



# GOES R

## Benefits of an Enterprise Algorithm Change Management Process



NOAA ~ NASA



Heather Kilcoyne  
NOAA/NESDIS/GOES-R  
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# Overview

- What is an Algorithm Change?
- Why are Changes so Complicated?
- How are All Systems the Same?
- How do we Improve the Process Across the Enterprise?
- How do we Accommodate Differences between Satellite Programs?
- How do we Move towards a Common Process?
- How do we Benefit from an Enterprise Change Management Process?



# What is an Algorithm Change?

- An Algorithm Change is a modification of the operational software that computes a data product.
- Throughout the phases of a satellite mission, reasons to change a data product algorithm arise, some examples are:
  - Pre-Launch: Testing increases knowledge of instrument performance and implementation of science in algorithms
  - Calibration/Validation (Cal/Val): Instrument calibration tweaks and resolution of errors, both software bugs and science application/implementation
  - Operations: Evolution of requirements with changing user needs and science advancement
- The Satellite Ground System (GS) must be prepared to collect, approve, test, and implement these changes correctly and efficiently in order to deliver reliable and consistent data to the users.



# Why are Changes so Complicated?

- People, people, lots of people!
  - Many different organizations (consisting of many different people) are involved in finding, investigating, and resolving the issues, and then implementing in the operational system.
  - Each group of people has a different vocabulary, way of working, and motivation.
- System Environments
  - Each organization works within their own systems.
  - Security concerns limit access across systems.
  - Transfer of software between environments can be difficult, as different programming languages, compilers, and even operating systems are used.
- Motivations
  - Scientists are motivated by data product accuracy.
  - System Software Engineers are motivated by operational system stability.
- Control
  - Users depend on the product being accurate and consistent, as surprises in the data quality or format can affect user applications.
  - A disciplined approach to change must be used to limit interference in their operational use.



# How are all Systems the Same?

**Regardless of system, all changes follow the same path....**

- Detect/Identify discrepancy (Algorithm Issue) in operational data product
- Report issue for communication with Project and Team
- Prioritize within Discipline's tasks after evaluation if within scope and resources
- Investigate cause
- Resolve the issue in the code, deliver change package, test, and approve the change to the baseline
- Implement the solution in the operational system
- Verify solution implemented correctly in operational system

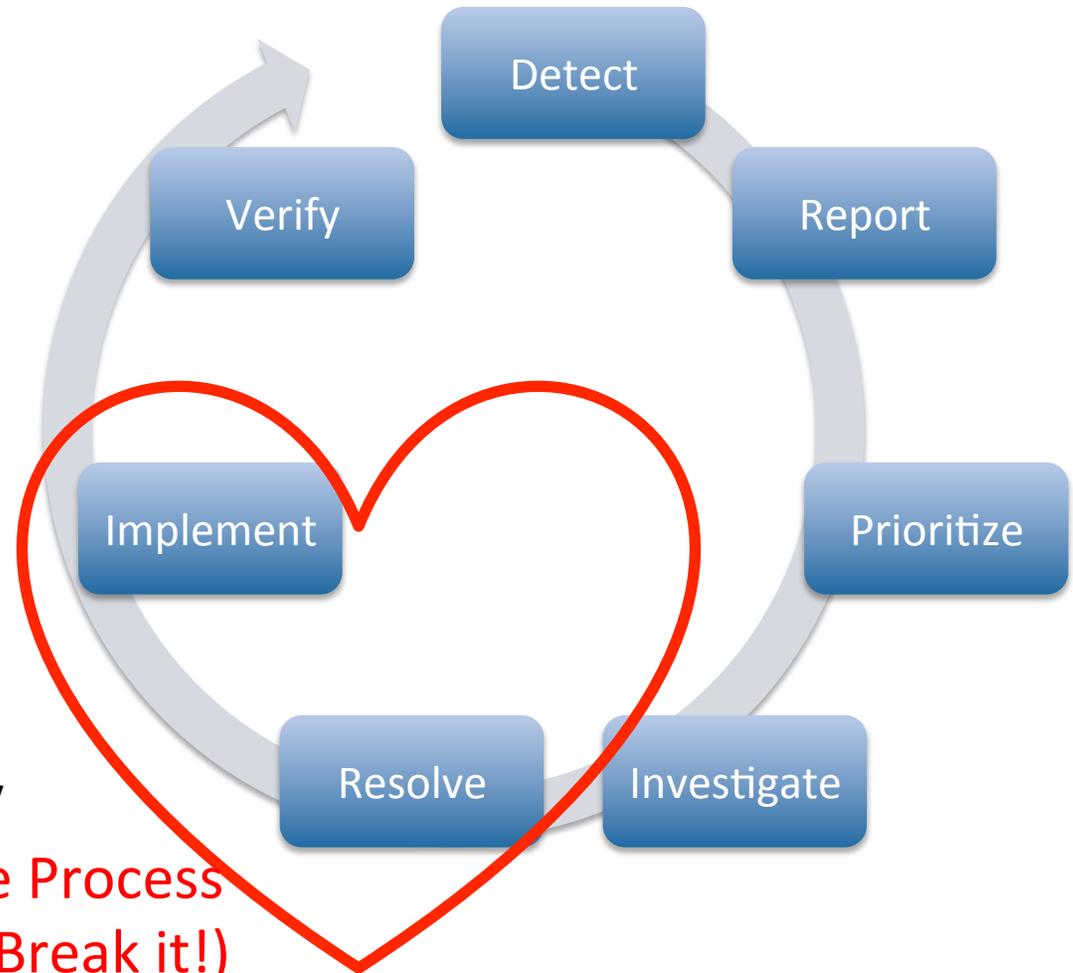




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## How do we Improve the Process across the Enterprise?

