Imperial College London

Geostationary Earth Radiation Budget

GERB data and products update

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GERB product status summary

GERB 4 operational @ 0°

- Series of version updates now being consolidated with an end-to-end reprocessing

    - Bug corrected in normalisation of un-filtering coefficients for GERB 4 which resulted in 5-6% elevation in SW products

    - North south mirror side pointing difference accounted for in geolocation

    - Quartz filter vignetting anomaly found to affect a several months of data (Nov 2018 to mid March 2019), and shorter periods through the subsequent record. Periods have been identified and corrective adjustment determined and implemented

    - Needs assessment to determine if it ready for release. GERB 4 responses quite different from other GERB's this has impact on geolocation accuracy and (hence) on correct application of unfiltering

Historical Ed 1 record (2004-2012)

- Updated extended and more complete monthly hourly average products (*GERB-HR-ED01 1hrCM)* netCDF CF complaint ops4MIPs compatible format

    - V1 release for 2007-2012 already available but V2 to dramatically reduce the impact of missing days of data and extend the period of data available being produced.

GERB 4 quartz filter anomaly

Periods of reduced SW / increased LW appearing in the record.

CALMON scans show the apparent reduction in the filter transmission which as not accounted for in the calibration parameters. This results in an uncorrected reduction in the SW and residual SW left in the LW derived by subtraction, giving the observed jumps in both records

Traced to the effect of an onboard autonomous safety procedure which alters the direction of the quartz filter movement
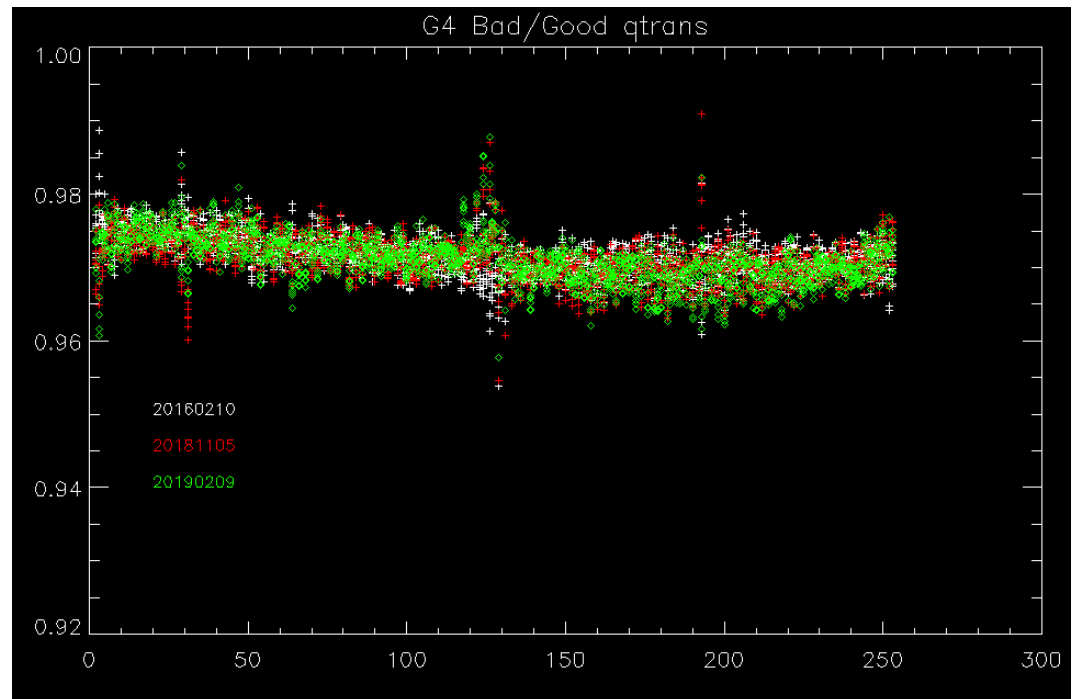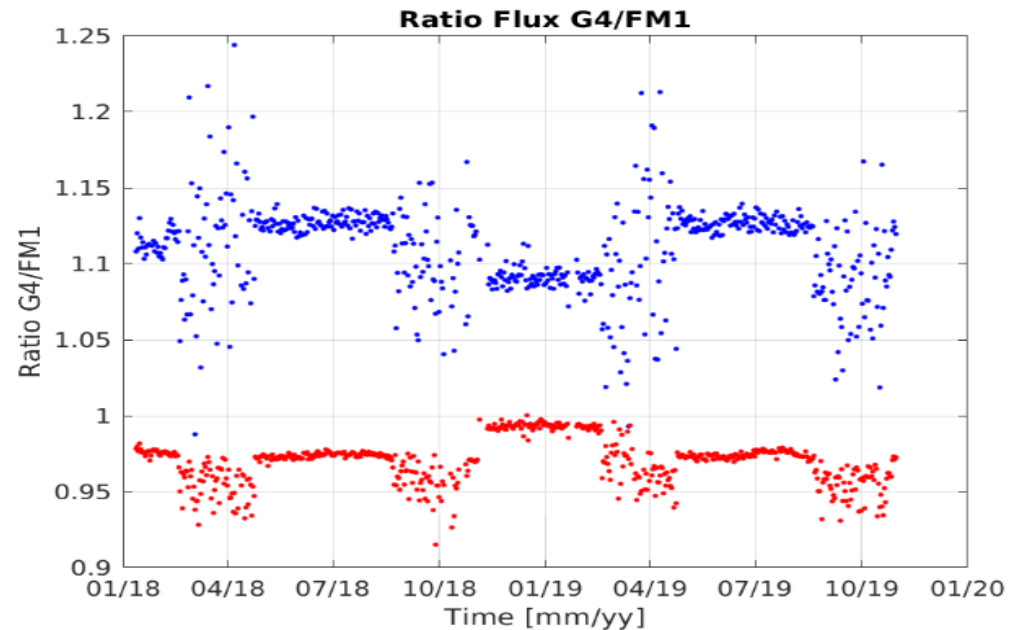
Quartz filter safety procedure reverses direction of filter to provide a quicker response time

- Employed on GERB 1, 2, 3 and 4
- Haven't seen a noticeable effect of GERBs 1 & 2
- GERB 3 and 4 show subsequent reduction in SW (by 2-3%) only cleared by power cycle

(or table rewrite to restore nominal direction of filter)

Part of the commissioning data and one operational period (Nov 2018 to March 2019) affected on GERB 4 before the effect diagnosed and corrected by amended operational procedures
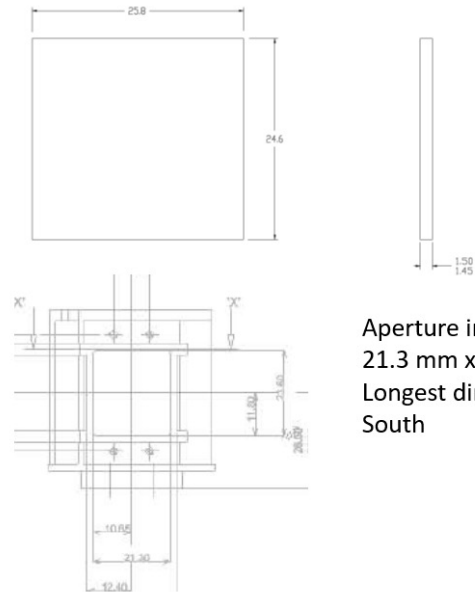
Large portions of the GERB 3 record affected.

