

MODIS and VIIRS Data Environmental Applications: Part 1

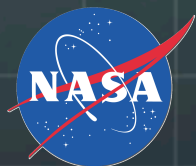
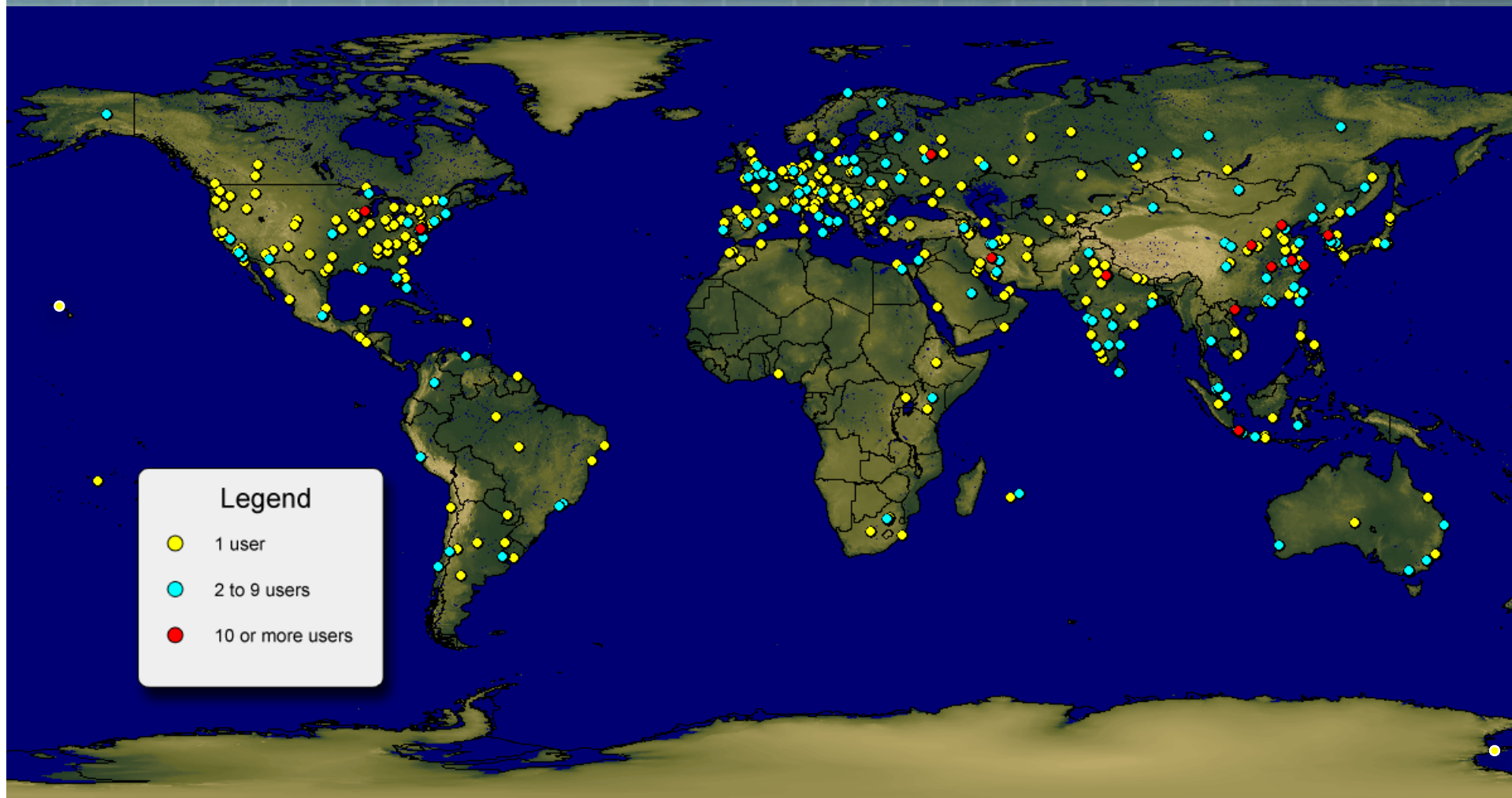
Kathleen Strabala
Hawaii Direct Broadcast Polar Orbiter Workshop
University of Hawaii Manoa
21 August 2013

Hawaii Polar Orbiter DB Products

- Products Created from:
 - Community Satellite Processing Package (CSPP) – VIIRS, CrIS and ATMS
 - International MODIS/AIRS Processing Package(IMAPP)
 - MODIS, AIRS and AMSR-E
 - SeaDAS – NASA Ocean Biology Group
 - <http://seadas.gsfc.nasa.gov/>
 - MODIS L1B software
 - Ocean products from MODIS and VIIRS
 - NASA science products distributed through the NASA Direct Readout Lab (DRL)
 - <http://directreadout.sci.gsfc.nasa.gov/>



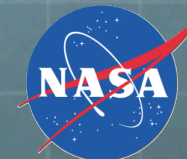
Global IMAPP Downloads



More than 1500 people have downloaded some part of the IMAPP suite of products representing 70 different countries and all 7 continents (since 2007)



<http://cimss.ssec.wisc.edu/imapp/>



International MODIS/AIRS Processing Package

[Home](#)[Download](#)[Applications](#)[History](#)[Credits](#)[Forum](#)

The International MODIS/AIRS Processing Package (IMAPP) allows ground stations capable of receiving direct broadcast data from the NASA [Terra](#) and [Aqua](#) spacecraft to create a suite of products from [MODIS](#), AIRS, AMSU, and AMSR-E. The IMAPP software is freely available, and is supported on Intel Linux host platforms.

IMAPP is also available as a Virtual Appliance for Windows, OS X, and Linux, offering a complete processing system for direct broadcast atmosphere, land, and ocean products from Terra and Aqua.

MODIS products (Terra and Aqua)

Atmosphere and Polar Products

- Cloud mask
- Cloud top pressure and temperature
- Cloud optical depth and effective radius
- Temperature and moisture profiles
- Total precipitable water
- Stability indices
- Aerosol optical depth
- Ice Surface Temperature
- Snow Mask
- Ice Cover and Ice Concentration
- Inversion Strength and Inversion Depth

[Learn more ...](#)

Land Products

- Land surface reflectance
[Learn more ...](#)
- Nadir BRDF-adjusted reflectance
[Learn more ...](#)

Image Products

- True color GeoTIFF and KML
[Learn more ...](#)

AIRS and AMSU Products (Aqua)

Sensor Products

- Calibrated and geolocated radiances and reflectances (AIRS)
- Calibrated and geolocated antenna temperatures (AMSU)

AMSR-E Products (Aqua)

Sensor Products

- Calibrated and geolocated antenna temperatures
[Learn more ...](#)

Atmosphere Products

- Rain rate
[Learn more ...](#)

Surface Products

- Soil moisture
[Learn more ...](#)
- Snow water equivalent
[Learn more ...](#)

NWP Products

The Direct Broadcast CIMSS Regional Assimilation System (DBCRAS) is a regional numerical weather prediction model that assimilates MODIS products in real time and creates forecasts up to 72 hours at 48 km and 16 km resolution.

[Learn more ...](#)

Aviation/Severe Weather Forecast Products

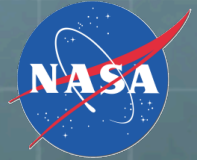
The IMAPP Overshooting Tops (OT) software package identifies regions of MODIS data that contain convective cloud tops that have broken through the tropopause into the lower stratosphere because of a strong updraft. Convective

What's New

- [Hyperspectral Retrieval Software v1.1 Release](#)
- [MODIS Aviation Weather Forecast Package \(Version 1.0\)](#)
- [MODIS Air Quality Forecast Package \(Version 1.0\)](#)



IMAPP Software Suite



MODIS Atmosphere and Polar Products

- Cloud mask
- Cloud top pressure and temperature
- Cloud optical depth and effective radius
- Temperature and moisture profiles
- Total precipitable water
- Stability indices
- Aerosol optical depth
- Ice Surface Temperature
- Snow Mask
- Ice Cover and Ice Concentration
- Inversion Strength and Inversion Depth

MODIS Land Products

- Land Surface Reflectance
- BRDF

MODIS Image Software

- MODIS in Google Earth (true color)

AIRS Level 1B

- Calibrated and geolocated radiances and brightness temperatures (AIRS)
- Calibrated and geolocated antenna temperatures (AMSU)

AIRS Retrievals

- JPL 3x3 FOV
- Dual Regression Single FOV

AIRS Utilities

- Collocating AIRS/MODIS utility
- AIRS HDF to BUFR utility

AMSR-E Level 1B

- Calibrated and Geolocated Antenna Temperatures

AMSR-E Products

- Rain Rate, Soil Moisture, Snow Water Equivalent

NWP Products

- Globally configurable regional numerical weather prediction model that assimilates MODIS DB products - DBCRAS

Aviation/Severe Weather Products

- Overshooting Tops Identification including turbulence and lightning potential

Air Quality Forecast Product – IDEA-I

Complete DB Processing System

- VA for Mac, Windows and Linux



<http://cimss.ssec.wisc.edu/cspp/>



Community Satellite Processing Package

[Home](#)[Download](#)[Applications](#)[History](#)[Credits](#)[Forum](#)

The Community Satellite Processing Package (CSPP) supports the Direct Broadcast (DB) meteorological and environmental satellite community through the packaging and distribution of open source science software. CSPP supports DB users of both polar orbiting and geostationary satellite data processing and regional real-time applications through distribution of free open source software, and through training in local product applications. CSPP is funded through [NOAA JPSS](#).

Suomi National Polar-orbiting Partnership (NPP) Products

CSPP software to support Suomi NPP:

- [VIIRS](#), [ATMS](#) and now [CrIS](#) calibration and geolocation software (Raw Data Records (RDRs) to Science Data Records (SDRs));
[Learn more ...](#)
- [VIIRS](#) Cloud Mask and Active Fires Environmental Data Records (EDRs);
[Learn more ...](#)
- [VIIRS](#) SDR reprojection software for the creation of GeoTIFFs and/or AWIPS NetCDF files;
[Learn more ...](#)
- [CrIS](#), [AIRS](#) and [IASI](#) University of Wisconsin dual regression single Field-of-View (FOV) Temperature, Moisture, Surface and Cloud Retrieval Environmental Data Record (EDR).
[Learn more ...](#)

Coming Soon:

- [VIIRS](#) Cloud Top Properties, Cloud Optical Properties, and Aerosol Optical Thickness Environmental Data Records (EDRs).
- [AVHRR](#) (POES and MetOp) Cloud and Land Surface Retrievals.

For more information about Suomi NPP, please see:

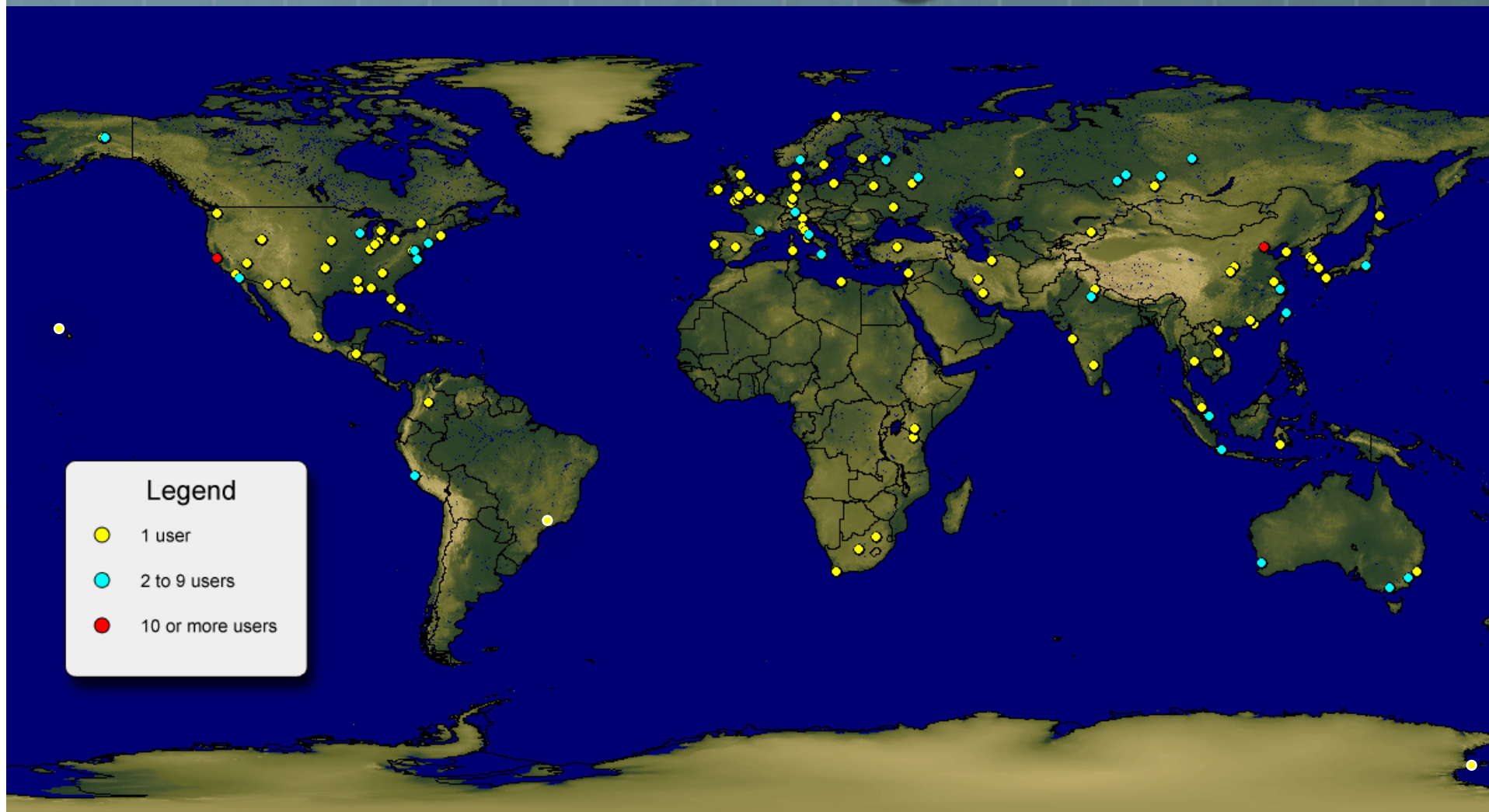
- the [JPSS website](#);
- the [Suomi NPP website](#);
- the [Suomi NPP document library](#).

What's New

- [Hyperspectral Retrieval Software v1.1 Release](#)
- [VIIRS Reprojection Software v1.0 Release](#)
- [VIIRS EDR v1.0 Release](#)
- [NPP SDR v1.3 Release](#)



Global CSPP Registrants



More than 300 people have registered since the first CSPP release in March 2012.



CSPP Software Suite



<http://cimss.ssec.wisc.edu/cspp>

- Science Data Record (SDR) Software
 - VIIRS, ATMS and CrIS calibration and geolocation software
 - Mx6.5 – Creates products close if not identical to those in IDPS
- Environmental Data Record (EDR) Software
 - VIIRS Cloud Mask and Active Fires Products
 - Mx6.5 – Close but not identical to IDPS because of use of different ancillary files
- UW Value Added Products
 - Hyperspectral Retrieval Package
 - Dual-Regression algorithm supporting CrIS, AIRS and IASI
 - VIIRS Polar2grid reprojection software package
 - Python based supporting AWIPS and GeoTIFF formats








Hawaii MODIS DB Data Server























Directory Structure



Index of /aqua/2013_08_19_231

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 images/	19-Aug-2013 22:49	-	
 level0/	19-Aug-2013 22:42	-	
 level1/	19-Aug-2013 22:42	-	
 level2/	19-Aug-2013 22:49	-	

Apache/2.2.15 (CentOS) Server at soest-hcc1.hcc.hawaii.edu Port 80

soest-hcc1.hcc.hawaii.edu/aqua/2013_08_19_231/level2/			
Personal MODIS DB Wx JPSS Technical			
Index of /aqua/2013_08_19_231/level2			
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 a1.13231.0105.crefl.500m.hdf	19-Aug-2013 01:16	202M	
 a1.13231.0105.crefl.1000m.hdf	19-Aug-2013 01:16	50M	
 a1.13231.0105.mask_byte1.hdf	19-Aug-2013 01:41	37M	
 a1.13231.0105.mod04.hdf	19-Aug-2013 01:41	1.2M	
 a1.13231.0105.mod06ct.hdf	19-Aug-2013 01:39	165M	
 a1.13231.0105.mod07.hdf	19-Aug-2013 01:40	31M	
 a1.13231.0105.mod14.hdf	19-Aug-2013 01:16	22M	
 a1.13231.0105.mod28.hdf	19-Aug-2013 01:37	16M	
 a1.13231.0105.mod35.hdf	19-Aug-2013 01:37	59M	
 a1.13231.0105.mod1st.hdf	19-Aug-2013 01:16	22M	
 a1.13231.0105.ndvi.250m.hdf	19-Aug-2013 01:16	231M	
 a1.13231.0105.ndvi.500m.hdf	19-Aug-2013 01:16	58M	
 a1.13231.0105.ndvi.1000m.hdf	19-Aug-2013 01:16	14M	
 a1.13231.0105.seadas.hdf	19-Aug-2013 01:21	209M	
 a1.13231.0105.wvnir.hdf	19-Aug-2013 01:41	16M	
 a1.13231.1135.mask_byte1.hdf	19-Aug-2013 11:57	56M	
 a1.13231.1135.mod06ct.hdf	19-Aug-2013 11:55	250M	
 a1.13231.1135.mod07.hdf	19-Aug-2013 11:56	47M	
 a1.13231.1135.mod14.hdf	19-Aug-2013 11:48	33M	
 a1.13231.1135.mod28.hdf	19-Aug-2013 11:52	24M	

Hawaii MODIS Standard Level 2 Products

[t1.13231.2100.crefl.1000\(500,250\)m.hdf - MODIS Corrected Reflectance 1km](#)

[t1.13231.2100.mask_byte1.hdf – MODIS Cloud Mask First Byte stripped file](#)

[t1.13231.2100.mod04.hdf – MODIS Aerosol Product file](#)

[t1.13231.2100.mod06ct.hdf – MODIS Cloud Top Properties file](#)

[t1.13231.2100.mod07.hdf – MODIS Atmospheric Profiles file](#)

[t1.13231.2100.mod14.hdf – MODIS Fire Product](#)

[t1.13231.2100.mod28.hdf – IMAPP MODIS SST file](#)

[t1.13231.2100.mod35.hdf – MODIS Cloud Mask file](#)

[t1.13231.2100.mod1st.hdf – MODIS Land Surface Temperature file](#)

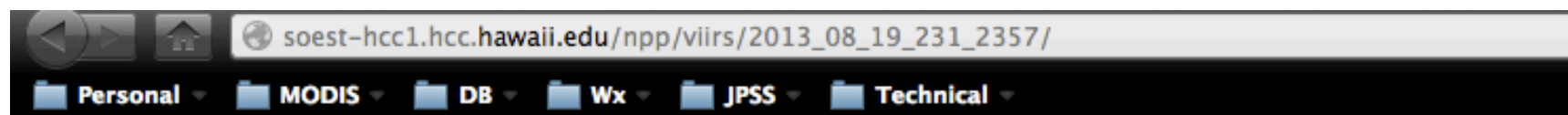
[t1.13231.2100.ndvi.1000\(500,250\)m.hdf – MODIS NDVI 1km resolution file](#)

[t1.13231.2100.seadas.hdf – MODIS SeaDAS Ocean Color product file](#)





[t1.13231.2100.wvnir.hdf – MODIS Near-IR Atmospheric Water Vapor file](#)

[geocatL2.Terra.2013231.210004.hdf – MODIS Overshooting Top Product File](#)

Hawaii VIIRS DB Data Server Directory Structure



Index of /npp/viirs/2013_08_19_231_2357

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 edr/	20-Aug-2013 00:58	-	
 geotiff/	20-Aug-2013 00:59	-	
 sdr/	20-Aug-2013 00:58	-	

Apache/2.2.15 (CentOS) Server at soest-hcc1.hcc.hawaii.edu Port 80

Hawaii VIIRS Standard Environmental Data Record (EDR) Products

- VIIRS EDR Products
 - Aerosol Optical Depth
 - VAOOO_npp*.h5 files
 - Sea Surface Temperatures
 - VSSTO_npp*.h5 files
 - Cloud Mask
 - IICMO_npp*.h5 files
 - Active Fires
 - AVAFO_npp*.h5 files



Geotiffs



Directory contains GeoTiff files of every band and true color image.


























- .0001 Radian Resolution (about 600m)
- Created from HDF4 files:
 - CREFLI – Corrected Reflectance I-Band Files
 - CREFLM – Corrected Reflectance M-Band Files



VIIRS Geotiff Files



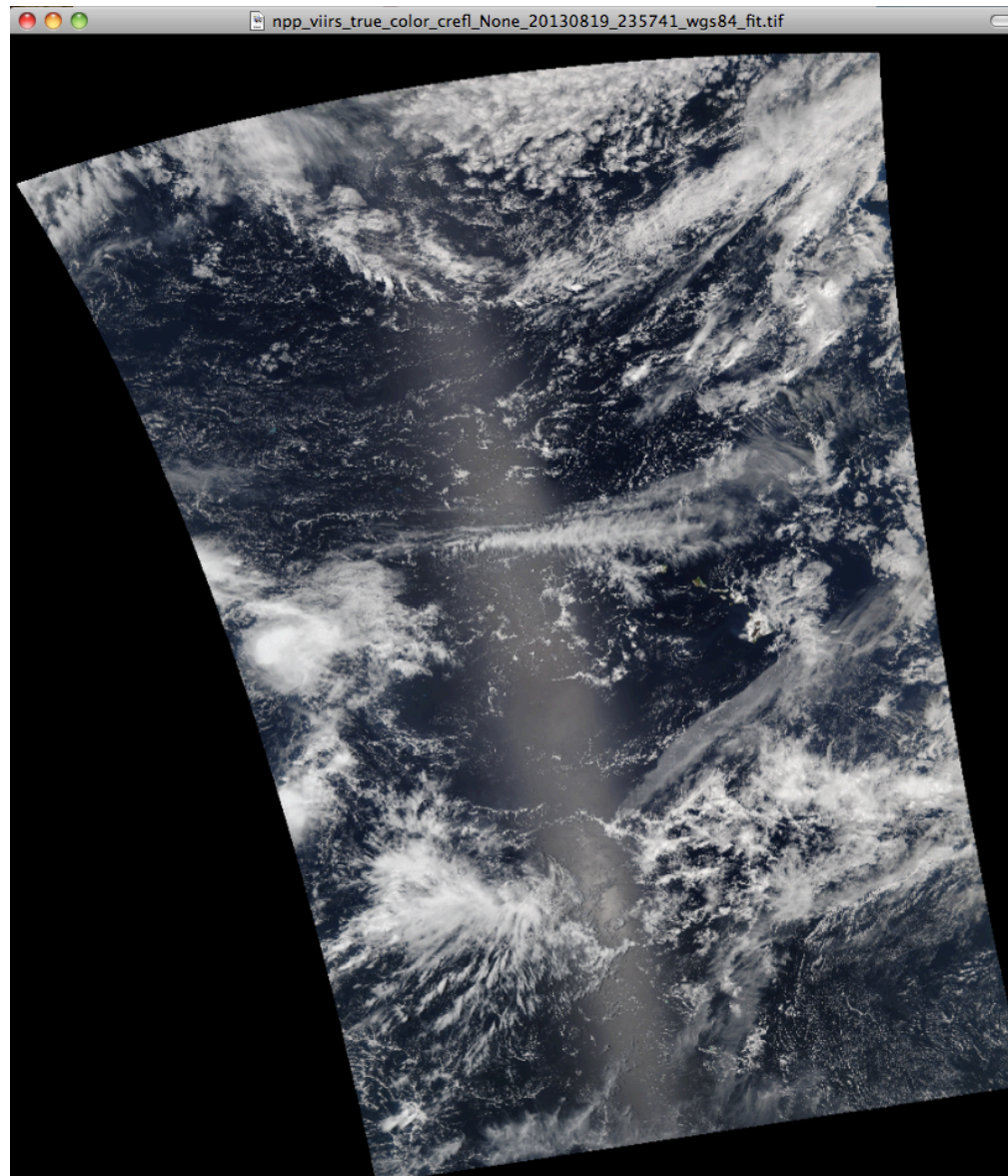
Generated
as part of the
CSPP package
polar2grid

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Personal MODIS DB Wx JPSS Technical			
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True Color GeoTIFF

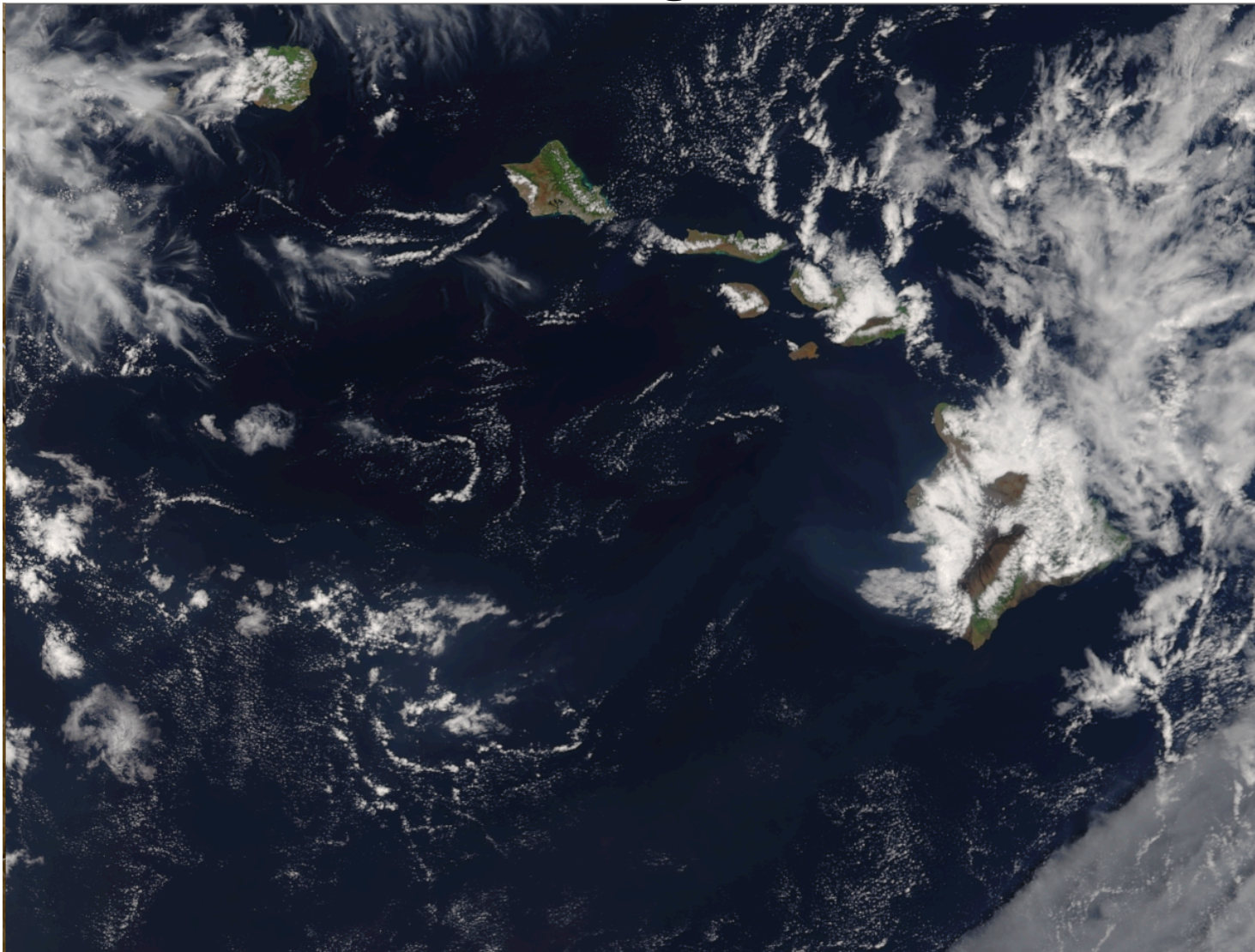
VIIRS 19 August 2013





True Color GeoTIFF

VIIRS 19 August 2013



S-NPP, Aqua and Terra DB Applications

- **Weather Observation and Forecasting**
 - Often thought of as research satellites
 - Data is Complimentary to Geostationary
 - Higher Spatial Resolution (data at 250 m - 1 km, products at 250 m - 5 km)
 - Unique spectral bands (such as Day/Night band)
 - New products (such as true color imagery)
 - Preparation for next generation of geo instruments
 - Key for forecasts is timeliness of data
 - IMAPP and CSPP provide NWS with real-time data
 - Post analysis – timeliness not as important
 - Temporal coverage is limiting

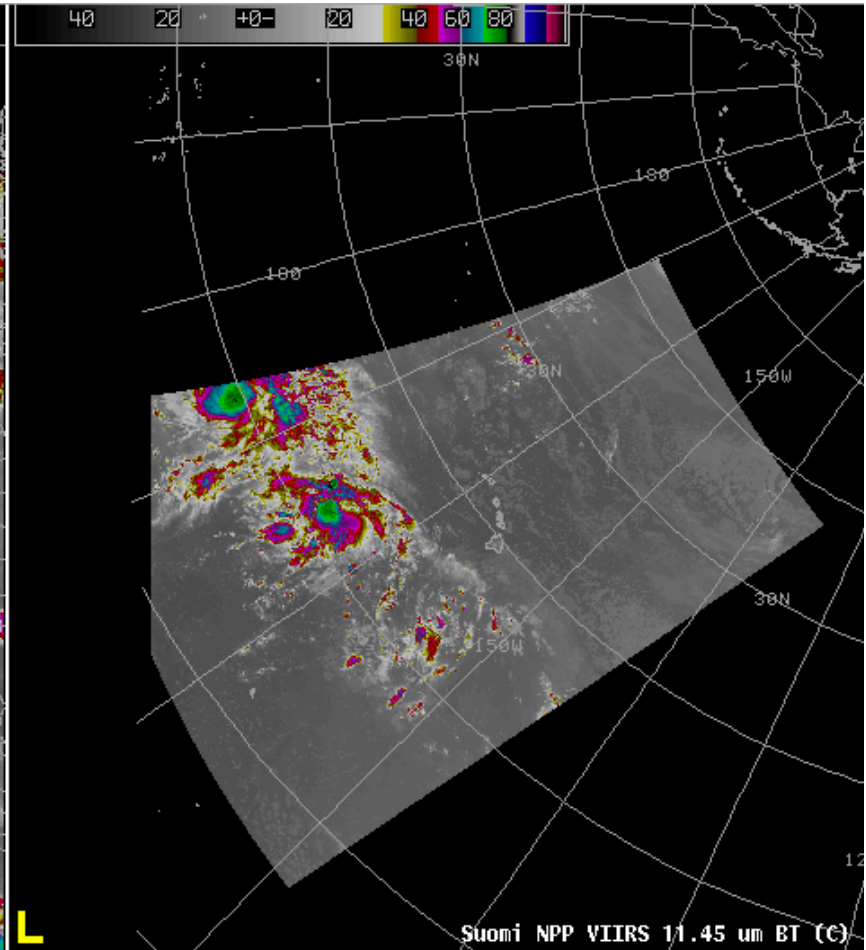
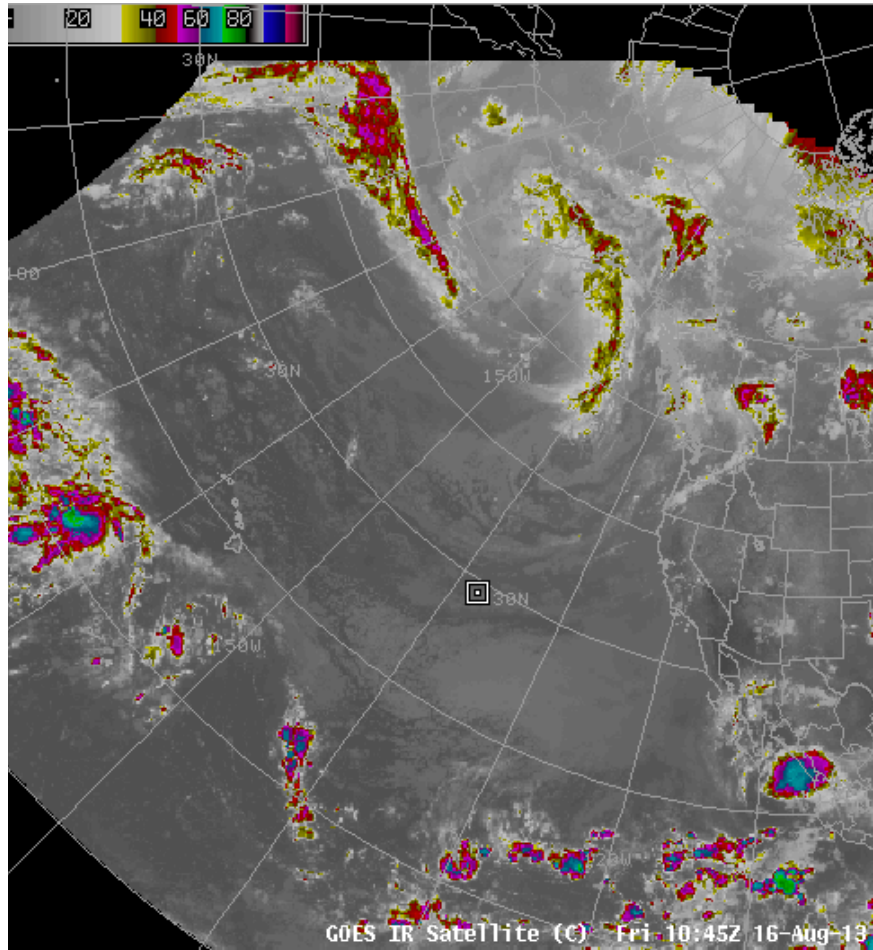
Weather and Forecasting

Complimentary to Geostationary

Example of Improved Spatial Resolution

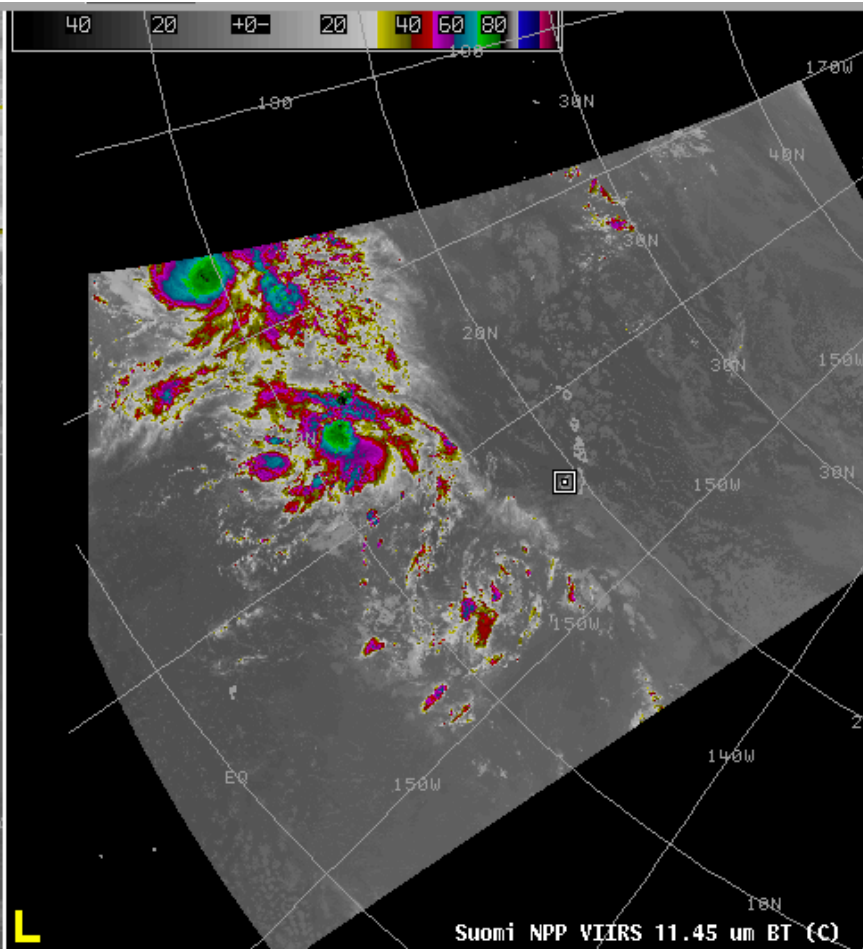
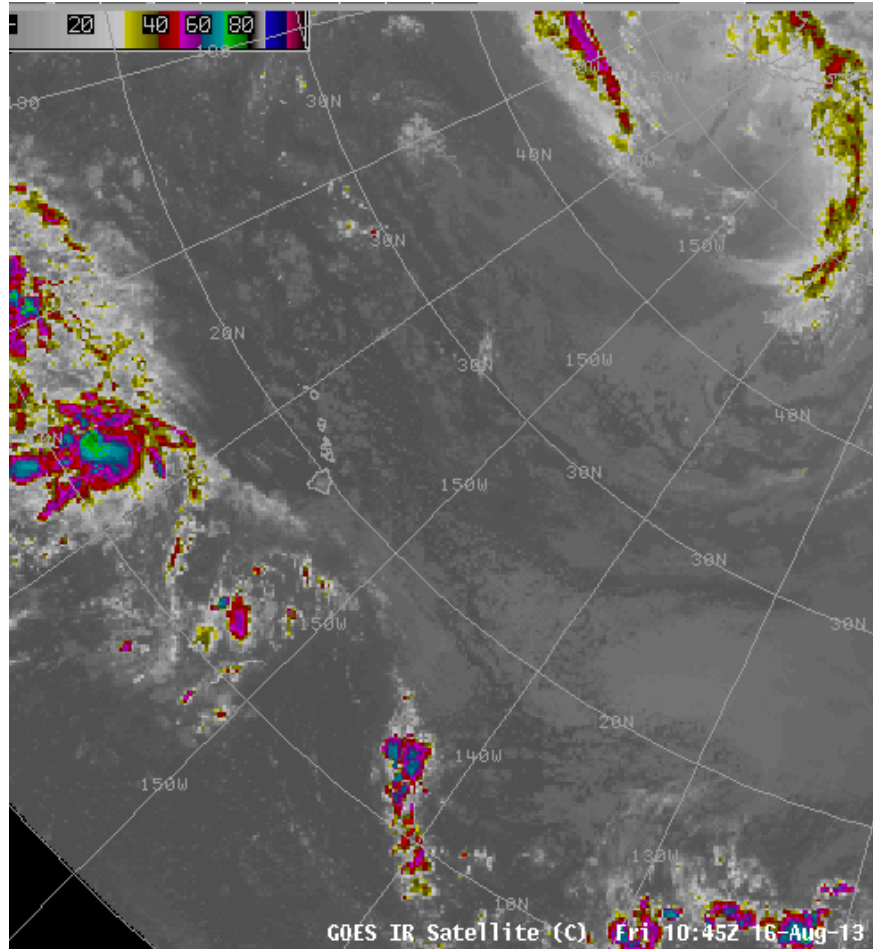


