



O2R20 – A 21st Century Approach to the Operationalization of Weather Science

Stephen Marley, Jeffries Technology Solutions Inc.

Steven Petersen, NOAA/NESDIS

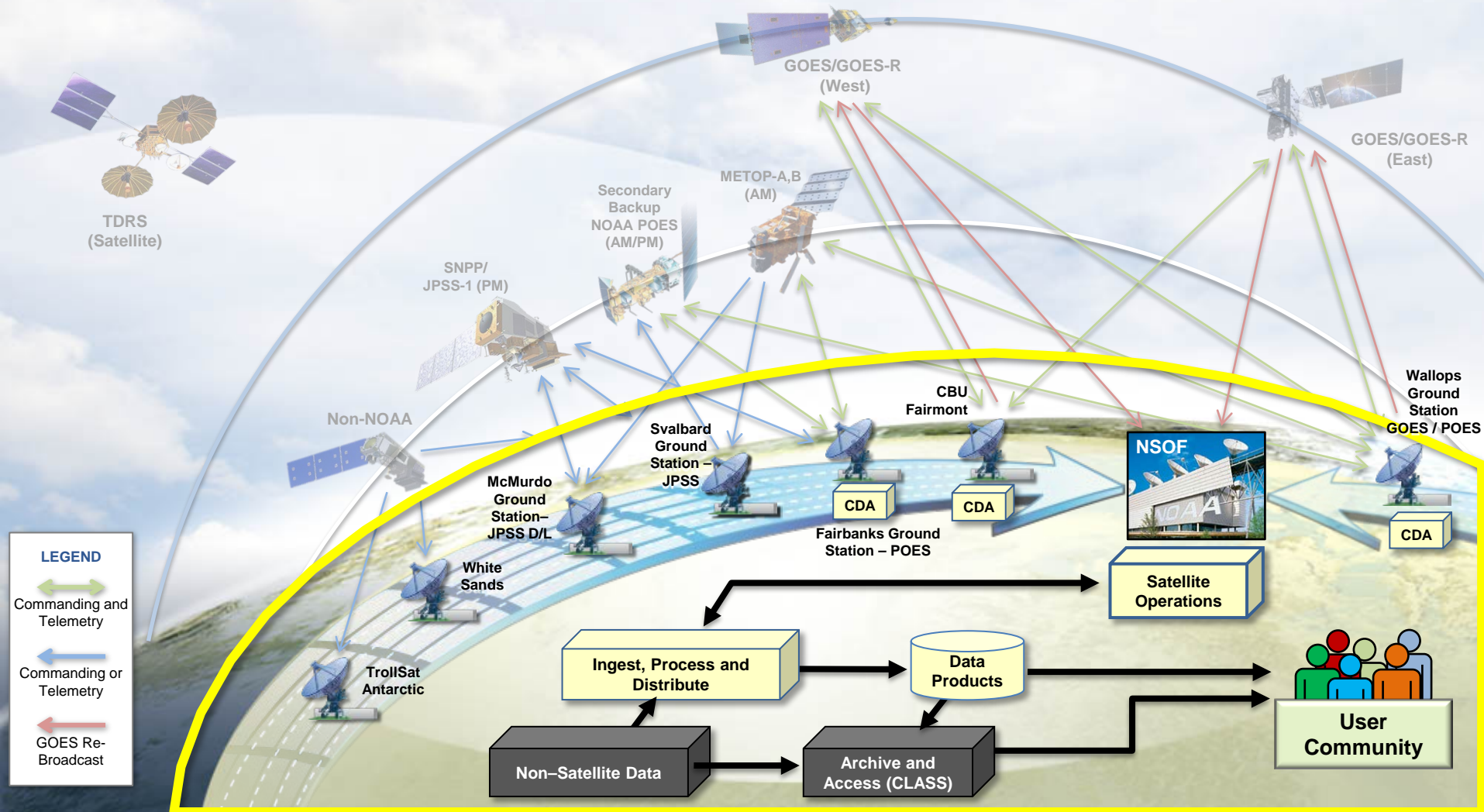
Maureen Madden, NOAA/NESDIS

Date:





