Collection 6.1 Terra MODIS IR Bands (MOD021KM) Calibration Change Supplement

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by Chris Moeller and Rich Frey (University of Wisconsin)

IR Band Calibration (MOD021KM)

The Terra MODIS Photovoltaic (PVLWIR) bands 27-30 are known to experience an electronic crosstalk contamination. The influence of the crosstalk has gradually increased over the mission lifetime, causing for example, earth surface features to become prominent in atmospheric band 27, increased detector striping, and long term drift in the radiometric bias of these bands. The drift has compromised the climate quality of C6 Terra MODIS L2 products that depend significantly on these bands, including cloud mask (MOD35), cloud fraction and cloud top properties (MOD06), and total precipitable water (MOD07). A linear crosstalk correction algorithm has been developed and tested by MCST. It uses band averaged influence coefficients based upon monthly lunar views by Terra MODIS and has been adopted for implementation into C6.1 operational L1B processing (Wilson et al. 2017). In stressing test cases from selected time periods of the Terra mission lifetime, the correction algorithm maintains or restores the MODIS PVLWIR band radiances to nominal performance as indicated through comparisons to Aqua MODIS radiances. The Figure 1 example for band 29 shows that the crosstalk influence has increased over time, driving the Terra MODIS C6 brightness temperatures (red) away from the C6 Aqua MODIS brightness temperatures (blue). For crosstalk corrected C6.1 data (green), the Terra and Aqua MODIS brightness temperatures are brought much more closely into agreement.

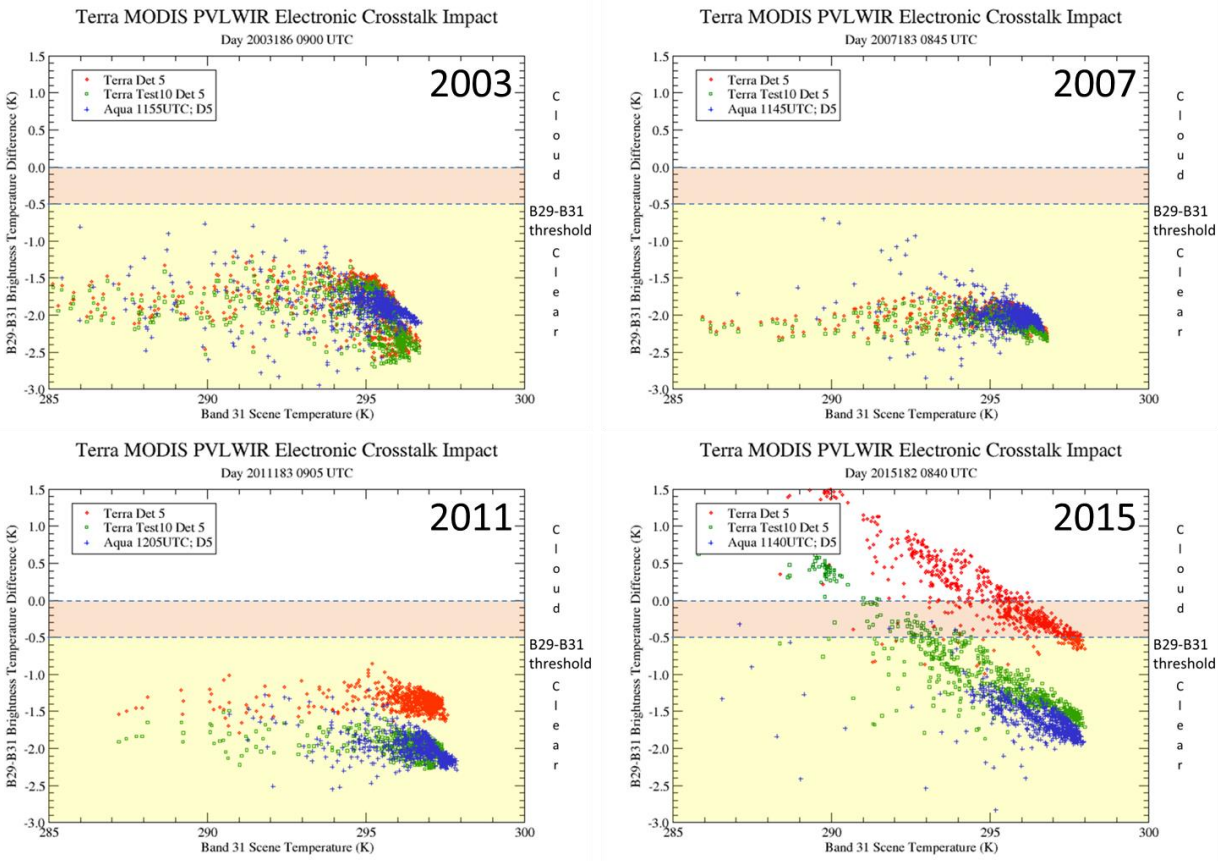

Figure 1. Terra MODIS B29-B31 brightness temperature difference examples for data scenes in four separate years. After crosstalk correction (green), B29-B31 differences closely match Aqua MODIS B29-B31 differences (blue) for all years. The initially very small correction increases through the mission.