GEO versus LEO perspective



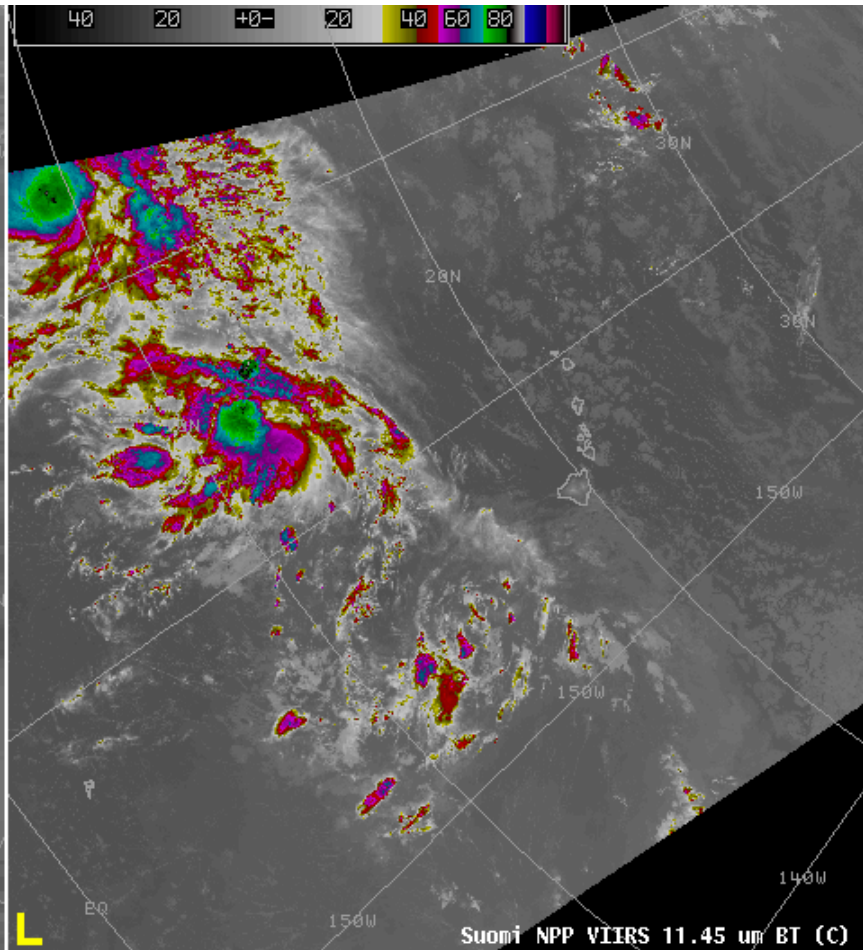
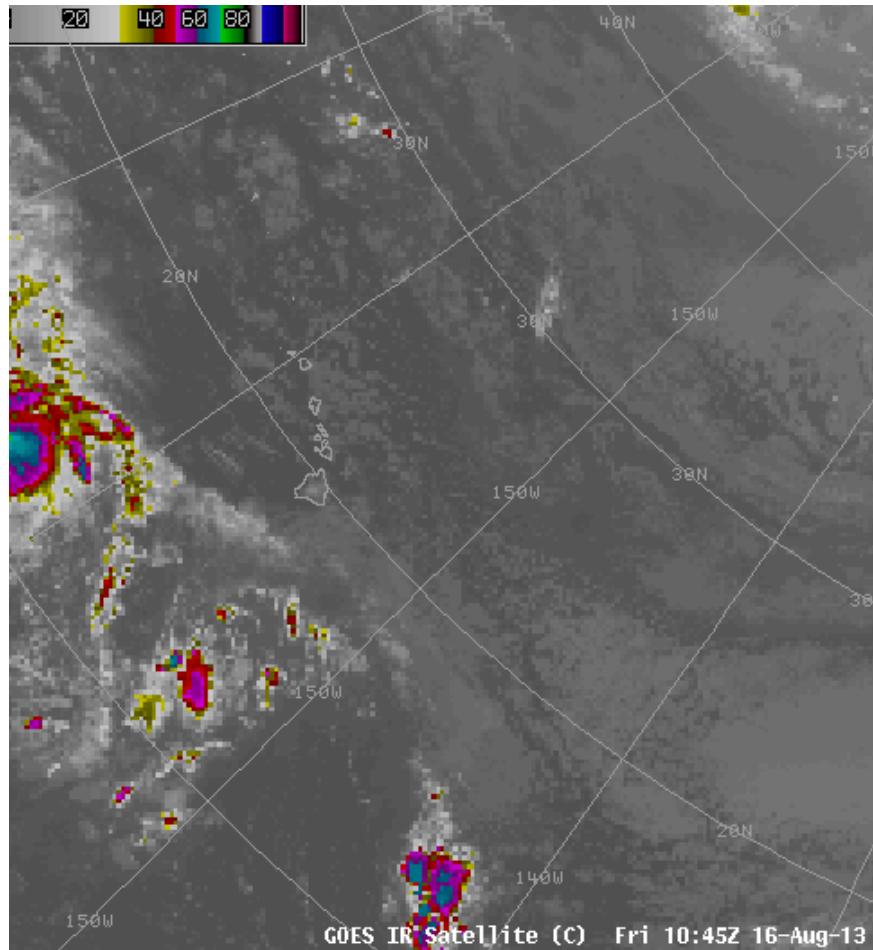


GEO versus LEO perspective



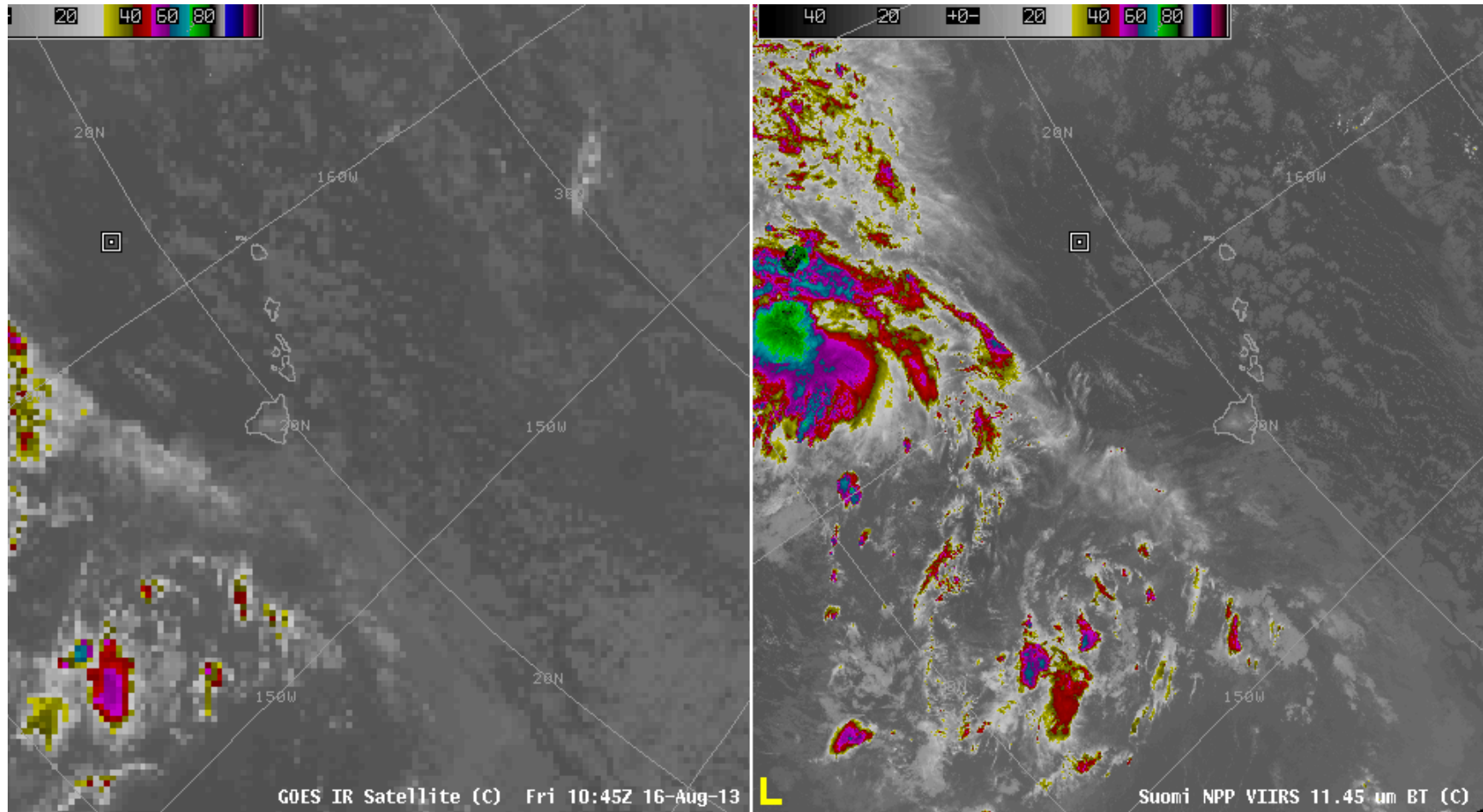


GEO versus LEO perspective



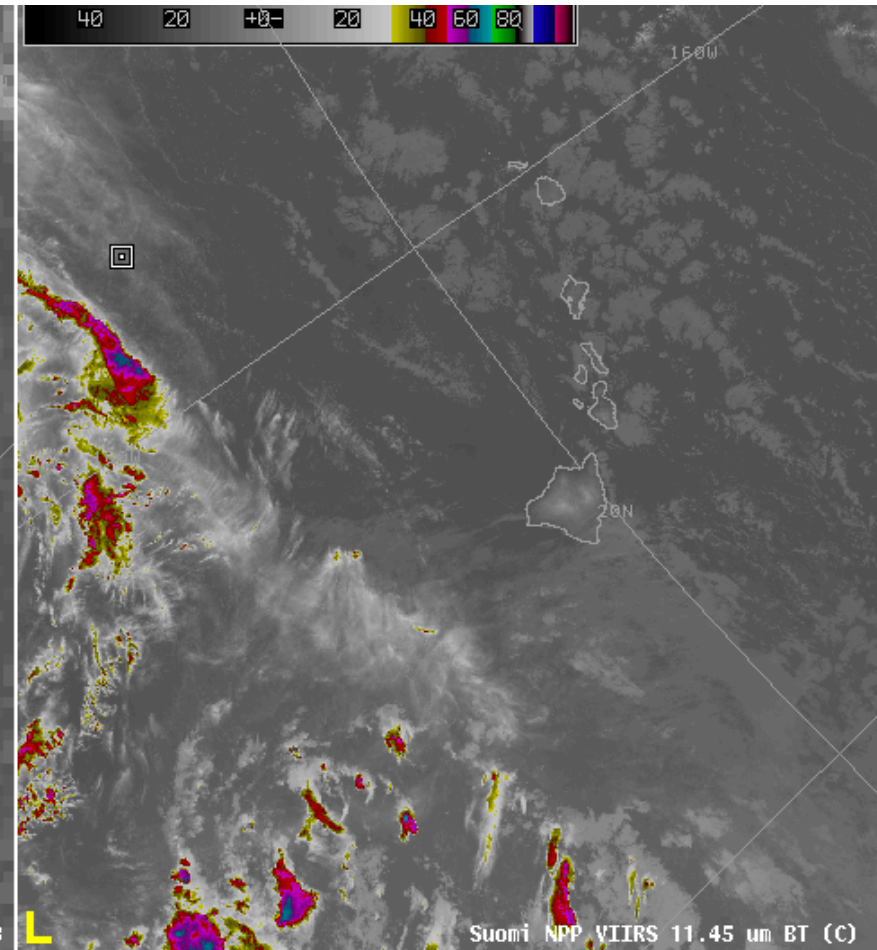
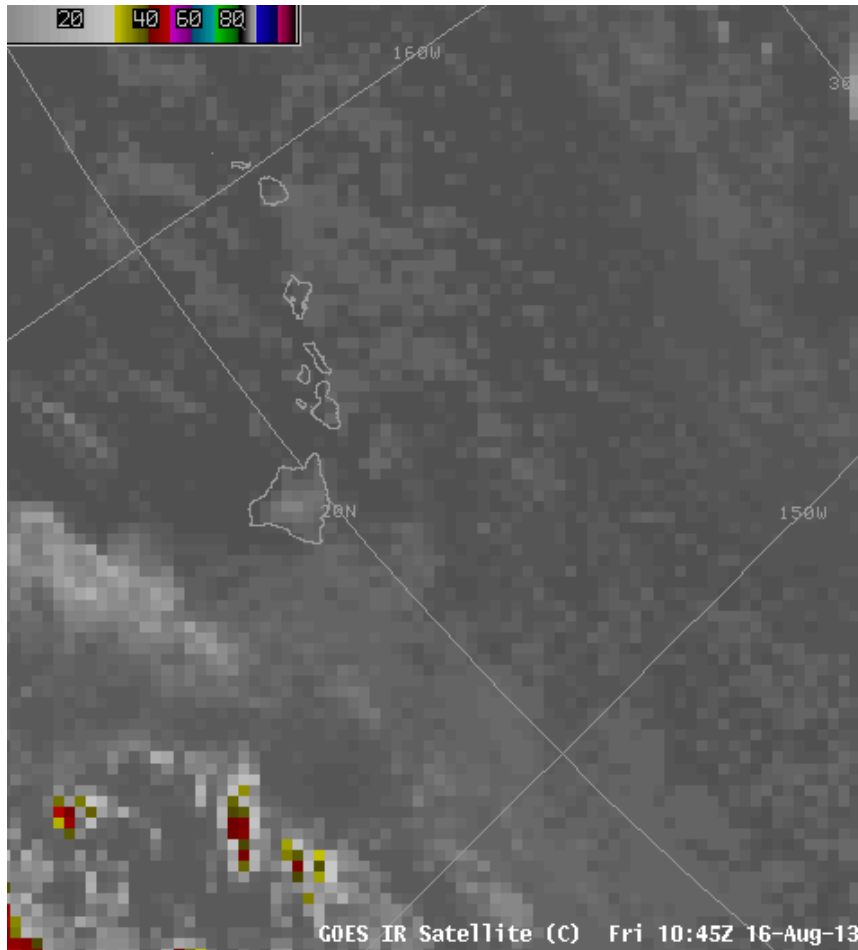


GEO versus LEO perspective



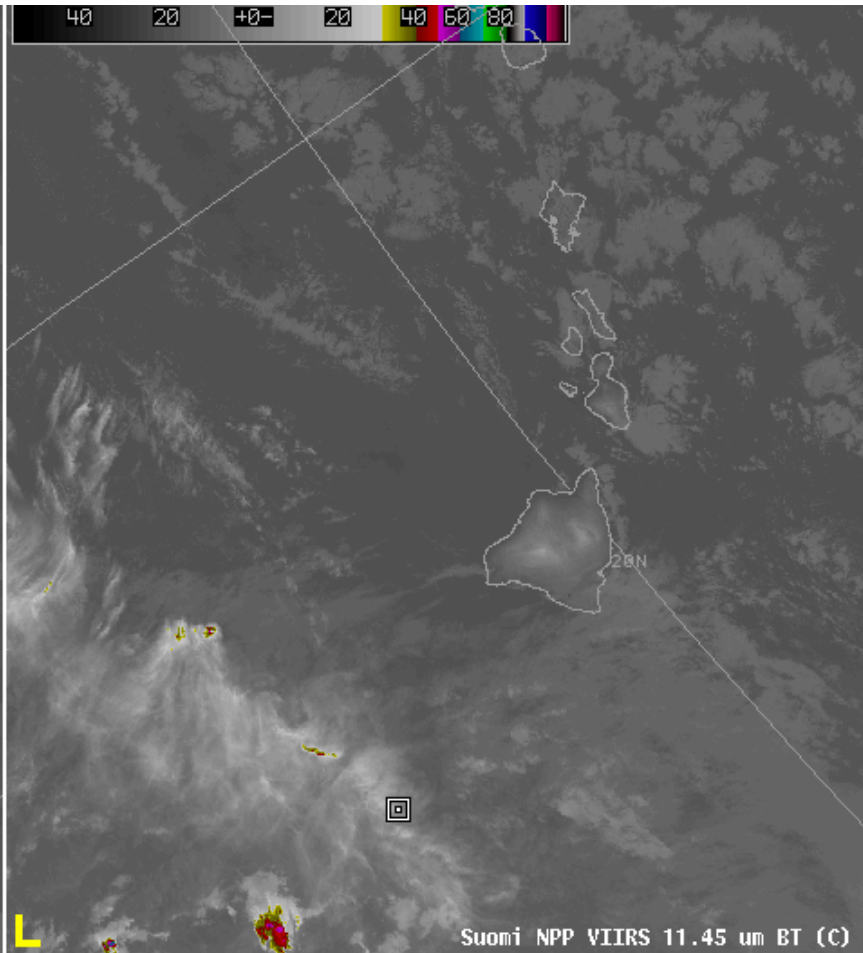
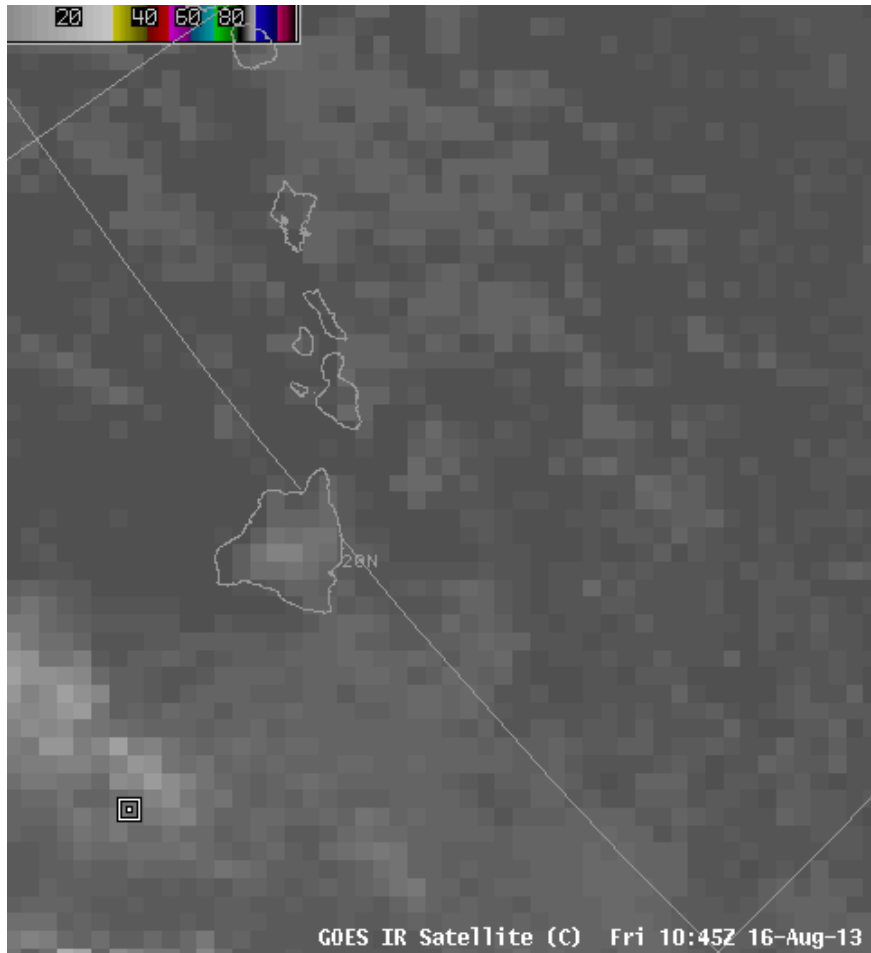


GEO versus LEO perspective





GEO versus LEO perspective



How Important Is Spatial Resolution?

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WEATHER AND FORECASTING

VOLUME 22

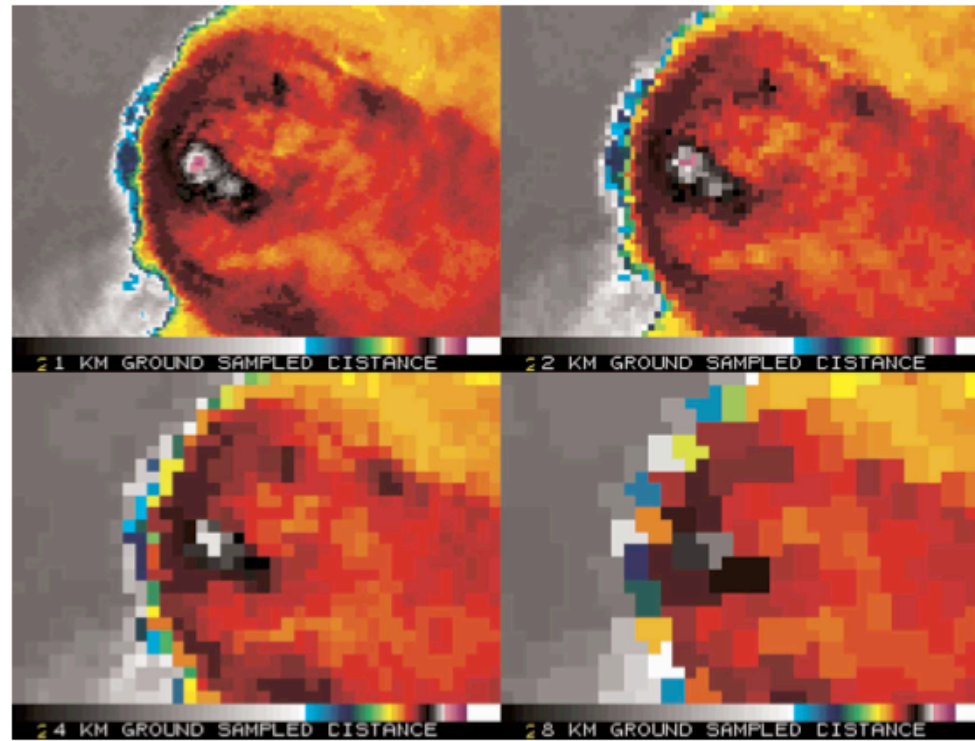
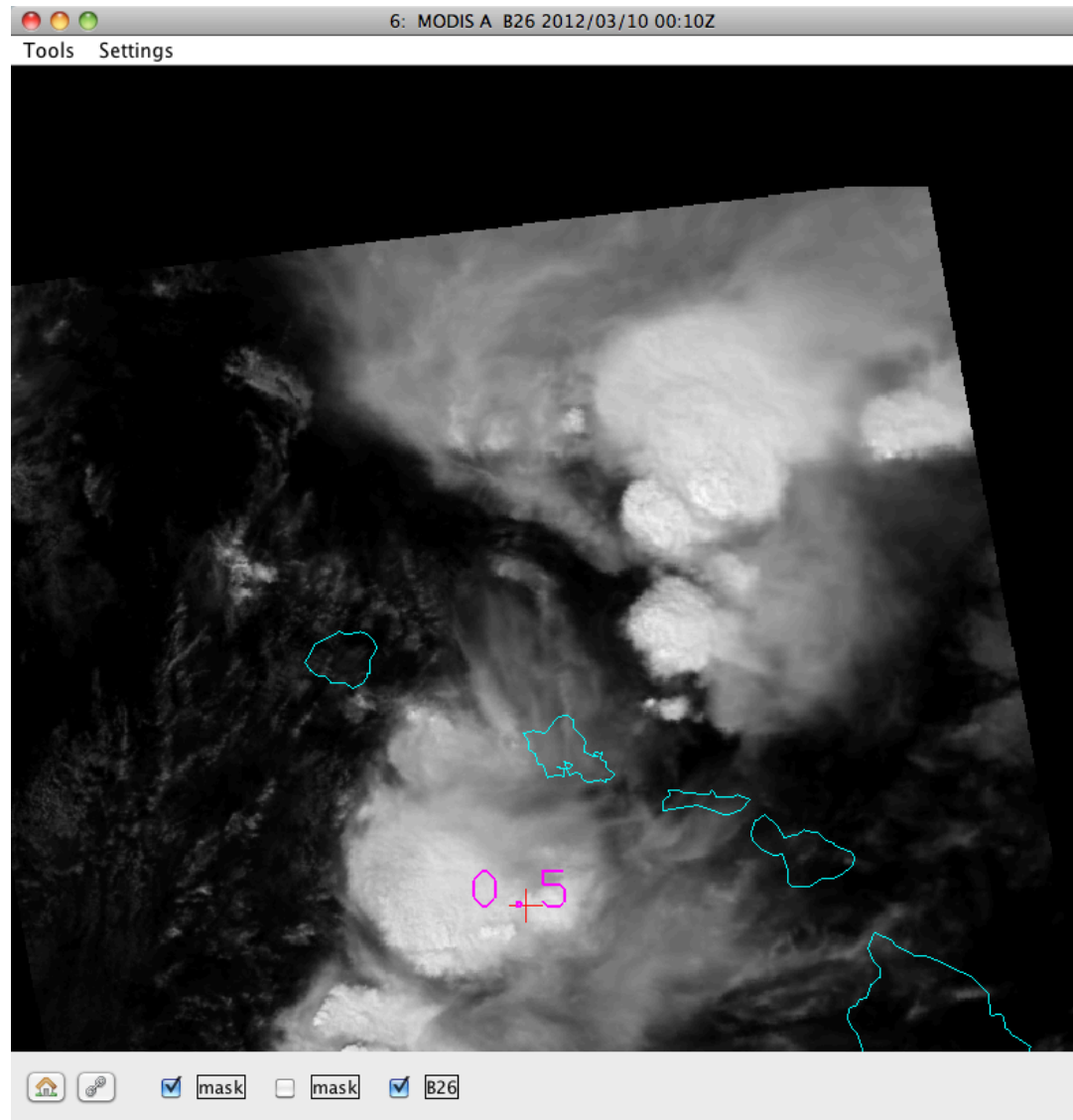


FIG. 3. Zoomed-in image of an enhanced-V feature located over northeast OK observed from enhanced LEO satellite imagery at 2218 UTC 6 May 2003 for 1-, 2-, 4-, and 8-km ground-sampled distances. The purple and white colors in the location of the updraft and overshooting top represent colder BTs, while the surrounding black and red colors represent warmer BTs.

A Quantitative Analysis of the Enhanced-V Feature in Relation to Severe Weather Jason C. Brunner, Steven A. Ackerman, A. Scott Bachmeier, and Robert M. Rabin
Weather and Forecasting Volume 22, Issue 4 (August 2007)
pp. 853–872

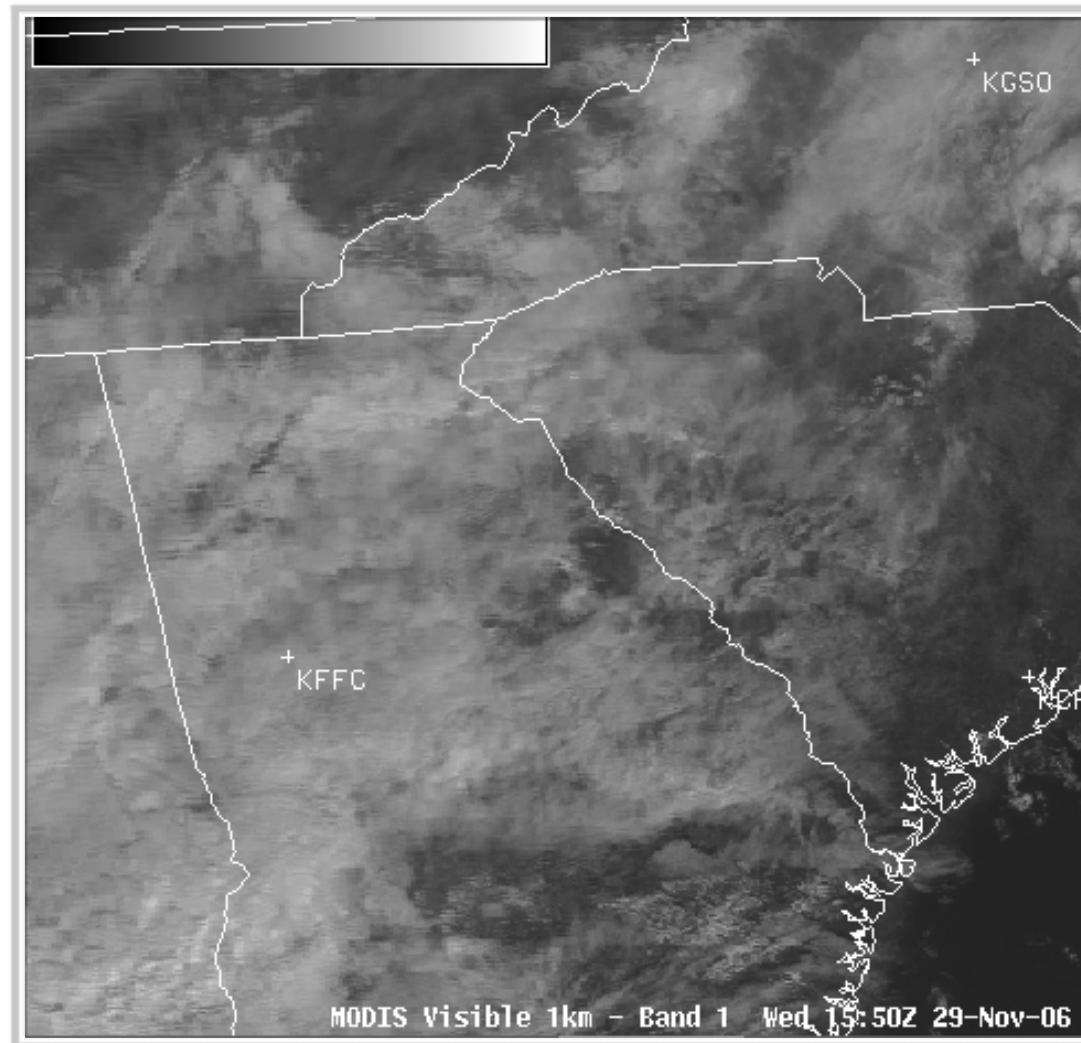
MODIS Water Vapor Band 26



Example of Increased Spectral Resolution

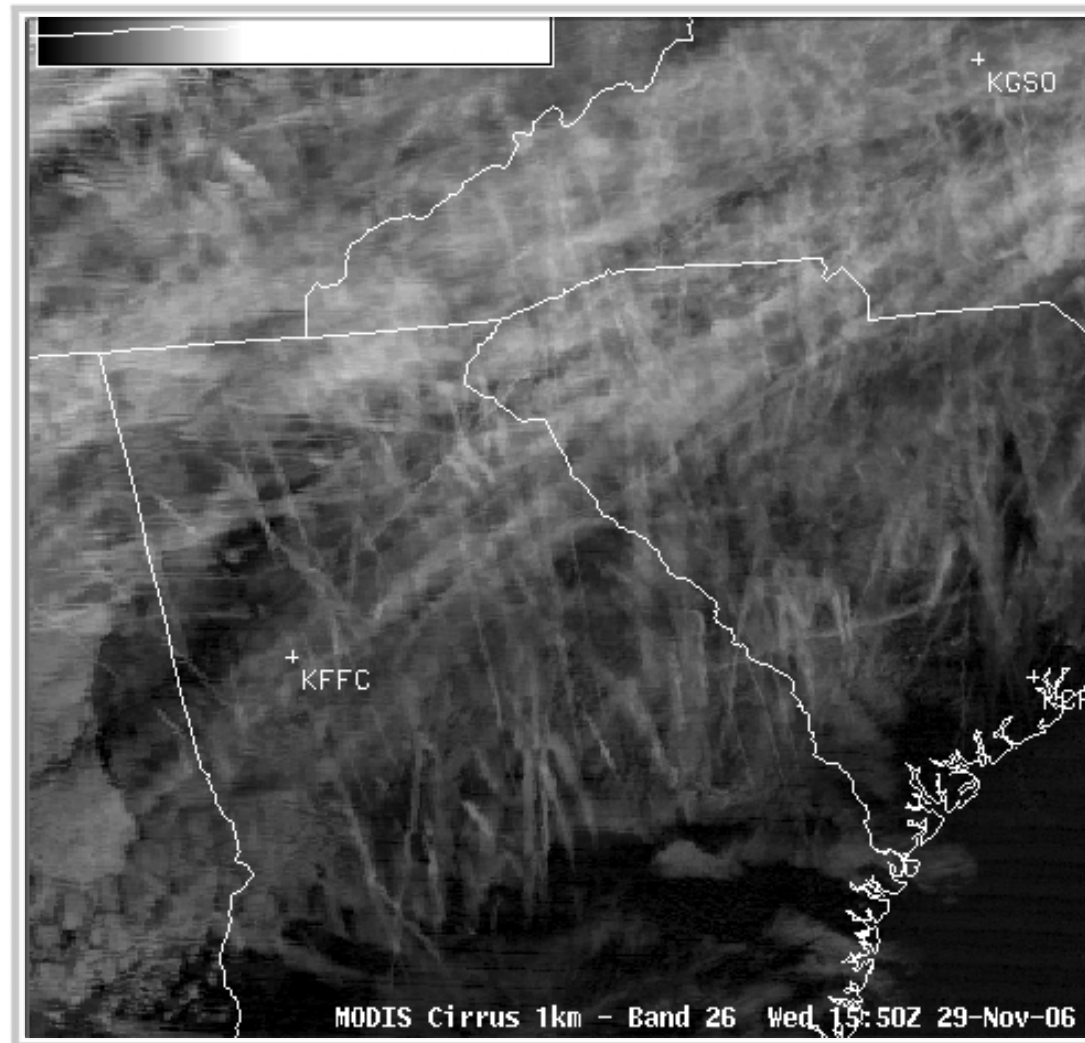
MODIS Imagery in AWIPS

Band 26: Cirrus detection ($1.38\text{ }\mu\text{m}$)



MODIS Imagery in AWIPS

Band 26: Cirrus detection ($1.38\text{ }\mu\text{m}$)



Can Polar Orbiter Data Really Be
That Useful to Forecasters?

