



GOES-R ABI Fact Sheet Band 13 ("clean" longwave infrared window band) The "need to know" Advanced Baseline Imager reference guide for the NWS forecaster



The Advanced Himawari Imager (AHI) 10.4 µm band image for Typhoon Maysak from March 31, 2015, at 6 UTC. Credit: CIMSS and JMA

In a nutshell

GOES-R ABI Band 13 (approximately 10.3 μm central, 10.2 μm to 10.5 μm)

Also similar to AHI Band 13

Not available on current GOES imager or sounder

Nickname: "Clean" longwave infrared window band

Availability: Both day and night

Primary purpose: Clouds

Uses similar to: GOES-R ABI Bands 11, 14 and 15 The 10.3 μ m atmospheric "clean" infrared window band is less sensitive than other infrared window channels to water vapor and, hence, improves atmospheric moisture corrections, cloud particle size estimation, and surface property characterization in derived products. The 10.3 μ m band does have a very small sensitivity to ozone, while the 11.2 μ m longwave window does not. In general, the 10.3 μ m band may be used much like the traditional infrared window due to less moisture absorption in the lower troposphere. *Source: Schmit et al., 2005 in BAMS, the ABI Weather Event Simulator (WES) Guide, Lindsey et al., 2012.*



The left panel shows the MTSAT infrared window band, while the right panel is of the JMA's AHI longwave window centered at 10.4 um. There is improved spatial resolution from the AHI, approximately by a factor of four. Both images are from November 3, 2015, at approximately 19:30 UTC, and each are shown in their native projection. This case is of the Mount Rinjani volcano in Indonesia. While MTSAT does show the plume (in the center of the image), the Himawari data (from JMA) depicts the plume more clearly and uniquely shows the hot spot associated with this event. This image was made in McIDAS-X. Warmer brightness temperatures (K) are denoted as darker shades of gray, while the colder values are denoted as white. Credit: SSEC and ASPB



Should the 10.3 μm or 11.2 μm band be the "default" atmospheric longwave IR window band?

According to Lindsey et al.: "Since the 10.3 μ m band is cleaner than the 11.2 μ m band, we recommend that forecasters default

to the 10.3 μ m band when simply looking at a window IR for estimates of radiating temperatures or subjective cloud identification and classification. But when a more detailed physical retrieval is being designed, characteristics of both bands need to be carefully considered. That said, ... all bands from the ABI... are planned to be available for use by forecasters and others."

