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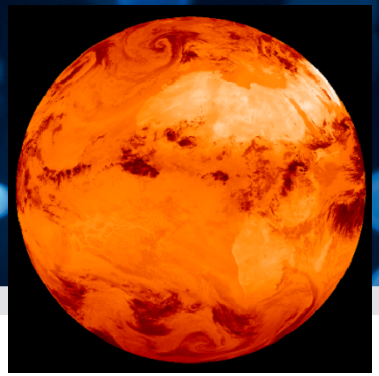
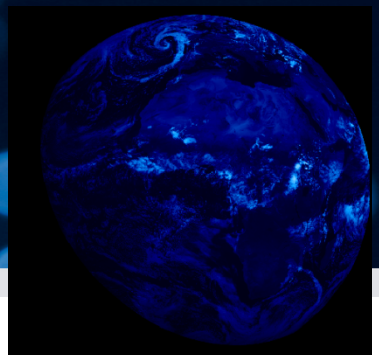
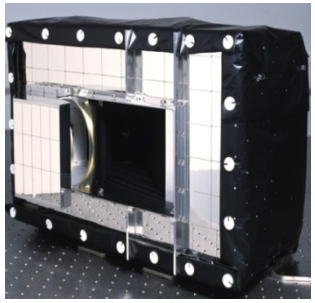
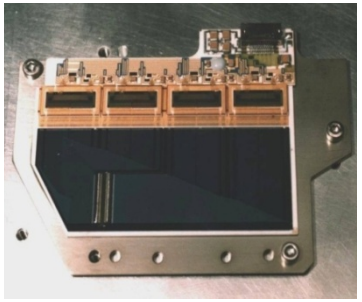
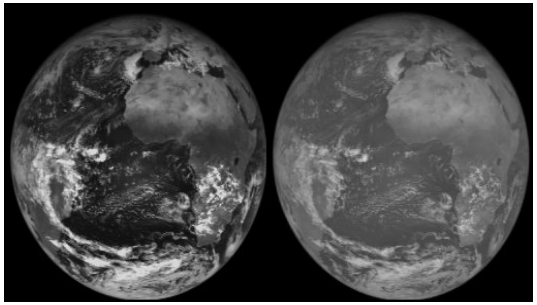




GERB Calibration status



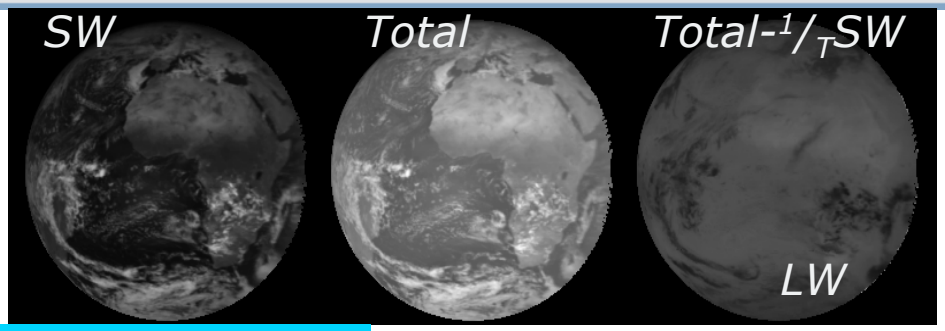




Jacqui Russell, (GERB project scientist) Imperial College

Imperial College London

From counts to radiance



$$\text{Scene radiance} = \frac{V(\text{Scene}) - V(\text{BB})}{\text{Gain}} + \text{BB radiance}$$

$$\text{Gain (TOT)} = \frac{V(\text{BB}) - V(\text{space})}{\text{BB radiance}}$$

$$\text{Gain (SW)} = B\text{x}\text{Gain (TOT)}$$

Internal black body is used to remove offsets and calibrate the counts to SW and Total filtered radiances. This requires **ground calibration parameters for the IBB and the gain ratio (B)**

LW is obtained by subtracted of SW from TOTAL, allowing for effect of quartz filter, requires **ground calibration info regard quartz filter transmission**.

