



Algorithm Development Executive Board Board Overview

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Algorithm Development Executive Board = ADEB



Outline

- Purpose of the ADEB
- Summary Findings of the ADEB
- ADEB Background
 - » Independent Review Process
 - » ADEB Overview & Organizational Context
 - » Roles and responsibilities
 - » Schedule & Deliverables
 - » STAR and Algorithm Working Group Considerations (Differences with a research project)
 - » ADEB Phase I Review Dates
- Independent Peer Review (IV&V) Summary Findings
- ADEB Findings
- Outcomes
- Action Items



Purpose of the ADEB

- The primary objectives established for the ADEB include:
 - » Provide a thorough, independent assessment of the GOES-R AWG Level-2 algorithms
 - » Provide an independent assessment of processes followed by the AWG in the course of their algorithm development activities
- Meeting these two key objectives is expected to result in the following:
 - » Delivery of the best possible Level-2 product algorithms to the GOES-R Program that will meet the documented requirements for these products, thus reducing overall programmatic risk
 - » Increased user confidence in the quality and utilization potential of the GOES-R Level-2 products



ADEB Summary Findings

“Overall the Board found the briefings were very professional, orderly, and complete. The Board commends the work of the STAR/AWG and recommends delivery of the 80% algorithms and their ATBDs to the GOES-R Program Office.”



