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.

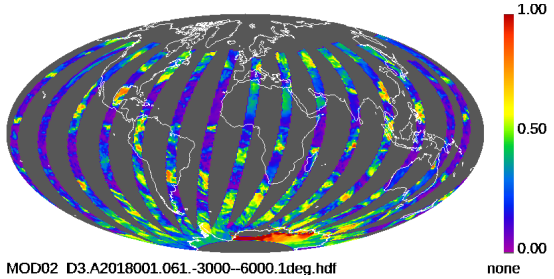
How does this Aggregation Algorithm work?

- 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 - MxD02SSH
  - 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^{o}
- This 5km granules are projected into a global equal latitude/longitude projection
  - Resulting in a 5kmx5km gridded product
- Overlapping orbits begins around 60^{o}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

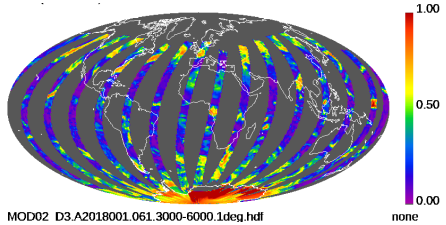
What we have done so far.

- 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
  - https://modis-images.gsfc.nasa.gov/vmanohar/L1B_aggr/MOD02_D3/index.htm
- 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.

