

COMET Program Training Resources: Part of the Solution as User's Prepare to Embrace Environmental Satellite Advances

Wendy Schreiber-Abshire, Patrick Dills, Marianne Weingroff
UCAR's COMET Program



AMERICAN METEOROLOGICAL SOCIETY

10 - 14 JANUARY 2016 • 96TH ANNUAL MEETING

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This lesson provides information on climatology—what it is, the factors that create an area's climate, and the sources and uses of climate information. Focused specifically on tropical Pacific islands, the content covers the key features influencing climate...

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Introduction to Climatology for the Tropical Pacific Islands

This lesson provides information on climatology—what it is, the factors that create an area's climate, and the sources and uses of climate information. Focused specifically on tropical Pacific islands, the content covers the key features influencing climate...

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Geospatial: A new topic area on MetEd

Posted on: 2015-10-29

An Introduction to Geodetic Datums

Data with a geographic component, geospatial data, is integral to hydrology, meteorology, and many other scientific fields. COMET has been addressing geospatial related topics for several years through our publications on hydrography (see our distance learning course, Elements of Hydrography), navigation (see the lesson, Principles of Celestial Navigation), and...

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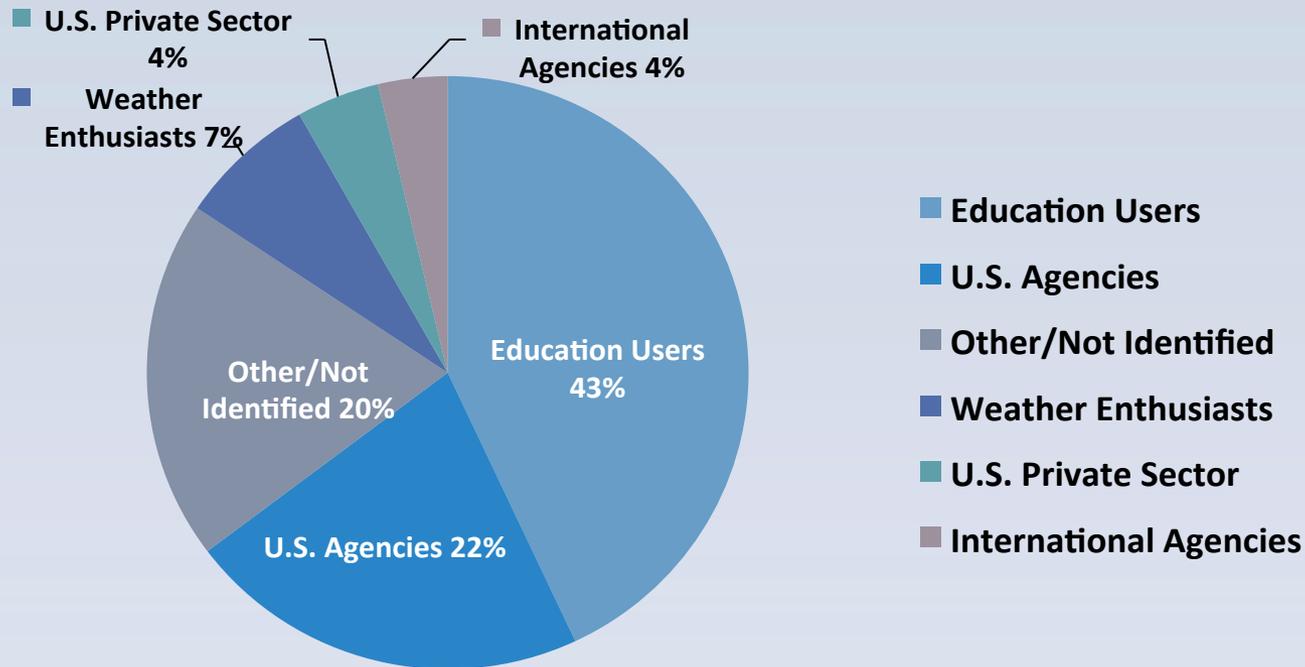
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GOES

S-NPP & JPSS

Multispectral Applications

GOES-R GLM:
Introduction to the Geostationary Lightning Mapper

GOES-R ABI:
Next Generation Satellite Imaging

GOES-R:
Benefits of Next-Generation Environmental Monitoring

Satellite Meteorology:
Introduction to Using the GOES Sounder

Satellite Meteorology:
GOES Channel Selection v2

The COMET® Program

Introduction to VIIRS Imagery and Applications

ADVANCES IN SPACE-BASED NIGHTTIME VISIBLE OBSERVATION

Produced by The COMET® Program

Suomi NPP:
A New Generation of Environmental Monitoring Satellites

IMAGING WITH VIIRS:
A CONVERGENCE OF TECHNOLOGY AND EXPERIENCE, 2nd Edition

Multispectral Satellite Applications:

RGB PRODUCTS

MULTISPECTRAL SATELLITE APPLICATIONS: MONITORING THE WILDLAND FIRE CYCLE 2ND ED.

