

Super Typhoon Noul as viewed from Himawari-8

Credit: Scott Bachmeier



Why the OCONUS is ready for the new generation of environmental satellites

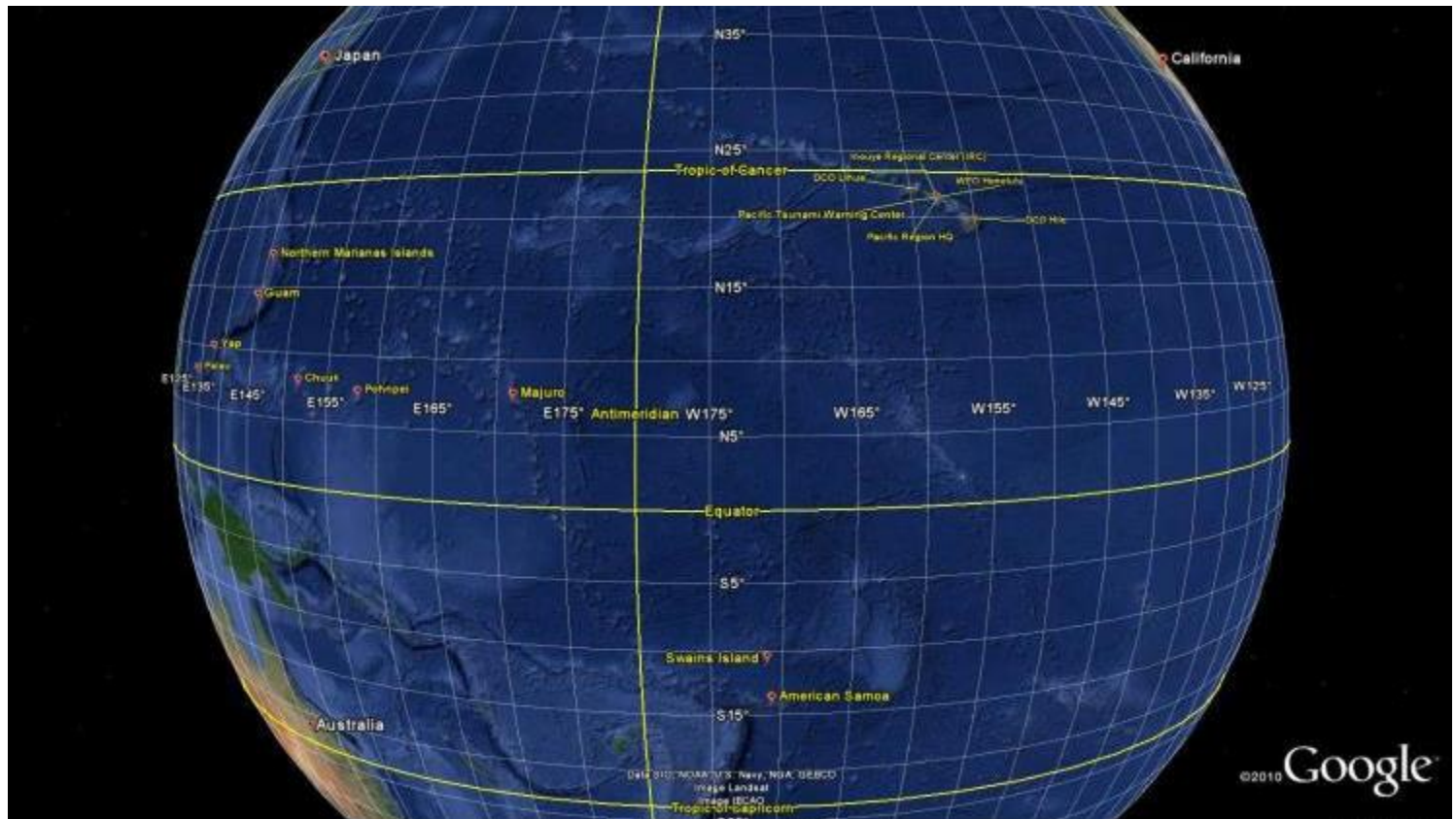


Jordan Gerth, Cooperative Institute for Meteorological Satellite Studies

# Outside Contiguous United States

- The “OCONUS” geographically includes:
  - Alaska
  - Hawaii
  - Puerto Rico, USVI, Guam, CNMI, American Samoa, Micronesia
  - Coastal Areas and Open Waters
- Challenges include:
  - In-situ data sparsity
  - Implementing and maintaining technical systems

# NWS Pacific Region



Credit: Eric Lau

# Keys to Success

- Improved direct broadcast and rebroadcast capabilities
- Leverage Himawari as much as possible to provide regionally relevant examples in preparation for GOES-R
- Emphasize baseline and under-demonstrated products
- Redundant delivery paths and formats

# Honolulu Community College

- L/X-band antenna installed in 2012 to track NPP, EOS, FY, MetOp, and POES satellites
- Provided critical day-night band imagery of Tropical Storm Flossie that led meteorologists to reposition center and adjust track
- VIIRS DNB remains popular with HFO forecasters
- Raw data is freely available to download via HTTP
- Supports research at the University of Hawaii

