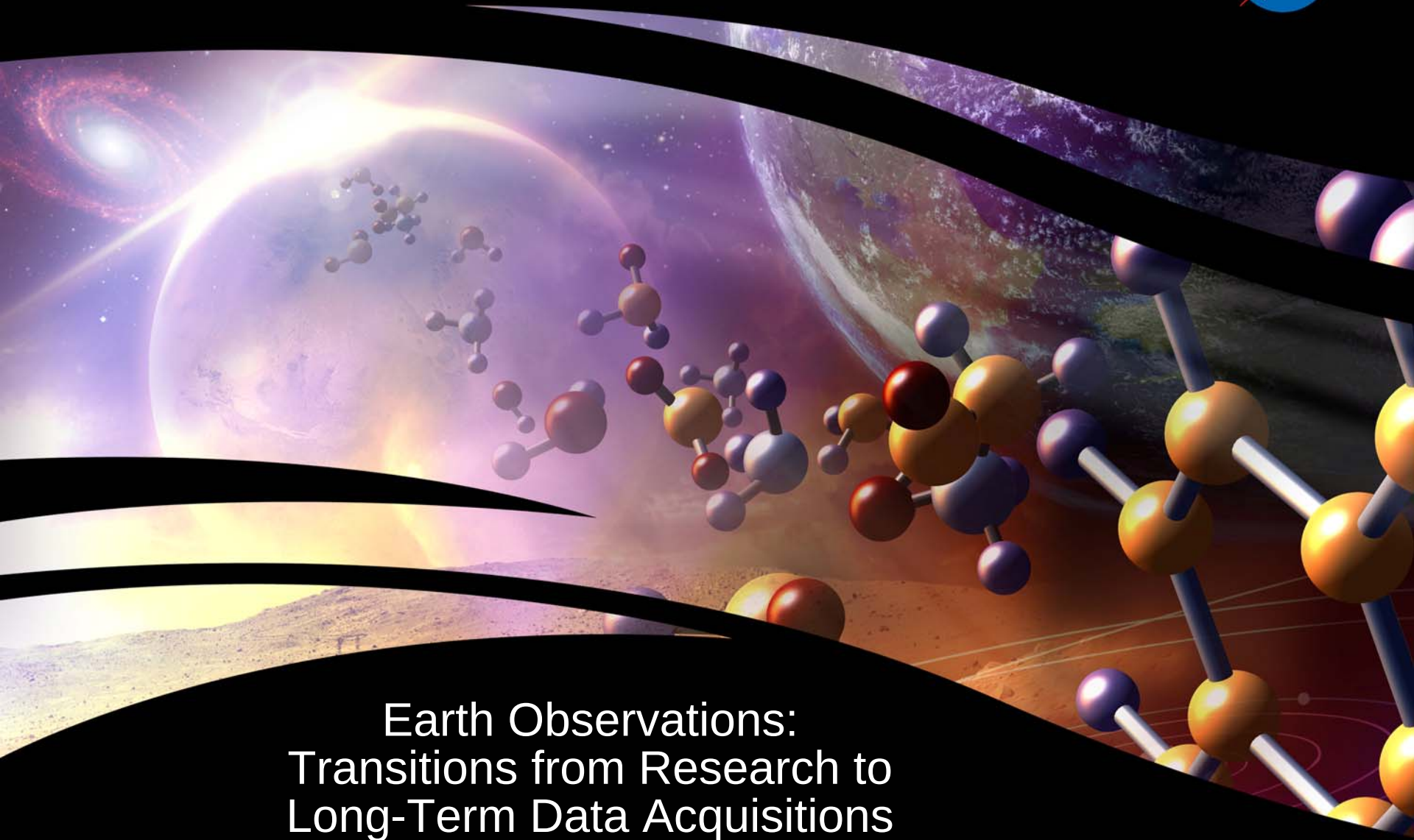
National Aeronautics and Space Administration



