Early IR Radiance (L1b) Evaluation

7 November 2001

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Early IR Radiance (L1b) Evaluation

Before starting direct assimilation and/or T(p), q(p) retrievals

1. Know the characteristics of your forward algorithm
2. Know the characteristics of the "truth" (background)
3. Know the characteristics of your input (L1b)
   - Radiometry
   - Spectral Characterization
   - Noise
   - Spatial

Don't forget: L1b QA files (dynamic product)
L1b channel properties file (static file
starting Launch+3 months)

Early IR Radiance (L1b) Evaluation

What is the rush?

Instrument state and data become stable at Launch + 3 months

Direct Assimilation effort can't get started until L1b has passed minimal evaluation.

Requirements for L1b software patches (if any)
need to be formulated at Launch + 5 months

First post-launch L1b software redelivery at Launch+7 months
Minimize L1b changes afterwards.

Early IR Radiance (L1b) Evaluation

Know the characteristics of your input (L1b)

Radiometric, Spectral, Noise , Spatial

More than 30 tasks have been proposed by various science team members in support of this analysis

Key to success by launch + 5 months are

- Communication
- Documentation
- Clear Milestones

Early IR Radiance (L1b) Evaluation

Know the characteristics of your input (L1b)

Radiometric, Spectral, Noise , Spatial

More than 30 tasks have been proposed by various science team members in support of this analysis

Milestones to be tracked:

1. Task and task owner verbally defined
2. Preliminary feasibility evaluation
3. Relevant data availability verified
4. Software ready and sensitivity verified
5. Results presented at software launch readiness review
   February 2002
6. First look results at launch + 3.5 months
7. Results/recommendation documented at launch + 5 months

Early IR Radiance (L1b) Evaluation

Know the characteristics of your input (L1b)

Proposed direct verification tasks

12 Radiometric + scan angle effects
3 Spectral
1 Spatial
5 Noise

Proposed indirect verification tasks

5 (obs-calc)
5 retrievals

hha 1 November 01	Earth scene based IR level 1b evaluation between launch+2 and launch+5 months	Concept defined	Initial Prototype evaluation using simulated data documented	Data input requirements documented and availability verified	Sensitivity analysis documente ation complete	Macro ready for real data		Launch+ 3 months Report on first real data	Launch+ 5 months Report
1. Radiometric Calibration									
	Evaluate during night time warm ocean using (bt2616 - Reynolds.surface.analysis) all scan angles	Hagan							
	Extremes test. For each channel look at 2% hottest and coldest BT's. Plot trend	McMillin							
	Radiance Covariance test. Verify that expected covariance agrees with observed.	McMillin							
	Reflectivity analysis to find channels effected by sun glint	McMillin							
	Radiance Covariance analysis	Strow							
	Low temperature radiometry verification using AMSU channels	Strow							
	Evaluate calibration artifacts at array boundaries viewing full footprint deep convective clouds	Aumann							
	Broadband radiometry comparisons using GOES imagers	Tobin							
	Eigenvector analysis of observed radiances to assess information content.	Goldberg							

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2. Scan angle dependent calibration accuracy									
	Evaluate (bt2616 - surface.analysis) as function of scan angle during night time warm ocean	Hagan							
	Mirror coating test using <210K scenes. Evaluate as function of scan angle.	McMillin							
	Demonstrate that there is less than 0.2K scan angle asymmetry, using upper tropospheric and stratospheric channels.	Aumann							
3. Spectral Calibration Verification									
	Use accurate RTA (correct frequency). Verify the level 1b provided frequency set is appropriate.	Strow							
	Use accurate RTA (correct frequency) with perturbed SRF's to verify that SRF's in orbit are the same as in RTA.	Strow							
	A simple spectral stability evaluation using channels straddling a line. Trend analysis of the difference.	McMillin							
3. Spatial Calibration Verification									
	Verify IR boresight using coastline crossings	Gregorich							

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5. Noise evaluation:									
	Verify level1b supplied noise estimates using using the statistics of adjacent footprint differences	Aumann	/hha/index.html						
	Noise evaluation using adjacent footprint difference under extended clear conditions (more than 2 footprints).	McMillin							
	Evaluate noise covariance and radiometric crosstalk.	McMillin							
	NeDT estimation using Earth scene data	Tobin							
	Evaluate noise covariance matrix using (ECMWF.calculated-observed).clear using fast RTA	Susskind							

