2014 STAR JPSS Annual Science Team Meeting Report

STAR JPSS Program
NOAA/NESDIS/STAR, College Park, MD 20740

Contents

Executive Summary

The first STAR JPSS Annual Science Team Meeting was held May 12-16, 2014 at the NOAA Center for Weather and Climate Prediction. The participants consisted of members from many disciplines across JPSS programs and the user community. More than 200 scientists participated in this meeting.

The primary goals slated for this meeting were to: 1) provide the opportunity for all of the members of the STAR JPSS team, especially external members working at universities, cooperative institutes, other government agencies and in industry, to meet and collaborate; 2) provide a forum where users and scientists could meet and create what will hopefully become an ongoing dialogue about the capabilities of the program to generate useful and innovative products for a variety of end users; 3)facilitate face-to-face meetings among the teams, STAR JPSS management and the AIT. Feedback from participants, team members, users and JPSS management was positive and indicated that these goals were satisfactorily fulfilled.

The meeting began on Monday afternoon with a plenary session featuring leaders from NOAA and the JPSS program giving information about the overall state of the program and the direction it was headed. Tuesday and Wednesday focused on overview presentations from the sensor data record (SDR) and environmental data records (EDR) team leads. Five SDR team leads (VIIRS, ATMS, CrIS, OMPS, ICVS) and nine EDR team leads (Soundings, Ozone, Aerosols, Clouds, Imagery, Land, Cryosphere, SST and Ocean Color) each presented their team's current status and future directions. Following SDR/EDR overview presentations, the meeting broke into three SDR breakout sessions, one dedicated for the VIIRS SDRs, another for ATMS/CrIS, and a third for OMPS. Detailed presentations and discussions were held in these breakout sessions on the state of validation and monitoring for each instrument, and future plans for J1. Following SDR breakout discussions, the meeting broke into five EDR disciplines (Land/Cryosphere, Atmosphere, Oceans, Soundings, and Ozone) and discussed known SDR issues, algorithm development, product improvements, and additional products derivable from J1.

On Thursday, the groups reconvened for a plenary discussion on non-NOAA satellite systems and products, and the necessity to develop systems to handle these data sets. Following presentations on the GCOM and the Sentinel satellite systems and products, discussions were held about utilizing these data sets with JPSS data products for generation of blended products, reprocessing and climate applications. This non-NOAA session was followed by ten user breakout sessions. S-NPP/JPSS data products, utility within their discipline, recommended enhancements, requirements, and challenges in meeting those requirements were discussed during these sessions. Summary presentations by the user team leads were presented in the report-back plenary session, followed by a session on transition to operations both in IDPS and NDE and the role of STAR AIT in fulfilling research to operations.

Finally, on Friday, three innovative science presentations showcased work being done with JPSS program data. The meeting concluded with the SDR and EDR team leads reported back on what they had learned during the week. Overall the meeting was considered a great success with wide participation within the JPSS cal val community and a wide dissemination of information within teams, between teams, and between users and the scientists who work to ensure that SNPP/JPSS data are of the highest possible quality.

Session 1: Welcome and Opening Remarks

Chairs: Lihang Zhou, Eric Gottshall

Session Summary: This session featured talks by six leadership figures within NOAA and the JPSS Program – each offering their view of the progress of this and related programs, and a take on their vision for STAR, JPSS, and NESDIS. One common theme, mentioned in some way by each of the six speakers was the need to move from satellite specific algorithms and move to "platform agnostic" algorithms that can work across multiple satellites.

The session featured overview talks from STAR director Al Powell, JPSS Director Harry Cikanek, Robin Krause from NESDIS headquarters discussing the "Strengthening NESDIS" initiative as well as overviews from JPSS Program Scientist Mitch Goldberg, DPA Manager Eric Gottshall, and STAR JPSS Program Manager, Lihang Zhou.

Al Powell (STAR), "Welcome & Introduction"

- Vision - stop satellite specific products, and start platform agnostic algorithm development
- STAR strategic plan - maximize impact of NOAA satellite program for benefit of society, communities, and economy.
- ATMS-CrIS improves forecasting
- Described the "strengthening NESDIS" reorganization and vision
- Support a "Weather Ready Nation"
- Systems Architecture and Advanced Planning group is the new Systems Engineering organization
- OSGS is producing an Enterprise Ground System

Harry Cikanek (JPSS), "JPSS Program Overview"

- In the process of revamping Ground Project to Block 2.0 - improve security; modernize system, modular design, capacity of handling multiple satellites (S-NPP, J1).
- Program has held several CDRs – C3S, IDPS, NDE, PDA. Also Mission CDR – all were very successful.
- S-NPP is operating well and the first annual operational review and joint steering review was successful.
- J1 coming along well, power on S/C bus, all instruments have been built, and some delivered.
- The observatory is scheduled to be integrated in December 2014
- Data products – JPSS adds an element of rigor for cal/val before and after launch, which lead to high quality S-NPP products.
- There is a move toward commonality across platforms, look at algorithms inherited – cost effective and efficient use of algorithms
- Implement health monitoring – LTM carefully – high level of data quality over time

Robin Krause (OSGS), "OSGS Status"

- Move to one ground system for all satellites
- NESDIS is becoming a Ground Enterprise

- Vision – one integrated cross-program, cross-NESDIS team creating and sustaining the Ground Enterprise ARrchitecture System (GEARS)
- Mission Success – accelerated deployment of new ground system capabilities while avoiding unnecessary cost. New satellites, processes, services faster and easier
- Cost Avoidance Success – eliminate redundancy, infrastructure, and staff.
- Whole goal – efficient, cost effective changes
- An Architecture and Transition Plan is in development, to be complete in September

Mitch Goldberg (JPSS), "Algorithm and User Assessments"

- These meetings very important for us to assess how we are doing with respect to algorithms and user engagement.
- Are algorithms meeting specs? Are validation plans sound and do they include user feedback? Need a long term strategy for enhancements including data fusion
- User feedback on when using product, funding, priority, how getting data, how JPSS will help, are you using them, are JPSS products part of a blended product? We want the products to be used.
- How do we need to enhance the data?
- Will transition to NOAA algorithms even if IDPS algorithm meets spec

Eric Gottshall (DPA), "S-NPP to JPSS-1: Making the Transition"

- In the transition, some things will stay the same, and some things will change.
- For this transition things that will stay the same are three primary objectives: provide quality data to meet science requirements for EOS, provide pre-operational demonstration risk reduction for J1, and support operational users.
- The things that are changing – J1 launch readiness becomes priority, limited algorithm changes until Block 2.0 is operational. ROSES 2013 changes NASA grant funding
- Suggest we need to be "Brilliant at the Basics"
- Partnerships between NOAA, NASA, JPSS, and STAR is being part of a Big System inside big government
- Opportunity this week to promote the partnership

Lihang Zhou (STAR), "Objectives & Logistics"

- This is the first time all the team members have had a chance to get together
- The STAR mission is algorithms, and we want consistent approaches for the algorithm development process and cal/val approach. STAR needs to provide users with accurate products and error characteristics
- Additionally, going forward into the J1 era we need to "harvest" lessons learned from S-NPP
- After 2-3 years of working with S-NPP algorithms, each lead will give overview of algorithm and its status, provide alternatives and their evaluation of these alternatives, and identify recommendation of which algorithms to select.
- Algorithm Maturity process – beta, provisional, validated – this week will inform users of these terms and encourage usage of this process for validation of products

- Department of Commerce Bronze Medal recognition for work on S-NPP EDRs.

Session 2: SDR Leads Review

Chair: Fuzhong Weng

Session Summary: The four SDR team leads, plus Ninghai Sun, representing the ICVS Long Term Monitoring team presented the recent accomplishments of their products, plus plans for the future. The session began with an overview by the overall SDR lead Fuzhong Weng, who highlighted the fact that three of the four SDRs have reached validated maturity status and the many papers written by the teams for the S-NPP Special Issue in JGR.

Overall, all of the instruments represented an improvement over previous generations of similar satellites, and have either reached, or were on track to become validated. There were a few outstanding minor issues such as striping for ATMS, and H/F factor trending issues with VIIRS, but overall the instruments are doing well.

For J1 there will be additional upgrades in the algorithms, in particular CrIS will move to the use of full spectrum, and OMPS will have a significant update in its algorithm. The instruments are currently in various stages of testing with some issues being found including excess noise in ATMS channel 17, and an issue with polarization for VIIRS.

Fuzhong Weng (STAR), "SDR Overview"

Dr. Weng presented some SDR accomplishments for the past year including the signing of the Algorithm Management Plan this past year, which among other things defines the long term monitoring plan. He pointed out that three of the four SDRs have reached validated maturity and that 34 papers were accepted and published in the AGU Journal of Geophysical Research Special Issue on S-NPP Cal/Val and Applications. He also said that STAR will be using ICVS for LTM.

Fuzhong Weng (STAR), "ATMS Overview"

ATMS is a new generation sounder and the calibration is more stringent than heritage AMSU. JPSS-1 ATMS is cleaner than S-NPP based on TVAC data, although there are problems with the cold space brightness temp observed during pitch over for reasons which are not yet known. ECMWF identified an ATMS striping issue and there are other issues including cold space brightness temps, the inadequate speed of the LUT updates, and J1 noise on channel 17. Dr. Weng also talked about ARTS, which will be used for reprocessing ATMS radiances

Q: Will a pitch over will be needed for J1?
A: Not sure at this time

Yong Han (STAR), "CrIS Overview"

S-NPP ICV ended in December 2013, LTM is underway, and the team is preparing for full spectral resolution data, J1 test data analysis and proxy data development. Observed uncertainties are much better than the specification, the software has been stable since Mx8.0, and documentation up to date. The truncated RDR implemented and validated but continued improvements are needed. These were compared and contrasted with the current IDPS algorithm, including data on the performance of current versus proposed algorithms

Q: When changing to full resolution is there a plan to allow the system to work in both modes?
A: Discussions are on-going about how to dynamically switch between normal to full resolution

Changyong Cao (STAR), "VIIRS Overview"

The VIIRS leads said that the team has added approximately 30 sites worldwide for validation time series. Among the outstanding issues are the SAA, which appears to be a problem for VIIRS – five of the seven "petulant mode" events started in the SAA. VIIRS is meeting all performance and accuracy specs but there are challenges in OCC and the team may not be fully utilizing the performance of the instrument. Questions remain on trends observed in the H and F factors, could be due to long term averaging in the F factors, as NASA didn't observe the same H and F trends as the operational version. A polarization issue has been discovered during J1 testing. Filter coating changes to J1 caused the polarization issues and the team is working to better characterize the problem.

Fred Wu (STAR), "OMPS Overview"

- Products and user review proved useful to the team.
- Performance versus spec wavelength registration and stray light still needs work to reach validated maturity.
- There is a significant "upper" for J1 that is a substantial change, will continue to use and improve the legacy algorithm with significant improvements.

Ninghia Sun (STAR), "Instrument Performance and Sensor Data Quality LTM in STAR ICVS"

- ICVS was able to identify a number of problems on S-NPP that helped the team focus their investigations.
- Presentation highlighted a number of problems related to each sensor/SDR discovered by ICVS.

Q: Are email notifications also sent to OSPO
A: They can be manually added now and it is being considered for automatic addition

Session 3: EDR Leads Review

Chairs: Ivan Csiszar, Ingrid Guch, Paul DiGiacomo

Session Summary: This session featured reviews of past progress and future work from the STAR JPSS EDR team leads. For all teams, there has recently been a question of whether to use the current IDPS algorithm or to move to a different algorithm, and where to process these if a new one is chosen. While all of these questions were not resolved – each team did present their recommendations.

Overall, the choices when there was a question of algorithm were to move away from the current IDPS algorithm. These included Suspended Matter, Aerosol Optical Thickness, Cloud Properties, NUCAPS for Soundings (a change which has already taken place), Active Fires, Fractional Snow Cover, Ocean Color, and SST (ACSPO, also already approved) have recommended making a change.

The products not recommended for a change, which include Imagery, VIIRS Cloud Mask, the land products, and some of the cryosphere products, are moving towards or have reached validated maturity.

Istvan Laszlo (STAR) and Shobha Kondragunta (STAR), "VIIRS Aerosol EDR Overview"

- There was a period of time when a processing error degraded the product, but that is no longer the case.
- Differences between VIIRS and MODIS are small and are smaller over ocean than land
- Covered the plans for improvement of the AOT
- There is a "NOAA VIIRS" alternate algorithm for risk reduction, which the team recommended over the current IDPS algorithm.
- Volcanic ash no longer an IDPS product due to errors.
- CALIPSO and MISR were used for comparison and compared to them the product accuracy is <20% - well below the 80% requirement, so the team recommends that users not use this product.
- The team recommends that the GOES-R ABI algorithm could be used as an alternate for Suspended Matter.
- Follow on charts also presented performance of alternate risk reduction algorithm.

Andy Heidinger (CIMSS), "Cloud EDR Overview"

- There have been many changes from to the VCM, with fewer changes to the cloud products but those are more significant.
- They attempt to establish general algorithms for all satellite sensors.
- NDE will have its own cloud mask.
- IDPS has a bad radiative transfer model and bad Surface Reflectance product.
- A summary of the team's recommendations for the algorithms to be used was provided and whether they should be transitioned due to performance or other reasons
    - Recommended sticking with current VCM, which is used right now
    - Recommended moving to CLAVR-x algorithm for clouds properties, since they outperform the IDPS and since the IDPS algorithm has no current operational users.

Comment: There are users that may not be known to the team and may come out at breakout sessions.

Sid Boukabara (JCSDA), "MIRS Algorithm for the S-NPP/JPSS/GCOM-W – Science and Products Overview"

- Overview of the MIRS and summary of its performance using data from ATMS and GCOM–W, AMSR-2
    - MIRS is a 1-D VAR Retrieval/Assimilation system which uses information from POES, MetOp A/B, DMSP, GCOM, and S-NPP/JPSS.
- Among the applications
    - Rainfall Intensity Forecast - GFS vs. MIRS/ATMS
    - Data Assimilation Applications
    - Climate applications
- Recommendation and Future Plans
    - On going and planned
        - New sea ice age, snow grain size
        - New science
        - Extended validation using independent evaluation
    - Leveraging NOAA Activities of support of JCSDA
    - Conclusions and recommendations
        - MIRS should be in the consolidated algorithm at NOAA for processing microwave sensors
        - Applied to 10 sensors to produce 7-13 products

Q: Are any plans for snowfall rate,
A: Yes, snowfall rate is planned for an up-coming version of MIRS

Mark Liu (STAR), "NUCAPS Overview"

- NUCAPS products from JPSS available from CLASS since April 8 are temperature, moisture, SO_2, and ozone profiles – this replaced the CrIMMS algorithm.
- Above 200 mb NUCAPS shows an expected out of spec error in the Polar Regions that are being addressed.
- Future plans are for microwave retrieval that were not originally part of the NUCAPS plans, but are required by JPSS once it took over for CrIMMS and also new JPSS trace gas requirements. Migrate to integrated sounding system for all available sensors.

Larry Flynn (STAR), "Ozone Overview"

- There may be some cross track problems but it is understood and can be corrected for.
- NOAA-19 and S-NPP comparisons show some problems (stray light, mismatches between NP and NM).
- OMPS can be very adaptable.
- The path forward has some tradeoffs over whether to implement changes now or wait until a few more improvements are made to them and implement later.

- Team challenges – do soft calibration now or wait performance vs. schedule these decisions to be made this month.

Don Hillger (CIRA), "Imagery Overview"
- The approximately 7 hour CLASS latency is the most common complaint from users.
- Not all (only six) M bands are turned into EDRs. The team is pushing to have all bands made into EDRs, which would not significantly increase processing requirements.
- Hillger explained differences between SDR and EDRs (remapping to GTM, bowtie deletion, etc.).
- Remapping initially caused some "missing triangle" problems but it was quickly solved.
- DNB is the SDR, and contains radiances. NCC is the EDR, and contains albedos.
- There was a large striping issue in the DNB product due to stray light, which has also been fixed.
- Would recommend discontinuing bowtie deletions from SDR

Q: What is causing the latency?
A: Users now dependant on CLASS for distribution

Ivan Csiszar (STAR), "Land Overview"
- Very complex physical interactions involved in the land products.
- Surface Reflective changes drove Vegetation Index changes in addition to new top of canopy requirement.
- The bright pixel surface albedo product is stable since transition to ops of BRDF LUT, how the dark pixel algorithm still has some problems.
- QST implemented earlier this year seen as a significant accomplishment but still needs some improvement.
- Use of I-band has greatly improved spatial resolution of active fires in experimental product
- Work needed in gridding/granulation between land team and cloud mask.

Jeff Key (CIMSS), "Cryosphere Overview"
- All products at provisional with some at validated stage 1
- At times the IDPS sea ice characterization EDR looks good but at others it appears to have problems e.g. characterizations changing from orbit to orbit; complexity of the algorithm has made troubleshooting difficult but it is on going
- Fractional snow cover suffers from its 2x2 pixel aggregation scheme (an unmet requirement), this causes unrealistic transitions between snow/no snow and replacement algorithms are being investigated.
- Binary snow map corrupted by bad cloud mask that identifies cloud as water. No action seen in a year. In follow up, VCM team said they were aware and working it.
- The team considers the algorithm change process to be cumbersome and lengthy.
- In summary:
    - SIC EDR is poor quality, may not be meeting 70% requirement, has no user
    - Ice Concentration IP is a good product that has user advocates for EDR status
    - Snow Binary Mask is good
    - Fractional Snow Cover is bad and is listed as a J1 upper

Sasha Ignatov (STAR), "Sea Surface Temperature Overview"

- The SST product is currently at provisional maturity, but the recommendation is to discontinue IDPS product and change to ACSPO in NDE since IDPS is currently not meeting specification in daytime
- A decision was made in January to transition back to ACSPO which meets the requirements in both day and night.
- ACSPO products to be archived at JPL not CLASS.
- Compared ACSPO performance against NAVO product (NOAA AVHRR heritage), and ACSPO has approximately a factor of three improvement in coverage

Q: Are there any ideas on the source of the warm bias in high latitudes?
A: Ice and cloud mask leakage, limitation of algorithm at high latitude

Q: Where do water temperatures over Canada near Hudson Bay shown in previous slide come from?
A: The product can display water of temps rivers/lakes etc., since the slide was provided by a Canadian partner, the land/water mask used is unknown

Menghua Wang (STAR), "Ocean Color Overview"

- Total of 16 discreet OCC products.
- Quality is extremely sensitive to SDR quality, requiring 0.1% SDR accuracy.
- There are apparent problems with M4 SDR.
- Described alternate multi-sensor level-1 to level 2 (MSL12) algorithm, which the team has recommended to replace the IDPS algorithm.

Q: Are the changes observed since February caused by sensor degradation?
A: Do not believe so since other teams are not showing same drop

Session 4a: VIIRS SDR Science Breakout Session

Chairs: Changyong Cao, Jack Xiong

Session Summary: Over 70 participants attended the VIIRS SDR breakout sessions on both Tuesday afternoon and Wednesday morning (May 13-14, 2014). The focus of the breakout meeting was to provide an update on VIIRS SDR calibration and validation efforts and an opportunity to communicate with VIIRS EDR teams and users. There were a total of 19 oral presentations and several technical posters that spanned from SDR team calibration efforts and performance enhancements, VIIRS EDR team feedback, to archiving VIIRS data for climate records.

The presentations focused on improving RSB, TEB, and DNB band calibration and validation. Presentations on RSB cal/val were mainly motivated to improve the VIIRS radiometric stability and accuracy suitable for ocean color applications through onboard calibration, inter-comparison, vicarious calibration, and lunar band ratio techniques. TEB presentations were useful to address the issues such as SST striping through detector level dependencies, cold scene bias and more. Effort to improve the DNB band calibration through vicarious approach was also presented. In addition, the progress on development of ground-based polarimetric spectroradiometer in support of J1 validation was also presented. In summary, the VIIRS instrument continues to perform well, meeting performance specifications.

Thermal Emissive Bands (TEB) Summary

- SST striping continues to be an issue that requires further investigation. Results show that M13 NEΔT at blackbody is 0.04 K (@ 300 K) while striping artifacts in earth scenes can be up to ~0.16 K, half of which are likely due to band averaging RSR effects.

Action: Further test the striping effect due to RSR averaging and research alternative algorithms

- C0 adjustment can reduce the M15 bias, but there are uncertainties in IASI/AIRS/CrIS consistency at low temperatures.
- "Mis-alignments" in the bow-tie region between scans reported by SST. A quick analysis using contrails does confirm the effect (up to 5 km displacement found between scans). However, these features disappear when the data are projected as shown in EDR imagery.
- Quality flag issues (other than Flight software)

Action: Further test the striping effect due to RSR averaging and research alternative algorithms

Action: Work with users who are concerned about M15/M16 consistency below 200 K and prioritize the implementation of C0 adjustments

Action: Further investigation using ground linear features needed because contrails are at much high altitudes

Action: Work with EDR teams to resolve the issues (Mx8.4 to be implemented next week)

Day/Night Band (DNB) Summary

- Stray light correction works well according to users.
- User feedback: Improvements and changes in calibration need to be well documented and made available to the public on-line.