# IRC Rooftop Antenna Farm

3.7 meter Himawari antenna 10/30/2015  
WFO Guam

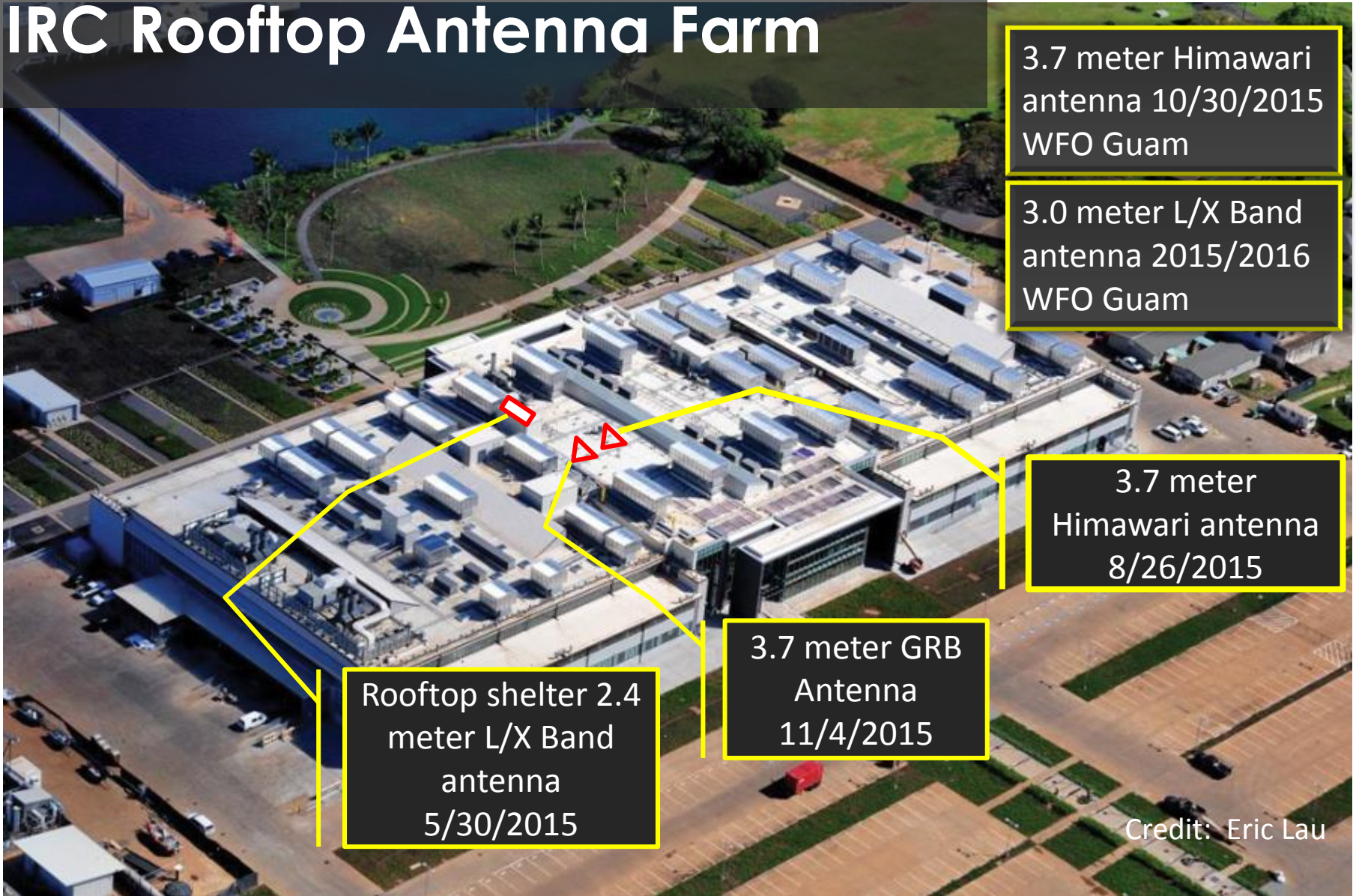
3.0 meter L/X Band antenna 2015/2016  
WFO Guam

3.7 meter Himawari antenna 8/26/2015

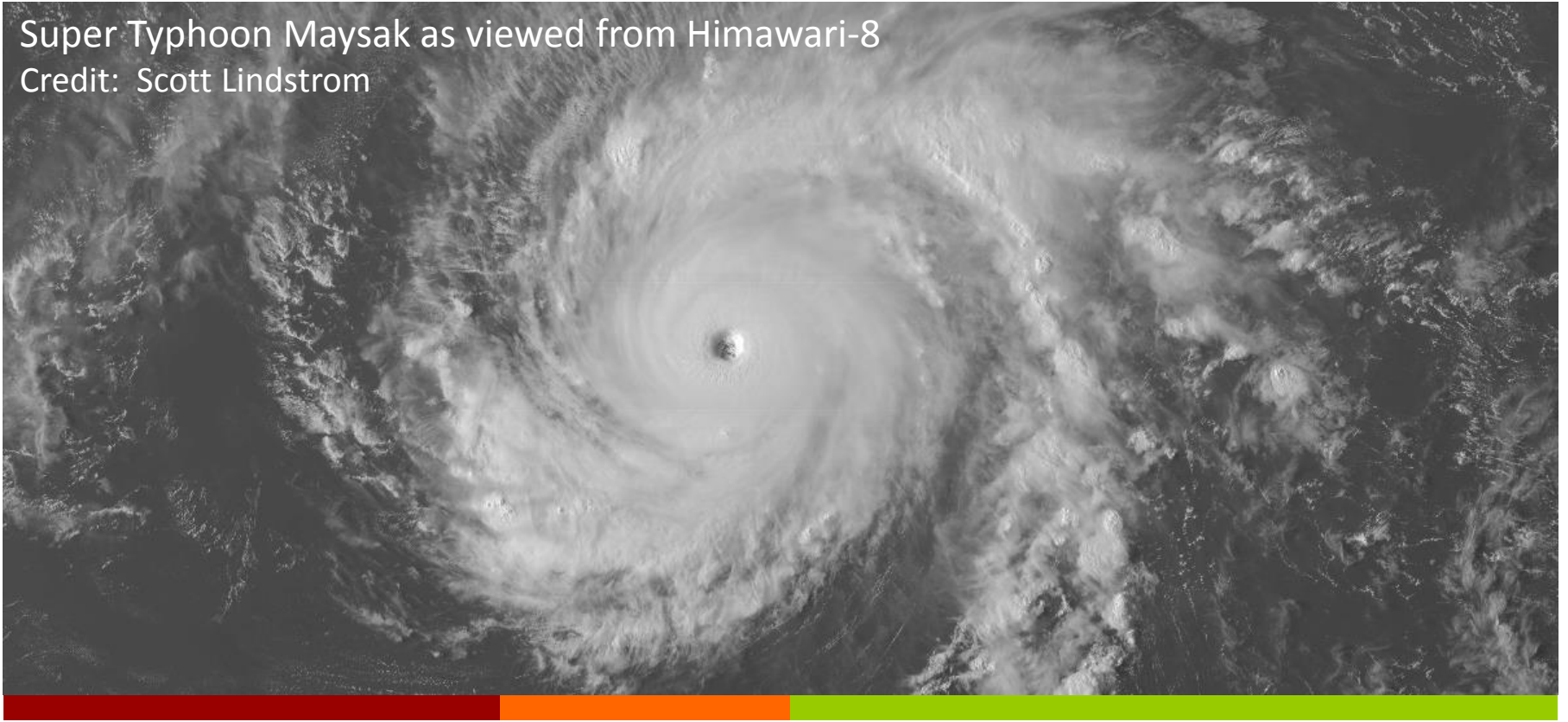
3.7 meter GRB Antenna 11/4/2015

Rooftop shelter 2.4 meter L/X Band antenna 5/30/2015

Credit: Eric Lau



Super Typhoon Maysak as viewed from Himawari-8  
Credit: Scott Lindstrom



## Himawari Imagery

via SSEC's RealEarth Web Map Service in near real-time:

<http://realearth.ssec.wisc.edu/>

# Training Paradigm

**Core**  
**General**  
**Specialized**



“Himawari” in Japanese translates to “sunflower” in English.



