The NRC Decadal Survey in Solar and Space Physics and Thoughts on the Space Weather Transition to Operations

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WHY UNDERTAKE A "DECADAL SURVEY"

- Take a long-term look at the field and recommend top priority scientific goals and directions for the future;
- Direct recommendations to the principal agencies that support facilities and research in the relevant fields;
- Provide recommendations for programmatic directions and explicit priorities for government investment in research facilities, including space flight missions; and
- Address issues of advanced technology, infrastructure, interagency coordination, education, and international cooperation.

Facilitates Planning, Coordination, Advocacy, and Outreach

Context

- *The Sun to the Earth—and Beyond: A Decadal Research Strategy in Solar and Space Physics*
  - Summary Report (2002)
  - Compendium of 5 Study Panel Reports (2003)

- First NRC “decadal survey” in Solar and Space Physics
  - Community-led
  - Integrated plan for the field
  - Prioritized recommendations
  - Sponsors: NASA, NSF, NOAA, DoD (AFOSR and ONR)

Survey's Task Statement and Changes From Previous Effort

- **Provide an overview of the science** and a broad survey of the current state of knowledge in the field, including a discussion of the relationship between space- and ground-based science research and its connection to other scientific areas;
- **Identify the most compelling science challenges** that have arisen from recent advances and accomplishments;
- **Identify**—having considered scientific value, urgency, cost category and risk, and technical readiness—the highest priority scientific targets for the interval 2013-2022, *recommending science objectives and measurement requirements for each target rather than specific mission or project design/implementation concepts*; and
- **Develop an integrated research strategy** that will present means to address these targets

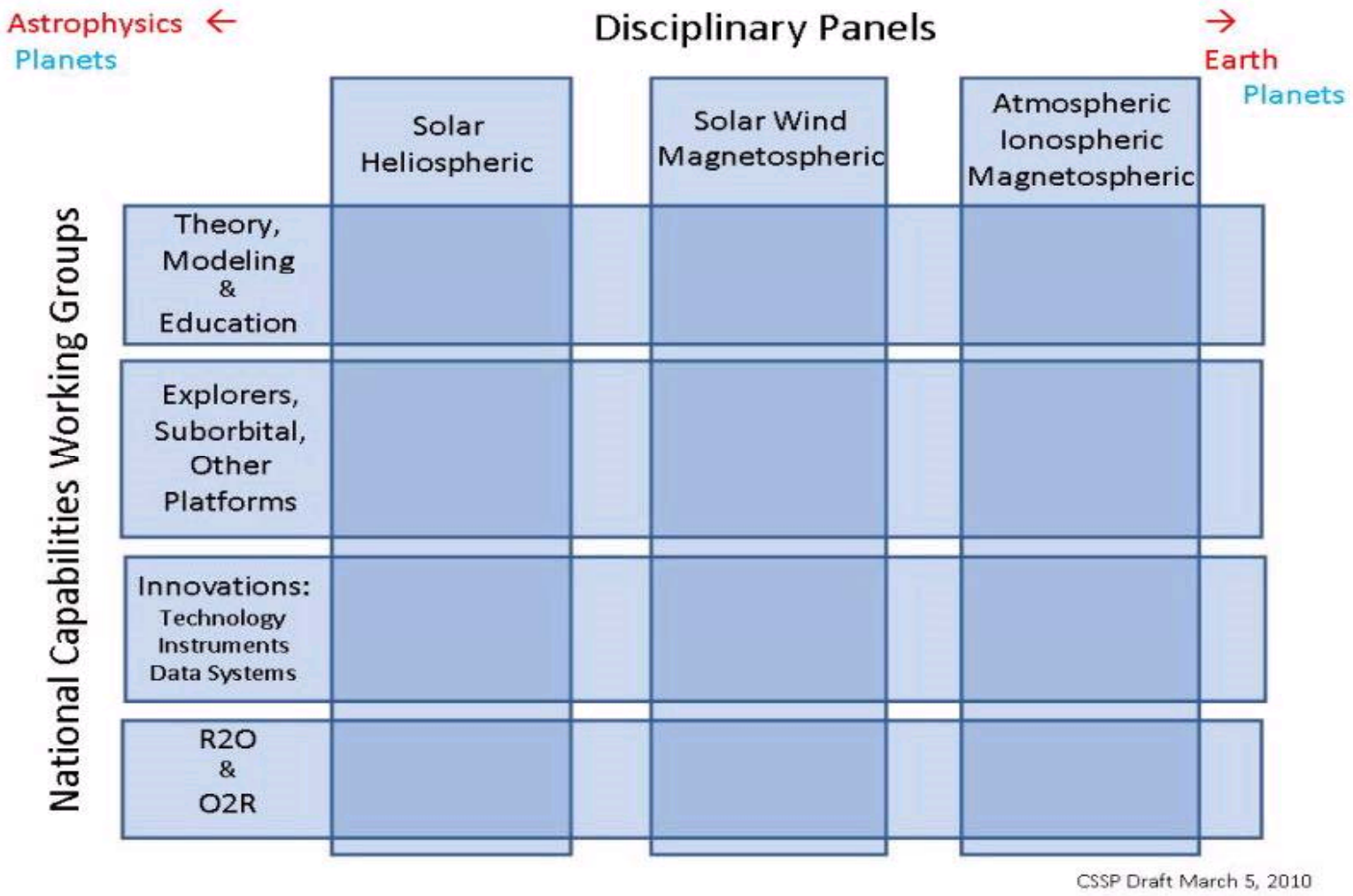
Note:

