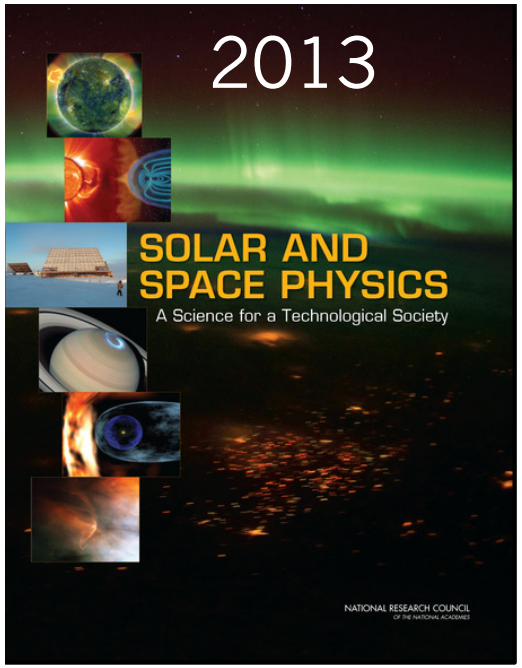

Midterm Assessment of Heliophysics Decadal Survey

Committee Progress

Committee Co-Chairs

Robyn Millan and Tom Woods

Committee Members

Tim Bastian, Monica Bobra, Anthea Coster, Ed DeLuca, Scott England, Stephen Fuselier, Ramon Lopez, Janet Luhmann, Katariina Nykyri, Jens Oberheide, Merav Opher, Karel Schrijver, Josh Semeter, Jeff Thayer, Alan Title

NRC Study Director: Art Charo

Committee Statement of Tasks

2013-2019

2020-2024

Next Decadal

1. Describe the **most significant scientific discoveries, technical advances, and relevant programmatic changes** in solar and space physics over the years since the publication of the decadal survey;
2. Assess **the degree to which the Agencies' programs address the strategies, goals, and priorities outlined in the 2013 decadal survey** and other relevant NRC and Academies reports, considering the national policy framework;
3. **Assess the progress** toward realizing these strategies, goals, and priorities;
4. **Recommend any actions that could be taken to optimize the science value** of the Agencies' programs including how to take into account emergent discoveries and potential partnerships since the decadal in the context of current and forecasted resources available to them;
5. **Provide guidance about implementation of the recommended portfolio** for the remaining years of the current decadal survey given actual funding levels, progress on decadal missions, and science and technology advances, but do not revisit or redefine the scientific priorities or recommended mission science targets;
6. **Recommend any actions that should be undertaken to prepare for the next decadal survey**--for example: enabling community-based discussions of (a) science goals, (b) potential mission science targets and related implementations, and (c) the state of programmatic balance; as well as identifying the information the survey is likely to need regarding the vitality of the field; and
7. **Recommend actions that would enhance all stages of careers** for scientists and engineers in the solar and space physics community.

Task 1: Significant Scientific and Technical Advances

Key Science Goal 1. Determine the origins of the Sun's activity and predict the variations in the space environment.				
Key Science Goal 2. Determine the dynamics and coupling of Earth's magnetosphere, ionosphere, and atmosphere and their response to solar and terrestrial inputs.				
Key Science Goal 3. Determine the interaction of the Sun with the solar system and the interstellar medium.				
Key Science Goal 4. Discover and characterize fundamental processes that occur both within the heliosphere and throughout the universe.				
	↑	↑	↑	↑
Science Challenge (extra search keywords)	**Key Goal 1**	**Key Goal 2**	**Key Goal 3**	**Key Goal 4**
AIMI = Atmosphere-Ionosphere-Magnetosphere Interactions				
AIMI-1 Understand how the ionosphere-thermosphere system responds to, and regulates, magnetospheric forcing over global, regional and local scales.		X		X
AIMI-2 Understand the plasma-neutral coupling processes that give rise to local, regional, and globalscale structures and dynamics in the AIM system.		X		X
AIMI-3 Understand how forcing from the lower atmosphere via tidal, planetary, and gravity waves, influences the ionosphere and thermosphere. (tides)		X		X
AIMI-4 Determine and identify the causes for long-term (multi-decadal) changes in the AIM system. (ionosphere, thermosphere)	X	X		X
SH = Solar and Heliospheric physics	1	2	3	4
SH-1 Understand how the Sun generates the quasi-cyclical magnetic field that extends throughout the heliosphere. (solar cycle, dynamo)	X		X	X
SH-2 Determine how the Sun's magnetism creates its hot, dynamic atmosphere. (solar, chromosphere, corona)	X			X
SH-3 Determine how magnetic energy is stored and explosively released and how the resultant disturbances propagate through the heliosphere. (solar, reconnection, flare, CME)	X			X
SH-4 Discover how the Sun interacts with the local interstellar medium.	X		X	X
SWMI = Solar-Wind Magnetosphere Interactions	1	2	3	4
SWMI-1 Establish how magnetic reconnection is triggered and how it evolves to drive mass, momentum, and energy transport. (magnetosphere)		X		X
SWMI-2 Identify the mechanisms that control the production, loss, and energization of energetic particles in the magnetosphere.	X		X	X
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.		X		X
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. (planet)		X		X

Recent Science Highlights in Midterm Report are organized by the Decadal Survey 12 Science Challenges

