

# The Himawari training program for NWS Pacific Region meteorologists

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# Training Paradigm

**Foundation**

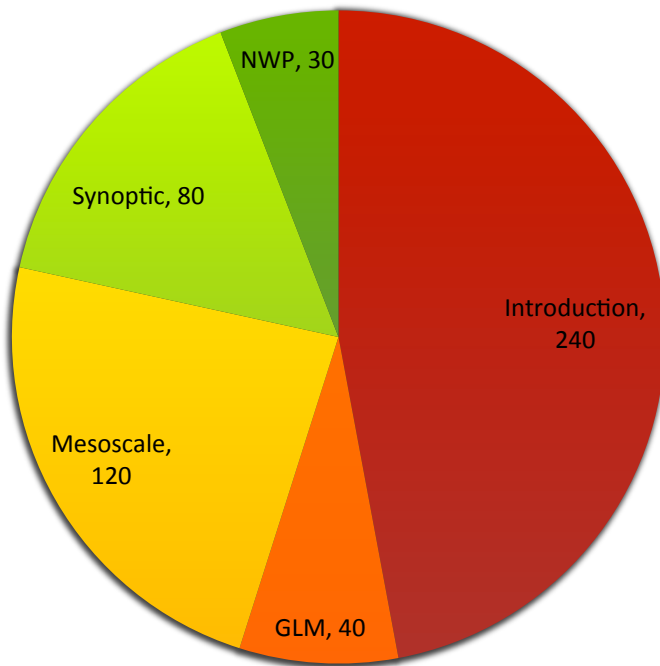
**General**

**Specialized**



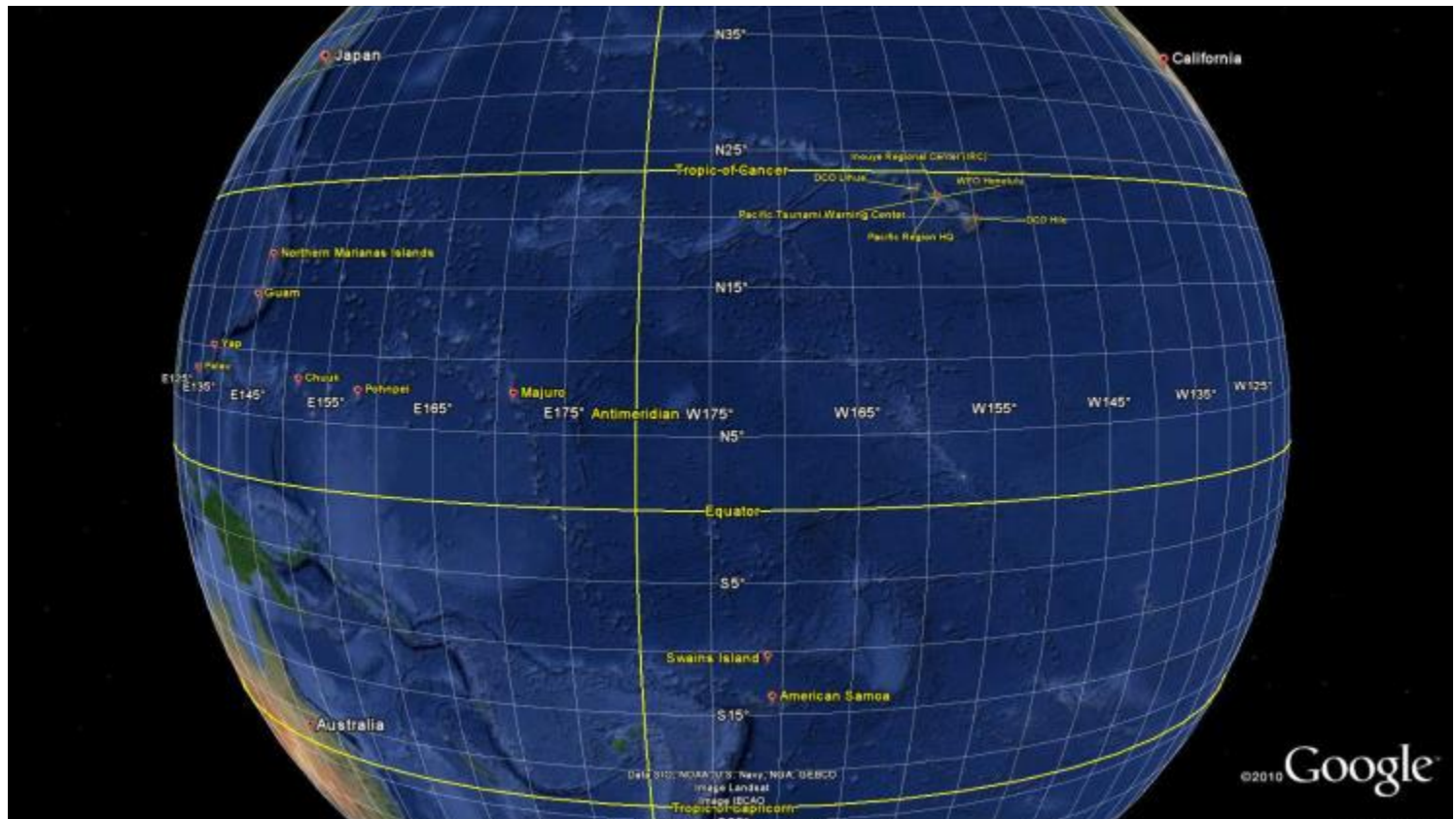


# Proposed Foundational Training for all NWS (US NMHS) meteorologists



- GOES-R Introduction and SatMet Background Track (240 minutes)
- Geostationary Lightning Mapper Track (40 minutes)
- Mesoscale/Convection Track (120 minutes)
- Synoptic Features Track (80 minutes)
- Numerical Weather Prediction and Data Assimilation Track (30 minutes)

# NWS Pacific Region



Credit: Eric Lau

# Special Training for Guam

- Himawari-8 is now operational
  - National GOES-R training program not yet ready
- Opportunity to train forecasters at NWS Guam on how to use ABI-like imagery before the rest of the NWS forecasters
- NWS sponsored the development of special training for Guam to assure “day one” readiness
  - Special training may be necessary for other OCONUS sites
- Elements of this training will filter into national training program for GOES-R



# Heritage of Training Workshops

- CIMSS previously developed software for visualizing multi-spectral imagery from polar-orbiting satellites
  - HYDRA
- Scientists from CIMSS travel to locations around the world to offer in-person training on meteorological satellite imagery to a variety of interested audiences
- The NWS has favored remote workshops in recent years due to easier logistics and decreased costs

# Training Challenge

- Develop a training course/workshop that
  - Lasts only a few days
  - Focuses on the “need to know” information
  - Ensures participants are ready to apply knowledge to operations, and continue learning
  - Incorporates lab sessions that encourage participants to interact with each other and interrogate the imagery
- Establish “day one” readiness

# Training Concept

- Bring instructors to train forecasters in their workplace
- Segment two-day workshop into 3 to 4 hour sections
- Regionally-relevant examples and lab activities
- Healthy ratio of hands-on interactivity to lectures
- Teach the meteorologists what the bands are *capable* of sensing; let the meteorologists learn what the bands *are* sensing
  - Develop expertise



# Leverage Community Resources

- Training materials and presentations that the JMA, Australian BOM, EUMETSAT, COMET, and others have already developed are suitable and relevant
  - Instructors reviewed existing body of training prior to developing content for the new course
- Apply existing resources, update with local examples, then fill any gaps
- Plan to share with the international community
- Contribute to broader US NWS training program