MONITORING THE CLIMATE SYSTEM WITH SATELLITES

SATELLITE MONITORING OF ATMOSPHERIC COMPOSITION

ATMOSPHERIC DUST

PRODUCED BY THE COMET PROGRAM

MW Remote Sensing

Microwave Remote Sensing: Overview, 2nd Edition

Land and Ocean Surface Applications

Clouds, Precipitation, & Water Vapor

Microwave Resources

Polar Satellite Products for the Operational Forecaster: Microwave Analysis of Tropical Cyclones

Advances in Microwave Remote Sensing: Ocean Wind Speed and Direction

JASON 2: USING SATELLITE ALTIMETRY TO MONITOR THE OCEAN

© THE COMET PROGRAM

Atmospheric Sounding

ADVANCED SATELLITE SOUNDING:

Toward an Advanced Sounder on GOES?

An Introduction to the EUMETSAT Polar System

FORMOSAT-3/COSMIC

Suomi NPP: A New Generation of Environmental Monitoring Satellites

Satellite Meteorology: Introduction to Using the GOES Sounder

Water Vapour Interpretation (MSC)

Assessing NWP with Water Vapour Imagery

Inferring Three Dimensions from Water Vapour Imagery

Satellite Feature Identification: Atmospheric Rivers

Satellite Feature Identification: Cyclogenesis

Satellite Feature Identification: Ring of Fire

Satellite Feature Identification: Blocking Patterns

Recognition and Impact of Vorticity Maxima and Minima in Satellite Imagery

Dynamic Feature Identification: Vorticity Maxima and Comma Patterns

Dynamic Feature Identification: Deformation Zone Distribution

Blowing Snow Baker Lake, Nunavut Canada 04-10 February 2003

Baker Lake

Imaging with VIIRS: A Convergence of Technologies and Experience, 2nd Edition



Languages: English
 Publish Date: 2012-04-26
 Skill Level: 1
 Completion Time: .75 - 1.00 h
 Includes Audio: no
 Required Plugins:
 AdobeReader, Flash
 Topics:
 Satellite Meteorology
 Included in Courses:
 Multispectral Satellite
 Application Topics Course

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Description

Objectives

Keywords

Addendum

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Reviews

This module introduces the VIIRS imager that was launched on the Suomi NPP (National Polar-orbiting Partnership) satellite in October 2011 and will fly on future U.S. JPSS weather satellites. The VIIRS imager has many advanced features that improve both spectral and spatial resolution. Together with modernized data communication and processing systems, VIIRS will provide consistent, high quality, and high resolution data to users. The module covers the enhanced capabilities of VIIRS by examining the systems that contributed to its development. Special attention is paid to the Day/Night Visible channel as VIIRS is the first instrument on a civilian satellite to image atmospheric and terrestrial features with and without moonlight.

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Imaging with VIIRS: A Convergence of Technologies and Experience, 2nd Edition



Languages: English
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 Skill Level: **1**
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 Required Plugins: AdobeReader, Flash
 Topics: Satellite Meteorology
 Included in Courses: Multispectral Satellite Application Topics Course

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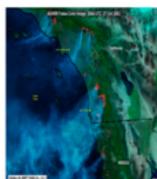
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 AVHRR false-color image of fires over Southern California and northwestern Mexico at 2044 UTC on October 27, 2003.

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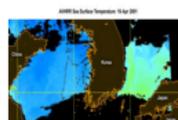

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description:
 AVHRR false-color image of fires over Southern California and northwestern Mexico at 2044 UTC on October 27, 2003.

[More details...](#)


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description:
 NOAA AVHRR channel grid, 1.1 km at nadir viewing angles.

[More details...](#)

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Suomi NPP: A New Generation of Environmental Monitoring Satellites



Languages: English, Spanish

Publish Date: 2012-05-01

Skill Level: 1

Completion Time: .75 - 1.00 h

Includes Audio: yes

Required Plugins: Flash

Topics:

Satellite Meteorology

Reviews:

☆☆☆☆☆ (0 reviews)

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The Suomi National Polar-orbiting Partnership or Suomi NPP satellite, launched in 2011, is the first of a new series of missions under NOAA's JPSS program. Suomi NPP has two major goals: global observing of the Earth's atmosphere, land, and ocean surface; and climate monitoring. Suomi NPP observations are used to create operational forecast products and provide input to numerical weather prediction models. They also provide continuity to the satellite climate record and other environmental datasets. This module provides an overview of the Suomi NPP satellite. The first half describes its mission, products, and instruments. The second half focuses on its role in environmental monitoring, offering examples of how it detects and monitors Earth's climate, land and ocean surfaces, atmosphere, and space weather.