GERB 4 quartz filter anomaly

QFM Quartz Filter

Filter dimensions

Aperture in holder is
21.3 mm x 23.6 mm
Longest dimension is North-South

Quartz Filter positioning

Motor is a 200 step/rev stepper motor

1 step = 1.8 deg

Distance of edge of filter holder to centre of rotation = 19.7mm

Therefore 1 step corresponds to linear motion of the edge by ~ 0.6mm

Telescope aperture is 20.6 x 20.6 mm

Filter holder aperture is 21.3 x 23.6 mm

Overlap (assuming apertures centred) = +/- 0.35mm

Therefore 1 step of the motor could lead to filter holder edge vignetting the telescope aperture.

GERB 4 quartz filter anomaly

1.024 adjustment to the GERB 4 SW during the anomalous periods required

- For GERB 4 the only extended period requiring correction are a few months of data end 2018-start 2019 as operational procedures then put in place to rewrite table after future table rewrites. However short periods of data (a few hours – days) in the subsequent record require correction and will be addressed on reprocessing

- Correction factor required for the large periods of GERB 3 will be determined after future tests on the magnitude of the effect for GERB 3 when these data are reprocessed (if funding allows).

GERB Obs4MIPS monthly diurnal average products
Monthly hourly CF complaint netCDF files 1 files

24 monthly hourly averages from the 4 15' timeslot HR observations for each day of the month for the GERB 60N/S, 60E/W region
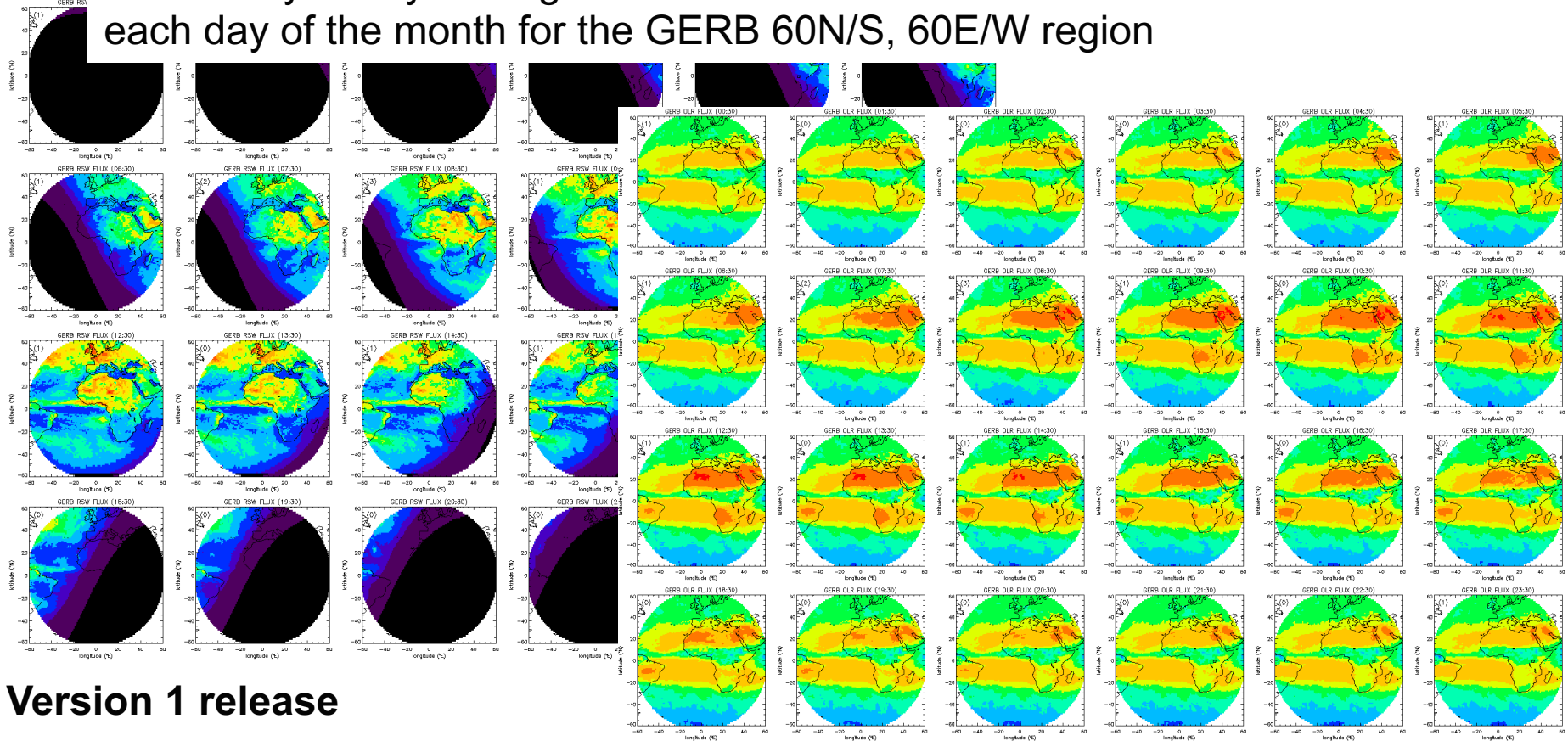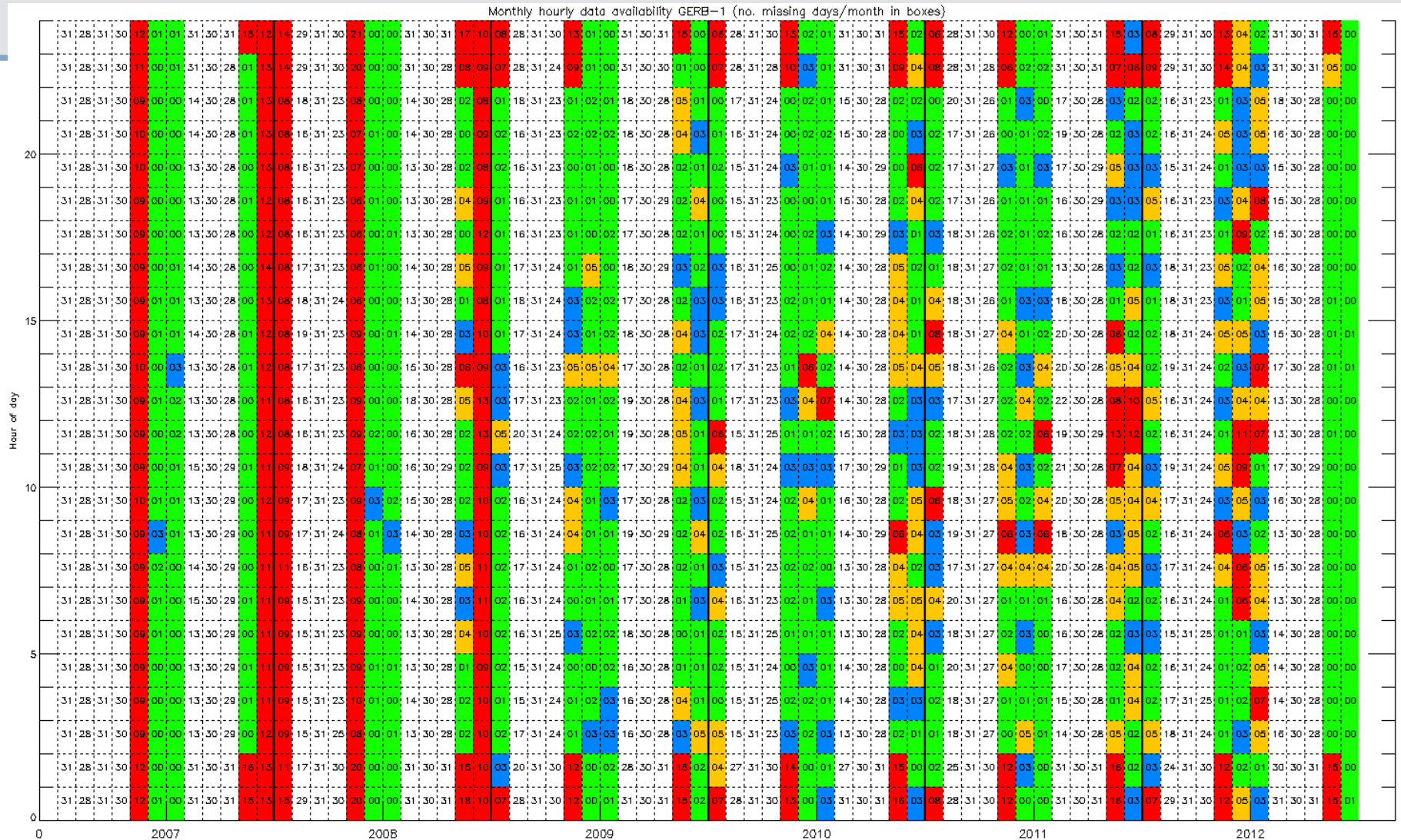