# Satellite-Related Training Topics

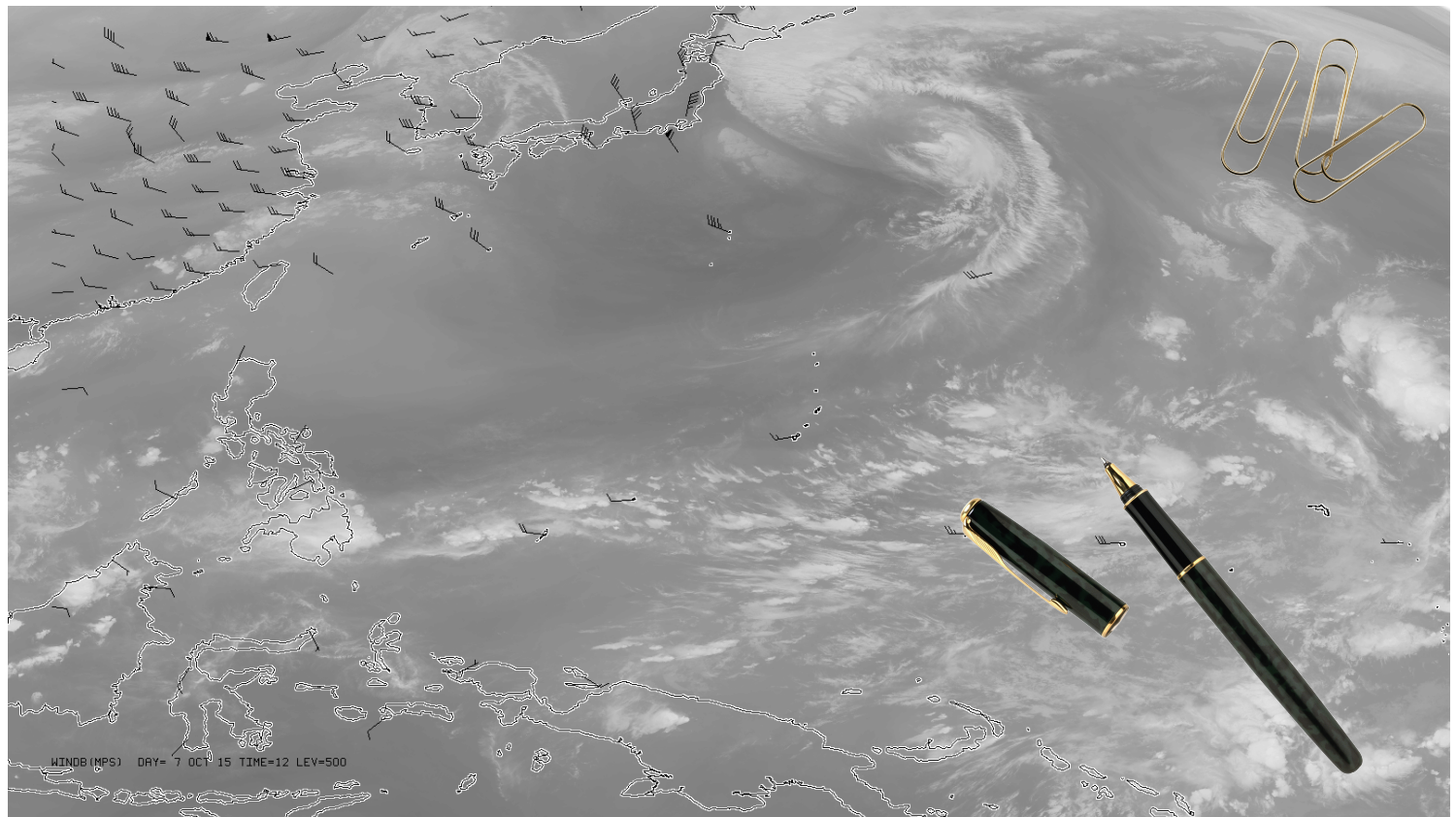
- Introduction to the new spectral bands
- Weighting functions and their relationship to vertical position of tropospheric features, particularly for the water vapor channels
- Visualization approaches for multi-spectral imagery (RGBs, band differences)
- Evolutionary considerations for the operational forecaster (spatial and temporal resolution)

# Meteorological Considerations

- Identifying air masses and features
  - Mesoscale and synoptic
- Aviation meteorology
  - Cloud phase (convection, icing, etc.)
  - Sulfur dioxide and volcanic ash
- Tropical meteorology
  - Typhoons
  - Extratropical transitions
  - Sea surface temperature