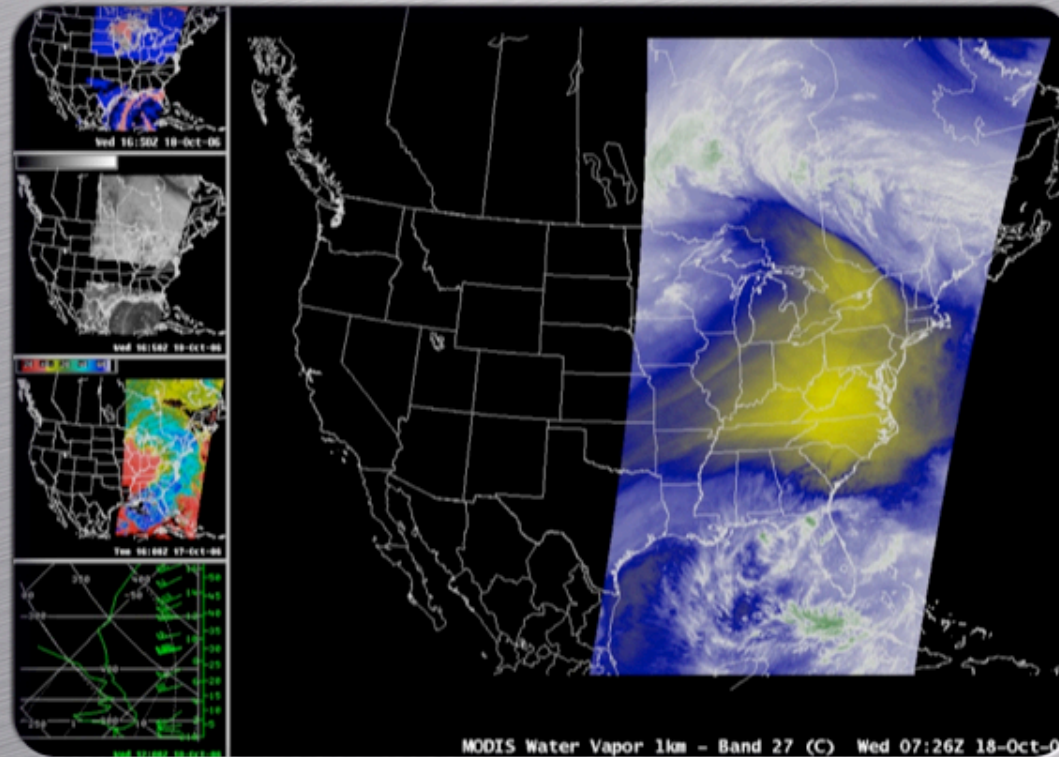
MODIS data to the NWS

- University of Wisconsin providing Direct Broadcast MODIS products to NWS since June 2006
- 1 km Reflectances and Brightness Temperatures
 - Bands 1 (.68 μm), Band 26 (1.38 μm), Band 7 (2.1 μm)
 - Band 20 (3.7 μm), Band 27 (6.7 μm), Band 31 (11 μm)
- Products
 - 1 km
 - Sea Surface Temperature, NDVI, Land Surface Temperature, Fog Product
 - 5 km
 - Cloud Top Pressure, Total Precipitable Water, Cloud Phase
- True Color 250 m Imagery

VIIRS data to the NWS

- University of Wisconsin providing Direct Broadcast VIIRS products to NWS in May 2012
- 1km Reflectances and Brightness Temperatures
 - M-Bands 5 (.67 μm), M-Band 7 (.86 μm), M-Band 10 (1.6 μm)
 - M-Band 12 (3.7 μm), M-Band 15 (11 μm)

MODIS Products in AWIPS



National Weather Service • Integrated Sensor Training Professional Development Series
Virtual Institute for Satellite Integration Training

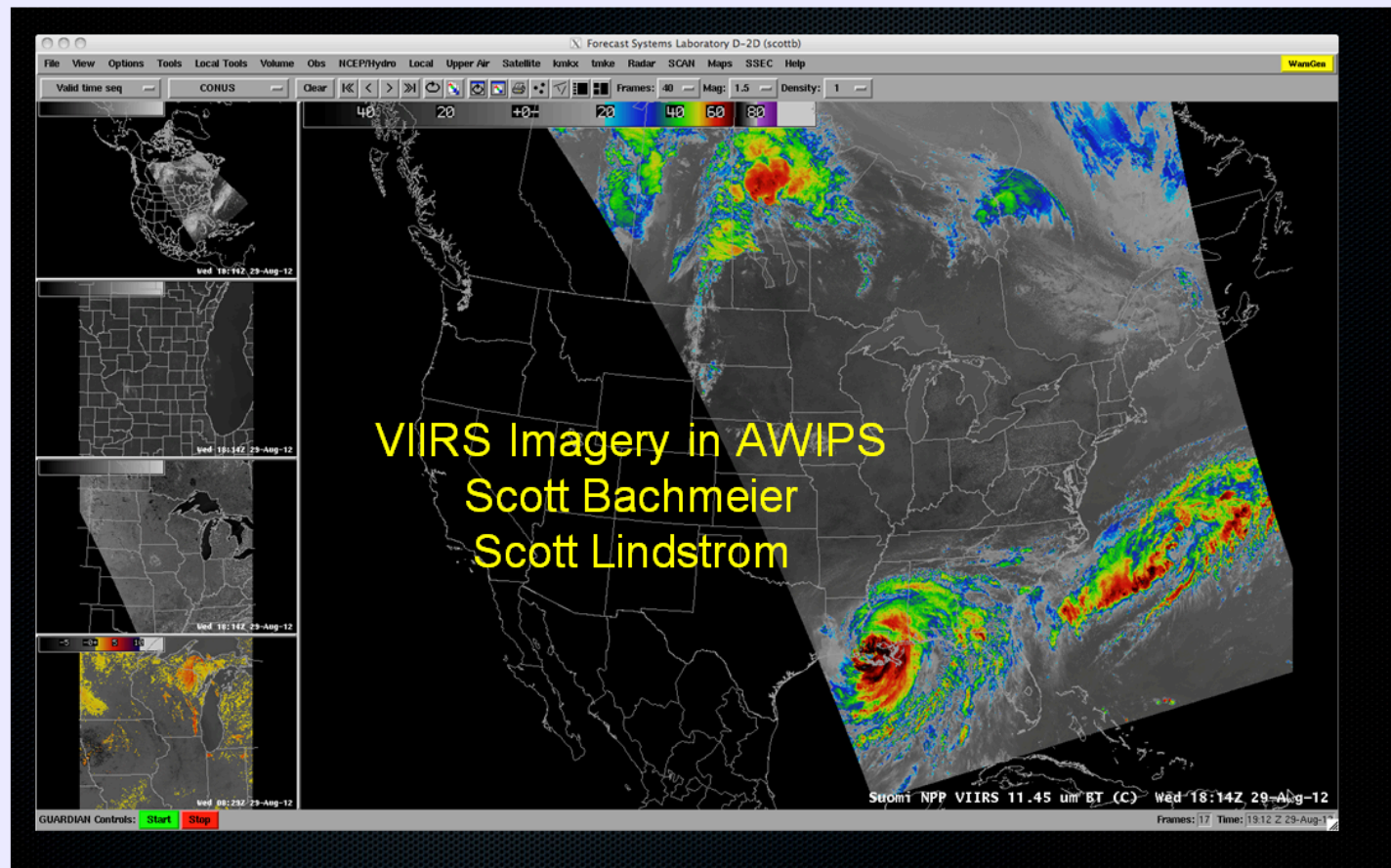
Virtual Institute for Satellite Integration Training
(VISIT) lesson - offered since October 2006

VISIT

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- VISIT Training DVD

VIIRS Satellite Imagery in AWIPS

Scott Bachmeier and Scott Lindstrom



Introduction

This basic-level VISIT teletraining lesson will describe the Visible Infrared Imaging Radiometer Suite (VIIRS) data from the Suomi/NPP (National Polar-orbiting Partnership) satellites that have recently been made available to the NWS Regional AWIPS servers (WFOs may add VIIRS imagery to their local AWIPS via LDM subscription). A variety of VIIRS examples will demonstrate the unique operational utility of these new satellite products, which will help forecasters prepare for new satellite channels and products coming in the JPSS and GOES-R era. (lesson created March 2012)

★ Anchorage ● Juneau
 ● Fairbanks ● Kodiak
 ★ Barrow Weather Service Office

◆ Hydrometeorological Prediction Center
 ◆ Aviation Weather Center
 ◆ Spaceflight Meteorology Group
 ◆ Anchorage Center Weather Service Unit (FAA)

Map of the United States showing the locations of various NOAA and FAA weather service offices. Red stars indicate locations with hydrometeorological prediction centers, while yellow dots indicate other service offices. The map includes a legend in the top left corner with the following text: '★ Anchorage', '● Juneau', '● Fairbanks', '● Kodiak', '★ Barrow Weather Service Office', '◆ Hydrometeorological Prediction Center', '◆ Aviation Weather Center', '◆ Spaceflight Meteorology Group', and '◆ Anchorage Center Weather Service Unit (FAA)'. The map shows numerous cities across the United States, with red stars placed in locations such as Anchorage, Barrow, Fairbanks, Juneau, Kodiak, and many others. The map also shows topographic features like mountains and rivers.

Background topography courtesy Ray Stenes, Johns Hopkins University

53 NWS forecast offices participating so far

Involved Weather Forecast Offices

Milwaukee, Wisconsin (MKX)

Bohemia, New York (ERH)
Kansas City, Missouri (CRH)
Fort Worth, Texas (SRH)
Salt Lake City, Utah (WRH)

59
TOTAL

Billings, Montana (BYZ)
Buffalo, New York (BUF)
Charleston, South Carolina (CHS)
Chicago, Illinois (LOT)
Eureka, California (EKA)
Glasgow, Montana (GGW)
Grand Rapids, Michigan (GRR)
Green Bay, Wisconsin (GRB)
La Crosse, Wisconsin (ARX)
Las Vegas, Nevada (VEF)
Marquette, Michigan (MQT)
Medford, Oregon (MFR)
Minneapolis, Minnesota (MPX)
Northern Indiana (IWX)
Phoenix, Arizona (PSR)
Raleigh, North Carolina (RAH)
Salt Lake City, Utah (SLC)
San Diego, California (SGX)
Spokane, Washington (OTX)
State College, Pennsylvania (CTP)
Wichita, Kansas (ICT)

Aberdeen, South Dakota (ABR)
Amarillo, Texas (AMA)
Binghamton, New York (BGM)
Blacksburg, Virginia (RNK)
Boulder, Colorado (BOU)
Burlington, Vermont (BTV)
Cleveland, Ohio (CLE)
Columbia, South Carolina (CAE)
Dallas/Fort Worth, Texas (FWD)
Davenport, Iowa (DVN)
Des Moines, Iowa (DMX)
Duluth, Minnesota (DLH)
El Paso, Texas (EPZ)
Greenville, South Carolina (GSP)
Indianapolis, Indiana (IND)
Kansas City, Missouri (EAX)
Lincoln, Illinois (ILX)
Lubbock, Texas (LUB)
Memphis, Tennessee (MEG)
Midland, Texas (MAF)
Monterey, California (MTR)
Newport, North Carolina (MHX)
Norman, Oklahoma (OUN)
Pendleton, Oregon (PDT)
Philadelphia, Pennsylvania (PHI)
Pittsburgh, Pennsylvania (PBZ)
Reno, Nevada (REV)
Riverton, Wyoming (RIW)
Springfield, Missouri (SGF)
Sterling, Virginia (LVX)
Topeka, Kansas (TOP)
Tulsa, Oklahoma (TSA)
Spaceflight Meteorology Group

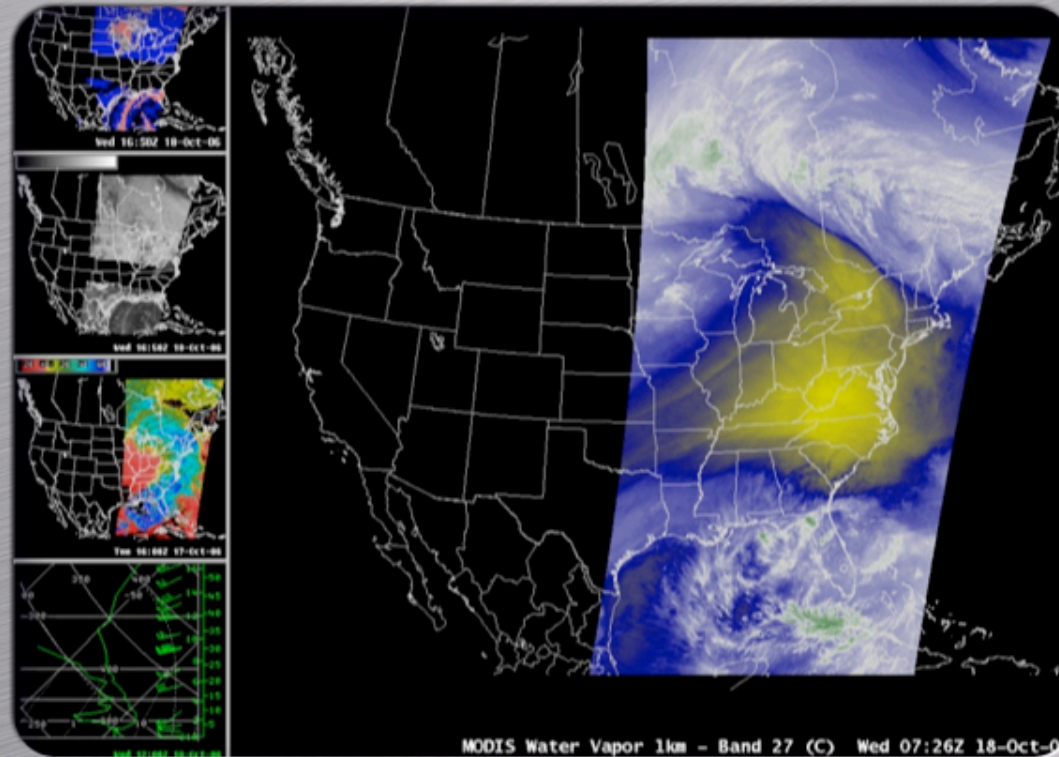


Last updated on Jul 6, 2012



4 Distribution Node 1 ≥250 MODIS AFDs Issued 21 ≥1 AFD Issued 33 Receive MODIS Imagery

MODIS Products in AWIPS



National Weather Service • Integrated Sensor Training Professional Development Series
Virtual Institute for Satellite Integration Training

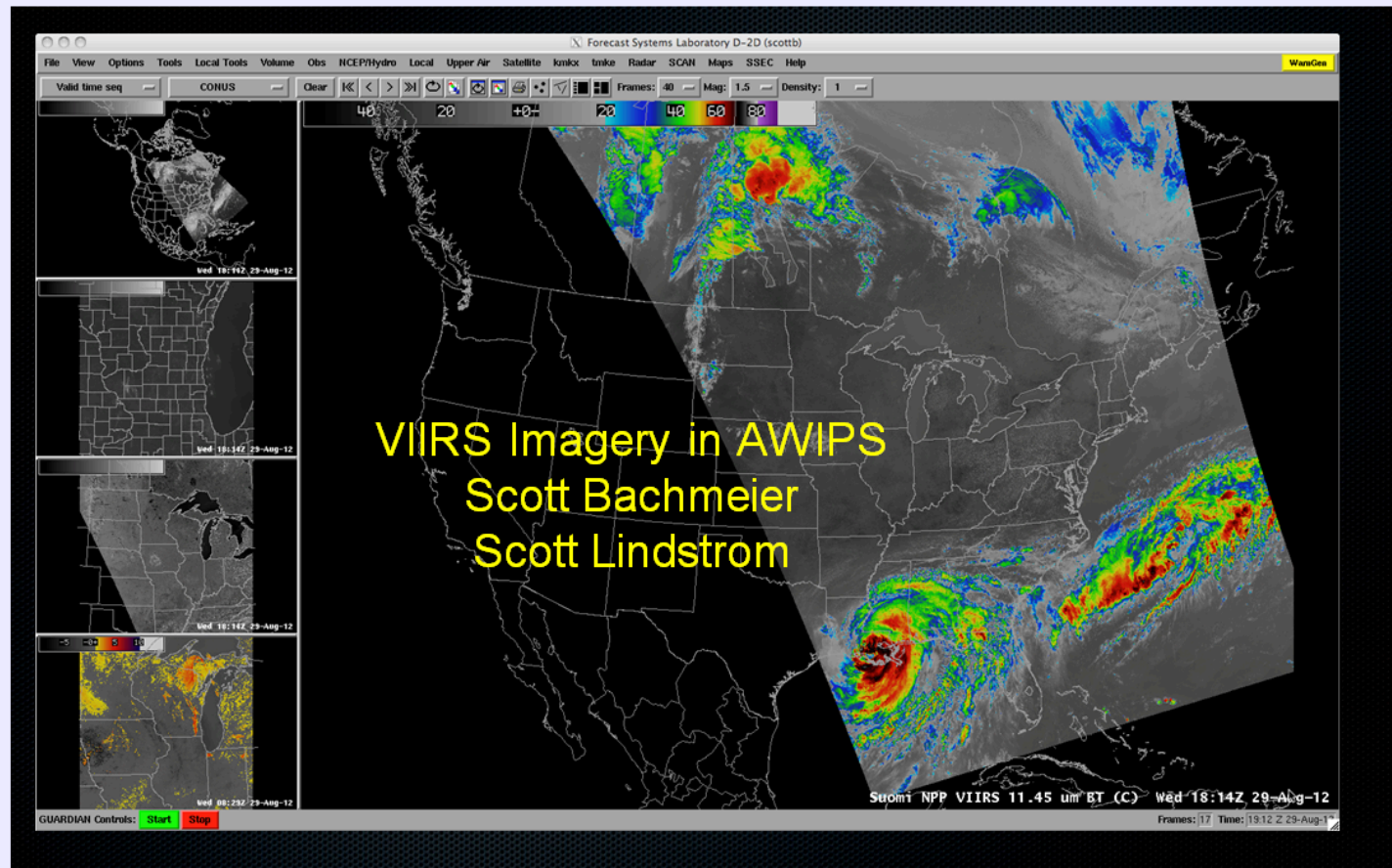
Virtual Institute for Satellite Integration Training
(VISIT) lesson - offered since October 2006

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- [Blog Sites](#)
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- [VISIT Training DVD](#)

VIIRS Satellite Imagery in AWIPS

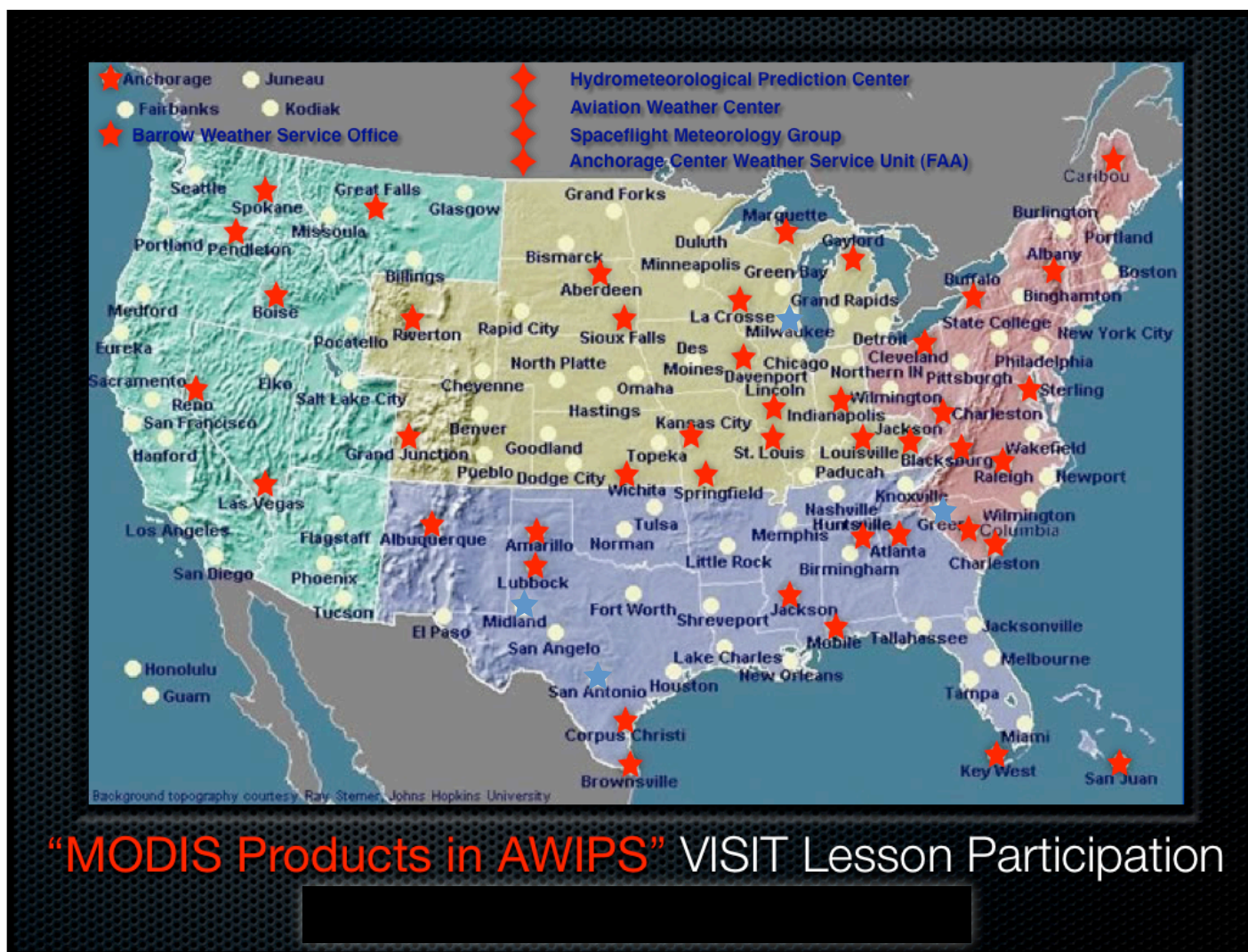
Scott Bachmeier and Scott Lindstrom



Introduction

This basic-level VISIT teletraining lesson will describe the Visible Infrared Imaging Radiometer Suite (VIIRS) data from the Suomi/NPP (National Polar-orbiting Partnership) satellites that have recently been made available to the NWS Regional AWIPS servers (WFOs may add VIIRS imagery to their local AWIPS via LDM subscription). A variety of VIIRS examples will demonstrate the unique operational utility of these new satellite products, which will help forecasters prepare for new satellite channels and products coming in the JPSS and GOES-R era. (lesson created March 2013)

MODIS Products in AWIPS



53 NWS forecast offices participating so far

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Dallas/Fort Worth, Texas (FWD)
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Sterling, Virginia (LVX)
Topeka, Kansas (TOP)
Tulsa, Oklahoma (TSA)
Spaceflight Meteorology Group

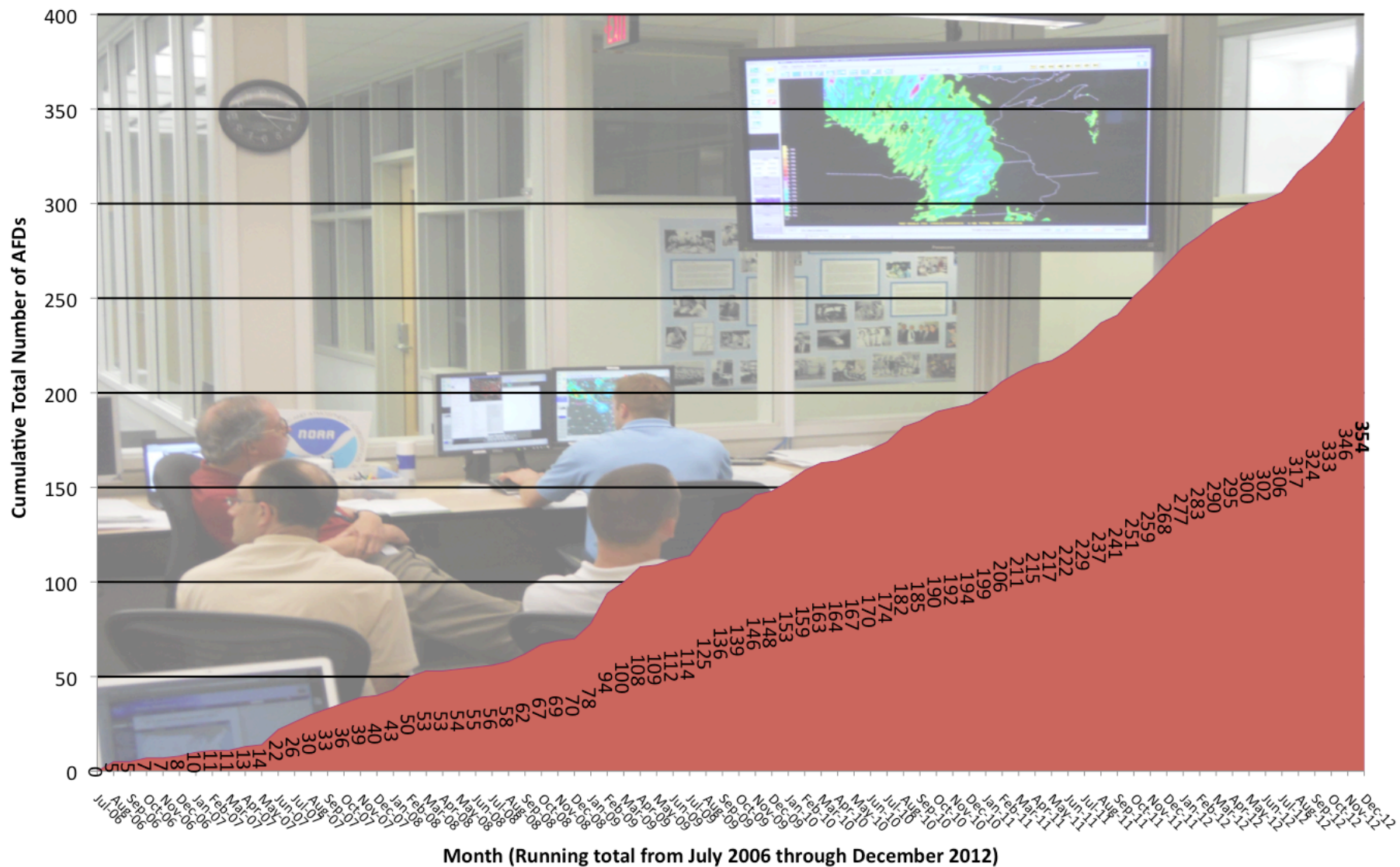


Last updated on Jul 6, 2012



4 Distribution Node 1 ≥250 MODIS AFDs Issued 21 ≥1 AFD Issued 33 Receive MODIS Imagery

MODIS in Area Forecast Discussions at NWS Forecast Offices through 12/31/2012



AREA FORECAST DISCUSSION

NATIONAL WEATHER SERVICE STATE COLLEGE PA

601 AM EDT TUE AUG 20 2013

.SYNOPSIS...

HIGH PRESSURE OFF OF THE EAST COAST WILL CONTROL THE WEATHER ACROSS PA THROUGH MIDWEEK. A COLD FRONT WILL PUSH THROUGH THE REGION LATE THURSDAY OR EARLY FRIDAY. CANADIAN HIGH PRESSURE WILL THEN BUILD SOUTHEAST INTO PENNSYLVANIA NEXT WEEKEND.

&&

.NEAR TERM /UNTIL 6 PM THIS EVENING/...

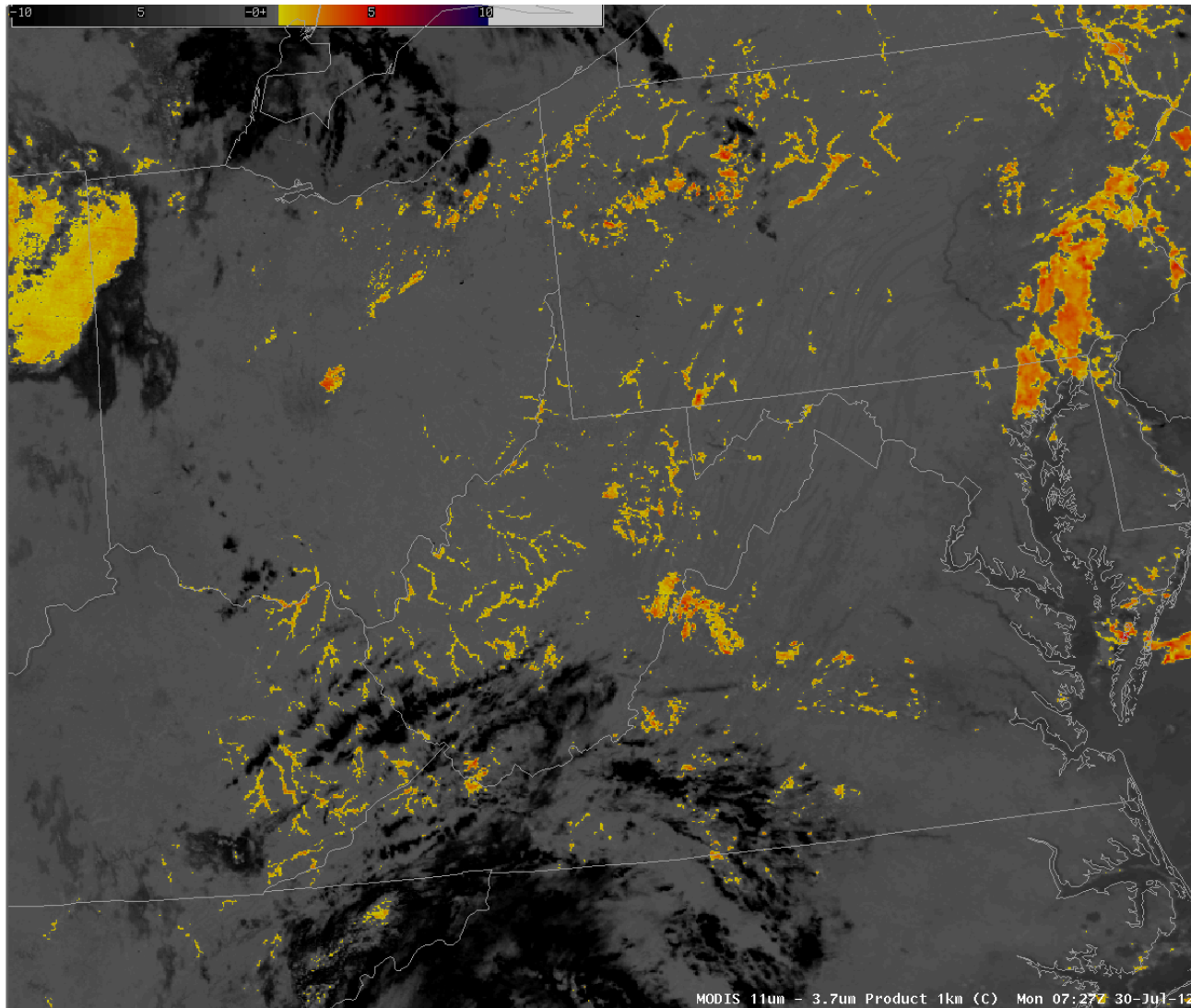
MODIS 11-3.7UM IMAGERY SHOWING WIDESPREAD VALLEY FOG ACROSS CENTRAL PA EARLY THIS AM. MANY LOCATIONS AOB 1/4SM VSBY AT 09Z...SO HAVE ISSUED A DENSE FOG ADVISORY THRU 13Z. 3KM HRRR SFC RH SUGGESTS THE FOG WILL BURN OFF IN MANY LOCATIONS BY ARND 12Z...BUT WILL LIKELY LINGER IN A FEW LOCATIONS UNTIL 14Z.

Supporting Visibility Forecasts

AREA FORECAST DISCUSSION
NATIONAL WEATHER SERVICE
STATE COLLEGE PA
543 AM EDT MON JUL 30 2012

.NEAR TERM /UNTIL 6 PM THIS
EVENING/...

**MODIS 11-3.7UM IMAGERY SHOWING
DENDRITIC PATTERN OF VALLEY
FOG ACROSS THE ALLEGHENIES
EARLY THIS MORNING...THE
RESULT OF A CALM WIND AND
TEMPS MUCH COOLER THAN THE
RIVER/STREAM WATER. ACROSS
SOUTHEAST PA...A MOIST SERLY
FLOW...COMBINED WITH
RADIATIONAL COOLING...IS
CAUSING LOW CLOUDS/FOG TO
DEVELOP.** LATEST MESOSCALE
MDL DATA INDICATES THE
ALLEGHENY VALLEY FOG WILL
BURN OFF BY ARND 13Z. MDL
SOUNDINGS SUGGEST THE LOW
CLOUDS/FOG ACROSS THE
SOUTHEASTCOUNTIES WILL LIFT
INTO A SCT-BKN CU LYR BY LATE
AM.





VIIRS data used by CONUS forecasters



AREA FORECAST DISCUSSION

NATIONAL WEATHER SERVICE MILWAUKEE/SULLIVAN WI

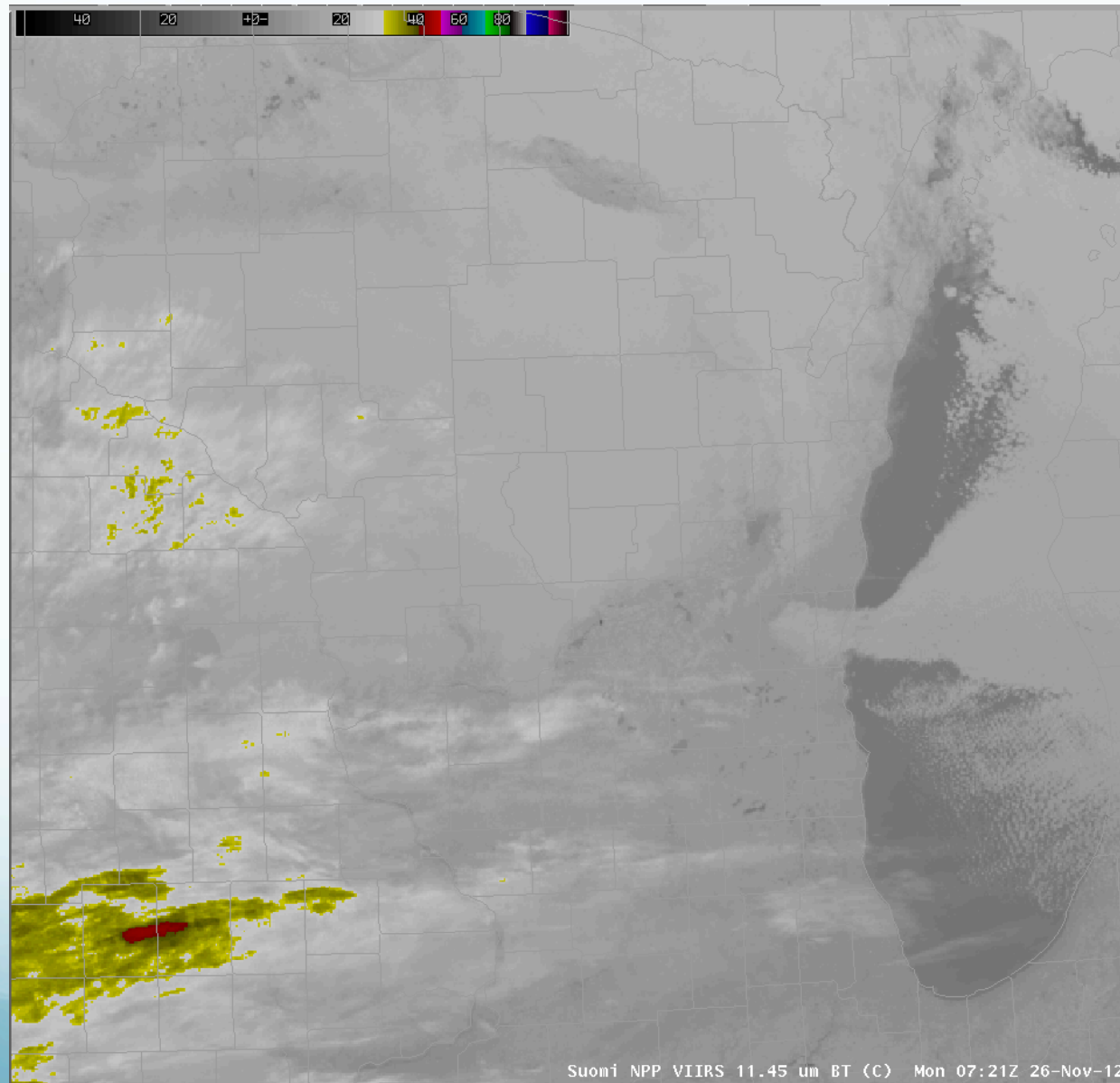
309 AM CST MON NOV 26 2012

.TODAY AND TONIGHT...FORECAST CONFIDENCE...MEDIUM TO HIGH

WEAK LOW LEVEL COLD AIR ADVECTION EXPECTED TO CAUSE AREAS OF LOWER CLOUDS OVER SRN WI FOR A TIME THIS MRNG. ***TIMELY VIIRS DAY/NIGHT BAND IMAGE FROM 0721Z SHOWED THICKER CLOUDS OVER NORTHWEST CWA EXTENDING ACROSS CENTRAL INTO NRN WI. A FEW FLURRIES GETTING SHAKEN FROM THESE CLOUDS FARTHER NORTH IN VICINITY OF WEAK LOW LEVEL CONVERGENCE.*** AS UPPER JET FINALLY SLIDES OFF TO THE EAST...LOW CLOUDS WILL INCREASE FOR A TIME EARLY THIS MRNG ACROSS SRN WI. HOWEVER INCREASING SUBSIDENCE FROM LEFT ENTRANCE REGION AND DRYING SHOULD RESULT IN CLOUDS DECREASING LATER THIS MRNG AND AFTN. DAYTIME TEMPS NOT EXPCD TO RISE MUCH DUE TO NORTHWEST WINDS CARRYING EVEN COLDER AIR OVER THE REGION. NORTHWEST WINDS AND APPROACHING HIGH PRESSURE ALSO PROTECTING SRN WI FROM THE ISENTROPIC LIGHT PRECIP EVENT GOING ON TO THE SOUTHWEST OF WI.