Earth Observations: Transitions from Research to Long-Term Data Acquisitions

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Transition Overview/Summary

Measurements over long time periods (> 1 satellite mission duration) are need for ***both*** short-term environmental prediction ***and*** climate/Earth system science research and applications

Three different activities

- ***Research*** to develop/demonstrate instruments, advance science
- ***Operational prediction*** to benefit society
- ***Long-term data acquisition*** to provide necessary measurements for both prediction and science

Timeline mismatches and appropriate resources are key challenges to transition

- Satellite missions are not long compared with development, operational utility analysis, and operational budget wedge development durations
- Substantial transition investment must be made early in research mission lifetime (often prior to launch, always prior to validation)

Types of Research to Operations (R2O) Transitions

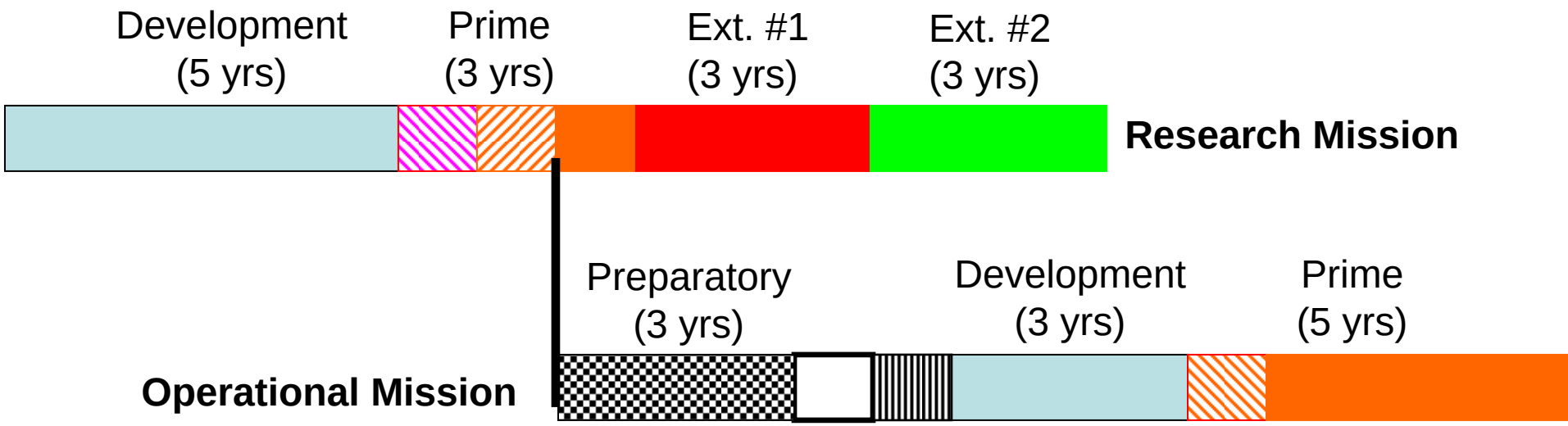
- **Type 1: Transition of Measurement Capability from NASA to NOAA**
  - NASA develops, launches and demonstrates utility of measurement in the context of a research mission
  - NOAA then implements the measurement as an operational mission(s)
    - NOAA pays for development, launch and operations
  - NOAA's POES and GOES systems are the products of this type of transition
  - Requires substantial investment by NOAA, and sustains measurements for operational use
- **Type 2: Use of Data Products From Research Missions In the Generation and Improvement of Operational Products**
  - NASA develops, launches and demonstrates the utility of measurement in the context of a research mission
  - NOAA demonstrates the operational utility of the measurement, using the research measurement to improve operational products
  - Many successful examples of this type of transition currently occurring.
  - Requires relatively small investment by NOAA, and provides operational improvement for the limited time that the research satellite flies, but does not sustain the measurement for long term operational use
- **Both types of transitions are important. In general, Type 2 transitions are a precursor to Type 1 transitions.**

