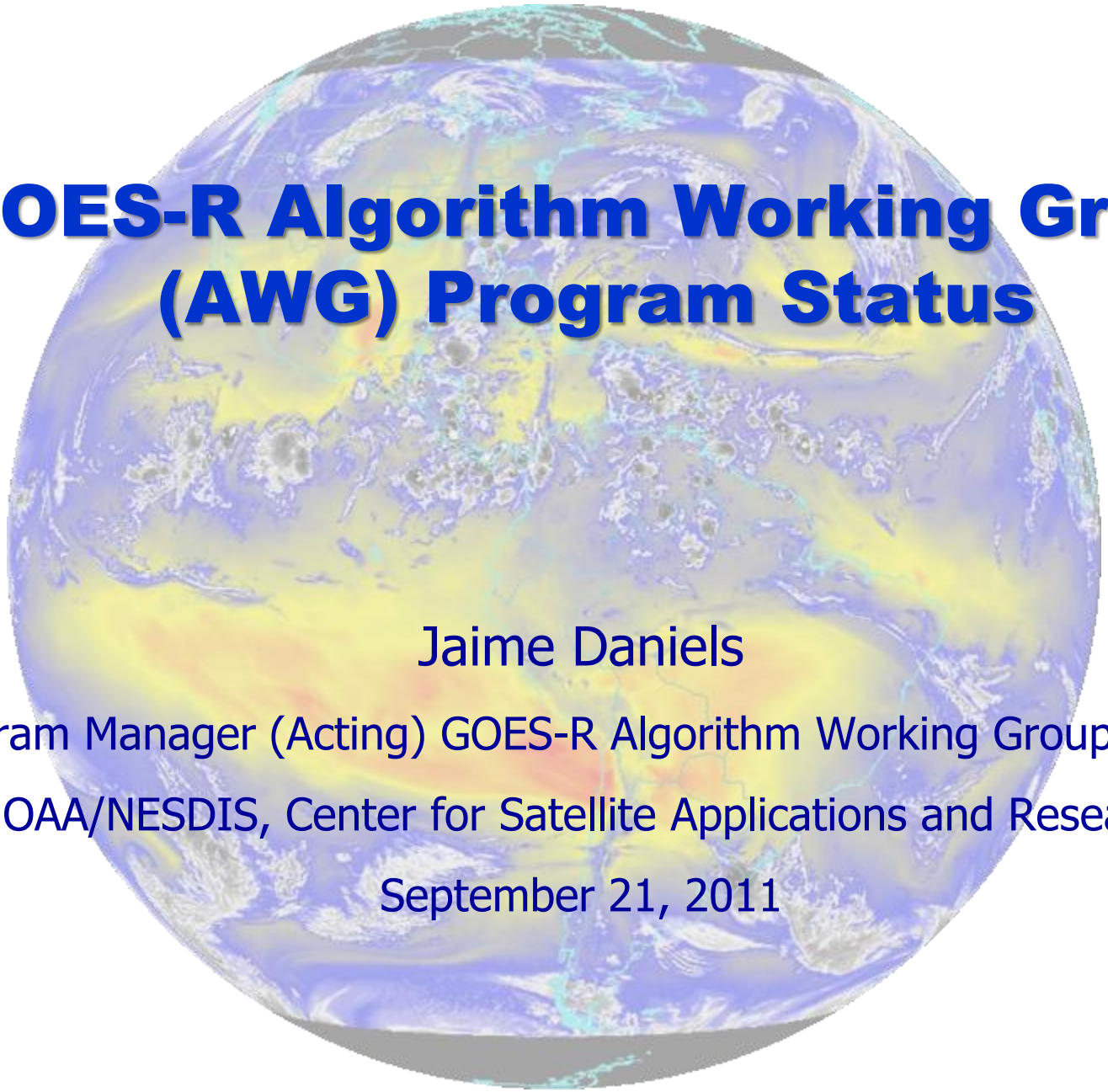


GOES-R Algorithm Working Group (AWG) Program Status

Jaime Daniels

Program Manager (Acting) GOES-R Algorithm Working Group (AWG)