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6. (calc-obs) Bias and stdev evaluation:									
	Evaluate (calculated.ECMWF - observed) for selected clear tropical ocean day and night. Evaluate bias as function of frequency, surface temperature, total moisture and scan angle. Evaluate st.dev relative to level 1b provided noise estimate Use exact RTA.	Strow							
	Evaluate (calculated.NCEP - observed) clear, night for tropical ocean night. Evaluate bias as function of frequency, surface temperature, total moisture and scan angle. Use fast RTA.								
	Develop simple (physical Pathfinder type) bias equation using (ECMWF.calculated - observed).clear using fast RTA	Susskind							
	Obs-calcs using ARM site and global radiosondes	Tobin							
	Monitor bias between observed radiances and radiances calculated from NCEP and ECMWF fields as a function of scan angle, latitude bands, day/nite, land type, etc.	Goldberg							

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7. Other tests:									
	Construct HIRS3 channel radiances from AIRS observations and evaluate using Pathfinder-like retrievals.	Susskind							
	Test clear detection algorithm that has been delivered to JPL (includes predicting 2616 from 8 and 11 micron channels,	Goldberg							
	Attempt first set of AIRS/AMSU retrievals using bias corrected radiances and a channel noise covariance matrix	Susskind							
	Derive first regression coefficients to see if NCEP model profiles can be derived from the radiances.	Goldberg							
	Verify that fixed N2O used for the RTA is appropriate	Strow							
Reference key	ftp://thunder.jpl.nasa.gov/hha/index.html	Aumann							

Three examples of concepts:

1. Radiometric calibration verification using SST and the 2616cm-1 super window channel at 0.2K level. Works well.

2. Verification of scan angle symmetry at 0.2K level. Works well, but restricted to high peaking CO_2 channels.

3. Verification of the AIRS IR boresight. One month of data for 2km probable error. This has to be factored into early plans for using AIRS VIS for cloud-free identification.

1. The initial radiometric calibration verification at a 0.2K level will be settled within days after data become available using the tropical ocean night granules and the 2616cm-1 super window channel.