Action: (Applies to all bands, not just DNB) - Enhance the VIIRS Event Log database to keep track of all changes (live demo provided in the breakout session). Shall add commentary on anomalies to facilitate reanalysis. Currently the database covers a large number of events but not completely.

Action: Develop vicarious calibration for DNB using DCC

Reflective Solar Bands (RSB) Summary

- Achieving sub-percent level accuracy and stability continues to be a challenge as demonstrated in recent F- and H-LUT trend changes.
- Based on independent analysis by multiple team members and OC team, a recent discrepancy in the operational RSB H-factor LUT was identified. This may have caused erroneous trends in the F-LUT. Validations at vicarious sites, DCC, and comparisons with MODIS supported the findings.
- The Aerospace Corp. team members agreed to take corrective actions to deliver an improved H- and F-LUT in the near future.
- Root cause for the recent F- and H-LUT trend changes requires further investigation. Possible causes include: a) abrupt change in solar diffuser reflectance; b) abrupt change in the gains of both SDSM and VIIRS.
- Simulate solar diffuser behavior when exposed to high energy particles
- Test solar diffuser sample pieces (in collaboration with UMD physics/astronomy department)

Action: Further investigate the root cause for the flattening trend in the F-factors.

Action: Prepare for early transition to RSBAutoCal to mitigate the recent calibration issues

Action: Address other discrepancies to include solar vector errors, and prepare LUT time series since launch (with uncertainties presented) for recalibration, reprocessing, and reanalysis by users (such as EDR OCC team and NCDC [C-RDR])

Action: The Aerospace Corp. to provide updated H- and F-Factor LUTs ASAP

VIIRS J1 Polarization Summary

- Good progress has been made in the planning for additional prelaunch characterization, global observation proxy data (such as from GOME PMD), and ground based measurements in support of modeling
- Uncertainty in the polarization phase can be a concern

Action: Provide feedback to Flight on the phase uncertainty concerns to see whether it can be improved for J1/J2

Action: Endorse all efforts in support of the polarization studies for J1 VIIRS, for example:

- **Verify GOME PMD global data and facilitate its use as proxy for J1 VIIRS**
- **Enhance ground based polarization measurements, improve the instrumentation to reduce uncertainties and add automation features, take full advantage of 3-D printing for easy hardware integration (adaptors, gears, lens holders, etc.)**
- **Explore low cost UAV platforms for more versatile polarization measurements to support CRTM model development and validation**

VIIRS SDR User Feedback Summary

- User feedback greatly contributed to the success of the VIIRS SDR session. Interactions between users and the “calibrators” are critical in resolve instrument performance issues.
- Thanks to all user groups (SST, DNB, RSB, polarization impact, NCDC, and others) - will expand the feedback portion next year.
- Thanks to all presenters and participants in the VIIRS SDR session!

Session 4b: ATMS/CrIS SDR Science breakout

Chairs: Fuzhong Weng, Yong Han, Dave Johnson

This session featured presentations on the state of both sounding instruments – ATMS and CrIS. For both instruments the focus was on J1 test results, as well as a review of S-NPP status, and upcoming algorithm changes for J1. Or ATMS, the future work includes a new destriping algorithm, implementation of ARTS to process ATMS TDRs offline, as well as continued validation with GPS-RO and NAST-M underflights. Overall, the state of the J1 ATMS instrument is good, with the exception of channel 17. The CrIS instrument is also performing well, and the team is preparing for implementing full spectral resolution.

Tiger Yang (UMD/ESSIC), "Advanced radiance transformation system (ARTS) and its applications for ATMS TDR processing"

- Features of ARTS
  - Three levels of quality control
    - granule
    - scan
    - channel
  - Supports small and large platforms
  - Geolocation calibration
  - Scan angle dependent feature from space view
  - Resampling TDR coefficients tuned to ensure remapped TDR has the best balance between noise and sampling
  - A new scheme for L1 detection and correction was developed
- Future work will focus on using ARTS to generate data for use in weather and climate study
- A request for a full radiance based calibration for historical record was made. Currently, the calibration is derived with respect to temperature, not absolute reference to establish the historical record. ARTS has several modules such as geolocation, based on GPS, TLE as a backup, and a 3-4 km uncertainty with respect to VIIRS.
- The full radiance has scan angle and polarization dependencies. The space scene would have 2.73 K but IDPS does not (small difference). New equation presented shows no more dependency on the scan angle.
- About resampling TDR - ARTS gives resolution enhancement (2.2°) or the downgraded product gives lower noise (5.2° spatial resolution)
- On the lunar contamination correction - without LI correction there is a large data gap whereas with LI correction the data gap is largely reduced.

Q: The geolocation using VIIRS is from the visible and IR measurements whereas ATMS is microwave, how do you make the geolocation match?
A: By using the strong contrast between land and ocean

Xiaolei Zou (FSU), "ATMS de-striping algorithms and test data for NWP impact studies"

- Optimal striping filters - total number of IMFs removed are two for channels 1-2, and three for channels 3-22

- There is a set of optimal filter for ATMS radiances designed to smooth out the striping noise but not to alter frequency weather signals
- Using brightness temperature in channel 8, smaller range of O-B; range is +/- 0.3 K
- A similar optimal striping filter will be developed for calibration counts and impact of striping noise of NEΔT will be quantified
- An effort is made to remove the striping error.
- Destriping is used the first component of the PCA. Radiance analysis is performed for part of the orbit.
- The proposed solution is to use a filter on the first component.
- The derived filter has almost no side-lobes and the results show strong removal of striping.
- A striping index is established and the striping filters are developed for each channel.

Q: What is the root cause of the striping?
A: fluctuation of the gain.

Q: Is striping expected for J1?
A: Yes, but not as much as S-NPP

Lin Lin (STAR), "Towards Establishing a Benchmark Instrument for Microwave Sounders"

- Brief description of GPS-RO; high resolution/no contamination/high precision and accuracy
- Collaboration of GPS and ATMS—use COSMIC geolocation at the altitude of maximum
- Before/after scan bias: spatial distribution more homogenous, more Gaussian
- This study can significantly contribute to a better refined post-launch calibration of ATMS, and future integration of ATMS data into long-term CDRs
- The goal is to help with the removal of striping.
- The use GPS-RO gives good atmospheric profiles. COSMIC has 0.65 K accuracy and 8 km geolocation accuracy.
- The focus is channels 5 and 13.
- Find ATMS and COSMIC matchups, then perform bias correction for each channel in ATMS. After this correction, the pdf is looks Gaussian.
- For simulation, the authors used the MONO RTM.
- The long term time series of COSMIC versus ATMS shows a bias of about 0.5 K (and increasing) since 2012.

Q : Was December 2011 used where wrong calibration coefficient were utilized?
A: Yes, they used the old SDR product

Vince Leslie (MIT/LL), "NAST-M Field Campaign for ATMS Validation"

- Airborne validation status - calibrated NAST-M; compared S-NPP ATMS measurements against NAST-M for May 13 sortie
- S-NPP Cal/Val Campaign; - remove limb darkening, limb 3; placed beam width for comparisons
- TDR-to SDR results—K and lower V band—in family and correlation matrices
- Measurement on 118.75 kHz on NAST-M—investigate this data product

- Reason for channel correlation;
- Successful airborne campaign—need to finish processing all sorties and investigate ATMS bias
- Need to analyze how the J1 and S-NPP spectra and correction matrices impact data products and instrumentation
- NAST-M is used for cross-validation from S-NPP field campaign
- S-NPP and J1 spectral analysis results are shown.
- The radiance to radiance comparison (underflight), NAST-M is being calibrated for V and G band.
- The results for May 10 underflights: In general the match is less that 0.5 K.
- The J1 test data were presented. Correlation matrix (covariance) is shown for J1 pre-TVAC. There is correlated noise between the 22 channels. The noise is lower than S-NPP.

Q: Is there 118 GHz on NAST-M?
A: Yes.

Q: What is the root cause of the noise correlation between channels?
A: The probable culprit is the substrate.

Otto Bruegman, Ed Kim, Kent Anderson, Joseph Liu, (NGES, NASA), "Early Results from J1 ATMS TVAC"

- The JPSS ATMS on-orbit accuracy issue is in channel 17. Combining non-linearity and instrument temperature—all channels are compliant with a small margin of accuracy at channel 13 and 15
- Note the Tb offset that could result unless gain variation can be predicted
- LI mitigation approach by switching between SPs should work for all ATMS 22 channels
- All microwave imagers exhibit striping at some level, yet no NWP users saw striping-related issues with forecasts using AMSU, MHS, etc.
- Striping observed is not exceeding any hardware specs; nevertheless ground processing changes (averaging) are being considered to reduce existing striping which can be applied to S-NPP and J1-J3 ATMS without any hardware changes.
- NWP users must demonstrate the quantitative impact on forecasts
- Channel 17 out of spec—waiver to be requested
- Parts for J2 and J3 already been acquired (receiver front ends). To procure new amps would be of order $30M.
- The radiometric test has been performed at 11 temperature plateaus from 95 K to 330 K
- The NEΔT is presented, only channel 17 is above specification.
- Channel 16 has an anomaly - periodic fluctuations at cold temperature. The function shows a very good parabolic fit for radiometric accuracy between the antenna temperatures versus channel temperature.
- The lunar intrusion alternate scheme was presented.
- The overall NEΔT is slightly lower for J1.
- On the striping, the next instrument will have less striping due to new instrumentation.

Q: What to do with channel 17?
A: A waiver will be requested.

Degui Gu (NGAS), "[NGAS Support for ATMS cal/val]"

- Several NGAS activities are presented which includes validation, DR investigation, LUT update, code update, striping noise analysis and mitigation, support J1 sensor characterization, and performance.
- A code error in ops failed to correct for lunar intrusion. The solution is to update the PCT in order to use correct beam size values. The implementation is now in Mx8.3. The code fix shows no data gaps.
- The raw cold count shows gain change over time. But it is not a concern.
- After correction, the LI pop up of about 1.5 K.
- After correction, noise is estimated for different channels.
- The overall noise is <0.1 K for all channels.
- The J1 analysis shows less striping to the exception for channel 16 and 17.

Q: Does the mitigation to striping use simulated data?
A: No, it is using homogeneous scenes.

Q: What is the root cause of the channel 16 dropout?
A: It is believed to be the 1/f module and has temperature dependency.

Q: How to prevent for J2?
A: Do better testing.

Ninghai Sun (STAR), "[STAR independent assessment of J1 TVAC]"

- Analyzing TVAC calibration data provides instrument assessment (e.g., accuracy, striping)
- 1,2, 5,6 on redundancy configuration
- Temperature dependent variation—NEΔT changed dramatically
- Mid/cold plate high temperature—cold plate temperature can effectively lower NEΔT
- Non-linearity fitting---RC1 vs. S-NPP: curve fitting reversed on 4, 5, 6
- Compared mid vs. cold plate temperature—particularly channels 16 and 17; higher level and striping index changed
- TVAC analysis of J1 ATMS by STAR is presented.
- The old plate test is stable.
- The NEΔT all meets spec except channel 16 (high temperature only) and 17 which was above spec for all temperatures.
- The Allan variance is computed for different configuration and it looks good.
- The radiometric accuracy of channel 16 is about – 0.3 K.
- The nonlinearity is small. But several V band peaks in nonlinearity are present (out of spec).
- The striping is present in J1. RC6 configuration differs from the other configuration.
- The colder plate temperature reduces the striping index.
- The count anomaly shows in Channel 15.

Q: Does the different team use the same equations to assess the noise?
A: No, then there should be a consensus between the teams. (Allan variance versus standard variance).

Dave Tobin (UW), "CrIS Radiometric Calibration"

- ICT emissivity and reflected terms - Cal/Val has not shown radiometric artifacts. The ICT was redesigned for J1 and J2 CrIS using improved design
- ICT temperature driver - phase change cells on the ICT are being considered for J2 CrIS which would further reduce BOL to EOL contributions, and allow performance to be verified on-orbit.
- Non-linearity - on-orbit RU contributions should be similar to those for S-NPP
- LW and MW detectors are being selected for J2 CrIS. An accurate measure on non-linearity should be assessed
- SW Band biases – the team investigated various mechanisms and as of yet has no answers on getting rid of biases
- Potential changes include removing spectral gaps, smaller and more numerous footprints. Both require funding to perform further design/costing
- RU should be similar to S-NPP CrIS for J1. J2 could feature possibly reduced RU pending detector selection
- The RU is the error bar of the radiance product.
- RU is not consistent for different sensor (IASI, CrIS). An effort is made to make the RU definition consistent between the different sensors.
- RU error budget has contribution from several factors (e.g. ICT temperature, non-linearity, etc.)
- RU from ICT emissivity for S-NPP has low emissivity but ICT environment mitigates this deficiency.
- The ICT for J1 has been redesign with e > 0.995
- The ICT temperature will change over time (degradation of PRT). The mitigation is to add phase change cells for J2 and there are discussions with program office, which will lead to better stability.
- The non-linearity is high for S-NPP, because there is not a good assessment of NL at detector level testing. Recommended to screen the detector with FTS for examples.
- The RU not accounted for right now - polarization, possible SW non-linearity, and spectral ringing.
- The possible change for J2 is to remove the spectral gaps between LW, MW, and SW.

Q: Are there any seasonal change is the RU?
A: No changes are seen due to ICT.

Larrabee Strow (UMBC), "CrIS Spectral Calibration"

- Two year neon calibration record from CCAST - re-process two years of SDRs with CCAST using metrology laser. This approach introduces noise. The results show no long term drifts but a small seasonal drift with solar heating of the instrument.
- Improving cal/val by improving CCAST - periodic sinc (psinc) were used for the correct ILS. IDPS and CCAST formerly used sinc function instead.
- SNOs using spectral conversion of AIRS: intercalibration of AIRS and CrIS can only be done with L1B data in window regions
- 0.2 K "ringing" may be due to a lack of frequency calibration. Standard error is extremely small
- The neon stability is examined along with the Sinc vs. Sinq comparison.

- The neon lamp is stable to +/-2 ppm. The measured laser wavelength matched the upwelling radiance.
- Sinc vs. Sinq - Using Sinq has much smaller bias of clear scenes. (obs minus computed NWP) in SWIR.
- The SNO with AIRS. Convert AIRS into CrIS like. After manipulation, two million SNO cases shows SNO difference within 0.1 K but higher in MW.

Q : Is there a neon lamp drift?
A: Found a -0.07 ppm trend since the beginning of the mission (so very stable).

Dan Mooney (MIT/LL), "CrIS Calibration Equation"

- "CMO" first then calibration
- Doing the interpolation before/after the calibration ratio makes a difference (SW)
- 2 distinct classes of calibration algorithms--interpolation
- Further analysis is ongoing produce optimal extended resolution spectra with correct calibration equation
- The differences between the candidates for radiometric equation reordering are presented.
- Two classes: ISA before F (resampling), and ISA after F.
- The current implementation has FOV view dependency (corner, side, center).
- The ripple envelope has band edges effects.
- The radiometric differences are small between the candidates but systematic

Vladimir Zavyalov, Mark Esplin (presented by Deron Scott)(SDL), "CrIS Noise Performance"

- The noise has a host of sources (17 identified)
- CrIS meets the noise specification.
- S-NPP CrIS MW FOV7 is above spec.
- The random noise is greater than correlated on-orbit.
- The comparison with IASI and AIRS versus CrIS low and full resolution is presented.
- The trending is very stable noise. There was one temporary anomaly in LW FOV1, which has resolved.
- A slight seasonal variation is observed. It appears not to be correlated with ICT temperature.
- The noise orbital variation is very small.
- The noise estimated using the imaginary part shows higher noise level than the real part.
- About orbit 6245, imaginary noise increase is correlated with DA-Y tilt higher variations.
- J1 VBENCH noise results - the MWIR FOV9 is out of family (higher noise).
- In the RRTVAC J1: MW FOV9 is now meeting the spec but is still out of family.
- During RRTVAC, the imaginary noise is higher and is sensitive to vibration.

Q: What is the noise increase of LW FOV1 root cause?
A: Root cause is not known?

Yong Chen (STAR), "Preparation of CrIS Full Resolution Processing"

- The full resolution work on the algorithm and code is ongoing.
- On August 27, 2013, full resolution data set was acquired. No change in the Obs – simulated (CRTM) before, during, and after the full resolution data acquisition. Therefore the code appears to have good radiometric accuracy.
- The prototype code development is based on Mx8.3 and ADL 4.2
- The prototype has new candidates for radiometric reordering.
- There is a need to compute the correct ISA and be efficient.
- The candidates show ringing. There is a need to select the truth spectra.
- The double difference method (CrIS-CRTM) - (IASI - CRTM) was presented. Difference of 0.1 K over window channels is reported.
- The full resolution CrIS matches well the IASI CrIS-like data over CO and CO_2 regions.
- The spectral shift using cross correlation methods is calculated.

Q: With the acquisition of full resolution on S-NPP, will we drop FOVs?
A: Yes, FOV4 in the direct broadcast will drop as reported by DPES/DPA. For J1, drop two FOV in the direct broadcast but we will have McMurdo station to reduce latency.

Q: Does, SNO CrIS-IASI difference in SW appears big?
A: Yes, it is somewhat high.

Q: Can the code perform a dynamic switch between low and full resolution.
A: No the code needs to recompile the code in order to switch resolution.

***Likun Wang (STAR)*, "*Towards Establishing a Reference Instrument*"**

- Spectral and radiometric consistency among CrIS, AIRS, and IASI is significant to GSICS community
- Hyperspectral radiance measurements can serve as benchmark for model assessment, but consistency if the key
- CrIS versus AIRS - the best we can do without reducing the spectral resolution
- Software updates - data in this study were processed using ADL 4.0 (comparable with Mx8.1)
- Differences between ADL and IDPS were negligible
- Differences between CrIS-IASI is reduced at LW bands with new a2 values
- Lesson learned - non-linearity plays an important role for CrIS radiometric accuracy, and should be carefully evaluated during prelaunch testing
- 0.1 K (absolute difference) can be used as an anchor for detecting trends
- How to establish radiometric consistency between CrIS, AIRS, and IASI.
- One technique is the SNO comparison. SNO happens at space infrequently depending on the satellites orbits. The SNO with AIRS is more challenging since AIRS spectral sampling is not uniform.
- To get better time series, CrIS data needs to be reprocessed to Mx8.1/8.2 for the past year, which was done.
- The new a2 give better match CrIS versus IASI.

Q: What is the comparison between IASI A vs. B (CrIS minus A or B)?
A: It shows a small difference, about 0.1 K.

Comment: We need to establish an absolute radiometric assessment.

Xin Jin (STAR), "Proxy dataset for Testing and Evaluating J1 CrIS SDR products"

- There is a need to establish testing data for the algorithm due to software bugs, and missing observation among other reasons.
- The testing cases divided into five groups,
  - Functional has two tests (golden day, full resolution)
  - Sensitivity test - e.g change a2 coefficients
  - Instrument - change CMO (>2 ppm), time stamp issues, impulse noise,
  - Engineering - BTM saturation
  - Abnormal inputs - data gaps, missing packets. Automatic/manual retasking

Degui Gu (NGAS), "NGAS Support for CrIS cal/val"

- CrIS SDR algorithm code updates to resolve DR 7542. Code was modified to compute and output valid NEΔNs.
- NGAS continues to support to CrIS sensor TVAC test data analysis
- NGAS worked on 27 DR since launch.
- At the beginning of the mission, 2/3 of the data were flagged as degraded.
- As an example DR 7542 NEΔN had zero values.
- DR 7466 - Extended radiance anomaly due to time stamp error.
- Science development focuses on combining the ISA and resampling matrices using least squares estimation approach.

Q: Can CMO with LSE be made available.?
A: Yes

CrIS SDR Group Discussion

- Two main topics, (1) Algorithm development, (2) J1 testing.
- J1 testing:
  - Window had leak. It has been resolved and now gives no tail end in LW. There is an obscuration cause by chip in the optics in FOV8.
  - RRTVAC testing to check low frequency vibration due to communication gimbal.
  - EMI testing results are looking good. Current TVAC is from June to October 13, 2014. This will include 8 thermal tests. Pre-ship review (PSR) is scheduled for the end of October. There is not enough time to do TVAC analysis to be ready for the PSR. TVAC analysis should take about 2 months.
  - A request is made to have draft of sell-off memos (from D. Tobin).
- Algorithm development:
  - The algorithm radiometric equation reordering and spectral calibration were discussed. There is need for the team to select the new algorithm (which candidate is the best).
  - The CMO will be a regression table. It will be interpolated to the measured laser wavelength. (179 MB per laser wavelength). An advantage is to compute the CMO offline so there is

visibility and there is no latency limitation. Also, we can select the best way to compute the CMO. As a disadvantage, if laser wavelength is way off the table range it would create an issue.

- Also there is need to smooth the measured laser wavelength.
- A suggestion is to interpolate the SA, then compute the inverse once per granule.
- There is a need to define the truth spectrum.
- The selection of one of the four candidates will use simulation and also by looking at real data.
- Also, there is a need to address the non-cyclical effect s of the FIR application on-board the instrument.

