NASA Heliophysics Strategic Planning

For

National Academy Committee on Solar and Space Physics

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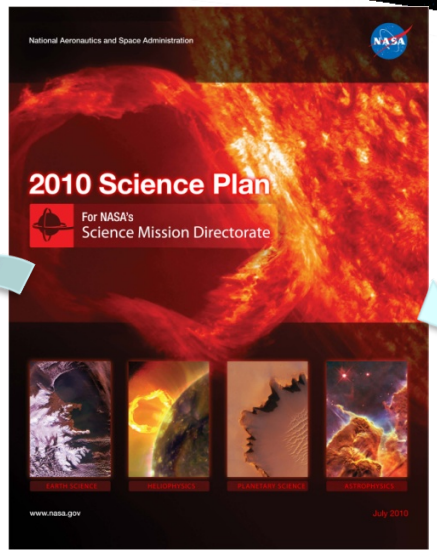
Heliophysics: Understand the Sun and its interactions with Earth and the solar system

Structure of Strategic Planning

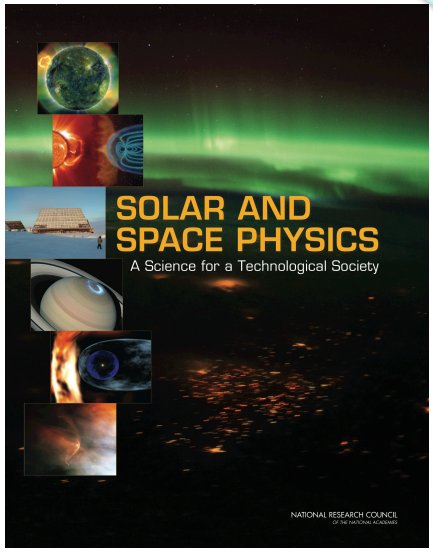
How do all the studies and documents relate?

