National Aeronautics and
Space Administration

Decadal Reflections

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Reflecting on the Decadal Survey

Considering the dynamic ecosystem and experience since the midterm, we would like to discuss the following questions:

- What is an effective approach to **prioritizing** observables?
- Who should be engaged (and how) for **determining** those priorities?
- How do we address the challenge of uncertainty in **costing and future budgets**?
- How can the recommendations and priorities of a Decadal Survey be structured so that they **support the agility** ESD needs in implementation?
- How do we keep pace with the rapidly changing EO ecosystem and **evolving user needs**?

Context and 2017 Decadal Lessons Learned

- **Initial cost estimates, assumptions, and scope** of the ESO missions were overly ambitious, resulting in combined costs above available NASA resources and mandated cost caps
- **NASA approach to architectures** was overly optimized
- **Assessed** experiences from previous decadal surveys, specifically regarding cost estimation
- **Key Findings from the Assessment:**
  - ***Budget Unpredictability:*** Tying recommendations to a rigid, assumed topline budget creates major implementation challenges when budgets fluctuate
  - ***Implementation Rigidity:*** "Targeted Observables" were largely implemented as optimized, large standalone missions, which limited architectural flexibility and drove up costs
  - ***Cost Estimation Gaps:*** Concepts under $500M previously lacked formal independent cost estimation, and the assumptions behind initial cost-binning and costing were not always fully documented or validated

We are a part of an **ecosystem**

Users & Decision-makers
Fed, state & local gov, private sector, others

Consultancies, Value-added Data Resellers

Commercial Satellite Providers

Other public EO providers

Researchers

NASA Earth Science

Evolving the Approach:

Full Community Engagement, Prioritization, and Flexibility

- **Expand community inputs through targeted, direct engagement with users outside the scientific community**

- **Prioritize science and observables through a mission-class based approach for NASA implementation**

- **Require flexibility to reaffirm or adjust priorities dependent on the evolving Earth Science domain during the next decade**

- **Focus on considering the:**
    - Unique capabilities that NASA brings to Earth observation, research and applications, and its importance for the Nation
    - Complementary, but independent, roles of other federal agencies with operational observation programs, including NOAA and USGS*
    - Expanding commercial EO sector and enabling its potential for advancing science and services
    - Evolving needs of users outside the scientific community across public, private, and civil sectors

**NASA is the only agency mandated in statute to establish priorities through Decadal Surveys*

Adopting a Mission-Class Prioritization Framework

Shifting focus toward organizing high-priority science objectives into cost-capped, competitive mission classes rather than tying recommendations to rigid, assumed budget profiles

Venture

- $35M-$250M
- < 36 months to orbit
- Higher-risk (tailored Class D and commercial best practices)
- EVO competition (PI-led) or Directed
- Fully commercial missions possible

Emphasizes rapid development, commercial partnerships, and innovative, high-risk/high-reward science

Explorer

- $251M-$500M
- 36-48 months to orbit
- Medium-risk (tailored Class C and commercial best practices)
- ESE Competition (PI-led) or Directed

Enables priority science and decadal objectives not met by Venture or commercial missions

Large

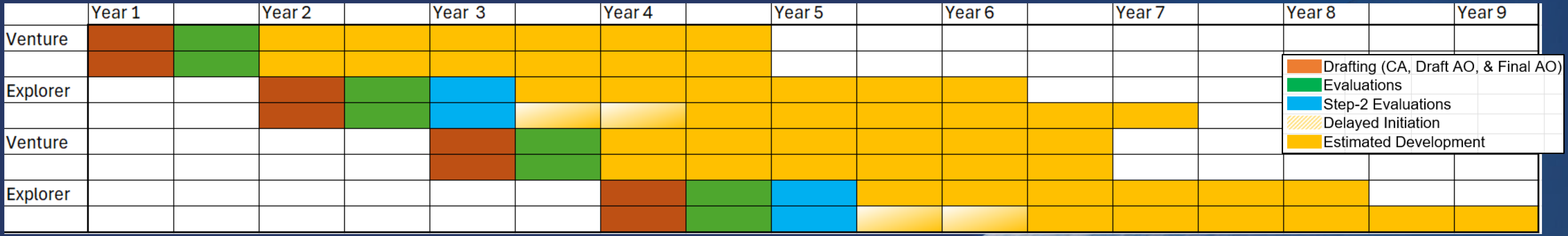
- >$500M
- Directed
- Lower-risk (typically Class C and commercial best practices)

Transformational science not achievable through smaller or disaggregated approaches

Structuring for Budget and Schedule Agility

- **Durability across a wide range of scenarios to strategically address priorities based on the available mission cadence resources**
- **Observables as flexible science goals rather than optimized, standalone mission mandates**
- **Opportunities to utilize innovative acquisition approaches to address science and applications goals**

Idealized Cadence of Venture/Explorer class opportunities:



Success
From 2017 Decadal model

The 2017 Decadal established a clear set of priority observables, and NASA is making strong progress in implementing them using the flexibility afforded by observables approach

Designated observables – reformulation made it possible to advance all five
Aerosols; Clouds, Convection, & Precipitation; Mass Change; Surface Biology and Geology; Surface Deformation & Change

Explorer observables – selected two missions, addressing three out of seven
Greenhouse Gases; *Ice Elevation*; Ocean Surface Winds & Currents; *Ozone & Trace Gases*; Snow Depth & Snow Water Equivalent; *Terrestrial Ecosystem Structure*; Atmospheric Winds

Incubation – progressing to on-orbit validation of both
Planetary Boundary Layer; Surface Topography & Vegetation

Participatory Engagement Approaches

Valuable new perspectives can be gained through novel public engagement activities

NASA has successfully used external expert organizations to conduct participatory engagement with the public to inform mission trade space

- Generated quantitative and qualitative data and feedback from public participants
- Strong citizen engagement with technical content, found it enjoyable, and pre- and post-surveys have shown significant learning and comprehension of NASA's missions

Best practices

- Experienced third-party organization to facilitate engagements
- Offer in-person and virtual formats
- Limit SME interaction to reduce bias
- Closed sessions to enable more candid, informed input

Summary and Looking Ahead

Building on our Foundation: We have an opportunity to update the "state of play" based on the rich history of our disciplines, rather than starting over from scratch

Prioritizing Science Trades over Mission Definition: To maintain flexibility, evaluate architectural trades and capabilities (leveraging tools like the NESSIE database) rather than locking into rigid mission point-designs early on

Designing for Agility: The urgency of Earth system and human system needs demands continuous agility—from the beginning of the decade through the midterm—ensuring we provide the best possible data *now*

Leveraging Earth Science's Unique Launch Flexibility: Because we can launch whenever a capability is ready, we have the distinct opportunity to rapidly address multiple objectives and perform dynamic portfolio refreshes at the midterm

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