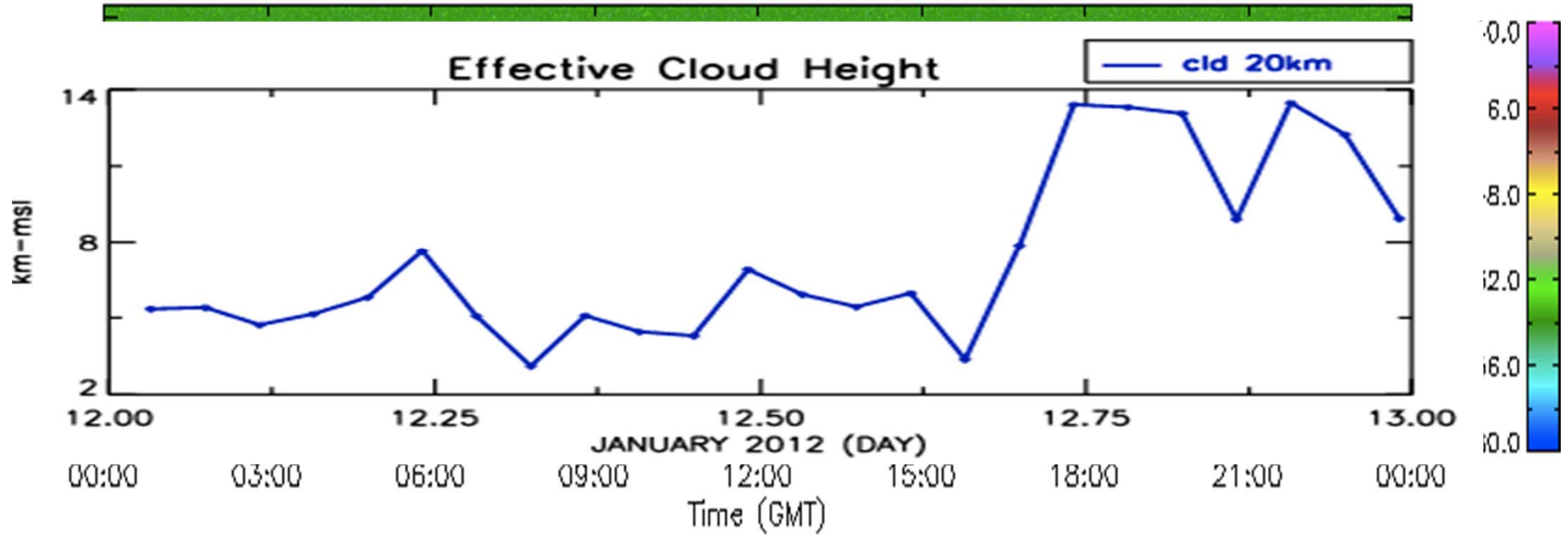


Averages of Cloud Radiation Parameters Computed for Pixels Surrounding Surface in Circle of radius 10 or 20 km

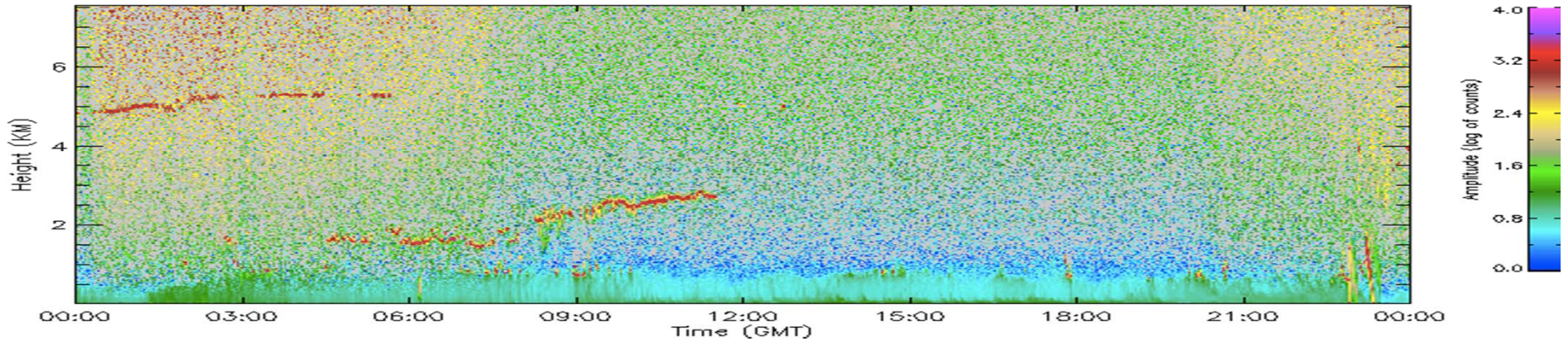
- two parameters / plot
 - total, ice, liq, or SCL
 - mean or std dev
- up to 4 plots / run
- up to 1 month of data
- ascii files or raw data files can also be printed or downloaded

