The newly revised GSICS DCC Calibration ATBD for GEO imagers: *Community feedback and Discussion*

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Newly revised DCC-IT Calibration ATBD highlights

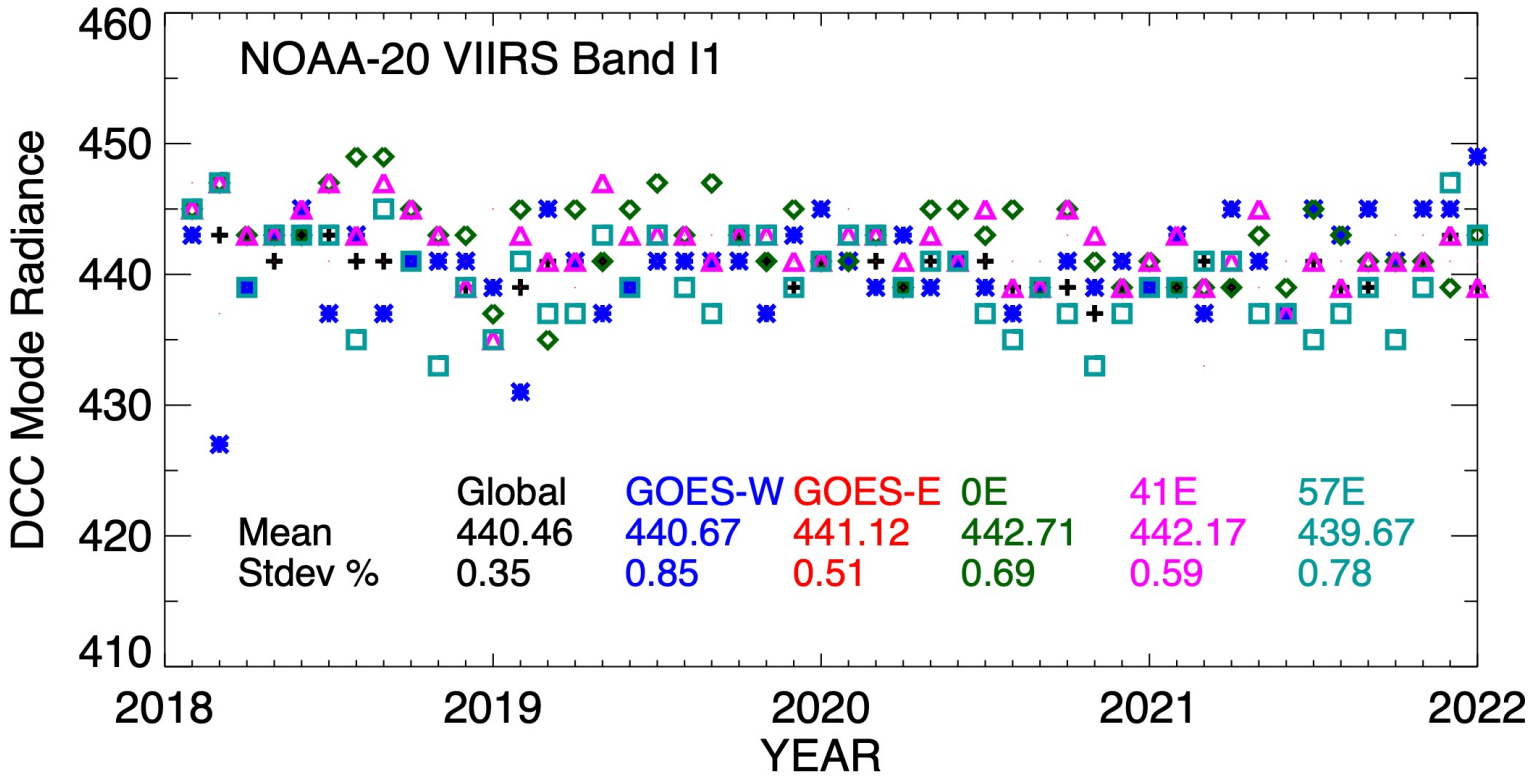
- *Extends the methodology to all spectral channels between 0.4-1.0 µm*
- *Uses the most recent and well-calibrated NOAA-20 VIIRS sensor as a reference instrument for DCC characterization*
- *IR BT threshold normalization between GEO and VIIRS for consistent DCC sampling and response*
- *Seasonal corrections of GEO monthly DCC response*
- *Spectral corrections using NASA Langley's robust online SBAF computation tool*
- *PDF bin optimization (0.2-0.4% of Mode)*