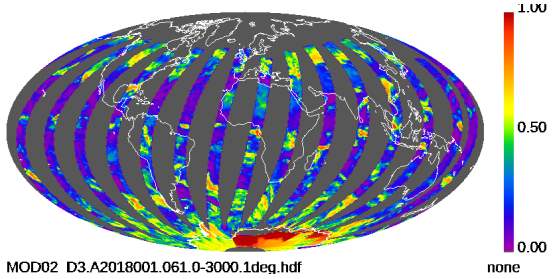
View zenith -60 to -30 deg

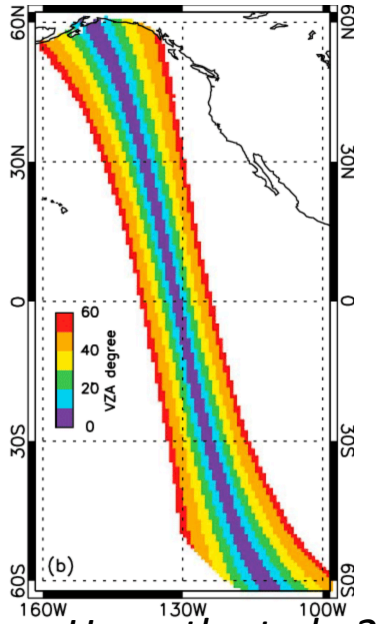


View zenith 30 to 60 deg



View zenith -29.9 to 29.9 deg

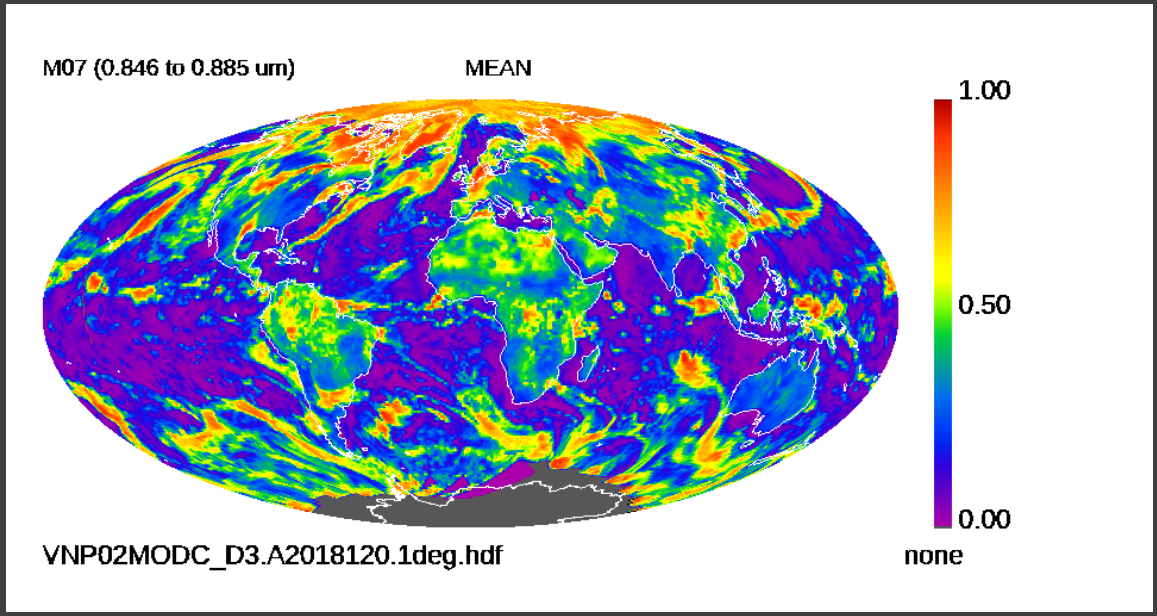


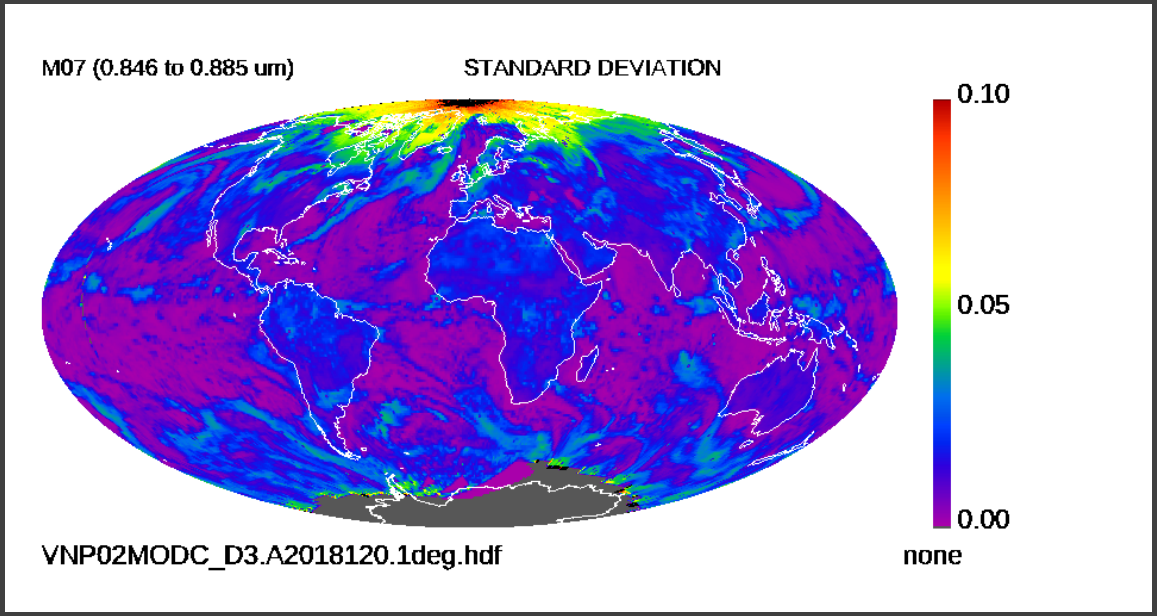


Horvath et al., 2013

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





