

# JAFIIR (JPSS Analysis Facility for Instrument Impacts on Requirements)

Efficient End-to-End Semi-Automated Algorithm Performance Analysis and Implementation Verification System

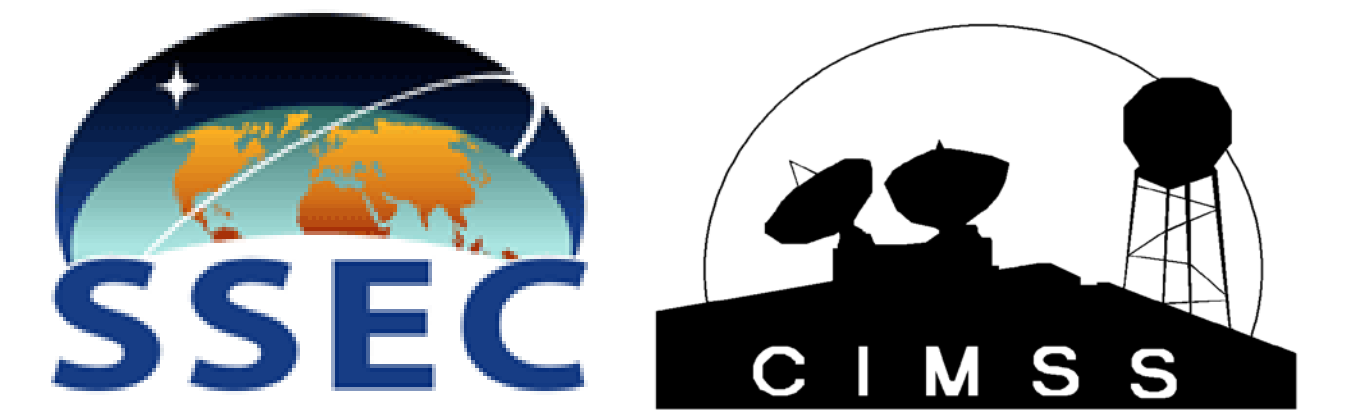


## Making use of CSPP

CSPP / IMAPP Users' Group Meeting – Madison, WI – 21-23 May 2013

Mat Gunshor, Hong Zhang, Allen Huang, Eva Schiffer -- CIMSS/SSEC UW-Madison  
Special thanks to Mitch Goldberg, and Ajay Mehta – NOAA/NESDIS

Corresponding Author: matg@ssec.wisc.edu



### JPSS VIIRS (on Suomi-NPP)

#### JAFIIR OBJECTIVES

- Leverage existing capabilities and those under development for MODIS and VIIRS in data processing and product evaluation to support analysis of instruments impacts on meeting user and product requirements.
- “Connecting the dots”, the components that have been built and/or are under development, to provide a flexible framework to effectively adopt component algorithms toward analyzing the sensor measurements with different elements of sensor characteristics (i.e. noise, navigation, band to band co-registration, etc.) and its impact on products.
- Assess and evaluate data and products (i.e. imagery, clouds, derived products, soundings, etc.) in a consistent way to ensure the instrument effects on the products can be fully accounted for, characterized and product performance can be analyzed.
- This is a coordinated team effort from JPSS Risk Reductions, Algorithm Working Groups, Calibration Working Groups, and other related projects. It will not independently develop any new algorithms or processing, but will leverage work already available or under development.
- JAFIIR is developing the capability for JPSS to assist the government’s instrument waiver analysis plan.