1. Heliophysics missions not yet in formulation or development will be reprioritized;
2. An independent contractor will assist the NRC in a cost and technical analysis of selected mission concepts.

Survey Organization

- Steering Committee
  - Approximately 18 representatives from across the community
  - Representatives from supporting study panels
- Interdisciplinary (~12-member) Study Panels
  - Atmosphere-Ionosphere-Magnetosphere Interactions
  - Solar Wind-Magnetosphere Interactions
  - Solar and Heliospheric Physics
- “National Capabilities” Working Groups
- Option for Focused Workshops (e.g., R2O)

Panel and Working Group Organization

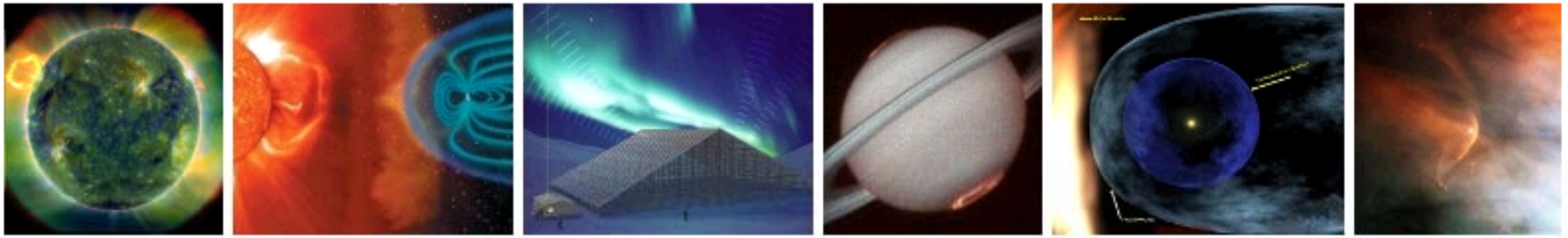


Schedule

- Spring 2010: Nominations to survey committee and panels completed
- Summer 2010:
  - First of up to 5 meetings of the survey committee
  - First of 3 meetings of the panels
  - Working groups are organized and meet with panels
- Survey committee and panels continue meeting throughout 2011
- Report due to sponsors by March 31, 2012

The 2013-2022 Decadal Survey

A Decadal Strategy for Solar and Space Physics (Heliophysics)



Special Announcement

The National Research Council is seeking recommendations for committee participants for the next decadal survey in solar and space physics (see below).

http://tinyurl.com/2b4e4sh

SpaceWx Transition of Research Understanding and Models to Operations

- NASA, NSF, and DoD have expended tens of millions of dollars to develop models of the local and regional reaction of the space environment to forcing inputs from the Sun.
- Some (many?) of these models are now mature and ready for transition to operations.
- Perhaps the largest barrier to transition of these models is monetary; for example to support model validation. This was recognized in the last decadal survey, which recommended:
  - The relevant federal agencies should establish an overall verification and validation program for all publicly funded models and system-impact products before they become operational.
  - The operational federal agencies, NOAA and DOD, should establish procedures to identify and prioritize operational needs, and these needs should determine which model types are selected for transitioning by the Community Coordinated Modeling Center and the Rapid Prototyping Centers.