Session 4c – OMPS SDR Breakout

Chairs: Fred Wu, Glen Jaross

Session Summary: The presentations covered the status of the OMPS SDR from the description of the instruments and the ConOps, to the details of the algorithms, the most recent results, the current issues and the expected modifications and improvements for J1.

The technical discussions highlighted ConOps, instrument and algorithm expected modifications for J1 and the current S-NPP OMPS SDR issues that are being worked out to obtain validation maturity (SL and wavelength shifts). Of interest was the team discussion that focused on lessons learned and improvements for J1.

A discussion session during the meeting focused largely on how to potentially make the SDR product more user friendly. There was also discussion of the need for a closer working relationship with both the Flight side, and Aerospace Corp., including easier access to important documentation.

Tom Kelly (NASA), "Derivation of solar irradiance for OMPS nadir instruments"

- Solar ConOps changes for J1: expand the solar measurements to get more observations. Same integration and number of coadds as for S-NPP, but 16 or 17 observations for NM at each diffuser position and 15 for NP instead of three and bibe. This will give us better statistics for the diffuser goniometric features.
- S-NPP Solar diffuser features: August solar reference calibration. Comparison of August 2012 to August 2013 shows similar structure due to diffuser features.
- Figure showing the amount of peak to peak variation as a function of solar beta angle. There is a beta for which there is minimum variation. Moving away from this beta angle gives larger variation. This is the reason to do beta at the same time all the time (beta = 19°).

Q: (Maria Caponi) When should we make the next yaw correction if no S/C delta modification?
A: July this year would be fine - no yaw, delta needed. Adjustment would be needed by March/April 2015.

- The new approach for J1 is to use same beta and solar ref cals, but a three orbit baseline for J1 versus three observations S-NPP. The Downside for three orbits is that you have more mechanism moves.

Mike Haken (NASA), "NASA Dark Current, Linearity, and Transients Calibration/Correction or OMPS Nadir Sensors"

- Dark current rates for image and storage regions are derived from sequence of full frame images. This replaced the original 100/10 (NM/NP) coadd nominal measurements,
- The original sequence was not designed for transient detection. The new one uses a temporal transient filter which allows tracking analysis of transients.
- The performance improvement of new sequence depends on magnitude and pixel location of transient events that were degraded by coadded measurements.
- It is effective even within large part of SAA (transient detection)

- Hot pixel number increases about linearly with time.
- Detection to declare hot (damaged) is 5 ct/s. It looks like 99 % will look damaged in 6 years from the extrapolating fit. However, just because the pixel is damaged doesn't mean that they are useless. To be declared useless it must reach about 1000 ct/s.
- Saturation must be estimated and corrected for. The uncorrected error in darks is very small.
- The Ball Aerospace linearity approach which failed to account for premature well filling on OMPS LP right side CCD has been fixed.

Q: (Maria Caponi) Does STAR have the linearity corrections for the Cal SDR?
A: Linearity corrections delivered to NOAA, but has not been implemented yet

Mark Kowitt (NASA), "Post launch wavelength registration of OMPS Nadir sensors"

- A hi-res wavelength solar spectrum, which was developed by KNMI for OMI, is convolved with the preflight BP.
- Each spatial index has an independent band center solution.
- Coefficients Improvements:
  - CBC tables for solar calibration updated for NP and NM
  - New mid EV CBC for NM
  - The crosstrack difference between EV and solar CBC are being studied
  - Extended tabulation of NP seasonal/annual shift vs. nadir telescope temperature
- Solar activity correction implemented
- NP intra orbital shift and EV CBC discontinuity now being studied.
- SDR EV in IDPS has an update from 2012 but not from February 2014 yet.
- NP slit edge features measured CBC vs. smoothed BATC CBC smile shows small slit edge irregularities.
- NM EV solar cross track offsets – Cross track error if used the solar cal to calibrate the EV. Difference between those 2 is about 0.008-.0002 nm.

Grace Chen (NASA GSFC), "S-NPP OMPS Nadir Instruments Stray Light Corrections"

- Instrument SL Characterization in prelaunch tests.
- SL come from outside Off target SL and ghost (internal reflection)
- Test to disassemble evenly the pixel PSF or ghost
- From information can model SL correction
- The result is a Gaussian and side bump. The bump is the ghost.
- Residual analysis reveals that the NP is OK, while the NM has a little bit of spatial dependence.

Q: (Chunhui Pan) How do you separate signal from SL ?
A: You can't tell but from nature we know. Only center pixel, on the center signal, all the tails are SL. Arbitrary cut off around the BP. Everything is around the center signal. You can put anywhere, part will be forward, and part SL

Glen Jaross (NASA), "Calibration in the NM-NP overlap regions"

- NP and NM mismatch should agree on the overlapping wavelength region and they do not. This problem is not seen in PEATE.
- Looked at SL, but there is too much radiance when you see the downturn and NP too little, so it is probably not caused by SL.
- The team also looked at dichroic effects. Transmission and reflectance curves shift when you decrease the temperature. The shift is very well known, but it turns out that there is no temperature difference between radiance and irradiance in orbit. N-value differences imply that there is a shift. Radiance or irradiance alone would shift, but not the ratio.
- J1 OMPS testing was conducted in August and made measurement in vacuum, temperature from 19 to -16. You see a steep fall off in transition region in both cases, but when you divide to get the N-value it is almost flat, so this cannot explain the situation.
- The team looked at Ground orbit wavelength shift which causes a radiometric calibration error. Irradiance calibration coefficients. Estimated calibration error. Shift about 0.1 nm.
- Magnitude in N values is 2.5 % and 4% at 305 nm
- The team did a simple lambda shift to show that the correction results in accurate solar irradiance measurements. This flattens it out and is about the right magnitude. However, this doesn't explain the ratio (R/I) differences, which need a change in the instrument with T. A dichroic effect would require a T change that doesn't exist.
- There is a predicted error in TOA reflectance based on ground to orbit wavelength shift. But not enough differential shift to explain observation. The NP prediction is opposite.
- The team looked at polarization sensitivity as well. The dichroic is highly polarization sensitive. Below 310 nm the dichroic cuts in and polarization sensitivity goes up (several percent) and the NP is flat. Not enough to explain what they are seeing.
- Concentrated on NP, because it is simpler than the NM in the 300-310 nm region. The SL is less about 0.5%), really minimum and there is 8-9 % to explain. Might have gotten SL wrong, but not enough to explain the 8-9%.
- The path forward is to focus on NP behavior in 300-310 nm, Solar SL (NM and NP), and reprocess selected data for soft calibration.

Glen Jaross (NASA), "Performance of the S-NPP OMPS Limb Profiler"

- Issues include pointing and internal SL gain matching.
- Reprocessing goal is to compare with SCIAMACHY.
- Global coverage in about 4 days.
- Vertical coverage varies because of the pointing of the satellite.
- The LP can see clouds at the lower altitudes. Some turn up at the long wavelengths, which is a sign of SL.
- The LP collects six images collected – a small and a large aperture for each of 3 slits – which provides better dynamic range. There is also a mix of long and short integration times. Combining apertures and integration times you get a dynamic range of 2 x 10^6.
- Radiances from different apertures do not match. The solution is to use the large aperture for UV, and the small aperture for VIS and IR. This trades some noise for smoother gain transitions.
- Spatial variations indicate radiance calibration errors at different tangent heights.

- The instrument is more sensitive thermally than expected. The resultant spectral shift small and constant in the first part of orbit and increases afterwards. There is also a seasonal variation in wavelengths which follow solar azimuth.
- The team compares LP and MLS profiles to estimate tangent height offset, which can cause large errors in radiance. There is a clear TH offset error of the order of 0.2-0.5 km with little latitude dependence. Probably remaining errors are a couple of hundred meters but not sure what it is due to and how to correct yet.
- The SL characterization is the same as NM.

Tom Kelly (NASA), "OMPS ConOps"

- Differences:
  - No Limb in J1
  - Higher data rate for J1 by nearly a factor of four once compression is accounted for (roughly 200 kb/s vs. 800 kb/s). J1 can support HR data.

Q: Can it support FF all the time?
A: No

- J1 has "reduced frame capability" for running the timing pattern generator. S-NPP reads the entire contents of the CCD in memory and then applies ST binning and gain correction. On J1 only a select subset of pixels of CCD is read into memory. The ST is specifically tailored for the Timing Pattern.

Q: (Bhaswar Sen) Is it the same TPG for EV NP for S-NPP and J1?
A: No – the TPG is different. We need a new TPG in ground. Need the timing offsets but know how it is done. It will look identical

- To prevent trouble when they integrate with S/C there is interchangability. Suppose they it on put the instrument, do integration testing and have trouble. Can back down from 10/80 to the 12/64 by changing a certain number of tables. Not all tables affected
- Each product set (the CBM, Image Profile, Gain, ST, TP and Global Config tables) works with the same version of the flight SW. This prevents trouble when they integrate with S/C. Suppose they put the instrument, do integration testing and have trouble. They can then back down from 10/80 to the 12/64 by changing a certain number of tables. Not all tables affected.
- J1 will have better along-track resolution – about 10 km for NM and 50 km for NP. The NM wavelength will increase to a range of 298-423 nm.
- Planned S-NPP improvements – test FSW 6 in S-NPP concurrent with Block 2.0 changes. Will move from current data rate to 12/32NC to 12/32C.

Q: Can we do compression for S-NPP?
A: Yes – Do it in the lab first

Matt Kowaleski (USRA), "Status and improvements of J1 OMPS pre-launch calibration"

- Design changes:
    - no LP
    - TC spectral range: 305-417 nm
    - Enhanced spatial resolution with new timing patterns
        - NP: from 250 km to ?
        - TC: 50 km to 15 km
- New diffuser (quartz volume diffuser) design implemented to minimize spectral features in solar calibrations. The surface is smoothed, which adds multiple reflections, so it reduces features.

Q: Does it cost you in signal?
A: Yes, it reduces by 10-20% - It might degrade faster.

- QVD testing found degradation and spectral dependence.   BATC performed conditioning to stabilize reflectivity.

Bhaswar Sen (NG), "J1 SCDB Analysis, Conversion to LUT, and Testing"

- Sensor Characterization databases provide the best estimate on sensor characteristics using ground based measurements.
- SCDB evaluation includes review of DADD, metadata and database structure. There is a lot more info in the metadata this time.
- OMPS does not use SCDB directly. Conversion of SCDB to LUT is the most interesting part.
- We realized that we need to assign a TPG to each profile ID. The current one for S-NPP has a flaw. We couldn't change the table unless they changed the whole collection of tables. Need changes in IDPS handling of tables to make this effective.
- LUTs will be tested using prototype J1 SDR algorithm with synthetic datasets.
- Scheduled for December 2014 completion.

Larry Flynn (STAR), "OMPS NP Solar Activity and MG II Index"

- Solar activity affects more in the tops than in the wings of Mg II doublet. We need an estimate of how the solar is changing for this feature.
- The MG II time series from GOME-2 sees less than 1% variation as function of time
- NP uses various wavelengths and the solar isn't accounted. Still we do rad/irrad and we use constant. The residual goes up and down. Solar input to atmosphere changes, the ozone changes in response to that. Not all the ups and downs are because the solar changed.
- We can track how much it is solar activity. This was investigated and solved sometime ago.
- Pattern of solar activity and pattern of wavelength shift. At Mg II index a big up and down in solar activity vs. wavelength. Correlate the Mg II index features wavelength changes to other changes in UV across spectrum

Jian Zeng/Mike Grotenhuis (STAR), "Compare SDR from Nadir Instruments of OMPS, GOME-2, MetOp-A/B, NOAA-19 SBUV/2, and CRTM simulations"

- During the past 12 months the GOME-2 has high degradation, about 20%.
- Degradation due to instrument diffuser, not calibration and occurs more at shorter wavelengths.
- Shorter wavelengths more difference than larger wavelengths when comparing OMPS NP to GOME-2.
- There are many uncertainties in geolocation and it is not really certain which instrument is better or worse.
- Periodically, the polar orbits align and we can compare NOAA-19 SBUV/2 to S-NPP NP. These chasing orbits, when the equator crossing is within 0.05° and the equator crossing time is within 20 minutes, have occurred 35 times since the instrument was activated.
- NM errors are usually within 10%, although the 302 and 306 nm wavelengths are much higher, probably due to stray light. There are also issues with the matching – as the orbits get farther apart away from the equator.

Chunhui Pan (UMD), "S-NPP OMPS Nadir Sensor Performance Monitoring"

- The following areas are being monitored: Dark current, spectral smile, wavelength variation, linearity, sensor noise, telemetry.
- Negative smear due to ground software error related to the NP smear bias correction.
- Overall, the noise meets requirements
- Dark changes are as expected. Predicting that in seven years 99% pixels become hot, but no impact on NM
- The bias is very stable. About 2-4 counts increase since launch.
- Anomalous smear values were automatically detected. The transient filter is being replaced to avoid such large peaks.
- Linearity measurement is made once a month. A LED illuminates the CCD. Before measurement there is a five minute lamp warm up to avoid changes. Linearity meets requirements.
- There is a wavelength shift in NM and NP solar spectra. NP has a well defined cycle by seasonal/solar beta angle, but not NM.
- The sensor optical degradation is less than 0.5%.
- Initially there was no stray light correction. Version 1 improved the SL slightly, while V2 improved it greatly.

OMPS Team Discussion

- STAR needs to understand UV instrument process similar to those for the imaging and sounding in the VIS, IR, and MW spectra
- Because of history STAR makes decisions, NASA calibrates instrument, NGAS adapts for IDPS, Raytheon implements and Aerospace coordinates.
- Future:
  - STAR expects to perform Cal/Val and adapt for IDPS,
  - Collaborate with NASA broadly and indefinitely,
  - Get advice from NGAS for as long as possible
  - Work with Raytheon and Aerospace as has been

- STAR should be able to independently to support CV and algorithm modifications at IDPS, with use of ADL and with the support of STAR AIT. Broad collaboration with NASA. Agreements between two agencies and depth of expertise.
- OMPS is nice instrument. Issues are things in the margins, in the percent level. Degradation of the order of ¼ % over 2 years is amazing.
- Cal SDR: Integration design review – Question about delivery to IDPS and storage to CLASS.

Comment: (Eric Beach) Externals can't be delivered directly because of IT security

Comment: (Maria Caponi) Need to increase the level of LUT automation. Skip the weekly DRs, CCRs, tests by NG and DPES. Start with DPES test only (doesn't involve STAR or others).

- Calibration updates changing too much, but now stabilized. For J1 the team needs to update the dark and evaluate stray light sooner.
- Historically didn't pay attention to instrument ConOps and didn't allow for flexibility of it. Flexibility of SDR is critical.

Comment: Format of SDR is difficult for users. Especially the Geo separated from EV and the fixed sizes.
Reply: It can be ordered as bundled and it is OK. IDPS has accepted that variable size SDR are possible

Comment: Going into code and manipulating the data is doable but not pleasant. Even when you bundle, because the GEO doesn't have the expansion of the array sizes, using it is a hassle. Only 35 cross track in Geo vs. 105 in SDR.

Q: Can we redefine SDR format? Too many fill values and separation Geo and SDR.

Comment: (Bashwar Sen): In OMI everything package together in a single HDF file. What aggregation should we do?

Comment (Maria Caponi): This was discussed before and we decided on unaggregated product because it gave the flexibility to aggregate any way one wanted…

Comment: (Larry Flynn) NOAA has readers because they have had to deal with this. They can provide to people. Is there a place where they can post JPSS related tools? A Potential solution is a document library for NOAA and S-NPP, and why not put the readers there?

Comment: (Fred Wu) The team needs more contact and collaboration with BATC including documentation, which is difficult to find in its current place in eRooms.

Comment (Maria Caponi) We need a better flight-ground interface. Glen is current interface, but there is a need for those that are working in the algorithm to be able to interface directly.

Session 5a: VIIRS Land Products Breakout

Chairs: Ivan Csiszar, Jeff Key

Session Summary: This session reviewed the status of the many cryosphere and land products. Overall both sets of products are headed in the right direction. However, there are some changes on the horizon. The factional snow cover product will get a new algorithm as the current one cannot meet requirements. The Sea Ice Characterization EDR is under intense investigation, and a new algorithm may need to be implemented for that product too.

On the land side, a new product – top-of-canopy EVI will be added to the VI suite, and a new Active Fires algorithm will be implemented as well. Of primary concern in discussions was the quality of both the upstream and downstream quality flags. There should be an organized effort to ensure that the QFs work as described in the documentation, and also according to the needs of the science teams and users.

Peter Romanov (CREST)/Igor Appel (STAR), "VIIRS Binary Snow Cover and an Alternative Algorithm for Snow Fraction"

- The land/water mask provided with the VIIRS snow product has inaccuracies due to incorrect interpretation of cloud and topographical shadows as "water" by the VCM, corrupting LWM in the snow product.
- The current snow fraction algorithm is useless. The new algorithm to replace it is to be delivered to IDPS in August 2015. The code is developed and needs to undergo further testing, but it is on schedule.
- In summary, the binary snow cover quite good, and there are some plans for enhancements but the snow fraction algorithm has to be replaced.

Mark Tschudi (U of Colorado), "Suomi-NPP VIIRS Ice Surface Temperature EDR Status"

- VIIRS IST in most cases meets 1 K uncertainty requirement. It has a cold bias compared to MODIS and IceBridge KT19, typically <1 K. Except when compared to NCEP, where it has a warm bias instead, but this isn't really an apples to apples comparison.

Robert Mahoney (NGAS), "VIIRS Sea Ice Concentration IP Status"

- Ice fraction (concentration) is an IP which is better at high and low Surface Temps, but worse in the middle. This is currently a non-deliverable, but will become deliverable for J1.

Mark Tschudi (UC), "VIIRS Sea Ice Characterization EDR"

- This product characterizes ice age classes as no ice, young/new, other. A deep dive study showed misclassification of "other" as "new/young" due to a sea ice reflectance LUT and to climatology model LUT. The team has a list of proposed enhancements, but is also looking at an alternative algorithm.
- The take away message is that there a lot still to be investigated with current and alternative ice age algorithm but the end is not in sight and the team is not sure how to address that. Sea Ice thickness is the hardest thing to do in remote sensing.

Robert Mahoney (NGAS), "Snow and Ice Gridding Status and Recommendations"

- A CCR is in place to automate the GMASI update and allow use as a fallback for either snow and/or ice if gridding for either is set to off.

Q: (Ivan Csiszar) Plans for use of VIIRS data in NOAA products.
A: (Sean Helfrich) IMSv3, due out in June 2014 applies all VIIRS I channels, DNB, binary ice/no ice, and ice age data. Ice concentration has much more detail, but at the time IMSv3 was being developed it wasn't a deliverable product, and they hope to use it in the future. Having products in NetCDF will help because most of HDF is discarded.

Sadashiva Devadiga (NASA GSFC), "Suomi-NPP VIIRS Land Product Quality Assessment Approach and Collection V1.1 Reprocessing"

- Products are in HDF4 archived/distributed from LAADS – three systems (LAADS AS 3000: IDPS aggregated; AS 3001: IDPS running at PEATE outputs; AS 3002: modified algorithms)
- Presentation includes proposed approach to replace NDVI gridding.

Comment: (Ivan Csiszar) The Land PEATE comparisons looked really good.

Comment: (Eric Vermote): Cautioned that it's not representative, you have to look where there has been change, such as in places with unexpected flooding.

Marco Vargas (STAR), "SNPP VIIRS Vegetation Index EDR"

- Monitoring vegetation changes temporally and spatially using NG CV tool cutouts.
- Several DRs:
    - DR 7039: Backup algorithm for EVI over snow/ice and clouds
    - DR 7488: Temporal compositing
    - DR 7217: Enhancement DR submitted by Lance Williams for tracking
- Green Vegetation Fraction – GVF: fraction of a pixel covered by green vegetation if it were viewed from above. Is an NDE NOAA Unique Product (NUP).

Comment: The comparisons to AERONET are from 2013 to present using the version of the SR algorithm prior to Mx8.3, which doesn't have all the QFs, but the MODIS QFs were used. Process for transitioning GVF to ops: has to run more than a month pre-operations in parallel with validation. Then it goes to SPSRB for NDE implementation for NOAA use. It is an NDE NUP, so it never goes into IDPS operations.

Eric Vermote (NASA GSFC), "Surface Reflectance, SDR, and VCM Feedback"

- SR team constantly monitoring improvements in SDR and VCM, which impact SR quality.
- SR had a problem with NAAPS climatology, but NAAPS was removed with DR 7488

Comment: In addition to SDR quality, there is also the issue of performance of the QFs. These were ignored them in the validation work and have not revisited that, but evaluation can begin.

Crystal Schaaf (UMass-Boston), "VIIRS Daily BRDF, NBAR, and Albedo"

- Spec is for single broadband albedo in swath at time of overpass, which is much different from heritage.

- The decision was made in April 2014 not to correct DPSA and to live with the BPSA. One reason is that the QFs checks were not implemented in the DPSA. MODIS DPSA algorithm is used to process VIIRS data offline at PEATE to produce DPSA and NBAR.