Baseline Products by Band

Wavelength Micrometers10.33Band number13Baseline Products1Aerosol Detection1Aerosol Optical Depth1Cloud SMoisture Imagery√Cloud Qptical Depth1Cloud Particle Size Distribution1Cloud Top Phase1Cloud Top Pressure1Cloud Top Temperature√Rainfall Rate/QPE√Legacy Vertical Temp Profile√Downward Shortwave Radiation: Surface√Porived Motion Winds1Fire Hot Spot Characterization1Fire Hot Spot Characterization√Snow Cover√Sea Surface Temperature√Sea Surfac		
Band number13Baseline Products	Wavelength Micrometers	10.33
Baseline ProductsAerosol DetectionAerosol Optical DepthClear Sky MasksCloud & Moisture ImageryCloud Optical DepthCloud Optical DepthCloud Optical DepthCloud Top PhaseCloud Top PressureCloud Top PressureCloud Top TemperatureHurricane IntensityRainfall Rate/QPELegacy Vertical Temp ProfileDownward Shortwave Radiation: SurfaceParived Motion WindsFire Hot Spot CharacterizationFire Hot Spot CharacterizationSnow CoverSonow CoverNotanic Ash: Detection/HeightRadiancesSol <td>Band number</td> <td>13</td>	Band number	13
Aerosol DetectionImage: style iterationAerosol Optical DepthImage: style iterationCloud & Moisture ImageryImage: style iterationCloud Optical DepthImage: style iterationCloud Particle Size DistributionImage: style iterationCloud Top PhaseImage: style iterationCloud Top HeightImage: style iterationCloud Top PressureImage: style iterationCloud Top TemperatureImage: style iterationAurricane IntensityImage: style iterationLegacy Vertical Moisture ProfileImage: style iterationDerived Stability IndicesImage: style iterationDownward Shortwave Radiation: SurfaceImage: style iterationDerived Motion WindsImage: style iterationFire Hot Spot CharacterizationImage: style iterationSnow CoverImage: style iterationSea Surface TemperatureImage: style iterationVolcanic Ash: Detection/HeightImage: style iterationRadiancesImage: style iteration	Baseline Products	
Aerosol Optical DepthIClear 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✓Legacy Vertical Moisture Profile✓Derived Stability Indices✓Total Precipitable Water✓Downward Shortwave Radiation: Surface✓Prived Motion Winds✓Fire Hot Spot Characterization✓Land Surface Temperature✓Snow Cover✓Volcanic Ash: Detection/Height✓Radiances✓	Aerosol Detection	
Clear Sky MasksICloud & Moisture Imagery√Cloud Optical DepthICloud Top PhaseICloud Top PhaseICloud Top PressureICloud Top Temperature√Hurricane Intensity√Rainfall Rate/QPE√Legacy Vertical Temp Profile√Downward Shortwave Radiation: Surface√Parived Motion WindsIFire Hot Spot Characterization✓Fire Hot Spot Characterization√Snow Cover√Notanic Ash: Detection/Height√Radiances√	Aerosol Optical Depth	
Cloud & Moisture Imagery√Cloud Optical DepthCloud Particle Size DistributionCloud Top PhaseCloud Top HeightCloud Top PressureCloud Top Temperature√Hurricane Intensity√Rainfall Rate/QPE√Legacy Vertical Moisture Profile√Derived Stability Indices√Total Precipitable Water√Downward Shortwave Radiation: SurfacePreived Motion WindsFire Hot Spot CharacterizationLand Surface Temperature√Snow Cover√Sea Surface Temperature√Nolcanic Ash: Detection/Height√Radiances√	Clear Sky Masks	
Cloud Optical DepthImage: cloud Particle Size DistributionCloud Top PhaseImage: cloud Top PhaseCloud Top HeightImage: cloud Top PressureCloud Top PressureImage: cloud Top TemperatureHurricane IntensityImage: cloud Top TemperatureHurricane IntensityImage: cloud Top TemperatureLegacy Vertical Moisture ProfileImage: cloud Top TemperatureLegacy Vertical Temp ProfileImage: cloud Top TemperatureDerived Stability IndicesImage: cloud Top TemperatureDownward Shortwave Radiation: SurfaceImage: cloud Top TemperatureDerived Motion WindsImage: cloud Top TemperatureFire Hot Spot CharacterizationImage: cloud Top TemperatureSnow CoverImage: cloud Top TemperatureSea Surface TemperatureImage: cloud Top TemperatureVolcanic Ash: Detection/HeightImage: cloud Top TemperatureRadiancesImage: cloud Temperature	Cloud & Moisture Imagery	√
Cloud Particle Size DistributionICloud Top PhaseICloud Top HeightICloud Top PressureICloud Top TemperatureIHurricane IntensityIRainfall Rate/QPEILegacy Vertical Moisture ProfileIDerived Stability IndicesITotal Precipitable WaterIDownward Shortwave Radiation: SurfaceIPerived Motion WindsIFire Hot Spot CharacterizationISnow CoverISea Surface TemperatureIVolcanic Ash: Detection/HeightIRadiancesI	Cloud Optical Depth	