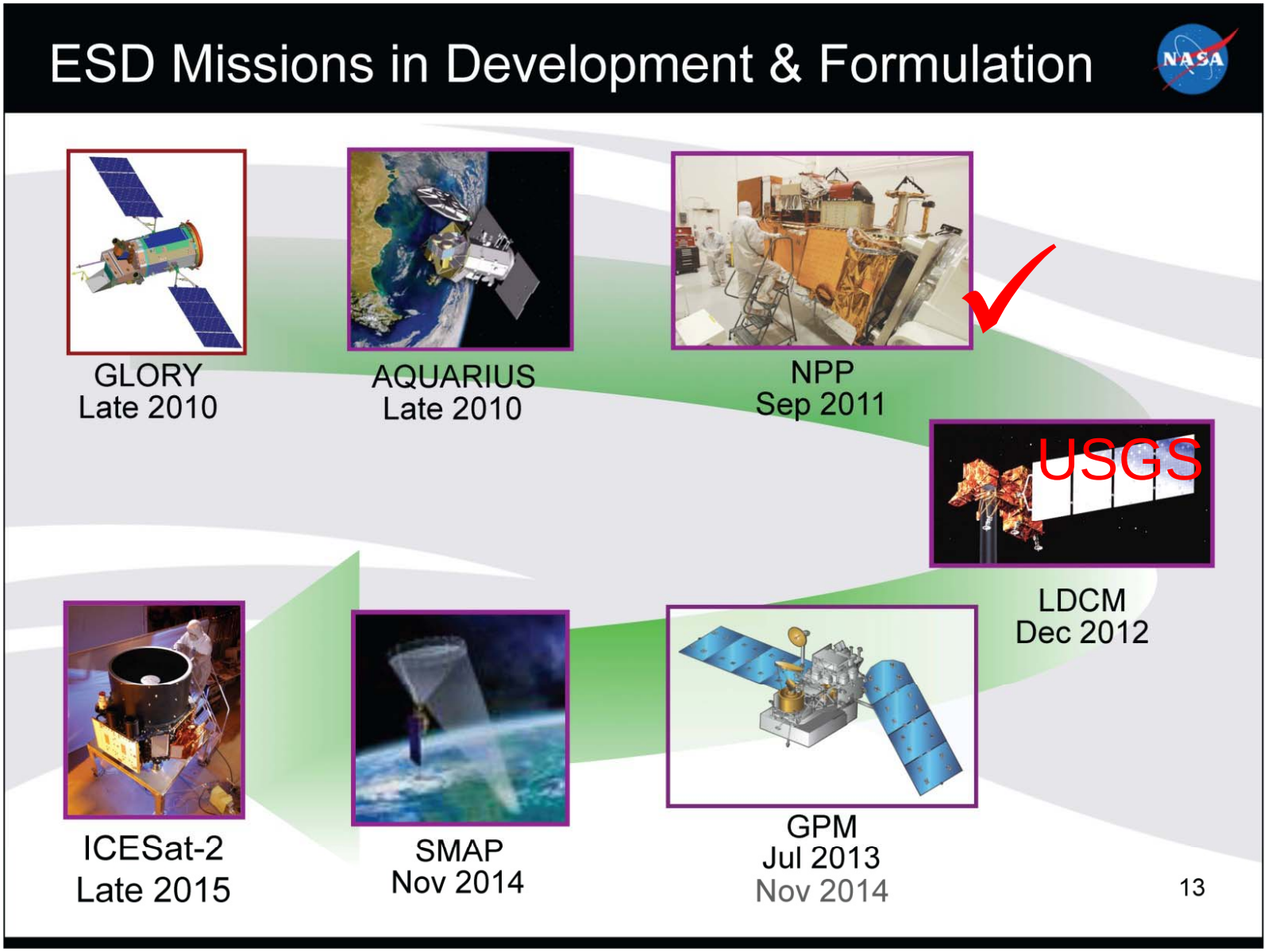
SpaceWx Transition to Operations-Observations