# Capstone Contouring Exercise



# Training Software: SIFT

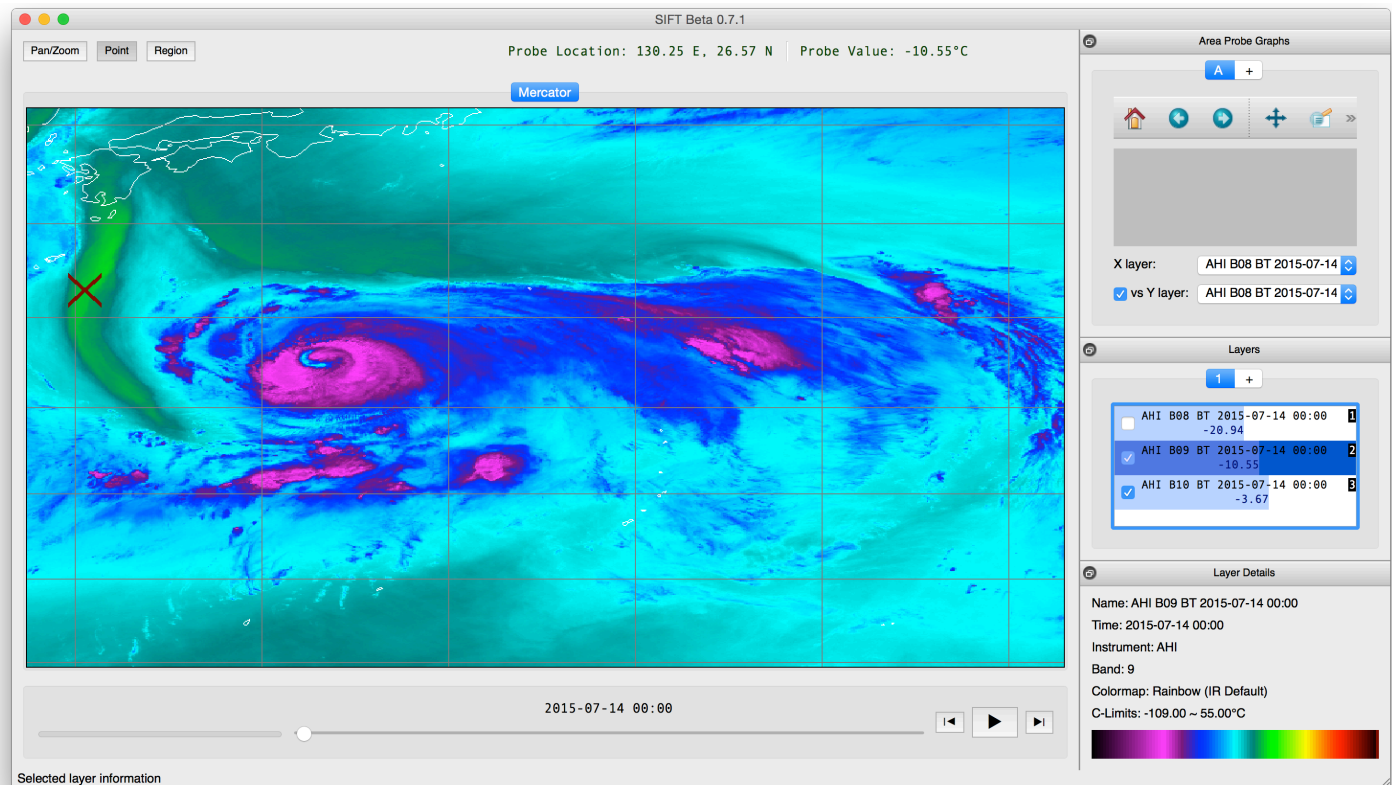
- Satellite Information Familiarization Tool
- Designed to run on mid-range consumer grade computers and notebooks
  - Windows and Mac
- Built with Python and PyCharm
  - Numerous open source packages: Numpy, Matplotlib, SciPy, Numba, PyProj, VisPy, PyOpenGL, NetCDF4, H5Py, Pillow, PyShp, Shapely, Rasterio, GDAL
- Supports Mercator projection only (current pre-release)
- Reads GeoTIFFs (current pre-release)