Cloud Top PhaseImage: cloud Top HeightCloud Top PressureImage: cloud Top PressureCloud Top TemperatureImage: cloud Top TemperatureHurricane IntensityImage: cloud Top TemperatureRainfall Rate/QPEImage: cloud Top TemperatureLegacy Vertical Moisture ProfileImage: cloud Top TemperatureLegacy Vertical Temp ProfileImage: cloud Top TemperatureDerived Stability IndicesImage: cloud Top TemperatureDownward Shortwave Radiation: SurfaceImage: cloud Top TemperatureDerived Motion WindsImage: cloud TemperatureFire Hot Spot CharacterizationImage: cloud TemperatureSnow CoverImage: cloud TemperatureSea Surface TemperatureImage: cloud TemperatureVolcanic Ash: Detection/HeightImage: cloud TemperatureRadiancesImage: cloud Temperature	Cloud Particle Size Distribution	
Cloud Top HeightICloud Top PressureICloud Top TemperatureIHurricane IntensityIRainfall Rate/QPEILegacy Vertical Moisture ProfileILegacy Vertical Temp ProfileIDerived Stability IndicesITotal Precipitable WaterIDownward Shortwave Radiation: SurfaceIPerived Motion WindsIFire Hot Spot CharacterizationISnow CoverISea Surface TemperatureIVolcanic Ash: Detection/HeightIRadiancesI	Cloud Top Phase	
Cloud Top PressureICloud 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✓Perived Motion Winds✓Fire Hot Spot Characterization✓Snow Cover✓Snow Cover✓Volcanic Ash: Detection/Height✓Radiances✓	Cloud Top Height	
Cloud Top TemperatureIHurricane Intensity√Rainfall Rate/QPE√Legacy Vertical Moisture Profile√Legacy Vertical Temp Profile√Derived Stability Indices√Total Precipitable Water√Downward Shortwave Radiation: Surface√Perived Motion WindsFire Hot Spot Characterization✓Land Surface Temperature√Snow Cover√Sea Surface Temperature√Volcanic Ash: Detection/Height√Radiances√	Cloud Top Pressure	
Hurricane Intensity√Rainfall Rate/QPE√Legacy Vertical Moisture Profile√Legacy Vertical Temp Profile√Derived Stability Indices√Total Precipitable Water√Downward Shortwave Radiation: Surface√Derived Motion WindsDerived Motion WindsFire Hot Spot Characterization√Snow Cover√Sea Surface Temperature√Volcanic Ash: Detection/Height√Radiances√	Cloud Top Temperature	
Rainfall Rate/QPEImage: constraint of the sector of the sect	Hurricane Intensity	√
Legacy Vertical Moisture Profile√Legacy Vertical Temp Profile√Derived Stability Indices√Total Precipitable Water√Downward Shortwave Radiation: Surface√Reflected Shortwave Radiation: TOADerived Motion WindsFire Hot Spot CharacterizationLand Surface Temperature√Snow Cover√Sea Surface Temperature√Volcanic Ash: Detection/Height√Radiances√	Rainfall Rate/QPE	
Legacy Vertical Temp Profile√Derived Stability Indices√Total Precipitable Water√Downward Shortwave Radiation: Surface√Reflected Shortwave Radiation: TOADerived Motion WindsFire Hot Spot CharacterizationLand Surface Temperature√Snow Cover√Sea Surface Temperature√Volcanic Ash: Detection/HeightRadiances√	Legacy Vertical Moisture Profile	√
Derived Stability Indices√Total Precipitable Water√Downward Shortwave Radiation: SurfaceReflected Shortwave Radiation: TOADerived Motion WindsFire Hot Spot CharacterizationLand Surface Temperature√Snow Cover√Sea Surface Temperature√Volcanic Ash: Detection/HeightRadiances√	Legacy Vertical Temp Profile	√
Total Precipitable Water√Downward Shortwave Radiation: SurfaceReflected Shortwave Radiation: TOADerived Motion WindsFire Hot Spot CharacterizationLand Surface Temperature√Snow Cover√Sea Surface Temperature√Volcanic Ash: Detection/Height√Radiances√	Derived Stability Indices	√
Downward Shortwave Radiation: SurfaceReflected Shortwave Radiation: TOADerived Motion WindsFire Hot Spot CharacterizationLand Surface TemperatureSnow CoverSea Surface TemperatureVolcanic Ash: Detection/HeightRadiances	Total Precipitable Water	√
Reflected Shortwave Radiation: TOADerived Motion WindsFire Hot Spot CharacterizationLand Surface TemperatureSnow Cover✓Sea Surface Temperature✓Volcanic Ash: Detection/HeightRadiances	Downward Shortwave Radiation: Surface	
Derived Motion WindsFire Hot Spot CharacterizationLand Surface TemperatureSnow CoverSea Surface TemperatureVolcanic Ash: Detection/HeightRadiances	Reflected Shortwave Radiation: TOA	
Fire Hot Spot CharacterizationImage: CharacterizationLand Surface Temperature√Sea Surface Temperature√Volcanic Ash: Detection/HeightRadiances√	Derived Motion Winds	
Land Surface TemperatureSnow Cover√Sea Surface Temperature√Volcanic Ash: Detection/Height✓Radiances√	Fire Hot Spot Characterization	
Snow CoverISea Surface TemperatureIVolcanic Ash: Detection/HeightIRadiancesI	Land Surface Temperature	
Sea Surface Temperature ✓ Volcanic Ash: Detection/Height ✓ Radiances ✓	Snow Cover	√
Volcanic Ash: Detection/Height Radiances 🗸	Sea Surface Temperature	√
Radiances 🗸	Volcanic Ash: Detection/Height	
	Radiances	\checkmark

