GSICS Inter-Calibration for Infrared Bands with Hyperspectral Sounder

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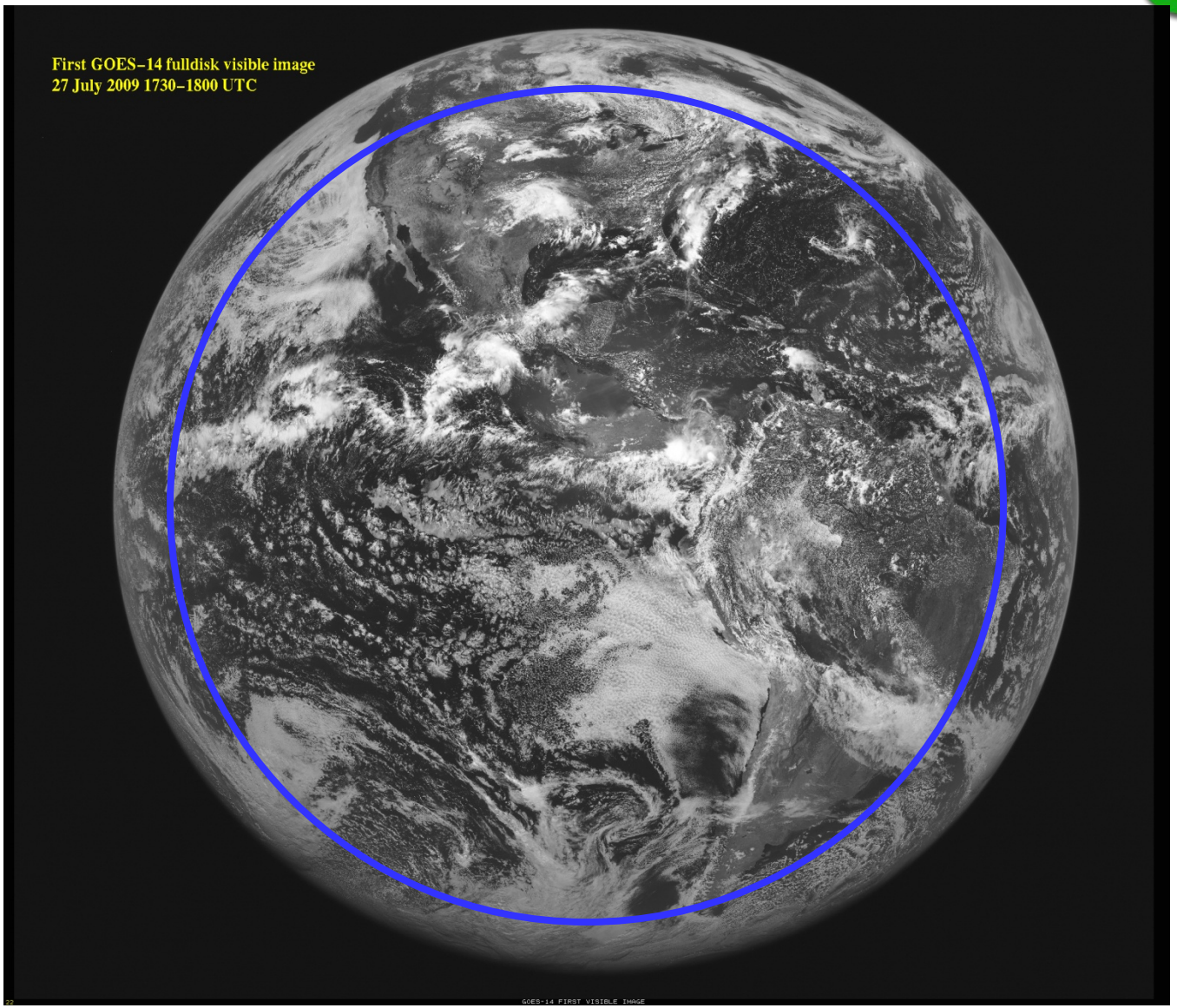
Outline

- Algorithm
- Products
- Future work

Basis for Inter-Calibration

- Calibration – quantifying the instrument responses to known signals.
  - Onboard Cal: Blackbody, Solar Diffuser;
  - Vicarious Cal: Invariant (desert, Moon) or derived (RTM)
  - Inter-Cal: Reference instrument
- Premises: two instruments should make identical measurements under identical conditions.
  - Concurrent in time;
  - Collocated in space (including spatial response);
  - Comparable spectral coverage and response; and
  - Co-aligned in viewing geometry.