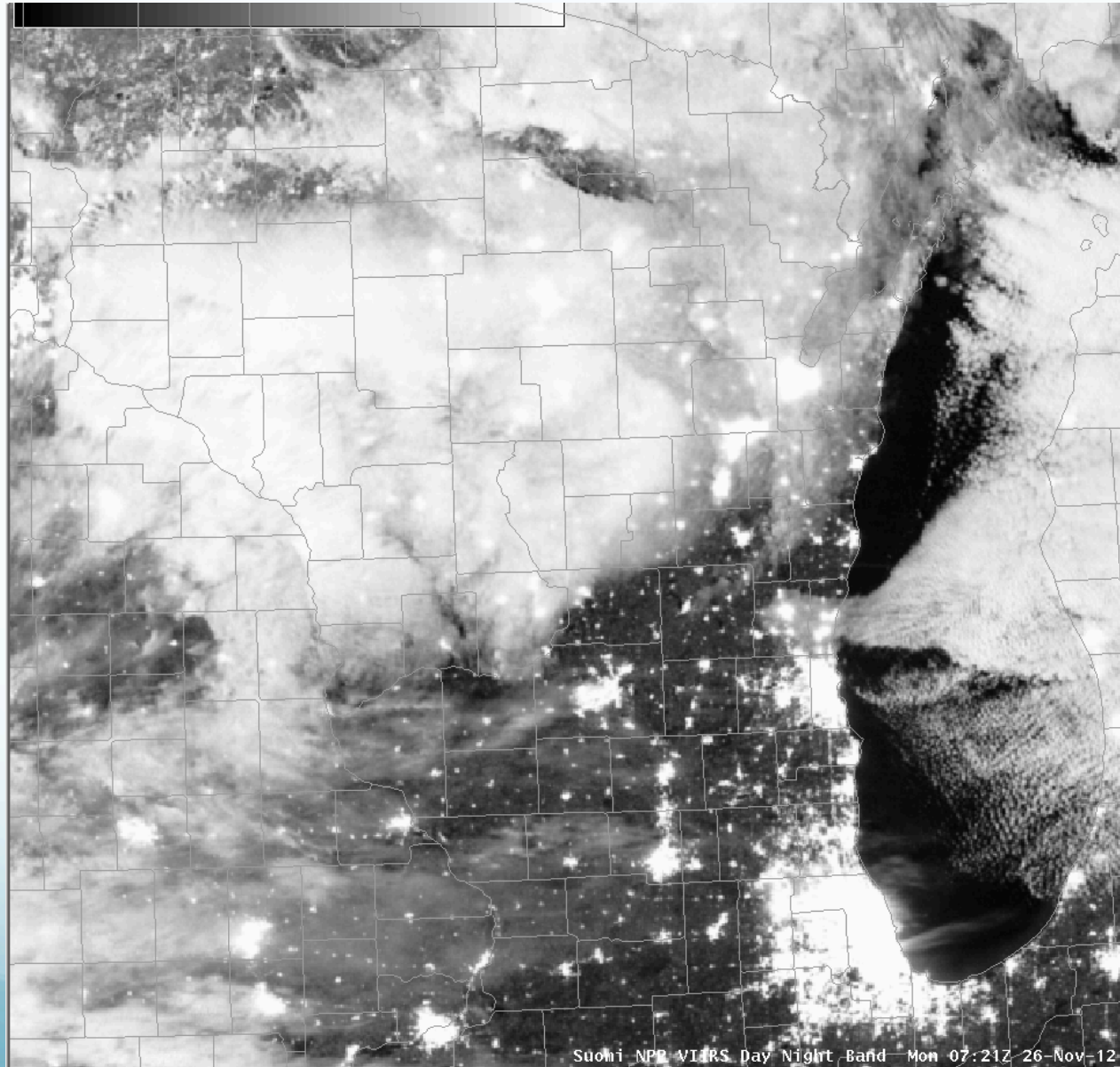


VIIRS data used by CONUS forecasters





VIIRS data used by CONUS forecasters



Suomi NPP VIIRS Day Night Band Mon 07:21Z 26-Nov-12



VIIRS Data used by CONUS Forecasters



From: Chad Gravelle <chad.gravelle@noaa.gov>
Subject: **DNB in NWS MTR Operations**
Date: November 6, 2012 1:26:40 PM CST
To: Kathy Strabala <kathys@ssec.wisc.edu>

Hi Kathy...

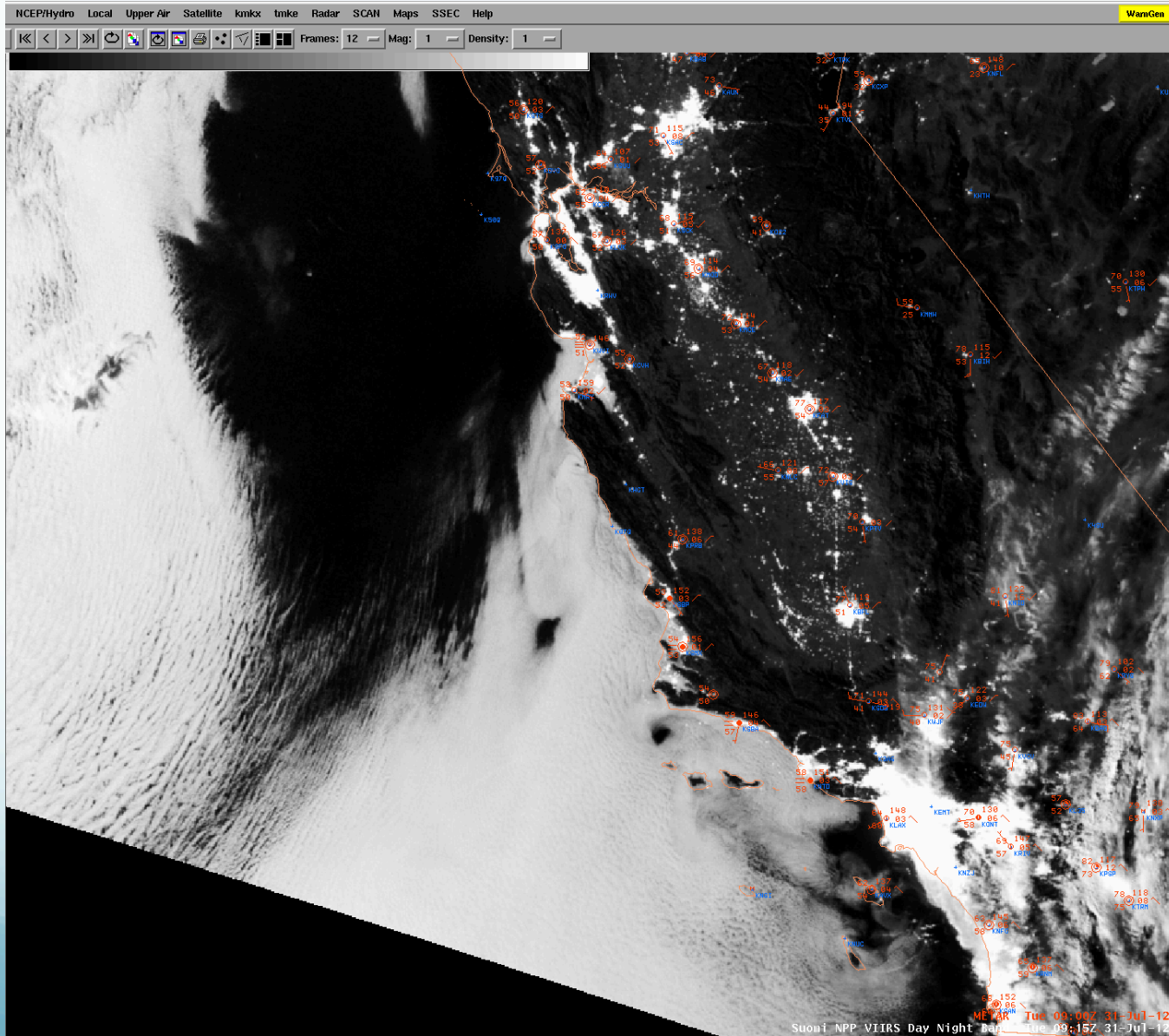
...I've asked NWS Monterey to provide me with some informal feedback when they find the DNB useful and how their meteorologists were using the imagery. I did this so that we can begin to develop a database of potential uses. The following was sent to me by one of their lead forecasters.

Chad,

Last week on our mids we issued some Dense Fog Advisories and Nowcasts. The fog was very shallow upon its return after an offshore wind event. We had numerous surface obs (ASOS sites, etc) reporting the fog. However, for us the night time pass usually comes at a good time (say between 8-10z). The resolution gave us the confidence upon actually seeing where the fog was to issue (and not issue) for certain zones. It also gave us increased confidence to issue a Marine Dense Fog Advisory for San Francisco Bay, a spot where we don't have real obs over the water in general. So, as is often the case its just another tool to help increase or decrease confidence. In situations where the skies are clear and the fog/cloud deck is shallow it can really pinpoint things for us along the coast where the marine layer intrusions can vary depending on exact location, valley and layer depth. Ryan



Identifying Maritime Stratus Intrusion at Night 31 July 2012

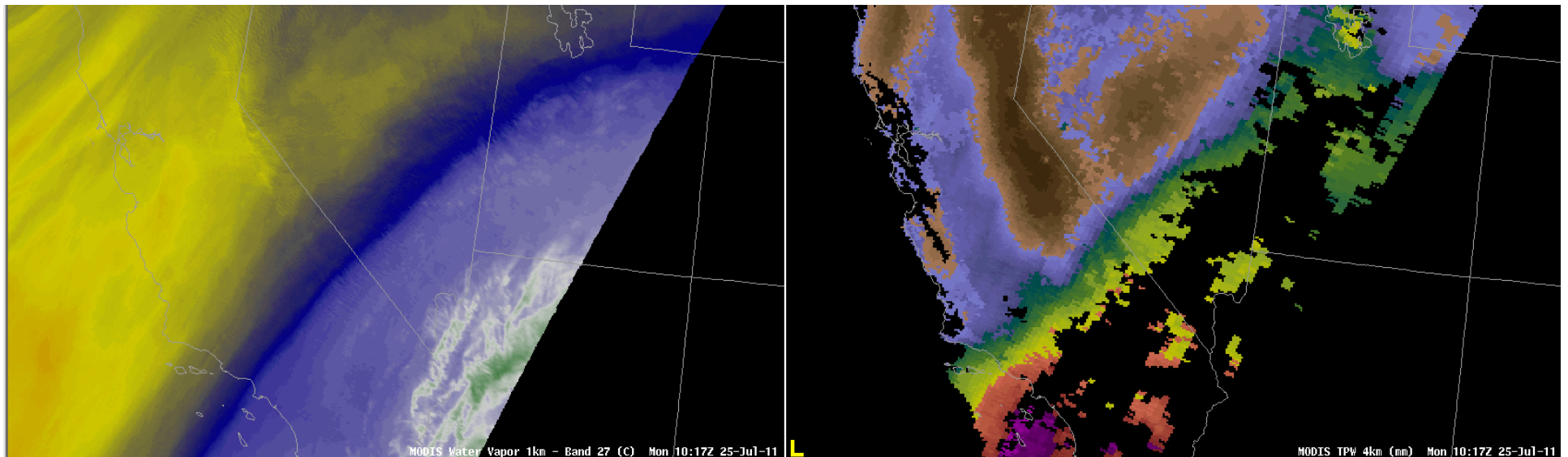


Support for Fire Weather Forecasts

AREA FORECAST DISCUSSION
NATIONAL WEATHER SERVICE SALT LAKE CITY UT
1024 AM MDT MON JUL 25 2011

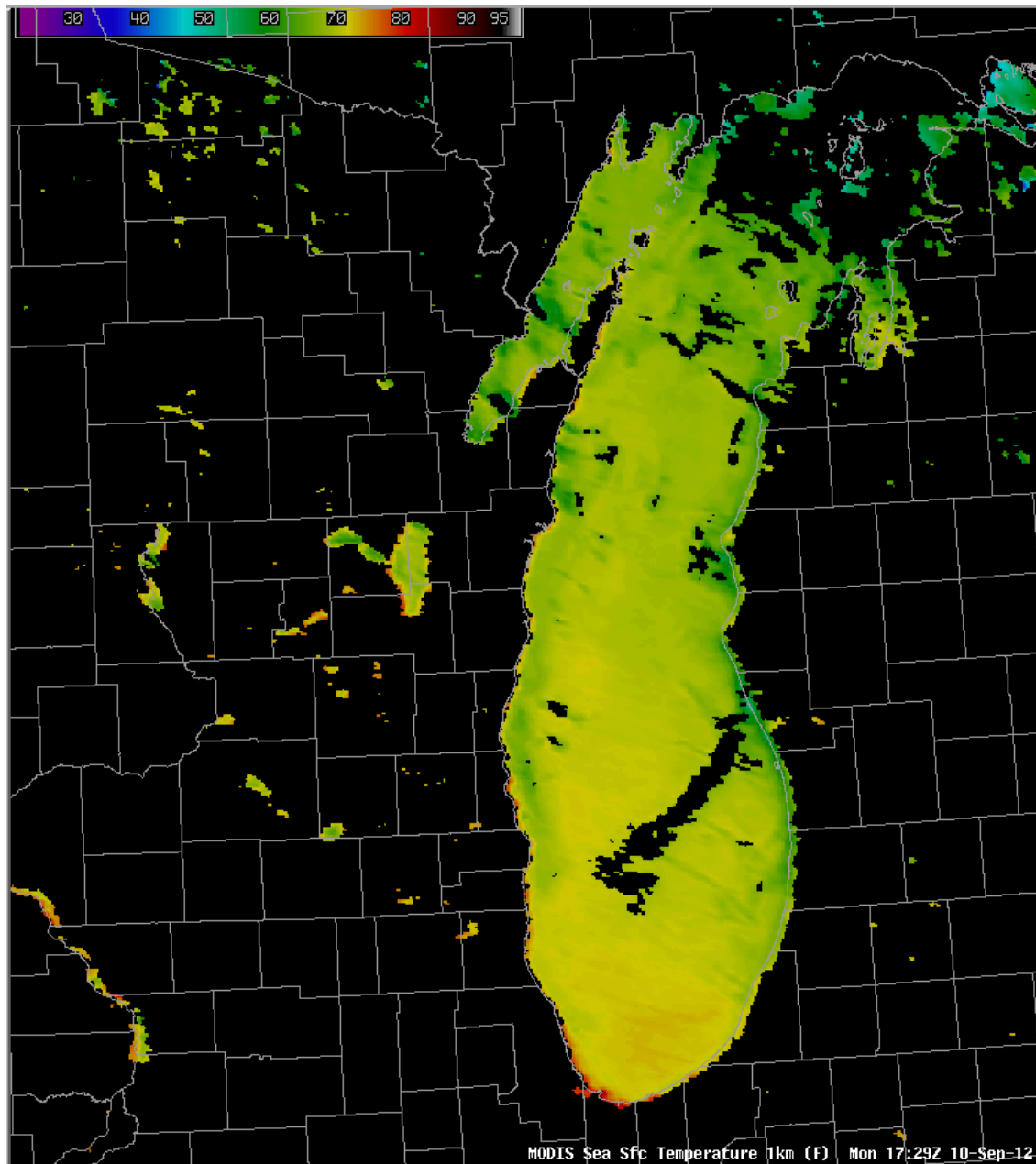


.FIRE WEATHER...MODIS WATER VAPOR IMAGERY INDICATES THAT PRECIPITABLE WATER VALUES APPROACHING ONE INCH HAVE PUSHED AS FAR NORTH AS THE SOUTHERN WASATCH FRONT THIS MORNING. THIS SURGE OF MOISTURE IS ALSO BRINGING EXTENSIVE CLOUD COVER TO CENTRAL AND NORTHERN UTAH THIS MORNING....WITH DEEP MOISTURE MOVING NORTH BELIEVE THAT RISK FOR DRY THUNDERSTORMS IS LIMITED PRIMARILY TO THE LEADING EDGE OF THE MOISTURE SURGE ACROSS NORTHERN UTAH...ALTHOUGH FEEL COVERAGE OF POTENTIAL DRY STORMS WOULD BE LIMITED



MODIS Imagery from UW SSEC Antenna 10:17 UTC 25 July 2011

MODIS SST supports Small Craft Advisory



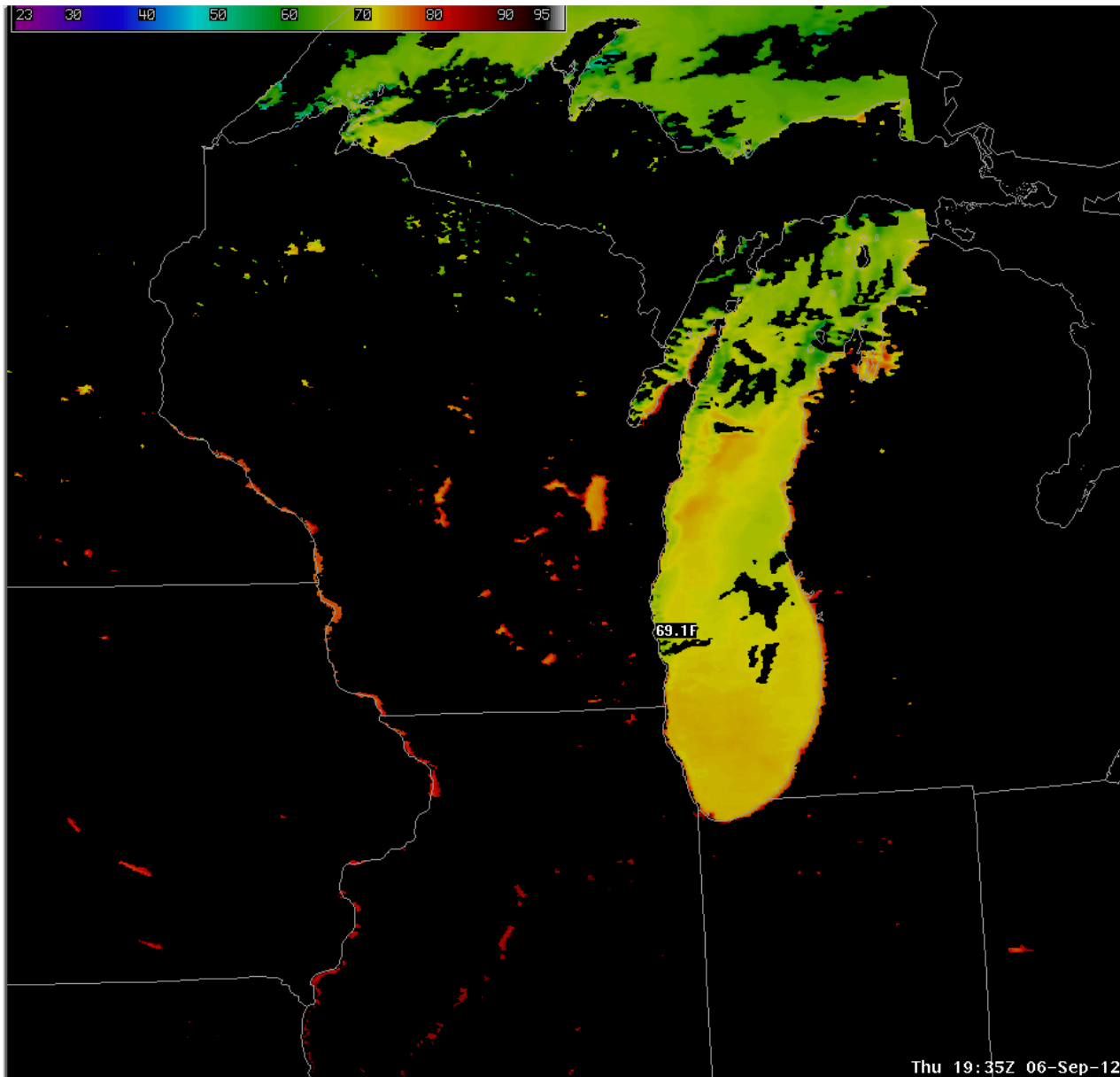
AREA FORECAST DISCUSSION
NATIONAL WEATHER SERVICE
MILWAUKEE/SULLIVAN WI
1056 PM CDT MON SEP 10 2012

.MARINE...TIGHTENING PRESSURE GRADIENT AND LOW LEVEL MIXING ENCROACHING ON THE VERY LOW LEVELS TO RESULT IN GUSTY WINDS PERSISTING THROUGH THE NIGHT ACROSS NORTHERN MARINE ZONES. OCCASIONAL GUSTS TO 25 KNOTS EXPECTED AT THE SHORE...MORE FREQUENT AWAY FROM THE SHORE DUE TO THE LOW LEVEL UNSTABLE AIR OVER THE LAKE SURFACE. MODIS IMAGERY SHOWS THE LAKE TEMP IN THE NEAR SHORE WATERS AROUND 20C.

HENCE PUSHED UP START TIME OF SMALL CRAFT ADVISORY ACROSS NORTHERN TWO ZONES TO PRESENT TIME...AND ALSO EXPANDED ADVISORY TO INCLUDE WIND POINT TO WINTHROP HARBOR ZONE WHICH BEGINS TUESDAY MORNING.



MODIS SST Supports Waterspout Forecasts



AREA FORECAST DISCUSSION
NATIONAL WEATHER SERVICE
MILWAUKEE/SULLIVAN WI
330 AM CDT FRI SEP 7 2012

.MARINE...TIGHTENING PRESSURE GRADIENT ASSOCIATED WITH DEEPENING LOW PRESSURE MOVING ALONG A FRONTAL BOUNDARY TO THE SOUTH OF LAKE MICHIGAN ALONG WITH A STEEPENING LOW LEVEL LAPSE RATE WILL RESULT IN GUSTY NORTH WINDS REACHING SMALL CRAFT ADVISORY LEVELS TONIGHT INTO SATURDAY. LATEST MODIS IMAGERY SHOWS LAKE SURFACE TEMPERATURE IN THE NEARSHORE WATERS 68-70F. STRONG LOW LEVEL COLD AIR ADVECTION IS EXPECTED TO INCREASE THE DELTA-T OVER THE LAKE TO 12-13 DEGREES THIS EVENING WITH CONVECTIVE CLOUD DEPTH INCREASING TO 15 TO 20K. WATERSPOUT INDEX INCREASES TO 8 TO 10 UNITS. WL ADD MENTION OF WATERSPOUTS TO HWO FOR LATE AFTERNOON INTO THE EVENING.



Thu 19:35Z 06-Sep-12

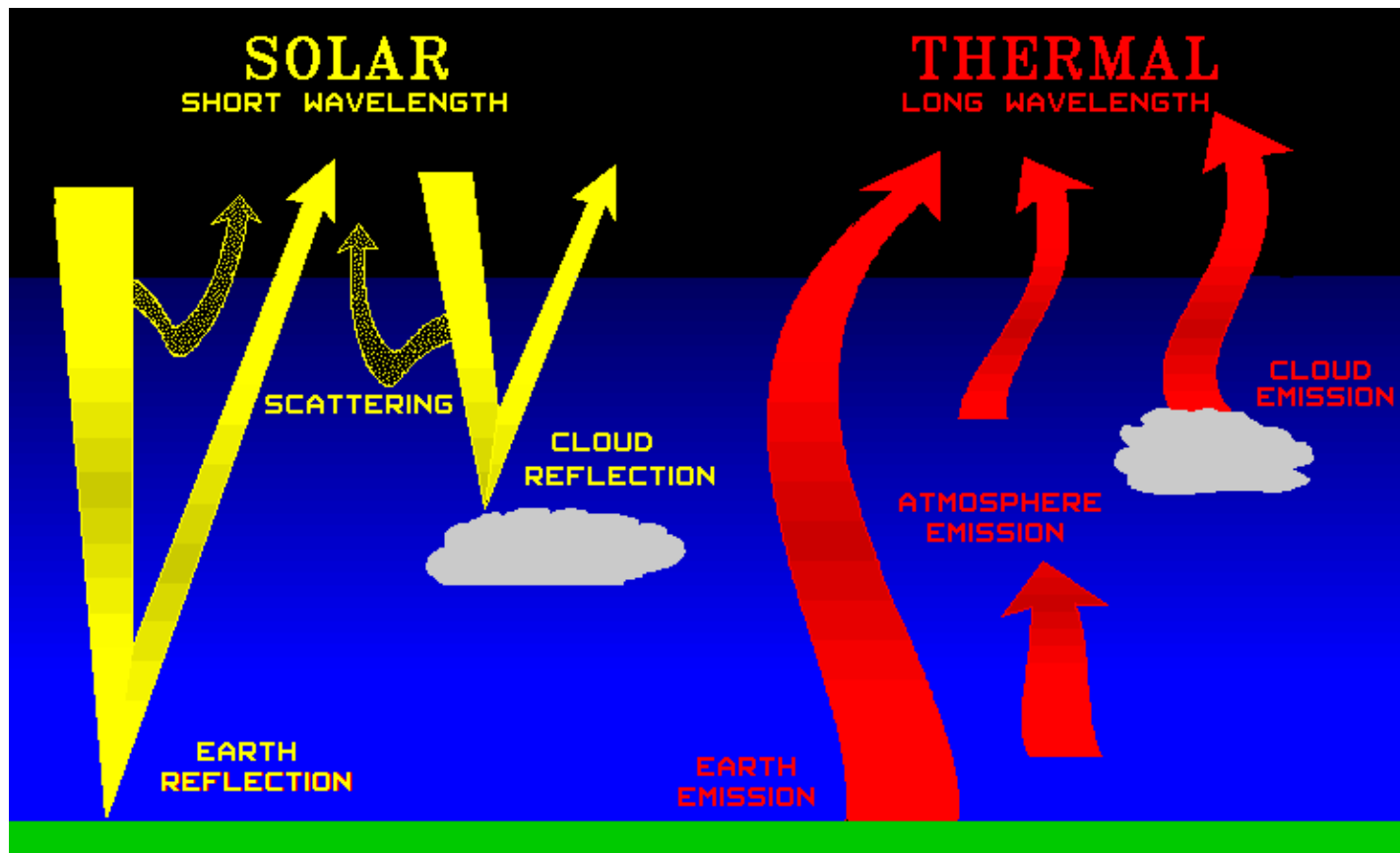
Quick Review of Remote Sensing Basic Theory

Paolo Antonelli
CIMSS
University of Wisconsin-Madison

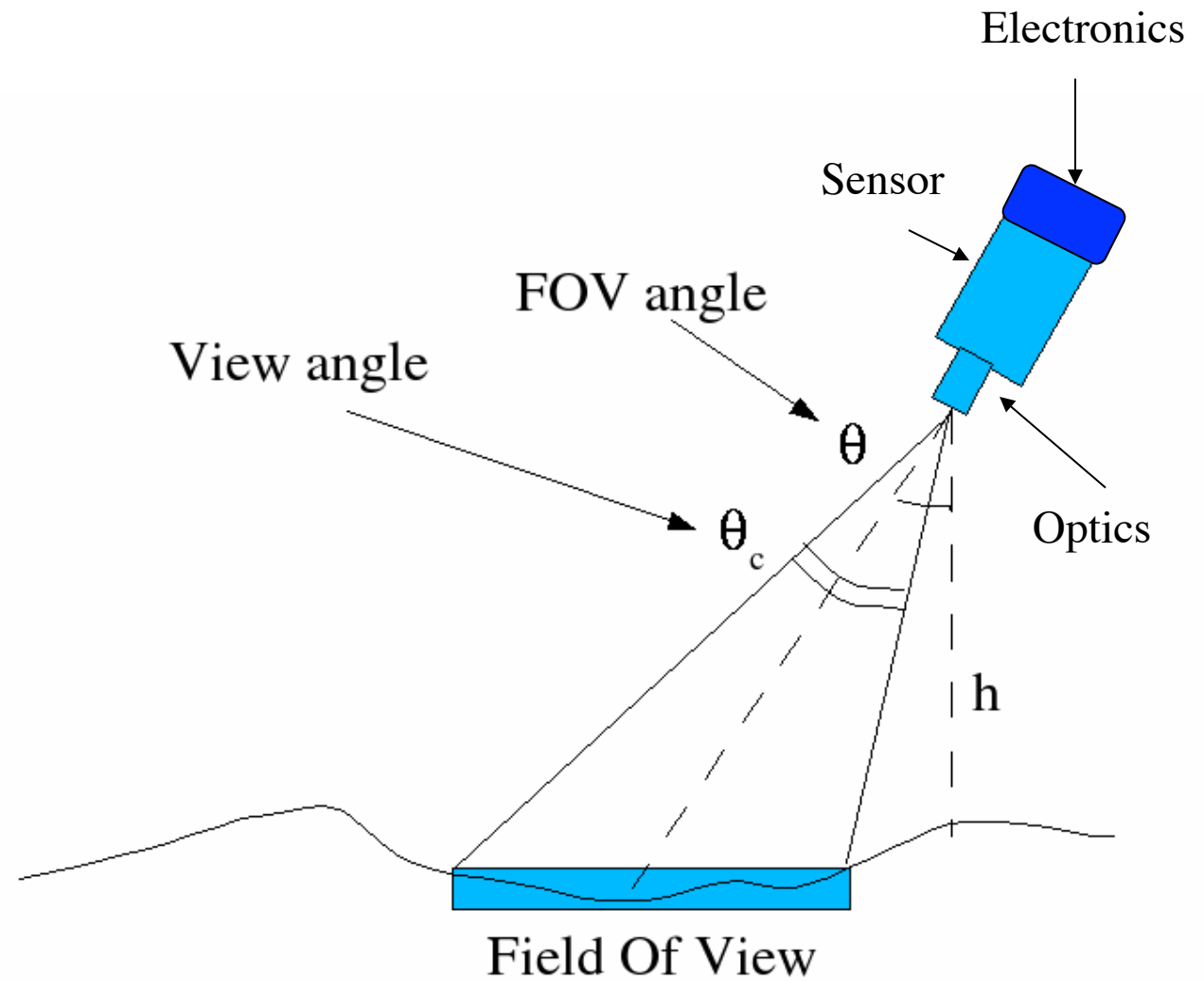


Visible
(Reflective Bands)

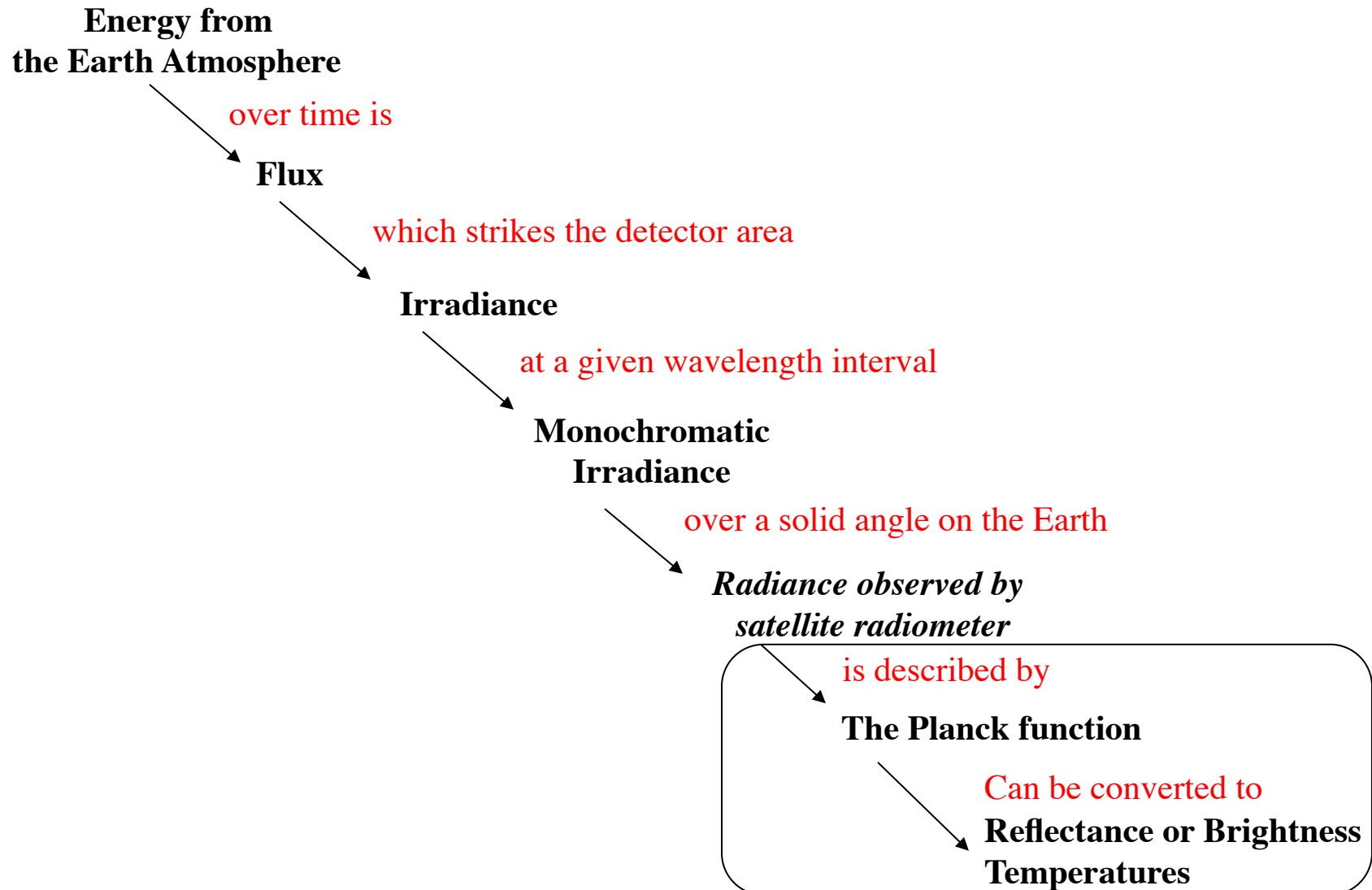
Infrared
(Emissive Bands)