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Introduction to VIIRS Imaging and Applications

- VIIRS capabilities vs. earlier imagers
- Imaging strategy, 22 bands, resolution
- Key applications
- Introduction to the Day-Night Band

Introduction to VIIRS Imaging and Applications
Produced by The COMET® Program

Introduction
Technical Advances
VIIRS Products and Applications
Environmental Data Records
About VIIRS Imagery and Products
True Color Products
Natural Color Products
Arctic Ice Motion
Convection
Fog and Low Clouds
Sea Surface Temperature
Tropical Cyclones
Volcanic Ash
Dust RGB for Volcanic Ash and Contrails
Multispectral Dust Enhancement
Ocean Color
Day Night Band
Summary
Lesson Summary

SNPP VIIRS True Color Composite From 15 Orbits 18 Jun 2012

NASA

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VIIRS Channels and Resolution
VIIRS Imaging and Moderate Channels
VIIRS, AVHRR, and OLS Resolution
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The extreme zoom below is of a shortwave infrared imaging channel of a nighttime fire using the I4 channel at 3.7 micrometers. Located near Ventura, California, the fire started inland and was blown toward the coast by offshore winds. At the time of this image, the fire had reached the coast. Notice the tiny 375-m pixels that make up the image. This channel is one of three VIIRS channels near this wavelength that are useful for fire detection. Pixels hotter than about 26 degrees C are colored red. Notice the fire-free corridor between two burning regions.

Suomi NPP VIIRS 0.375 km 3.74 µm Channel 0949 UTC 03 May 2013
119.1°W 119.9°W

34.2°N
34.1°N
34°N

Between Santa Barbara and LA, CA

VIIRS Grid 0.37 km at Nadir
"Imaging" Resolution

NASA/COMET Program

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"Fog" or "low clouds at night" products have significantly improved the detection of stratus and fog. These products exploit the differential low cloud emissivities in two input infrared channels. When the channels are combined into a pixel-by-pixel image difference, low clouds and fog stand out distinctly, as we see in the images over Pennsylvania below. Use the slider to view both images.

Suomi VIIRS 10.6 - 3.74 µm 0801 UTC 06 Jun 2012

10.6 3.74

0 2 4 6 8 10 12

With a spatial resolution of 0.37 km, the VIIRS "imaging" infrared channels enable much finer detail than AVHRR or MODIS. In the GOES comparison, the fog pixels are so "blocky" that it's hard to assess the extent and detail of fog coverage. In contrast, the detailed VIIRS product lets forecasters pinpoint the fog regions within individual valleys. For information on viewing fog at night, see COMET's Advances in Space-Based Nighttime Visible Observation lesson at https://www.meted.ucar.edu/training_modules.php?id=990.

Introduction to VIIRS Imaging and Applications
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MODIS and VIIRS have special "ocean color" channels that provide spatial detail and have the ability to quantify and understand bio-optical properties of the ocean surface. Ocean color depends on the number of microscopic marine plants, called "phytoplankton." These plants contain chlorophyll, a green pigment. These images are season-long composites of ocean chlorophyll concentrations derived from visible measurements made by VIIRS. The purple and blue colors represent lower chlorophyll concentrations, the oranges and reds higher chlorophyll concentrations. The left composite shows summer in the Northern Hemisphere. The composite on the right shows summer in the Southern Hemisphere.

Suomi NPP VIIRS Global Chlorophyll Composite
Boreal Summer 21 Jun 2011 - 20 Sep 2012
Austral Summer 21 Dec 2011 - 20 Mar 2012

Chlorophyll (mg / m³)

0 2 4 6 8 10

NASA/Suomi NPP/Noaa/Kerling

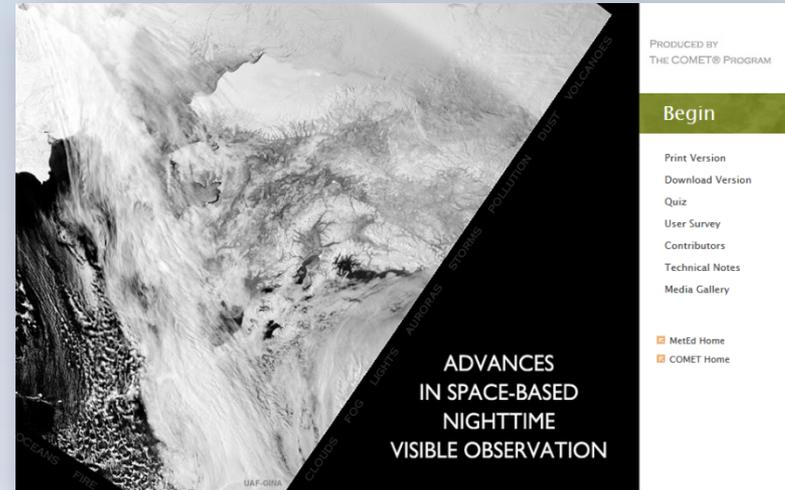
Looking at the Northern Hemisphere summer (left image), which statements are true of the bio-optical activity in the Arctic Ocean? (Choose the best answer.)

