

# Increased Satellite Reception and Utilization Capabilities in NWS Pacific Region

Satellite Testbeds and Proving Ground Activities

12<sup>th</sup> Annual Symposium on New Gen Operational Environmental Satellite Systems

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**Jordan J. Gerth**

Assistant Researcher, Liaison to NWS Pacific Region  
Cooperative Institute for Meteorological Satellite Studies  
University of Wisconsin at Madison

**Bill D. Ward**

Environmental and Scientific Services Division Chief  
National Weather Service Pacific Region Headquarters

**Eric K. Lau**

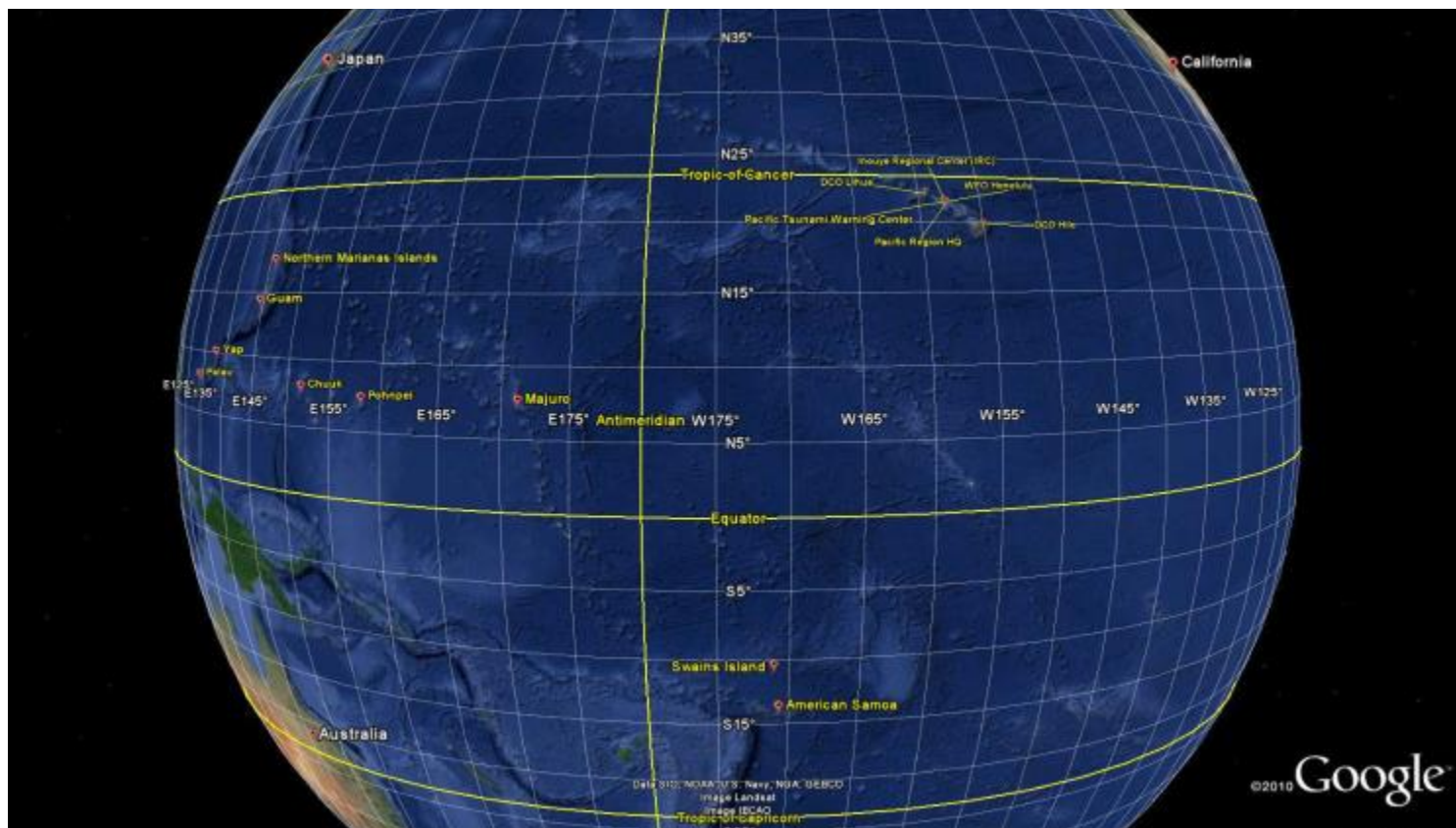
Environmental and Scientific Services Meteorologist  
National Weather Service Pacific Region Headquarters