# Instructor-led Himawari Training

- Three instructors on-site with five, four-hour learning blocks over 2.5 days (course run twice in one week)
- Approximately 25% lecture, 75% interactive labs
- For Guam, training will focus on:
  - Introduction to the AHI and remote sensing concepts
  - Band composites and RGBs
  - Satellite applications for aviation forecasting
  - Identifying weather systems and meteorological features
  - Tropical cyclones
- Course delivery slated for November or December 2015

# GOES-R ABI Band Fact Sheets



## GOES-R ABI Band 1 ("Blue" visible)

The "need to know" Advanced Baseline Imager reference guide for the NWS forecaster



Above: Simulated image of ABI Band 1 for Hurricane Katrina. This image was simulated via measurements of high spatial resolution central model runs and advanced central model radiative transfer models. (Credit: CIMSS)

### In a nutshell

GOES-R ABI Band 1 (0.47  $\mu\text{m}$  central, 0.45  $\mu\text{m}$  to 0.49  $\mu\text{m}$ )

Also Himawari-8/9 ABI Band 1, Suomi NPP VIIRS Band M2

New for GOES-R Series, not available on current GOES

**Nickname:**  
"Blue" visible band

**Availability:**  
Daytime only

**Primary purpose:**  
Aerosols

**Uses similar to:**  
GOES-R ABI Band 2

The 0.47  $\mu\text{m}$ , or "blue" band, is used for monitoring aerosols, clouds, and tracking. This blue band is used in combination with other bands and/or "natural color" imagery of estimates of visibility. This band is used to improve numerous product face products. Other products that are essential for a natural color composite are the "red" (0.64  $\mu\text{m}$ ) and "green" (0.51  $\mu\text{m}$ ) bands. (Credit: CIMSS)



Suomi NPP images of similar blue band apparent in the 0.468  $\mu\text{m}$  band. (Credit: CIMSS)



every minute. The second full disk scan every 5 minutes.

## Himawari AHI Fact Sheet Band 2 ("Green" visible)

The "need to know" Advanced Himawari Imager reference guide for the NWS forecaster



The next-generation geostationary meteorological satellites of the Japan Meteorological Agency, Himawari-8, was successfully launched on October 7, 2014 from the Tanegashima Space Center in Tanegashima, Japan. Photo and video courtesy: Japan Meteorological Agency.

### In a nutshell

Himawari AHI Band 2 (0.51  $\mu\text{m}$  central, 0.50  $\mu\text{m}$  to 0.53  $\mu\text{m}$ )

Also similar to the Suomi NPP VIIRS Band M4

Not available on current GOES or with the GOES-R series ABI

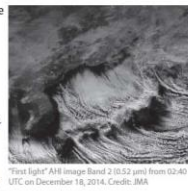
**Nickname:**  
"Green" visible band

**Availability:**  
Daytime only

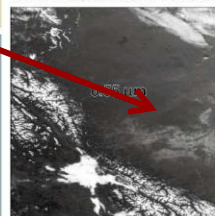
**Primary purpose:**  
Solar insolation estimates

**Uses similar to:**  
GOES-R ABI Band 1, Band 2

The 0.51  $\mu\text{m}$ , or "green" band, is one of the three visible bands on the Himawari-8/9 imager. The longitude for Himawari-8 is 140 East. The Japan Meteorological Agency (JMA) recently launched this satellite with the Advanced Himawari Imager (AHI) as part of its payload. A very similar band, 0.55  $\mu\text{m}$ , is included on NASA's MODIS and Suomi NPP VIIRS instruments. This band will provide daytime observations related to the land, clouds and aerosols. This green band, combined with the "blue" (0.47  $\mu\text{m}$ ) and "red" (0.64  $\mu\text{m}$ ) bands will provide "natural color" imagery of the Earth-atmosphere system. This band is essential for a natural "true color" Red-Green-Blue (RGB) composite. Measurements in the green band can be used for air pollution studies and other products such as solar insolation estimates.



"First Light" AHI image Band 2 (0.51  $\mu\text{m}$ ) from 02:40 UTC on December 16, 2014. Credit: JMA



Suomi NPP images of a similar green band (left) and true color (right) images. Note the snow, low cloud and vegetation in the 0.55  $\mu\text{m}$  band, which is a key component to the true color image. The image is over part of Canada (October 17, 2014). Image from CIMSS.



(0.47  $\mu\text{m}$ ), red (0.64  $\mu\text{m}$ ) and "veggie" (0.86  $\mu\text{m}$ ) bands.

Unlike the AHI, there is no green band on the GOES-R series ABI. Hence, this band will be approximated from other spectral bands for use in generating true color imagery. In the case of the ABI, this approach will be a look-up table using the blue (0.47  $\mu\text{m}$ ), red (0.64  $\mu\text{m}$ ) and "veggie" (0.86  $\mu\text{m}$ ) bands.



Suomi NPP images of a similar green band (left) and true color (right) images. Note the snow, low cloud and vegetation in the 0.55  $\mu\text{m}$  band, which is a key component to the true color image. The image is over part of Canada (October 17, 2014). Image from CIMSS.

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## Baseline Imager reference guide for the NWS forecaster

Baseline Imager reference guide for the NWS forecaster

The ABI visible band is the 0.6  $\mu\text{m}$  (or "red" band). During the daytime, it will be used for detection of fog, estimation of solar insolation and depiction of diurnal clouds. It is called the red band because the center frequency of this band is in the red part of the visible spectrum. The 0.6  $\mu\text{m}$  visible band is also used for snow and ice cover, detection of severe weather, low-level cloud-drift winds, volcanic ash, hurricane analysis, and winter storm analysis. A similar band on the Advanced Baseline Imager (ABI) has demonstrated many of these applications, although the ABI has improved spatial and temporal resolutions. This band is essential for a natural color composite. Since there is no "green" ABI band on the GOES-R series, this band will be approximated from other spectral bands for use in generating "true color" imagery. In the case of the ABI, this approach will be a look-up table using the "blue" (0.47  $\mu\text{m}$ ), red (0.64  $\mu\text{m}$ ) and "veggie" (0.86  $\mu\text{m}$ ) bands. Source: Schmit et al., 2005 in BAMS, Miller et al. 2012 Weather Event Simulator (WES) Guide by CIMSS.