Transition and Long-term Data Acquisition System

- An effective, competent, and predictable long-term data acquisition system is ***essential***
  - Short-term predictions (eg. weather and seasonal)
  - Earth System science (long-duration processes)
- The present US system fails short on all accounts
  - Climate and Earth system science objectives cannot masquerade as “weather prediction enhancers”
  - No agency or organization is ***committed*** to an ***effective*** in long-term data acquisition in support of science
  - NOAA cannot effectively garner resources for its desires or responsibilities
    - Space weather: NASA ACE mission returns “operational” near-real-time data stream since January 1998, but no replacement plans until this year (DSCOVR)
    - Ocean Vector Winds: NASA QuikSCAT returned “operational” near-real-time data stream from 2/2000 – 11/2009, but no long-term US replacement plans (compare with Metop)
    - Sea-Surface Topography: NASA/CNES research was prime support for TOPEX/Poseidon (8/92), Jason-1 (12/2001), OSTM (6/2008), finally firm plans/budget for long-term nadir altimetry (NOAA/EUMETSAT) for Jason-3

R2O Transition Timeline

Operational preparation begins after algorithm refinement on research mission



Commissioning/Validation

Operational budget wedge negotiation

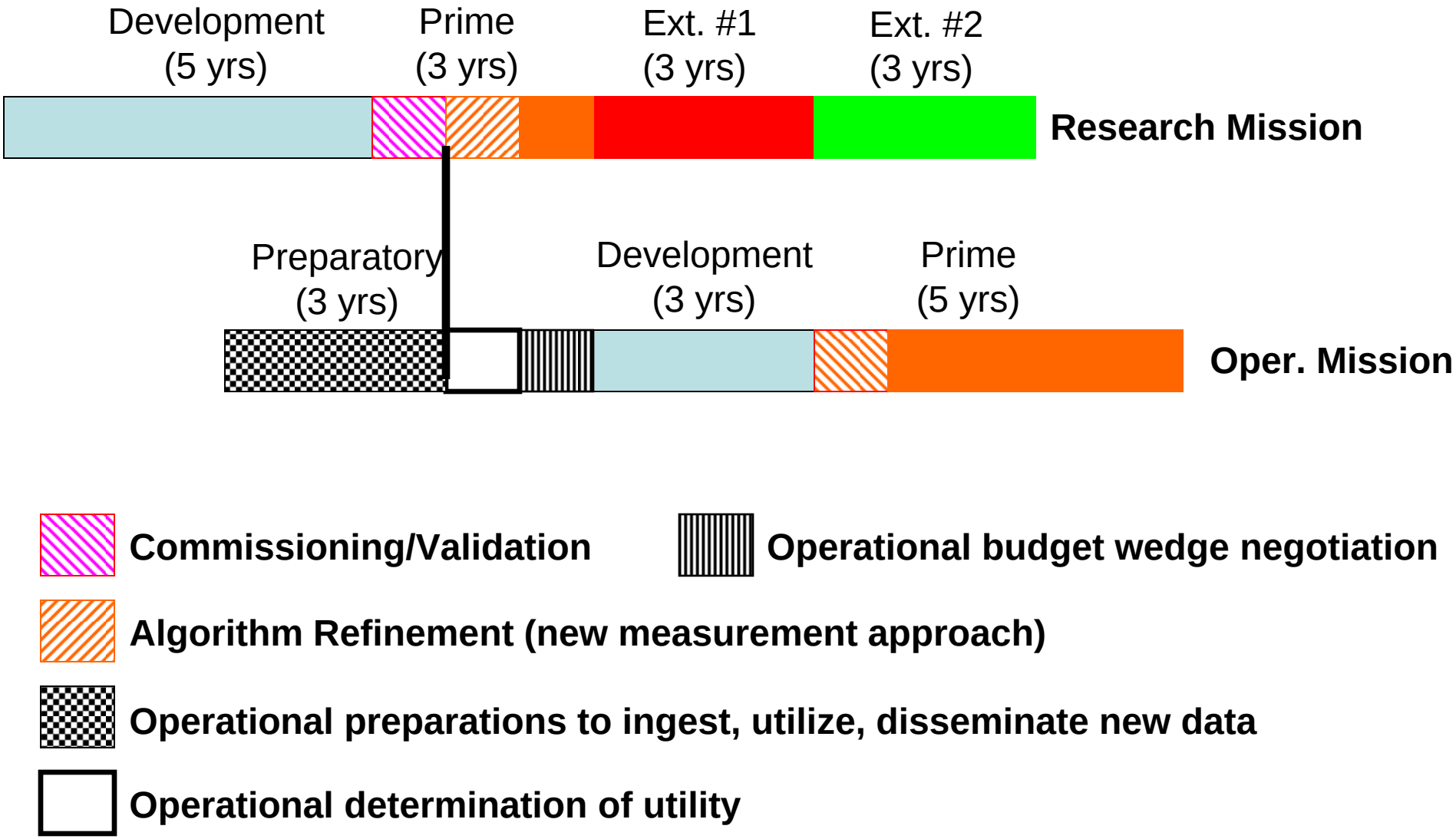
Algorithm Refinement (new measurement approach)

