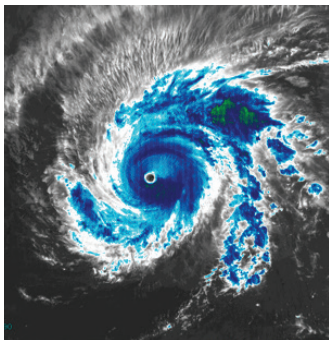
GOES-R ABI Fact Sheet Band 7 ("Shortwave window" infrared)

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



The Advanced Himawari Imager (AHI) 3.9 µm for Typhoon Maysak from March 31, 2015, at 06 UTC. Credit: CIMSS and JMA

In a nutshell

GOES-R ABI Band 7 (approximately 3.9 µm central, 3.8 µm to 4.0 µm)

Similar to Suomi NPP VIIRS Bands I4/M12/M13, MODIS Bands 20/21/22/23, AVHRR Band 3, SEVIRI Band 4, AHI Band 7

Available on current GOES (imager and sounder)

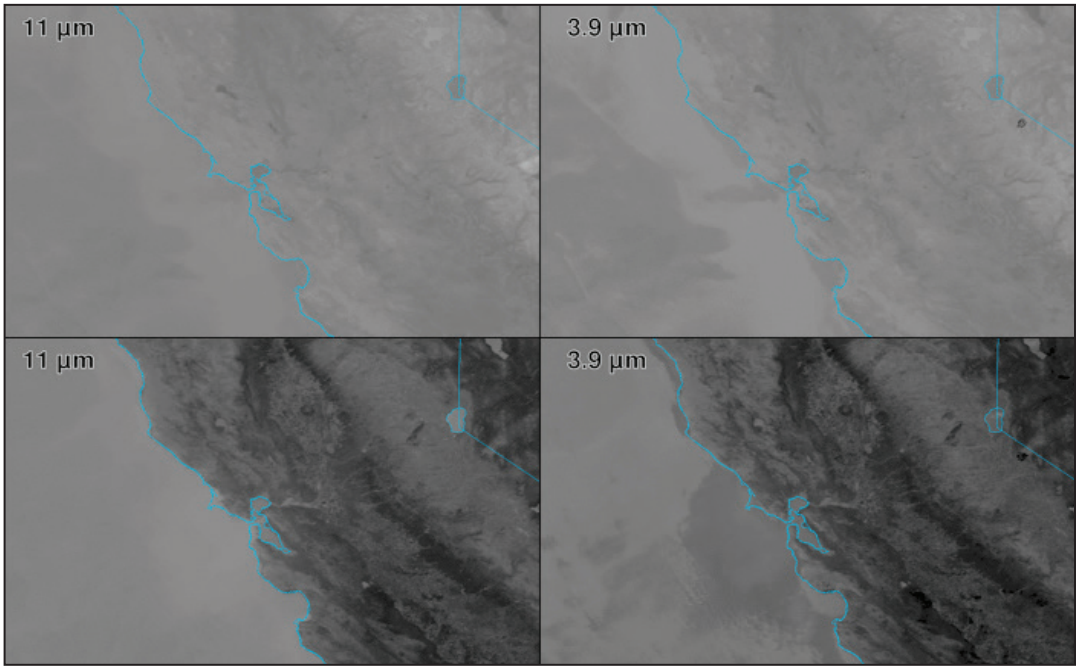
Nickname: "Shortwave window" infrared band

Availability: Both day and night; during the day contains a reflected solar component

Primary purpose: Low fog and stratus, clouds, fires, atmospheric motion vectors, volcanic ash, etc.

Uses similar to: At night, other longwave infrared window bands

The shortwave IR window (3.9 µm) band (on the current GOES imagers) has been demonstrated to be useful in many applications, including fog/low cloud identification at night, fire/hot-spot identification, volcanic eruption and ash detection, and daytime snow and ice detection. Low-level atmospheric vector winds can also be estimated using this band. The shortwave IR window is also useful for studying urban heat islands and clouds. Compared to nighttime, there will be overall warmer temperatures in this shortwave window band during the day, due to the additional reflected solar component. *Source: Schmit et al., 2005 in BAMS, and the ABI Weather Event Simulator (WES) Guide by CIMSS.*



MODIS Aqua images from June 22, 2015, of the 11 µm (left panels) and 3.9 µm (right panels) bands. The top images are from 09:55 UTC (nighttime), while the lower panels are from 21:00 UTC (daytime). The fire (or hot spot) near the California/Nevada border (southeast of Lake Tahoe) is evident in the 3.9 µm imagery (Band 22). The 3.9 µm imagery brightness temperatures will generally be greater during the daytime due to additional reflected solar radiation. Fog is along the California coast. The same enhancements are used in each image, with the darker colors representing hotter temperatures. These images were made in McIDAS-V. Credit: SSEC

Did You Know?