Includes contributions from colleagues

# 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

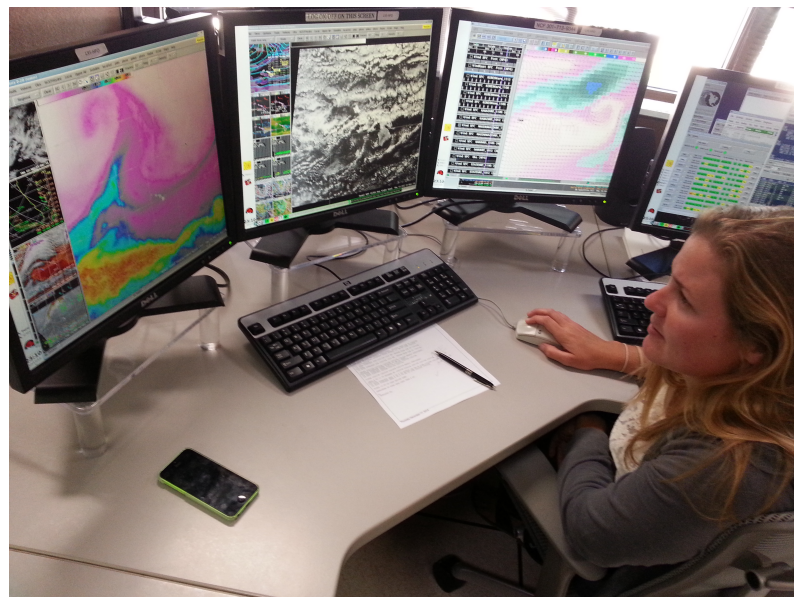
# NWS Pacific Region



Credit: Eric Lau

# Satellite Proving Ground

- The goal of the satellite proving ground is ultimately to achieve widespread readiness amongst field forecasters through early exposure to prospective capabilities, imagery, and products.



# Satellite Proving Ground

- The proving ground also assures that these new capabilities, imagery, and products meet the long-term needs of the field in confronting forecast challenges, and
- that technical systems that provide satellite data to the field are adequate in enabling forecasters to sufficiently interrogate the imagery and products as part of their forecast and analysis decisions.

# Keys to Success

- Improved direct broadcast and rebroadcast capabilities
- Leverage Himawari imager as much as possible to provide regionally relevant examples in preparation for GOES-R Advanced Baseline Imager (ABI)
- Emphasize baseline and under-demonstrated products
- Redundant delivery paths and formats
  - Pacific Region: Where “big data” meets “big region”