#### VIIRS Spectral Characteristics

|               | Band No.     | Wavelength (nm) | Node/ Hourly Sample Interval (km Downtrack x Crosstrack) | Driving EDR            |                     |
|---------------|--------------|-----------------|--|------------------------|---------------------|
| VIS/NIR Bands | M1           | 0.412           | 0.742 x 0.259  | Ocean Color Aerosols   |                     |
|               | M2           | 0.445           | 0.742 x 0.259  | Ocean Color Aerosols   |                     |
|               | M3           | 0.488           | 0.742 x 0.259  | Ocean Color Aerosols   |                     |
|               | M4           | 0.555           | 0.742 x 0.259  | Ocean Color Aerosols   |                     |
|               | I1           | 0.640           | 0.371 x 0.387  | Imagery                |                     |
|               | M5           | 0.672           | 0.742 x 0.259  | Ocean Color Aerosols   |                     |
|               | M6           | 0.746           | 0.742 x 0.776  | Atmospheric Correction |                     |
| CCD           | I2           | 0.865           | 0.371 x 0.387  | NDVI                   |                     |
|               | M7           | 0.865           | 0.742 x 0.259  | Ocean Color Aerosols   |                     |
|               | DNB          | 0.7             | 0.742 x 0.742  | Imagery                |                     |
|               | S/WVIR Bands | M8              | 1.24   | 0.742 x 0.776          | Cloud Particle Size |
|               |              | M9              | 1.379  | 0.742 x 0.776          | Cirrus/Cloud Cover  |
|               |              | I3              | 1.61   | 0.371 x 0.387          | Binary Snow Map     |
|               |              | M10             | 1.61   | 0.742 x 0.776          | Snow Fraction       |
| M11           |              | 2.25            | 0.742 x 0.776  | Clouds                 |                     |
| I4            |              | 3.74            | 0.371 x 0.387  | Imagery Clouds         |                     |
| M12           |              | 3.70            | 0.742 x 0.776  | SST                    |                     |
| LWIR Bands    | M13          | 4.05            | 0.742 x 0.259  | SST Fires              |                     |
|               | M14          | 8.55            | 0.742 x 0.776  | Cloud Top Properties   |                     |
|               | M15          | 10.763          | 0.742 x 0.776  | SST                    |                     |
|               | I5           | 11.450          | 0.371 x 0.387  | Cloud Imagery          |                     |
| M16           | 12.013       | 0.742 x 0.776   | SST  |                        |                     |

JAFIIR is able to use Suomi-NPP VIIRS data.

- Realtime RDRs collected at SSEC, direct broadcast
- RDR to SDR to EDR processing done in real-time.
- All data archived locally.

#### Modeling of Instrument Effects (Using Instrument Specifications)

Four basic instrument effects have been applied to Suomi NPP VIIRS:

##### Noise (NEdT or NEdR)

Random noise is generated such that for m lines by n elements in an image a random number generator is used on all mXn points where the standard deviation of what will be added to those mXn points is the noise (such as the NEdR equivalent of 0.1K at 300K for IR bands).

##### Calibration Offset

- IR Bands: Example, add radiance equivalent to 1K to every pixel.
- Vis/NIR Bands: Example, add reflectance to every pixel.