ADEB Background



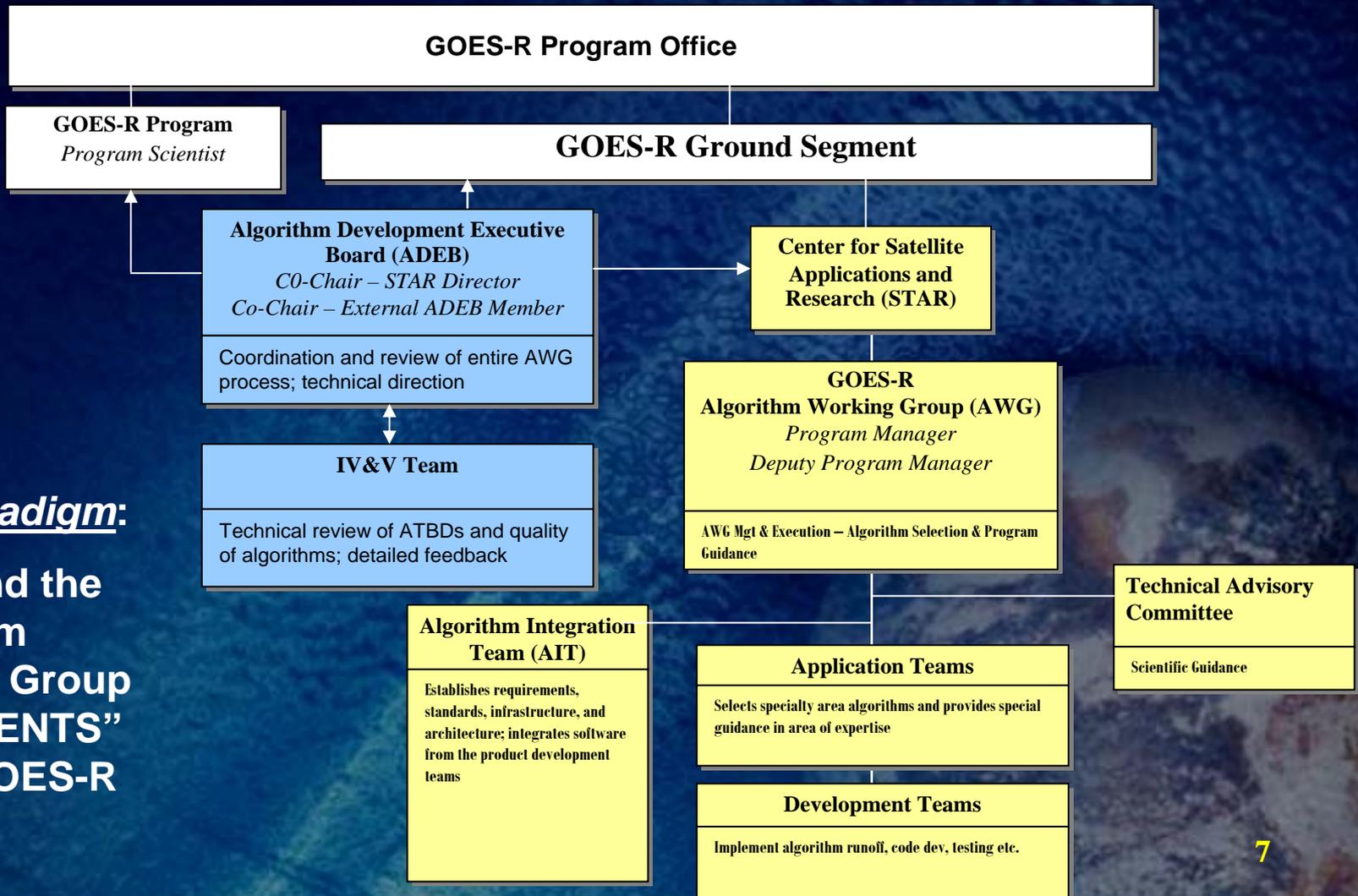
ADEB Review Process

Two core components...

- **Independent Peer Review (IV&V):** Detailed technical review of each algorithm, its theoretical basis, test and validation procedures, and the algorithm theoretical basis document (ATBD)
 - » proxy datasets
 - » validation methods
 - » integration and related processes
 - » assessment of algorithm compliance with GOES-R specifications
- **Algorithm Development Executive Board:** Overall review of the AWG processes, algorithm and documentation readiness, and associated deliverables for:
 - » meeting program needs
 - » providing capabilities to build a robust ground system
 - » delivering quality algorithms and products to users
 - » meeting user requirements



ADEB Context & Relationships



New Paradigm:

STAR and the Algorithm Working Group are “CLIENTS” of the GOES-R program



ADEB Executive Board Membership

Coordination and review of entire AWG process; technical direction...

- Don Berchoff / Mike Johnson – NOAA/OS&T (Co-Chair)
- Al Powell – NOAA/NESDIS/STAR (Co-Chair)
- Bob Arnone – NRL-Stennis
- David Benner – NOAA/NESDIS/OPDPD
- Brant Foote – NCAR RAL
- James Gleason – NASA/GSFC
- Steve Goodman – NOAA/NESDIS GPO
- Marty Ralph – NOAA/OAR/ESRL
- Thomas Vonder Haar – Colorado State U.
- John Zapoctocny - AFWA

Co-Chairs: Mike Johnson – responsible for discussing and summarizing feedback in final report
Al Powell – responsible for administration, ADEB organization, etc.
- Ensuring FACA requirements are met



Peer Review - IV&V Team Membership

Independent technical review of ATBDs and quality of algorithms...

- Rob Levy – SAIC/NASA
- Sundar Christopher – UAH
- Gregg Gallina – DC VAAC
- Jeff Hawkins – NRL
- Steven D. Miller – CIRA
- Tom Kopp – DOD/AFWA/Aerospace
- Jim Coakley – NOAA CLOS
- Jeff Dozier – UCSB
- Bert Davis – U.S. Army CRREL
- Kostantine Georgakakos - HRC
- Soroosh Sorooshian – UC Irvine
- Dennis Chesters – NASA
- Kevin Schrab – NWS
- Mike Turk – NOAA/NESDIS/SAB
- Louis Giglio – SSAI
- Jeffrey Reid – NRL Monterey
- Jeffrey L. Privette – NOAA/NODC
- Simon Hook – NASA JPL
- Dave Sharp – NOAA/NWS
- Kyle Wiens – Texas Tech
- Paul Stackhouse – NASA LRC
- Dr. S.K. Yang – NOAA/NWS
- John Gille – NCAR
- Edward M. Armstrong – NASA
- Gary Wick – NOAA
- Kenneth Casey – NOAA
- Jim Jung – JCSDA
- John LeMarshall – Australia BOM



Roles and Responsibilities Summary

GOES – R Program

- Funding resources
- Requirements and Schedule
- Secretariat
- Scope of review
- GOES-R program personnel

STAR

- ADEB review planning and coordination
- Exec Board and Peer Review - IV&V
- Team nominations and coordination
- AWG oversight
- AWG review coordination
- Ensure AWG deliveries

ADEB

- Review of AWG processes
- Review of AWG Product Application Teams (incl algorithms, ATBDs, test and validation plans)
- Review of proxy and simulated datasets, product validation approaches, etc.
- Final report and briefing

AWG

- Management of algorithm development and deliveries
- Develop algorithms to meet GOES-R requirements
- Delivery of ATBDs and other documents to GOES-R
- ADEB review facilitation
- Written response to ADEB findings and IV&V feedback



