

IMAPP: Supporting Aqua and Terra Direct Broadcast Users for 15 Years

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Cooperative Institute for Meteorological Satellite Studies
Space Science and Engineering Center
University of Wisconsin Madison
CSPP/IMAPP Users' Group Meeting
15 April 2015

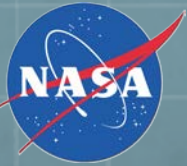


Lots of Others

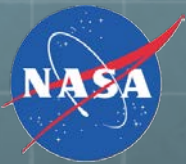


James Davies, Brad Pierce, Elisabeth Weisz, Eva Borbas, Robert Aune, William Straka, Scott Mindock, Ray Garcia, Graeme Martin, Nadia Smith, Rebecca Cintineo, Dave Hoese, Eva Schiffer, Katja Hungershofer, Jeff Key, Jordan Gerth, Scott Bachmeier, Mike Pavolonis, Crystal Schaaf, Yanmin Shuai, Peter Albert, Kris Bedka, Nigel Atkinson, Denis Denis Margetic, Tom Heinrichs, Dayne Broderson, Peter (Kung-Hwa) Wang, Aniko Kern, Christelle Ponsard, Philip Frost, Riris Adriyanto, Wei Gao, Jerrold Robaidek, Rosie Spangler, Paul Menzel, Tom Rink, Maria Vasys, Jerrold Robaidek, Rosie Spangler, Janean Hill, Douglas Ratcliff, Kevin Hallock, Nick Bearson, Richard Frey, Chris Moeller, Steve Ackerman, Dave Santek, Russ Dengel, William Smith, Scott Nolin, John LaLande, Bill Bellon

- UW SSEC
- NOAA/STAR
- Boston University
- NASA Goddard Space Flight Center
- Institut für Weltraumwissenschaften, Freie Universität, Berlin, Germany
- German Weather Service (DWD)
- NASA Langley
- NASA SPoRT
- Met Office
- NWS
- Taiwan Central Weather Bureau, Taipei
- Australian Bureau of Meteorology
- Eötvös Loránd University, Budapest, Hungary
- East China Normal University, Shanghai, China
- GINA Alaska
- EUMETSAT
- BMKG, Indonesian Agency for Meteorology, Climatology and Geophysics
- CSIR South Africa
- INPE/CPTEC
- Jet Propulsion Lab (JPL)



IMAPP



International MODIS/AIRS Processing Package

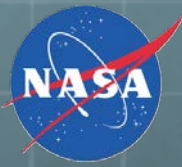
Funded by NASA since 2000

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

- 61 software packages released in 15 years
- More than 2000 registrants from 76 different countries
- 12 direct broadcast workshops held on 6 continents serving students from more than 60 countries
- 15 MODIS related software packages
- 6 AIRS related software packages
- 4 AMSR-E software packages



IMAPP Global Users



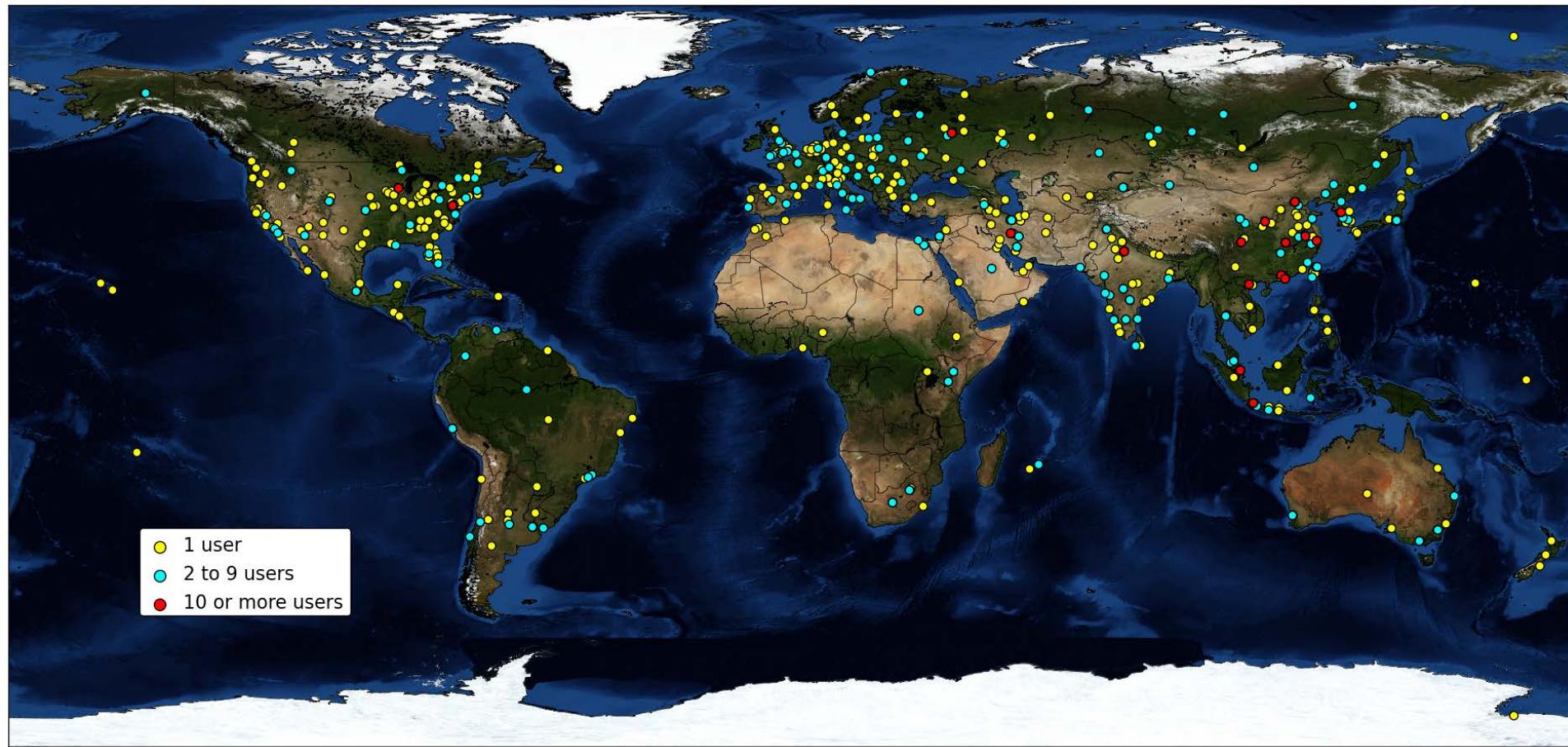
76 Different Countries (> 1/3 of the world total)

Italy
Argentina
Brazil
Kazakhstan
Ukraine
Indonesia
China
Denmark
South Africa
Taiwan
Japan
Morocco
Iran
Singapore
India
Germany
United Kingdom
Iceland
Slovenia
Uganda

Australia
Czech Republic
Canada
Spain
Chile
Pakistan
Nepal
Portugal
Poland
Saudi Arabia
El Salvador
Colômbia
Serbia
Kenya
Oman
Sweden
Uzbekistan
Switzerland
Peru
Ethiopia

Mexico
Hungary
Belgium
Norway
Venezuela
Sri Lanka
France
Russia
Vietnam
Mongolia
Turkey
South Korea
UAE
Lithuania
United States
Thailand
Philippines
Ethiopia
Suriname
Netherlands

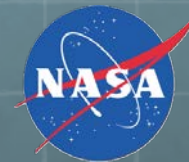
Romania
Malaysia
Algeria
Reunion
Austria
Finland
Czech Republic
New Zealand
Guatemala
Uruguay
Israel
Azerbaijan
Cuba
Kuwait
Syria
Dominican
Republic
Belarus
Laos



More than 2000 Registrants since launch of new website in 2007



Global IMAPP Workshops



Web site: <http://cimss.ssec.wisc.edu/dbs/>

2004 – Nanjing, China

2004 – Perth, Australia

2005 – Taipei, Taiwan

2005 – Beijing, China

2006 – Andenes, Norway

2006 – Pretoria, South Africa

2007 - Cachoeira Paulista, Brazil as part of GEOSS

2009 – Stellenbosch University, South Africa

IGARSS Short Course 4: MODIS direct broadcast data for enhanced forecasting and real-time environmental decision making

2011 June – Shanghai, China

2011 September – Jakarta, Indonesia

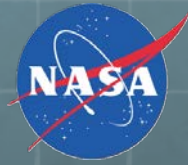
WMO Region V Training workshop on satellite applications for meteorology and climatology

2013 September – Honolulu, Hawaii

Hawaii VIIRS / MODIS Direct Broadcast Applications Workshop

2015 February – Miami, Florida

AOML Miami VIIRS / MODIS Direct Broadcast Applications Workshop



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 effective radius and cloud optical thickness
- Temperature and moisture profiles
- Total precipitable water
- Stability indices
- Aerosol optical depth (3km and 10km)
- 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 ...](#)
- MODIS L1B and True Color GeoTIFF
[Learn more ...](#)

AIRS and AMSU Products (Aqua)

Sensor Products

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

[Learn more ...](#)

Atmosphere Products

- JPL Temperature and moisture profiles (3x3 AIRS FOV)
[Learn more ...](#)
- UW Temperature and moisture profiles (single FOV AIRS, CrIS and/or IASI dual regression technique)
[Learn more ...](#)
- Collocated AIRS/MODIS temperature and moisture profiles (single AIRS FOV; clear and cloudy sky)
[Learn more ...](#)

Utilities

- AIRS HDF to BUFR converter
[Learn more ...](#)

NWP Products

The Direct Broadcast CIMSS Regional Assimilation System (DBCRAAS) 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 ...](#)

GeoTIFF Web Mapping Service (WMS) MODIS Display Tool

This package provides users with the capability to display and share GeoTIFF products through a web browser in a Google Maps interface. It is designed specifically for display of MODIS and VIIRS default GeoTIFF files created by the Polar2Grid reprojection software package. It is distributed as a virtual machine (VM).

[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 storms with OTs have the potential to produce severe weather at the ground (heavy rain, damaging winds, hail and tornadoes) as well as aviation hazards including lightning and turbulence.

[Learn more ...](#)

Air Quality Forecast Products

- The Infusing Satellite Data Into Environmental Applications - International (IDEA-I) software utilizes the MODIS Aerosol Product (MOD04) to identify regions of elevated air pollution, then runs a trajectory model to forecast the vertical and horizontal movement of the aerosols in the next 48 hours.

[Learn more ...](#)

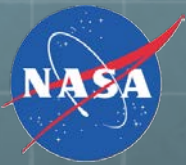
- A second version of the IDEA-I software identifies regions of high

What's New

- MODIS Level 2 Package v3.1
- MODIS Reprojection Software v1.2
- AIRS, CrIS and IASI Stratospheric Ozone Intrusion Forecast Package v1.0
- AIRS, CrIS and IASI Hyperspectral Sounder Retrieval Package v1.3
- GeoTIFF Web Mapping Service Display Package v1.0
- EOS HYDRA2 Data Analysis Tool v1.0
- MODIS Air Quality Aerosol Forecast Package (Version 1.1)



Suite of Products



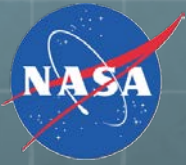
MODIS Products (Terra and Aqua)

- **Atmosphere Group Collect 6**
 - **Cloud mask (MOD35)**
 - **Cloud top pressure and temperature (MOD06CT)**
 - **Cloud effective radius and cloud optical thickness (MOD06OD)**
 - **Temperature and moisture profiles (MOD07)**
 - **Total precipitable water (MOD07)**
 - **Stability indices (MOD07)**
 - **Aerosol optical depth (3km and 10km) (MOD04)**
 - **Bright Target Aerosol Optical Depth (Deep Blue) (MOD04)**

- **Polar Products from Jeff Key (NOAA Cryosphere)**
 - **Ice Surface Temperature**
 - **Snow Mask**
 - **Ice Cover and Ice Concentration**
 - **Inversion Strength and Inversion Depth**



Suite of Products



MODIS Land Products (Terra and Aqua)

- MODIS Surface Reflectance (MOD09)
- Nadir Bidirectional Reflectance Distribution Function (BRDF)

MODIS Image Products

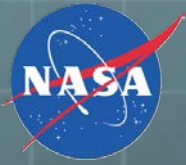
- Polar2Grid reprojection software for AWIPS, GeoTIFF, and KML
- True Color Reprojection for Display in Google Earth (DB Google Earth) – Full Resolution

AIRS and AMSU Products (Aqua) from Jet Propulsion Lab (JPL)

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



Suite of Products



AIRS and AMSU Products (Aqua)

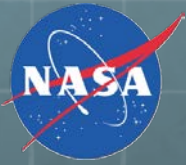
- 3x3 AIRS FOV retrievals – JPL (Collect 5)
- UW Dual Regression single FOV retrievals (AIRS, CrIS, IASI)
- Collocated AIRS/MODIS retrievals.
- AIRS/AMSU HDF4 to BUFR Converter with Met Office (Meeting request from John Le Marshall at BOM)

AMSR-E Products

- Calibrated and Geolocated Antenna Temperatures
- Rain Rate
- Soil Moisture
- Snow Water Equivalent



Suite of Products



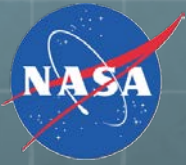
HYDRA2 Multispectral Data Analysis Toolkit - more later

Numerical Weather Prediction (NWP) Model DBCRAS

- 🌐 Direct Broadcast CIMSS Regional Assimilation system (DBCAS).**
- 🌐 Globally configurable NWP at 48 km resolution**
- 🌐 Nested grid at 16 km.**
- 🌐 72 hour forecast of gridded meteorological fields.**
- 🌐 Assimilates MODIS Cloud (MOD06) and Moisture (MOD07) Retrievals to improve initial conditions in the model.**
- 🌐 Output includes forecast IR and Water Vapor Satellite Imagery.**
- 🌐 Used in several sites around the world including ISRO India.**



Suite of Products



Web Mapping Service for display of GeoTIFFs created by Polar2Grid - More later

Overshooting Tops Aviation Hazard Software

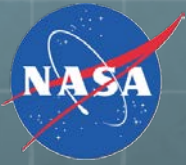
- **Identifies potentially dangerous convection that protrudes into the stratosphere.**
- **Using Dr. Kris Bedka algorithm applied to IR bands.**
- **Creates output product images that include areal coverage of danger of lightning and turbulence.**

Infusing satellite Data into Environmental Applications – International (IDEA-I)

- **Globally configurable package for Air Quality Forecasters**
 - **MODIS Aerosol Pollution forecast trajectories, using MOD04 products with web interface and control of animations.**
 - **AIRS Stratospheric Ozone intrusions trajectories, using AIRS upper tropospheric ozone retrievals with webs inteface and control of animations.**



Suite of Products

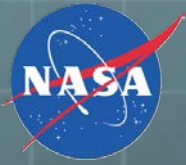


IMAPP Virtual Appliance

- A complete free Aqua and Terra DB processing system (Level 0 to Level 2 products plus quicklooks) in the form of a Virtual Appliance which can be installed and run on:
 - Microsoft Windows (7, Vista, XP)
 - Linux
 - Apple OS X
- Uses all freely available software that is available from IMAPP, SeaDAS and NASA DRL
- Easy to install and run full-featured processing system Level 0 – Level 2 plus browse images



Aqua and Terra Status



- Terra launched in 1999
 - original design life was 6 years
 - Current life expectancy: Terra has far exceeded its design life and has a strong chance of operating successfully into the early 2020s.

<http://terra.nasa.gov/about>

- Aqua launched in 2002
 - Current life expectancy: Aqua has a strong chance of operating successfully into the early 2020s
 - Greater detail on the status of the Aqua spacecraft, instruments, and other aspects of the mission are presented in a PDF [Aqua Status file](http://aqua.nasa.gov/sites/default/files/AquaStatus_March2015.pdf), updated monthly.