NOAA/NESDIS, Center for Satellite Applications and Research

September 21, 2011

Outline

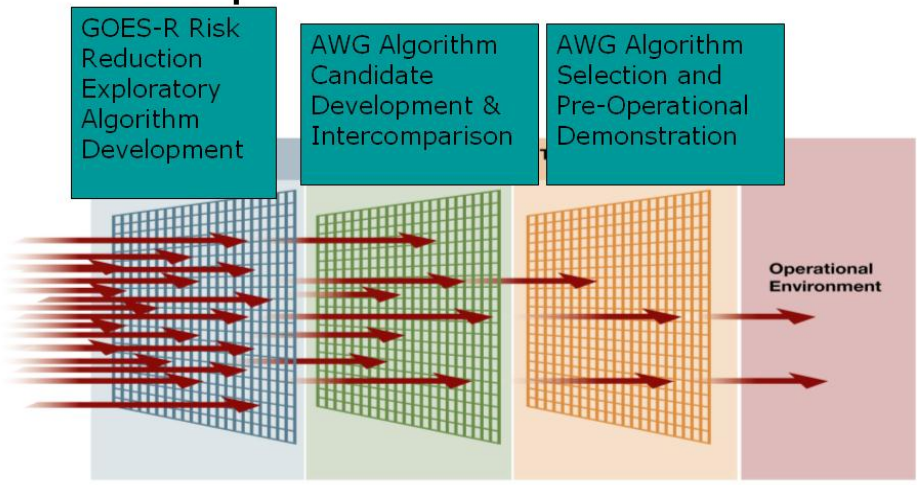
- AWG Role
- Level-2 Product Algorithm and Validation Scope
- AWG Meetings and Reviews
- Progress and Current Efforts
- Looking Ahead

GOES-R Algorithm Working Group

- Mission:
  - To select, develop, test, validate, and demonstrate Level-2+ algorithms that meet the GOES-R F&PS requirements and provide them to the GOES-R Ground Segment.
  - Provide sustained life cycle validation and Level-2 product enhancements

- **End-to-End Capabilities**
  - Instrument Trade Studies
  - Proxy Dataset Development
  - Algorithm Development and Testing
  - Product Demonstration Systems
  - Development of Cal/Val Tools
  - Integrated Cal/Val Enterprise System
  - Radiance and Product Validation
  - Algorithm and application improvements
  - User Readiness and Education

Algorithm Research to Operation Process



AWG Teams

AWG Product Application Teams	Team Lead
Imagery	Tim Schmit
Soundings	Tim Schmit
Winds	Jaime Daniels
Clouds	Andrew Heidinger
Aviation	Ken Pryor, Wayne Feltz
Hydrology	Robert Kuligowski
Land	Bob Yu
Cryosphere	Jeff Key
Radiation Budget	Istvan Lazslo
Lightning	Bill Koshak
SST	Alexander Ignatov
Ocean Dynamics	Eileen Maturi
Aerosols/Air Quality/Atmos. Chemistry	Shobha Kondragunta

AWG Specialty Teams	Team Lead
Proxy Data	Fuzhong Weng
Cal/Val (Sensor)	Changyong Cao
Algorithm Integration	Walter Wolf

AWG GOES-R L2 Algorithm Development Activities Reduce Risk

- **Allowed for early assessments of product quality**
  - Early accuracy and precision analysis performed
  - Opportunity to refine L2 product requirements

- **Government-side (AWG) implementation of ATBDs (ie.,software) that allows for L2+ product verification prior to GS vendor implementation**
  - AWG employs use of proxy data (simulated or real data from satellite instruments currently in orbit)
  - Proxy data run through L2 algorithms developed for GOES-R and L2 product are generated
  - Correlative measurements from other observing systems (surface-based, satellite-based, etc) used to characterize and quantify L2 product performance
  - Testing results enable algorithm verification of Product Measurement Accuracy and Product Measurement Precision specifications; reported in ATBDs