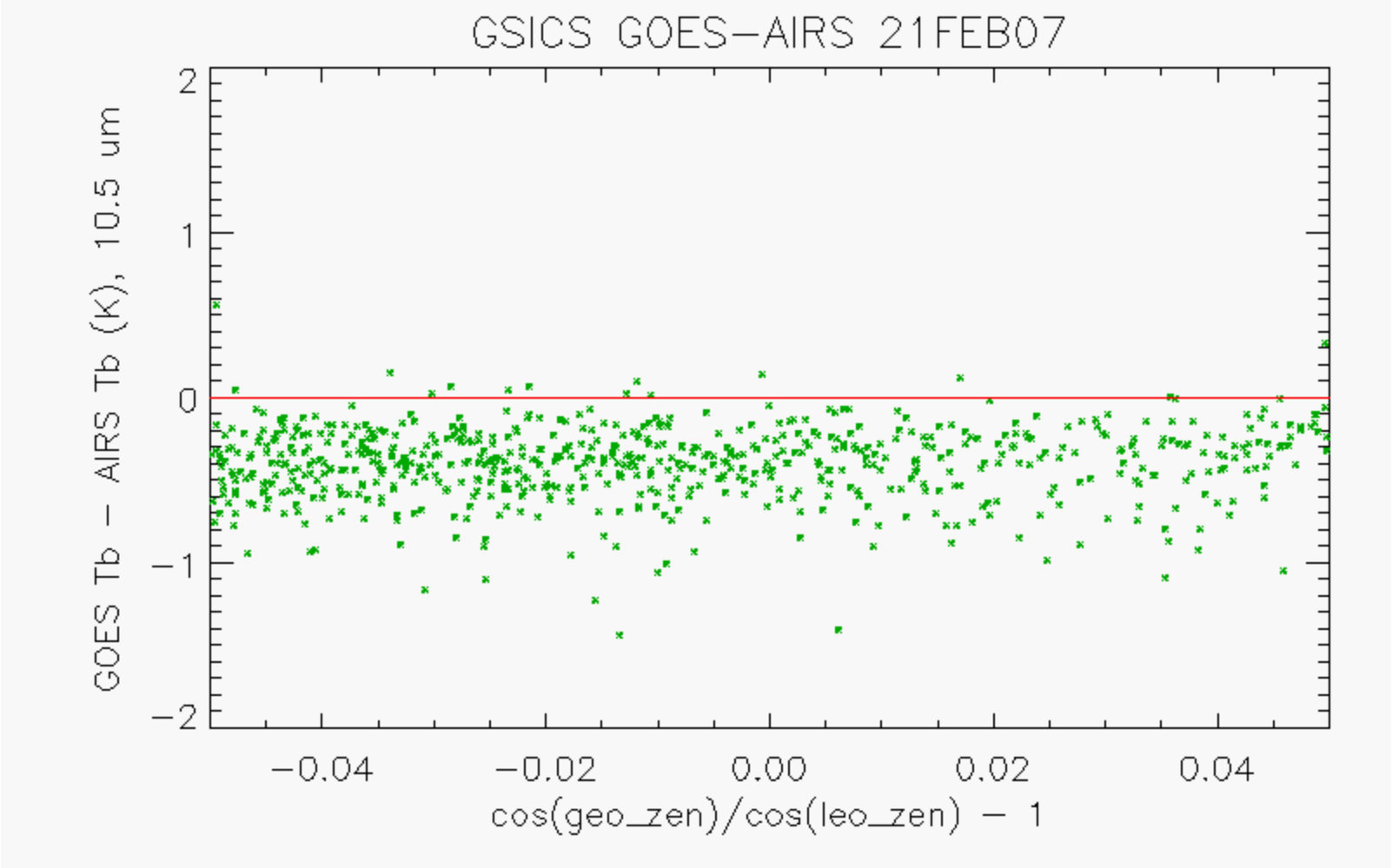
1. Subsetting



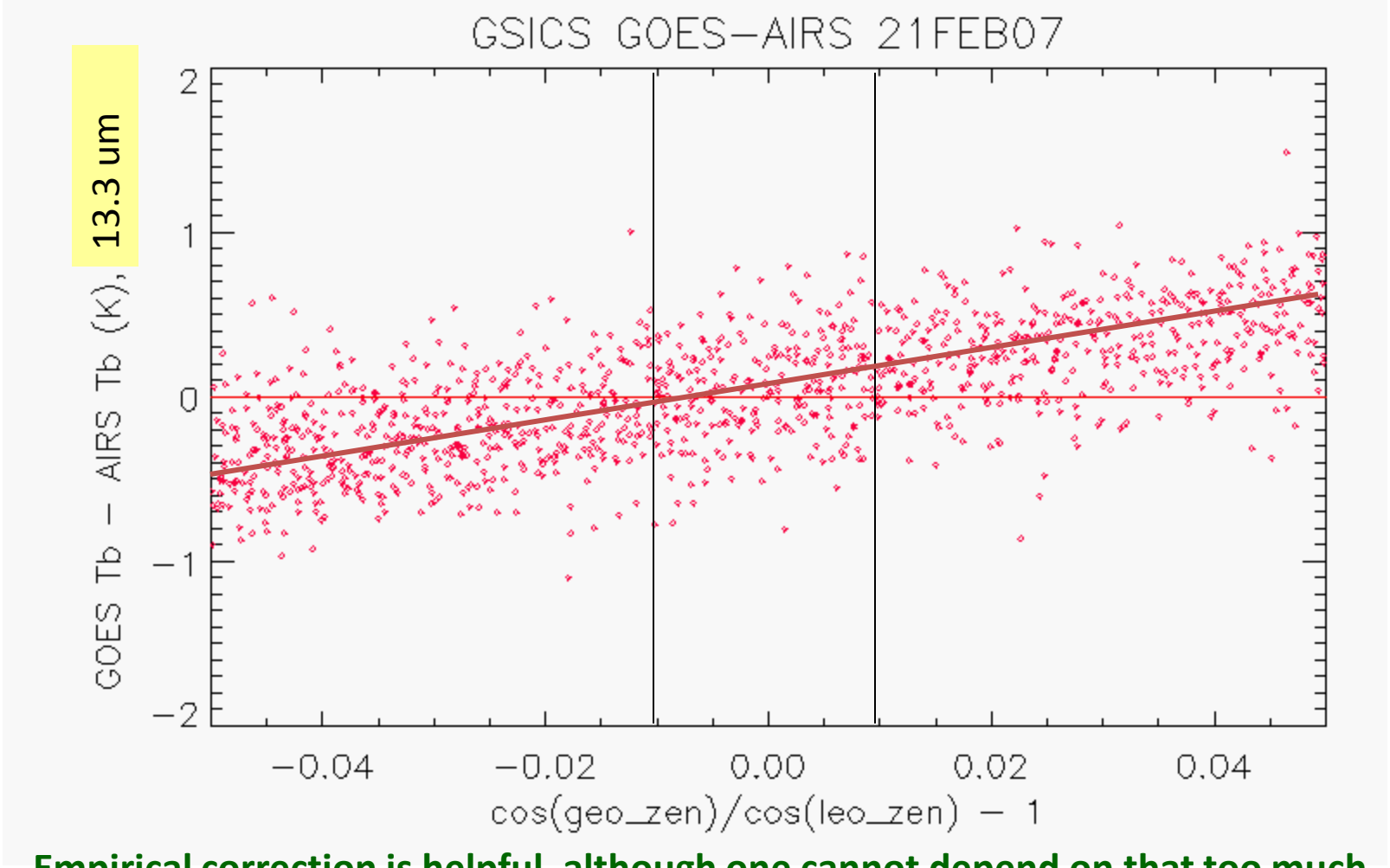
2. Collocation

- **Time**
  - From Telemetry
  - Threshold depends on refresh rate and size of data
- **Location**
  - Operational geolocation
- **Angle**
  - $|geo\_zen - leo\_zen| < threshold$ – penalize at small angle