a) The reds along the land areas indicate high concentrations of chlorophyll

b) The Arctic is covered with ice, suppressing biological activity

Advances in Space-Based Nighttime Visible Observation

- Technical Improvements with Suomi NPP VIIRS Day-Night Band
- Lunar cycle & modeling, constant contrast techniques for normalized imagery
- Meteorological and other applications
- Future improvements in NT visible imaging



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ADVANCES IN SPACE-BASED NIGHTTIME VISIBLE OBSERVATION
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Introduction
About Nighttime Imaging
History of Nighttime Visible Observation
About the Module
Nighttime Visible Imaging With the DNB
Lunar Phases and Modeling
Applications of Nighttime Visible Imaging
Future of Nighttime Visible Observation
Interpretation Guidelines
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NE Afghanistan, 29 Nov 2012: DNB NPP VIIRS DNB Moonlit Night Visible

Nighttime visible imaging complements and, in many cases, improves upon infrared (IR) images. Although nighttime products made from multiple infrared channels have improved in recent years, they still have limitations.



ADVANCES IN SPACE-BASED NIGHTTIME VISIBLE OBSERVATION
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Nighttime Visible Imaging With the DNB
Lunar Phases and Modeling
Lunar Phases
Lunar Model
Exercise 1
Exercise 2
Applications of Nighttime Visible Imaging
Future of Nighttime Visible Observation
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Illumination varies tremendously throughout the lunar cycle. For example, the full moon is about nine times brighter than a quarter moon and hundreds of times brighter than a crescent moon. To account for these huge variations in lunar illumination, some groups use a lunar model to normalize the data. This approach accounts for highly variable input lunar illumination and outputs constant illumination. This greatly improves the quality of imagery and the capacity to build quantitative products.

Here's a sample image before the lunar model is applied. The cities of South Africa are visible but we can't see many clouds because of the low illumination from the first quarter moon that's about 22 degrees above the horizon. Applying the lunar model brightens the data as if the moon were full and directly overhead. **HOVER OVER THE IMAGE AND MOVE THE SLIDER TO SEE THE NORMALIZED IMAGE. (ON TOUCH SCREEN DEVICES, TAP THE IMAGE SIDES TO TOGGLE.)** So many more clouds are evident! This is known as "near constant contrast" (NCC) imagery. It looks the same regardless of the lunar phase or elevation and enables us to process effective images even with marginal lunar conditions.

Suomi NPP VIIRS DNB Night Visible Over Southern Africa With Normalization
0030 Local Time 28 Jun 2012

20 Degrees Elevation



ADVANCES IN SPACE-BASED NIGHTTIME VISIBLE OBSERVATION
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Applications of Nighttime Visible Imaging
Lunar Phases and Modeling
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Fog/Stratus
Airglow
Polar Nights and Auroras
Wildland Fires
Volcanoes
Dust Storms
Air Pollution
Moonlight
Lightning
Gas Flares
Ships and Boats
Population/Economic Geography
Future of Nighttime Visible Observation
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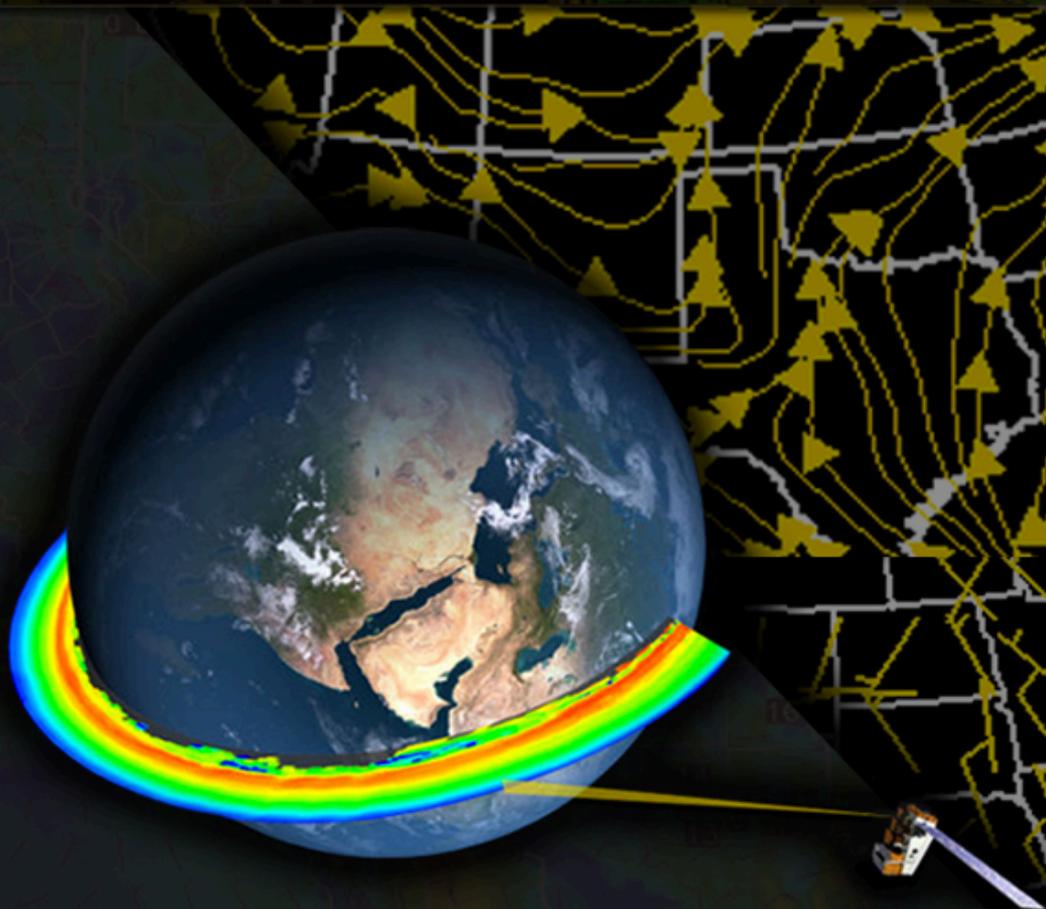
This section explores the use of nighttime visible images and derived products to detect and monitor a variety of meteorological and other features at night. The derived products are made from VIIRS DNB visible images and infrared channels. As of 2013, some are currently available while others are still experimental.