Sensor Geometry



Terminology of radiant energy



Visible: Reflective Bands

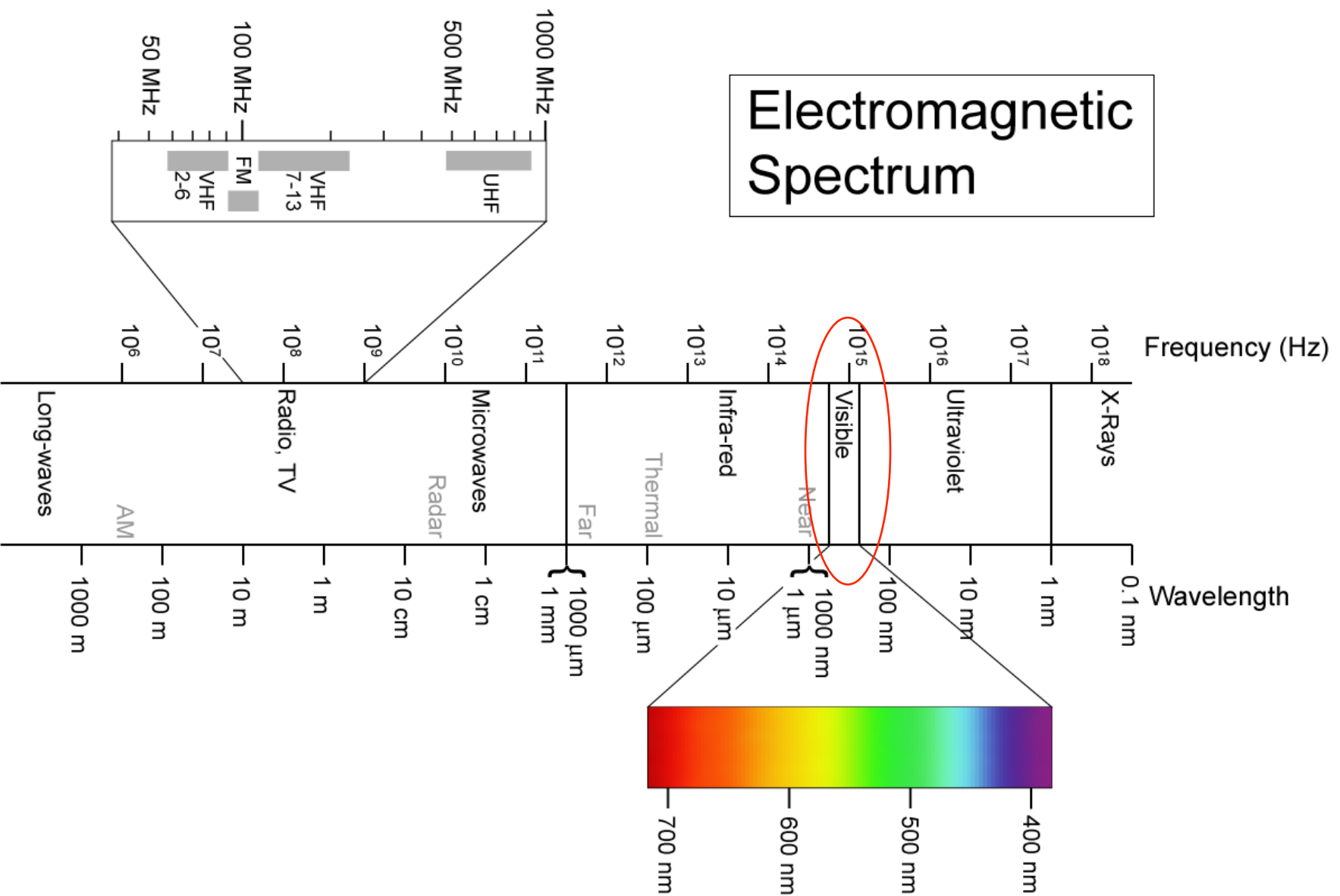
Used to observe solar energy reflected by the Earth system in the:

- Visible between .4 and .7 μm
- NIR between .7 and 3 μm

About 99% of the energy observed between 0 and 4 μm is solar reflected energy

Only 1% is observed above 4 μm

Electromagnetic Spectrum



Ocean: Dark

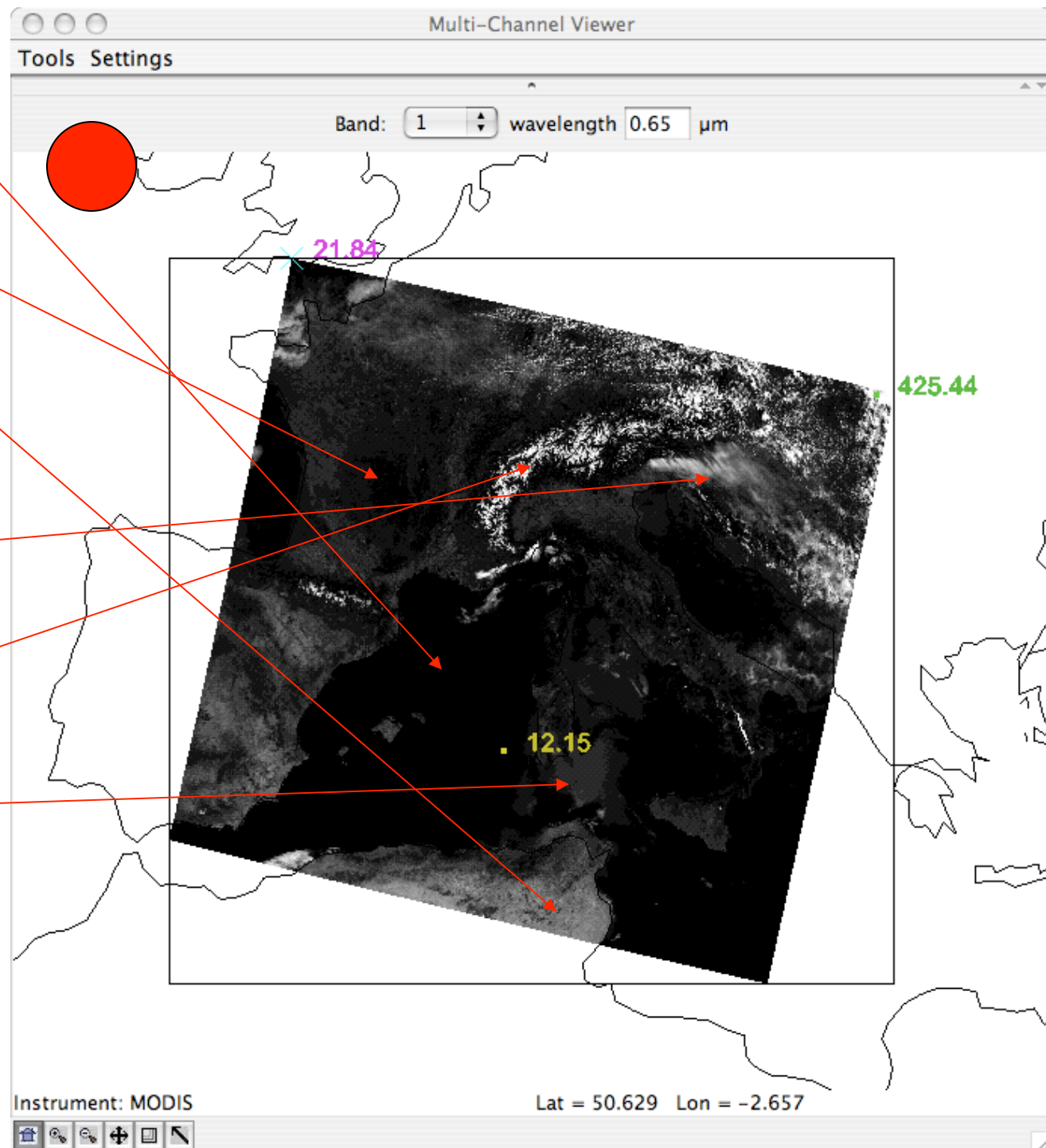
Vegetated
Surface: Dark

NonVegetated
Surface: Brighter

Clouds: Bright

Snow: Bright

Sunglint



Reflectance

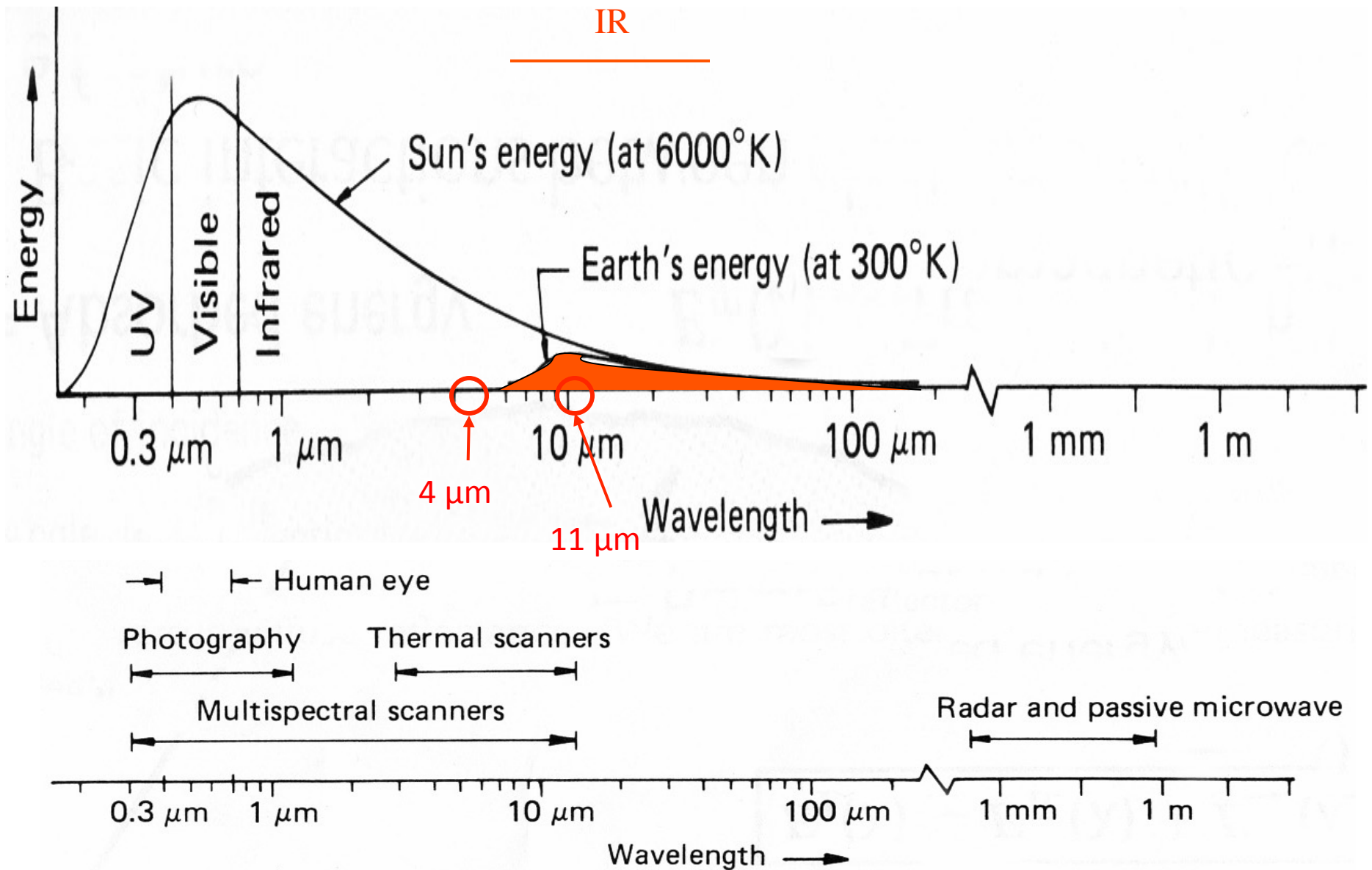
- To properly compare different reflective channels we need to convert observed radiance into a target physical property
- In the visible and near infrared this is done through the ratio of the observed radiance divided by the incoming energy at the top of the atmosphere
- The physical quantity is the Reflectance i.e. the fraction of solar energy reflected by the observed target

Emissive Bands

Used to observe terrestrial energy emitted by the Earth system in the IR between 4 and 15 μm

- About 99% of the energy observed in this range is emitted by the Earth
- Only 1% is observed below 4 μm
- At 4 μm the solar reflected energy can significantly affect the observations of the Earth emitted energy

Spectral Characteristics of Energy Sources and Sensing Systems



Brightness Temperature

- To properly compare different emissive channels we need to convert observed radiance into a target physical property
- In the Infrared this is done through the Planck function
- The physical quantity is the Brightness Temperature i.e. the Temperature of a black body emitting the observed radiance

Observed BT at 11 micron

Window Channel:

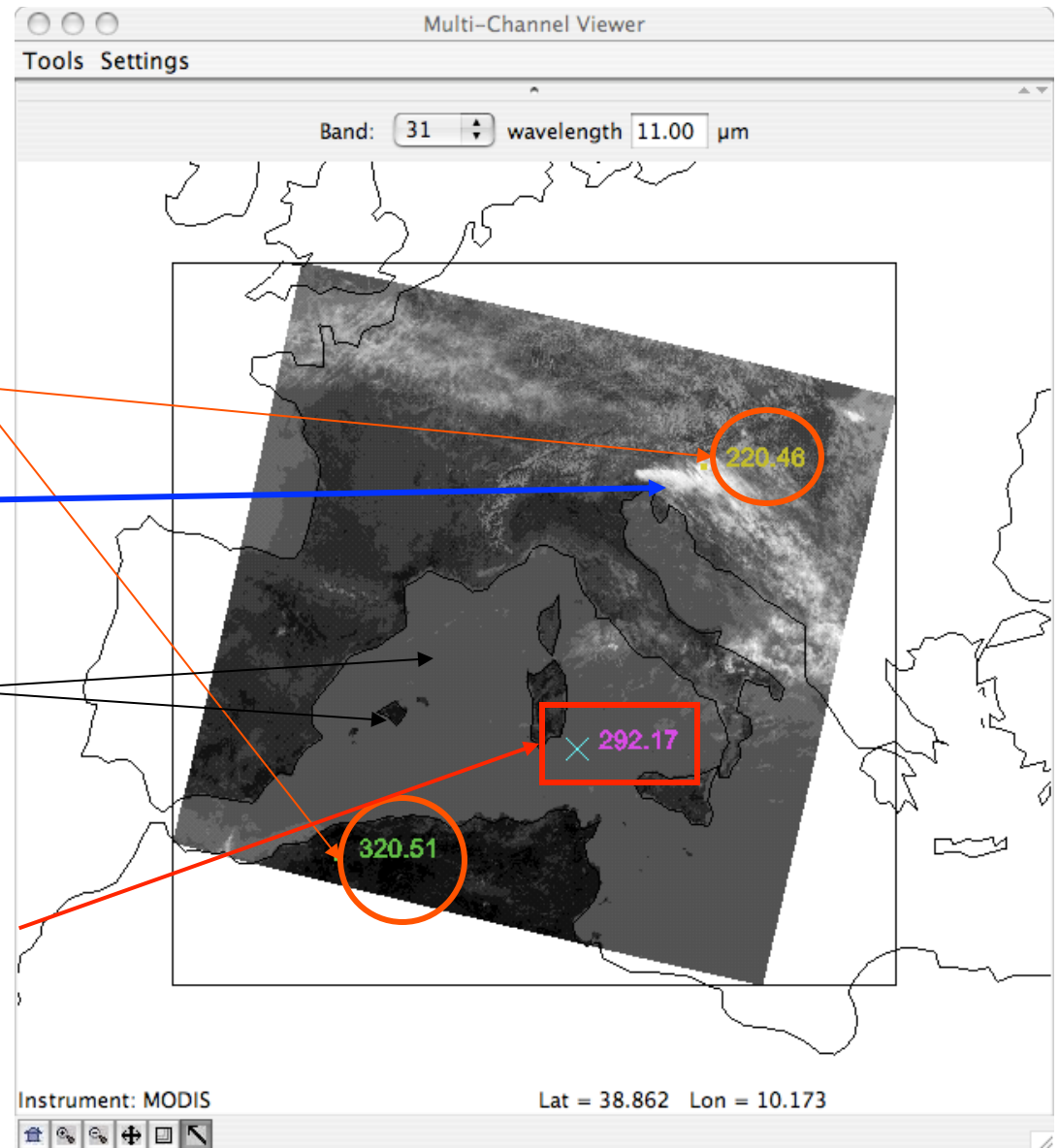
- little atmospheric absorption
- surface features clearly visible

Range [220K 320K]
Celsius=Kelvin - 273.16

Clouds are cold

Values over land
Larger than over water

Undetectable Reflected Solar
Even over Sunlint



Observed BT at 4 micron

Window Channel:

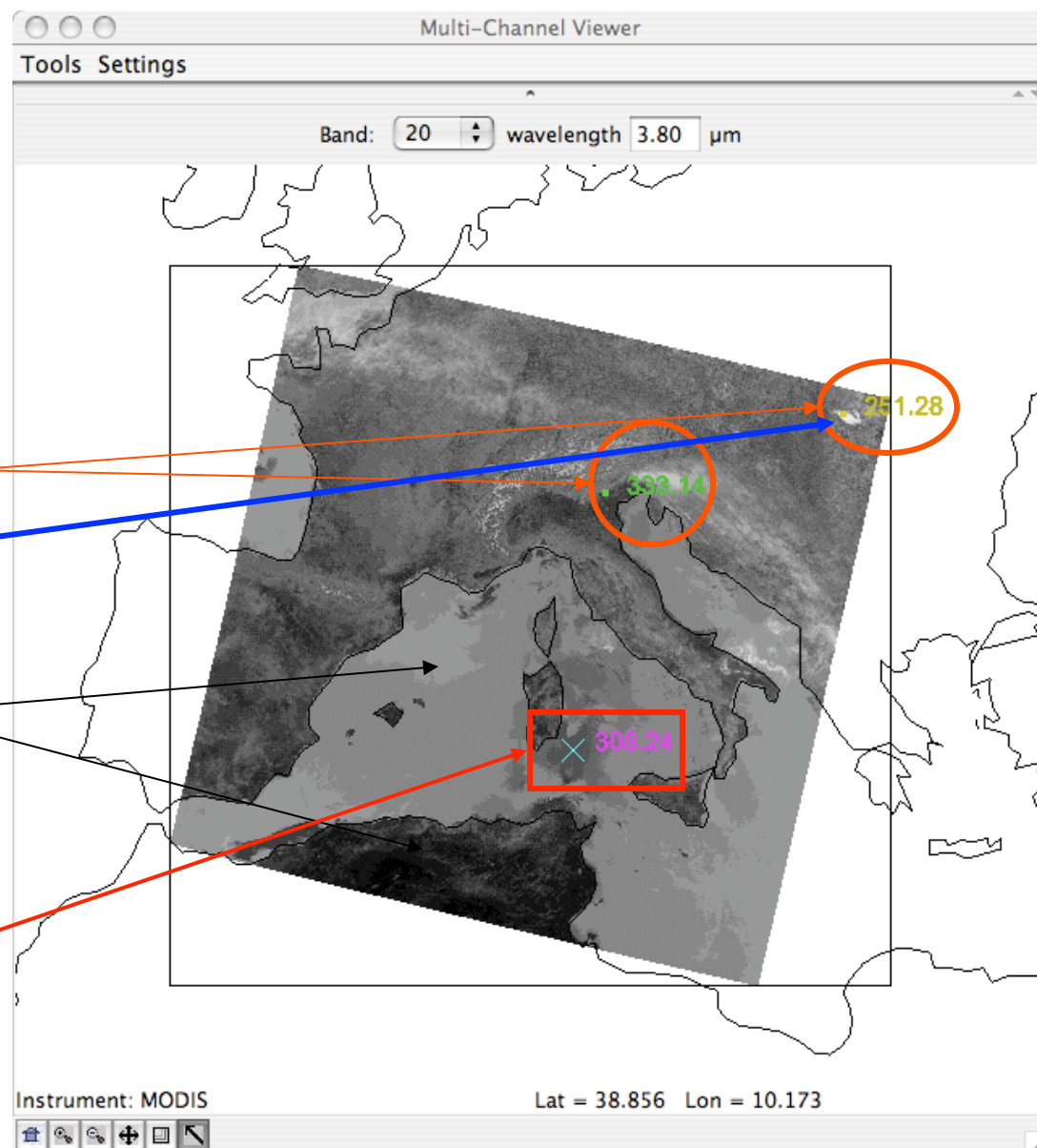
- little atmospheric absorption
- surface features clearly visible

Range [250K 335K]
Celsius=Kelvin - 273.16

Clouds are cold

Values over land
Larger than over water

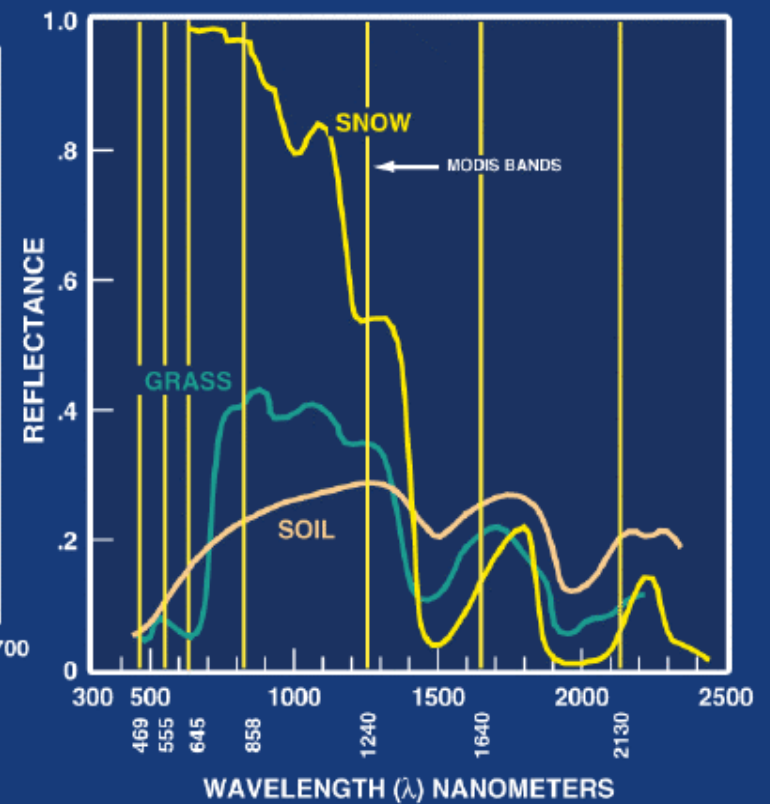
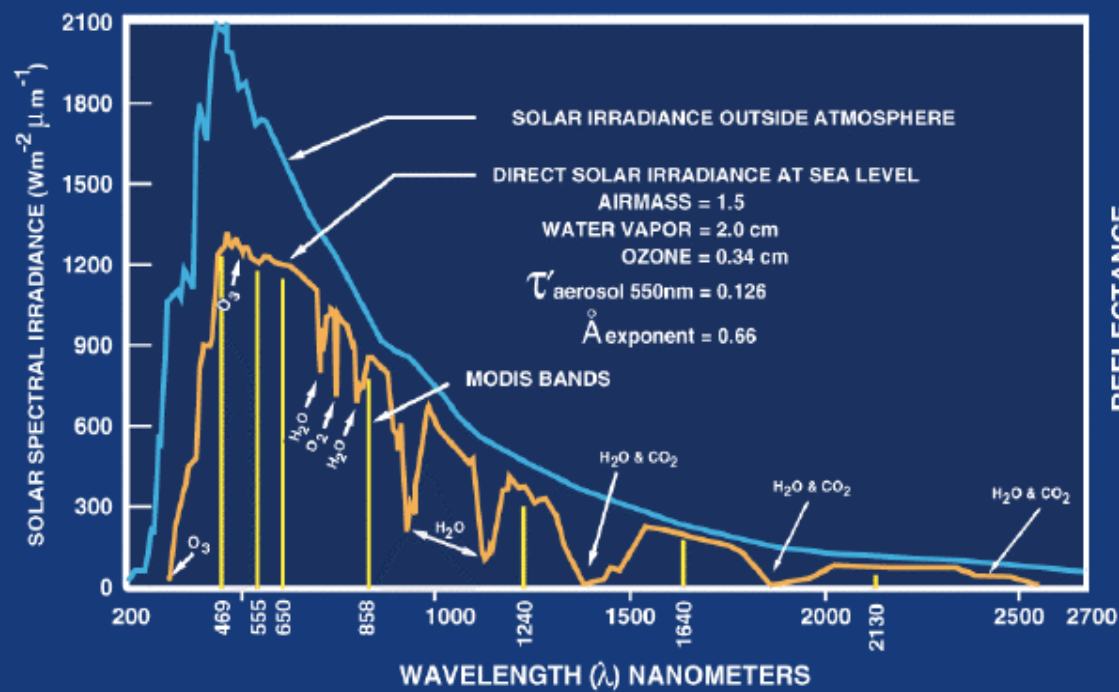
Reflected Solar everywhere
Stronger over Sunlint



