GRWG Web Meeting
2010-11-18
Traceability to Common References

Agenda

- Rüdiger Kessel - Theory
- Tim Hewison – Examples
- All – Discussion

Highlights of 9th GSICS Exec Panel

- Meeting material available on the web page:
  - http://www.wmo.int/pages/prog/sat/meetings/GSICS-ExecutivePanel-9.html
  - JAXA, now full member, has indicated PoCs for GRWG & GDWG
  - Roshydromet officially re-joins as well, A. Uspensky is poc for the Panel, other poc still TBD. I suggest you invite Uspensky for the joint meeting
  - ISRO needs to designate its pocs (similarly, we should send invitations to A.S. Kiran Kumar, pending designation of WG pocs)
  - IMD considering joining. 25 years of INSAT data to reprocess…
  - JMA has provided a prototype of web page, to be finalized
  - GRWG, GDWG are tasked to review the outcome of the 2nd workshop and take appropriate action to address the recommendations.
  - Still waiting for SCOPE-CM to express its "Statement of needs".

GSICS Global Space-based Inter-Calibration System

Practical Example: Defining Common Channels for GEO IR Imagers

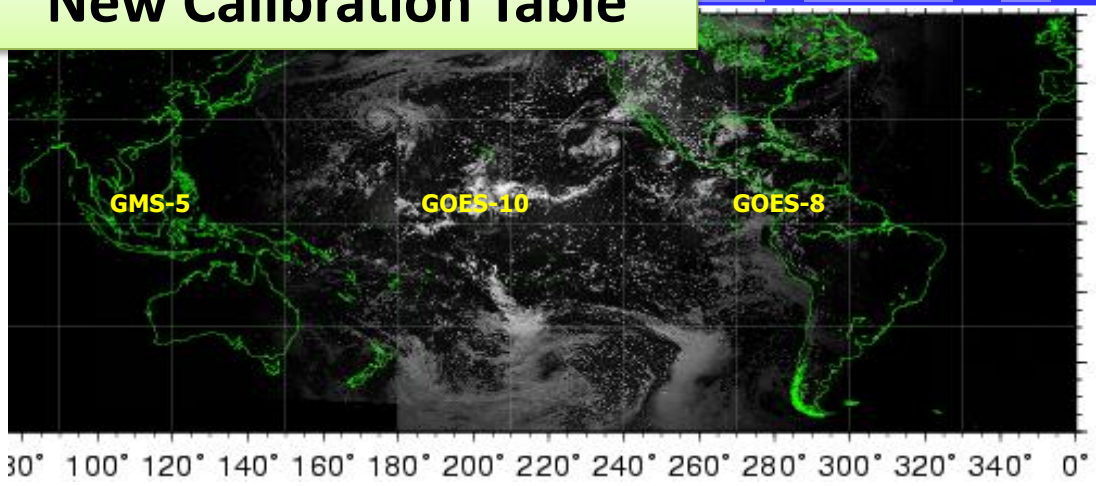
Tim Hewison

EUMETSAT

Composition of GEO VIS Images

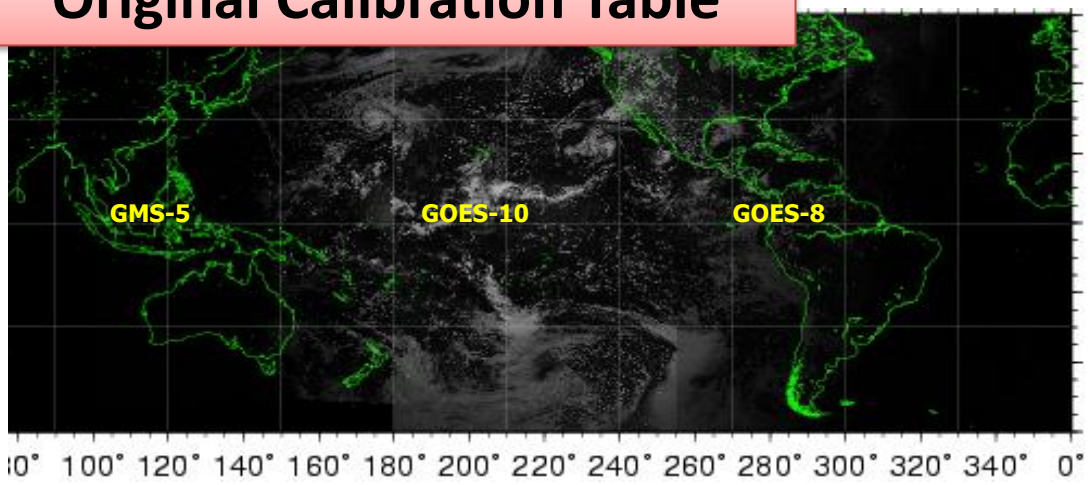
Collaborate research with CEReS, Chiba University

New Calibration Table



- Defining Common Reference Channels essential for traceability for multiple instruments
- Also useful for generation of composite datasets

Original Calibration Table



From 9th GSICS Exec Panel – Nov 2010
Courtesy of Tomoo Ohno (JMA)

discontinuity

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Ways to Define Common Reference Channels

- Choose one GEO instrument as a reference standard
  - Politically difficult?
  - Some GEOs will not overlap – no collocations – but that doesn't matter
  - Still need transformations for other satellites in same series
- Choose one LEO instrument as a reference standard
  - e.g. MetopA/HIRS
  - Potentially large uncertainties introduced by spectral correction
- Define a Synthetic Standard
  - Expanded here for further study

