







# SeaSpace users of TeraScan and CSPP software world-wide

*Dr Kota Prasad*  
*V.P. Research and Development*  
*SEASPACE CORPORATION*  
*USA*



# SeaSpace Corporation



-  Founded in 1982
-  Located in San Diego, California
-  Leading provider of satellite remote sensing ground stations and software
-  Comprised of scientists and engineers



# End-to-End Capabilities



Product and Software Design

Site Planning



Manufacturing



Testing



Installation



Training

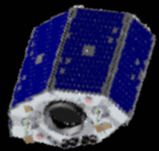


Service and Support

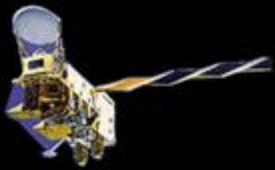




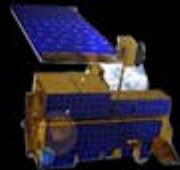
# Direct Broadcast Supported Satellites



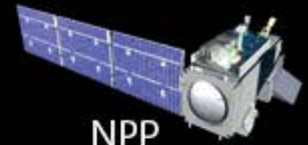
Aqua



Terra



Aura



NPP



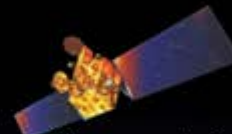
FY-3B/C



DMS series  
**SSMIS**



METOP



Oceansat-2



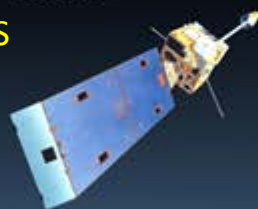
NOAA series



FY-1D\*



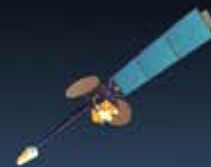
COMS  
HRIT/LRIT



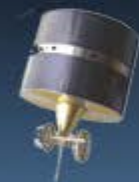
GOES series



MSG



MTSAT



FY-2D/E/F



Himawari-8

**GOES-R**

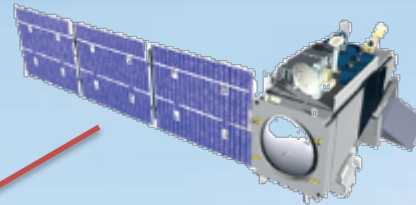


\* No longer operational, but SeaSpace supports processing of archived data





# Direct Broadcast Ground Station



High Rate Demodulator



Acquisition/Processing Computer(s)



Visualization System w/Software

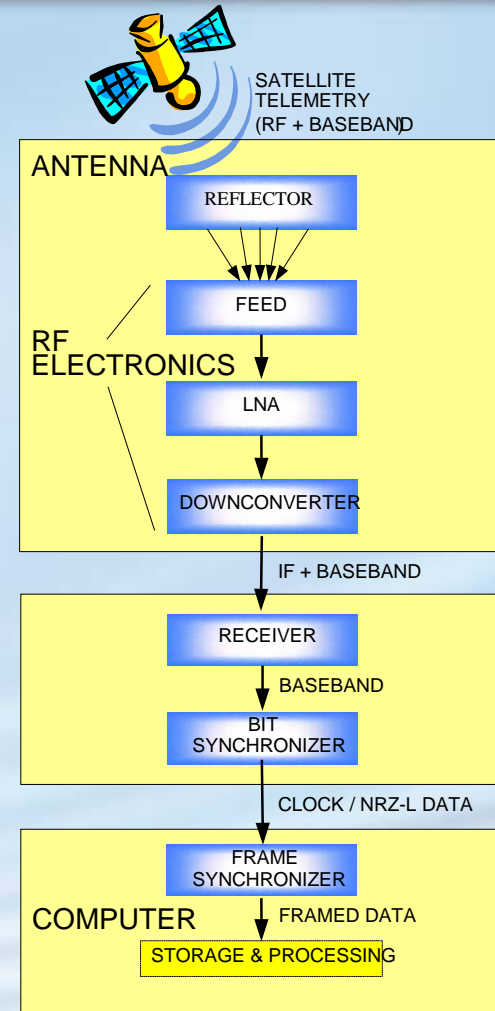




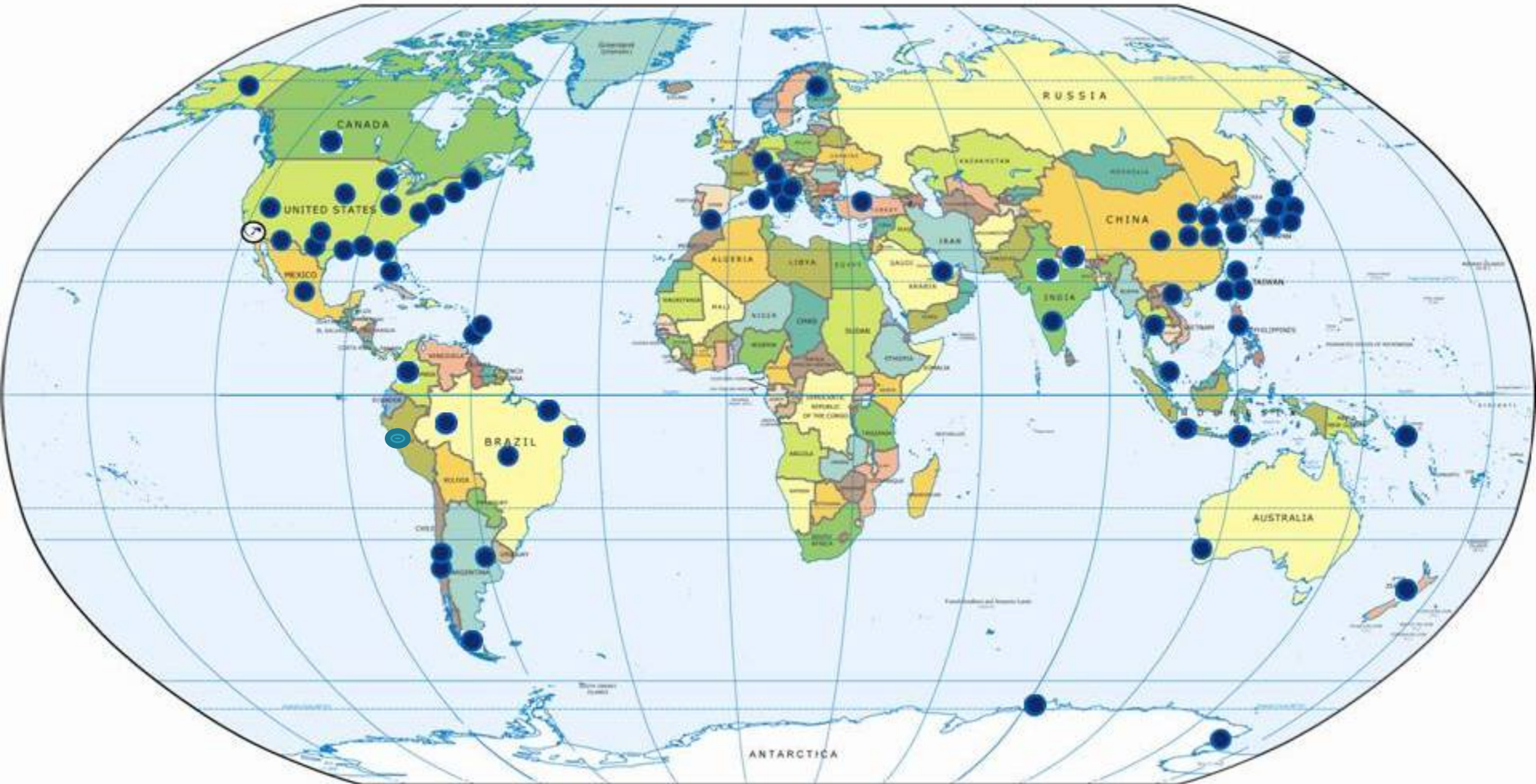
# Acquisition

TeraScan® controls all steps of acquisition:

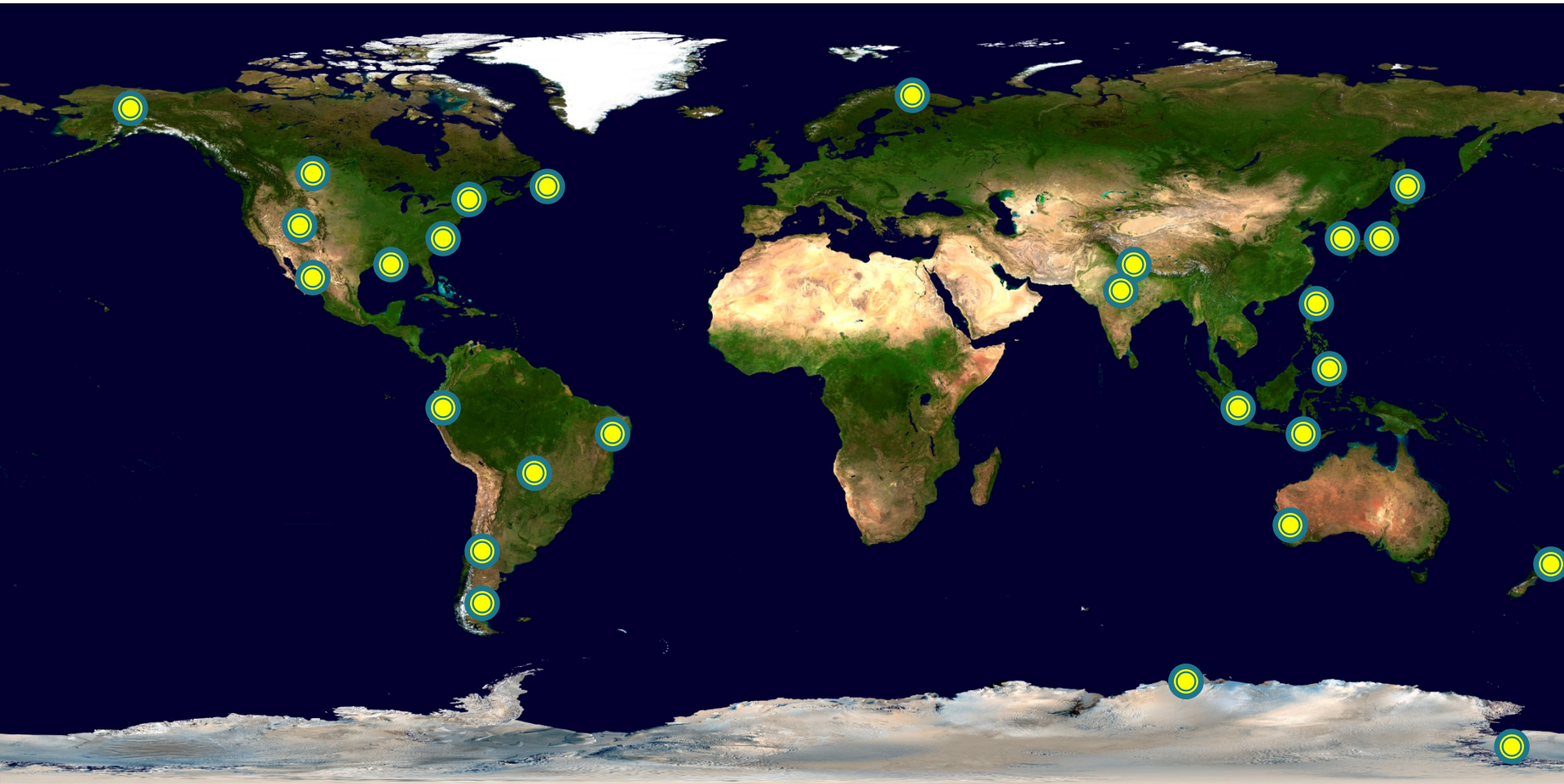
- Scheduling
- Antenna tracking
- Reception
- Data transfers
- Catalogue, Search & Retrieve



## SeaSpace X-Band Satellite Ground Station Installations

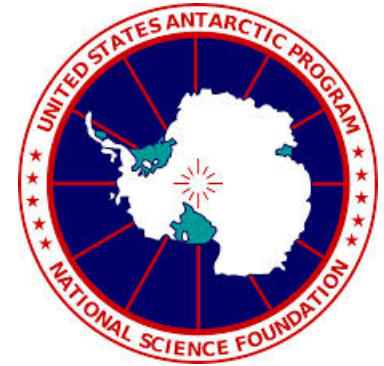


# SeaSpace NPP installation sites





The City College  
of New York



ICIMOD



CWB Taiwan



FINNISH METEOROLOGICAL  
INSTITUTE



Environment  
Canada



Instituto Nacional de  
Tecnología Agropecuaria



KMA  
Korea  
Meteorological  
Administration



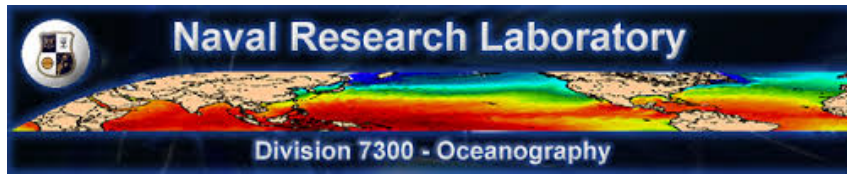
INMET  
Instituto Nacional  
de Meteorología



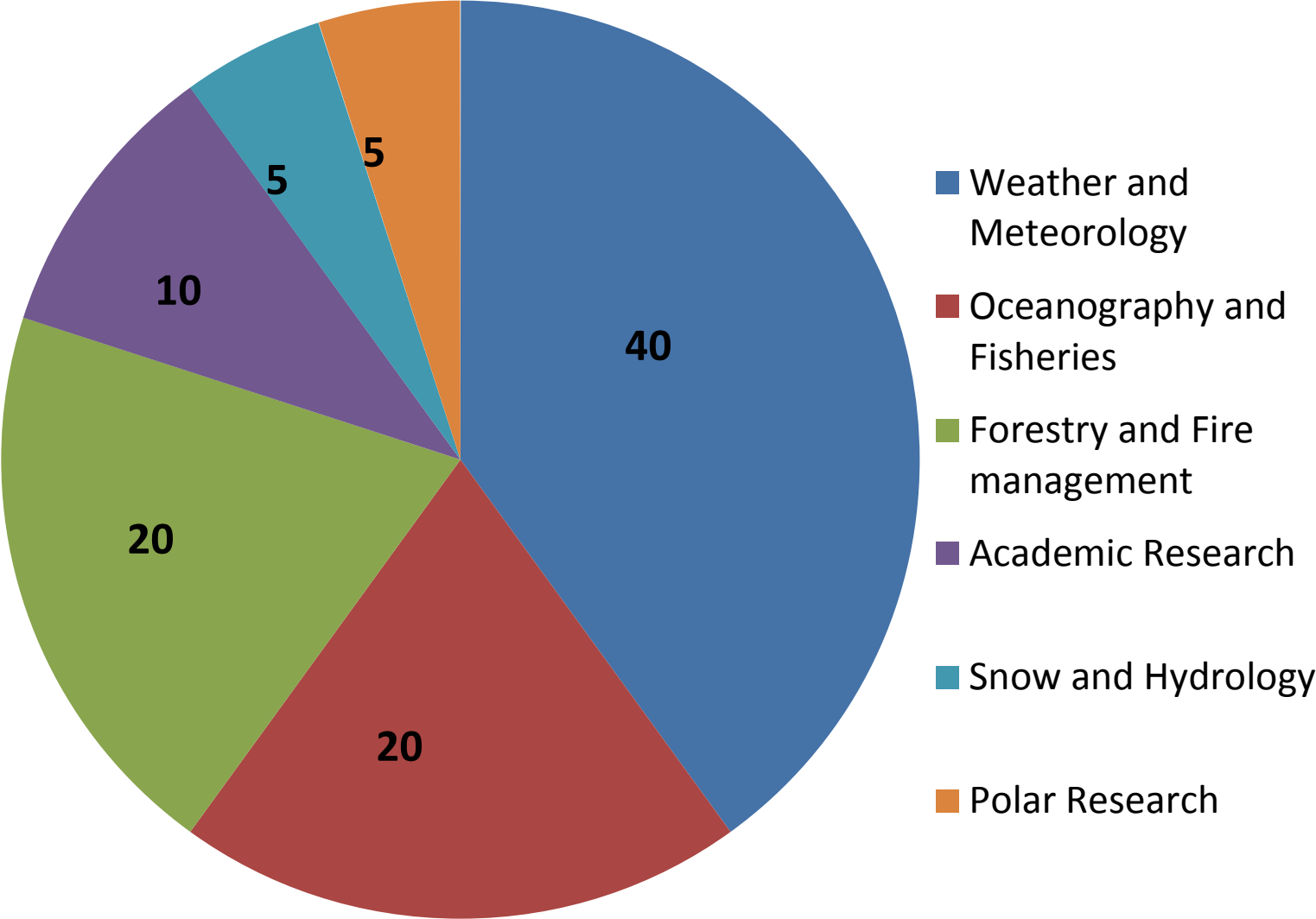
UNIVERSITÀ DEGLI STUDI DI SALERNO



METSERVICE  
New Zealand

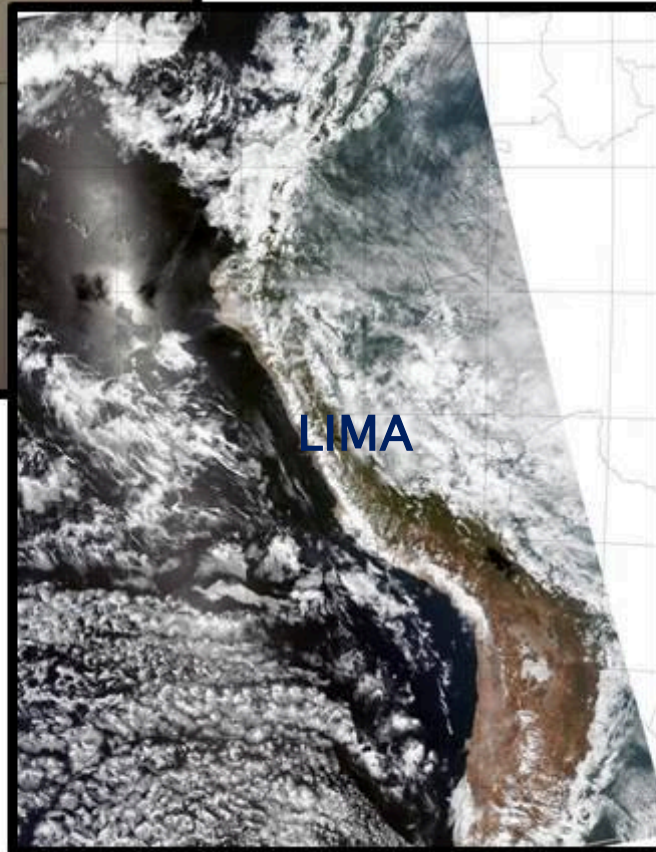


# SeaSpace End users



# SeaSpace completes installation at IMARPE, Peru

2015



***SeaSpace completes installation of a 2.4 m X/L system in record time (55 days !). IMARPE is the National fisheries and Oceanographic research Institute of Peru***

***Left:  
S-NPP VIIRS RGB  
generated from data  
acquired on Feb 19, 2015  
18:57 GMT***



# Project: SIPAM – Porto Vehlo, Brazil



**Sistema de Vigilancia  
de la Amazonía**



# Project: SIPAM - Belem, Brazil



**Sistema de Vigilancia  
de la Amazonía**



# Project: CONAE, Argentina

## Comisión Nacional de Actividades Espaciales



- Buenos Aires, Argentina
- Comisión Nacional de Actividades Espaciales
- Installation of 3.6m X-Band Reception system





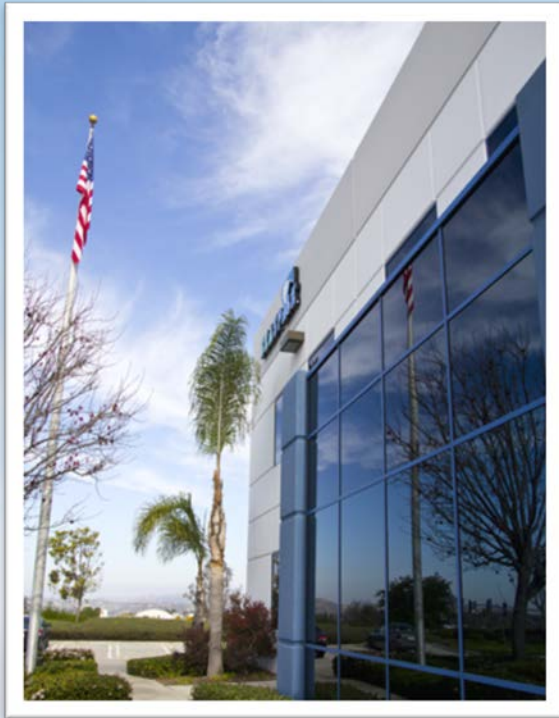
# Project: INOCAR, Guayaquil, Ecuador

- Guayaquil, Ecuador
- Instituto Oceanografico de la Armada
- Installation of 2.4 SeaTel X/L Band Antenna System
- Focus on Hydrographic Service, Navigation, Oceanography, Meteorology, Marine Sciences, Marine Signaling





# TeraScan® Processing Software



- TeraScan® is the ultimate remote sensing software tool box that fulfils your requirement for *automated* satellite data acquisition and processing.
- The TeraScan common Data Format (TDF) is an extremely versatile file format capable of assimilating a wide variety of *data types, shapes and sizes*. For example, a single dataset could contain *satellite image data, random in-situ data, and 3-D model data*. The TDF also allows applications to access data without any knowledge of the physical layout of that data.
- CSPP is integrated with TeraScan for NPP Stations