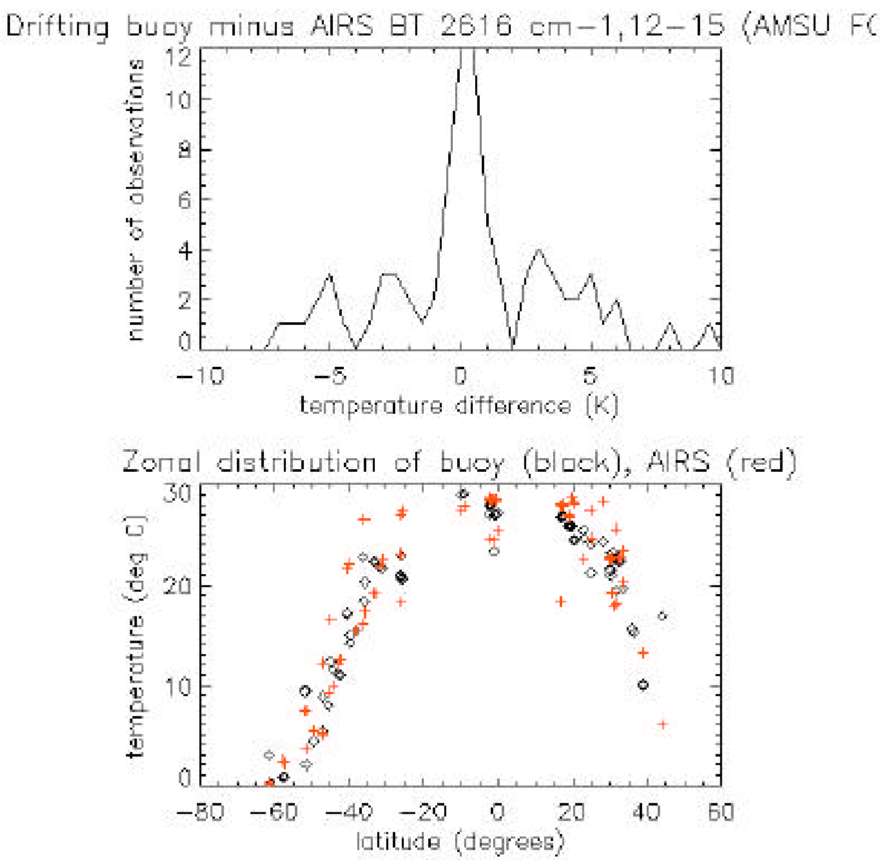
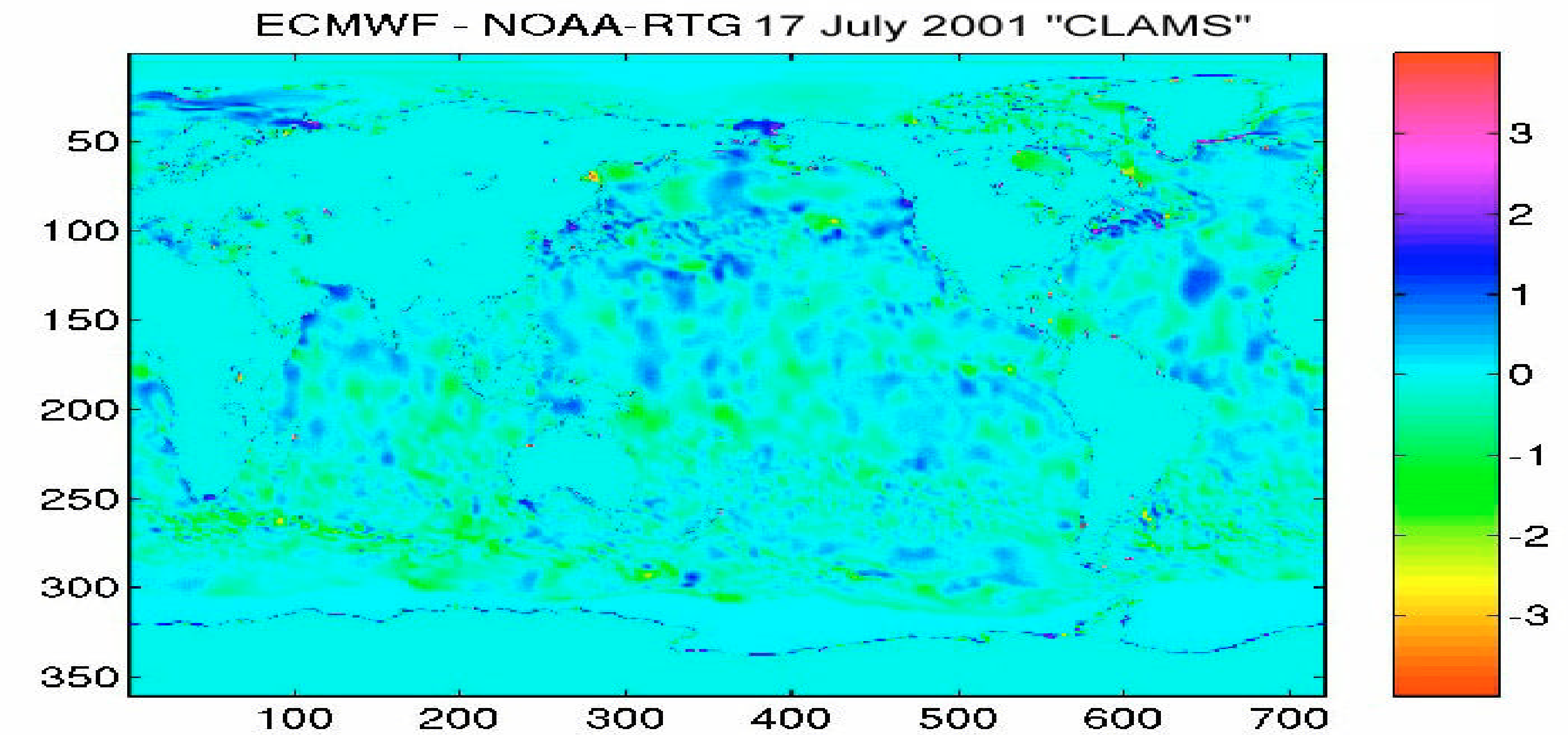


Figure 1. Histogram of the difference between measured SST and AIRS simulated brightness temperatures at the top-of-the-atmosphere, adjusted to the surface, for a window channel located at 2616 cm^{-1}. The data set represents comparisons obtained in cloud-free conditions over the globe for December 15, 2000.