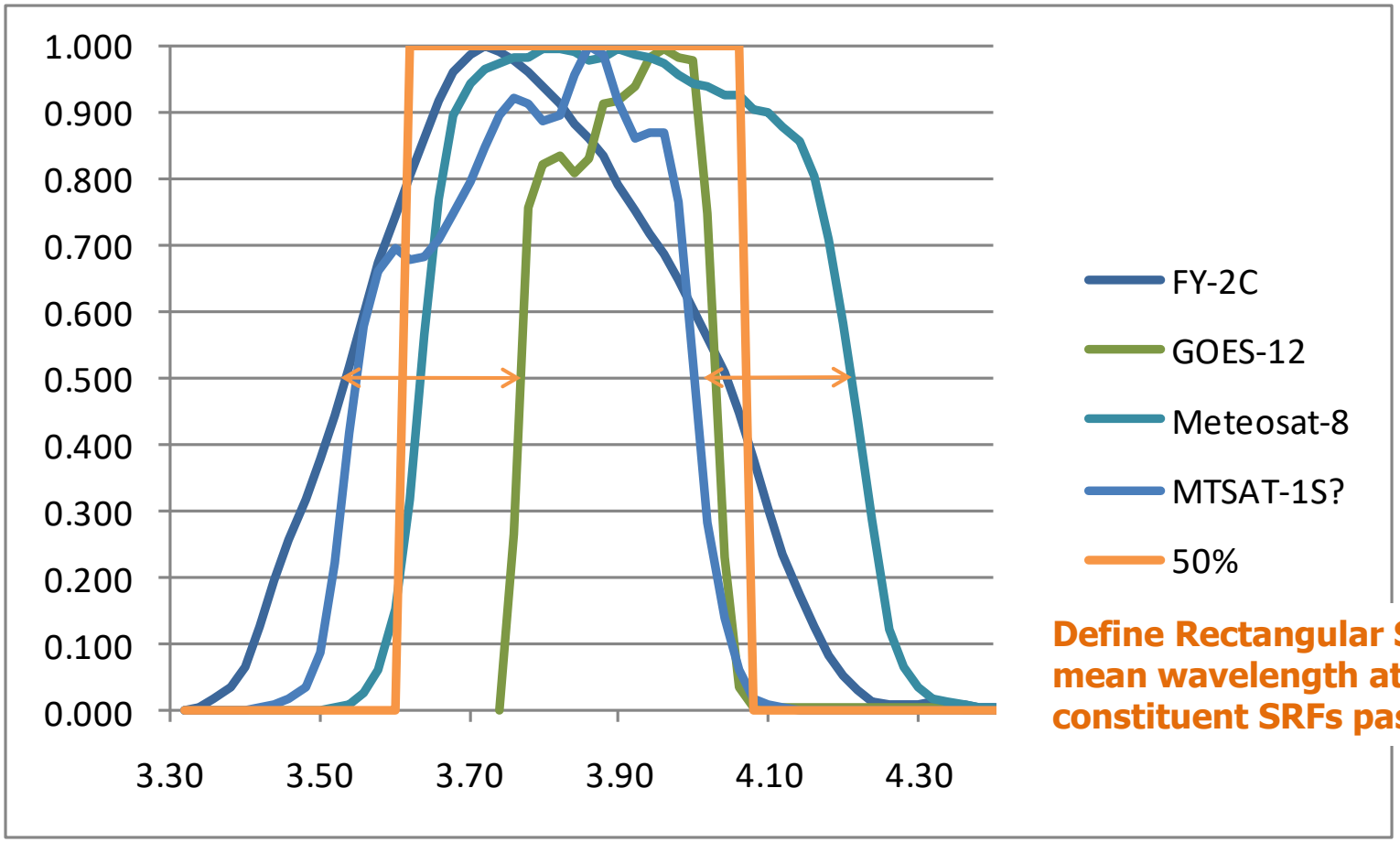
Requirements to Define a Synthetic Standard

- Hybrid of different GEO instruments
- Needs to be static?
- What mix of GEO satellites? - Current?
- How to define mix of channels
  - Single or Multiple Channels?
  - Defined by correlation threshold of radiances
    - – or uncertainty of spectral conversion

Options to Define a Synthetic Standard

- Manually *crafted* SRFs
  - + Simple
  - - Arbitrary!
- Define a Hybrid of GEO instruments
  - Rectangular SRF with bandwidth defined by mean wavelengths
    - where SRFs cross 50%
    - containing 95% (?) of cumulative radiance of full SRF
      - + More accurate reflect SRF of absorbing channels
      - - Need to convolve with realistic radiance spectra – from where?

Simple Choice: 3.9 µm Channels



Define Rectangular SRF by mean wavelength at which constituent SRFs pass 50%

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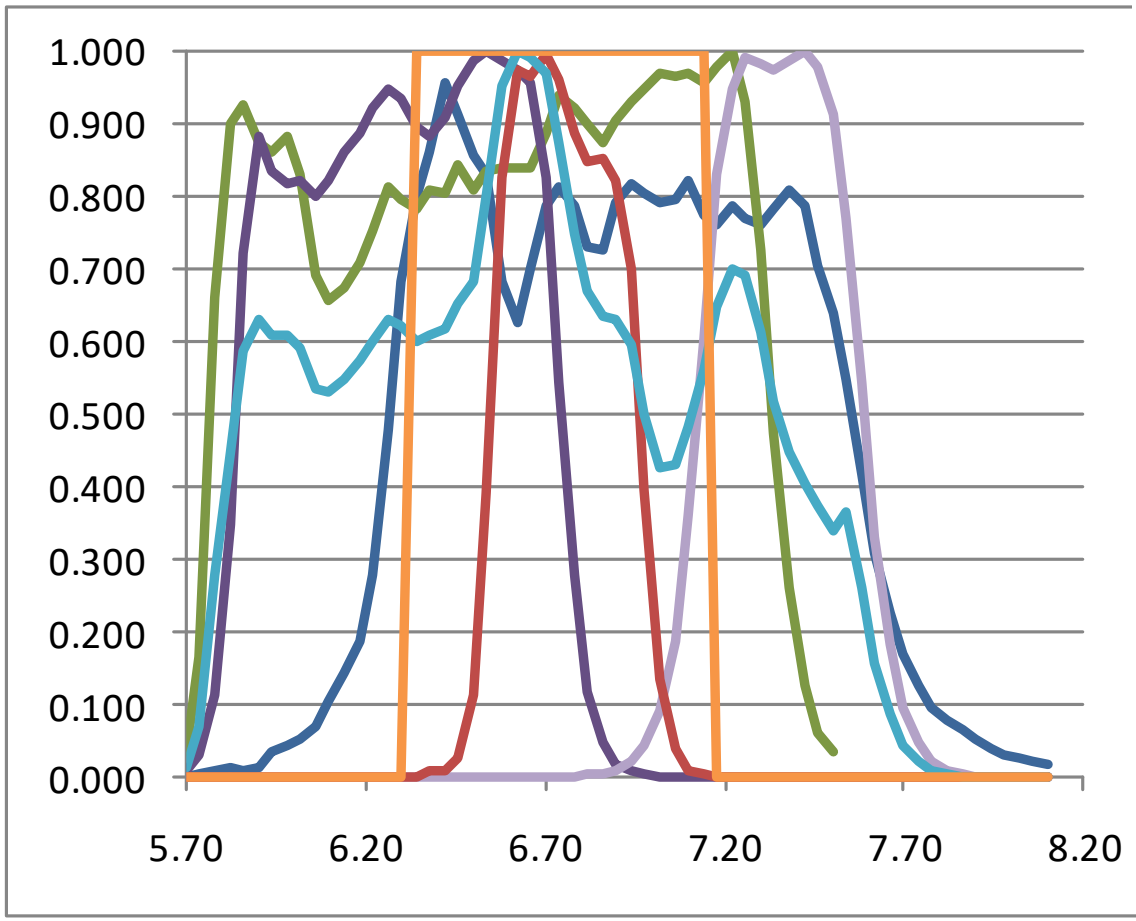
Harder Choice: WV Channels



