A Collaborative Approach for Algorithm Operationalization

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JeTSI

Outline

- The Problem: Getting Novel, Robust Science Into Operations
- Tightening the O2R2O Loop
  - Eliminating Rewriting
  - Reducing Manual Configuration
  - Providing a Unified Testing Framework
- Building an Open Standard
  - Multi-Mission Enterprise Algorithm Model
- Implementing Advanced O2R2O Principles
  - Algorithm WorkBench Component Model
  - Applicability to JPSS Modeling

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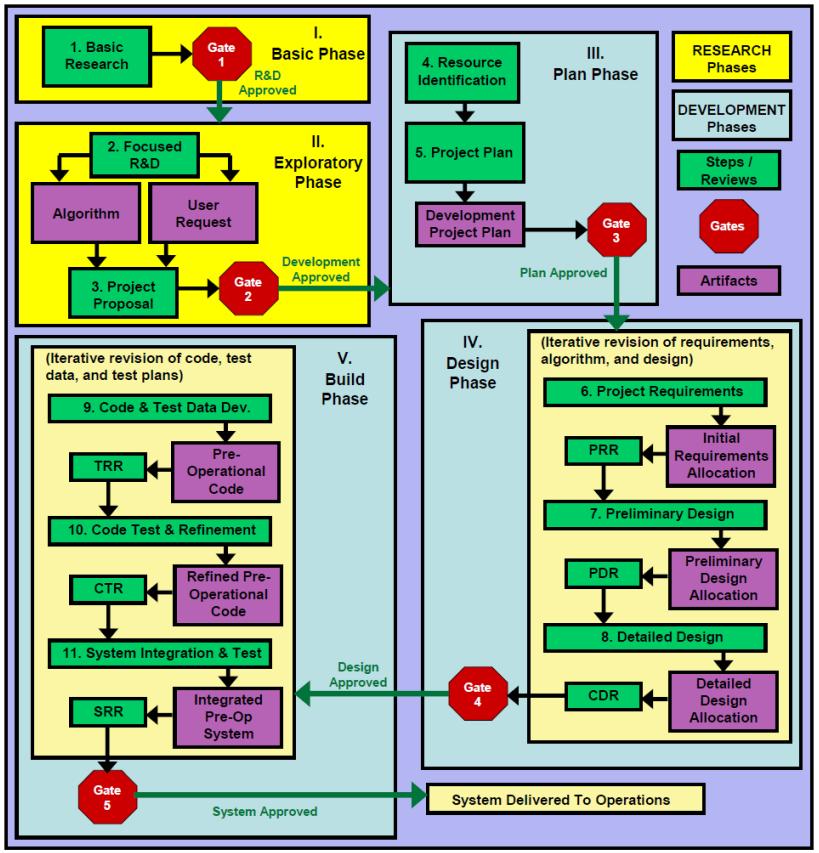
The Problem: Getting Novel, Robust Science Into Operations

- Desire is for cutting-edge data products built from the newest data streams
- Existing process is effective, but requires a long timeline between science and operations
- Strive for a more efficient process that moves algorithm developers closer to operational systems