Comparison of Cloud Heights over Manus, 12 Jan 2012

TWPC1 Mode:Cl co-pol Reflectivity on 20120112

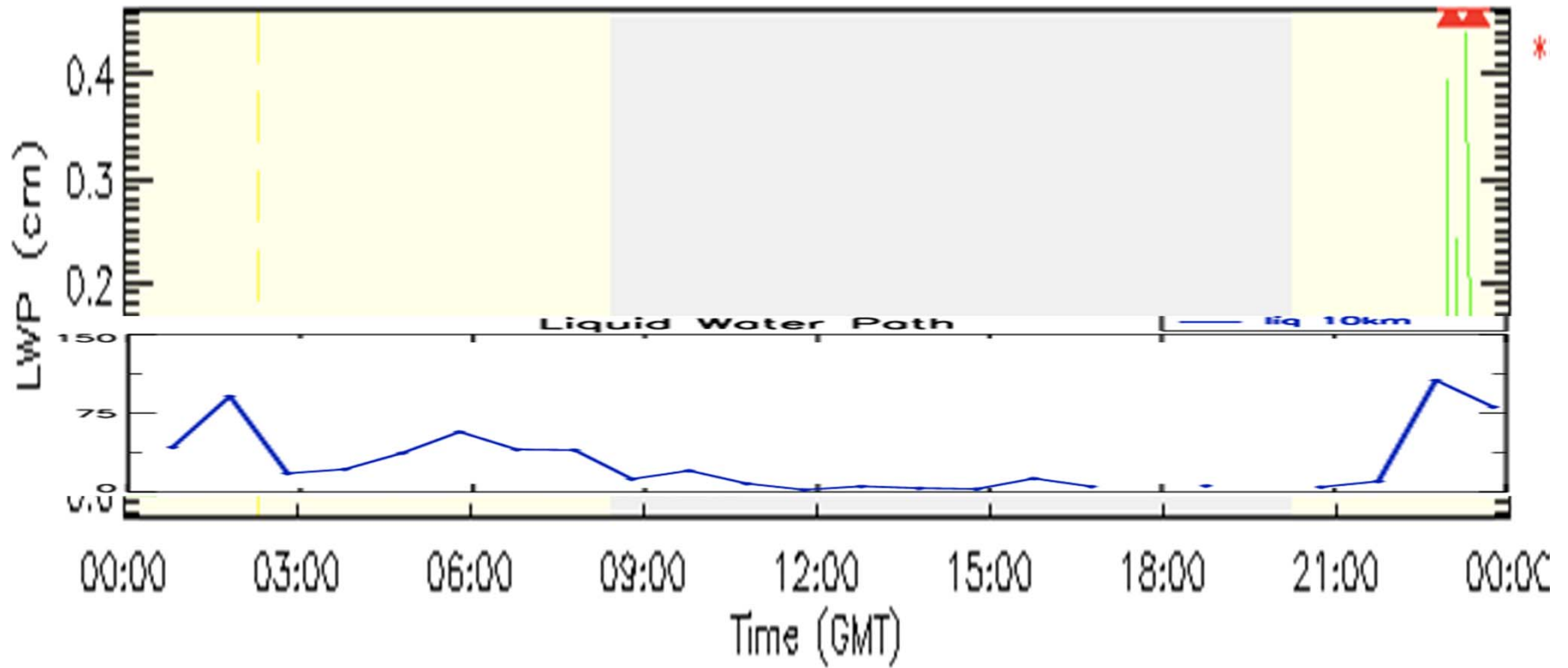


TWP C1 Ceilometer Range and Sensitivity Normalized Backscatter on 20120112

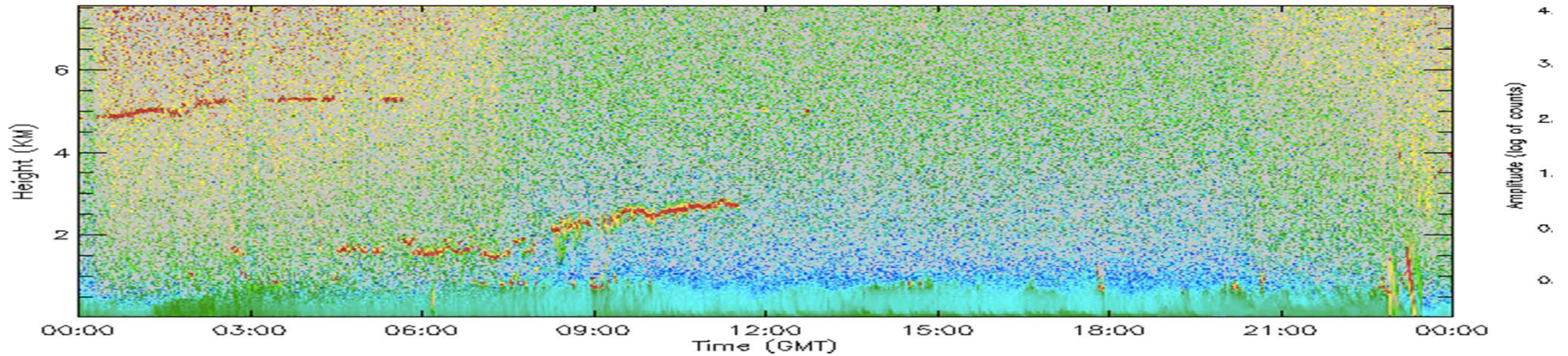