Blue, synthetic green and red bands from ABI simulated data (from CIMSS). Image from Don Hilligs.



While many think that the visible band on the first geostationary imager on ATS-1 in December 1966 was a band centered at 0.64  $\mu\text{m}$ , the band on ATS-1 actually peaked at approximately 0.52  $\mu\text{m}$ . The approximate resolution for this sensor was 3 and 4 km. It was this imager that took the first full-disk Earth images from vortuous orbit and the first image of Earth and the moon together.

With examples from VIIRS

Thanks to Tim Schmit, George Tuggle, Michelle Smith, Carven Scott, and Bill Ward

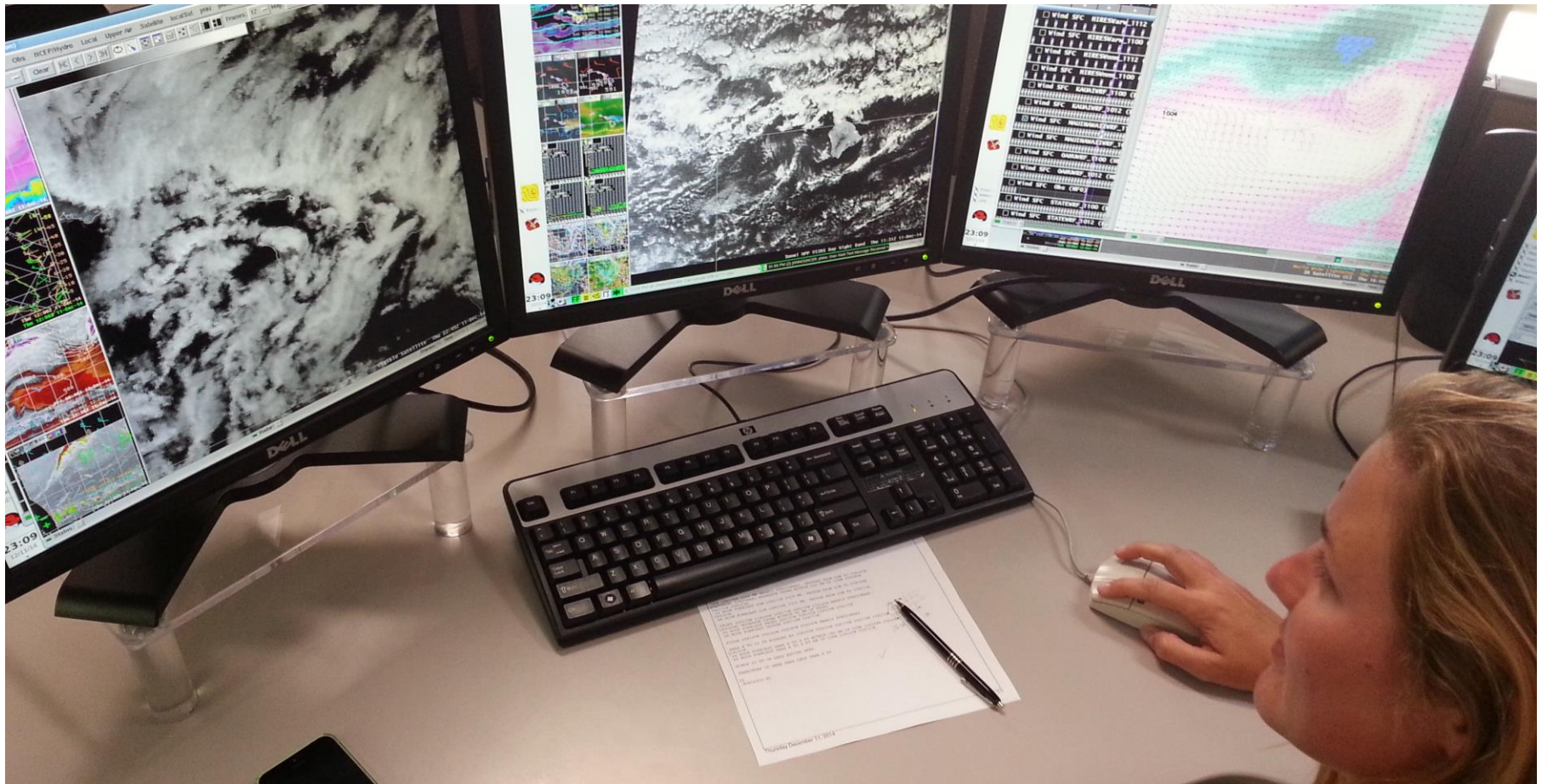
# Web Applications as Learning Tools

- Tom Whittaker and Tim Schmit have developed web applications (“webapps”) to assist in learning about the spatial, spectral, and temporal improvements of the Advanced Baseline Imager (ABI)
- A number of cases from the Advanced Himawari Imager (AHI) are included
- New webapps focus on understanding RGB creation
- Webapps are incorporated into proposed training course content and upcoming fact sheets

# SatRGB Web Application

The screenshot displays the 'First Light AHI Satellite RGB Webapp' interface. The main heading is 'First Light AHI Satellite RGB Webapp' with a sub-note: 'Please note that all the applets on these pages use HTML5 and require an up-to-date browser! These are also "touch-friendly" and should run on mobile devices.' Below this, the text reads 'Combine images from JMA's AHI to make an RGB'. A grid of 12 satellite images is shown, each with a title and date: Maysak (30MAR2015), Cyclone (13APR2015), Guam (21APR2015), S. Australia (21APR2015), Alaska (21APR2015), Hawaii (21APR2015), American Samoa (21APR2015), Russia (21APR2015), Japan (21APR2015), Southern Hemisphere (25JAN2015), Russia (25JAN2015), and Japan (25JAN2015). On the left side, there are logos for 'THE UNIVERSITY OF WISCONSIN MADISON', 'CIMSS', and 'SSEC'. An inset window titled 'Combine Three Images into One Red-Green-Blue (AHI) Image' is overlaid on the right, showing a detailed view of a cyclone image. This inset window includes a 'Select Images' section with three color-coded channels (Red, Green, Blue) and their corresponding wavelengths (6.2 μm, 8.5 μm, 6.5 μm). It also features 'Set Scale Factor' controls, 'Invert Image' buttons for each channel, and a 'Combine Channels' button. A black arrow points from the 'Cyclone (13APR2015)' image in the main grid to the inset window.