Different instruments have channels of different widths

Some instruments have multiple channels within the same band

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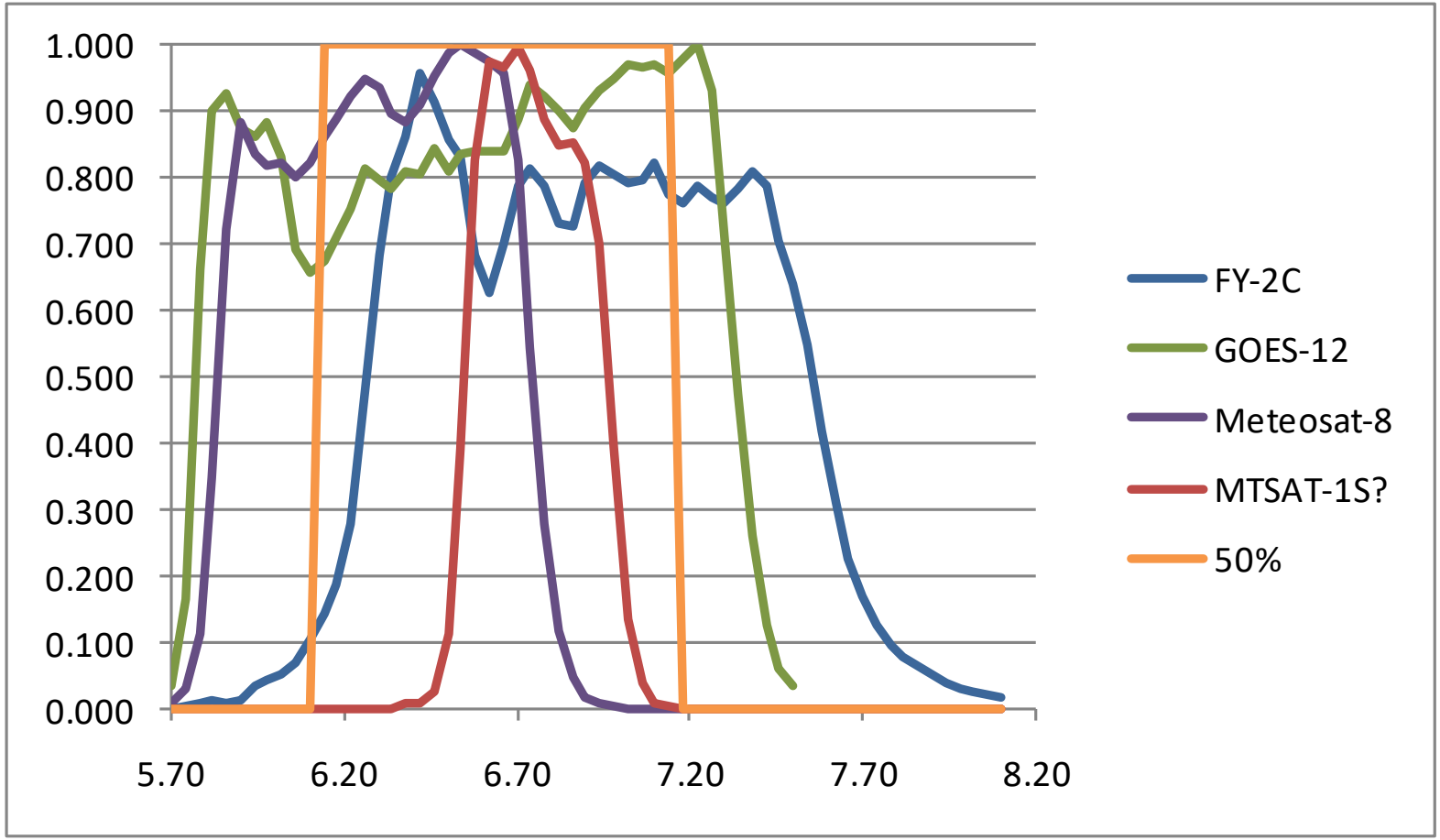
6.2µm Channels