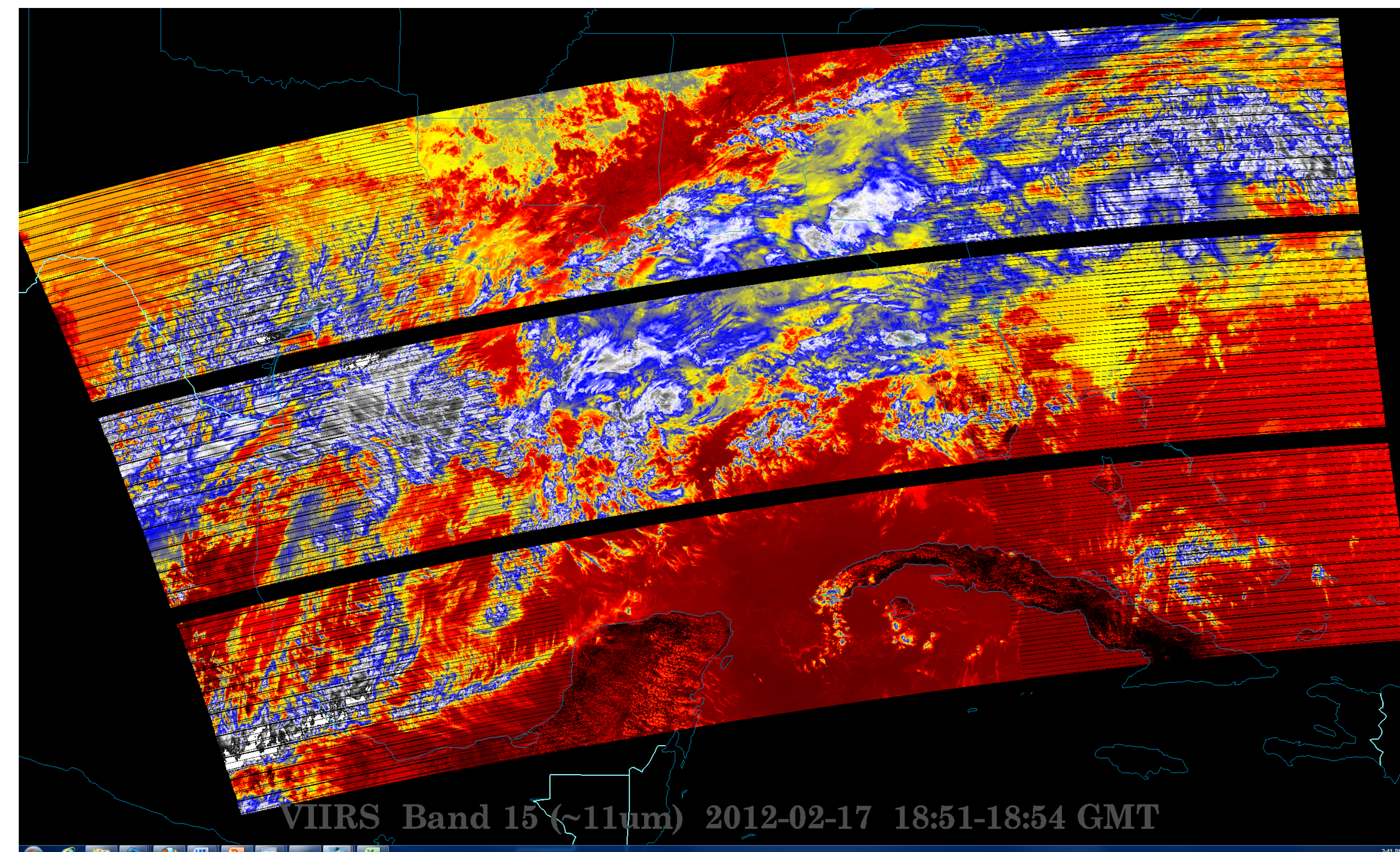
##### Navigation Error

To simulate this error a random compass direction (0-359.99 degrees) is selected for each pixel and a normalized random distribution for distance based on 21 micro radians (0.75km, ABI spec) is added. Then the radiance for that pixel is “smudged” in that direction using linear interpolation. The result is a new image with the original Lat/Lon grid but slightly altered radiances. A few pixels may have large differences from the original because they were on the edge of a feature such as a cloud.