NESDIS Ground Enterprise



The Ground Enterprise Connects Multiple Elements of NESDIS



NESDIS Ground System-Mission Line of Sight



*OSGS sustains, enables, and creates the systems and services that comprise the **NESDIS** Ground Enterprise.*

NESDIS GROUND SYSTEM MISSION LINE OF SIGHT

NOAA MISSION

SCIENCE

To understand and predict changes in climate, weather, oceans and coasts

SERVICE

To share that knowledge and information with others

STEWARDSHIP

To conserve and manage coastal and marine ecosystems and resources

Resilient Ecosystems, Communities, and Economies

Environmental intelligence is critical to achieving the objectives of all of NOAA's goals. NOAA is, at its foundation, an environmental information generating organization

NESDIS MISSION

- To acquire and manage the Nation's operational environmental satellites
- To operate the NOAA National Data Centers
- To provide data and information services including Earth system monitoring
- To perform official assessments of the environment
- To conduct related research

NESDIS is the world's most comprehensive source and recognized authority for satellite products, environmental information, and official assessments of the environment in support of societal and economic decisions.

OSAAP
GOES-R
JPSS
OPPA
STAR
NCEI
ACIO-S
OSGS
OSPO

OSGS MISSION

SUSTAIN

Sustain NESDIS legacy ground systems and develop early, enterprise elements

ENABLE

Transition and sustain next generation ground segments for JPSS and GOES-R

CREATE

Develop and deploy common Ground Enterprise Architecture Services



Imperative for Change



- **Constraints**

- Limited budget for the sustainment of older operational satellite science algorithms

- **Opportunities**

- OSPO is looking to retire products and product systems as new products become operational
- OSGS is moving towards an Integrated Ground Enterprise where the algorithms become services

- **Goal**

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



International Weather Community Evolution



- **From Earth Observations to Earth Information System**
 - Holistic space program investment approach (including space, ground and application segments) ensuring turning satellite observations into value-added products, information and knowledge supporting many applications
- **Improving Measurement precision and long-term consistency**
 - The strategic focus for improving measurement precision while also enhancing spatial, spectral, and temporal resolution.
- **Go beyond International Coordination to start International Planning***
 - International committees by government-designated entities move towards global planning, optimization & interoperability

*Zhang et al, Development of a Vision of WIGOS Space-based Component in 2040 (NOAA Satellite Conference, 2015)



Weather Forecasting Trends



- **Assimilation of Radiances for NWP**
 - Assimilated radiances (cf. parameter retrievals) offers many operational benefits. Moves the emphasis on EDR/L2 processing to post assimilation
- **Predictive Analytics (Big Environmental Data)**
 - Pattern based analysis, enhancing deterministic forecasts to provide risk based decision support
- **Warn on Forecast**
 - Nowcasting becomes the primary tool for severe Weather Services.
 - e.g. realtime mesoscale NWP providing rolling 30-90 minute forecasts updated every 5-15 minutes

