



6.2 Future Remote Sensing with NexSat



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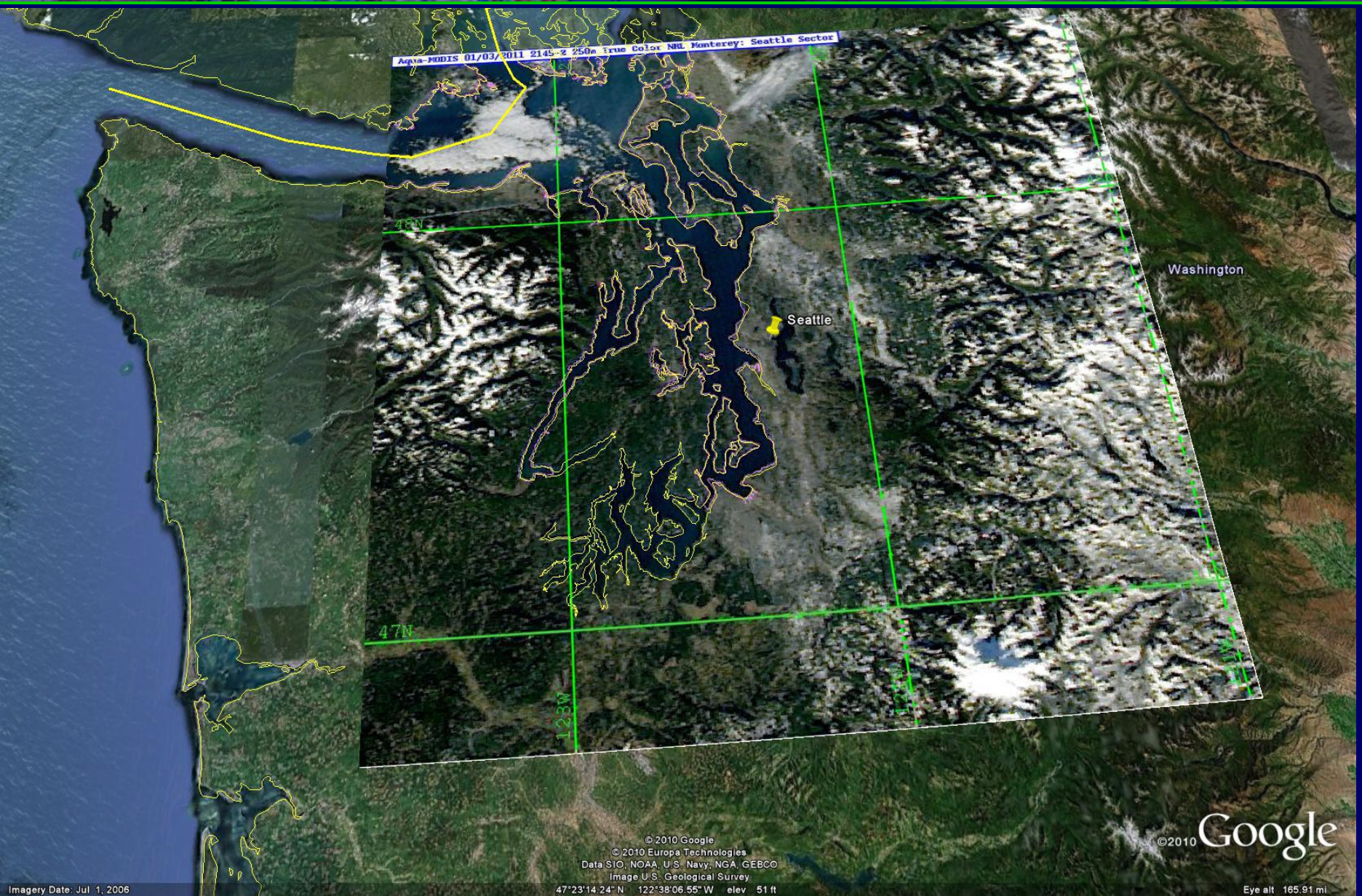
¹ Naval Research Laboratory (Monterey)

² Cooperative Institute for Research in the Atmosphere

³ Science Applications International Corporation



NexSat Website Interface



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Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image U.S. Geological Survey

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Imagery Date: Jul 1, 2006

47°23'14.24" N 122°38'06.55" W elev 51 ft

Eye alt 165.91 mi



NRL Satellite Constellation

Polar Orbiting Satellites (31)

Imagers (Vis/IR):

- NOAA - AVHRR (5)**
- METOP - AVHRR (1)**
- DMSP - OLS (5)**
- NASA - MODIS (2)**
- Comm - SeaWiFS**

Microwave Imagers: DMSP SSM/I (2), SSMIS (3)
 NASA TMI, AMSR-E
 NRL WindSat

Micro Sounders: NOAA/MetOp AMSU-B (3), MHS (2)

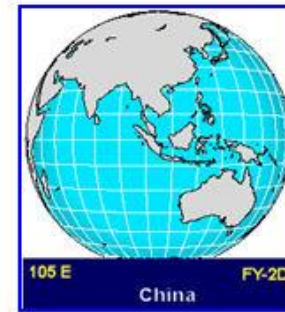
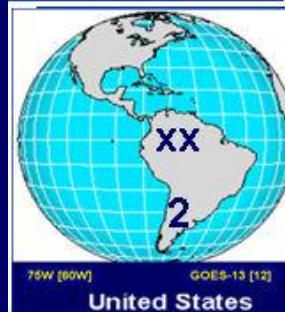
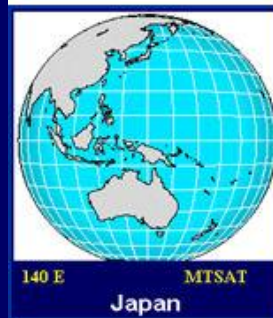
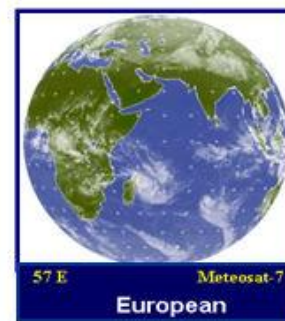
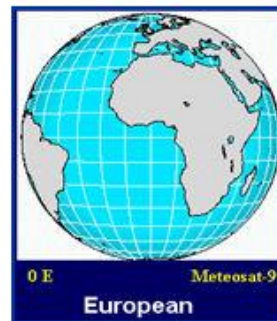
Microwave Radar: NASA TRMM PR, CloudSat,
 EUMETSAT ASCAT, ERS-2

Collaborations: FNMOC, AFWA, NASA, NOAA, NAVO, CIRA

Data latency: GEO < 1 hour
 LEO 0.5 - 3 hours

Data volume: 250 – 300 GB/day

GEO Orbiting Satellites (7)