Time Series of LWP over Manus, 12 Jan 2012

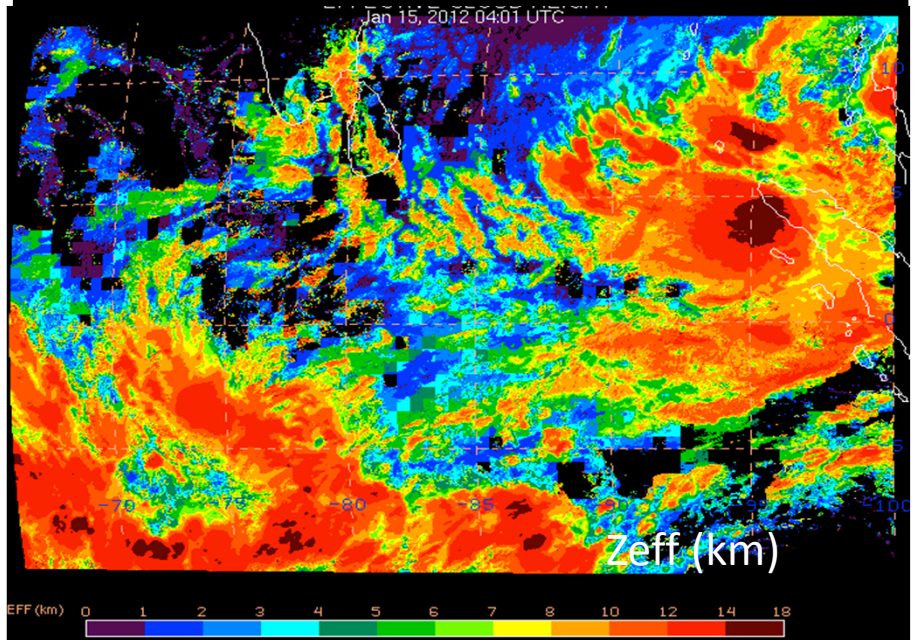
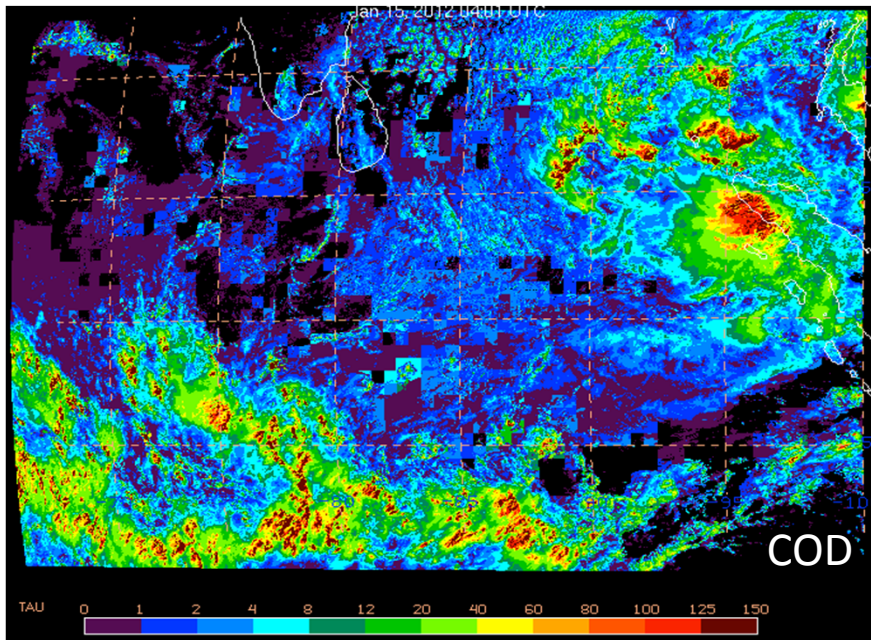
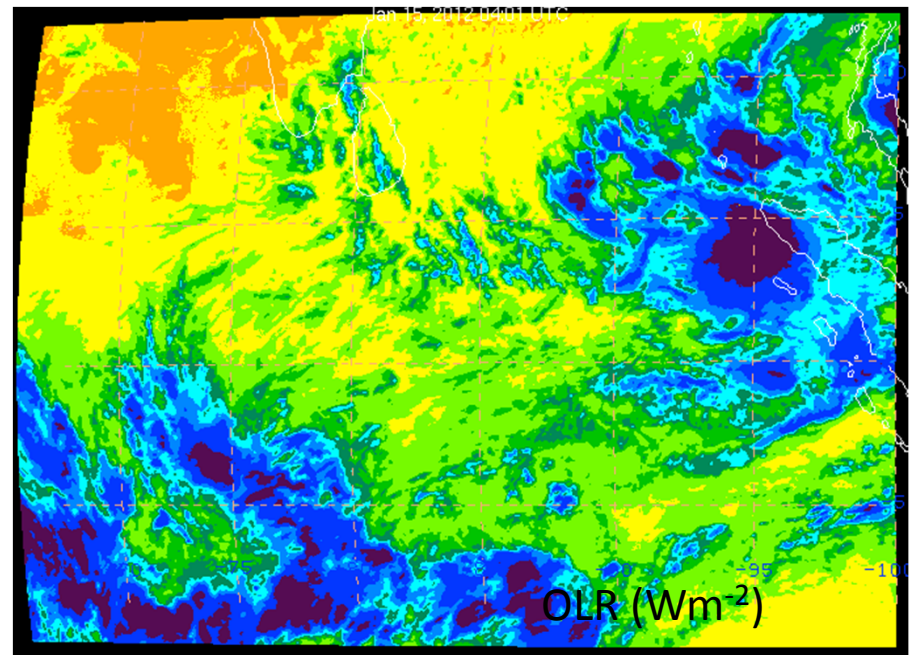
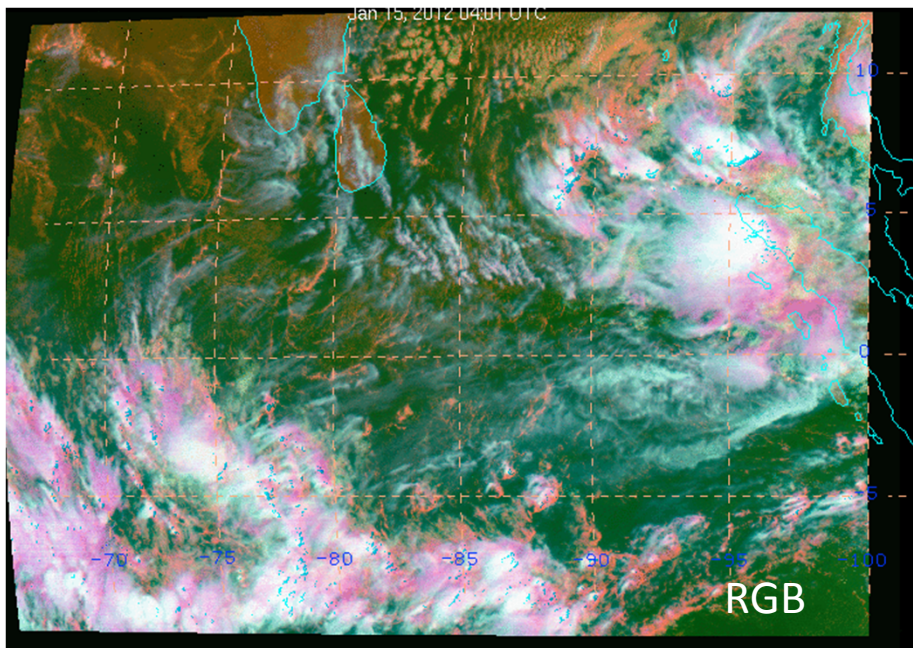
TWP C1 MWR LWP on 20120112



