

Midterm Assessment of the Heliophysics Decadal Survey

Art Charo, Ph.D.
Senior Program Officer
Space Studies Board

Update to HPAC, December 18, 2018

Background on the 2013 Survey

Solar and Space Physics: A Science for a Technological Society

- Sponsors: NASA and NSF (NOAA support affected by FY11 CR).
- Study initiated in Fall 2010.
- Building on the research accomplishments over the past decade, **the report presents a program of basic and applied research for the period 2013-2022 that will advance scientific understanding of the Sun, Sun-Earth connections and the origins of “space weather,” and the Sun’s interactions with other bodies in the solar system and with the local interstellar medium.**

2013 Decadal Survey Terms of Reference-I

1. **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;
2. **Identify the most compelling science challenges** that have arisen from recent advances and accomplishments;
3. **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
4. **Develop an integrated research strategy** that will present means to address these targets.

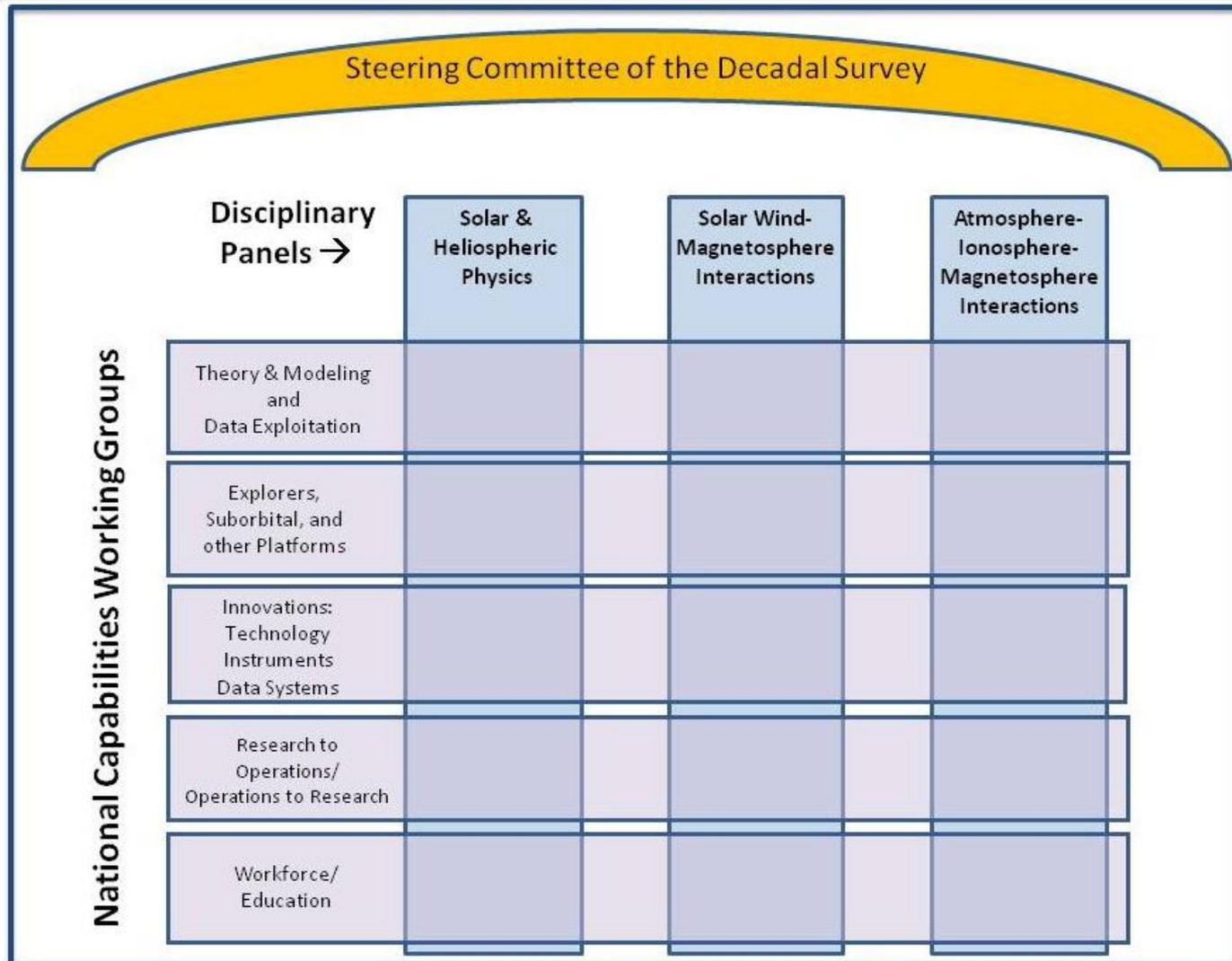
Terms of Reference-II

- **The scope of the study will include:**
 - The structure of the Sun and the properties of its outer layers in their static and active states;
 - The characteristics and physics of the interplanetary medium from the surface of the Sun to interstellar space beyond the boundary of the heliosphere; and
 - The consequences of solar variability on the atmospheres and surfaces of other bodies in solar system, and the physics associated with the magnetospheres, ionospheres, thermospheres, mesospheres, and upper atmospheres of the Earth and other solar system bodies.
- **Within scope:**
 - Missions and space instrument programs to be conducted to support key science objectives
 - Basic or supporting/enabling ground-based laboratory and theoretical research in solar and space to ground-based implementations (e.g., ground-based solar observatories)
 - Value of operational space weather services to society and the role of NASA and NSF research in underpinning and improving these services

Survey Organization-I

- **Steering Committee:** 18 members representing the broad solar and space physics community.
 - Responsible for the recommendations in the final report
 - Included a liaison from each of the disciplinary study panels
- **Disciplinary Study Panels:** each ~ 15 members
 - Atmosphere-Ionosphere-Magnetosphere Interactions
 - Solar Wind-Magnetosphere Interactions
 - Solar and Heliospheric Physics
- **“National Capabilities” Working Groups**
 - 5 WGs ~ 12 members/group drawn from the survey and the community.
 - Work across the study panels; address cross-cutting issues; report back to SC
 - Non-survey members appointed as unpaid consultants; WGs were not formal NRC committees
- **Topical Workshops**
 - Solar Probe Plus (per a June 2011 NASA request)
 - Research to Operations/Operations to Research

Survey Organization-II



Survey Recommendations: Summary for NASA (in order of priority; details in back-ups)

1. **Complete implementation of missions that are currently selected;** maintain cost and schedule commitments. This includes RBSP, MMS, Solar Probe Plus, Solar Orbiter, along with IRIS and other already selected Explorers.
