Enterprise Plan for Algorithm Development and Integration to Operations

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Look towards the future

- Little or no monies are available to maintain older operational satellite science algorithms as GOES–R and JPSS systems are developed and become operational.

- OSPO is looking to retire products and product systems as new products become operational.

- OSGS is moving towards one Ground Enterprise ARchitecture System (GEARS) where the algorithms become services.
Current Algorithm Problem

- Multiple versions or type of algorithms for similar products are run in operations

- Multiple versions of algorithms are running in different systems on different hardware within OSPO
Solution

- Develop Enterprise Algorithms

- Implement Enterprise Algorithms within common system within OSPO
  - Eventually the GEARS system
Enterprise Algorithm Definition

- An enterprise algorithm is an algorithm that uses the same scientific methodology and software base to create the same classification of product from differing input data (satellite, in-situ or ancillary).
Motivation – Users

- Brings continuity of NOAA products between current and future NOAA operational satellites

- Supports the NWS Office of Science and Technology’s implementation strategy of multi-sensor algorithms and products
Motivation – NESDIS

- Enterprise Algorithms have the following advantages:
  - Continuity of NOAA products between current and future NOAA operational satellites
  - Cost effective processing for NOAA products
  - Maintenance of fewer algorithms and systems within operations
  - One transition of the algorithm service to the GEARS system
Algorithms
Types of Algorithms

- **Individual** – One algorithm suite per program per instrument (stovepipes)
- **Linked** – Algorithms that are developed for one instrument and may be dependent upon other products from that instrument (JPSS and GOES–R)
- **Individual Enterprise Algorithm Suite** – Algorithms that run on multiple instruments within one system
- **Complex Enterprise Algorithm Suite** – Algorithms that run on multiple instruments that have been designed to be transitioned to GEARS
Individual Algorithms

- Independent software base
- Minimal software reuse – algorithm team must develop data readers and writers for the instrument used
- Project only hardware – may or may not be shared with other instrument algorithms
- Medium development cost
- High maintenance cost
Linked Algorithms

- New system for new algorithm suite
- Products are linked together – product precedence
- Coordinated product development
- Project does not care about other satellites and/or instruments – requirements outside the project have no weight
- High cost
- System complexity determines maintenance cost
Individual Enterprise Algorithm Suites
Individual Enterprise Algorithm Suites

- Individual Enterprise Algorithm Suite is a program that has been developed by a science team to create their suite of products for multiple satellites
  - AVHRR Clear-Sky Processor for Oceans (ACSPO) – SST for polar satellites, currently being updated to process AHI data
  - Microwave Integrated Retrieval System (MiRS) – Microwave product suite for most microwave instruments
  - NESDIS Unique CrIS and ATMS Product System (NUCAPS) – Sounding product suite created using AIRS, IASI and CrIS hyperspectral sounding data
Software

- Algorithm methodology and software is reused for multiple instruments
- Reduced algorithm development time
- Algorithms and software may not have been designed to be transitioned into a service base system
Issues: Run in Multiple Systems

- The Enterprise Algorithm Suites are currently run in multiple processing systems within OSPO
- Different versions of the suites are run in each of the processing systems
- Regression tests may not be conducted – deliveries for each instrument individually
Steps Towards GEARS

- Consolidate Enterprise Algorithm Suites onto one or two processing system within OSPO
- Remove versionitis by conducting regression tests for the products
- Minimize software deliveries by updating algorithm for multiple satellites at once
- Evaluate algorithm implementation and work with STAR development team to create GEARS like algorithm service interfaces
Complex Enterprise Algorithm Suite
Complex Enterprise Algorithm Suite

- STAR Enterprise Processing Framework
- Overall program that keeps common data in memory
  - Individual algorithm teams create their own subroutines to plug into the program
  - Algorithm teams are dependent upon products from other algorithm teams
- Redundancy removed that is common amongst algorithms
More Enterprise Algorithms

- Work is being conducted to modify NOAA Heritage Cloud, Cryosphere, Volcanic Ash, and Aerosol algorithms to work on VIIRS data.

- For most products, the heritage algorithm is the GOES–R algorithm.