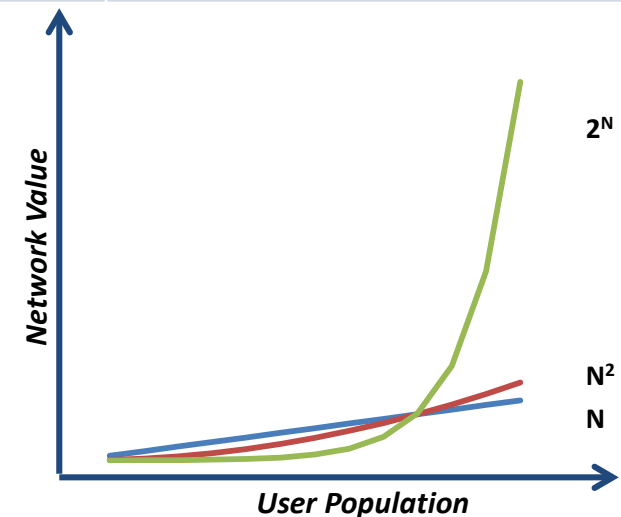


Social Networking Impact



Platform Era	Use Model	Network Value	Role of NOAA	Wx Community Role
1 st Generation (Pre-JPSS / GOES-R)	Broadcast	Sarnoff $\propto N$	<ul style="list-style-type: none">All Observations,All Products and,Most Applications	<ul style="list-style-type: none">Consume NOAA data with little value-add
2 nd Generation (JPSS / GOES-R)	Networked	Metcalf $\propto N^2$	<ul style="list-style-type: none">All Observations,Most products, andMany Applications	<ul style="list-style-type: none">Value-add to NOAA data for particular customer needs
3 rd Generations (Post-JPSS / GOES-R)	Communities of Interest	Reed $\propto 2^N$	<ul style="list-style-type: none">Most ObservationsFoundational ProductsCore Mission Applications	<ul style="list-style-type: none">Uses NOAA data as the base from which to add value in diverse markets

As the relative cost of IT Infrastructure continues to decrease, the role of the provider as the “sole source” of value will diminish → the End-Users will be empowered





Architectural Responses



- **NESDIS Ground Enterprise needs to facilitate:**
 - Integrated Global Observation Environment
 - NOAA will increasingly depend on non-NOAA data to execute its mission. Interoperability will be essential.
 - Heterogeneous End-User Services
 - Diverse data needs driven by “localized” priorities. Flexible provisioning is key.
 - Dispersed Value Generation
 - NESDIS facilitates value-add, but isn’t the sole (or even dominant) provider of it. Re-focus on enabling science rather than generating product



Implications for the NESDIS Ground Enterprise



- **Decoupling the Applications from Observation**
 - Traditional tight coupling of the science with observation ground system implementation is neither cost effective nor desirable
 - Decoupling of the application of observation from the operation of the observation systems will free the applications community:
 - Algorithms are no longer tied to a specific infrastructure
 - Enables Enterprise Algorithms that support multiple observation platforms
 - Promises increased application innovation by end-user communities;
 - Rapid R2O;
 - Lower upfront investment for new missions;
 - Improved data interoperability



Requirements Implications



- **The future offers tremendous potential**
 - Harnessing the power of a large and diverse applications community, but
 - Invokes the risk of dysfunctional chaos
- **Need “Constrained Innovation” establishing the coordination frameworks by which:**
 - **Agencies coordinate** – e.g. observation architecture, and operational data sharing
 - **Observation Systems measure** – e.g. instrument characteristics, orbital architecture
 - **Providers deliver data** – e.g. products, resolution (spatial, temporal, spectral)
 - **Applications share information** – e.g. Data Format, Content/Exchange models
 - **Users communicate results** – e.g. decisions, uncertainty