AWG ADEB Schedule

- PHASE I: Review of 80% Baseline Level 2 Products;
(Delivery Sept 2009)
- PHASE II: Review of 100% Baseline Level-2 Products &
80% Option 2 Level-2 Products);
(Delivery Sept 2010)
- PHASE III: Review of 100% Option 2 Level-2 Products;
(Delivery Sept 2011)
- GOES-R O&M (Bi-annual review?)
 - » on-orbit product validation
 - » continuity of services



Phase I Review Dates

- June 23: Peer Review IV&V Invite letters sent out
- June 25: ADEB Invite letters sent out
- July 1: Peer Review IV&V Participants Telecom
- July 20-24: AWG Annual Meeting (ADEB and IV&V invited)
- Aug 21: ADEB Participants Telecom
- Aug 21: Peer Review IV&V Reports due
- Sep 11: AWG application team responses to IV&V reports due
- Aug 27-28: ADEB meeting
- Sept 25: AWG application team responses to ADEB report due
- Oct 30: ADEB Final report provided to the GPO
- Feb 19 (Dec 3): ADEB Briefing to the GOES-R Program



GOES-R Operational Products

BASELINE (25)

GLM Advanced Baseline Imager (ABI)

- Clouds and Moisture Imagery
- Clear Sky Mask
- Temperature and Moisture Profiles
- Total Precipitable Water
- Stability Parameters (Lifted Index)
- Cloud Top Pressure and Height
- Cloud Top Phase
- Cloud Particle Size Distribution
- Cloud Optical Path
- Rainfall Rate
- Aerosol Detection
- Aerosols Optical Depth
- Derived Motion Winds
- Hurricane Intensity
- Volcanic Ash
- Fire/Hot Spot Characterization
- Land and Sea Surface Temperature
- Snow Cover
- Downward Surface Insolation: SFC
- Reflected Solar Insolation: TOA

- Lightning Detection

OPTION 2 (34)

Advanced Baseline Imager (ABI)

- Cloud Layer/Heights
- Cloud Ice Water Path
- Cloud Liquid Water
- Cloud Type
- Convective Initiation
- Turbulence
- Low Cloud and Fog
- Visibility
- Surface Albedo
- Upward Longwave Radiation (TOA)
- Downward Longwave Radiation (SFC)
- Downward Longwave Radiation (SFC)
- Total Ozone
- SO2 Detections (Volcanoes)
- Surface Emissivity
- Aerosol Particle Size
- Vegetation Index
- Vegetation Fraction
- Snow Depth
- Flood Standing Water
- Rainfall probability and potential
- Enhanced "V"/Overshooting Top
- Aircraft Icing Threat
- Ice Cover
- Sea & Lake Ice Concentration, Age, Extent, Motion
- Ocean Currents



Deliverables to GOES-R Program (Ground Segment)

- Algorithm Packages (APs)
 - » Algorithm Theoretical Basis Documents (ATBD)
 - » Instrument proxy datasets
 - » Product output datasets (for comparison)
 - » Algorithm Interfaces and Ancillary Data Description (AIADD) document
 - » List of computer equipment used and run times, etc. for contractor planning
- Schedule of Deliveries:
 - ✓ September 2008: As-Is ATBDs
 - ✓ September 2009: 80% APs for Baseline Products
 - September 2010: 80% APs for Option 2 Products
 - September 2010: 100% APs for Baseline Products
 - September 2011: 100% APs for Option 2 Products



ADEB Focus

Demonstrating an equitable process...

- Are the candidate algorithms complete and technically well chosen?
- Are our validation criteria clear, valid and appropriate?
- Was the process for evaluating and selecting the algorithms fair and open?
- Were the algorithm results / decisions logical in reasoning and well documented?
- Did we achieve community buy-in and participation?



ADEB Focus

Demonstrating the algorithm performance...

Did we demonstrate that the algorithms:

- Will satisfy the required specifications?
- Will be an improvement on past algorithms?
- Will be robust on-orbit (i.e. graceful degradation)?

Other questions and comments are welcome on any topic of interest to the ADEB.