At a later stage the resulting filtered radiances are unfiltered**, requiring knowledge of the instrument spectral response**

GERB 3 and GERB 4 enhanced ground calibration data

- *Improved broadband SW standard with more detailed characterisation*
  - *More energy at shorter wavelengths*
  - *Angular and spatial variation characterised (previously an uncertainty term)*

- *Long wave response characterised at instrument level using black bodies varied over temperature range 234 K – to 341 K.*

- *More detailed instrument level spectral measurements*
  - *Data obtained for all pixels using many filters*
  - *Two sides of mirror characterised individually*

- *More detailed mirror witness sample measurements*

- *More accurate detector measurements (GERB 4 only)*

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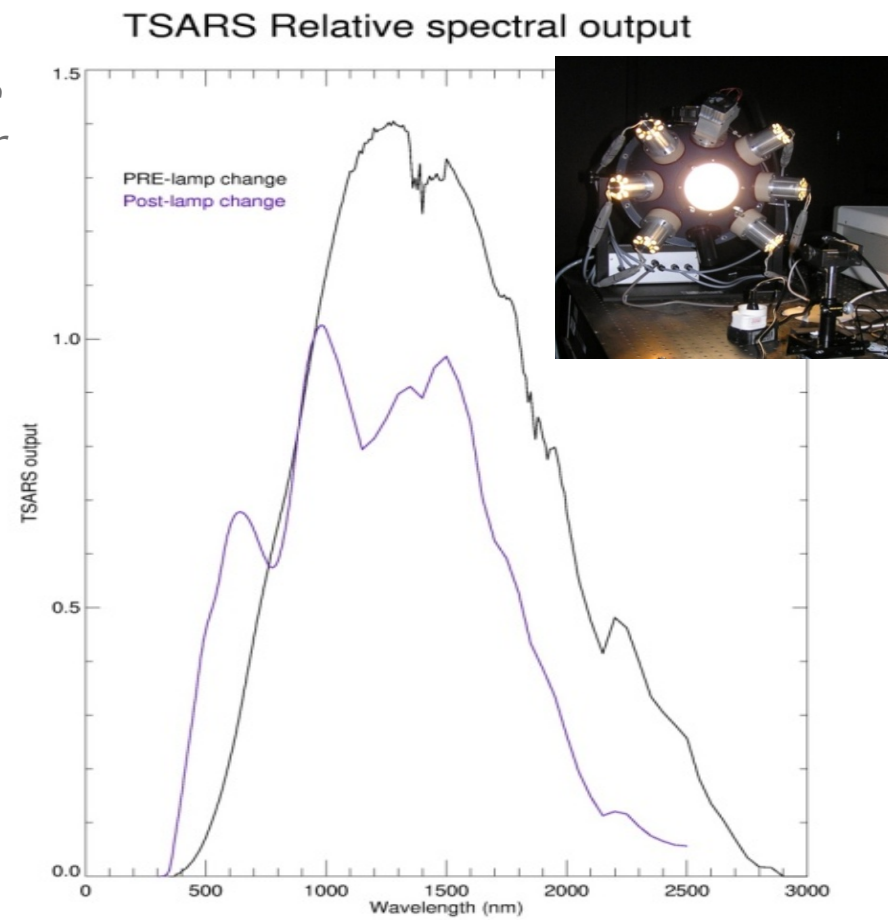
SW reference source modification

Calibration uses broadband shortwave source to provide system level measurement of filter transmission and gross tuning of measured relative level of shortwave and long-wave portion of the response. 'B' factor

$$\text{Gain (SW)} = B \times \text{Gain (TOT)}$$

Ideal source has same distribution of energy as Earth scenes

Improved source still not ideal but provides more energy at shorter wavelengths.