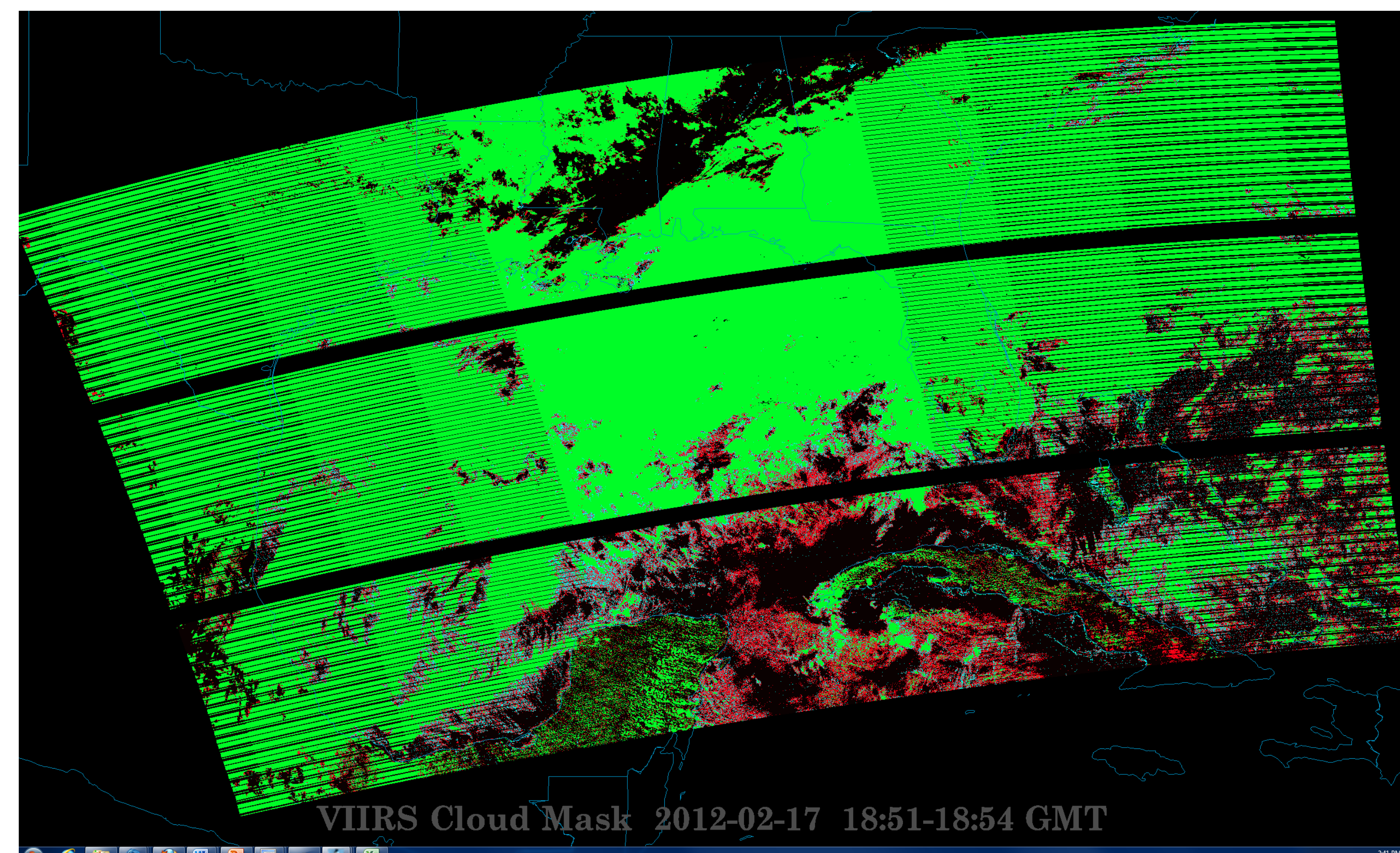
##### Striping

A calibration offset on the order of the noise for any given band is added to every nth line, to simulate a certain number of bad detectors.

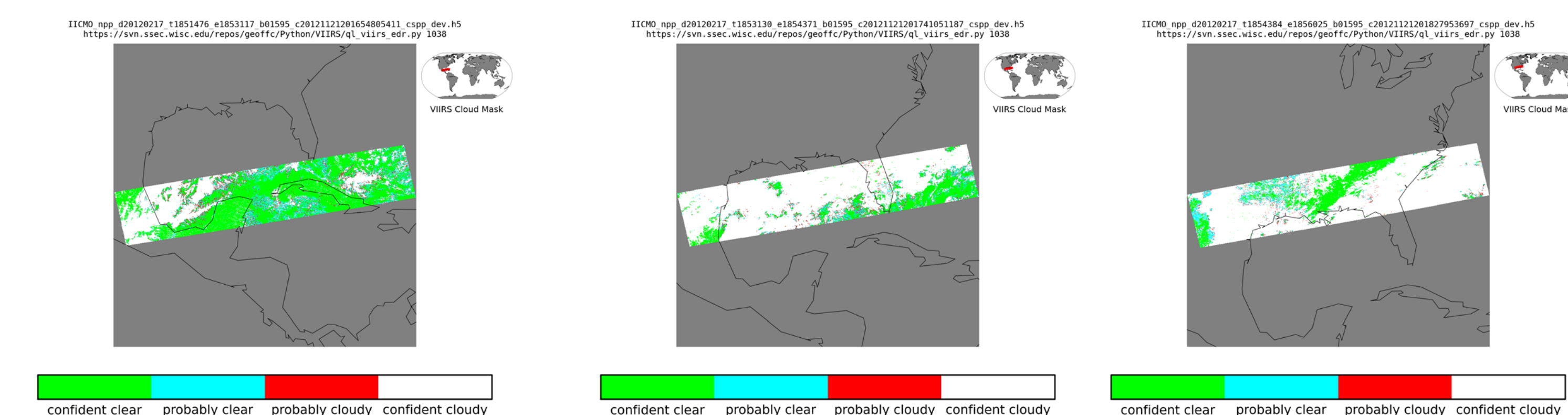
### JAFIIR Prepares for VIIRS Waivers



Three VIIRS granules stitched together with McIDAS-V.



