Notes on destriping MODIS Band 26

Chris Moeller, Scientist
Cooperative Insitute for Meteorological Satellite Studies
University of Wisconsin-Madison
2002

.

An effort was made to develop coefficients to correct MODIS Band 26 (1.38 um) earth scene radiances for striping and anomalous earth surface features. Pre-launch testing showed a possible spectral leak into band 26 from a spectral region near band 5 (1.24um). It is thought that this leak imparts earth surface reflectance into band 26 and may also be contributing directly or indirectly to striping in band 26. Using band 26 and band 5 earth scene radiances in moist regions (to isolate the out-of-band signal in band 26 radiance), detector based influence coefficients have been generated and tested on various granules. A simple model has shown promise

$$L_{26,\,i,\,cor} = L_{26,\,i} - A_i * L_{5,i}$$

where $L_{26,i}$ is B26 radiance ('cor' is corrected) for detector i, $L_{5,i}$ is B5 radiance for detector i, and A_i is the influence coefficient for detector i.

The correction effectively softens the striping in band 26 and eliminates most of the earth surface features from the image (see Figure 1); additional testing suggests that the influence coefficients contribute a 1-2% uncertainty on the corrected band 26 radiances.

Removing striping and anomalous surface features in Band 26 will improve the MODIS Cloud Mask by enabling the 1.38 um cirrus cloud test. Previously, the test threshold was assigned a high reflectance to reduce the impact of striping in MODIS band 26 on the Cloud Mask product. With a lower threshold, it is expected that the Cloud Mask will be able to detect cirrus with optical depths of about 0.01.