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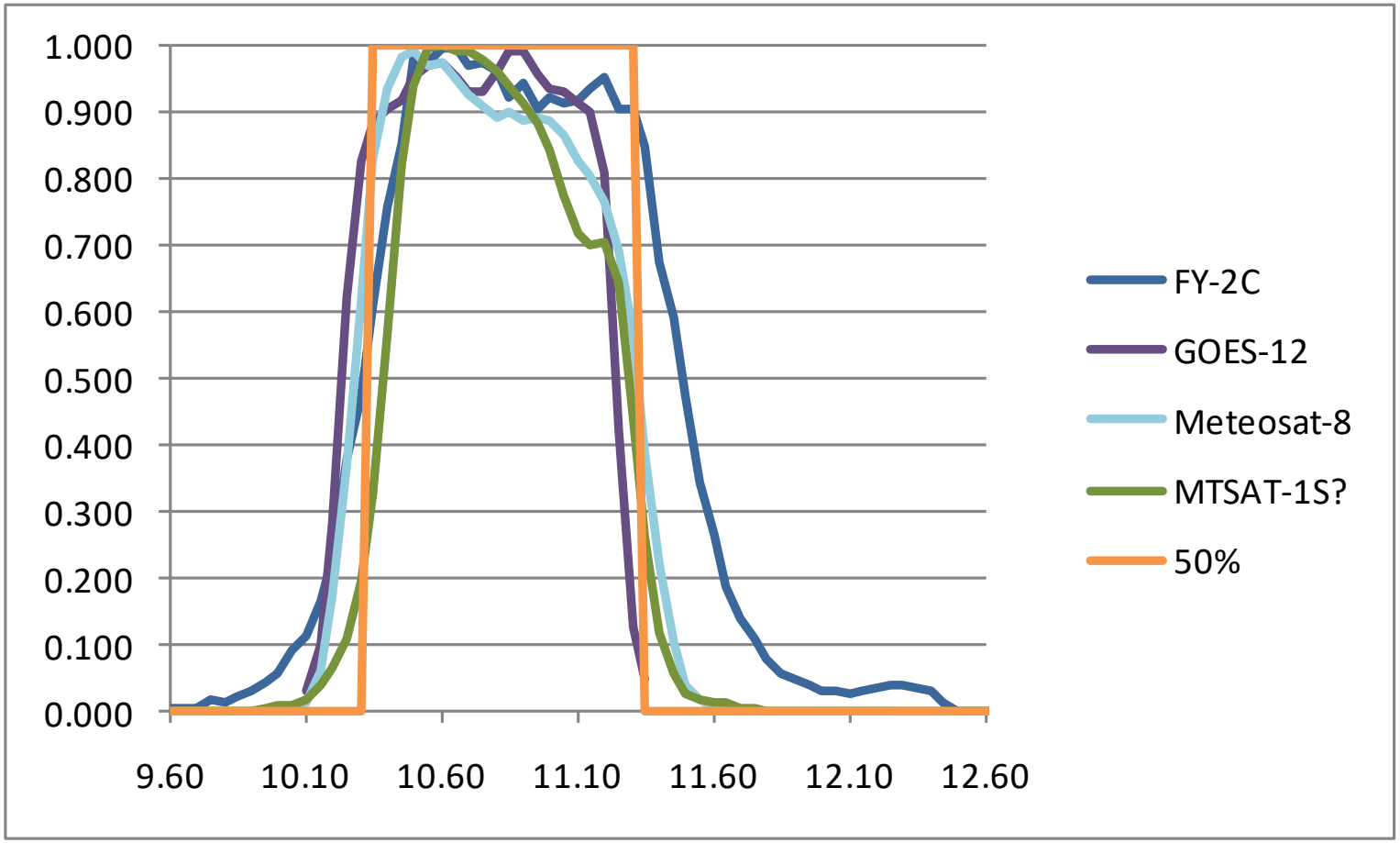
10.8µm Channels



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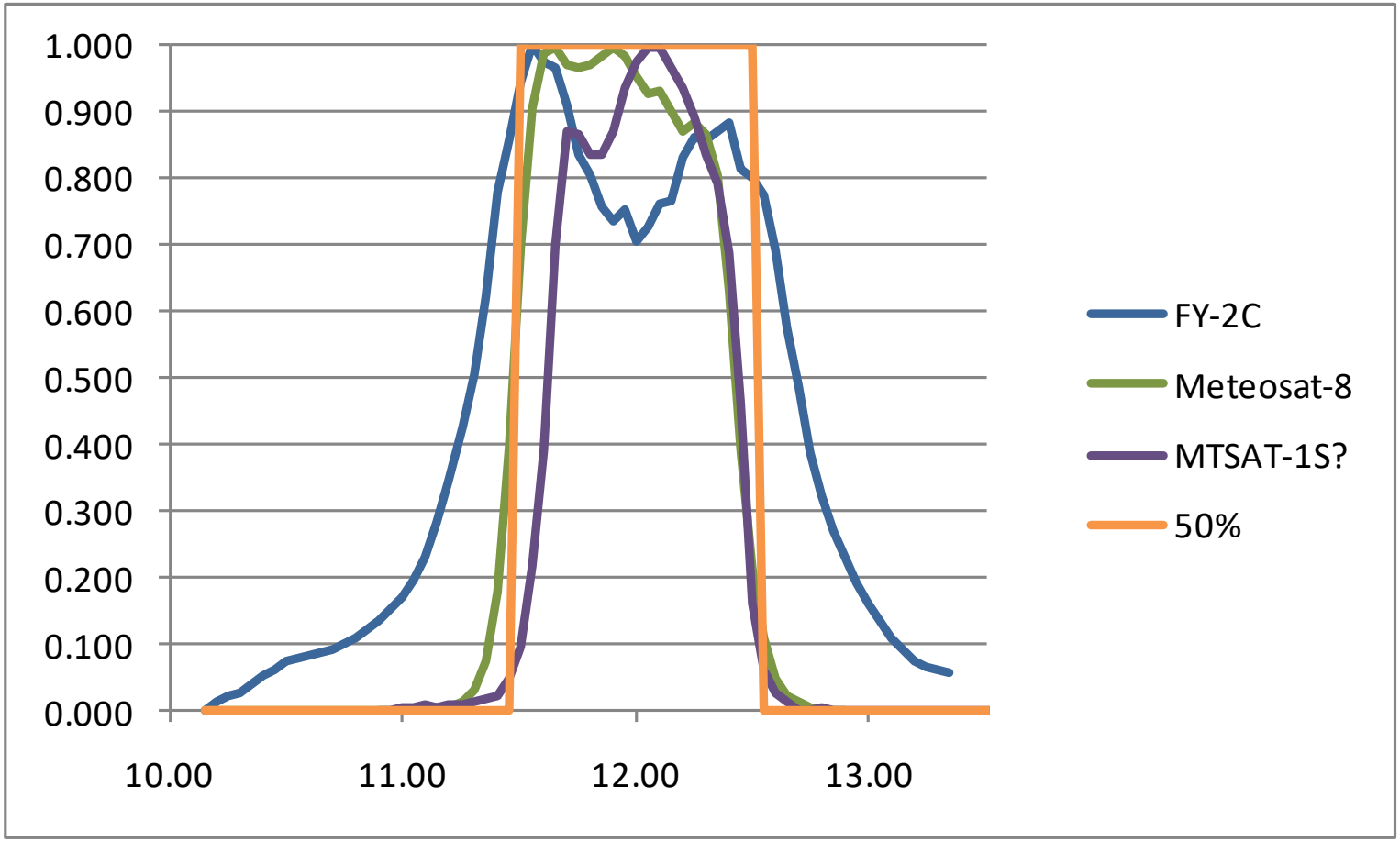
12.0µm Channels