Operational preparations to ingest, utilize, disseminate new data

Operational determination of utility

R2O Transition Timeline

Operational utility analysis begins after research mission validation



One Solution Approach: "Minor" Perturbation to Agency Roles

- ***Planned multiple-mission builds***
  - NASA plans for 2, "identical" flights for selected new measurements
    - Sequential builds for efficiency
    - Second mission extends time series, provides realistic time for development of future budget wedge by/for "operational" agency
    - Second mission provides some measure of mitigation in the event of catastrophic failure of first mission
  - "Operational" agency plans for 2 additional "near-identical" missions/instruments
    - Sequential builds for efficiency
    - Possible evolutionary, but not revolutionary, changes to NASA-proven design

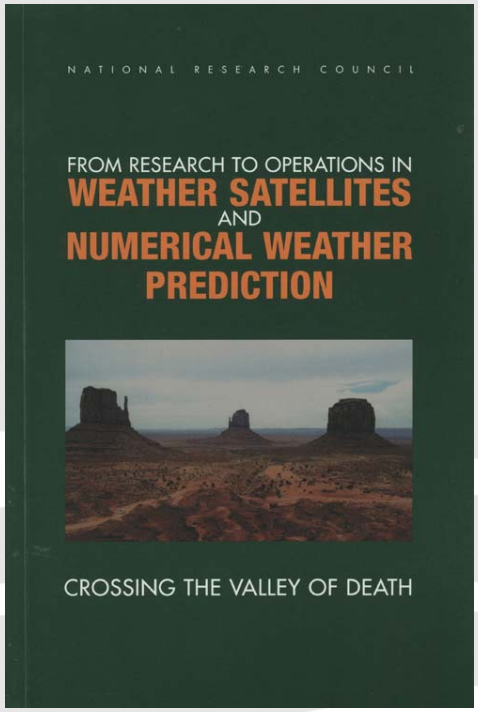
- ***True cost of needed capability is recognized from the start***
- ***Realistic time for successful transition***
- ***Will result in a robust plan to do significantly less than at present***