Suomi NPP VIIRS DNB Nighttime Visible Images & Products

If you are not familiar with RGB products, we recommend that you take COMET's Multispectral Satellite Applications: RGB Products Explained module at https://www.meted.ucar.edu/training_module.php?id=568.

How Satellite Observations Impact NWP

Produced by The COMET® Program



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How Satellite Observations Impact NWP

90-120 minute interactive lesson

Description

Objectives

Keywords

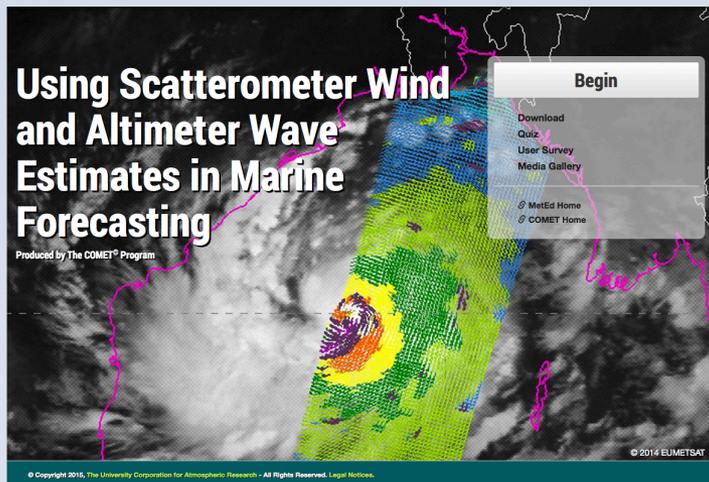
Media Gallery

Reviews

By the end of the lesson, users should be able to:

-  Describe the impact of satellite observations on numerical weather prediction (NWP) model analyses and forecasts
 - Identify the primary types of environmental satellites that provide observations to data assimilation (DA) systems and NWP models
 - Describe the major components of forecast models and how they forecast atmospheric processes
-  Describe how observations from new satellite instruments are vetted for use in DA systems
-  Describe the process of assimilating satellite observations and retrievals once they have been accepted for use in DA systems
 - Provide examples of how model limitations can impact the assimilation and use of satellite observations in NWP
-  Describe expected developments in satellite, DA, and NWP systems that will address current challenges and improve NWP forecast quality

NEW! Using Scatterometer Wind and Altimeter Wave Estimates in Marine Forecasting *(sponsored by EUMETSAT & NESDIS)*



Advanced level lesson. Just over 1-hr long. Includes:

- Scatterometer & Altimeter Basics
- Computing Wind Estimates
- Rain Effects
- Key Applications
- Case Studies

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- Computing Wind Estimates
- Rain Effects
- Altimetry Case Study: Tropical Cyclone Hagupit (Ruby)
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USER SURVEY

MEDIA GALLERY

Altimeter Data and Wave Heights

This example of a tropical cyclone comes from the U.S. National Weather Service Ocean Prediction Center.

ASCAT Extratropical Cyclone and Storm Force Ocean Winds Over North Atlantic 12 May 2014

ASCAT wind vector retrievals confirm storm force winds just south of Greenland, in the channeling flow between the occluded front and the coast. Significant wave heights in the storm force winds are 22 feet (7 meters).

Area of storm force winds

ASCAT Colors to Wind Speed Legend (kt)

6	12	13	21	27	34-47	48-63	55	62	74
					Gale	Storm			

Where there are storms and strong ocean winds, we find potentially hazardous rough seas and big waves.