Tim′s Topics

During the early

formulation phase of the ABI, in the late 1990s, this spectral band was not included. In fact, the ABI was originally only eight spectral bands. Dr. Paul Menzel suggested the 10.3 µm band based on his experience with a similar band from a research sensor, the MAS (MODIS Airborne Sensor) on the NASA ER-2 high-altitude research aircraft. The data revealed the utility of this clean longwave infrared window for seeing through some clouds to ice (when differenced with a 8.6 µm band). The NOAA research council added the 10.3 µm band to the suite of ABI bands as a result. Several other international geostationary imagers now have, or will have, this spectral band.

Tim Schmit is a research meteorologist with NOAA NESDIS in Madison, Wisconsin.

Ward's Words

Though the



weighting functions peak at the surface, longwave infrared window bands brightness temperatures are not necessarily representative of the two-meter shelter temperature, particularly during the day and over land, when certain land surfaces can warm substantially compared to the air temperature. Because of the water vapor absorption in infrared window bands, they do not provide a great estimate of the "skin" temperature. There are baseline products that exist to provide this information, though users can also estimate some quantities. For example, sea surface temperature is approximately twice the ABI Band 14 brightness temperature less than the ABI Band 15 brightness temperature based on regression algorithms developed with polarorbiting satellite imagers.

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



The clear-sky weighting function (or contribution function) represents the layer of the atmosphere where the satellite-sensed radiation originates. This figure depicts the weighting functions for United States standard atmosphere scenes without the presence of clouds for window bands on the ABI. All of these weighting functions peak at the surface, suggesting that the surface temperature and emissivity dominate the brightness temperature in cloud-free scenes. Credit: CIMSS

ABI Band	Approximate Central Wavelength (μm)	Band Nickname	Туре	Nominal sub satellite pixel spacing (km)
13	10.3	"Clean" Longwave window	IR	2
14	11.2	Longwave window	IR	2
15	12.3	"Dirty" Longwave window	IR	2

Further reading

ABI Bands Quick Information Guides: http://www.goes-r.gov/education/ABI-bands-quick-info.html J. Appl. Remote Sensing: http://spie.org/Publications/Journal/10.1117/1.JRS.6.063598 MAS: http://mas.arc.nasa.gov/reference/mas.pdf ABI Weighting Function page: http://cimss.ssec.wisc.edu/goes/wf/ABI/ CIMSS Satellite Blog: http://cimss.ssec.wisc.edu/goes/blog/archives/20096 CIMSS Satellite Blog: http://cimss.ssec.wisc.edu/goes/blog/archives/19897 GOES-R COMET training: http://www.goes-r.gov/users/training/comet.html GOES-R acronyms: http://www.goes-r.gov/resources/acronyms.html



WWW.NESDIS.NOAA.GOV | WWW.GOES-R.GOV | TWITTER: NOAASATELLITES | FACEBOOK: GOES-R