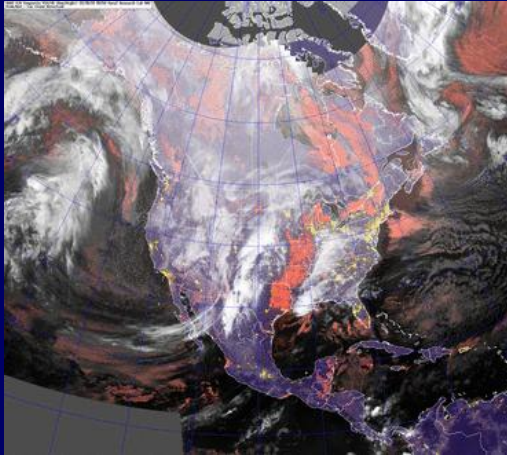
Courtesy: Johnson & EUMETSAT



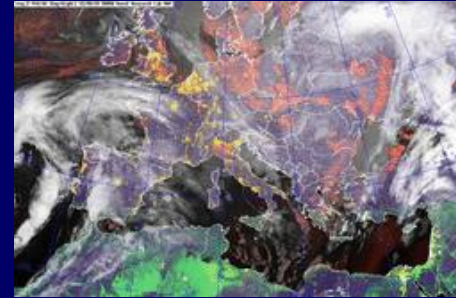
Global Coverage

Primary domains using global GEO data

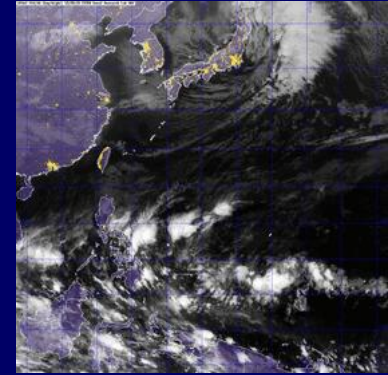
North America



Europe



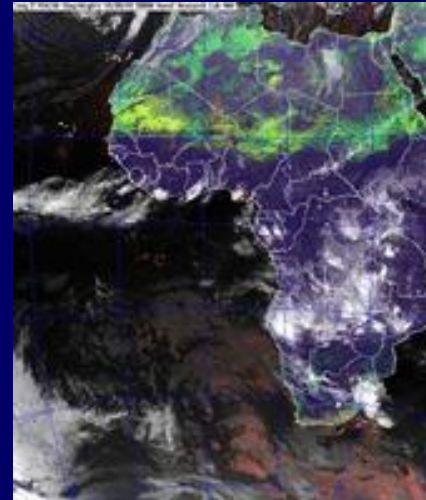
West Pacific



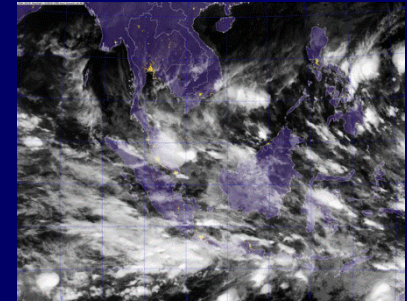
South America



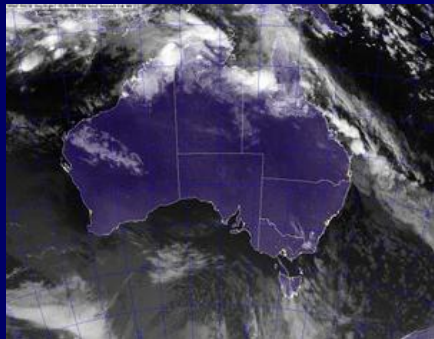
Africa



Indonesia



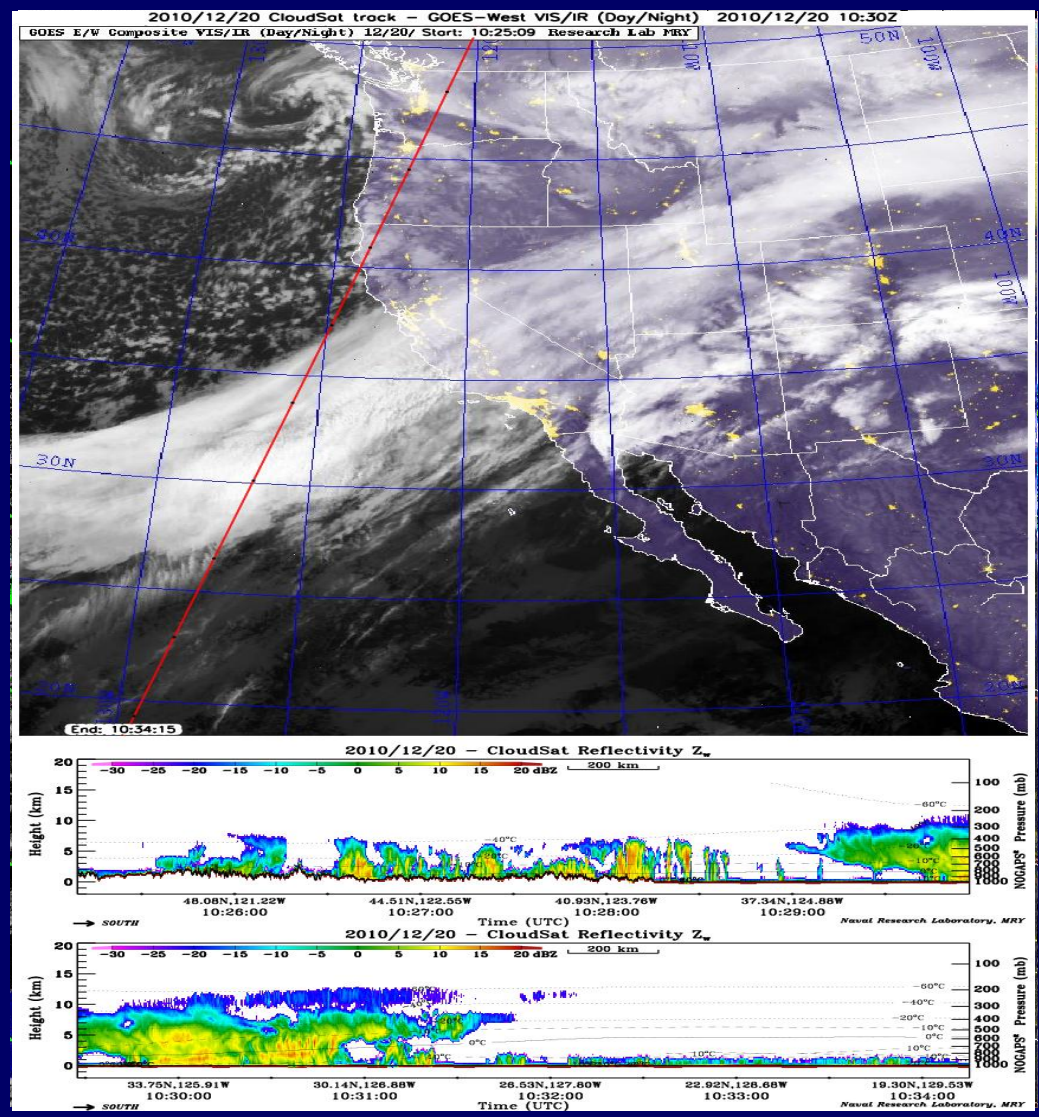
Australia





NexSat Product Examples

CloudSat

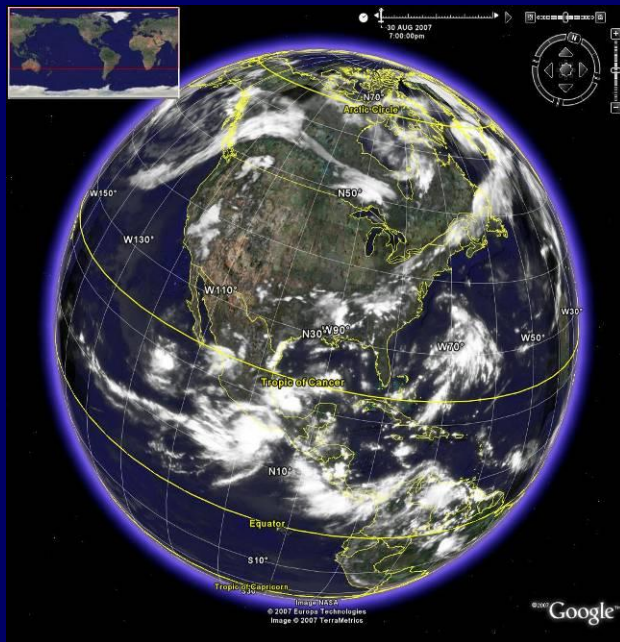




Google Earth

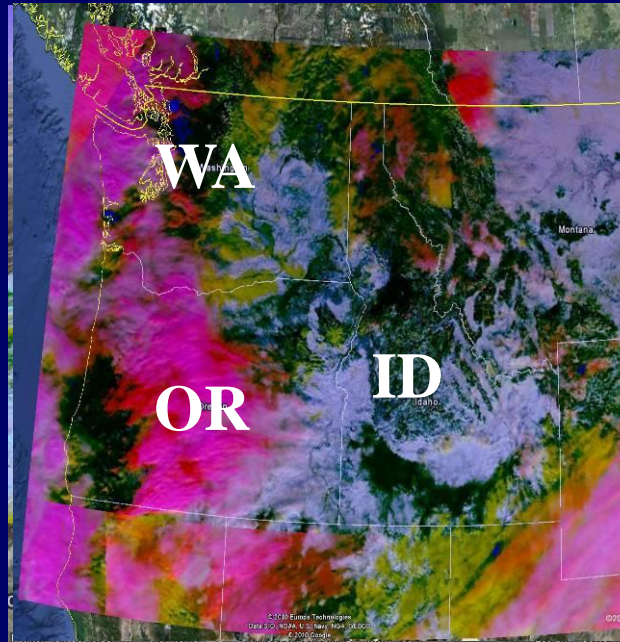
new dimension of environmental depiction

Global Clouds



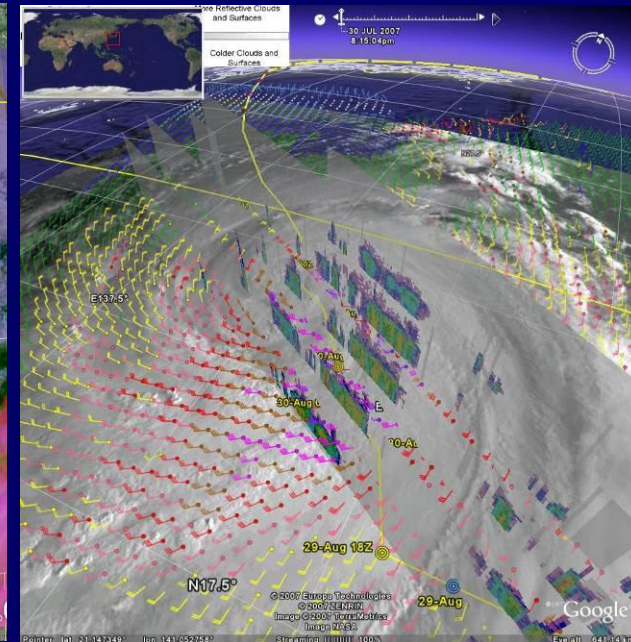
1-D field

Snow-Cloud



value-added

IR, winds and rain

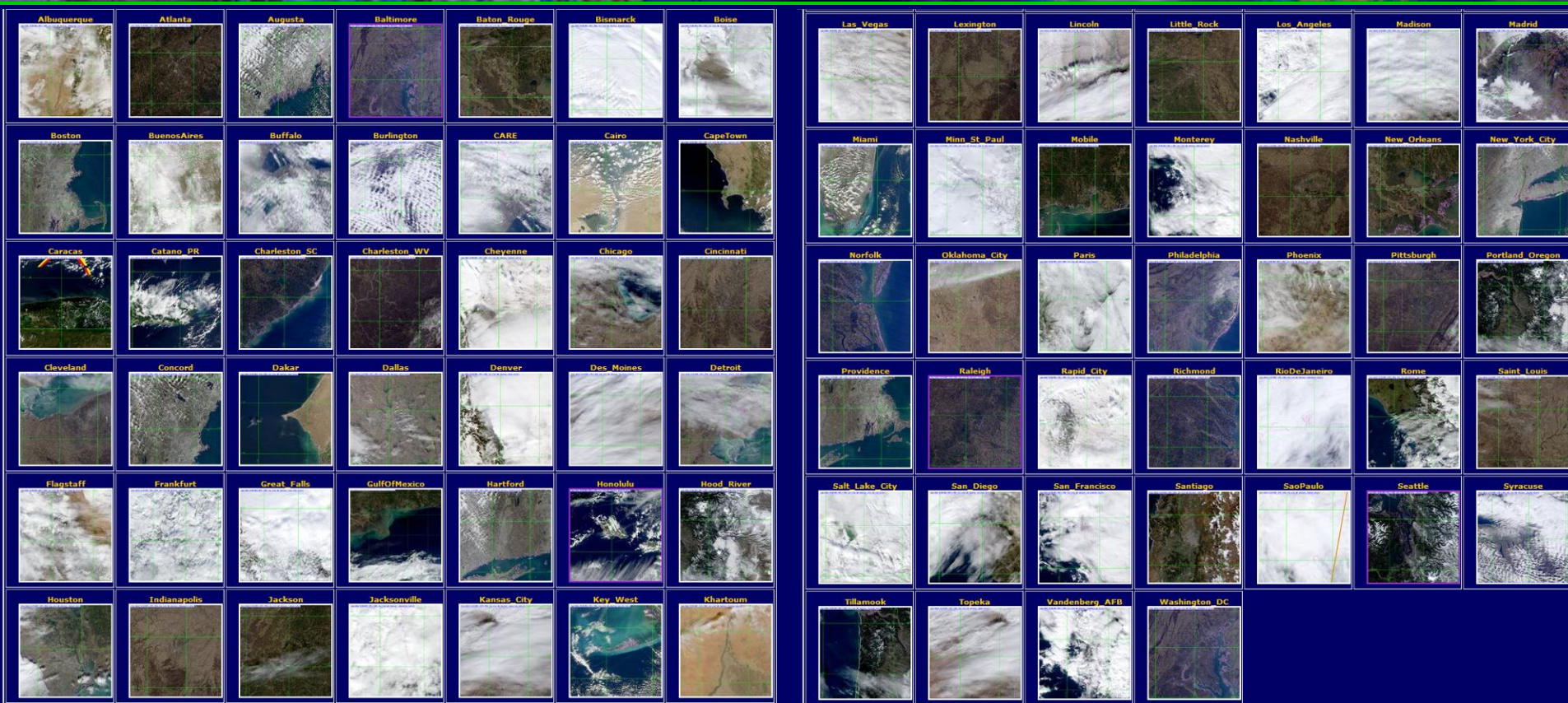


multi-dimensional

courtesy: Joe Turk



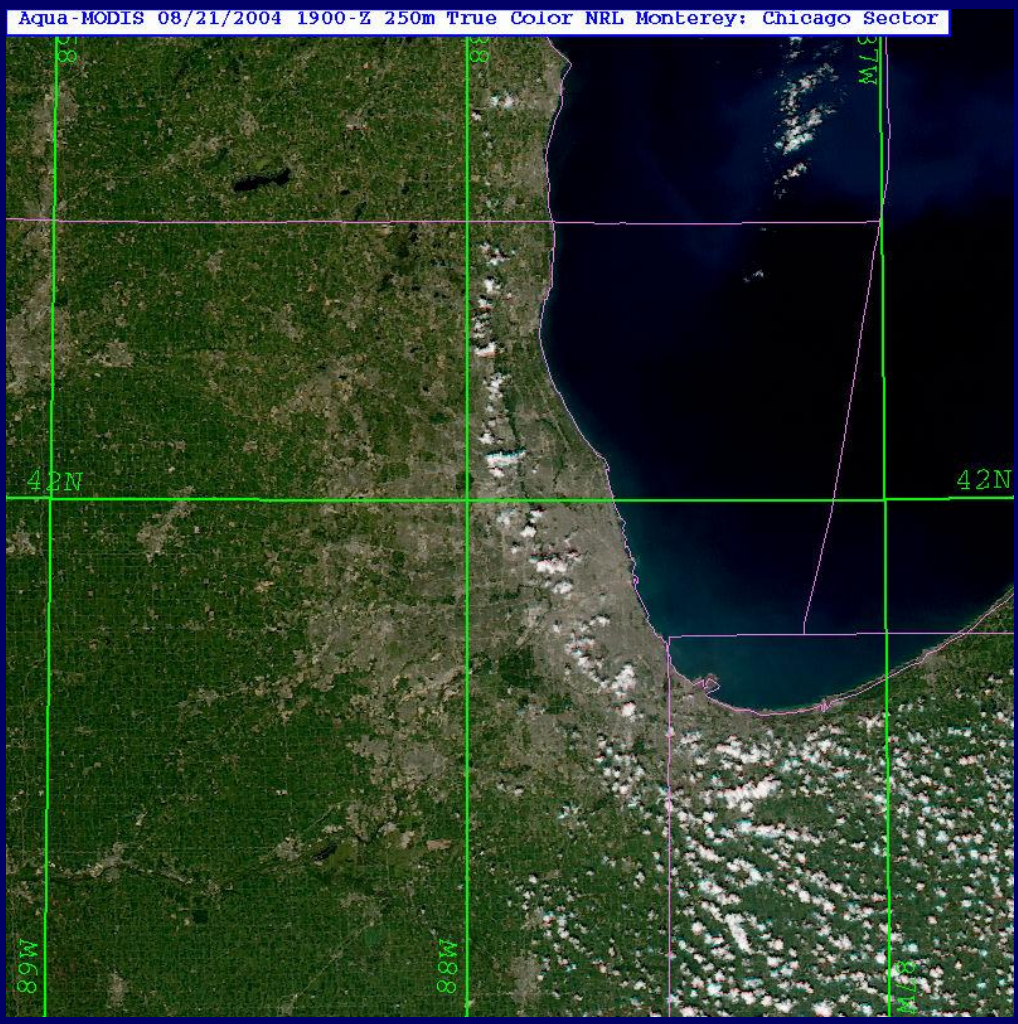
NexSat city coverage



- 81 cities globally
- MODIS 0.25 km resolution
- true color & bio mass products
- Google Earth viewing option