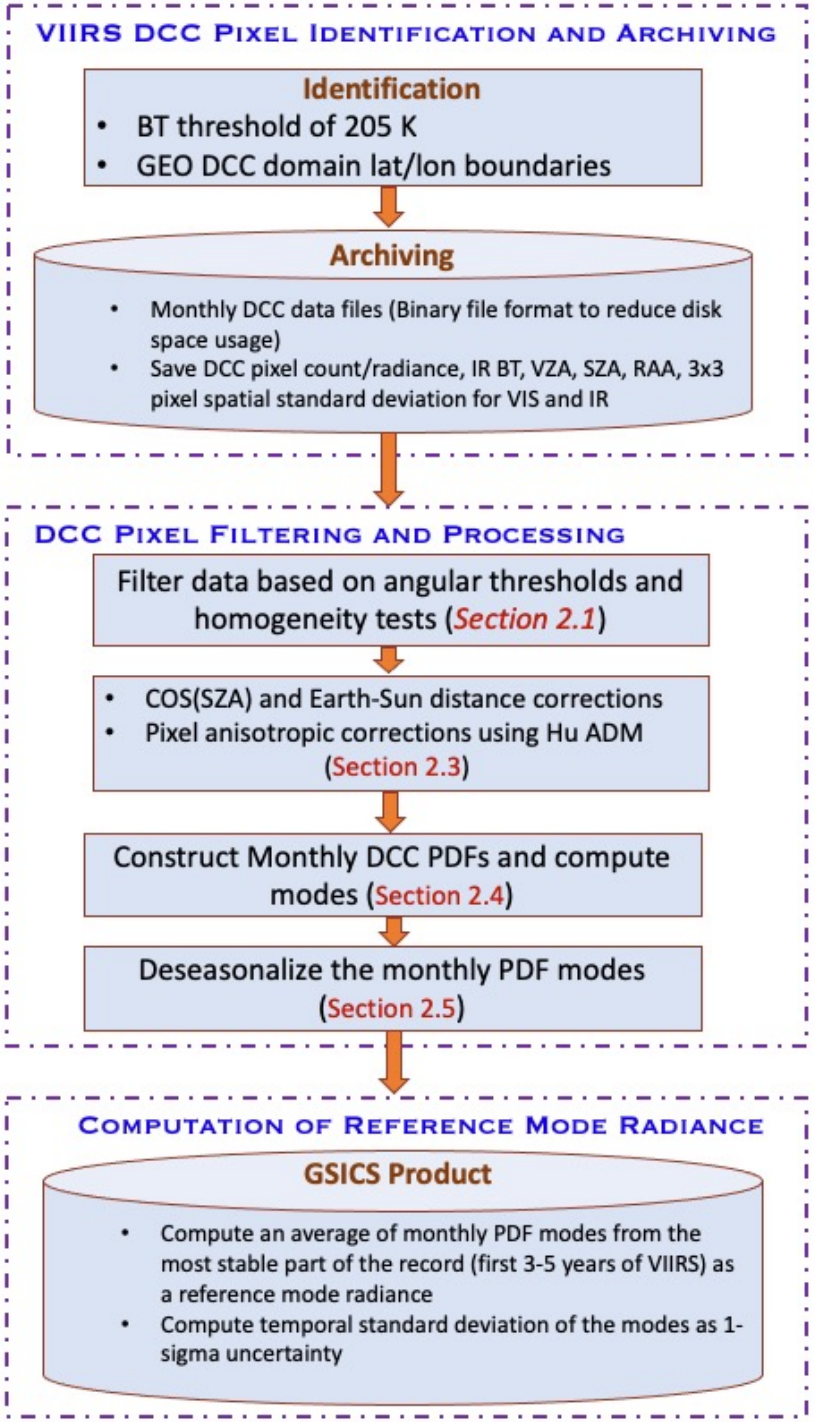
Key assumptions of DCC-IT calibration method