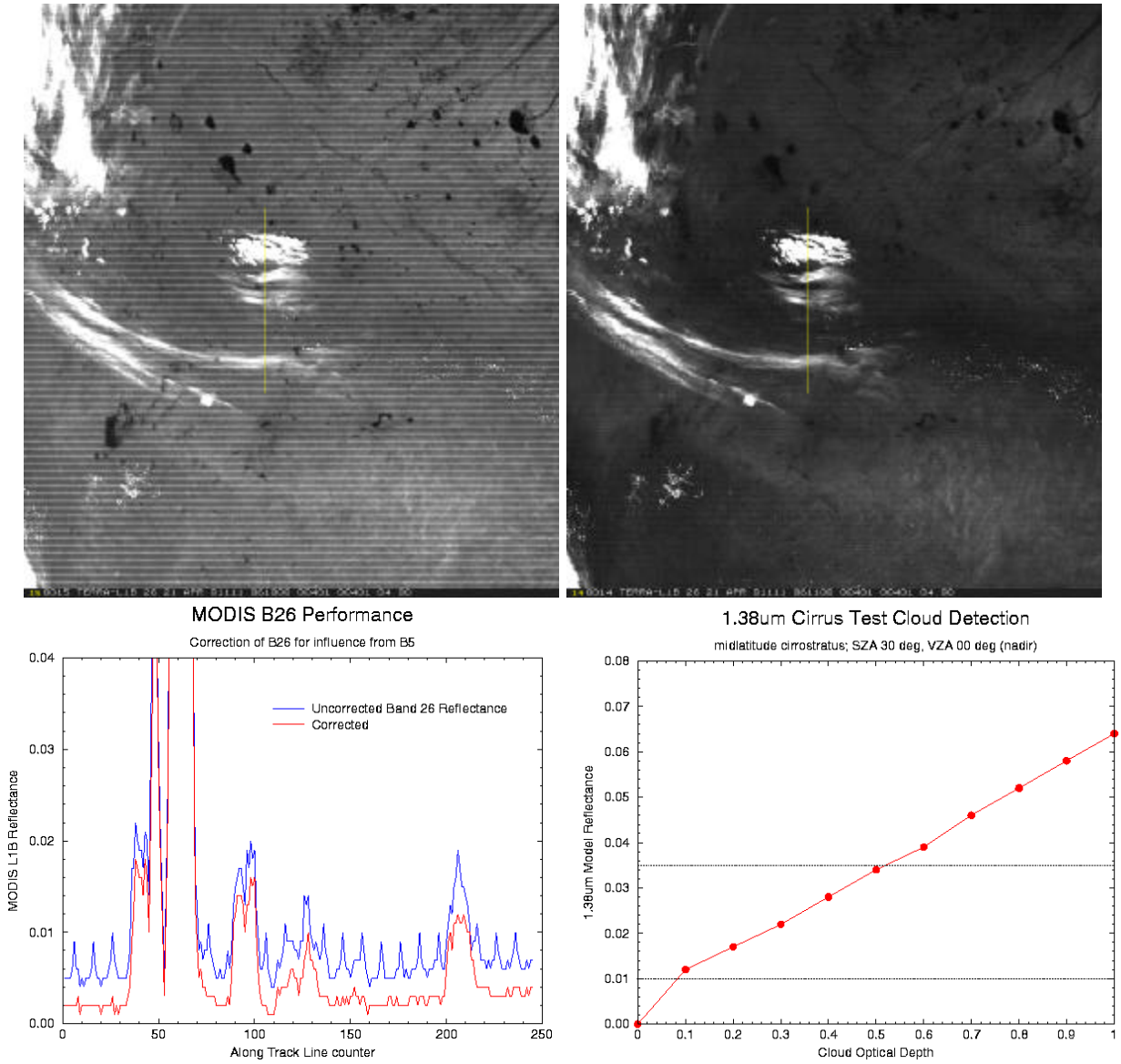

Figure 1. MODIS Band 26 L1B imagery on 21 April 2001 (left) and after correction for influence from spectral leak at Band 5 (right). Striping and surface reflection are much reduced in the corrected image. Along track profile (bottom left) shows diminishing of striping (regular blue spikes are muted in the red trace) and reduction of surface reflectance (elevated average signal of blue trace versus red trace) in the corrected data, effectively increasing the contrast between cirrus cloud features and the background. The reduction of striping and surface reflectance will allow the cirrus cloud threshold to be reduced to near 0.01 reflectance (lower right), allowing cirrus cloud with optical depths as low as 0.01 to be detected.

Coefficients to correct MODIS Band 26 (1.38um) earth scene radiances for striping and anomalous earth surface features have been developed and delivered to the MODIS Calibration Support Team (MCST) for implementation in DAAC Terra MODIS L1B processing. The coefficients will be available for use in processing the Terra MODIS Collect 4 data set. Separate coefficients were developed for MODIS A-side 1, B-side, and A-side 2 operational configurations. The coefficients demonstrate dependence on the MODIS configuration (Figure 2). Testing the correction algorithm has shown that surface land features and striping are largely removed from the band 26 imagery (Figure 3), in agreement with forward model simulations. The corrected radiances in tropical regions become slightly negative in many cases; however, this is not unexpected as random noise in band 26 is capable of driving a low signal negative. High contrast zones such as coastlines also exhibit a weakness in the correction procedure; this is likely due to an additional optical crosstalk from band 6 into band 26. Since the impact is low, this will remain uncorrected. Early review of Aqua MODIS data shows similar behavior in band 26, suggesting that a similar correction may be useful when processing Aqua MODIS data to L1B.

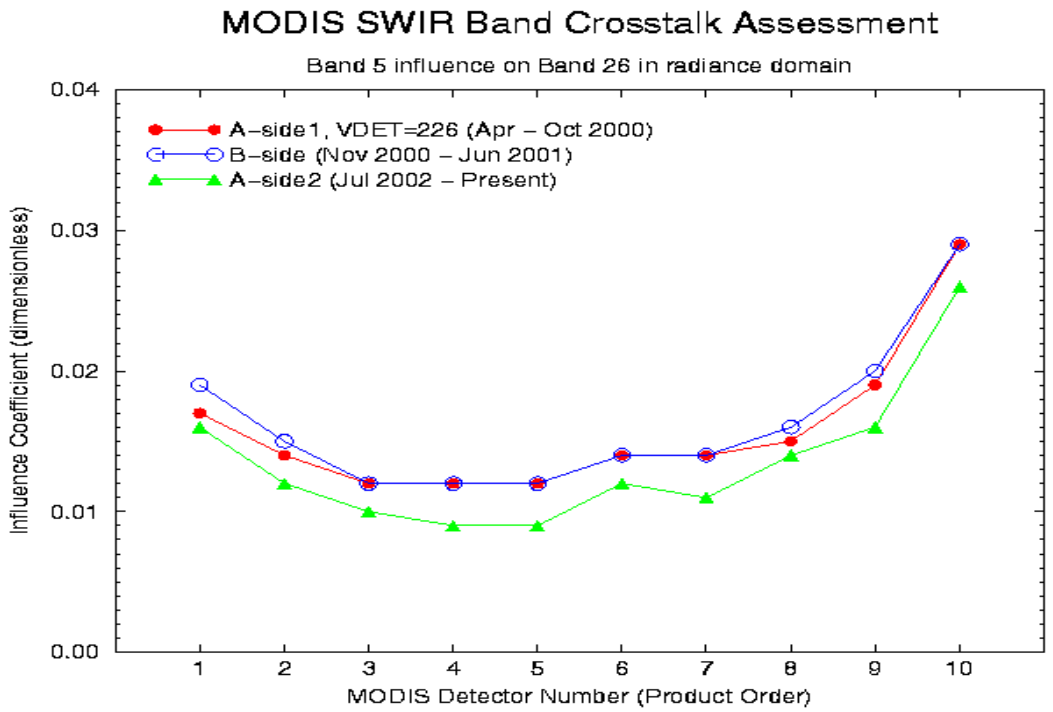

Figure 2: MODIS Band 26 correction coefficients for A-side, B-side, and A-side 2 configurations. A-side and B-side coefficients are very similar; however A-side 2 shows dependence on the configuration. The coefficients are detector dependent within each configuration to reduce detector striping.