AWG Algorithm Development Scope

Baseline Level-2 Products

Cloud and Moisture Imagery (KPP)	Lightning Det: Events, Groups, Flashes*
Aerosol Detection (including Smoke & Dust)	Legacy Vertical Moisture Profile
Aerosol Optical Depth	Legacy Vertical Temperature Profile
Volcanic Ash: Detection & Height	Derived Stability Indices
Clear Sky Masks	Total Precipitable Water
Cloud Optical Depth	Fire / Hot Spot Characterization
Cloud Particle Size Distribution	Rainfall Rate/QPE
Cloud Top Phase	Sea Surface Temperature (skin)
Cloud Top Height	Downward Shortwave Rad.: Surface
Cloud Top Pressure	Reflected Shortwave Rad.: TOA
Cloud Top Temperature	Hurricane Intensity
Land Surface (Skin) Temperature	Snow Cover
Derived Motion Winds	

ABI	GLM

*** Included in GRB**

AWG Algorithm Development Scope

Day-2 Capabilities…

Aerosol Particle Size	Absorbed Shortwave Radiation: Surface
Aircraft Icing Threat	Downward Longwave Radiation: Surface
Visibility	Flood / Standing Water
Total Ozone	Ice Cover
Cloud Type	Snow Depth (over Plains)
Cloud Ice Water Path	Surface Albedo
Cloud Layers / Heights	Surface Emissivty
Cloud Liquid Water	Vegetation Fraction: Green
SO_2 Detection	Vegetation Index
Low Cloud and Fog	Ocean Currents
Upward Longwave Radiation: Surface	Ocean Currents: Offshore
Convective Initiation	Sea and Lake Ice: Age
Enhanced-V / Overshooting Top	Sea and Lake Ice: Concentration
Tropopause Folding Turbulence Prediction	Sea and Lake Ice: Motion
Upward Longwave Radiation: TOA	Probability of Rainfall
	Rainfall Potential

ABI

AWG Level-2 Product Validation Scope

- **Development of Level-2 product validation tools needed *post-launch* for:**
  - Routine monitoring of L2 product performance *(accuracy, precision)*
  - "Deep-dive" assessments and analysis of products *(problem resolution)*

- **Continued quantification of product performance**
  - Through ***pre-launch*** Level-2 product demonstrations and validation studies
  - Using available ABI proxy data and reference/"ground truth" measurements

AWG Meetings & Reviews 2011

- **Validation Workshop (May 10-11, 2011)**
  - Each AWG team presented its ongoing and planned efforts that involve the development of tools/capabilities and use of pertinent data sources for GOES-R Level-2 baseline product validation activities.
  - Each AWG team highlighted their ongoing and planned validation activities for their baseline L2 products
    - Validation strategies
    - Routine validation tools
    - "Deep-Dive" validation tools
    - Ideas for the further enhancement and utility of validation tools
  - Share information and capabilities that will be relevant to post-launch cal/val activities

http://www.star.nesdis.noaa.gov/goesr/vtools_ws_May2011.php

AWG Meetings & Reviews 2011

- **AWG Annual Meeting (June 14-16, 2011)**
  - Reviewed the progress of the AWG over the past year and discuss/review objectives of the coming year
  - Informed the GOES-R Program Office and the AWG Technical Advisory Committee (TAC) on the status of the AWG and receive guidance.
  - Product application teams presentations
    - Option-2 product algorithm development
    - Present some feedback on Algorithm Development Executive Board's (ADEB) independent peer review report of the Option-2 products
    - Validation focus for the Baseline products
  - Highlighted collective AWG assets and capabilities
    - Proxy datasets
    - Product Processing Framework
    - Product validation tools
    - End-to-end capabilities/tools to support instrument waiver process

http://www.star.nesdis.noaa.gov/goesr/AWG_Meetings.php

Sample of AWG Technical Advisory Committee (TAC) Recommendations

- "Due to greatly improved capabilities of the GOES-R system (total lightning, volcanic ash, aircraft icing, fog, turbulence, etc.) and large investment, the GOES-R should be put in to operational services as soon as possible. This best would allow the Nation to reap the benefits of GOES-R."