Comment: (Bob Yu) Clarified that BPSA is daily while DPSA is daily running with a 17-day NBAR so would expect variation.

Comment: (Miguel Roman) Have discovered that the quality flag documentation does not match the code. The science teams need to take ownership of the use of QFs and work with upstream product team producing them.

Comment: (Eric Vermote) With the aerosol analysis, the VCM ephemeral QF was not used due to a misunderstanding about the flag.

Comment: (Wael Ibrahim) The code implements the flags as they are defined. It is implemented the way it came to IDPS. Need to get to the origin of the QF and how it is defined. The VIIRS SDR Cal OAD has some information, but a lot of the background on why quality flags are defined as they are is captured in Tech Memos.

Bob Yu (STAR), "S-NPP Land Surface Temperature Product: Accomplishments and Issues"

- Acknowledge that some stations still not performing well, but globally meet spec.
- One issue is the impact of Surface Type accuracy. He's debating whether to switch from emissivity implicit to emissivity explicit algorithm. He cautions that comparing data from different satellites introduces error due to temporal and viewing angle. Ground data also has a lot of variability.

Comment: (Bob Yu) Preference is to move away from land cover based emissivity? He proposes NOAA and GOES blended algorithms but it depends on resources. With MODIS 6, Simon Hook put in refinements including not using emissivity – so recommend coordinating with him as he's already done a lot of the work.

Xiwu Zhan (STAR), "Surface Type"

- QST EDR is just QST IP with daily fire and snow/ice flag updates. Production of the QST IP annual update could be done mostly automated at IDPS once gridding is turned on.
- Confusions between several similar classes for example cropland and grassland. Would like to see an assessment of the LST impact due do that mis-categorization.

Q: What was the user implication of accuracy of 70%?
A: Not sure of DoD use but, two products downstream use it and determination was that 70% is adequate (not sure whether LST impact analysis resulted in a quantitative accuracy requirement for ST)

Louis Giglio (UMD), "Active Fires: SDR Quality, Replacement Code and I-Band Product"

- Use of QFs. All pixels >385 K flagged as poor; problems in M13
- Saturated pixels have same brightness temp of 192 K
- Eight DRs filed
- Erroneous aggregation of pixels would require a flight software correction

Comment: (Wael Ibrahim) What is your Rosetta Stone for QFs? QF of poor quality calibration does not provide enough information. There are tech memos that document the rationale went into deciding how to set QFs. VIIRS SDR Cal OAD provides all the QF definitions. There was an architecture decision not to have a separate byte for a fill value.

Comment: (Lushalon Liao) Suggested most of the issues were software except for the saturation issues. Have been proposing to flag analogue saturation and it's not getting addressed. The request to make bands behave nicely when saturated had $10M price several years ago so never happened.

Comment: (Jim Gleason) Looking into flagging the aggregation.

Comment (Ivan Csiszar) Collectively the science team needs to determine whether the QFs as currently defined are sufficient.

Recommendation: Everyone complained about quality flags…recommend that there be an effort to document all the past knowledge that went into definition and use of quality flags. Use SDR as the template. Dig back into all the NG Tech Memo's.

Kevin Gallo (STAR), "NOAA-USGS Land Product Validation System"

- http://landsat.usgs.gov/LPVS.php
- A Land Product Validation System (LPVS) for enhanced data access, retrieval, and analysis of GOES-R ABI and JPSS VIIRS land data and products

Comment: As a satellite inter-comparison system it is very useful, but it's not a Cal/Val tool, as it doesn't do the analysis. Recommend call it an inter-comparison system, not validation as have worked for years to get standards on what constitutes validation. Goal is to have a long term trending system.

Comment: (Miguel Roman) Emphasized that it needs to be considered with respect to what it already being sanctioned within CEOS (?) GCOS (?) Although inter-comparison is necessary, the protocol for the evaluation is critical.

Land Products Closing Dialogue

Deliverable from this session is the report back.
Ivan listed several issues to discuss:

- Product/Algorithm classification.
- Remaining work with S-NPP
- J1 Readiness
    - Algorithm upgrades per L1
    - Any other critical upgrades
    - J1 test data
- Common algorithms
    - Science readiness and usability
    - Merged/fused products
- Ground Implementation options
    - IDPS, NDE, NASA
- What are the test data needs for J1?

- Get the SDRs stabilized.
- Can algorithm providers recommend algorithm improvements that exceed the requirements?

Comment: (Ivan Csiszar) Suggests finding a user that says they need it.

Comment: (Mitch Goldberg) however will say to follow the formal requirements process. Bottom line is that it needs to be driven by the documented user need.

Session 5b: VIIRS Atmospheric Products Breakout

Chair: Ingrid Guch

Session Summary: This session featured presentations on the Imagery products, Cloud EDR products, and Aerosols. This set of products presents the most and least advanced of the EDR products. The VCM ad Imagery products have reached higher level validated status, while the Cloud Properties and Suspended Matter products are still at beta and awaiting implementation of a new algorithm.

A group discussion at the end revealed that there was concern about the path forward for products changing algorithms or implementation systems to become validated. Also,, the participants felt that there should have been a separate VCM breakout session – since it feeds into a variety of products, many of which were occupied in their own breakouts.

Curtis Seaman (CIRA), "Evaluation of Suomi NPP VIIRS Imagery"

- Geolocation error fixed, land surface aligned with maps
- EDR terrain correction applied
- Striping and stray light in DNB reduced
- All imagery EDR products have achieved Validated stage 3
- DoD needs clouds which is the reason the EDR was not geolocated initially

Recommendation: Look into parallax for clouds

Kim Baugh (CIRES), "Nightfire: Using the VIIRS Nighttime M-bands to Detect and Characterize Combustion Sources"

- Used to detect gas flaring at nighttime
- High temp detection uses band M10
- Low temp detection uses M12/M13 Clouds over fire causes problems, which has been noted and is being worked on.

Q: Have you used M10 to look for nighttime nuclear cooling tower?
A: Not yet. Will check.

Q: Have you seen Saturation at M12 or other bands?
A: Saturation at other bands, Seen it on M10 once.

Bob Holz (SSEC), "JPSS Validation System"

- System ingests VIIRS/MODIS/AVHRR/CloudSat/ATMS/etc.
- Collocation CALIPSO and VIIRS FOV
- Leverage UW Atmospheric PEATE processing system, use integrated orbiting prediction for geophysical and multi-sensor processing, work for both GEO and polar-orbiting satellites
- Aqua/CALIPSO and S-NPP in sync one day in every three days
- For VIIRS cloud top height, IDPS has significant low bias against CALIPSO, the NDE version has no bias

- MODIS and VIIRS cloud optical thickness has a significant bias
- IDPS VIIRS aerosol over land has bigger discrepancy compared to MODIS

Q: Do you do real-time CALIPSO collocation with VIIRS?
A: Yes.

Curtis Seaman (CIRA), "Evaluation of the VIIRS Cloud Base Height (CBH) EDR Using CloudSat"

- Retrieving CBH from VIS/IR information is difficult, first attempt of evaluation on a large scale
- Errors in upstream retrievals all directly impact CBH
- CBH has some skill when CTH (thickness) is "within spec"
- Lift condensation height for connective clouds make more sense than cloud base height

Q: Who are the users?
A: Aviation users, weather service users, polar wind users

Eric Wong (NGAS), "Summary of Comparisons between S-NPP VIIRS and CALIPSO/PATMOS-X Cloud Properties and Progress in Addressing the Discrepancies"

- VIIRS cloud top height has low bias compared with CALIPSO, possible problems in land surface albedo
- Discrepancies in COT/EPS comparisons
- Will improve surface albedo

Kurt Brueske (Raytheon), "VIIRS Cloud Mask Mx8.4 Enhancement CCR-14-1515"

- This CCR will improve night cloud characterization over snow and ice

Ed Hyer (NRL), "Preparation for Assimilation of Aerosol Optical Depth Data from S-NPP VIIRS in a Global Aerosol Model"

- S-NPP VIIRS in a global aerosol model
- Need to QA VIIRS aerosol data to filter out outliers for data assimilation system
- All granule ancillary data used to filter, e.g., cloud adjacency
    - Over-land: MCD43 snow filter used
    - Over-ocean, excluded above 65° N
- truncation is a problem at low AOD
- need to expand dynamic range of VIIRS retrievals for high AOD

Hongqing Liu (STAR/IMSG), "The JPSS Risk Reduction Aerosol Algorithm"

- Enterprise approach, a single algorithm on JPSS and GOES-R
- Extensive internal tests to minimize the dependence on external cloud mask
- The products extends the range of aerosol optical thickness

Pubu Ciren (STAR/IMSG), "Application of DAI-based Smoke/Dust Detection Algorithm to VIIRS Observations"

- The product adapts the GOES-R ABI aerosol (dust and smoke) detection algorithm
- Use deep-blue and shortwave-IR developed for MODIS
- Dust and smoke detections meet L1RD requirements
- Additional validation on smoke detection is needed

Q: Will the algorithm be included in IDPS?
A: It will be part of the SM algorithm in IDPS.

Sarah Lu (EMC), "Toward Improving NCEP Global Aerosol Forecasting System using VIIRS Aerosol Observations"

- NCEP is developing global aerosol forecasting/assimilation capability including currently an operational dust-only forecasts
- The FY15 plan to extend the dust-only system to include sulfate, sea salt, and carbonaceous aerosols

Land Products Session Discussion

Q: Is there a comparison effort between NRL and NCEP aerosol data assimilation?
A: Yes, through the joint center, there is collaboration between the two centers

Q: Turn off M7?
A: Chris Albrige has CCN using M11, turn off M7 at night and keep M11

Q: From looking at cloud top height/base imagery, can the elevation community use the information?
A: Cloud height/base retrievals are more telling than imagery. Cloud top height, has to estimate of the cloud base, operational on POES.

Q: How does the cloud mask and dust retrieval interact?
A: From looking at the imagery, it's subject to human interpretation. Retrieval algorithms automatically decide whether it is clouds and aerosols. The aerosol composition is important information to DAI.

Takeaway messages

Shoba Kondragunta: Aerosol and cloud products path forward is not clear. Is the algorithm going to IDPS or NDE? What is the validation plan?

Andy Heidinger: Should have a breakout session on VCM involving users.

Don Hillger: The Cloud mask can use more presentations. We should have more comparisons between different cloud masks, e.g., DNB cloud mask?

Istvan Laszlo: Regarding the path forward, cloud products migrate from IDPS to NDE. VCM is going to stay where it is. How are cloud products in NDE made available to IDPS?

Overall EDR products combine land and atmosphere. Conversation between clouds, land, and aerosol, should have a breakout session on VCM.

Cloud optical thickness requires good land products, the land/clouds should interact.

Session 5c: VIIRS EDR - Oceans

Co-Chairs: Paul DiGiacomo and
Alexander (Sasha) Ignatov for Seas Surface Temperature sub-section
Menghua Wang for Ocean Color sub-section

Session Summary: The VIIRS EDR – Oceans breakout session was further subdivided by application. The SST presentations focused on the implementation and results from the ACSPO algorithm which recently replaced the IDPS algorithm as the official JPSS SST product. Along the current efforts to improve this product are innovative destriping and cloud mask techniques.

The Ocean Color team is also implementing a new algorithm – MLS12, although the presentations for this group were largely about validation efforts. The group discussion at the end had several important recommendations. Among them – there is a desire for new Kd(PAR) product. Because calibration is important, the team feels that J1 must consistently perform lunar calibration maneuvers throughout the entire mission

Alexander Ignatov (STAR), "JPSS SST Products"

Sasha introduced the SST session and acknowledged VIIRS SST team members and associated groups (ACSPO users, JPSS, SDR, NASA, NDE, DPA, etc.). ACSPO and NAVO VIIRS SST algorithms were compared and contrasted. Both are GDS2, available (or shortly to be) via JPL/NODC; ACSPO retrieval domain is larger than NAVO, by a factor of ~3, due to NAVO narrow swath VZA<54°, conservative cloud mask; NAVO STDs are smaller than ACSPO by a narrow margin.

Bruce Brasnett (CMC, presented by Ignatov), "Some Early Results Assimilating ACSPO VIIRS L2P Datasets"

The Canadian Meteorological Center has users that desire products that cover large lakes, coastal regions, marginal seas, and high latitudes. ACSPO VIIRS has better coverage than NAVO AVHRR for these areas. VIIRS bias north of 60° N is larger than that of NAVO AVHRR and will have to be monitored. In general, ACSPO VIIRS L2P is an excellent product. The current plan at CMC is to assimilate ACSPO VIIRS L2P dataset when it becomes available.

Andy Harris (CICS/ESSIC/UMD), "Assimilation of VIIRS SSTs and Radiances into Level 4 Analyses"

VIIRS has been successfully incorporated into Geo-Polar Blended 5-km global SST analysis. Coverage is improved with respect to MetOp AVHRR. Biases compared with NCEP RTG_HR_SST indicate problems with the latter. Accumulated thermal stress is a predictor of bleaching risk of coral reefs. Coral Reef Watch Alert products are based on degree heating weeks which are calculated from anomalies from a long term climatology. New analysis enables much greater precision, e.g. small fringing reefs. Accurate Coral Reef Watch alerts depend upon high quality climatologies which require future reprocessing (needed for many anomaly-based products). Also desirable are high-resolution (1/80°) targeted regional analyses and improved cloud detection for SST.

Irina Gladkova (CCNY/CREST), "Pattern Recognition Enhancements to ACSPO Clear-Sky Mask"

ACSPO Clear-Sky Mask (ACMS) performs well on a global scale but tends to over-screen some highly dynamic areas (e.g., with strong currents, cold upwellings, eddies) as well as the coastal zones. A supplemental algorithm to the current ACSPO Clear-Sky Mask based on pattern recognition is being explored. The preliminary analyses suggest that some of the limitations inherent to the current ACSM may be alleviated and SST coverage improved. The improvements are mostly noticeable in the areas interesting to ACSPO users, including dynamic areas of the ocean and coastal zones. Future work will include tuning the algorithm, with emphasis on resolving the remaining cloud leakages.

Karlis Mikelsons (CIRA), "Destriping VIIRS brightness temperatures for SST"

Fast, operational production ready destriping code developed at NOAA is capable of working with S-NPP VIIRS and Terra/Aqua MODIS. The current generation rewritten into C is 10 times faster than GPU-IDL for VIIRS (×0.025, 15sec/10min granule). Brightness temperature and SST imagery, ACSPO cloud mask, and SST gradients are significantly improved. The next steps are to incorporate destriping code as a preprocessor for ACSPO VIIRS in NDE operations and to destripe "optional" IR bands (VIIRS: M13, M14; MODIS: B22, B23, B29).

Peter Minnett (U of Miami, presented by Ignatov), "VIIRS Atmospheric Correction Algorithms"

At satellite zenith angles >55°, differences between the VIIRS skin SST retrievals and the subsurface temperatures measured from drifting buoys are statistically worse than those at zenith angles <55°.

J-F Cayula (QinetiQ North America, presented by Ignatov), "Effect of VIIRS Cloud Mask on accuracy of SST"

The increased SST data coverage seen with the VCM compared with NAVOCEANO comes from cloud leakage in the original VCM. VCM requires additional tests as SST cloud detection usually handles all contaminants: A) Daytime: reflectance test contingent on field test; B) Nighttime: NCM aerosol test + adjacency test/field test.

Robert Arnone (U of So. Miss.), "Sea Surface Temperature: Regional Studies"

Over compensation in the Cloud Mask can impact the Ocean Model SST. For example, assimilating SSTs from either S-NPP (relatively relaxed masking) or IDPS (relatively aggressive cloud masking) along a dynamic edge causes differences in the modeled location of a filament detail. Future work includes validation SST products in coastal and estuarine areas.

Menghua Wang (STAR), "Highlights of Ocean Color EDR Overview"

MSL12 is going forward as the operational algorithm, but it has not been decided how/where to implement. The goal is to have common processing system to process NOAA and non-NOAA sensor data and be able to make corrections quickly. There are currently two SDR problems of concern for ocean color: 1) M4 is biased low in 2013 compared with 2012; 2) Since February 2014, using an F-factor that models continuous degradation results in an upward trend (i.e. apparent detector improvement) when in fact actual detector degradation has flattened.

Discussion: Standard products were discussed – Eric Bayler wants Kd(PAR) as operational user for EMC; Chris Brown questioned supplying nLw's instead of Rrs's.

Kenneth Voss (UM), "Why MOBY and why MOBY-Refresh"

High quality, in situ data are essential for ocean color vicarious calibrations. "MOBY-Refresh" is the next generation in situ optical buoy. The MOBY-Refresh package aims to reduce water leaving radiance uncertainties through the concept of simultaneity: 1) Simultaneous acquisition of all Lu, Ed, and Es data (7-8 channels); 2) Possibility to include calibration inputs at same time (red, blue LED's, incandescent lamp); 3) Simultaneous acquisition of other auxiliary measurements: tilt, roll, arm depth.

Q: ***Where are data archived?***
A: At CoastWatch.

Q: Do you have a fluorometer alongside MOBY?
A: Answer from Ken, yes, but not used for ocean color vicarious calibration (more like validation).

Comment: Use the NOAA term "Tandem Mission" for overlap deployment of new and old MOBY

Comment: Specific requirements at NOAA that CoastWatch and NASA do not meet regarding archiving.

Kevin Turpie (NASA GSFC), "Calibration uncertainty in ocean color satellite sensors and trends in long-term environmental records"

Because the atmosphere contributes to ~90% of the measured light, a small error has a relatively large effect on surface contribution. Opposite-signed errors between the two NIR bands lead to significant effects in the surface measurements. Errors in surface measurements for the blue and green bands lead to errors in the estimate of Chlorophyll a. As a result, temporal trends in these errors can lead to spurious trends in Chlorophyll a.

Michael Ondrusek (STAR), "Validation of ocean color sensors using a profiling hyperspectral radiometer"

With good calibration techniques and careful attention to protocols, Hyperpro instruments can provide accurate traceable validation measurements for ocean color sensors. Calibrations can be stable for years. Repeatability and consistency between Hyperpros are very good. Hyperpros matched MOBY and Boussole well. Hyperpro instruments compared well to above-water instrument. Frequent calibrations and inter-calibrations are recommended and the new multi-cast method and Prosoft Version 8 should be used for collecting and processing data.

Action: Cara volunteered cruises of opportunity for Hyperpro deployment.

Puneeta Naik (CIRA), "Effective Band Center Wavelengths for MODIS and VIIRS for Open Ocean Waters"

For the bands analyzed with the MOBY site (open oceans), the out-of-band (defined as 1% wider than maximal band-width) contribution for VIIRS is less than ~5% except for band M5 (671 nm) while for MODIS, is less than ~3%. The high out-of-band contribution at the band M5 of VIIRS is due to a large leakage (out-of-band spectral distribution) from the blue region of the spectrum.

Ocean Color Roundup Discussion

J1 polarization is out of spec.

OC depends on SDR to do fast corrections on February 2014 F-factor problem – we are losing chlorophyll data at a very high rate (i.e. overcorrecting results in chlorophyll retrievals with negative values, which equals no data).

Desirability of a future K_d(PAR) product was reiterated. NOAA ocean color is producing K_d(490) as a standard product. K_d(PAR) can be modeled from K_d(490). CoastWatch can create a K_d(PAR) product from OC K_d(490), but it will not be "operational". Operational K_d(PAR) was acknowledged as a user request.

Bruce – generally has been agreed that more time for polarization testing will be needed, but also brought up concerns about phase polarization – need to make sure we have good understanding of these uncertainties. Why is M4 so bad? Not answered.

Paul – "future J1" We need to make sure lunar maneuvers stay in the plan and continue to be included in NOAA program. Kevin said on NASA side, SeaWiFS was always pressured to drop these maneuvers. Paul noted that at NOAA there will be the pressure to "collect as much data as possible" from operational aspect and that we have to be vigilant about being sure it gets included for long term.

Session 5d: Soundings Breakout Session

Co-Chairs: Mark Liu, Tony Reale

Session Summary: The Soundings session were largely focused on Level 2 and Level 3 products instead of radiances, especially product performance and validation.

Bill Smith (CIMSS), "Validation of CrIS Dual Regression Sounding Product during the Airborne Suomi-NPP Cal/Val Campaign"

- Talked about a May 2013 Field Campaign
  - Dual Regression Algorithm
    - Model correction
- Gave an example of a tornado case (multiple aircraft and satellite overpasses)
  - Lifted Index stability parameter
  - Retrieved LI seen to evolve with the IASI, CrIS, and AIRS overpasses

Q: (Chris Barnet) Asked about the direct broadcast station nearest to Oklahoma.
A: Either Norman, but otherwise Wisconsin. Wisconsin may miss some lower 48 states.

Q: (Antonia Gambacorta) Asked about the radiative transfer correction.
A: Bias correction using forecast model. Interpolates the retrieval. For real-time direct broadcast. Trying to get as much detail out of the data.