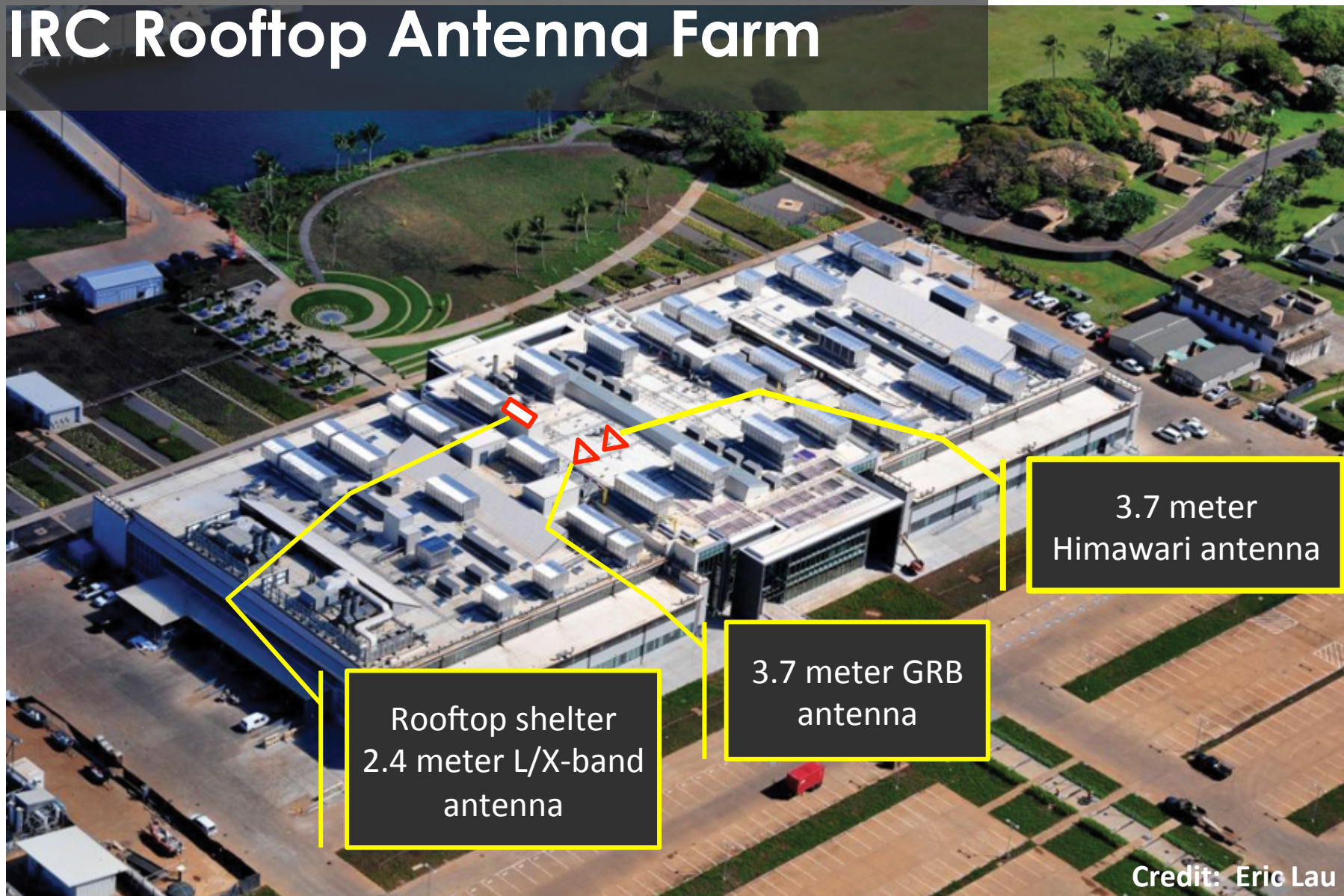
# Infrastructure to Support

- Terrestrial bandwidth upgrade
- New HimawariCast antennas in Hawaii and Guam
- New L/X-band antenna in Hawaii
- GOES-R GRB antenna in Hawaii
  - Installation in February 2016
- L/X-band antenna in Guam
  - Installation in summer 2016
- New satellite processing server



Photo credit: Liam Gumley

# IRC Rooftop Antenna Farm



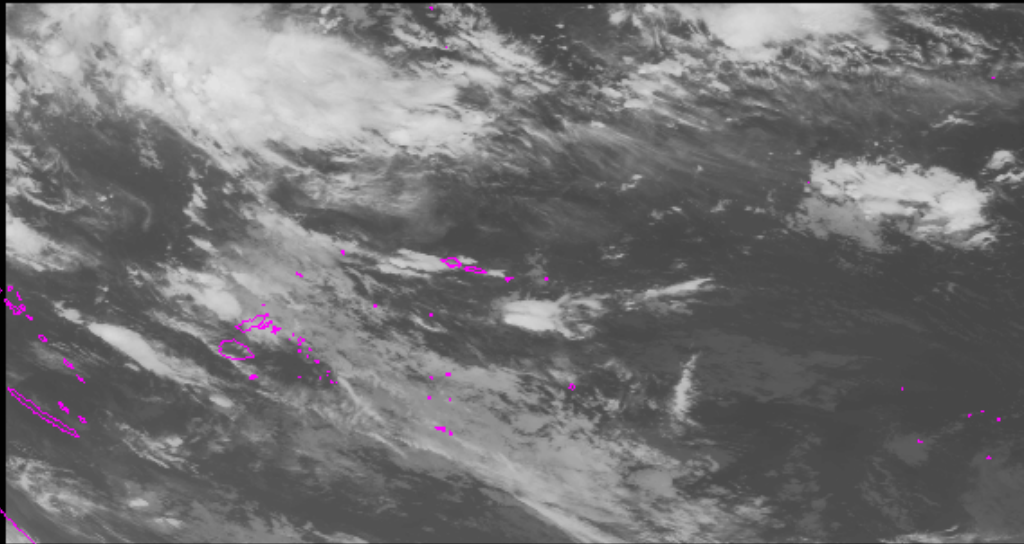


# Honolulu Community College

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

# Demonstrations to Date

- VIIRS Environmental Data Records (EDRs)
- Select bands and products from the Advanced Technology Microwave Sounder (ATMS)
- MODIS imagery and products
- Rainfall rate and quantitative precipitation estimate
- CIRA Orographic Rainfall Index (ORI)
- Rapid scan operations for OCONUS sectors