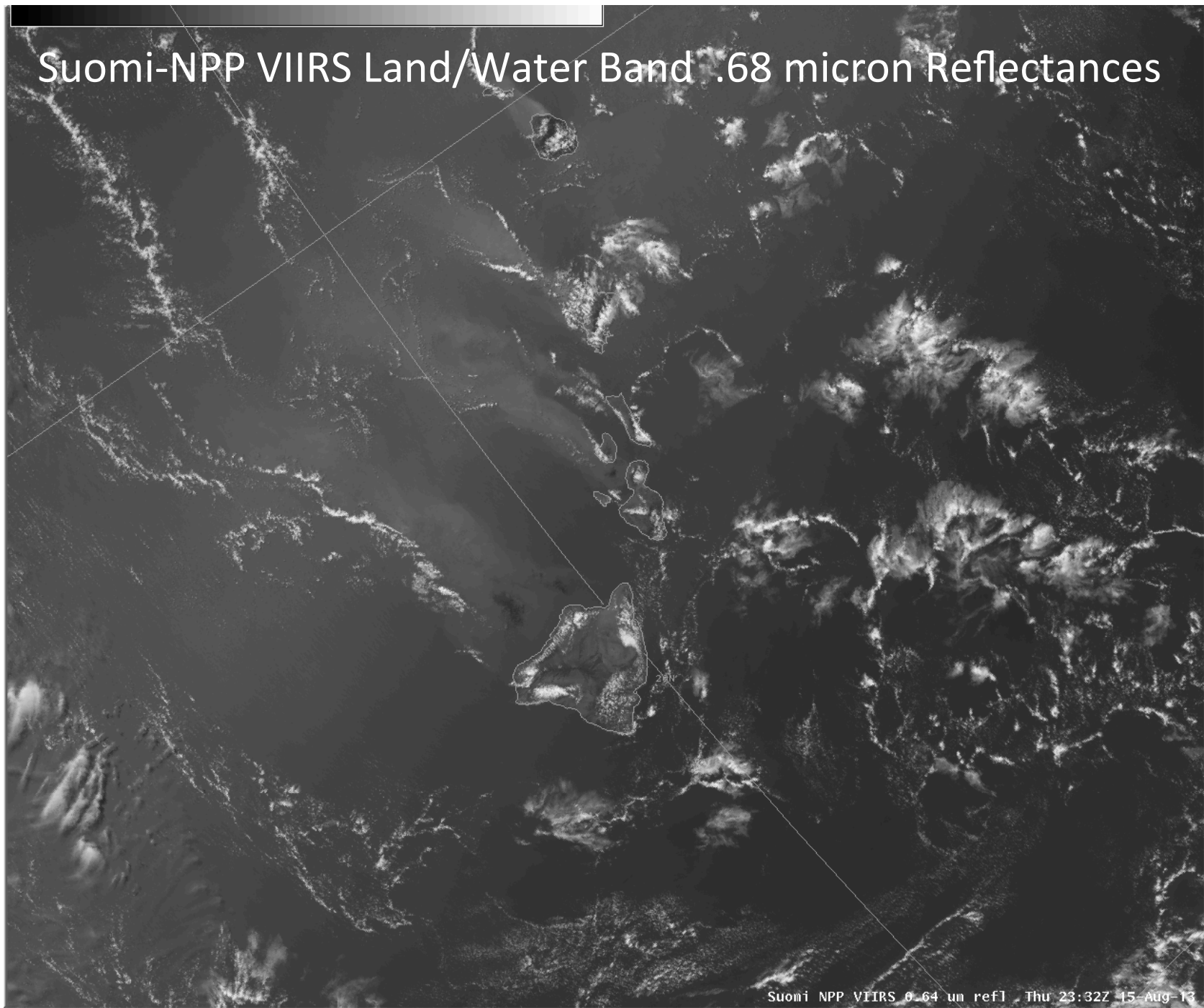


VIIRS and MODIS observations and products in AWIPS

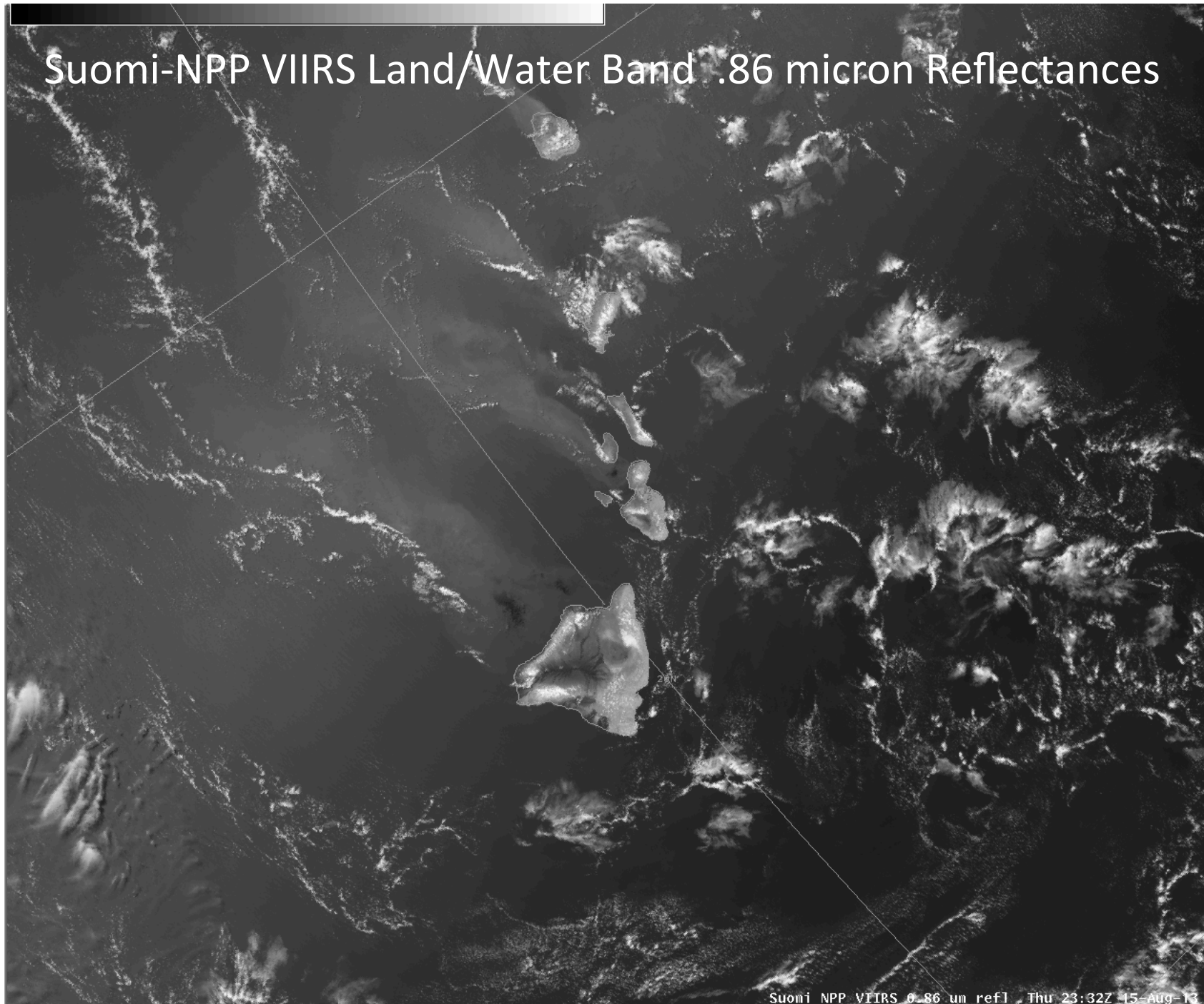
LAND-SOLAR RADIATION



Suomi-NPP VIIRS Land/Water Band .68 micron Reflectances

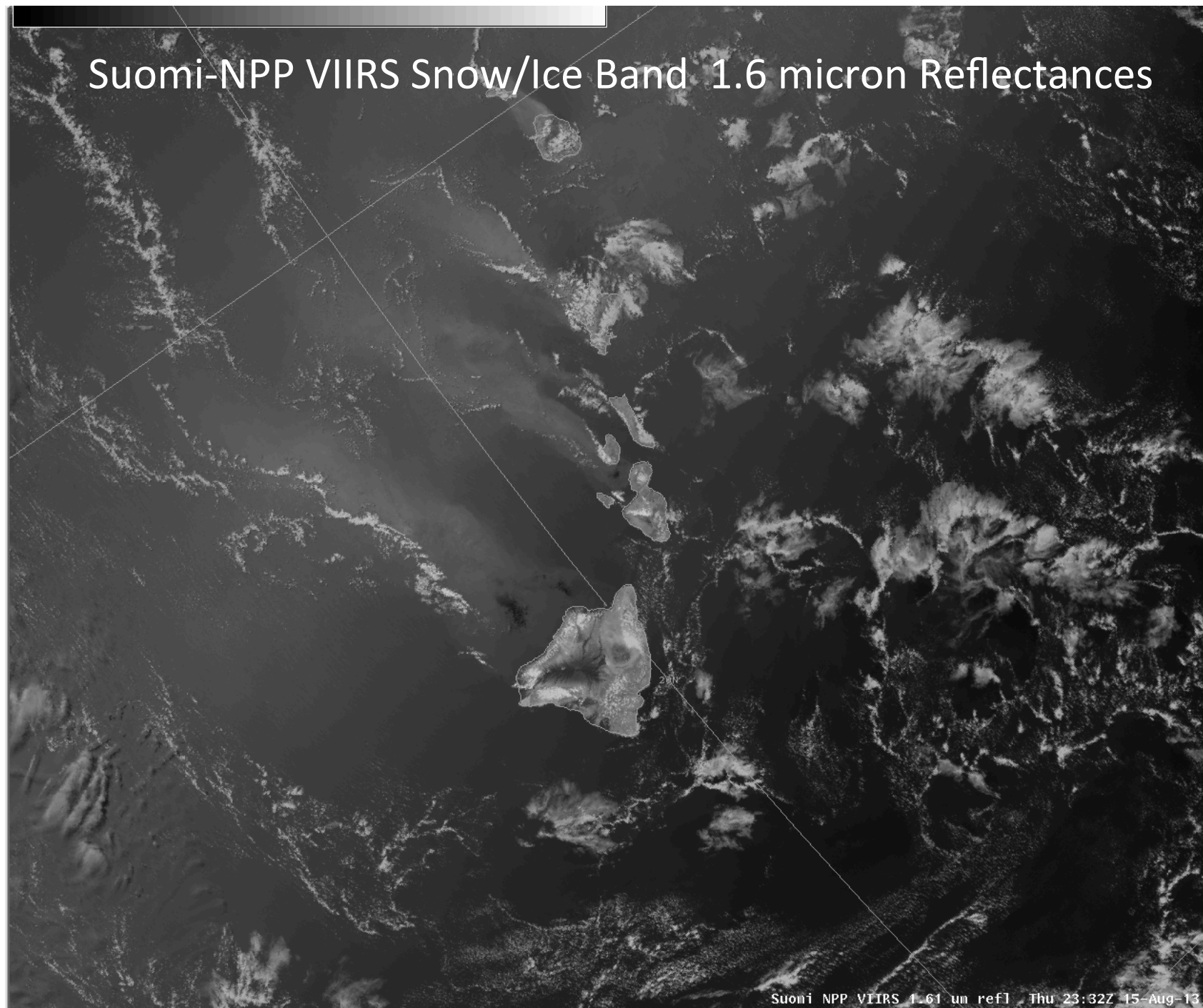


Suomi-NPP VIIRS Land/Water Band .86 micron Reflectances

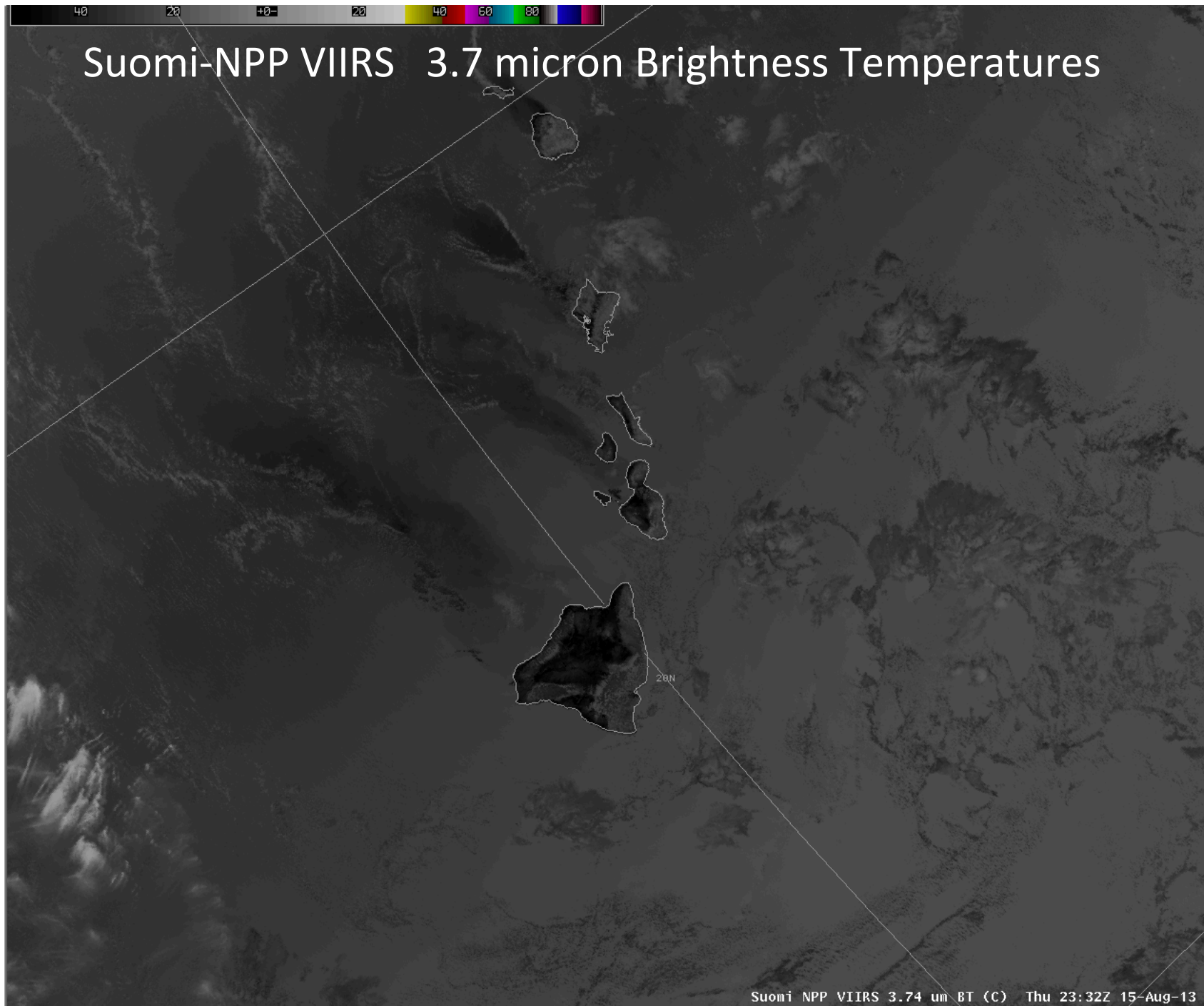


Suomi NPP VIIRS 0.86 um refl Thu 23:32Z 15-Aug-13

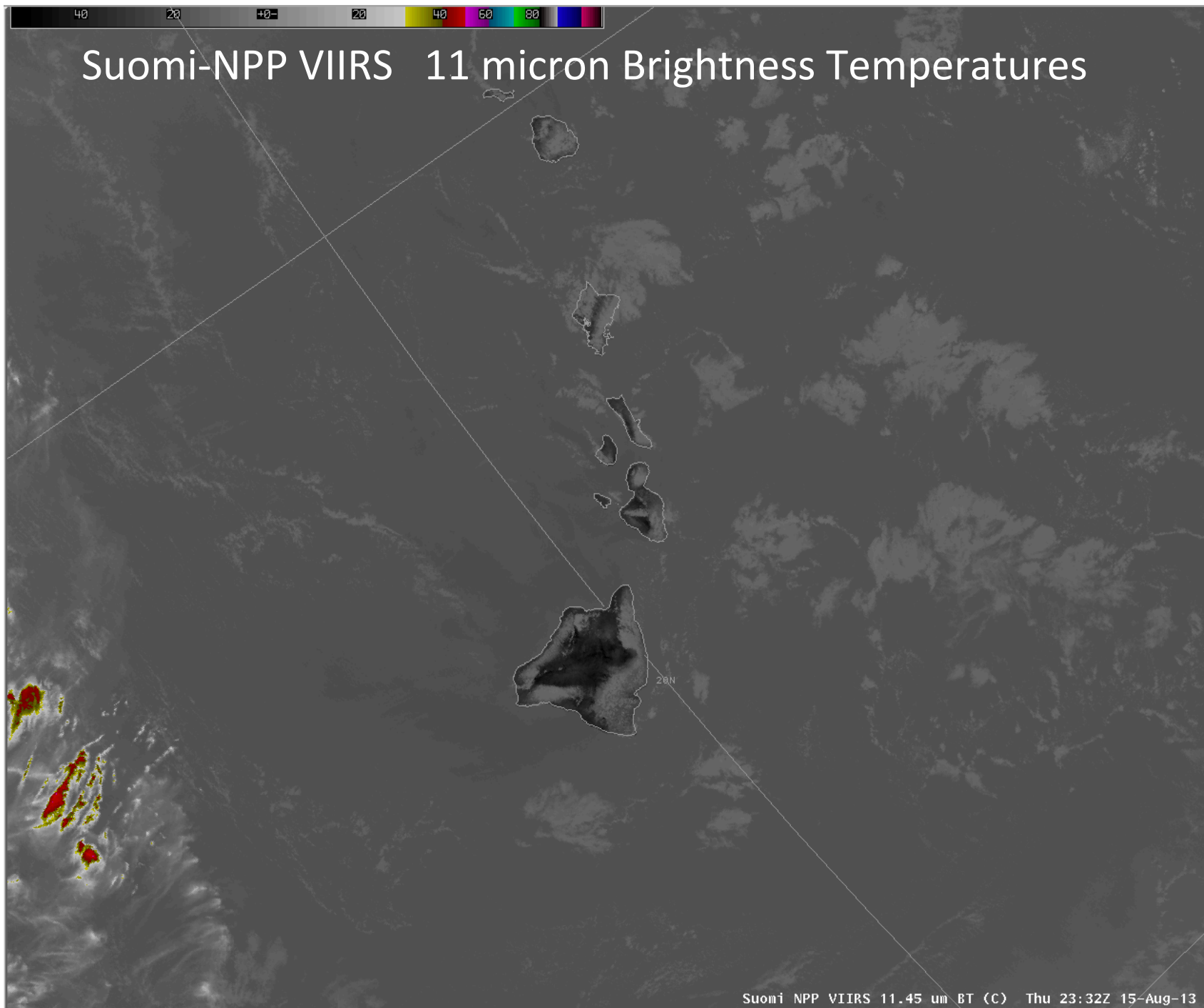
Suomi-NPP VIIRS Snow/Ice Band 1.6 micron Reflectances



Suomi-NPP VIIRS 3.7 micron Brightness Temperatures

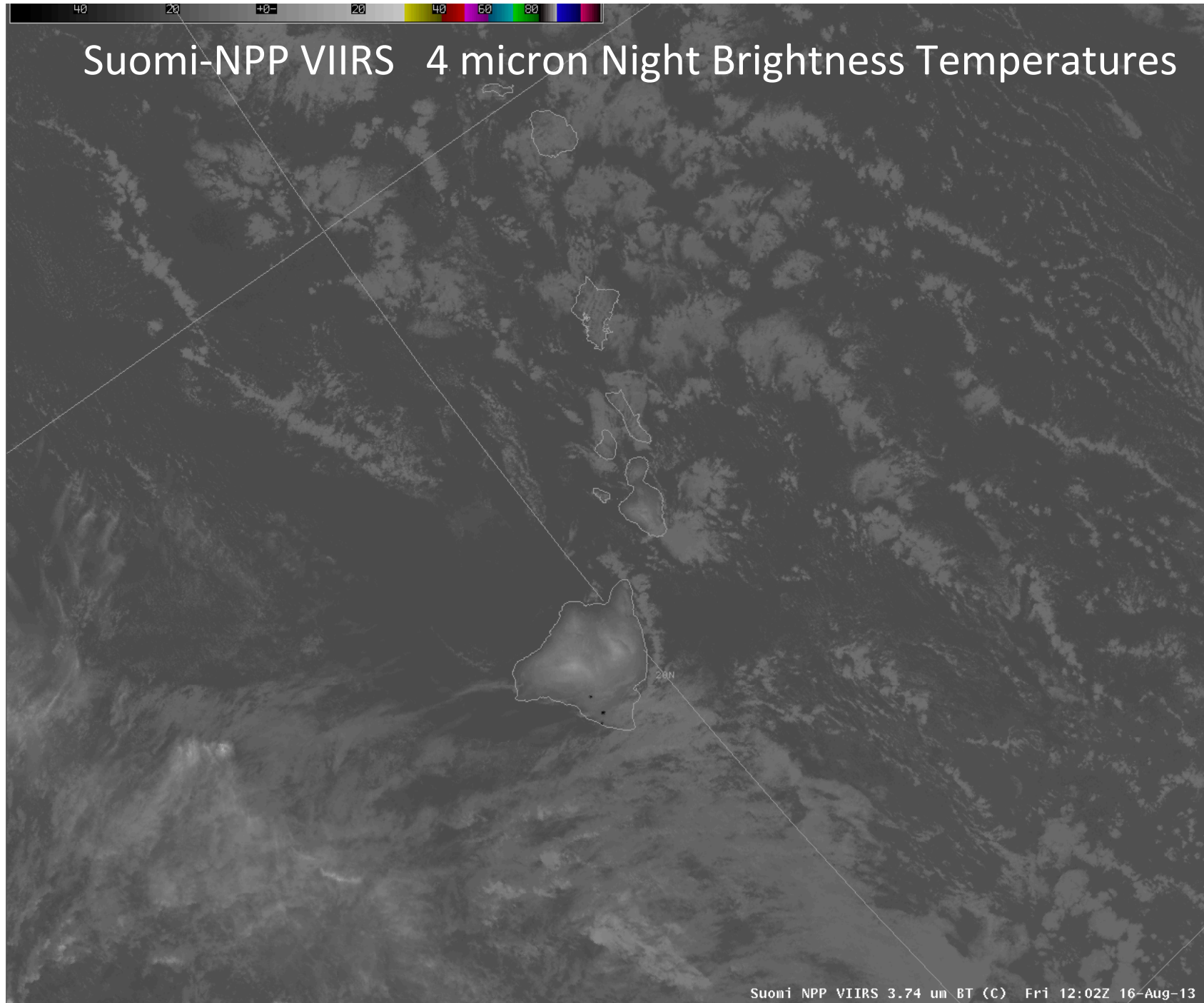


Suomi-NPP VIIRS 11 micron Brightness Temperatures

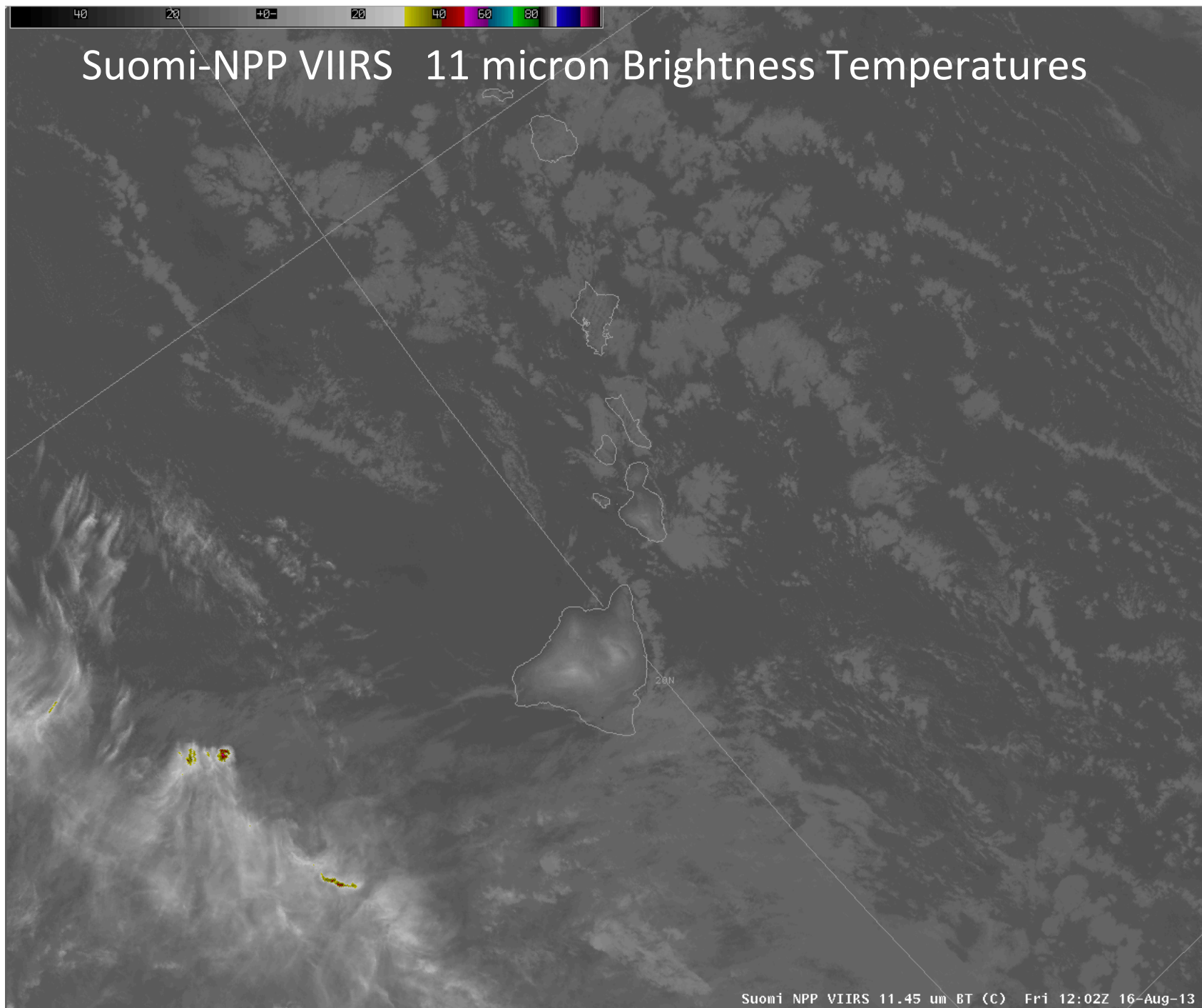


Suomi NPP VIIRS 11.45 um BT (C) Thu 23:32Z 15-Aug-13

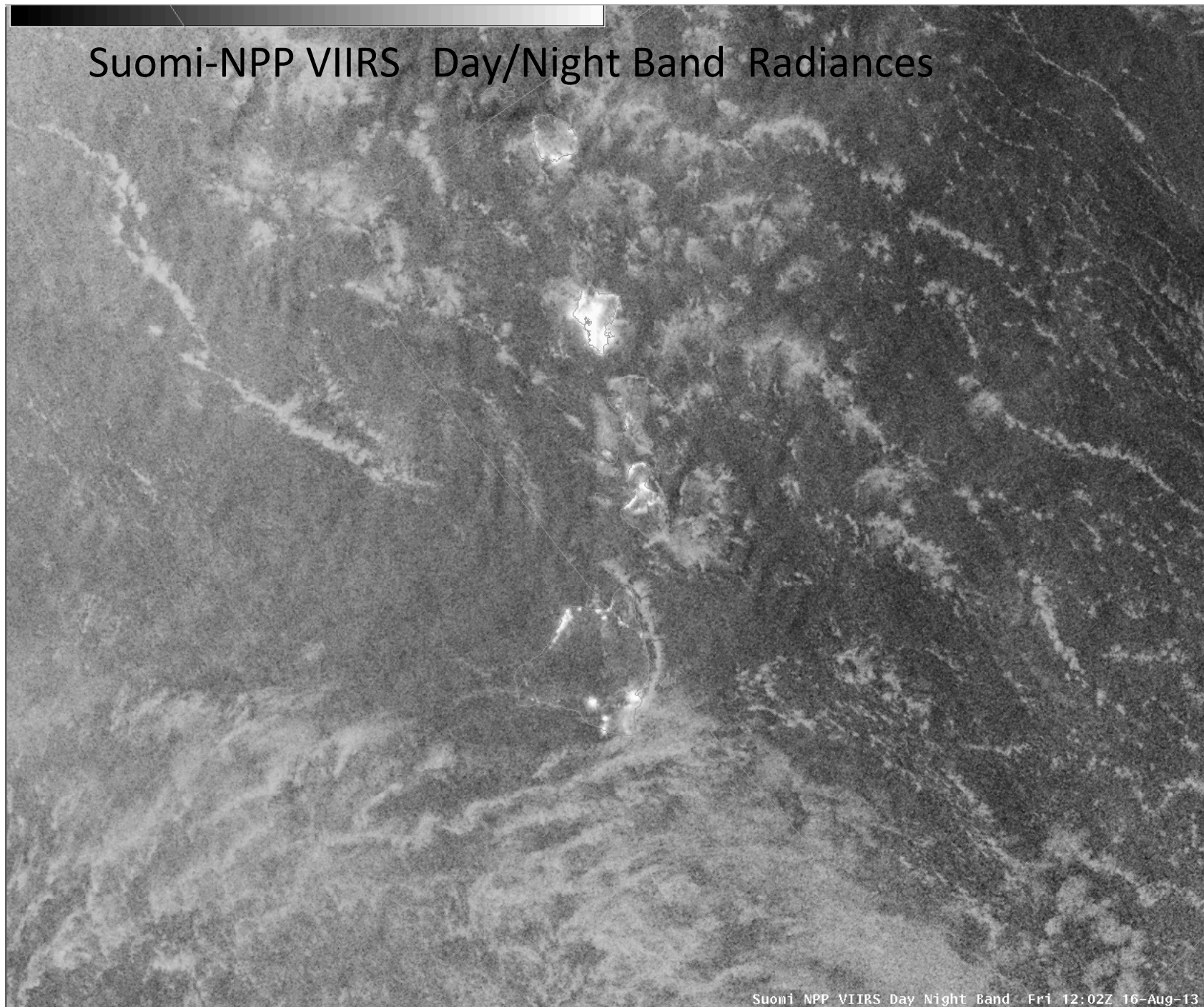
Suomi-NPP VIIRS 4 micron Night Brightness Temperatures



Suomi-NPP VIIRS 11 micron Brightness Temperatures

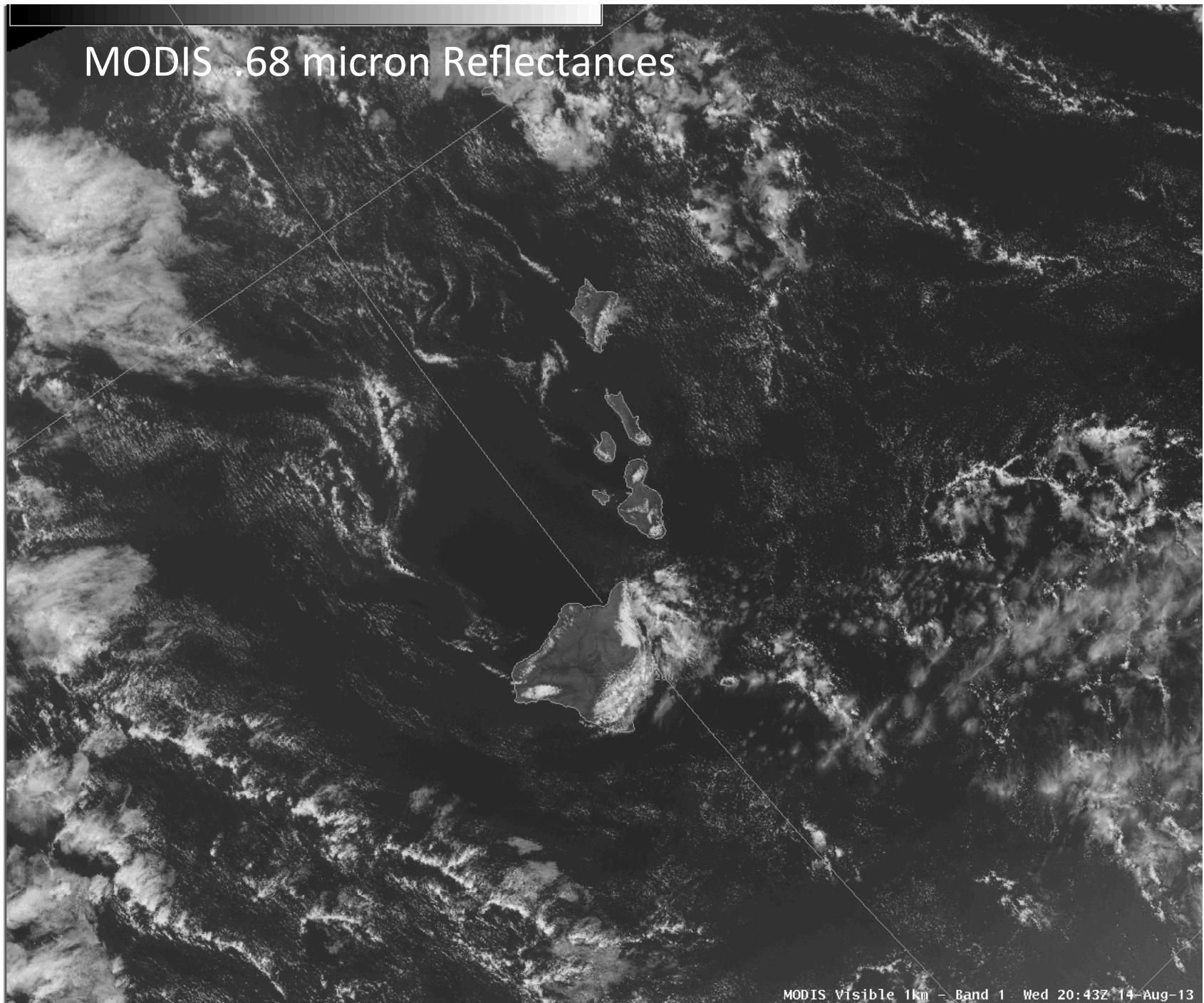


Suomi-NPP VIIRS Day/Night Band Radiances

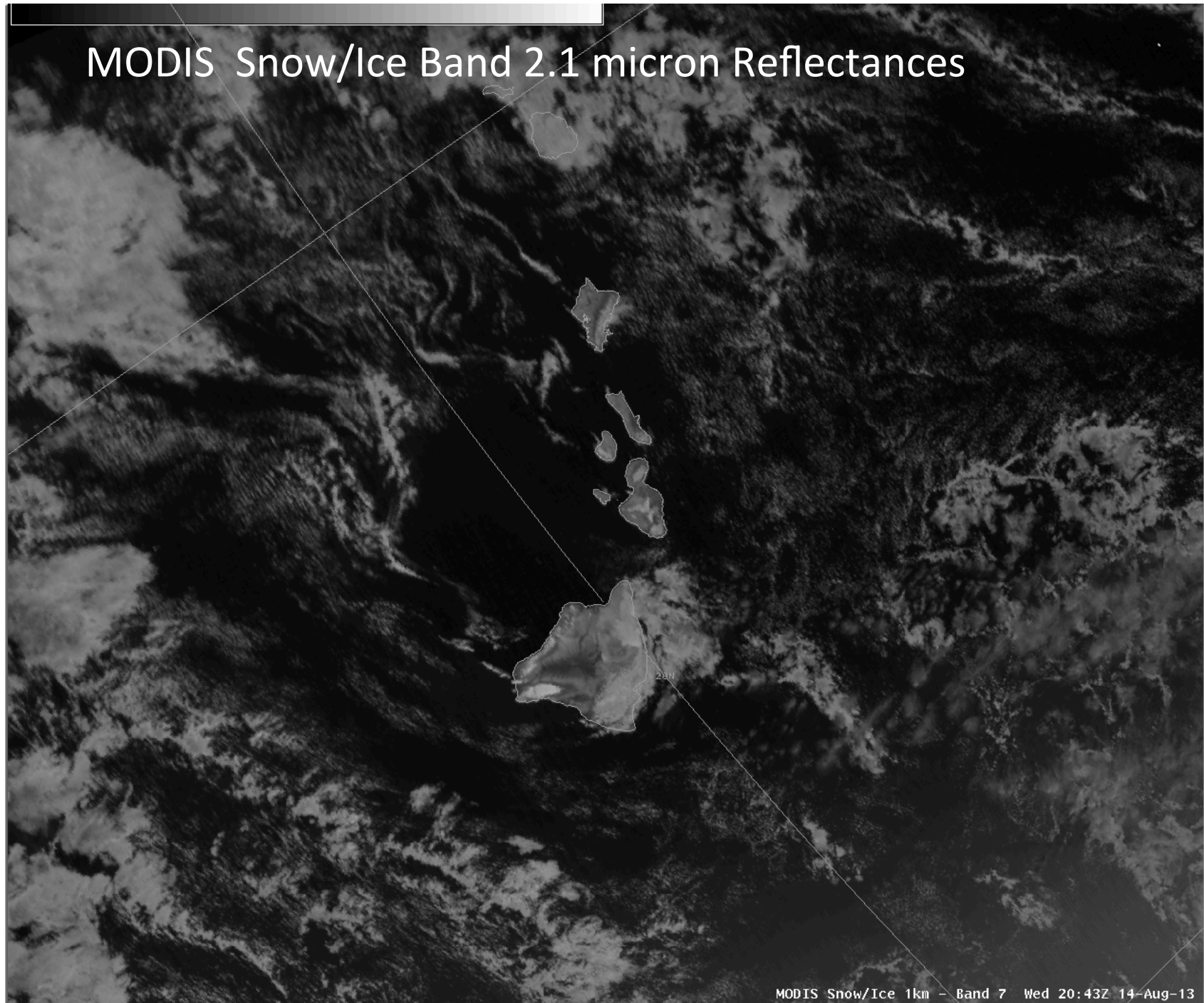


Suomi NPP VIIRS Day Night Band Fri 12:02Z 16-Aug-13

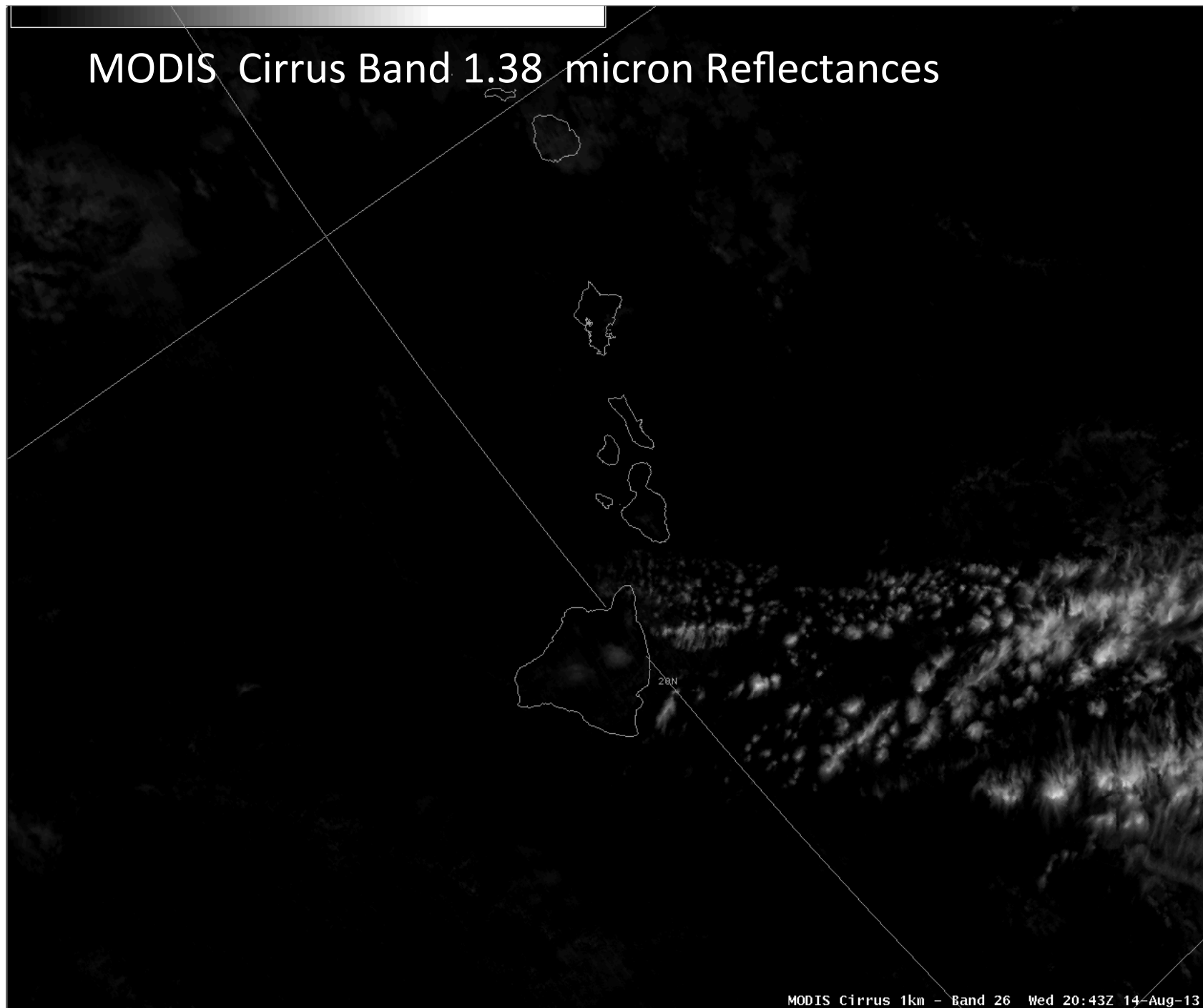
MODIS .68 micron Reflectances



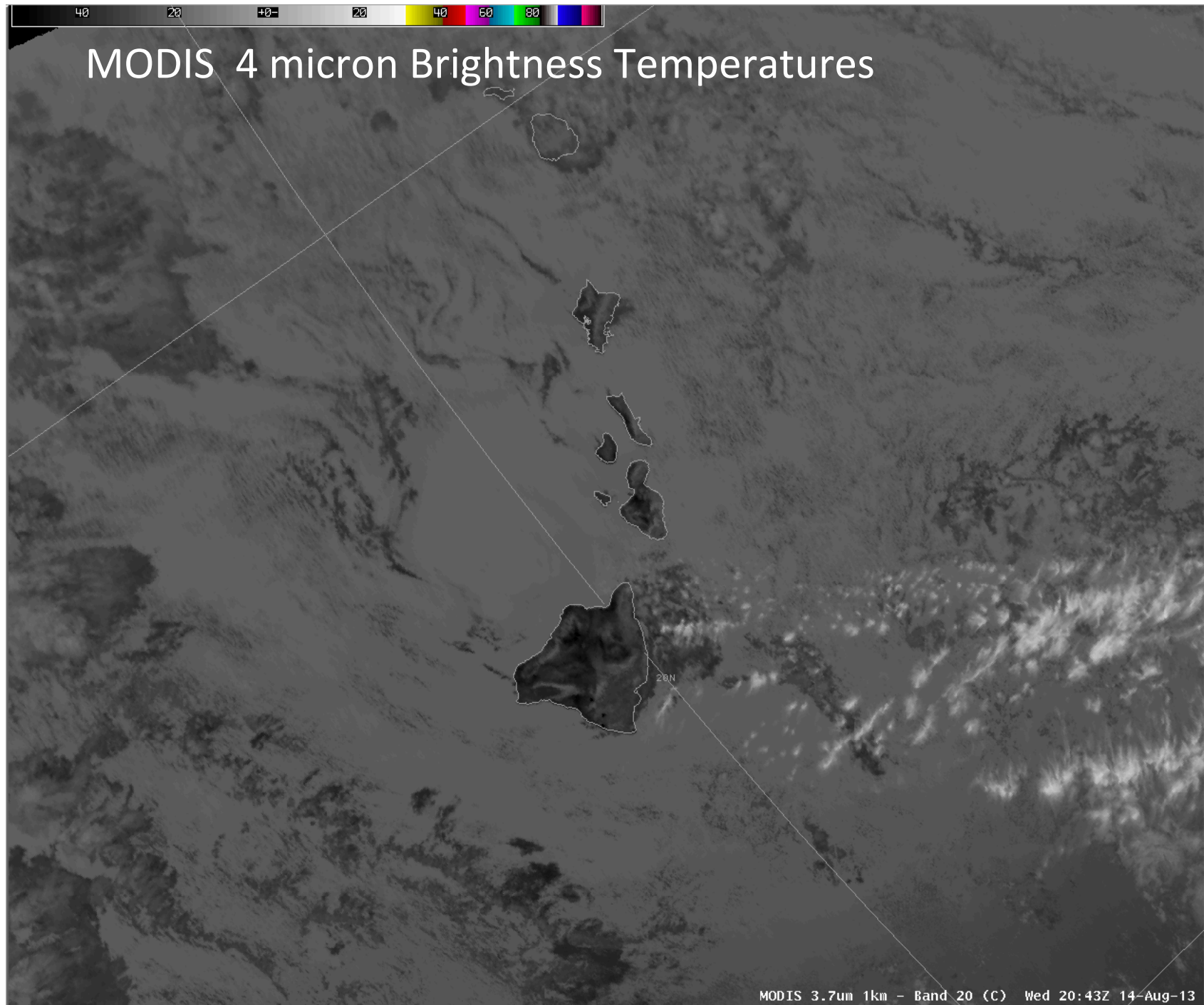
MODIS Snow/Ice Band 2.1 micron Reflectances



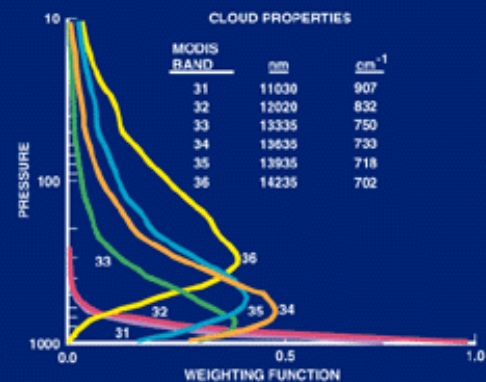
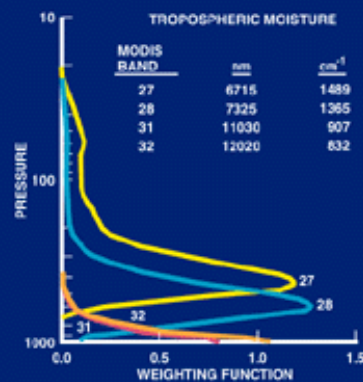
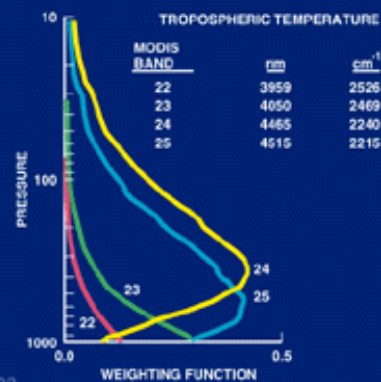
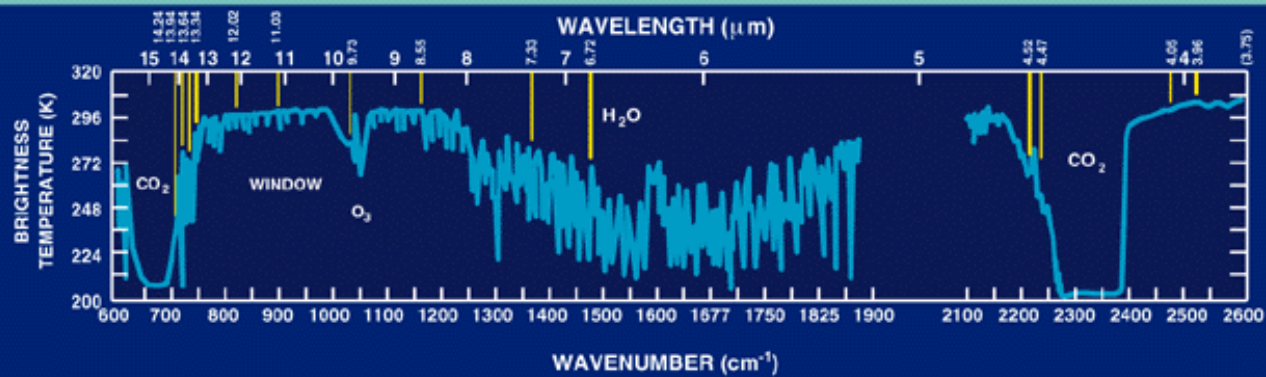
MODIS Cirrus Band 1.38 micron Reflectances