- "Successful delivery of Baseline products to the GOES-R Program Office has been a result of outstanding scientific technical and managerial work. All involved deserve the highest commendation."

- "Activities on track. TAC sees no show stoppers. Good Progress has been made on baseline (100% ATBDs) and option 2 (80% ATBDs). More detailed work remains."

- "Much high quality work related to the generation of Option 2 products has been presented at 2011 GOES-R AWG review. The Low Cloud and Fog and SO2 Detection products for example are needed for aviation safety and the Convective Initiation product is of clear assistance in severe weather prediction. It is important that the benefits to be accrued from the Option 2 products are not lost to the community."

AWG Meetings & Reviews 2011

- **Algorithm Development Executive Board (ADEB) Meeting (August 2-4, 2011)**
  - Provided a thorough, independent assessment of the GOES-R AWG Option-2 Level-2 product algorithms
  - Provide an independent assessment of processes followed by the AWG in the course of their algorithm development activities
  - Supported by a team of Independent Peer Reviewers (IPR) who performed a technical review of the Option-2 Product ATBDs
  - Preparing a final report for the GOES-R Program summarizing their findings with respect to state and readiness of the Option-2 product algorithms

Advisory Committee Members

TAC Members

- **John LeMarshall(C)** (Former Dir of JCSDA; Australian Bur. of Met.)
- **Kevin Schrab** (NWS/OCWWS)
- **Tom Vonder Haar** (Prof at CSU; Former Dir CIRA)
- **Paul Menzel** (UW; Former Chief Scientist of STAR)
- **Russ Schneider** (NCEP/ Dir. Storm Prediction Center)
- **David Byers** (NRL)
- **Mike Johnson** (NWS/OS&T)
- **Tom Schott** (NESDIS rep for OSD)
- **James Yoe** (NCEP)
- **Jim Gleason** (Proj. Scientist JPSS)

ADEB Members

- **Mike Johnson(C)** (NWS/OS&T)
- **Brant Foote** (Dir NCAR RAP)
- **Alex Trichtchenko** (Environ. Canada)
- **Paul Menzel** (UW; Former Chief Sci. of STAR)
- **John Zapotocny** (Chief Scientist AFWA)
- **Steve Goodman** (GOES-R Program Scientist)
- **Rolf Stuhlmann** (EUMETSAT MTG Program Scientist)
- **Tom Vonder Haar** (Prof at CSU; Former Dir CIRA)
- **Dan Satterfield** (Chief Meteorologist, WHNT-TV, Huntsville)
- **Marty Ralph** (Dir. for NOAA Testbeds, NOAA OAR)
- **Tsengdar Lee** (Prog. Mgr. NASA Earth Sci. Directorate)
- **Tom Renkevens** (NOAA/SSD/OPSP)