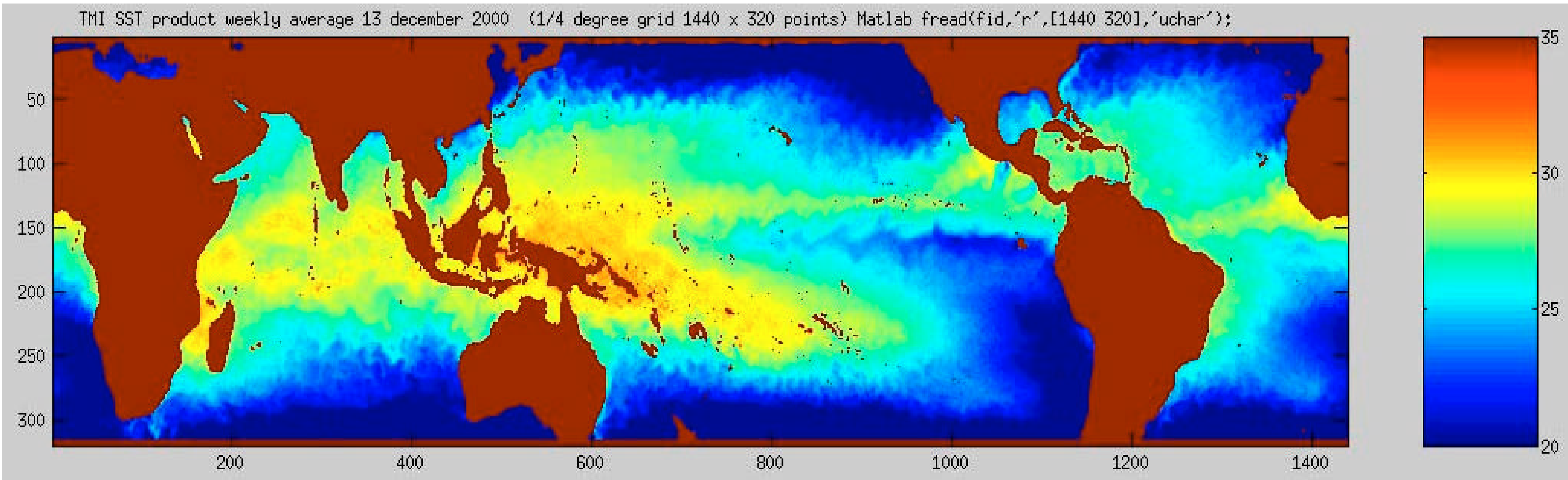
Comparison of T2616cm-1 data with surface model data has a high yield, but is not a primary sensor comparison.