Three VIIRS Cloud Mask granules stitched together with McIDAS-V.



- JAFIIR will be able to measure the effects of a change in radiances on product output
- Many algorithm teams have a need to validate their product against another type of measured data to quantify product performance.

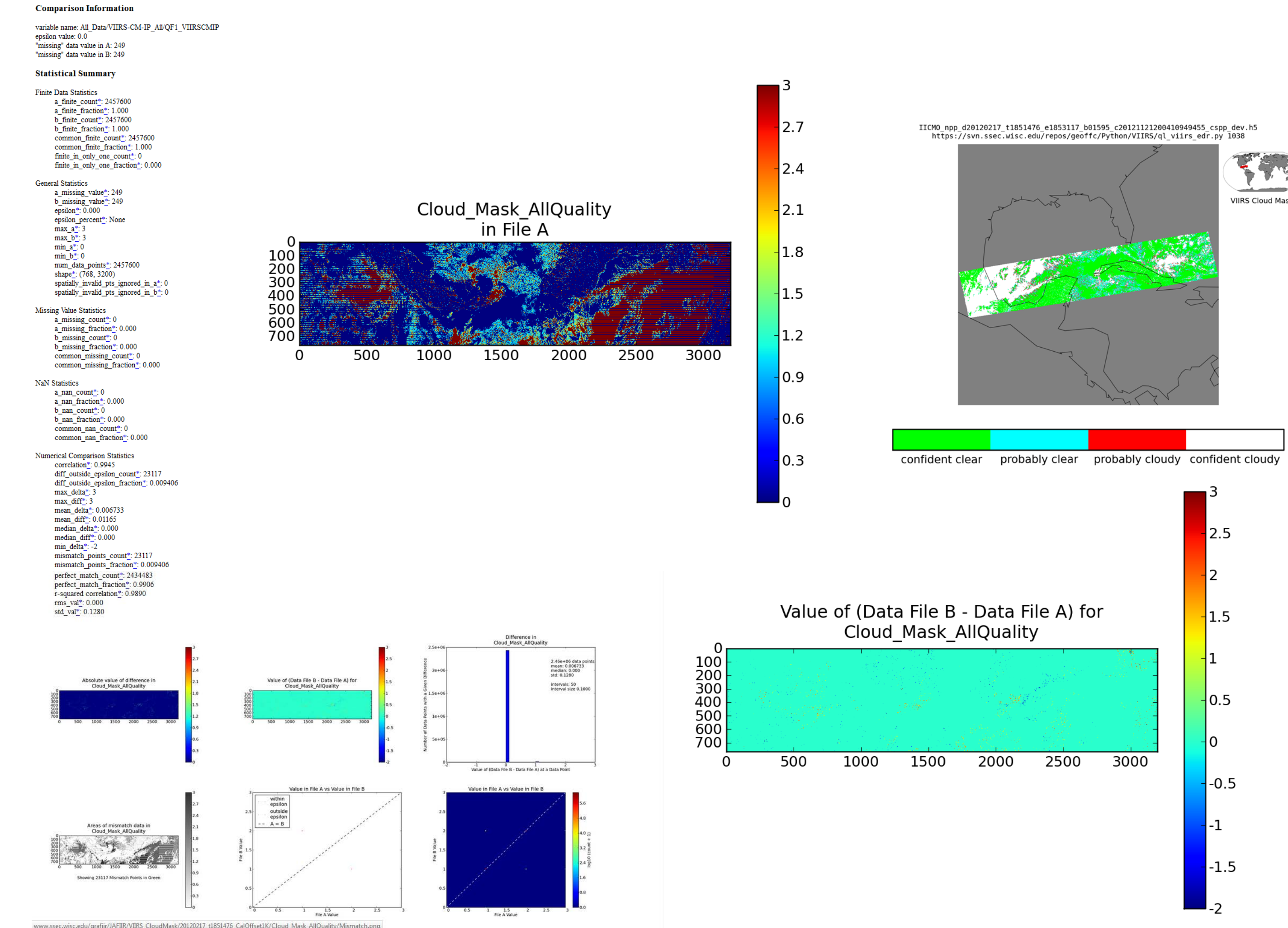
### Glance: An Efficient Evaluation and Validation Tool