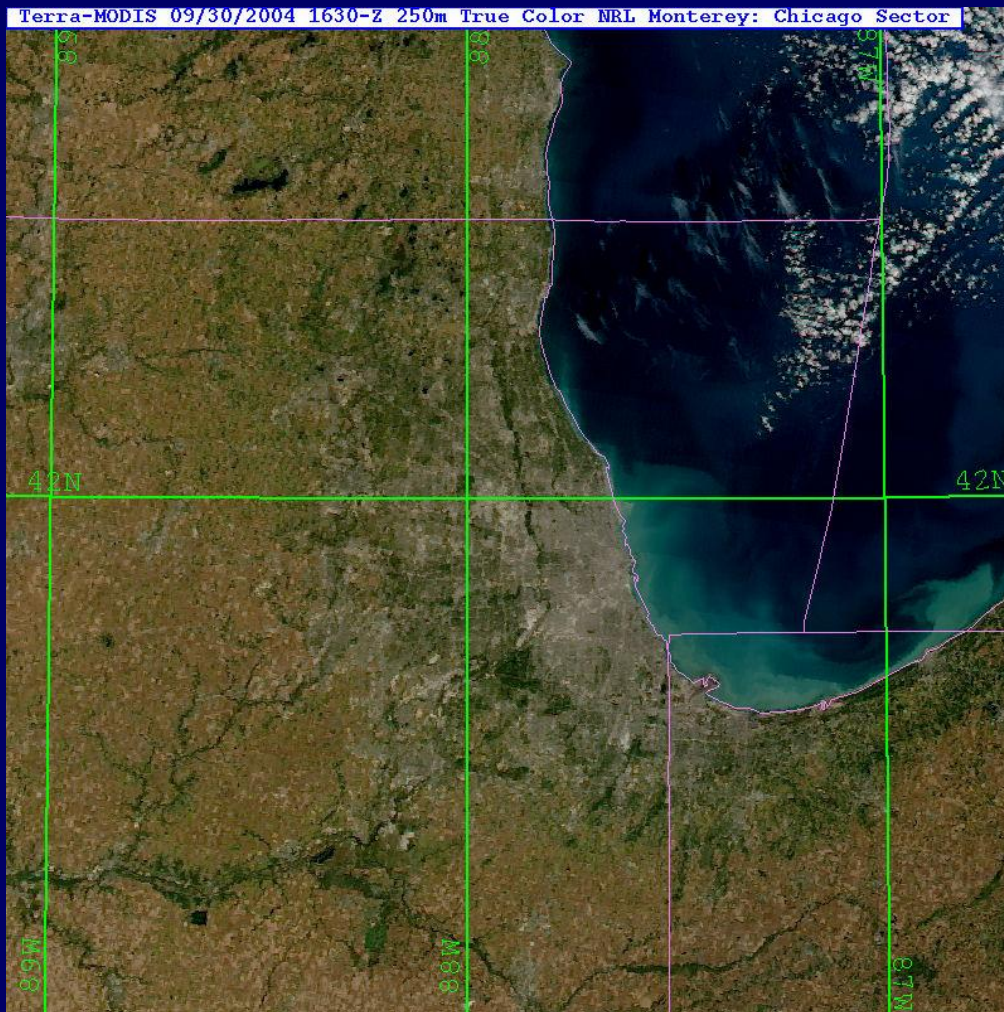


Chicago: Summer Green



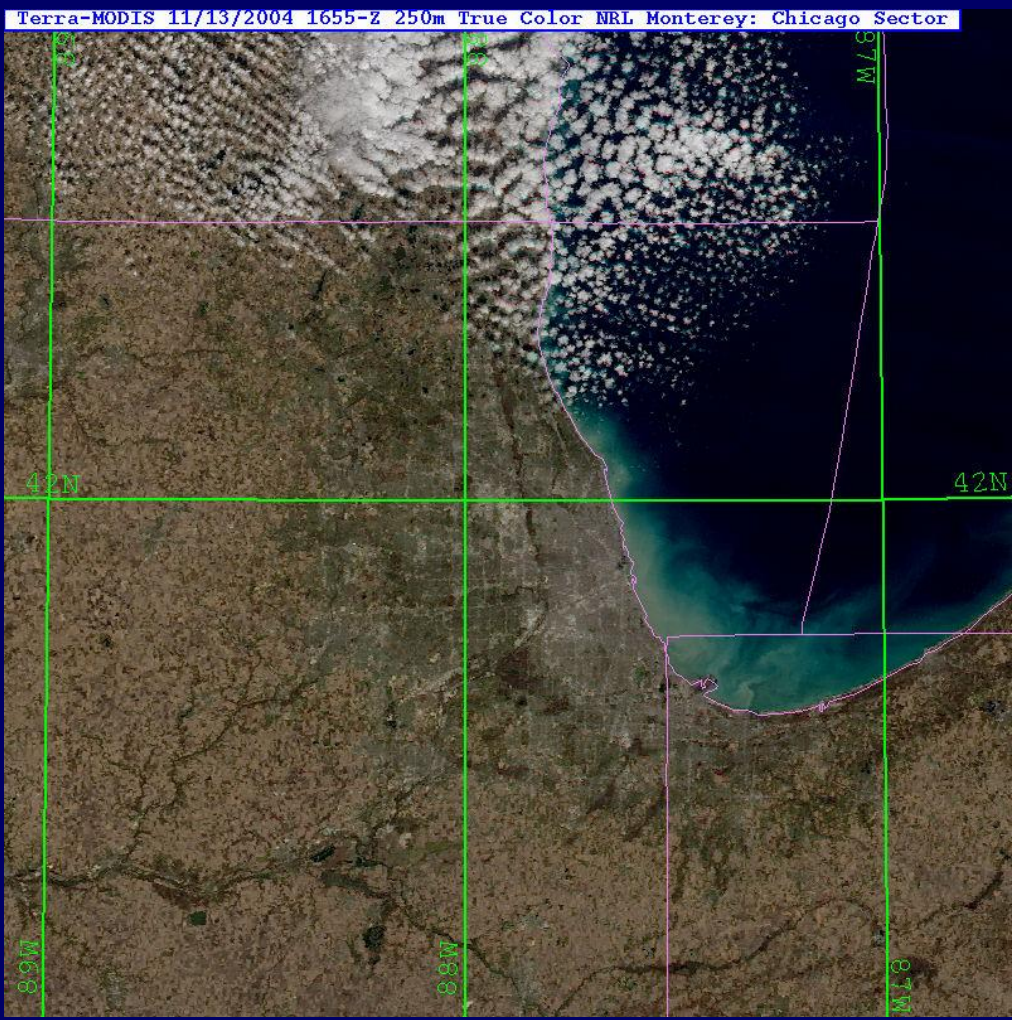


Chicago fall Colors



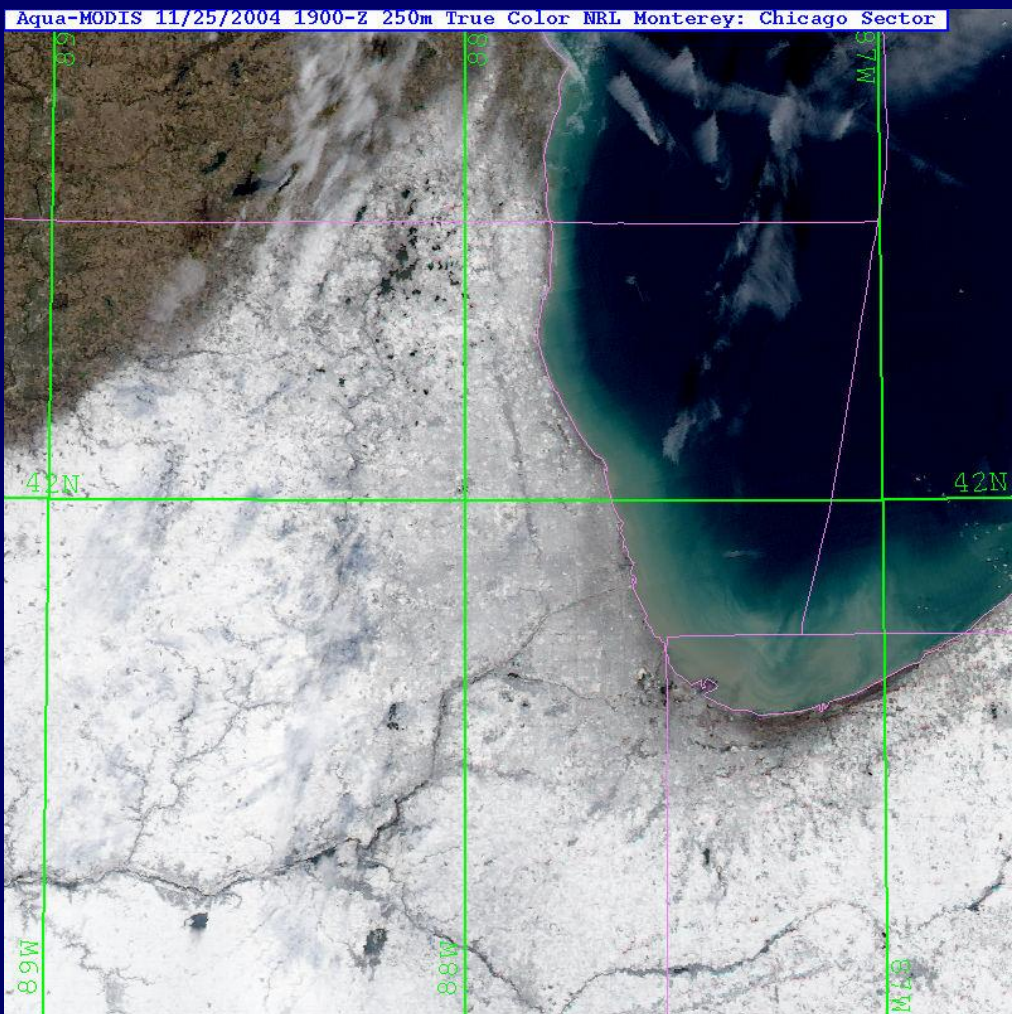


Chicago after the leaves fall



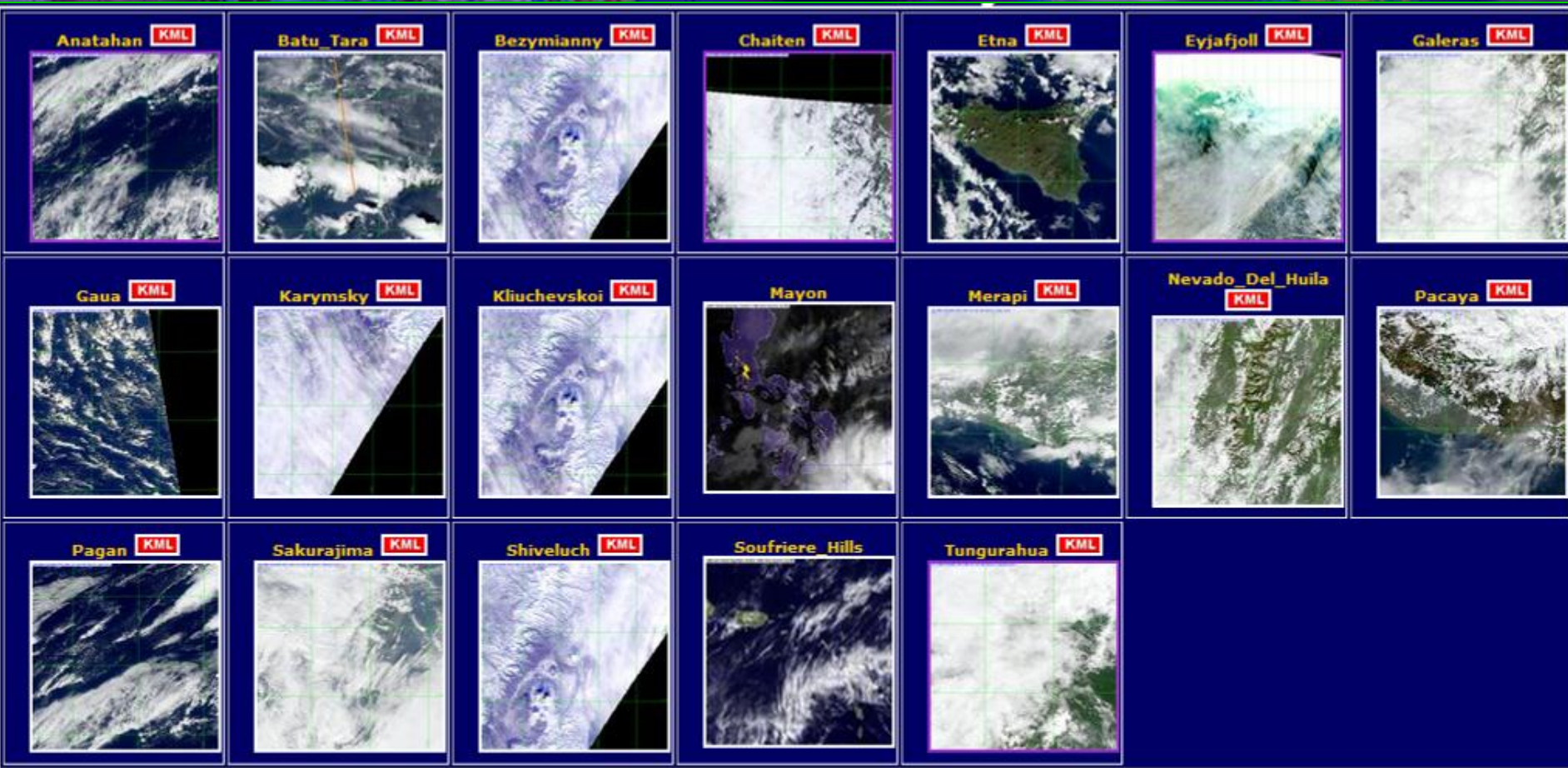


Chicago late autumn snow





NexSat volcano coverage



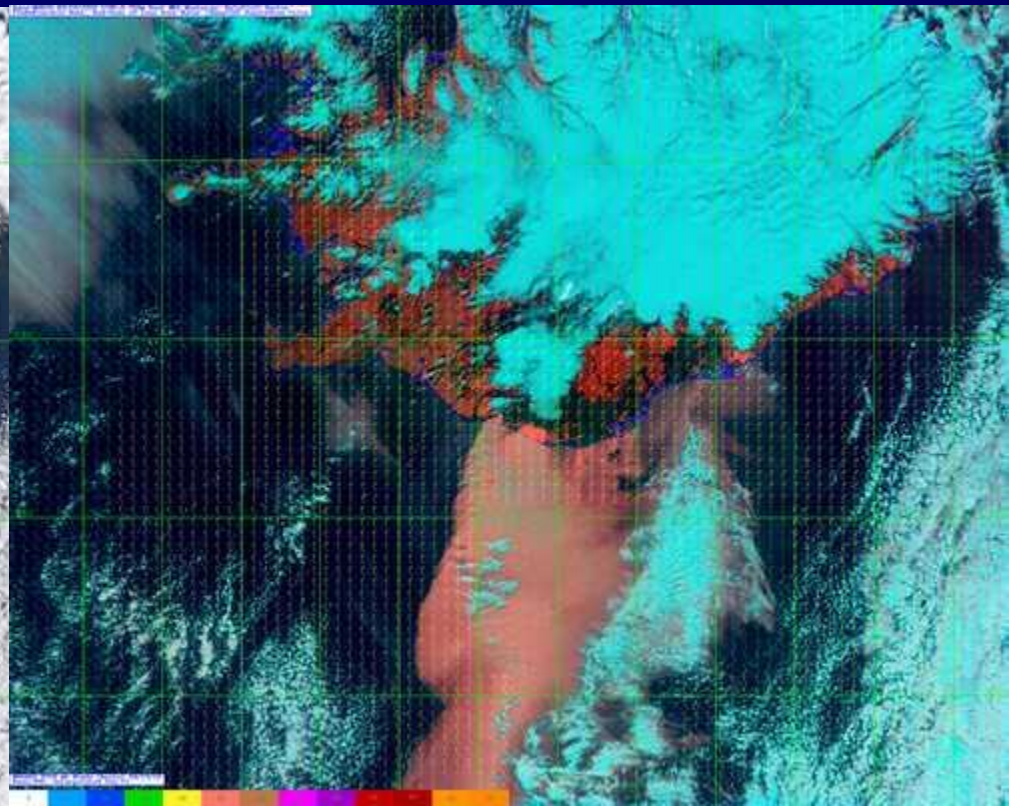