Algorithm Working Group Considerations

- Trying to deliver the mature and proven algorithm that satisfies GOES-R specifications & requirements
- Consistency with legacy products in use for continuity purposes must be considered (while demonstrating improvement)
- Trying to deliver ‘consistent processing with similar spectral usage’ – STAR and international objective
- Algorithms ASSUME that the sensor meets its specifications at this point in the program

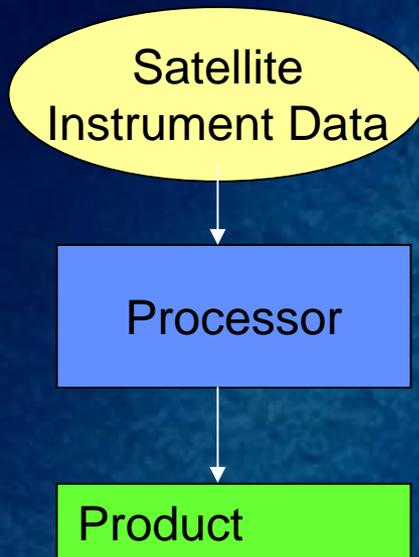


Algorithm Working Group Considerations

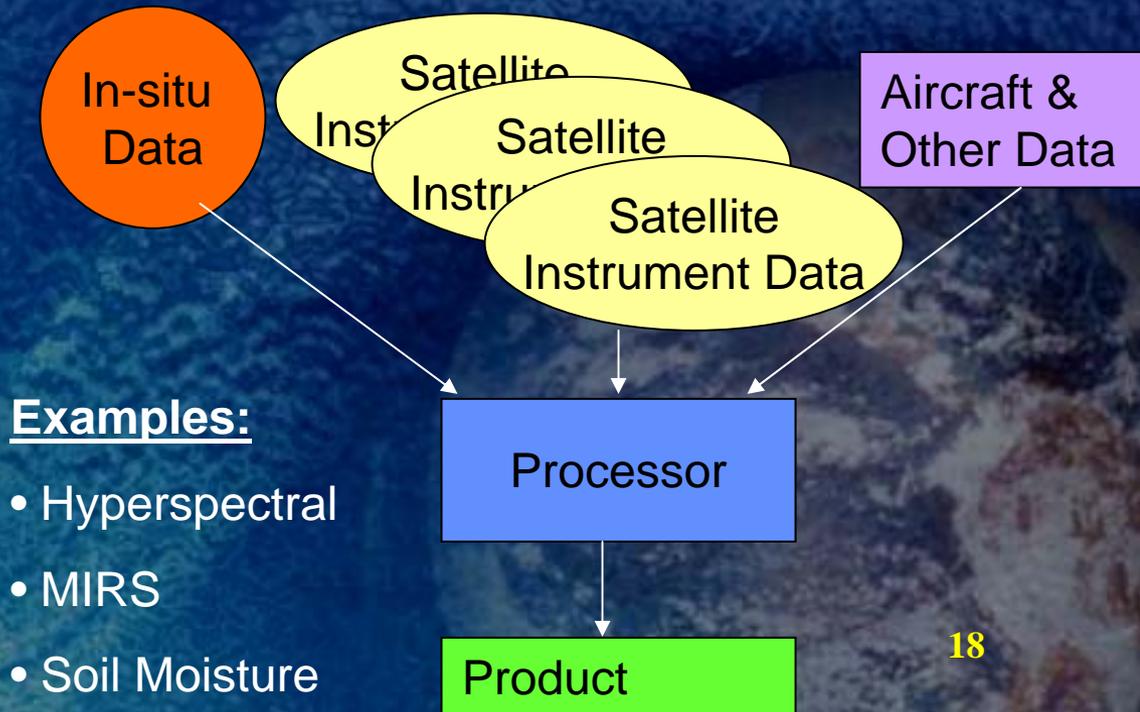
Multiple Sensor Use in Products

• Changing paradigm:

Old Approach:



New approach:





Multiple Data Source Use in Products

What this means for GOES-R...

- Some algorithms will need to use microwave data to meet threshold requirements
 - » Rainfall rate algorithm is an example
- STAR will develop and demonstrate new techniques under the GOES-R Risk Reduction Program
- Operational implementation of new techniques is envisioned after the GOES-R and NPOESS ground systems are declared operational
- Ancillary data required to produce products
- Future advancements will require integrating these systems
 - » Demonstrate the merged capability
 - » Creation of validation toolkits



AWG Program Constraints

Research & development with a purpose...

- Must meet the program schedule and cost constraints
- Must deliver algorithms that will meet the specifications / requirements (or provide early notice to the GOES-R Program Office, GPO)
- Must provide supporting information & reporting:
 - » Earned value management (EVM), milestone reporting, cost & schedule discrepancies, etc. (direct oversight by GPO)
- Must provide our deliverables to the GPO:
 - » ATBDs, Test files & Data files, output files
- Each algorithm has followed rigorous programmatic reviews
 - » PDR, CDR, TRR, etc. to satisfy GPO requirements



Peer Review (IV&V) Summary Findings



Peer Review (IV&V) Summary Findings

Peer Review (IV&V) questions asked and their summary outcomes by ATBDs.