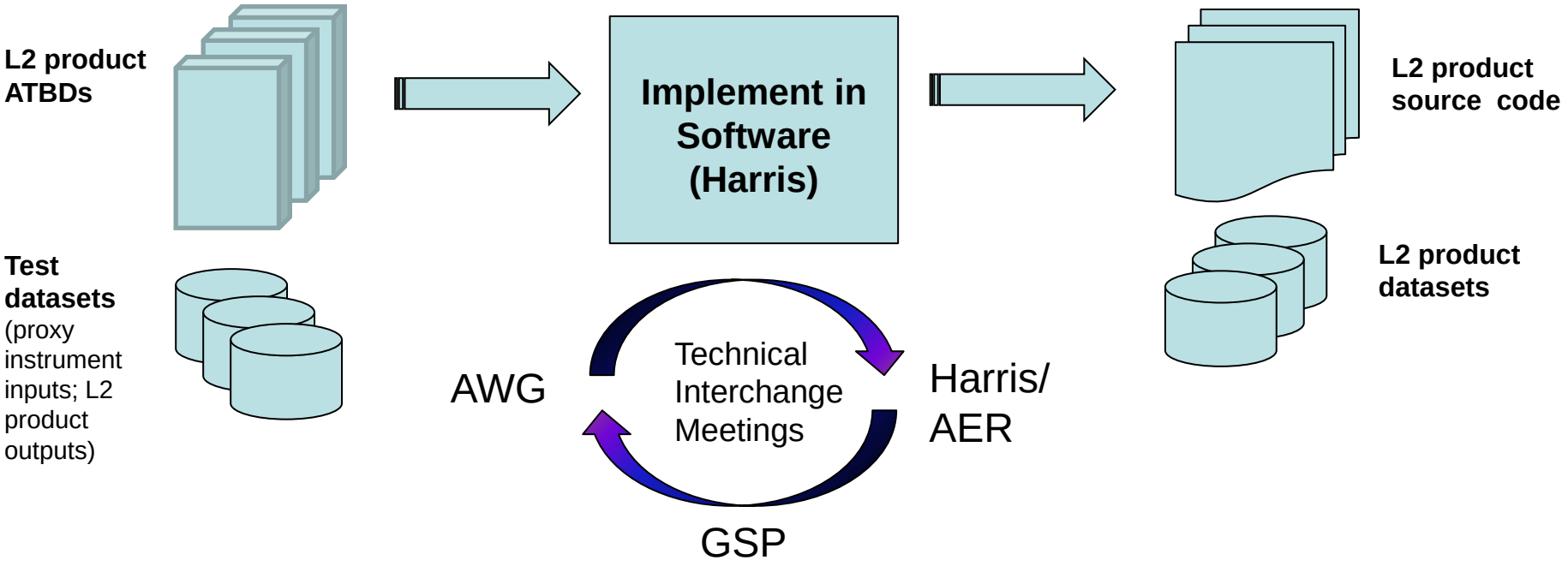
PROGRESS AND CURRENT EFFORTS

AWG Deliverables & Status

- **Algorithm Packages (APs)**
  - Algorithm Theoretical Basis Documents (ATBD)
  - Instrument proxy datasets
  - Product output datasets (for reproducibilty)
  - Algorithm Interfaces and Ancillary Data Description (AIADD) document
- **Schedule of Deliveries to the GOES-R Program**

✓ September 2008:	As-Is ATBDs
✓ September 2009:	80% APs for Baseline Products
✓ November 2010:	100% APs for Baseline Products
	80% APs for Option 2 Products
September 2011:	100% APs for Option 2 Products; 80% Visibility AP
September 2012:	100% APs for Visibility, Rainfall Potential, and Rainfall Probability Routine Validation Tool Documentation

From ATBDs to Level-2 Product Software



- **AWG is currently working closely with Harris/AER and the GOES-R Ground Segment Project (GSP) and Harris/AER in support of Harris' implementation of GOES-R Level-2 product algorithms**

➢ Process is critical for proper implementation of the L2 product algorithms

➢ Process is key for Harris to meet the reproducibility requirement (GSFPS-2758)

➢ Good progress is being made!

Product Application Team Progress

Option-2 Product Algorithms…

- Teams have developed, tested, and delivered Versions 4 & 5 of their Option-2 product algorithms to the AIT

- Teams have worked to enhance their validation datasets, where possible, in response to an ADEB recommendation to “pursue more complete datasets”

- Completed their Algorithm Readiness Reviews (ARR)

- Completed their 100% Algorithm Theoretical Basis Documents (ATBD)

Product Application Team Progress

Baseline Product Algorithms…

- Teams have been interacting with GSP and Harris/AER and responding to specific algorithm questions

- Teams involved in a number of baseline product validation activities
  - Development of their routine and "deep-dive" validation tools
  - Continuing to validate their baseline products and enhance their validation datasets, where possible, in response to an ADEB recommendation to "Continue to pursue more complete data sets even after 100% delivery".
  - Some teams have established routine near real-time product processing, when possible, using available proxy data
  - Identification of case study situations where algorithms are not performing well
  - Algorithm enhancements (beyond the 100% delivered algorithm)