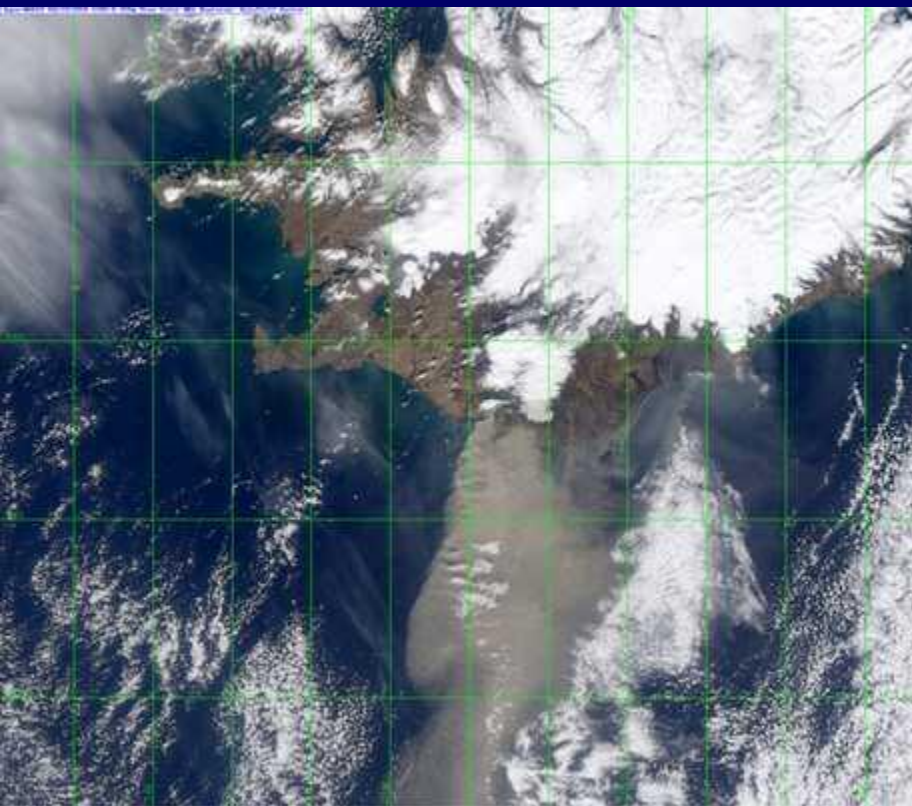
- Currently, 21 active sites
 - MODIS 0.25 km resolution, OLS 1 km resolution
- vis, IR, true color, biomass, fire, dust, night visible, volcanic ash products
- Google Earth viewing option



Volcano Monitoring Eyjafjallajökull

MODIS True Color

NRL "Dust" Product

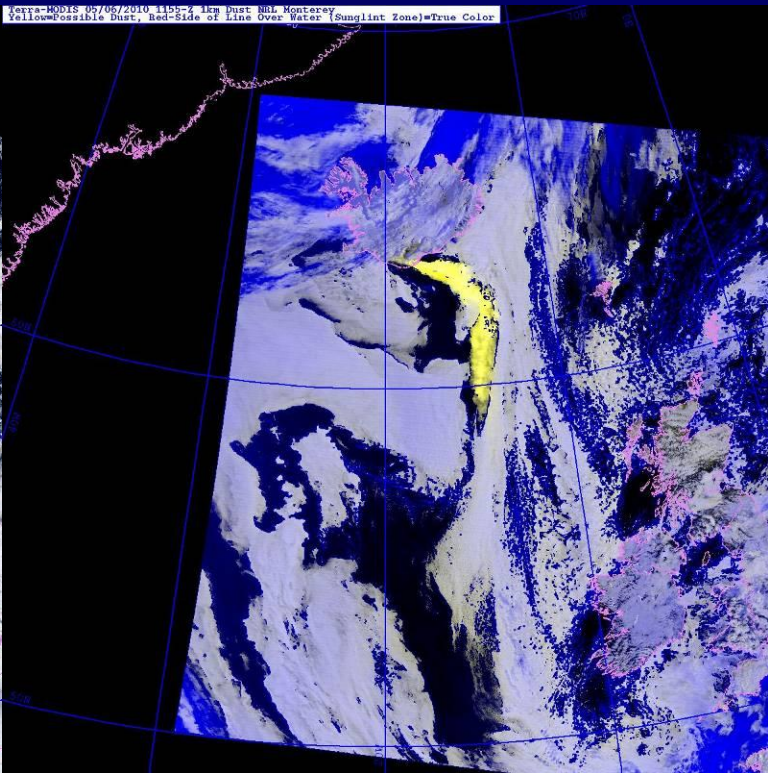
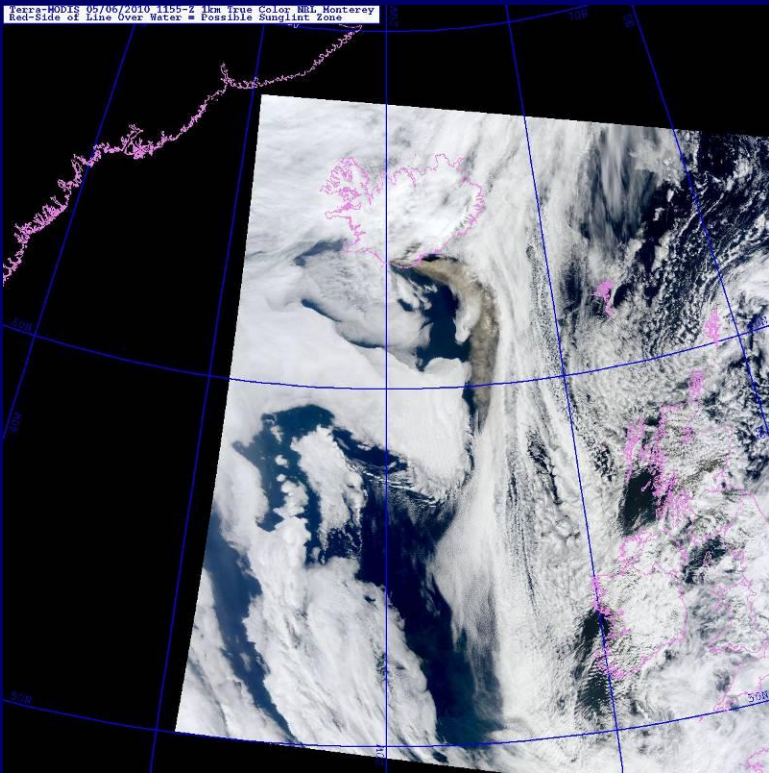