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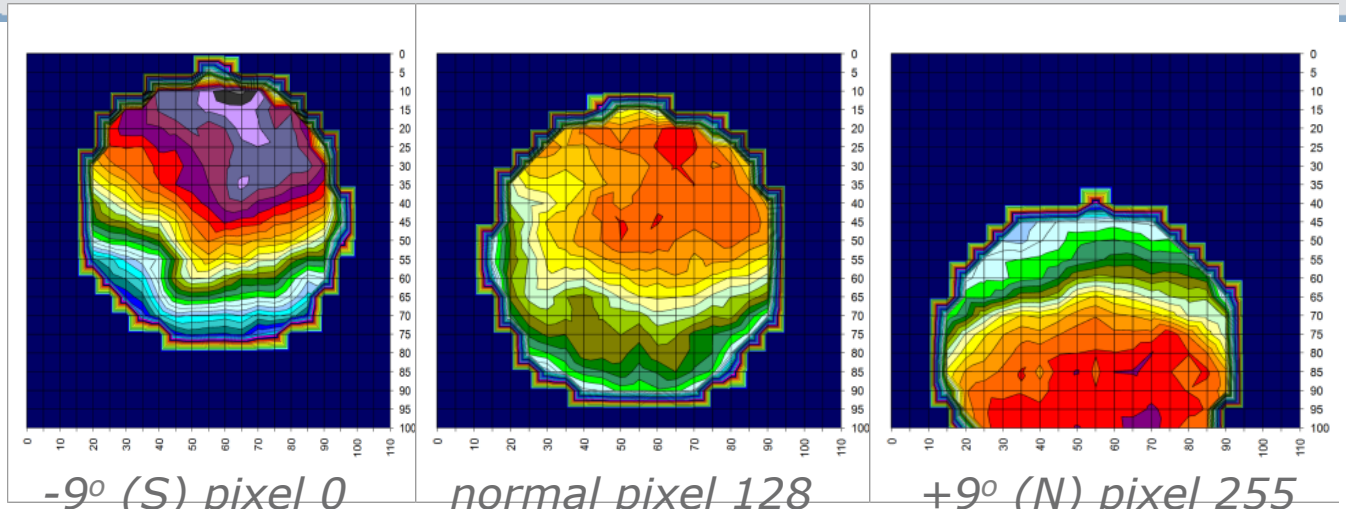
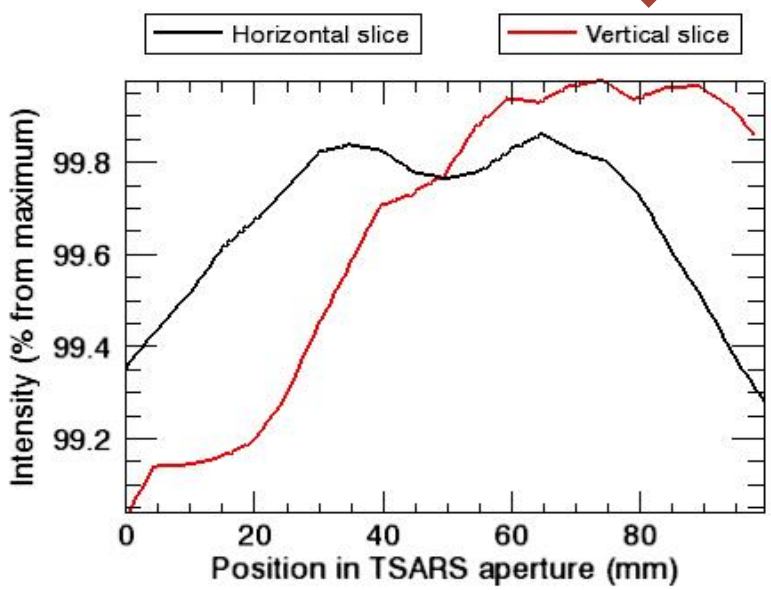
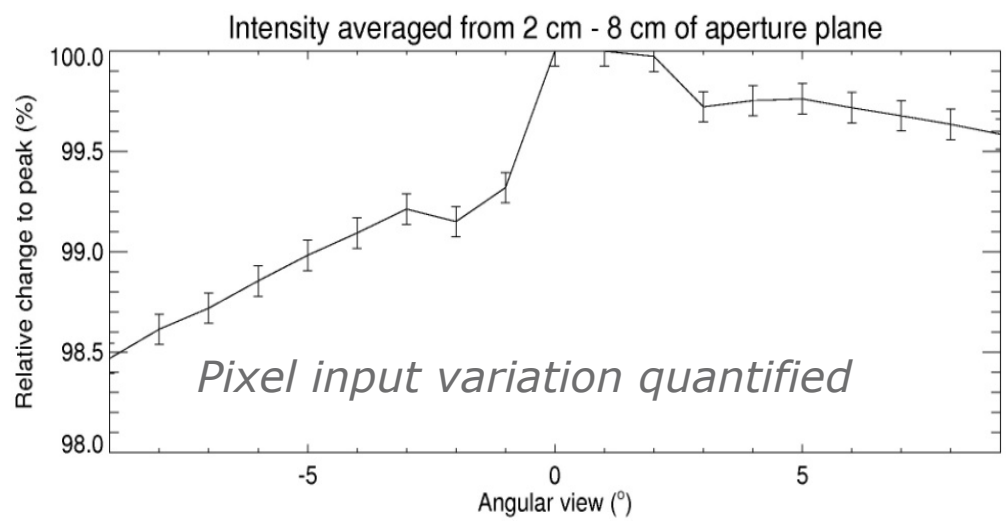
SW reference source characterisation



Angular and spatial variations characterised by NPL using a filter radiometer lens combination to image the VISCS aperture plane onto the plane of the radiometer input, such that the radiometer observes approximately a 5 mm spot in this aperture plane.