  - $|sec(geo\_zen) - sec(leo\_zen)| < threshold$ – penalize at larger angle
  - $|cos(geo\_zen)/cos(leo\_zen) - 1| < threshold$

2. Collocation

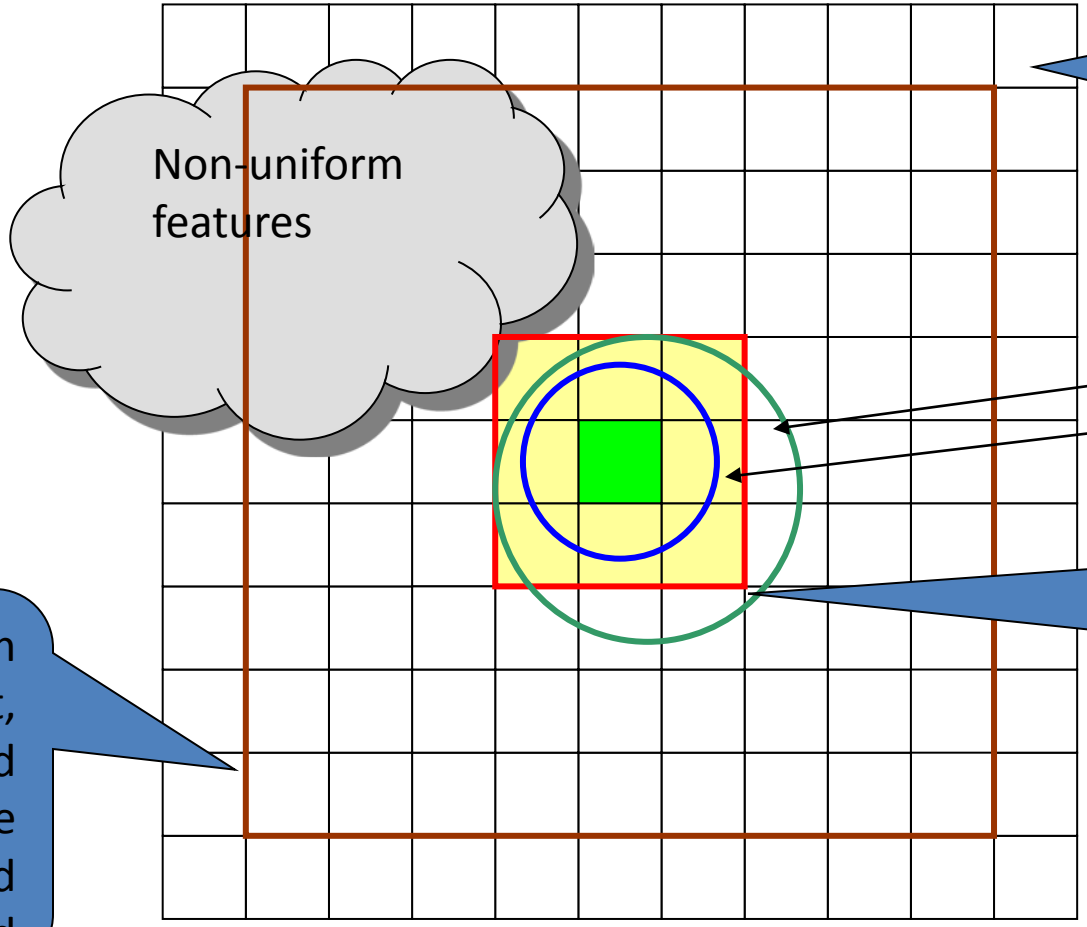


2. Collocation



Empirical correction is helpful, although one cannot depend on that too much since this correction depends on the lapse rate