Version 1 release

Only months outside the GERB 'eclipse seasons', i.e. Jan, May, June, July, Nov, Dec
If more than 5 days of missing data for an hour it is not produced.
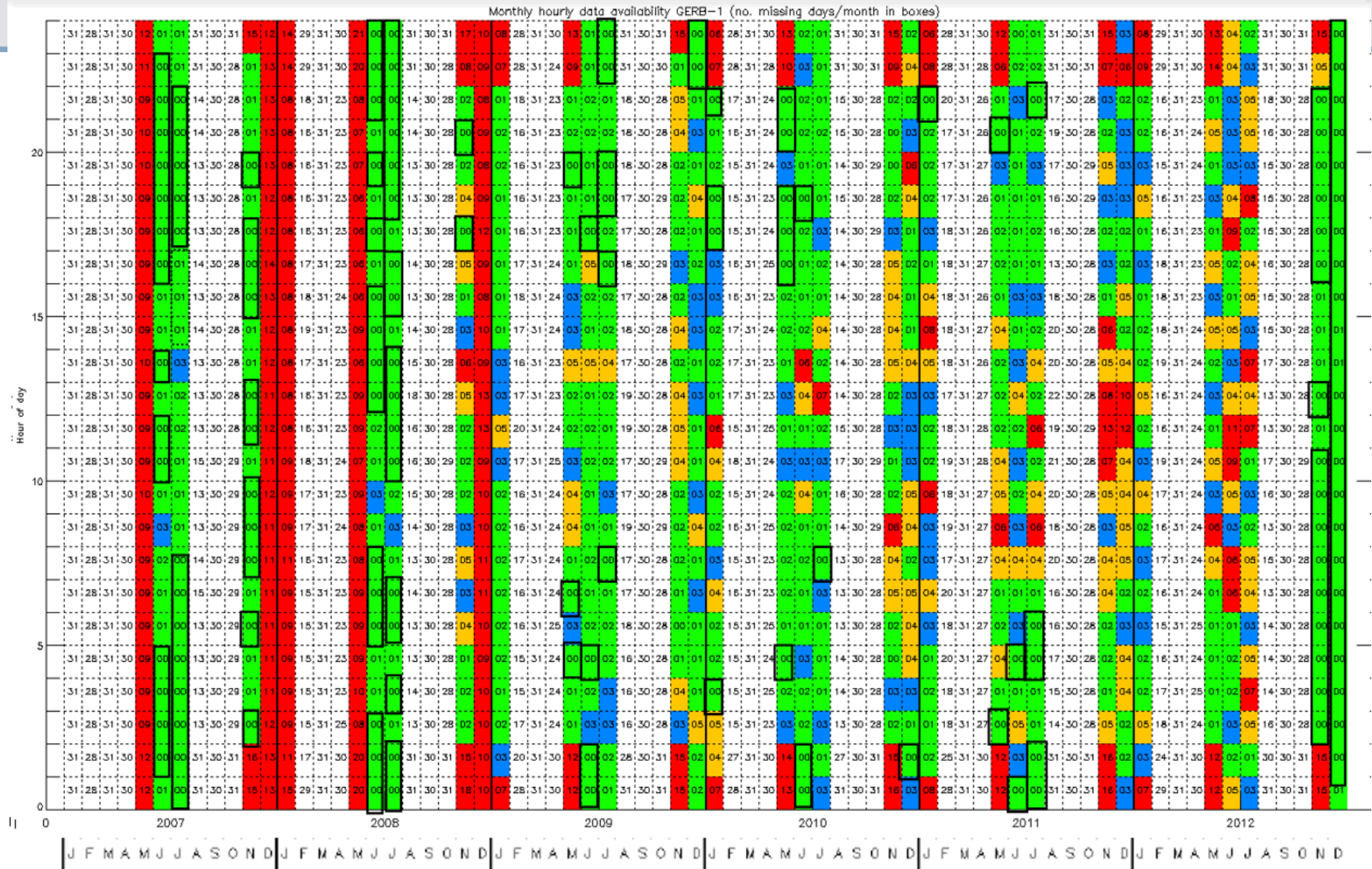Currently for GERB 1 record May 2007 – Dec 2012