AWG Cal/Val Tool Development

Two Categories of Validation Tools…

- **"Routine" Calibration/Validation Tools**
- **"Deep-dive" Calibration/Validation Tools**

	"Routine" Validation Tools	**"Deep Dive"** Validation Tools
	Bulk/overview analysis	Detailed/point analysis
	Executed soon after product generation	Not executed in real-time. May need to wait for other datasets
	Run routinely	Run when more detailed analysis of product performance is needed
	Run within OSPO and STAR	Run within STAR
	Automated	Automated and/or Interactive components

AIT Progress

- Algorithm Framework Deltas (bug fixes)
- Completed Code Unit Test (CUT) reviews (Option-2 product algorithms)
- Completed integration of new option-2 product algorithm code updates (Version 4 & 5) into framework
- Generation and redelivery of some baseline product test data sets
- Correct problems uncovered as a result of interchanges with Harris/AER
- Completed generation of baseline products over longer time period (4 month runs that span all seasons)
- Coordinating validation tool software developed by teams and is working toward designing an integrated validation system
- Coordinating AWG team responses with GSP and Harris/AER

Proxy Team Progress

1. Update of GOES-R Simulator

- Biases of GOES-11/12 and MSG SEVIRI channels using GSICS algorithms
- CRTM codes were updated with both SEVIRI and GOES SRF
- Two new IR land surface models were put into CRTM, and impact studies were preformed
- New IR emissivity model and simulated emissivity spectra

2. Proxy Data for AWG Algorithms

- Wild fire events in Arkansas and British Columbia from November 2008 (WRF, 4 bands)
- Produced ABI imagery for seven tropical cyclones, convective events, midwest winter storm
- WRF-CHEM (4 km, 12 km) 16 Aug 2006; ABI all bands (Delivered. 03/2011), 16 May 2010

3. Proxy BUFR Data for NWP Community

- Produced SEVIRI BUFR data (clear-sky radiances) and is now in NCEP/NCO operational system
- Tested GOES full resolution imager data in BUFR format
- GOES imager data was tested in GFS and WRF