April 19, 2010



NexSat Support Volcano monitoring

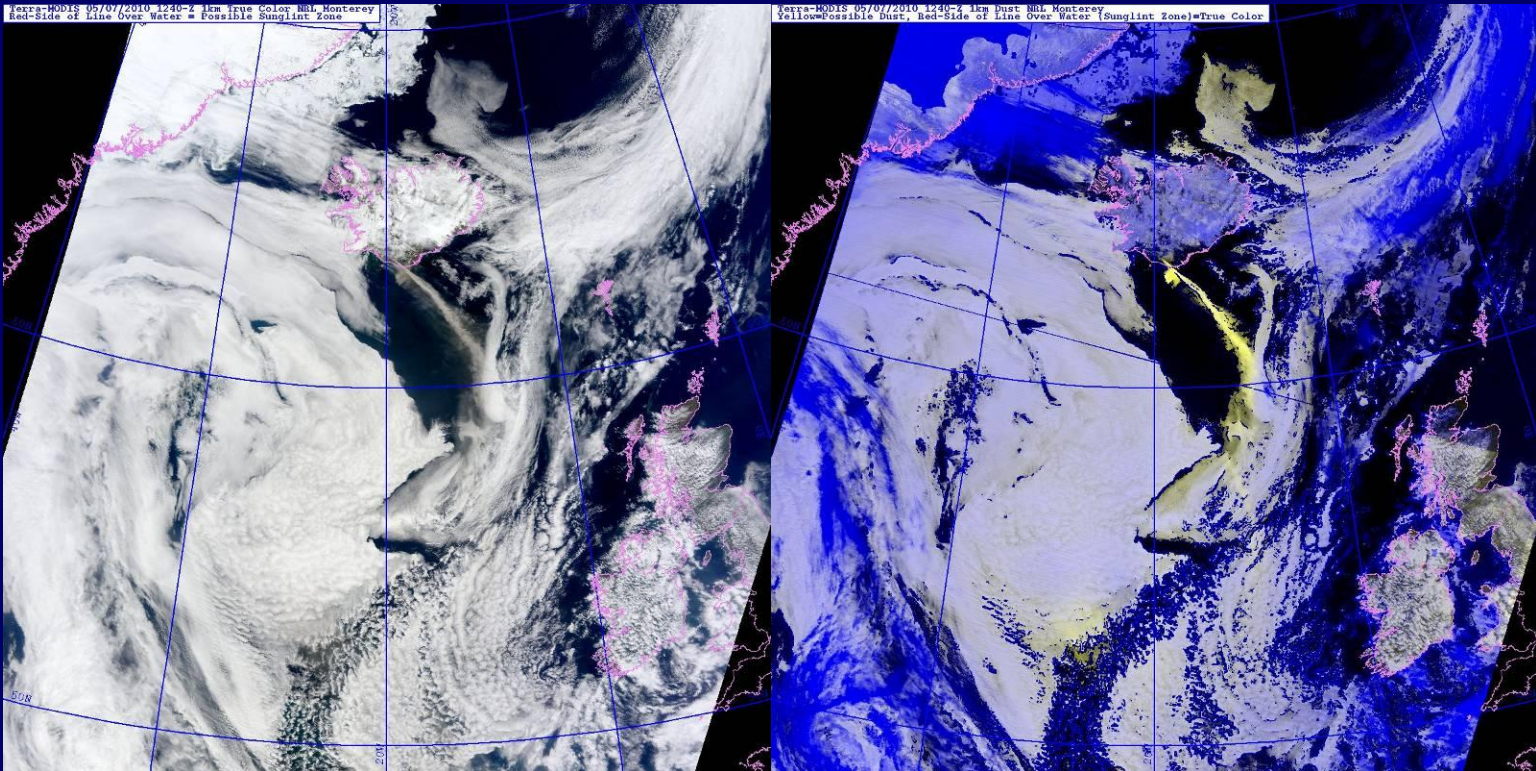
2010/05/06 1155 UTC Terra MODIS





NexSat Support Volcano monitoring

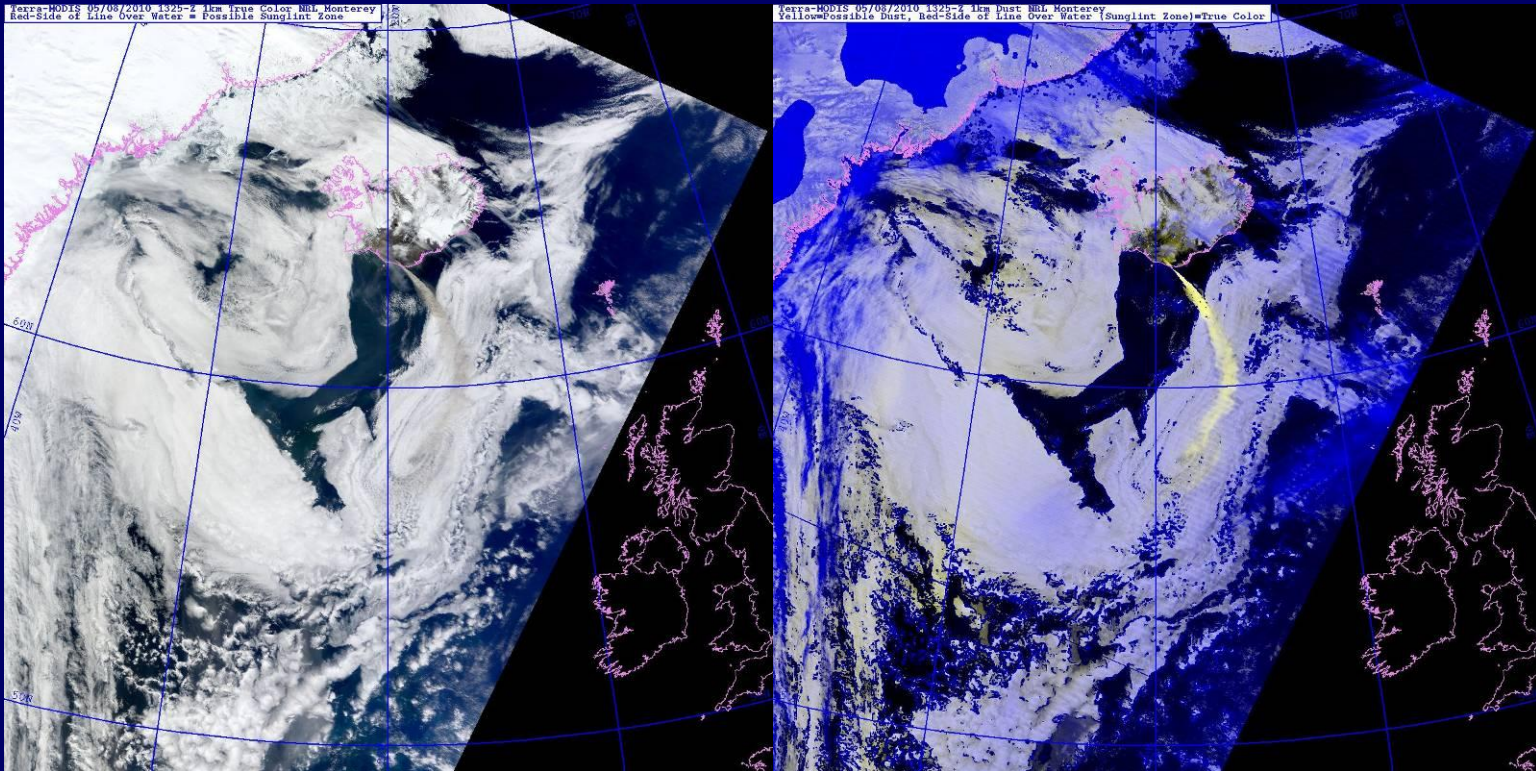
2010/05/07 1240 UTC Terra MODIS





NexSat Support Volcano monitoring

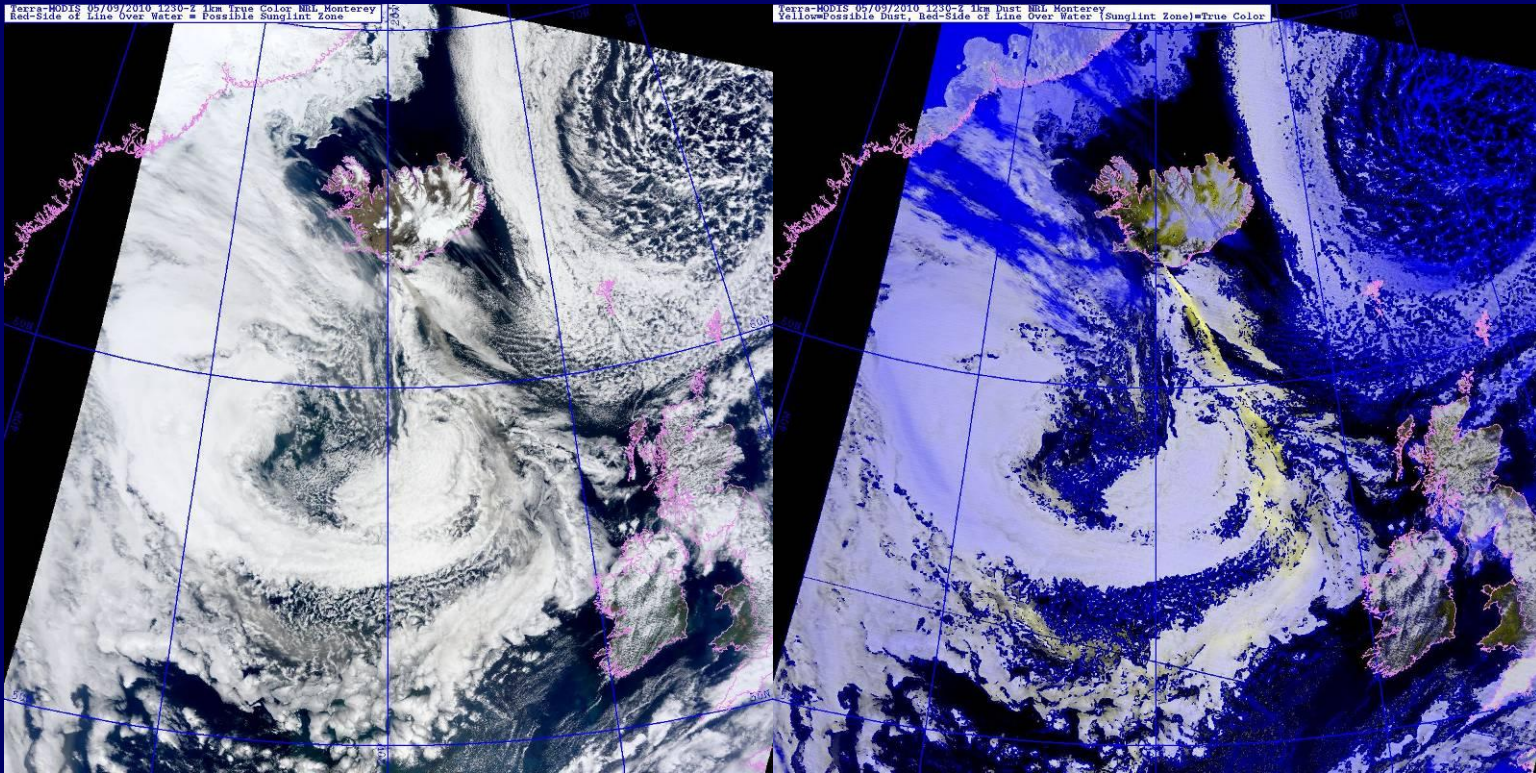
2010/05/08 1325 UTC Terra MODIS





NexSat Support Volcano monitoring

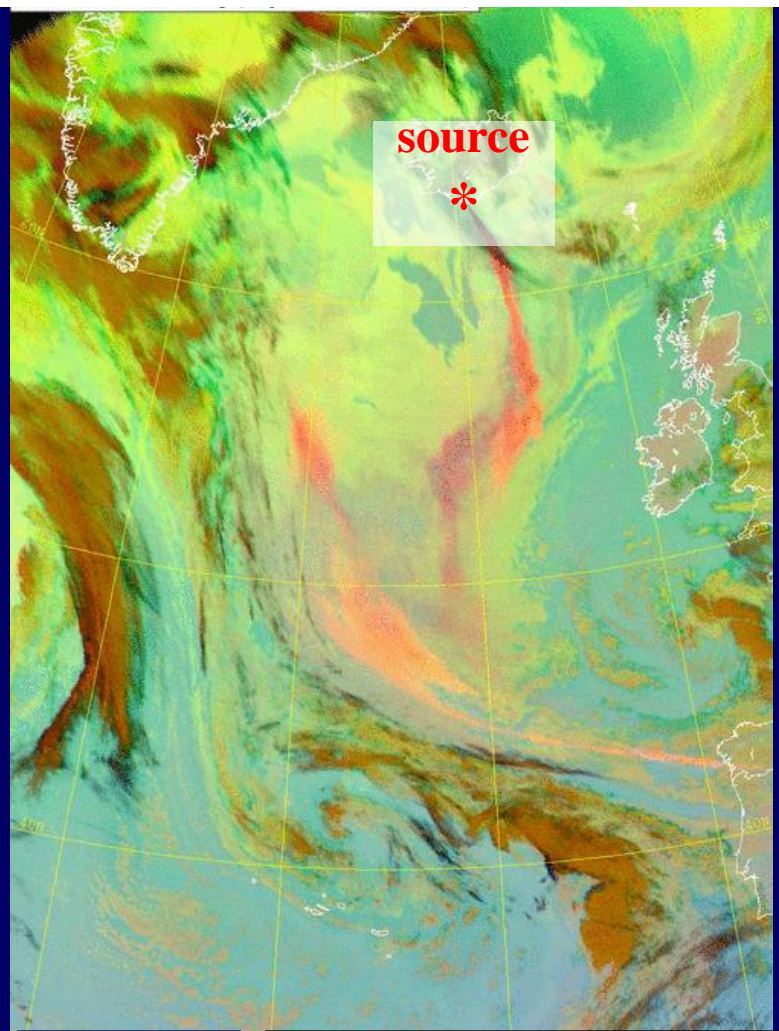
2010/05/09 1230 UTC Terra MODIS





Animating the eruption May 8

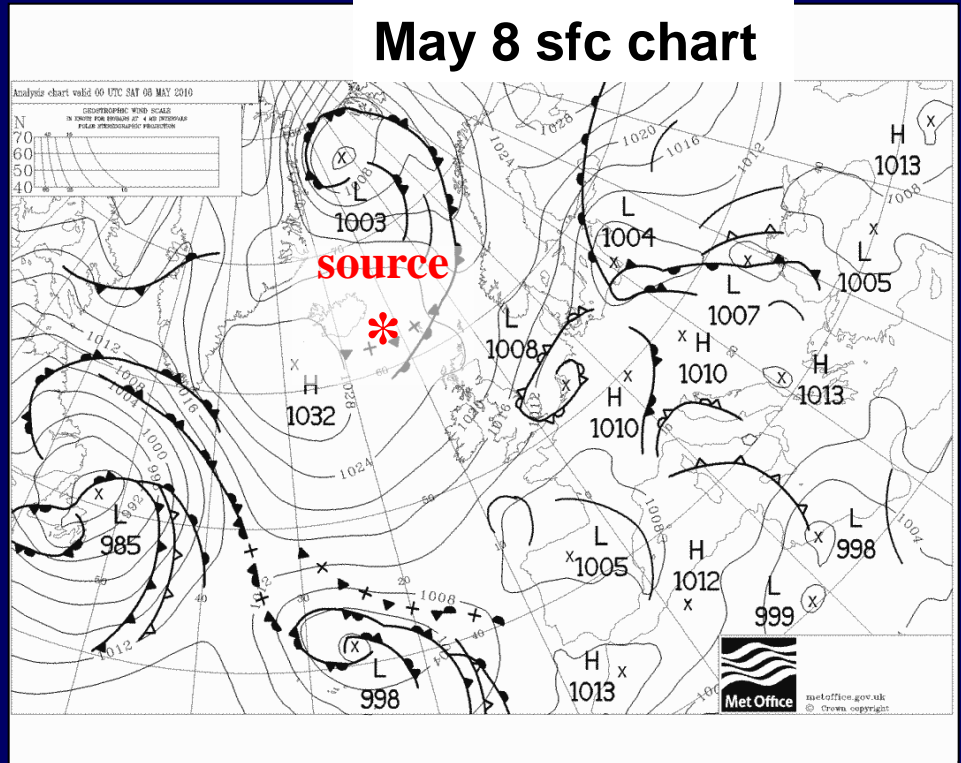
Meteosat-9 EUMETSAT Volcanic Ash & SO2 algorithm