# Main SIFT Features

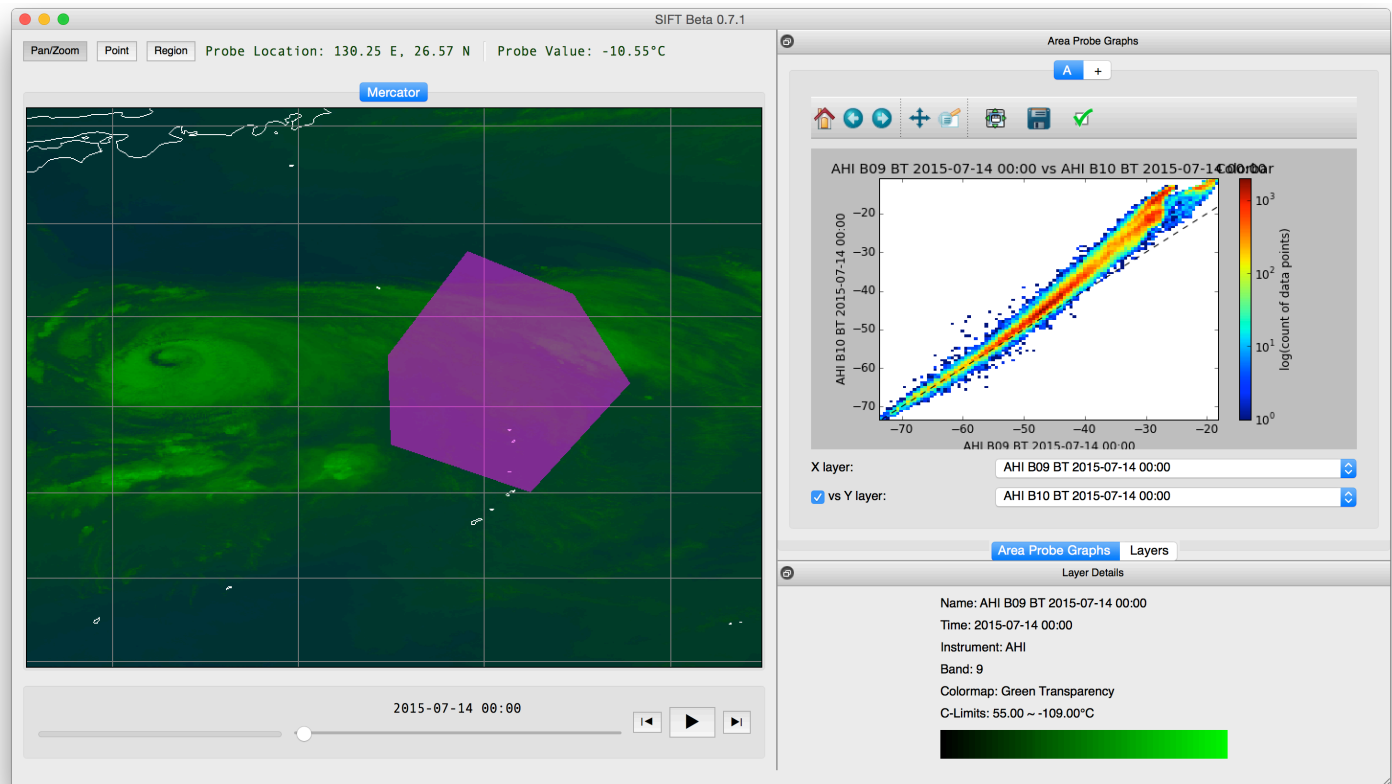
- Loop through multiple bands for a single time, or multiple times for a single band
- Change color enhancement by band
  - Transparent gradients are available
- Seamless panning and zooming across entire full disk, even while looping
- Probe a point to determine reflectance or brightness temperature for all loaded bands
- Create histograms (single band) and density maps (two bands) based on user-defined polygon



# SIFT Example



# SIFT Example



# Future of SIFT

- Many prospective features
  - Possibility to make source code available for community development
- Unique opportunity to reach international community with visualization and data interrogation software for meteorological satellite imagery
  - Plan to support other advanced imagers
- Software could scale to work on tablets and potentially other mobile devices if data is available from a central repository

# Web Applications as Learning Tools

- CIMSS hosts web applications (“webapps”) to assist learning about the spatial, spectral, and temporal improvements of the Advanced Baseline Imager (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.)