- Real-time upstream measurements of solar wind parameters and solar energetic particle intensities:
  - Currently relying on instruments on ACE; DSCOVR may provide a follow-on; but no plans beyond and no plans to develop enhanced operational capabilities for continuous monitoring from L1.
- Real-time detection of Coronal Mass Ejections (CMEs):
  - Coronagraphs observe CMEs and they are able to indicate halo CMEs, which, when Earth-directed, may produce strong geomagnetic disturbances, BUT:
    - SOHO/LASCO: extended mission phase ends 12/31/12.
    - STEREO: 2 year mission; 5-year goal and no follow-on
    - Coronagraph on DSCOVR? Note: No coronagraph on SDO

SOHO, STEREO, SDO, and RBSP are NASA research missions that are, or will be, used for operations, but they are not operational.

The World According To Art

Near-term NASA R2O Candidates



Slide courtesy of NASA ESD

Earth Science Decadal & Transition to Operations

- "There is a lack of clear agency responsibility for sustained research programs and the transitioning of proof-of-concept measurements into sustained measurement systems…The elimination of the requirements for climate research-related measurements on NPOESS is the most recent example of the failure to sustain critical measurements."

- "Institutions have responsibilities that are in many cases mismatched with their authorities and resources: institutional mandates are inconsistent with agency charters, budgets are not well matched to emerging needs, and shared responsibilities are supported inconsistently by mechanisms for cooperation."

- **Recommendation**: The Office of Science and Technology Policy, in collaboration with the relevant agencies and in consultation with the scientific community, should develop and implement a plan for achieving and sustaining global Earth observations. This plan should recognize the complexity of differing agency roles, responsibilities, and capabilities as well as the lessons from implementation of the Landsat, EOS, and NPOESS programs.

Summary

- While the current NASA-NOAA transition pathways have included successful examples, transitions have been ad hoc and often complex and unstructured
- No organizational mechanism exists to ensure efficient and effective transitions
- A structured, consistent, and well-defined organizational approach to transitioning is needed to:
  - Help to improve communication and coordination between parties
  - Help identify and evaluate missions for potential transitions
  - Create opportunities to infuse new technologies

BACKUP SLIDES

Future Needs Identified by NOAA SWPC

(from NRC, 2009: *Severe Space Weather Events*)

- Secure an operational L1 solar wind monitor.
- Transition a numerical coronal mass ejection/solar wind model into operations.
- Secure backup capability for GOES-10 XRS (X Ray Spectrometer) data stream.
- Transition the whole-atmosphere model into operations.
- Develop forecast capabilities based on STEREO data streams.
- Revamp the concept of operations of the Space Weather Forecast Office.
- Transition a coupled magnetosphere/whole-atmosphere model into operations.
- Develop precision Global Positioning System forecast and correction tools.
- Develop operational radiation environment models.

Space Weather and Transition to Operations in the 2002 Survey

- Recommendation: NOAA should assume responsibility for the continuance of space-based measurements such as solar wind data from the L1 location as well as near Earth and for distribution of the data for operational use.

- Recommendation: NASA and NOAA should initiate the necessary planning to transition solar and geospace imaging instrumentation into operational programs for the public and private sectors.

Space Weather and Transition to Operations in the 2003 Survey-I

- Challenge 5: Developing a near-real-time predictive capability for understanding and quantifying the impact on human activities of dynamical processes at the Sun, in the interplanetary medium, and in Earth's magnetosphere and ionosphere. What is the probability that specific types of space weather phenomena will occur over periods from hours to days?

Transition to Operations in the Previous Survey—Con't

- Recommendation: The relevant federal agencies should establish an overall verification and validation program for all publicly funded models and system-impact products before they become operational.

- Recommendation: Clear policies should be developed that describe government and industry roles, rights, and responsibilities in space weather activities. Such policies are necessary to optimize the benefits of the national investments, public and private, that are being made.