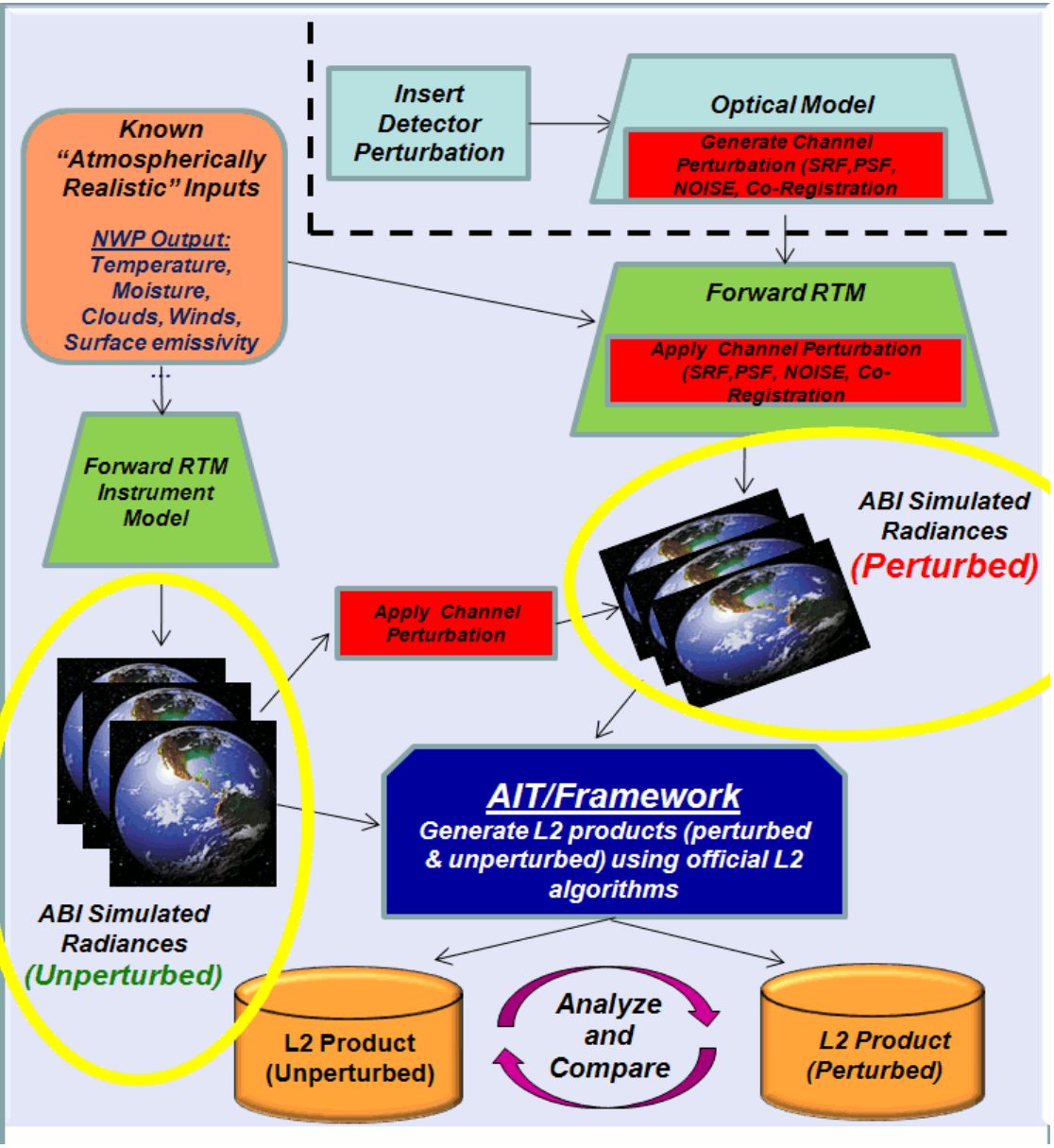
4. Forecast Impacts from Uses of GOES-R Proxy Data

- WRF/GSI rainfall forecast using GOES-11/12 IR
- Impacts of IR emissivity in GFS

AWG Capabilities in Support of the End-to-End Waiver Analysis Process

GOES-R Analysis Facility for Instrument Impacts on Requirements (GRAFIIR)

- Collection of capabilities/tools that support the GOES-R Program's "Photons to Products Modeling Capabilities"
  - NWP modeling
  - Radiative Transfer Model
  - Instrument perturbation tools
  - AWG L2 product algorithms
  - GLANCE Tool: Statistical comparison tool to analyze and quantify impact of perturbations



LOOKING AHEAD

Looking Ahead

- **Near-term AWG deliverables**
  - 100% Option-2 L2 Algorithm Packages; 80% Visibility Algorithm Package (9/30/2011)
  - 100% Option-2 L2 Algorithm Packages for Visibility, Rainfall Potential, and Rainfall Probability (9/30/2012)
  - Routine L2 product routine validation tool documentation (9/30/2012)

- **Continue to support the baseline Level-2 product algorithm implementation activity being done by the Harris Team**

Looking Ahead

- **Continue Level-2 product validation preparation activities**
  - Continue validation tool development & documentation
  - Pursue more complete validation datasets
  - Generate products from available proxy/simulated data
    - routine near real-time processing (outlier studies and analysis)
    - manual processing (case studies)
  - Continue to validate and characterize product performance

- **Continue Level-2 Algorithm Enhancements (beyond 100% algorithm delivery)**
  - Carefully manage L2 algorithm deltas
  - Support GOES-R Program in Planning for Launch
  - Development of a Level-2 Product Calibration/Validation Plan
  - Development of an algorithm transition plan

Looking Ahead

- **Support User Readiness and Evolving User Needs through AWG involvement in**
  - GOES-R Proving Grounds activities
  - GOES-R3 activities
  - JCSDA activities (NWP readiness)

- **Initiate Planning for AWG Activity in FY12**

BACKUPS