# TeraScan®



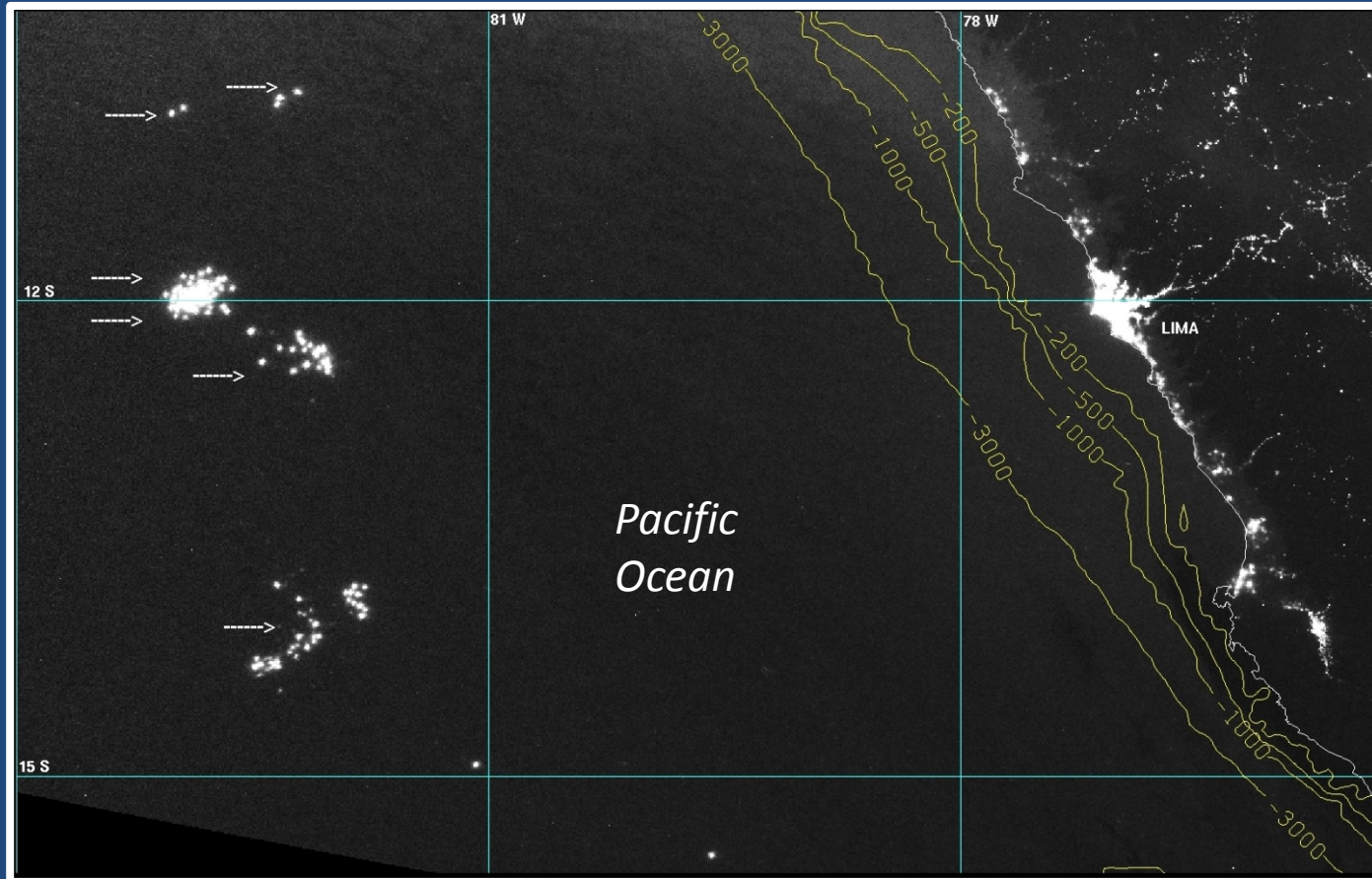
- TeraScan 4.1.1 released (see website for details and highlights)
- COMS LRIT product added
- Vectorizing tools for import into ArcGIS
- Import and Display GeoTIFF / HDF5 files
- NPP VIIRS Products
  - Fire detection Hot Spot / csv output
  - Aerosol Optical Depth
  - Ocean Color and Sea Surface temp.
  - Fog / Low Cloud detection
  - Cloud height, temp, Phase, pressure, and Probability
- Himawari-8 Ingest and L2 products
- Skew-T plot for NPP CrIS Retrievals
- VIIRS DNB / Snow-Ice discrimination
- **DMSP SSMIS Ingest, wind, Ice and WV products**

# SeaSpace NPP & MODIS products



## Some applications

# Monitoring fishing fleets off Peru at night using VIIRS

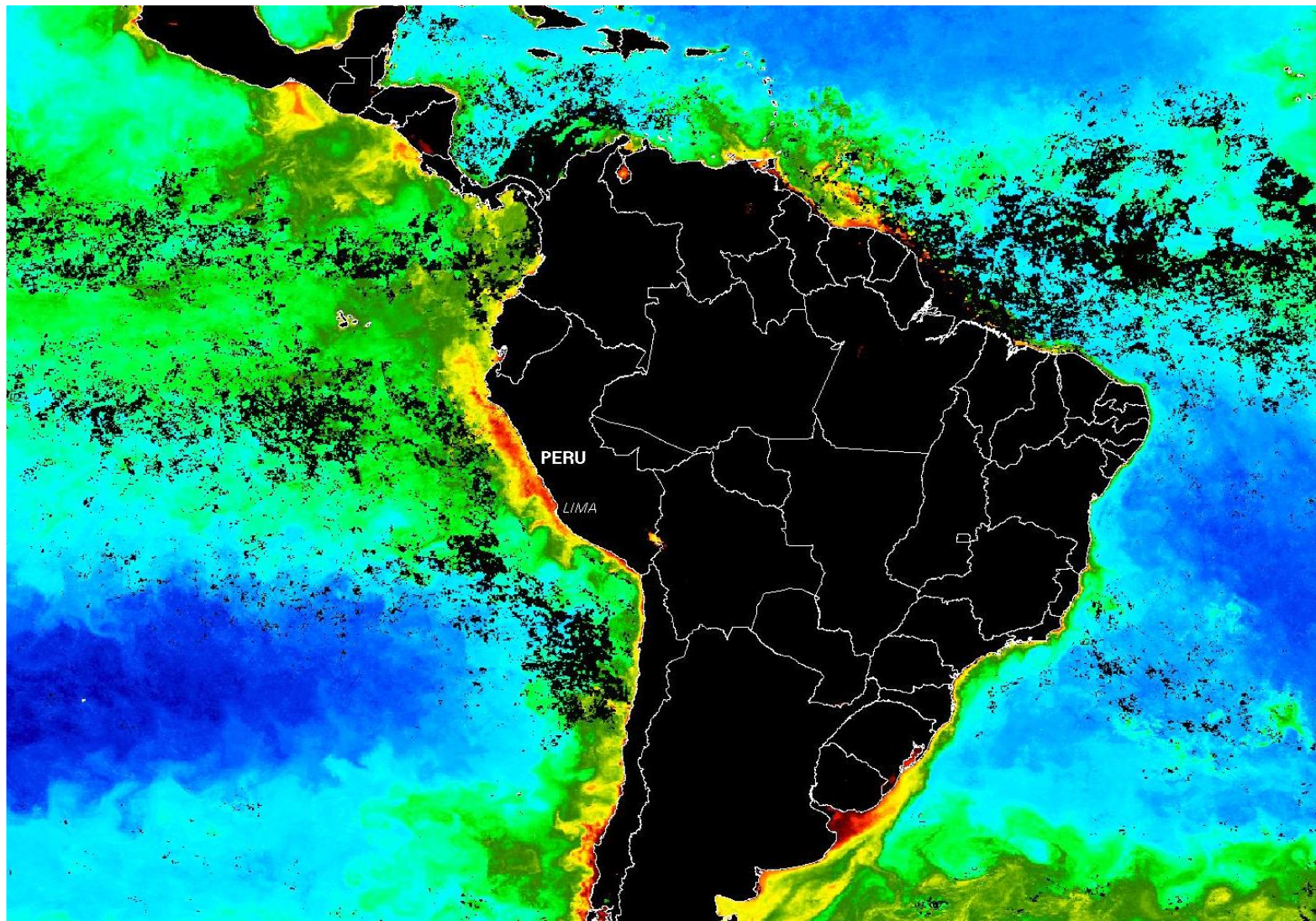


DMSP  
OLS  
Heritage

*TeraScan VIIRS Day and Night Band nighttime data from August 22, 2014 off the coast of Lima, Peru showing lights from fishing fleets. Squid jigging vessels using strong lights to attract squid and these can be mapped using VIIRS DNB nighttime data (fleets marked by arrows).*



# VIIRS Ocean Color (chlorophyll) Product

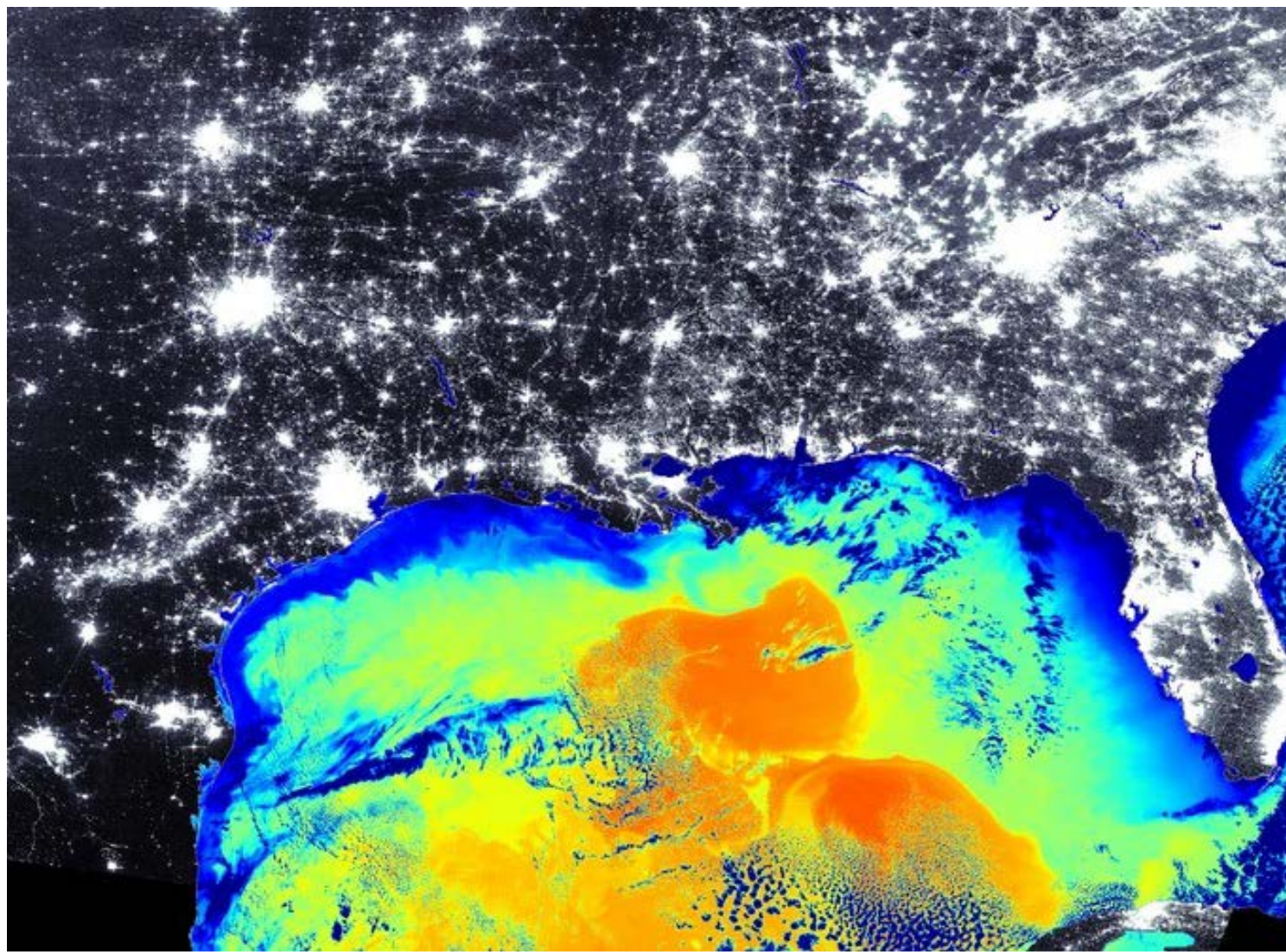


VIIRS  
OceanChl

Feb  
2015  
Composite

IMARPE  
Peru

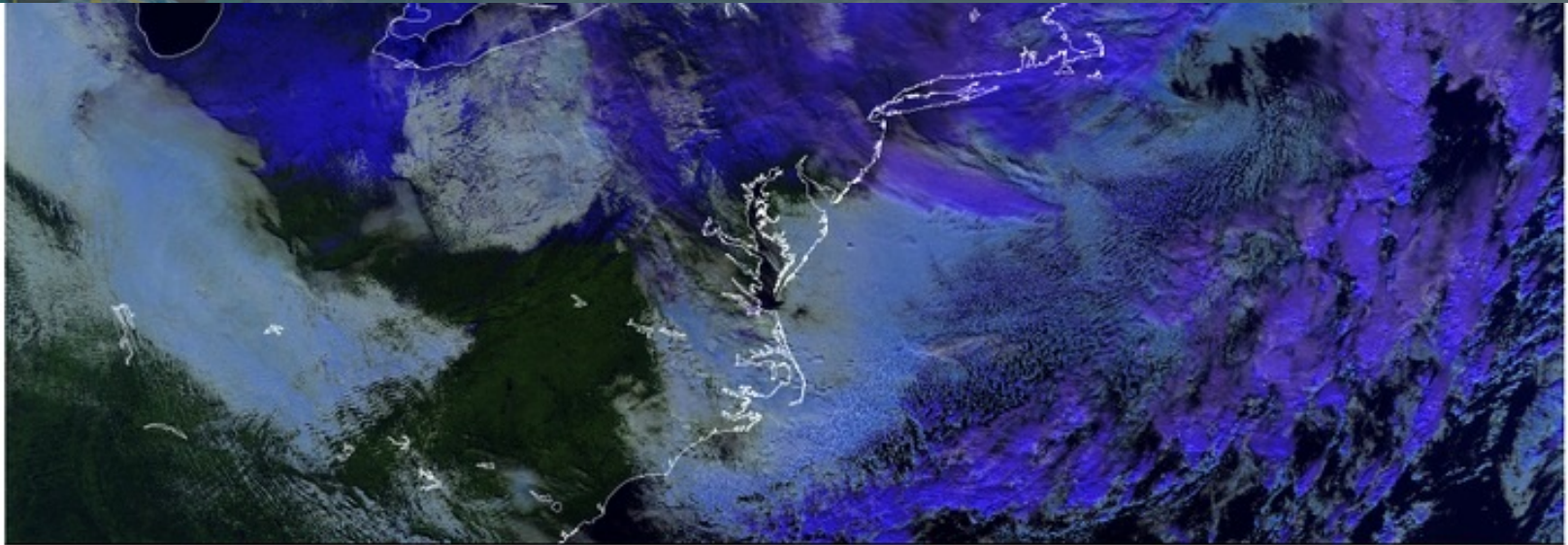
# Day Night Bands – LSU Baton Rouge



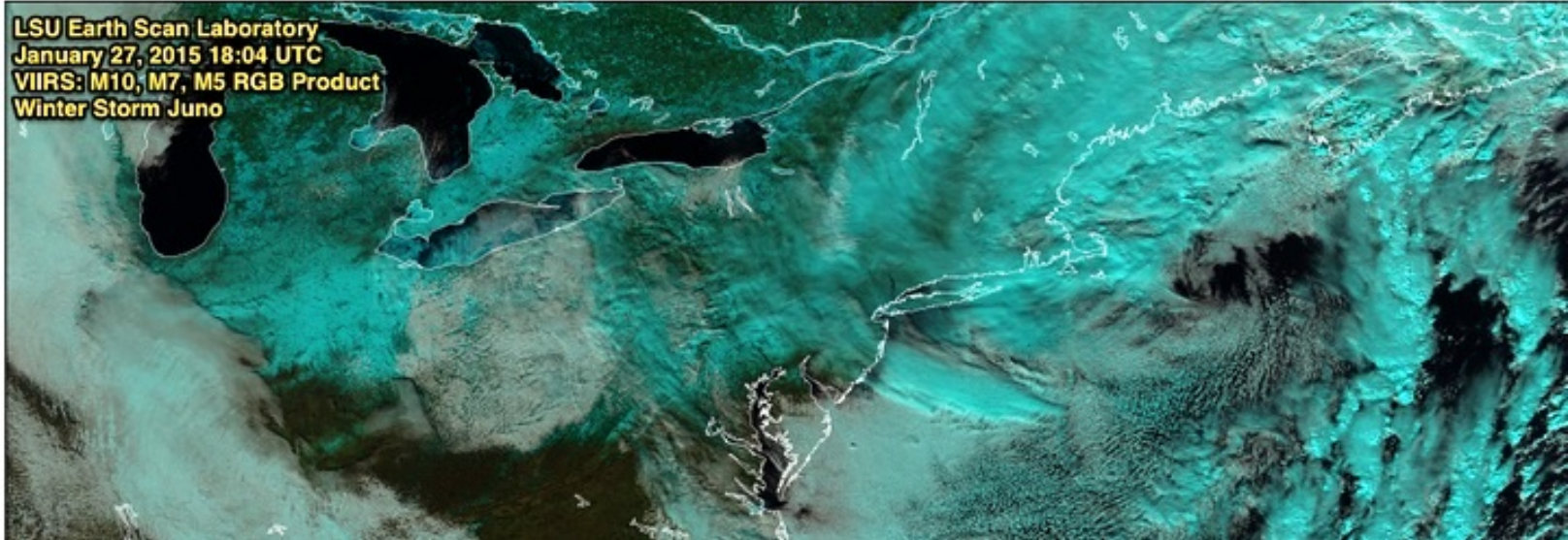
Credits:  
*Ric Haag*  
*Earth*  
*Scan*  
*Lab,*  
*LSU*

Loop current and nocturnal light - combine

# Ice clouds and Icing - LSU Baton Rouge



Credits:  
*Ric Haag*  
*Earth*  
*Scan*  
*Lab,*  
*LSU*



LSU Earth Scan Laboratory  
January 27, 2015 18:04 UTC  
VIIRS: M10, M7, M5 RGB Product  
Winter Storm Juno