Algorithm R20



- **Enterprise Product Lifecycle**

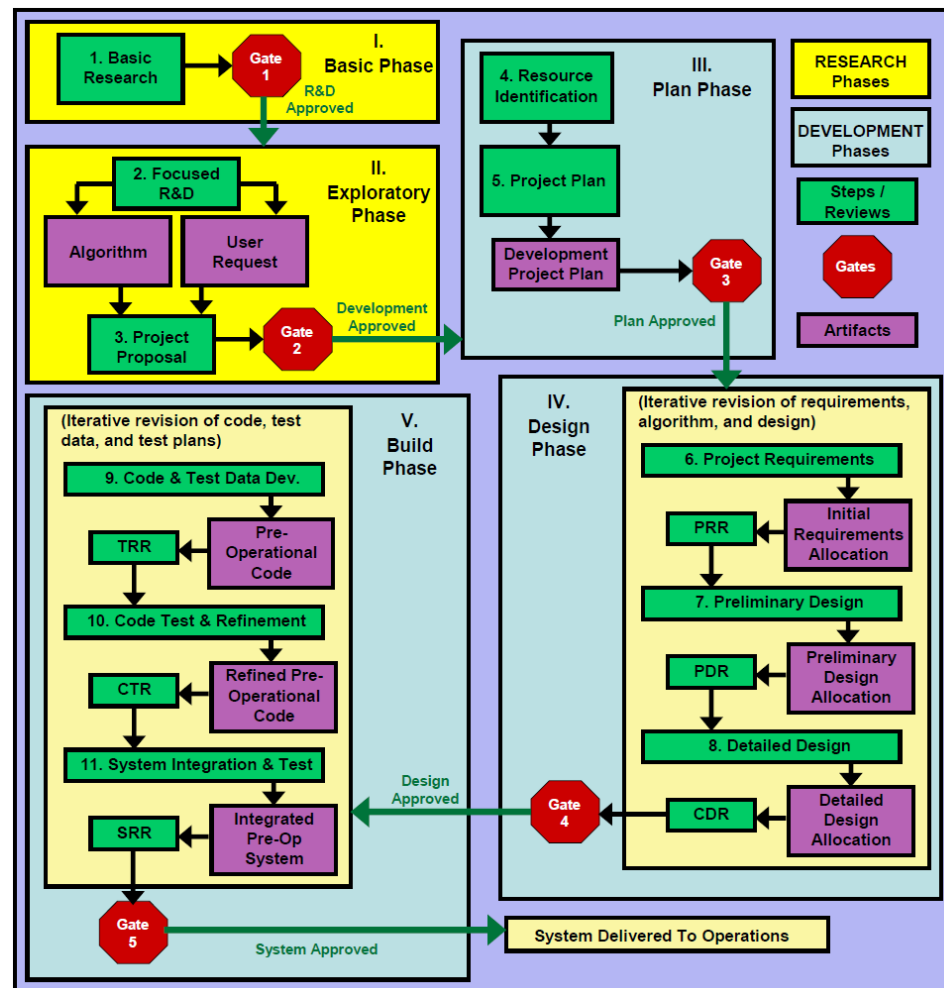
- Formal process for product algorithm development and operational integration
- Focus is on a repeatable mature approach that ensures high-quality operational algorithms