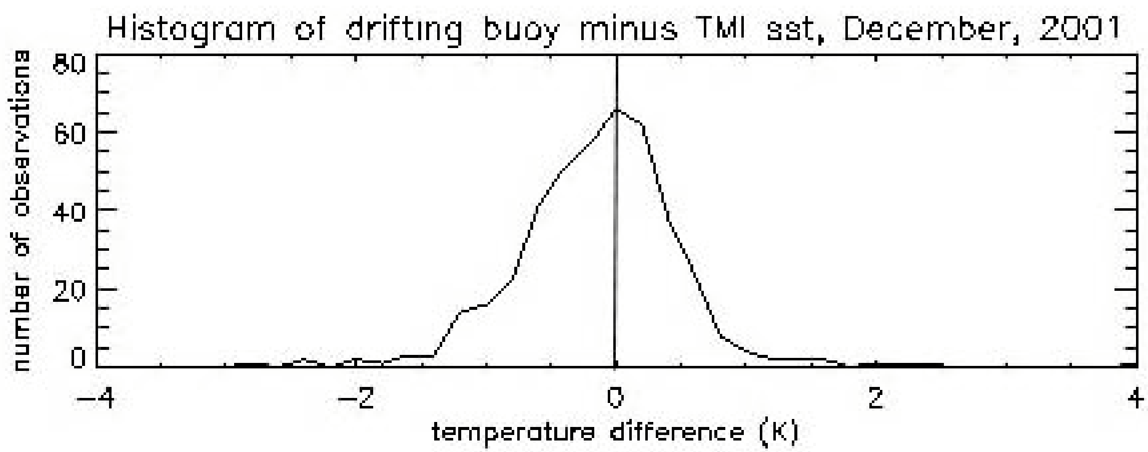


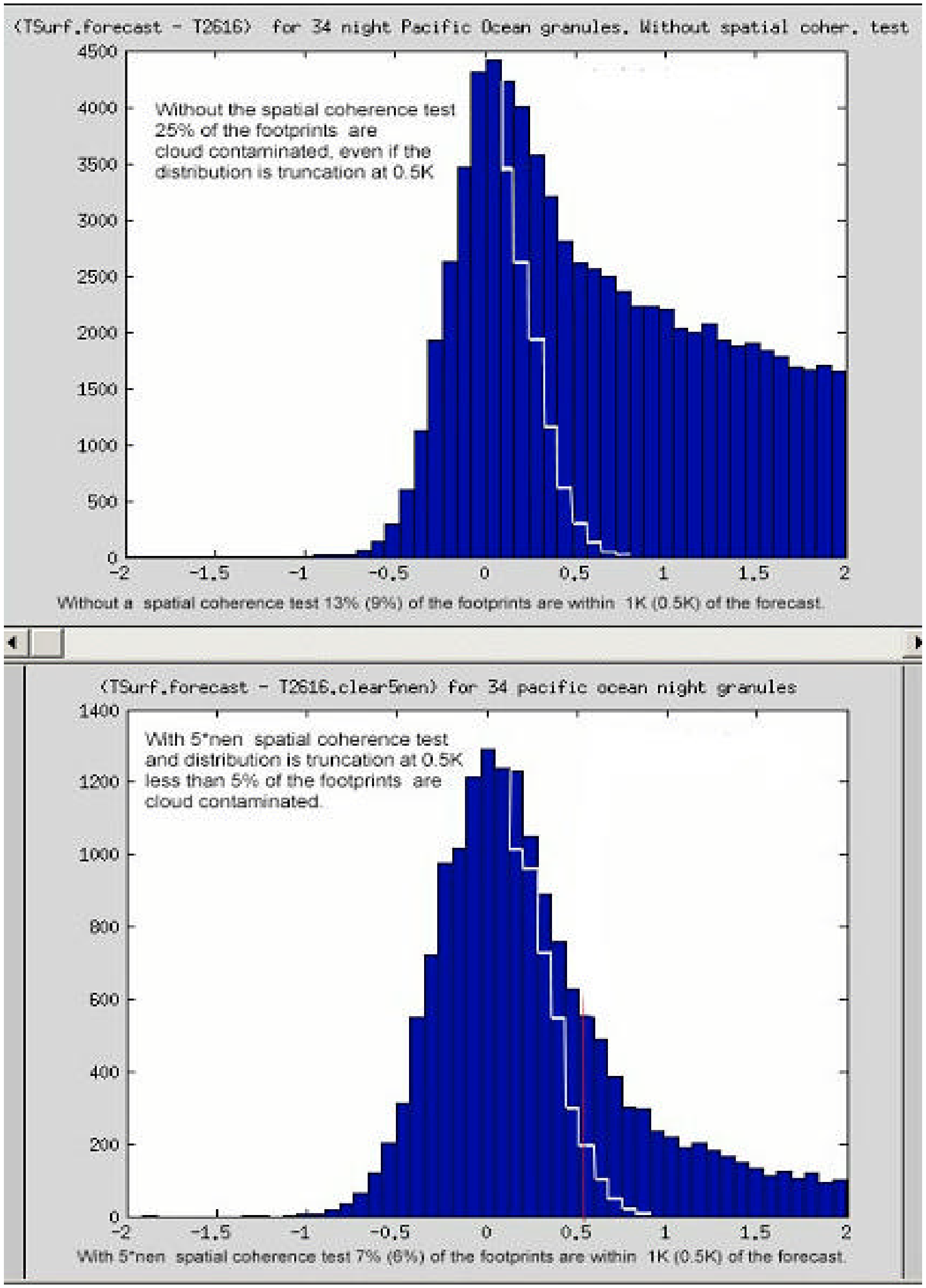
ECMWF and NOAA.RTG Mean(ECMWF-NOAA.RTG)=0 and STD(ECMWF-NOAA.RTG)=0.5K, but the models disagree significantly. Note the north/south asymmetry and the patchy differences.

(L. Strow analysis)

TMI SST Product comparison with drifting buoys: 1K rms







Results for 34 tropical night time granules using the 2616cm-1 super window channel using V2.1.5 12 December 2001 simulation.