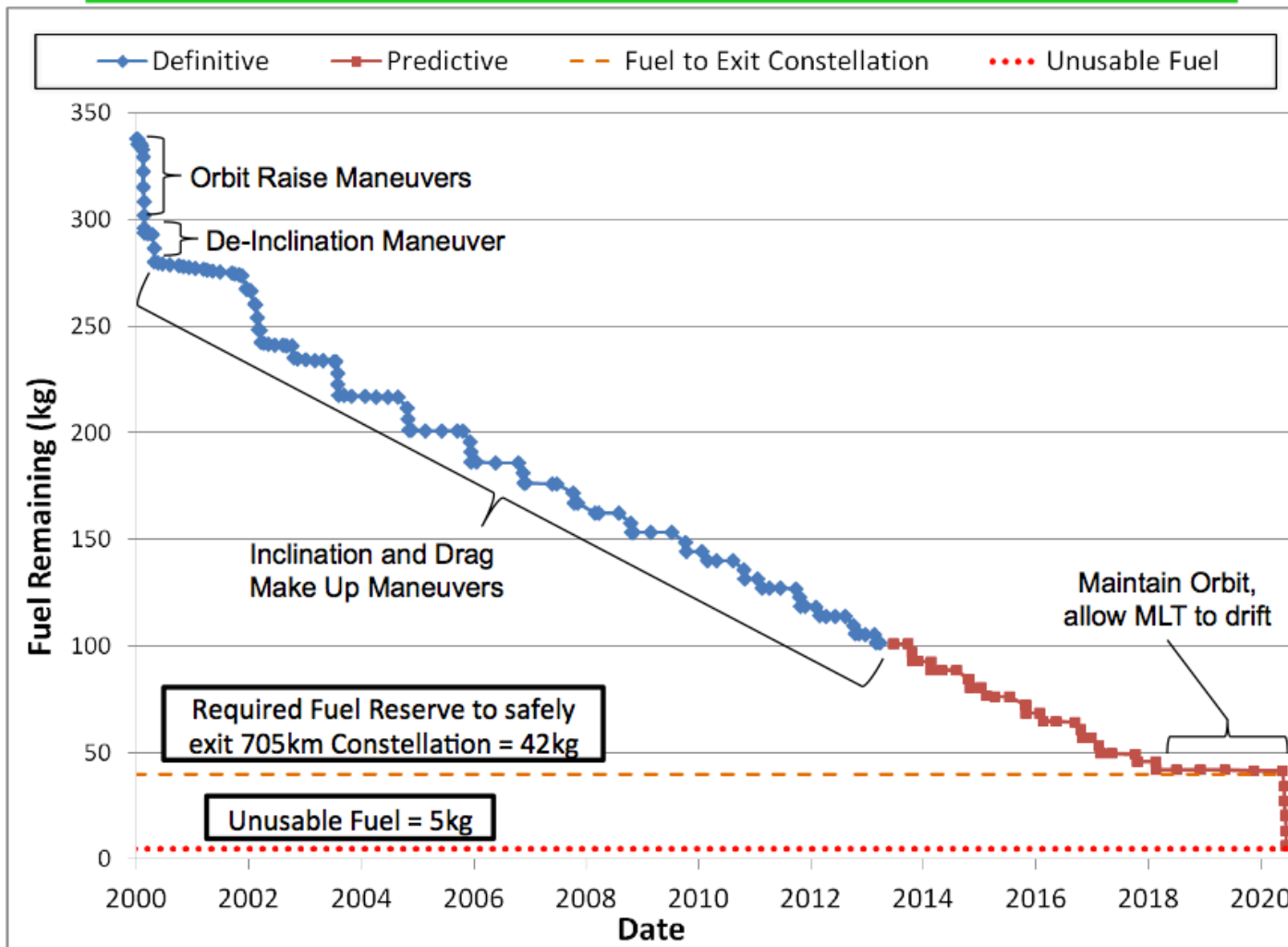
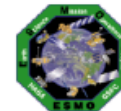
http://aqua.nasa.gov/sites/default/files/AquaStatus_March2015.pdf

<http://aqua.nasa.gov/>



Fuel Usage: Actual & Predicted

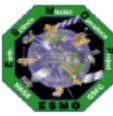
(Updated April 2013)



Based on predicted fuel usage, Terra can continue to perform propulsive maneuvers (to maintain the orbit) to support the science requirements into 2020. Mean Local Time (MLT) will drift from 10:30am to 10:15am.



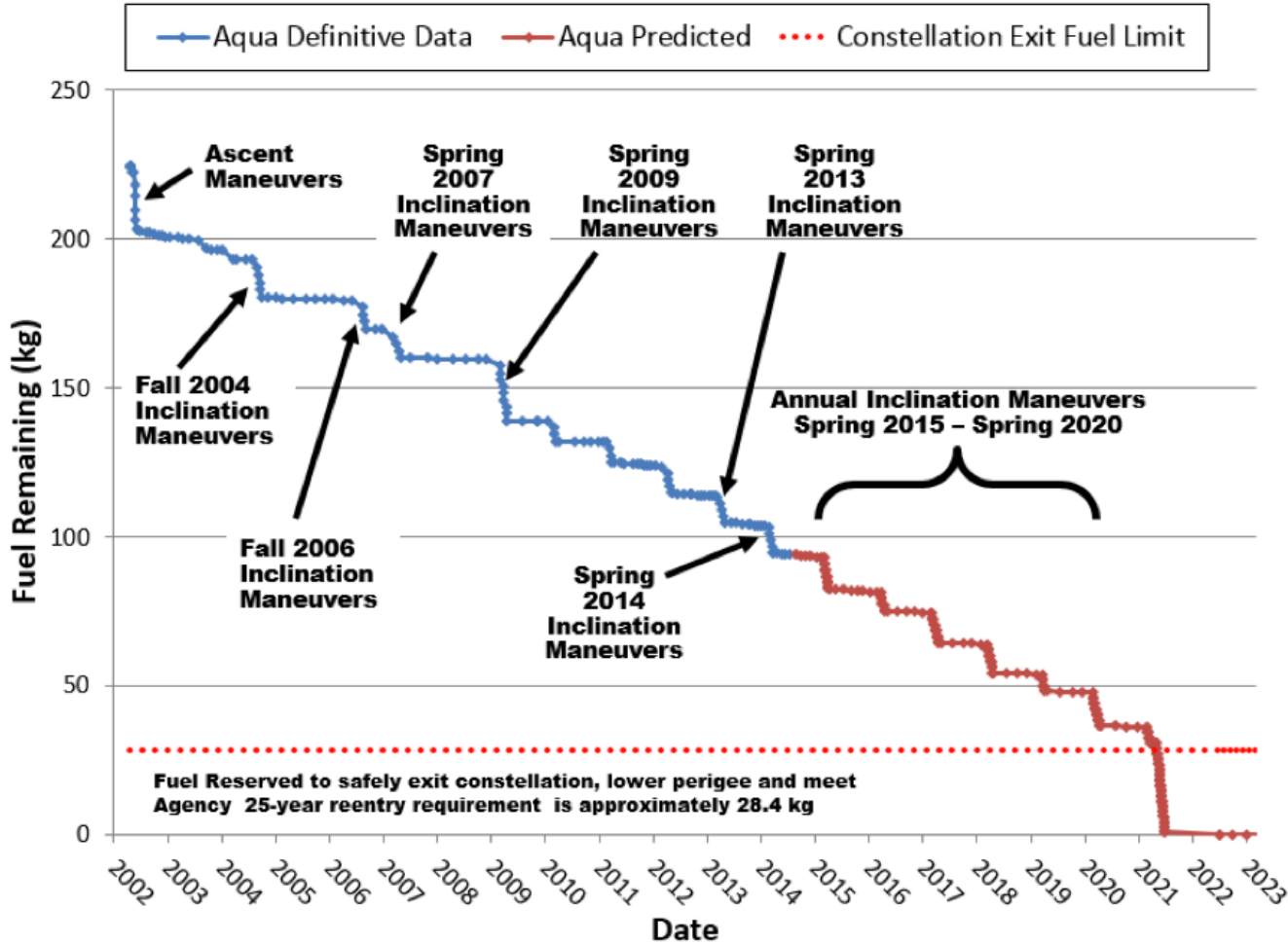
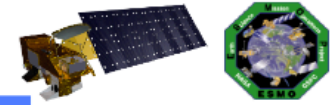
Terra Summary



- **Spacecraft Bus – Nominal Operations (Very Good Health)**
 - All Components remain on primary hardware with following exception:
 - Direct Access Modulator (X-Band) primary side failed in 2008. No impact to Nominal Operations
 - Battery Cell Failure (1 of 108). No impact to Nominal Operations
 - Battery Heater Control failure (effects 4 of 18 Heater Groups). No impact to Nominal Operations
 - Solar Array Panel Failure (1 of 24) in Sept 2000. No impact to Nominal Operations
 - Solid State Recorder Print Wire Assembly Anomalies (9 of 59 are offline)
 - Operationally able to manage by reducing ASTER data captured and increasing playback opportunities
 - Recycle of Memory Unit likely to recover all PWAs currently offline however not warranted at this time
- **MODIS – Nominal Operations (Very Good Health – loss of redundancy)**
 - All voltages, currents, and temperatures as expected
 - Power Supply Failure (June 2001). Switched to redundant. Single point of failure
 - Formatter Degradation (Sept 2002). Switched to redundant. Single point of failure
 - MODIS Solar Diffuser Screen Door Failed Closed (May 2003); Solar Diffuser Door was configured to remain open indefinitely in July 2003; Current configuration allows for Nominal Science
- **MISR – Nominal Operations – (Excellent Health)**
 - All voltages, currents, and temperatures as expected
- **ASTER – Nominal Operations (TIR and VNIR – Excellent Health, SWIR – Failed)**
 - All voltages, currents, and temperatures as expected.
 - SWIR – Compressor unable to maintain detector temperature after April 2008. No Science Data
 - VNIR – Nominal Operation
 - TIR – Nominal Operation
- **CERES-FORE and AFT (FM-1 & FM-2) – Nominal Operations (Excellent Health)**
 - All voltages, currents, and temperatures as expected.
 - Cross-Track and Biaxial Modes fully functioning.
 - All channels remain operational.
- **MOPITT – Nominal Operations. (Good Health – loss of redundancy, partial blockage)**
 - All voltages, currents, and temperatures as expected
 - Displacer-B Failure (May 2001). Operating Compressor B at reduced speed to minimize spacecraft disturbance
 - Chopper motor failure – data collection modified – no impact on science data (August 2001)



Fuel Usage: Actual & Predicted (Updated September 2014)

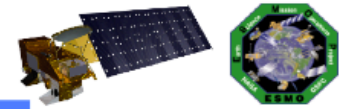


Fuel usage continues to follow prediction

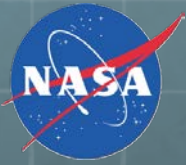


Aqua Summary

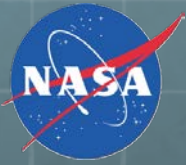
(as of March 25, 2015)



- **Spacecraft Bus** – Nominal Operations (Excellent Health)
 - All Components remain on primary hardware.
- **MODIS** – Nominal Operations (Excellent Health)
 - All voltages, currents, and temperatures as expected.
 - All Components remain on primary hardware.
- **AIRS** – Nominal Operations (<5% of Channels degraded) – (Excellent Health)
 - Cooler A Telemetry is frozen since March 28, 2014 to last known value. Not impacting Science
 - All other voltages, currents, and temperatures as expected.
 - ~200 of 2378 channels are degraded due to radiation, however they are still useful.
- **AMSU-A** – Nominal Operations for 12 of 15 Channels (Good Health)
 - All voltages, currents, and temperatures as expected.
 - 3 of 15 channels have been removed from Level 2 processing.
- **CERES-AFT (FM-3)** – Nominal Operations (Excellent Health)
 - All voltages, currents, and temperatures as expected.
 - Cross-Track and Biaxial Modes fully functioning.
 - All channels remain operational.
- **CERES-FORE (FM-4)** – Nominal Operations (Good Health)
 - All voltages, currents, and temperatures as expected.
 - Cross-Track is Nominal. Biaxial Mode is Nominal when used.
 - The Shortwave channel failed on March 30, 2005; the other two channels remain operational.
- **AMSR-E** – Operating at 2 rpm; No Science – Calibration Only (Poor Health)
 - All voltages, currents, and temperatures as expected.
 - Operating at reduced rotation rate for calibration purposes only.
- **HSB** – Non-operational since February 2003 anomaly

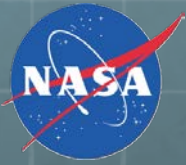


What's New?



HYDRA2

- Allows interactive display of Level 1B and Level 2 products from multispectral imagers (VIIRS, MODIS), high spectral resolution sounders (CrIS, IASI, AIRS), and microwave sounders (ATMS, AMSU).
- Different data sets can be collocated, compared, combined, and masked.
- Designed to be easy to learn and use, especially for students.
- Supported on Windows, OS X, and Linux.



Is it Useful?



Miami 2015



[Workshop Home Page](#)

[Location](#)

[Agenda \(pdf\)](#)

[Lectures](#)

[Labs](#)

[Software](#)

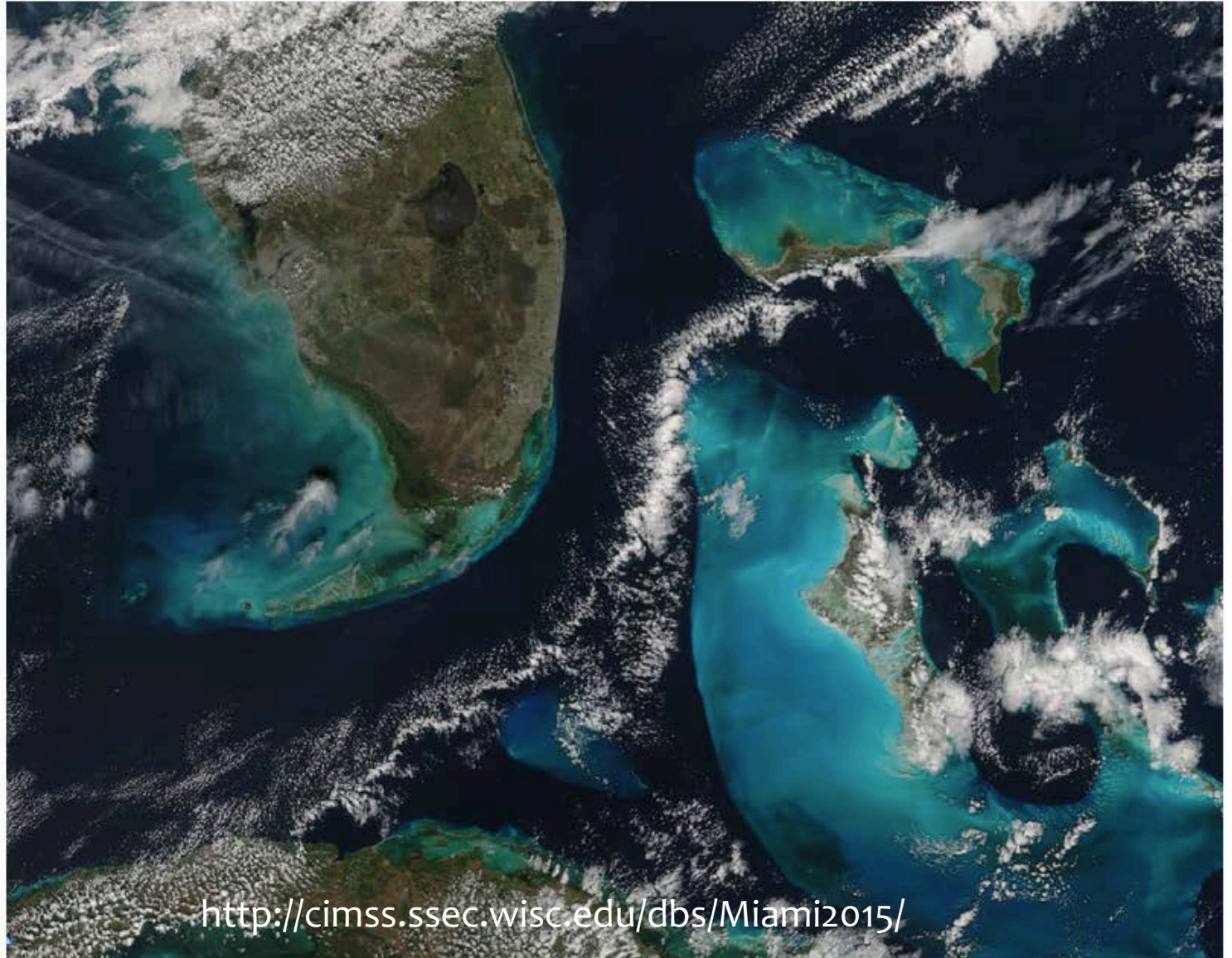
[Useful Links](#)

[Pictures](#)

[Sponsoring Institutes](#)

[DBS home page](#)

Miami AOML Direct Broadcast Applications Workshop



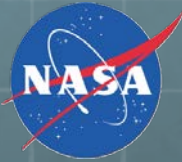
<http://cimss.ssec.wisc.edu/dbs/Miami2015/>







2015 Miami Polar Orbiter Workshop: Satellite Direct Broadcast in Support of Real-Time Environmental Applications



Location: Atlantic Oceanographic and Meteorological Laboratory (AOML) of NOAA, Miami, Florida

Date: 10-13 February 2015

Workshop Agenda

**Day One Polar Orbiter Sensors - including MODIS and VIIRS imagers
10 February 2015 Liam Gumley**

9:00 AM – Noon Lecture: Introduction to Polar-Orbiting Satellites and Sensors

- Properties of Polar-Orbiting Satellite sensors
- Bowtie effects and data aggregation
- SDR and Level 1B products and formats
- Software for visualization of SDRs and Level 1B files
- Overview of DB system at AOML
- Overview of Software for SDR and L1B file generation
- CSPP – Community Satellite Processing Package

Noon – 1:00 PM Lunch on Site and Loading of Lab Data to Laptops

1:00 PM – 5:00 PM Lab Session: Exploring MODIS and VIIRS L1B data in Hydra

- Learning Hydra
- Exploring S-NPP SDR and MODIS L1B using data from the AOML antenna

**Day Two Level 2 Polar Orbiter Products and Applications
11 February 2015 Kathleen Strabala**

9:00 AM – Noon Lecture: MODIS Level 2 and VIIRS EDR algorithms and products

- MODIS and VIIRS Atmosphere Products and Applications including identification of severe weather signatures and atmospheric turbulence.
- MODIS and VIIRS Land Products and Applications including fire detection.
- MODIS and VIIRS Ocean Products and Applications.
- VIIRS Day/Night Band Applications.

Noon – 1:00 PM Lunch on Site and Loading of Lab Data to Laptops

1:00 PM – 5:00 PM Lab Session: MODIS and VIIRS data and product applications

- Exploring VIIRS Day/Night Band Capabilities.
- Exploring MODIS and VIIRS Cloud Composition and Severe Weather Detection Capabilities.
- Exploring MODIS and VIIRS Fire Detection capabilities.
- Exploring Ocean Features in MODIS and VIIRS data.