Transition and Long-term Data Acquisition

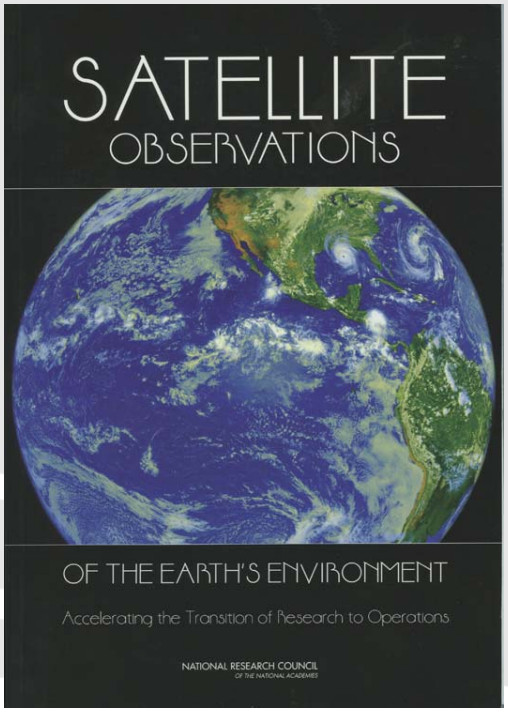
- ***Earth System science and environmental monitoring and prediction require effective, multi-decadal data acquisition systems. The long-term system is needed to:***
  - Justify initiating new measurements
  - Support and advance science programs for studying climate-scale phenomena
  - Encourage and support applications development through assured data availability
- ***The U.S. must develop a predictable, cost-effective mechanism for civilian long-term data acquisition that encourages technology infusion and that enables climate monitoring, delivery of expanded societal benefits, and advances understanding of the Earth System***

BACKGROUND

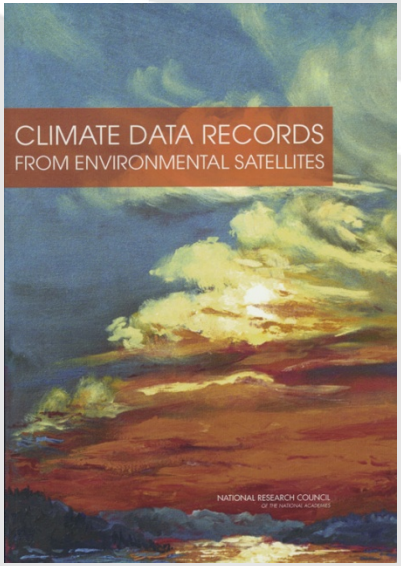
Recent NRC Reports on Research-to-Operations Transitions



"Valley of Death"
BASC, 2000
Barron & Mahoney



"CONNTRO"
SSB/BASC, 2003
Anthes & Avery
Appendix with 10 case studies



"CDR"
BASC, 2004
Robinson

Overarching Challenges

"The major challenges in accomplishing [the transition from research to operations] are institutional." (*Valley of Death,* p. 21)

- **VALLEY OF DEATH**
  - Gaps/barriers between research results and *recognized operational needs*
  - "Pull" impediments
  - E.g., transition of NASA systematic measurements to NOAA

- **VALLEY OF LOST OPPORTUNITIES**
  - Gaps/barriers that arise when the relevance of research results to operational needs is *not recognized*
  - "Push" impediments
  - E.g., transition of PI-led or technology demonstration missions/products to NOAA

- ***Continuous, near-real-time data streams are essential for operations***

- ***Both "Push" and "Pull" transition processes and dynamics require time periods commensurate with or longer than satellite mission lifetimes***

Requirements for Effective Transitions (*Valley of Death* and CONNTRO)

- **Continuous communication and feedback between research and operational communities**. *NOAA should:*
  - **Formally recognize the continuous need for operational improvements**
  - Understand evolving operational requirements
  - Strive for "state of the art" operational systems
  - Seek to maximize contributions from research community
- **Development of appropriate transition plans**. *The US should have:*
  - **Formalized, predictable (not ad hoc) interagency transition processes**
  - Commitment to algorithm development transition commensurate with hardware transition
  - Geophysical calibration/validation by operations agency to research standards
- **Adequate resources for transition**. *It must be recognized that:*
  - **Transition requires significant planning and implementation resources**
  - **Transition takes significant time**:
    "Experiences at ECMWF, EMC, …indicate that [the] preparation for implementation requires 2 or more scientists [working] for 2-5 years before launch if the new instrument is to be used effectively shortly after launch."
  - *Obtaining and focusing these resources requires extremely high-level attention and commitment to the transition process*