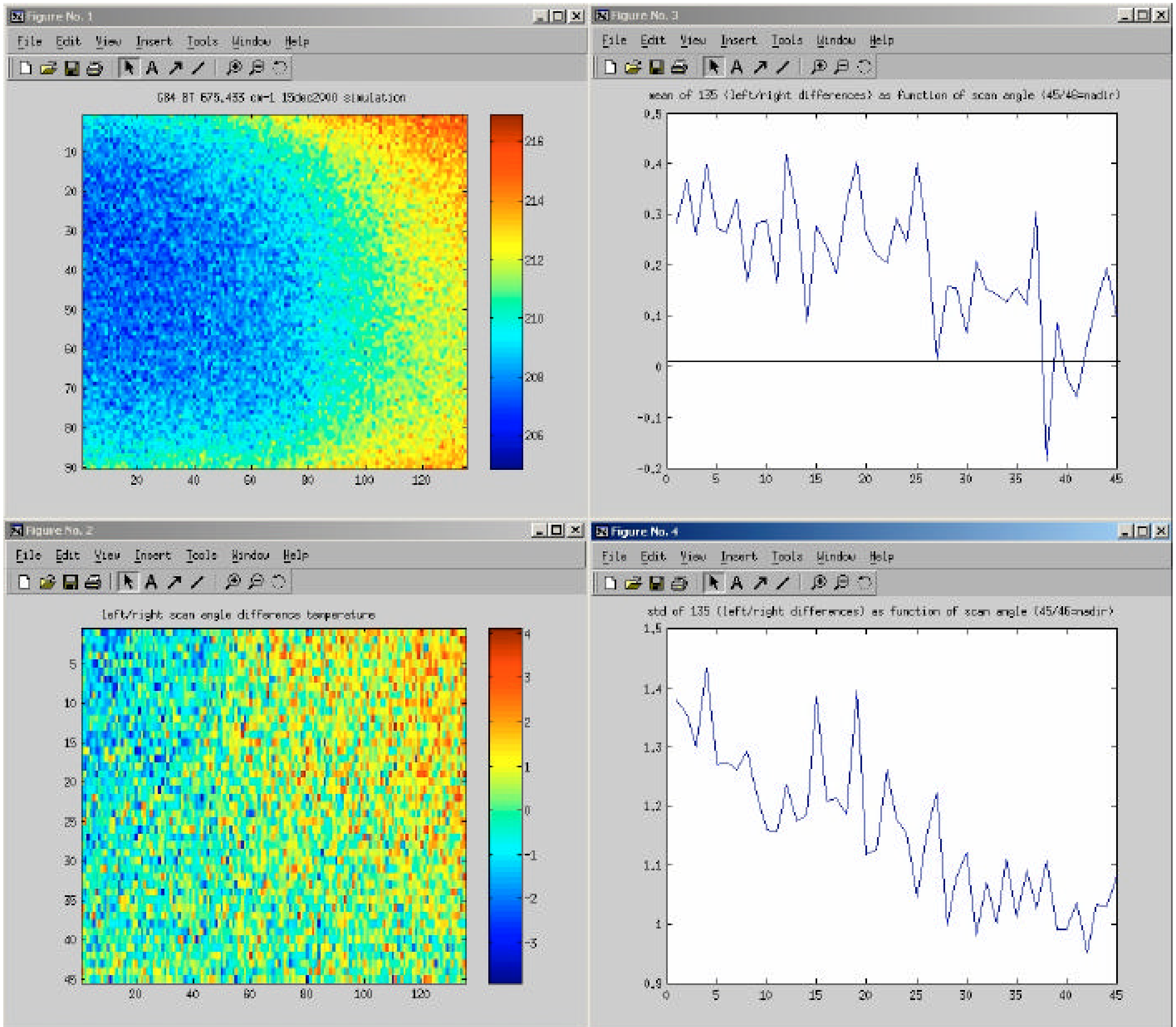
The data produce a well defined mode of (TSurf-T2626) close to zero.

Clear filtering the data with a spatial coherence test using adjacent footprints cuts down the number of points, but produces a better defined mode.