M10 - 1.6  
M7 - 0.86  
M5 - 0.67

Winter storm Juno

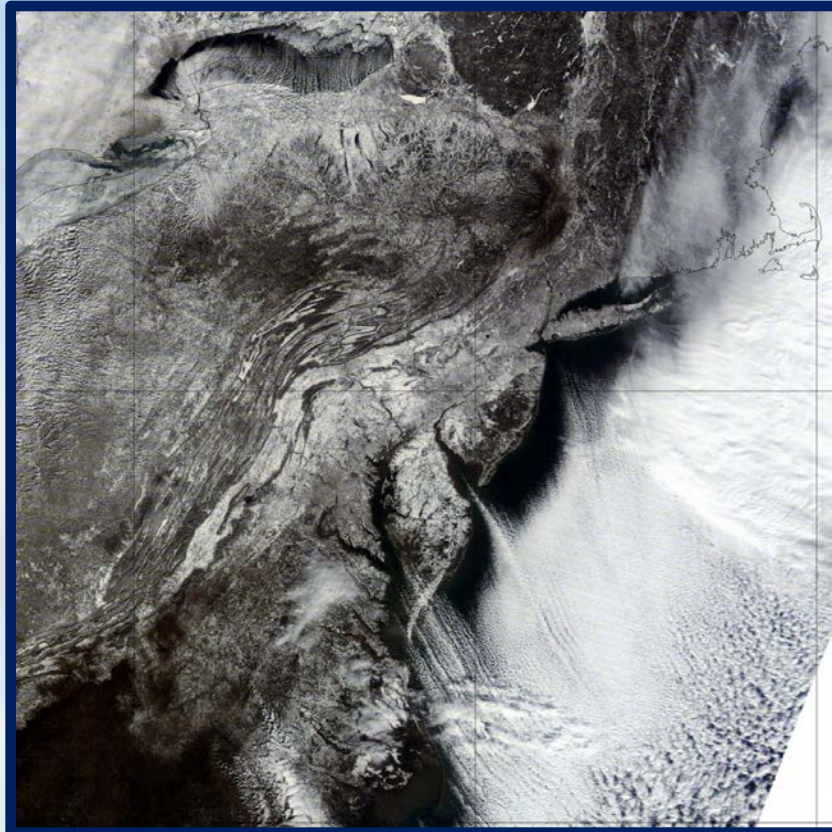


# Visible Infrared Imaging Radiometer Suite (VIIRS) at University of Delaware

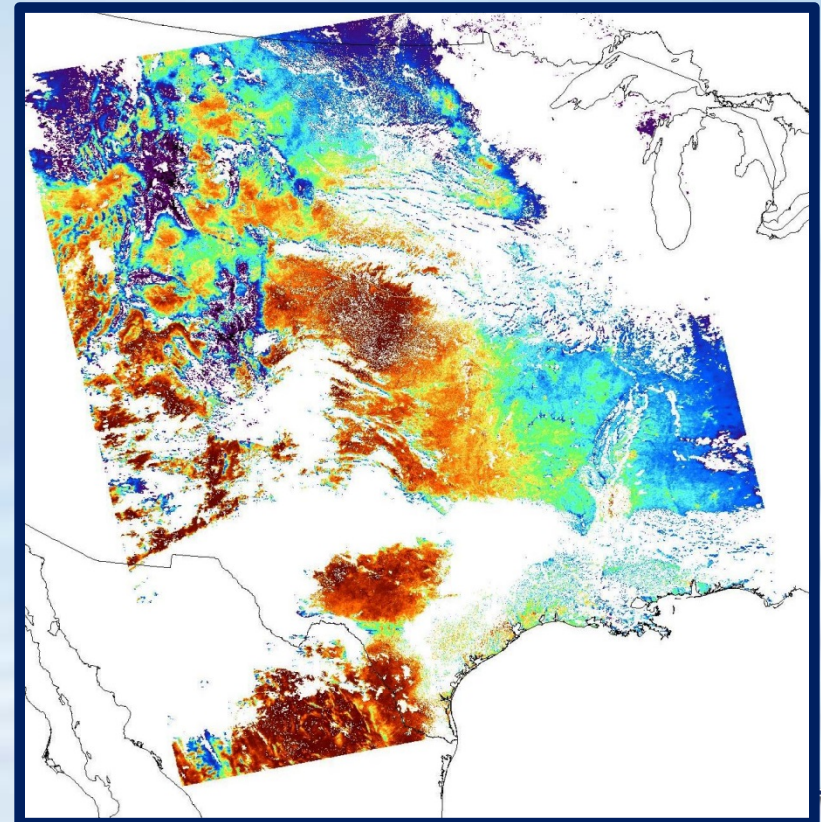


UD SATELLITE RECEIVING STATION

RGB - SNOW



Land Surface Temperature



# Skew-T Plots from CrIS – CWB Taiwan

TAINAN

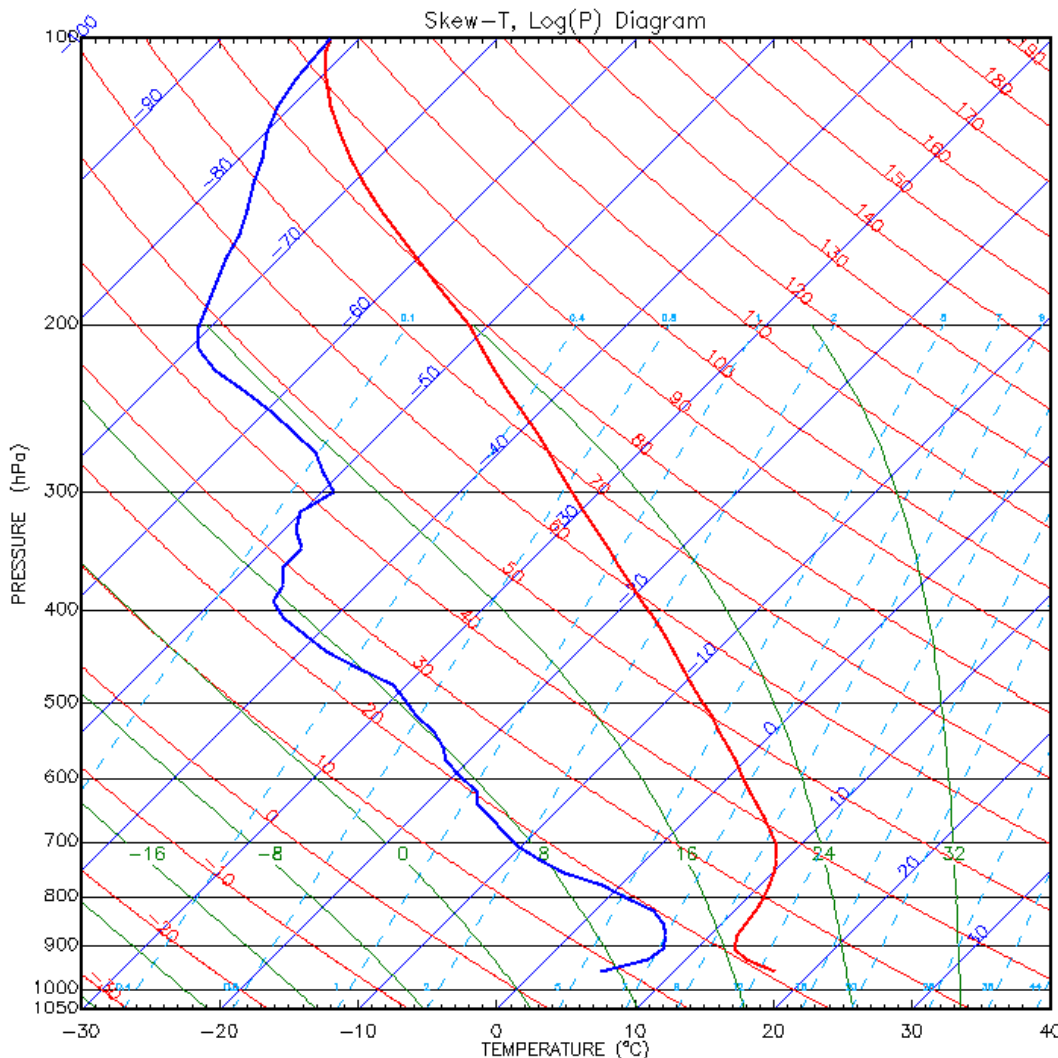
DATE : 20150404

TIME : 0514 UTC

Clear Sky

CAPE = 0.00 J/kg

Lifted Index = 11.8 °C

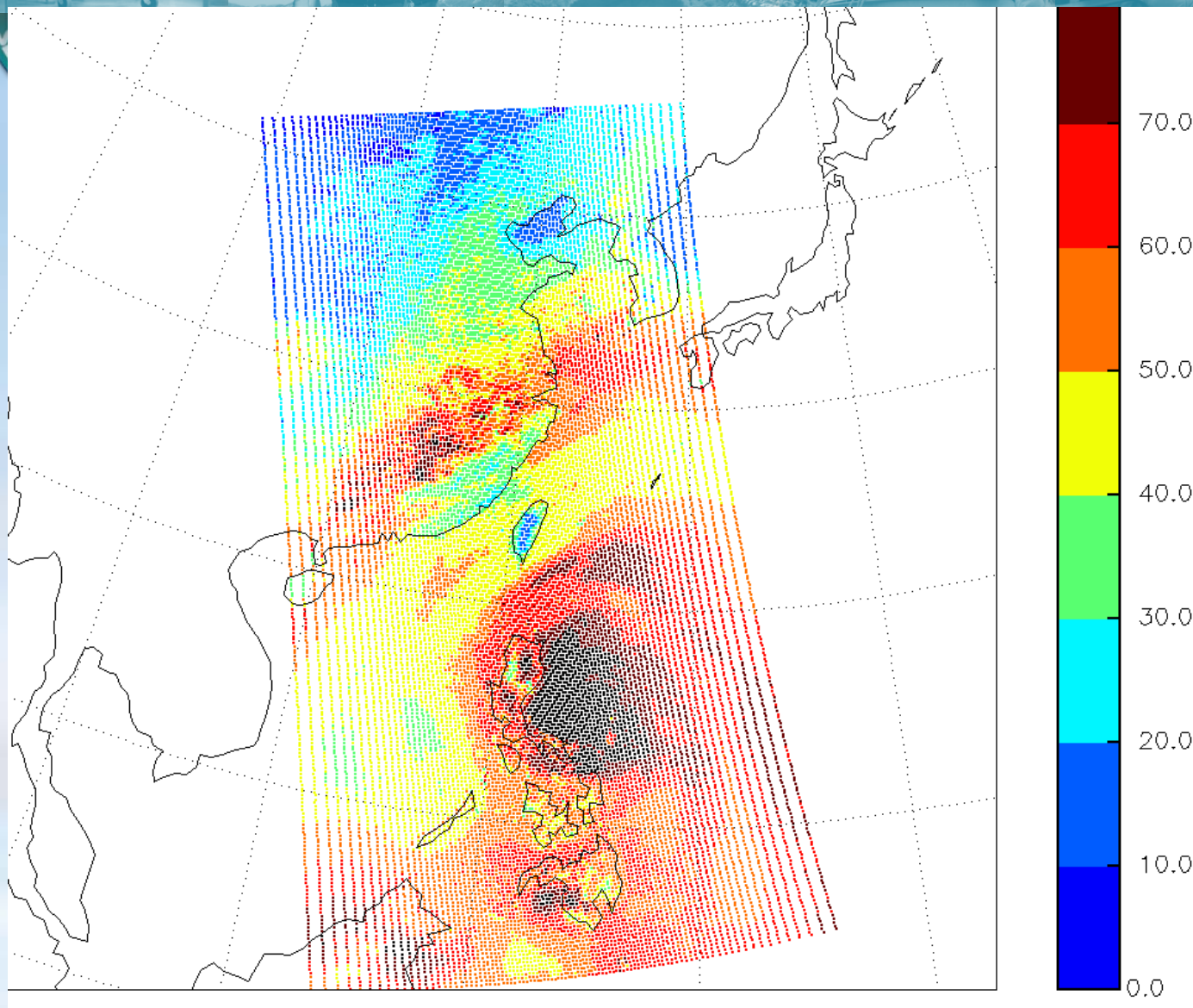


Credits:  
**Candy Liao,**  
**Central Weather Bureau,**  
**Taiwan**

Skew-t plots from CrIS profiles



# Total Precip Water – CWB Taiwan

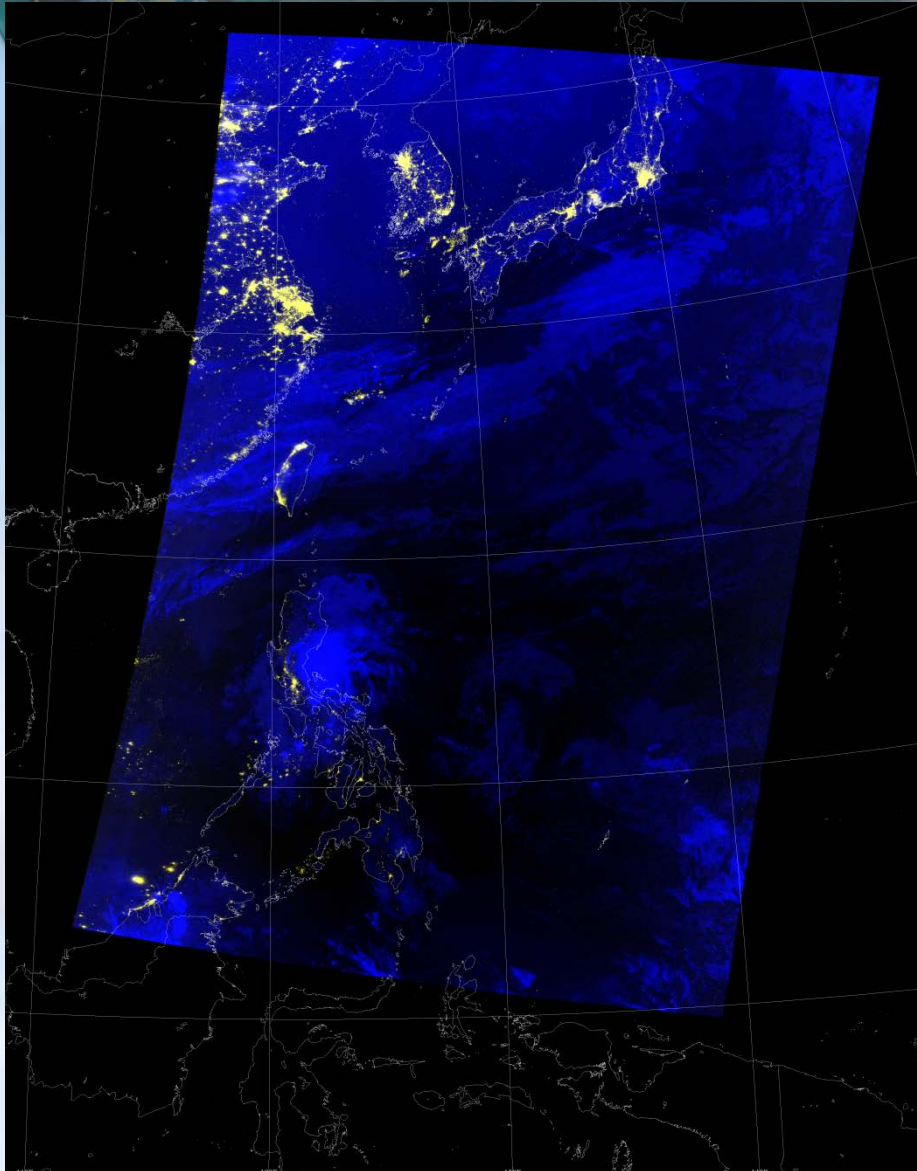


Credits:  
***Candy Liao,***  
***Central***  
***Weather***  
***Bureau, Taiwan***

***SENSOR:***

***NPP ATMS***

# DNB Cloud monitoring – CWB Taiwan



Credits:  
***Candy Liao,***  
***Central***  
***Weather***  
***Bureau, Taiwan***

***VIIRS DNB***

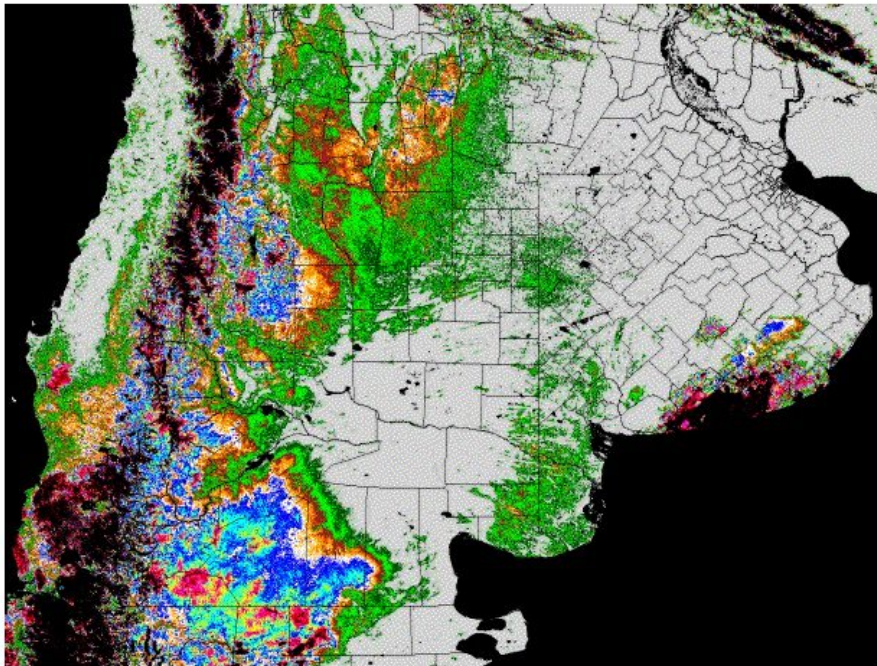


# Visible Infrared Imaging Radiometer Suite (VIIRS) at INTA Argentina

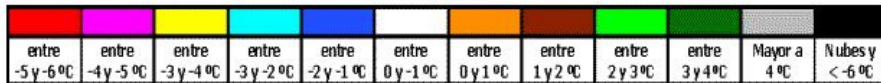
TEMPERATURA DE SUPERFICIE - SATÉLITE NPP



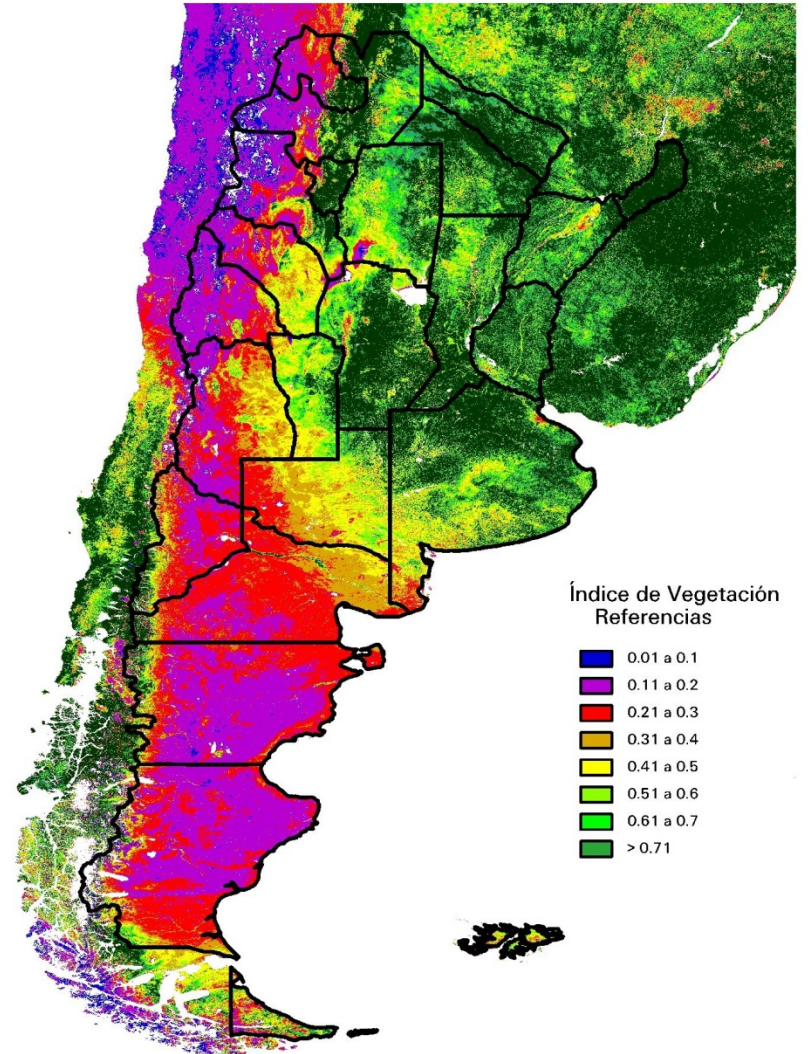
04 de Noviembre de 2014 - Horario de Pasaje: 01:54 hs  
Resolución: 375m



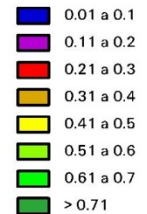
Referencias



Identifying areas of frost



Índice de Vegetación Referencias

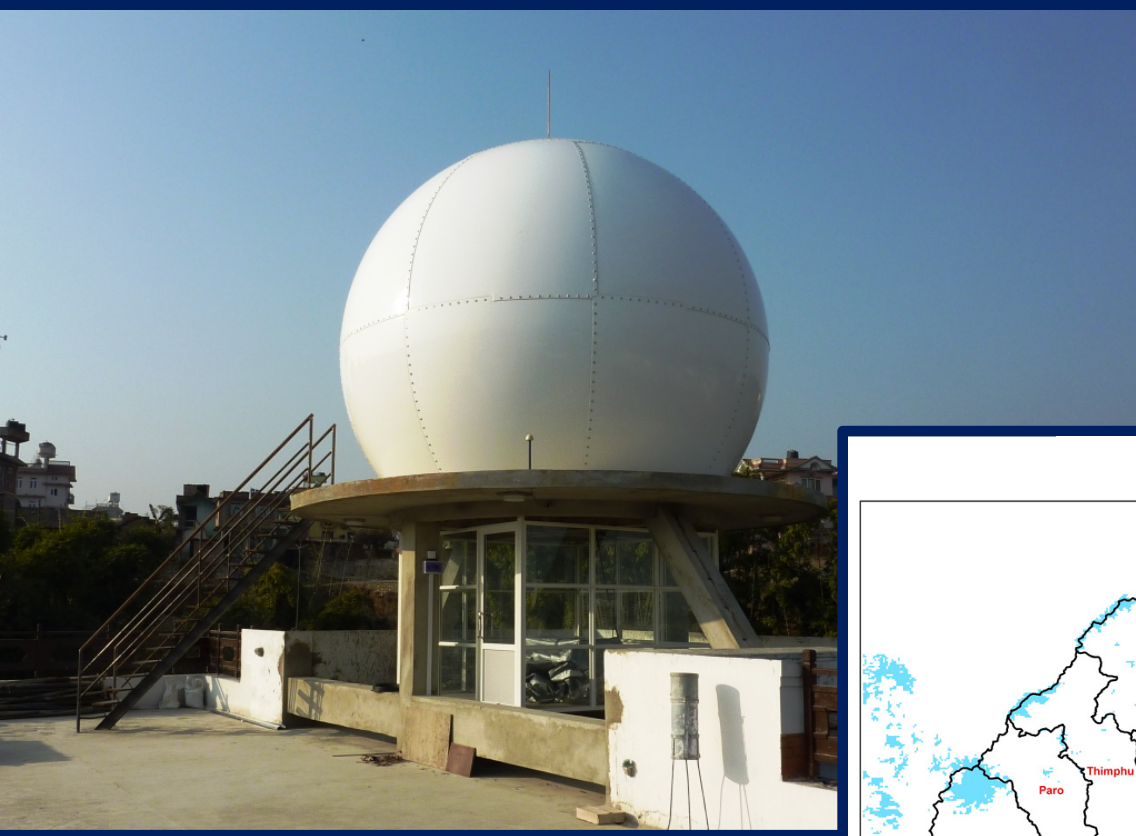


ÍNDICE DE VEGETACIÓN (NDVI)  
Satélite NPP. Resolución 375m  
Período: 01-Febrero al 10-Febrero de 2015





# Snow monitoring at ICIMOD, Nepal



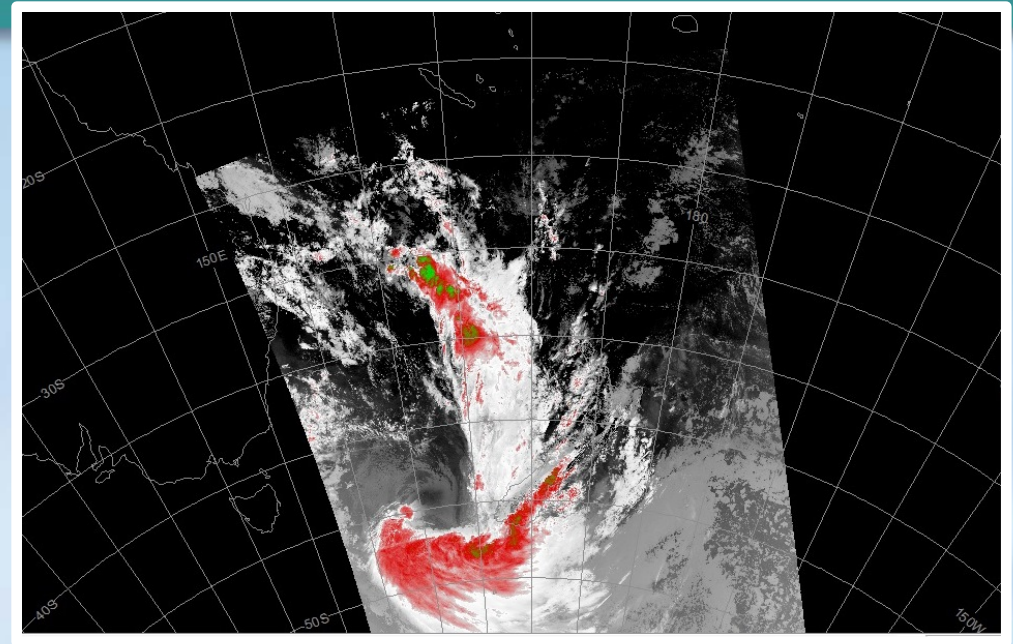
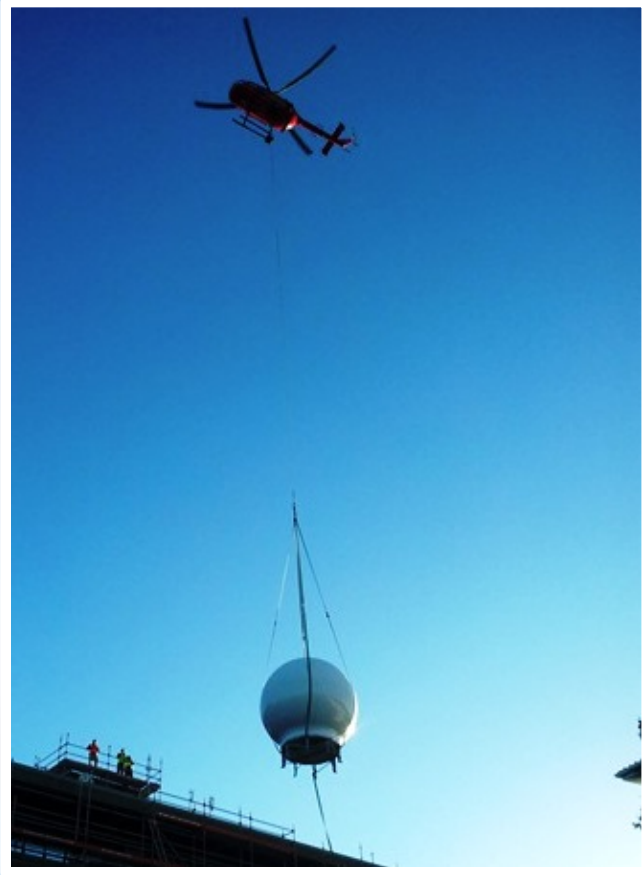
ICIMOD, Kathmandu