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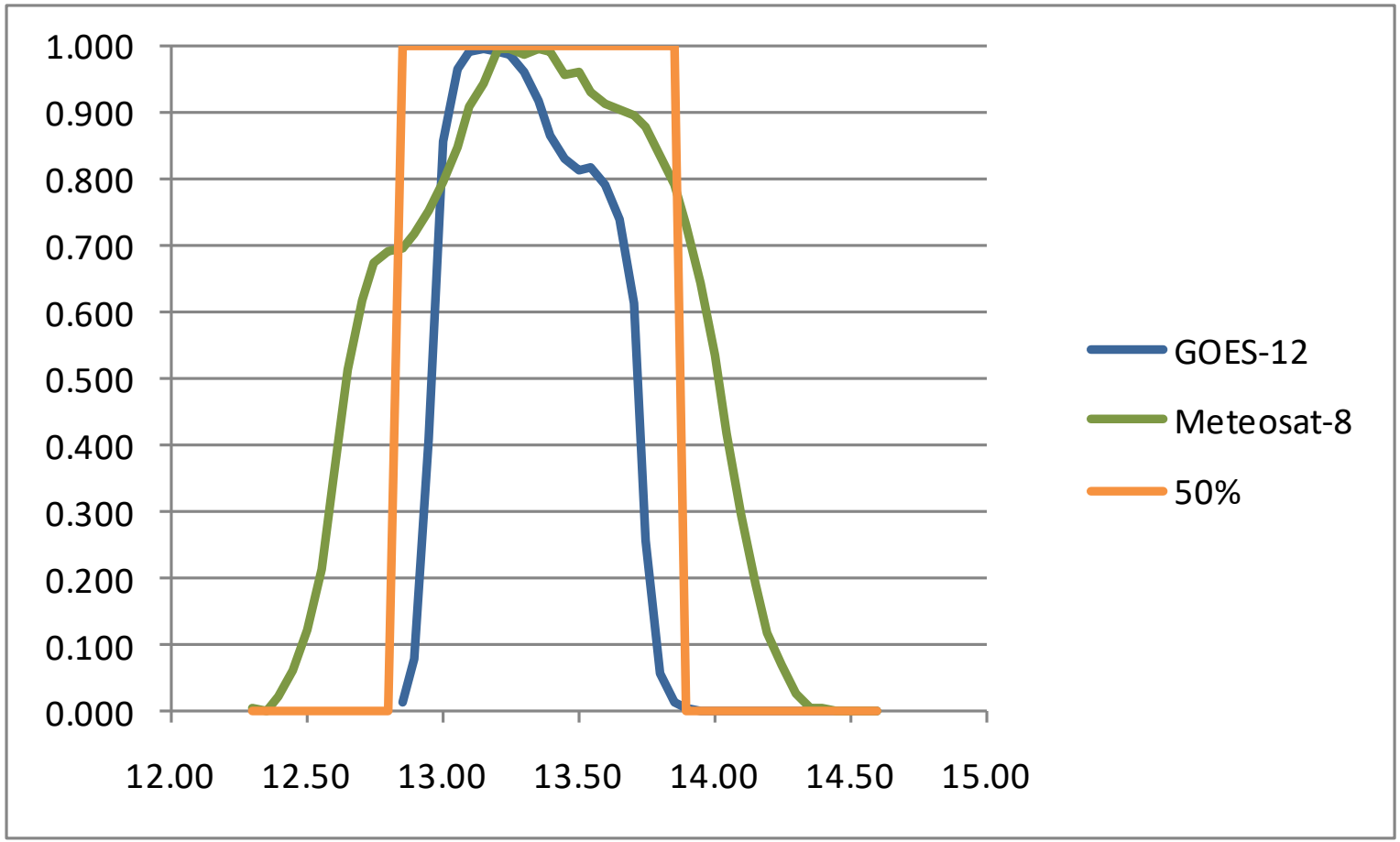
13.4µm Channels