[http://cimss.ssec.wisc.edu/goes/webapps/satrgb/overview\\_ahi.html](http://cimss.ssec.wisc.edu/goes/webapps/satrgb/overview_ahi.html)



# Imagery, products available to HFO

Aviation desk forecaster Leigh Anne Eaton uses geo and polar satellite imagery

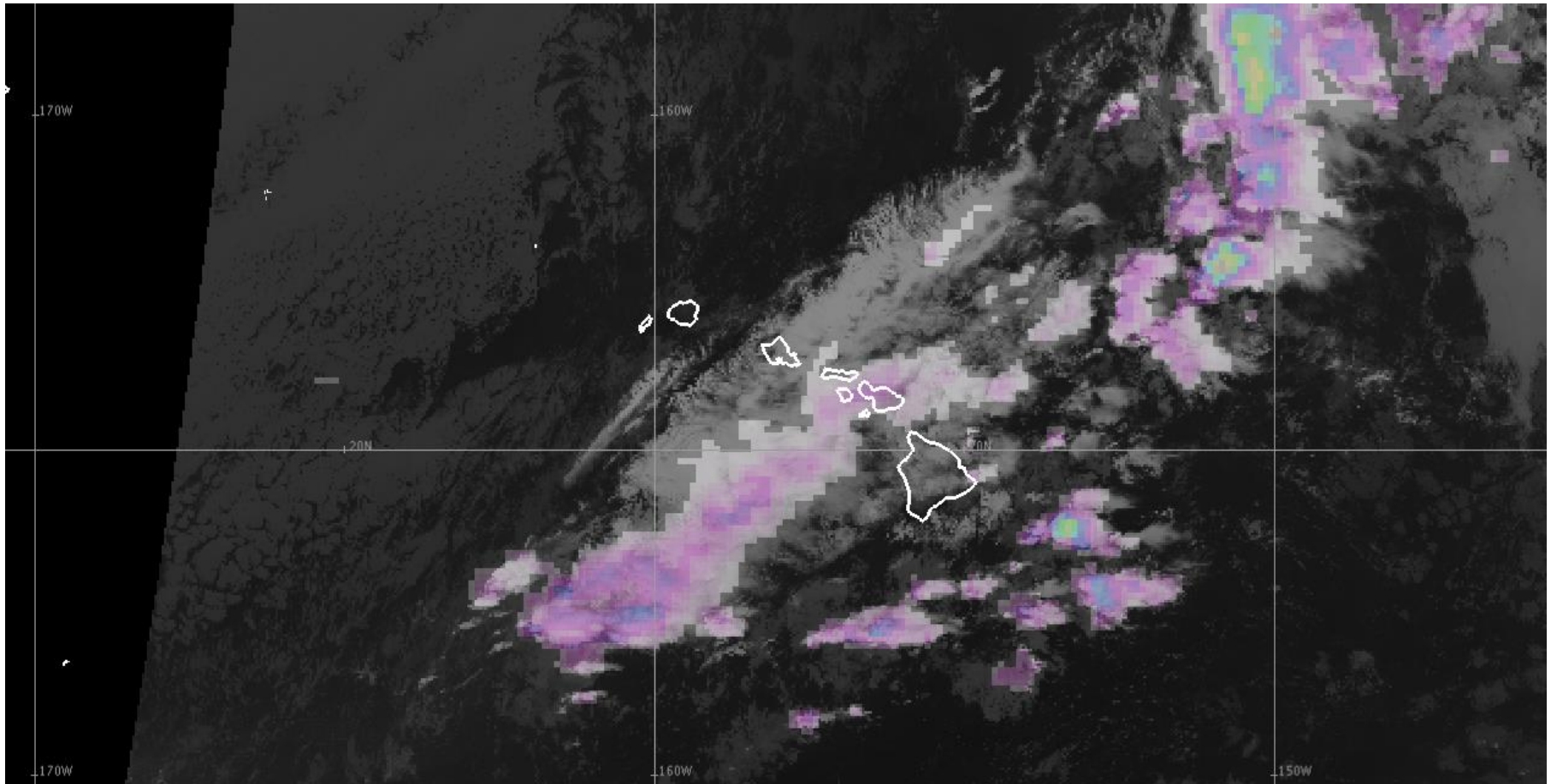


# Imagery, products available to HFO

- VIIRS EDR
  - I1, I2, I3, I4, I5
  - M1, M4, M9, M14, M15, M16
  - NCC
  
- ATMS
  - 90 GHz
  - Rain Rate (MIRS)

Right: SOO Bob Ballard





28 February 2015 11:49 UTC

Example of NPP-ATMS Rain Rate and 11.0  $\mu\text{m}$  IR Window in AWIPS II

# Imagery, products available to HFO

- MODIS Imagery

- Bands 1, 2, 7, 20, 26, 27, 31

- MODIS Products

- Cloud Top Temperature (CTT)

- Fog Difference

- Land Surface Temperature (LST)

- Normalized Difference Vegetation Index (NDVI)

- Sea Surface Temperature (SST)

- Total Precipitable Water (TPW)