Monitoring the vegetation, snow cover and hydrology of the Himalayas





# Weather forecasting at New Zealand Met



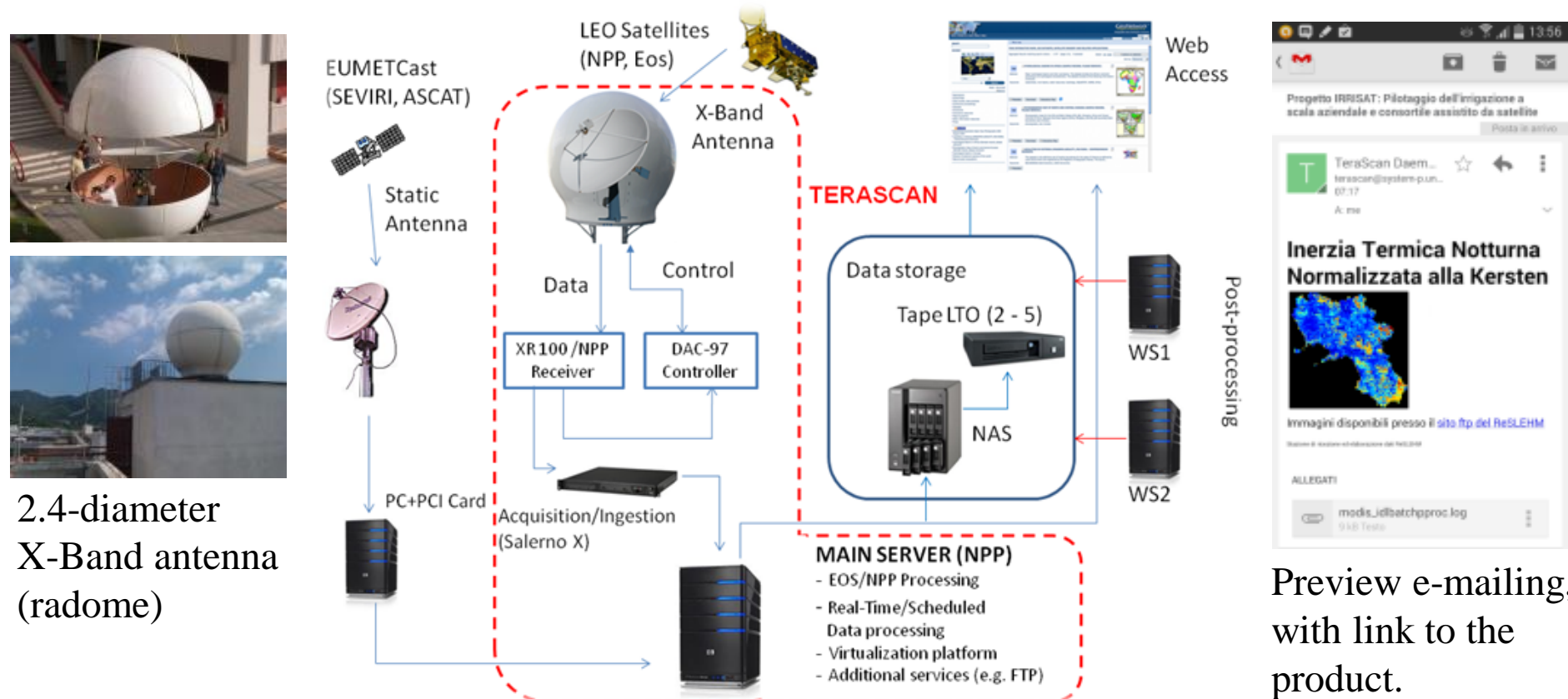
- NPP VIIRS RGB
- IR channel difference for weather forecasting

System recently upgraded for NPP reception

# The Ground Station at the University of Salerno, Italy (ReSLEHM)

The University of Salerno Ground Station and Laboratory ReSLEHM (Remote Sensing Laboratory for Environmental Hazard Monitoring), is capable of automated reception, integrated processing and distribution of data from:

- Polar-orbiting satellites: Terra e Aqua (MODIS), Suomi NPP (VIIRS, ATMS, CrIS);
- Geostationary satellites: MSG (SEVIRI) via EUMETCast Data Dissemination System.



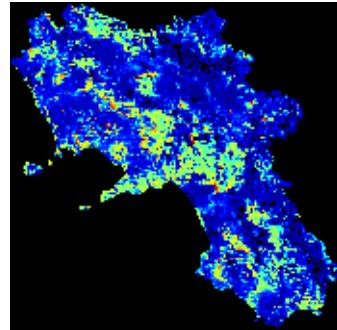
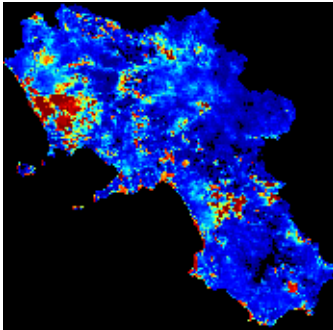
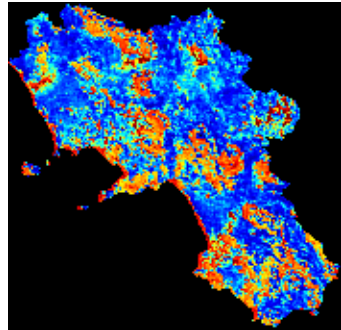
# RESULTS: Soil water content estimates

$K_p$  before/after the **63 mm rainfall** event of the last decade of July 2012 (DOYs 200-211) .

DOYs: 195

197

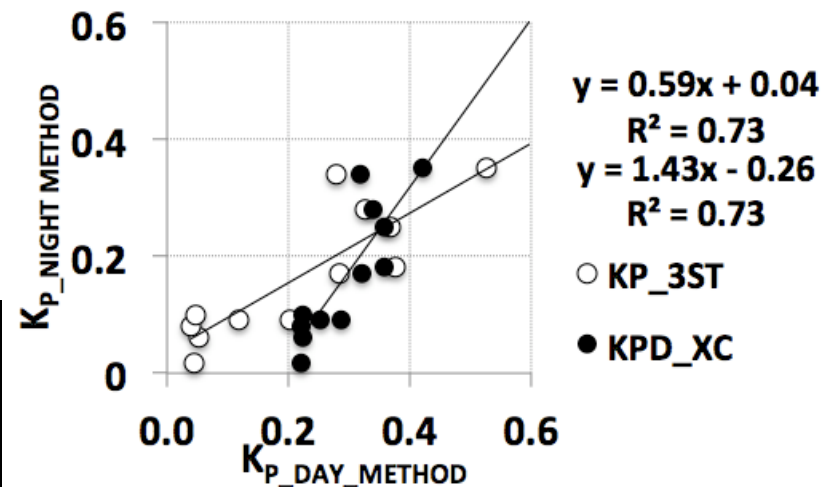
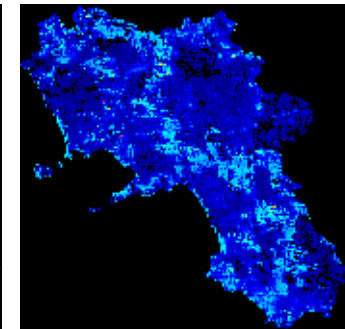
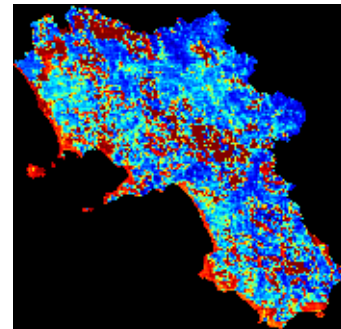
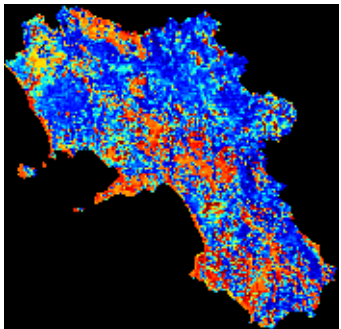
200



218

220

221

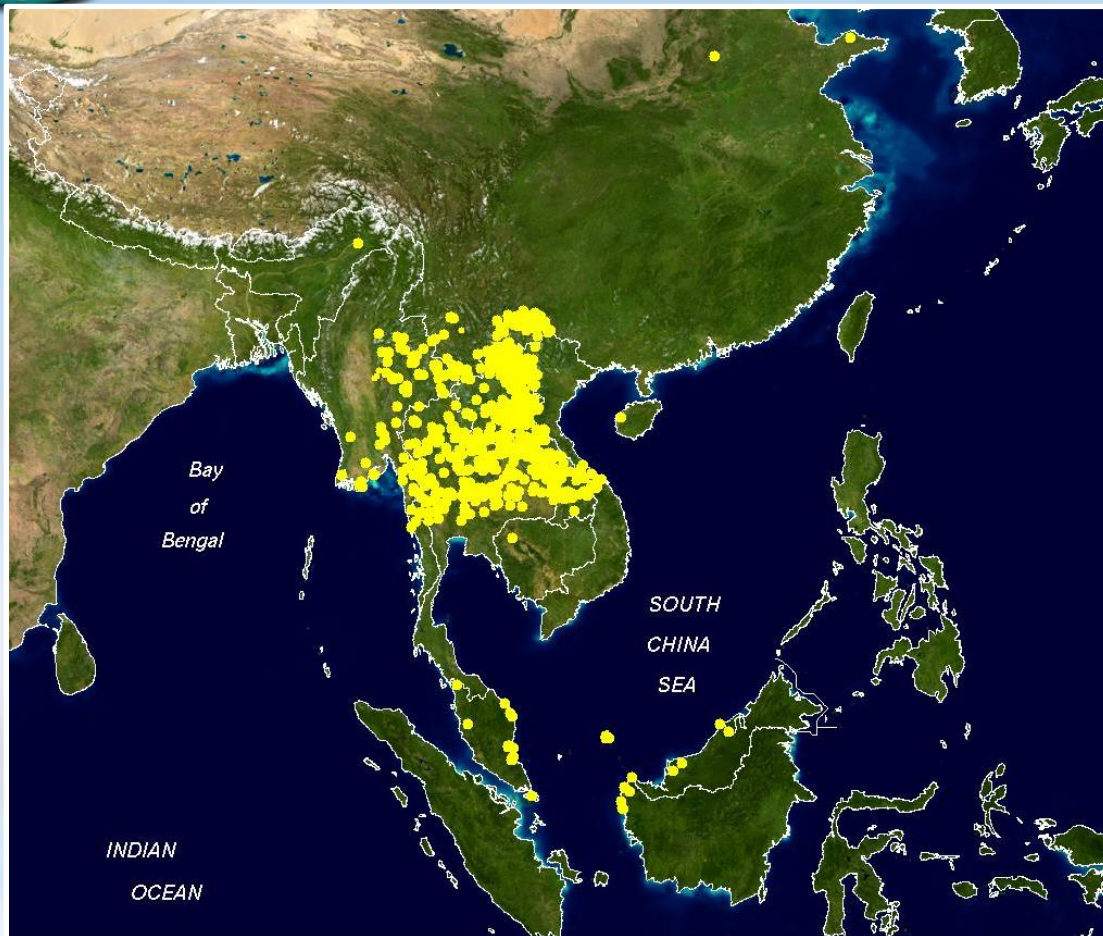


This work has been supported by the E.U.-Rural Development Plan of Campania Region 2007-2013, Measure 124 “Health Check”, under grant D.R.D. DRD n.44 del 14/06/2010 “IRRISAT” (CUP: B35C11000090004).

Slides courtesy:  
Antonio Maltese,  
Univ of Salerno, Italy



# Active Fire detection using MODIS and NPP VIIRS



Multiple active Fires

Source MODIS and NPP VIIRS

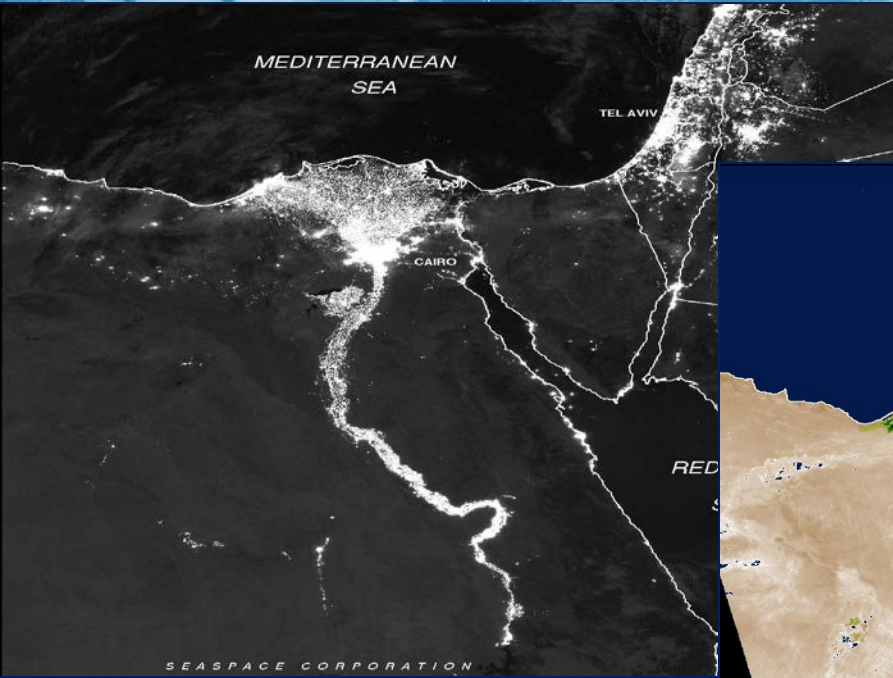
Period- March 01 – 05, 2014

Data processed using NASA and TeraScan processing algorithms

**THAILAND**



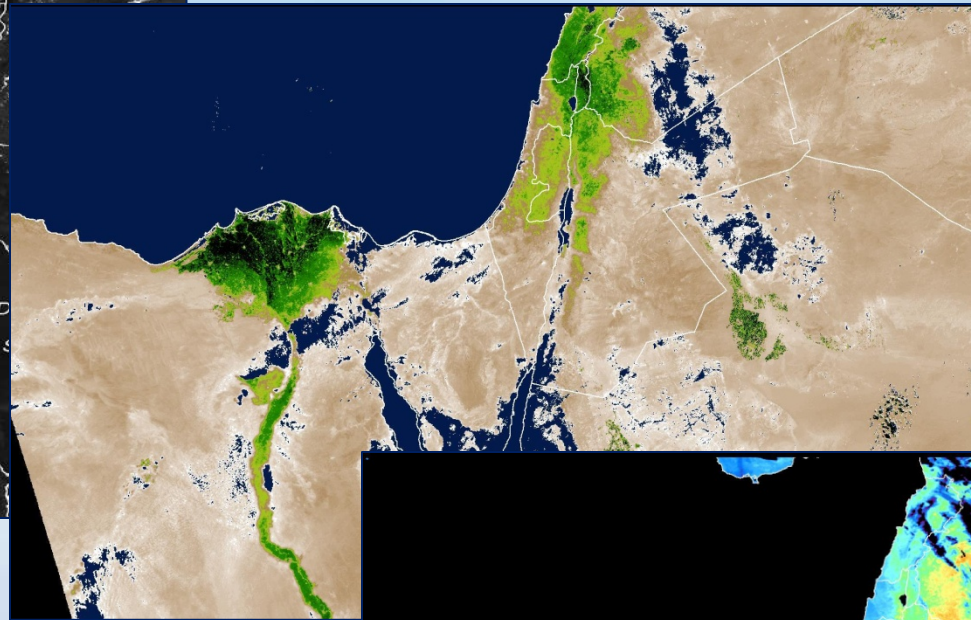
# Day Night Bands – Nile River Valley



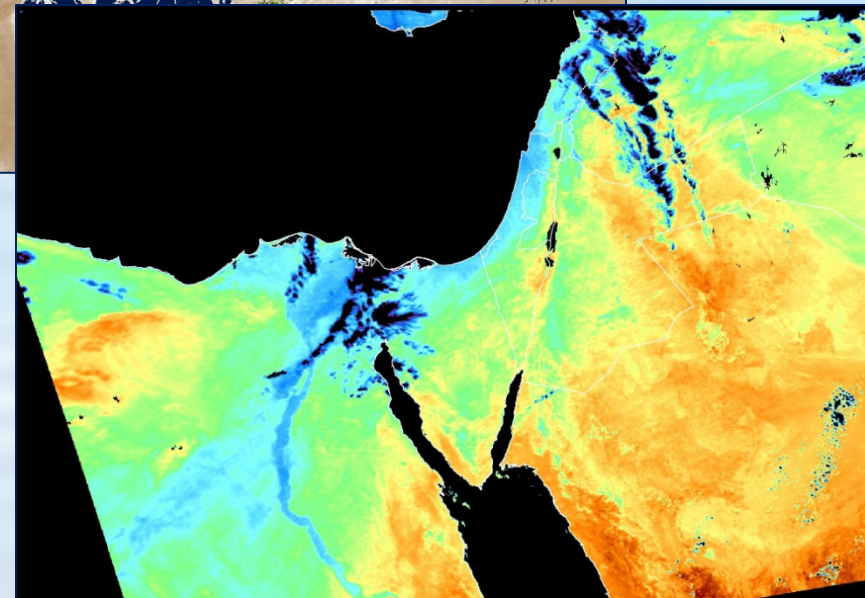
**DNB night lights**



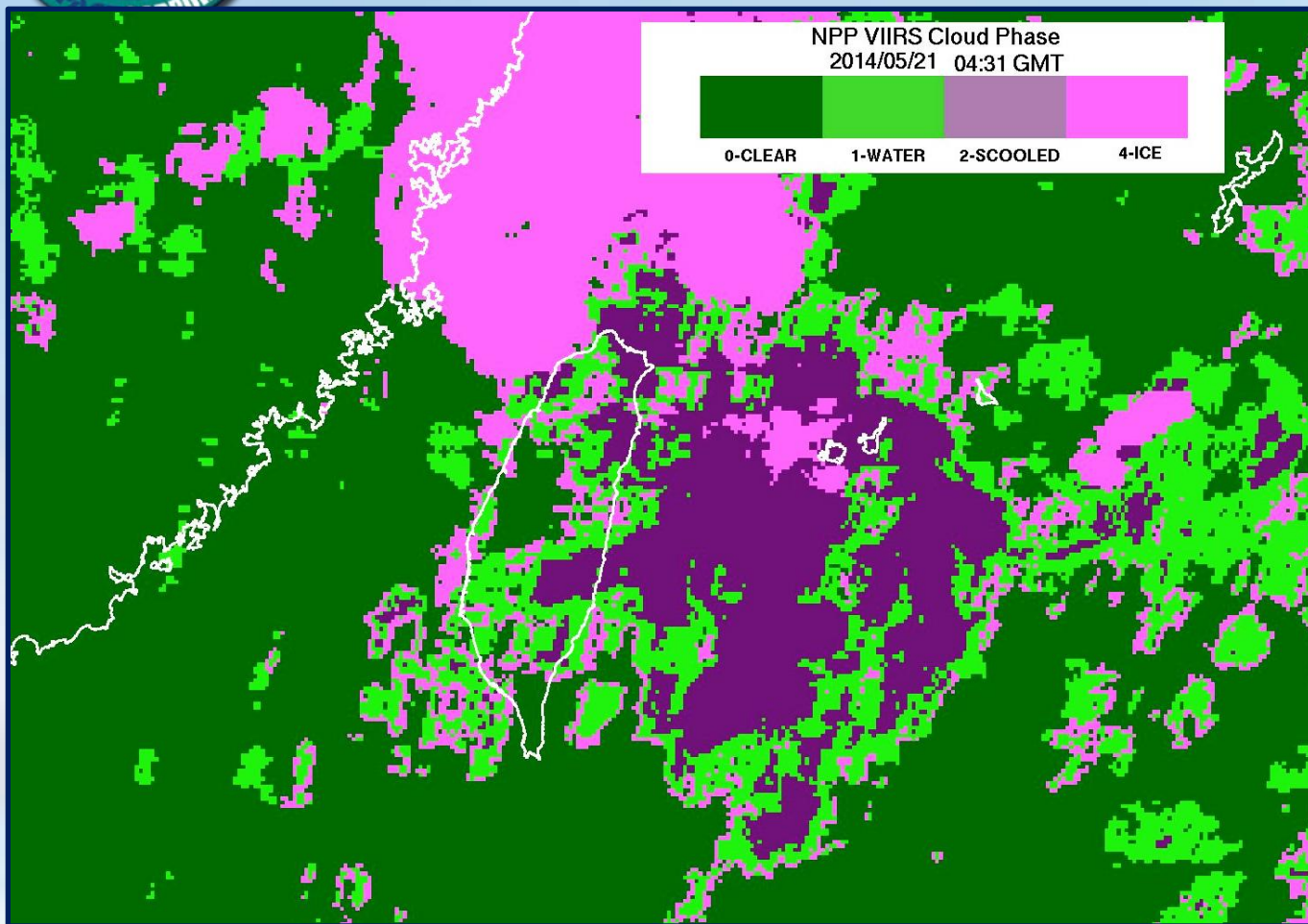
**NDVI**



**Land Surface Temperature**



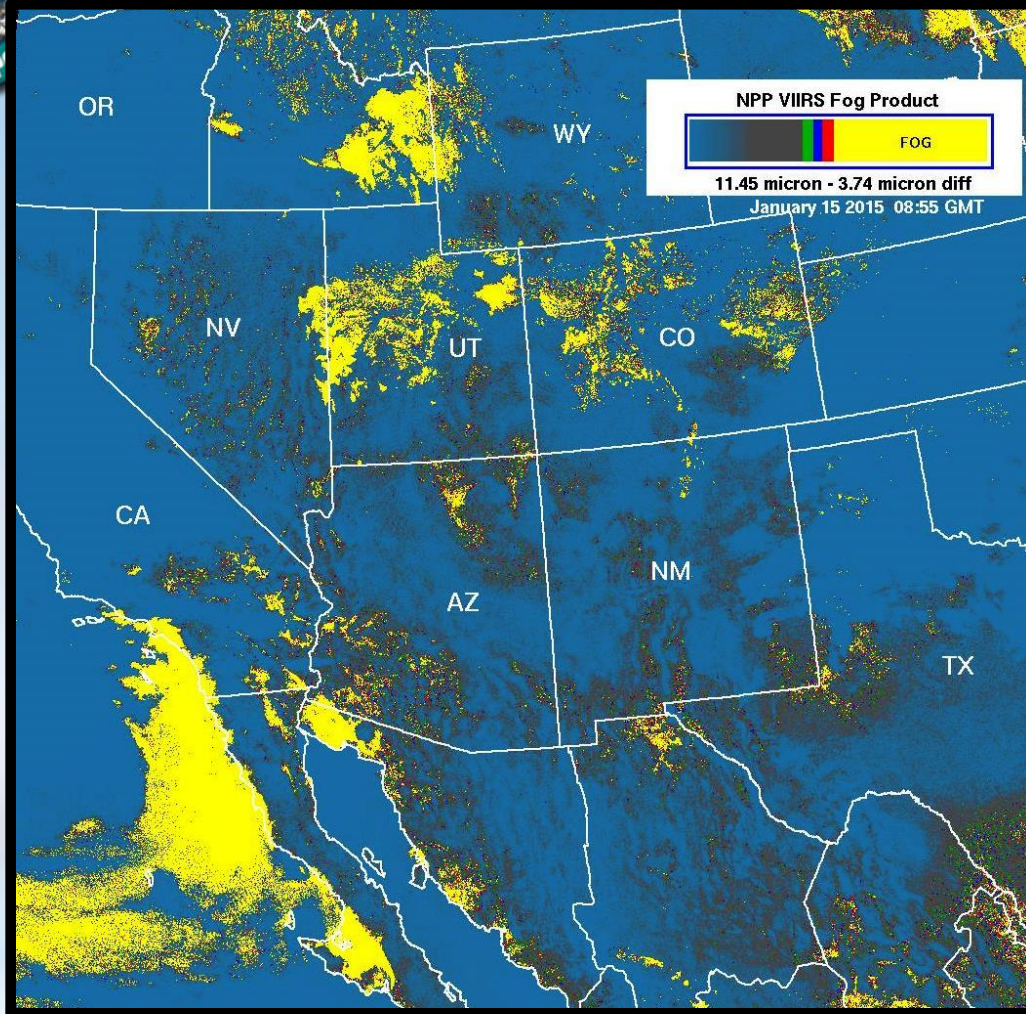
# Visible Infrared Imaging Radiometer Suite (VIIRS) Cloud Product Suite integration (CWB Taiwan)