3a. Spatial Transform



GEO FOV, may be square or overlapping

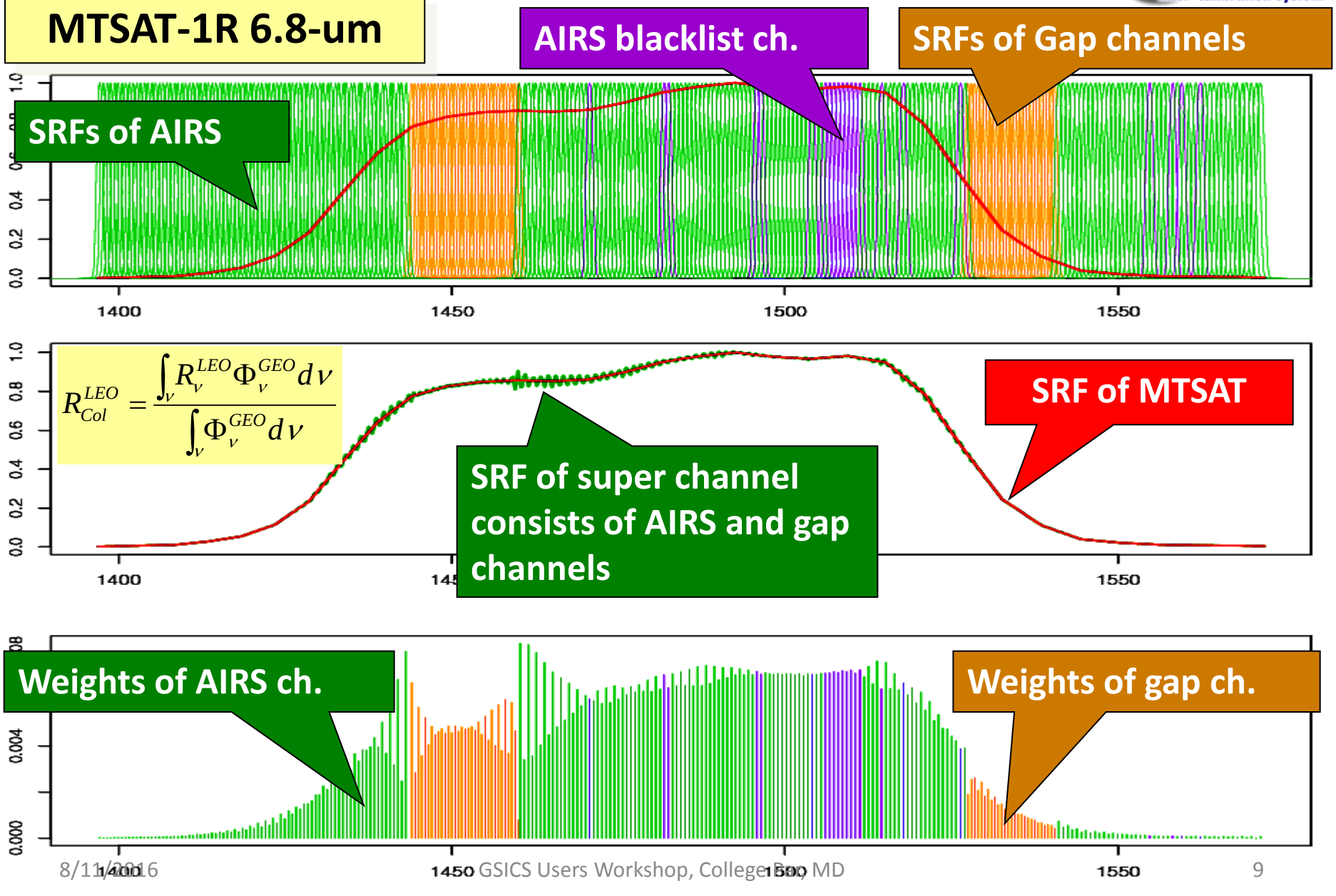
LEO FOV, relative to GEO FOV

Collocation FOV, may depend on GEO and LEO FOVs

Collocation environment, may depend on time window and wind speed

3b. Spectral Transform

MTSAT-1R 6.8-um



4. Selection

- Several reasons
  - Performance under certain conditions, e.g., night
  - Narrow down threshold, e.g., time window
  - Avoid certain conditions, e.g. sun glint
- Weighted average/regression is superior than threshold
- ATBD facilitates these options. No specific recommendation/discrimination