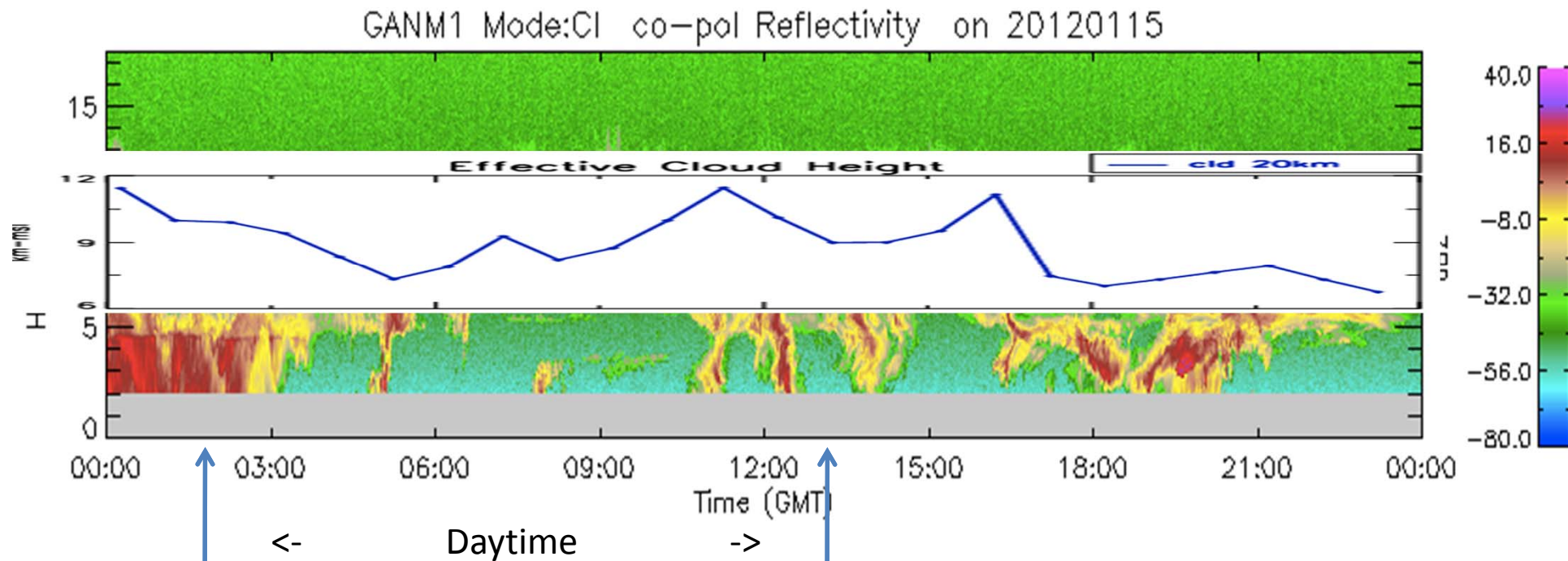
TWP C1 Ceilometer Range and Sensitivity Normalized Backscatter on 20120112