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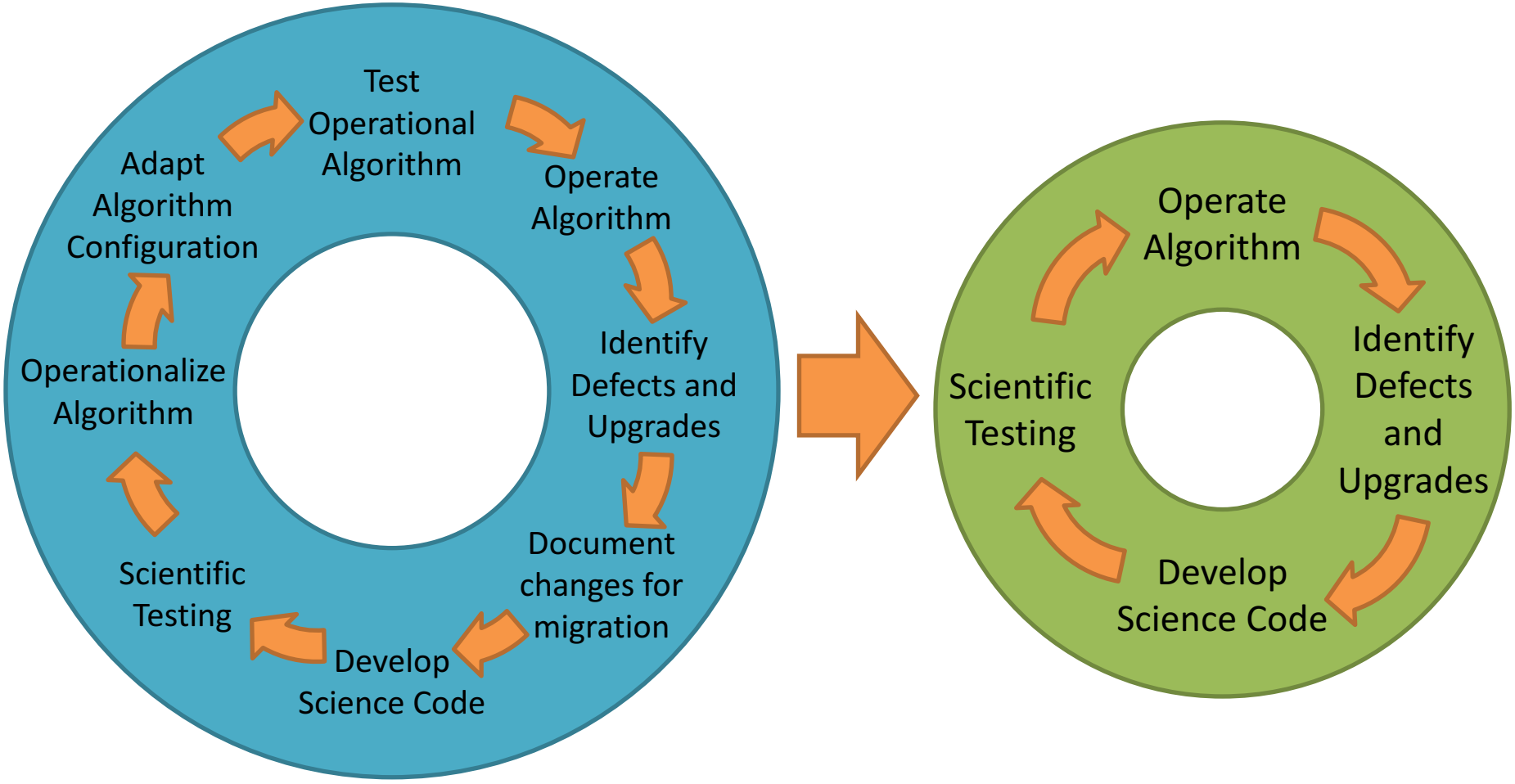
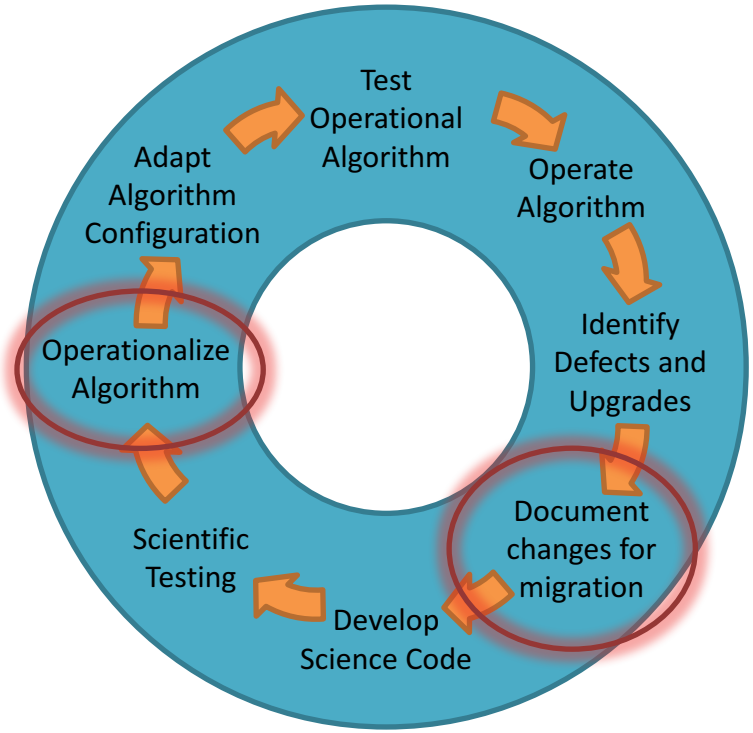
Tightening the O2R2O Loop