5a. Analysis – Quantify Bias

Satellite: Meteosat-9 SEVIRI

Channel: IR13.4

Year Month Day

Date: 2009 06 01

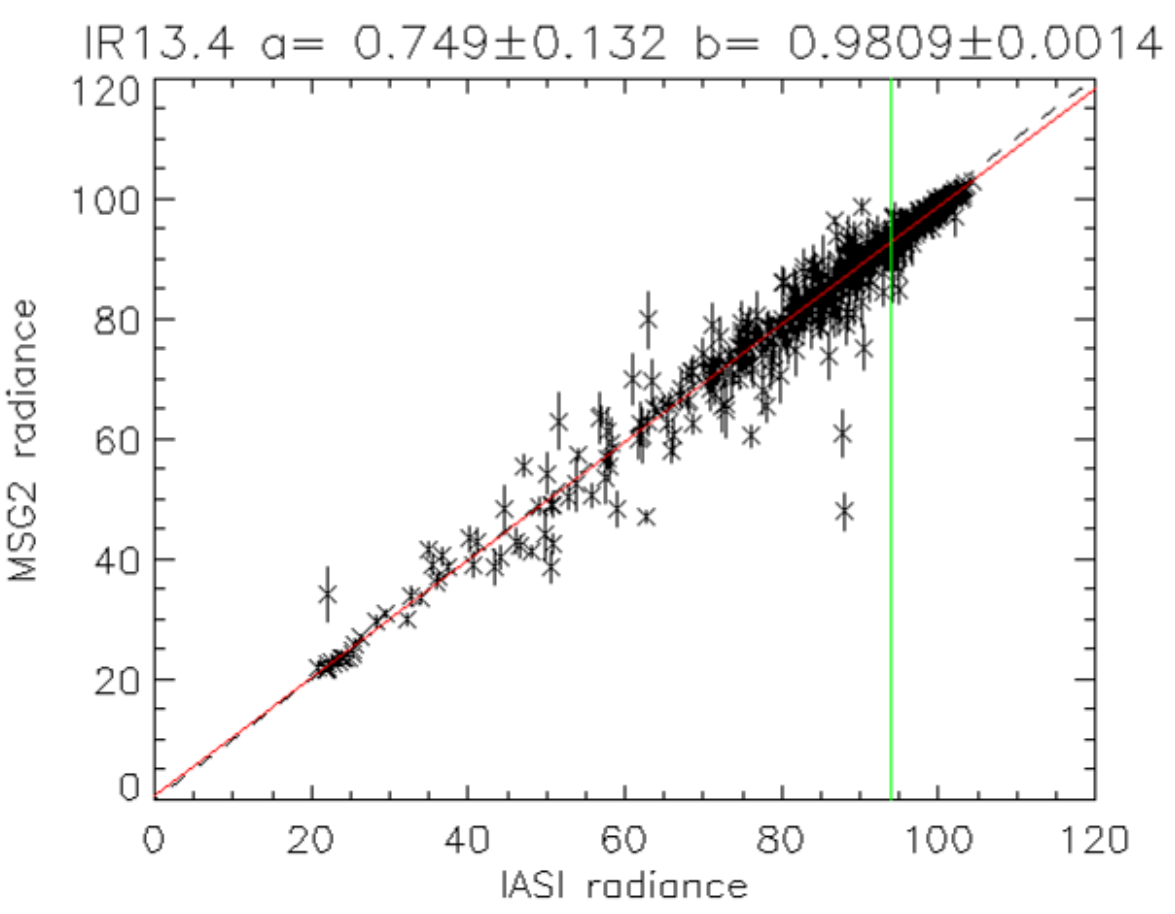
Time: 2130

Display: Regression Scatterplot

Legend

- Radiances from collocation
  Error bars: 1-σ uncertainty
- Weighted Linear Regression
- Reference Scene Radiance

Units: mW/m²/st/cm⁻¹

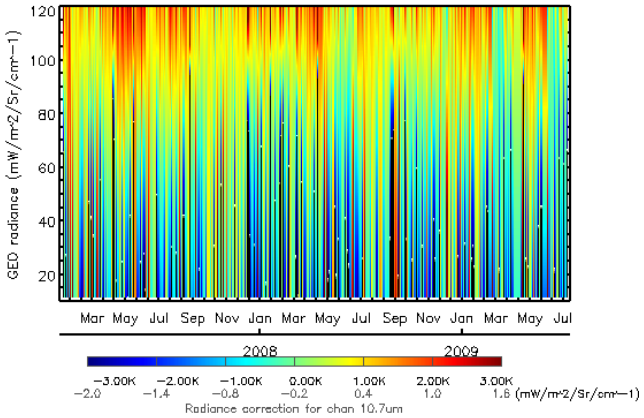


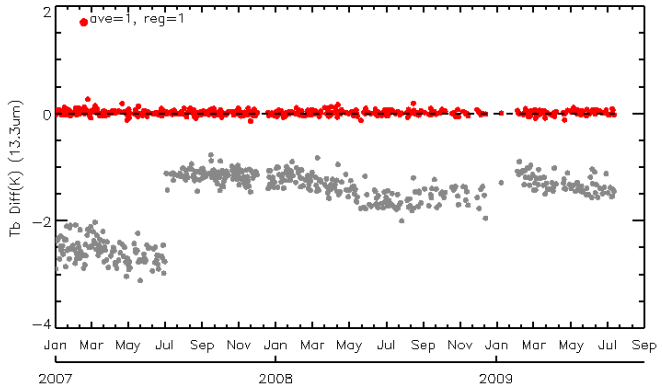
5b. Analysis – Correct Bias

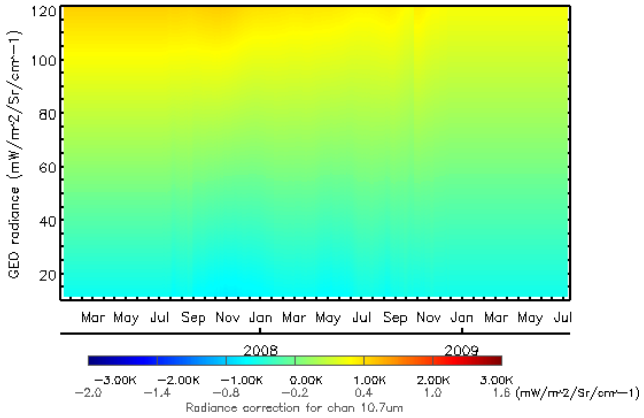
$$R_{GSICS} = -\frac{a}{b} + \frac{1}{b} R_{GEO}$$