2. **Initiation of the DRIVE program** as an augmentation to the existing enabling research program. The DRIVE components provide for operation and exploitation of the Heliophysics System Observatory for effective research programs. The community must be equipped to take advantage of new innovative platforms.
3. **Execution of a robust Explorer program** with an adequate launch rate, including missions of opportunity (MOOs). The cadence should be accelerated to accomplish the important science goals that do not require larger missions and to provide access to space for all parts of the discipline.
4. **Launch of strategic missions in the reinvigorated STP line and in the LWS line** to accomplish the committee's highest-priority science objectives. This includes first the notional **IMAP** investigation and then **DYNAMIC** and **MEDICI** in the STP program and **GDC** as the next larger-class LWS mission.

The Midterm Assessment

Statement of Task

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.

Committee

Robyn Millan*, Dartmouth College, co-chair

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

Tim Bastian*, NRAO

Monica Bobra, Stanford

Anthea Coster, MIT

Ed DeLuca, Harvard SAO

Scott England, Va. Tech.

Stephen Fuselier, SWRI

Ramon Lopez*, UT Arlington

Janet Luhmann, Berkeley

Katariina Nykyri, Embry-Riddle

Jens Oberheide*, Clemson Univ.

Merav Opher*, Boston Univ.

Karel Schrijver, Lockheed-Martin (ret.)

Josh Semeter*, Boston Univ.

Jeff Thayer*, Univ. of Colorado

Alan Title, Lockheed-Martin

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

<h1>Committee Expertise</h1>	Served on 2013 Heliophysics Decadal Survey	Atmosphere-Ionosphere-Magnetosphere Interactions	Solar Wind-Magnetosphere Interactions	Solar and Heliospheric Physics	Comments
Robyn Millan, Dartmouth College, co-chair	yes		x		X-ray obs to study high energy particles in astrophysical environments. PI BARREL
Tom Woods, Univ. Colorado/LASP, co-chair	yes			x	UV spectroscopy; solar irradiance; atmospheric chemistry; climate change
Tim Bastian, NRAO	yes			x	Chaired NRC review of NSF Geospace Portfolio; Fast Radio Imaging Spectroscopy of the Sun
Monica Bobra, Stanford Univ.				x	Space Weather; Machine learning with solar data
Anthea Coster, MIT/Haystack		x			Ionospheric and SpaceWx research esp. with GPS
Ed DeLuca, Harvard SAO				x	Chaired NASA Roadmap Cmtee. Solar coronal physics; astrophysical fluid dynamics; dynamo theory
Scott England, Va. Tech.		x			Project Scientist for ICON. Planetary atmospheres and the space environment
Stephen Fuselier, SWRI			x		IBEX, MMS; current member of CSSP
Ramon Lopez, UT Arlington	yes		x		Solar wind-magnetosphere coupling and space weather. Education and Outreach
Janet Luhmann, Berkeley SSL			x		Solar Wind Interactions with Planets; Space Weathe
Katariina Nykyri, Embry-Riddle			x		2012-2018 GEM Steering Committee
Jens Oberheide, Clemson Univ.	yes	x			Dynamics of Earth's mesosphere-thermosphere-ionosphere system
Merav Opher, Boston Univ.	yes			x	Computational and theoretical plasma physics
Karel Schrijver, Lockheed-Martin (ret.)				x	Solar and heliospheric activity; space weather impacts; cool-star magnetic activity
Josh Semeter, Boston Univ.	yes	x			Ionosphere Interactions/RS Tech Dev.
Jeff Thayer, Univ. of Colorador	yes	x			Remote sensing of atm. & ionosphere
Alan Title, Lockheed-Martin, (NAS/NAE)				x	Effects of solar magnetic field throughout the interior and outer atmosphere of the Sun. Instrumentation