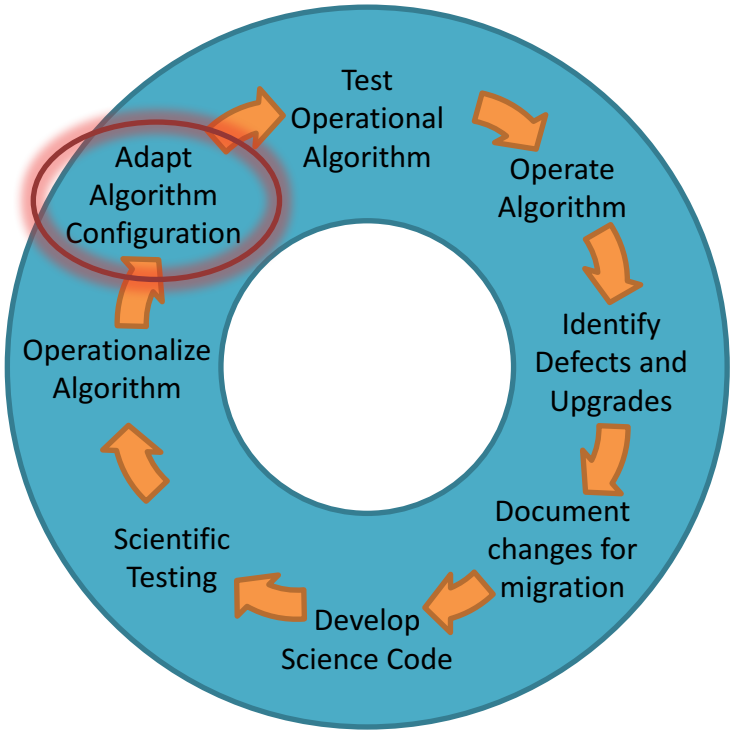
Eliminating Rewriting

- Strive for a single codebase that is shared between science and operational environments
- Algorithms must use common data interfaces
  - Allow data to be retrieved in different ways in test vs. operations
- Algorithms must be independent of block size and parallelization
  - Different operational systems will invoke algorithms on data with different coverage and resolution