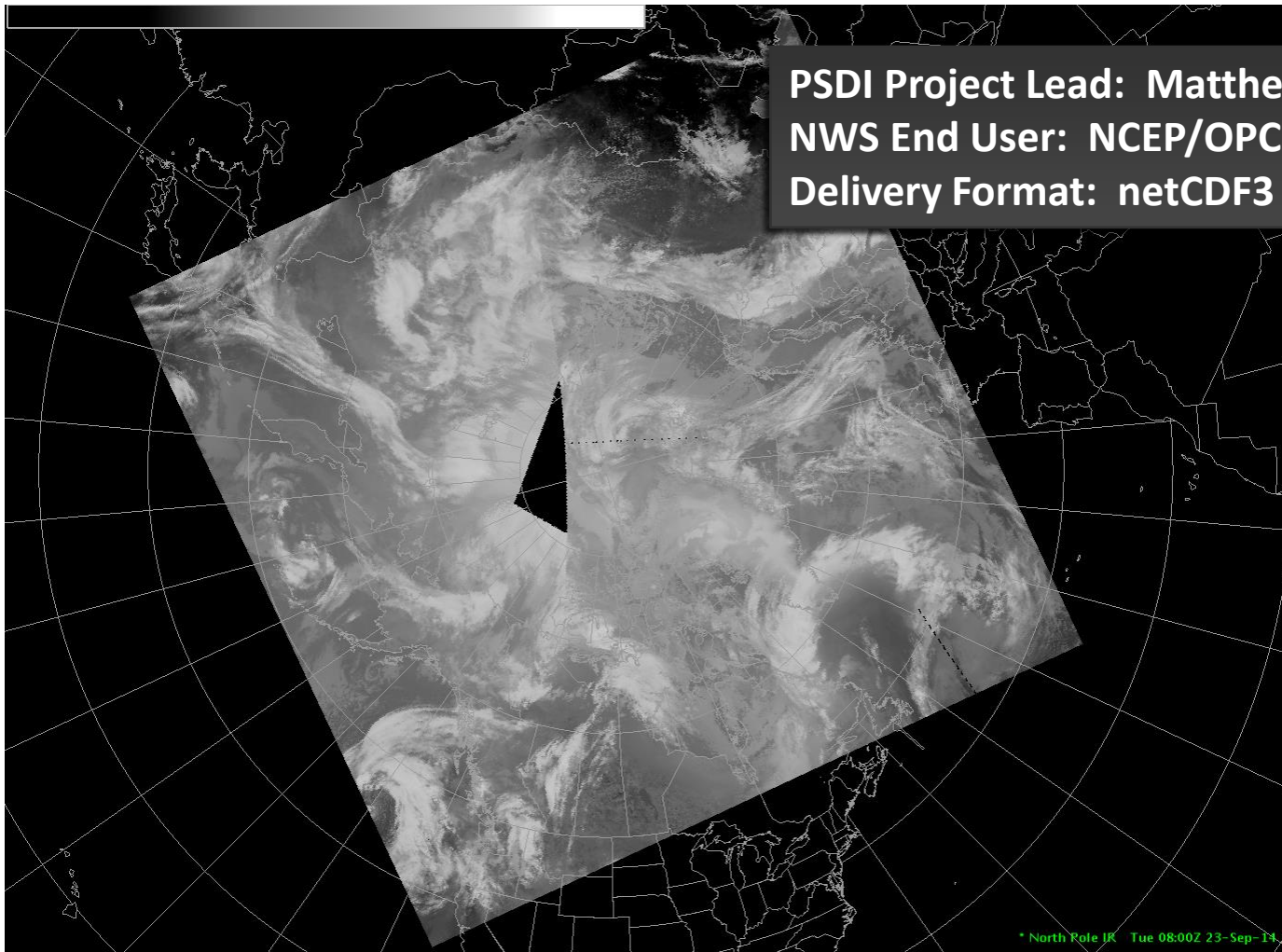
# VIIRS candidate products for HFO

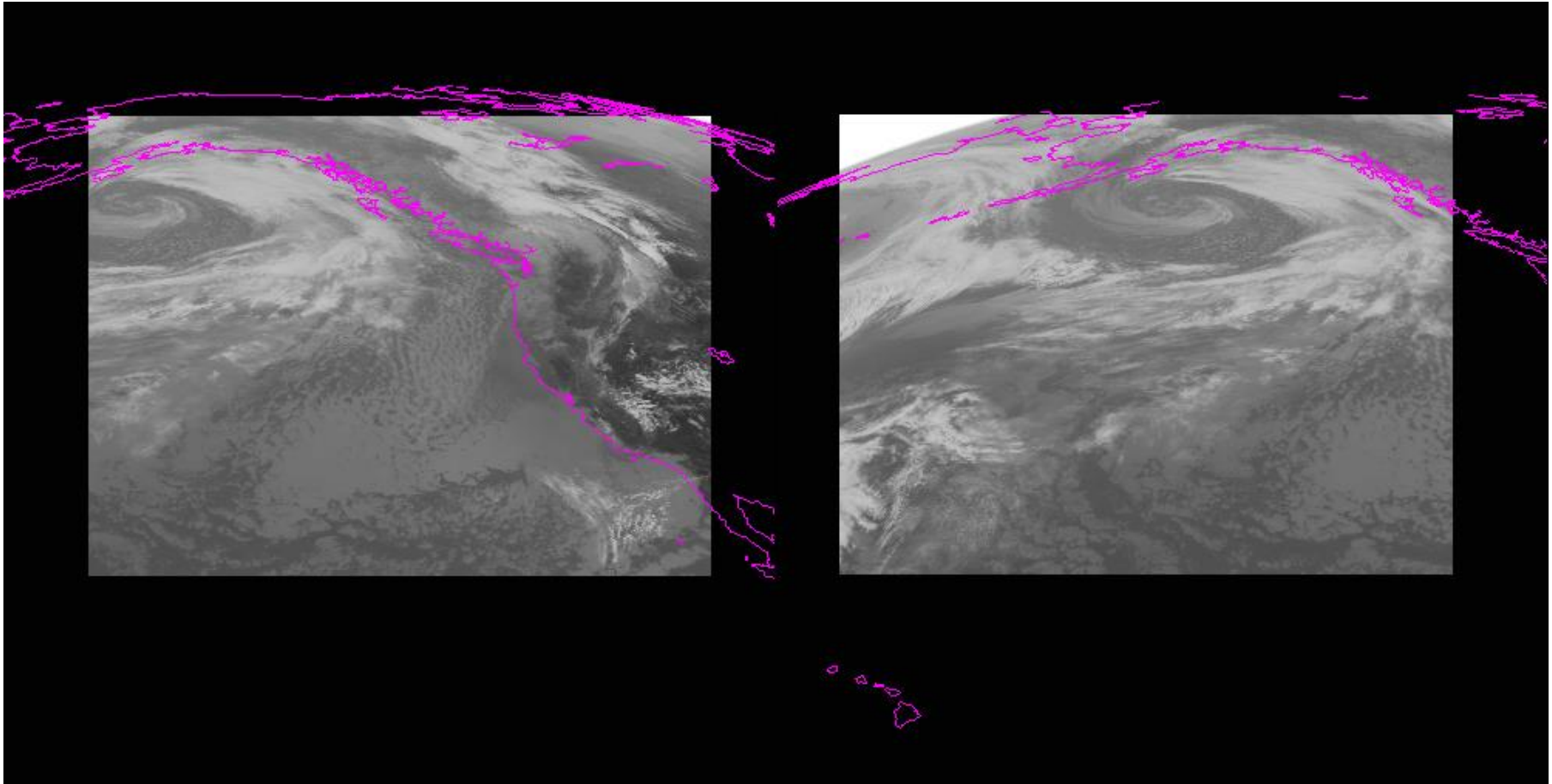
- VIIRS Active Fires
- VIIRS Aerosol Optical Thickness
- VIIRS Suspended Matter
- VIIRS Sea Surface Temperatures
- VIIRS Normalized Difference Vegetation Index
- VIIRS Enhanced Vegetation Index
- VIIRS Land Surface Temperatures