source
*

SO2 range

volcanic ash range



May 8 sfc chart

source
*

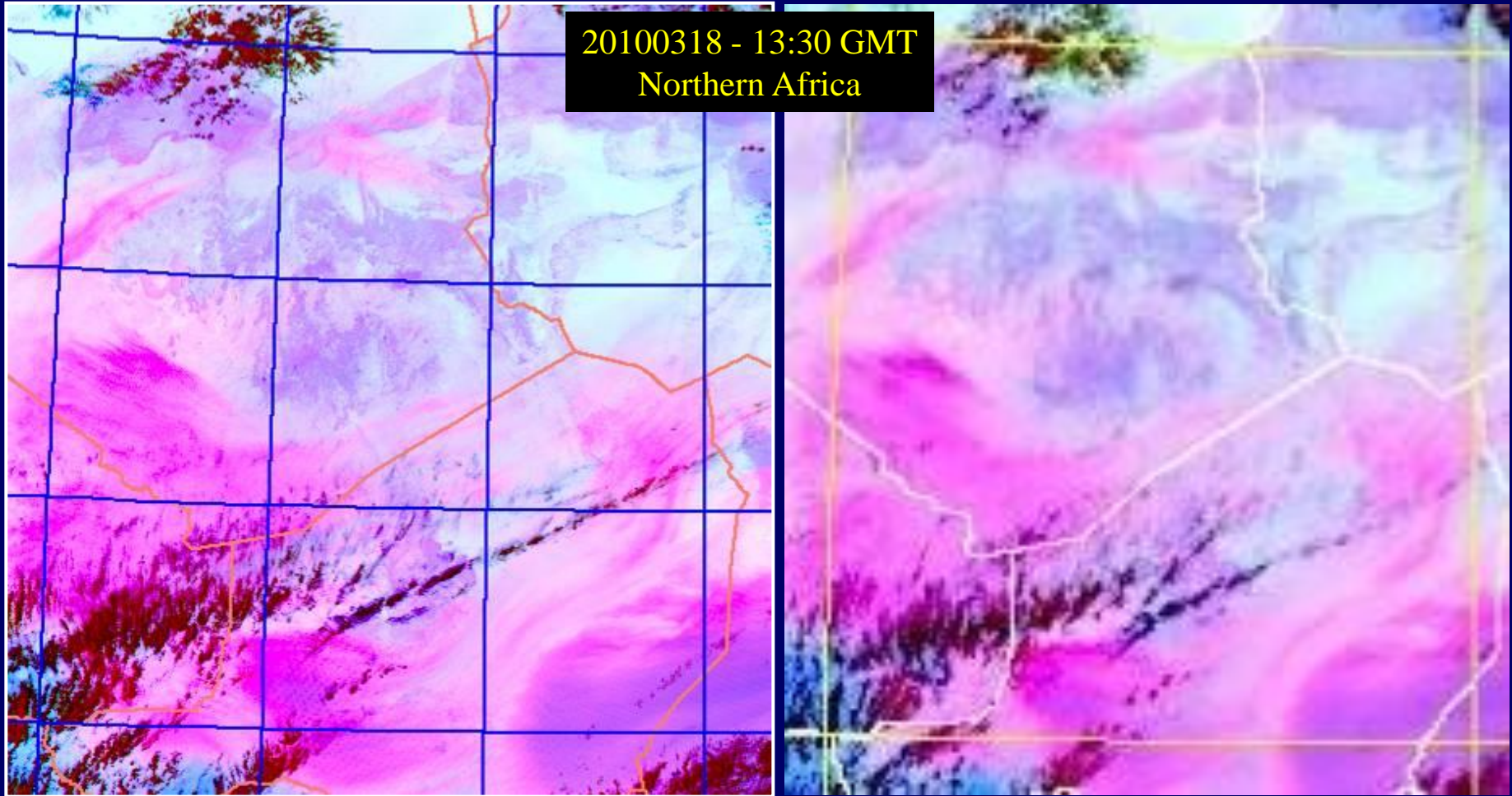




NexSat applications

Day and night dust monitoring

EUMETSAT-MSG and NRL-MODIS RGB dust algorithms



MODIS 1 km
~4 times daily

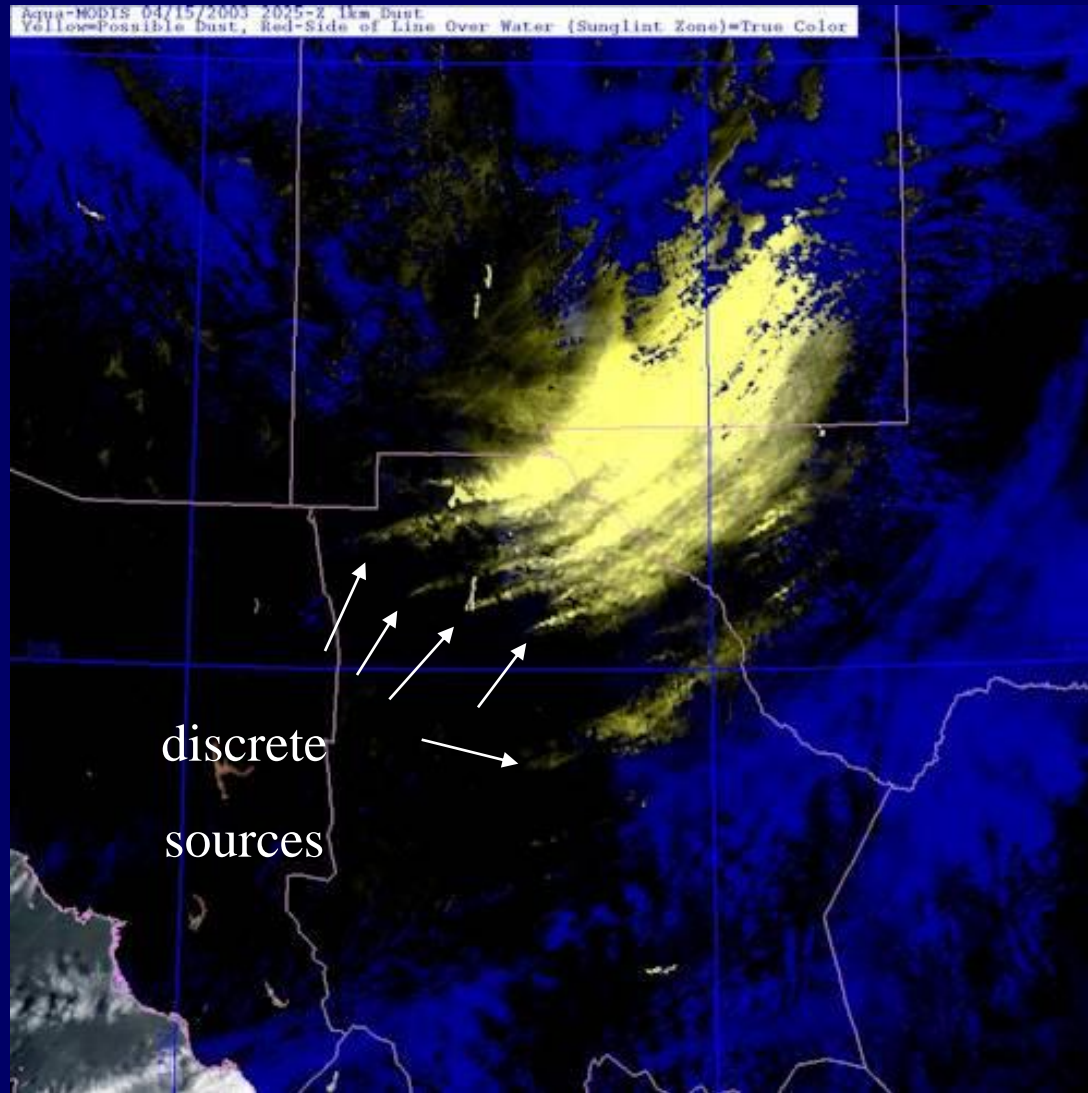
MSG 3 km
(hourly)



NexSat applications

NRL MODIS dust detection algorithm

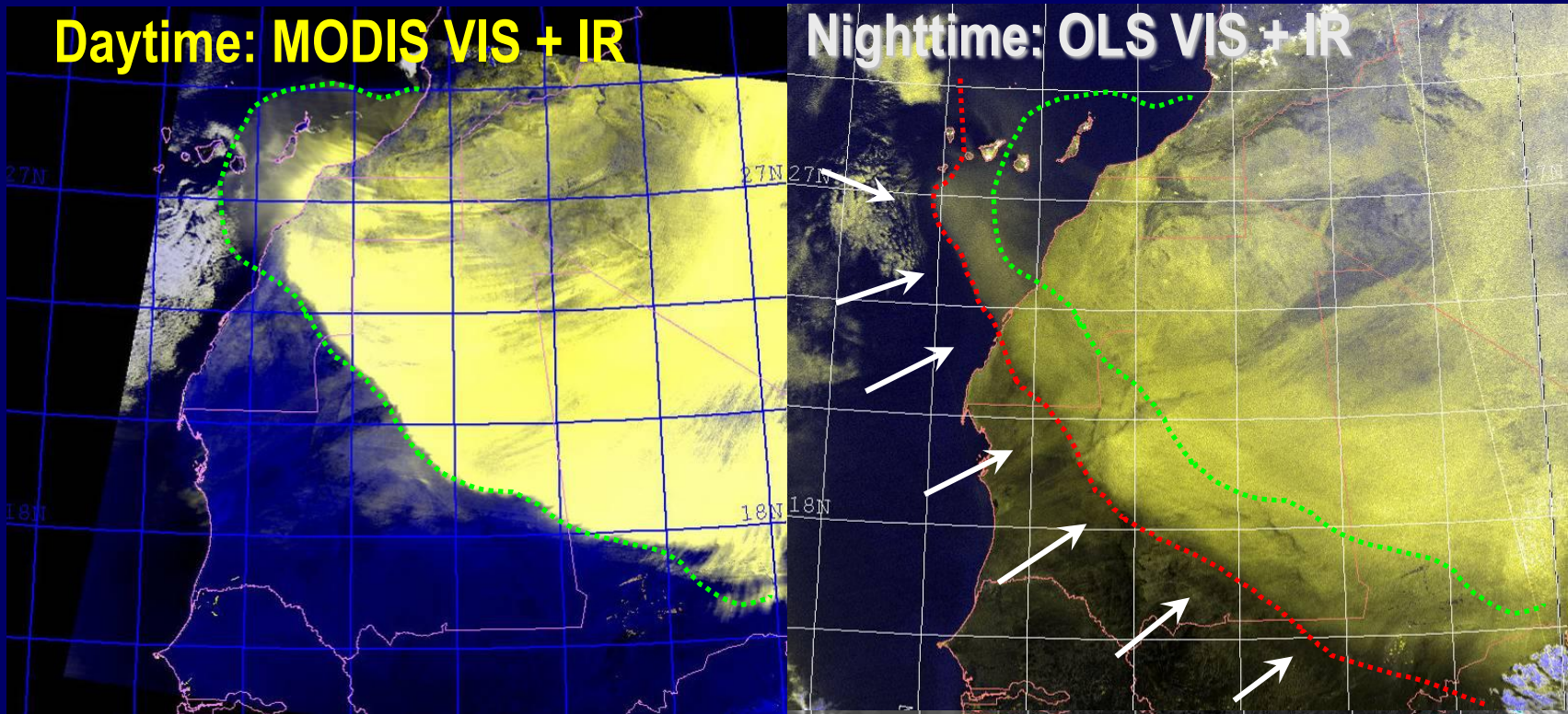
April 15, 2003 Chihuahuan Desert





NexSat applications

Demonstrating VIIRS DNB dust detection at night



3 March 2004, 1110 GMT

3 March 2004, 2017 GMT

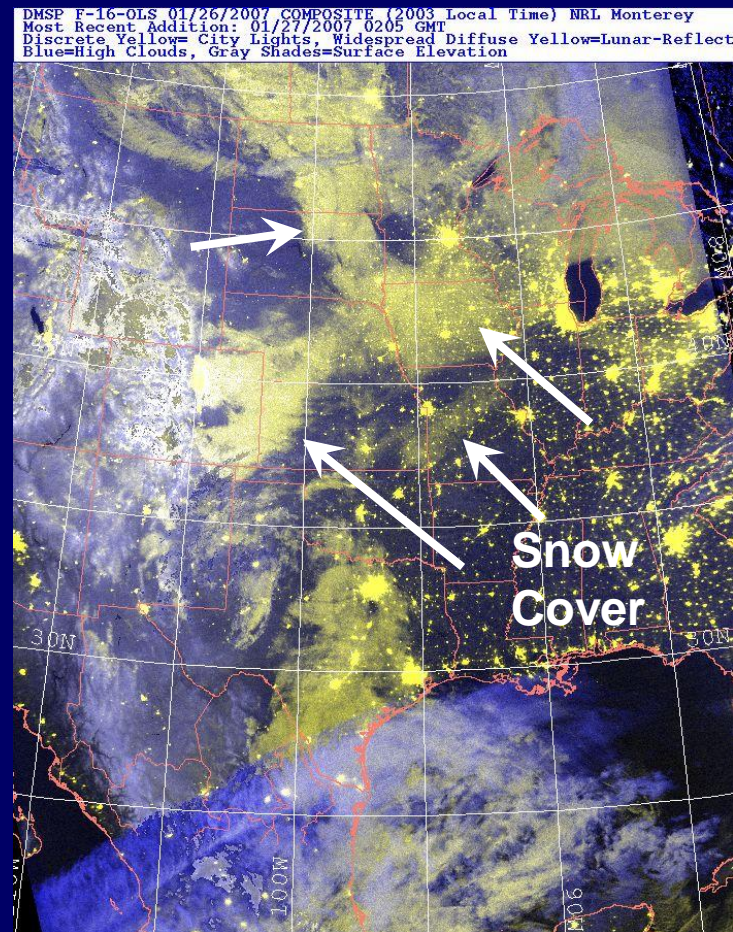
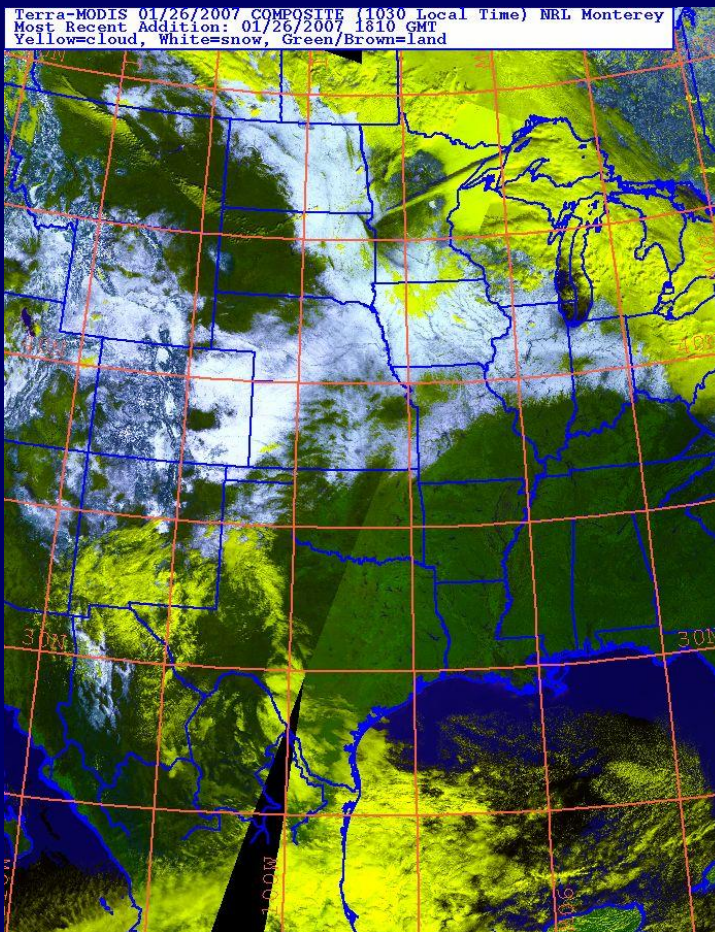
→ Moonlight reflectance highlights dust plumes at night. A mid-morning (0930/2130) orbit would be particularly valuable for tracking the advance of plumes after sunset.