Joel Susskind (NASA GSFC), "CrIS/ATMS Retrievals Using an AIRS Science Team Version 6-like Retrieval Algorithm"

- AIRS Climate Data Records (Level 3 products)
- How well can CrIS/ATMS continue AIRS CDRs beyond 2020?
- GSFC Sounder Research Team (SRT) CrIS/ATMS v5.7 same as AIRS v6 except uses the regression first guess instead of Neural Network.
- Joel said that NN improved AIRS. NN and regression are trained on ECMWF.

Q: Chris Barnet How is QC?
A: Climate is good. Best is data assimilation or weather, which is tighter.

Comment: 80% yield for skin temperature seemed high; Grid boxes produces apparently high yield (only need one accepted retrieval in grid box)

Q: (Fuzhong Weng) Asked about solar reflectance
A: The retrieval retrieves the effective SW reflectivity. The RTA includes the bidirectional reflection.

Q: (Antonia Gambacorta) How do you QA skin temp?
A: Over ocean they use the error estimate. Error estimate is trained against ECMWF. Need to optimize the QC flags. Over land we don't know the truth, so more difficult. Use the T profile QC.

Antonia Gambacorta (STAR), "Status of the NOAA Operational Hyper Spectral IR + Microwave Retrieval Algorithm"

- NOAA MW+IR retrieval system (not just NUCAPS)
- MW-only retrieval was not a requirement in the past; inherited from JPSS requirements
- Phase 3 efforts
- NUCAPS Phase 3 ARR this summer

Q: (Joel Susskind): RTA for CrIS? Larrabee's SARTA.
A: It's old one. 2008. Has non-LTE. Will be ready for full-res later in 2014.

Chris Barnet (STC), "Recent analysis of the NOAA CrIS/ATMS EDRs in complex weather regimes"

- Chris designed this talk around users
- CalWater 1 Early Start Campaign NOAA Gulfstream-IV Flights; CalWater 2 campaign is occurring in January-February 2015; 30-day; http://esrl.noaa.gov/psd/calwater
- Rivers are narrow regions of enhanced water vapor transport "filaments"; transport a lot of water like "real" rivers
- Microwave retrieval is useful for this application (captures features not caught by the IR regression); need to reconsider first guess
- "Retrievals from CrIS/ATMS could improve landfalling forecasts"
- CalWater campaign excellent opportunity for satellite cal/val and engaging science community

Q: (Bill Ward (NWS)): Aware of SHOUT Global Hawks?
A: Have heard of it, but not familiar. Can find out more about the campaign.

Action: (Nick Nalli) To get contact info for onboard participation with STAR dedicated RAOBs in-house for NOAA ship Ronald H. Brown.

Comment: (Monika Kopacz) Connection between satellite and field campaigns is good, but they aren't committed to it; campaign doesn't really support trace gas at this point.

Eric Fetzer (JPL), "What can we learn from 11 years of AIRS observations?"

- Fetzer says that 80 papers use multiple AIRS EDRs; there is a big community out there using the products; showed a figure showing over 631 publications using AIRS EDRs alone
- "More AIRS spectra than people" accumulated over 11 years (10 billion spectra)

Comments: (Joel Susskind) AIRS works well in cloudy, partly cloudy conditions - it doesn't need to be clear. Fetzer largely agreed, but clear scenes are best.

Xu Liu (NASA LaRC), "Single FOV ATMS/CrIS Products Under All Sky Condition"

- All-sky Single FOV retrieval - Like AIRS it is height dependent QA, but it uses MW information below cloud instead of cloud-cleared radiance
- Only 4-10% of the data are used in assimilation - fast RTM is needed for hyperspectral. Most cloudy radiances not used in assimilation
- Uses PCRTM - principal component based RTM. First RTM in PCA space instead of channel space - monochromatic calculations at subsampled wavenumbers

- PCRTM OE retrieval algorithm; PCRTM models the PC scores directly providing simultaneous retrieval. OE algorithm in PC space provides Averaging Kernels

Q: (Joel Susskind) Where does the background state come from if it is not MW or ECMWF?
A: Background is a RAOB climatology.

Q: (Evan Fishbein) What do AKs look like for cloud/water/temp?
A: Clouds are single parameter, don't have AK. Did a 1-D var so the AKs have the cross-terms in it.

Comment: (Mitch Goldberg) Direct readout has different retrieval algorithms and the PCRTM algorithm can be implemented there as it already had MIRS, NUCAPS, and DR. You cannot have multiple algorithms in operations.

Chris Grassotti (JCSDA), "MIRS Science Improvements and ATMS Sounding Products"

- MIRS system is a 1-D VAR system utilizing a cost function. It is same algorithm for all system and produces T(p), q(p), CLW(p), RWP(p),IWP(p), Tskin, emis(ν).
- A common set of underlying modules facilitates application to different sensors
- New CRTM v2.1.1 implemented in MIRS for all sensors in STAR test
- It has an offline scan-dependent radiometric bias correction. They just get TDRs and SDRs from IDPS, so the team needs to know changes in TDRs and SDRs that can change the results

Q: Are there resources for reprocessing of data?
A: There are not resources at STAR. MIRS is not a climate mission, but they will try to reprocess for case studies.

A.K. Sharma (OSPO), "Updates on NUCAPS Operational Products and Services"

- OSPO NUCAPS operational updates
- Users include NCEP, GMAO, AWIPS, STAR, CLASS (domestic) and EUMETSAT, CMC, JMA, BOM (international)
- NUCAPS built for NDE system. It has a different architecture from IASI so it had to be rebuilt.

Q: (Tony Reale) Do the maps of trace gases include the MW-only products?
A: No, just the accepted IR+MW. However, MW-only product only relevant for T and H_2O.

Q: (Bomin Sun): Do you use MetOp-B?
A: Yes, we have MetOp-B, but there are problems.

Q: (Monika Kopacz): Did not see ammonia and N_2O in the list.
A: We don't have ammonia and it was never a part of the plan.

Tony Reale (STAR), "NOAA Products Validation System (NPROVS) and NPROVS+"

- NPROVS, NPROVS+, standardizing validation
- We (STAR) have validation datasets that we encourage others to use.

Q: (Chris Barnet) Dedicated RAOB should be closer than +/- 6 hr, 150 km
A: Yes, the single closest is used.

Q: (Antonia Gambacorta): What do you mean by clear?
A: IR+MW passed QC.

Q: (Chris Grassotti): What is AEROSE?
A: AEROSE is the ship-based campaign shown on the NPROVS. collocation figure.

Q: Quality of GPS in the stratosphere – when you get to 10 mb, it's starts becoming sensitive to the a priori. Different products have different qualities. Therefore it may not be as reliable as you think.
A: Agree, around 5 mb. This is being discussed by others.

Brad Zavodsky (SPoRT), "Applications using Satellite Sounder Products at the NASA SPoRT Center"

- SPoRT science applications include:
  - Total ozone for stratospheric intrusions and CrIMSS O_3 research product
  - Profiles for convective initiation, specifically during late morning and early afternoon before convection begins with significant cloud cover
- A unified algorithm would be embraced by forecasters. SPoRT would like to be involved with the NUCAPS developers and users
- Assimilation of T and H_2O profiles into GSI and WRF. There are positive impacts in partly cloudy scenes in ways that radiances can't be used. some dry bias in AIRS relative to model
- Assimilating profiles into WRF for improving midlatitude cyclone and non-convective wind forecasts

Q: (Tony Reale) SPoRT seems to be similar to AWIPS, is that true?
A: We work with developing modules to bring data to AWIPS - they are interested in working with NUCAPS data.

Nick Nalli (STAR), "Validation of the NOAA Unique CrIS/ATMS Processing System (NUCAPS) Operational Retrieval Products"

Q: (Chris Barnet) Do you know the L1 requirements for ozone?
A: No, I did not know what they were, but I will look into them.

Q: (Monika Kopacz) WRF-CHEM won't be sufficient for conducting CO validation; are you looking into any field campaign datasets.
A: Yes, we are looking into getting aircraft CO data.

Comment (Chris Barnet) WRF-CHEM should not be called "validation."

Bill Ward (NWS), "GPS Antennas in the South Pacific"

- GPS uses delay in receiving signal to calculate water vapor above the GPS
- GPS units provide low cost additions in data sparse Pacific Region

Monika Kopacz (Climate Program Office), "The need for atmospheric chemistry products from CrIS"

- Atmospheric Chemistry products from CrIS
- What is the "best" CO product (up until CrIS)? Not a clear-cut answer. But CrIS has no CO product if the full-res is not obtained.
- CrIS needs to provide long term high quality CO retrieval to continue CO monitoring from space. NOAA should be concerned with air quality
- CrIS products need to be validated with future NOAA and other campaigns

Q: (Mitch Goldberg) What kind of latency do you need to use the data?
A: Operational product not needed for research. But for air quality forecasting it would be good to have the near-real time.

Comment: (Chris Barnet) User's include "sporadic users" using data for campaigns, etc. We have a consistent IASI dataset CO/methane since 2009. We would like to work with the campaign; campaign users the data is there for them. We could reprocess the campaign dataset. INTEX total was 300 granules.

Comment: (Mitch Goldberg) It's useful that someone from NOAA is saying these products are useful.

Session 5e – OMPS EDR Breakout

Chair: Larry Flynn

Session Summary: The OMPS EDR session presented a number of uses for the OMPS instrument beyond the standard UV-based total column and profile ozone products. These included aerosols, SO_2, a combined IR/UV ozone product, and limb based ozone products.
The session ended with a discussion of the path forward – including a variety of improvements to the OMPS ozone EDRs and the upgrade to the V8 algorithm.

Omar Torres (NASA GSFC), "Potential use of the OMPS NM to provide aerosol information"

- There are several techniques for measuring aerosols
- Rayleigh scattering of UV light by particles is the physical basis for absorption
- The residual of an equation using two UV wavelengths is a measure of the observed change in spectral dependence from a purely molecular atmosphere and is a signal related to aerosol, giving an aerosol index.
- The magnitude of the AI is a unique identifier of absorbing aerosols such as smoke, dust, and ash
- Because Total Ozone requires a large footprint, UV instruments generally have coarse spatial resolution, which can limit the usefulness of the data.
- TOMS and OMI have been used in the past to detect aerosols. OMI has a resolution of 13 km x 24 km. OMPS native pixel size is 3 km x 12 km along track, but onboard averaging produces 50 km x 50 km. The higher resolution allows identification of individual smoke plumes for example.
- Combining UV and visible and IR from the same platform is best and S-NPP allows for this for the first time.
- VIIRS HR can provide information on sub pixel cloud presence in the larger OMPS field

Kai Yang (UMD), "Linear Fit SO_2 retrieval with TOMS V8 total O_3"

- This technique for detecting SO_2 has been used since OMI and will transition to NOAA for operational processing with V8 TC.
- Below 325 nm the SO_2 cross-section is more absorbing than O_3 and the other way on the other side.
- As a rough estimate: 1 DU of SO_2 that is not accounted in O_3 gives a 2 DU error in the O_3 retrieval.
- There are three different products – lower troposphere representing pollution and volcanic degassing, middle troposphere, representing volcanic degassing and eruption, and lower stratosphere, representing solely volcanic eruptions.
- If SO_2 is above 100 DU then non-linear effects will lead to underestimation by this algorithm.
- OMPS has better stability than OMI and has unprecedented SO_2 sensitivity – Not just volcanic eruption but anthropogenic from pollution plants. The scale is every small. It can be seen every day over China, but to see it over the US even with one month of data is very good sensitivity!

Jianguo Niu (STAR), "TOAST versions, improvements and validation"

- Combining IR at lower atmosphere with UV at higher atmosphere for a new ozone product
- Currently TOAST is derived using TOVS/HIRS for the IR, and SBUV/2 for the UV portion with eight UV derived layers, and one from IR.

- TACO is a new version that uses CrIS and OMPS. It will provide 1° x 1° total O_3 plus12 layers – four from CrIS via NUCAPS and eight from OMPS and SBUV/2.
- The pattern is the same for TACO and TOAST, but TOAST has higher ozone on low altitude and lower in higher. TACO however, more closely matches in situ measurements.

Trevor Beck (STAR), "O3ProV8 Implementation with ADL"

- Update from V6 to V8 that is what is being used for SBUV/2 and has been in existence since 2003. The goal was to minimize the number of code changes from V6.
- Code has machinery to use more than the 13 wavelengths it currently uses.
- The single and multiple scatter channels handled separately.
- -0.1% difference for 300 profiles compared to NOAA-19. For the 21 layers the residual good compared to NOAA 19

Matt Deland (SSAI), "OMPS LP – L2 Product Update"

- Instrument description
    - 290-1000 nm
    - 1-25 nm variable resolution
    - 0-80 km altitude
    - 1 km sampling
- Major LP products
    - Gridded radiances,
    - Ozone profile (UV for stratosphere and lower mesosphere, visible for lower stratosphere)
    - Aerosol extinction coefficient
- Processing status: release 1 products in October 2012 and release 2 in April 2014.
- Ozone reprocessing in May 2014
- Aerosol reprocessing by end of May 2014
- L1 changes since release 1: intraorbit dynamic tangent height, wavelength gridding, eliminate merging of multiple gain/aperture values for each pixel radiance, prioritize data selection to use high gain
- L2 changes – new ozone a priori from 2012 MLS data. Retrieval from all three slits, so it is like three in close formation.
- Compared to MLS, the LP ozone profile is lower in the lower atmosphere (centered roughly 20 km)
- Future work:
    - Aerosol correction
    - Polar mesospheric cloud correction
    - External profiles into troposphere
    - Derive improvements to GMAO above 40 km

Craig Long (CPC), "Application of OMPS Ozone Products"

- OMPS NP will allow CPC continuity in ozone monitoring
- OMPS TC and LP provide additional tools to work with. TC is better because of HR

- What CPC uses the ozone data for:
  - Day to day: monitor ozone hole
  - Seasonal: relationship of profile and TC to phase of QBO, impacts of winters with stratospheric warming
  - Inter annual to decadal: creation of cohesive data for long term trend detection
- Day to day description – Picture complete but smooth because is what they have to work with. TC instrument gives more and more interesting info, provides 35 positions, has 100 scan positions. Finer resolution features helps numerical models
- Contrast of ozone hole in different years. Last year on smaller side because of lower temperatures than average in the polar region. 2013 still pretty large but not as high as previous. Annual variability will increase the time when we will be able to say that the hole is healing.
- Largest time scales will be used to create complete ozone records by combining multiple satellites. Global mean has been declining until 1997 and then increasing. There have been big changes in the high latitudes, but not so much in the southern latitudes.
- Numerical forecast centers do incorporate these data in their radiation scheme.
- UV index forecasts rely upon good ozone forecasts

Q: Will OMPS NP be added to SBUV/2 in data assimilation?
A: Yes.

Emily Berndt (SPoRT), "Development and Application of Hyperspectral Infrared Ozone Retrieval Products for Operational Meteorology"

- SPORT – Forecast challenge and ozone,
- Sport set up in 2002 to apply satellite measurements and unique Earth science research to improve the accuracy of short term weather prediction at the regional and local scale.
- Research to operations – Maintain interactive partnership.
- Create product training, target assessment to see if product is meeting need.
- National centers OPC the biggest users. Cyclogenesis and development of hurricane force winds.
- Identify regions of stratospheric air and potential for tropopause folding can enhance forecasts.

Session 6: Non-NOAA Satellite Data

Chairs: Paul DiGiacomo, Mitch Goldberg

Session Summary: The session on non-NOAA satellite data featured talks on GCOM, Sentinel, and CoralWatch. Overall there was a feeling that there needs to be a clearer path for STAR to access non-NOAA data, but questions about who had a requirement to make the data access operational.

A long discussion ensued between talks about the need for reprocessing, which was a common theme of this meeting. Overall, there was agreement that reprocessing needs to be done, but as with non-NOAA data, the question is – is there a requirement and a user need for such data and at what NOAA organizational niche should the effort be placed and resources allocated?

Paul Chang (STAR), "NOAA GCOM-W1 PROJECT: Global Change Observation Mission 1st – Water "SHIZUKU" (GCOM-W1)"

Japan's GCOM program is their contribution to the Global Earth Observation System of Systems (GEOSS). GCOM-W1 was launched May 18, 2012 with Advanced Microwave Scanning Radiometer 2 (AMSR2). JAXA sends L0 plus ancillary data. The NOAA JPSS Office supports the generation and distribution of AMSR2 SDR and EDR products for NOAA users. STAR is developing software (GAASP) to generate EDR's and reformat data to netCDF4. GAASP will be developed in four stages and will eventually provide 10 EDR products. Delivery 1 has occurred. The AMSR2 sensor has been well-calibrated to significantly improve geophysical retrievals. Double difference approach used to inter-calibrate AMSR2 residual biases in observed temperature brightness (BT). It was found that AMSR2 measures warmer BT when compared to TMI. Corrected AMSR2 BTs were used in EDR products (TPW, CLW, SST, SSW, and precipitation). Validations for four ocean scene EDRs were presented. Requirements are being met for several products. Delivery 2 is expected this winter (2014).

- *Product website: http://manati.star.nesdis.noaa.gov/gcom*

Paul DiGiacomo (STAR), "Opportunities & Challenges for leveraging the European Sentinel(-3) Missions in support of NOAA User Needs"

Many key satellite data streams needed by NOAA users are only available from non-NOAA external sources, both foreign and domestic. Non-NOAA satellite data are also necessary to augment, or may complement, existing/planned NOAA assets. Presently no clear path or institutional framework exists within NOAA for the systematic acquisition of many external satellite data sets. Existing efforts are largely bottom-up, ad hoc and best effort endeavors. Other challenges include the need to redefine the "operational" paradigm beyond the near-real time provision of data. Reprocessing, blended products et al. are required to support user needs. The ESA Sentinel 1-A satellite was launched in April 2014. STAR has received and processed sample data. Infrastructure is being prepared to receive and process data flow when available. Sentinel 3 mission is scheduled to launch mid-2015 and will support high resolution ocean and land color measurements (OLCI) and sea and land surface temperature (SLSTR) along with a topography package. OLCI is seen as a follow on and improvement of MERIS and will provide data not available from VIIRS. High resolution data are necessary for NOAA operational needs. For example, the necessity of switching to MODIS data when MERIS was lost significantly reduced the sensitivity of the

NOAA-NOS weekly harmful algal bloom (HAB) forecast product. The HAB forecast will require OLCI data when it is available. How do we (NOAA) proceed with the acquisition, development, and (operational) distribution et al. of non-NOAA data (foreign & domestic) in the JPSS (polar)/GOES-R (geo) era in support of user needs?

Comment: (Jeff Key) S3 will have the same radar altimeter as Cryosat-2 used for sea ice thickness. S3 will co-fly with Cryostat 2 which also has laser, so the combination will be very good for ice thickness.

Q: How do we bring into ops? Need to get hard requirements into place.
A: Sometimes needs are documented in L1 requirements but aren't being met. On the other hand, sometimes requirements have no pathway for L1 requirements documentation. These scenarios must be resolved.

Mark Eakin (Coral Reef Watch), "The Importance of Reprocessing and Blending in Coral Bleaching Products: No satellite is an island, and history is key to understanding the present"

Users need data and products, they are not concerned with missions, data streams etc. Coral bleaching is a result of thermal stress on the animal/plant symbiotic coral system. Under thermal stress, the coral animal ejects its symbiotic algae and appears bleached. Corals can recover from a mild thermal stress event, but die as events become more severe. Coral Reef Watch uses existing operational sea surface temperature (SST) data to derive anomaly products which identify "hot spots" reported in a bleaching alert product used by managers in making decisions about resource utilization. Accurate, unbiased, high resolution and multiple satellite data are required to make a reliable long-term climatology on which to base anomalies. Alerts are based on exceeding a threshold of "degree heating weeks". Reprocessing data is needed to stitch together current data with data from legacy missions. Funding for reprocessing and smoothing for high quality climatological record has come sporadically from different sources. For current SST values, blended SST is imperative as most coral reefs are perpetually cloud-covered. An example was shown where, in Thailand, 6 months persistent cloud cover would have obscured seeing a huge bleaching event in 2010 if only polar orbiter data were available. At least 2 external research laboratories are using NOAA products to make their own regional coral bleaching reports which are used by local managers in decision-making and provide information to the public.

Q: Where does reprocessing for Coral Reef Watch occur?
A: It is done in "science".

Q: (Mitch Goldberg) Why put it into operational?
A: Needs to be "routine and sustained"

Comment: (Mitch Goldberg) Hard to put reprocessing into L1 requirements without any idea of a cost estimate. Better to keep in research environment.

Comment: (Deirdre Byrne) Don't conflate "low latency" with "operational". Data needs can be routine and sustained but have a high latency.

Comment: Reprocessing efforts can be scheduled, and rescheduled. The problem is that there is no funding to pay for them – they are being done "under the table".

Q: Things have to be done, why don't we do them more simply (i.e. CGMS). Why so complex?

A: (Mitch Goldberg) My position is that reprocessing should be research-based. Real time products can be produced by OSPO, while climatology products should be made by STAR (where you have the support of cal/val, access to data). It is essentially already being done and paid for in STAR as you are doing cal/val algorithm development. You need to keep validating – in order to check validation, research is doing a reprocessing to check new algorithms – so that's reprocessing in research. Program scientists could come up with science requirements (separate from L1 requirements). L1 requirements are mission requirements.