# Contributions are not OCONUS only

- Delivered several enhancements to the AWIPS II baseline code, including:
  - additional true color capabilities for satellite and gridded data,
  - code to add satellite source and configurability to satellite legends,
  - code to capture frames with date and time in the filename,
  - code to make warning polygon outline settable in bundle file, and
  - code to ingest Lambert Conformal projections with two standard parallels using the “regionalsat” decoder

# Arctic Satellite Composite Project





# Recommendations for OCONUS

During Hurricane Iselle, we realized that OCONUS RSO sectors were unavailable

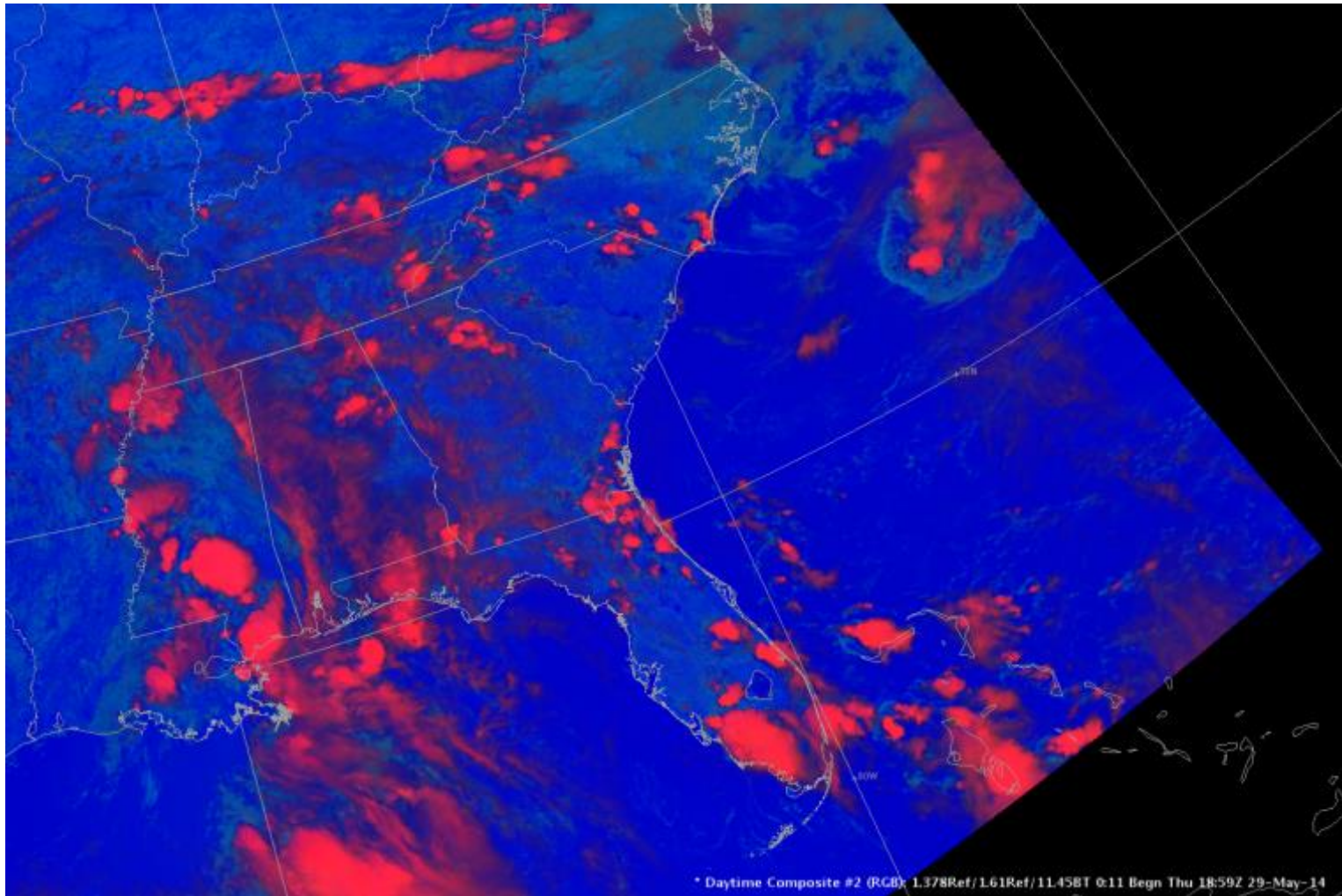


# Recommendations for OCONUS

- Advocate for northern hemisphere scan strategy from current GOES in case of satellite anomaly
  - New sector for the GOES-R era?
- Implement procedures for field offices to test and request GOES rapid scan operations for OCONUS sectors
- Create RGBs with AWIPS II directly, based on individual bands, instead of delivering pre-made, eight-bit RGBs

# VIIRS Daytime Composite #2

(1.378  $\mu\text{m}$ , 1.61  $\mu\text{m}$ , 11.45  $\mu\text{m}$ )