Terra MODIS high latitude simultaneous nadir overpasses (SNOs) with MetOp-A IASI provide insight on MODIS long term radiometric trending. C6 biases and trends easily exceed 1 K in bands 27 and 30 over the eight year period in Figure 2, indicating that the MODIS C6 L1B radiances of these bands are not useful for climate science. The sharp increase in the B27 bias for April 2016 reveals a significant change in band 27 performance after the February 2016 Terra safe mode event. The safe mode event resulted in a significant increase in electronic crosstalk for all PVLWIR bands. Bands 28 and 29 show trends that are closer to 0.5 K over the period. Although these are smaller trends, they nevertheless impact L2 products. Further, evidence from these products suggests that the trends are significantly larger for each PVLWIR band in warm scenes such as exist in the low latitudes of the tropical zone. Unfortunately, there are no low latitude SNOs between Terra and MetOp-A with which to verify this behavior in L1B radiances.

The MODIS C6.1 biases and trending are significantly reduced compared to C6 (Figure 2). In B27 the trend reduces from about -2 K for these SNO scenes down to about 0.5 K over the 8 year period, (and would be less but for the April 2016 data point after the safe mode). The band 30 trend, while significantly reduced in C6.1, is still about 1.0 K, suggesting that the crosstalk correction is not as effective for this band as for the other PVLWIR bands. Trends in band 28 and 29 are reduced to < 0.2 K. Biases in all bands are smaller (closer to zero) in C6.1.

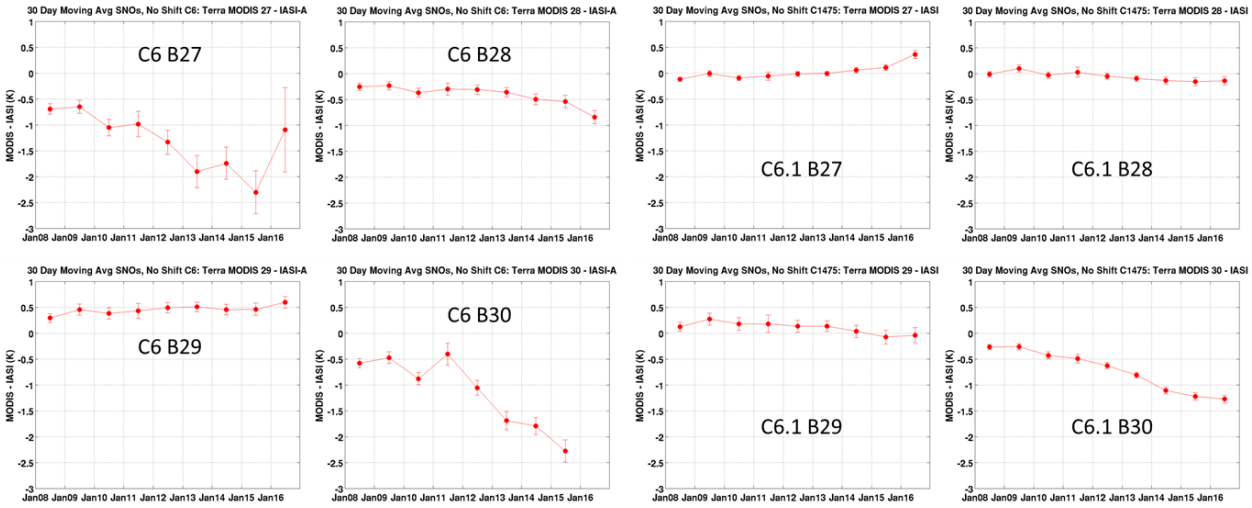

Figure 2. Terra MODIS radiometric bias trends based upon high latitude SNO comparisons with MetOp-A IASI for C6 (left 4 panels) and for C6.1 (right 4 panels). After crosstalk correction (C6.1), radiometric trends are greatly reduced, with exception of B30 which still shows trending over the 8+ years of data.

Reference

Wilson, T., A. Wu, A. Shrestha, X. Geng, Z. Wang, C. Moeller, R. Frey, and X. Xiong. Development and Implementation of an Electronic Crosstalk Correction for Bands 27-30 in Terra MODIS Collection 6. *Remote Sens*., 9, 569, 2017, doi:10.3390/rs9060569.