DYNAMO Domain, 4-km FY-2E, 14 Jan 2012

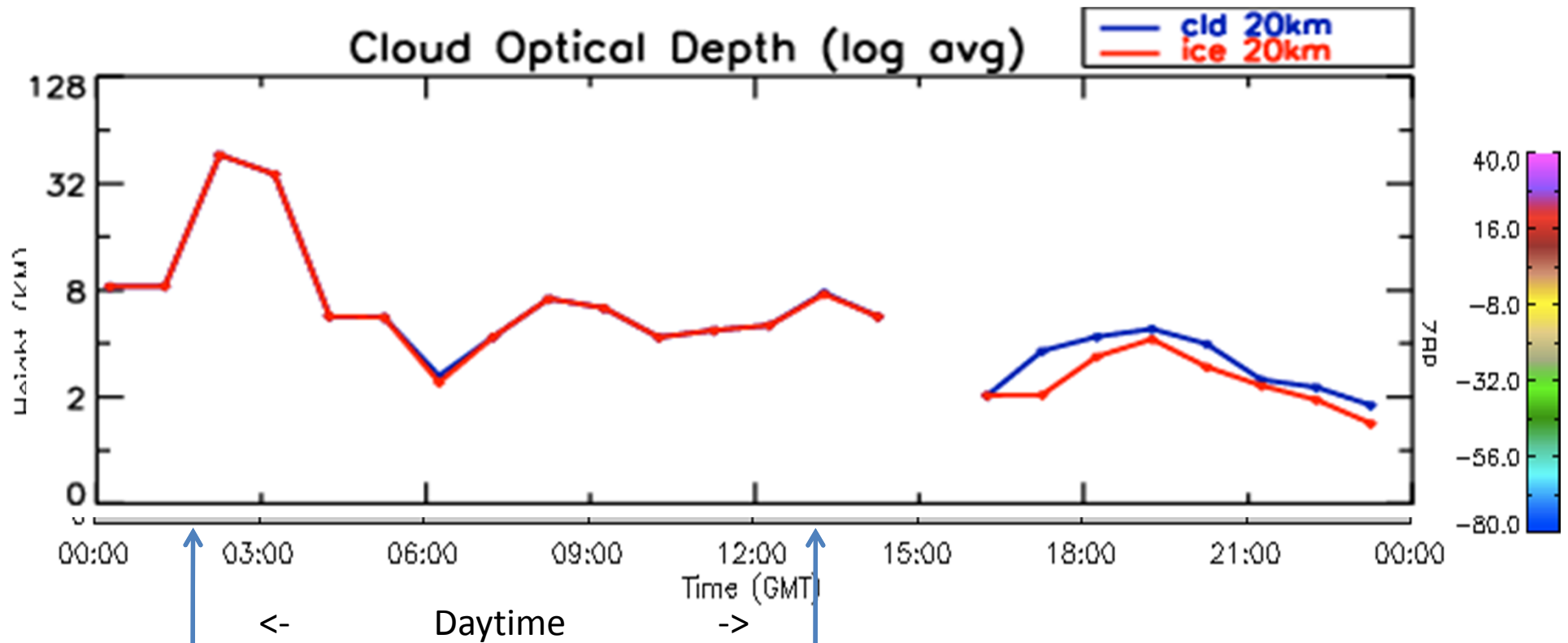


Comparison of Cloud Heights over Gan, 15 Jan 2012



- FY-2E effective heights typically near center of cirrus, except when thin enough for lower cloud to affect the signal
 - need for a multilayer detection/retrieval method
- FY-2E cloud heights surprisingly good considering nighttime IR woes
 - may be an anomaly
 - trust, but verify