Wide variety of studies, both internal and NASA-sponsored NRC studies

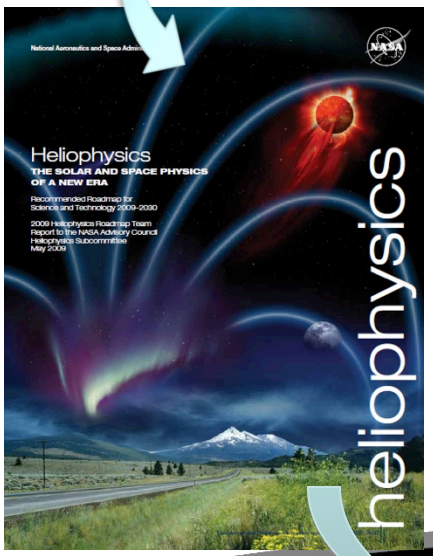


NASA Science Plan

National Academies Decadal Survey

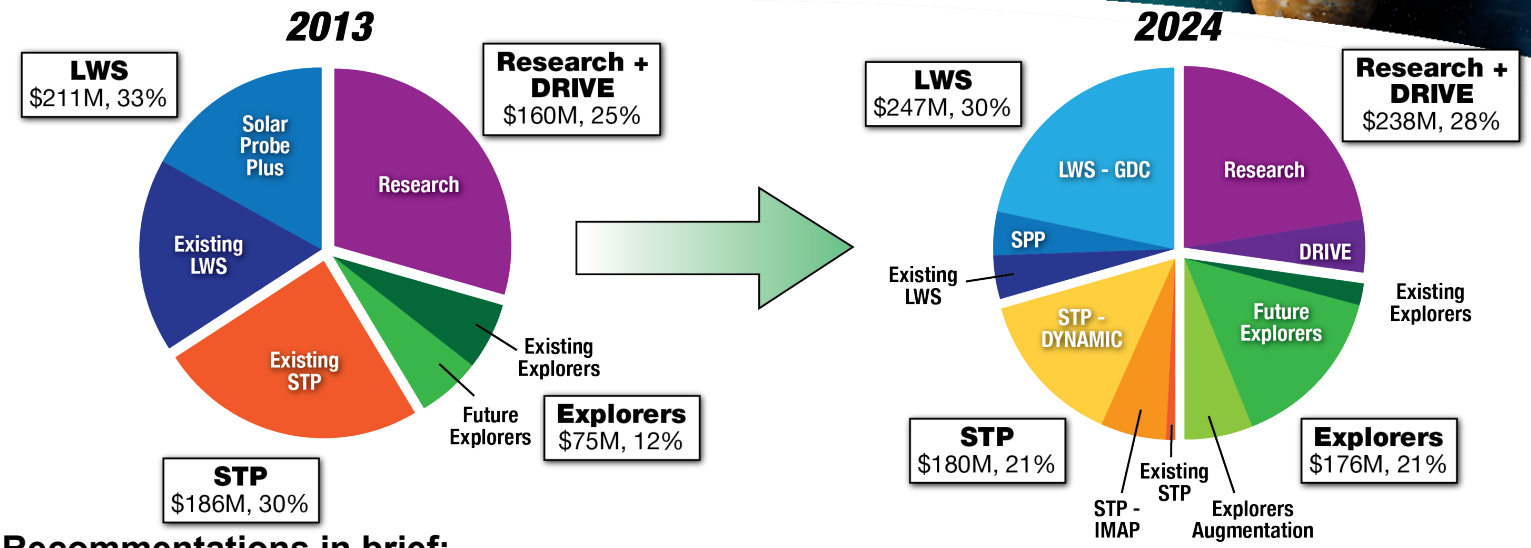


Heliophysics Roadmap



NASA Strategic Plan

Decadal Survey Result: A Balanced and Revitalized Program



Recommentations in brief:

Complete the current program: Completion of the missions currently selected, with commitment to maintaining cost and schedule, continued operation of Heliophysics System Observatory and research program. Van Allen Probes Launched Aug. 30, 2012, Other missions (IRIS, MMS, Solar Orbiter, Solar Probe Plus proceeding on schedule and within current budget baseline

Initiation of the DRIVE program as an augmentation to the existing enabling research program. The DRIVE components provide for better operation and exploitation of the Heliophysics System Observatory and for more effective research programs. Reorganized the current competed R&A grant program to take advantage of DRIVE initiative as funds increase over the next 5 years

Execution of a robust Explorer program with an increased launch rate, including missions of opportunity (MOOs). The cadence should be accelerated to accomplish the important science goals that do not require larger missions. Working toward future increases.

Launch and/or start of four new strategic missions in the reinvigorated STP line as a new medium class, PI-Led line, and in the LWS larger class mission line to accomplish the committee's highest-priority science objectives. Beginning development of next STP mission AO.
Studying recommendation and impacts for PI-led STP missions

Decadal Survey:A New Vision for Space Weather and Space Climate

Strengthen the Current National Space Weather Program:

- Re-charter the National Space Weather Program
  - NASA recognizes the importance of the NSWP and will work with its partners and governing agencies to ensure, to the extent possible, the requirements of the U.S. National Space Policy are fulfilled.
- Multi-agency Partnership for Solar/Solar Wind Observations to achieve continuity of solar and solar wind observations.
  - NASA agrees on the importance of solar and solar wind measurements for both operational and research aspects. NASA will continue collaborating with NOAA, DoD, and NSF in supporting a national program of space weather observations.

Congressional Testimony

The survey has been well received at NASA and has features that make it an effective guide for NASA's planning over the next decade.

- First, the scientific program recommended would significantly improve our understanding of the Sun-Earth-Heliosphere system; the survey specifically targets areas for which observations and understanding do not currently exist.
- Second, the survey recommended a realistic program for NASA's portion of the survey. The top priorities require only modest investments with the potential for immediate rewards. In addition, the survey includes Decision Rules that can be applied if resources are substantially different than projected. The Decision Rules preserve balanced progress across the sub-disciplines and minimize disruption of the highest-priority targets for advancement.
- Last, the program recommended can significantly advance our Nation's capability to provide space weather data and information for severe events and NASA appreciates the emphasis on inter-agency cooperation.

Congressional Testimony (2)

- As a top priority, the decadal survey endorses NASA's current program of missions in development and formulation
- The second priority recommendation is the DRIVE initiative, which includes recommendations for augmenting operating missions, research grants programs, technology development, and low-cost access to space (LCAS). This will optimize the scientific return of current and future missions by establishing a healthy research environment and will also enable future missions through its technology enhancements.
- The next priority is the acceleration and expansion of the Heliophysics Explorer program. The Explorer program has a long history of returning cutting edge science and provides tremendous value to Heliophysics science.
- The survey also prioritizes science targets for four recommended missions in the Solar Terrestrial Probes (STP) program and the Living with a Star (LWS) program, NASA concurs with the science targets suggested and plans to initiate pre-formulation activities for the some of the missions. In addition, NASA appreciates the flexible nature of the survey's mission recommendations – by providing science targets and leaving the detailed implementation for the procurement phase, NASA can ensure that these missions are guided by the latest science and enabled by the latest technologies.