CLAVRx Algorithms  
EDRs generated:  
Cloud Phase  
Cloud Type  
Cloud Optical Depth  
Cloud Height  
Cloud Top Temperature  
Cloud Probability

**Discriminates between ice, water, supercooled and clear pixels**

# Detecting Nighttime Fog using VIIRS and TeraScan



*Left:*

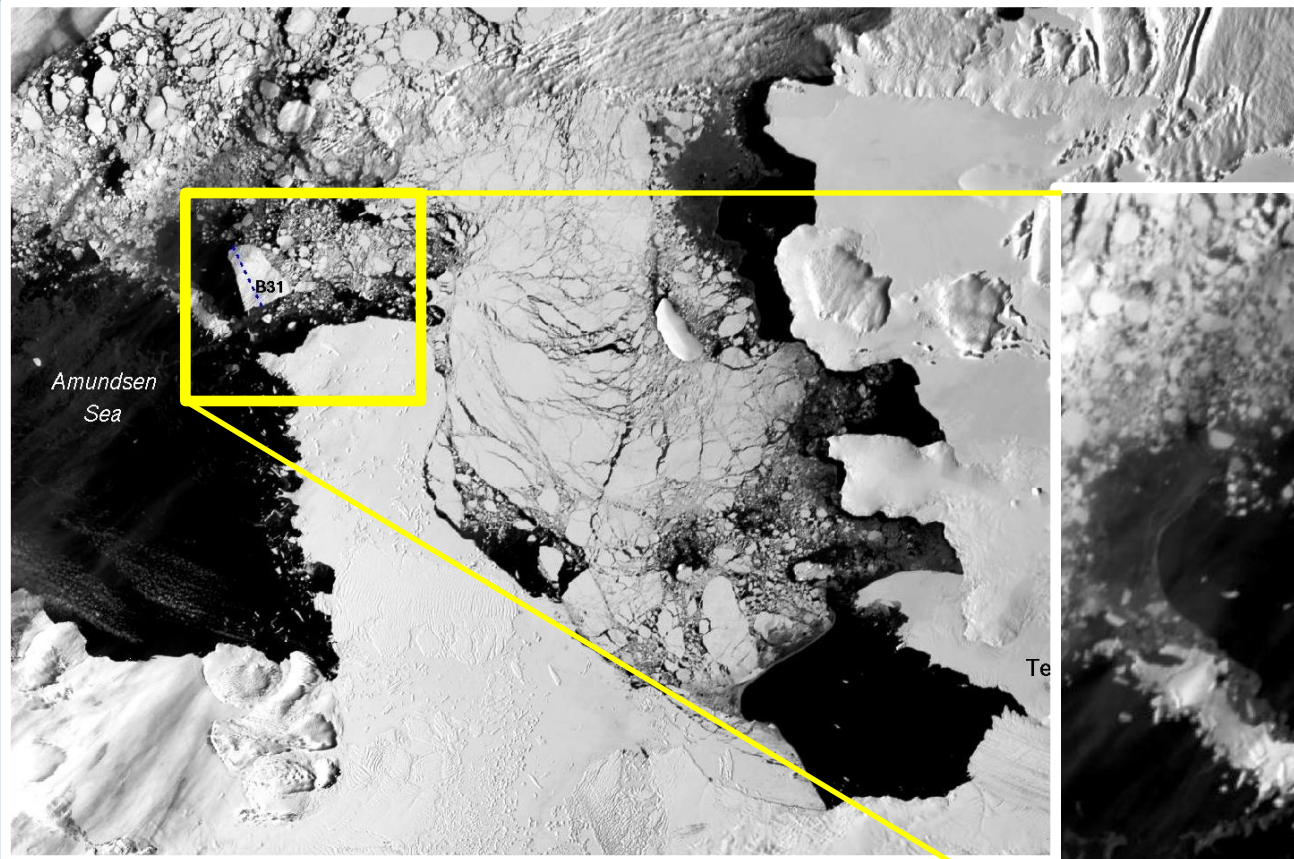
*VIIRS Imagery Channels at 11.45 micron and 3.74 micron were used to generate the nighttime fog product.*

*The fog / stratus product employs the I channel brightness temperature difference between Channels 4 and 5 to identify areas of fog and stratus (yellow).*

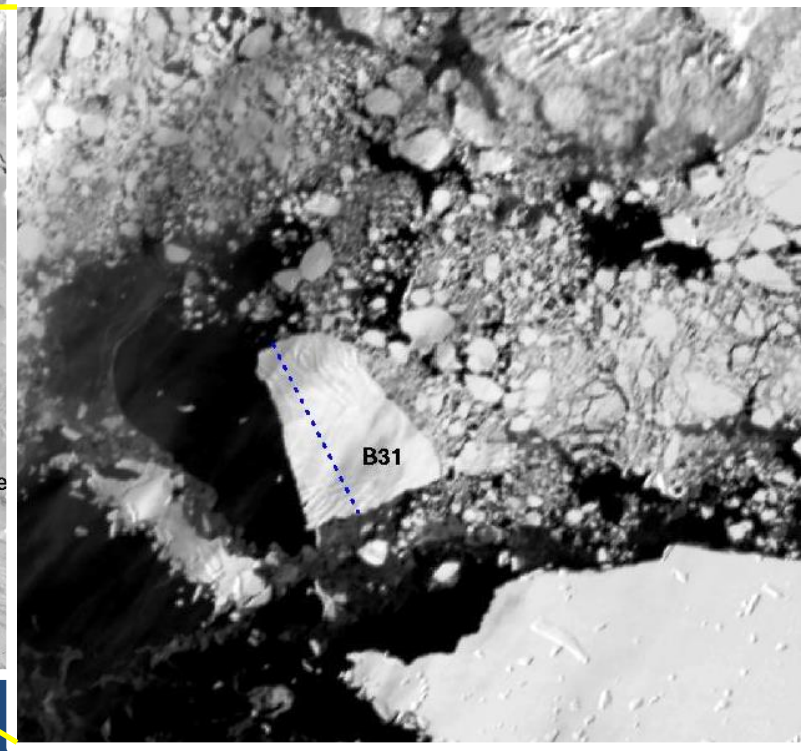
*Data processed and remapped using TeraScan / TeraVision*

**VIIRS Fog Product – January 15, 2015 08:55 GMT**

# TeraVision maps massive Antarctic Iceberg



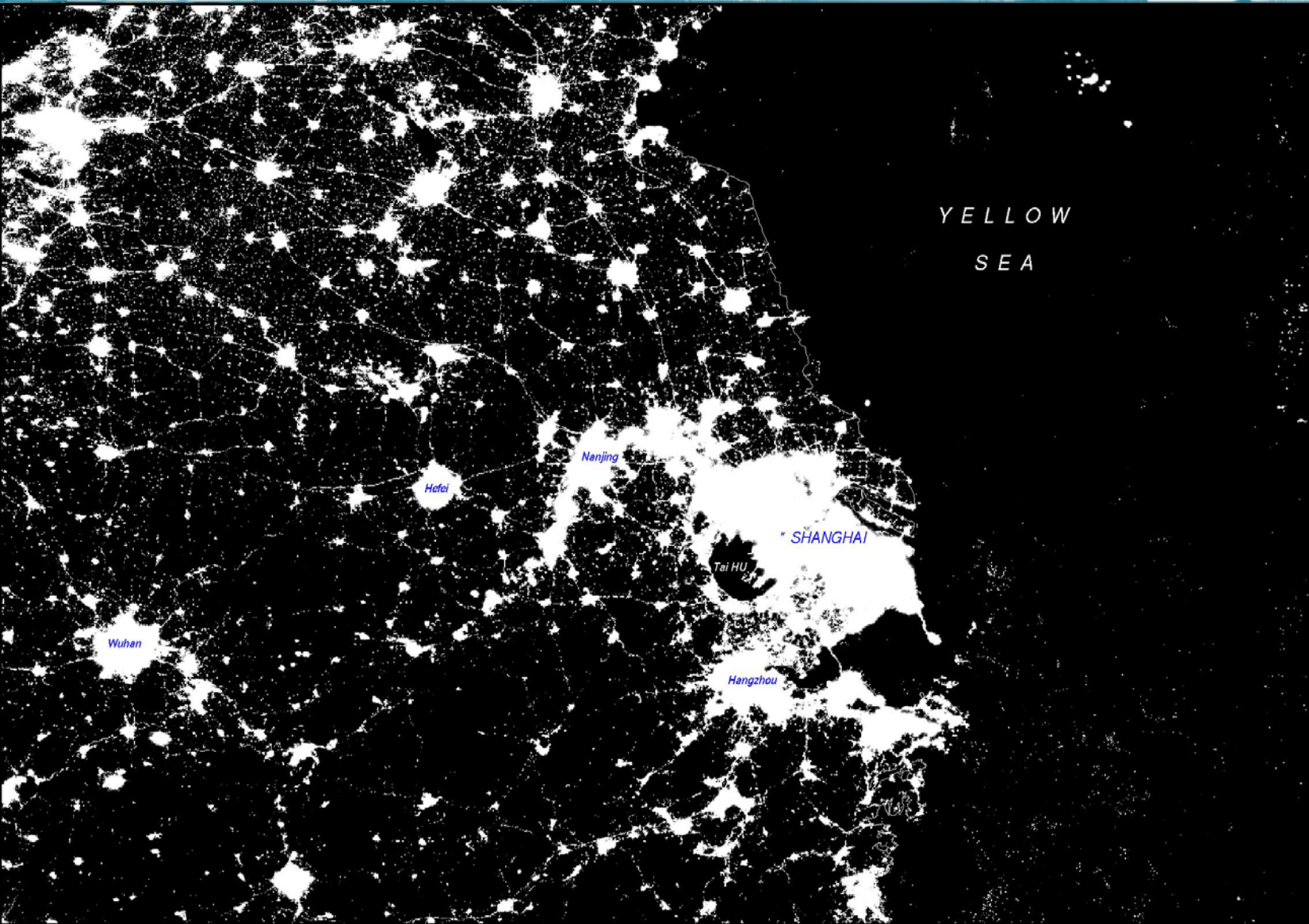
*Area Zoom of iceberg B31*



*TeraVision "survey" tool measured the size of a massive Iceberg (B31) near Amundsen Sea, Antarctica. The Iceberg measured 28.8 Km long and 17.6 Km wide. According to Antarctic research scientists this Iceberg will continue to move west. Tracking icebergs are important because they pose danger to ships servicing Antarctica. Aqua MODIS data from Nov 23, 2014 processed using TeraScan and analyzed using TeraVision.*

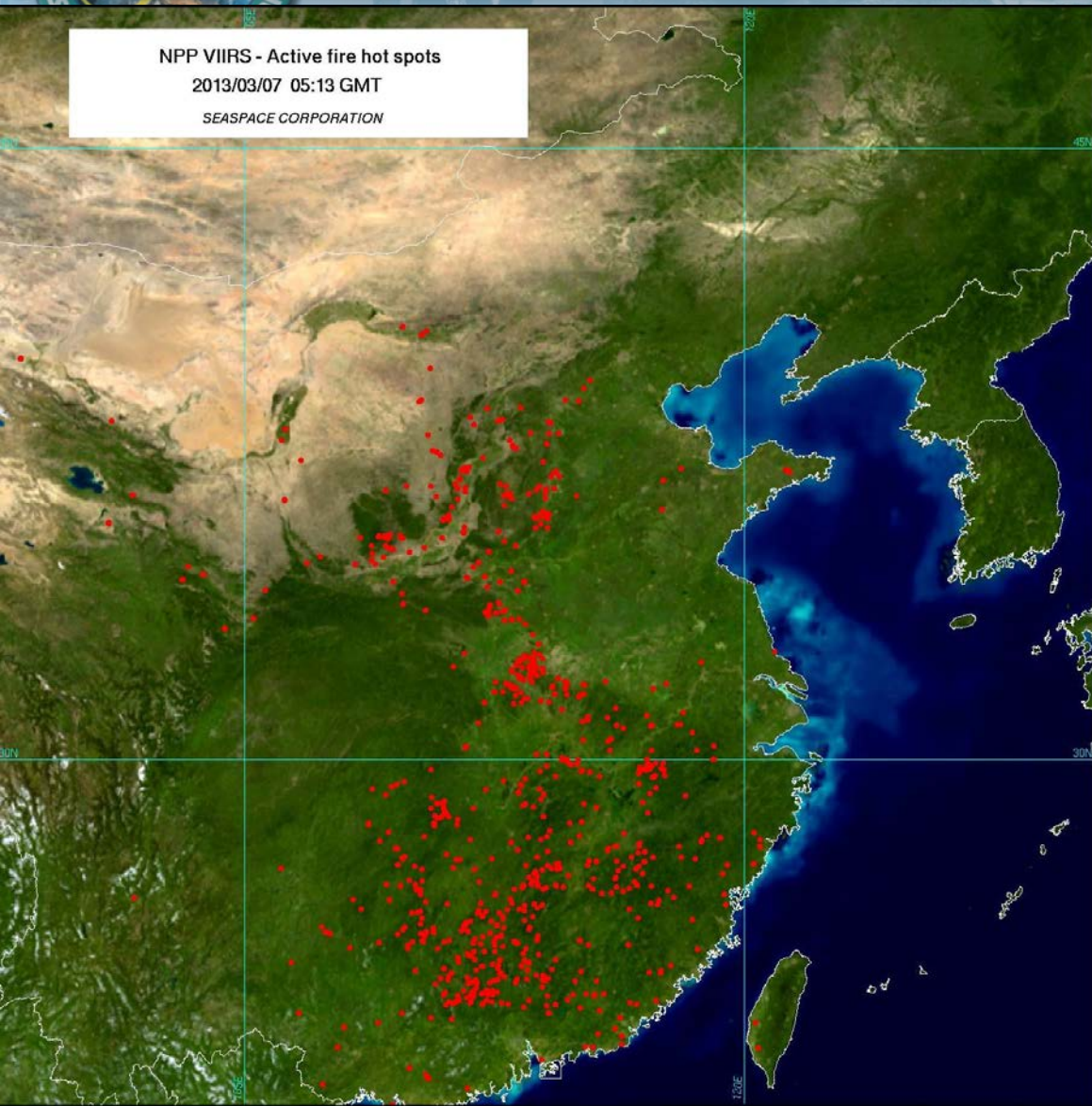


# Day Night Bands



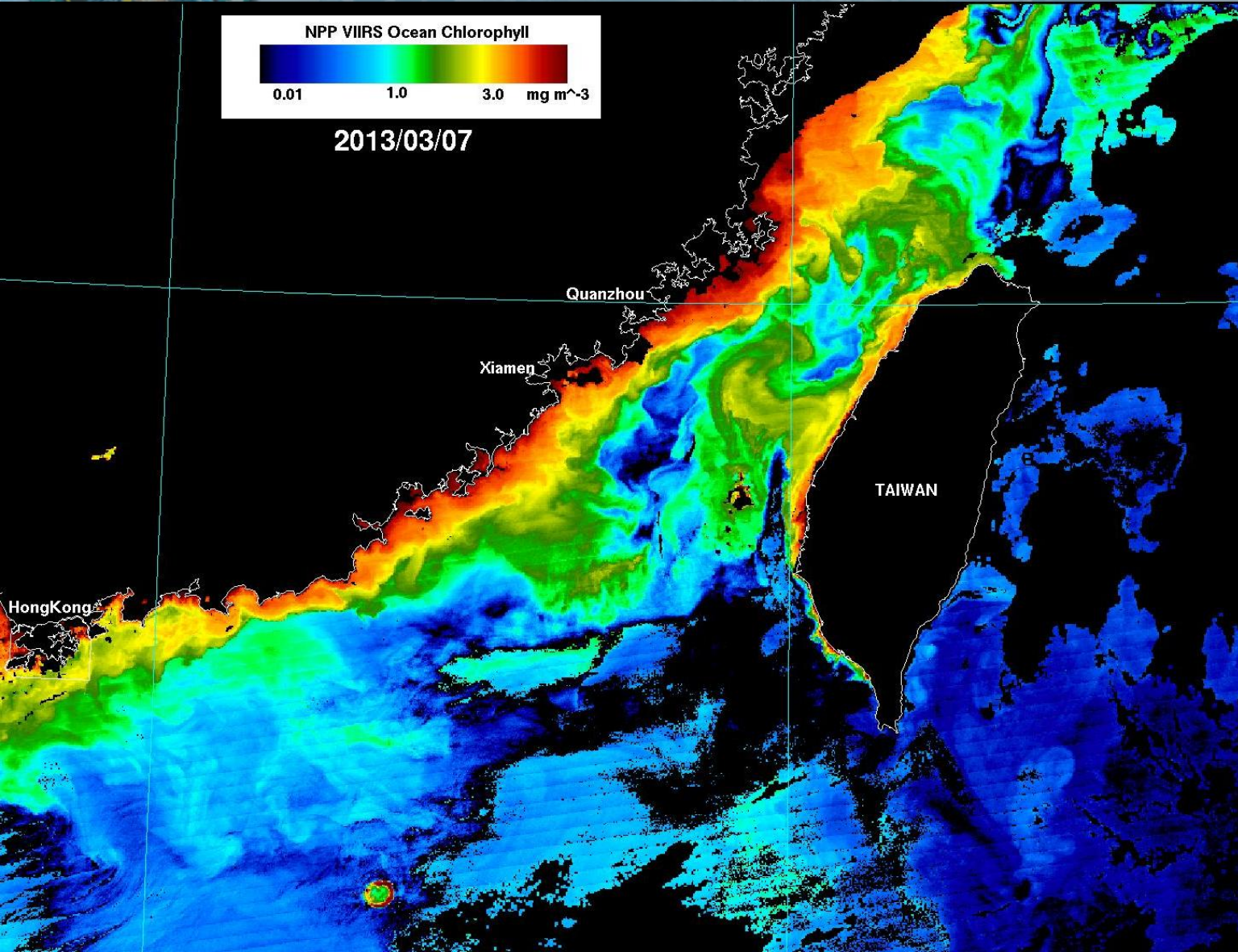
长三角的城市之光和东海黄海上的船只等

# NPP VIIRS FIRE POINTS



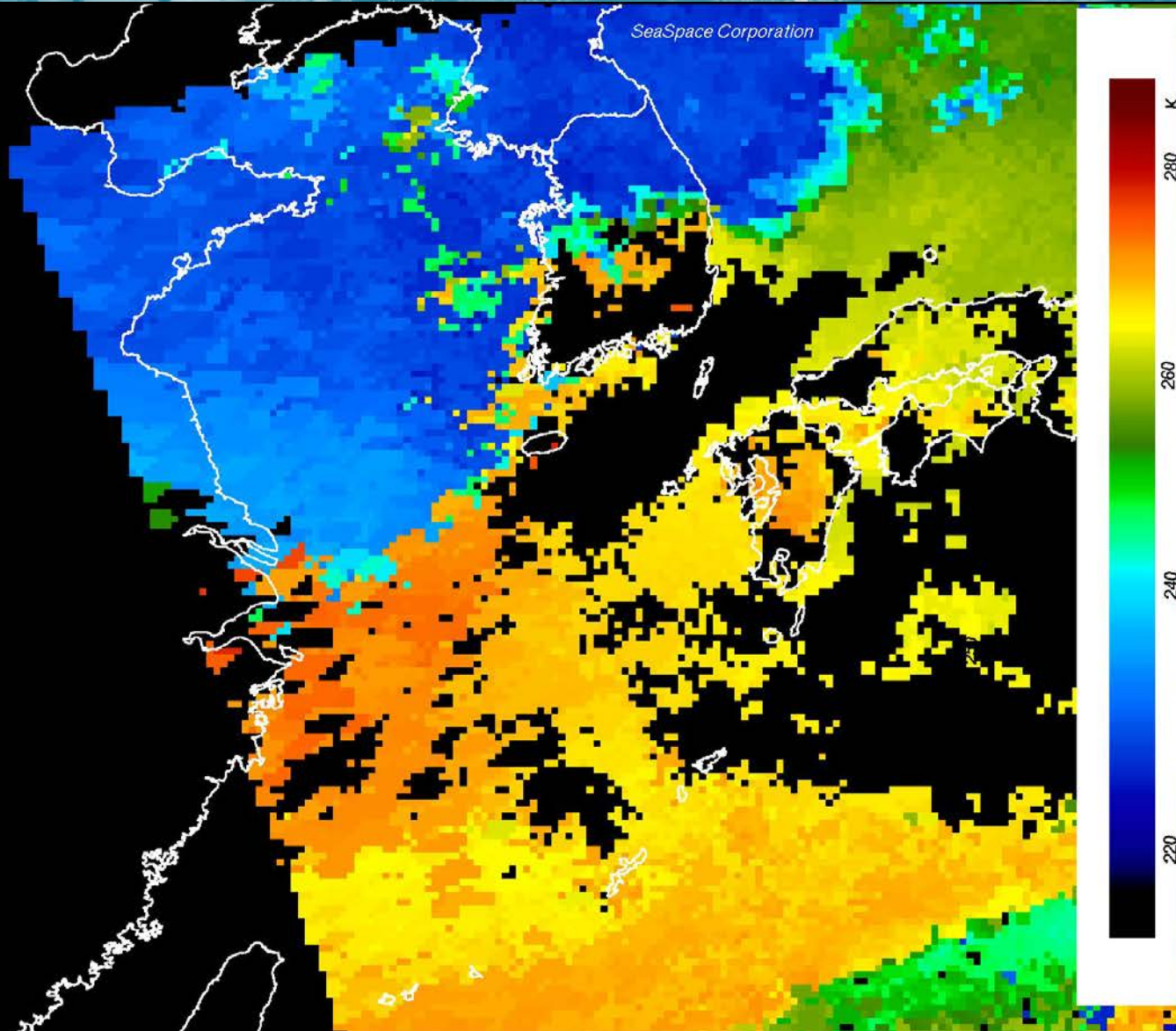
NPP VIIRS 火点分布图

# NPP VIIRS Ocean Color (chlorophyll)



NPP VIIRS  
海洋颜色  
(叶绿素含量)