	Is the algorithm well describe, including definitions of inputs and outputs, science descriptions, equations, etc?	Would you be able to develop your own algorithm code from the description included in the ATBDs?	Was the algorithm sufficiently validated and will it meet the required performances?
No Issues			
Minor Issues			
Major Issues			
Aerosol Detection	Green	Green	Green
Aerosol Optical Depth and Aerosol Size	Green	Green	Yellow
Clear Sky Mask	Green	Yellow	Green
Cloud and Moisture Imagery	Yellow	Yellow	Green
Cloud Optical Path	Green	Green	Green
Cloud Particle Size Distribution	Green	Green	Green
Cloud Top Pressure and Height	Green	Green	Green
Cloud Type and Phase	Yellow	Green	Yellow
Derived Motion Winds	Green	Green	Green
Downward Surface Insolation	Green	Green	Yellow
Fire/Hot Spot Characterization	Yellow	Yellow	Green
Hurricane Intensity	Green	Green	Yellow
Land Surface Temperature	Green	Green	Green
Legacy Temperature and Moisture Soundings	Green	Green	Green
Lighting Detection	Yellow	Green	Green
Rainfall Rate	Green	Yellow/Green	Yellow
Sea Surface Temperature	Green	Yellow/Green	Green
Snow Cover	Green	Green	Green
Stability Parameters (eg. Lifted Index)	Green	Green	Green
Volcanic Ash	Green	Green	Green



Peer Review (IV&V) Summary Findings

- The AWG welcomed the peer review IV&V findings
- Overall, the peer review findings provide confidence that the algorithm approaches were sound and correct
- All identified issues can be addressed
- No major algorithm “show stoppers”



ADEB Findings



ADEB Findings

- **Finding 1:** Insufficient Validation. The reporting of measurement validation lacked clarity and completeness. The validation is acceptable for the 80% level, but is not adequate for 100% delivery.
- **Recommendation 1:** Pursue more complete data sets. Measurement validation must be conducted with thoroughness and completeness within a sustained validation/verification framework and should consider using “human in the loop.”
- **AWG Response:** AWG agrees. More complete data sets are part of the 100% algorithm deliveries. Sustainable validation systems is identified in the AWG development activities and work is starting in 2009. The AWG is working with the Program Proving Ground’s effort to implement the “human in the loop.”



ADEB Findings

- **Finding 2:** Few “out-of-the-box” choices In general, there were very few cutting-edge algorithms selected even though in some cases recent advances have been made.
- **Recommendation 2A:** The Board recognizes that algorithm development must be “frozen” at some point in order to deliver an operational code. However, the Board encourages streamlining the algorithm development process, so that new more advanced code can be integrated into operational code versions as early as possible.
- **AWG Response:** Agreed, the AWG will continue to consider enhancements even after the algorithms have been delivered. These enhancements, many of which will be developed by the R3 program, can be introduced post-launch if results demonstrate a significant improvement. The AWG approach is to adapt mature algorithms from heritage systems whenever possible. This provides high confidence in meeting requirements and also offers the added benefit of having consistent products from similar observing systems in different orbits (Polar, Geostationary) so that products can be blended. It should be noted that many of the heritage approaches are actually advanced algorithms applied to advanced research instruments. These advanced instruments, for example MODIS, are similar to the advancements that will be provided by ABI. By following this approach we are also leveraging the investments of science teams, such as the MODIS clouds, aerosol, land, and sea surface temperature teams.



ADEB Findings

- **Recommendation 2B:** Encourage research to operations activities to the greatest extent possible.
 - **AWG Response:** The AWG agrees and plans to introduce demonstrated improvements through the NESDIS SPSRB process.
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- **Recommendation 2C:** Teams are encouraged to recognize and view their product in terms of user intention to merge observational products. For example, some of those merged products will consist of satellite polar and geostationary data, and other products will consist of blends of radar and satellite data or satellite and model data.
 - **AWG Response:** The AWG understands this and has implemented a blending of satellite observational data into some of its baseline algorithms such as precipitation. The R3 program includes the development and demonstration of merged products.