NPOESS and the Transition to Operations

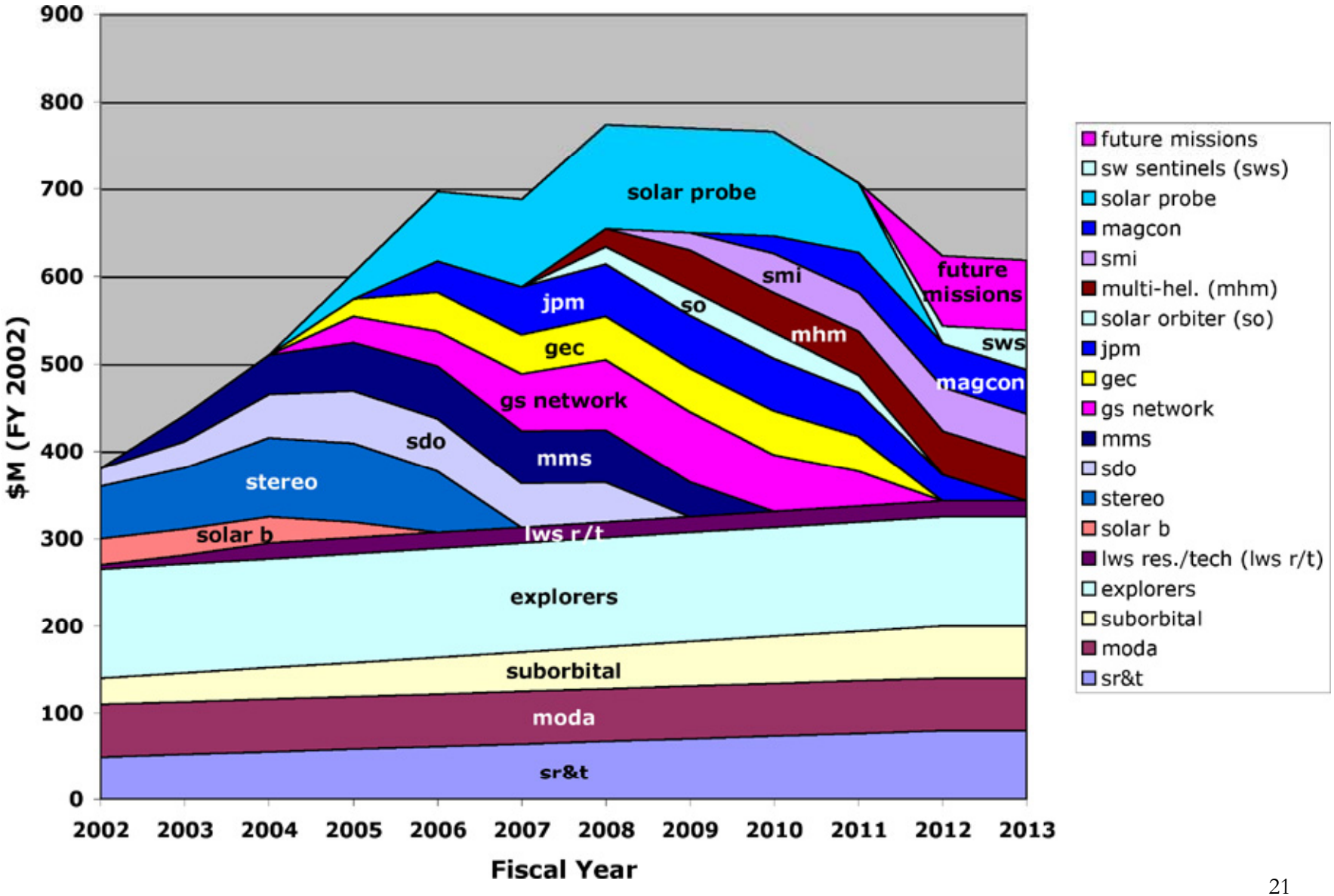
- Sustained Climate Observations
  - A long-term climate strategy must provide for the essential characterization, calibration, stability, continuity, and data systems required to support climate applications.

- National Policy for Provision of Long-term Climate Measurements
  - Much of climate science depends on long-term, sustained measurement records. Yet, as has been noted in many previous NRC and agency reports, the nation lacks a clear policy to address these known national and international needs.

- Clear Agency Roles and Responsibilities
  - Institutions have responsibilities that are in many cases mismatched with their authorities and resources: institutional mandates are inconsistent with agency charters, budgets are not well matched to emerging needs, and shared responsibilities are supported inconsistently by mechanisms for cooperation.

NASA Mission Costs

(Solar Probe Start in FY03)



Current NASA R2O Candidates

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