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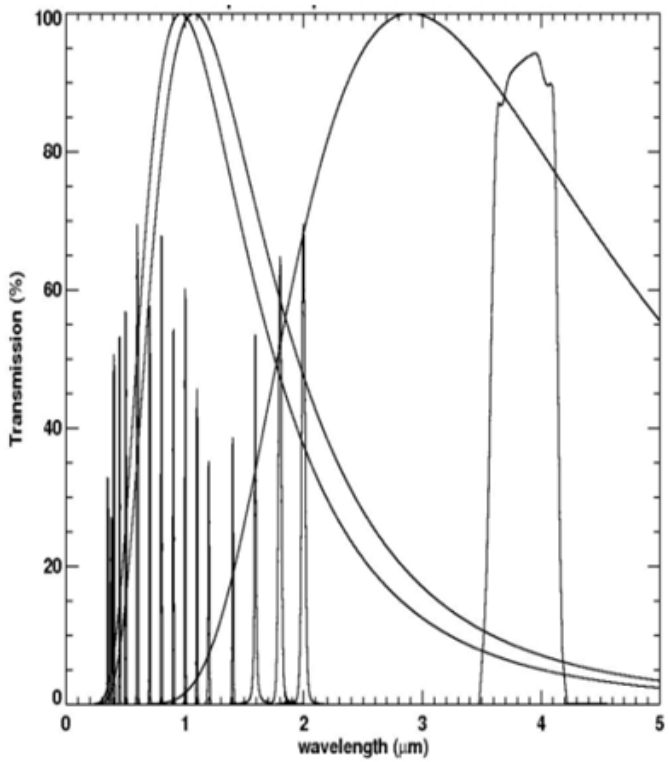
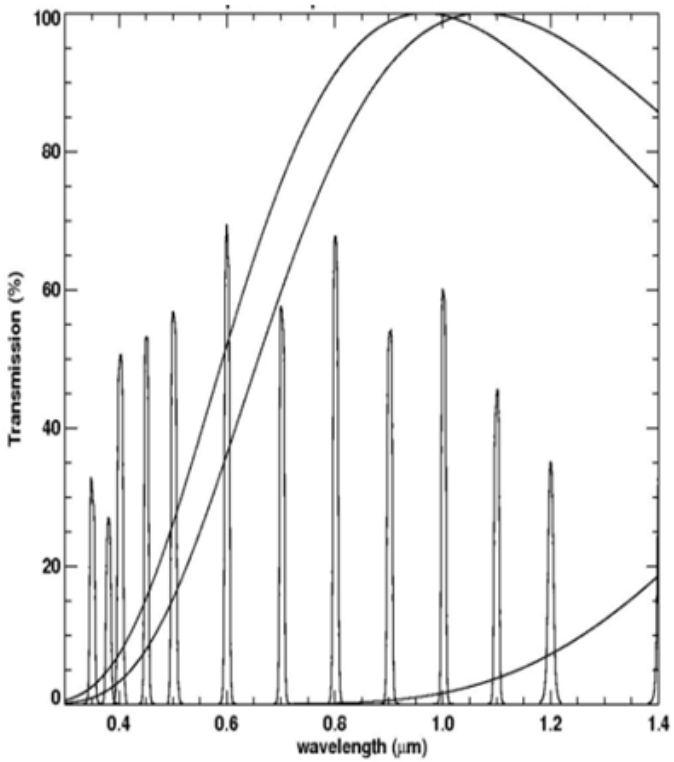
Enhanced system level spectral response measurements

Previously relied on unit level measurements of detector and mirror witness samples from same coating run





Spectral response spot check measurements using 23 separate spectral filters:

0.35,0.38,0.40,0.45,0.5,0.6,0.7,0.8,0.9,1.0,1.1,1.2,1.4,1.6,1.8,2.0,3.8,**4.7,5.1,7.8**,10.3,12.5 and 20.0 μm

Latest ground cal potential

New measurements offer for GERB 4 (and GERB 3)

- the possibility of using a system level measured spectral response
- improved characterisation of pixel to pixel variability in SW response
- better characterisation of the LW response to cold scenes
- potential to transfer some of these advantages to earlier GERBs by cross calibration after launch
- provide validation point on proposed GERB aging corrections

In orbit calibration: updates for Edition 2

- Edition 1 data used fixed spectral response and did not seek to unify differences in calibration between instruments.
- Edition 2 will seek to unify record and address pixel to pixel calibration differences and calibration drifts:
  - Calibration differences with some scene dependence apparent in 2007 between GERB 2 and GERB 1 will be removed by references to GERB 1.
  - Loss of response at short wavelengths leading to decreasing unfiltered radiances & fluxes in Ed 1 record over time to be addressed with adjustment to filtered radiance or time varying spectral response
  - Accuracy of longwave for coldest scenes improved by comparison with GERB 3 commissioning data
  - Pixel to pixel variation in response addressed

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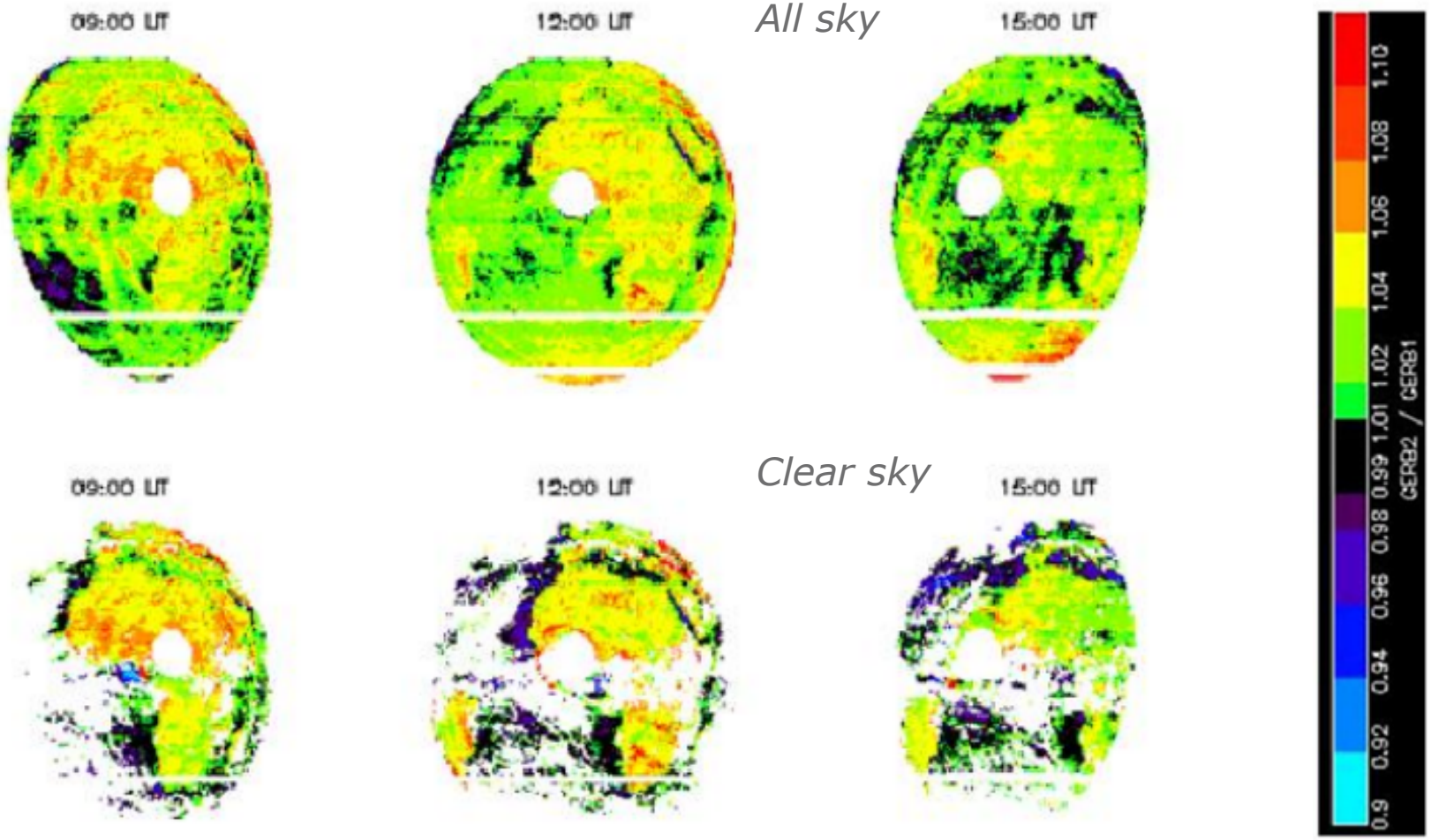
GERB SW calibration offsets