# Recommendations for OCONUS

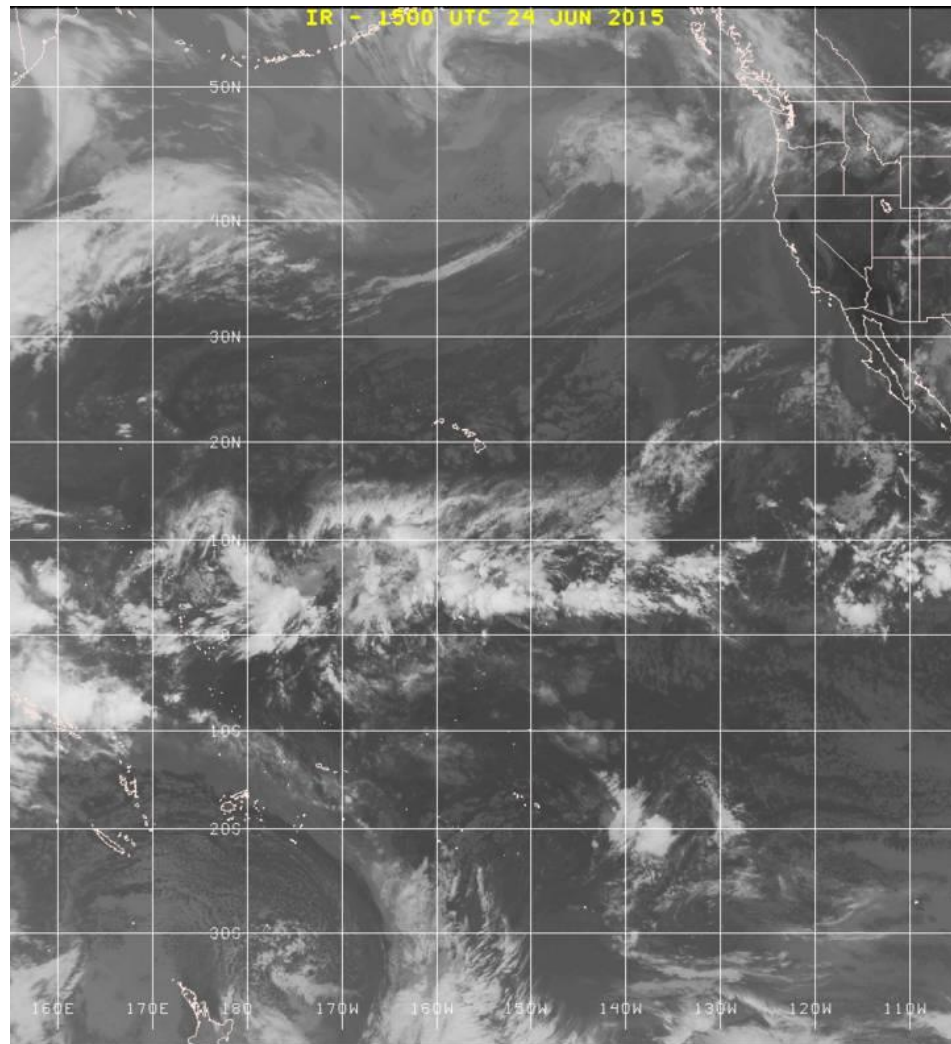
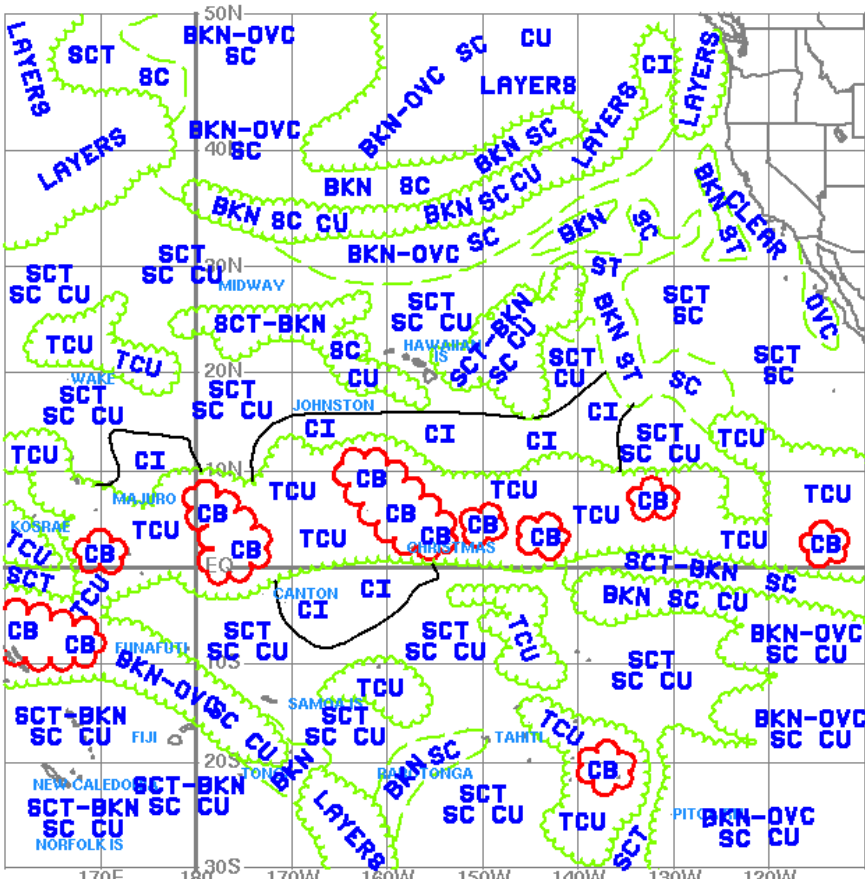
- Install central server for processing Himawari files and creating imagery and products for AWIPS
- Develop plan for how imagery from KMA's Geo-KOMPSAT 2A AMI can support NWS operations in the Western Pacific
- Maintain dedicated funding to support network of satellite data receiving stations as well as satellite-related meteorological research and development focused on OCONUS challenges

# Visiting Scientist Program

- Targets scientists with legitimate interest in working with NWS operations in the Central Pacific and establishing a long-term relationship
- High priority given to scientists seeking to demonstrate baseline products, or new risk reduction products that solve tropical or subtropical forecast challenges or reduce workload
- Scientists spend a week or more in Honolulu working alongside forecasters



# Significant Cloud Features



**KVM-70 SIGNIFICANT CLOUD FEATURES: JUN 24 2015 15 UTC**

U.S. Dept. of Commerce/NOAA/National Weather Service Honolulu, Hawaii



# Questions? Comments?

- [Jordan.Gerth@noaa.gov](mailto:Jordan.Gerth@noaa.gov)
- Thoughts to keep in mind:
  - Consistency and reliability
    - Ken Rizzo, former Meteorologist-In-Charge
  - “Be good at the things that don’t take talent.”
    - Bo Ryan aphorism
- Join us in Honolulu!
  - 2016 OCONUS Satellite Proving Ground Technical Interchange Meeting