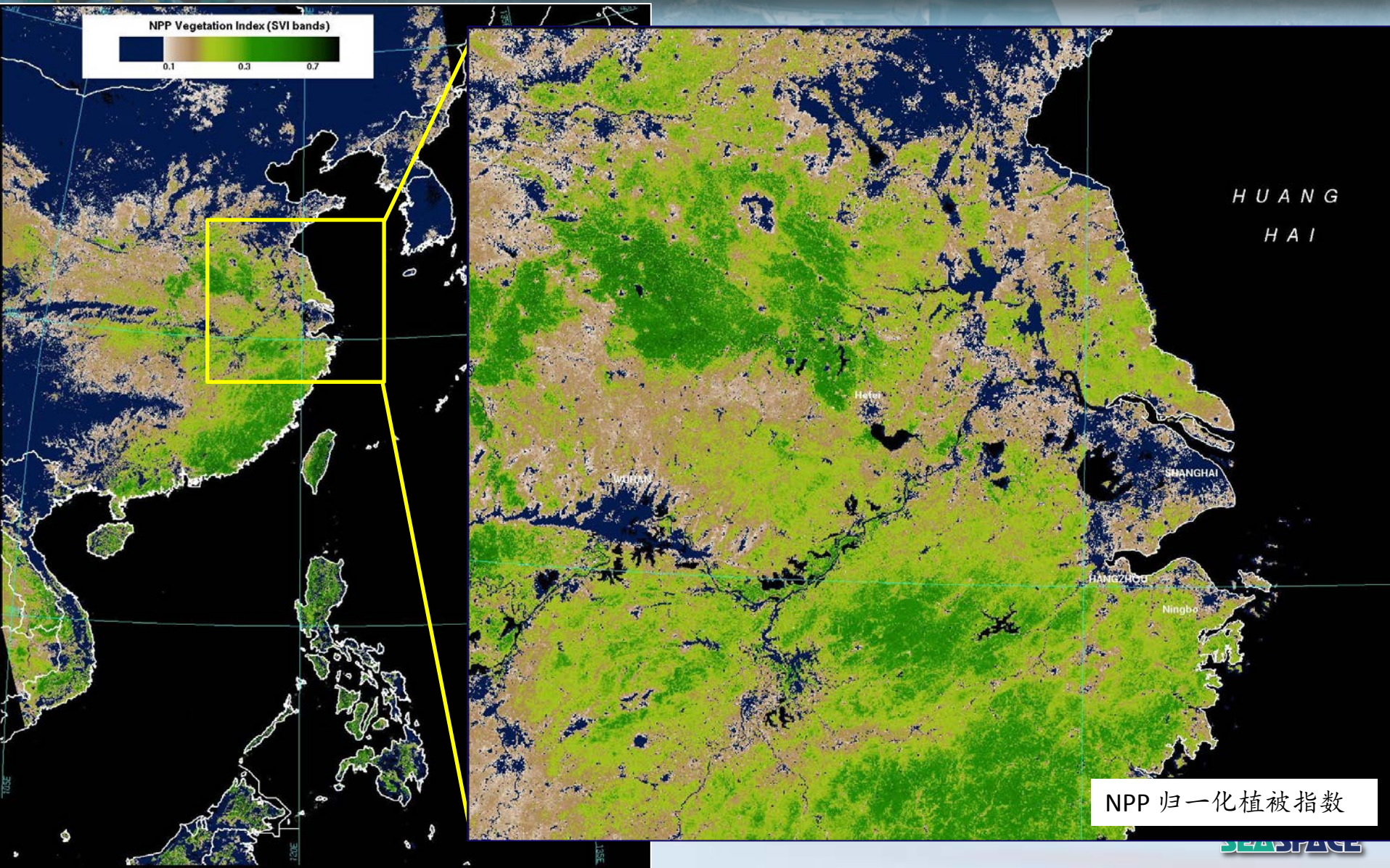
# S-NPP Cross-Track Infrared Sounder (CrIS) level2 retrieval of Cloud Top Temperatures over China and S. Korea. 2013/02/28



NPP CrIS 云顶温度反演

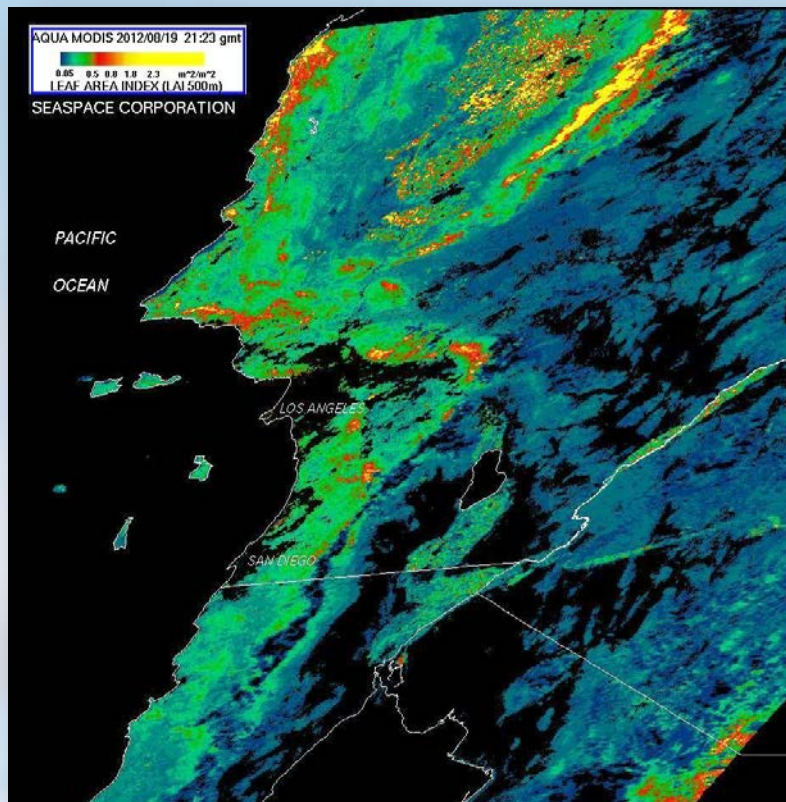


# NDVI from Suomi NPP





# MODIS Leaf Area Index (LAI) and FPAR algorithm for Direct Broadcast applications (Indian Agri Research In)

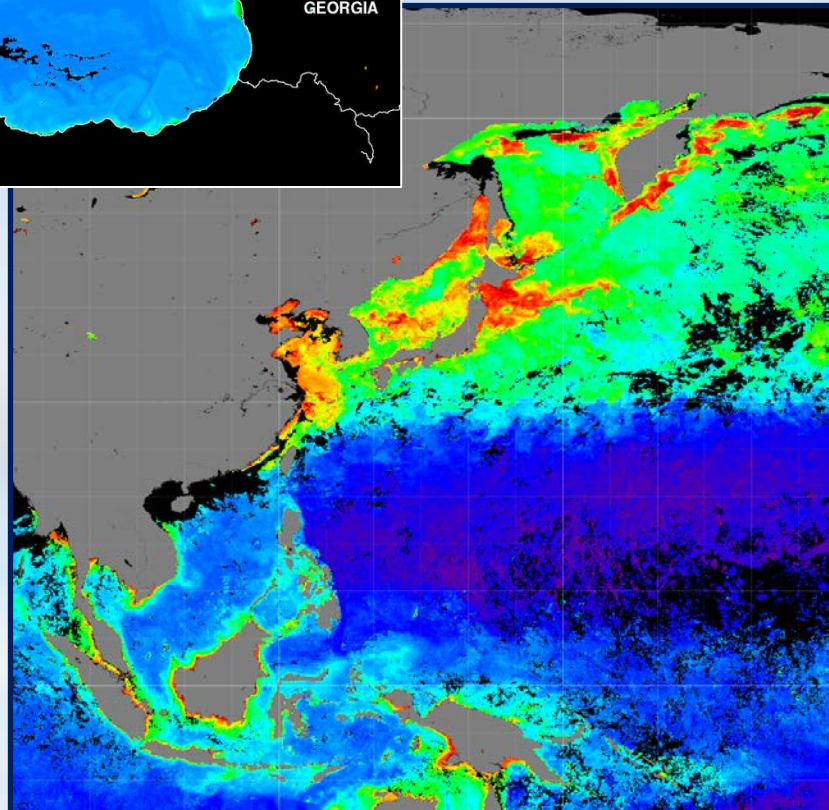
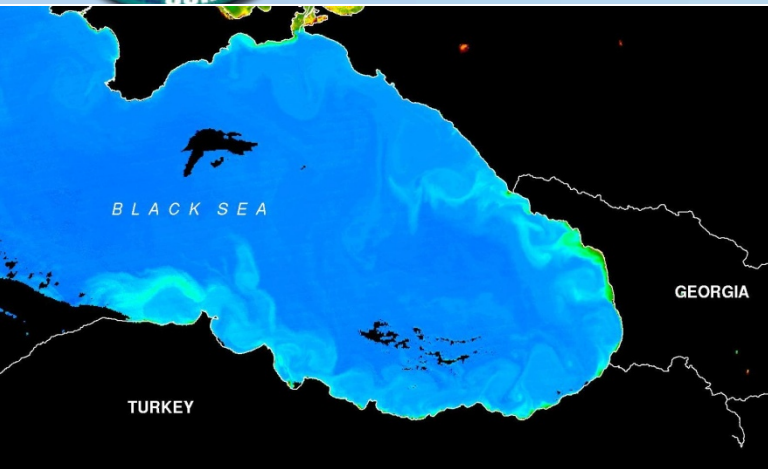


- Works with DB BRDF and surface reflectance input files
- Requires MODIS landcover files to cover Area of Interest
- Outputs include LAI and FPAR at 500m resolution in sinusoidal projection
- TeraScan generates modland\_tiles based on the input LAI tiles
- Remaps using master or master2 in sinusoidal map projection

MODIS 叶面积指数图



# Visible Infrared Imaging Radiometer Suite (VIIRS) Ocean Color integration

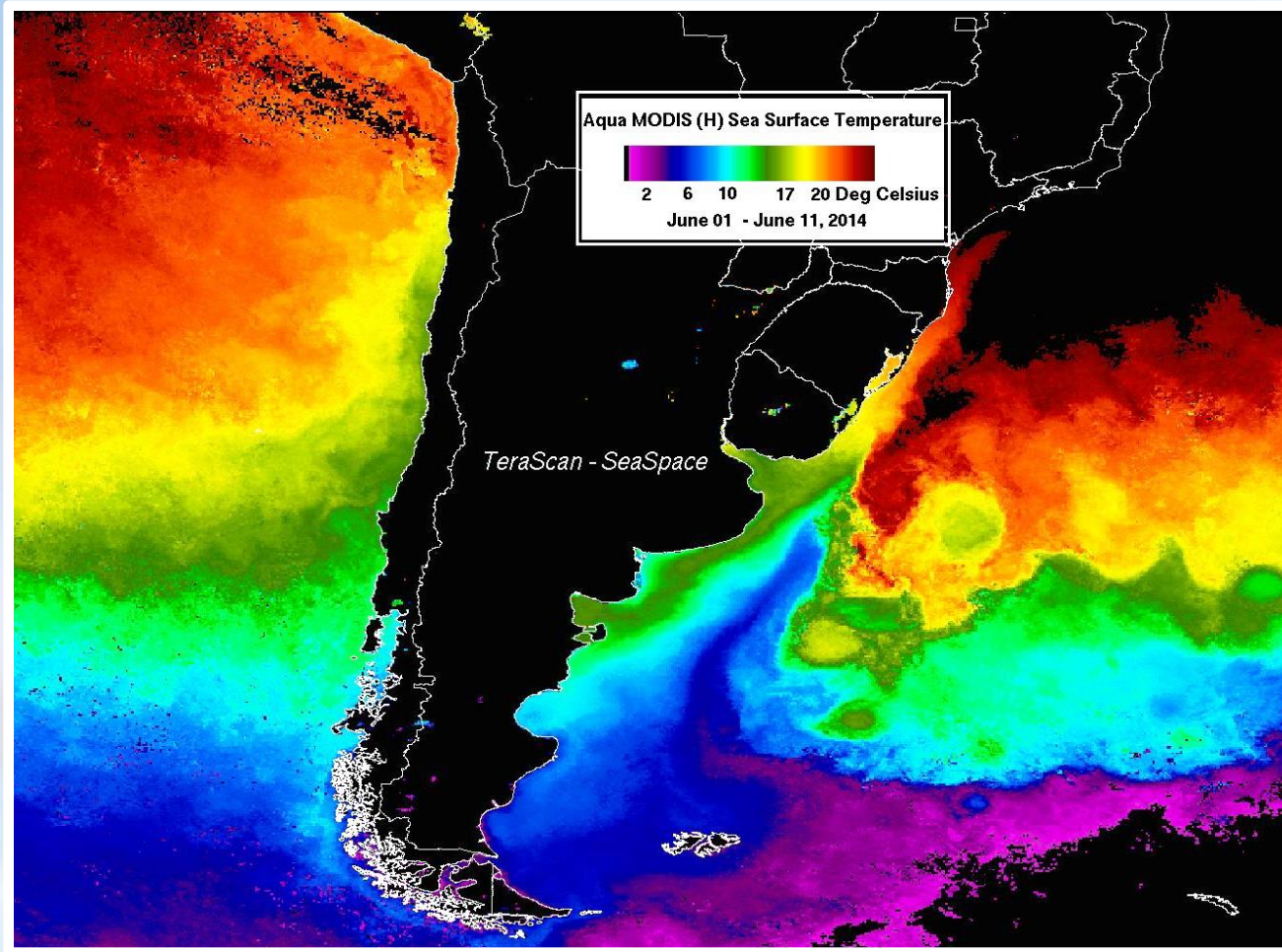


- Generate SDRs using CSPP
- Generate Ocean Color products using SeaDAS7
- Generate TeraScan Data Format file
- Forward remap to mercator proj.
- Land mask and apply color palette
- Standard "I2gen" ocean color product support for Water-leaving radiance and bio-optical retrieval products

*Japanese users from Hokkaido Univ and MAFFIN*



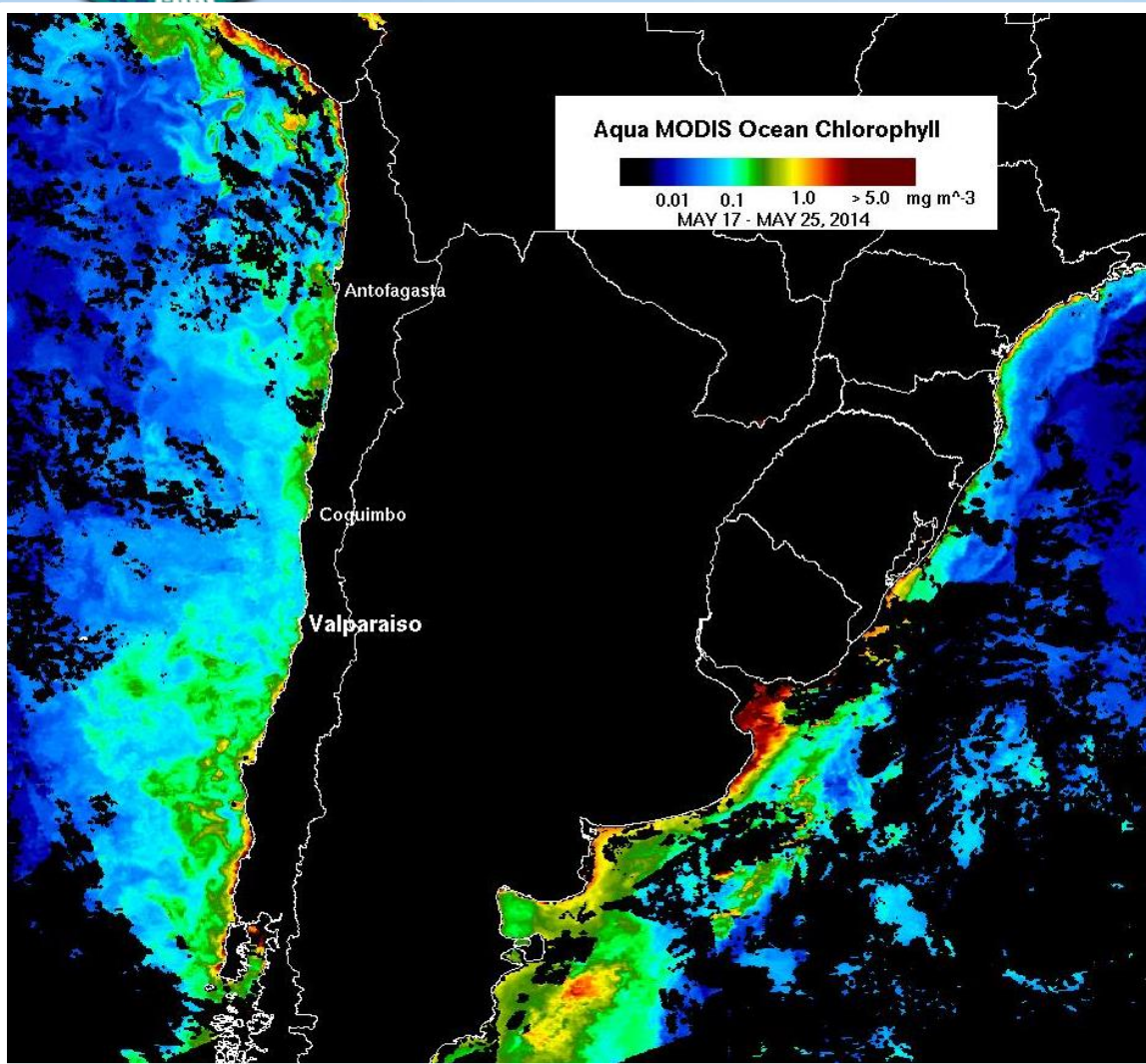
# Aqua MODIS Sea Surface Temperature Composites



- Daily SST processing using SeaDAS7
- Generate TeraScan Data Format file
- Forward remap to mercator proj.
- Land mask and apply color palette
- Weekly or Monthly composites using TeraScan



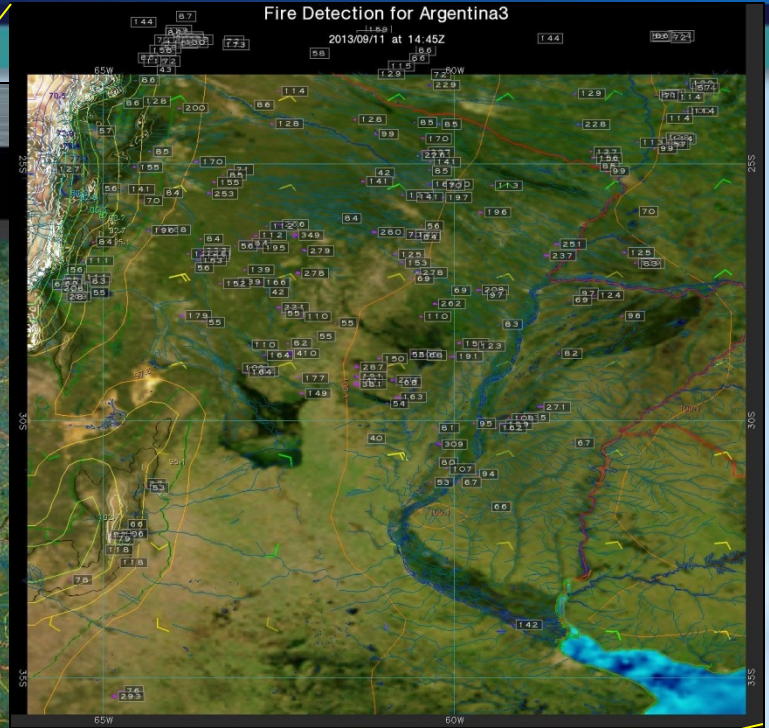
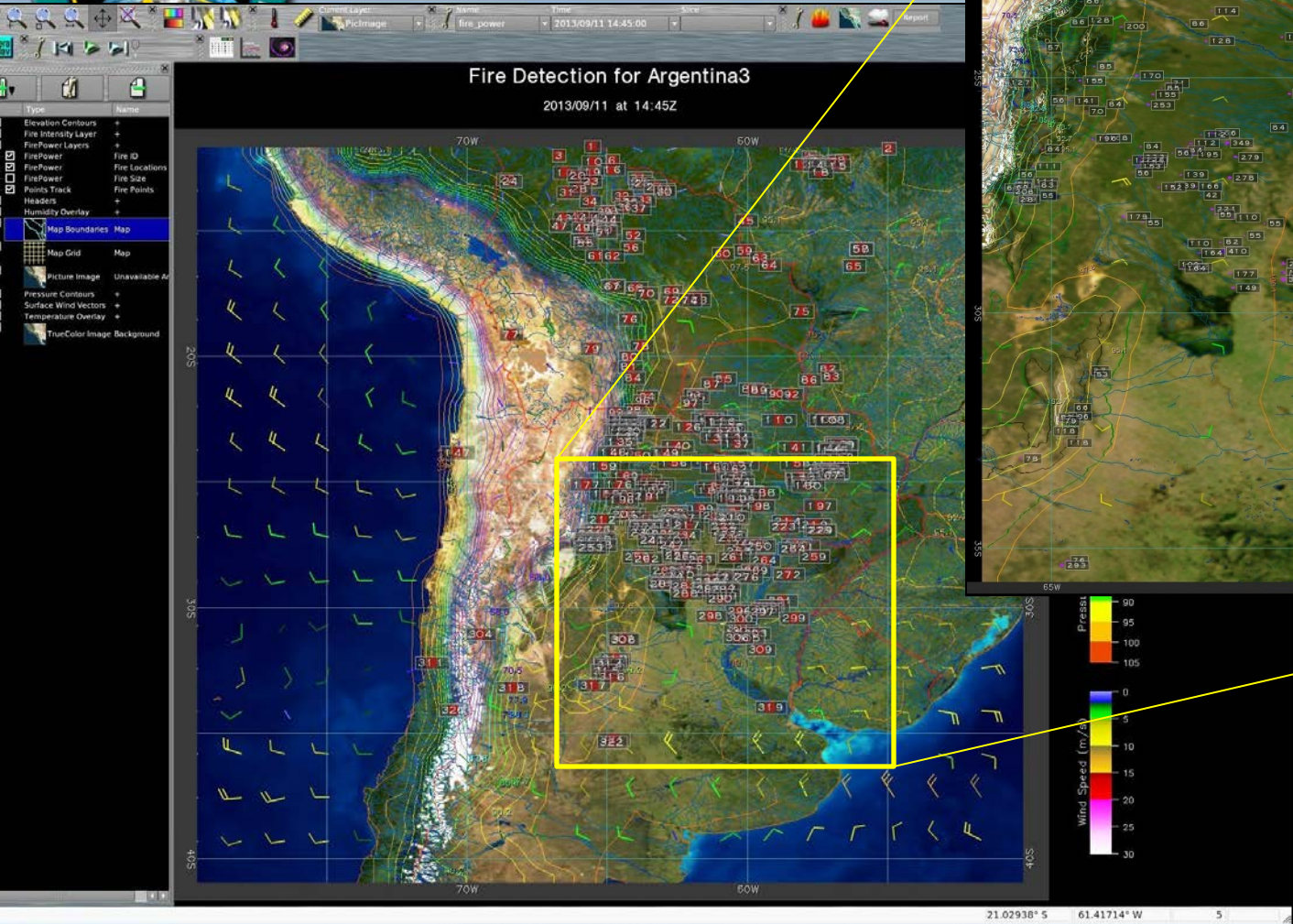
# Aqua MODIS Ocean Chlorophyll Composites