- NESDIS Office of Systems Architecture and Advanced Planning (OSAAP) will develop and maintain systems engineering policy, define and manage enterprise-level configuration control, and coordinate and communicate NESDIS enterprise solutions across NOAA and to external end users of the data.
- OSAAP is working with the NESDIS Office of Satellite Ground Services (OSGS), Office of Satellite and Product Operations (OSPO), Center for Satellite Applications and Research (STAR), JPSS, and GOES-R to establish a Common Algorithm Change Management Process that can be tailored for every program.
- The processes used by POES, JPSS, GOES, and GOES-R are the basis for developing a common process that can be tailored for use in all NESDIS Missions.
- Lessons Learned on Heritage Missions provide insight into inefficiencies and how they can be resolved or avoided.



## Lessons Learned (1/2)

- A Kaizen Event was conducted to evaluate the JPSS Algorithm Change Management Process in January 2013.
  - Kaizen Events are independently facilitated meetings where a team involved in a work process spend a week focused on analyzing how to improve the work process.
  - Goal was to reduce the processing time (while maintaining product integrity) for completing changes and improve communication and coordination among participating organizations.
  - Team members selected from JPSS Ground Project, NOAA JPSS Office, OSPO, GOES-R Ground Segment Project, and STAR.
  - The Current State and Ideal State were documented, and problems identified.
    - Analyses and changes performed on different operational baselines.
    - Delivered Algorithm Packages lacked reproducibility and were not complete.
    - Working environments differed from operational environment.
  - Outcome:
    - Quality Control of Delivered Algorithm Packages (DAPs) improved and content standardized.
    - Work towards limiting differences between working and operational environments.
    - OSPO included in review and prioritization of potential changes.



## Lessons Learned (2/2)

- Communication between and amongst participating organizations is key element of success.
- NESDIS organizations (STAR, OSPO, Program personnel and their Ground and Flight Contractors) can work shoulder-to-shoulder to make changes.
  - Types of change determine who does the bulk of the work, but all three groups are involved to some degree in each.
  - Contractual relationships should be structured to allow for technical interchange as needed to support mutual success.
- Algorithm Review Board (ARB) retains review and approval of science changes with the Subject Matter Experts and Organization accountable for Data Product Quality.
  - Provides early communicate of change to all stakeholders to assess impact prior to implementation.
  - Forum of people focused only on data product performance.
- Consistent application of DAP definition eases movement across organizational boundaries.



# How do we Accommodate Differences between Satellite Programs?

- JPSS and GOES-R have differing organizational structures, but the need for the Cal/Val Scientists, Users, Program Personnel, and OSPO Personnel to collaborate to resolve issues is identical.
  - GOES-R is following the JPSS lead by establishing an Algorithm Review Board to review and approve all science-related baseline changes.
  - The Delivered Algorithm Package (DAP) for GOES-R will be similar to that used for the initial science algorithm deliveries to the Program, which was tailored for S-NPP/JPSS.
- Tailoring for each Program will be needed to accommodate each separate Ground System.
  - Testing of DAP by Program prior to ARB review eliminated for GOES-R with STAR access to GS Development Environment.
  - GOES-R system ability to update algorithms without full software release may speed implementation of minor algorithms modification.
- Roles in the Process are filled by the appropriate position based on Program Accountability/Responsibility.
  - ARB Chair is the entity accountable for Data Product Quality during the specific phase of the program.
    - JPSS: Data Products and Algorithms Lead/Algorithm Project Lead
    - GOES-R: Program Systems Engineering/Program Scientist
    - Both will transition to OSPO when systems handed over to OSPO.
  - Data Product Lead is the owner of the algorithm and recommends changes to the ARB chair
    - JPSS: STAR personnel lead the Cal/Val teams and transition to Long-Term Monitoring support to OSPO in operations.
    - GOES-R: Instrument vendor responsible for algorithm development/issue resolution during Cal/Val, Program personnel and OSPO will facilitate collaboration between Calibration Working Group (CWG) and instrument vendors.



## How do we move towards a Common Process?

- Cal/Val Teams and Data Users will report, prioritize, resolve, and verify potential changes in the same way.
  - GOES-R is working with OSPO to update the legacy OSPO CM process to a new, consolidated process that will accommodate both new systems.
    - One type of “algorithm trouble ticket” will be used across all systems.
    - Original type of “configuration change request” will be used across all systems.
  - GOES-R is adopting the JPSS prioritization scheme, based on product priority and severity of discrepancy.
- All Programs will move towards a common vocabulary.
- Tools will be used across Programs.
- New Programs will tailor the established Algorithm Change Process for their systems.



## How do we benefit from an Enterprise Change Management Process?

- No need to “reinvent the wheel” with every new mission, but tailoring allows individual project needs to be addressed.
- Easier for developers to understand what is needed to transition new science into operations and training minimized across programs.
- Costs for implementing changes are decreased with increased efficiency.
- Common use of vocabulary and tools will ease participation across multiple missions.
- Changes are implemented more quickly, resulting in improved data for user applications.
- Data quality is maintained for the end users.