NASA's Gap-Filled Collection 6 MODIS Gross and Net Primary Production Data Products, MOD17A2HGF, MOD17A3HGF, MYD17A2HGF and MYD17A3HGF

1. Introduction

Starting from the Collection 6 (C6), NASA MODAPS is generating the year-end gap-filled MODIS 500m Gross, Net Photosynthesis, and Net Primary Production (GPP/PsnNet/NPP) data products, using the same science algorithm that is used to generate the Collection 5.5 (C5.5) improved 1km MOD17 by the Science Computing Facility (SCF) at the Numerical Terradynamic Simulation Group (NTSG) in University of Montana. Due to limited resources, NTSG has no plan to extend or update the C5.5 MOD17 data from 2015 onwards and the C5.5 NTSG version will be decommissioned in the future, once the MODAPS C6 version becomes available through the DAACs. This document provides general information on the major differences between the two and known issues, to facilitate the user community. Users are requested to read this document and familiarize themselves with the MODAPS C6 version of the gap-filled M*D17 products that are further discussed below and make plans to switch to this version. Section 2 describes the MODAPS version of the gap-filled M*D17GF data products, while section 3 lists the major differences between the NTSG and MODAPS M*D17GF and their causes, and finally, section 4 highlights the known issues in MODAPS C6 version of the products and any science updates planned for C6.1. To be concise, we use M*D to refer to MOD or MYD, and M*D17 refers to both 8-day M*D17A2 and annual M*D17A3. For more details on the data products, user are encouraged to read the user guide for the C6 MOD17 (Running and Zhao, 2019), available at https://landweb.modaps.eosdis.nasa.gov/QA_WWW/forPage/user_guide/MOD17UsersGuideV4.2June2019.pdf

2. Year-end Gap-filled C6 M*D17A2HGF and M*D17A3HGF

The C6 non-gap-filled operational M*D17 products from MODAPS pose an issue for users to directly use the data. This is because the estimated 8-day GPP/PsnNet and annual NPP contain some unreliable estimates due to contaminated FPAR/LAI inputs from 8-day M*D15A2H with bad quality. The bad quality is mainly caused by the unfavorable atmospheric conditions such as cloudiness and/or high-level aerosol, resulting in unreliable FPAR/LAI retrieval even with the 8-day data compositing process. In most cases, the contaminated GPP/PsnNet and NPP have lower values compared to valid estimates, because of contaminated or unreliable input FPAR/LAI. To address the issue, NTSG had adopted the method proposed by Zhao et al. 2005 to generate an improved, year-end gap-filled C5.5 MOD17. This same algorithm is now being used at MODAPS to produce the gap-filled variation of the operational M*D17 (M*D17HGF). At the end of each year, when the entire 8-day operational M*D15A2H are available, an independent process first generates the gap-filled FPAR/LAI (M*D15A2HGF). The process is based on the method proposed by NTSG (Zhao et al., 2005) and employs a temporal gap-filling algorithm to fill in all pixels with bad FPAR/LAI data quality for any 8-day period. Then, this M*D15A2HGF is used as input to the M*D17 algorithm to generate the M*D17A2HGF (8-day) and the M*D17A3HGF (annual) gap-filled variations. As the gap-filled FPAR/LAI product (M*D15A2HGF) filled those

FPAR/LAI flagged with bad-quality, the 8-day M*D17A2HGF have higher GPP and PsnNet on average than the corresponding operational M*D17A2H (Figure 1).