- This will bring scientific consistency between the GOES–R products and VIIRS products.
VIIRS and GOES–R Cloud Products

- Cloud Mask
- Cloud Top Phase
- Cloud Type
- Cloud Top Height
- Cloud Cover Layers
- Cloud Top Temperature
- Cloud Top Pressure
- Cloud Optical Depth
- Cloud Particle Size Distribution
- Cloud Liquid Water
- Cloud Ice Water Path

(All GOES–R heritage)
VIIRS and GOES–R Aerosol Products

- Aerosol Detection
- Aerosol Optical Depth
- Aerosol Particle Size

- Volcanic Ash Mass Loading
- Volcanic Ash Height

(All GOES–R heritage)
VIIRS and GOES–R Cryosphere Products

- Binary Snow Cover
- Fractional Snow Cover
- Ice Concentration and Cover
- Ice Surface Temperature
- Ice Thickness/Age

(Ice products have GOES–R heritage, Snow products have operational heritage)
Cloud and Wind Enterprise Algorithms

- Cloud algorithms from AVHRR and GOES are being migrated to a common software base (the SAPF) in operations

- Derived Motion Winds algorithms from AVHRR and MODIS are being migrated to a common software base (the SAPF) in operations

- All cloud and wind products in operations will be consolidated when these projects are complete
Transition to Enterprise Algorithms
STAR ASSISTT

- The Algorithm Scientific Software Integration and System Transition Team (ASSISTT) designs and develops algorithm processing suites/systems that are transitioned to OSPO.

- Once these satellite suites/systems are transitioned to operations, STAR works in coordination with OSPO to maintain the science within these systems.

- ASSISTT specializes in this end to end process (design, development, transition to operations, and maintenance) for algorithm processing systems and their products.
## Satellite Algorithm Integration for Common Ground System

### Tasks
- Lead Process Lifecycle Reviews
- Provide scientists with software development guidance
- Integrate algorithms into processing systems
- Perform unit, regression and system tests
- Package and deliver algorithms/systems to OSPO
- Requirements development and tracing
- Configuration Management
- Risk Management
- Implementation of one program to create all satellite products
- Implementation of a hardware cluster for algorithm testing and reprocessing

### Projects
- **Supported by ASSISTT**
  - GOES-R
  - JPSS
  - NDE (Six projects)
  - Himawari-8
  - GCOM (AMSR-2 Instrument)
  - GOES Clouds, Winds, Fog, Land Surface Temperature, and Radiation Budget
  - AVHRR Clouds and Volcanic Ash
  - Product Tailoring
  - Product Monitoring
  - Direct Broadcast
  - OSGS Algorithm Prototype

### Enterprise
- **Implementation of the STAR Enterprise Algorithms** *
  - Winds – GOES-R ABI, Himawari-8, S-NPP VIIRS, GOES, AVHRR, SEVIRI, MODIS
  - Cloud Products – GOES-R ABI, Himawari-8, S-NPP VIIRS, GOES, AVHRR, SEVIRI, MODIS, MTSAT
  - Volcanic Ash – GOES-R ABI, Himawari-8, S-NPP VIIRS, AVHRR
  - Cryosphere Ice Products – GOES-R ABI, Himawari-8, S-NPP VIIRS
  - Aerosol Detection – GOES-R ABI, Himawari-8, S-NPP VIIRS
  - Aerosol Optical Depth – GOES-R ABI, Himawari-8, S-NPP VIIRS
Steps towards GEARS
Transition Steps for Algorithms to GEARS

- Create Enterprise Algorithms
- Implement Enterprise Algorithms into a common system(s)
- Migrate common system Enterprise Algorithms to GEARS system
Enterprise Algorithms have the following advantages for a GEARS implementation:

- Development cost reduction
- One transition of the algorithm to the GEARS system
- Enables easier transition to algorithms as a service
Summary

- Enterprise algorithms are a logical step in the transition to the GEARS system
  - Consolidation of science
  - Consolidation of systems
  - Minimization of operational software to maintain

- Goal is for these enterprise algorithms to become GEARS services
Backup Slides
ASSISTT – Enterprise Algorithms

- Winds – GOES–R ABI, Himawari–8, S–NPP VIIRS, GOES, AVHRR, SEVIRI, MODIS
- Cloud Products – GOES–R ABI, Himawari–8, S–NPP VIIRS, GOES, AVHRR, SEVIRI, MODIS, MTSAT
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