# New American Samoa Rapid Scan Sector

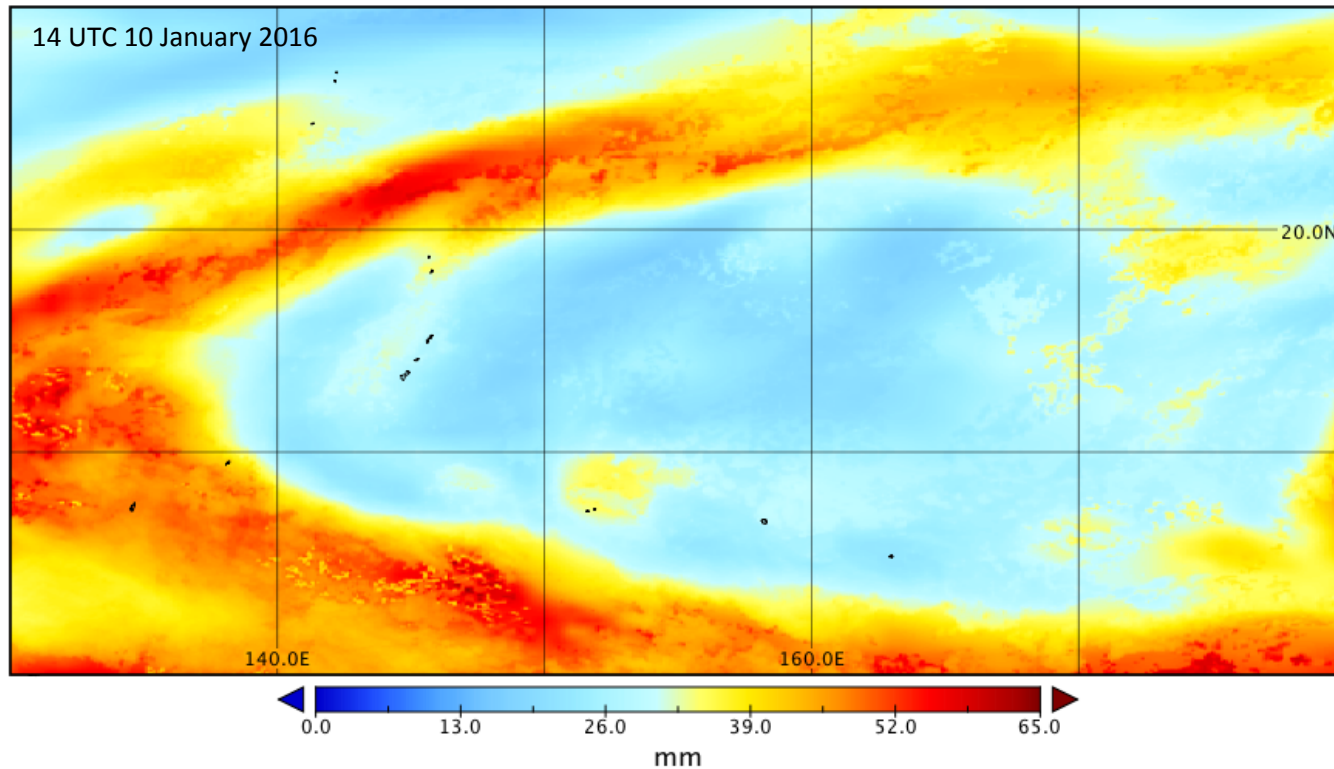
Tested on 15 December 2015

Two other previous GOES-15 rapid scan sectors re-implemented for Alaska earlier

# Upcoming Product Demonstrations

- From geostationary imagers
  - Products that improve aviation services, such as
    - Tropopause folding detection
    - Total precipitable water
    - Cloud layers and heights
    - Enhanced “V” and overshooting top detection
  