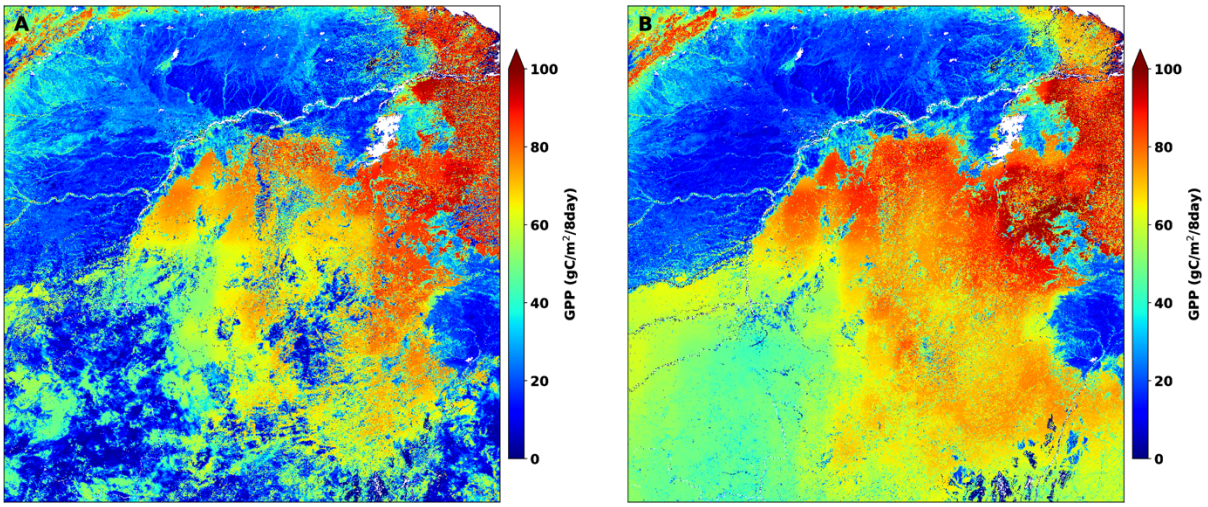

Figure 1, Comparison of total GPP from the operational C6 MOD17A2H (A) and C6 MOD17A2HGF (B) for title h11v08 which covers part of cloudy Amazon in 8-day 2005057. The mean GPP value is 39.996 and 49.714 gC/m²/8day for A and B respectively.

3. Differences between the C6 M*D17HGF and the NTSG improved C5.5 MOD17

There are some obvious and expected differences between the MODAPS M*D17GF and the NTSG C5.5 M*D17 products that are caused by differences in inputs and resolutions. Some of these are listed below that are known to cause major differences between the MODAPS gap-filled C6 M*D17GF and the NTSG's C5.5 improved MOD17:

1) M*D17HGF products are produced for both Terra (MOD) and Aqua (MYD) satellites whereas NTSG MOD17 is only produced for Terra.
2) M*D17HGF is using operational global meteorological data generated by the GEOS system at GMAO/NASA, whereas NTSG MOD17 used global meteorological data from NCEP Reanalysis II generated by NOAA's Earth System Research Laboratory (ESRL/NOAA) as inputs.
3) M*D17HGF is using MCDLCHKM, a quasi 3-year 500m land cover data, as input whereas NTSG MOD17 used a fixed Collection 4 MODIS land cover (MOD12Q1) across the entire data periods.
4) M*D17HGF uses the gap-filled MODIS 500m FPAR/LAI (M*D15A2HGF*) products that are in-turn based on C6 8-day 500m M*D15A2H and hence, are current up to 2019 and will be updated in future. On the other hand, NTSG used C5 1km MODIS FPAR/LAI (MOD15A2) data as input that ended in 2015, with the decommissioning of MODAPS C5 products.
5) Annual M*D17A3HGF has no data field for annual total GPP whereas NTSG MOD17A3 has this parameter.
6) From 2000 to 2015, the correlation between global terrestrial annual total NPP and global annual atmospheric CO_2 growth rate is -0.594 for NTSG MOD17A3 and 0.034 for MOD17A3HGF, respectively. Because of the important role of interannual climate

variability on NPP variations and change (Nemani et al, 2003; Zhao and Running, 2010), such large differences in the correlation imply the large impacts of differences in two different meteorological data drivers, GEOS data from GMAO/NASA and NCEP Reanalysis II from ESRL/NOAA, on the estimated NPP and its inter-annual variations. Science team at NTSG is researching these differences.

4. Known issues of C6 M*D17HGF and Plan for C6.1

As mentioned above, annual M*D17A3HGF has no total GPP data field whereas NTSG MOD17A3 has. For user community, annual total GPP is an important ecological metric besides annual total NPP. Though users can get annual GPP through processing all of the 46 8-day M*D17A2HGF files, the work will be laborious and adding it as a new data field in annual M*D17A3HGF would greatly facilitate user community. C6.1 annual M*D17A3HGF will include annual total GPP as a new data field with a name "Gpp_500m". Moreover, a climatology FPAR/LAI intermediate product (MCD15A2HCL*) will be used as backup to replace all pixels with bad FPAR/LAI data quality for operational C6.1 M*D17 whereas year-end C6.1 M*D17HGF will still use the gap-filled M*D15A2HGF* at the end of each year.

*Note that the M*D15A2HGF and the MCD15A2HCL, discussed in this document are intermediate products and are currently not distributed to general users.

References:

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