Daily SNPP-VIIRS NASA L1B M7 reflectance

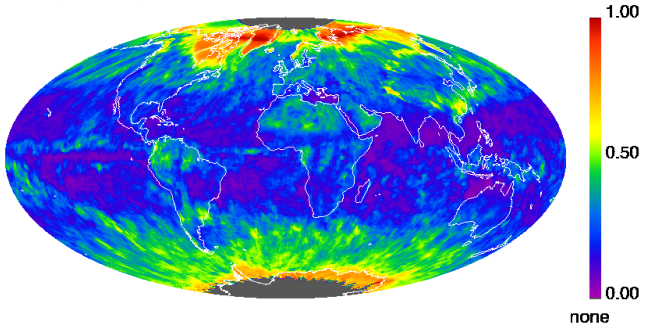
-60^{o} to + 60^{o} view zenith angle

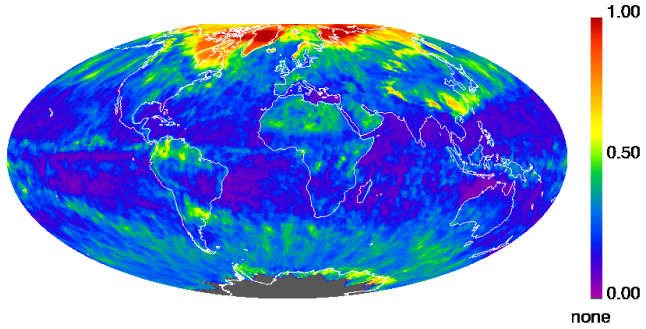
-60 to -30 deg

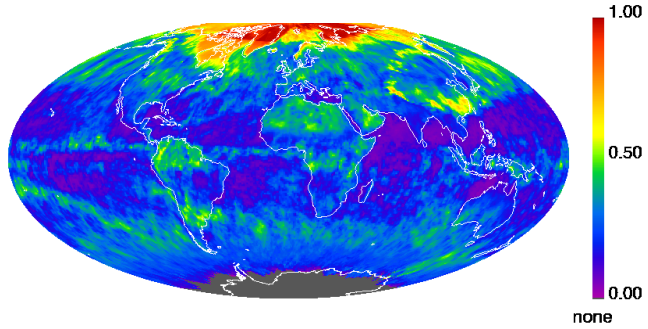
-29.9 to +29.9 deg

30 to 60 deg

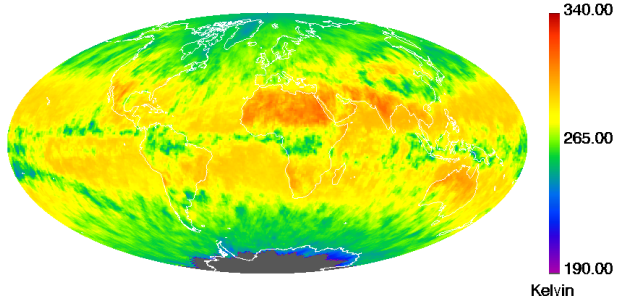
Band 1 - 0.65µm

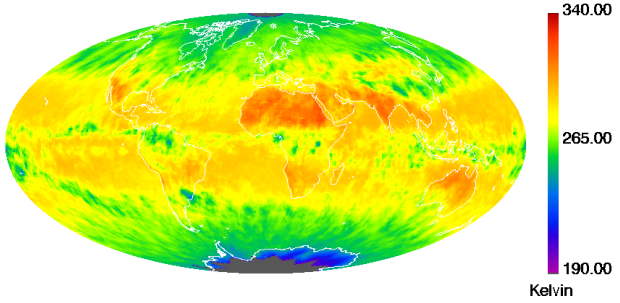


