Overview of MODIS and VIIRS Top-Of-Atmosphere Reflectances and Radiances Aggregation Algorithm

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What are we trying to do?

- Calibration drifts and offsets of the sensors tend to impact the interpretation of science products.
- Moving from one version of L1B LUT to next also have shown to impact the downstream products
- Generate Level 3 like aggregations of Level 1B calibrated top-of-atmosphere radiance and reflectance data.
- Time series of this data over time would provide differences between sensors (Terra and Aqua or SNPP and J1/J2, etc.)
  - Some differences would come from diurnal cycles of clouds and aerosols
  - Some from the calibration offsets and drifts
- This data set will provide a nice diagnostic for quality assurance of downstream products.
How does this Aggregation Algorithm work?

• An existing tool from LDOPE was used to develop this algorithm

• We use the 5km sub-sampled coarse L1B calibrated reflective and emissive data
  • MODIS - MxDO2SSH
  • VIIRS - VNP02MODC, VNP02IMGC

• Observations are filtered to use only the day time pixels
  • Day time is observations with the solar zenith angle less than 81.36°

• This 5km granules are projected into a global equal latitude/longitude projection
  • Resulting in a 5kmx5km gridded product

• Overlapping orbits begins around 60°N/S latitude reaching to a maximum of 16 orbits towards the pole for MODIS and 14 orbits for VIIRS.

• The gridded 5km data is then averaged to 1degx1deg resolution
What we have done so far.

• Developed the algorithm as a stand alone tool.
• We tested this on MODIS (Terra and Aqua) and VIIRS (SNPP) to generate daily and monthly gridded L3 calibrated radiance data from multiple bands.
  • Can be implemented to other sensors
• For aggregation we use sensor geometry as a variable in gridding.
• We are hoping this can be used as a tool to understand if the performance of science data products is being impacted from the L1B data.
  • In case of Terra and Aqua how much they diverge from each other.
Daily Terra MODIS C61 0.65 µm Band1 reflectance

- Reflectance aggregated based on view zenith angle
  - -60.0 to -30.0
  - -29.9 to 29.9
  - 30.0 to 60.0

Horvath et al., 2013
Daily SNPP-VIIRS NASA L1B M7 reflectance

-60° to + 60° view zenith angle
MODIS-Terra monthly mean (April 2016) at different sensor zenith angle range
Aqua Band 2 – 0.86µm
SNPP VIIRS M7 – 0.86µm

Zonal Mean Time series
-60 to +60 deg view zenith angle
Climate Record Challenges - Calibration Story #1

Terra MODIS Liquid water Cloud Optical Thickness (COT) Trends
18-yr time series, ±60° zonal mean

- Land:
  - C6: -2%/dec
  - C51: -13%/dec

- Ocean:
  - C6: -0.5%/dec
  - C51: -6%/dec

Influence of:
- 0.67 µm channel calibration drift
- 0.86 µm drift
Climate Record Challenges - Calibration Story #2

Terra MODIS Cloud Fraction Trends

18-yr time series, ±25° zonal mean over ocean

influence of IR crosstalk impacting 8.5 µm channel (primarily)

C6.1: ~0.1%/dec
Summary

• This kind of L3 like L1B calibrated top-of-atmosphere reflectance and radiance data would be very useful and help us identify the impact of calibration or offset on the downstream products sooner.

• In case of continuity products this would help to point out one sensors’ offset in reference to the other.

• And help the science team make the required corrections in the downstream product algorithms and maintain the climate record.

• We appreciate if MCST and VCST could support and assist us with this algorithm.