Congressional Testimony (3)

- The decadal survey went beyond its Heliophysics science recommendations and also made recommendations related to space weather applications that are addressed collectively to the relevant government agencies. NASA recognizes the importance of the recommendations and will continue collaborating with other agencies to realize the decadal survey recommendations. However, as the survey acknowledges, these separate space weather recommendations are above and beyond current funding resources for the foreseeable future. Nonetheless, NASA and NOAA currently work together (with other government agencies) on satellite development, operations, data processing, and modeling that inform and improve space weather predictions. NASA is also committed to supporting its part of the National Space Weather Program (NSWP), a federal interagency initiative established to improve coordination on space weather activities.

NASA Heliophysics Roadmap: Spring 2013

Decadal Survey provides a strategic framework for all of solar and space physics

- Advice on the state of the field, the most compelling science challenges, the highest priority science targets for future missions and a recommended strategy to achieve the science goals

Role of NASA Advisory Council Heliophysics Subcommittee (HPS) in Roadmap

- Provides direct oversight, dialog, and review of the Roadmap process
- Delivers the Roadmap to the Science Committee of the NASA Advisory Council

Roadmap will provide guidance for NASA's tactical implementation responding to the Decadal survey recommendations

- Develop a clear science traceability throughout NASA heliophysics programs.
- Align the science strategy developed by the Decadal with the Heliophysics Program over the next 10 years and extend the strategy out to 2033
- Develop the technology requirements not just for the coming decade, but for longer term.
- Follow the 2009 Roadmap paradigm of presenting a science priority with a flexible mission implementation approach consistent with the current (FY13) budget profile

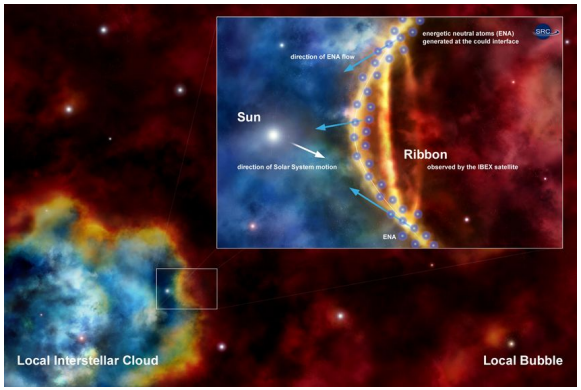
The Future: A Vibrant Heliophysics Program

- Use the Decadal Survey and Heliophysics Roadmap as springboards to develop Heliophysics into a mature science, one poised to take advantage of discoveries and provide direct benefits to both the science of space weather and through its study of fundamental processes, and coupled systems, all of NASA science.
- Implementing the NRC Decadal Survey recommendations:
  - Continue the current program – 5 years into next decade for missions currently in formulation or development.
    - Van Allen Probes Launched Aug. 30, 2012, Other missions (IRIS, MMS, Solar Orbiter, Solar Probe Plus proceeding on schedule and within current budget baseline
  - Strengthen our Research and Analysis and Technology Programs – Reorganized the current competed R&A grant program to take advantage of DRIVE initiative as funds increase over the next 5 years
  - Work toward more frequent, lower cost missions – Expand Explorers, Missions of Opportunity
  - Begin development of the highest priority Strategic mission (STP, LWS) science targets: outer heliosphere, Geospace coupling.
    - Beginning development of next STP mission AO.
    - Studying recommendation and impacts for PI-led STP missions.

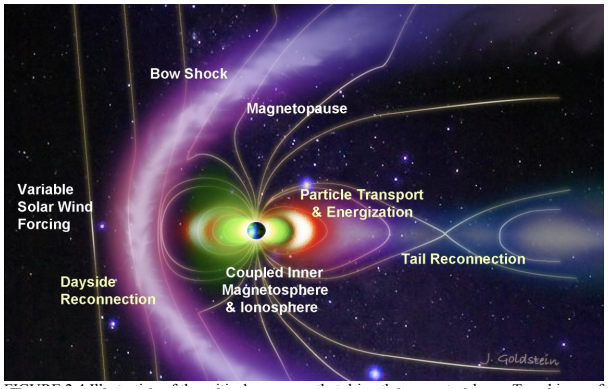
BACK-UP

Recommended Mission Science Goals

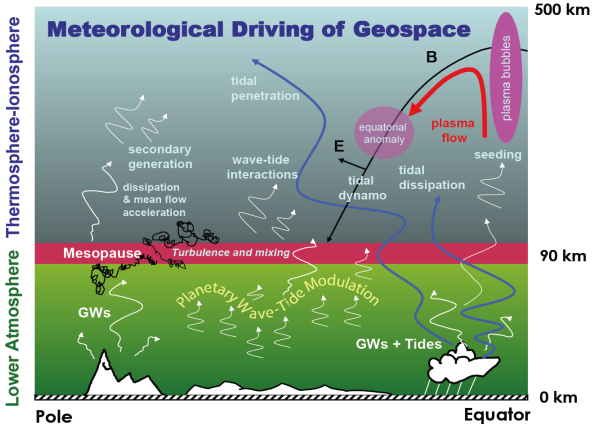
Future STP Missions: PI-Led, $520M (FY12) Life Cycle
Future LWS Missions: Strategic, ~$1B Life Cycle