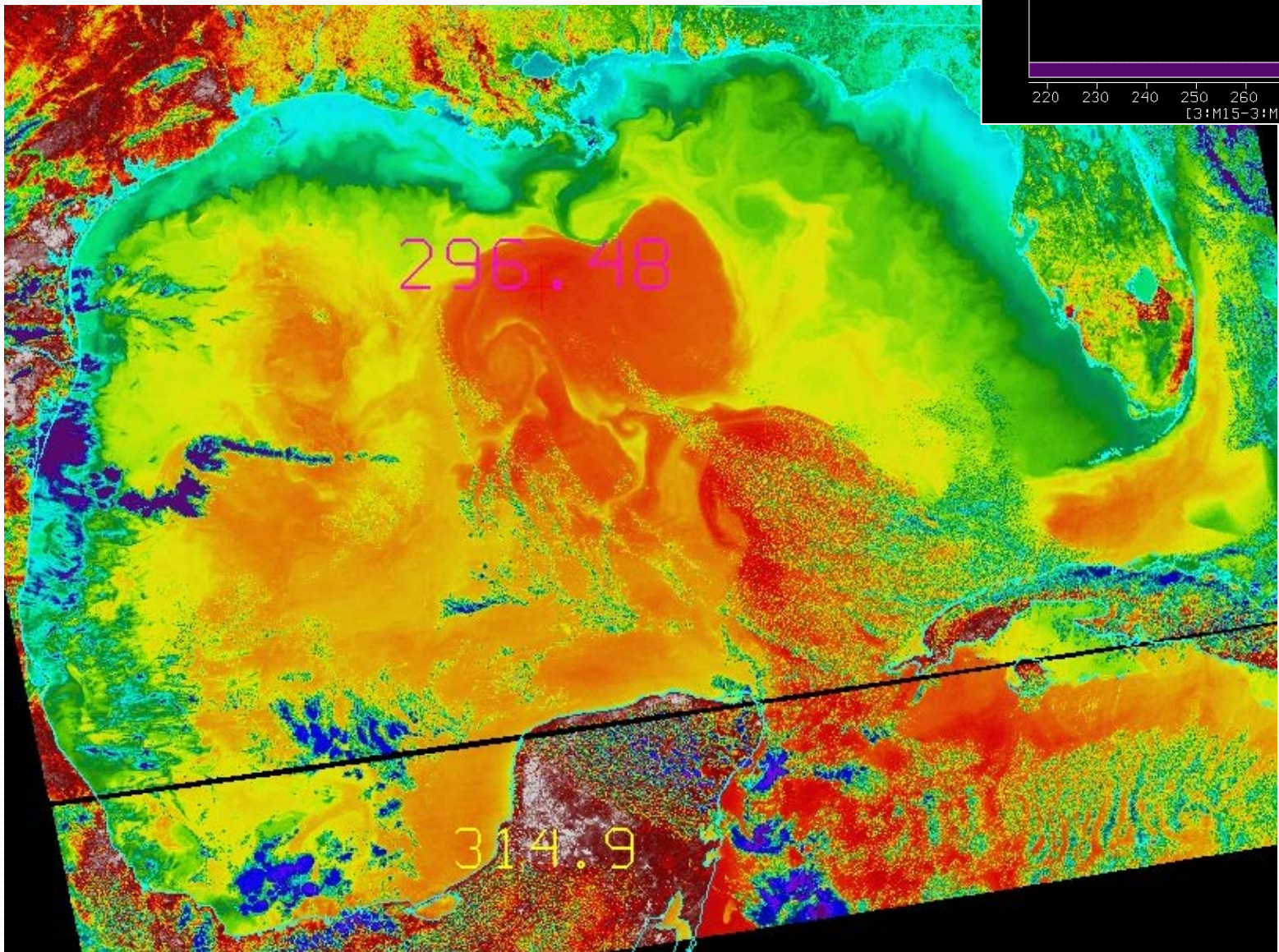
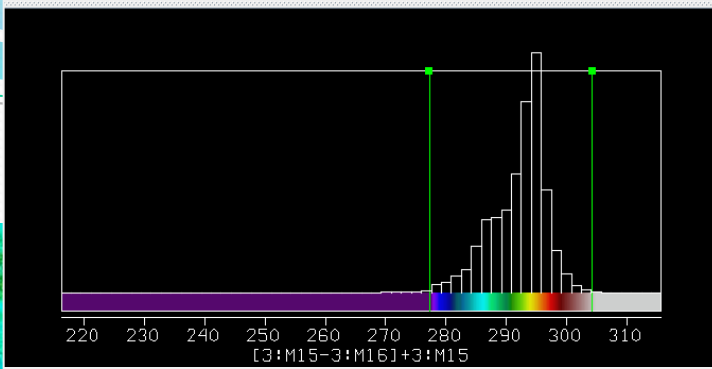


Predicting Bluefin Tuna Spawning in the Gulf of Mexico using Polar Orbiter Imagery

Alexandra Ender
Sarah Privoznik
Estrella Malca

13 February 2015

Maximum observed temperature
= 296.48K (23.3°C)





Hydra



Objetivo: Inspeccionar da

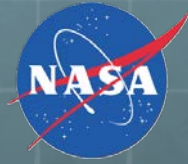
Visualización y análisis de datos

- ✓ TERRA (MODIS)
- ✓ AQUA (MODIS y AIRS)
- ✓ NPP (VIIRS, CrIS y ATMS)
- ✓ Metop-A y B (IASI)

Plataformas soportadas: Apple OS X, Micros



espectr



Programa

Contenidos generales

- *Introducción a la Tecnología de la Percepción Remota.*
- *Fundamentos físicos de la teledetección.*
- *Características de los sistemas satelitales.*
- *Posibilidades de aplicación de los datos provistos por los distintos sistemas satelitales.*
- *Interpretación visual de imágenes.*
- *Productos derivados.*
- *Emergencias ambientales.*
- *Aplicación y metodología en estudios de casos.*

Lunes 2 de junio de 2014

Teoría: Introducción Fundamentos de la percepción remota. Radiación electromagnética. Características del espectro electromagnético. Interacción de la radiación con la atmósfera. Interacción de la radiación con los elementos de la superficie de la tierra. Características de los sistemas satelitales. Tipos de sensores. Imágenes reflectivas y térmicas. Imágenes multiespectrales (RGB).

Práctica: Exploración de distintas bandas del espectro electromagnético utilizando imágenes de los satélites NOAA y METOP (AVHRR). Interpretación visual de imágenes espectrales y multiespectrales. Combinación de bandas en RGB.

Martes 03 de junio de 2014

Teoría: Satélites meteorológicos y ambientales: NOAA y METOP (AVHRR), TERRA y AQUA, NPP, GOES, LANDSAT y SPOT: Ejemplos de aplicaciones. Corrección geométrica y radiométrica. Realces.

Práctica: Acceso a datos satelitales a través de sitios de internet, búsqueda de distintos productos. Aplicaciones. Corrección por distorsión geométrica (Pasadas en borde, vs Pasadas cenitales). Aplicaciones de realces.

ACTIVIDAD N° 6

Material Provisto:

-Imagen satelital MODIS TERRA 14/01/2010 a las 14: 00 UTC. 500 metros de resolución espacial.

Obtenida del sitio <http://lance-modis.eosdis.nasa.gov/cgi-bin/imagery/realtime.cgi>

Software HYDRALII <http://cimss.ssec.wisc.edu/imapp/download/>



Figura 1: Firmas espectrales para distintas superficies

Ejercitación:

Imagen satelital -MODIS TERRA 14/01/2010 a las 14: 00 UTC. 500 metros de resolución espacial.

Obtenida del sitio: <http://lance-modis.eosdis.nasa.gov/cgi-bin/imagery/realtime.cgi>

1. Abrir la imagen correspondiente al 14/1/2010 MODIS-TERRA a las 14:00 utc a 500 metros de resolución espacial. (Open file, voy al directorio y la abro).

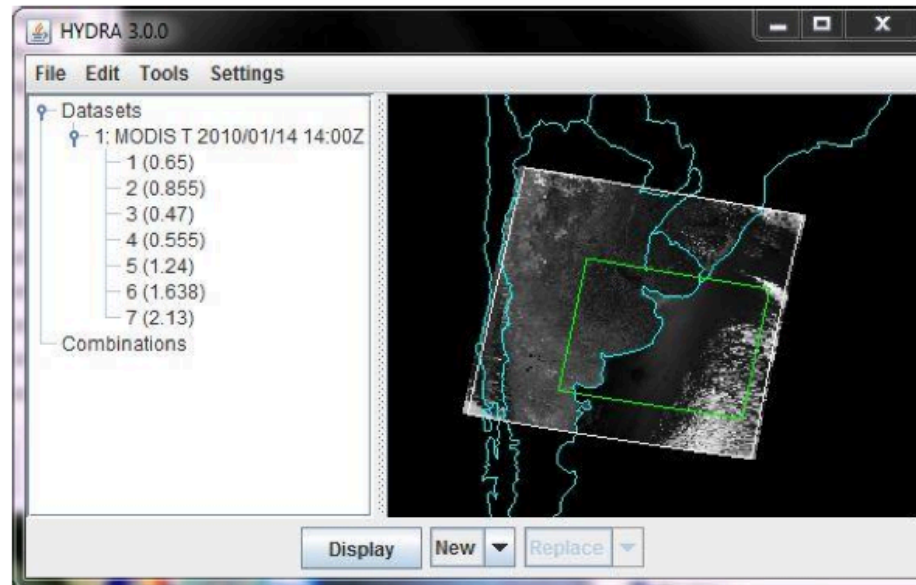
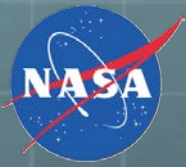


Figura 3: imagen 14-1-2010 MODIS-TERRA

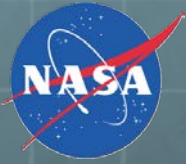
2. Realizar un recorte de la imagen según **Figura 3** y luego crear una imagen en composición color verdadero en RGB. (Menú principal – tools- RGB composite). Desplegar en una nueva ventana en RGB, las bandas correspondientes a una composición color verdadero utilizando de referencia el material provisto en esta práctica. **Figura 2.** (características del espectro electromagnético).



Polar2Grid



- Written to reproject/reformat MODIS L1b and L2 products for display in UW National Weather Service visualization and analysis system AWIPS (I and II)
- Needed a replacement for previous reprojection licensed software for deployment outside of Wisconsin (Alaska / Pacific)
- Extended for creation of GeoTIFFS including true color (v1.2)
- Executes Corrected Reflectance (crefl) software (available from NASA DRL website), if files are not already available, then uses those files to create reprojections.
- Simple implementation through bash scripts wrapping python:
 - `modis2awips.sh -g grid -f <files>`
 - `modis2gtiff.sh -g <grid> -f <files>` (-g is optional – defaults to Google projection ~ 600m)
 - `crefl2gtiff.sh -g <grid> -f <files>` (-g is optional – defaults to Google projection ~ 600m)

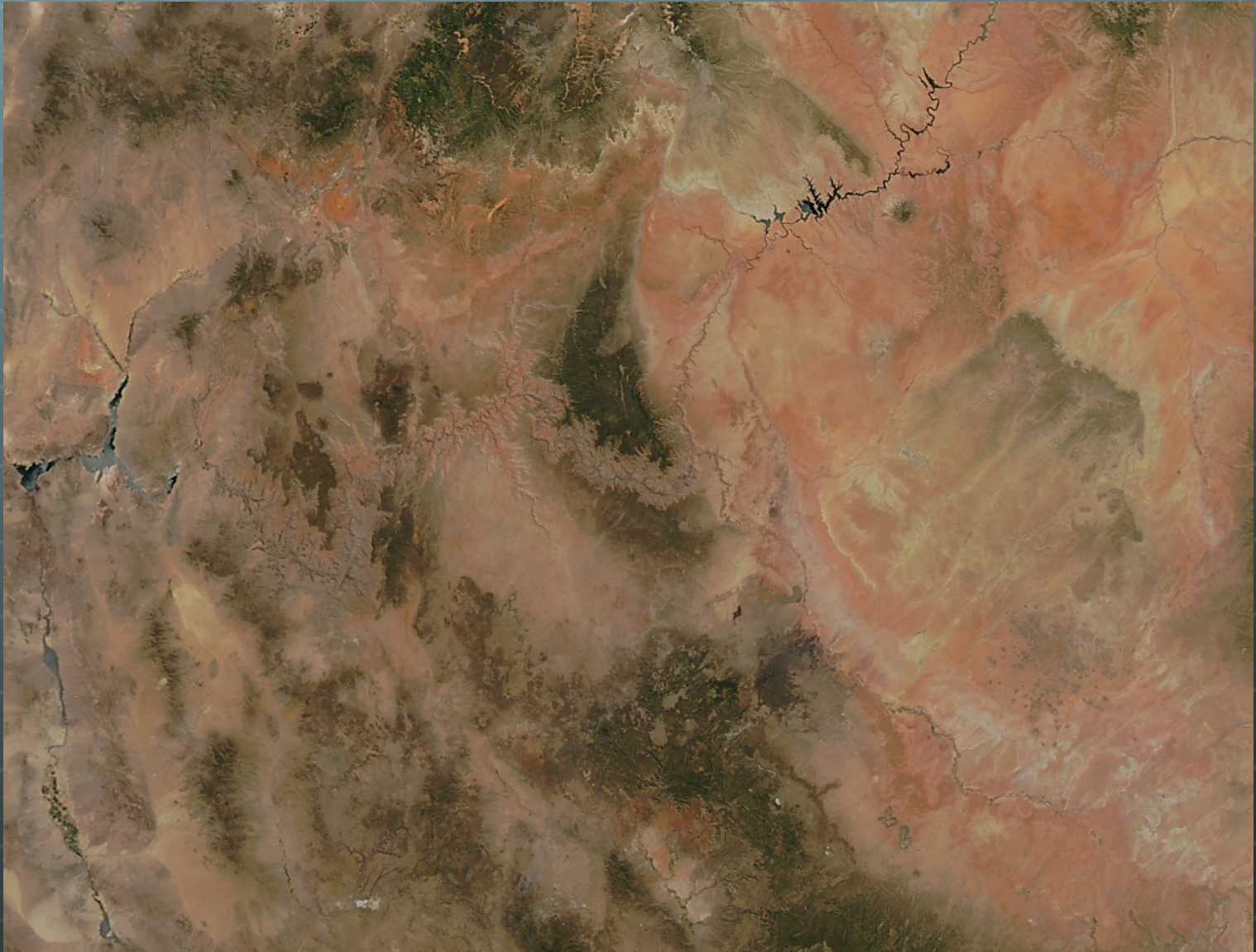
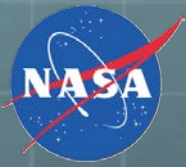


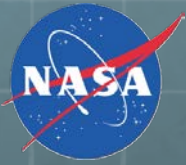
Polar2Grid

- Example: Define my own grid by using helper script:
 - `p2g_grid_helper.sh -p <projection> grid_name center_longitude center_latitude pixel_size_x pixel_size_y grid_width grid_height`
 - Default projection is lambert conic conformal
 - `p2g_grid_helper.sh grand_canyon -112.1 36.1 500 500 1000 750`
 - `grand_canyon, proj4, +proj=lcc +datum=WGS84 +ellps=WGS84 +lat_0=36.100 +lat_1=36.100 +lon_0=-112.100 +units=m +no_defs, 1000, 750, 500.000, -500.000, -114.936deg, 37.756deg`
 - `crefl2gtiff.sh --grid-configs grid_example.conf -g grand_canyon -f ../input/a1.13171.2033.crefl.{1000m,250m}.hdf`



