A composite image of Earth from space, showing the Western Hemisphere. A vibrant green aurora-like glow is visible over the Americas, extending from the North Pole down to the equator. The background is a dark starry sky with some nebulae.

*The green earth tilts through a sphere of air
And bathes in a flame of space.
There are houses hanging above the stars
And stars hung under a sea...*

MORNING SONG FROM "SENLIN", Conrad Aiken

Heliophysics Subcommittee Report

NASA Heliophysics Subcommittee (HPS)

March 2016



*And a sun far off in a shell of silence
Dapples my walls for me...*

MORNING SONG FROM "SENLIN", Conrad Aiken



Heliophysics Subcommittee (HPS) Membership

HPS Membership -

- Vassilis Angelopoulos (University of California, Los Angeles)
- Spiro Antiochos (NASA Goddard Space Flight Center)
- Jill P. Dahlburg (Naval Research Laboratory, Chair)
- Bart W. De Pontieu (Lockheed Martin Space Systems Corporation)
- Mihir I. Desai (Southwest Research Institute)
- Heather A. Elliott (Southwest Research Institute)
- Michael W. Liemohn (University of Michigan, Vice-Chair)
- Ralph L. McNutt, Jr. (The Johns Hopkins University)
- Neil Murphy (Jet Propulsion Laboratory)
- James M. Russell III (Hampton University)
- Roger W. Smith (University of Alaska Fairbanks)
- W. Kent Tobiska (Space Environment Technologies)



AGENDA -

- HPD Division Overview
- HPD Flight Program Status
- DRIVE Outlook
- Living with a Star [LWS]
 - Update
 - Steering Committee Report
- Heliophysics Communications
- Payload Adapter Fittings [PAFs]
- Risk Tolerance and Requirements
- Research Opportunities in Space and Earth Sciences [ROSES]
 - Top-level 2016 Changes
 - ROSES 2015 Assessment / Research & Analysis [R&A] Programs Update
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} **Steven Clarke's Presentation**



The HPS wishes to congratulate the HPD on how well the Division fared in the NASA FY17 budget request, and we are looking forward to the future with the National Space Weather Action Plan "front and center."

The HPS would like to express its sincere thanks to Steve Clarke, for taking care to ensure that attention continues to be focused on the important Decadal Survey DRIVE initiative.



Diversify observing platforms with microsattellites and mid-scale ground based assets;
Realize scientific potential by sufficiently funding operations and data analysis;
Integrate observing platforms and strengthen ties between agency disciplines;
Venture forward with science centers and instrument and technology development; and,
Educate, empower, and inspire the next generation of space researchers.



AGENDA -

- HPD Division Overview
- HPD Flight Program Status
- **DRIVE Outlook**
- Living with a Star [LWS]
 - Update
 - Steering Committee Report
- Heliophysics Communications
- Payload Adapter Fittings [PAFs]
- Risk Tolerance and Requirements
- Research Opportunities in Space and Earth Sciences [ROSES]
 - Top-level 2016 Changes
 - ROSES 2015 Assessment / Research & Analysis [R&A] Programs Update
 - ROSES Survey Results
- Big Data Task Force Update



HPS March 2016 DRIVE Outlook

The Decadal Survey for Heliophysics, *Solar and Space Physics: A Science for a Technological Society*, has as its first recommendation to implement the DRIVE initiative, to "develop more fully and employ more effectively the many experimental and theoretical assets at NASA, NSF, and other agencies."

The HPS commends the HPD for taking a proactive stance to utilize funds unleashed due to the success of current projects in development, or new funds that are becoming available, for the betterment of DRIVE.



The HPS is pleased to see the diversified nature of the HPD allocations, in science centers, grants, instrument development, and small satellites.



AGENDA -

- HPD Division Overview
- HPD Flight Program Status
- DRIVE Outlook
- Living with a Star [LWS]
 - Update
 - Steering Committee Report
- Heliophysics Communications
- Payload Adapter Fittings [PAFs]
- Risk Tolerance and Requirements
- Research Opportunities in Space and Earth Sciences [ROSES]
 - Top-level 2016 Changes
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 - ROSES Survey Results
- Big Data Task Force Update



HPS March 2016 Living with a Star [LWS]: Update, and Steering Committee Report

Dr. Elsayed Talaat (NASA-HQ) provided a LWS update. He noted that there has been a true watershed event, in that now we have a US Government space weather strategy and action plan spearheaded by the OSTP under the SWORM (Space Weather Operations, Research, and Mitigation) Initiative.