Comment: (Paul Chang) There needs to a place where science requirements can be documented.

Comment: (Mitch Goldberg) Cant' just reprocess for sake of reprocessing, there has to be a product need.

Comment: Reprocessing should be explicitly included in the requirements documentation being formed right now for the Common Ground system.

Comment: (Tom Schott) Ground system development is for next 20 years – need to have it included – maybe L1 requirement for OSGS.

Comment: (Mitch Goldberg) Fixed budgets impose limitations. Algorithm development requires reprocessing to update algorithms as an L3 requirement. Why should JPSS do it again/also?

Comment: (Mark Eakin) We still need to "beg, borrow and steal" to do reprocessing within research.

Comment:(Mitch Goldberg) STAR has a healthy budget for long term monitoring.

Comment: (Lihang Zhou) FY15 planning includes long term monitoring for SDR and for EDR.

Comment: (Deirdre Byrne) Don't shy from defining requirements because you don't have the money. Document the requirements through the system and then you can justify requesting the funding necessary to meet them.

Comment: (Paul DiGiacomo) There are cases where requirements have been documented but are not being met.

Comment: (Mitch Goldberg) Agree, let's put reprocessing into requirements for OSGS; in the meantime, keep doing inside of research, not operational.

Comment: (Ivan Csiszar) Remember that reprocessing comes in bundles.

Comment: (Mitch Goldberg) That is another example of why you don't want to put reprocessing into L1 requirements.

Comment: (Larry Flynn) Three year ago, L1 requirement for long-term stability for ozone was removed from the document. STAR is not a user, so STAR has no way to put things into SPSRB and SPSRB doesn't take long-term requests.

Comment: (Mitch Goldberg) IDPS was never going to do long term – so that's why it got taken out.

Comment: (Sasha Ignatov) NASA has established "collections" and the user community is savvy about what reprocessing is the latest, best. The community is looking to us at JPSS to follow this behavior.

Comment: (Mitch Goldberg) The proving ground is the place where science can bridge some of the gaps between "NASA-style" mission collections and JPSS "operations."

Comment: (Paul DiGiacomo) NOAA needs to have an institutional top down recognition of the need for accessing non-NOAA data.

Mitch Goldberg (JPSS), "Improving User Utilization of JPSS Products"

Higher level products are often needed by users. Products under development still need to demonstrate their utility. This can be done through a research test bed. For example, if Paul Chang is getting data from Sentinel 3, Paul then demonstrates the value of using S3, which then justifies the long term investment for acquiring and using the S3 data. We still need a formalized "step 2" after value has been demonstrated in the test bed. This session will break out in User Splinter Groups. This is a forum for users not just STAR people. A "thread analysis" was suggested as a way to define operational user requirements (i.e. a thread needs to be "thick" where data are needed continuously, whereas the thread can be "thin" if the data stream can be broken and gap filled in later). Splinter Groups are charged with answering several questions laid out in the slides covering continuity, benefits or improvements expected, pattern of product use (which, when, how often, funded, etc.).

Q: (Paul DiGiacomo) Can we bring non-NOAA data into the discussion?
A: Focus on JPSS data but bring in non-NOAA data if needed.

Q: (Bruce Guenther) Is there a place to suggest a product might meet needs if we could add some capability?
A: Yes, that is product enhancement.

Q: (Alex Ignatov) Is there a place to add what products out there are better?
A: Yes, that is covered in the basic questions and should be included.

Q: If an agency requests a new product, can JPSS produce it? For example, the Census Bureau may request a specific data product, can NOAA do it?
A: Congress says NOAA must meet the request. The cost is recoverable from the receiver but only if the receiver has requested a unique product used only by the receiver.

Session 7: User Breakouts

Chairs: Mitch Goldberg, Ingrid Guch

Session Summary: The user-breakout session was chaired by Mitch Goldberg and Ingrid Guch. The chairman of the group presented a concise briefing directing the attendees to user-breakout sessions. A questionnaire was provided to the groups with overarching goals of knowing the value of the S-NPP data products to improve NOAA partner services was provided. The questionnaire contained a set of basic questions on the S-NPP/JPSS data products and utility within their discipline, and enhancements recommended for the S-NPP products for utmost utility within their discipline. Responses received from each user group contained a discussion on:

A. S-NPP/JPSS Products: (1) New and unique S-NPP/JPSS products in advancing their research applications; (2) S-NPP/JPSS products as a continuity to legacy POES, METOP, DMSP, EOS;
B. Product Utility: Impact (low, medium, and high) of using the S-NPP/JPSS and the reasons in receiving the positive impacts.
C. Enhancements: Product enhancements needed towards accessibility, performance (accuracy, precision and uncertainty);
D. Future Use of S-NPP/JPSS products: Plans, funding availability, priorities, getting data, issues on the operational use of S-NPP/JPSS in conjunction with legacy products, generation of blended products;
E. Additional work needed to ensure that the S-NPP/JPSS products are well utilized.

Following is a summary of responses for items A-E based on the presentations made by each user group. The user group presentations are available for a down-load from STAR website and should be referred for a discussion and future course of action.

Overall there were two common requests or questions. The first is that there needs to be some organized reprocessing of the data to ensure continuity as changes are made. The second was that there are latency concerns, particularly for those who need the data in near real time. Overall both the teams and the users found these meetings beneficial to making the S-NPP products more useful.

<u>Land Data Assimilation</u>

Presenters: Mike Ek, Ivan Csiszar
Moderator: Gary McWilliams

A. Soil Moisture, GVF, (and density of vegetation), vegetation type, soil type products derived from the S-NPP/JPSS provide continuity to legacy products. Consistency between the S-NPP/JPSS products and the legacy products is a must for R&D efforts, operational utility and Land Data Assimilation (LDA).
B. The impact of utilizing the S-NPP/JPSS products is expected to be high and is contingent upon (a) the readiness and model transition from R&D to operations; (b) consistency between land and cryosphere products; (c) availability of additional products such as VIIRS NDE GVF weekly at 4 km, subdaily LST, SA, spectral emissivity blended product (including CrIS), and MODIS heritage products.
C. Product enhancements towards accessibility with required latencies (snow: daily; GVF: weekly), improvements to GRIB2 formatting, global APU requirements for all conditions are needed.

D. Near future use of Soil Moisture, GVF products through partly funded JCSDA activities. The priority is high for this activity. Some of the issues include transition to operations within NCEP.
E. Additional efforts in understanding R&D and operational needs and requirement definitions.

<u>Cryosphere</u>

Presenters: Sean Helfrich, Jeff Key
Moderator: Ray Godin

A. VIIRS snow and ice products provide continuity with products from heritage imagers such as AVHRR, MODIS, and OLS, e.g., snow cover (binary and fractional*), sea ice extent, sea ice concentration, sea ice surface temperature, imagery (including icebergs, Great Lakes ice). AMSR2 and ATMS provide continuity for sea ice concentration, snowfall, snow water equivalent (SWE), snow depth. New capabilities that S-NPP can provide include: VIIRS: sea ice concentration, ice "age"/thickness; AMSR2 : sea ice type (first-year, multiyear), ATMS: Snow Grain Size. The S-NPP/JPSS product processing systems should include automated algorithms for ice motion, ice edge, and icebergs that are currently missing.
B. The impact of utilizing the S-NPP/JPSS products is 'medium'. The availability of better spatial resolution products from both VIIRS and AMSR2 provide detailed structure and delineation. VIIRS will help resolve summertime ice edge degradation and concentration over SSMIS. New products can be applied directly into the NIC snow and ice analysis system.
C. Some of the desired enhancements to the S-NPP/JPSS product catalogue include Snow Density over land, Snow Depth over Ice, Ice Motions, Iceberg detection, ice edge, Uncertainty metrics, Ice Age (years), freshwater ice concentration and thickness products. S-NPP/JPSS could provide these products.
D. **Priority for using S-NPP/JPSS products at NIC is high**. The NIC has already begun using VIIRS imagery. **Other VIIRS products are being evaluated (sea ice characterization and concentration; snow cover).** AMSR2 products are not yet operational but test data will be evaluated over the next 6-12 months. The use of VIIRS blended products is largely unfunded and there are no funds to transfer AMSR2 products into NIC operations. S-NPP/JPSS products are also part of blended products. Examples include IMS, NIC charting, NAVO's Arctic Cap Nowcast/Forecast System (ACNFS).
E. With regards to additional work needed, the VIIRS Sea Ice Concentration IP needs its own set of quality flags. It needs to be a deliverable IP (despite plans for Block 2.0). More tools and algorithms are needed to assist in product blending and metadata of blended products.

<u>Imagery/Cloud applications</u>

Presenters: Michael Folmer, Don Hillger, Andy Heidinger, Bill Ward
Moderators: Victoria Ozokwelu and Bill Sjoberg

A. S-NPP/JPSS imagery and cloud products provide continuity with products from heritage imagers. These products are distributed through primarily through LDM.
B. Impact of using S-NPP/JPSS products is high, and the DNB is being worked as a L1RD KPP, and has been shown to be critical in NWP centers, AK and WFOs.
C. Product enhancements towards accessibility (data formats, AWIPS 1 and AWIPS 2, tools to manipulate data sets); latency; validating products with model data; moving products from the demonstration efforts to operations in NCEP Centers, regions, and WFOs are needed.
D. Future use of S-NPP/JPSS products and hybrid LEO-GEO imagery products (OPC, WPC, NWS Pac and AK is already doing this from DB), evaluating single channel and RGB Products continuity with Geo are some of the high priority tasks.

E. Additional work related to the verification of physical consistency from cloud products and solar insolation, Cloud levels and type for aviation support, Polar wind data assimilation into models allow full-fledged utility of the S-NPP/JPSS products.

CrIS Atmospheric Chemistry

Presenters: Monika Kopacz, Chris Barnet
Moderator: Laura Ellen Dafoe

A. S-NPP/JPSS NUCAPS products provide continuity with products from heritage instruments MetOp/IASI, EOS/AIRS EOS/Aura/TES, EOS/Terra/MOPITT. Although no new gas products from S-NPP/JPSS, products are generated globally with 70% coverage with long term monitoring and continuity through multi-year overlap of products
B. Although S-NPP/JPSS product utility is currently sporadic for science applications, users of legacy instrument (AIRS/TES, MOPITT) products will use CrIS products and will have vested interest in utilizing S-NPP/JPSS products in near future.
C. Desired enhancements to the S-NPP/JPSS products include improvements to data access through CLASS (currently cumbersome; lack of tools to narrow search range), product performance (APU) improvements utilizing full spectral resolution, generation of tailored products (e.g. lower vertical sampled CO with averaging kernels) and web-site visualization tools.
D. STAR/CPO has a funded work plan to develop products engaging user community, generation of blended products (TOAST, TACO-O_3)
E. Additional work related to the inclusion of averaging kernels in operational products (data reduction), validation of product with respect to reference instrument, generation of long products, and closer collaboration between developer and user community allow full-fledged utility of the S-NPP/JPSS products.

CrIS OLR

Presenters: Pingping Xie, Mark Liu
Moderator: Murty Divakarla

A. S-NPP/JPSS OLR product provides continuity of OLR products for use with the heritage instrument products. Community including Climate Prediction Center would like to replace the AVHRR based OLR data with a blended product derived from hyperspectral CrIS observations and other sensors expected to provide improved.
B. The impact of utilizing the S-NPP/JPSS OLR products is expected to be 'medium'. Availability of S-NPP/JPSS OLR product helps to develop Inter-satellite calibration among hyper-spectral OLR sensors from different platforms and in developing a single time series of high quality OLR product with reduced latency (~12 hours) and refined resolution from multiple platform / sensors.
C. Desired enhancements for the S-NPP/JPSS OLR product include accessibility with required latencies, reprocessing capability to retrieve OLR product every time a new algorithm is implemented, product APU improvements and verification to utilize the product for climate applications, improvements to data access to climate centers around the world for climate monitoring and decision support.
D. Future use of S-NPP/JPSS OLR product will commence after finishing a task (expected to be commissioned in FY15-FY16) towards generation of homogeneous record of OLR from multiple satellite/sensors and generate a time series of OLR product from 1981. A proposal was drafted to NESDIS/OSD on converting IASI OLR to operation and another one to be submitted to JPSS on CrIS OLR. The proposal for IASI OLR has been funded up to FY14 and we haven't heard any funding

from JPSS for CrIS OLR. The priorities include reprocessing the IASI/CrIS OLR and blend them with OLR from other historical data to generate a consistent record.

E. Additional work related to the generation of blended OLR products towards a seamless time series for climate applications will help to utilize S-NPP/JPSS products around the world for climate applications, monitoring and decision support services.

Microwave Precipitation

Presenters: Ralph Ferraro, Limin Zhao, Dave Kitzmiller
Moderator: Lance Williams

A. S-NPP/JPSS (including GCOM) products, for most of the users, provide continuity to the legacy products from both sounders and imagers.
B. ATMS provides greater swath width and better sensor signal quality, more channels, and better resolution. Compensates for loss of MetOp-A data.
C. Product enhancements include better latency (DB over OCONUS a possible solution), data access/security issues, and common format (netCDF vs. HDF) for L1, L2. Consistency between JPSS satellite and legacy products; APU performance; long term stability and reprocessing; error characteristics for all user time/space needs are other desirable enhancements.
D. The CMORPH and GPM projects are already testing these rain products (GOES-R, JPSS PGRR and NASA). The NESDIS bTPW and bRR are also testing ATMS and GCOM products (PSDI, JPSS). ScAMPR (GOES-R baseline QPE) will indirectly use via blended MW L2 data set
E. Additional work towards product fusion meeting all user needs; synergistic use with GOES-R utilizing 1 minute rapid scan (SRSOR), lightning etc; advancement in products (snowfall rate, warm rain, orographic precipitation, cloud microphysics); long term stability and reprocessing will help utilize S-NPP/JPSS products for a broad range of applications.

Ozone

Presenters: Craig Long, Larry Flynn
Moderator: Wayne McKenzie

A. S-NPP/JPSS OMPS Nadir Mapper Total Ozone, OMPS Limb Profiler Ozone Profile products provide continuity to the legacy products produced from POES, MetOp, DMSP, EOS. In addition, S-NPP/JPSS OMPS produces atmospheric SO_2 products, UV aerosol products, and atmospheric NO_2 products
B. S-NPP/JPSS OMPS ozone products are of high value for long term monitoring at NCEP. In addition, CrIS-NUCAPS IR ozone products are component of the operational TOAST/TACO daily maps.
C. Product enhancements include generation of CDRs for ozone watch. S-NPP RDRs are capable of producing CDRs; because of changes in NOAA operational SDRs, the data files at CLASS do not provide a consistent set for this purpose.
D. We need funding for J1 ozone CDR creation/reprocessing. Higher spatial resolution is desired for regional air quality.
E. The legacy V8 algorithm is being implemented. It will allow required performance for J1 when SO_2 exclusions end. In addition, high This will ensure S-NPP/JPSS products are well utilized

VIIRS Aerosol Assimilation

Presenters: Shobha Kondragunta, Sarah Liu
Moderator: Julie Price

A. S-NPP/JPSS products provide continuity to the legacy products for utility in many agencies for global and regional model applications (NWS/NCEP; NOAA/ESRL); WFOs; NRL: EOS MODIS, MISR, CALIPSO; AFWA & NCAR: EOS MODIS; EPA: EOS MODIS, MISR, CALIPSO; NASA/GMAO:
B. S-NPP/JPSS product utility is of high importance at NRL, NASA and NESDIS. At NWS dust and aerosol product utility is of high priority but hindered by funding constraints.
C. Product enhancements include accessibility (data flow, latency, format); reprocessing needs for re-analysis of global and regional models; product performance (accuracy, precision); quality and coverage issues (snow/ice flag; coverage over bright surface, increase measurement range);
D. Future use and priority to utilize S-NPP/JPSS product is high for all users. Activities at different user agencies are funded except NWS global and regional model applications. NWS regional air quality forecasting program wants to assimilate but needs support. They want to leverage from research development (GSI) at ARL, ESRL, NCAR and implementation will require funding.
E. Additional work to utilize S-NPP/JPSS suspended matter products requires improvements to S-NPP/JPSS product quality and software development efforts within the user agencies (modifications to modeling, decision tools, visualization to use the new products). NASA anticipates complete data set (product and metadata) to apply bias corrections with respect to MODIS. Better understanding of cloud mask effects on AOT, understanding quality flags with reference to MODIS, snow mask improvements are other improvements that require additional work for a full-fledged utilization of S-NPP/JPSS products.

<u>Ocean Color</u>

Presenters: Menghua Wang, Rick Stumpf, Cara Wilson
Moderator: Arron Layns

A. S-NPP/JPSS Ocean Color products provide continuity to legacy products produced from POES, EOS such as SeaWiFs and MODIS.
B. S-NPP/JPSS Ocean Color product is of high importance for many agencies starting with fisheries (NRT surveys and long term model predictions), NWS (ecosystem forecasting), NOS (HAB, sanctuaries), OAR (isoprene emission), and NESDIS (ecosystems). Some of the other non-NOAA users include agencies of Maryland DNR, commercial/recreational fisheries, and science/research users.
C. Product enhancements include data accessibility to Surveys; NRT for cruise tracks (~12h); Episodic Events Management (i.e., oil spill, sediment plumes – NRT ~3 h preferred); generation of high quality time series data sets for all the operational products. Long term consistency, merged data sets from multiple satellites, and uncertainties documented along with products.
D. Future use and priority to utilize S-NPP/JPSS Ocean color product is high for all users.
E. Availability of additional products such as Primary Productivity, Chromophoric Dissolved (Organic) Matter (CDM or CDOM), Suspended Particulate Material, Particulate Inorganic Carbon (PIC), and Chlorophyll Frontal Product will require additional work but helps for a full-fledged utility S-NPP/JPSS products.

<u>SST</u>

Presentes: Alexander Ignatov, Ken Casey, Bob Grumbine
Moderator: John Furgerson

A. S-NPP/JPSS VIIRS L3U SST product provide continuity for NAVOCEANO NOAA-19 and NOAA-18 GAC AVHRR L2P products used operationally in the Bureau of Meteorology's global and regional SST analyses and global ocean. Currently, the S-NPP VIIRS SST products are not used in the SST analysis and ocean model systems. However, these products will be used as soon as ACSPO VIIRS L3U products are in place. VIIRS data are expected to augment and eventually replace MODIS data in the coming years in Multi-scale Ultra-high Resolution (MUR) SST analysis and high-resolution L3 product(s).

B. S-NPP/JPSS SST product utility is of high importance once available as L2/L3 product. Current users include NOAA STAR (GEO/POLAR Blended L4), Coral Reef Watch, NOS/NESDIS (Chesapeake Bay Ecosystem analysis), NCDC (Reynolds SST L4), NASA JPL (JPL MUR L4) and many international users.
C. Product enhancements include accessibility and latency requirements for ingesting into real-time SST analysis systems; product performance with APU requirements meeting or exceeding currently available NAVOCEANO NOAA-19 L2P products; availability of L3 products; consistently reprocessed data from start of mission spatially and temporally.
D. VIIRS products are of High priority, along with AMSR-2 L2P at UKMO as well as at NASA/JPL and NOAA. Also, SST product assimilation into NOAA’s operational hydrodynamic models is a priority for NOAA’s Ocean Service. The product is of second priority at JMA to ingest into SST analysis after MTSAT and Himawari product. Although the SST product is expected to be utilized, funding situation in various agencies vary from fully funded project to no funding.
E. With regards to additional work needed for best use of the S-NPP/JPSS SST product, issues related to the latency, data volume, availability of consistently reprocesses L2/L3 data with improved accuracy and precision stands as foremost priorities.

Session 8: Transition to Operations

Chairs: Walter Wolf, Tom Schott, Pat Purcell

Session Summary: This session featured talks on the systems that the STAR JPSS program uses to take raw data and turn it into usable products. Ensuring high quality data products is a complex undertaking which requires significant oversight – whether it is in IDPS or NDE. The STAR AIT team, which presented its analyses of these processes, including their similarities and differences, has been integral to making this tradition to operations easier for the science teams.

Eric Gotshall (JPSS/DPA), "Algorithm Change Management Process"

Gave an overview of the current IDPS system and how NASA and NOAA are working together in this system. He mentioned that there was no choice to re-architect an ideal operation system for S-NPP and IDPS was the best option at the time as S-NPP launch was approaching. Once there is an operational system doing development is not possible.

- Eric also presented the overview of the change management process and how the algorithms move from one phase to another from science team to operations.

Q: (Larry Flynn) Will IDPS and NDE merge one day.
A: Yes

Tom Schott (NOAA/OSD), "NESDIS Unique Product (NUP) Development"

Gave an overview of NUPS. Described how algorithm packages are developed by STAR with OSPO product area lead participation. The software finally runs with NDE, a subsystem of ESPC. Products are available by subscription to real-time operational end users. The results will be provided to CLASS.