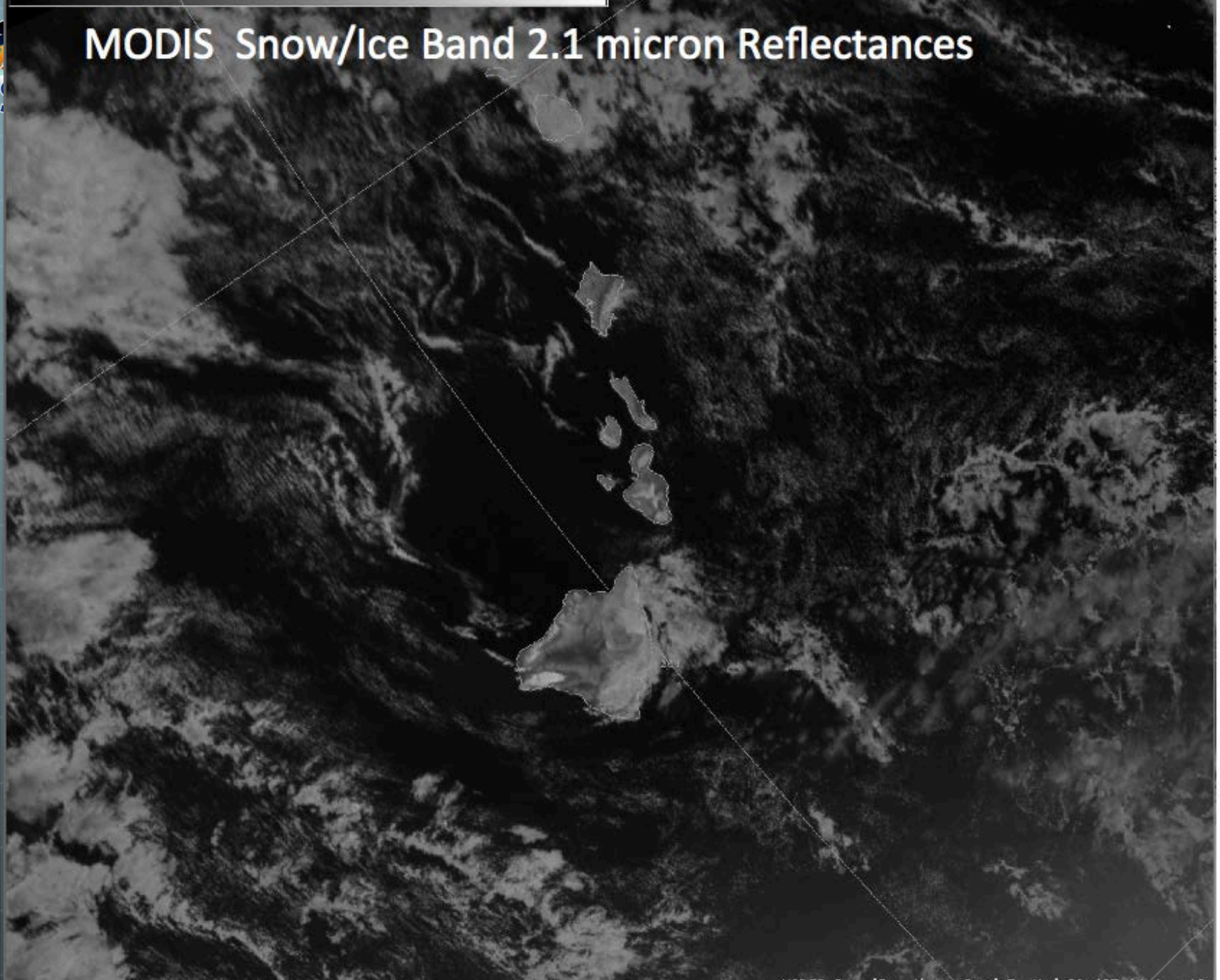
Polar2Grid



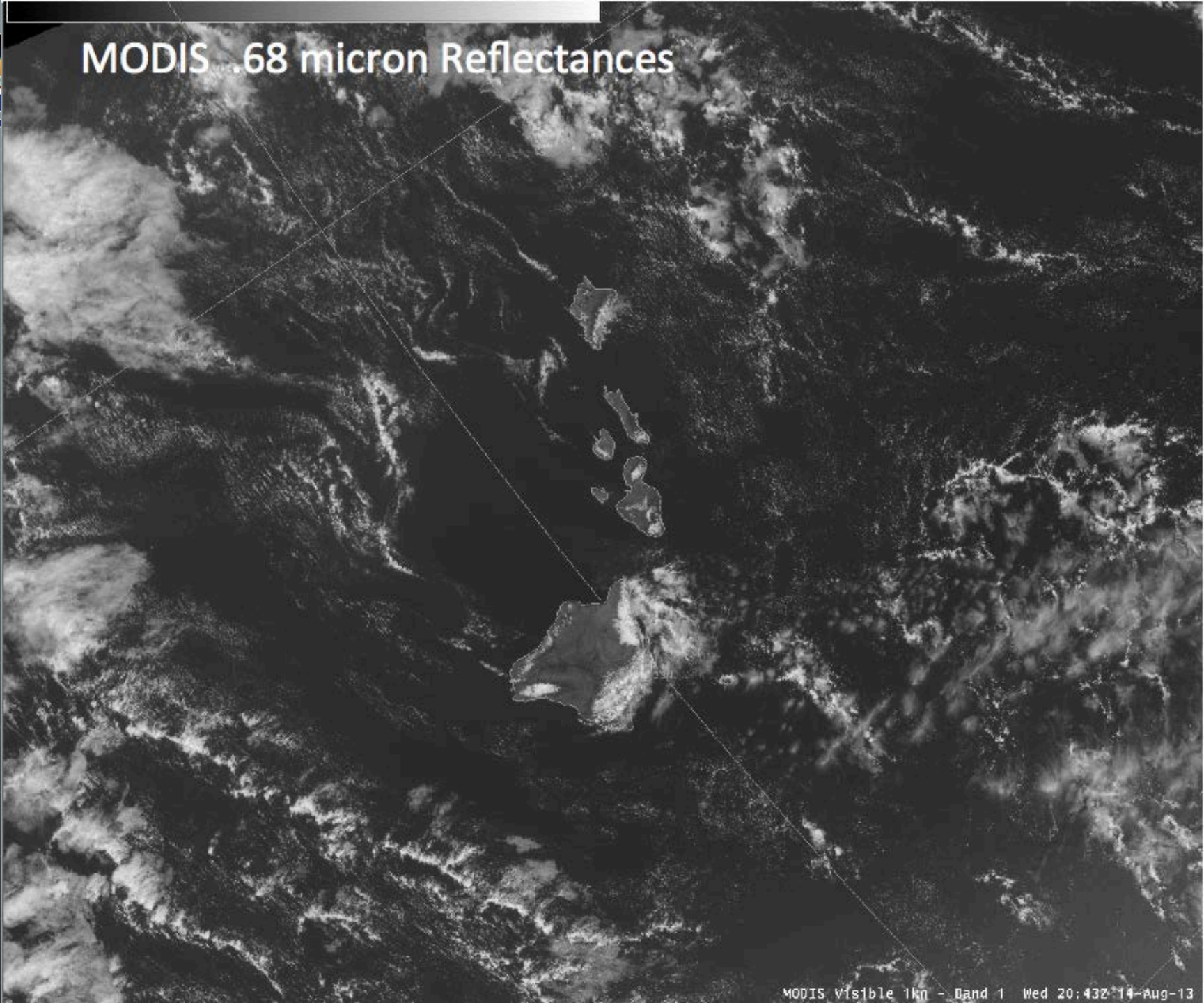


Examples of MODIS Data Displayed in AWIPS

MODIS Snow/Ice Band 2.1 micron Reflectances



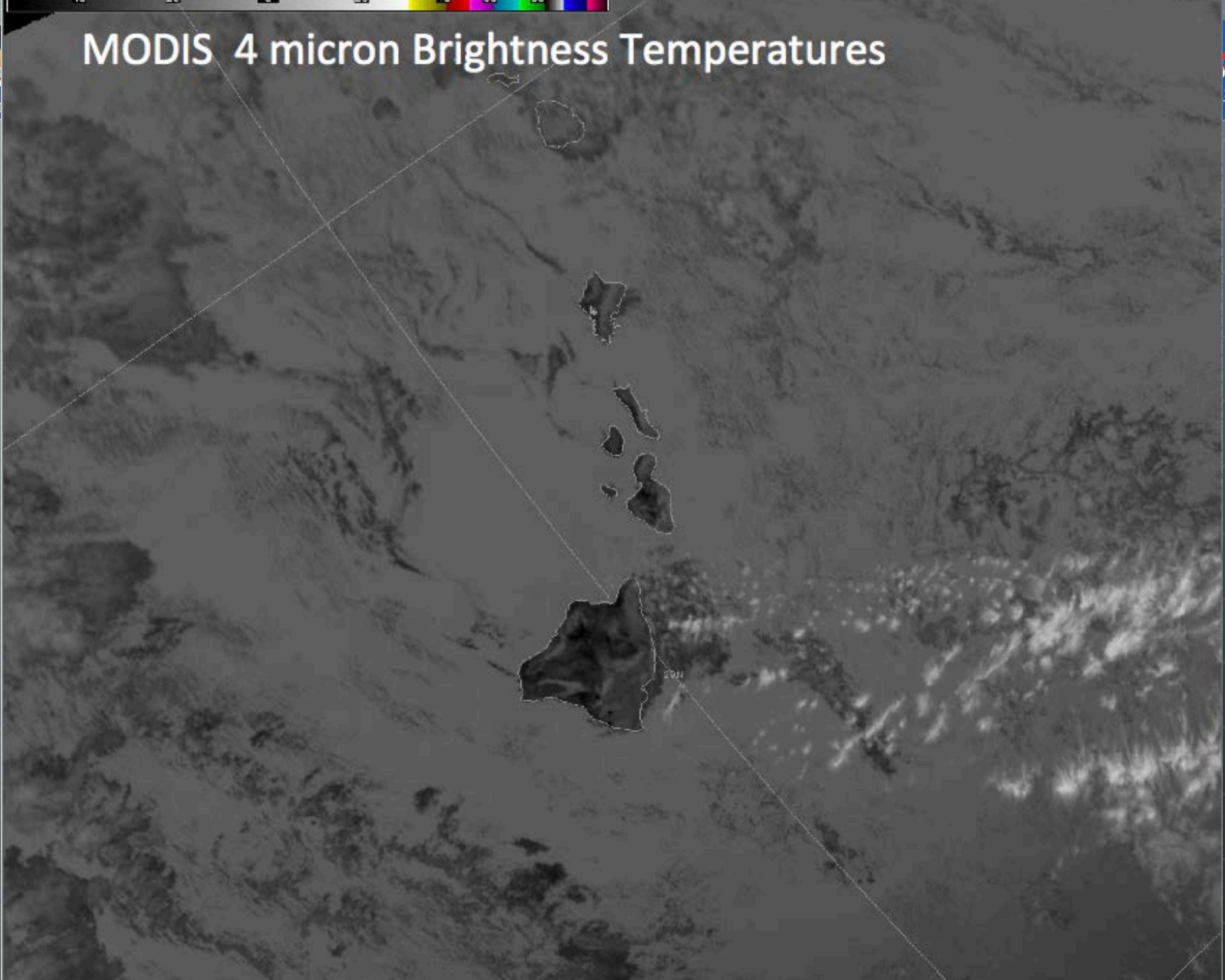
MODIS .68 micron Reflectances

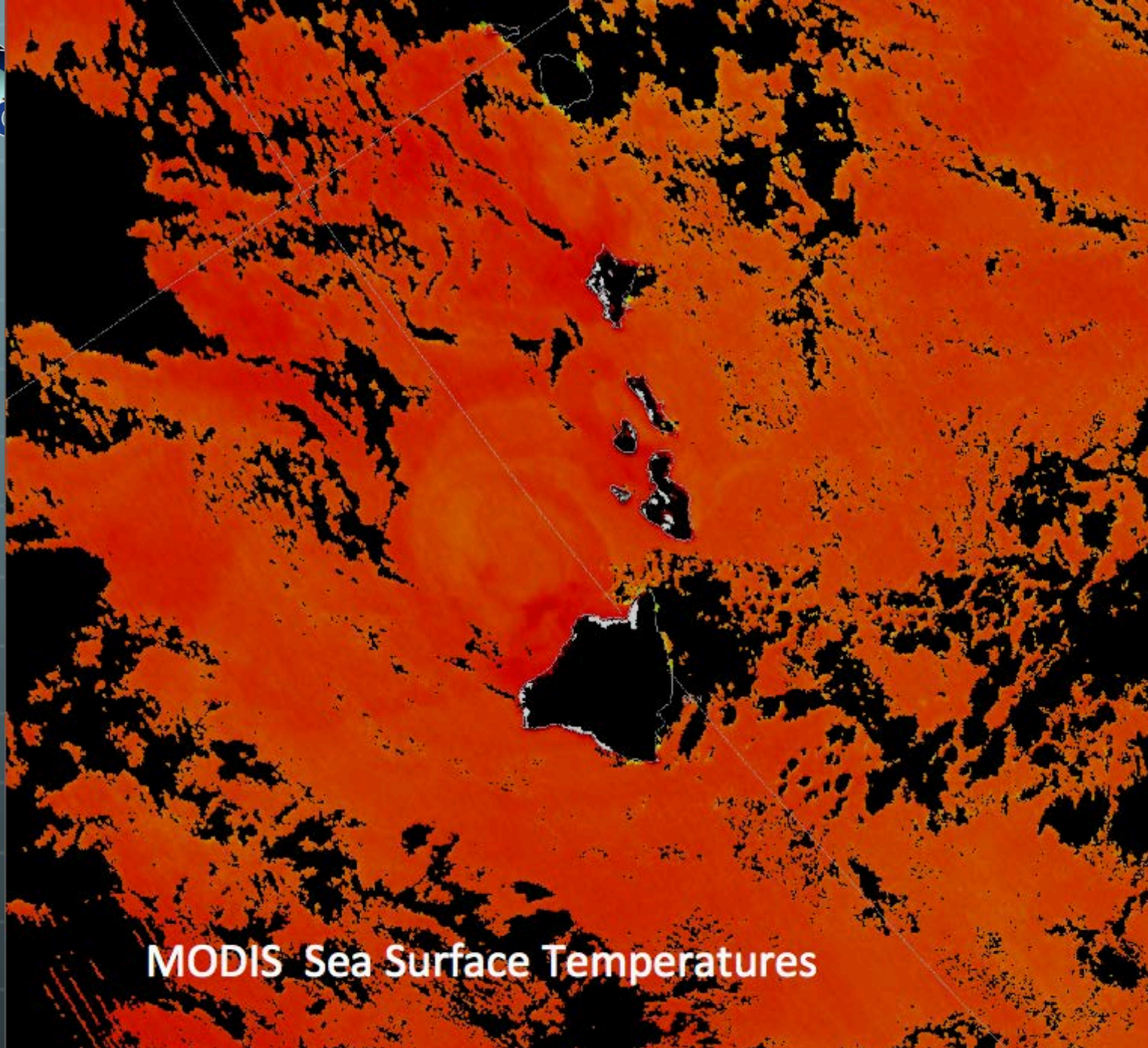


MODIS Cirrus Band 1.38 micron Reflectances

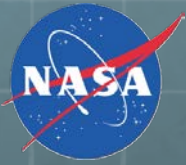


MODIS 4 micron Brightness Temperatures





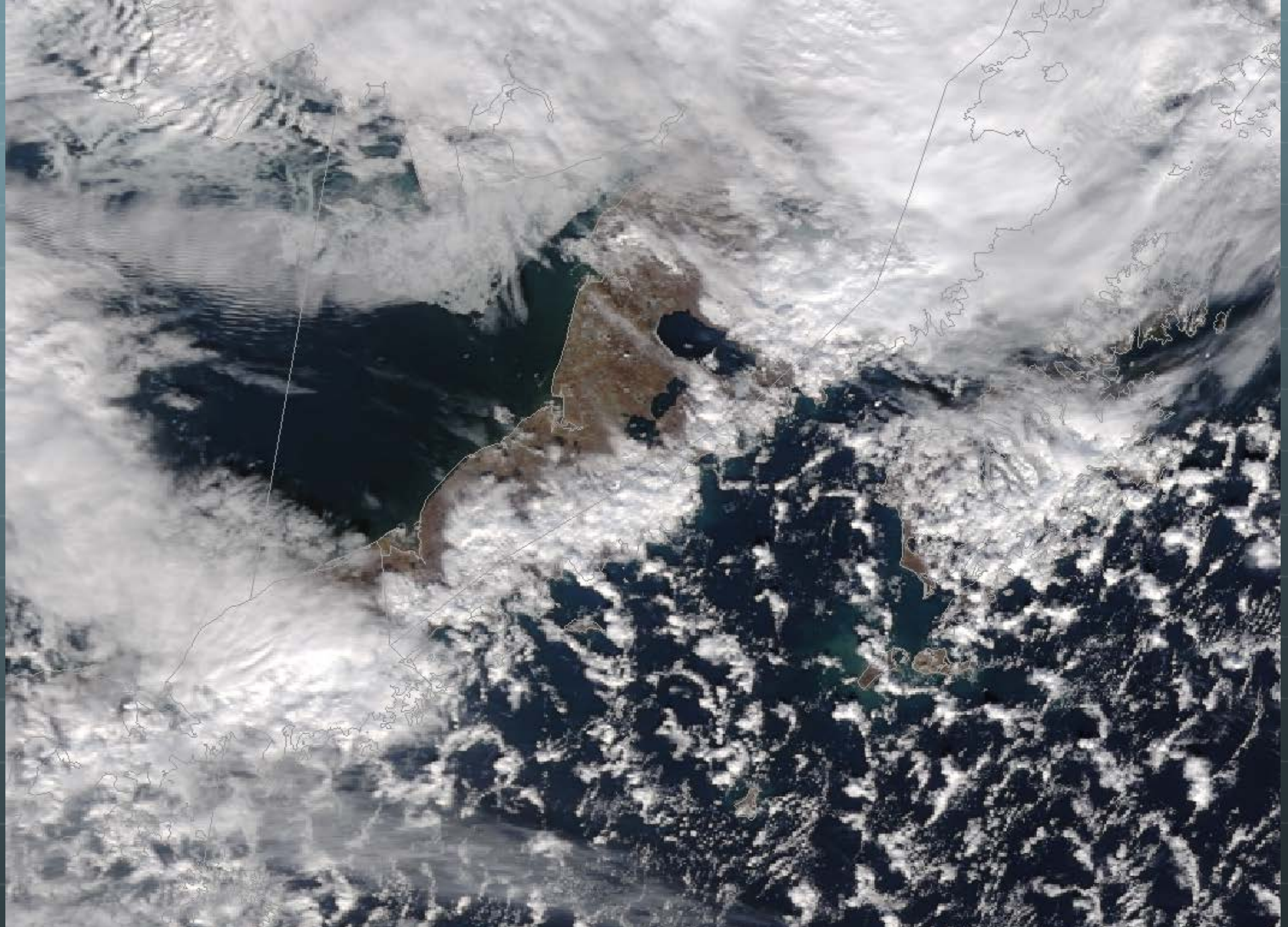
MODIS Sea Surface Temperatures



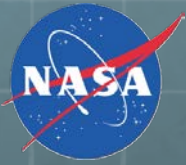
1st Example of MODIS 24 Bit True Color RGB Display in AWIPS-II