Topics:

In this topic area, find out how current and future satellites and their sensors work, how to interpret what they tell us, and how to make forecasts and other weather products from their data.

Sort by:

1 - 4 out of 4 results



Curso de orientación sobre los satélites GOES-R

Languages: Spanish, English
Time to Complete: 3-5 h
Topics:

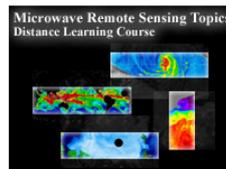
Este curso a distancia brinda a cualquier pronosticador, estudiante, investigador u otra persona interesada la oportunidad de explorar a su propio ritmo las prestaciones, los productos y las aplicaciones que los satélites GOES-R de próxima generación pondrán a nuestra ... [Read more »](#)



GOES-R Satellites Orientation Course

Languages: English, Spanish
Time to Complete: 3-4 h
Topics: Satellite Meteorology

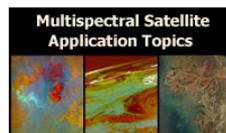
This self-paced distance learning course introduces forecasters, students, researchers, and other interested learners to the capabilities, products, and applications anticipated with the next-generation GOES-R satellites. The three core lessons in this course are: GOES-R: ... [Read more »](#)



Microwave Remote Sensing Topics Distance Learning Course

Languages: English
Time to Complete: 4-6 hrs
Topics: Satellite Meteorology

This self-paced distance learning course provides forecasters, students, researchers, developers, and other interested learners with a foundation in the science, products, and applications of space-based satellite microwave remote sensing. The three core modules that ... [Read more »](#)



Multispectral Satellite Application Topics Course

Languages: English
Time to Complete: 6 to 8 hrs
Topics: Satellite Meteorology, Satellite

This self-paced distance learning course provides forecasters, students, researchers, and other interested learners with a foundation in the products and applications from multispectral satellite observations and various

Special Interest

More on Satellite Meteorology

Did you know that our individual GOES-R+ lessons are organized into their own distance learning course? Learn more on the [GOES-R Satellites Orientation Course](#) page.



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Languages: English
 Completion Time: 3-4 h
 Topics:
 Satellite Meteorology

Enrollment Information:

Enroll

Description Objectives Overview Additional Resources

Description

This self-paced distance learning course introduces forecasters, students, researchers, and other interested learners to the capabilities, products, and applications anticipated with the next-generation GOES-R satellites.

The three core lessons in this course are:

- GOES-R: Benefits of Next-Generation Environmental Monitoring
- GOES-R ABI: Next Generation Satellite Imaging
- GOES-R GLM: Introduction to the Geostationary Lightning Mapper

Course Outline

Core Topics/Modules

GOES-R: Benefits of Next-Generation Environmental Monitoring

Languages: English, Spanish
 Publish Date: 2008-12-19
 Last Updated On: 2013-04-18
 Skill Level: 1

Topics:
 Emergency Management, Satellite Meteorology
 ★★★★★ (2 reviews)

GOES-R ABI: Next Generation Satellite Imaging

Languages: English, Spanish
 Publish Date: 2013-02-19
 Skill Level: 1

Topics:
 Satellite Meteorology
 ★★★★★ (0 reviews)

GOES-R GLM: Introduction to the Geostationary Lightning Mapper

Languages: English, Spanish
 Publish Date: 2014-09-05
 Skill Level: 1

Topics:
 Mesoscale Meteorology, Satellite Meteorology
 ★★★★★ (1 review)

Optional Topics/Modules

Multispectral Satellite Applications: RGB Products Explained Optional

Languages: English, Spanish
 Publish Date: 2013-07-08
 Last Updated On: 2013-07-22
 Skill Level: 2

Topics:
 Satellite Meteorology
 ★★★★★ (6 reviews)

Multispectral Satellite Applications: Monitoring the Wildland Fire Cycle, 2nd Edition Optional

Languages: English
 Publish Date: 2013-06-11
 Skill Level: 2

Topics:
 Fire Weather, Satellite Meteorology
 ★★★★★ (0 reviews)

How Satellite Observations Impact NWP Optional

Languages: English
 Publish Date: 2014-03-12
 Last Updated On: 2013-06-14
 Skill Level: 2

Topics:
 Numerical Modeling (NWP), Satellite Meteorology
 ★★★★★ (2 reviews)

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Satellite Meteorology: GOES Channel Selection V2 Optional

Languages: English, Spanish
 Publish Date: 2011-05-04
 Skill Level: 2

Topics:
 Satellite Meteorology
 ★★★★★ (0 reviews)