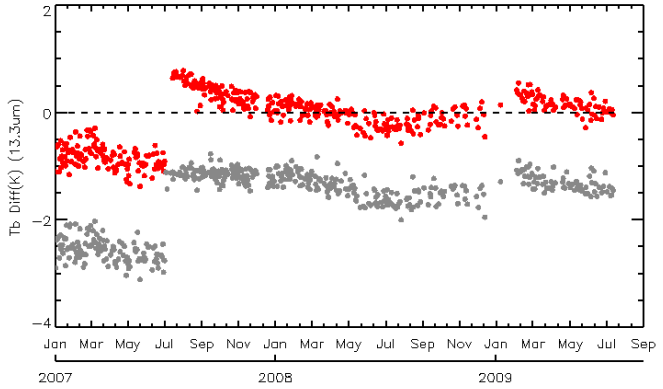
- GSICS Corrected radiance from GEO operational product
  - *a, b* from weighted regression
- Reduced Major Axis – under investigation
- Period of regression is critical

5b. Analysis – Correct Bias









Outline

- Algorithm
  - Quantify the difference – magnitude and uncertainty
  - Correct the difference – empirical removal
  - Understand the difference – root cause analysis.
- Products and Applications
  - Core products: Refer to GCC talk.
  - Double Difference (Wang et al.)
  - Outgassing
  - Spectral Response Function
  - Midnight Blackbody Calibration Correction
  - Image Navigation and Registration (Yu et al.)
  - HIRS
- Future work

Monitoring HIRS by inter-comparison with IASI

gsics.tools.eumetsat.int/plotter/ Public Website

EUMETSAT GSICS Global Space-based Inter-Calibration System

GSICS Calibration Products Plotting Tool

Login Register

Configuration and Plot

GSICS Collaboration Server
EUMETSAT

GSICS GPRC
EUMETSAT

Reads data from Server

Correction Type
Re-Analysis Corrections (RAC)

Satellite/Instrument
METOPA HIRS

Reference Satellite/Instrument
METOPA IASI

Mode
Demonstration

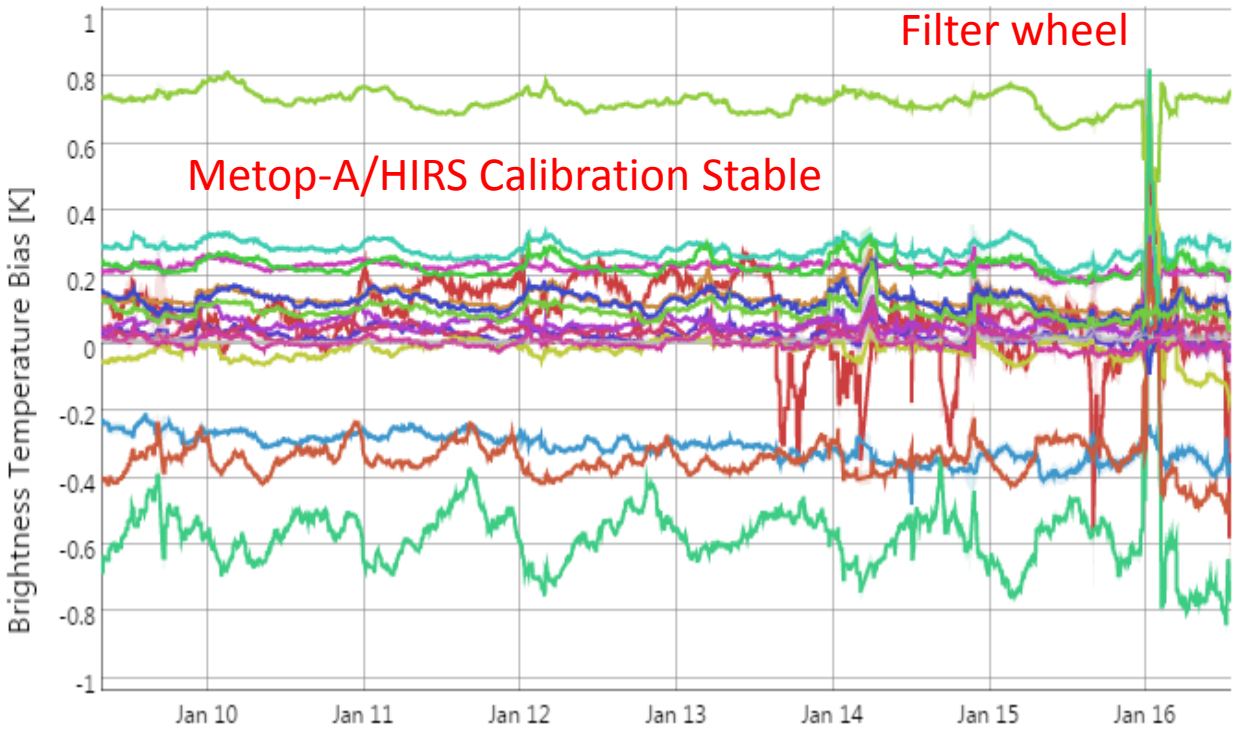
Prototype Product

Dataset Start Year
2009

Dataset Start Date-time (MM/dd hh:mm:ss)