Alaska March 2015

Individual CREFL Files created by Polar2Grid
Displayed together using AWIPS-II

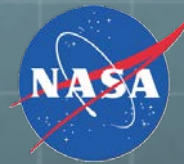


Band 1 (0.64 um) Corrected Reflectance / Band 4 (0.56 um) Corrected Reflectance / Band 3 (0.47 um) Corrected Reflectance Mon 21:01Z 16-Mar-15



Supporting CONUS NWS since 2006

Support National Weather Service Forecasters



Involved Weather Forecast Offices

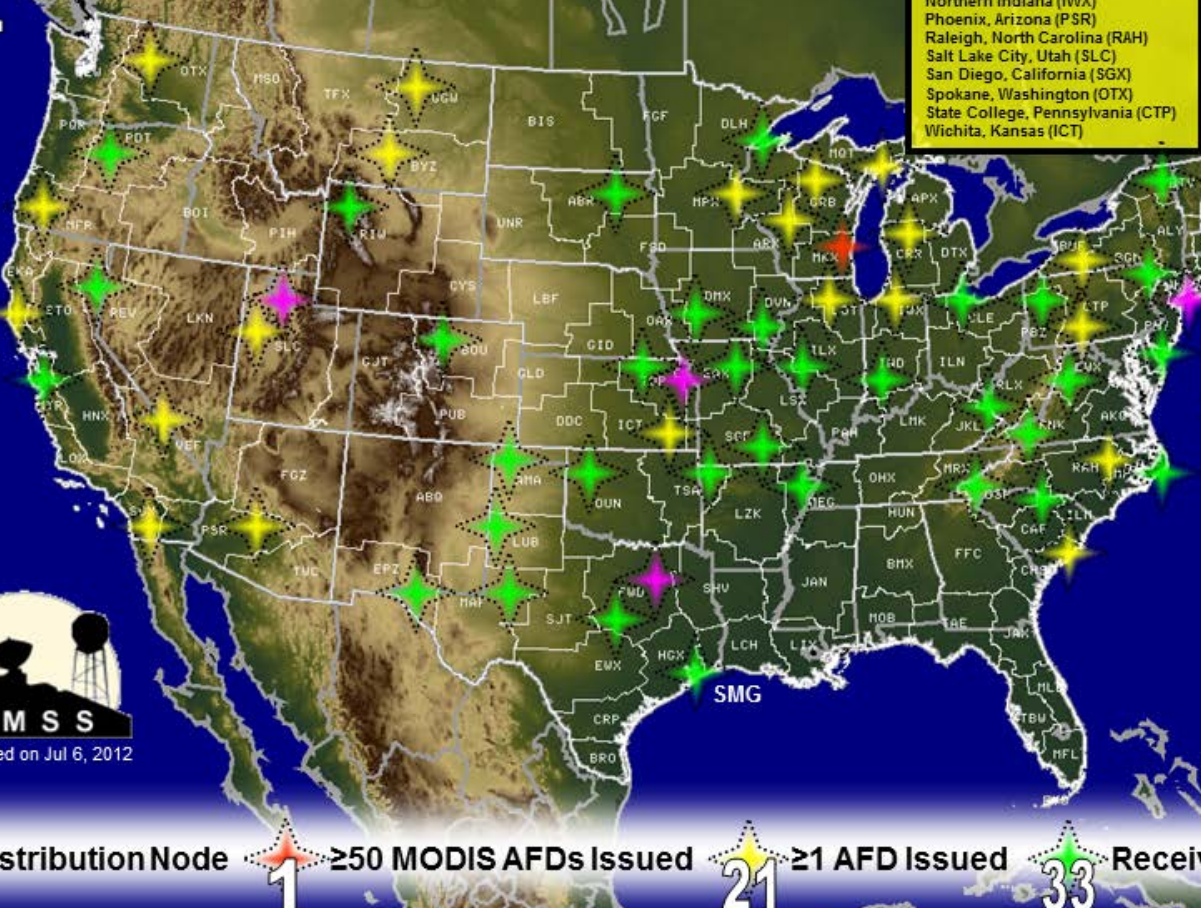
59
TOTAL

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

Milwaukee, Wisconsin (MKX)

Billings, Montana (BYZ)
Buffalo, New York (BUF)
Charleston, South Carolina (CHS)
Chicago, Illinois (LOT)
Eureka, California (EKA)
Glasgow, Montana (GGV)
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 (IVX)
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)

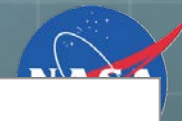
Aberdeen, South Dakota (ABR)
Amarillo, Texas (AMA)
Binghamton, New York (BGM)
Blacksburg, Virginia (RNK)
Boulder, Colorado (BOU)
Burlington, Vermont (BTV)
Cleveland, Ohio (CLE)
Columbia, South Carolina (CAE)
Dallas/Fort Worth, Texas (FWD)
Davenport, Iowa (DVN)
Des Moines, Iowa (DMX)
Duluth, Minnesota (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 (RIV)
Springfield, Missouri (SGF)
Sterling, Virginia (LWX)
Topeka, Kansas (TOP)
Tulsa, Oklahoma (TSA)
Spaceflight Meteorology Group



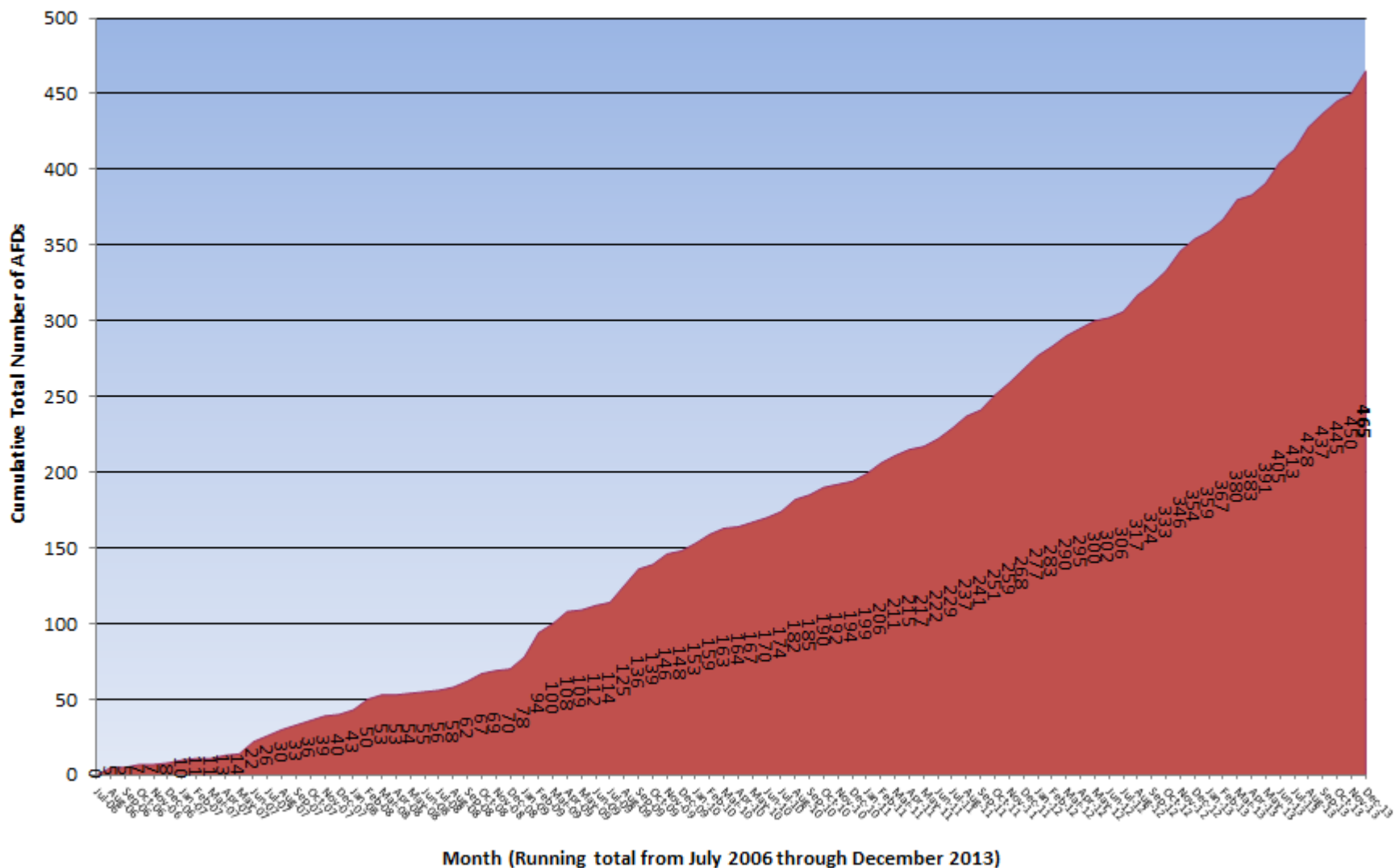
Last updated on Jul 6, 2012

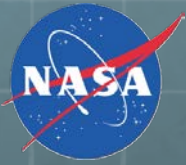


★ 4 Distribution Nodes
 ★ 1 ≥50 MODIS AFDs Issued
 ★ 21 ≥1 AFD Issued
 ★ 33 Receive MODIS Imagery



MODIS in Area Forecast Discussions at NWS Forecast Offices through 12/31/2013





**AREA FORECAST DISCUSSION
NATIONAL WEATHER SERVICE GLASGOW MT
220 PM MDT FRI MAR 20 2015**

.SHORT TERM...FOR NORTHEAST MONTANA...TONIGHT THROUGH SATURDAY...CAUGHT BETWEEN A HIGH PRESSURE NORTHEAST OF OUR REGION AND A DEVELOPING LOW PRESSURE TO OUR SOUTHWEST. HAVE HAD A BAND OF LOWER CLOUDS SNEAK IN FROM THE NORTH BUT THEY NOT HAD MUCH SOUTHWESTWARD EXTENT TODAY. IT LOOKS LIKE THOSE CLOUDS WILL DISSIPATE BY THIS EVENING WITH THE NEXT BATCH OF LOWER TO MID CLOUDS COMING IN AFTER SUNSET TONIGHT.

WE HAVE A WEAK SHORTWAVE MOVING OVER THE TOP OF THE UPPER LEVEL RIDGE TONIGHT WHICH COULD BRING SOME LIGHT RAIN TO OUR NE CORNER. OTHERWISE FOR TONIGHT THROUGH SATURDAY AFTERNOON ITS THE CALM BEFORE THE SATURDAY NIGHT AND SUNDAY STORM.

***OF INTEREST IS THE MODIS SATELLITE IMAGERY SHOWING THE ICE ROTTING PRETTY QUICKLY ON FORT PECK LAKE. WITH TEMPERATURE IN THE UPPER 50S AND 60S ALONG THE LAKE TOMORROW WE MAY SEE MOST OF THE ICE GONE BY THE END OF THE WEEKEND...ESPECIALLY WITH THE EXPECTED RAINFALL ON TOP OF ANY REMAINING ICE.
FRANSEN***

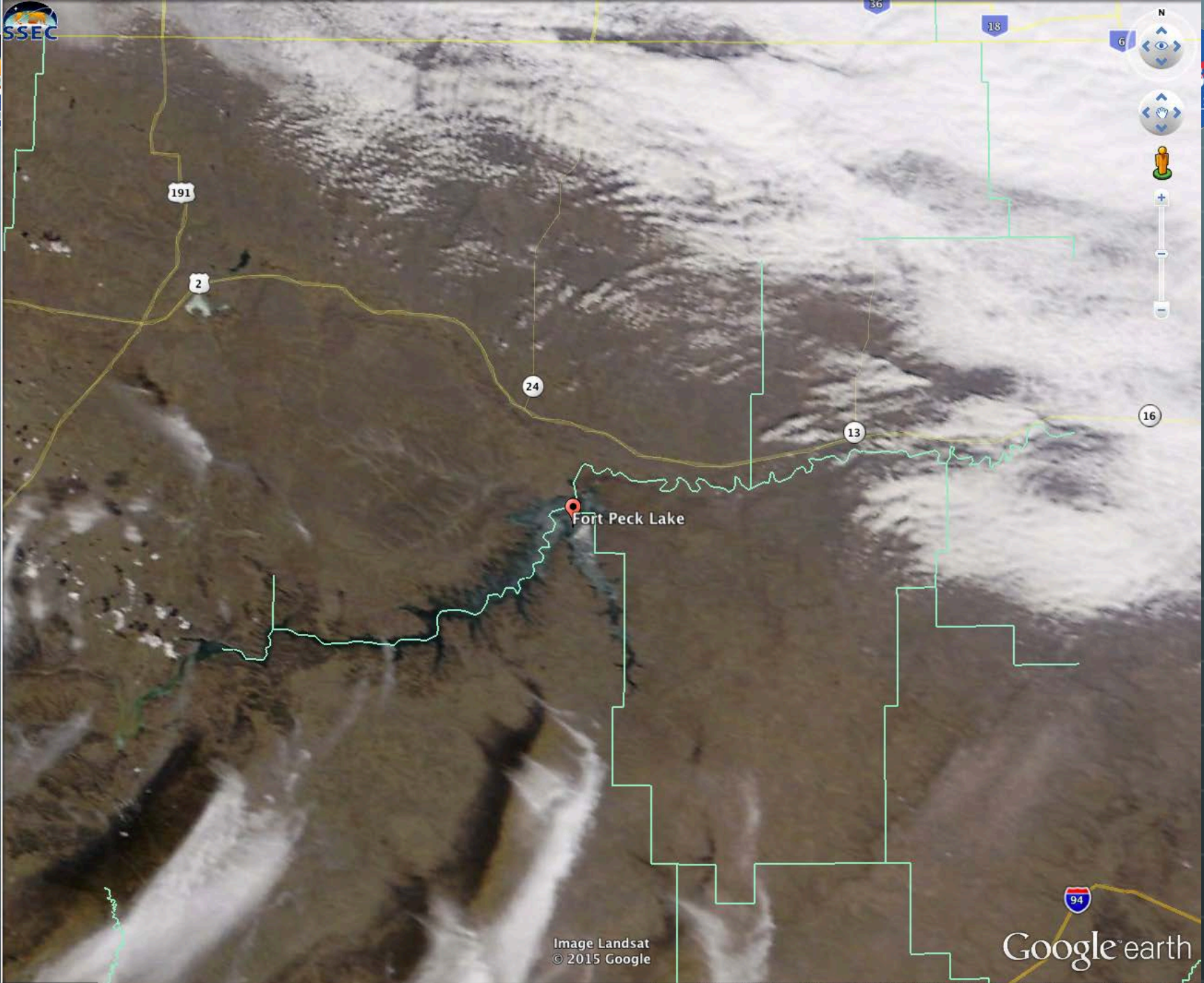


Image Landsat
© 2015 Google

Google earth



NWS
National Weather Service

The National Weather Service (NWS) provides weather, hydrologic, and climate forecasts and warnings for the United States, its territories, adjacent waters and ocean areas, for the protection of life and property and the enhancement of the national economy.
www.weather.gov



NWS BUFFALO ✓
@NWSBUFFALO

+ Follow

Today's satellite image: snow cover once again over WNY. But, ice slowly melts from Lakes Erie and Ontario. #modis



NATIONAL WEATHER SERVICE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

March 28, 2015
Ice Cover over Lake Erie and Lake Ontario



Weather Forecast Office
Buffalo, NY

www.weather.gov/buf | @NWSBuffalo

GRAPHIC CREATED:
3/28/2015 4:39 PM

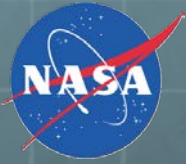
RETWEETS
28

FAVORITES
8



1:48 PM - 28 Mar 2015



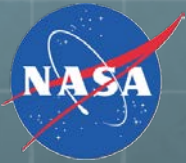


IMAPP RealEarth Web Mapping Service

- This package provides users with the capability to display and share GeoTIFF products through a web browser in a Google Maps interface.
- It is designed specifically for display of MODIS and VIIRS default GeoTIFF files created by the **Polar2Grid** reprojection software package.
- It is distributed as a virtual machine (VM).



IMAPP WMS



The screenshot displays the IMAPP WMS web application interface. The browser address bar shows the URL `regcm.elte.hu:8001` and the search bar contains the text "Aniko". The interface includes a navigation menu with options like "Personal", "MODIS", "DB", "Wx", "JPSS", and "Technical".

The main content area features a map of Europe and Africa. A date and time overlay indicates "2015-04-10 18:13 UTC" with coordinates "57.70N 58.71W". The map shows various countries and bodies of water, including the North Atlantic Ocean, Mediterranean Sea, and Arabian Sea.

On the left side, there are several control panels:

- Display Controls:** Includes "Settings" and "Share" buttons.
- Animation:** Features playback controls (play, stop, previous, next) and a "Times" section with "Relative", "Absolute", and "By Product" options. A "Last: 7 days" filter is set.
- Layers:** Includes "Presets", "All", and "Displayed" buttons, along with a search bar and a list of layers such as "MODIS" and "VIIRS".

At the bottom of the map, there is a scale bar and a "Terms of Use" link. The SSEC logo is visible in the bottom left corner of the map area.