- Described the approval process for a NUP project, SPSRB review process, and the role of annual review and LORWG reviews.
- Presented the eight step process for the lifecycle of a NUP
- Presented the current JPSS L1RD NUPs that will be operational for S-NPP by 2015
- Said that IDPS Ground, NDE Ground, and ESPC Legacy are all trying to come together. We need to stop thinking of them as separate entities.
- During development, NUPs follow the SPSRB, which is an exceptional R2O process. The steps to product approval, lifecycle, and relevant review boards were presented. There are 14 NUPs already in operations and more on the way. Blended products (products dependent on more than one satellite) are also supported.

Walter Wolf (STAR), "Comparing the change process of JPSS & SPSRB"

Compared the change process between the two production systems IDPS and NDE. Both go through the same phases. However, because they are managed by different contractors, the procedures that are followed in these phases are different. Solers for NDE and Raytheon for IDPS have major procedural differences in the "Test and Implementation" phase.

Q: Did you compare the legacy production systems or just compared NDE versus IDPS.
A: Compared legacy systems too.

Tom King (NOAA/STAR/IMSG), "The STAR Algorithm Integration Team (AIT) Research to Operations Process"

Tom King gave an overview of STAR AIT and research to operation process in general. STAR AIT acts as a middle man, coordinating with scientists, operations, and other stakeholders. Principle services include: cleaning and updating science code so that it meets operational coding standards, maintaining version control, analyzing codes and running tests, and stakeholder interactions.

- Informed the common problems that we see with research codes for operational purposes.
- Presented R2O process methodology, reviews and documentation, coding standards, stakeholder interaction and risk tracking
- Presented some R2O examples such as NUCAPS project

Bigyani Das (NOAA/STAR/IMSG), "STAR AIT Capabilities"

Bigyani Das presented on the capabilities of JPSS Algorithm Integration Team. She talked about ADL that the team uses for testing, troubleshooting and generating product data for various S-NPP and JPSS products.

- Described eight different steps that JPSS AIT uses for code testing and troubleshooting
- Gave some examples relating to Cryosphere team's integration efforts for GMASI tile implementation
- Provided information about AIT's communication strategy and quality check strategy
- In depth presentation of the step-by-step process, from acquiring new versions of ADL to integrating and delivering an algorithm. AIT has version control, allowing control over multiple instances of the operational system.

Chris Sisko (NOAA/OSPO), "S-NPP/JPSS ESPC Operations (Today and Tomorrow)"

Chris gave the description about the current ESPC system and future goals. He provided information about the planned backup systems for various projects such as "Consolidated Backup", "GOES-R Backup", "JPSS Backup" and "Critical Infrastructure Protection" systems.

- Presented plans for quality monitoring
- Current challenges such as infrastructure constraints supporting significant transition activities

Session 9: Innovative Science and Team Leads Reports Back

Chairs: Lihang Zhou, Aaron Layns

Session Summary: The session began with three innovate talks from three disciplines – land, ocean, and the atmosphere – exploring new techniques and uses for the products.

This was followed by the SDR team leads presenting their review. Overall, the teams have made significant progress on resolving all known S-NPP issues, and are actively working on changes for J1. These include new algorithms for OMPS and CrIS, as well as higher resolution for those instruments.

The EDR leads presented products in a variety of states. Overall, there was repeated concern about the process going forward. Many products seem to be in limbo – with a new algorithm needed and even selected, but no official guidance on path forward for implementing these products.

Of the many EDR products, the Fractional Snow Cover, Ozone, Cloud Properties, Aerosol Optical Thickness, Suspended matter, Ocean Color, SST, and Soundings all have or will move to a different algorithm.

Miguel Roman (NSAS GSFC), "Use of Suomi-NPP Data for Global Land Change Science and Applications"

- Highlighted improved capabilities of the VIIRS instruments
- Noted that it could be used to measure a variety of phenomenon associated with humans settlements, including temporal energy use patterns related to holiday celebrations
- In US, residential and commercial areas show different patterns of peak lighting associated with Christmas
- Cities are particular prone to damage from climate change, so studying human settlement patterns is important.

Iriana Gladkova (CREST), "Towards Simultaneous Clear-Sky and Ocean Dynamics Analyses in the NOAA SST System"

- Clear sky masks are often conservative, and the misclassification mostly occurs in areas of highly variable SST, which are of most interest to users.
- This method seeks to remove false alarms (pixels labeled as cloudy, but really clear) by using a unique pattern detection method.
- The method looks for gradients ridges (narrow areas of high SST gradient), segments the underlying delta SST field using standard clustering techniques, analyzes segmented areas adjacent to those "ridges", and then keeps the one's that statistically are more like statistically similar to ocean than cloud.
- The data is first destriped, and resampled to account for bowtie deletions, both of which can add spurious patterns into the data.

Xiaolei Zou (STAR), "On Assimilation of ATMS and CrIS Data in HWRF"

- HWRF had to be improved to include satellite data assimilation. The model top had to be raised.
- ATMS has a positive impact on HWRF forecast. Water vapor channels in particular contribute positively due to improved QC.
- CrIS produces mixed impacts. Problems with Nonlocal thermal equilibrium in the CO_2 band, and lack of correction for reflected solar radiance in the surface channels causes issues.

Fuzhong Weng (STAR), "ATMS Team Lead Report"

- Major accomplishments
    - Products declared Validated Maturity
    - Prelaunch test analyses conducted by four groups with consistent results
    - NEΔT meets spec for all channels except 17
    - ARTS being created to correct angle dependent errors
- Future plans
    - Make destriping algorithms operational
    - Complete TVAC analysis, generate J1 PCT, and develop proxy data
    - Improve destriping algorithms for J1 WG bands

Yong Han (STAR),"CrIS Team Lead Report Back"

- Product validated and meets spec. Good SDRs being produced at a rate of 99.8%.
- Upcoming events
    - J1 SDR code and LUTs due to be delivered by January 15, 2015.
    - S-NPP CrIS to be switched to full spectral resolution mode in December
- Team needs to define truth spectra with channel response functions to remove ringing artifacts.
- Team agreed to change CMO computation scheme.
- Calibration code will be modularized so that changes can be implemented quickly once decisions are made

Changyong Cao (STAR), "VIIRS SDR Session Summary"

- SST striping continues to be an issue.
- Team is making progress on characterizing polarization, but the uncertainty is still a big concern.
- There was a change in the calibration trend after an anomaly in February. Since then the F-factor trend have remained steady instead of slowly increasing. The current operational SDR calibration is off by roughly 1% due to this change.

Fred Wu (STAR), "OMPS Team Lead Report Back"

- 12 presentation in session 4c covering S-NPP, NP, NP, and LP, and J1.
- STAR expects to:
    - Perform cal/val and adapt for IDPS
    - Collaborate with NASA broadly and indefinitely
    - Get advice from NGAS for as long as possible
    - Work with Raytheon and Aerospace as has been
- Lessons Learned from S-NPP:
    - Inflexible code, esp. Cal SDR

- Update the DARK sooner
  - Evaluate stray light and update the correction sooner.
  - Wavelength registration may depend on temperature.
  - Dichroic transmittance may change after orbit.
  - Need offline science code.
  - Need tools to interrogate the RDR/SRD
  - Need tools and data to compare (GOME-2, SBUV/2, OMI, CRTM, MLS, …)
  - Need to access BATC documents
- New Challenges of J1:
  - Pre-processor
  - Spectral gaps
  - Cal RDR collection
  - Cal SDR improvements
- Meeting was excellent opportunity to work with users and document progress.

Ninghai Sun (STAR), "IVCS Team Lead Report Back"

- ICVS-lite will be transitioned to GRATIVE, which has 24/7 mode. STAR will maintain the system.
- ICVS will work with SDR teams to generate and archive J1 proxy data. S-NPP anomalies found in ICVS will be used to test quality flags in J1.
- ICVS will begin building EDR LTM prototype
- Team will work on improve bias characterization.

Istvan Laszlo and Shobha Kondragunta (STAR), "Aerosol EDR Team Report"

- Eight aerosol presentations in breakout
- Current AOT/APSP meet validation criteria
- Alternative algorithms for AOT/APSP would use ABI algorithm, offer more coverage, better accuracy over land – but needs more testing and acceptance by users
- Alternate SM algorithm will use-deep-blue and shortwave-IR channels
- Future efforts:
  - Extend AOT rage
  - More aggressive filtering
  - Develop seasonal and regional land surface reflectance relation to reduce high AOT bias
  - Create data in MODIS-like format

  The path forward isn't clear – is it IDPS or NDE. If there is a brand new algorithm, does the maturity status restart at beta?

Andy Heidinger (STAR), "Clouds Team Lead Report "

- Four presentations
- Move from IDPS to CLAVR-x in NDE is going forward. Need sample data set to prepare users.
- Cloud Mask should be more cautious in moving to a different algorithm.
- Recommends having as VCM breakout, as did the Aerosol team.

Tony Reale (STAR), "Soundings Team Lead Report"

- 13 presentations and over 50 participants for Soundings Breakout

- Focused largely on product performance and validation, with little feedback for planned EDR sounding work.
- Presentations from users should be formulated into an evolving list of users and applications.
- Need to:
    - Clearly define STAR's position with respect to project independent oversight for respective product development, implementations (research to ops), routine monitoring and validation; NPROVS/NPROVS+ as source of standardized validation (RT model, sensor) at STAR.
    - Clearly define role/requirement for externals (NASA and CIMSS) in EDR development/validation
    - Plan for gas retrievals

Larry Flynn (STAR), "Report Back on Ozone and OMPS Products"

- Breakout sessions focused on not only ozone, but also atmospheric chemistry and aerosol products that can be derived from OMPS.
- Recommends 3x12 km^2 spatial resolution for aerosol retrieval.
- SO_2 is an IP for total ozone, and V8 is needed for a high quality retrieval.
- OMPS will continue heritage blended IR/UV product (TOAST to TACO), as well as continuing the ozone profile CDR provided by SBUV(/2) and the total column ozone products provided by TOMS/OMI.

Don Hillger (STAR), "VIIRS EDR Imagery Report Back"

- The team relies on interaction with the SDR teams
- The team also has shared issue – such as the need for lower latency products.
- In the future the team will pursue making all M-Bands into EDR.

Ivan Csiszar (STAR), "Land Breakout Session Report"

- General issues with quality flags in input data.
- Algorithm updates due for VI and Active Fires
- LST will work on implementing emissivity implicit formulation
- S-NPP can work as a proxy for J1 but critical J1 features need to be captured
- Validation efforts include multi-satellite intercomparison including Landsat, and linkage to CEOS, and GCOS ECVs.

Jeff Key (STAR), "Cryosphere EDR Team Report"

- The team has completed new validation studies for all five products (Ice Surface Temperature, Sea Ice Characterization, Sea Ice Concentration, and Binary and Fractional Snow Cover).
- Gridding has been improved significantly.
- A new fractional snow cover algorithm has been implemented and testing has began
- Sea Ice Characterization needs work, and a new algorithm may be needed.
- Like many teams, there is a question of how the maturity process will proceed for products that are likely to be replaced.

Alexander Ignatov (STAR), "SST Report Back"

- Over the past year the team has moved to the ACSPO product.
- In the coming year the team
  - Focus on users – work individually, address concerns
  - Archive ACSPO L2 GDS2 at JPL/NODC, discontinue IDPS.
  - Establish reprocessing, back-fill ACSPO VIIRS to January 2012
  - Go validated with ACSPO SST (meets specs, long term monitoring established)
  - Explore improved Quality Flags / Levels in ACSPO
  - Implement destriping operationally
  - Explore pattern recognition ACSPO clear-sky mask enhancements

Menghua Wang (STAR), "Ocean Color Team Report"

- Team will move from current IDPS algorithm to MLS12
- A VIIRS calibration issue is causing a mismatch between VIIRS and MODIS chlorophyll values, possibly from incorrect VIIRS F-factor trending
- Users desire new products:
  - Primary Productivity
  - Chromophoric Dissolved Organic Matter
  - Suspended Particulate Material
  - Particulate Inorganic Carbon
  - Chlorophyll Frontal Product
- Because of the sensitivity of the Ocean Color EDR products, J1 and J2 must continue with both solar and lunar calibrations.

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Appendix A: Poster Session

Vicky Lin	STAR	*NOAA STAR ICVS-LTM S-NPP VIIRS web page*
Huan Meng	STAR	*ATMS Retrieved Snowfall Rate*
Yong Chen	ESSIC/UMD	*Assessments of CrIS Spectral Calibration Accuracy and Stability*
Joe Taylor	SSEC/UW	*S-NPP/JPSS CrIS: Calibration Validation with the Aircraft Based S-HIS*
Denis Tremblay	Science Data Processing Inc.	*JPSS-1 CrIS Bench Data and Preliminary Assessment of the Instrument Stability*
Yan Bai	ERT	*VIIRS Calibration Knowledgebase of SDR Data Quality Assurance*
Jon Fulbright	Sigma Space	*Solar Vector Error in the S-NPP Common GEO Code, the Correction, ad the Effects on the VIIRS SDR RSB Calibration*
Xiaoxiong Xiong	NASA GSFC	*VIIRS Lunar Observations and Applications*
Taeyoung Choi	ERT	*Validation of S-NPP VIIRS Radiometric Stability using Lunar Band Ratios*
Aaron Pearlman	ERT	*Progress in Developing Ground-Based Polarimetric Spectroradiometer to Support VIIRS Validation*
Junqiang Sun	STAR/GST	*VIIRS RSB On-Orbit Calibration and Performance*
James Biard	NCDC	*Easy Access to the VIIRS Science RDR*
Ning Lei	Sigma Space	*Determine S-NPP VIIRS SDSM Screen Transmittance from Both Yaw Maneuver and Regular On-orbit Data*
Fei Meng	UMD	*Spatial and Temporal Variation of VIIRS Derived AOT Over East China*
Zhiquan Liu	NCAR	*Assimilation of VIIRS AOT EDR for Air-Quality Analyses and forecasts: A Comparison with the Assimilation of MODIS AOT*
Ho-Chun Huang	CICS-MD/ESSIC/UMD/STAR	*The Evaluation of VIIRS Aerosol Retrievals Over Ocean*

Jingfeng Huang	ESSIC/UMD	*Spatial and Temporal Characterization of the Difference between Multi-Sensor Aerosol Retrievals and AERONET measurements*
Peng Yu	ESSIC/CICS/UMD	*To Monitor and Validate the VIIRS LST Product*
Yuling Liu	CICS/UMD	*Validation of the S-NPP VIIRS Provisional LST Product*
Zhuo Wang	UMD	*Revealing Issues for Improving VIIRS LST Retrieval*
Nicholay Shabanov	IMSG	*Evaluation of Performance of VIIRS VI EDR over Network of AERONET Sites*
Jiao Wang	U. of Hawaii at Manoa	*Validation of VIIRS Vegetation Index EDR Using In Situ Radiation Sensor Measurements*
Zhangyan Jiang	STAR/AER	*Real-time Daily Rolling Weekly Green Vegetation Fraction Derived from the S-NPP Satellite*
Hai Zhang	STAR/IMSG	*Improving the Estimated Surface Reflectance Ratios for VIIRS Aerosol Retrieval Over Land*
Dongdong Wang	UMD	*Direct Estimation of Land Surface Albedo from VIIRS: Algorithm Improvement and Preliminary Validation Data*
Rui Zhang	UMD	*VIIRS Surface Type Algorithm Refinement and Preliminary Validation*
Craig Long	CPC	*Extension of CPC's Ozone Monitoring Using OMPS Ozone Products*
Irina Petropavlovskikh	CIRES/U. of Col.	*OMPS Ozone Validation by the NOAA Ground-based Ozone Network*
Kenneth Voss	U. of Miami	*Current and Future Marine Optical Buoy*
Lide Jiang	STAR/CIRA	*A New Blended Near-infrared Ocean Reflectance Correction Algorithm for Satellite Ocean Color Data Processing in Coastal and Inland Waters*
Xiaoming Liu	STAR	*River Runoff Effect on the Suspended Sediment Property in the Upper Chesapeake Bay Using MODIS Ocean Color Data and Model Simulations*
Seunghyun Son	STAR/CIRA	*Satellite-measured Net Primary Production in the Chesapeake Bay*

Wei Shi	STAR	*IR-based Ocean Color IOP algorithm for Coastal and Inland Waters*
Puneeta Naik	STAR/CIRA	*Effective Band Center Wavelengths for MODIS and VIIRS for Open Ocean Waters*
Rob Arnone	U. of So. Miss.	*Repair for VOCCO Coastal Products: Evaluation of IDPS Ocean Color Products in Coastal Regions*
Ryan Vandermeulen	U. of So. Miss.	*Enhanced Monitoring of Bio-Optical Processes in Coastal Waters Using High Spatial Resolution Channels on S-NPP VIIRS*
Ryan Vandermeulen	U. of So. Miss.	*Estimating Sea Surface Salinity in Coastal Waters of the Gulf of Mexico Using Visible Channels on S-NPP VIIRS*
Jennifer Bowers	QinetiQ North America	*Regional Vicarious Gain Adjustment for Coastal VIIRS Products*
Jean-Francois P. Cayula	QinetiQ North America	*Comparison of VIIRS SST Fields Obtained from Differing SST Equations Applied to a Region Covering the Northern Gulf of Mexico and Western North Atlantic*

Appendix B: Acronyms

ABI	Advanced Baseline Imager
ACNFS	Arctic Cap Nowcast/Forecast System
ACSM	ACSPO Clear Sky Mask
ACSPO	Advanced Clear-Sky Processing over Oceans
ADL	Algorithm Development Library
AER	Atmospheric and Environmental Research, Inc.
AERONET	Aerosol Robotic Network
AEROSE	Aerosols and Ocean Science Expeditions
AFWA	Air Force Weather Agency
AGU	American Geophysical Union
AI	Aerosol Index
AIRS	Atmospheric Infrared Sounder
AIT	Algorithm Integration Team
AK	Averaging Kernels
AMSR	Advanced Microwave Scanning Radiometer
AMSU	Advanced Microwave Sounding Unit
AOD	Aerosol Optical Depth
AOT	Aerosol Optical Thickness
APSP	Aerosol Particle Size Parameter
APU	accuracy/precision/uncertainty
ARL	Air Resources Laboratory
ARR	Algorithm Readiness Review
ARTS	Advanced Radiance Transformation Scheme
AS	Archive Set
ASAP	as soon as possible
ATMS	Advanced Technology Microwave Sounder
AVHRR	Advanced Very-High Resolution Radiometer
AWIPS	Advanced Weather Interactive Processing System
BATC	Ball Aerospace Technology Corporation
BOL	beginning of life
BOM	Bureau of Meteorology
BP	bandpass
BPSA	bright pixel surface albedo
BRDF	bidirectional reflectance distribution function
bRR	Blended Rainfall Rate
BT	brightness temperature
BTM	Bit trim mask
bTPW	Blended TPW
C3S	Command, Control, and Communications Segment
CALIPSO	Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation

CBC	Channel Band Center
CBH	Cloud Base Height
CBM	Command Block Memory
CCAST	CrIS Calibration Algorithm and Sensor Testbed
CCD	charge-coupled device
CCN	Cloud Condensation Nuclei
CCNY	City College of New York
CCR	code change request
CDM	Chromophoric Dissolved Matter
CDOM	Chromophoric Dissolved Organic Matter
CDR	Climate Data Record
CDR	Critical Design Review
CEOS	Committee on Earth Observation Satellites
CGMS	Coordination Group for Meteorological Satellites
CICS	Cooperative Institute for Climate and Satellites
CIMSS	Cooperative Institute for Meteorological Satellite Studies
CIRA	Cooperative Institute for Research in the Atmosphere
CIRES	Cooperative Institute for Research in Environmental Science
CLASS	Comprehensive Large Array-data Stewardship System
CLAVR-x	Clouds from AVHRR-extended
CLW	cloud liquid water
CMC	Canadian Meteorological Centre
CMO	correction matrix operator
CMORPH	CPC Morphing Technique
ConOps	Concept of Operations
COSMIC	Constellation Observing System for Meteorology, Ionosphere, and Climate
COT	Cloud Optical Thickness
CPC	Climate Prediction Center
CPO	Climate Program Office
C-RDR	Climate-RDR
CREST	Cooperative Remote Sensing Science and Technology Center
CrIMMS	Crosstrack Infrared/Microwave Sounder Suite
CrIS	Crosstrack Infrared Sounder
CRTM	Community Radiative Transfer Model
CTH	Cloud Thickness
CUNY	City University of New York
CV	Calibration/Validation
DADD	Detailed Architecture Description Document
DAI	Dust Aerosols Index
DB	direct broadcast
DCC	Deep Convective Clouds
DMSP	Defense Meteorological Satellite Program
DNB	Day/Night Band