- **DCC-IT inter-calibration technique relies on a large ensemble of tropical DCC pixels identified using similar thresholds for reference LEO and target GEO sensors**
- **DCC-IT does not require simultaneous and ray-matched observations between GEO and LEO for inter-calibration**
  - *Agencies do not need to acquire real-time VIIRS (or any other reference sensor) data for calibrating GEOs*
  - *DCC response over a specific GEO domain is stable and characterized using the reference VIIRS instrument*

Reference DCC mode values

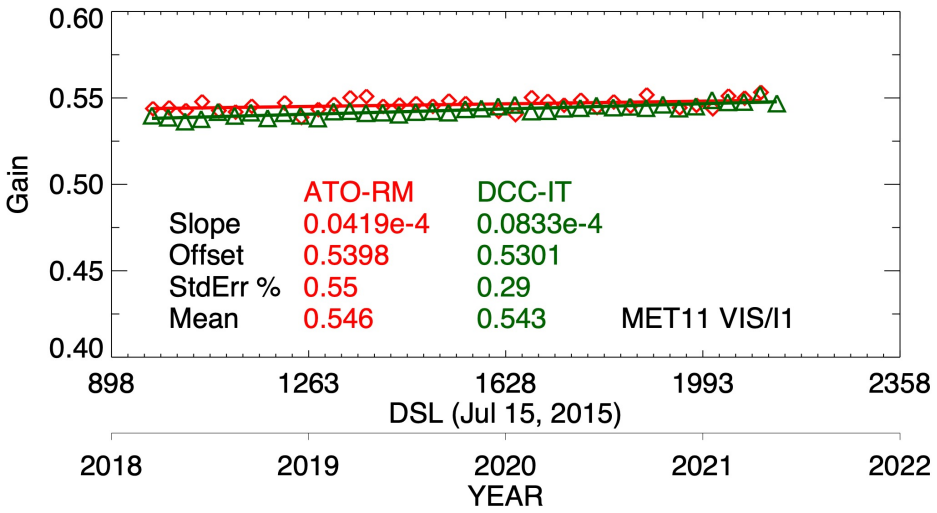
- **NOAA-20 VIIRS L1B Collection 2.1 products from NASA Land SIPS used as reference**
- **Regional variation of DCC mode is ~1%**
  - ***brightest over 0°E longitude***
  - ***DCC radiances are lower over TWP***