Missing days of data in the monthly hourly average

Monthly hourly data availability GERB-1 (no. missing days/month in boxes)

Blue: 3 days missing   Yellow: 4-5 days missing   Red: > 5 days missing

Missing days of data in the monthly hourly average

Monthly hourly data availability GERB-1 (no. missing days/month in boxes)

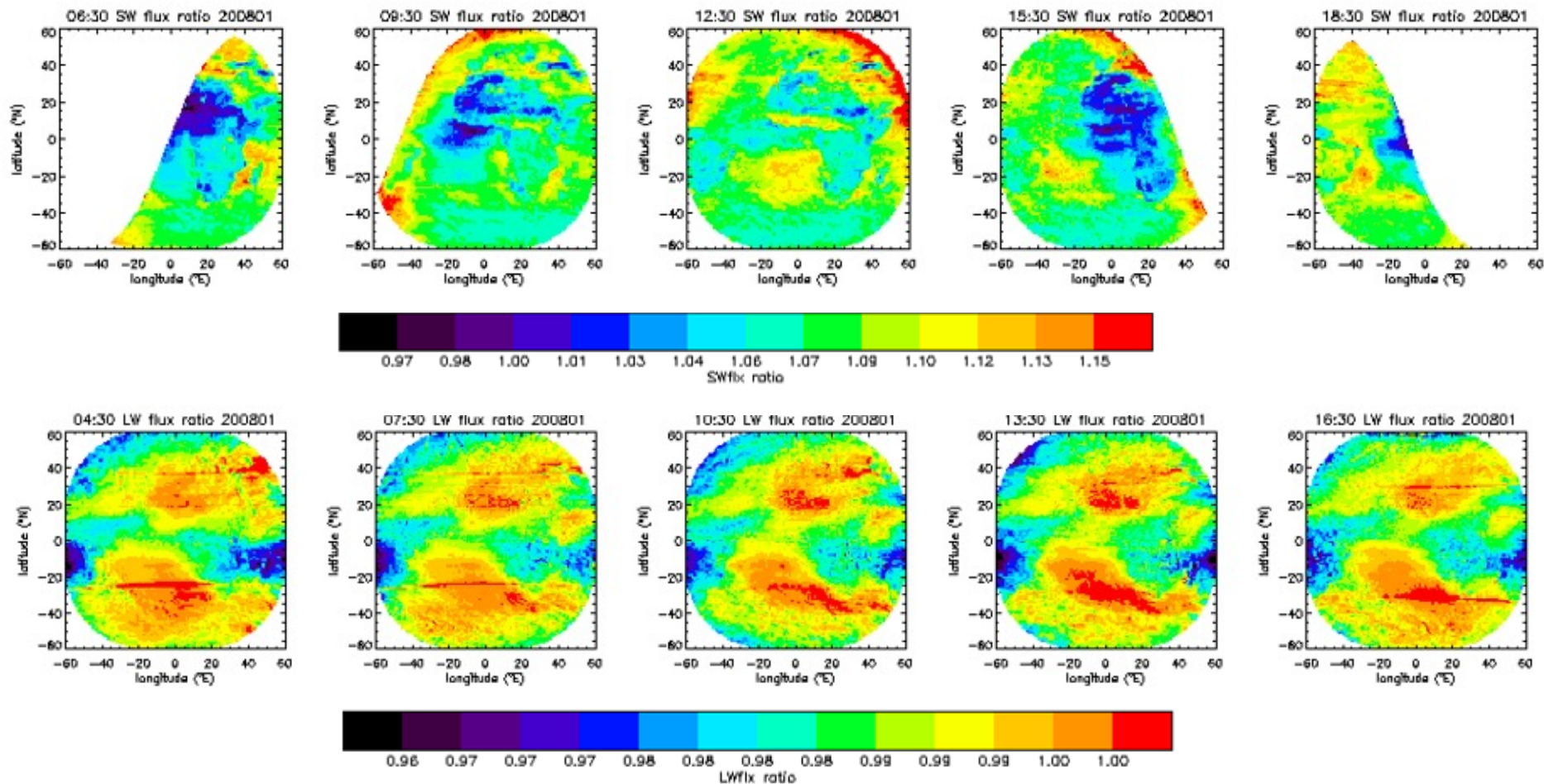# Effect of missing days of data on the average

OLR

RSW
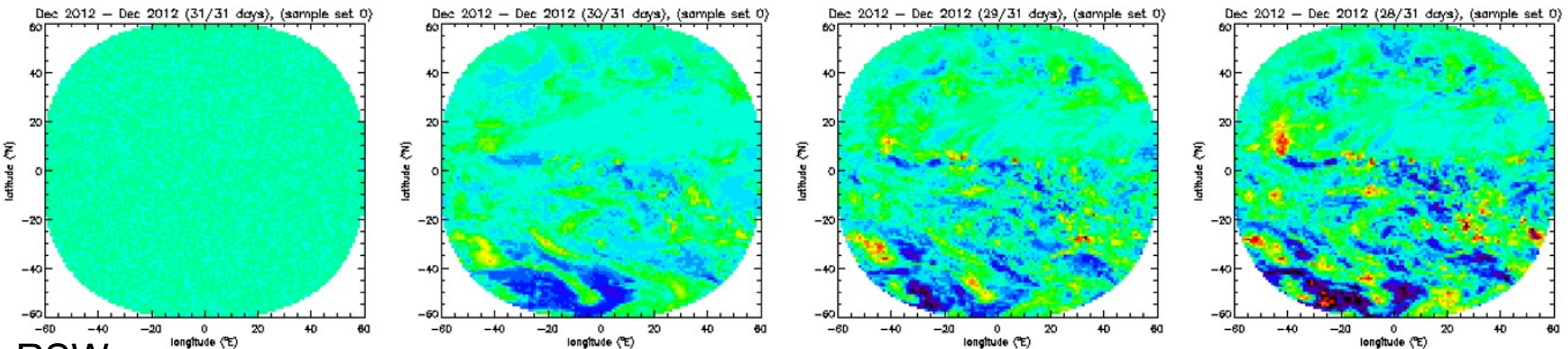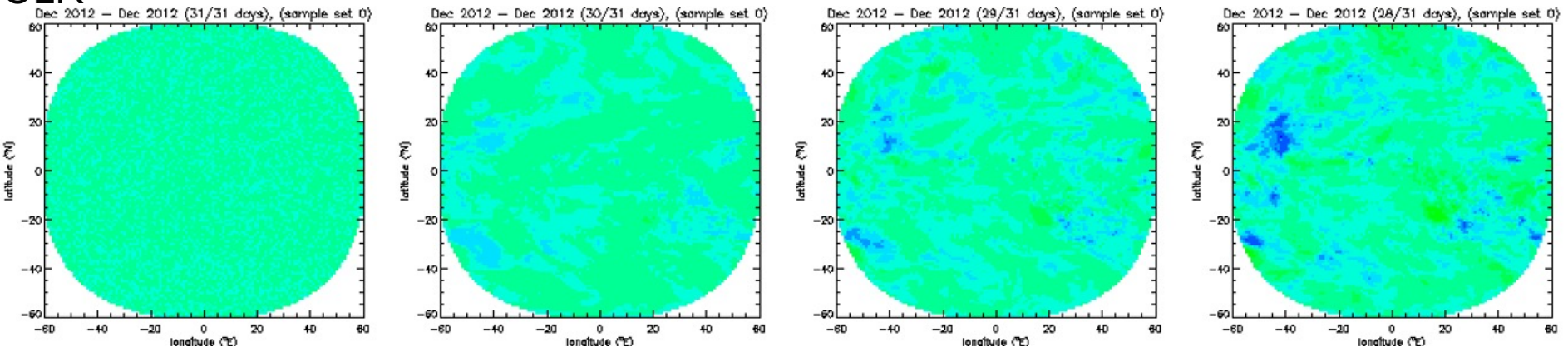
Flux difference