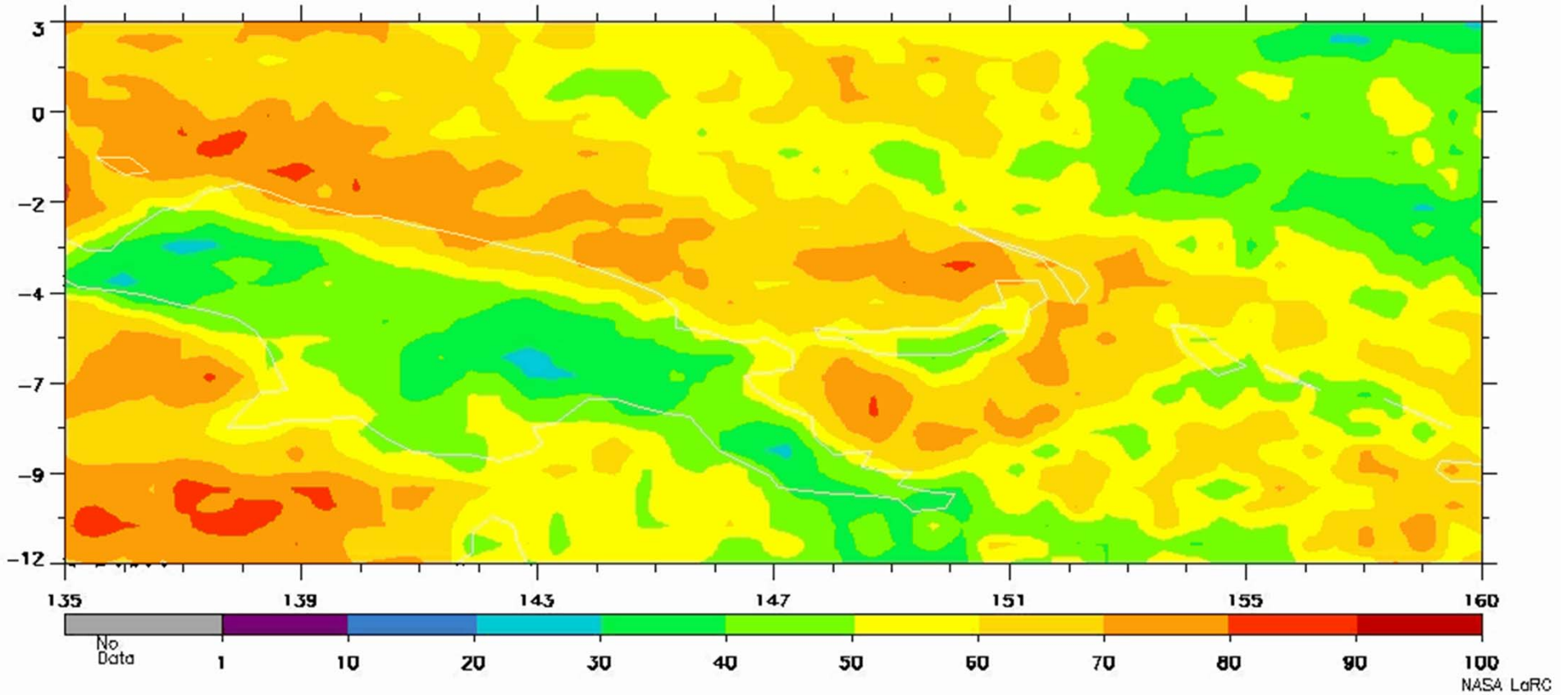
Time Series of Cloud Profiles & VISST COD over Gan, 15 Jan 2012



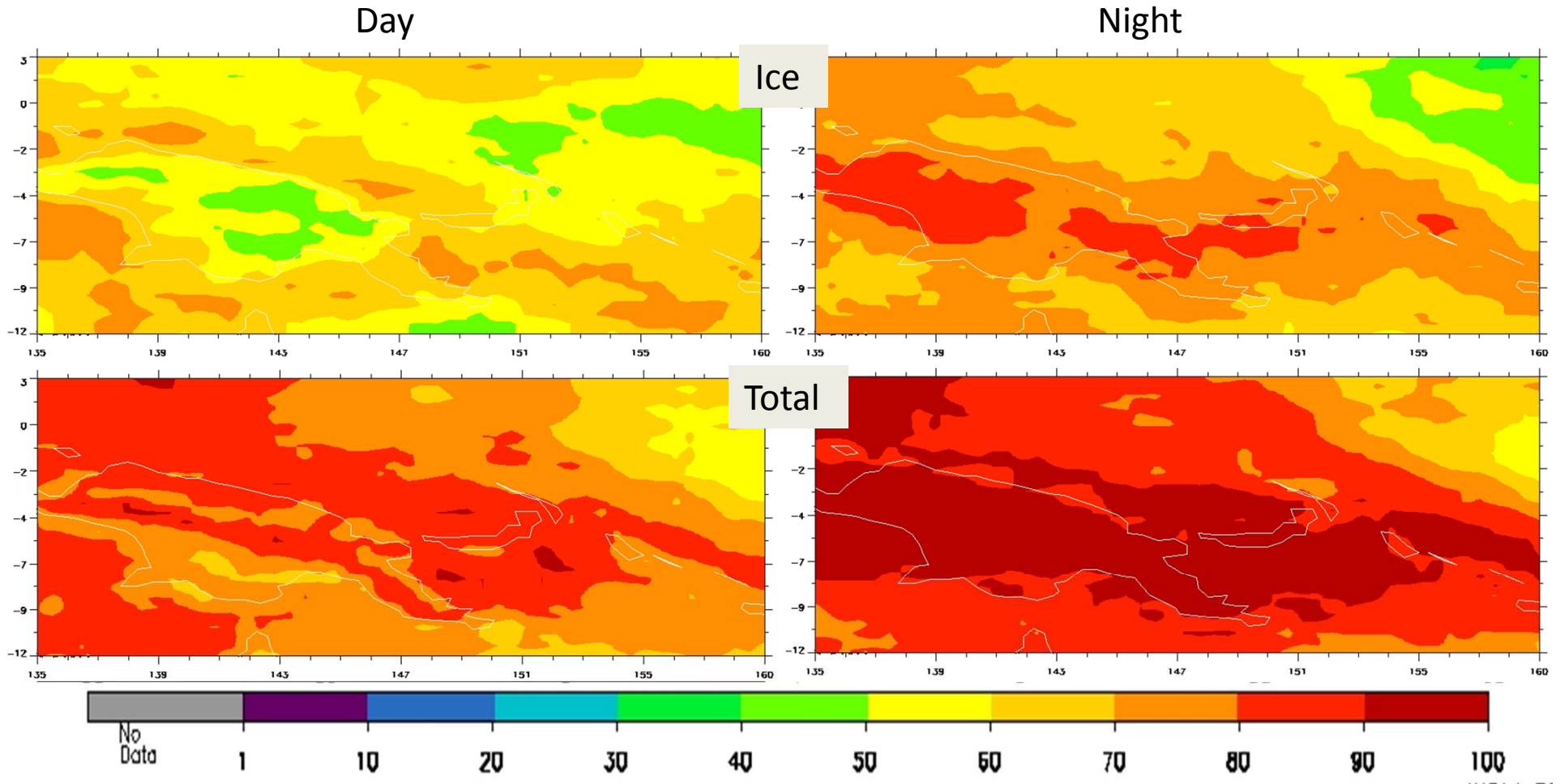
- Cloud optical depth limited at night by IR opacity – thin clouds ($\tau < 4$) OK
- Stability of FY-2E VIS calibration unknown