<http://regcm.elte.hu:8001/>

Display Controls

Settings Share

Animation



Times

Relative Absolute By Product

Last: 7 days



Set times



Layers



Presets All Displayed



Search



MODIS

Aqua MODIS Infrared Composites (Day)  

Aqua MODIS Infrared Composites (Night)  

Aqua MODIS Infrared Swaths  



Aqua MODIS Near Infrared Composites (Day)  

Aqua MODIS Near Infrared Swaths  

Aqua MODIS Short Wave Infrared Composites (Day)  

Aqua MODIS Short Wave Infrared Composites (Night)  

Aqua MODIS Short Wave Infrared Swaths  

Aqua MODIS True Color Composites (Day)  

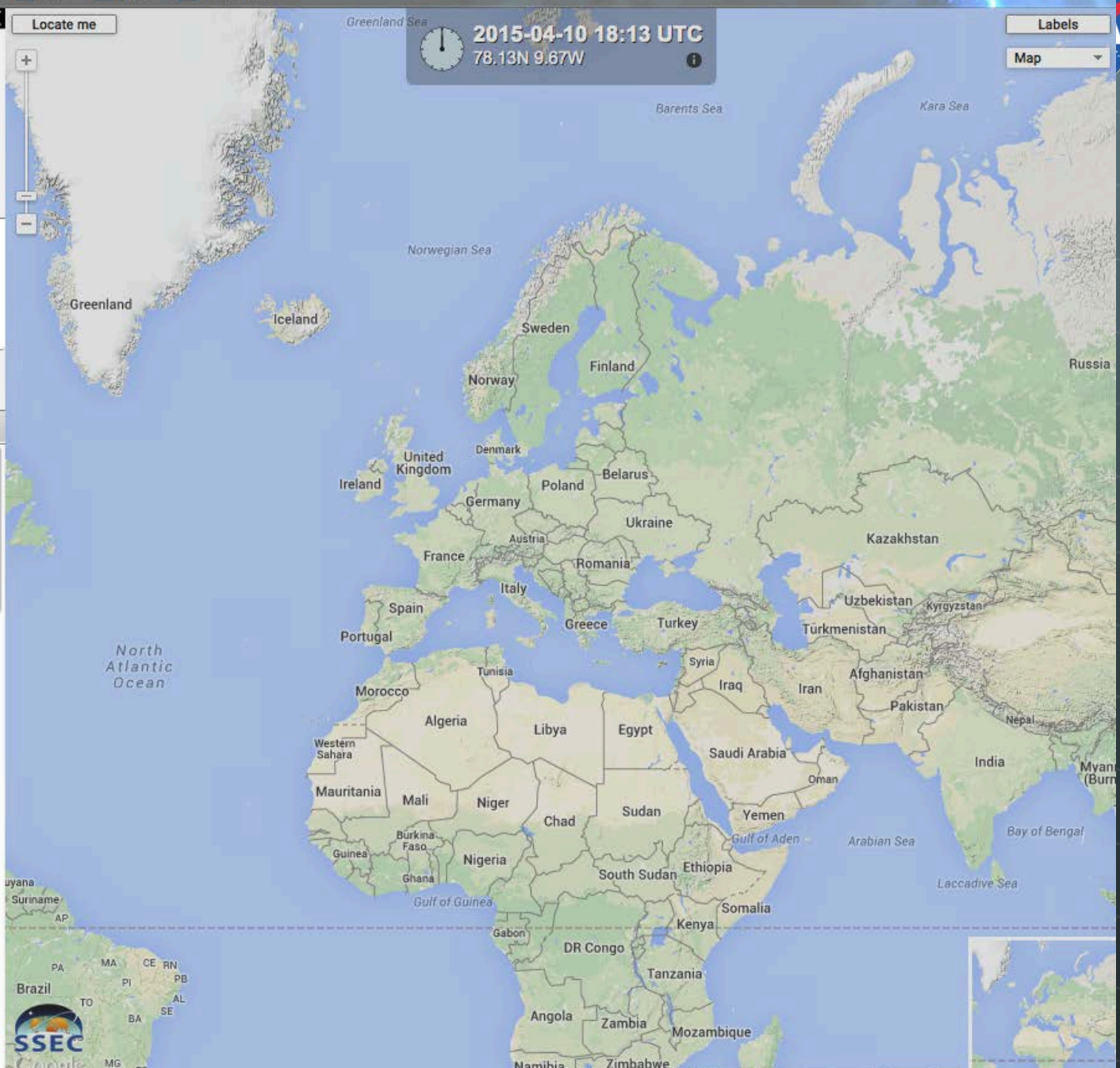
Locate me



2015-04-10 18:13 UTC
78.13N 9.67W




Labels Map



Settings Share

Animation



Times

Relative Absolute By Product

Terra MODIS True Color Composites (Day)

Last: 7 days

Set times

Layers

Presets All Displayed

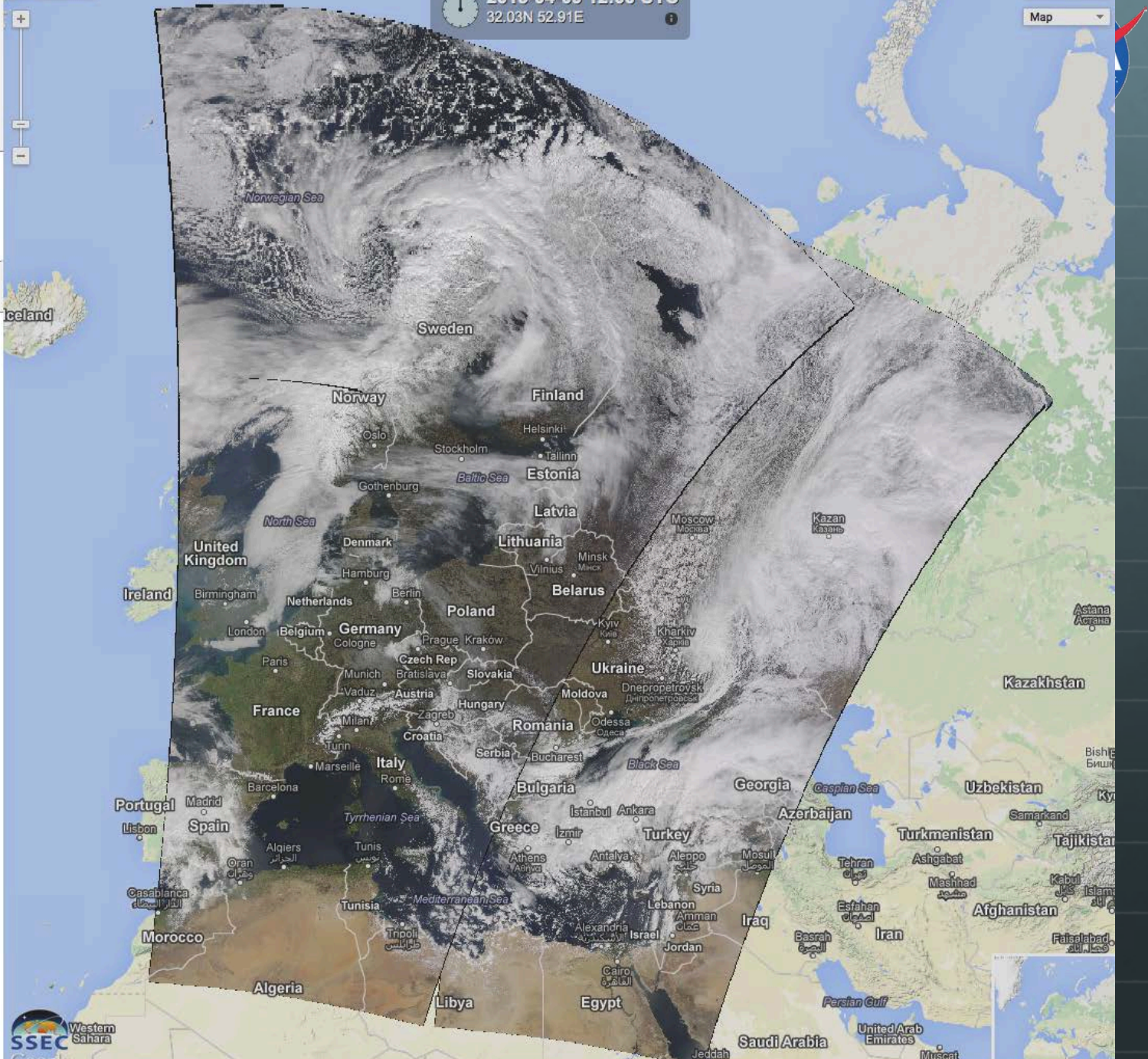
Layer preview for Terra MODIS True Color Composites (Day) with a thumbnail image and control icons.

Locate me

2015-04-09 12:00 UTC
32.03N 52.91E

Labels

Map



Animation



Times

Relative Absolute By Product

Aqua MODIS True Color Com

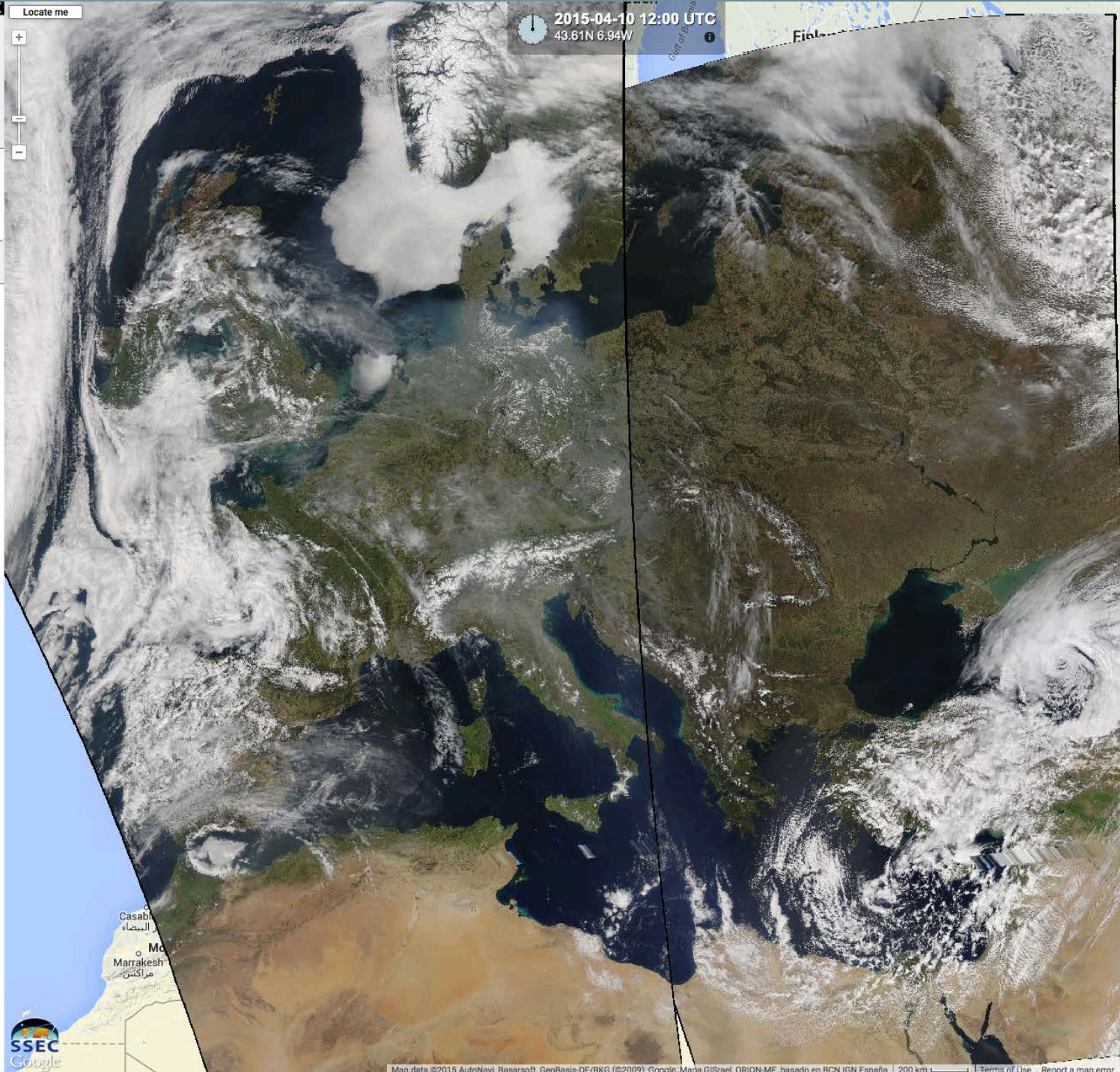
Last: 7 days

Set times

Layers

Presets All Displayed

Aqua MODIS True Color Composites (Day)



2015-04-10 12:00 UTC
43.61N 6.94W

- Nizhny Novgorod
Нижний Новгород
- Saratov
Саратов
- Volgograd
Волгоград
- Georgia
- Tbilisi
თბილისი
- Armenia
- Tabriz
تبریز
- Tosul
الموصل
- Erbil
اربع
- Kirkuk
كركوك
- Baghdad
بغداد

Casablanca
الرباط
Marrakesh
مراكش



Settings Share

Animation

Navigation controls: back, forward, stop, play, refresh, zoom in, zoom out.

Times

Relative Absolute By Product

Aqua MODIS True Color Composites (Day)

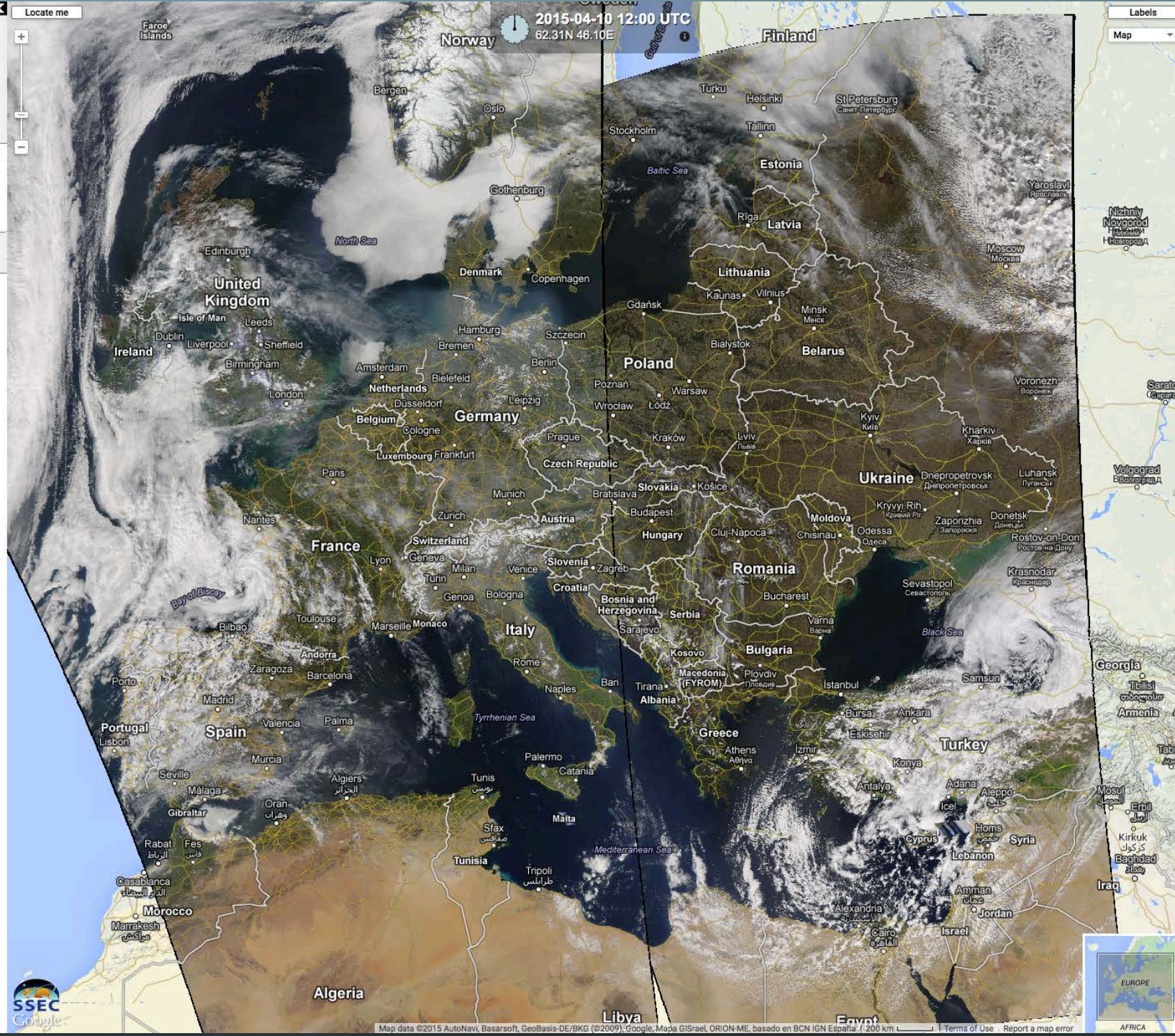
Last: 7 days

Set times

Layers

Presets All Displayed

Layer list: Aqua MODIS True Color Composites (Day) [checked]



Display Controls

Settings Share

Animation



Times

Relative Absolute By Product

Terra MODIS True Color Composites (Day)