NexSat applications

Snow cover detection at night

Multi-spectral techniques with DNB: separate cloud from snow cover & sea-ice.

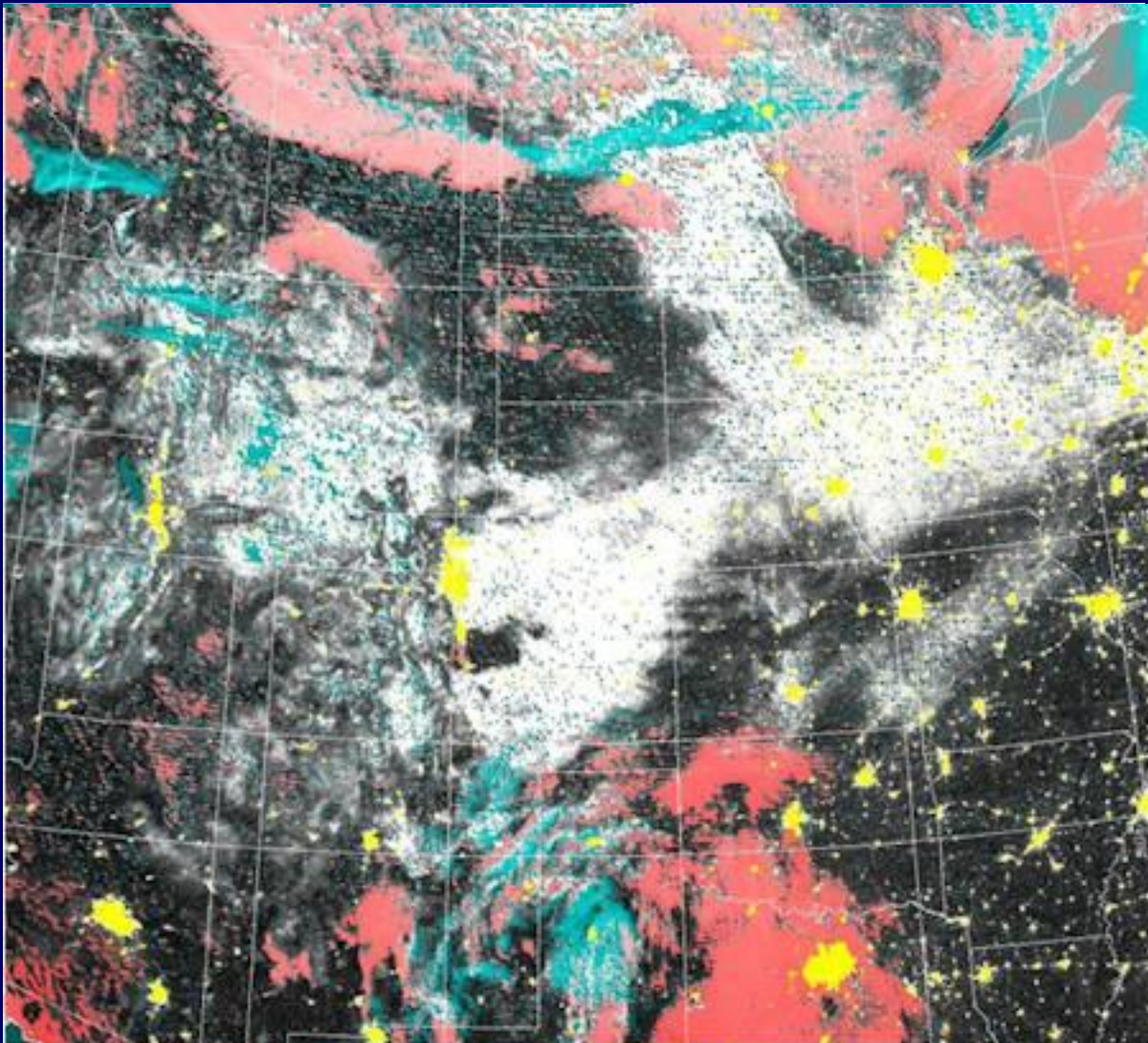


→ We can simulate the capability of VIIRS via space/time matching of OLS and sensors possessing NIR channels...



NexSat applications

Snow/cloud detection at night



Low
Cloud

High
Cloud

City
Lights

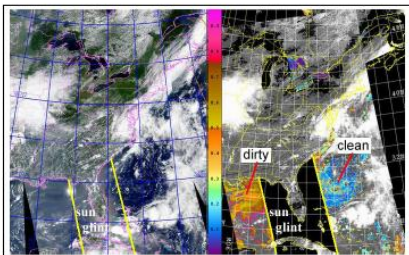
Snow
Cover



NexSat on-line product training



Satellite Product Tutorials: Aerosol Optical Thickness



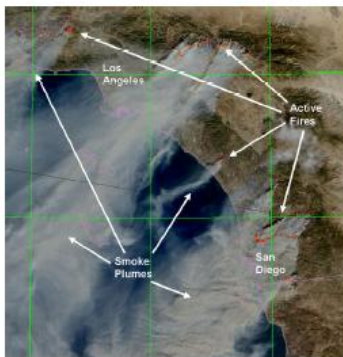
Above: The true color image on the left mimics what the human eye would "see" from space. The observer is somewhat limited in determining how clean or polluted the atmosphere appears over the region displayed. On the right, the aerosol optical thickness product greatly improves the interpretation of atmospheric turbidity over the water regions. As shown, the Gulf of Mexico has relatively high aerosol (polluted) content, while the cloud-free regions off the SE coast of the US are fairly clean. The annotated "sun glint" regions indicate strong mirror-like sunlight reflection off water. These regions present a problem to the aerosol optical thickness product and are removed (blocked out) from the imagery.

Why We're Interested.

Aerosols are small particles in the air that originate from a number of different natural and human-activity sources, including ocean spray, dust



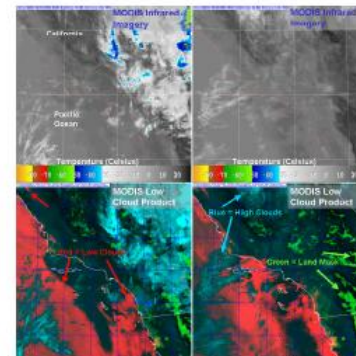
Satellite Product Tutorials: Detecting Fires



Above: In October 2003, wildfires fueled by years of drought and strong Santa Ana winds ravaged Southern California. The fires storm as observed by MODIS from 500 miles overhead is shown in the above image. Here, active fires highlighted in red and yellow (hottest). The military used similar products during the early stages of Operation Iraqi Freedom to monitor the oil fields of southern Iraq (during the 1991 Gulf War they were set ablaze and caused severe visibility hazards for pilots).



Satellite Product Tutorials: Low Clouds at Night



Above: The nighttime low cloud product simplifies in most cases the detection of marine layer clouds and coastal/inland fog banks at night by color-coding these features in the scene as red. In the examples above, conventional infrared imagery (top panels) fails to reveal the detail of low cloud cover (lower panels; red) throughout the scene. Contemporary operational sensors easily exploit the physics allowing for this technique. However, important exceptions to the straightforward interpretation of the product occur. The current application of the traditional low cloud detection product makes allowance for these exceptions through additional color-coding of "potential problem areas" as green.

Online tutorials are designed to orient new users with NexSat products using simple and straight-forward illustrative examples, all the while tying into the general theme of future JPSS/VIIRS capabilities.



NexSat collaboration

CoCoRaHS: volunteer precipitation observers



[Training](#) **NexSat** [Feedback?](#) [About_Nexsat](#)



Global_Map CONUS

/NorthAmerica/CONUS

Products

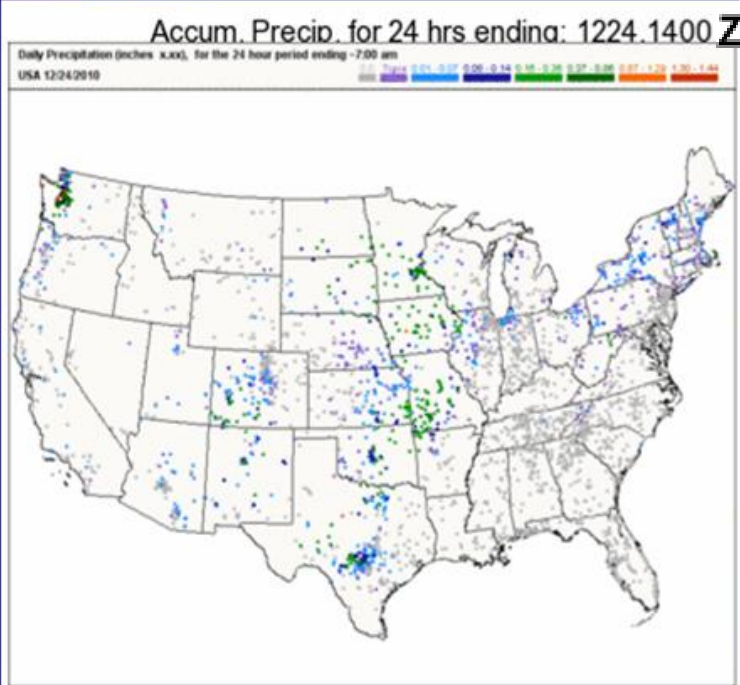
- Google Earth
 - Visible
 - Infrared
 - Vapor
 - True Color
 - GEO-Color
 - Cloud Tops
 - Cloud Layers
 - Cirrus
 - Snow Cover
 - Rain Rates
 - Rain Totals
 - Contrails
 - BioMass
 - CloudSat
 - Winds
 - Aerosol
 - Low Cloud
 - Model Overlays
 - Night Visible
- Age <= 12 h

Age <= 24 h

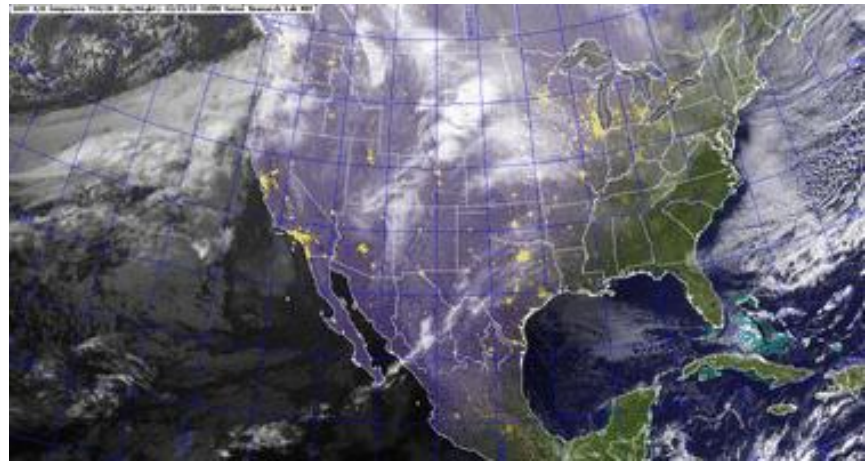
Age > 24 h

NOTE: IE7 users; set browser security setting to MEDIUM for controls to work. Tools > Internet Options > Security Precipitation observations provided courtesy of CoCoRaHS. What does UTC or Z mean?

Mode: Direction: Frame: 20 Slider: Dwell First: Dwell Last: Speed: Step:



GEO-color 24hr animation 1223 14Z – 1224 14Z





NexSat collaboration

West Africa weather satellite community

Focus: mesoscale hazards, Saharan dust

Products

- Visible
- Infrared
- Vapor
- True Color
- GEO-Color
- Cirrus
- BioMass
- CloudSat
- aod_blend
- day_natural_color
- Dust
- Night Visible

Age <= 12 h
Age <= 24 h
Age > 24 h

Latest Archive Small Large | Single Multi Animate

dust_enhance/modis_composite_BETA/20100827.1330.Aqua.modis

(This is the "Closest To" ARCHIVED image. NOTE: click "Latest" for la

The satellite image shows West Africa with a grid overlay. A large area of dust is visible over the Sahel region, appearing in shades of brown and orange. The surrounding areas are green, indicating vegetation. The image is framed by a blue border.