GERB 2 / GERB 1 SW flux 2007 comparison

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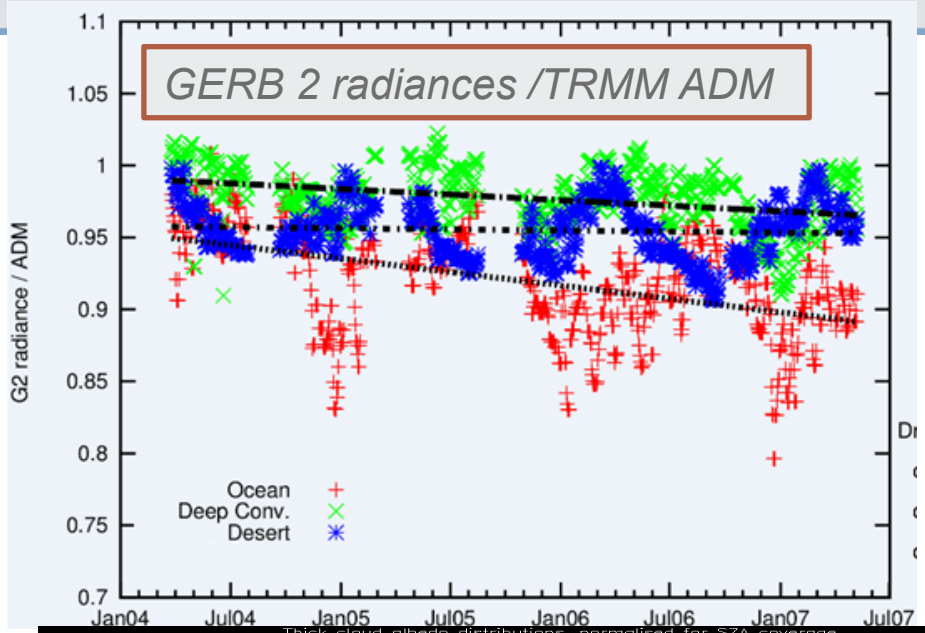
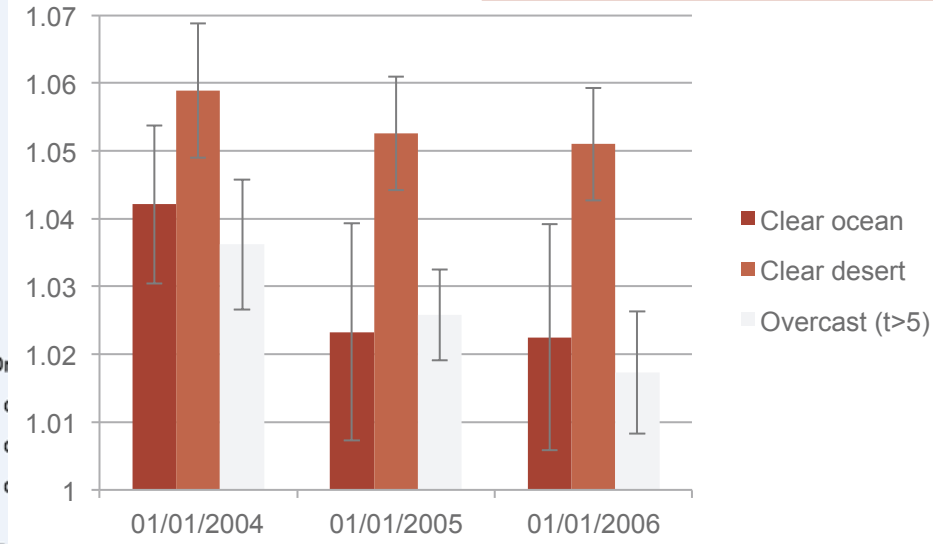
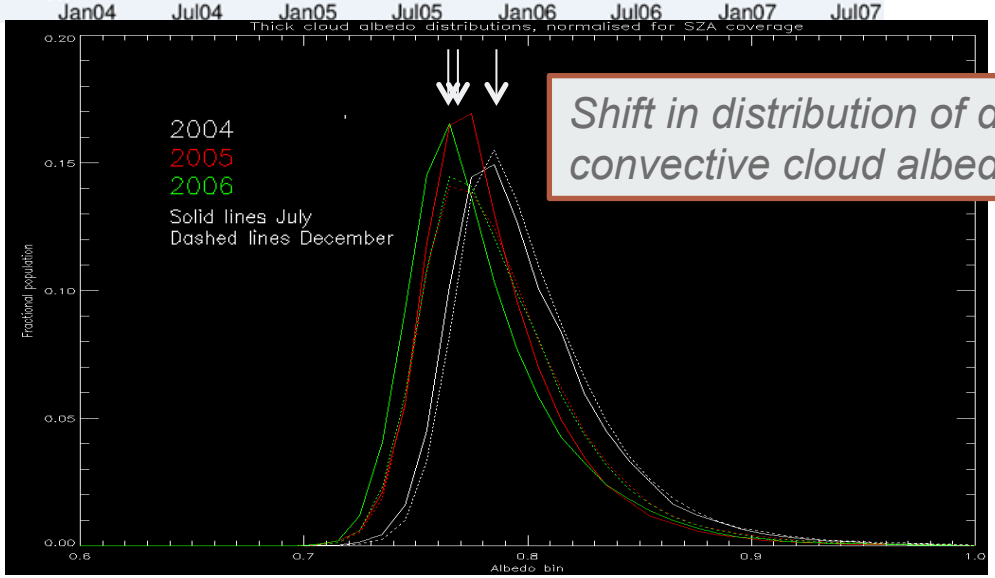
In Oribt SW response changes