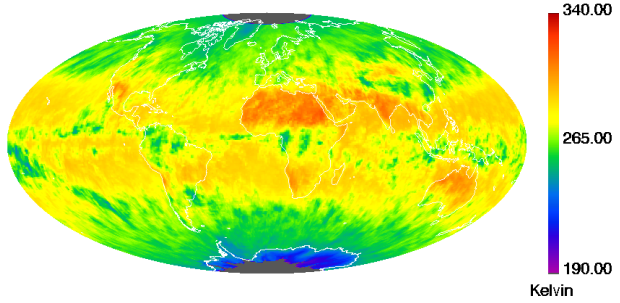




Band 31 – 11µm



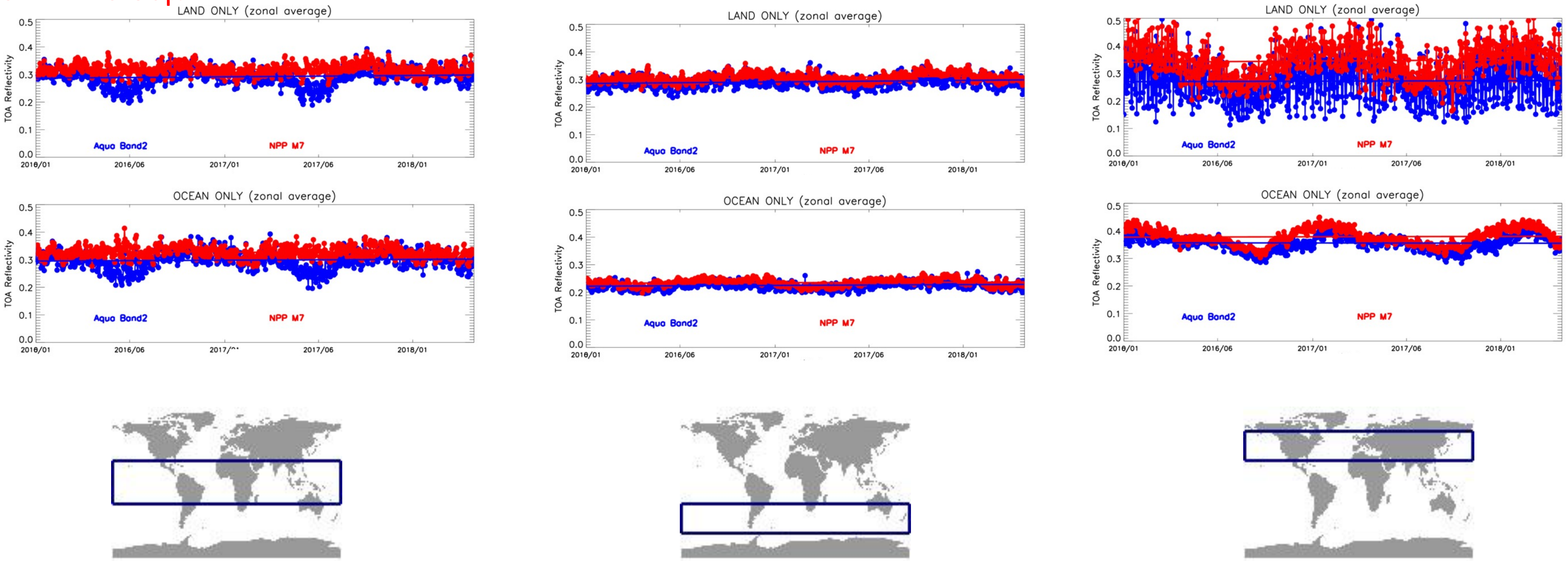




MODIS-Terra monthly mean (April 2016) at different sensor zenith angle range

Aqua Band 2 – 0.86µm

SNPP VIIRS M7 – 0.86µm



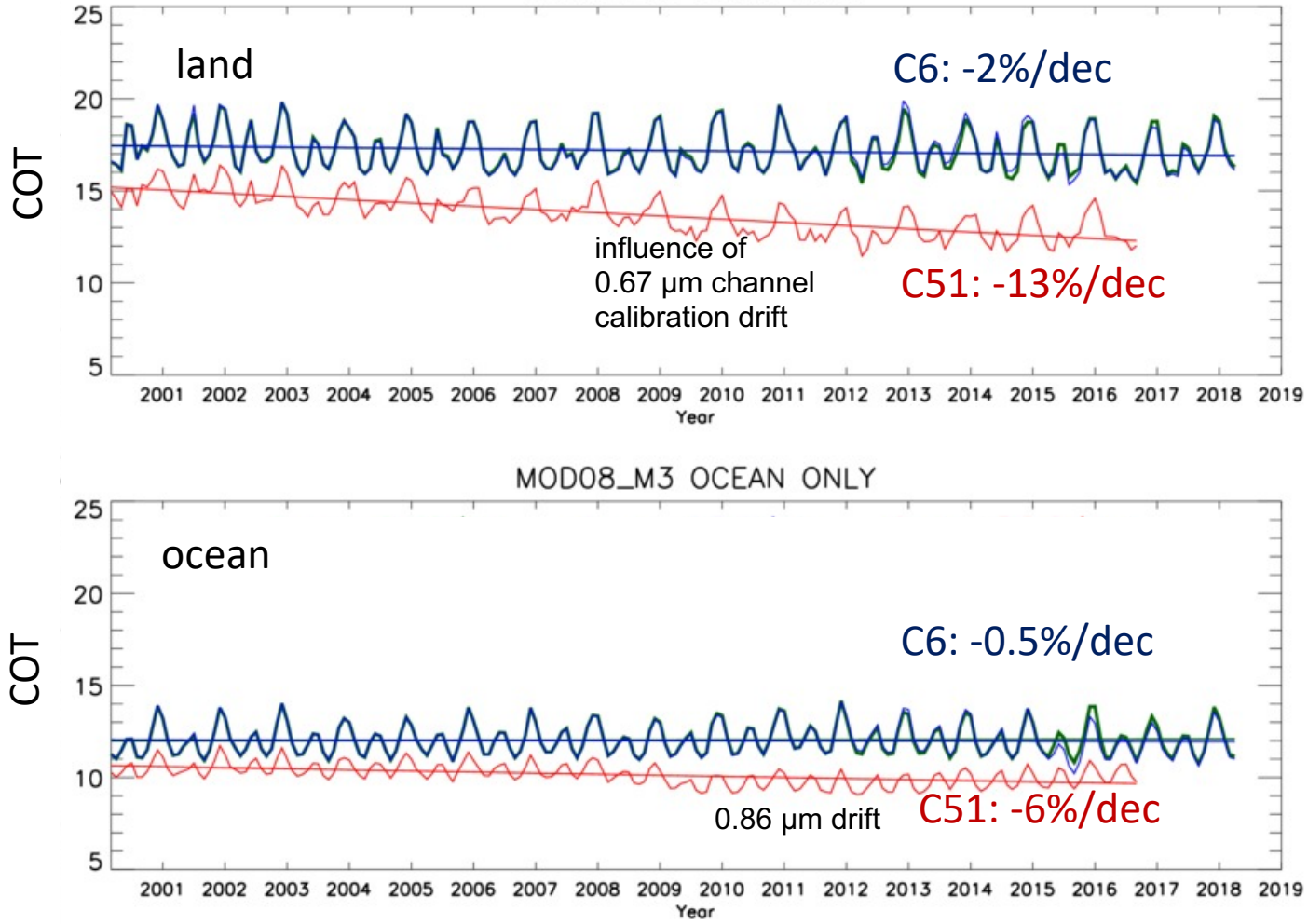
Zonal Mean Time series

-60 to +60 deg view zenith angle

Climate Record Challenges- Calibration Story #1

