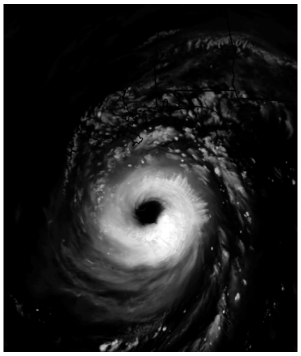
GOES-R ABI Fact Sheet Band 4 ("Cirrus" near-infrared)

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



Above: Simulated image of ABI Band 4 (1.37 µm) 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 4 (approximately 1.37 µm central, 1.36 µm to 1.38 µm)

Similar to Suomi NPP VIIRS Band M9 and MODIS Band 26

New for GOES-R series, not available on current GOES or Himawari-8

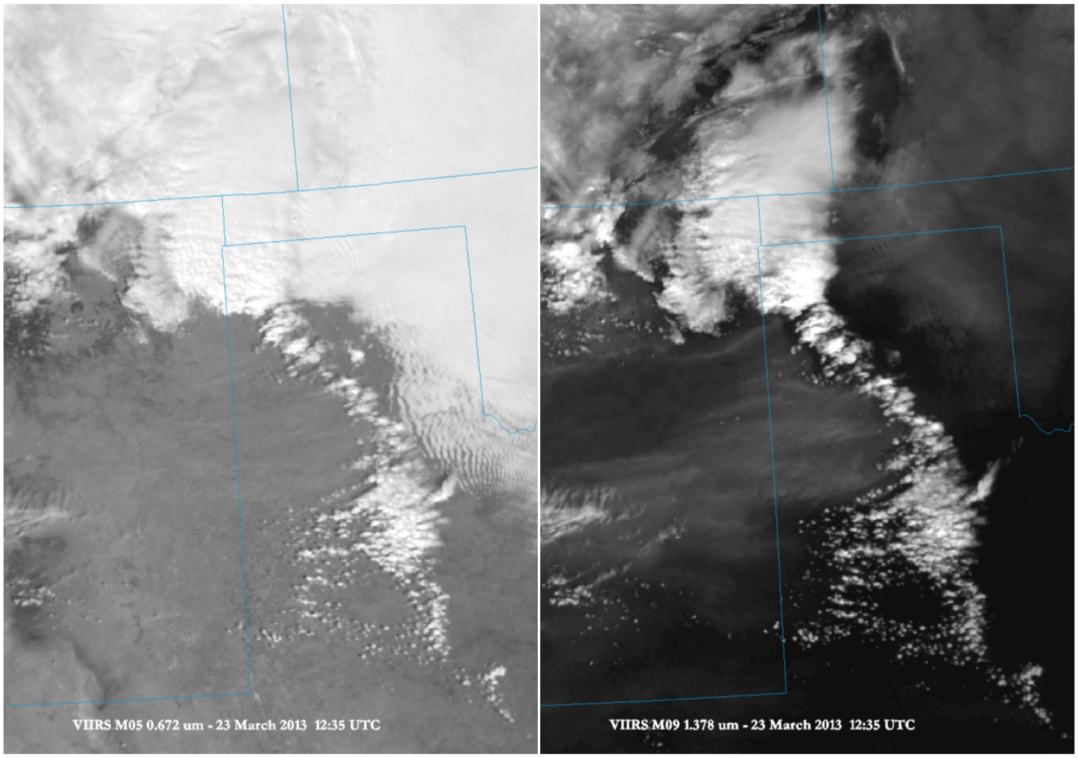
Nickname: "Cirrus" near-infrared band

Availability: Daytime only

Primary purpose: Cirrus detection

Uses similar to: None

The "cirrus" near-infrared band at 1.37 µm will detect very thin cirrus clouds during the day. This band is centered in a strong water vapor absorption spectral region. It does not routinely sense the lower troposphere, where there is substantial water vapor, and thus provides excellent daytime sensitivity to high, very thin cirrus under most circumstances, especially in warm, moist atmospheres. Correction for the presence of contrail and thin cirrus, which are possible with this band, is important when estimating many surface parameters. Hence, this band can be used to distinguish between low and high clouds or other bright objects and high clouds. *Source: Schmit et al., 2005 in BAMS, and the ABI Weather Event Simulator (WES) Guide by CIMSS.*



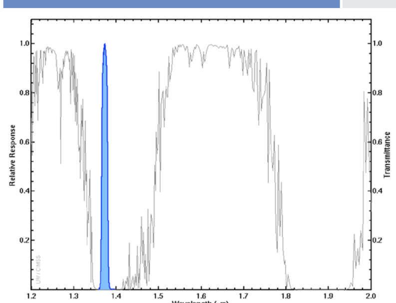
Suomi NPP VIIRS images from March 23, 2015 at 12:35 UTC for the 0.672 µm (left) and the 1.378 µm (right) bands over parts of New Mexico and Texas at 750 m resolution. The dust is much more apparent in the 1.378 µm band. These images were made using McIDAS-V. Credit: SSEC

Did You Know?