GERB 2 SW update / CERES Ed3





Shift in distribution of deep convective cloud albedo

Temporal character and spectral detail of changes need to be characterised

Ongoing activities for Edition 2 calibration updates

- Detail the GERB 1 / GERB 2 differences in terms of gain & spectral response and unify –
  - employ co-incident lunar scans for SW gain normalisation
  - Filtered radiance comparison and scene dependencies for spectral differences
- Extend deep convective analysis
- Extend GERB / CERES comparisons
  - reduce comparison noise by considering spatial and temporal homogeneity
  - better accounting of instrument PSFs.
  - Express spectral changes via scene dependence or unfiltering factor changes.
- Complete reanalysis of the onboard SW calibration monitor results
  - Previous results indicated lack of sensitivity to SW changes but should be recomputed including spectral component of corrected monitoring diode results
- Use GERB 3 & future GERB 4 comparison points to cross check

END

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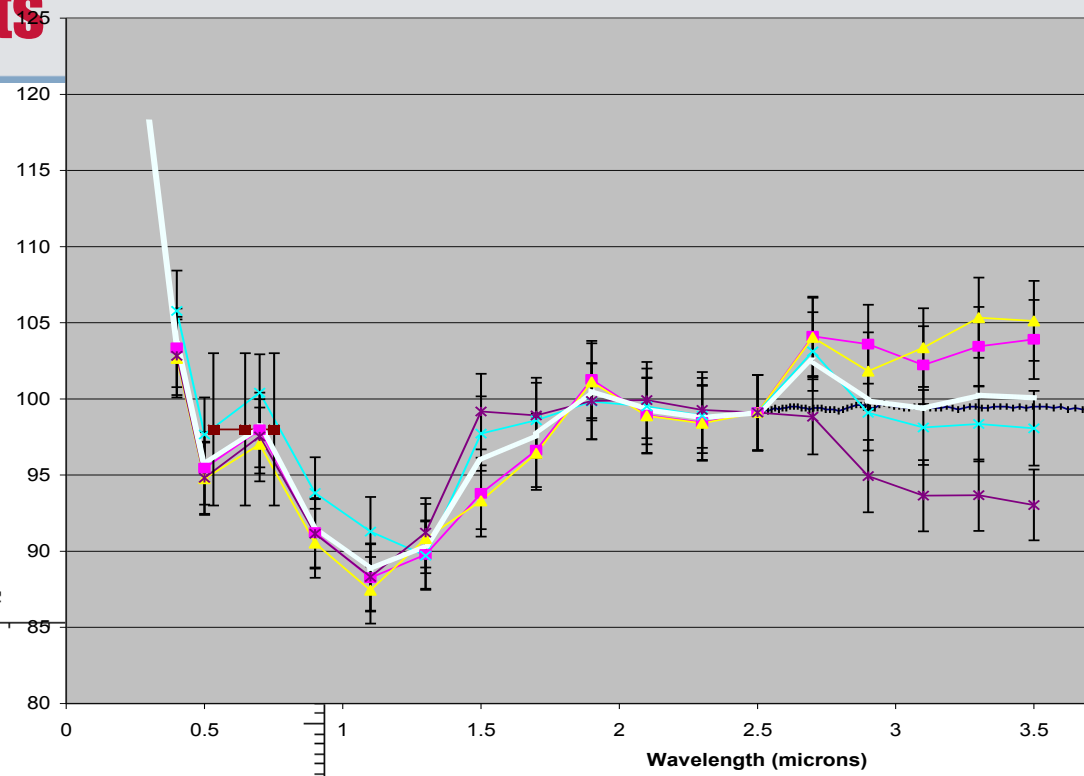
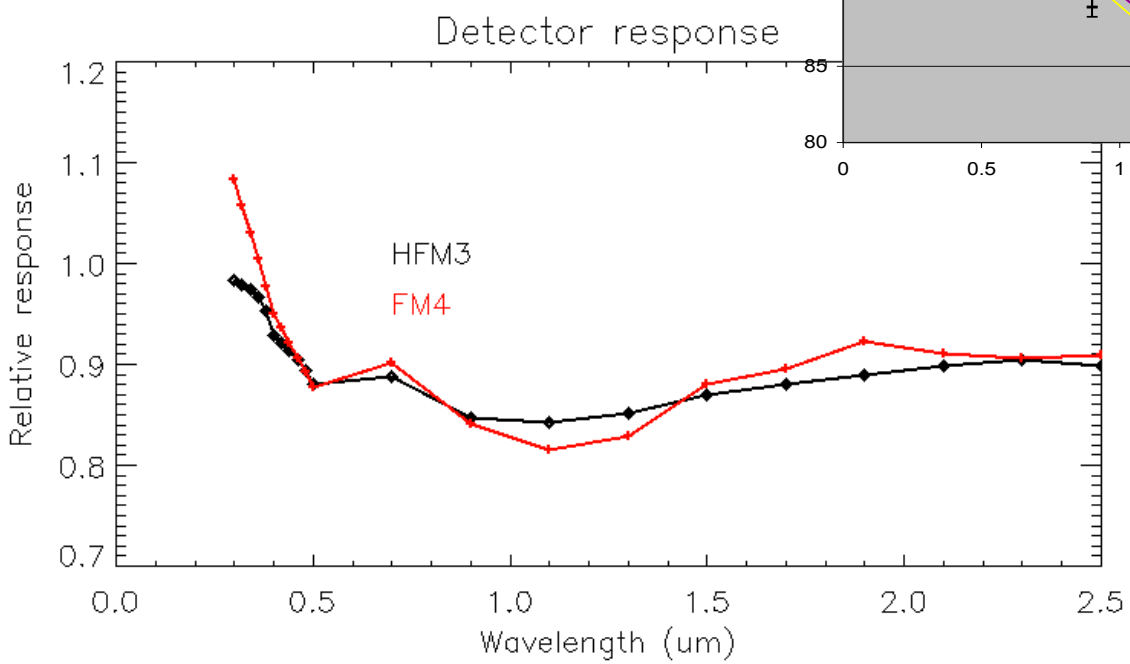
Detector SR measurements

FM4 are the measurements made on the GERB 2 detector. Some corrections required post measurement on these due to measurement setup issues uncovered post launch.





HFM3 is the GERB 4 detector, same batch of detectors as all other GERBs. Measurements use new technique, provide improved spectral response and accuracy