- From microwave sounders
  - Precipitation rate
  - Sea surface temperature

## Total Precipitable Water

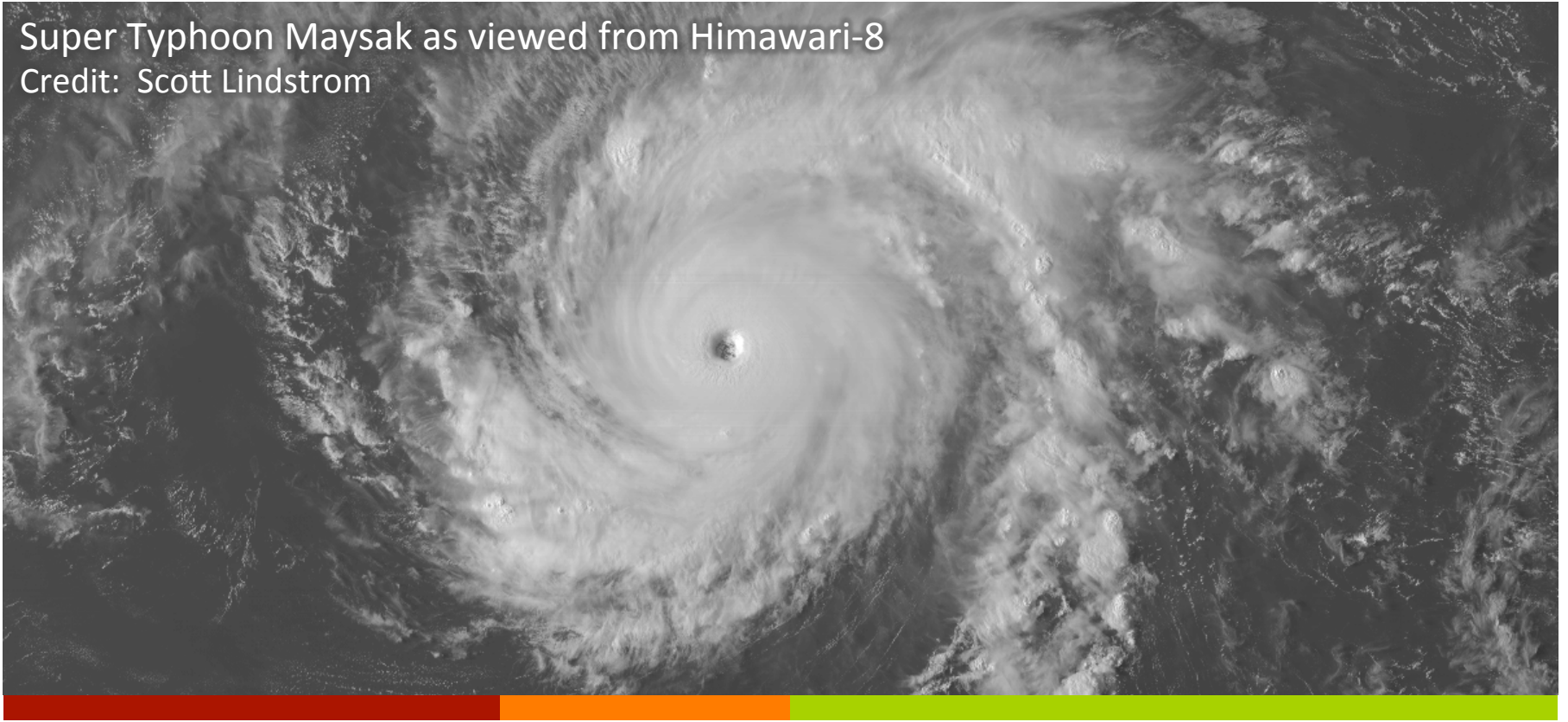


# All Weather Total Precipitable Water from Himawari

For more information: **8.1 Real Time All-weather Precipitable Water Product Development from Geostationary Infrared Radiances and Applications in Weather Forecasts**, Thursday, 14 January 2016: 8:30 AM, Room 245

Jun Li, CIMSS/Univ. of Wisconsin, Madison, WI; and J. Gerth, Z. Li, Y. K. Lee, T. J. Schmit, and S. Bachmeier

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/Foundation

General

Specialized



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

# Instructor-led Himawari Training

- Three instructors on-site with four, four-hour learning blocks over two days (course run twice in one week)
- Approximately 25% lecture, 75% interactive labs
- For Guam, training focused on:
  - Introduction to the AHI and remote sensing concepts
  - Band composites and Red-Green-Blue (RGB) composites
  - Satellite applications for aviation forecasting
  - Identifying weather systems and meteorological features
  - Tropical cyclones
- Course delivered in November 2015, with a mini workshop in Hawaii in December 2015



# HFO Meteorologist Training



Photo credit: Jay Breidenbach

# Web Applications as Learning Tools

- CIMSS hosts web applications (“webapps”) to assist users with learning about the spatial, spectral, and temporal improvements of the ABI, as well as image composites (e.g., RGBs)
  - The use of “webapps” is incorporated into new training course content
  - A number of cases from the Advanced Himawari Imager (AHI) are included
  - Work with modern browsers and usable on newer mobile devices (smartphones, tablets, etc.)