ADEB Findings

- **Finding 3:** Good mix on teams but possible “Group-Fest” Team members were well-qualified and covered the spectrum of required expertise. However, in general the same people were involved in the development and review process.
- **Recommendation 3:** Recommend teams encourage outside participation by seeking comments and feedback through conference presentations and by peer review throughout.
- **AWG Response:** We feel we are compliant with this recommendation. From the beginning, the AWG formed teams with a wide representation of scientist from academia, industry and Government. The AWG worked with the GOES-R Program Office to implement a peer review (IV&V) process with participants that are independent from the AWG. The algorithms are discussed at the GOES Symposiums at the AMS and other meetings, including the GOES User Conference.



ADEB Findings

- **Finding 4:** IV&V Technical Review was really a peer review not an IV&V Technical Review.
- **Recommendation 4:** Change the name from IV&V Team to Independent Peer Review to avoid misconceptions.
- **AWG Response:** The AWG agrees and will change the name to Peer Review (IV&V).



ADEB Findings

- **Finding 5:** The questions expressed to the peer reviewers were good, but may have limited a broader response.
- **Recommendation 5:** Instructions to the peer reviewers should encourage comments above and beyond simply answering the questions.
- **AWG Response:** The AWG agrees and will provide an expanded format when it convenes the next ADEB meeting for the 100% Baseline algorithm delivery.



ADEB Findings

- **Finding 6:** The mandated use of legacy languages (Fortran 77/90, C) by the AWG and GOES-R contractor may be a cost driver in the future.
- **Recommendation 6:** Software engineering processes employed by the Algorithm Integration Teams should follow modern coding standards.
- **AWG Response:** The AWG use of legacy languages is consistent with nearly every major earth observation application software systems. For example, the current POES, GOES, NASA EOS, future NPOESS, and world-wide numerical weather and climate prediction centers all use Fortran 90 and C. The AWG developed and implemented mature coding standards and CMMI processes to enable the GOES-R contractor to reuse much of the code, thereby reducing costs and risk to the GOES-R Program.



ADEB Findings

- **Finding 7:** Responses to peer reviews (IV&V) was somewhat uneven, e.g., Precipitation Group presentation did not respond to peer review (IV&V) comments.
- **Recommendation 7:** Responses to peer reviewed (IV&V) feedback should be expressed via formal action items.
- **AWG Response:** The Precipitation Group has modified their response to better reflect the peer review comments. The AWG has compiled application team response reports for all IV&V and ADEB comments. These documents have been uploaded to the AWG web site and are available to review.



ADEB Findings

- **Finding 8:** Robustness (graceful degradation) of algorithms not fully addressed. Impacts due to sensor/channel degradation or loss were only partially addressed by most of the Application Teams with little or no quantitative assessment of impact to product quality as input data degrade.
- **Recommendation 8:** Include thorough assessments of product impacts due to data degradation in the 100% review.
- **AWG Response:** Agreed, the AWG will spend more time addressing this in the 100% delivery.



ADEB Conclusion

“The Board unanimously agreed that there are no show stoppers for the delivery of the 80% algorithm set. We would like to recognize the carefully thought out process that is in place, that the management team is both skilled and knowledgeable, and that the program is committed to delivery of a product set meeting or exceeding user requirements. The Board found the user readiness planning presentation very helpful.

We recommend that the above findings be formally addressed as actions to be reviewed at 100% delivery. Finally, there are a number of insightful comments and cautionary notes that have been made by individual reviewers; the individual reports are found in Appendix 2. We recommend that consideration be given to the individual report comments, and we ask that the GOES-R Program Office review these individual reports for potential future actions.”



Topics for the Next ADEB Meeting

- Based on the ADEB feedback, we recognize we need to inform the ADEB on:
 - » GOES-R Risk Reduction Program
 - Funds Proposals For Innovative Algorithms, Blended Products, and User Readiness
 - » AWG plans for sustained product validation
 - Product monitoring and validation toolkits being developed
 - » AWG plans for user evaluation of “Official” GOES-R products through GOES-R Proving Ground Program and other user interaction mechanisms
 - » Process to test new approaches after 100% algorithm delivery
 - » SPSRB process for implementation of Day-2 algorithms
 - » Algorithm graceful degradation approaches



Topics for the Next Peer Review (IV&V)

- Inclusion of more concise instructions, guidelines, and questions that reflect all ADEB concerns
- Conduct the peer reviews early enough to give the ADEB more time to review and provide comments



Questions and Discussion

- The time is now open for questions and discussion



ADEB and Peer Review (IV&V) Reports

- To access reports and application team responses, please visit:
 - » <http://www.orbit.nesdis.noaa.gov/star/goesr/ATBD.php>
 - » login: atbd
 - » pw: adebivv