Drs. Mark Linton (NRL) and Eftyhia Zesta (GSFC) then delivered the 2016 LWS Steering Committee Report. The HPS concurred with their suggestions for community involvement in developing the annual LWS Science Topics, and also offers this recommendation:

Recommendation to the HPD: The HPD should investigate developing a broad community program by which the HPD would effectively provide the science research and analysis required for the success of SWORM.



HPS March 2016 Living with a Star [LWS]: Update, and Steering Committee Report (*cont*)

Major Reasons for Proposing the Recommendation: The Presidents FY17 budget mandates \$10M to the LWS program specifically for providing the benchmarks, knowledge gaps, and other information requested by the National Space Weather Action Plan [SWAP]. This is a highly encouraging development, for which the HPD is to be commended, because it demonstrates that the Executive Branch recognizes both the importance of space weather to the Nation, and the key role that Heliophysics research must play in addressing the National space weather needs. To respond to this opportunity, the HPD should start a new program that successfully addresses the immediate demands of SWORM and identifies the key science areas that require new NASA Research & Analysis [R&A] in support of the Space Weather Action Plan.

Consequences of No Action: Not providing the rigorous science-based information required by SWORM would adversely impact the Nation's ability to respond to and mitigate space weather-related threats to civilian, military, and commercial infrastructure and the space program.



AGENDA -

- HPD Division Overview
- HPD Flight Program Status
- DRIVE Outlook
- Living with a Star [LWS]
 - Update
 - Steering Committee Report
- **Heliophysics Communications**
- Payload Adapter Fittings [PAFs]
- Risk Tolerance and Requirements
- Research Opportunities in Space and Earth Sciences [ROSES]
 - Top-level 2016 Changes
 - ROSES 2015 Assessment / Research & Analysis [R&A] Programs Update
 - ROSES Survey Results
- Big Data Task Force Update



HPS March 2016 Heliophysics Communications

Karen Fox (NASA-HQ) provided an update about HPD Communications.

Resulting from her vibrant briefing and the resulting HPS discussion, the HPS offers this recommendation:

Recommendation to the HPD: The visibility of heliophysics programs and activities in NASA's communication campaign should be elevated as part of the ongoing, coordinated HPD communications strategy by defining a new campaign focused on the Nation's rapidly increasing space-based assets.

Major Reasons for Proposing the Recommendation: While the HPD has numerous successful missions and programs, including elevation of space weather to the level of White House support, these activities are often not immediately recognizable to either policy-makers or the public as having direct benefits to the Nation's infrastructure. The adage "out-of-sight, out-of-mind" relates to a lack of connection between heliophysics successful programs and public/policy perception.



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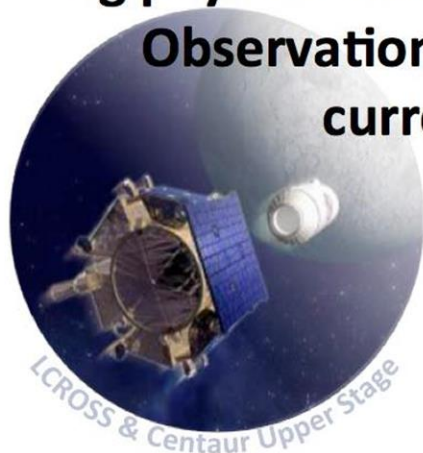
- HPD Division Overview
- HPD Flight Program Status
- DRIVE Outlook
- Living with a Star [LWS]
 - Update
 - Steering Committee Report
- Heliophysics Communications
- **Payload Adapter Fittings [PAFs]**
- Risk Tolerance and Requirements
- Research Opportunities in Space and Earth Sciences [ROSES]
 - Top-level 2016 Changes
 - ROSES 2015 Assessment / Research & Analysis [R&A] Programs Update
 - ROSES Survey Results
- Big Data Task Force Update



HPS March 2016 Payload Adapter Fittings [PAFs]

Dr. Dan Moses (NASA-HQ) provided an update about fueled PAFs. The HPS offers this comment.