Anomaly in Jan 2016 – Filter wheel

Metop-A/HIRS Calibration Stable



Evaluates Bias – Plotted as Time Series

Hewison

Development of GSICS products for HIRS?

- Metop/HIRS: Mature Algorithm, based on GEO-LEO IR inter-cal wrt IASI
- NOAA/HIRS: Need to implement LEO-LEO collocation system
- Suitable for:
  - Instrument monitoring
  - Near Real-time Corrections
  - Re-Analysis Corrections (e.g. case studies)
- But no further development without strong user needs
- Could also develop
  - Archive Re-Calibration – to support FCDR generation
  - Harmonising data from all instruments in HIRS series
  - Based on activities supporting re-calibration of Meteosat archive
- Any beta testers?

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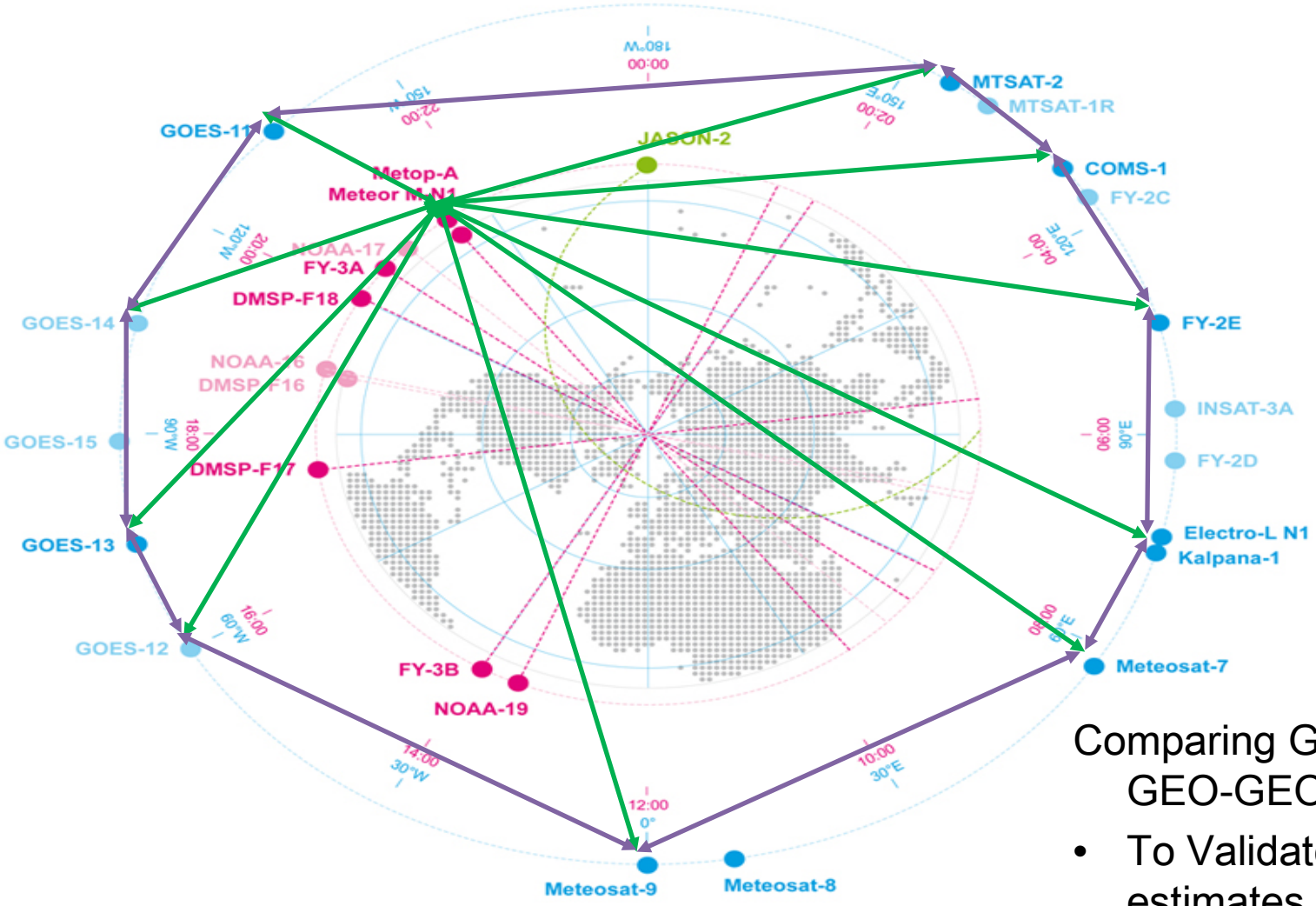
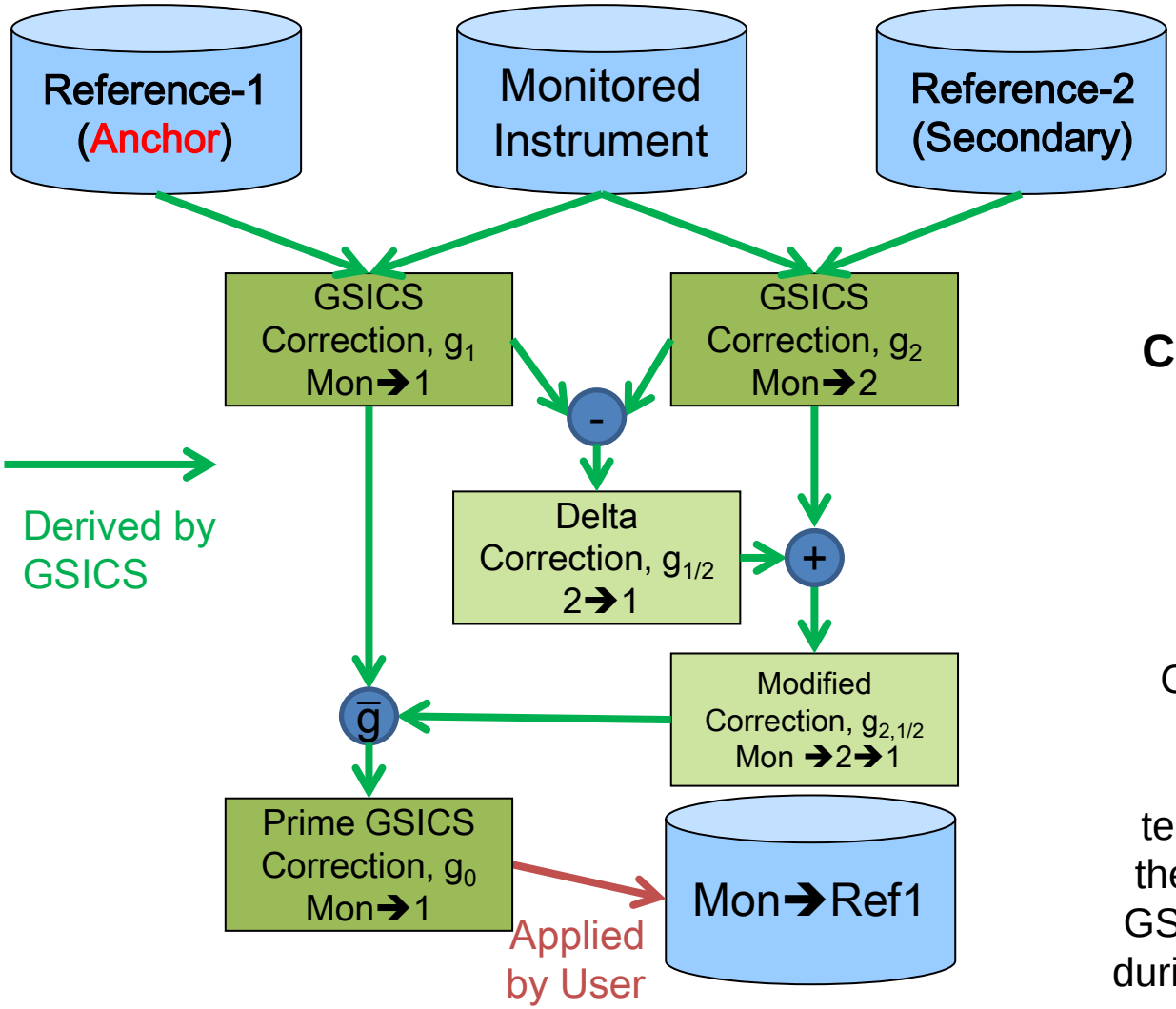


Comparing GEO-LEO and GEO-GEO Differences

- To Validate Uncertainty estimates
- Ensure consistency

Generate global L2 products

Prime Correction



Correcting the Corrections and Blending References

Action: GRWG.2016.3e.1: Tim Hewison to consider revising terminology used in the current "Primary GSICS Corrections", during demonstration phase (closed)

IR Reference Sensor Traceability And Uncertainty Report

- Aims
  - To support the choice of reference instruments for GSICS and IASI as Anchor
  - To provide traceability between reference instruments (IASI, AIRS, CrIS)
  - By consolidating pre-launch test results and various in-flight comparisons
  - To seek consensus on the uncertainties in the absolute calibration of the reference sensors
- Limitations
  - No new results, just expressing results of existing comparisons in a common way,
  - reformatting where necessary, to allow easy comparisons.
- Error Budget & Traceability
  - Focus on Radiometric and spectral calibration
  - AIRS, IASI, CrIS
- Inter-comparisons
  - Polar SNOs, Tandem SNOs, Quasi-SNOs, GEO-LEO Double Differencing, NWP Double-Differencing, Regional Averages ("Massive Means"), Aircraft Double-Differences, other
- Conclusions

Summary

- Overview of algorithm, products, and future work.
- User comments on planned future work.
- User suggestion of new future work.
- User feedback on existing products.