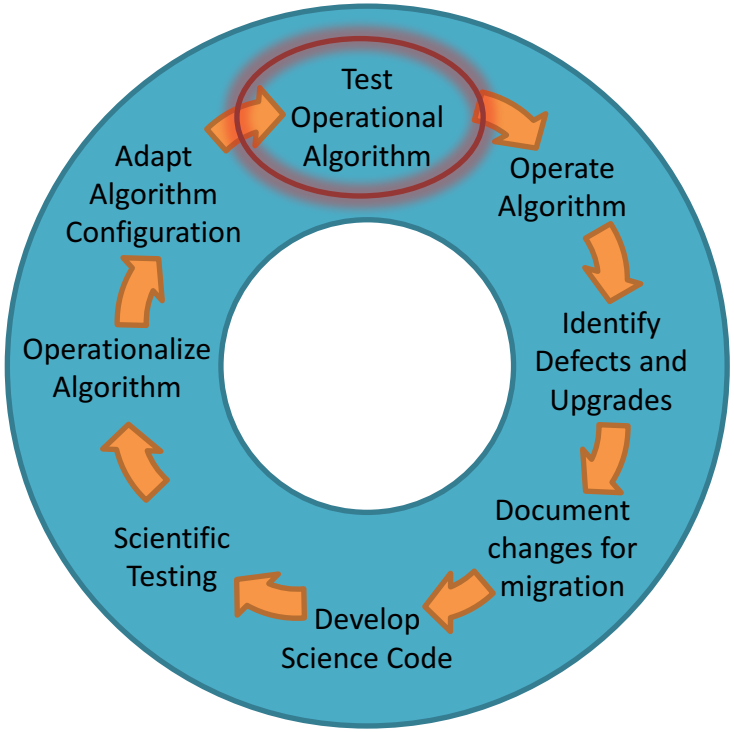
Reducing Manual Configuration

- Develop a system-independent way to express algorithm configuration
  - Represent data flows between algorithms
  - Allow different system configurations to substitute data from different sources
  - Flexible model that can be read and modified by a variety of tools
- System Configurations must be editable by algorithm developers
  - Test subsets of operational systems for small-scale integrations



Providing a Unified Testing Framework

- Scientific and Operational configurations must be testable on the same data
  - Test infrastructure must use same data interfaces as algorithms, to ensure portability
- Testing mechanisms must use algorithm configuration model
  - Facilitate automated tracking of data as system is tested
  - Verify complete system coverage



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Building an Open Standard

- Genuine Multi-Mission sharing of algorithms and data requires collaboration
  - Democratization of developing systems and algorithms that can run within them
- No single organization should serve as authority
  - Must enable distributed management of algorithms
  - Algorithms must be encapsulated as components
- Standards must address the needs of diverse missions and systems
  - Facilitate smooth data flow between weather models, LEO, and GEO observing platforms
  - Allow new and upgraded data streams to be migrated to existing algorithms

Multi-Mission Enterprise Algorithm Model

- Describe algorithm inputs and outputs in abstract terms
  - Allow algorithms to be run at different grid resolutions
  - Automated systems to track algorithm interdependencies
  - Generate processing trees algorithmically
- Represent outputs in semantically-useful form
  - Users can apply reusable tools to export data in a variety of formats
- Allow user-driven modification of metadata
  - Users can experiment with configuration changes and visualize their results on the entire processing chain

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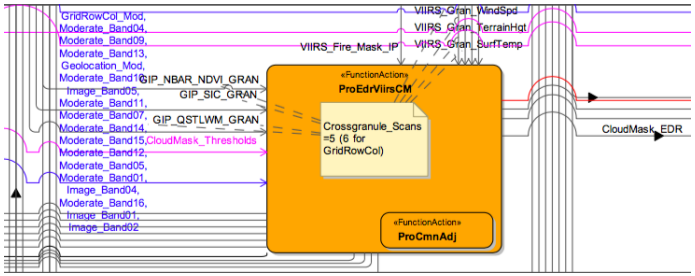
Algorithm Workbench Component Model

- AER Algorithm WorkBench is a complete ground processing system, evolved from the GOES-R testing infrastructure
  - Runs multiple algorithm blocks in parallel
  - Allows users to automatically generate execution trees
  - Can be run on user workstations, servers, or cloud systems
- Initial Effort Implements Open-Standard principles
  - Algorithm data are stored as freely-editable XML files
  - Fragment-based storage architecture is designed to be extended by multiple users
  - Shared algorithm data model can be implemented in different environments

Applicability to JPSS Modeling

- Prototype effort using MagicDraw and the AER Algorithm WorkBench to work with JPSS algorithm model
  - Users can model algorithm components in MagicDraw
  - Allows desktop visualization and editing of system design
  - Algorithm WorkBench imports XML model and can immediately use algorithms in its generated trees



Summary

- Current Research to Operations loop is effective but high-overhead
- Using abstract design principles, algorithms can standardize on a single code base shared between research and operations
- Algorithm component metadata can allow system engineering models to directly control algorithm execution
- Prototype effort using MagicDraw and AER Algorithm WorkBench has demonstrated these principles