Congratulations to the HPD for their investigation and positive findings on the use of fueled PAFs. These PAFs will enable a wider range of Small Explorer mission orbits to be attained, provide deployment sequence flexibility and allow upper stage restart capability at reduced costs to NASA. A system carrying a 0.4-m³, 180-kg payload was demonstrated in 2009 on the LCROSS (Lunar Crater Observation and Sensing Satellite). PAFs with propulsion are currently available from a number of vendors.





AGENDA -

- HPD Division Overview
- HPD Flight Program Status
- DRIVE Outlook
- Living with a Star [LWS]
 - Update
 - Steering Committee Report
- Heliophysics Communications
- Payload Adapter Fittings [PAFs]
- Risk Tolerance and Requirements
- Research Opportunities in Space and Earth Sciences [ROSES]
 - Top-level 2016 Changes
 - ROSES 2015 Assessment / Research & Analysis [R&A] Programs Update
 - ROSES Survey Results
- Big Data Task Force Update



HPS March 2016 Risk Tolerance & Requirements

Dr. Jeff Newmark (NASA-HQ) presented a risk tolerance briefing to the HPS. He discussed: flight program governance; how risk is tailored for missions of various levels of resources; and, the subject of the risk posture in the 2016 ROSES / H-TIDeS (Research Opportunities in Space & Earth Sciences / Heliophysics Technology & Instrument Development for Science) call for proposals.

The HPS wishes to thank Jeff for his very comprehensive and helpful briefing, and plans to take up this topic further at the HPS summer meeting, with an emphasis on CubeSats.





AGENDA -

- HPD Division Overview
- HPD Flight Program Status
- DRIVE Outlook
- Living with a Star [LWS]
 - Update
 - Steering Committee Report
- Heliophysics Communications
- Payload Adapter Fittings [PAFs]
- Risk Tolerance and Requirements
- Research Opportunities in Space and Earth Sciences [ROSES]
 - Top-level 2016 Changes
 - ROSES 2015 Assessment / Research & Analysis [R&A] Programs Update
 - ROSES Survey Results
- Big Data Task Force Update



HPS March 2016 ROSES: Top-level 2016 HPD Changes

Dr. Mona Kessel (NASA-HQ) provided an update about top-level changes for 2016 ROSES HPD calls.

The HPS was glad to hear that, for 2016 --

- the Guest Investigator [GI] proposal length will be reduced to 10-pages from 15-pages;
- the HPD canceled the STEP-1 *review*, so there will be no 2016 "discouraged" proposals. (However, it is important to note that STEP-1 proposals continue to be mandatory, and that Title, Team, and Topic cannot change after a STEP-1 proposal submittal, from a perspective of development of proposal review teams.);
- Supporting Research award sizes will be increased to \$200K.

When considering ROSES 2016, the HPS also discussed early career funding. Accordingly, the HPS offers the following recommendation.



HPS March 2016 ROSES: Top-level 2016 HPD Changes (*cont*)

Recommendation to the HPD: The HPD should assess the possibility of creating a new ROSES program element that exclusively supports early career researchers.

Major Reasons for Proposing the Recommendation: As part of the top priority DRIVE program, the 2012 Decadal survey recommended to educate, empower, and inspire the next generation of space researchers. A separate program that exclusively supports early career researchers should encourage, inspire, and enable promising recent PhDs to carry out high impact, cutting-edge research that benefits the Heliophysics community.

Consequences of No Action: Currently, early career researchers are required to support their research activities by competing with more experienced researchers for funds through existing ROSES program elements where the overall success rates have been steadily declining. Not having a dedicated program could discourage many promising early career researchers from continuing within the field, ultimately causing a deficit in the highly trained workforce that is critical for implementing future NASA and HPD strategic plans.



HPS March 2016 ROSES: 2015 Assessment / R&A Programs Update

Dr. Arik Posner (NASA-HQ) provided an assessment about ROSES 2015, and an update about HPD Research & Analysis [R&A] programs.

In his update, three ROSES calls are currently 'TBD' --

- H-GI-MMS (Guest Investigator - Magnetospheric Multiscale Mission),
- H-GCR-SP (Grand Challenge Research - Science Centers), and
- H-USPI, for research based on data from another country.