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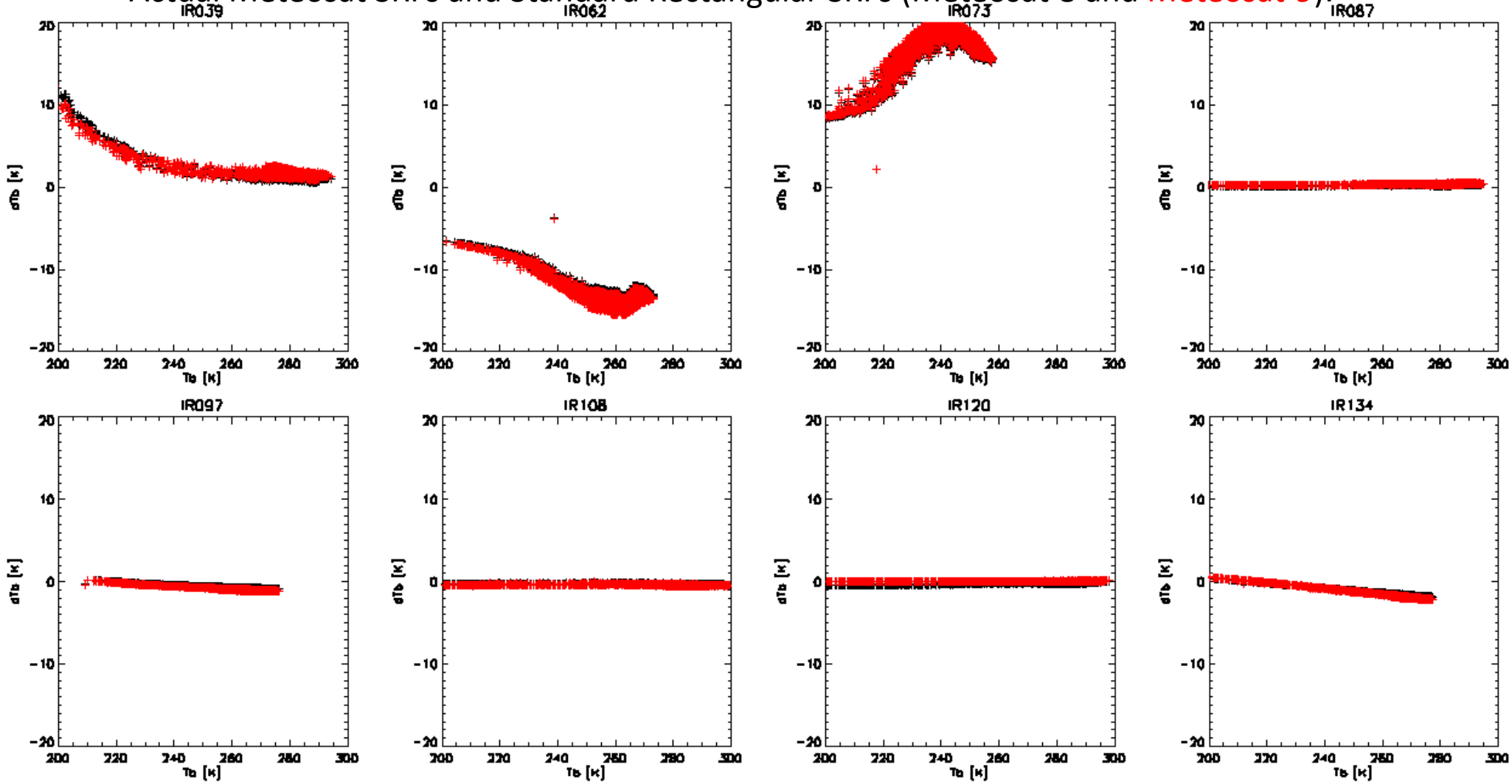
Error introduced by Spectral Conversion

Compare Radiances obtained from IASI radiance spectra convolved with
Actual Meteosat SRFs and Standard Rectangular SRFs (Meteosat-8 and Meteosat-9):



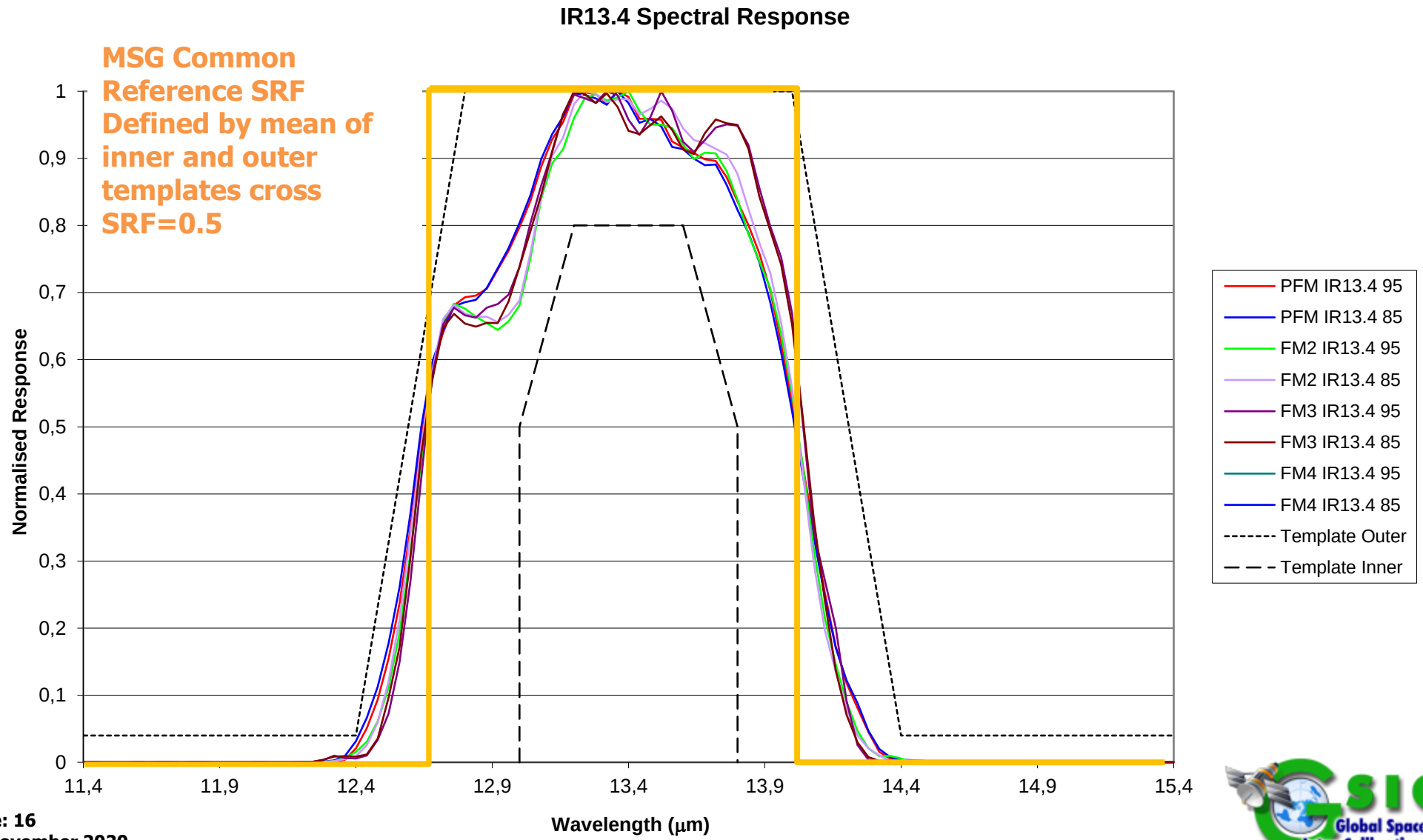
Uncertainty introduced by Spectral Conversion