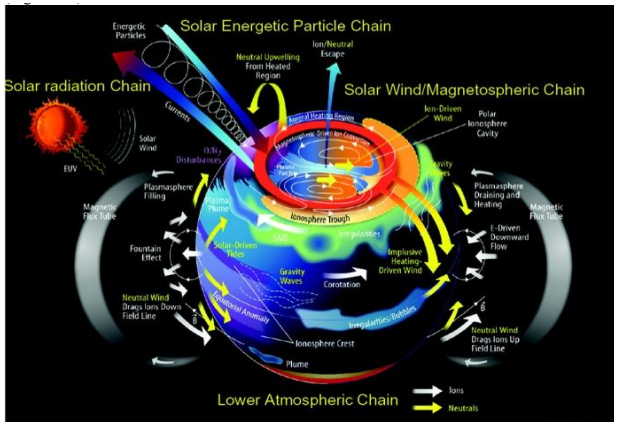
Understand the outer heliosphere and its interaction with the interstellar medium



Determine how the magnetosphere-ionosphere-thermosphere system is coupled and how it responds to solar and magnetospheric forcing



Provide a comprehensive understanding of the variability in space weather driven by lower-atmosphere weather on Earth



Understand how Earth's extended atmosphere absorbs solar wind energy

Heliophysics Roadmap Strategy

- Addresses difficult but real constraints including fiscal and access to space.
- Continues the paradigm of presenting a science queue with a flexible mission implementation approach consistent with the current (FY13) budget profile
- Stresses system understanding
- Prioritizes science and defers the mission definition until implementation.
- Basis of launch cadence recommendations
  - Multiple fundamental process Targets (STP Program)
  - Multiple interconnection pathway Targets (LWS Program)
  - Explorer Class frequent focused science
- Drives the need to contain mission cost growth
- Drives the importance of supporting programs in development of an integrated view

Decadal Report Goals & Challenges

Science Goals for the Next Decade	
1	Determine the origins of the Sun's activity and predict the variations in the space environment.
2	Determine the dynamics and coupling of Earth's magnetosphere, ionosphere, and atmosphere and their response to solar and terrestrial inputs.
3	Determine the interaction of the Sun with the solar system and the interstellar medium.
4	Discover and characterize fundamental processes that occur both within the heliosphere and throughout the universe.

Solar and Space Physics Decadal Science Challenges

The Sun and Heliosphere

SH-1	Understand how the Sun generates the quasi-cyclical magnetic field that extends throughout the heliosphere
SH-2	Determine how the Sun's magnetism creates its hot, dynamic atmosphere.
SH-3	Determine how magnetic energy is stored and explosively released and how the resultant disturbances propagate through the heliosphere.
SH-4	Discover how the Sun interacts with the local interstellar medium.

Solar Wind - Magnetosphere Interactions

SWMI-1	Establish how magnetic reconnection is triggered and how it evolves to drive mass, momentum, and energy transport.
SWMI-2	Identify the mechanisms that control the production, loss, and energization of energetic particles in the magnetosphere.
SWMI-3	Determine how coupling and feedback between the magnetosphere, ionosphere, and thermosphere govern the dynamics of the coupled system in its response to the variable solar wind.
SWMI-4	Critically advance the physical understanding of magnetospheres and their coupling to ionospheres and thermospheres by comparing models against observations from different magnetospheric systems.

Atmosphere-Ionosphere-Magnetosphere Interactions

AIMI-1	Understand how the ionosphere-thermosphere system responds to, and regulates, magnetospheric forcing over global, regional and local scales.
AIMI-2	Understand the plasma-neutral coupling processes that give rise to local, regional, and globalscale structures and dynamics in the AIM system.
AIMI-3	Understand how forcing from the lower atmosphere via tidal, planetary, and gravity waves, influences the ionosphere and thermosphere.
AIMI-4	Determine and identify the causes for long-term (multi-decadal) changes in the AIM system.