- **Pros**

- Well Governed Science
- Performance & Reliability

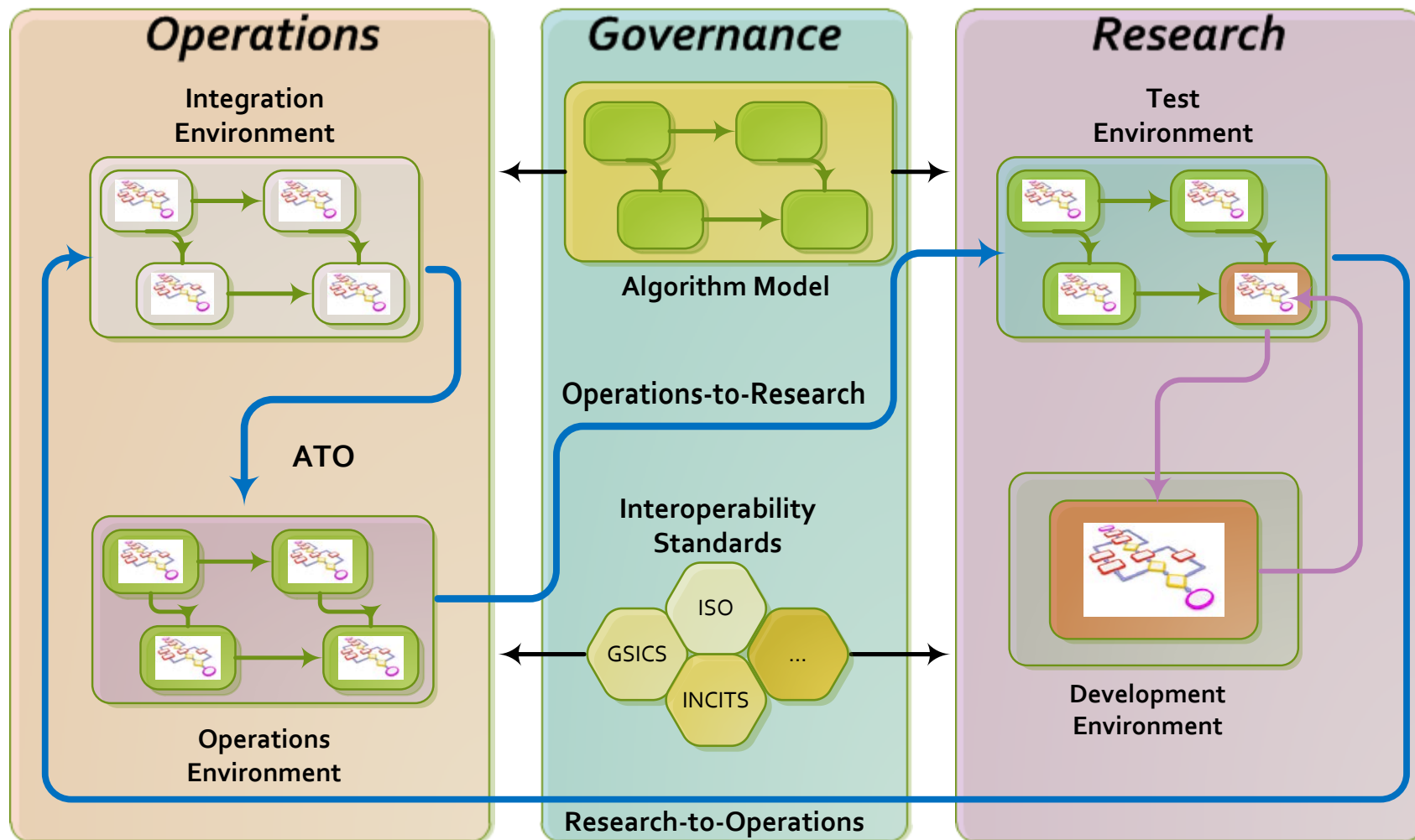
- **Cons**

- Slow to Respond to Change
- Mission Dependent Integration
- Divergent Implementation