Mean Diurnal Variation in Ice Cloud Fraction Manus Domain January 2012

MANUS Cloud Fraction Ice Day Average(2012 Jan 0032)



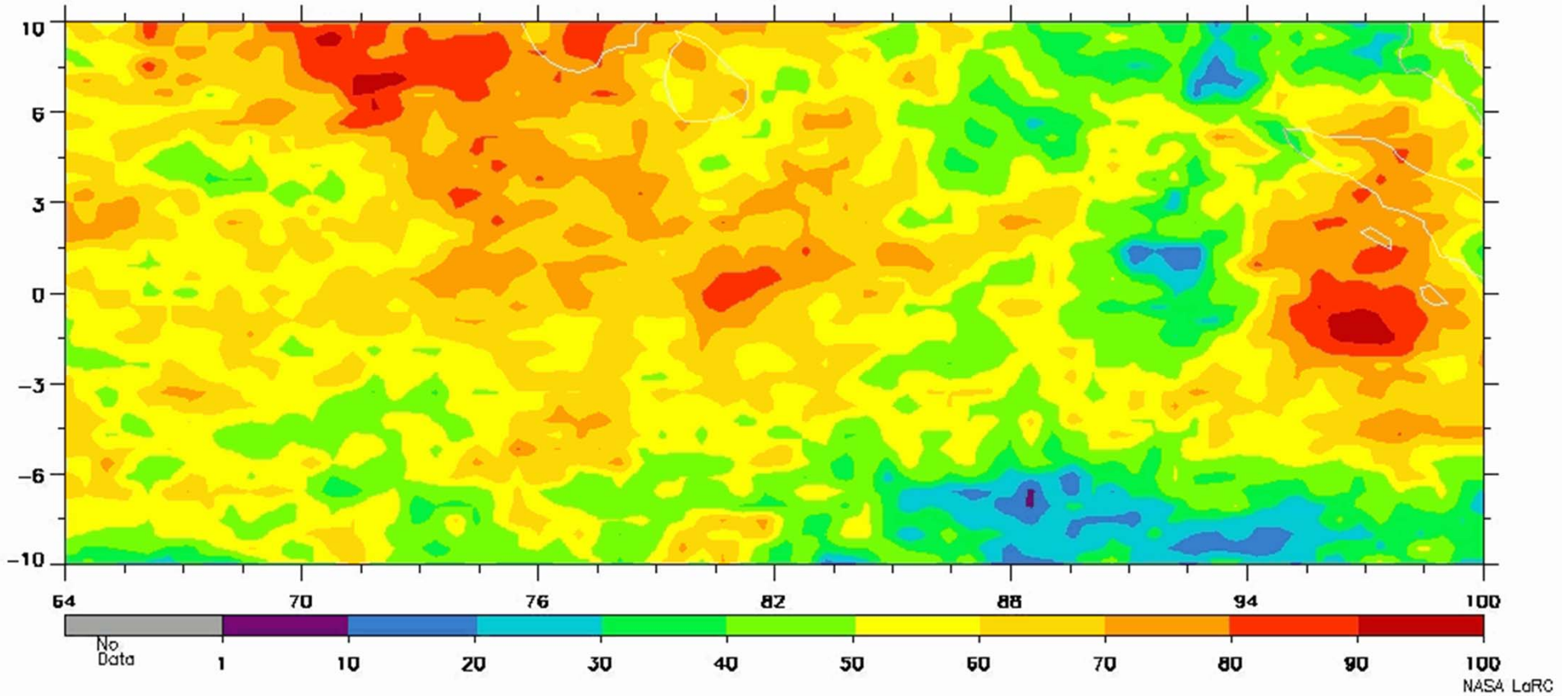
Mean Cloud Fraction, Manus Domain, January 2012



- Ice & total cloud coverage greater at night
 - algorithm artifact?
- Strong ocean-land diurnal differences
 - New Guinea water peaks during day, ice at night