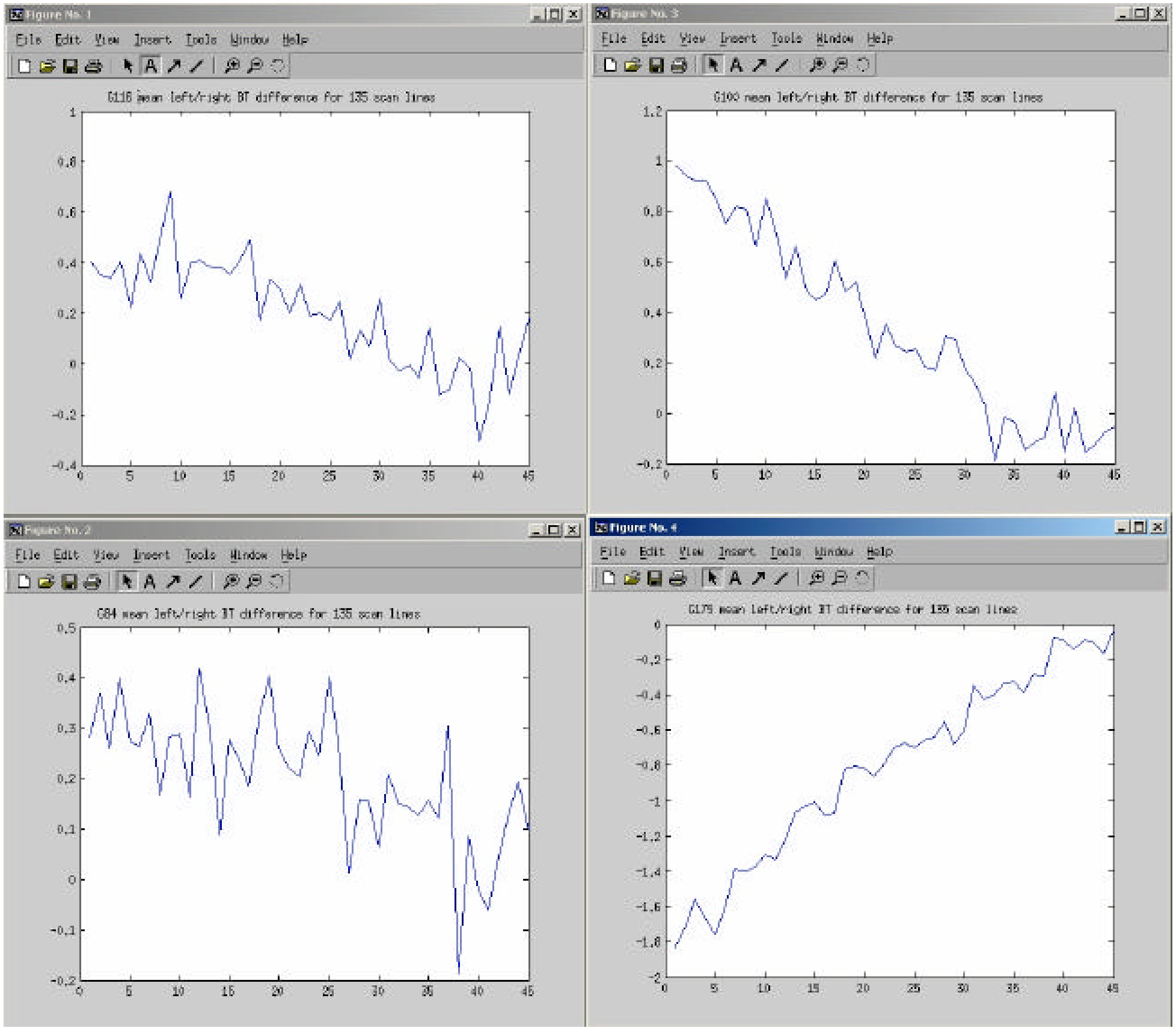
With clear filtering the standard deviation of the (SST-T2626) is dominated by the model error. The NEDT of the 2616cm-1 channel at 300K is 0.1K.

2. Potential scan angle asymmetries can be evaluated quickly at the fraction of a degree level using left/right bias from a few dozen tropical ocean granules.

Left/right scan asymmetry analysis
Granule 84 V2.1.5 15dec2000 simulation @675cm-1



Left/right scan asymmetry analysis
Granules 84, 100, 116, 175 V2.1.5 15dec2000 simulation @675cm-1