#### Cloud\_Mask\_AllQuality Variable Comparison

Report produced with glance, version 0.1.0.0  
Analysis generated on: 2012-02-17 18:54:00 UTC  
File A:  
File B:  
File C:  
File D:  
File E:  
File F:  
File G:  
File H:  
File I:  
File J:  
File K:  
File L:  
File M:  
File N:  
File O:  
File P:  
File Q:  
File R:  
File S:  
File T:  
File U:  
File V:  
File W:  
File X:  
File Y:  
File Z:  
File AA:  
File AB:  
File AC:  
File AD:  
File AE:  
File AF:  
File AG:  
File AH:  
File AI:  
File AJ:  
File AK:  
File AL:  
File AM:  
File AN:  
File AO:  
File AP:  
File AQ:  
File AR:  
File AS:  
File AT:  
File AU:  
File AV:  
File AW:  
File AX:  
File AY:  
File AZ:  
File BA:  
File BB:  
File BC:  
File BD:  
File BE:  
File BF:  
File BG:  
File BH:  
File BI:  
File BJ:  
File BK:  
File BL:  
File BM:  
File BN:  
File BO:  
File BP:  
File BQ:  
File BR:  
File BS:  
File BT:  
File BU:  
File BV:  
File BW:  
File BX:  
File BY:  
File BZ:  
File CA:  
File CB:  
File CC:  
File CD:  
File CE:  
File CF:  
File CG:  
File CH:  
File CI:  
File CJ:  
File CK:  
File CL:  
File CM:  
File CN:  
File CO:  
File CP:  
File CQ:  
File CR:  
File CS:  
File CT:  
File CU:  
File CV:  
File CW:  
File CX:  
File CY:  
File CZ:  
File DA:  
File DB:  
File DC:  
File DD:  
File DE:  
File DF:  
File DG:  
File DH:  
File DI:  
File DJ:  
File DK:  
File DL:  
File DM:  
File DN:  
File DO:  
File DP:  
File DQ:  
File DR:  
File DS:  
File DT:  
File DU:  
File DV:  
File DW:  
File DX:  
File DY:  
File DZ:  
File EA:  
File EB:  
File EC:  
File ED:  
File EE:  
File EF:  
File EG:  
File EH:  
File EI:  
File EJ:  
File EK:  
File EL:  
File EM:  
File EN:  
File EO:  
File EP:  
File EQ:  
File ER:  
File ES:  
File ET:  
File EU:  
File EV:  
File EW:  
File EX:  
File EY:  
File EZ:  
File FA:  
File FB:  
File FC:  
File FD:  
File FE:  
File FF:  
File FG:  
File FH:  
File FI:  
File FJ:  
File FK:  
File FL:  
File FM:  
File FN:  
File FO:  
File FP:  
File FQ:  
File FR:  
File FS:  
File FT:  
File FU:  
File FV:  
File FW:  
File FX:  
File FY:  
File FZ:  
File GA:  
File GB:  
File GC:  
File GD:  
File GE:  
File GF:  
File GH:  
File GI:  
File GJ:  
File GK:  
File GL:  
File GM:  
File GN:  
File GO:  
File GP:  
File GQ:  
File GR:  
File GS:  
File GT:  
File GU:  
File GV:  
File GW:  
File GX:  
File GY:  
File GZ:  
File HA:  
File HB:  
File HC:  
File HD:  
File HE:  
File HF:  
File HG:  
File HH:  
File HI:  
File HJ:  
File HK:  
File HL:  
File HM:  
File HN:  
File HO:  
File HP:  
File HQ:  
File HR:  
File HS:  
File HT:  
File HU:  
File HV:  
File HW:  
File HX:  
File HY:  
File HZ:  
File IA:  
File IB:  
File IC:  
File ID:  
File IE:  
File IF:  
File IG:  
File IH:  
File II:  
File IJ:  
File IK:  
File IL:  
File IM:  
File IN:  
File IO:  
File IP:  
File IQ:  
File IR:  
File IS:  
File IT:  
File IU:  
File IV:  
File IW:  
File IX:  
File IY:  
File IZ:  
File JA:  
File JB:  
File JC:  
File JD:  
File JE:  
File JF:  
File JG:  
File JH:  
File JI:  
File JJ:  
File JK:  
File JL:  
File JM:  
File JN:  
File JO:  
File JP:  
File JQ:  
File JR:  
File JS:  
File JT:  
File JU:  
File JV:  
File JW:  
File JX:  
File JY:  
File JZ:  
File KA:  
File KB:  
File KC:  
File KD:  
File KE:  
File KF:  
File KH:  
File KI:  
File KJ:  
File KK:  
File KL:  
File KM:  
File KN:  
File KO:  
File KP:  
File KQ:  
File KR:  
File KS:  
File KT:  
File KU:  
File KV:  
File KW:  
File KX:  
File KY:  
File KZ:  
File LA:  
File LB:  
File LC:  
File LD:  
File LE:  
File LF:  
File LG:  
File LH:  
File LI:  
File LJ:  
File LK:  
File LL:  
File LM:  
File LN:  
File LO:  
File LP:  
File LQ:  
File LR:  
File LS:  
File LT:  
File LU:  
File LV:  
File LW:  
File LX:  
File LY:  
File LZ:  
File MA:  
File MB:  
File MC:  
File MD:  
File ME:  
File MF:  
File MG:  
File MH:  