Future O2R2O Model

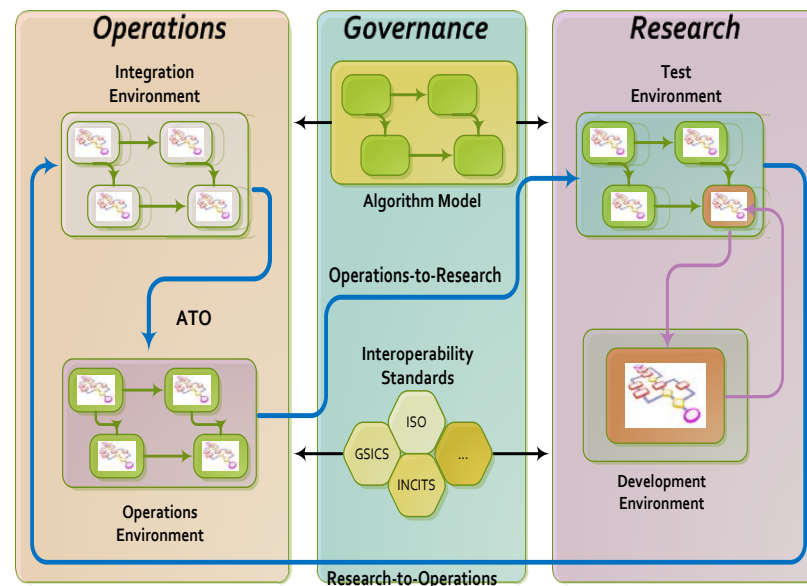




Future O2R2O Model

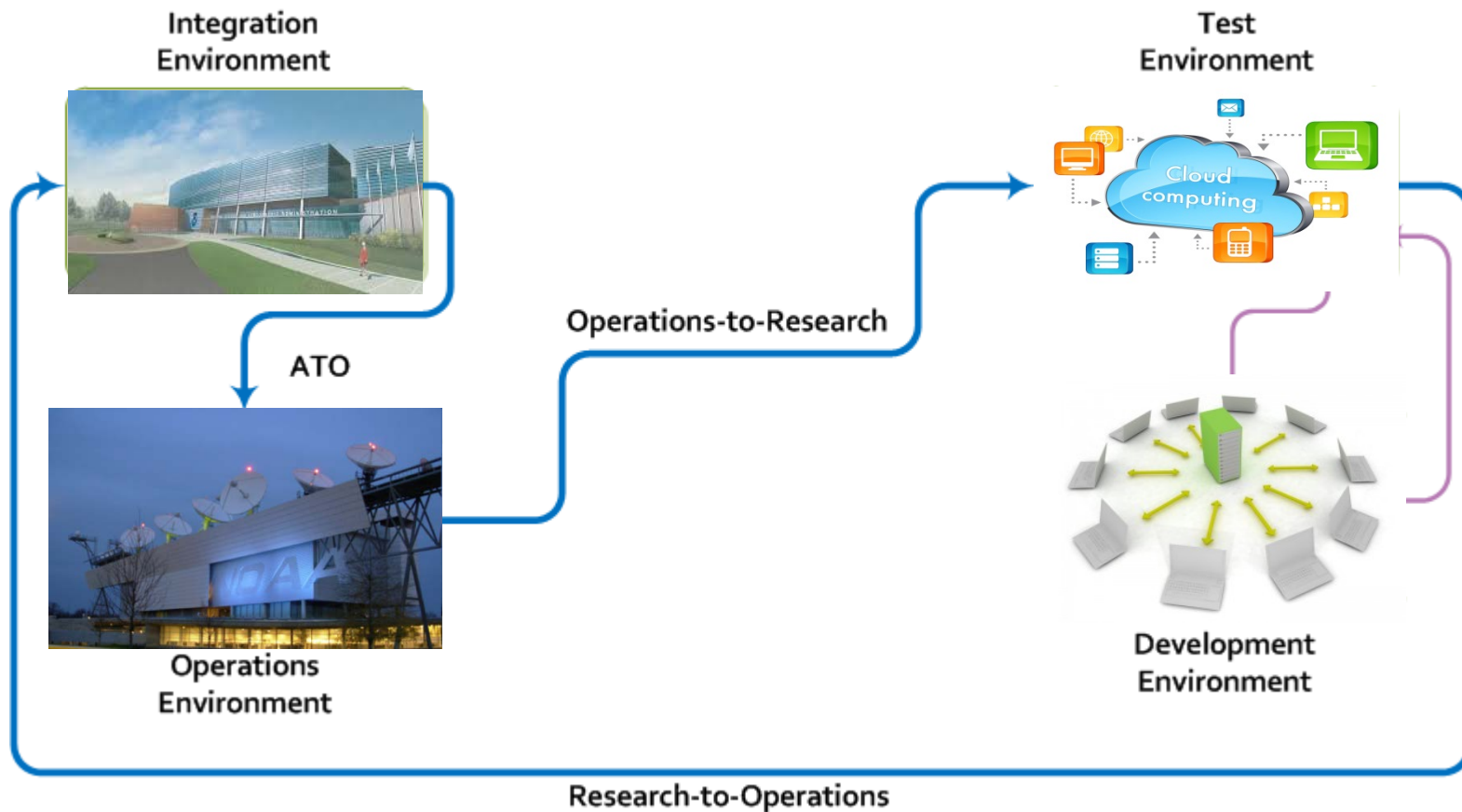


- Both Research and Operations use the same set of Governed Algorithm Models
- Each Algorithm Process interfaces to other algorithms and the execution environment through controlled API's
- Algorithm R&D is performed against the operational baseline





Deployment Flexibility





Summary



- **Current R2O Approach within NOAA is not Sustainable**
- **Technology Trends Demand a more Adaptable Approach to the Operationalization of Science**
- **NESDIS/OSGS is Architecting a New Approach that Provides Flexibility while Ensuring Integrity**