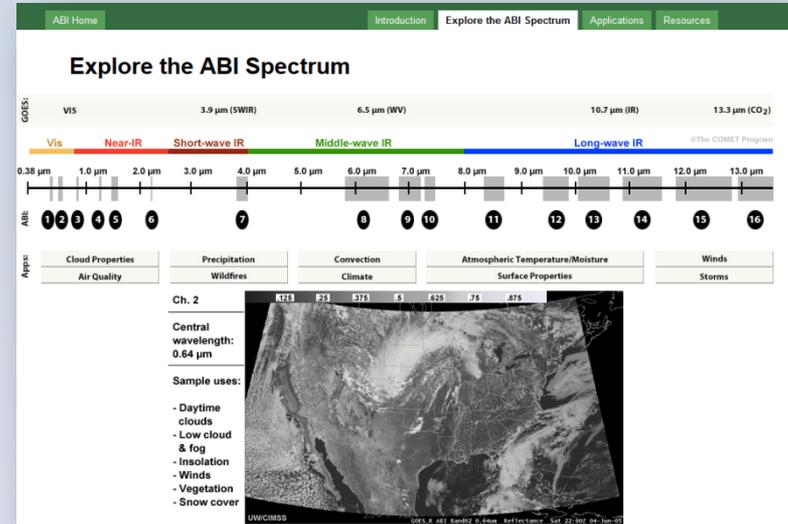
Advanced Himawari Imager (AHI): What's Different from the GOES-R Advanced Baseline Imager (ABI) Optional

Languages: English
 Publish Date: 2015-01-27
 Skill Level: 1

Topics:
 Satellite Meteorology
 ★★★★★ (1 review)

GOES-R ABI: Next Generation Satellite Imaging

- Interactive exploration of ABI's 16 bands, linking bands to observable phenomena
- Movies describing advancements in ten application areas (e.g. analysis, forecasting, NWP, climate and environmental monitoring)



Advanced Himawari Imager (AHI)

- Brief overview of the Himawari-8 AHI
- Highlights differences from GOES-R ABI
- Spectral bands and scan strategies
- Benefits of data and products for users over the Pacific and Americas

Advanced Himawari Imager (AHI):
What's Different from the GOES-R Advanced Baseline Imager (ABI)

Produced by The COMETS Program

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- References
- Contributors

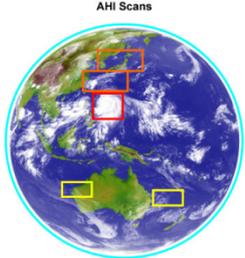
LESSON

- PRINTABLE VERSION
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Himawari-8 Coverage

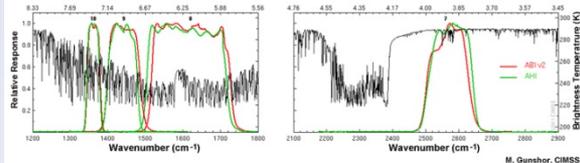
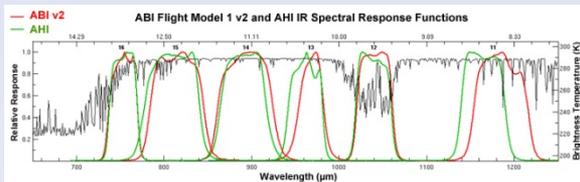
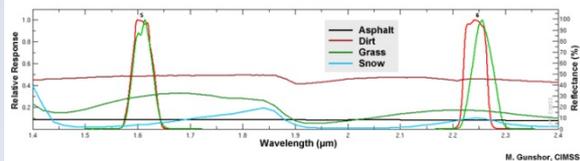
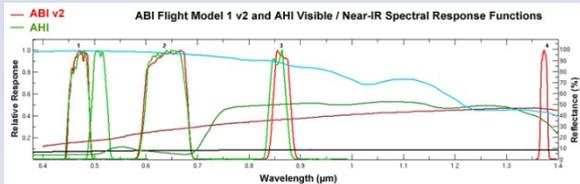
Himawari-8 is located at the equator and 140° E longitude. The imager provides full disk data and imagery every 10 minutes, two sectors over Japan every 2.5 minutes, and one moveable typhoon targeted area every 2.5 minutes.

AHI Scans



■ Full Disk
■ Japan Area (Regions 1 and 2)
■ Moveable Target Area (Region 3)
■ Landmark Areas (Regions 4 and 5)