DS Key Science Goal 4
Fundamental Processes
Dynamos
Solar and Planetary Winds
Magnetic Reconnection
Collisionless Shocks
Turbulence
Plasma Neutral Interactions

Tasks 2,3,4,5: Progress on DS Plans and Implementation

Progress and Plans for Realizing DS 15 Goals

HP Decadal Survey Research Recommendations	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
0. Complete the current program	MMS Launch		Parker Solar Probe Launch			Solar Orbiter Launch		DKIST Operational		
1. Implement the DRIVE initiative	*See Separate Figure for DRIVE Progress*									
2. Accelerate and expand the HP Explorer Program		SMEX SALMON		SALMON		MIDEX				
3. Restructure STP as a moderate-scale, PI-led line										
3.1. Implement an IMAP-Like Mission										
3.2. Implement a DYNAMIC-Like Mission										
3.3. Implement a MEDICI-Like Mission										
4. Implement a large LWS GDC-like mission				GDC STDT						
HP Decadal Survey Application Recommendations	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
1. Recharter the National Space Weather Program		Implementation Plan			Action Plan					
2. Multi-agency partner for solar and solar wind observations										
2.1. Continuous solar wind observations from L1	DSCVR Launch							IMAP 2024 Launch SWFO 2024 Launch		
2.2. Continue space-based coronagraph and solar magnetic field measurements	NASA SOHO, STEREO, SDO; NSF NSO GONG									
2.3. Evaluate new observations, platforms, and locations				MOU for NOAA at L1 and ESA L5						
2.4. Establish a SWx research program at NOAA for R2O										
2.5. Develop distinct programs for space physics research and space weather specification and forecasting				NOAA, NASA, NSF O2R						

Draft Chart on Progress

Color Key: NASA, NSF, NOAA (other)

Tasks 2,3,4,5: Progress on DS Plans and Implementation

Progress and Plans for Realizing DRIVE Initiative

Diversify	2014	2015	2016	2017	2018	2019
New NSF Midscale Project Line					Midscale RI-2 proposals	
Enhance NSF CubeSat Program					NSF Big Ideas Constellation	
New NASA Tiny-satellite Grants Program	ROSES 2013 H-TIDeS		MinXSS, 1st NASA SMD CubeSat- launch		ROSES 2019 H-FORT	
Enhance NASA Sounding Rocket, Balloon, and Tiny-satellite Programs	NASA has met or exceeded the goal of six (6) new starts per year between 2013-2017					
Realize						
Enhance NSF funding for NSO solar synoptic observations and DKIST operations	FY16 $2.5M investment in GONG	NOAA/NSF Agreement for GONG support		FY19 $8M Ops forward funding + $3.5M for L2 data products		DKIST first light
Augment NASA MO&DA support by $10M/year						
Enhance NASA Guest Investigator (GI) Program	ROSES 2014 GI: Van Allen Probes, BARREL, IRIS		ROSES 2016 -2017 GI support for MMS		ROSES 2018 GI	
Evaluate Impacts on NASA Extended Missions		Misson Senior Reviews				
Integrate						
Have NASA-NSF-DOE multiagency program on laboratory plasma astrophysics and spectroscopy	ROSES 2013-2019: H-TIDeS includes LNAPP element					
Ensure NSF basic research across sections, divisions, and directorates, (e.g. outer heliosphere)						
Coordinate NASA-NSF-NOAA ground- and space-based solar-terrestrial observations and technology						
Venture						
New NASA-NSF Heliophysics Science Centers					NASA HSC Step-2 proposals due	
Consolidate NASA technology funding in SR&T, LWS, and LCAS programs into a single program	ROSES 2013-2019 H-TIDeS includes ITD elemnet				H-TIDeS split into H-TIDeS and H-FORT	
Address technology for constellation missions					NSF Big Ideas Constellation	
Educate						
Enhance and Diversify NSF Faculty Development in the Space Sciences (FDSS) program		2 FDSS awards			2019 FDSS proposals due	
Continue NSF Center for Integrated Space Weather Modeling (CISM) summer school	CISM summer school renamed Boulder Space Weather Summer School, administered and organized by NCAR, funded by NSF					
Have NSF community workshops for professional development of graduate students						
Recognize Solar and Space Physics as subdiscipline for NSF's annual Survey of Earned Doctorates						

Draft Chart on Progress

Color Key

Community Input Solicited for Progress, Implementation, Next DS

Conferences: Committee Poster and Town Halls at SpWx Week, SPD, GEM, CEDAR, **SHINE**

Email to Committee: ssp-midterm@nas.edu

Midterm Assessment Committee

Robyn Millan*, Dartmouth College, co-chair

Tom Woods*, Univ. of Colorado/LASP, co-chair

Art Charo, NRC Study Director

Tim Bastian*, NRAO

Monica Bobra, Stanford Univ.

Anthea Coster, MIT

Ed DeLuca, Harvard SAO

Scott England, Va. Tech.

Stephen Fuselier*, SwRI

Ramon Lopez*, UT Arlington

Janet Luhmann, Univ. of Calif. Berkeley

Katariina Nykyri, Embry-Riddle Univ.

Jens Oberheide*, Clemson Univ.

Merav Opher*, Boston Univ.

Karel Schrijver, Lockheed-Martin (ret.)

Josh Semeter*, Boston Univ.

Jeff Thayer*, Univ. of Colorado/AES

Alan Title, Lockheed-Martin

**Served on the steering committee or one of the study panels of the 2012 decadal survey*