Using NB-BB to fill the missing GERB: NB availability
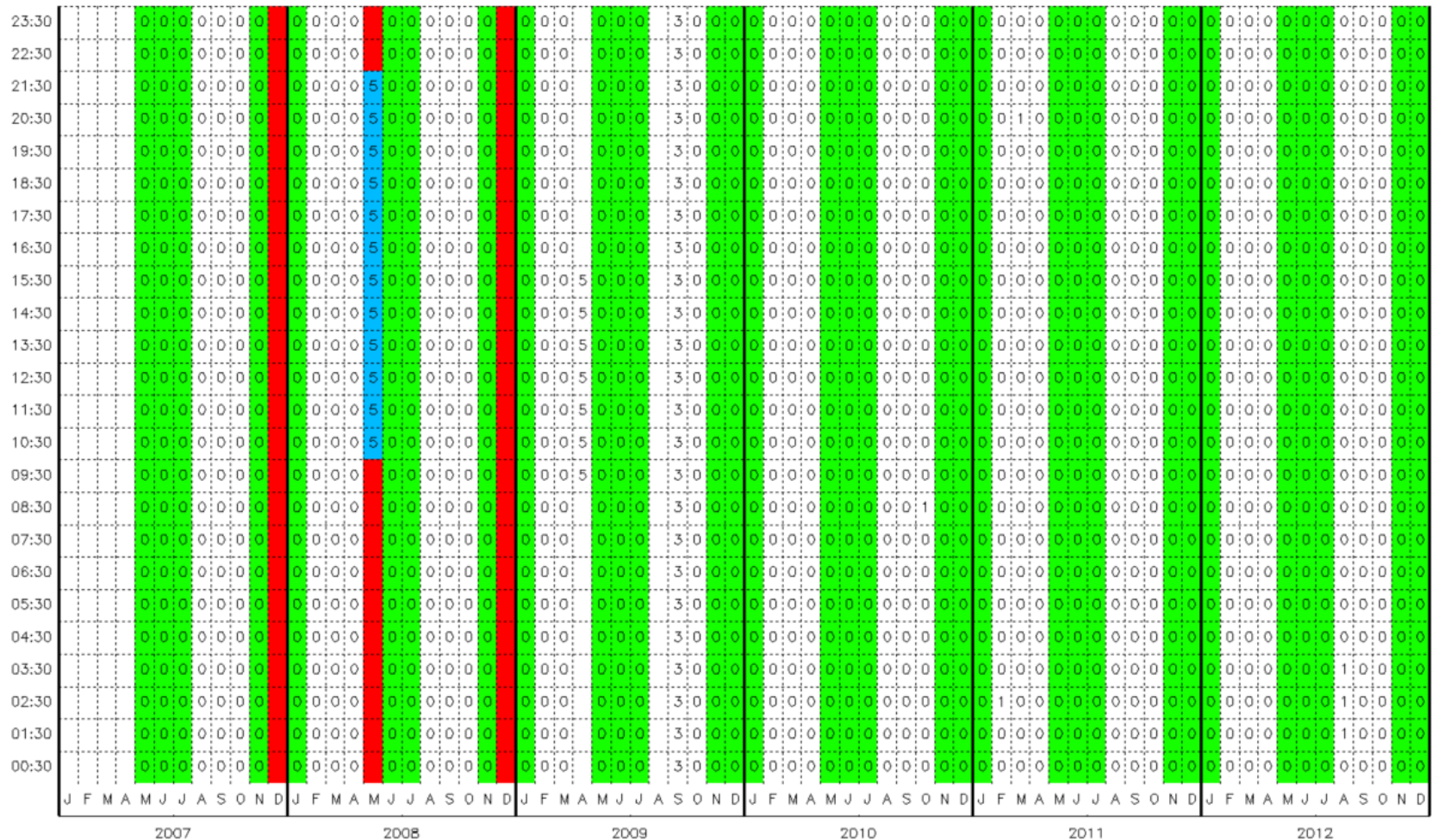
Correcting to the NB-BB to the GERB observations

- GERB processing produces a GERBlike BB estimate from the NB as part of the product production but not optimised for filling on the product level

Using the monthly average ratio to correct daily data

- Can we improve the GERB monthly diurnal average by filling missing days with corrected GERBlike data, by deriving a correction from the available GERB data?