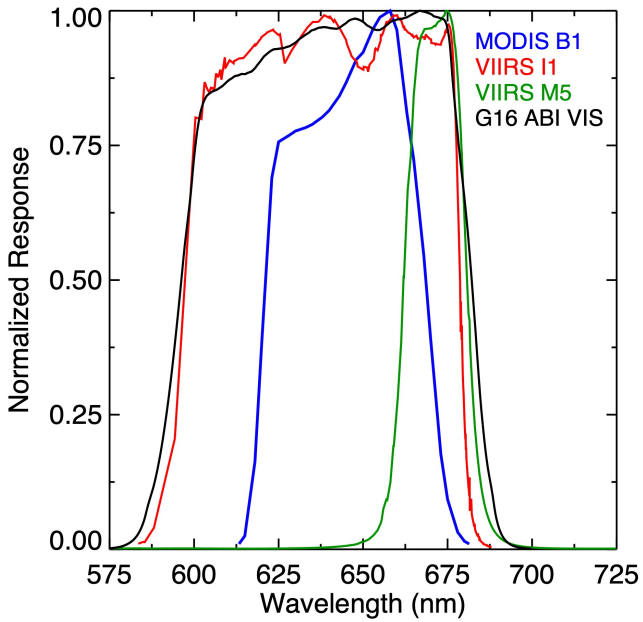


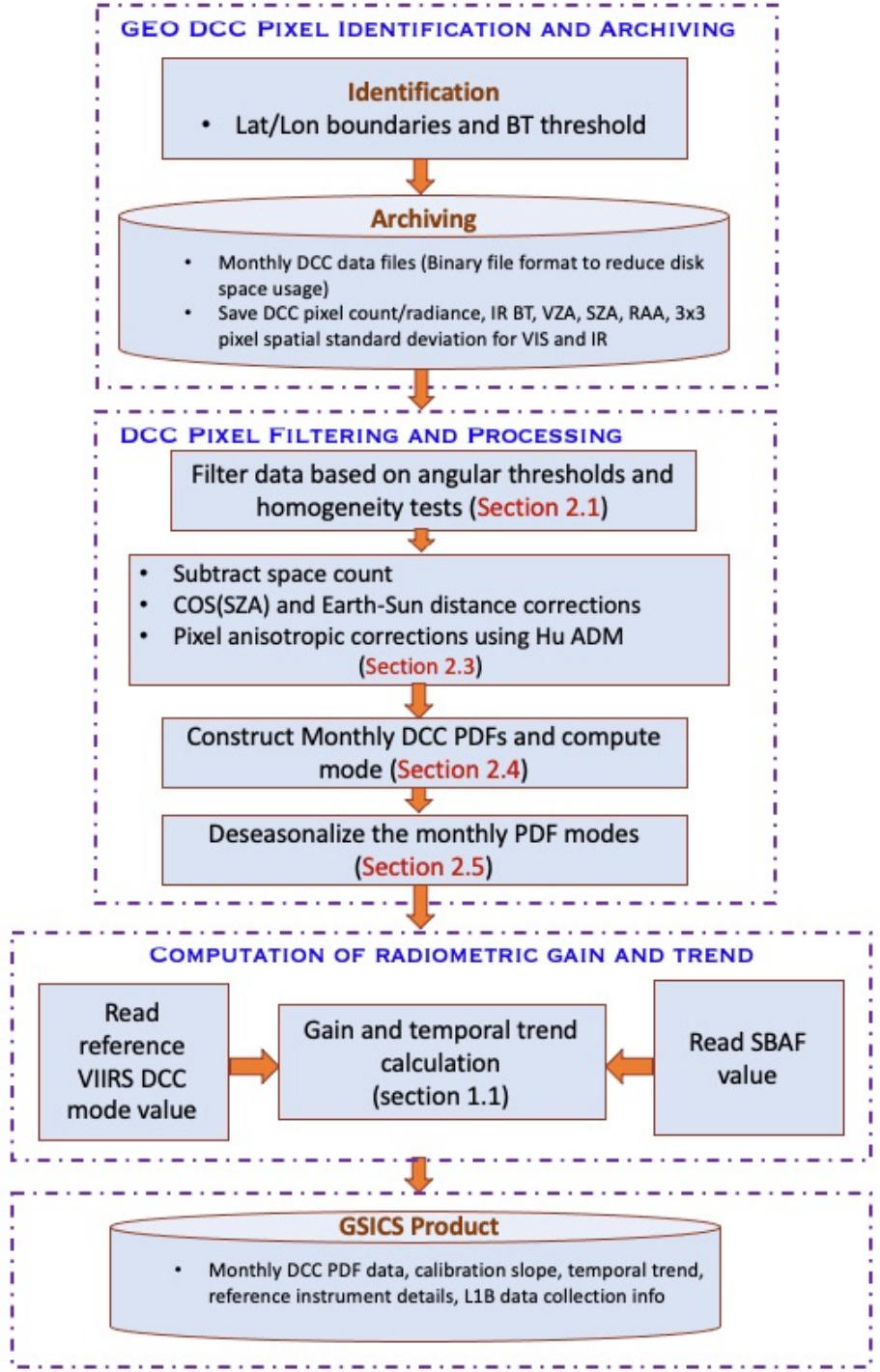


Computation of monthly GEO calibration gain

- $\gamma_{GEO,cal-slope} = \frac{L_{GEO,Mode,reference}}{C_{GEO,Mode,observed}}$ $(Wm^{-2}\mu m^{-1}sr^{-1}/Count)$
  - ***VIIRS mode radiance must be corrected for spectral differences using SBAF***
  - ***Space count or sensor offset must be subtracted from the GEO counts***
- **Use I1 (instead of M5) band for new generation GEOs**
  - **Better matching SRFs (mitigate SBAF uncertainty)**
- **DCC-IT gains are consistent with those from direct ray-matching approach (ATO-RM)**