Terra MODIS Liquid water Cloud Optical Thickness (COT) Trends

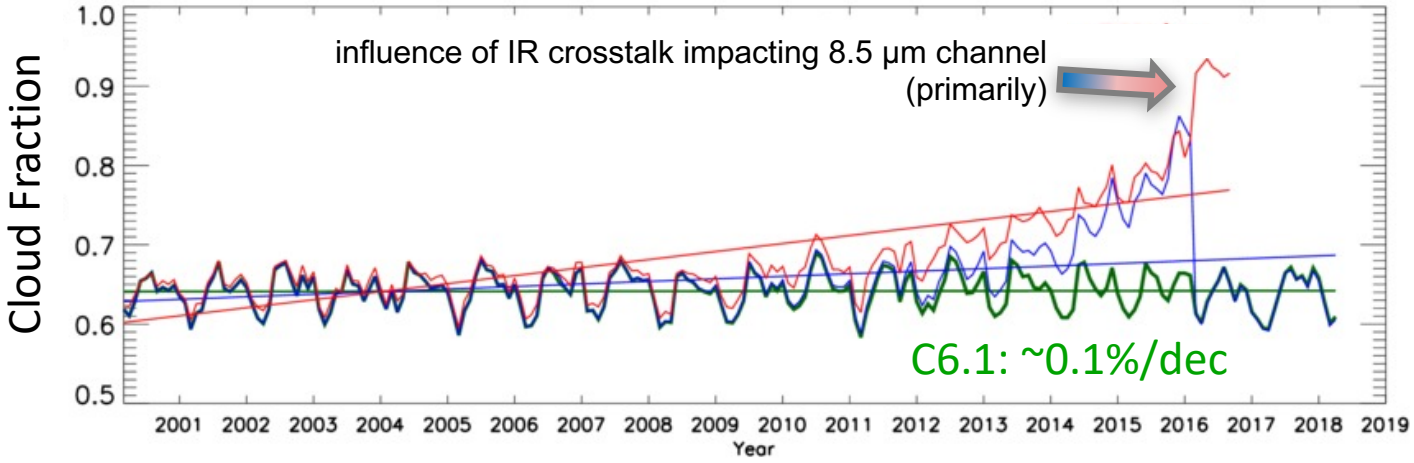
18-yr time series, ±60° zonal mean



Climate Record Challenges- Calibration Story #2

Terra MODIS Cloud Fraction Trends

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



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.