

Lab 4: MODIS Image Artifacts

Exercise 1: Examining MODIS image artifacts

Start Hydra and load the Terra MODIS Level 1B file from 2007 day 140 at 09:45 UTC named MOD021KM.A2007140.0945.005.2007141001410.hdf. Load the region shown in Figure 1 at full resolution in the Multi-Channel Viewer.

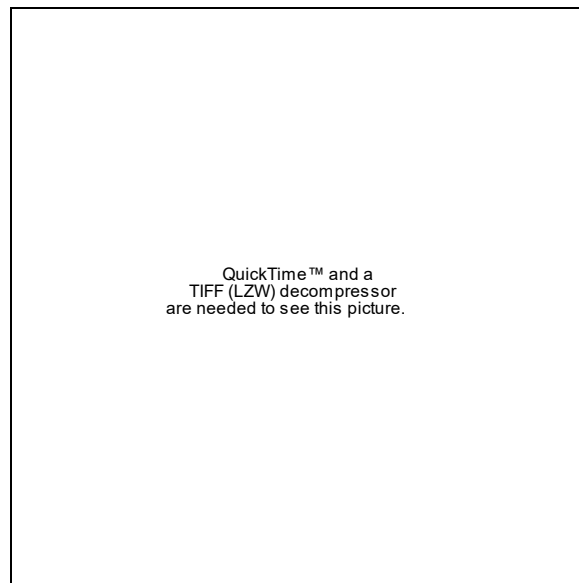


Figure 1: Region selection for bow-tie effect

1.1 Try to visualize the Bow-Tie effect, and describe its appearance in the image. In particular, explain in which part of the MODIS granule this effect is most evident, and what you had to do to visualize it. You may wish to select the Settings | Projection | Instrument for this purpose.

(a) Is the Bow-Tie effect present in all channels? Is it more distinct in some channels? Try to identify a channel where the bow-tie effect is very distinct, and another channel where it is not distinct.

(b) Can you think of any possible applications of the scene oversampling introduced by the bow-tie effect?

1.2 Now load the full resolution subset as shown in Figure 2, and display band 1 ($0.66 \mu\text{m}$).

(a) Create a transect down the center of this region. Make sure you include some land, water, and cloud in the transect. Now select band 2 (0.87 μm) in the Multi-Channel Viewer window (the transect plot should update to show the band 2 transect). In this way, describe the general appearance of the transect plot for bands 1, 2, and 3 (e.g., where are the reflectances high, and where are they low).

QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.

Figure 2: Region selection for image artifacts

(b) Now view the same scene (with the transect plot active) for IR bands 31 and 27. Briefly describe differences in the images and transects from these two bands and classify the differences according to:

- atmospheric conditions
- instrument artifacts such as detector imbalance, bad detectors, and mirror side differences

(c) For band 27 only:

- What is the approximate peak-to-peak noise in the transect plot (in Kelvin), and what could be the cause?

- Does the observed pattern appear to be consistent (i.e., predictable) in the transect plot? Can you identify the period of the noise pattern?

- How would you correct the image (i.e., remove the striping) if:

The detectors are out of balance with each other?

One detector is behaving unpredictably?

All detectors are biased with respect to truth?

Close the Transect plot window when you are done with this question.

1.3 Now load band 8 (0.45 μm), which is used for ocean color retrievals. This band generally saturates over bright targets such as clouds or deserts. Examine different regions of the scene to find areas where band 8 saturates.

(a) What is the approximate saturation reflectance value in band 8?

(b) What is the saturation reflectance in bands 9, 12, 13, and 16 (0.443, 0.565, 0.653, 0.865 μm)?

(c) Other than clouds, what features in this scene cause these bands to saturate? You may need to examine other bands (e.g., 1, 2, 31) to answer this question.

Exercise 2: Examining destriped MODIS images

While keeping the Multi-Channel Viewer from Exercise 1 open, load the destriped Terra MODIS Level 1B file named MOD021KM.A2007140.0945.005.2007141001410.destripe.hdf and start a new Multi-Channel Viewer. In this file, thermal emissive bands 20, 22-25, 27-36, and reflected solar band 26 have been destriped by the method of matching empirical distribution functions.

2.1 Examine the destriped MODIS IR bands in the same way as Exercise 1.2 (b).

(a) Briefly note how the image quality has improved in the destriped MODIS bands, compared to the original data. Is the difference in image quality small or large for each band?

(a) Repeat the band 27 transect plot of Exercise 1.2 (c). What is your estimate for the peak-to-peak noise (in Kelvin) of the destriped band 27 data?