# SatRGB Web Application

The screenshot displays the 'First Light AHI Satellite RGB Webapp' interface. The main heading is 'Combine images from JMA's AHI to make an RGB'. Below this, a grid of 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)
- Japan (25JAN2015)

An inset window titled 'Combine Three Images into One Red-Green-Blue (AHI) Image' is shown on the right. It features a large satellite image of a cyclone and a control panel with the following options:

- Select images: 0.66  $\mu\text{m}$  (red), 0.86  $\mu\text{m}$  (green), 0.63  $\mu\text{m}$  (blue)
- Set Scale Factor: 1.0, 1.0, 1.0
- Invert Image (for each channel)
- Buttons: Invert Image, Combine Channels, Show overlay

Logos for The University of Wisconsin-Madison, CIMSS, and SSEC are visible on the left side of the main interface.

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

# ABI and AHI Band Fact Sheets



## GOES-R ABI Fact Sheet

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 a combination of high spatial resolution numerical model runs and advanced "forward" 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 AHI Band 1, Suomi NPP VIIRS Band M2

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

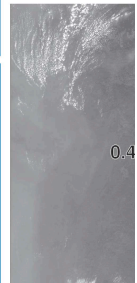
**Nickname:**  
"Blue" visible band

**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. In addition to this band, there are a number of other visible bands. Measurements of cloud optical depth and tracking. This blue band is used in combination with other bands and/or "natural color" imagery to provide estimates of visibility. The blue band is used to improve numerous product (e.g., fog, visibility, and surface products). Other products are essential for a natural color imagery.



Suomi NPP images of a similar blue band. (Credit: CIMSS)

**Did You Know?** The blue band is available every minute. The second full disk scan every 5 minutes.

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



## 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 satellite of the Japan Meteorological Agency, Himawari-8, was successfully launched on October 7, 2014 from the Tanegashima Space Center in Kagoshima, Japan. Photo and caption source: 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

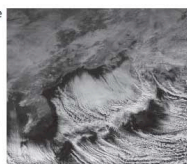
**Nickname:**  
"Green" visible band

**Availability:**  
Daytime only

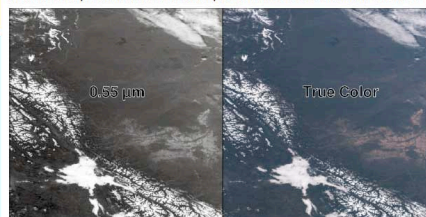
**Primary purpose:**  
Solar insolation estimates

**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.



"True color" AHI image (Band 2, 0.51  $\mu\text{m}$ ) from 02:40 UTC on December 18, 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.

**Did You Know?**

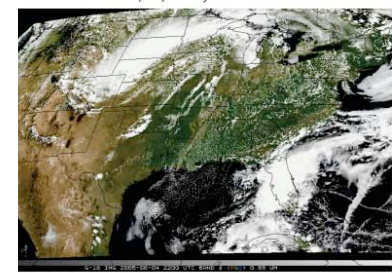
Unlike the AHI, there is no green band on the GOES-R series ABI. Hence, this band will be approximated from other spectral bands for use in generating true color imagery. In the case of the ABI, this approach will be a look-up table using the blue (0.47  $\mu\text{m}$ ), red (0.64  $\mu\text{m}$ ) and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



## GOES-R ABI Fact Sheet Band 2 ("Red" visible)

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

The 0.64  $\mu\text{m}$ , or "red" band, is used for the 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, canic ash, hurricane analysis, and winter storm analysis. A similar band on the ES imager has demonstrated many of these applications, although the ABI approved spatial and temporal resolutions. This band is essential for a natural color imagery. 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 Hillger.

**Did You Know?**

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 a geostationary orbit and the first image of Earth and the moon together.