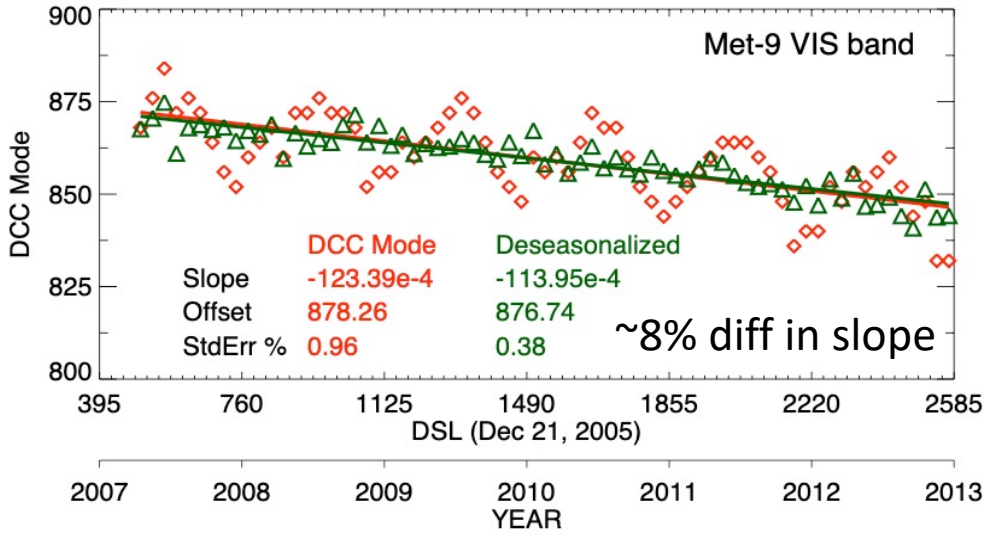


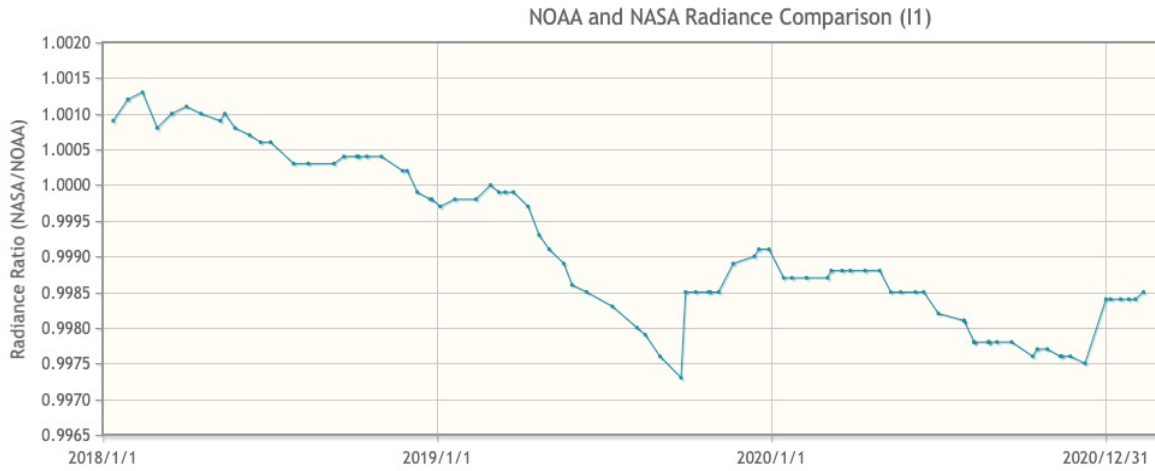


Feedback from EUMETSAT

- Deseasonalization Approach: Uniform or Agency-specific
  - *Should not matter if the deseasonalization does not alter the trend or mean absolute bias*
- Trend difference before and after deseasonalization
  - **0.51%/year vs 0.47%/year**
- Reference dataset should be made explicit (e.g. NOAA-20 VIIRS Collection 2.1 processed by NASA Land SIPS)
- Briefly describe differences between the NOAA and NASA datasets
  - *Consistent within 0.2%*
- Monthly processing of DCC data and file format: agency specific
- **Section for GSICS products**