- Daily Ocean Color processing
- Generate Ocean Color products using SeaDAS7
- Generate TeraScan Data Format file
- Forward remap to mercator proj.
- Land mask and apply color palette
- Standard "I2gen" ocean color product support for Water-leaving radiance and bio-optical retrieval products
- Weekly or Monthly composites using TeraScan



# Wild fires in S.America (INTA)



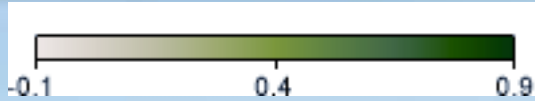
- Locations
- Size
- Intensity
- fire weather

*Demonstration of active fire detection using MODIS data over Argentina and Bolivia – September 2013*





# Level3 Terra MODIS NDVI Product



- Normalized Difference Vegetation Index
- May 2014
- Monthly Composite
- Eliminates Clouds and enhanced Land cover features



# MODIS Weekly Active Fire Composite Product

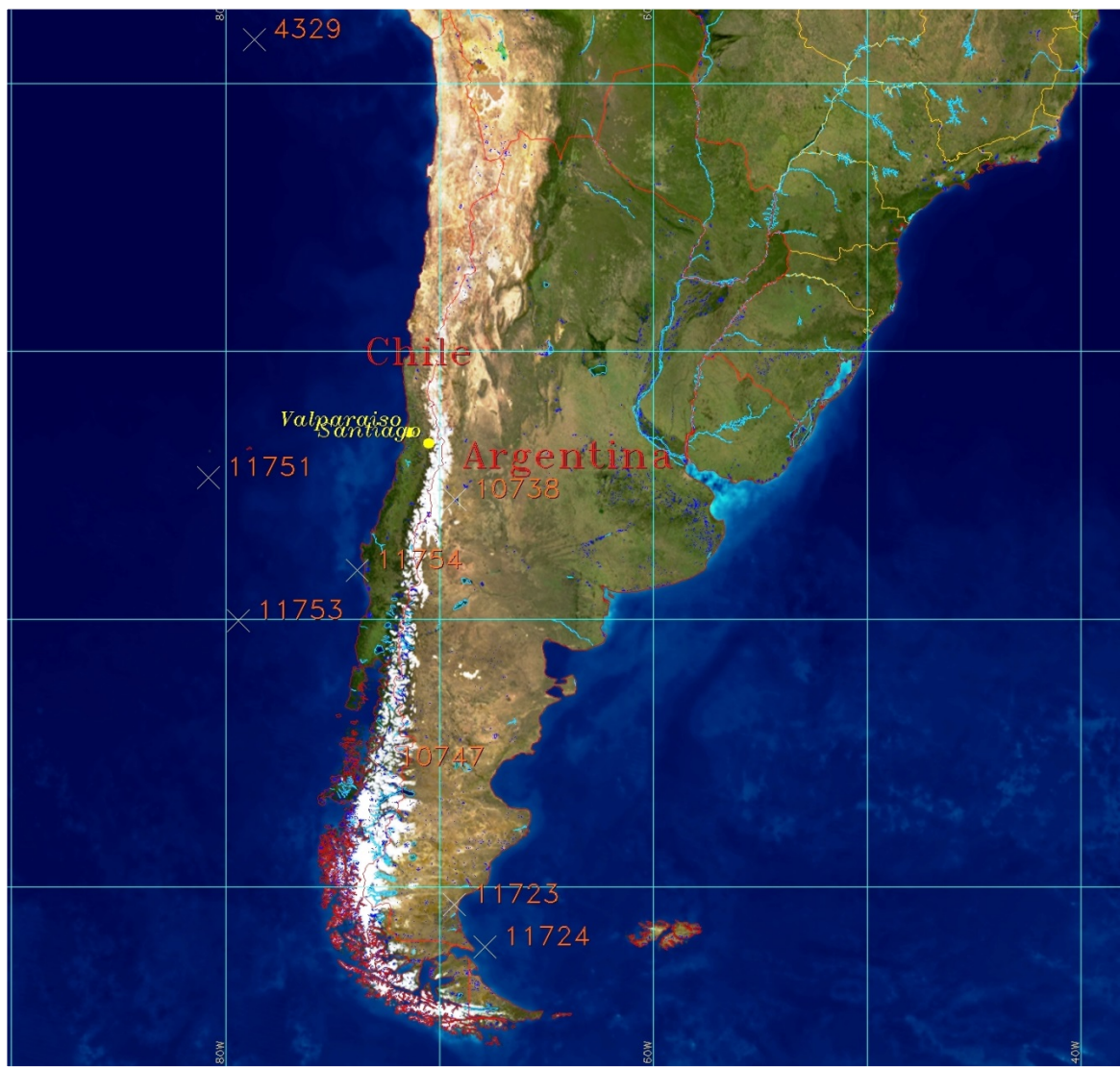


- Active fires detected by MOD14 Algorithm
- Period: Feb 20 – Mar 01 2015
- Chile, Argentina and Brazil
- Eliminates Clouds and enhanced fire detections





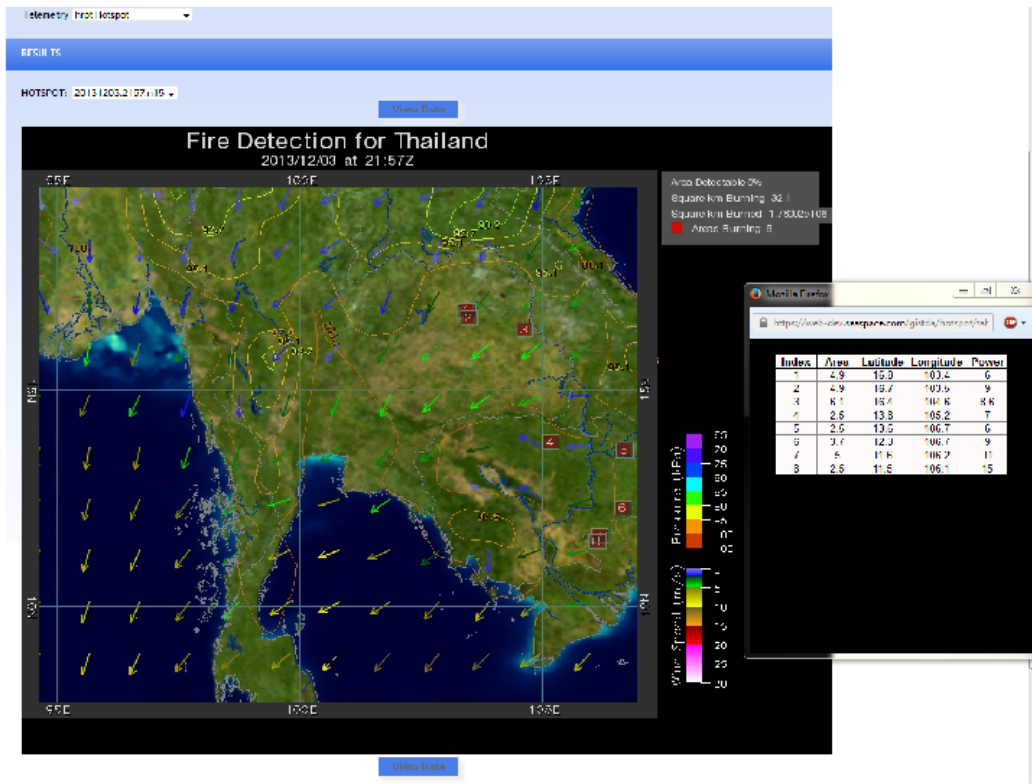
# NOAA-19 A-DCS platform location



- TeraScan A-DCS functions for NOAA-19 and Metop satellites
- Identification of Platform transmitters (PTTs)
- Land and Ocean transmitters
- ARGO data



# Active Fire detection using MODIS and NPP VIIRS



- Multiple active Fires
- Source MODIS and NPP VIIRS
- Customized interface for GISTDA
- Data processed using NASA and TeraScan processing algorithms
- Latitude / Longitude table
- CSV export file option
- HTML5 for easy access

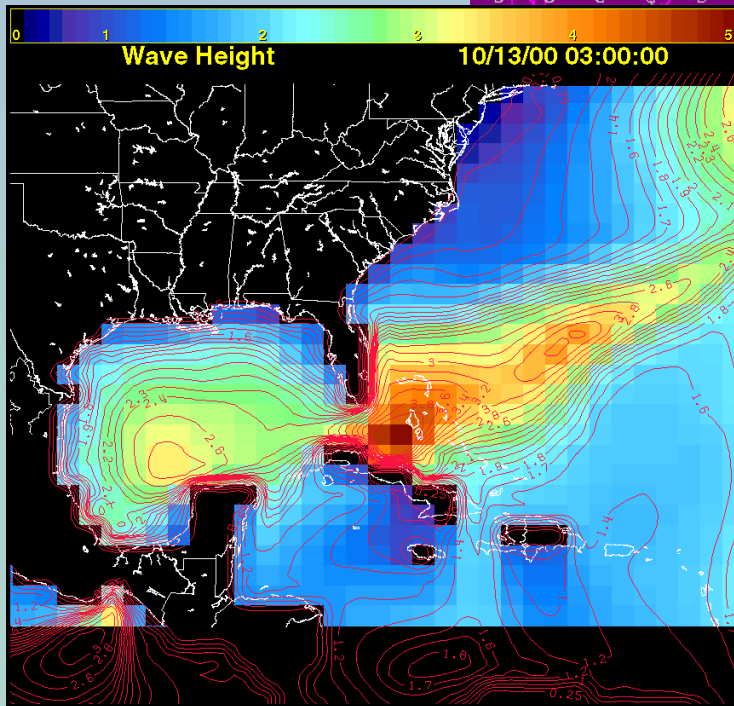
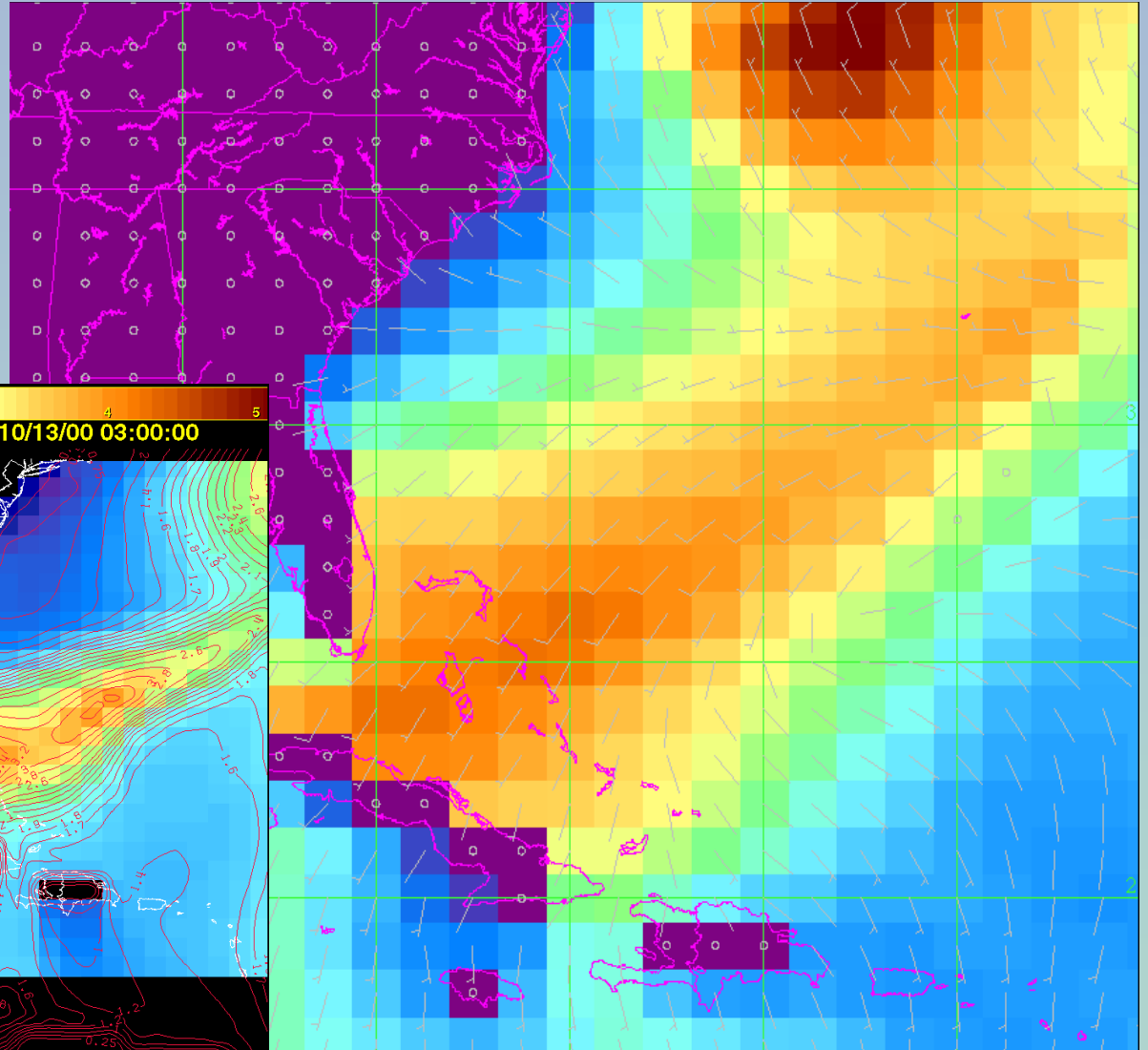
# Products: Forecasts

Surface Winds

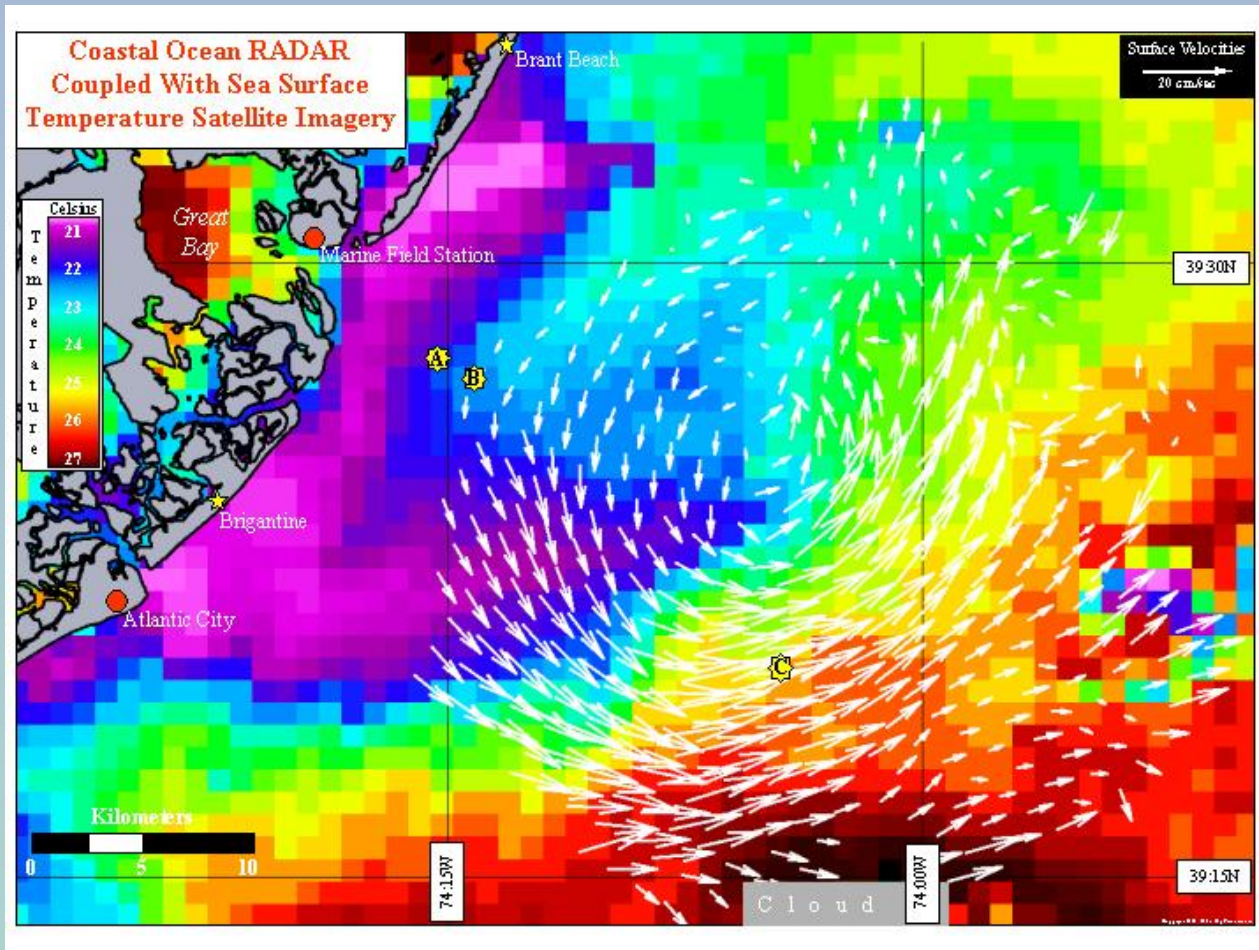
Wave height

Text Forecasts

Weather Discussions



# CODAR + Satellite Data



**CODAR = HF Radar**



# Storm tracker interface for COMS / Feng Yun 2

South East Asia      Infrared

**SEASPACE**

Regions  
 South East Asia  
 Thailand

Channels  
 Infrared  
 Water Vapor  
 Visible

Latest 2014.1027.2100

**GISTDA**

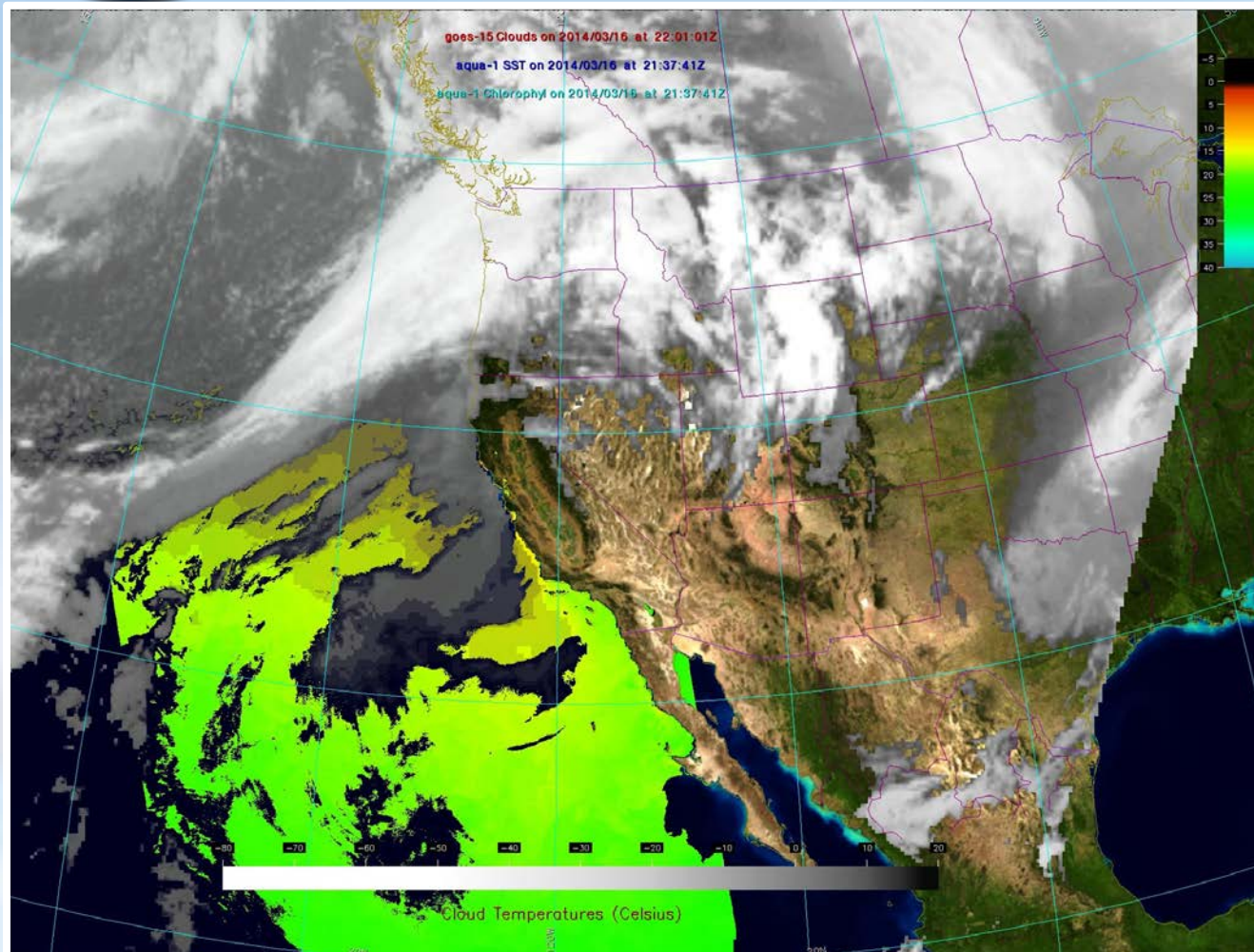
-70 -60 -50 -40 -30 -20 -10

START   STOP   VIEW   <PREV   NEXT>

- COMS / FY2 or other Geo
- Tracks and animates Typhoons
- Customized interface for GISTDA
- Data processed using KMA and TeraScan processing algorithms
- Frame animate and control
- Infrared, Water Vapor Or Visible



