MODIS Land C61 Changes

1. Introduction

The land products are being reprocessed through this minor reprocessing campaign (Collection 61) mainly to address known issues and inconsistencies in the C6 L1B products revealed by the MODIS Calibration Science Team (MCST) after the completion of the C6 reprocessing. This reprocessing will also include improvements to some of the land products from code change to address known issues in the operational C6 products and make additional new land products not generated in the C6 reprocessing. Some of the C61 calibration changes and the land product specific changes were put in operation in the C6 forward processing. The C61 reprocessing when completed is expected to provide user with temporally consistent set of land product suite from the full mission period of Terra and Aqua.

2. C61 Level-1B (L1B) Calibration Changes

a. **Change to Response-versus-Scan angle (RVS) approach that affects reflectance bands for Aqua and Terra MODIS**: A change in the RVS approach that uses fixed desert sites was implemented in C6 for Terra MODIS from the beginning of the Terra mission from 24 Feb 2000 onwards and for Aqua MODIS from 27 July 2016 onwards. The C6.1 reprocessing will apply this change in RVS approach to calibration of reflectance bands from the beginning of the Aqua mission from 25 June 2002 onwards, as well.

b. **Correction to adjust for the optical crosstalk in Terra MODIS Infrared (IR) bands:** The C6 Terra MODIS products, especially cloud products were negatively impacted by the optical crosstalk in IR bands (B27 – B30). Though the crosstalk issue was present from the beginning of the mission, its impact on the product wasn't significant, and not noticeable until after year-2009. The IR crosstalk effect became more significant following the MODIS Terra safe hold in February 2016. The C6.1 reprocessing implements an approach to correct this crosstalk in the calibration from the beginning of the mission through the safe hold period and into the forward processing period. For more detailed information see the Terra IR Bands Calibration Change Supplement at https://modis-atmosphere.gsfc.nasa.gov/documentation/collection-61

c. **Correction to the Terra MODIS forward Look-Up Table (LUT) update for the period 2012 - 2017**: The C6 Terra L1B data products from the period 1 January 2012 (2012 001) through 11 February 2017 (2017 042) were generated using faulty calibration LUTs because of an error in the process generating the routine forward LUT updates by the MODIS Characterization Support Team (MCST). This error, which was fixed in January 2017, affected bands 1 and 2 only and had extremely minor impact on Atmosphere Team products. The C6.1 reprocessing will fix this error.

3. **C61 L1B Polarization correction to the RSB bands**

The C61 L1B Polarization Correction (PC) addresses some of the shortcomings that were noted in the C6 PC approach, namely:

a. The C6 PC coefficients for Terra do not extend beyond year 2013 and thereafter no incremental updates were made for C6. The coefficients for all years beyond year 2013 are an extrapolation since the end of 2013. In C61, these PC coefficients have been updated, based on latest set of L1B LUTs from Ocean Biology Processing Group (OBPG).
b. The Terra gain-factors for C6, based on cross-calibration with Aqua, were derived prior to a change to RVS corrections approach for Aqua by MCST, which was put in forward production in C6 from 27 July 2016 onwards. Thus, in C61, the gain-factors for Terra have been updated based on Aqua L1B that incorporates this change in Aqua RVS correction approach. This change to Aqua RVS correction approach has already been described in section 2.
c. Some of the band specific detrending coefficients, have been updated in C61 for both Terra and Aqua, after taking into consideration the latest approach for RVS correction for Aqua and the corrected gain-factors for Terra.

4. Changes to Atmosphere Cloud Mask

The C61 MODIS cloud mask science algorithm is exactly the same as the one that was used for C6. Improvements in the C61 cloud mask performance arises solely from the implementation of an electronic cross-talk correction for the MODIS Photovoltaic (PVLWIR) bands 27-30 in C61 L1B.

5. Land Product specific Changes

a. Snow (MxD10):
    i. Minor code change to L2 snow to reduce the ice/snow commission errors over land and inland water bodies.
    ii. Addition of a new Cloud Gap Filled Daily L3 Snow product (MxD10A1F) that maximizes snow extent over cloud covered areas and tracks the persistence of cloud coverage unless it is reset at the beginning of every "water year" or first day of temporal coverage.
b. LC (MCD12Q1 and MCD12Q2)
    i. Minor fix to UMD Land Cover Class in C6 MCD12Q1/C1
    ii. Known issue in C6 MCD12Q2 to improve the snow filtering approach.
c. VI (MxD13 Suite): Following changes were implemented and put in operation in C6 forward processing starting data day 2017 257 (14 September 2017)
    i. Bug fixes for VI usefulness bit reset, address an issue related to spikes of large VI values, Code changes to improve product quality, Improved logic for compositing to optimize NDVI under 30VZA for good quality data, Backup EVI equation updated to use the EVI2
d. Evapotranspiration (MxD16) and GPP/NPP (MCD17):
    i. Use Climatology LAI/FPAR as back up to the operational LAI-FPAR
e. DSR/PAR (MCD18):
    i. Change in resolution of tiled product from 5km to 1km

ii. Add CMG products

f. MAIAC (MCD19):
    i. Add 250m resolution bands
    ii. Generate MCD19A3 as daily product
    iii. Addition of MAIAC MCD19A1/A2 CMG products.
g. JPL LST (MxD21):
    i. Use GEOS data replacing MERRA2
    ii. Add CMG products (MxD21C1/C2/C3)
h. VCF:
    i. Fix for LWM in the intermediate process - where the water mask over some land tiles in the higher latitudes was showing some discrepancy, when compared to the similar product generated at SCF. This fix was put in forward production in C6 since data day 2019001 (1 January 2019)