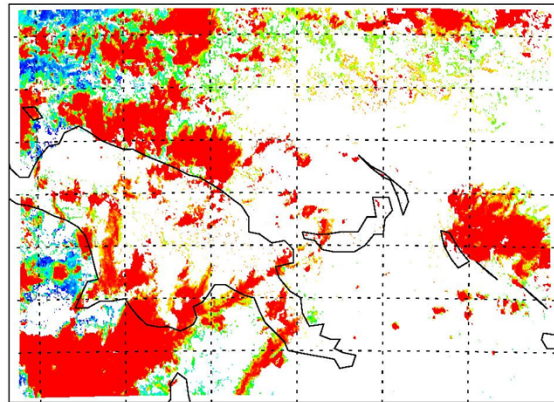
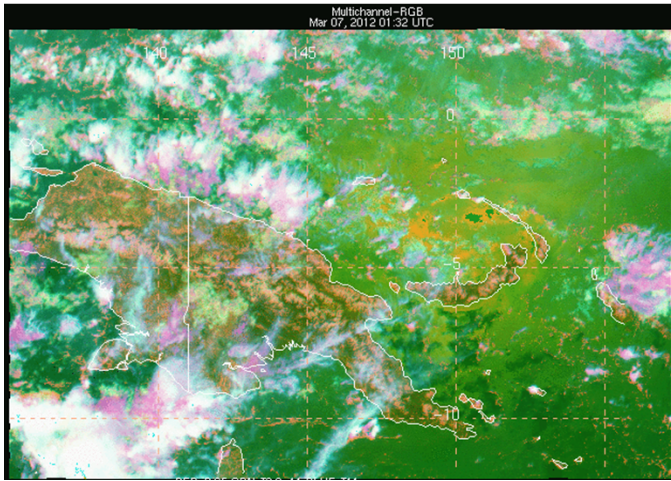
Mean Diurnal Variation in Ice Cloud Fraction DYNAMO Domain January 2012

AMIE Cloud Fraction Ice All Average(2011 Oct 0000)

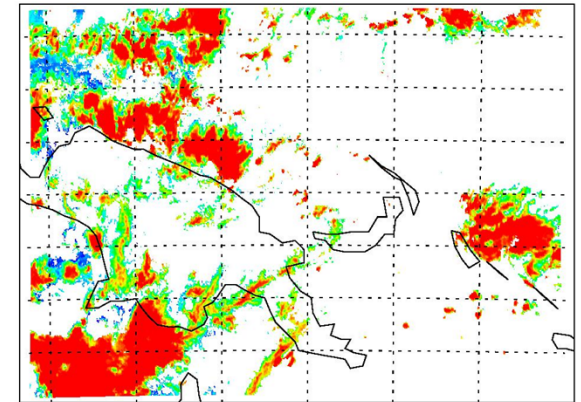
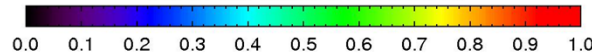


Dealing With Cirrus Over Low Clouds

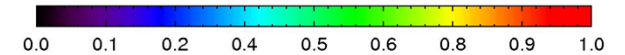
- New algorithm for cirrus using 6.7 & 11- μm channels (WIT)
 - could provide day-night consistency
 - can be used to estimate cirrus overlap with VISST results



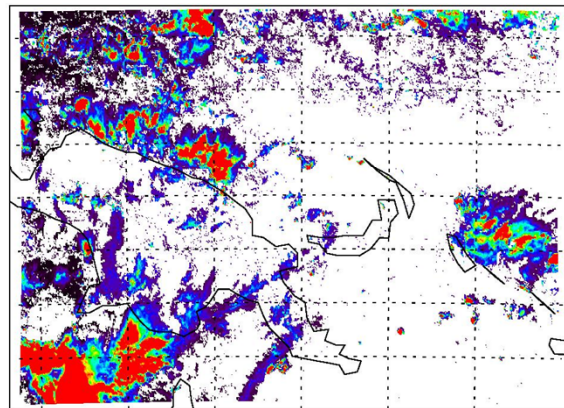
VISST Ice Cloud IR Emittance



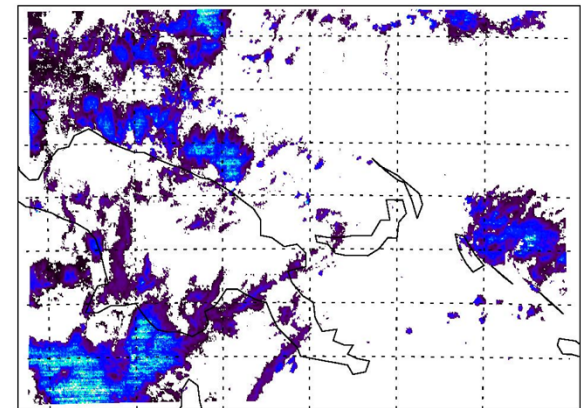
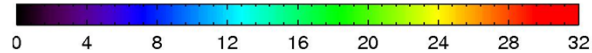
WIT Ice Cloud IR Emittance



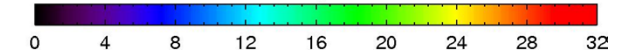
- differences in emittance & optical depth can be exploited to determine cloud layering



VISST Ice Cloud Optical Thickness



WIT Ice Cloud Optical Thickness



Summary & Future for AMIE Satellite Products

- Data are available now
 - results are preliminary, but should be useful
 - beware of FY-2E
- Data will be reprocessed with “best” calibrations
 - will attempt to identify worst of FY-2E images
 - will compare MTSAT with FY-2E in overlap
- Will develop WV-channel based cirrus/multilayer detection method
- Add CERES-MODIS cloud properties and broadband fluxes
 - higher resolution
 - direct broadband TOA measurements
 - adjust GEO broadband data to match
- Will respond to team requests