<http://cimss.ssec.wisc.edu/education/goesr/>

# SatRGB Web Application

The screenshot displays the 'First Light AHI Satellite RGB Webapp' interface. The browser address bar shows the URL: [cimss.ssec.wisc.edu/goes/webapps/satrgb/overview\\_ahi.html](http://cimss.ssec.wisc.edu/goes/webapps/satrgb/overview_ahi.html). The page title is 'First Light AHI Satellite RGB Webapp'. A note states: '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.'

The main heading is 'Combine images from JMA's AHI to make an RGB'. Below this, a grid of satellite images is displayed, each labeled with a location 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)

A black arrow points from the 'Cyclone (13APR2015)' image to a larger, detailed view of a combined RGB image. This detailed view is titled 'Combine Three Images into One Red-Green-Blue (AHI) Image'. It shows a large, swirling storm system. Below the image, there are controls for selecting images, setting scale factors, and inverting images. The controls include a 'Select images' section with three color-coded buttons (red, green, blue) and a 'Set Scale Factor' section with three input fields. There are also checkboxes for 'Invert Image' and a 'Combine Channels' button. A 'Show overlay' checkbox is also present.

[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 Band 1

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)

The 0.47  $\mu\text{m}$ , or "blue" band, is used for monitoring aerosols. There are a number of uses for this band. Measurements of clouds. Measurements of and tracking. This blue band from other bands and/or natural color" imagery of estimates of visibility. The improve numerous product face products). Other products are essential for a natural "Weather Event Simulator (WES) Guide by CIMSS.



Suomi NPP images of similar blue band 1 in the 0.488  $\mu\text{m}$  band. (Credit: NASA)

### 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



every minute. The second full disk scan every 5 m



## 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

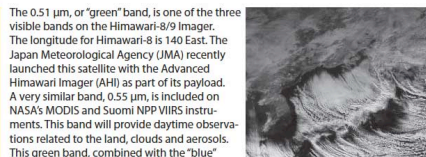
Not available on current GOES or with the GOES-R Series ABI

**Nickname:**  
"Green" visible band

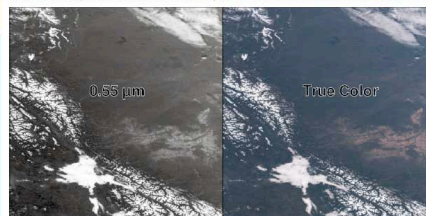
**Availability:**  
Daytime only

**Primary purpose:**  
Solar insolation estimates

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



"True light" AHI image Band 2 (0.52  $\mu\text{m}$ ) 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.



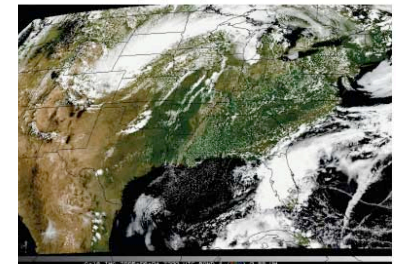
Unlike the AHI, there is no green band on the GOES-R Series ABI. Hence, this band will be approximated from other spectral bands for use in generating true color imagery. In the case of the ABI, this approach will be a look-up table using the blue (0.47  $\mu\text{m}$ ), red (0.64  $\mu\text{m}$ ) and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



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

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 ES imager has demonstrated many of these applications, although the ABI improved spatial and temporal resolutions. This band is essential for a natural "true 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 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.