DNR	Department of Natural Resources
DoD	Department of Defense
DPA	Data Products and Algorithms
DPES	Data Products Engineering and Systems
DPSA	dark pixel surface albedo
DR	Direct Readout
DR	discrepancy report
DU	Dobson Unit
ECMWF	European Centre for Medium-range Weather Forecasting
ECV	Essential Climate Variable
Ed	downwelled irradiance
EDR	Environmental Data Record
EMC	Environmental Modeling Center
EMI	electromagnetic interference
EOL	end of life
EOS	Earth Observing System
EPA	Environmental Protection Agency
EPS	Effective Particle Size
ERT	Earth Resources Technology, Inc.
Es	surface irradiance
ESA	European Space Agency
ESPC	Earth System Prediction Capability
ESRL	Earth System Research Laboratory
ESSIC	Earth System Science Interdisciplinary Center
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
EV	Earth view
EVI	Enhanced Vegetation Index
FF	full-frame
FIR	finite impulse response
FOV	field-of-view
FSU	Florida State University
FSW	Flight Software
FTS	Fourier Transform Spectrometer
FY	fiscal year
GAC	Global Area Coverage
GAASP	GCOM AMSR2 Algorithm Software Processor
GCOM(-W)	Global Change Observation Mission (Water)
GDS	GHRSST Data Specification
GEARS	Ground Enterprise Architecture System
GEO	Geostationary Earth Orbit
GEOSS	Global Earth Observation System of Systems
GFS	Global Forecast System
GHRSST	Group for High Resolution SST

GMAO	Global Modeling and Assimilation Office
GMASI	Global Multi-sensor Automated Snow/Ice
GRAVITE	Government Resource for Algorithm Verification, Independent Testing, and Evaluation
GOES	Geostationary Operational Environmental Satellite
GOME	Global Ozone Monitoring Experiment
GPM	Global Precipitation Measurement
GPS	Global Positioning System
GPS-RO	GPS-Radio Occultation
GPU	Graphics Processing Unit
GRIB	Gridded Binary
GSFC	Goddard Space Flight Center
GSI	Gridded Statistical Interpolation
GSICS	Global Space-based Inter-Calibration System
GST	Global Science and Technology, Inc.
GTM	Ground Track Mercator
GVF	Green Vegetation Fraction
HAB	harmful algal bloom
HDF	Hierarchical Data Format
HR	high resolution
HWRF	Hurricane Weather Research and Forecasting
I-Bands	Imaging bands
IASI	Infrared Atmospheric Sounding Interferometer
ICT	internal calibration target
ICV	Intensive Cal/Val
ICVS	Integrated Calibration/Validation System
IDL	Interactive Data Language
IDPS	Interface Data Processing Segment
ILS	instrument line shape
IMF	Intrinsic mode function
IMS	Interactive Multisensor Snow and Ice Mapping System
IMSG	IM Systems Group
INTEX	Intercontinental Chemical Transport Experiment
IP	Intermediate Product
IR	infrared
ISA	inverse self-apodization
IST	Ice Surface Temperature
IT	information technology
IWP	Ice Water Path
JAXA	Japan Aerospace Exploration Agency
J1/2/3	JPSS-1/2/3
JCSDA	Joint Center for Satellite Data Assimilation
JMA	Japan Metrological Agency

JPL	Jet Propulsion Laboratory
JPSS	Joint Polar Satellite System
Kd	Diffuse attenuation coefficient
KNMI	Royal Netherlands Meteorological Institute
KPP	Key Performance Parameter
L1/2/3/4(A/B/G/P/U)	Level 1/2/3/4(A/B/G/P/U)
L1RD	Level 1 Requirements Document
LAADS	Level 1 and Atmosphere Archive and Distribution System
LaRC	Langley Research Center
LDA	Land Data Assimilation
LDM	Local Data Manager
LED	light emitting diode
LEO	Low Earth Orbit
LI	Lunar Intrusion
LL	Lincoln Labs
LORWG	Low-Earth Orbit Requirements Working Group
LP	Limb Profiler
LPVS	Land Products Validation System
LSE	land surface emissivity
LST	Land Surface Temperature
LTE	local thermodynamic equilibrium
LTM	long-term monitoring
Lu	upwelled radiance
LUT	lookup table
LW	longwave
LWM	land water mask
M-Bands	Moderate-resolution bands
MCD	MODIS Combined Dataset
MERIS	Medium Resolution Imaging Spectrometer
MHS	Microwave Humidity Sounder
MiRS	Microwave Integrated Retrieval System
MISR	Multi-angle Imaging Spectroradiometer
MIT	Massachusetts Institute of Technology
MLS	Microwave Limb Sounder
MOBY	Marine Optical Buoy
MODIS	Moderate-resolution Imaging Spectroradiometer
MOPITT	Measurements Of Pollution In The Troposphere
MSL12	Multi-Sensor Level 1/2
MTSAT	Multifunctional Transport Satellites
MUR	Multi-scale Ultra-high Resolution
MW	midwave
NAAPS	Navy Aerosol Analysis and Prediction System
NASA	National Aeronautics and Space Administration

NAST-M	NPOESS Airborne Sounding Testbed – Microwave
NAVO	Naval Oceanographic Office
NAVOCEANO	Naval Oceanographic Office
NBAR	normalized BRDF-adjusted reflectance
NC	Non-compressed
NCAR	National Center for Atmospheric Research
NCC	Near-Constant Contrast
NCDC	National Climate Data Center
NCEP	National Centers for Environmental Prediction
NCM	NAVOCEANO Cloud Mask
NDE	NPP Data Exploitation
NDVI	Normalized Difference Vegetation Index
NESDIS	National Environmental Satellite, Data, and Information Service
netCDF	Network Common Data Format
NGAS	Northrop Grumman Aerospace Systems
NGES	Northrop Grumman Electronic Systems
NIC	National Ice Center
NIR	near IR
NL	non-linearity
nLw	net water leaving radiance
NM	Nadir Mapper
NN	Neural Network
NOAA	National Oceanic and Atmospheric Administration
NODC	National Oceanographic Data Center
NOS	National Ocean Service
NP	Nadir Profiler
NPOESS	National Polar-orbiting Operational Environmental Satellite System
NPROVS	NOAA Products Validation System
NRL	Naval Research Laboratory
NRT	Navigation Response Teams
NUCAPS	NOAA Unique CrIS/ATMS Processing System
NUP	NOAA Unique Product
NWP	numerical weather predication
OAD	Operational Algorithm Description
OAR	Office of Oceanic and Atmospheric Research
OCC	Ocean Color/Chlorophyll
OCONUS	Outside the Continental United States
OE	Optimal Estimation
OLCI	Ocean Land Colour Instrument
OLR	outgoing longwave radiation
OLS	Operational Linescan System
OMI	Ozone Monitoring Instrument
OMPS	Ozone Mapping Profiler Suite

OPC	Ocean Prediction Center
OSD	Office of Systems Development
OSGS	Office of Satellite Ground Services
OSPO	Office of Satellite and Product Operations
PAR	Photosynthetically Active Radiation
PATMOS-X	AVHRR Pathfinder Atmosphere-extended
PCA	principal component analysis
PCRTM	Principal Component-based. Radiative Transfer Model
PCT	Processing Coefficients Table
PDA	Product Distribution and Access
pdf	probability distribution function
PEATE	Product Evaluation, Analysis, and Testing Element
PGRR	Proving Ground/Risk Reduction
PIC	Particulate Inorganic Carbon
PMD	Polarization Measurement Device
POES	Polar Orbiting Environmental Satellites
PRT	platinum resistance thermometer
PSDI	Product System Development and Implementation
PSF	point spread function
psinc	periodic sinc
PSR	pre-ship review
QA	quality assurance
QBO	Quasi-Biennial Oscillation
QC	quality control
QF	quality flag
QPE	quantitative precipitation estimate
QST	Quarterly Surface Type
QVD	Quartz Volume Diffuser
R&D	research and development
R2O	research to operations
RAOB	radiosonde observation
RC	redundancy configuration
RDR	Raw Data Record
RGB	red-green-blue
ROSES	Research Opportunities in Space and Earth Sciences
Rrs	remote sensing reflectance
RRTVAC	Risk Reduction TVAC
RSB	reflective solar bands
RSR	relative spectral response
RTA	radiative transfer algorithm
RT	radiative transfer
RU	Radiometric Uncertainty
RWP	Rain Water Path

S/C	spacecraft
S3	Sentinel 3
SA	self-apodization
SA	Surface Albedo
SAA	South Atlantic Anomaly
SARTA	Stand-alone AIRS Radiative Transfer Algorithm
SBUV	Solar Backscatter Ultraviolet
ScAMPR	Self-Calibrating Multivariate Precipitation Retrieval
SCDB	Sensor Characterization Database
SCIAMACHY	Scanning Imaging Absorption spectrometer for Atmospheric Chartography
SDL	Space Dynamics Laboratory
SDR	Sensor Data Record
SDSM	Solar Diffuser Stability Module
SeaWiFS	Sea-Viewing Wide Field-of-View Sensor
SHOUT	Sensing Hazards with Operational Unmanned Technology
SIC	Sea Ice Characterization
SL	stray light
SLSTR	Sea and Land Surface Temperature Radiometer
SM	Suspended Matter
SNO	simultaneous nadir overpass
S-NPP	Suomi National Polar-orbiting Partnership
SP	Scan Profile
SPoRT	Short-term Prediction Research and Transition Center
SPSRB	Satellite Product and Services Review Board
SR	Surface Reflectance
SRD	Sensor Requirements Document
SRSOR	Super Rapid Scan Operations for GOES-R
SRT	Sounder Research Team
SSAI	Science Systems and Application, Inc.
SSEC	Space Science and Engineering Center
SSMIS	Special Sensor Microwave Imager/Sounder
SST	Sea Surface Temperature
SSW	Sea Surface Wind
ST	Sample Table
STAR	Center for Satellite Applications and Research
STC	Science & Technology Corporation
SW	shortwave
SWE	snow water equivalent
TACO	Total ozone Analysis of CrIS and OMPS
TC	Total Column
TDR	Temperature Data Record
TEB	thermal emissive bands
TES	Tropospheric Emission Spectrometer

TH	tangent height
TIROS	Television Infrared Observation Satellite
TLE	two-line element
TMI	TRMM Microwave Imager
TOA	top-of-atmosphere
TOAST	Total Ozone Analysis from SBUV and TOVS
TOMS	Total Ozone Mapping Spectrometer
TOVS	TIROS Operational Vertical Sounder
TPG	Timing Pattern Generator
TPW	total precipitable water
TRMM	Tropical Rainfall Measuring Mission
TVAC	thermal vacuum
UAV	unmanned aerial vehicle
UC	University of Colorado
UKMO	United Kingdom Meteorological Office
UMD	University of Maryland
USGS	United States Geological Survey
USRA	Universities Space Research Association
UV	ultraviolet
UW	University of Wisconsin
VCM	VIIRS Cloud Mask
VI	Vegetation Index
VIIRS	Visible Infrared Imaging Radiometer Suite
VIS	visible
VZA	Viewing Zenith Angle
WFO	Weather Forecast Office
WRF-CHEM	Weather Research and Forecasting (WRF) model coupled with Chemistry
WPC	Weather Prediction Center

Appendix C: Breakout session attendance

Session 4A – VIIRS SDR - Tuesday PM

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Session 4A – VIIRS SDR - Wednesday AM

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Session 4C – OMPS SDR - Wednesday AM

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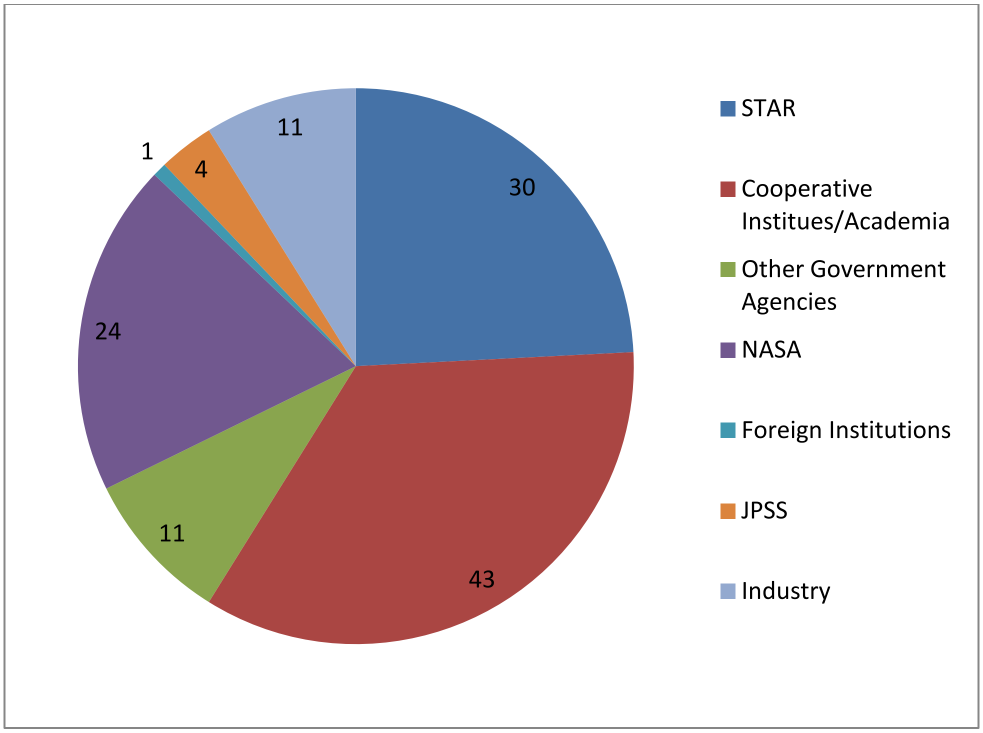
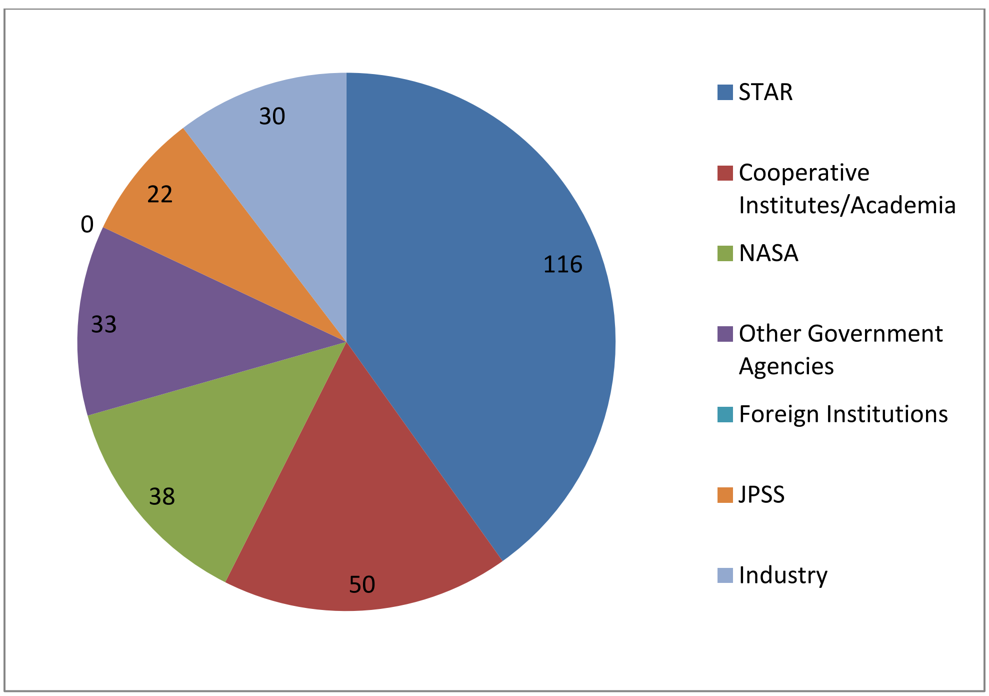
Appendix C: End Notes

Who attended the STAR JPSS Annual Science Team Meeting?

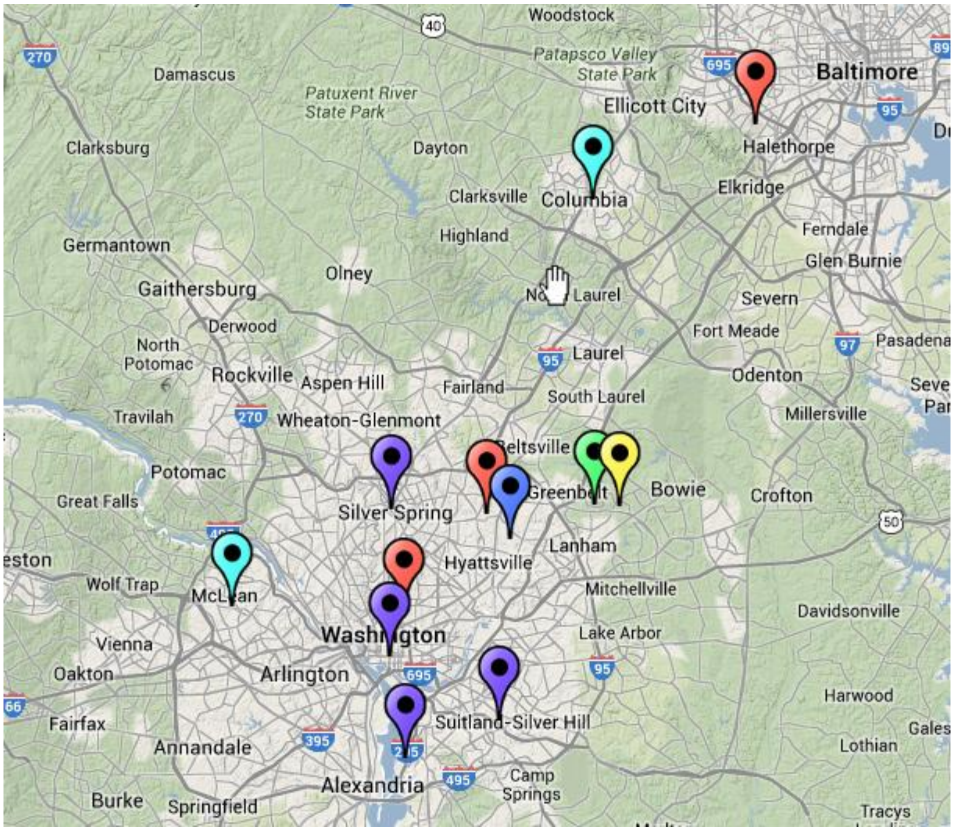
Presenter Organizations (excluding team lead reports)

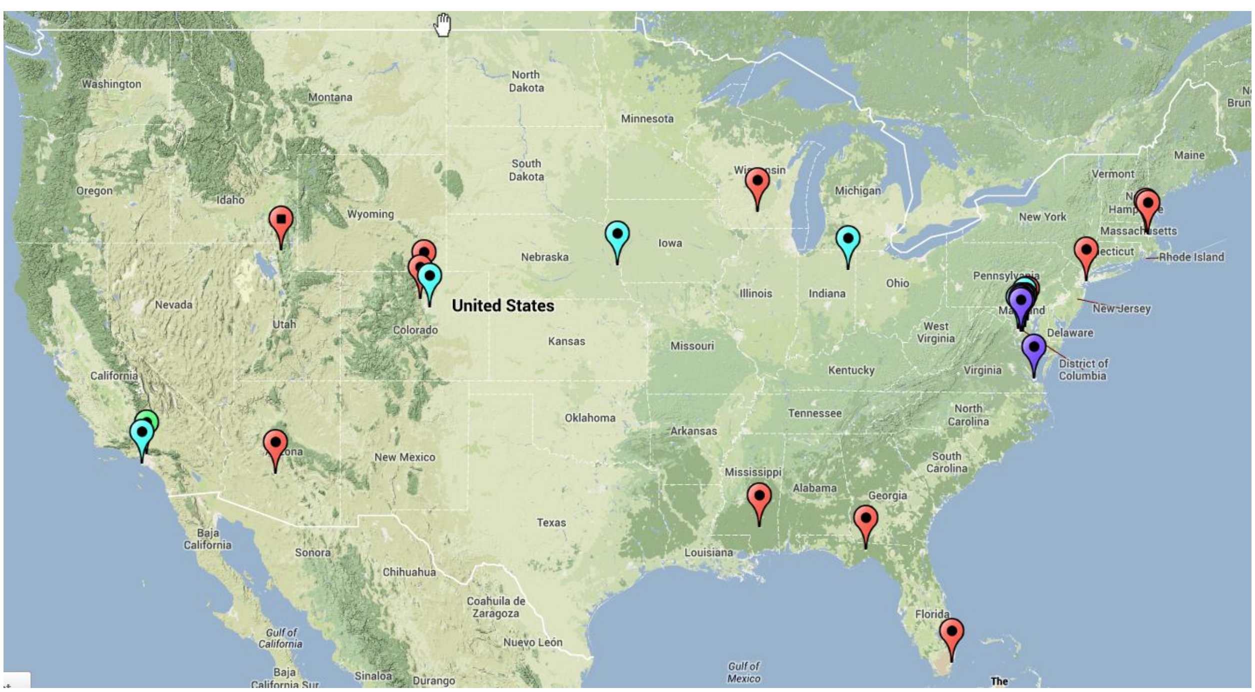


Attendee Organizations



Where did our attendees and presenters come from?





What did they talk about?