  Deliverables
  - *GSICS DCC Reference Dataset*
  - *GSICS DCC intermediate products (if needed)*
  - *GSICS VNIR DCC product*
  - *Benchmark dataset (to test the implementation)*

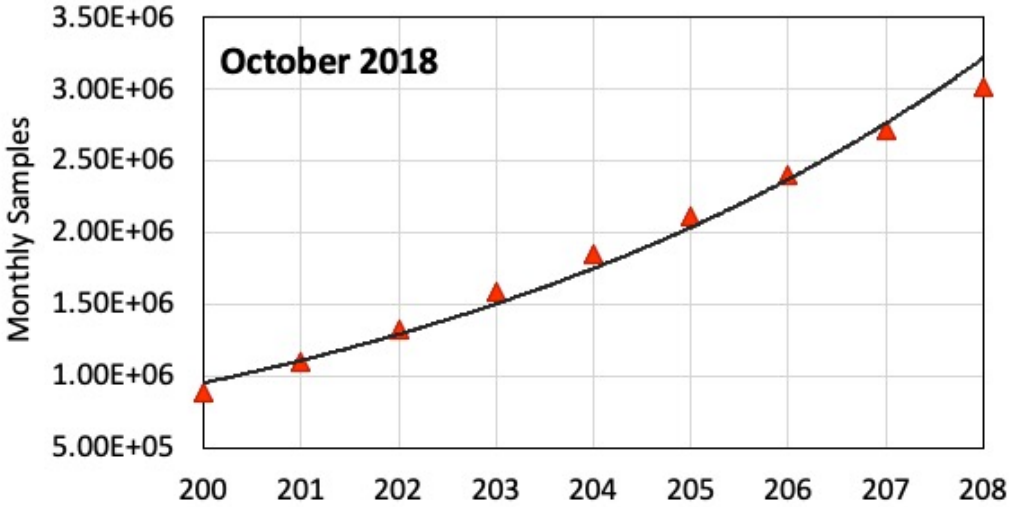


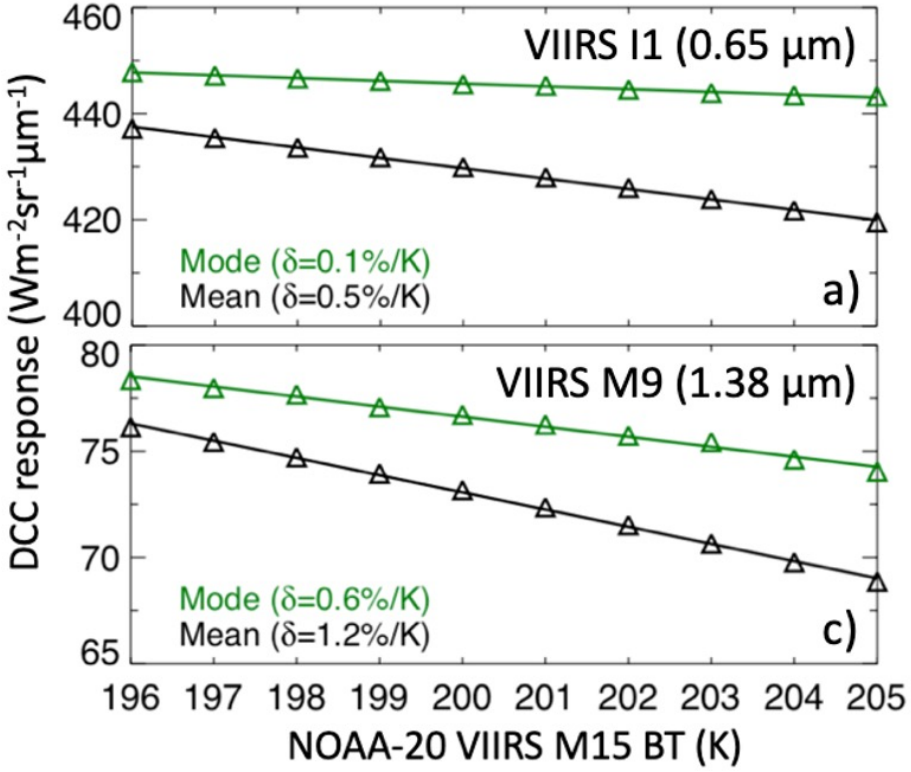


https://ncc.nesdis.noaa.gov/NOAA-20/GSICS_on-orbit_Reference.php

Feedback from EUMETSAT contd.