- Compare Radiances obtained from IASI radiance spectra convolved with:
  - Actual Meteosat SRFs
  - Standard Rectangular SRFs
- Calculate Residuals of Quadratic fit over full range of radiances:

Channel	IR3.9	IR6.2	IR7.3	IR8.7	IR9.7	IR10.8	IR12.0	IR13.4
STD SRFs	0.72	0.73	1.10	MSG Only		0.03	0.10	0.08
MSG SRFs	0.77	0.10	0.09	0.06	0.05	0.02	0.04	0.14

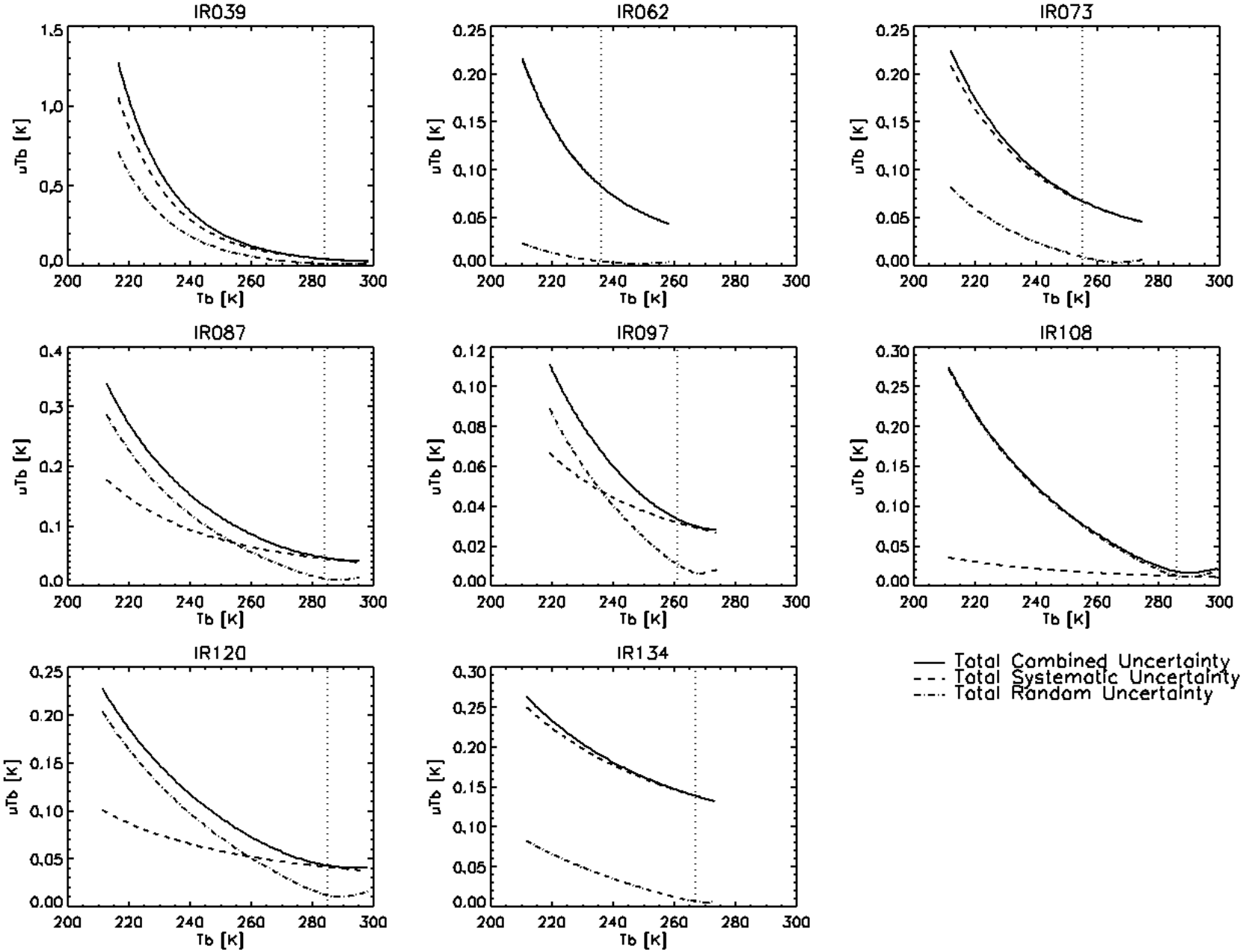
- Uncertainty Analysis shows these map into systematic uncertainties of biases estimated from GSICS Correction evaluated for Standard Radiance scenes with similar order of magnitudes
  - Dominate the error budget for 3.9µm and WV channels
  - Need more sophisticated definition of SRFs to reduce errors