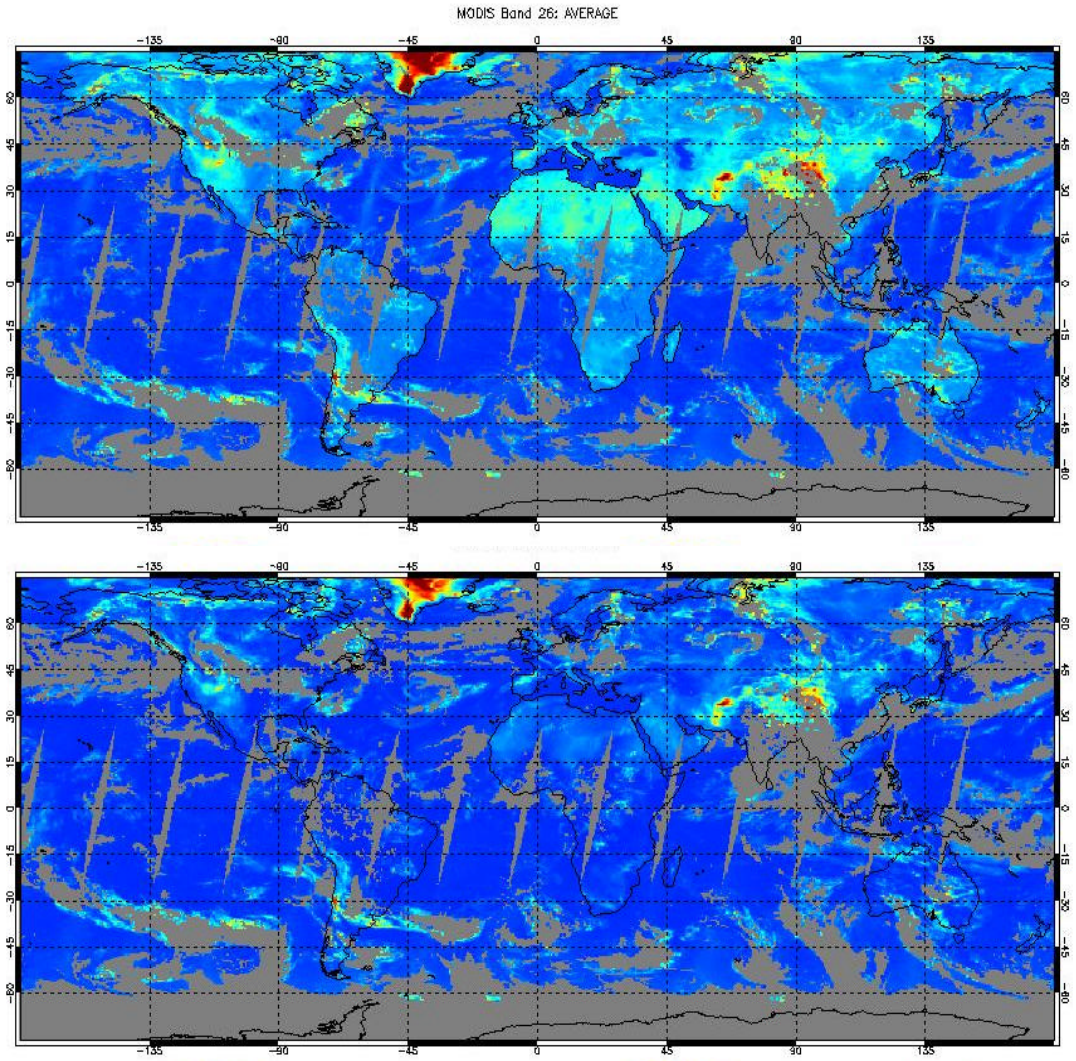

Figure 3: MODIS Band 26 global average clear sky radiance maps for uncorrected (top) and corrected (bottom) band 26 radiances. Uncorrected radiances show effects of land surface reflectance; much of this is removed in the corrected band 26 data, improving the contrast between thin cirrus cloud and the low reflectance clear sky background. Regions with small atmospheric water vapor (e.g. Greenland, Himalayan and Andes Mountains) show up as high reflectance features due to surface reflectance reaching the top of atmosphere in the absence of cloud. Gray areas are zones of cloudiness or no data coverage.