The HPS was very interested in the way the GCR-SP planning is shaping up, and offers this recommendation:

Recommendation to the HPD: The HPD should define and provide an implementation plan and timeline for the Heliophysics Science Centers [HSCs] called for in the DRIVE initiative. Means of providing community input and concurrence with the approach advocated should be provided, e.g. via a "tiger team" of community researchers. Specifics should be presented to the HPS at its next meeting.



HPS March 2016 ROSES: HPD Survey Results

Dr. Mona Kessel provided a positive assessment about the reviewer segment of the new HPD ROSES Survey. As result of following discussion, the HPS offers this recommendation:

Recommendation to the HPD: The HPD should consider developing material for and regularly holding Proposal Writing Workshops to instruct researchers in the best practices of successful proposals.

Major Reasons for Proposing the Recommendation: The declining selection rate within HPD ROSES elements has increased the importance of submitting high quality proposals. Analyzing the features of successful proposals, and then sharing these "best practices" with the community, would be highly beneficial. Issues to be highlighted could be the scope/number of science objectives, motivation necessary to achieve "compelling" science merit, presentation and justification of the chosen methodology, and techniques for conveying scientific closure within the proposal. Examples should be made available. This type of workshop was conducted by the HPD in 2011 [http://heliophysics.nasa.gov/AGU11Proposal_Workshop.pdf].



AGENDA -

- HPD Division Overview
- HPD Flight Program Status
- DRIVE Outlook
- Living with a Star [LWS]
 - Update
 - Steering Committee Report
- Heliophysics Communications
- Payload Adapter Fittings [PAFs]
- Risk Tolerance and Requirements
- Research Opportunities in Space and Earth Sciences [ROSES]
 - Top-level 2016 Changes
 - ROSES 2015 Assessment / Research & Analysis [R&A] Programs Update
 - ROSES Survey Results
- **Big Data Task Force Update, provided by Dr. Jeff Hayes (NASA-HQ)**





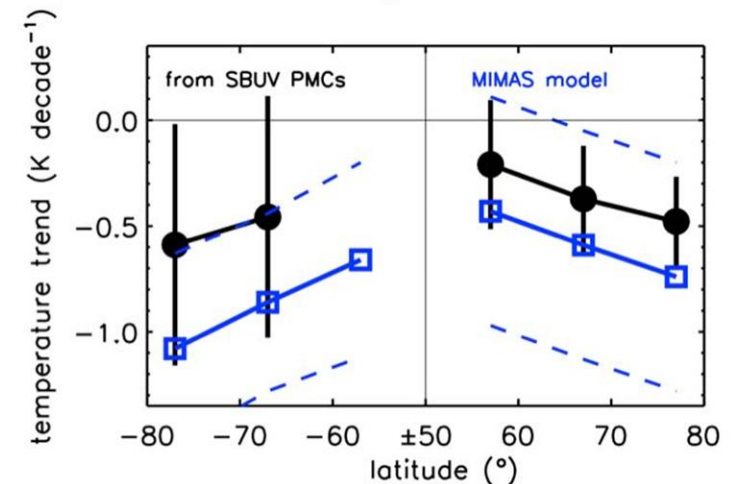
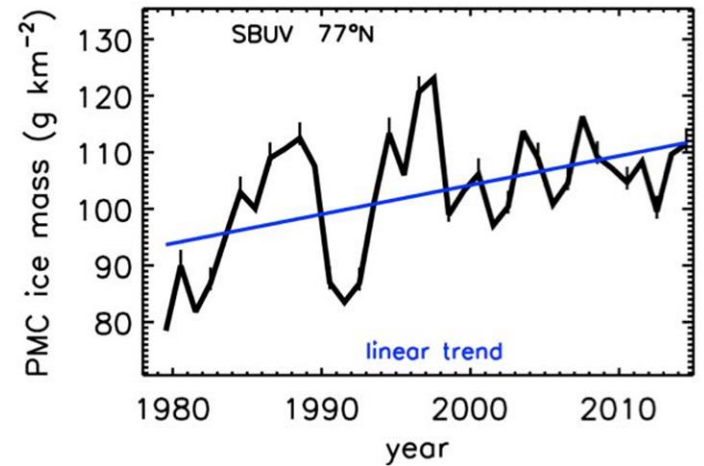
AGENDA -