Defining MSG Common Reference



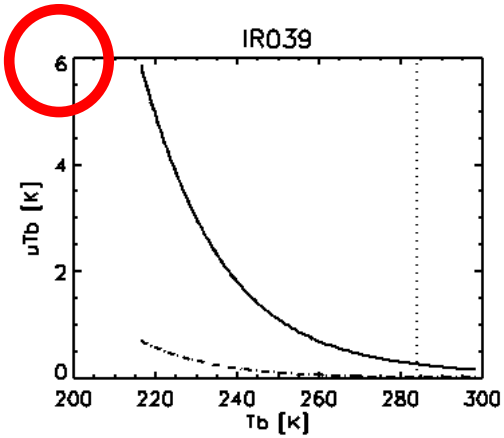
Results of Uncertainty Analysis

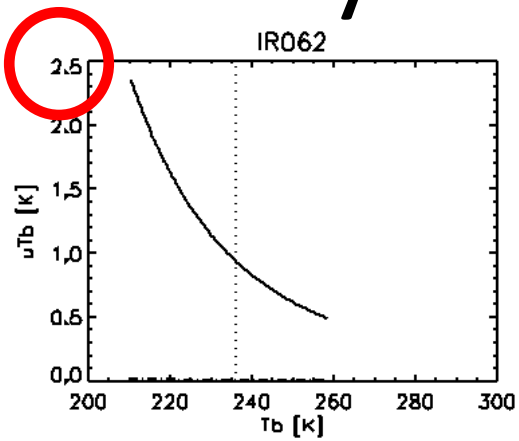
Using Specified Template MSG SRFs

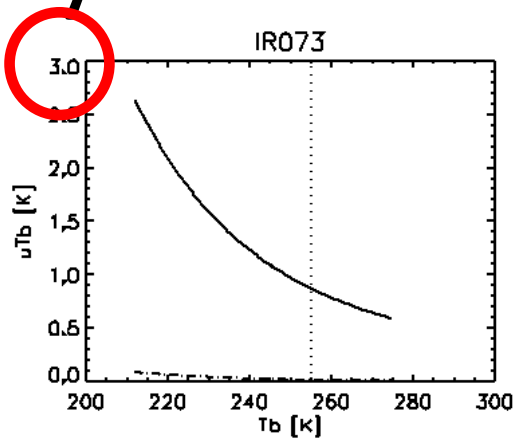


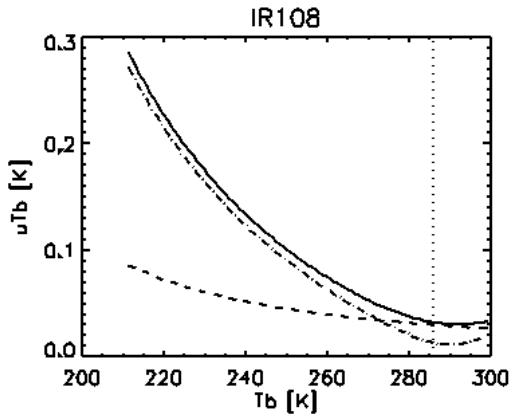
Results of Uncertainty Analysis

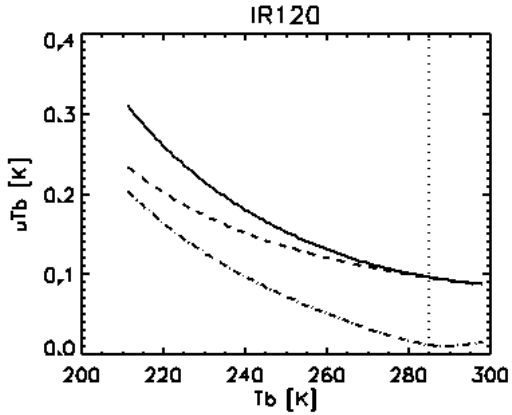
Using Common Reference STD SRFs

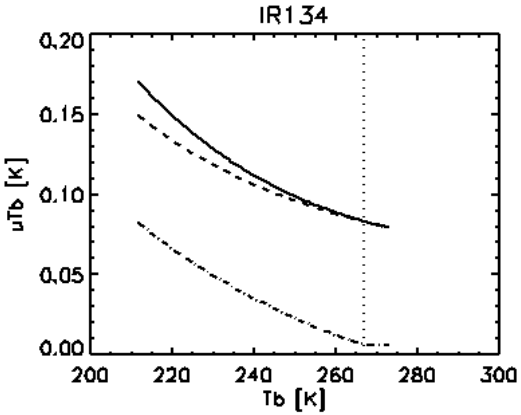












Discussion Points

- Still need products based on “actual” SRF of each instrument
- But do we need to define this as a different product class?
- What level of uncertainties are ‘acceptable’?
  - For current GEO imagers? – Near Real-time and Re-Analysis
  - For historic GEO imagers
- How do we select the ‘best’ definition of common reference channels?
- Who wants to investigate each option?
- How do we compare them?
- When?

Thoughts on Traceability

Rüdiger Kessel

NIST

What Maketh a Measurement Device?

- A good measurement device has the following properties:
  1. It is stable between calibrations
  2. It has a high resolution
  3. It has only very small deviations from linearity
  4. It has low noise (repeatable)
- So it is stability, resolution, linearity and low noise the "makes" a measurement device. How "accurate" you can measure with it, depends on the actual calibration. All these properties can be verified without external reference (but with external reference the task is much easier).
- Only if these properties of the measurement device have been established, does it make sense to calibrate the instrument. So in the absence of a reliable traceability chain we should focus on these properties now. Adding a calibration factor later to the game is not a big deal.

Traceability Concepts

The key issue in the traceability game is a way to prove that the system is indeed stable to a certain degree. On earth we simply re-calibrate to ensure this. Whatever has been done some time ago is meaningless until one can prove that the system is indeed in the very same state as during calibration.

Instead of trying to construct SI traceable statements, we should recognize that:

1. SI traceability is not possible without regular re-calibration.
2. SI traceability need to be demonstrated
3. SI traceability is not needed to make results comparable
4. Stability is more important then traceability to SI

Traceability v Stability

- "In the absence of SI traceability, stability is more important than traceability"
  - If SI traceability could be established, it would still be important to demonstrate stability between calibrations
- So we need to demonstrate stability.
  - One way (the only way?) of doing this independent of environmental changes is by inter-calibration.
    - But this can only ever demonstrate relative stability.