# Combining Polar and Geo satellite data



**Blue Marble  
Background**

**Clouds - GOES**

**Sea Surface  
Temperature  
Aqua MODIS**

**Data combine using  
Qtview recipe file**



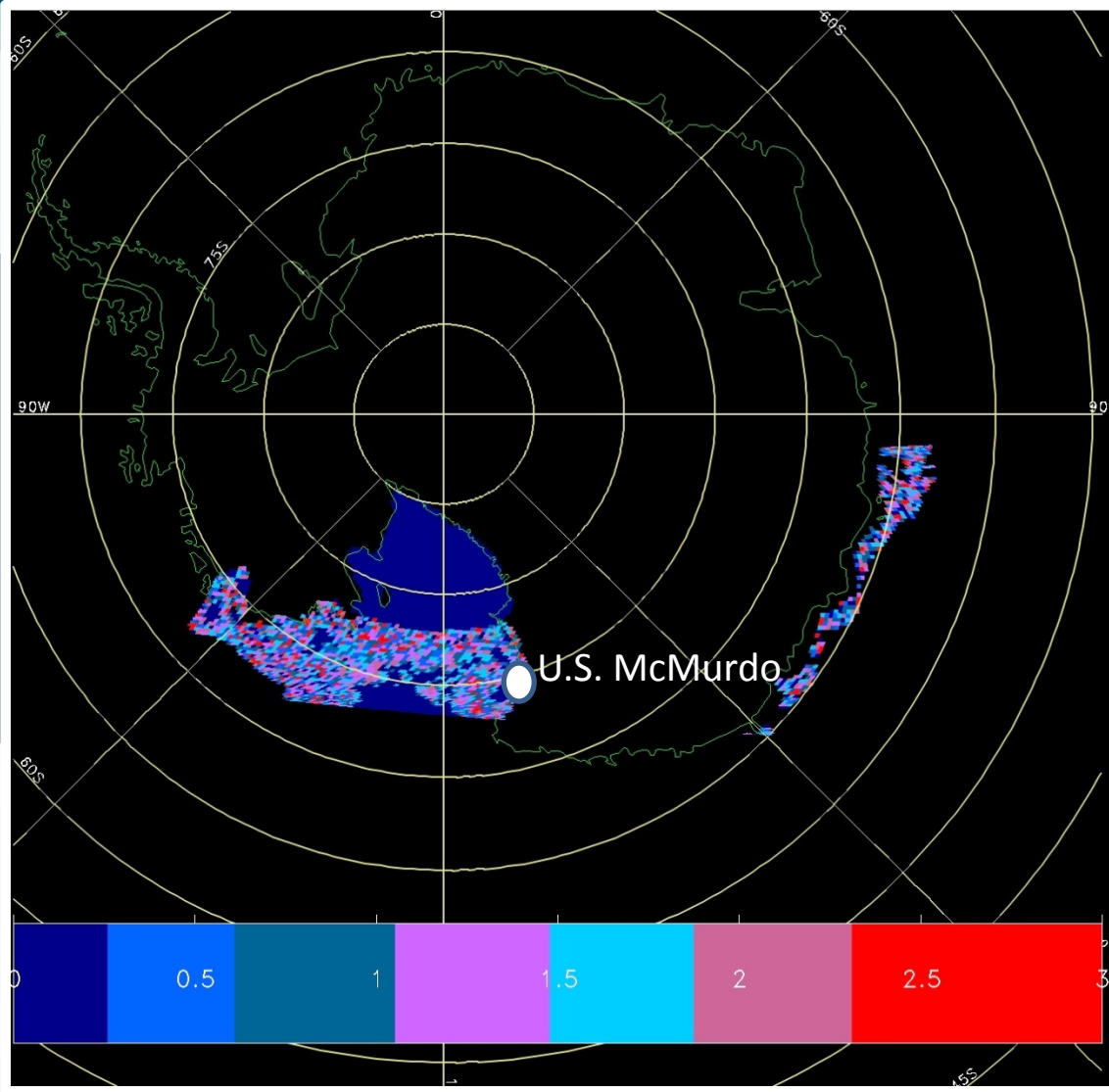
# SeaSpace Corporation



**Real-time DMSP SSMIS  
support**



# SeaSpace Corporation



**DMSP SSMIS**  
**Sea-Ice concentration**

**Real time Data**  
**telemetry**

**March 20, 2015**

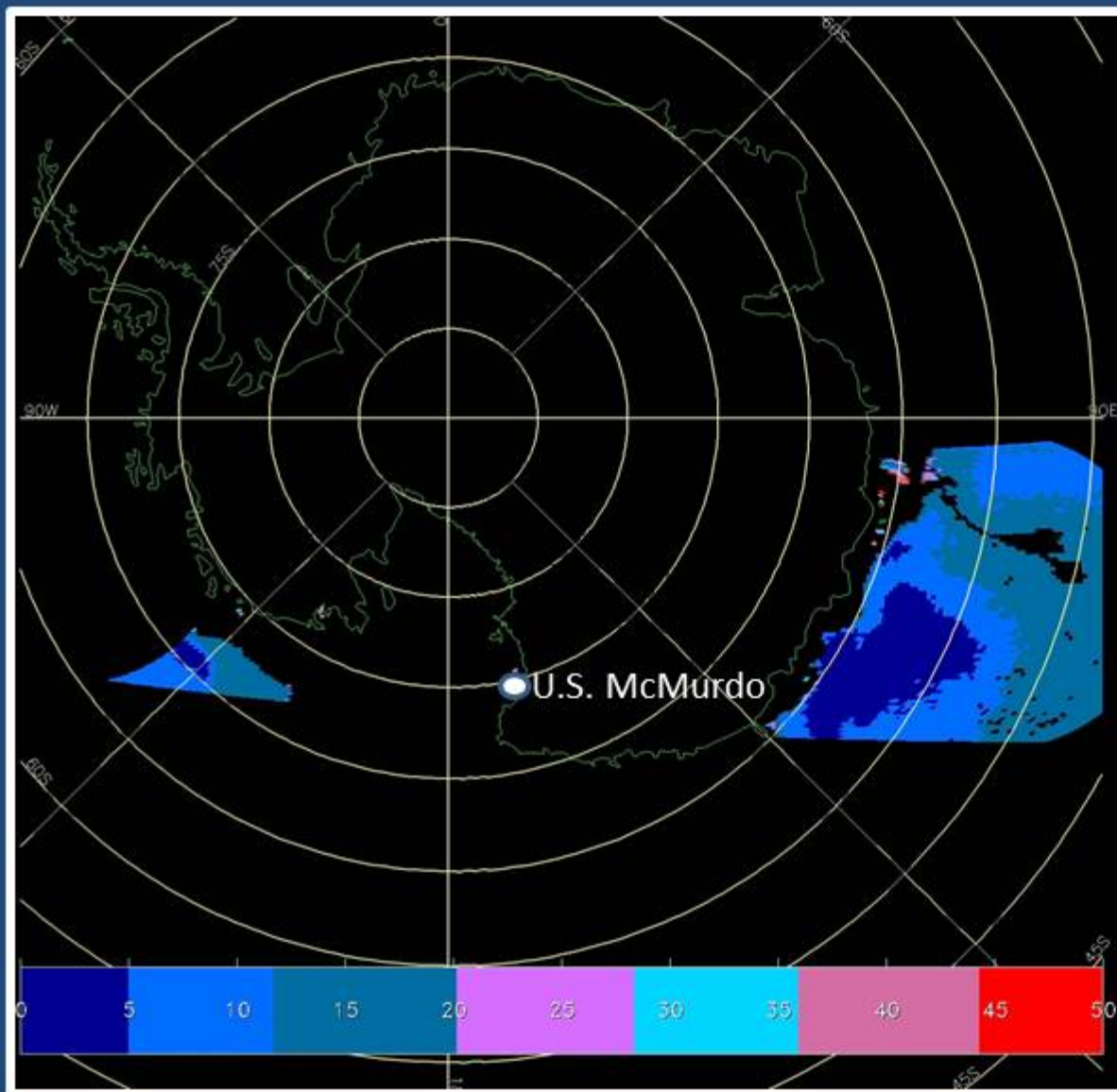
**McMurdo Station**

*Data processed and  
remapped using  
TeraScan*

0=land, 1=no ice, 2=near  
coast, 3=ice 4=possible ice  
5=sea, 6=coast



# Real-time Wind Speeds from DMSP SSMIS and TeraScan



TeraScan has included an algorithm to compute real-time wind speeds from DMSP SSMIS RTD data

*Left: Wind Speeds (m/s) from March 20, 2015 SSMIS data acquired over Antarctica. Data processed and remapped using TeraScan*

# S. Korean Icebreaker acquires SeaSpace WDS System



*South Korean Icebreaker Araon acquires a SeaSpace 1.5 m Weather Decision System (WDS). The system will be used to support high quality polar remote sensing research and support the Jang Bogo Antarctic Research Station*

*Icebreaker Araon – image courtesy KOPRI*

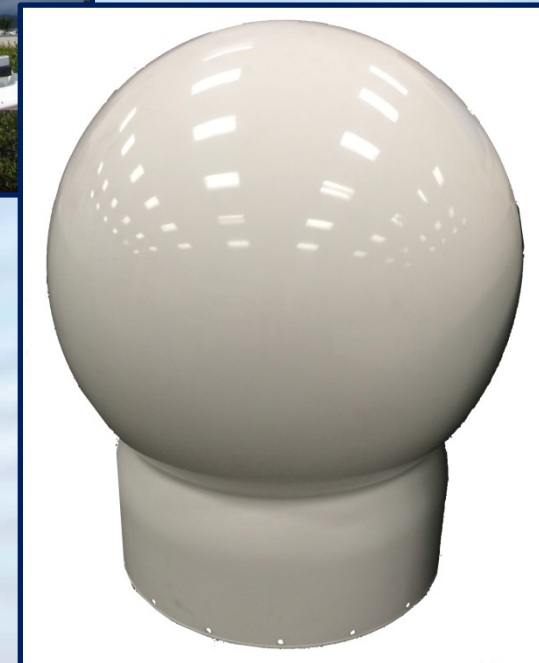


# WDS / LRIT Shipboard Systems

- 0.61m
- Shipboard stabilized
- NOAA, Metop and LRIT reception



Hakaryu Maru



# SeaSpace supports Himawari & GOES-R

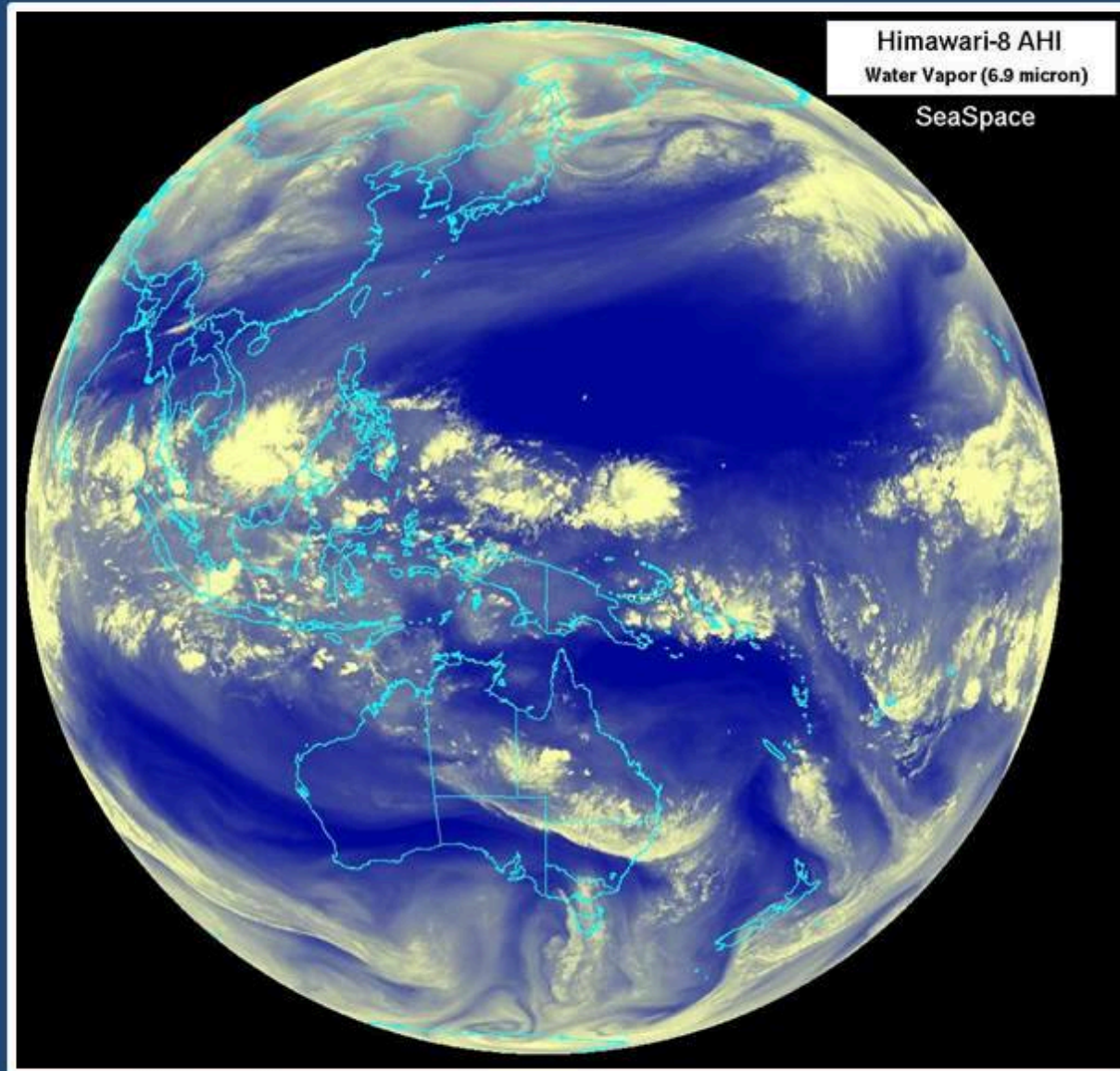


Image courtesy: [www.goes-r.gov](http://www.goes-r.gov)



Image courtesy: JMA

# Mid-Level Water Vapor using Himawari-8 AHI



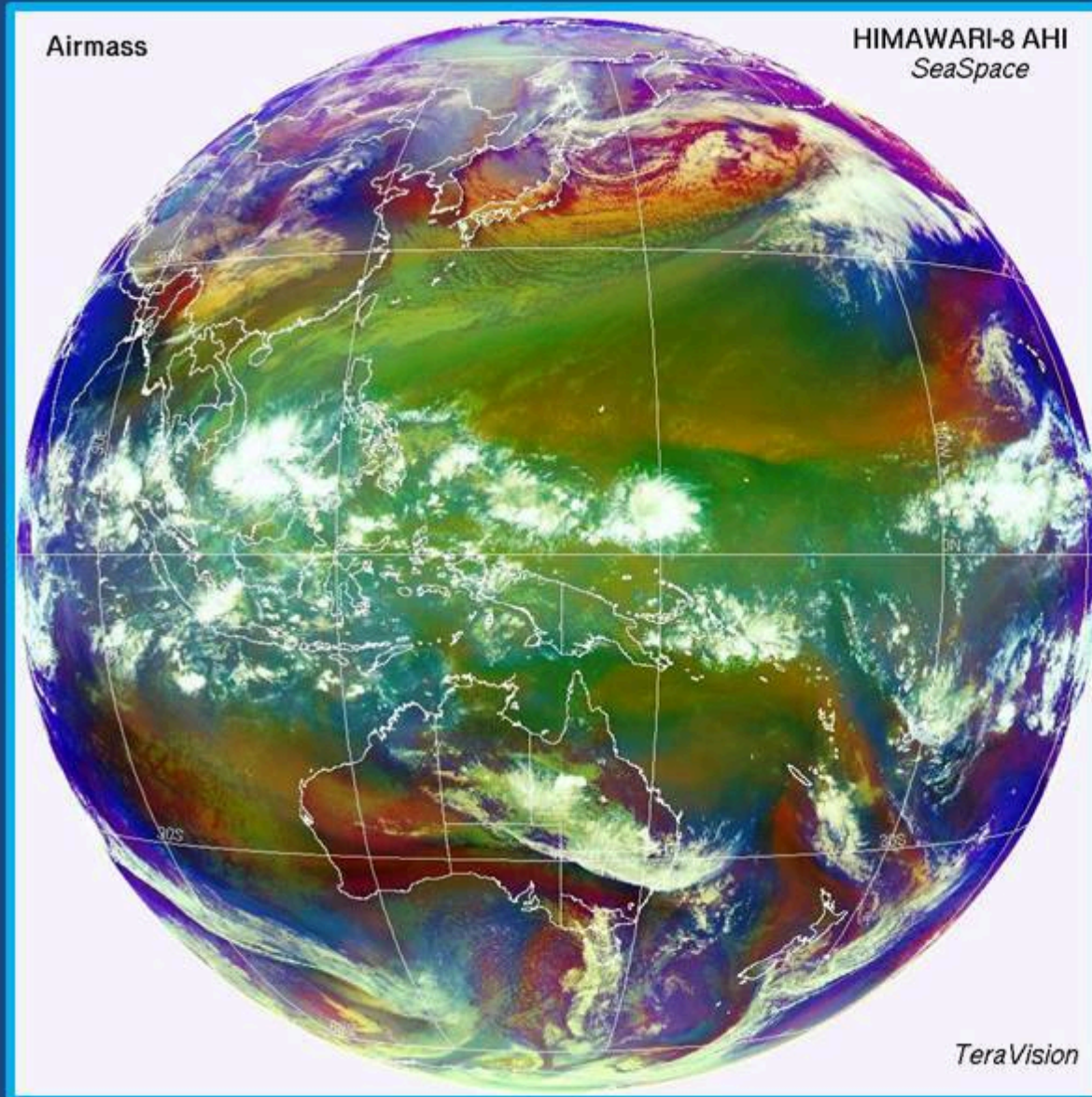
Advanced Himawari Imager (AHI) provides Water Vapor channels at High- Mid- and Low-atmospheric levels making it more useful to map winds and rainfall.

*Left: AHI Water Vapor channel at 6.9 micron.*

*Data earth-located and enhanced using TeraScan / TeraVision.*

Water Vapor product from Himawari-8

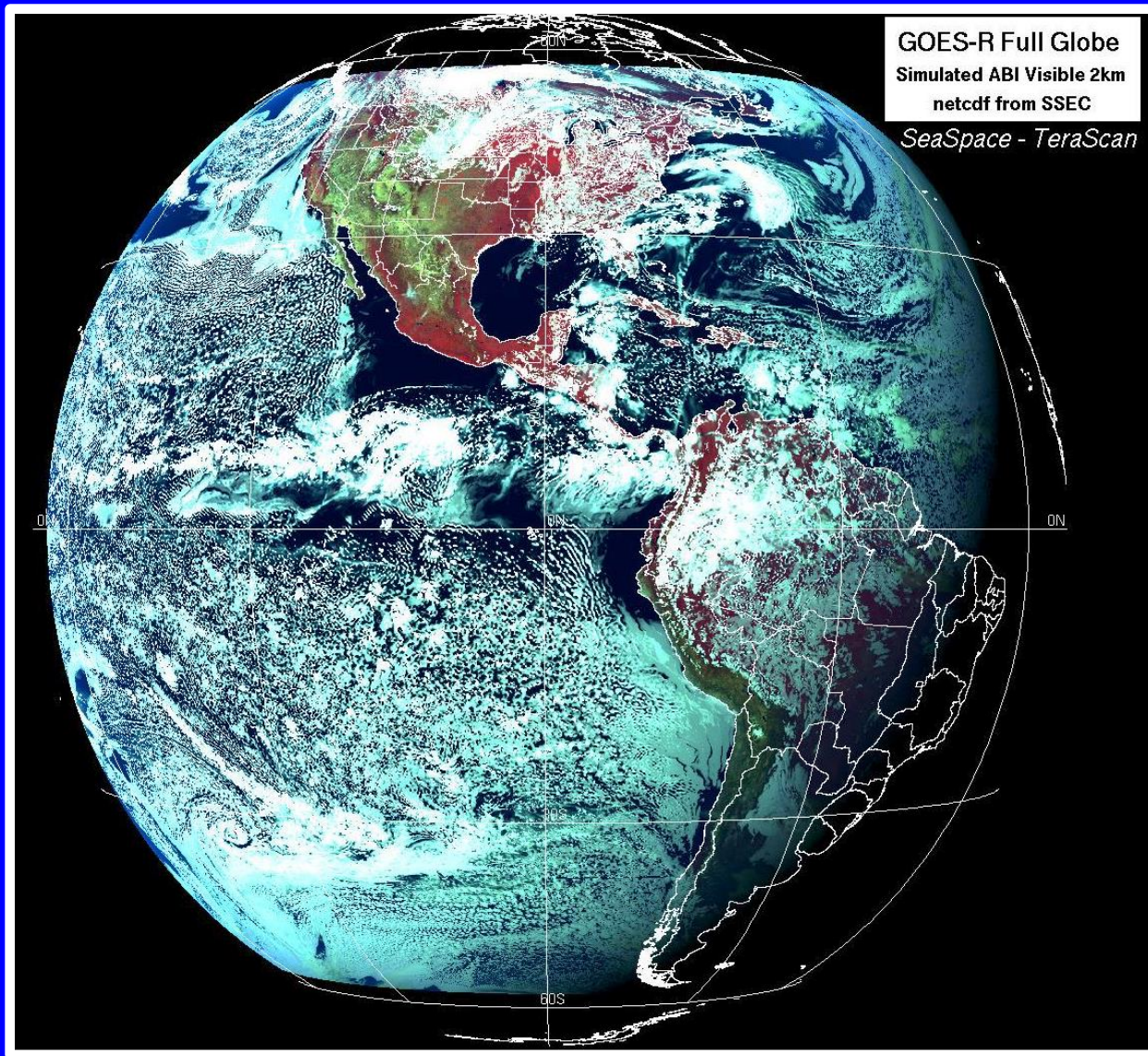
# Airmass product using Himawari-8 AHI



*Airmass is a special RGB combine product that clearly helps to define the development of low clouds (warm airmass), Mid-level clouds (cold airmass) and High-level clouds (Jet Stream/potential vorticity). Areas of warm airmass in this image are shown in reddish brown.*

*Data earth-located and enhanced using TeraScan / TeraVision.*

*Proof-of-concept derived product from Himawari-8*



ABI scans  
about 5  
times  
faster  
than the  
current  
GOES  
imager

**Simulated ABI RGB channels – netCDF data from UW SSEC**



# SeaSpace Corporation



- Thank you

**Email:**

*[kprasad@seaspace.com](mailto:kprasad@seaspace.com)*