- Significance of IR BT normalization: Impact on sampling and DCC Mode/Mean sensitivity
  - *DCC response has dependency on BT threshold*
- IR BT normalization using IASI intercalibration
  - Use IASI spectra above DCC and have a proper SBAF approach for the 11um band?
  - Would allow to derive SBAFs for older instruments than VIIRS on NOAA-20…
  - *Goal is not to characterize spectral differences*
  - *Obtain consistent DCC pixel identifications*
- Could you provide the SBAFs (in the IR) for all the Meteosat missions? At the moment the ATBD does include only Meteosat-8 and 11.
  - *SBAFs can be estimated from Langley's IASI tool*
  - *Knowing SBAF is not adequate as it doesn't account for the calibration difference*
  - *Long term stability of IR calibration and instrument characterization/performance at cold scenes are critical*
  - *Direct intercalibration of reference and target IR channels is the most effective way*





Feedback from GOES-R CWG, NOAA

- Need a section to outline SI-traceability
  - *CPF as a SI-traceable reference, transfer to N20-VIIRS->MODIS and others*
  - *DCC-IT does not need simultaneous measurements*
  - *With proper IR BT normalization and consistent DCC sampling, CPF reference can be transferred back in time*
  - *Decadal variation of DCC is minimal based on 20 years of MODIS data*
- Elaborate. Vis & IR for GEO do not have the same resolution. Nor the IR (& VIS) for GEO vs. LEO
  - *Spatial homogeneity tests help*
  - *Sub-sampling vs averaging should be similar over homogeneous DCC regions*
  - *GEO and LEO spatial resolution difference*

Feedback from JMA

- Deseasonalization process is only applied to GEO satellites. Isn't the process necessary for VIIRS data?
  - *Reference DCC mode value is derived from timeseries mean*
- Does this mean that each GEO satellite operator doesn't need to process VIIRS data?
  - *No coincident VIIRS data needed for this method*
- The SRF of Himawari-8 shown in Fig.2 looks that of Band 14 (11.2um). If yes, "Him-08 Band 13 (10.8um)" in the Table 1 --> "Him-08 Band 14 (11.2um)". In addition, would you let me know the reason why you don't adopt AHI/B13 but B14? Both of the SRFs of B13 and B14 are close to that of VIIRS M15.
  - *Choose IR channel with better radiometric performance at cold end, and good stability over time*
- How can we select the bin size? A bin size is required to compute a mode. Do you have any good idea to make the first bin size?
  - *Optimal PDF bin size depends on DCC pixels, instrument bit resolution, balance between noise and trend detection, temporal stability (large temporal degradation may need bin adjustment over time, discretization issue)*
  - *Start with bin size =0.5% of mean*