The 1.37 µm band is known as the cirrus band, but it is also useful in detecting other upper-level features. The 1.37 µm band is not limited to only detecting upper level clouds, but under certain conditions can also detect smoke and ash plumes from volcanic activity. MODIS and VIIRS imagery from the 1.37 µm band have shown ash plumes which can be helpful in issuing volcanic ash SIGMET (Significant Meteorological Information) for the aviation community.

Baseline Products by Band

Wavelength Micrometers	1.37
Band number	4
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	√



The ABI (blue shaded curve) spectral response function for the 1.37 μm band, along with a high-spectral resolution curve of the total transmittance through the atmosphere. Note how the 1.37 μm band is in the center of a water vapor absorption region and hence will appear dark for most clear sky scenes. Credit: CIMSS

Carven's Corner

Meteorologists may wonder how the cirrus band shows cloud scenes with little water vapor in the atmosphere. When the column total precipitable water is less than about 0.4 in, surface features will appear in cloud-free scenes. The drier the atmosphere, the more pronounced the surface features.

Unlike most near-infrared bands, the reflectance for dirt, snow and grass are all approximately the same in the 1.37 μm band. Generally, reflectance is between 35% and 50% for these surface features. Cirrus over snow cover and an otherwise very dry troposphere may be more difficult to detect because of this. In dry and windy regimes behind fronts passing over the southwestern U.S., it is possible to see lofted dust in the cirrus band, in part due to the lesser absorption of limited tropospheric water vapor, particularly in the middle and upper levels.

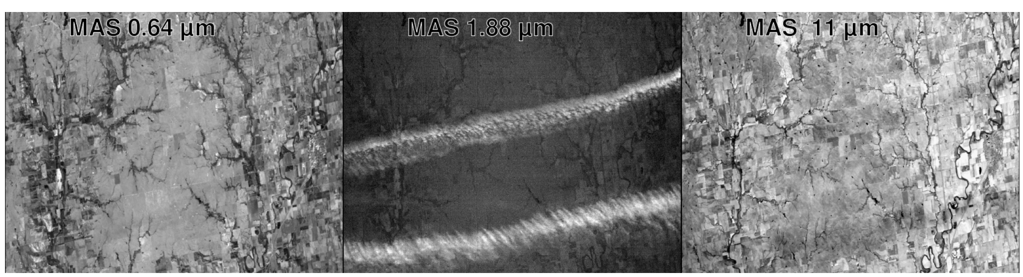
Carven Scott is the ESSD Chief in NWS Alaska Region and a former SOO.

Tim's Topics

Each of the spectral bands on the ABI have a "champion." In this case it was Bo-Cai Gao, the lead author on "An algorithm using visible and 1.375 μm channels to retrieve cirrus cloud reflectances from aircraft and satellite data."

Note that the 1.88 μm has similar physics as the 1.37 μm band, given both are in strong water vapor absorption regions. It is this absorption that allows the cirrus clouds to stand out, since usually there is enough moisture in the troposphere, and especially near the surface, to block the surface signal. The GOES-R Cloud Mask algorithm uses information from the 1.37 μm. The ATBD states, "this channel has been shown to be extremely helpful in detecting thin cirrus, which can often be undetected by the other reflective channels."

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



NASA's MODIS Airborne Simulator (MAS) was used, in part, to demonstrate several of the spectral bands of the ABI. In this case from the MAS, upper-level cirrus are clearly evident in the 1.88 μm image (center panel), but much less in the traditional visible band (left) and the longwave window band (right). Credit: NASA and SSEC

ABI Band	Approximate Central Wavelength (μm)	Band Nickname	Type	Nominal sub satellite pixel spacing (km)
4	1.37	"Cirrus" band	Near-IR	2

Further reading

ABI Bands Quick Information Guides: http://www.goes-r.gov/education/ABI-bands-quick-info.html
Journal article: http://modis-atmos.gsfc.nasa.gov/_docs/Gao_et_al._%282002b%29.pdf
VIIRS Fader Example: http://cimss.ssec.wisc.edu/goes/abi/viirs_clouds.html
Weighting functions: https://cimss.ssec.wisc.edu/goes/abi/vis_IR/wghtfnc_trans.html
GOES-R COMET training: http://www.goes-r.gov/users/training/comet.html
GOES-R acronyms: http://www.goes-r.gov/resources/acronyms.html