File MI:  
File MJ:  
File MK:  
File ML:  
File MN:  
File MO:  
File MP:  
File MQ:  
File MR:  
File MS:  
File MT:  
File MU:  
File MV:  
File MW:  
File MX:  
File MY:  
File MZ:  
File NA:  
File NB:  
File NC:  
File ND:  
File NE:  
File NF:  
File NG:  
File NH:  
File NI:  
File NJ:  
File NK:  
File NL:  
File NM:  
File NN:  
File NO:  
File NP:  
File NQ:  
File NR:  
File NS:  
File NT:  
File NU:  
File NV:  
File NW:  
File NX:  
File NY:  
File NZ:  
File OA:  
File OB:  
File OC:  
File OD:  
File OE:  
File OF:  
File OG:  
File OH:  
File OI:  
File OJ:  
File OK:  
File OL:  
File OM:  
File ON:  
File OO:  
File OP:  
File OQ:  
File OR:  
File OS:  
File OT:  
File OU:  
File OV:  
File OW:  
File OX:  
File OY:  
File OZ:  
File PA:  
File PB:  
File PC:  
File PD:  
File PE:  
File PF:  
File PG:  
File PH:  
File PI:  
File PJ:  
File PK:  
File PL:  
File PM:  
File PN:  
File PO:  
File PP:  
File PQ:  
File PR:  
File PS:  
File PT:  
File PU:  
File PV:  
File PW:  
File PX:  
File PY:  
File PZ:  
File QA:  
File QB:  
File QC:  
File QD:  
File QE:  
File QF:  
File QG:  
File QH:  
File QI:  
File QJ:  
File QK:  
File QL:  
File QM:  
File QN:  
File QO:  
File QP:  
File QQ:  
File QR:  
File QS:  
File QT:  
File QU:  
File QV:  
File QW:  
File QX:  
File QY:  
File QZ:  
File RA:  
File RB:  
File RC:  
File RD:  
File RE:  
File RF:  
File RG:  
File RH:  
File RI:  
File RJ:  
File RK:  
File RL:  
File RM:  
File RN:  
File RO:  
File RP:  
File RQ:  
File RR:  
File RS:  
File RT:  
File RU:  
File RV:  
File RW:  
File RX:  
File RY:  
File RZ:  
File SA:  
File SB:  
File SC:  
File SD:  
File SE:  
File SF:  
File SG:  
File SH:  
File SI:  
File SJ:  
File SK:  
File SL:  
File SM:  
File SN:  
File SO:  
File SP:  
File SQ:  
File SR:  
File SS:  
File ST:  
File SU:  
File SV:  
File SW:  
File SX:  
File SY:  
File SZ:  
File TA:  
File TB:  
File TC:  
File TD:  
File TE:  
File TF:  
File TG:  
File TH:  
File TI:  
File TJ:  
File TK:  
File TL:  
File TM:  
File TN:  
File TO:  
File TP:  
File TQ:  
File TR:  
File TS:  
File TT:  
File TU:  
File TV:  
File TW:  
File TX:  
File TY:  
File TZ:  
File UA:  
File UB:  
File UC:  
File UD:  
File UE:  
File UF:  
File UG:  
File UH:  
File UI:  
File UJ:  
File UK:  
File UL:  
File UM:  
File UN:  
File UO:  
File UP:  
File UQ:  
File UR:  
File US:  
File UT:  
File UY:  
File UV:  
File UW:  
File UX:  
File UY:  
File UZ:  
File VA:  
File VB:  
File VC:  
File VD:  
File VE:  
File VF:  
File VG:  
File VH:  
File VI:  
File VJ:  
File VK:  
File VL:  
File VM:  
File VN:  
File VO:  
File VP:  
File VQ:  
File VR:  
File VS:  
File VT:  
File VU:  
File VV:  
File VW:  
File VX:  
File VY:  
File VZ:  
File WA:  
File WB:  
File WC:  
File WD:  
File WE:  
File WF:  
File WG:  
File WH:  
File WI:  
File WJ:  
File WK:  
File WL:  
File WM:  
File WN:  
File WO:  
File WP:  
File WQ:  
File WR:  
File WS:  
File WT:  
File WU:  
File WV:  
File WW:  
File WX:  
File WY:  
File WZ:  
File XA:  
File XB:  
File XC:  
File XD:  
File XE:  
File XF:  
File XG:  
File XH:  
File XI:  
File XJ:  
File XK:  
File XL:  
File XM:  
File XN:  
File XO:  
File XP:  
File XQ:  
File XR:  
File XS:  
File XT:  
File XU:  
File XV:  
File XW:  
File XX:  
File XY:  
File XZ:  
File YA:  
File YB:  
File YC:  
File YD:  
File YE:  
File YF:  
File YG:  
File YH:  
File YI:  
File YJ:  
File YK:  
File YL:  
File YM:  
File YN:  
File YO:  
File YP:  
File YQ:  
File YR:  
File YS:  
File YT:  
File YU:  
File YV:  
File YW:  
File YX:  
File YY:  
File YZ:  
File ZA:  
File ZB:  
File ZC:  
File ZD:  
File ZE:  
File ZF:  
File ZG:  
File ZH:  
File ZI:  
File ZJ:  
File ZK:  
File ZL:  
File ZM:  
File ZN:  
File ZO:  
File ZP:  
File ZQ:  
File ZR:  
File ZS:  
File ZT:  
File ZU:  
File ZV:  
File ZW:  
File ZX:  
File ZY:  
File ZZ:

Example of Glance web report:

- Calibration offset (1K) added to VIIRS 10.8um Band M15
- Cloud Mask and Cloud Phase generated
- Glance used to compare products statistically and visually.



➢ GLANCE is a Python software tool in development by the UW-CIMSS GRAFIIR team to efficiently & consistently compare two datasets in a semi-automated way. “Glance at the differences.”

- The code is user input driven, so statistics, such as epsilon (threshold) are dynamically changed by user input for each variable.
- Glance can generate a report in html format which includes product images, difference images, scatter plots, and histograms; also included are various statistics.
- Compare algorithm output to ensure processing system, algorithm and ancillary datasets are installed correctly.
- Compare algorithm outputs and obtain useful statistics for varying instrument effect(s)/added noise
- Automating time consuming manual GRAFIIR analyses
- Glance will be used as a validation tool for Imagery and other AWG teams

#### JAFIIR SUMMARY

JAFIIR is to

1. Implement a facility environment (including leveraging CSPP direct broadcast realtime RDR to SDR to EDR functionality) to allow easy and consistent use of Suomi-NPP VIIRS data and product algorithms.
2. Design an efficient approach in coordination with VIIRS sensor and algorithm scientists to analyze the effects of sensor components such as noise, navigation, band to band co-registration, striping and other effects identified to be significant on product algorithms and imagery.
3. Assist the government’s response to future VIIRS instrument waivers requested by industry by providing statistical analysis, reports, and imagery.
4. The CIMSS JPSS JAFIIR Team has demonstrated the key components of responding to waiver/deviation requests.