  - YES as long as we derive a location and time of day specific correction from the monthly average derived from the available GERB data and the matched GERB like.
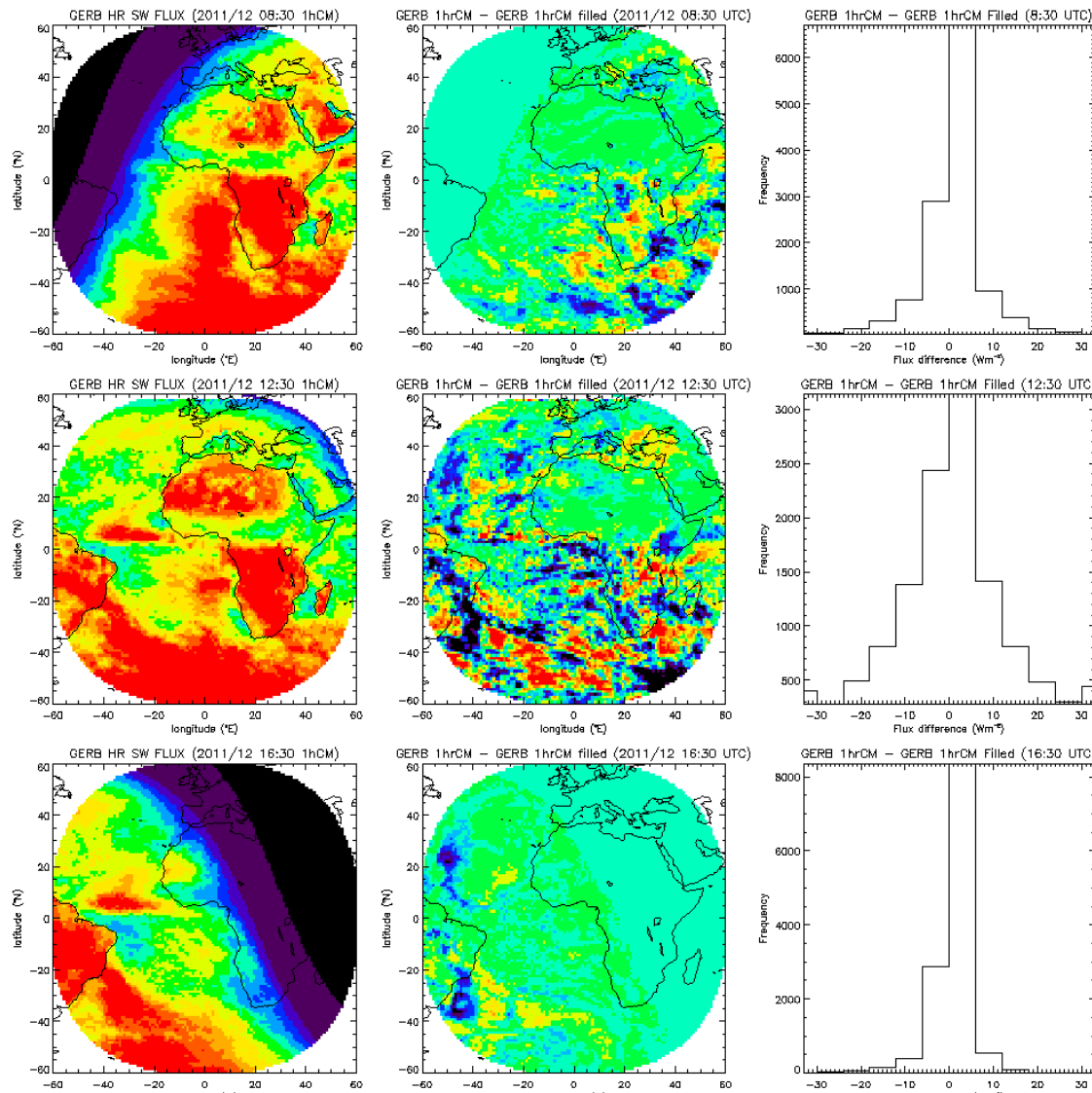

July 2008
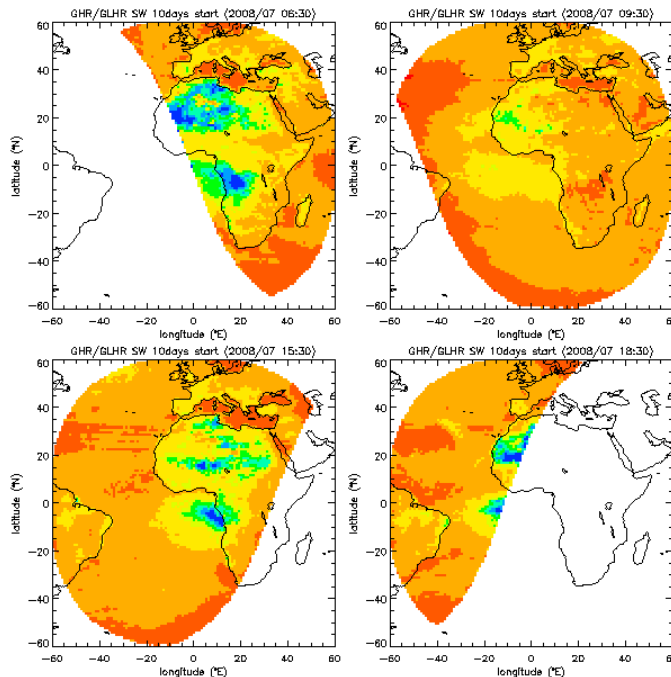
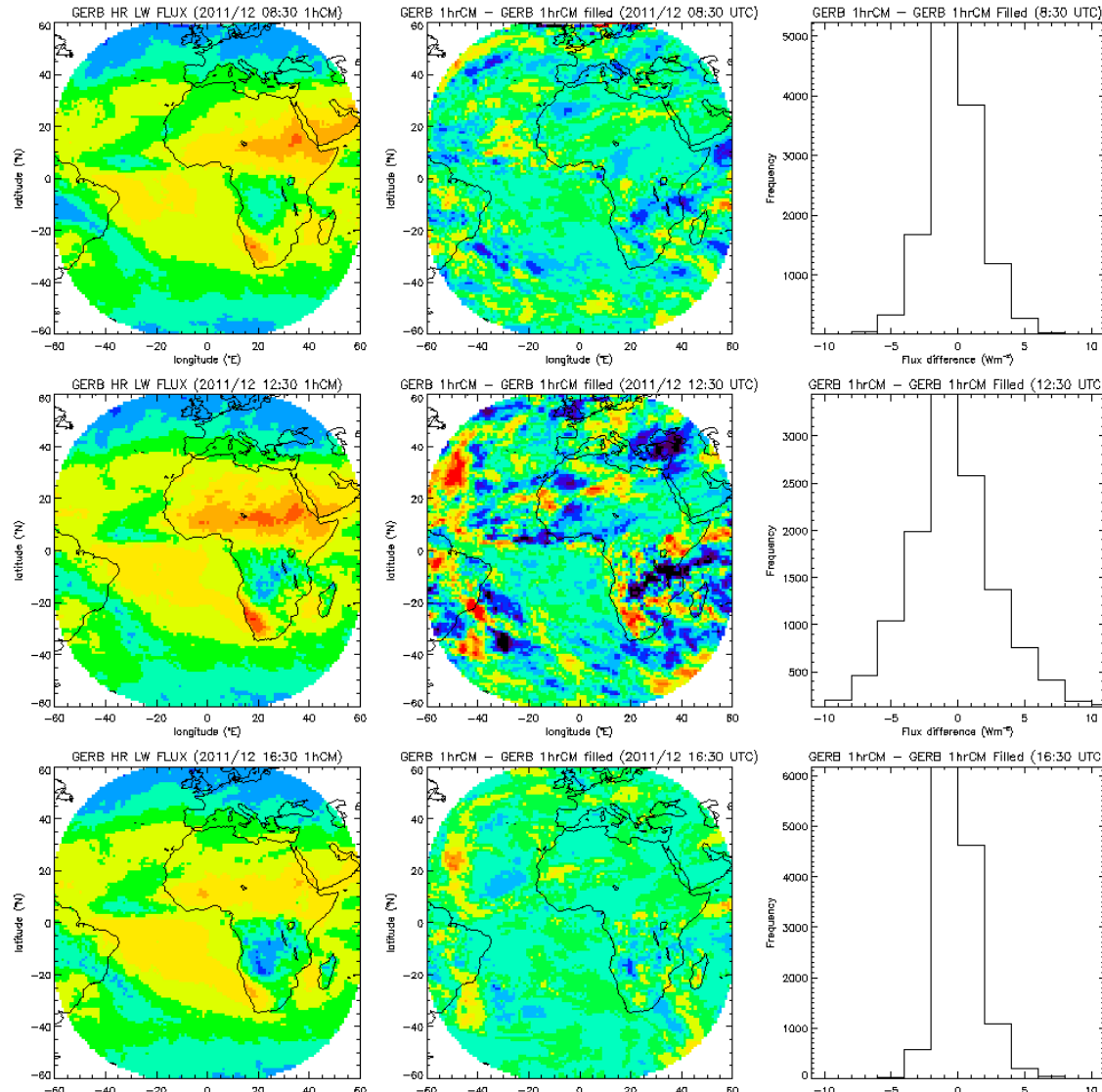Dec 2012
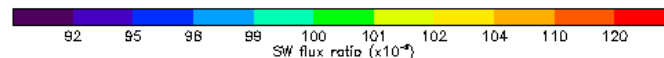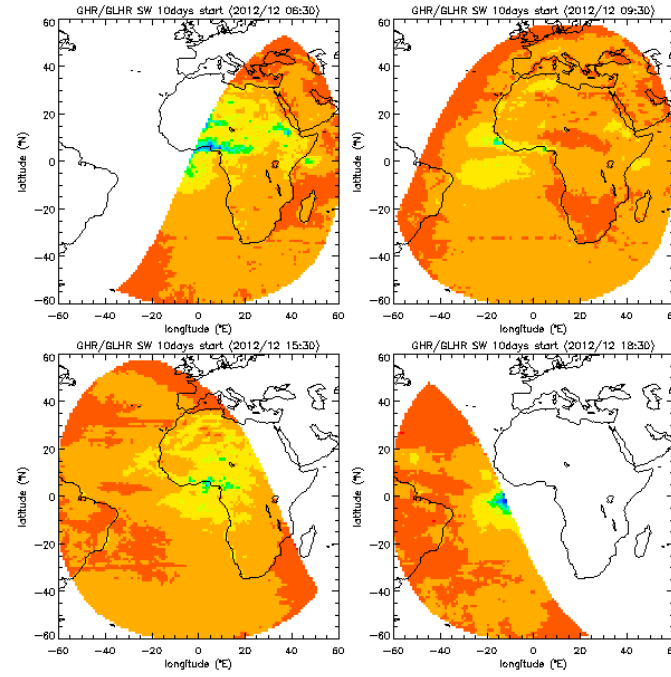
Impact of filling: SW examples