To fully understand a spectral band, it's necessary to consider both its central wavelength and also its spectral width. For example, the current GOES and EUMETSAT imagers both have bands nominally centered at 3.9 µm. Yet, due to their spectral widths, the observed brightness temperatures can be quite different. During the night, the wider EUMETSAT band (approximately 3.6 to 4.2 µm) can be cooler (due to more absorption associated with CO_2), yet during the day, the wider EUMETSAT band can be warmer due to more reflected solar energy.

Baseline Products by Band

Wavelength Micrometers	3.9
Band number	7
Baseline Products	
Aerosol Detection	√
Aerosol Optical Depth	
Clear Sky Masks	√
Cloud & Moisture Imagery	√
Cloud Optical Depth	√
Cloud Particle Size Distribution	√
Cloud Top Phase	
Cloud Top Height	
Cloud Top Pressure	
Cloud Top Temperature	
Hurricane Intensity	
Rainfall Rate/QPE	
Legacy Vertical Moisture Profile	
Legacy Vertical Temp Profile	
Derived Stability Indices	
Total Precipitable Water	
Downward Shortwave Radiation: Surface	
Reflected Shortwave Radiation: TOA	
Derived Motion Winds	√
Fire Hot Spot Characterization	√
Land Surface Temperature	
Snow Cover	√
Sea Surface Temperature	√
Volcanic Ash: Detection/Height	
Radiances	√

Ward's Words

Of all of the spectral bands on the GOES-R ABI, Band 7 has the greatest bit depth. That is, the number of discrete values is greater than for the other bands. The reason for this is that Band 7 must be able to sense both very cold features (convective cloud tops) and very hot features (fires). Band 7 will be sent to the Advanced Weather Interactive Processing System (AWIPS) with a depth of 14 bits. The ABI was designed to sense a maximum temperature of 400 K in Band 7.
The other ABI bands are delivered to AWIPS with a depth of 12 bits, and a maximum temperature that is lower and more consistent with maximum terrestrial or atmospheric temperatures (between 300 K and 330 K).

Bill "Hima-Ward-i" Ward is the ESSD Chief in NWS Pacific Region and a former Guam forecaster.

Tim's Topics

According to the Planck equation, a band centered at 3.9 µm has much more sensitivity to temperature than a band centered near 11 µm. Thus, there are many uses for the 3.9 µm band, often in conjunction with a longwave infrared band. This is the case for both qualitative imagery and derived (level 2) products. Examples of qualitative applications include the imagery itself, band differences, and/or combining the images in a red-green-blue combination. As shown in the ABI products by band table, examples of quantitative products include: aerosol detection, clear sky cloud mask, cloud properties, derived atmospheric motion vectors, hot spot detection and characterization, snow cover, sea surface temperature and fog/low stratus.

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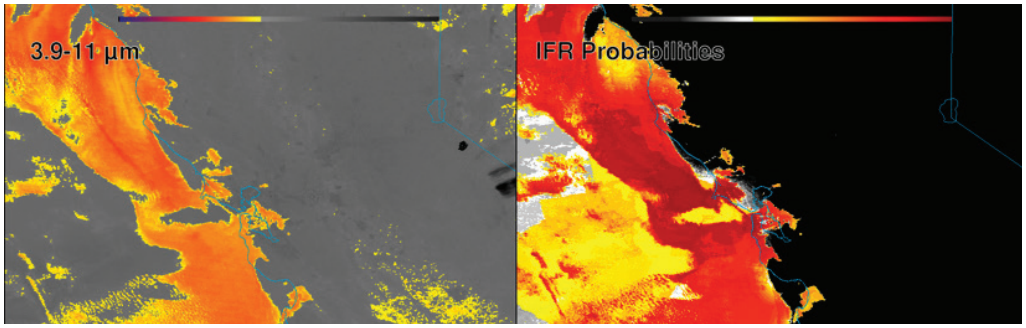

These images are from MODIS data on June 22, 2015 (09:55 UTC). This is the same time depicted in the panels on the previous page. The left panel is an image of the difference between the 3.9 and 11 µm bands, where negative differences are color-coded, beginning with a value of -1.2 K. The right panel is the GOES-R algorithm IFR (Instrument Flight Rules) probabilities, where higher probabilities are color coded, beginning with 38%. The IFR probability product better characterizes the fog and low clouds than either the band itself or the band difference. Credit: ASPB and CIMSS

ABI Band	Approximate Central Wavelength (µm)	Band Nickname	Type	Nominal sub satellite pixel spacing (km)
7	3.9	"Shortwave window" band	IR*	2

*with a reflected daytime solar component

Further reading

ABI Bands Quick Information Guides: http://www.goes-r.gov/education/ABI-bands-quick-info.html
CIMSS Fog Product Examples blog: http://fusedfog.ssec.wisc.edu/
CIMSS Satellite blog: http://cimss.ssec.wisc.edu/goes/blog/archives/category/fog-detection
GOES-R COMET training: http://www.goes-r.gov/users/training/comet.html
GOES-R acronyms: http://www.goes-r.gov/resources/acronyms.html