Meteorological Satellite Center of Japan Meteorological Agency

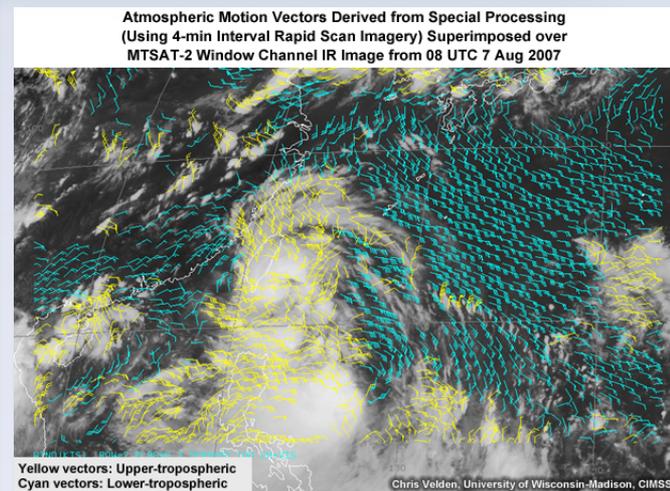


AHI Channels

Ch 1 0.46 μm	Ch 2 0.61 μm	Ch 3 0.64 μm	Ch 4 0.86 μm
Ch 5 1.61 μm	Ch 6 2.26 μm	Ch 7 3.90 μm	Ch 8 6.18 μm
Ch 9 6.95 μm	Ch 10 7.34 μm	Ch 11 8.60 μm	Ch 12 9.81 μm
Ch 13 10.35 μm	Ch 14 11.20 μm	Ch 15 12.30 μm	Ch 17 13.30 μm

(1.38 μm channel not available on AHI)

The COMET Program / Meteorological Satellite Center of the Japan Meteorological Agency

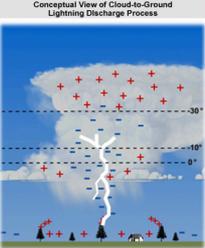


GOES-R GLM: Introduction to the Geostationary Lightning Mapper

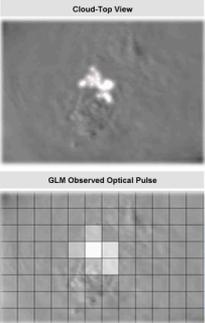
- Conceptual exploration of lighting and detection
- Movies describing improvements that the GLM is expected to bring to a variety of applications

GLM Home About the GLM Observing Lightning Applications Resources

GOES-R GLM: Introduction to the Geostationary Lightning Mapper



Cloud-Top View



BEGIN »

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GOES-R: Benefits Module

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GOES-R GLM Applications

This section describes some of the improvements that the GLM is expected to bring to a variety of applications. Click each application. When you are finished, explore the Resources (final tab) and take the lesson quiz.

Convection



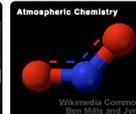
Strike Hazard Warnings



Aviation



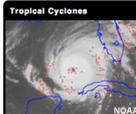
Atmospheric Chemistry



Quantitative Precipitation Estimation



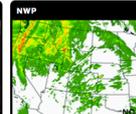
Tropical Cyclones



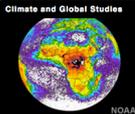
Fires



NWP



Climate and Global Studies



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Observing Lightning

Introduction to Lightning Lightning Flash Exploration Questions Producing GLM Flashes

Lightning Flash Exploration

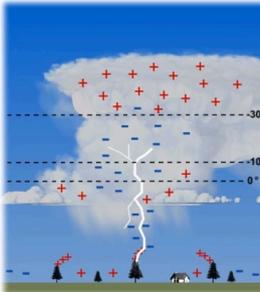
This page lets you explore the steps in a cloud-to-ground lightning flash. Click each step to hear a description of what happens. If you want to view the sequence without narration, click the View Animation Only button. When you are finished, click the Question tab to answer questions about the process.

Step 1 Step 2 Step 3 Step 4 **Step 5** Step 6 Step 7 View Animation Only

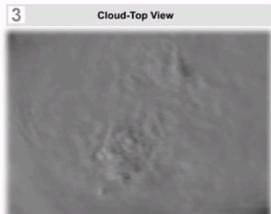
Step 5: Dart Leader

hr min sec msec usec
00:00:00.107 080

1 Conceptual View of Cloud-to-Ground Lightning Discharge Process



3 Cloud-Top View



2 Ground-Based Lightning Detection

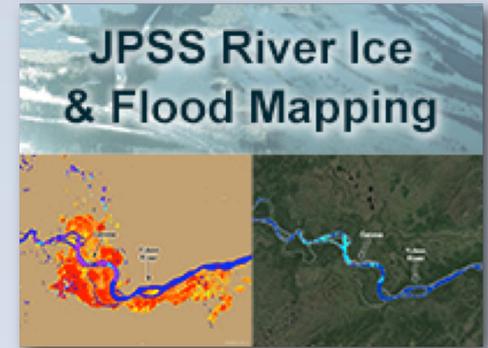


◆ Low frequency radio wave listening network detections
● VLF Lightning Mapping Array (LMA) detections

The COMET Program

00:31 / 00:36

In Progress / Coming Soon



- Lesson on COSMIC-2
- Lesson on SNPP/JPSS River Ice and Flooding Products
- Condensed and Updated versions of many lessons in support of user readiness for GOES-R
- Portuguese versions of elements from the GOES-R lessons
- French versions of:
 - Assessing NWP with Water Vapour Imagery
 - Using Scatterometer Wind and Altimeter Wave Estimates in Marine Forecasting
 - Four newest ASMET Lessons

abshire@ucar.edu



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