NexSat Support

recent activities

Field Experiments in 2010/2011

- TCS-10/ITOP (July – October)
 - WESTPAC region
- Cape Canaveral (16-27 August)
 - West Atlantic
- Hydrometeorology Testbed (HMT) Atmospheric Rivers (Dec – Mar)
 - Eastern Pacific/CA

Disaster Relief in 2010

- Haiti earthquake
- Russian summer fires
- Iceland volcano
- Gulf of Mexico oil spill

Ongoing support

- GOES-R Proving Grounds
- West Africa severe weather
- US Navy



NexSat support

NexSat monitored oil spill for Navy operations

April - June



Deepwater Horizon Explosion- 19 April 2010

- CDR John Dumas [Joint Forces Command]

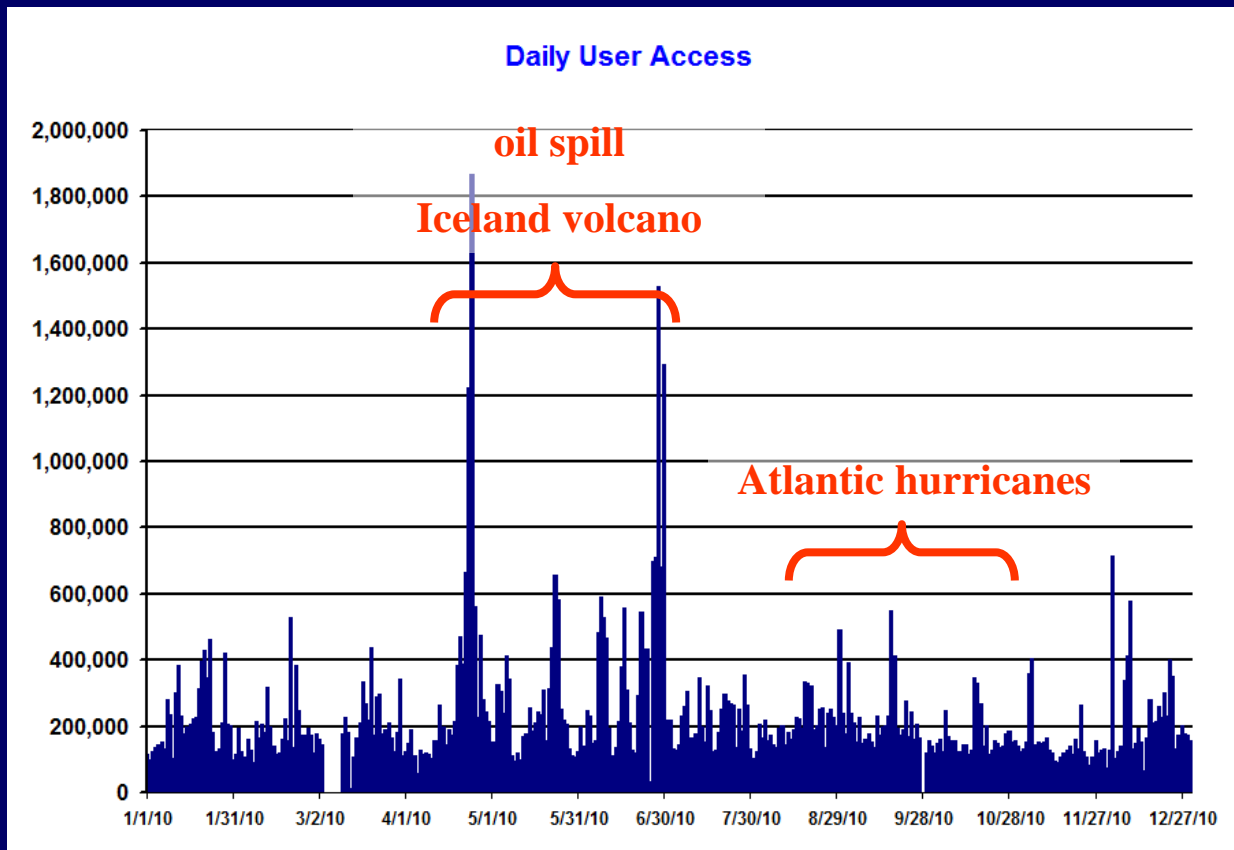
“This support has been fantastic, thank you.”

- Roffer's Ocean Fishing Forecasting Service, Inc. [NOAA support staff]

“Thanks. We have been using your site everyday for the oil as well as other applications. We like your site. Easy to manipulate and see the data.”



NexSat user statistics 2010 results



provided by: Wusage

Accesses

Visits

Total

80,748,851

1,174,128

Daily Average

231,464

3,478



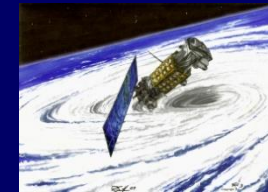
Looking beyond NPOESS

Evolution of The Polar Satellite Programs



NPOESS C-2

Early Morning Orbit



DWSS

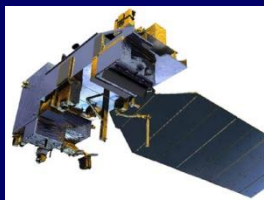


MetOp

Mid-morning Orbit



MetOp



NPOESS C-1

Afternoon Orbit

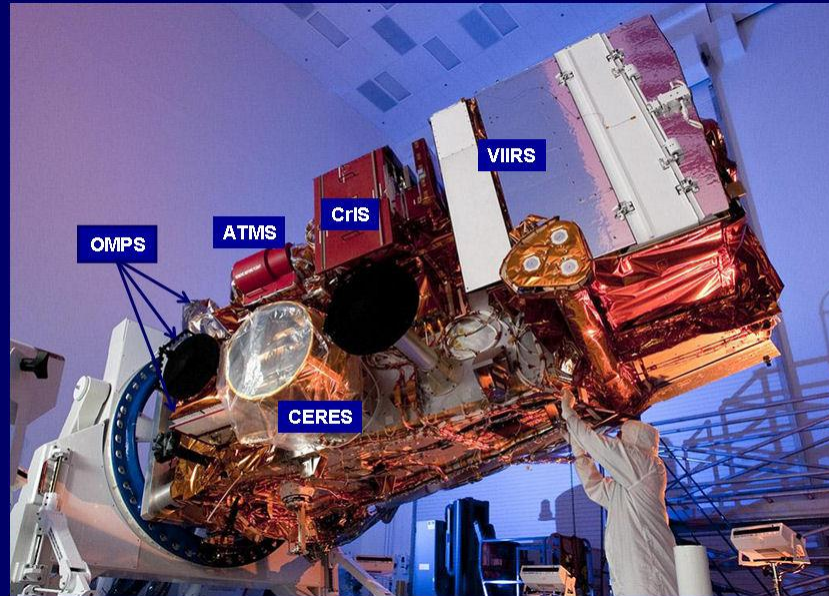


JPSS

St. Germain, K, et. al.; The NPOESS to JPSS Transition and the NPOESS Preparatory Project, presented at 2010 Fall Meeting, AGU, San Francisco, Calif., 13-17 Dec



NPP status



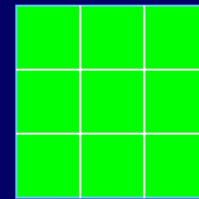
- October 2011 launch on schedule
- 5 instruments
- prototype to JPSS and DWSS eras
- NexSat website demos VIIRS data



VIIRS

16
Moderate
Resolution
Channels

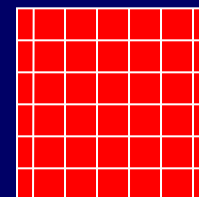
.74 km



1 Day/Night
Channel

5
Fine
(Imager)
Channels

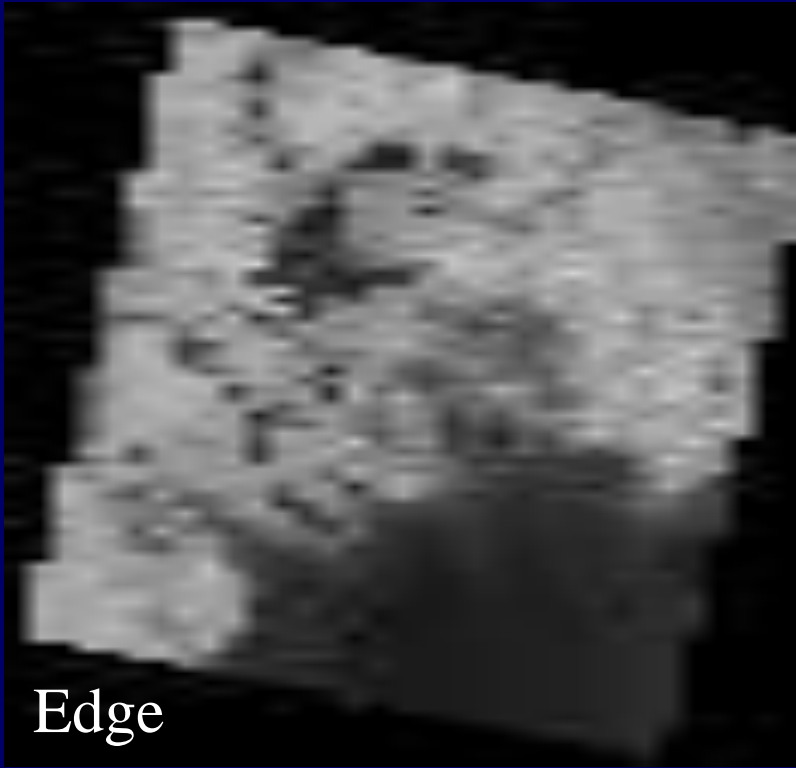
.37 km



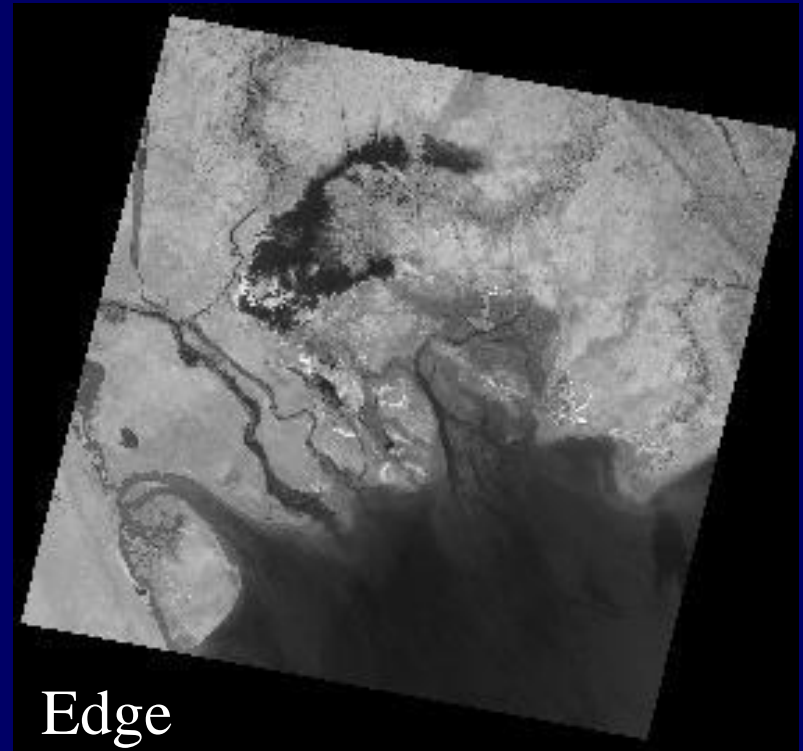


Improved detail with VIIRS

AVHRR VISIBLE
SIMULATION



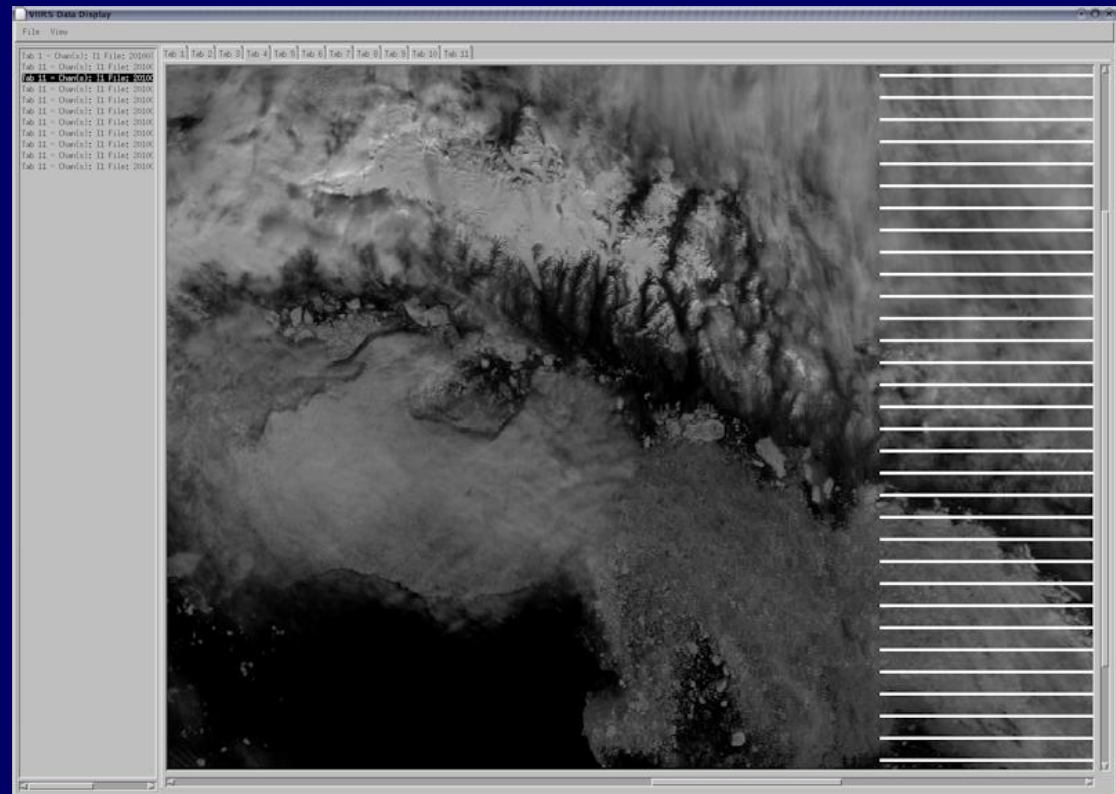
VIIRS VISIBLE SIMULATION
Imager Band (Visible)





Hosting VIIRS proxy data

GUI (under development)



- NexSat hosting products
- reformatted MODIS data
 - HDF5 data by NOAA GRAVITE
- Products:
cloud top height, cirrus,
contrails, cloud layers, etc.



Summary

NexSat

www.nrlmry.navy.mil/NEXSAT.html

- demonstrate near real time state of the art products
 - 38 GEO and LEO sensors, VIS, IR, microwave
- primary objective: anticipate NPP VIIRS
 - educates scientists/public on current and future sensors
- supports variety of missions
 - disaster relief, field programs, mesoscale monitoring