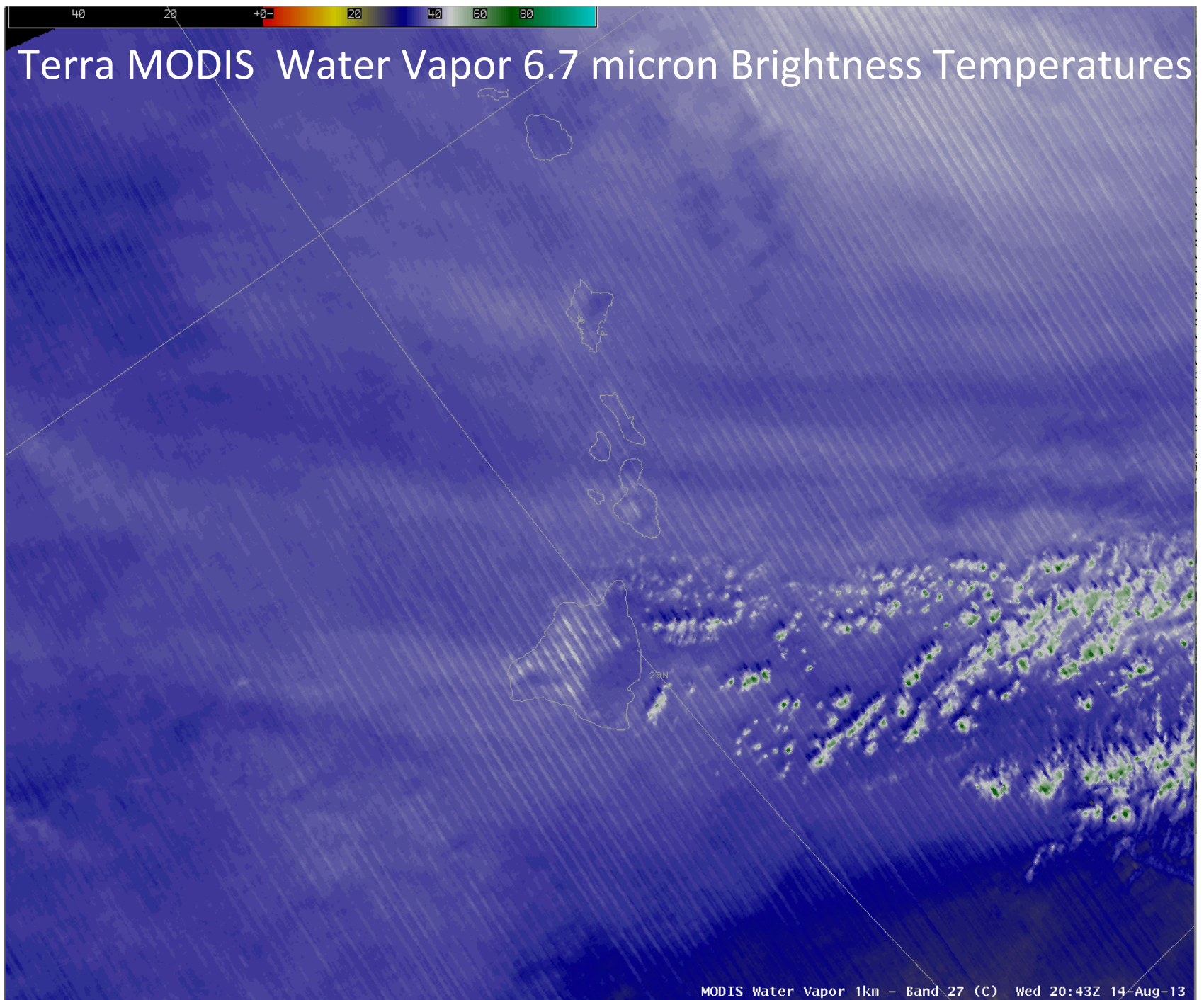


MODIS 4 micron Brightness Temperatures

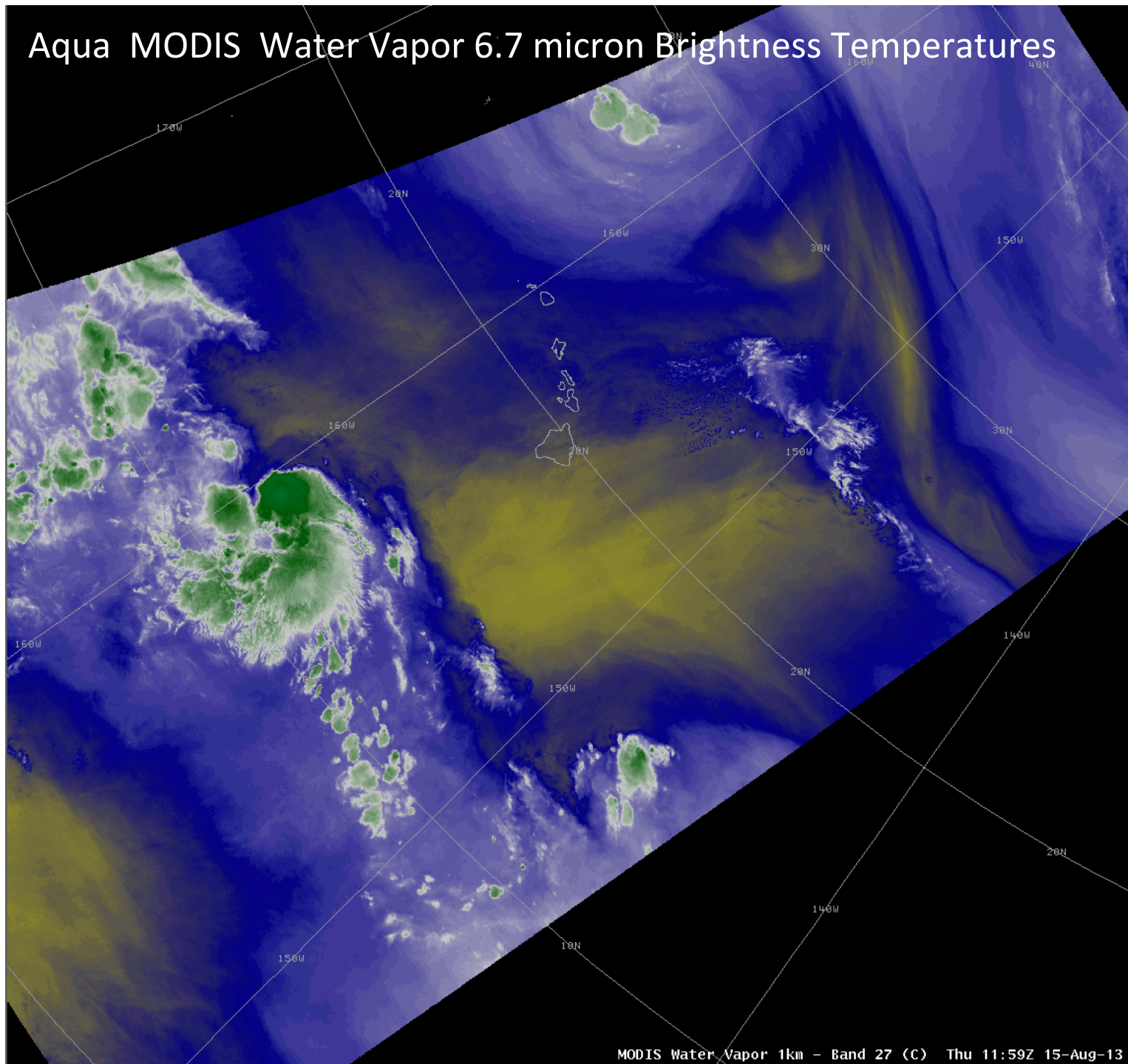


ATMOSPHERE - THERMAL RADIATION

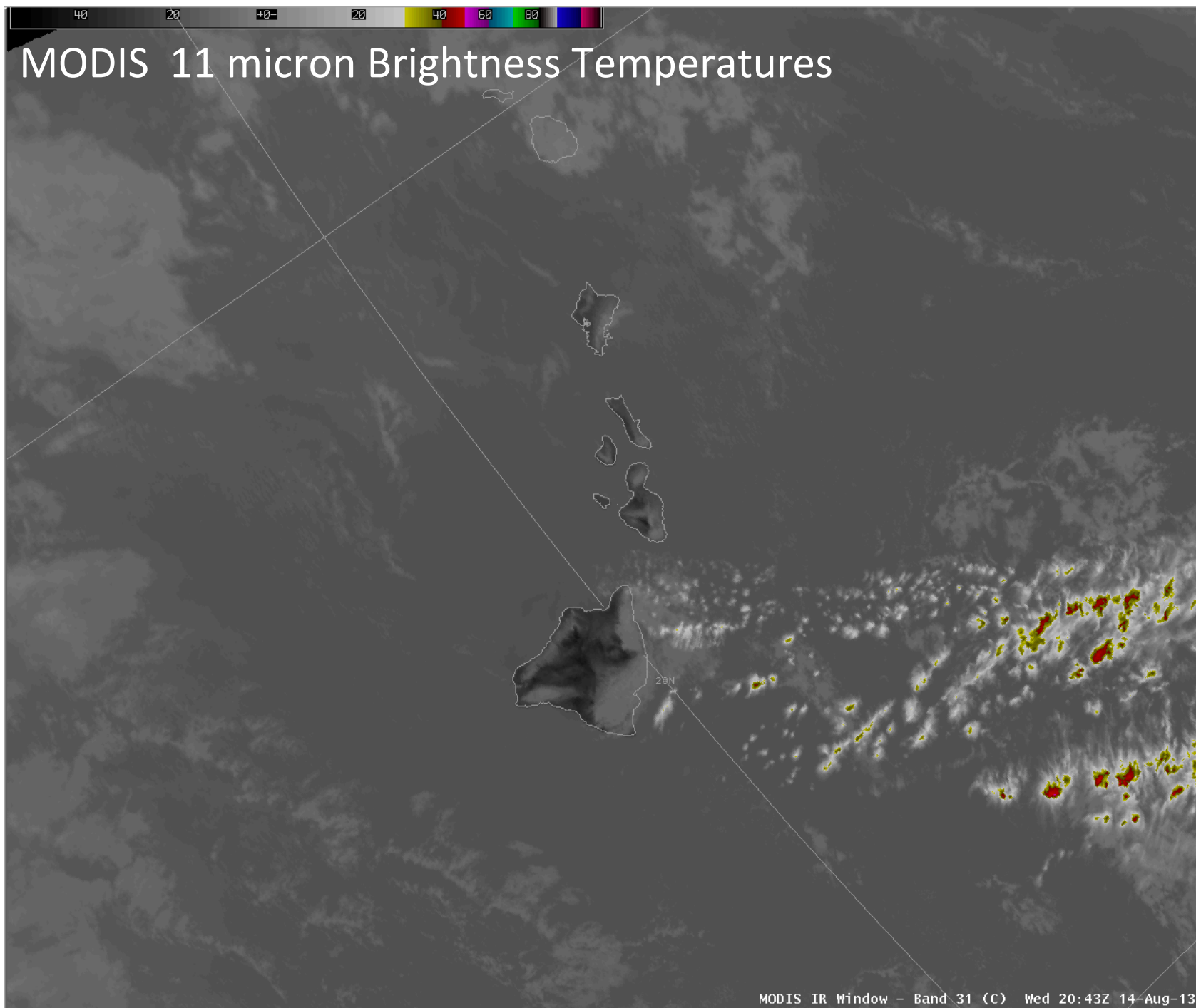


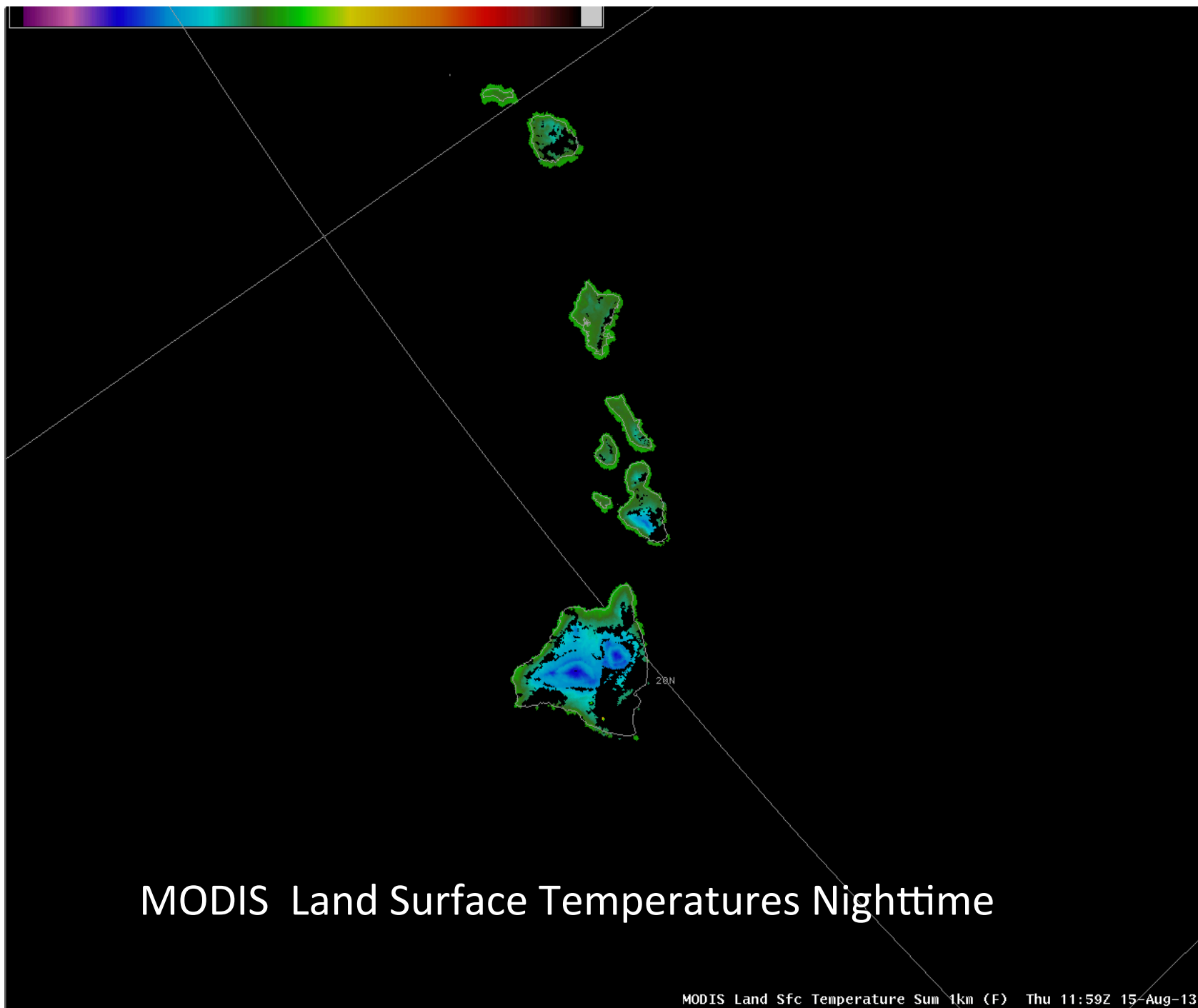


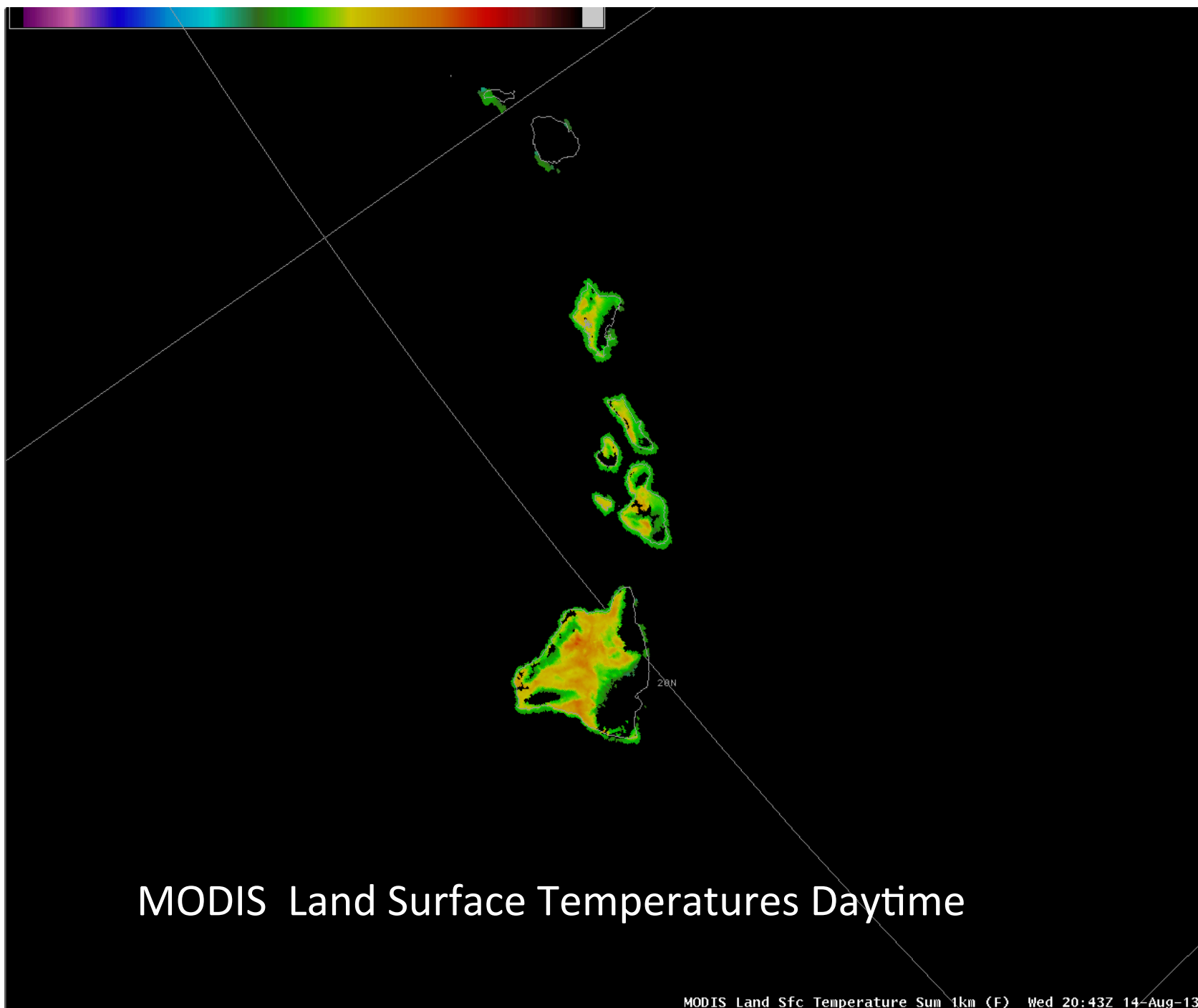
Aqua MODIS Water Vapor 6.7 micron Brightness Temperatures

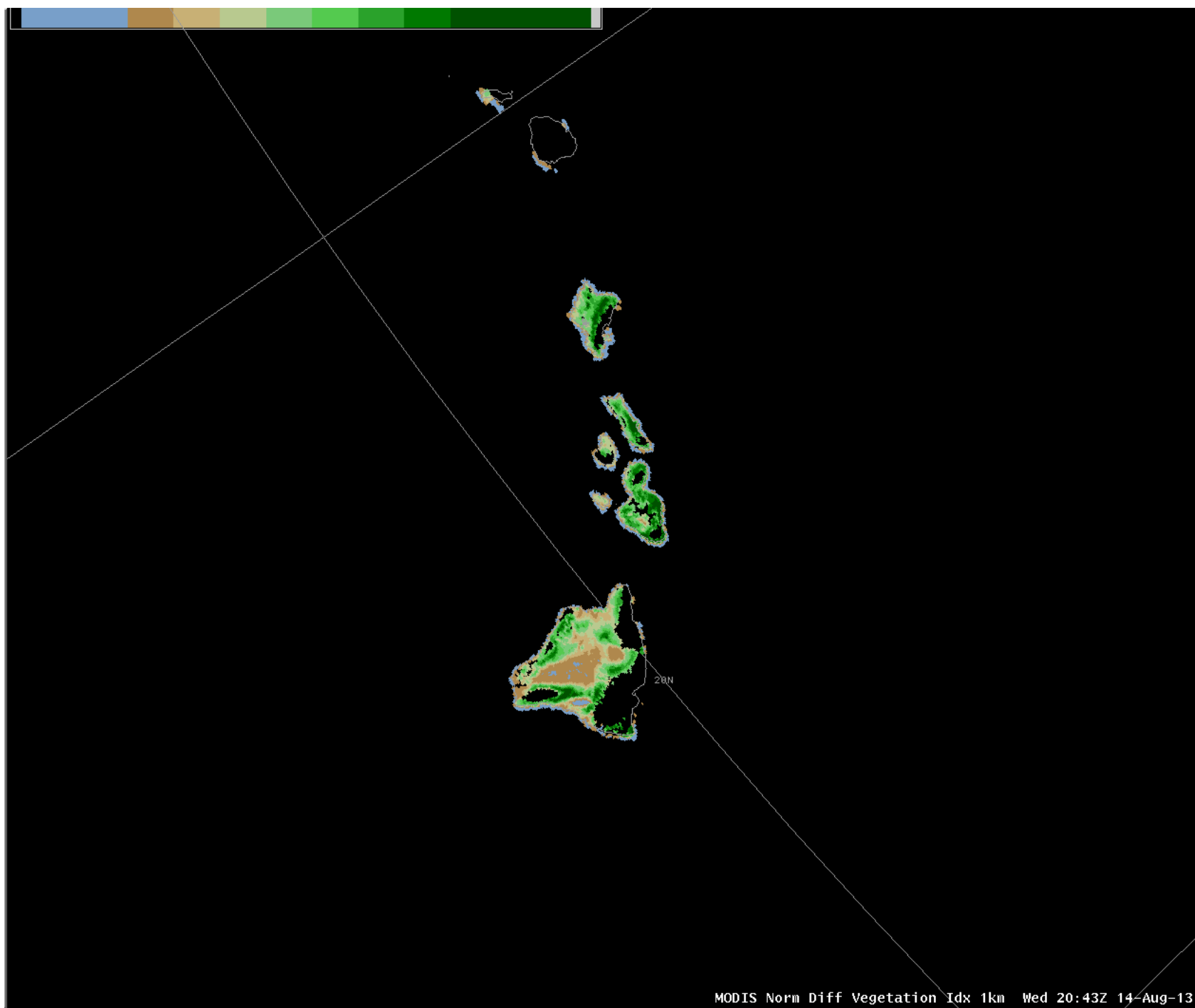


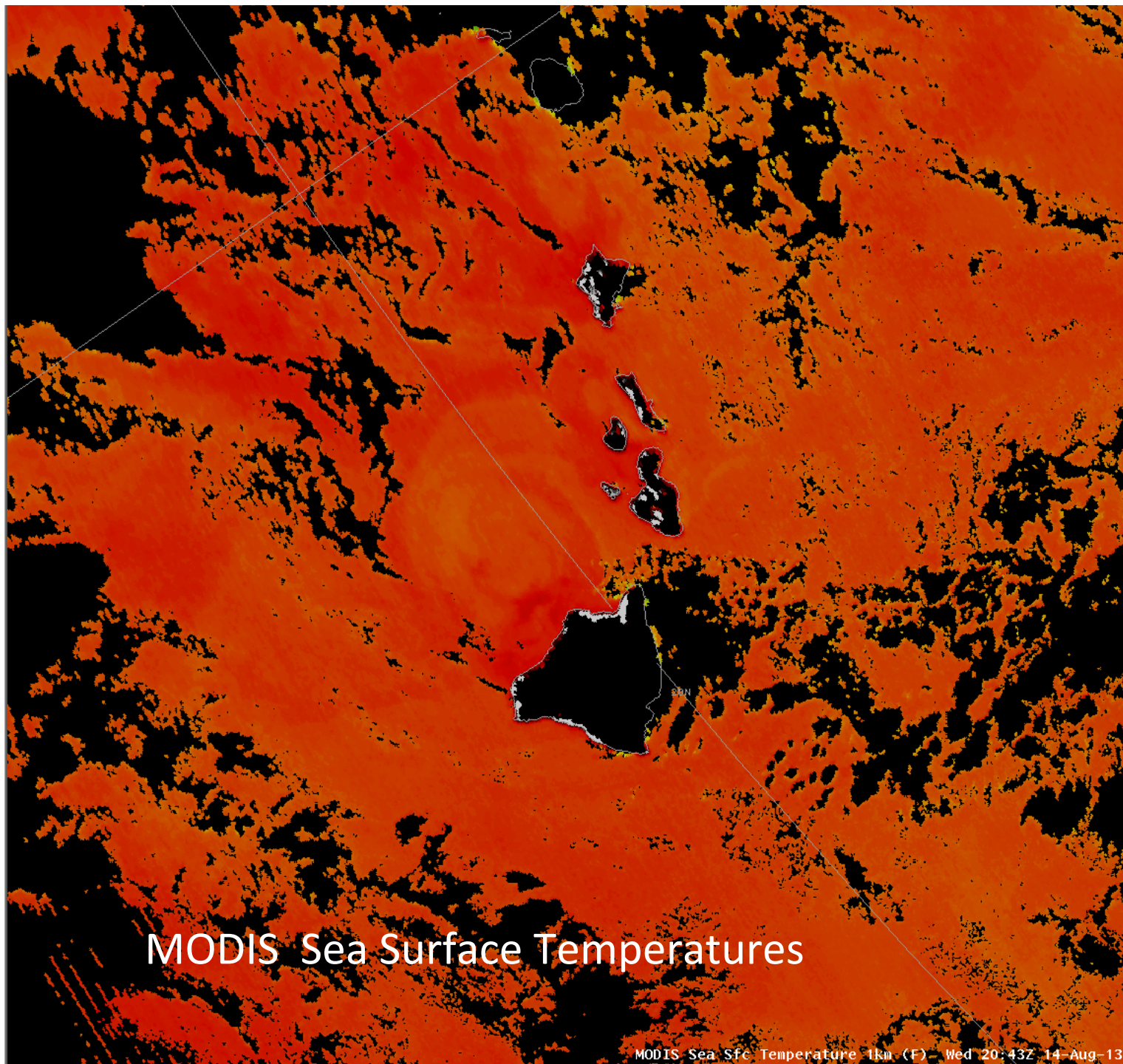
MODIS 11 micron Brightness Temperatures

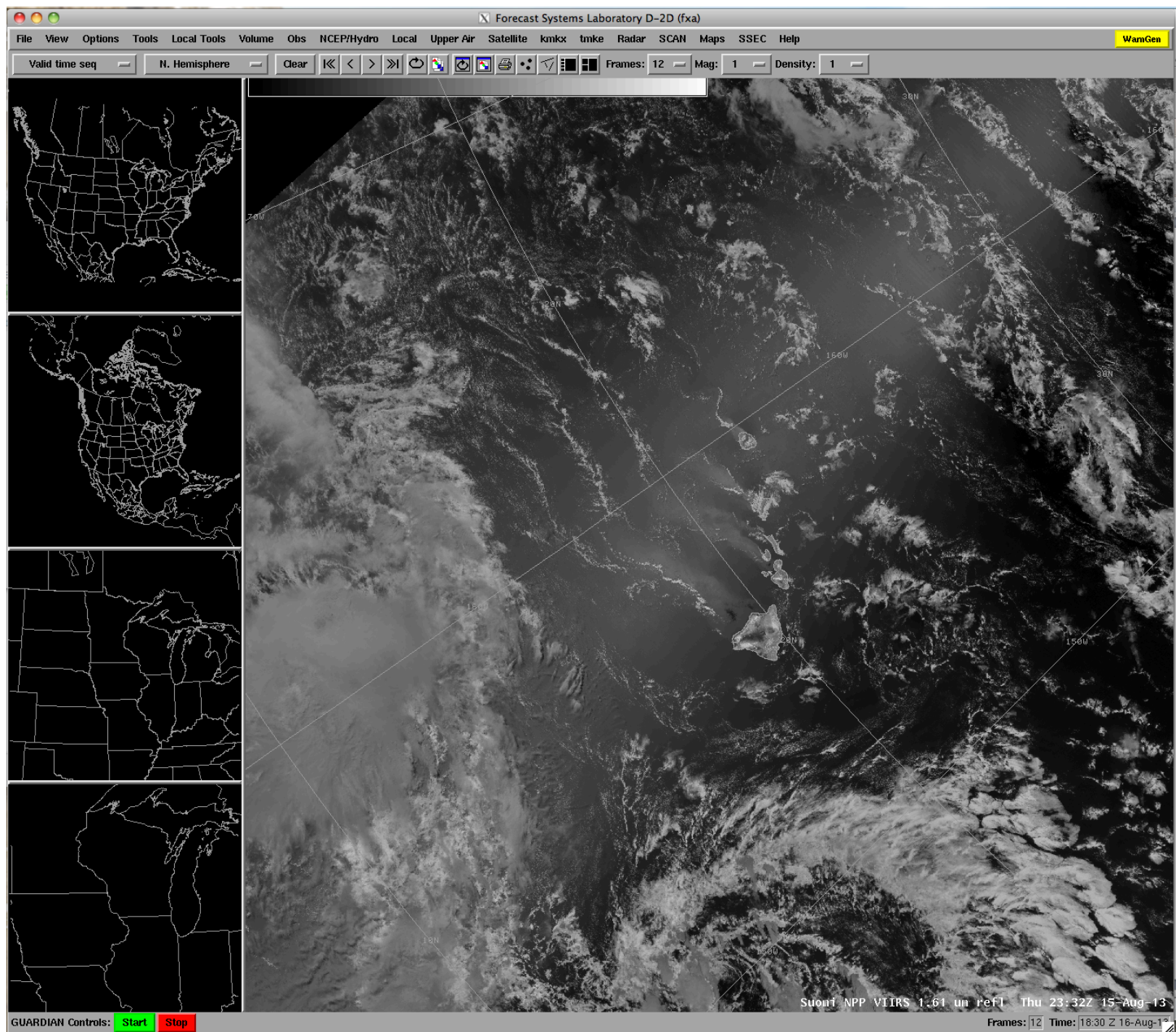


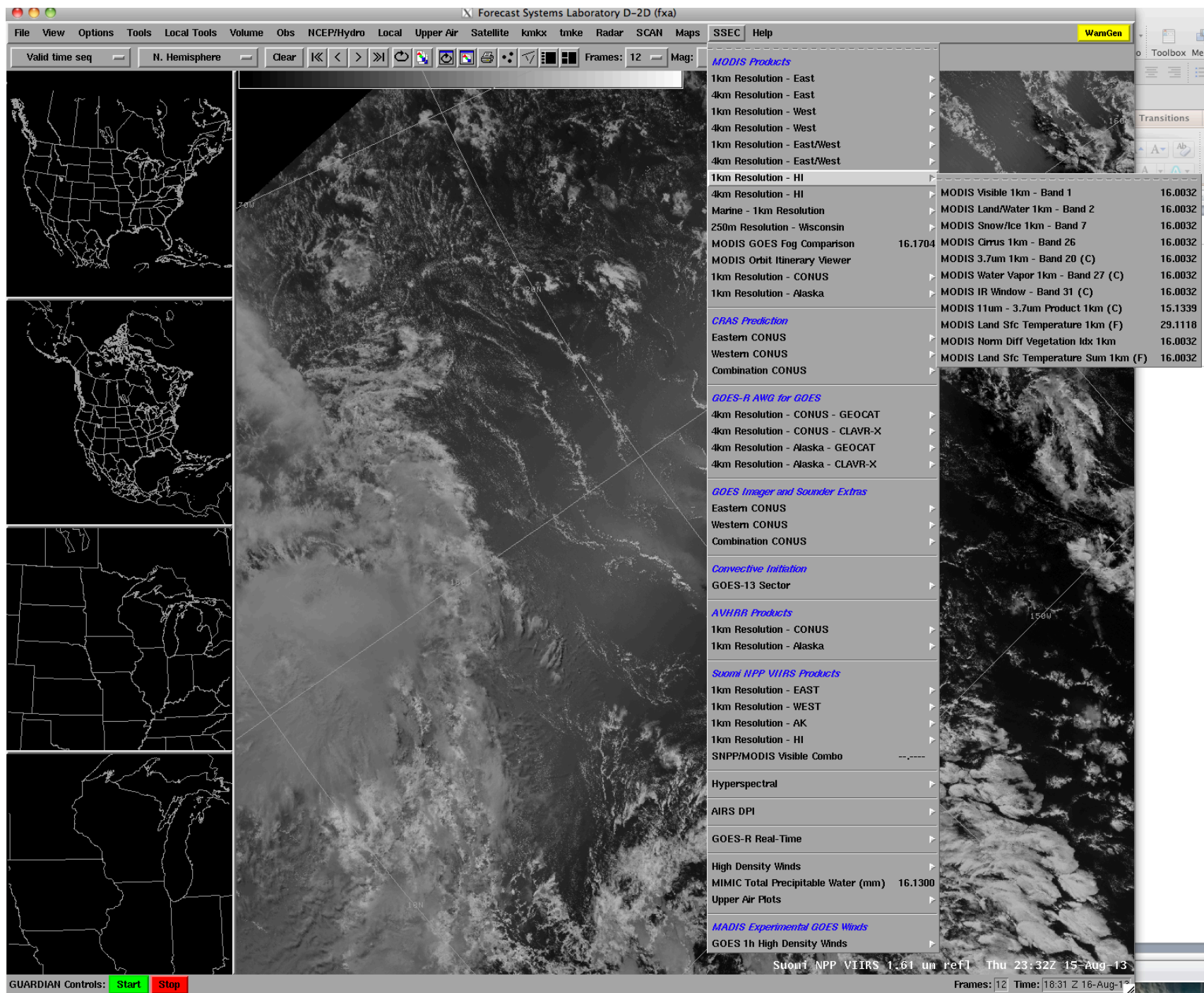












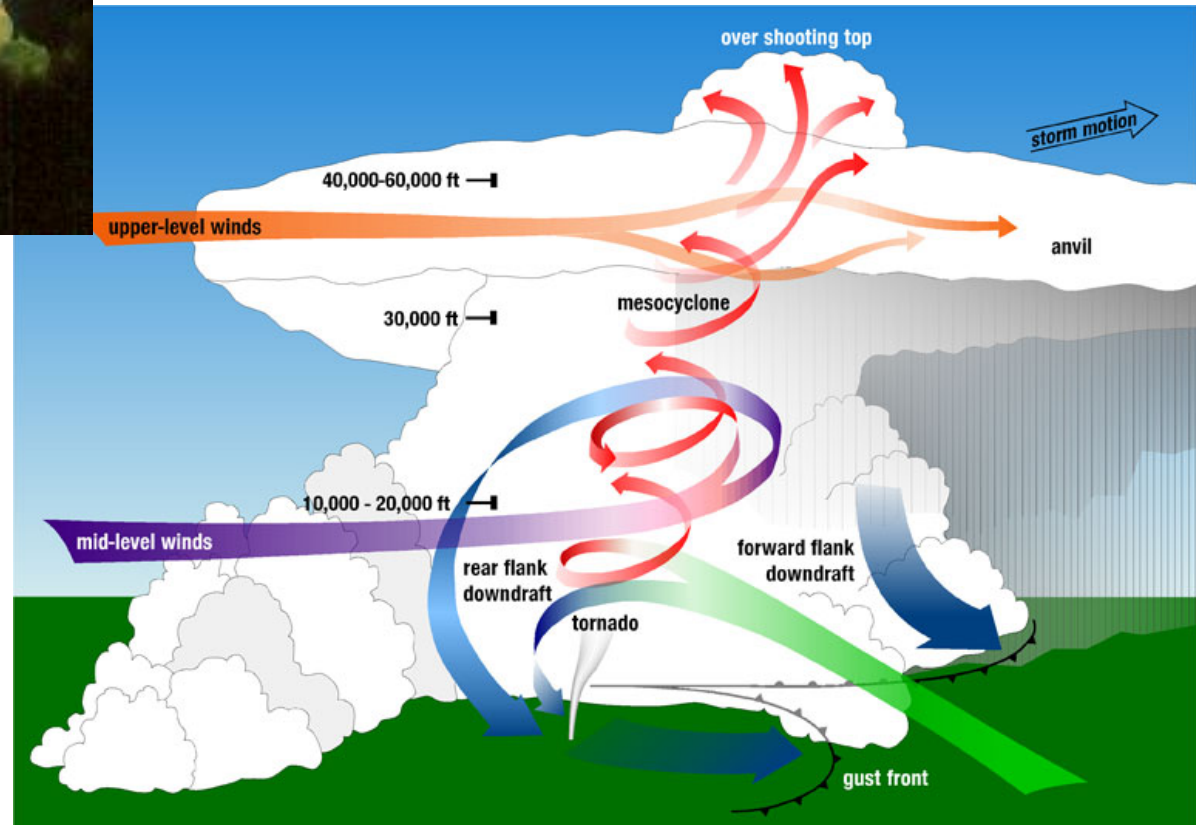
Thunderstorms

- Characteristics of Severe Weather as Observed from Satellite
 - Overshooting Tops
 - Gravity Wave Generation

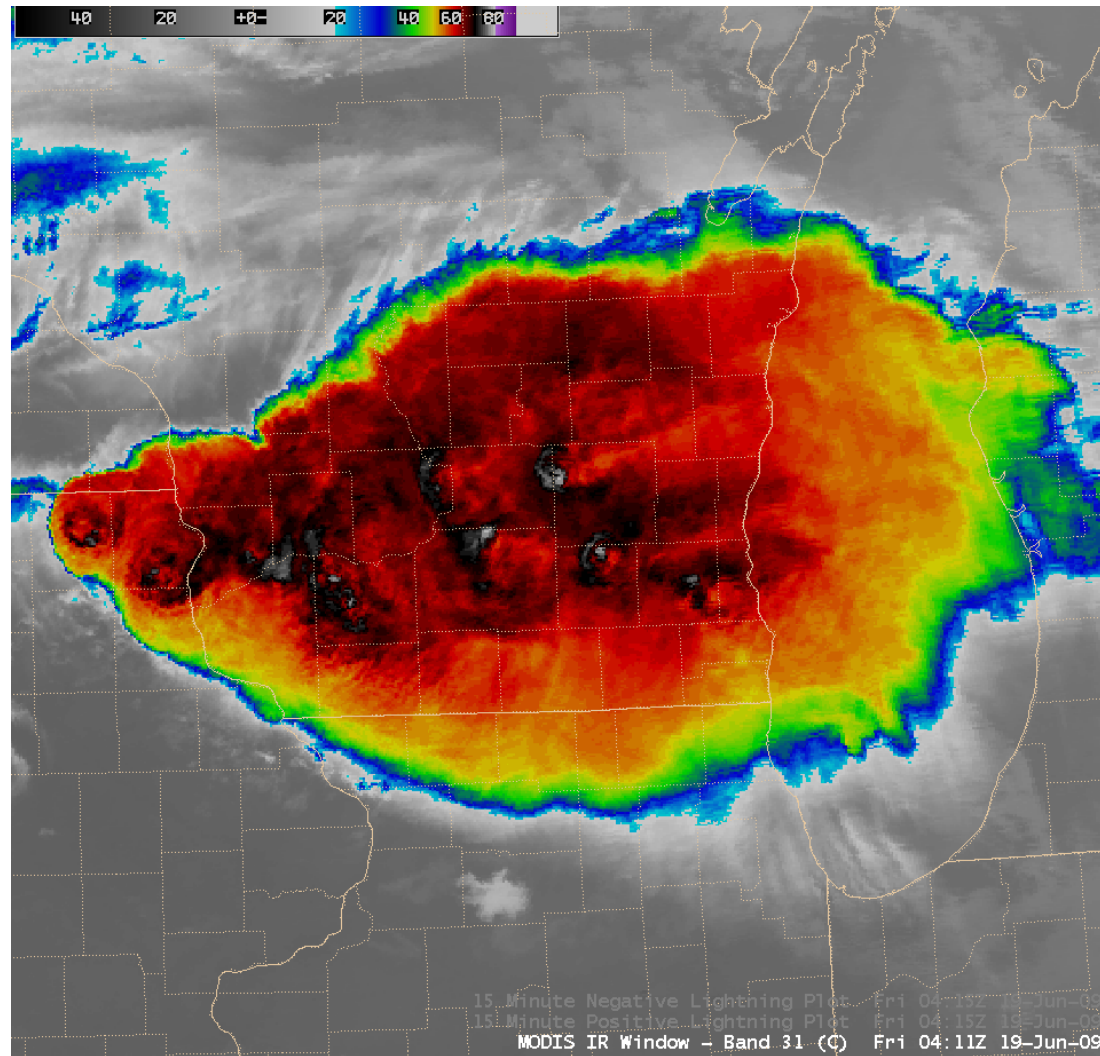
Overshooting Top



A dome-like protrusion above a thunderstorm anvil, representing a very strong updraft and hence a higher potential for severe weather with that storm. A persistent and/or large overshooting top often is present on a supercell.