- HPD Division Overview
- HPD Flight Program Status
- DRIVE Outlook
- Living with a Star [LWS]
- Heliophysics Communications
- Payload Adapter Fittings [PAFs]
- Risk Tolerance and Requirements
- Research Opportunities in Space and Earth Sciences [ROSES]
- Big Data Task Force Update
- Science Highlights --
 - AIM (Aeronomy of Ice) and SBUV (Solar Backscatter UV Instrument) satellite data shows that air on the edge of space is getting colder and more humid
 - The Sun is not about to enter another Maunder Minimum

AIM and SBUV satellite data shows that air on the edge of space is getting colder and more humid

RESULTS POINT TO A GROWING BELIEF THAT GREENHOUSE GASES AND GLOBAL CHANGE HAVE INCREASED THE NUMBER AND BRIGHTNESS OF PMCS.

- Polar Mesospheric Clouds (PMCs) occur ~50 miles above the earth surface in polar summer
- Analysis of 36 years of PMC data measured by the SBUV instrument show that PMC ice mass has been increasing
- AIM/SOFIE observations allow a rigorous interpretation of SBUV PMC change revealing that temperatures are decreasing by 0.5 ± 0.2 K per decade and H₂O is increasing by 0.07 ± 0.03 ppmv per decade
- Changes in both temperature and H₂O are equally important in causing PMCs to vary
- The observed changes have been anticipated due to increasing CO₂ and CH₄.

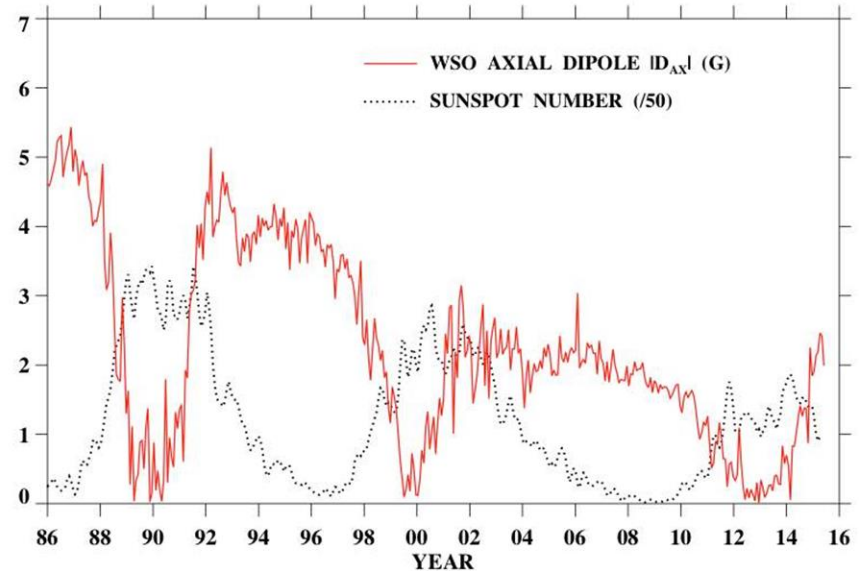


*Hervig, Mark E., Uwe Berger and David E. Siskind, Decadal variability in PMC and implications for changing temperature and water vapor in the upper mesosphere, *J. Geophys. Res. Atmos.*, 121, doi:10.1002/2015JD024439

Solar Cycle 25 will have an amplitude similar to that of the current Solar Cycle 24

In dynamo models of the Babcock-Leighton type, the Sun's axial dipole component provides the seed for the sunspots of the next cycle. The axial dipole strength during the declining phase of each cycle is thus a good predictor of the amplitude of the following cycle.

As shown at the right, the Sun's axial dipole component went through zero in 2012 and has now increased to a strength comparable to its strength during 2002-2008.



Sheeley & Wang, *ApJ*, 809, 113 (2015): The recent rejuvenation of the Sun's large-scale magnetic field: a clue for understanding past and future sunspot cycles;

Wang & Sheeley, *ApJ*, 694, L11 (2009): Understanding the geomagnetic precursor of the solar cycle.

The Sun is not about to enter another Maunder Minimum!