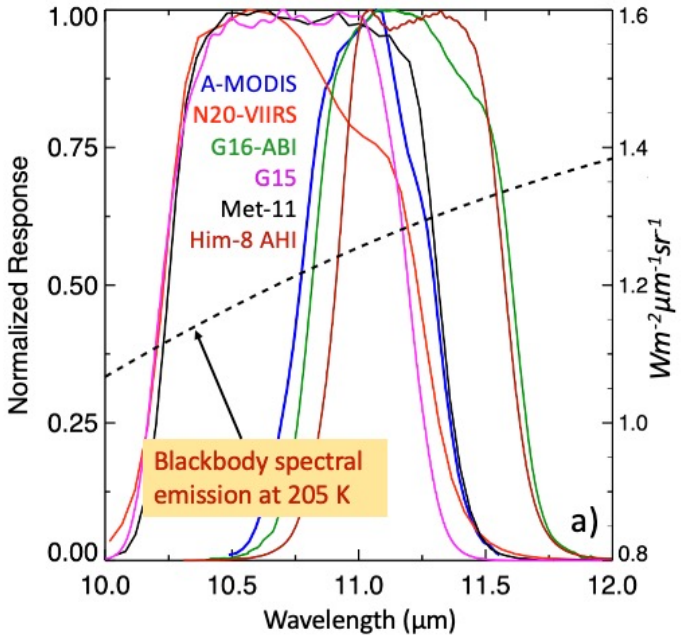
Conclusions

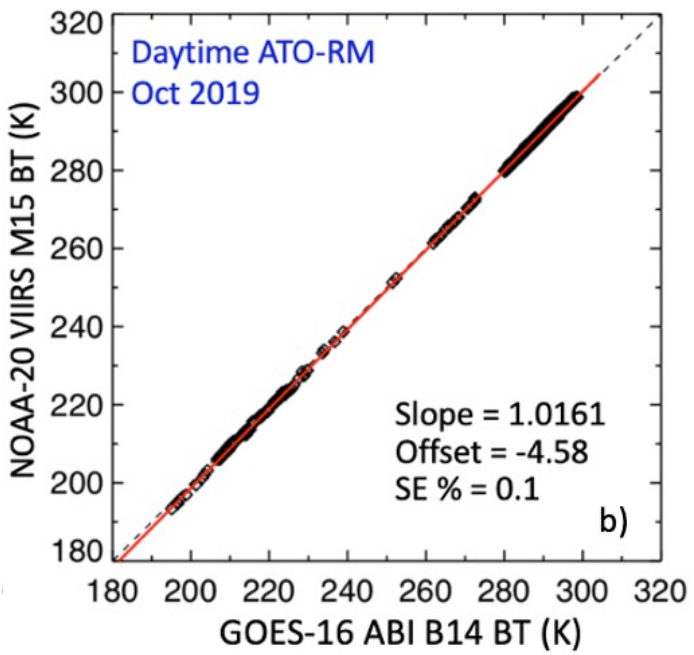
- DCC are an excellent invariant target for post-launch radiometric calibration of satellite sensors.
- DCC can be referenced to a well-calibrated sensor (MODIS or VIIRS) for transferring absolute calibration to other GEO and LEO sensors.

- The newly revised GSICS DCC ATBD offers several improvements:
  - *Extends the methodology to all spectral channels between 0.4-1.0 µm*
  - *Inter-calibration uncertainty is reduced by applying*
    - *IR BT threshold normalization between GEO and VIIRS*
    - *Deseasonalization of monthly DCC responses*
  - *Uses the most recent and well-calibrated NOAA-20 VIIRS sensor as a reference instrument for DCC characterization*
  - *Provides more comprehensive details on the formulation and implementation of DCC method*
    - *Reference DCC modes for multiple GEO domains, SBAF computation, uncertainty analysis, GSICS DCC products, SI-traceability in future*
- **Next steps:** Complete ATBD (July 2022), Joint DCC implementation paper

Back up slides

IR BT threshold normalization





GEO Imager IR Channel	*BT threshold equivalent to VIIRS M15 205 K*
Met-8 Band 9 (10.8 μm)	206.0
Met-11 Band 9 (10.8 μm)	205.9
GOES-16 Band 14 (11.2 μm)	206.1
Him-08 Band 14 (11.2 μm)	205.4
FY2G Band 2 (10.8 μm)	203.5
COMS Band 4 (10.8 μm)	206.7

- GOES-16 ABI and Himawari-8 AHI IR channels would measure DCC BT slightly warmer than NOAA-20 VIIRS M15, provided they are all consistently calibrated
- *A DCC pixel with a BT of 205 K measured by VIIRS M15 is recorded as 206.1 K by GOES-16 ABI B14*
- *For consistent DCC sampling between GEO and VIIRS, the GEO IR BT threshold must be adjusted to equivalent VIIRS BT*
- *The magnitude of BT adjustment might change over time depending upon the temporal stability of the IR calibration onboard GEO and VIIRS*
- *BT normalization is essential to account for any differences in SRFs and calibration of the IR channels between GEO and VIIRS*