<http://www.goes-r.gov/>

# Visiting Scientist Program

- The program targets scientists with legitimate interest in working with the NWS in the Central Pacific and establishing a long-term relationship.
  - Scientists travel to Honolulu to work alongside forecasters.
  
- High priority is given to scientists developing and seeking to demonstrate baseline products, or new risk reduction products that solve tropical or subtropical forecast challenges or reduce workload.
  - Decrease stovepipes

# Final Thoughts

- In the United States, NWS Pacific Region is on the frontier of new generation weather satellites and leading the forecaster training effort and technical implementation out of necessity.
- We can continue to improve how we tailor imagery and develop research products to support the NWS operational weather mission through the proving ground and visiting scientist program.
- Managing “big data” is about confining and conveying when, where, and how to users.

# Tropical Cyclone Ula

**Questions?  
Comments?**

**Jordan Gerth**

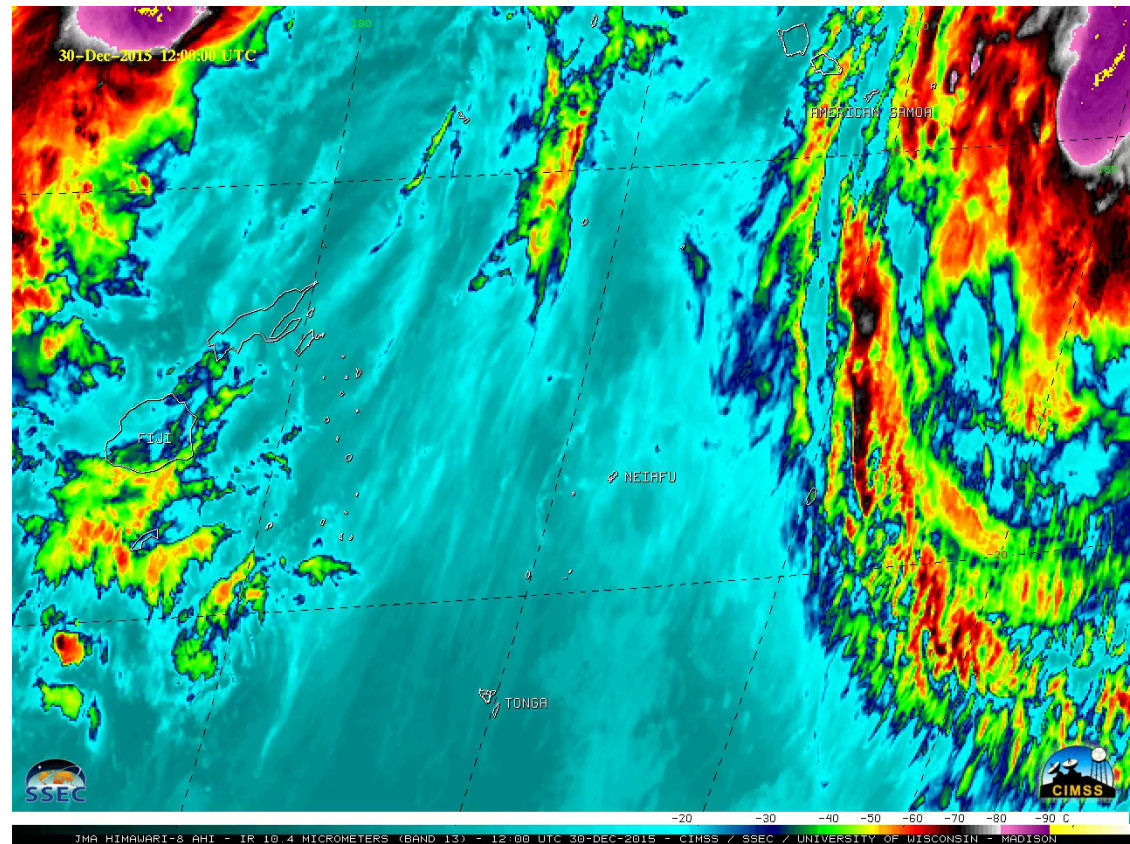
[Jordan.Gerth@noaa.gov](mailto:Jordan.Gerth@noaa.gov)

**Bill Ward**

[Bill.Ward@noaa.gov](mailto:Bill.Ward@noaa.gov)

**Eric Lau**

[Eric.Lau@noaa.gov](mailto:Eric.Lau@noaa.gov)



Animation credit: Scott Bachmeier