3. Usable accuracy for the AIRS Boresight verification can be achieved with one month of data.

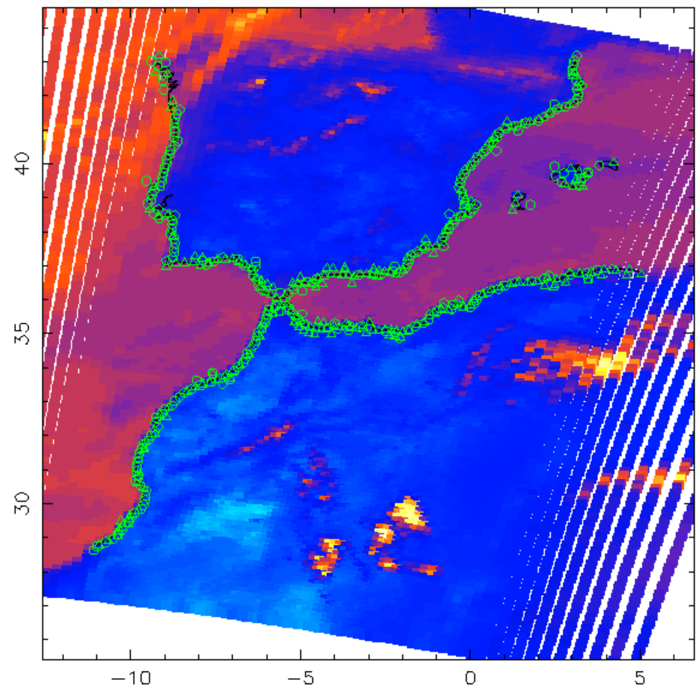
The method uses coast line crossing registration relative a 0.2 km coastline grid as described in the AIRS IR level 1b ATBD

MODIS data were screened between May 20, 2001 and June 20, 2001 for potential clear coastlines using GOES visible images. This produced 14 usable coast lines overpasses. AIRS data were simulated by adding 15 x15 MODIS channel#31 (11 microns) to create AIRS equivalent footprints.

Analysis of the 14 overpasses resulted in a boresight determination with a 2 km probable error in lat and long. This accuracy is marginal for coregistration with AIRS VIS for clear determination.

Each satellite overpass of a clear coastline produces one cross-track/along-track position solution

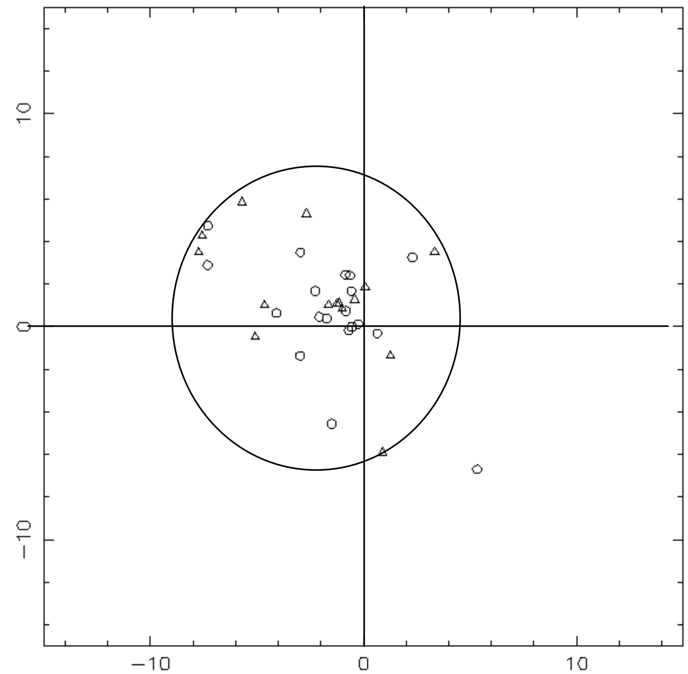
Coastline Image Map – NW Africa 010530 DW



A clear day over the Spain and North Africa

Overlay of the results for all 14 clear coastline overpasses globally for June 2001 fit into a 15 km diameter circle.

Error Scatter Plot – Raw Data 10/27/2001 (km)



[km longitide]

The combination of all 14 overpasses locates the AIRS boresight vector with a probable error of 2 km

Dave Gregorich

Closing thoughts on Early IR Radiance (L1b) Evaluation

RTA at the correct frequencies not available until later. Select channels accordingly.

Cloud contamination has to be dealt with before an official clear filter has been certified .

Circular arguments are to be avoided.

mean(calc-obs) does not validate radiometry

std(calc-obs) is not a measure of instrument noise

Know the limitations of your "truth" (NCEP/DAO/ECMWF/...)

Limit the task: Results and clear recommendations for L1b software have to be reached by Launch + 5 months to support the Launch + 7 month L1b update.

Early IR Radiance (L1b) Evaluation

Lear to use and understand the L1b QA files (dynamic product) and L1b channel properties file (static file starting Launch+3 months) before major time investment in the early evaluation of earth scene data.

Tom Pagano's talk follows