Last: 7 days

Set times

Layers

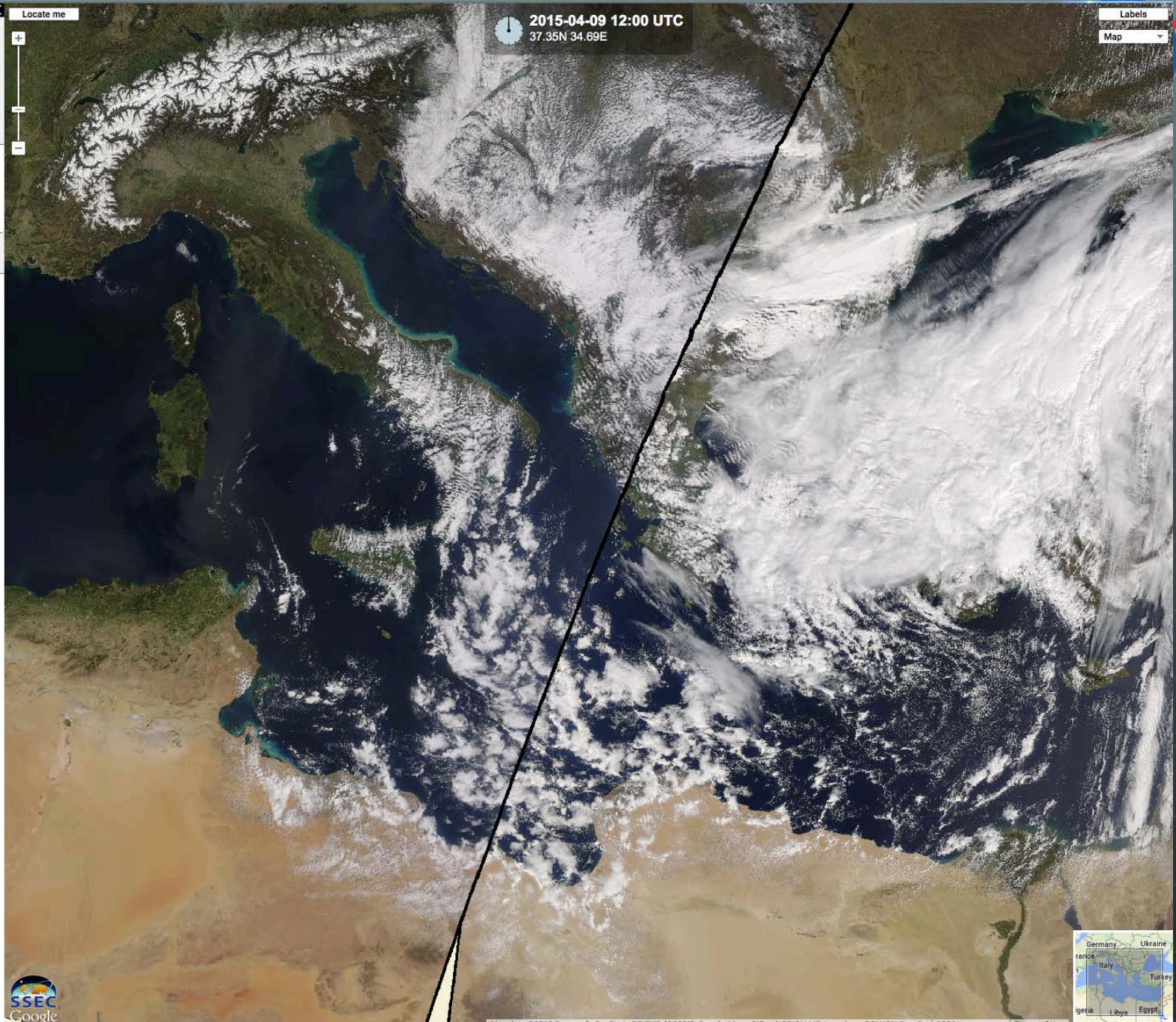
Presets All Displayed

Terra MODIS True Color Composites (Day)



2015-04-09 12:00 UTC
37.35N 34.69E

Labels
Map





Share Display



Aqua MODIS True Color Composites (Day)

Last 6 hours

Google Maps

[Web link](http://regcm.elte.hu:8001/s/Gmd) http://regcm.elte.hu:8001/s/Gmd

Google Earth

[KML link](#) (Aqua MODIS True Color Composites (Day))

THREDDS Catalog

[THREDDS catalog](#)

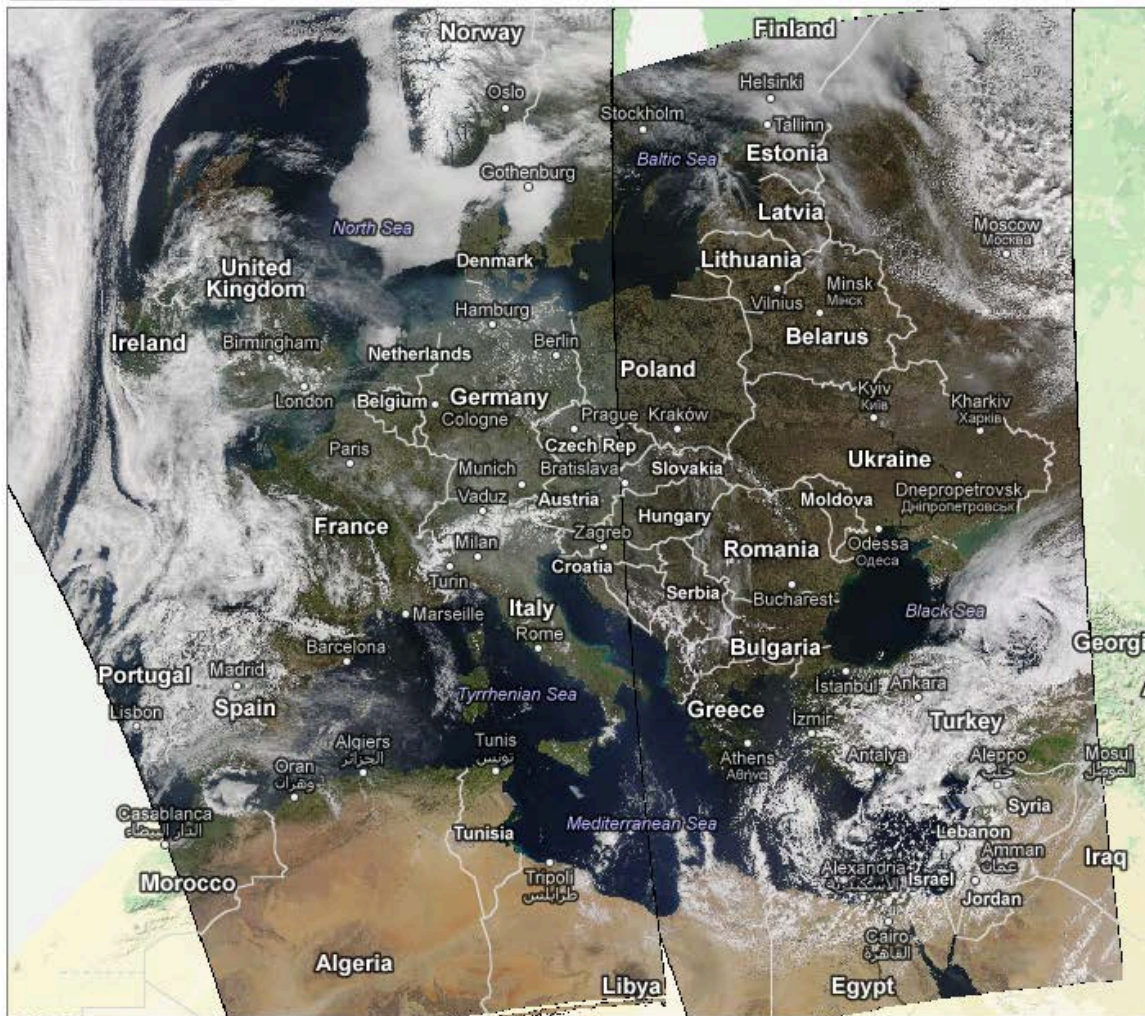
Social



Image

Static

Animated





Google Earth Pro

Sign in

▼ Search

Search Google Parcel Search (APN)

Search

ex: 94043

[Get Directions](#) [History](#)

▼ Places

My Places

- ✓ [Sightseeing Tour](#)
Make sure 3D Buildings layer is checked

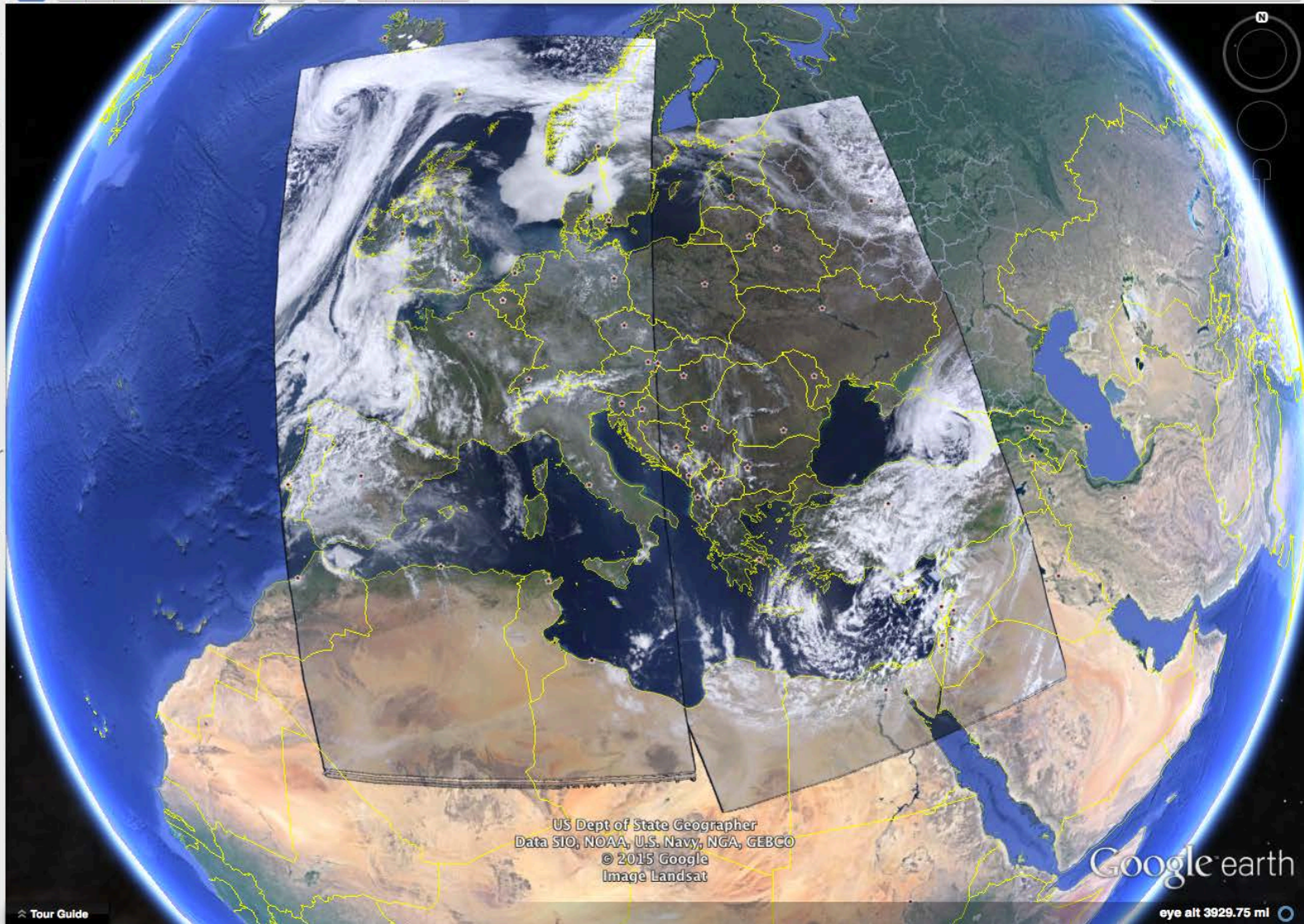
Temporary Places

- ✓ [Aqua MODIS True Color Composi...](#)

▼ Layers

Earth Gallery >>

- Primary Database
- Earth Pro (US)
- Borders and Labels
 - Places
 - Photos
 - ✓ Roads
 - 3D Buildings
- Ocean
- Weather
- Gallery
- Global Awareness
- More
- ✓ Terrain



US Dept of State Geographer
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2015 Google
Image Landsat

Google earth

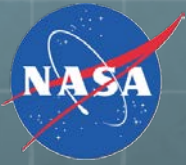
eye alt 3929.75 mi

Tour Guide

Share files for display in Google Earth



IDEA-I Ozone



- **Infusing satellite Data into Environmental Applications – International (IDEA-I)**
- **Uses UW Dual Regression Retrievals from Hyperspectral Sounders (AIRS, CrIS and IASI) to identify regions of high ozone concentrations in the upper troposphere**
- **Trajectory model is run using GFS forecast grids to predict movement of ozone in 3 dimensions**
- **Trajectories color coded to help identify when the ozone may affect humans at the surface (Stratospheric Intrusions).**
- **Especially important to Air Quality Forecasters in Western US Mountain States (exceptional events).**
- **Brad Pierce demonstrated the IDEA-I ozone trajectory forecasts capabilities using an event in June 2012.**

<http://cimss.ssec.wisc.edu/idea-i/Usozone/>

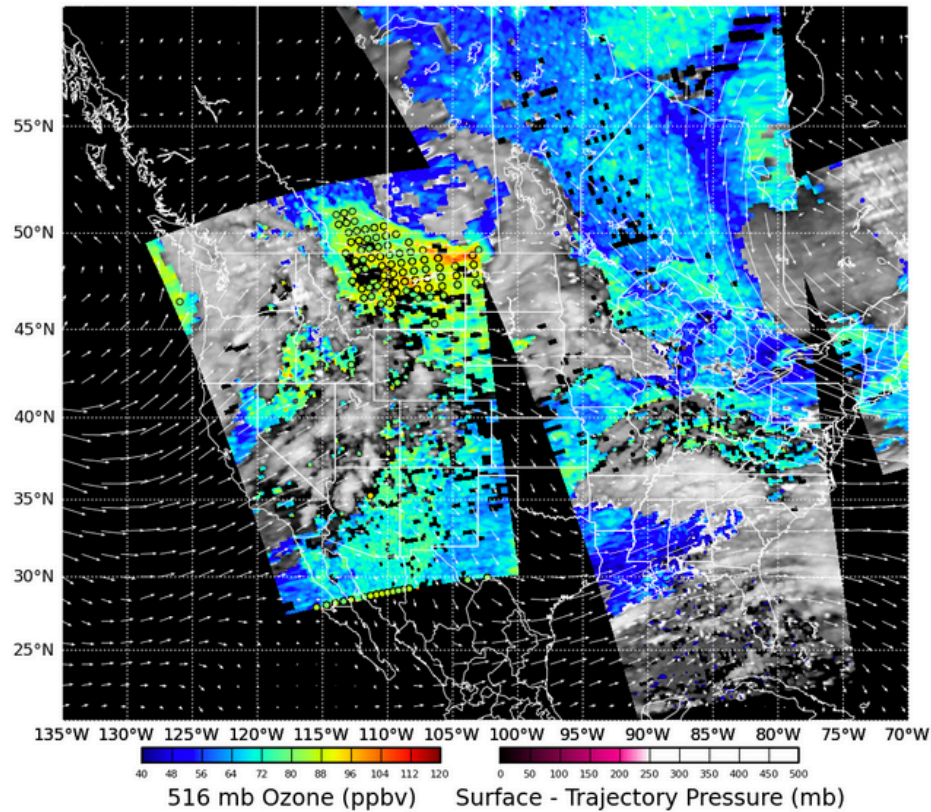
Ozone Forward Trajectory Forecast

Sensor: AIRS CrIS IASI » Node: Ascend Descend » Date:

< play > rock slower faster zoom

AIRS Ozone & Ozone Trajectories on 2015-03-22 19Z

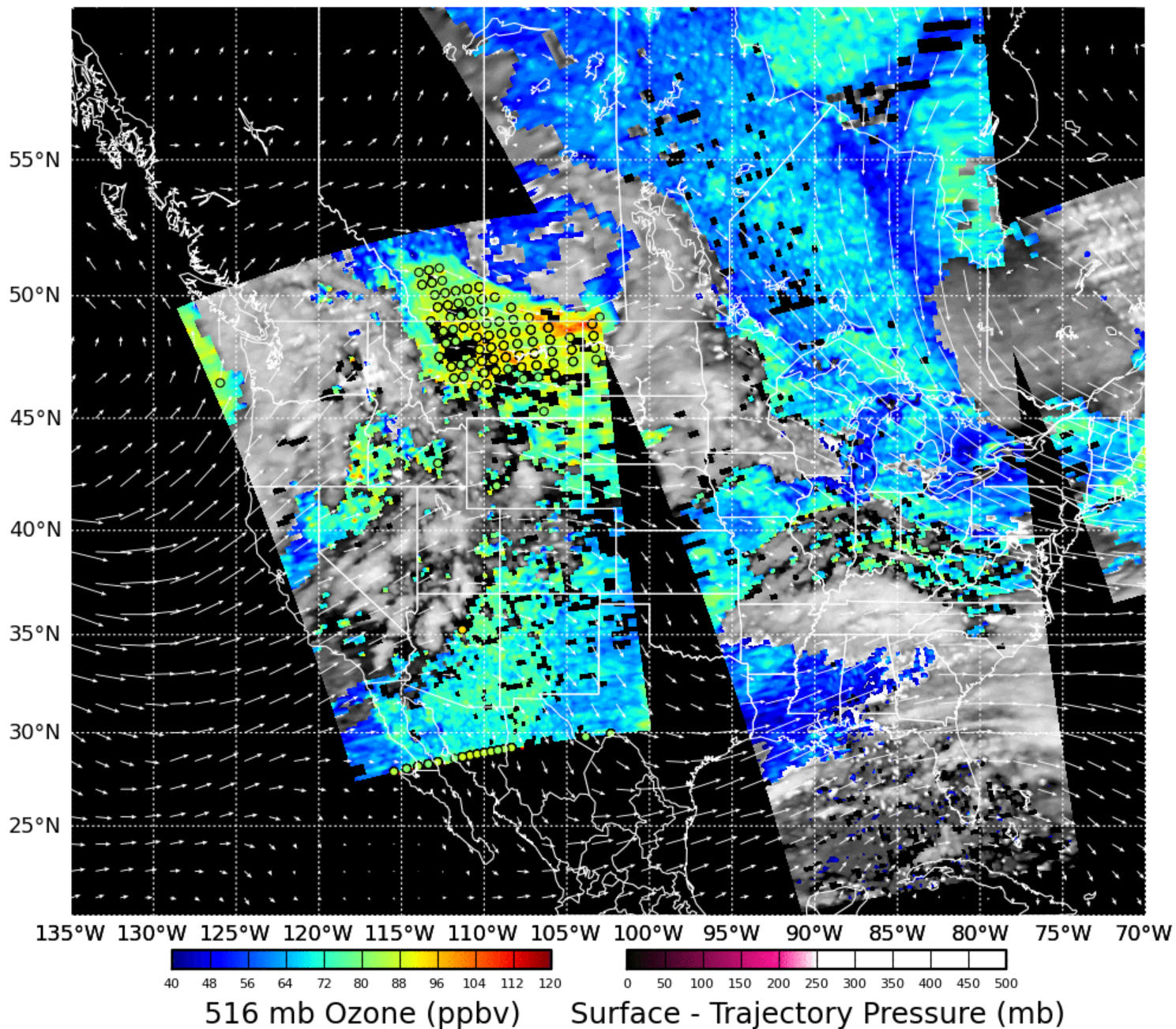
AIRS swath start times: 1718Z 1852Z 2034Z



Last updated: 3 February 2012

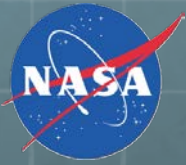
AIRS Ozone & Ozone Trajectories on 2015-03-22 19Z

AIRS swath start times: 1718Z 1852Z 2034Z



516 mb Ozone (ppbv)

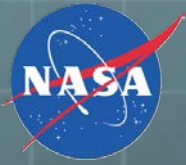
Surface - Trajectory Pressure (mb)



IMAPP MODIS V3.x Level 2 Release



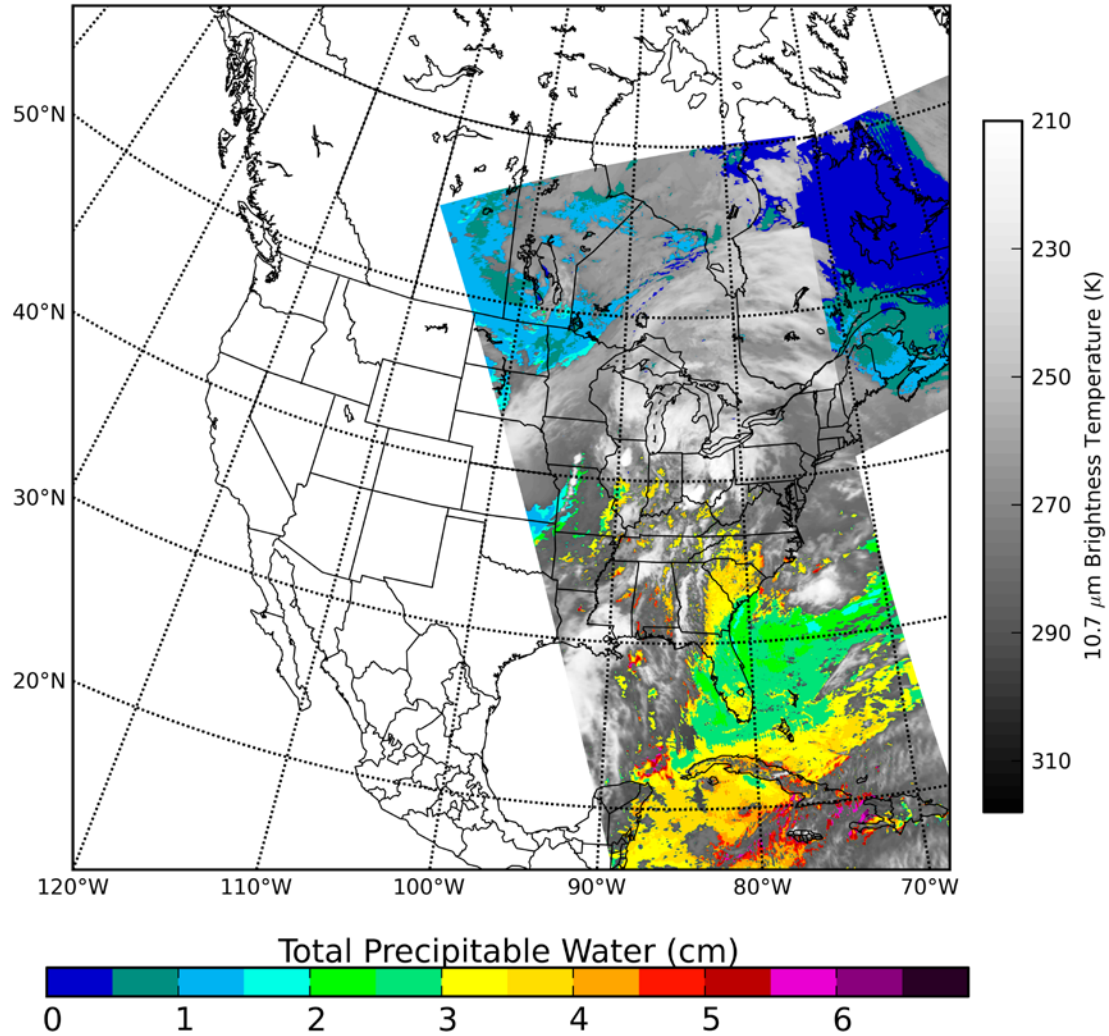
IMAPP MODIS L2



- Collect 6 versions of Atmosphere Group software.
- No longer removes toolkit dependencies or simplified I/O.
 - Result is products that are identical in format (including Metadata) as the NASA archive products.
 - Still uses different ancillary data files because of real time execution – products will not be identical.
- Re-aggregation of Aqua 250m bands with other resolutions
- IMAPP naming conventions or LAADS/LANCE naming conventions can be used for input files.
- Compression of output HDF4 files is now a runtime option.
- Quick look software now python based (no McIDAS based).

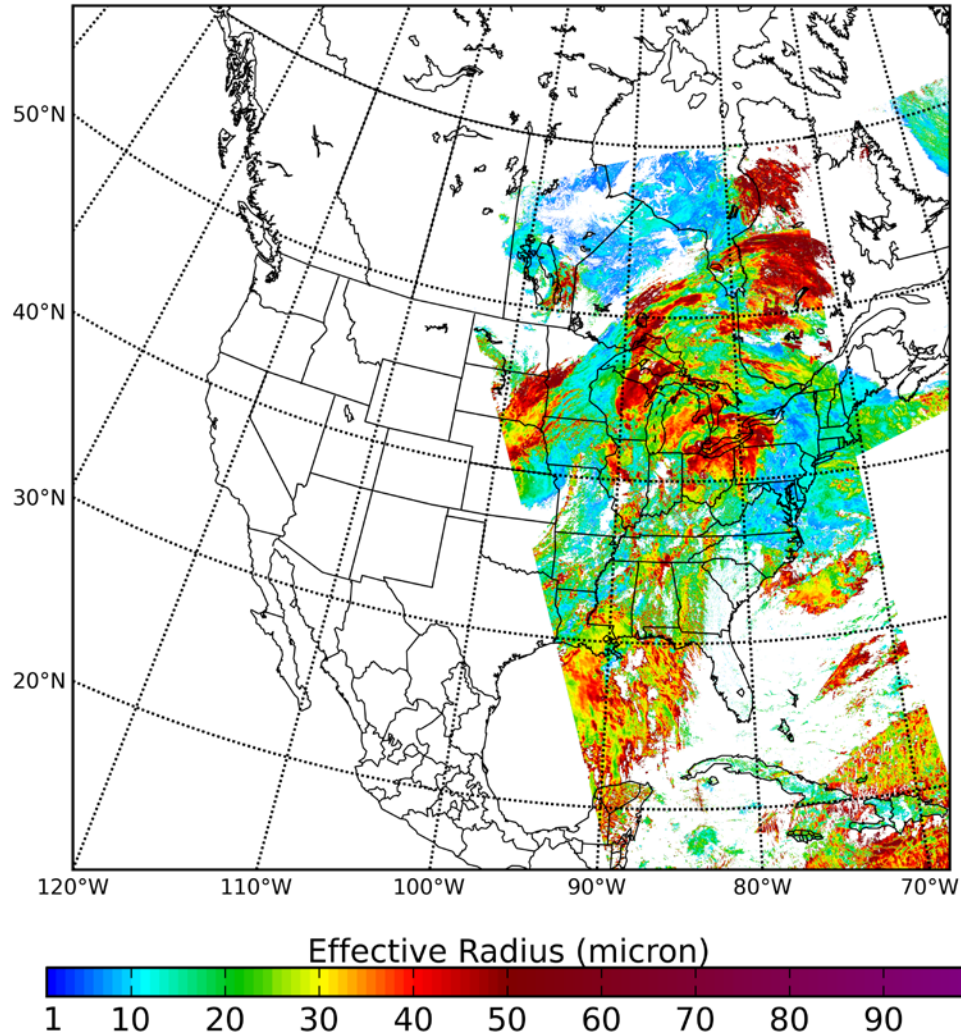
MODIS Total Column Precipitable Water

Aqua 2015-04-09 day 1703UTC 1837UTC



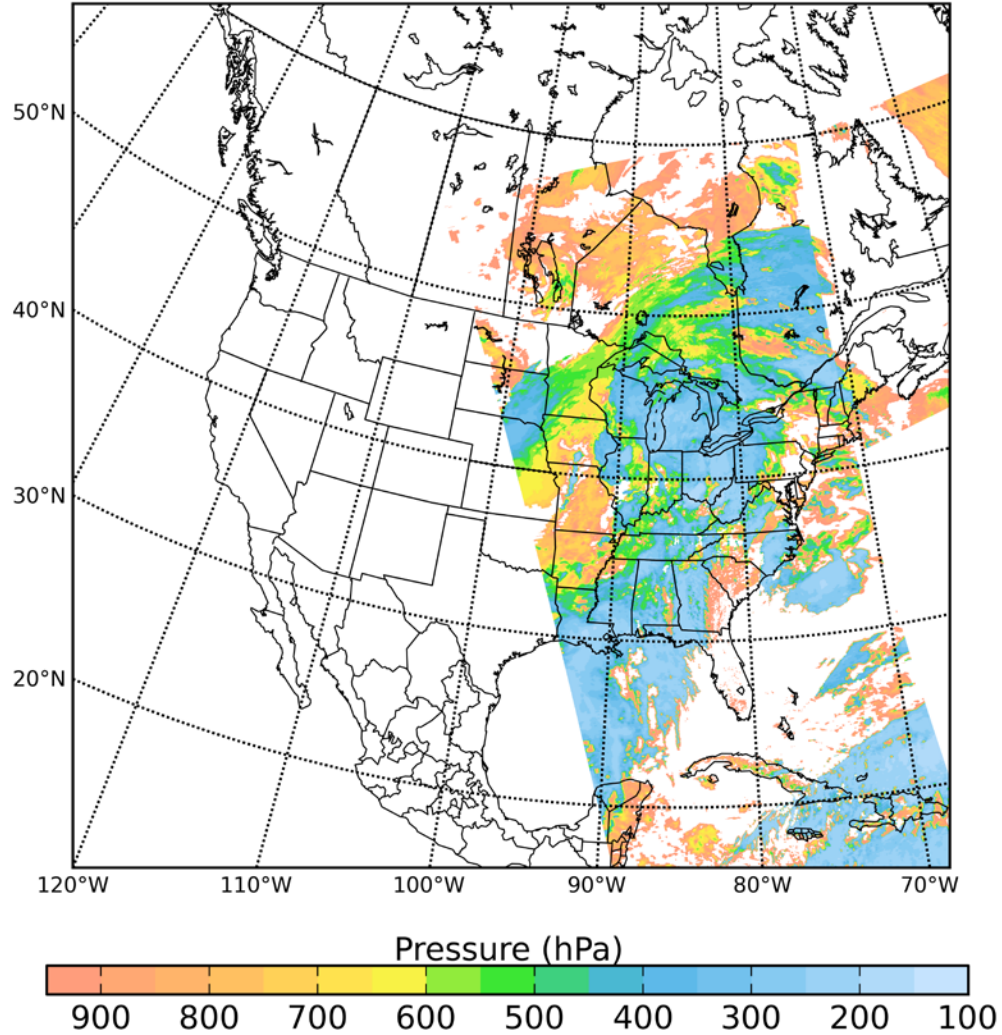
MODIS Cloud Effective Radius

Aqua 2015-04-09 day 1703UTC 1837UTC



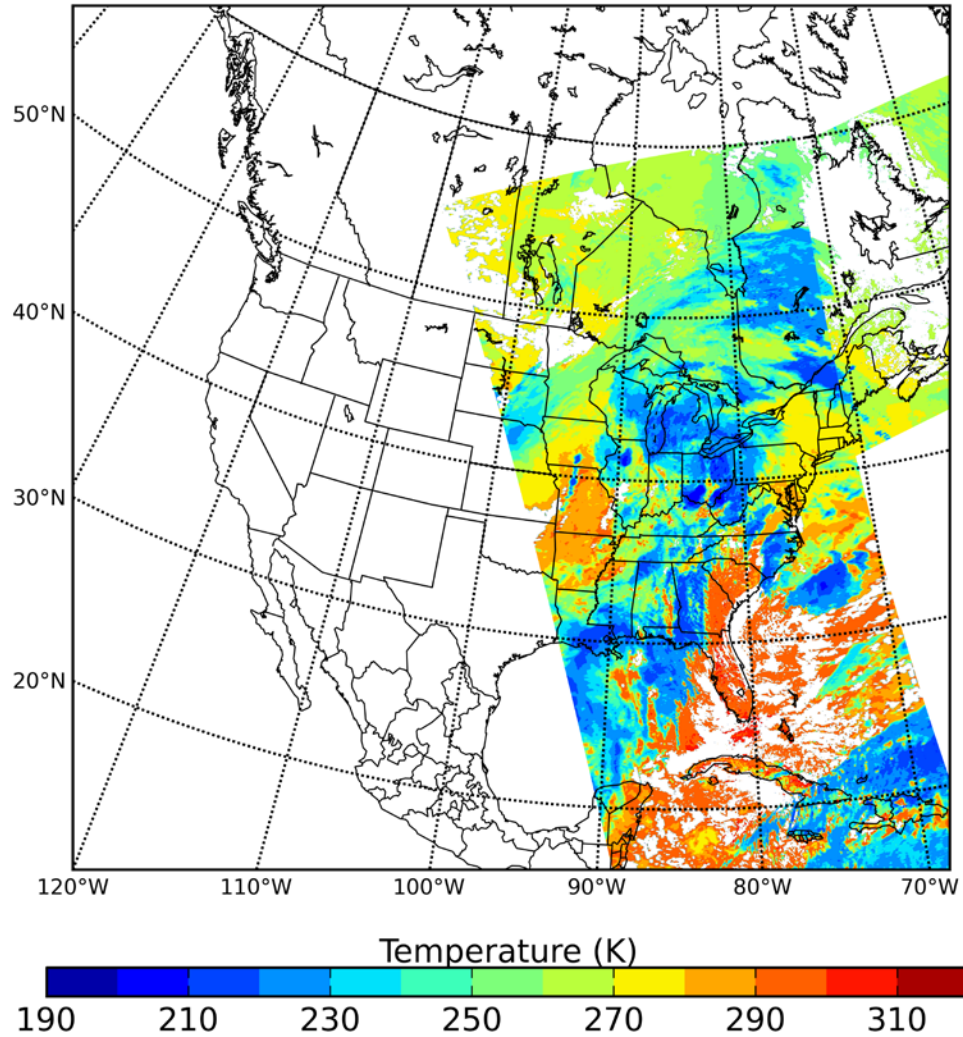
MODIS Cloud Top Pressure

Aqua 2015-04-09 day 1703UTC 1837UTC



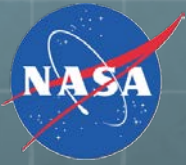
MODIS Cloud Top Temperature

Aqua 2015-04-09 day 1703UTC 1837UTC





Future Plans



Funding through 2016

- Significant Reduction in \$\$ Amount

Coming Soon:

- DBVM Version 2.0
 - Updated software options
 - Updated VM
- AIRS L1 and L2 Jet Propulsion Lab (JPL)
 - Collect 6 Software for Direct Broadcast

Later in 2015

- Aviation Hazard Products?
 - Visibility
 - Turbulence
- Update to BRDF package – with Crystal Schaaf