Severe Thunderstorm Example 2

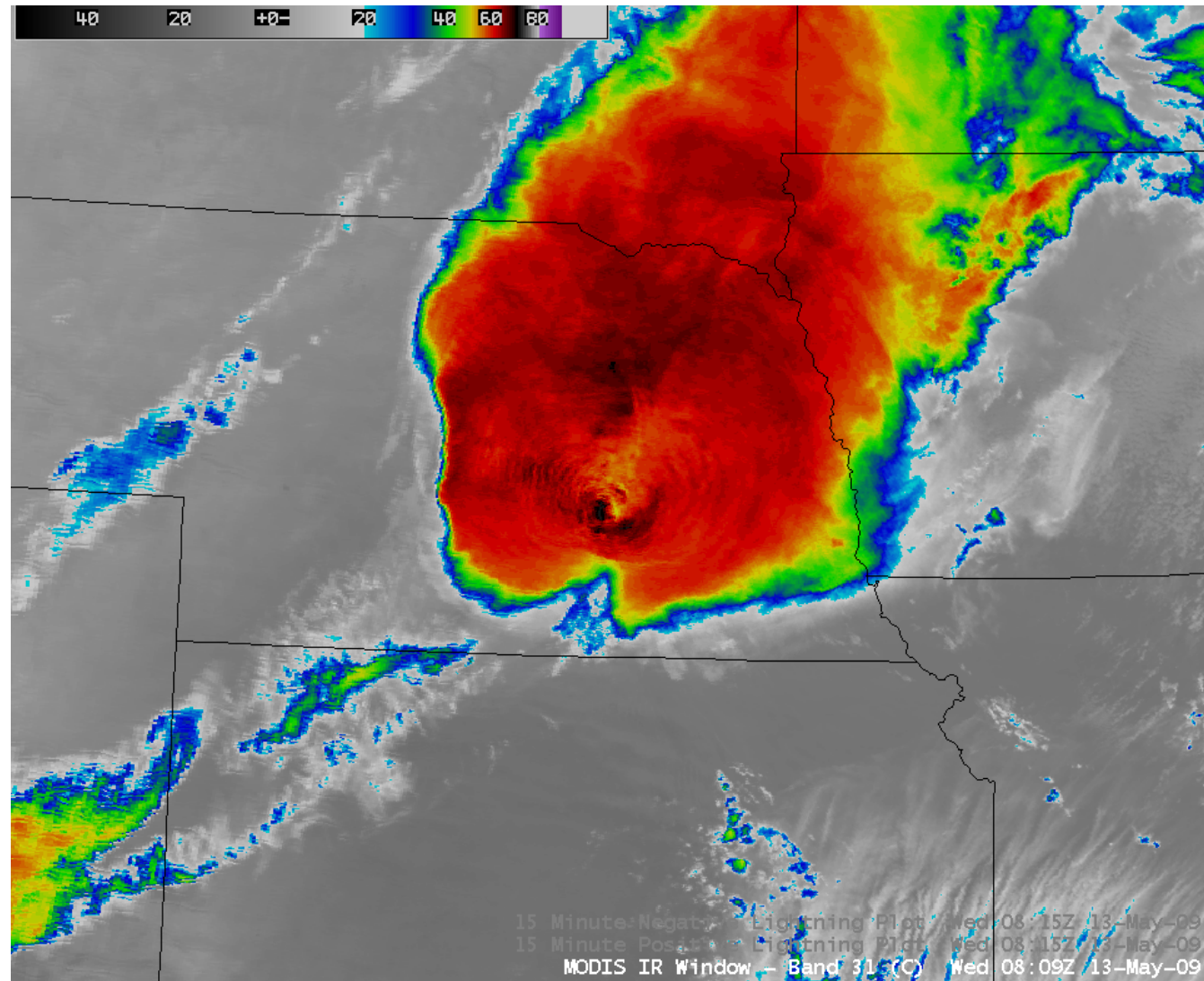


Including
Lightning
Detection

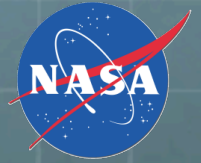
04:11 UTC
19 June 2009

During the 15-minute interval ending at 04:15 UTC this storm produced over 900 lightning strikes

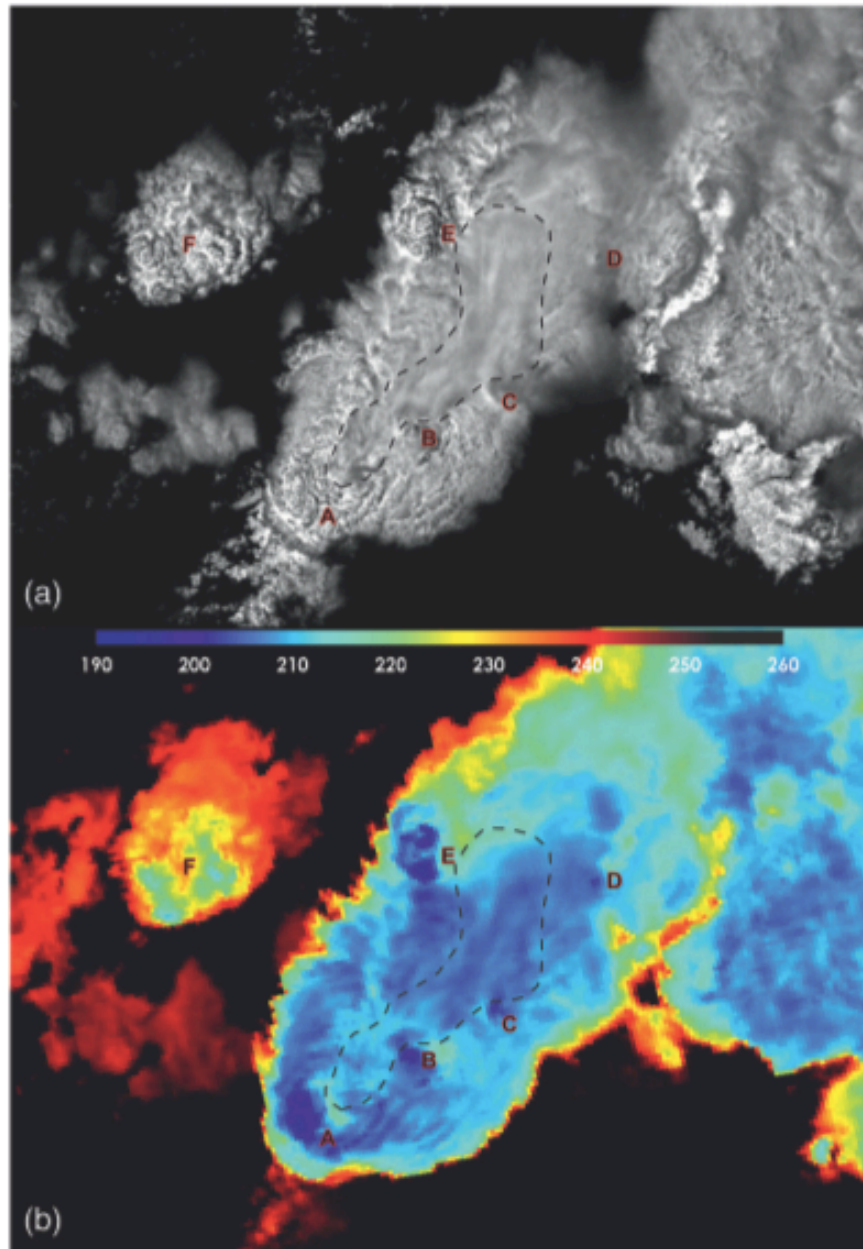
Severe Thunderstorm Case 2



Including
Lightning
and Hail
Reports
13 May 2009

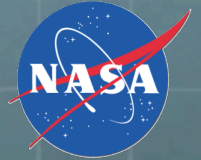


Bedka, K., Brunner, J.,
Dworak, Feltz, W., Otkin, J.
and T. Greenwald: 2010.
**Objective Satellite-Based
Detection of Overshooting
Tops Using Infrared Window
Channel Brightness
Temperature Gradients,**
Journal of Applied Meteorology
and Climatology, Vol. 49, pp.
181-202.



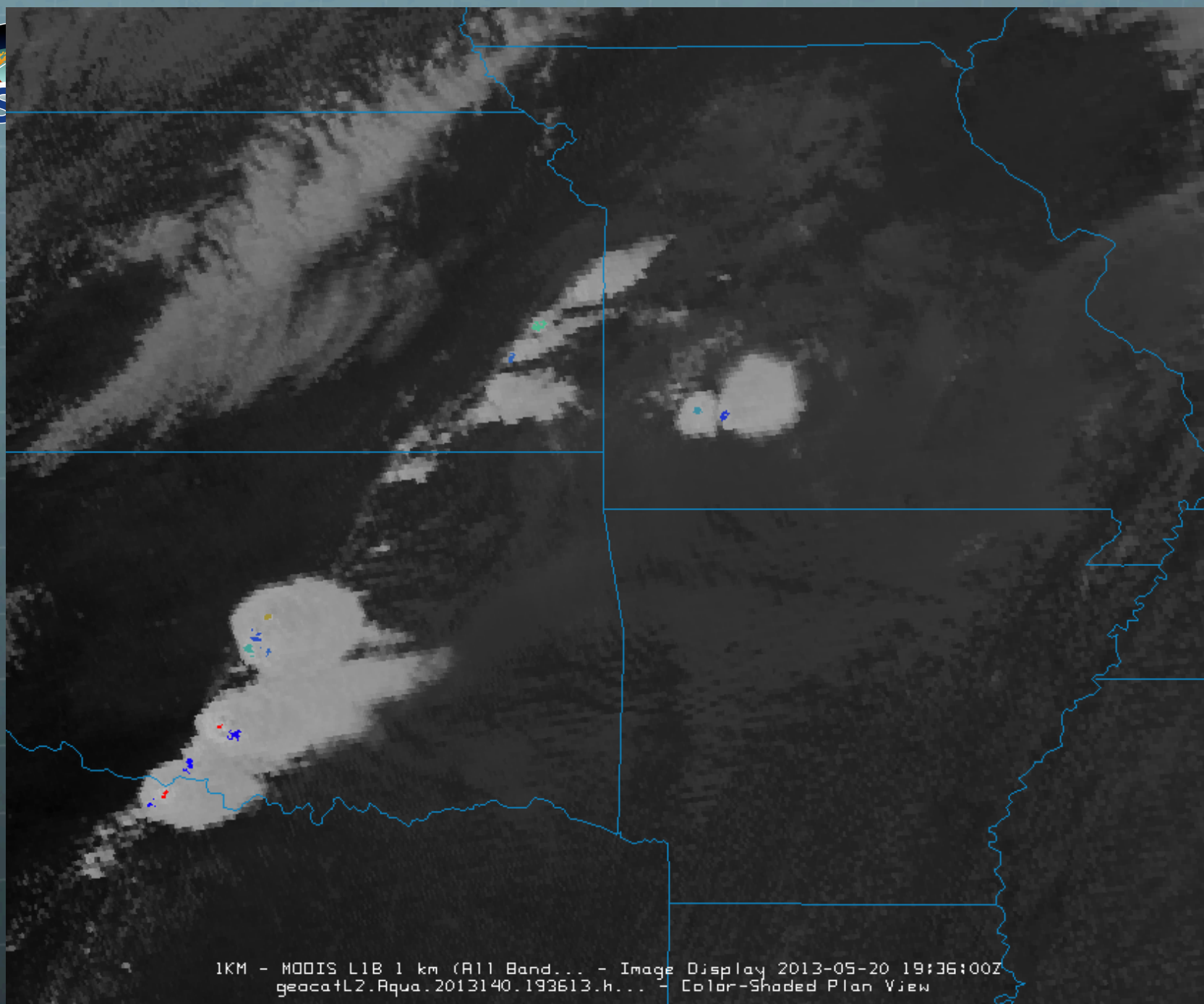


IMAPP GeoCAT Output HDF4 File

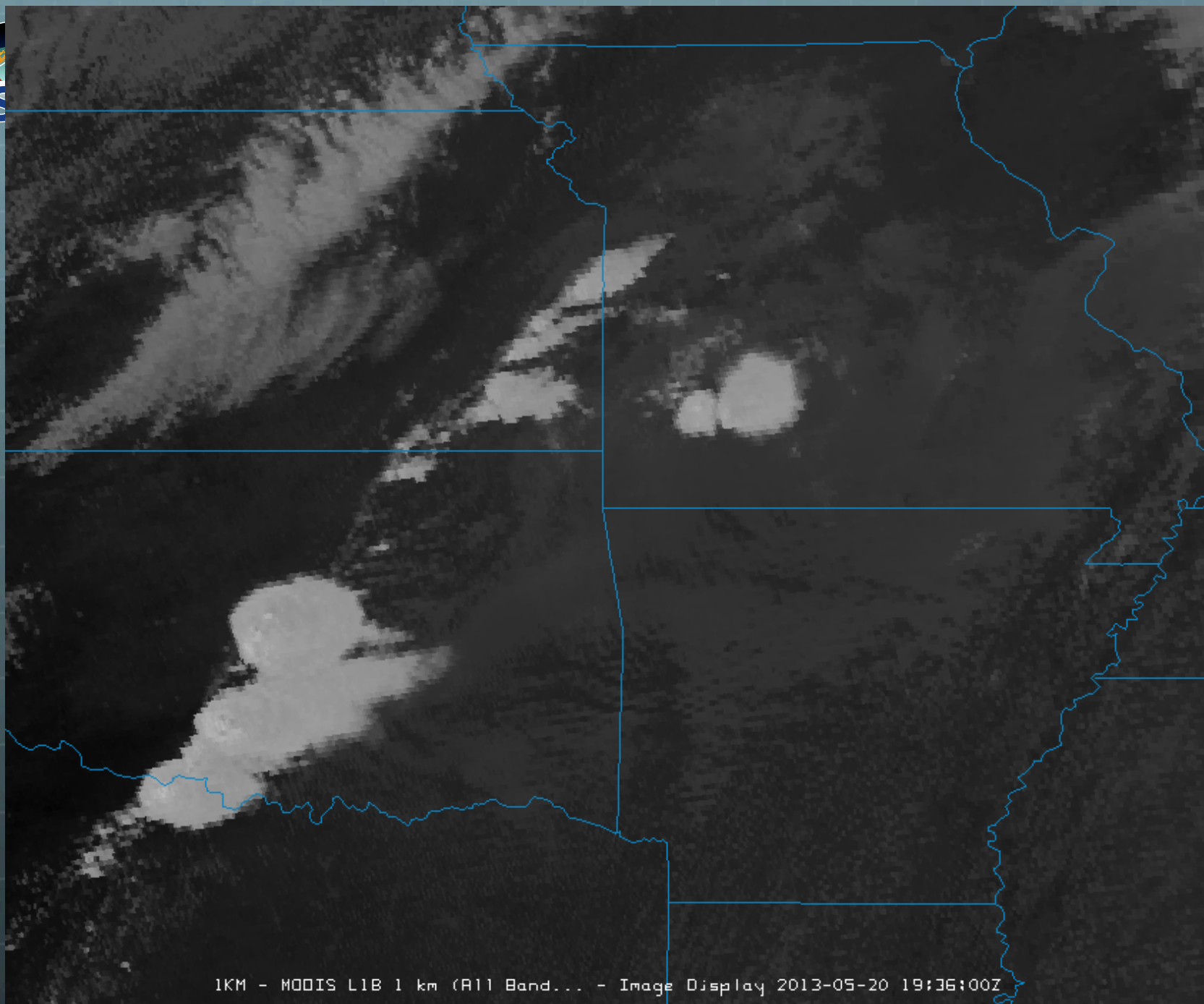


geocatL2.Terra.2013140.041735.hdf

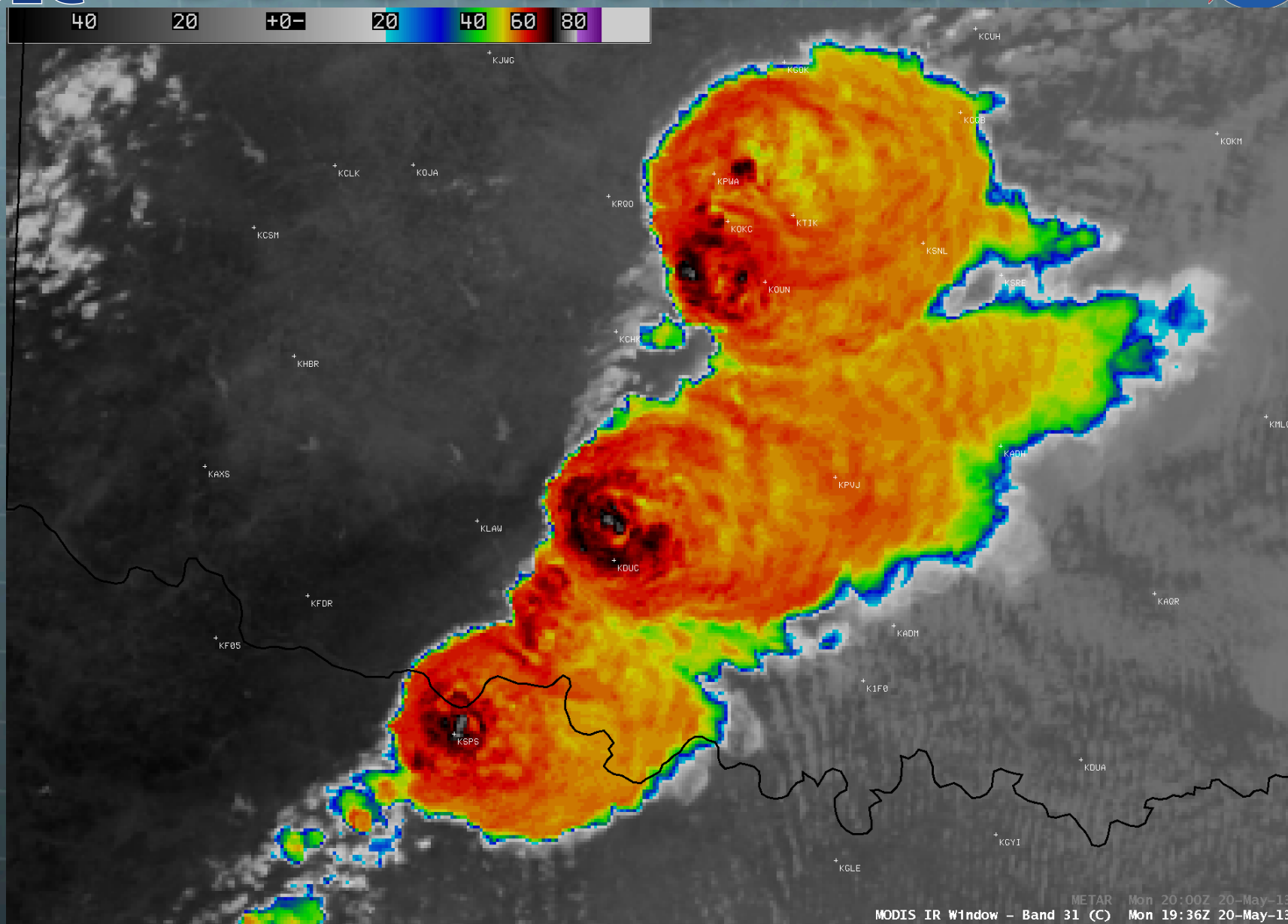
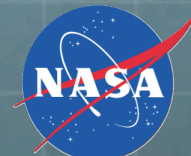
- Dimensions: lines = 4610, elements = 1354 ;
- 1 km resolution
- Variables:
 - short pixel_latitude(lines, elements) ;
 - short pixel_longitude(lines, elements) ;
 - short pixel_solar_zenith_angle(lines, elements) ;
 - short pixel_satellite_zenith_angle(lines, elements) ;
 - short pixel_relative_azimuth_angle(lines, elements) ;
 - byte pixel_surface_type(lines, elements) ;
 - byte pixel_ecosystem_type(lines, elements) ;
 - float ot_overshooting_top_grid_magnitude(lines, elements) ;
 - short ot_overshooting_top_grid_number_of_anvil_pixels (lines, elements) ;

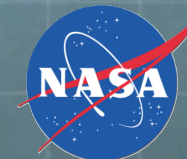


1KM - MODIS L1B 1 km (All Band... - Image Display 2013-05-20 19:36:00Z
geocatL2.Aqua.2013140.193613.h... - Color-Shaded Plan View

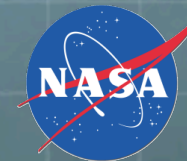


1KM - MODIS L1B 1 km (All Band... - Image Display 2013-05-20 19:36:00Z

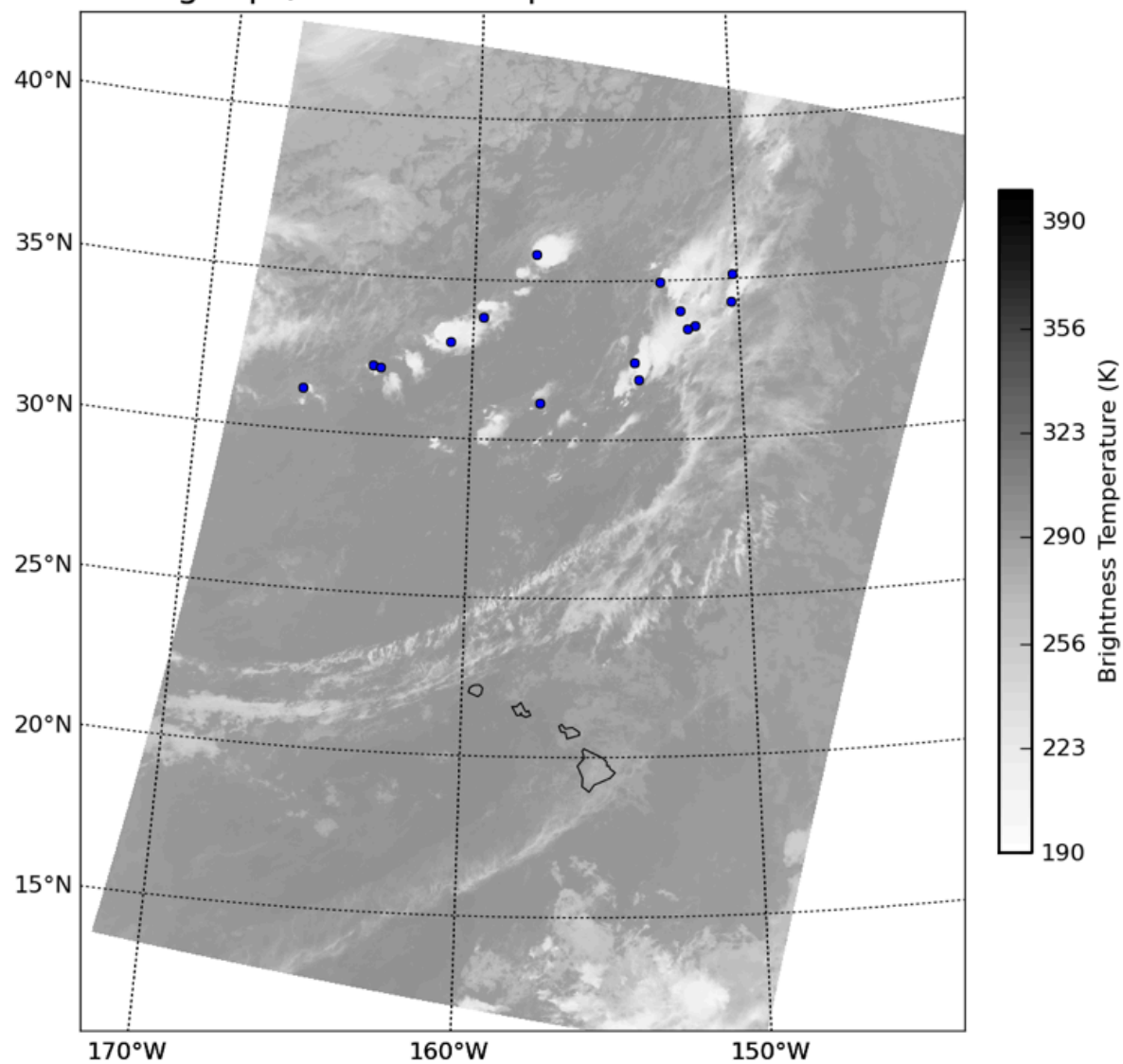


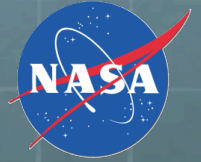


soest-hcc1.hcc.hawaii.edu/aqua/2013_08_20_232/images/		
Personal MODIS DB Wx JPSS Technical		
Parent Directory		
	AQUA_20_Aug_2013_0010_AerosolOpticalDepth.GIF	20-Aug-2013 00:36 47K
	AQUA_20_Aug_2013_0010_Band_01.GIF	20-Aug-2013 00:36 488K
	AQUA_20_Aug_2013_0010_Band_07.GIF	20-Aug-2013 00:36 508K
	AQUA_20_Aug_2013_0010_Band_26.GIF	20-Aug-2013 00:36 369K
	AQUA_20_Aug_2013_0010_Band_27.GIF	20-Aug-2013 00:36 195K
	AQUA_20_Aug_2013_0010_Band_31.GIF	20-Aug-2013 00:35 351K
	AQUA_20_Aug_2013_0010_CloudMask.GIF	20-Aug-2013 00:36 81K
	AQUA_20_Aug_2013_0010_CloudPhase.GIF	20-Aug-2013 00:36 68K
	AQUA_20_Aug_2013_0010_CloudTopPressure.GIF	20-Aug-2013 00:36 207K
	AQUA_20_Aug_2013_0010_RGB.JPG	20-Aug-2013 00:36 719K
	AQUA_20_Aug_2013_0010_SeaSurfaceTemperatures.GIF	20-Aug-2013 00:36 133K
	AQUA_20_Aug_2013_0010_WaterVapor.GIF	20-Aug-2013 00:36 68K
	AQUA_20_Aug_2013_1218_Band_27.GIF	20-Aug-2013 12:35 170K
	AQUA_20_Aug_2013_1218_Band_31.GIF	20-Aug-2013 12:35 326K
	AQUA_20_Aug_2013_1218_CloudMask.GIF	20-Aug-2013 12:35 77K
	AQUA_20_Aug_2013_1218_CloudPhase.GIF	20-Aug-2013 12:35 62K
	AQUA_20_Aug_2013_1218_CloudTopPressure.GIF	20-Aug-2013 12:35 208K
	AQUA_20_Aug_2013_1218_SeaSurfaceTemperatures.GIF	20-Aug-2013 12:35 133K
	AQUA_20_Aug_2013_1218_WaterVapor.GIF	20-Aug-2013 12:35 62K
	LightningRisk_MODIS_Aqua.2013232.0010.png	20-Aug-2013 00:28 371K
	LightningRisk_MODIS_Aqua.2013232.1218.png	20-Aug-2013 12:30 364K
	OverShootingTops_MODIS_Aqua.2013232.0010.png	20-Aug-2013 00:28 394K
	OverShootingTops_MODIS_Aqua.2013232.1218.png	20-Aug-2013 12:29 387K
	TurbulenceRisk_MODIS_Aqua.2013232.0010.png	20-Aug-2013 00:28 388K
	TurbulenceRisk_MODIS_Aqua.2013232.1218.png	20-Aug-2013 12:30 381K



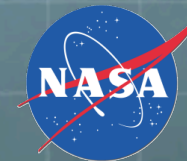
Overshooting Tops/Thermal Couplets: 2013-08-20 at 12:18 UTC



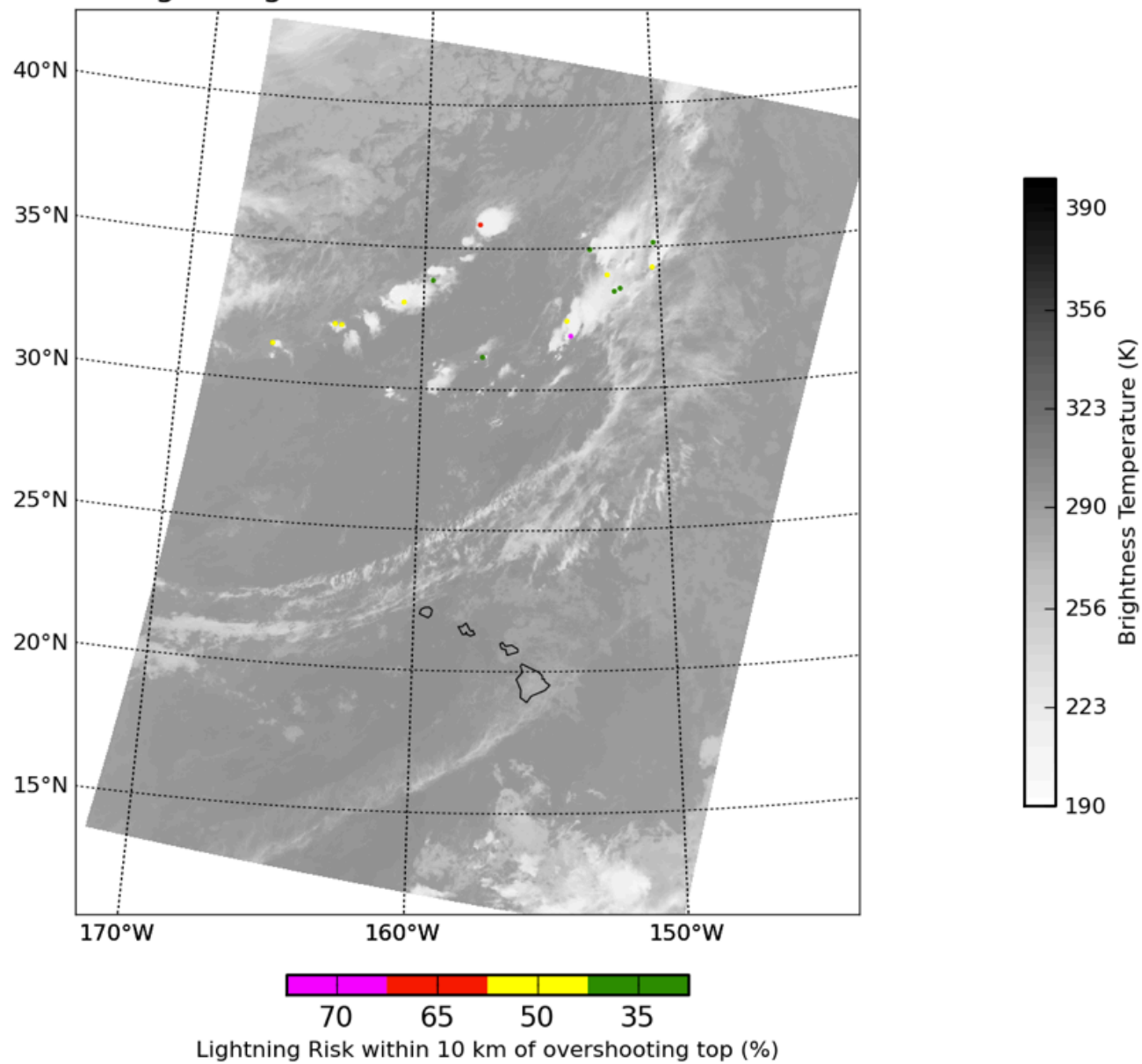


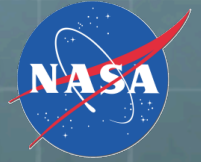
IMAPP Overshooting Top Lightning Risk Image

- According to the study by Bedka et al. 2010 (JAM), with the presence of an overshooting top, there is a 35% chance or greater, 50% chance or greater, 65% chance or greater, or 70% chance or greater of experiencing CG lightning within 10 km of the overshooting top center depending on the brightness temperature of the overshooting top. The colder the overshooting top brightness temperature is, the greater the chance of CG lightning. These relationships are shown on this image with each colored region identifying the area within a 10 km radius of the overshooting top center.



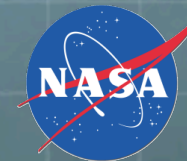
Lightning Risk: 2013-08-20 at 12:18 UTC





IMAPP Overshooting Top Turbulence Risk Image

- According to the study by Bedka et al. 2010 (JAM), with the presence of an overshooting top there is a 25% or greater chance of experiencing turbulence within 25 km of the overshooting top center. This relationship is shown on this image with each red region representing the area within a 25 km radius of the respective overshooting top center.



Turbulence Risk: 2013-08-20 at 12:18 UTC