Dec 2011 RSW
08:30 [5 missing days filled];
12:30 [10 missing days filled];
18:30 [2 missing days filled]

Mean difference (unfilled - filled):
0.366260   0.242164   0.0575517
Std deviation in difference:
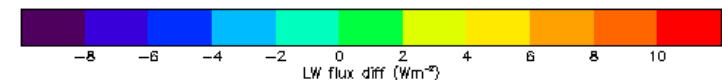6.90267   15.2354   4.13581
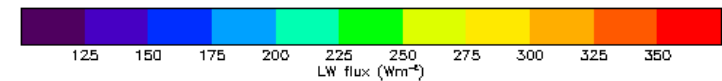
Impact of filling: LW examples

Dec 2011 OLR
08:30 [5 missing days filled];
12:30 [10 missing days filled];
18:30 [2 missing days filled]

Mean difference (unfilled - filled):
-0.245531   -0.340297   0.119912
Std deviation in difference:
 2.30952   3.88556   1.49315

Residual error of filling

To determine the error due to filling missing data we did a series of tests by removing available data and then seeing how well it can be replicated at the monthly hourly average scale using this filling method.

Following examples shown for 'worst case' of sequential missing days.

Data that is systematically missing at end of start of the month potentially most detrimental effect on estimated correction ratio due to the change in solar angles through the month