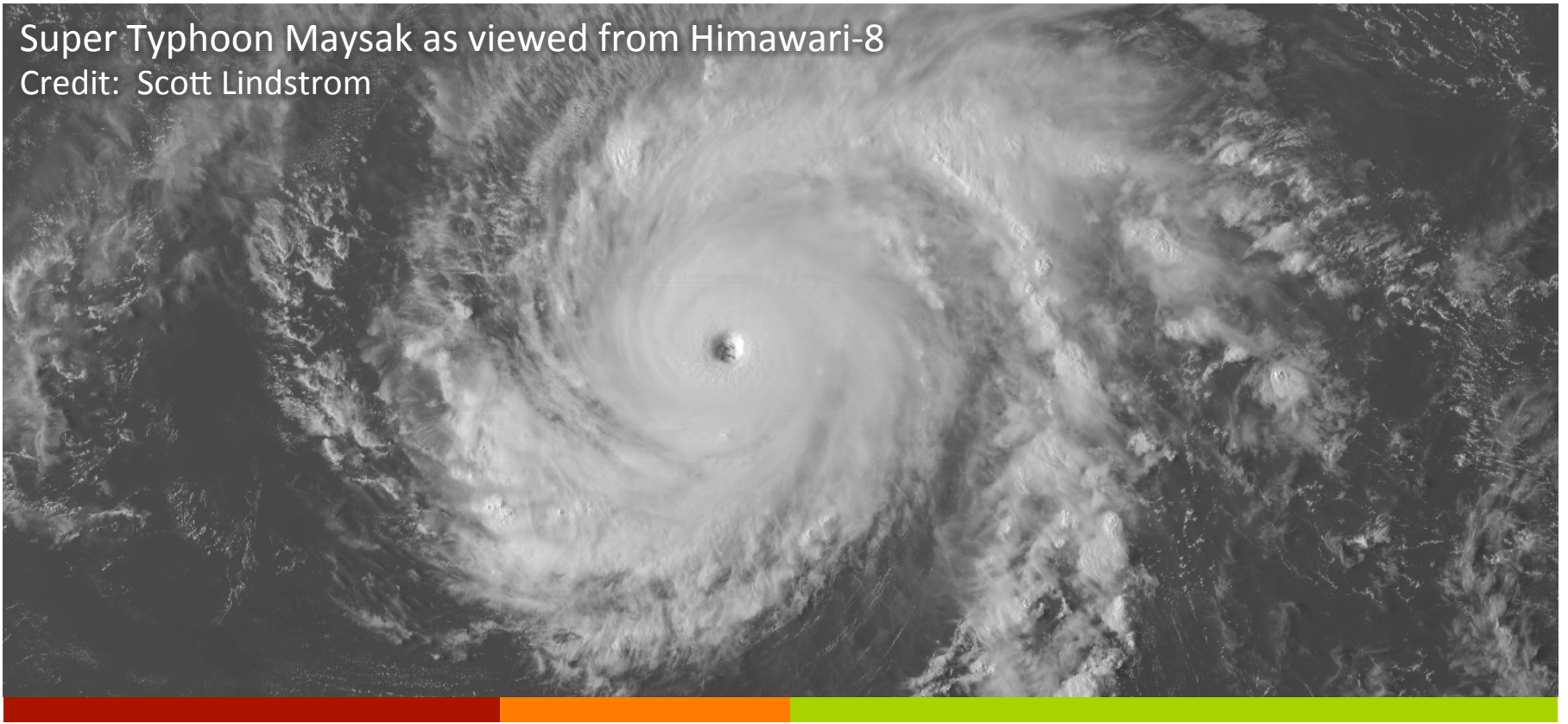


While many think that the visible band on the first geostationary imager on ATS-1 in December 1966 was a band centered at 0.64  $\mu\text{m}$ , the band on ATS-1 actually peaked at approximately 0.52  $\mu\text{m}$ . The approximate resolution for this sensor was 3 and 4 km. It was this imager that took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



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

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



Questions? Comments?

Send me an e-mail:

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# Foundational Training Plan

- GOES-R Introduction and SatMet Background Track (240 minutes)
  - Basic principles of radiation (15 minutes)
  - Basic operation of the GOES-R satellites (15 minutes)
  - Spectral bands (90 minutes)
  - Multi-channel interpretation approaches (30 minutes)
  - Baseline products (80 minutes)
- Geostationary Lightning Mapper Track (40 minutes)



# Foundational Training Plan

- Mesoscale/Convection Track (120 minutes)
  - Pre-convective environment
  - Features
  - Convective evolution
- Synoptic Features Track (80 minutes)
  - Cyclogenesis
  - Jet features and general circulation patterns
  - Atmospheric Rivers
  - Tropical to Extratropical Transition
- Numerical Weather Prediction and Data Assimilation Track (30 minutes)