Recommendations to NASA (Newmark, 2014)

- | Priority | sub | Recommendation |
|----------|-----|--|
| 0 | | Complete the current program |
| | 0.1 | Van Allen Probes |
| | 0.2 | BARREL |
| | 0.3 | IRIS |
| | 0.4 | MMS |
| | 0.5 | Solar Orbiter |
| | 0.6 | Solar Probe Plus |
| 1 | | Implement the DRIVE initiative |
| | 1.1 | NASA tiny-satellite grants program (and overall LCAS) |
| | 1.2 | Permanently augment MO&DA support |
| | 1.3 | Directed guest investigator program as %-age of mission |
| | 1.4 | Laboratory plasma astrophysics and spectroscopy |
| | 1.5 | Coordinate programs across agencies |
| | 1.6 | Heliophysics science centers |
| | 1.7 | Consolidate technology funding, including constellations |
| | 1.8 | Educate |
| 2 | | Accelerate and expand the Heliophysics Explorer program |
| 3 | | Restructure STP as a moderate-scale, PI-led line |
| | 3.1 | IMAP-like |
| | 3.2 | DYNAMIC-like |
| | 3.3 | MEDICI-like |
| 4 | | LWS Geospace Dynamics Constellation - like |

TABLE S-1. Top-Level Decadal Survey Research Recommendations

Priority	Recommendation	NASA	NSF	Other
0.0	Complete the Current Program	X	X	
	Implement the DRIVE Initiative			
1.0	Small satellites; mid-scale NSF projects; vigorous ATST and synoptic program support; science centers and grant programs; instrument development	X	X	X
2.0	Accelerate and Expand the Heliophysics Explorer Program Enable MDEX line and Missions of Opportunity	X		
3.0	Restructure STP as a Moderate, PI-Led Program	X		
3.1	Implement an IMAP-Like Mission	X		
3.2	Implement a DYNAMIC-Like Mission	X		
3.3	Implement a MEDICI-Like Mission	X		
4.0	Implement a Large LWS GDC-Like Mission	X		

TABLE S-2. Top Level Decadal Survey Applications Recommendations

Priority	Recommendation	NASA	NSF	Other
1.0	Re-charter the National Space Weather Program	X	X	X
2.0	Multi-Agency Partnership for Solar/Solar Wind Observations	X	X	X
2.1	L1 Solar Wind (DISCOVER, IMAP)	X		X
2.2	Coronagraph and Magnetograph	X		X
2.3	Evaluate New Observations, Platforms	X	X	X
2.4	Establish a SWx Research Program for Effective Research-to-Operations Transition at NOAA			X
2.5	Establish Distinct Programs for Space Physics Research and Space Weather Forecasting and Specification	X	X	X

Issues for the Next Survey (strawman for discussion)

- Ensuring the next decadal is executable
- Utility of decision rules
- Best practices for the Congressionally-mandated CATE process
- Missions vs. Point-Designs vs. Science Targets
- Actions ahead of the survey
 - NASA sponsorship of studies?
 - Academy workshops or studies to feed into the survey?
 - Improving community engagement
 - Committee diversity, inc. early career
 - Steps to facilitate the consideration of new platforms, technologies, and implementation options (commercial, constellations, ride-share, MOOs) in survey plans
 - Building connections to international partners

Schedule

- NASA Contract: Fall 2018
- Committee approval: December 11, 2018
- Meetings:
 - First In-Person Meeting: January 24-25, 2019 (tentative) in Washington DC
 - Agency briefings
 - Meeting 2: March-April, 2019 in Boulder, CO (tentative)
 - Meeting 3: May-June, 2019 in Irvine, CA (tentative)
 - Meeting 4: Writing meeting if necessary. Date/Location, TBD
- Approved Pre-Pub: Due Oct. 2019 unless extended