RSW residual error filling 5 and 16 missing days from the start of Dec 2012
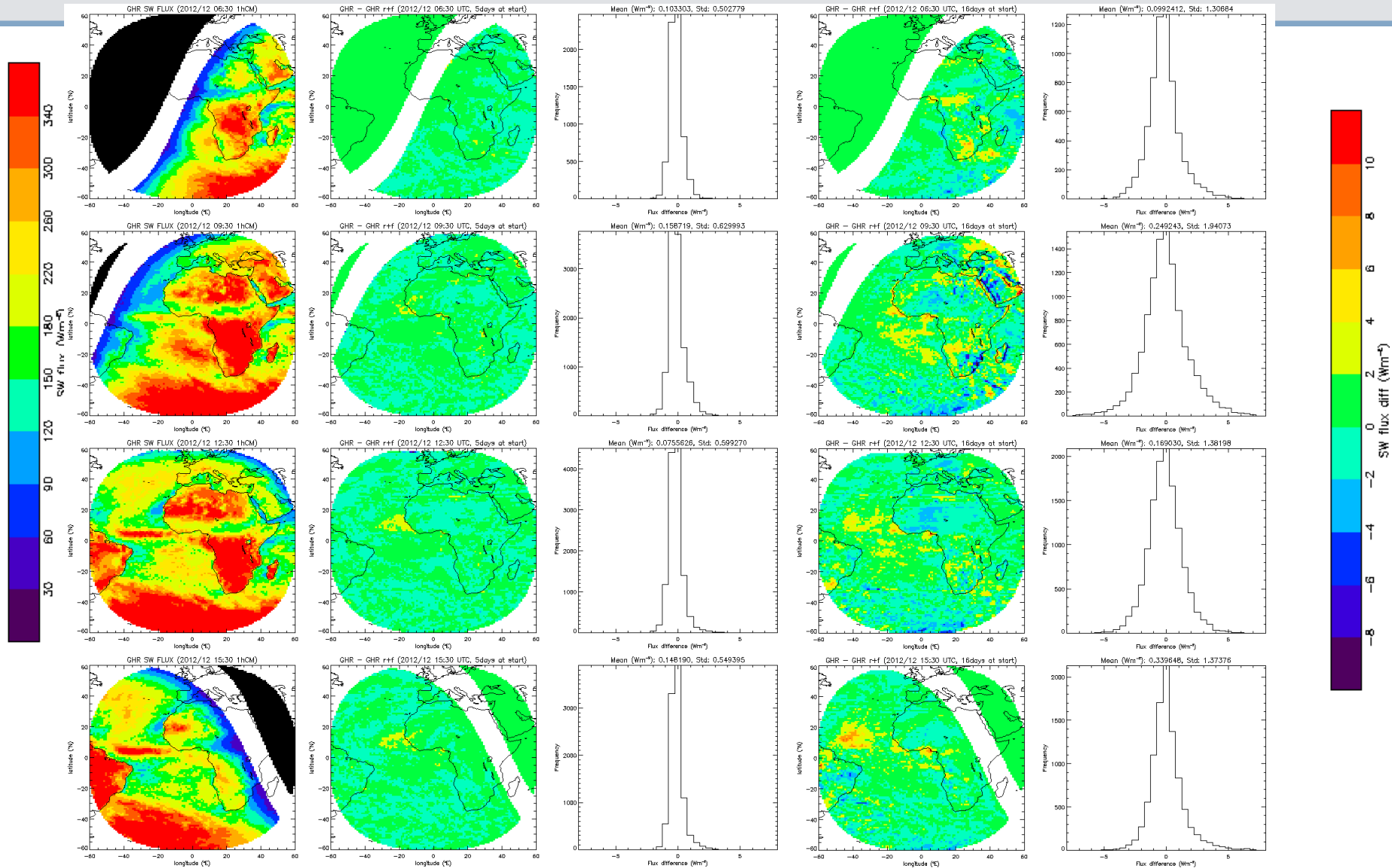
OLR residual error filling 5 and 16 missing days from the start of Dec 2012
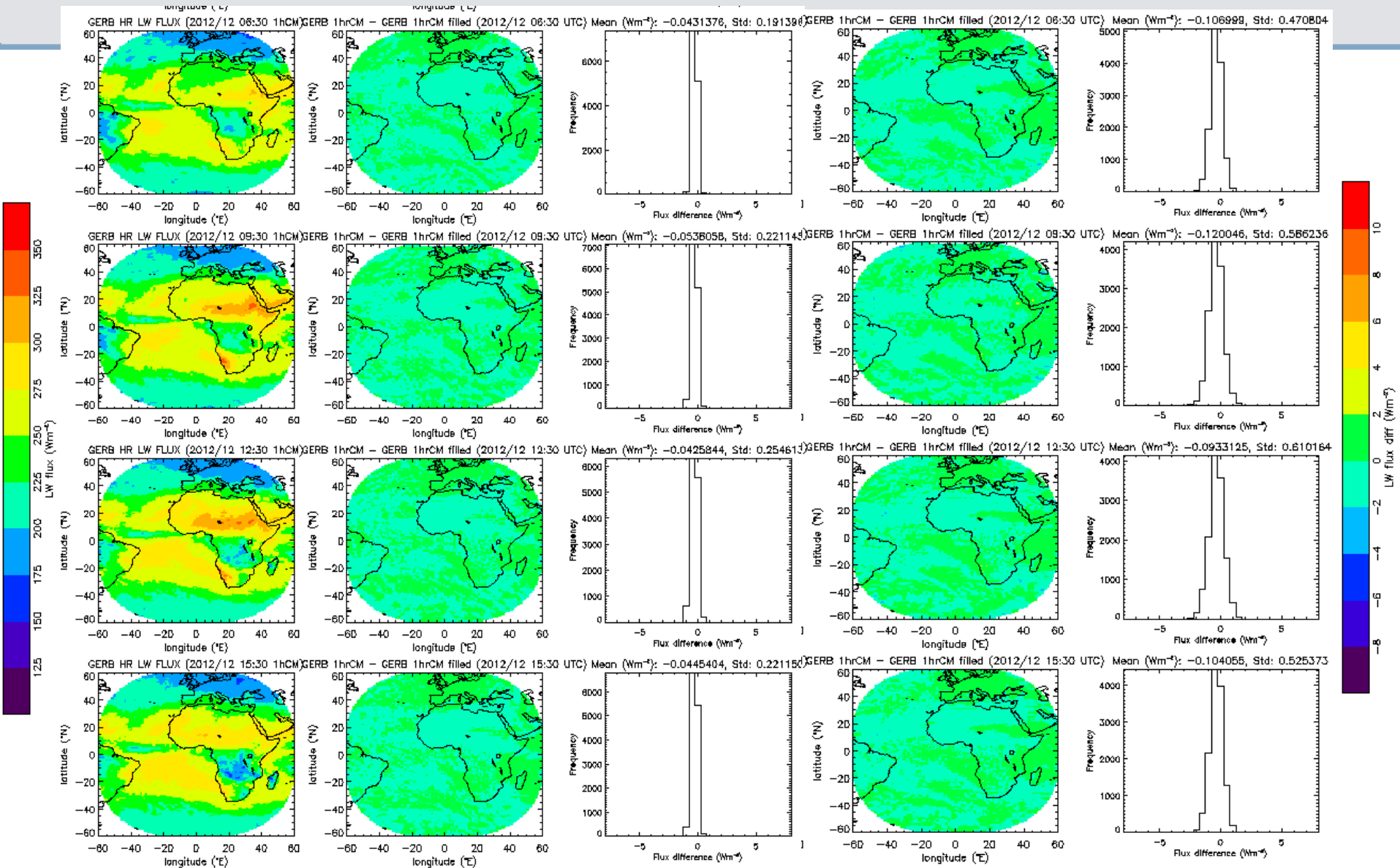
Summary and conclusions

- Missing hours of GERB observations affect the monthly mean and potentially the fidelity of the diurnal cycle due to different days data missing at different times.
- Improvements can be made by filling with GERBlike (BB estimated from the METEOSAT SEIVIRI NB) if they are corrected first with regional and time of day (for the SW) correction factors.
- These factors can be derived from the monthly average of the available GERB observations
- Even which a significant number of days are missing, correction is sufficient that the resulting residual error (compared to no missing GERB) in the filled monthly mean is relatively small. Filling 5 days of data even if they are sequential is expected to result in errors distribution at the 1 degree scale with mean < 0.2Wm-2 and SD < 0.6Wm-2 for the RSW and less than half that in the OLR
- Potential to fill up to half the month seems feasible, although with larger residual errors (SW bias upto around 0.5Wm-2 and SD upto 1.5Wm-2), being investigated to enable the half months of GERB observations in Feb and Aug currently missing from the record to be provided as full monthly averages.

Current status

- Filled V2 of the GERB 1 period (2007-2012) for May, June, July, Nov, Dec, Jan has been processed and is available for use.
- Products for the GERB 2 period (2004-2007) in the production now
- Further studies to determine if Feb and August data can be added to these records using these filling methods.