Decadal Survey for Solar and Space Physics (2024-2033)
NASA Responses to Decadal Survey Committee Questions

Introduction

This document is intended to record key points and information conveyed from the National Aeronautics and Space Administration (NASA) to the National Academy of Sciences, Engineering, and Medicine (NASEM). These were part of discussions between the Decadal Survey Steering Committee (DSC), its panels, and NASA.

It captures the DSC questions and the NASA response(s). Some text was lightly edited to improve clarity in the transition from a verbal conversation to a written record, but no edit changed the questions' intent or answers' content.

(Some answers contain a section labeled "*Additional information*". This section augments aspects of the NASA response and/or provides additional information not captured in the original discussion. This information was all provided after the meeting.)

The information is sorted by topic, as displayed below. Each broad topic includes several more-specific subtopics, which are categorized by the abbreviation used in the question identifiers (i.e., ChDS-1).

Abbreviation	Title
General	
ChDS	Charge to the Decadal Survey
Budg	NASA Budget (General)
PoR	Program of Record
SotP	State of the Profession
Collabs	Collaborations (Intra-Agency, Inter-Agency, International)
Programs	
GenPg	NASA Programs (General)
R&A	Research and Analysis
EXP	Explorers
LWS	Living With a Star
STP	Solar Terrestrial Probes
SpWx	Space Weather
Tech	Technology
Projects	
GenPj	NASA Projects (General, including costing)
DYN	DYNAMIC
GDC	Geospace Dynamics Constellation

Change Log

Rev.	Date	Description of Changes
00	5/3/23	Document creation, capturing questions from Steering Committee Meeting #1 (Kick-off) and Meeting #2

General

ChDS-1. Is there a top-down message that NASA is being given that would help the DSC better answer the charge for space weather (SpWx) and space situational awareness (SSA)?

Government working groups are in place to develop the top-down message, and the Decadal Survey (DS) should look to them.

Additional information: The Space Weather Supplemental Presentation identifies the National Space Weather Strategic Action Plan and the PROSWIFT Act as governing guidance. (Other relevant documents and guidance can be found in the Space Weather Operations, Research and Mitigation Subcommittee [SWORM] publications.)

Within the Space Situational Awareness/Orbital Debris (SSA/OD) Supplemental Presentation, the NASA Office of Inspector General report, the National Orbital Debris Research And Development Plan, and the National Orbital Debris Implementation Plan all provide guidance and include earlier governing documents and guidance. For instance, the Implementation Plan, Action 2.3.1, identifies NASA as the Lead and relates to the Orbital Debris Tiger Team activity discussed in Question SSA-2.

Below are links to some of the committees and working groups active in space weather that NASA participates in or works with. These are in addition to the links and other documents included in the Space Weather and SSA/OD Supplementation presentations.

- Space Weather Roundtable (National Academy of Sciences)
- Space Weather Council (NASA)

For both space weather and SSA, there are on-going Government discussions. If those efforts produce a public guidance document during the DS process, NASA will notify the DSC and provide a link where the document can be accessed.

ChDS-2. Is the DSC able to build scenarios with recommendations that do not rely solely on the mission proposed budget assets we anticipate will be there?

When talking about flexibility in implementation, recommendations should not give prescribed implementation and should be more science-focused to give Heliophysics Division (HPD) flexibility to pivot when new science emerges. Providing scenarios such as that is a great way to enable the flexibility and ability to support DS-recommended science.

Additional information: During the Kick-off Presentation, NASA requested an ambitious but realistic strategy that has flexibility, does not prescribe

implementation, and does not rely on only a small number of large investments (Slides 3, 21).

In the 2024 Decadal Survey Study Approach's NASA-specific guidance, the survey is asked to prioritize goals and objectives for projects for the Living With a Star (LWS), Solar Terrestrial Probes (STP), and Space Weather Programs. NASA expects recommendations for LWS and STP to include a range of project sizes (i.e. Missions of Opportunities to large missions), and recommendations for Space Weather to include a restricted range of project sizes (i.e. not large missions).

ChDS-3. How do we maximize on the number of possible measurements and how do we facilitate collaboration with our international partners?

HPD has a lot of examples of international collaboration in the current fleet. We would love to see comments on the strength of how we're enabling compelling science with international collaborations, including if we could be doing something better. When writing recommendations, the DS should look at the big science goals and then the balance of implementation between the organizations to address those science goals.

ChDS-4. Would creating a strategy for the Heliophysics System Observatory (HSO) be a beneficial recommendation? How could the DS help with that?

[This question was rolled into the surrounding discussion.]

Additional Information: NASA does not prescribe exactly how the DS addresses the HSO, but did request that the survey consider balance of investments and fully budget for the associated costs.

NASA has asked the DSC to consider a few specific aspects of portfolio balance:

- Science area, timing, cost
  - See: 2024 Decadal Survey Study Approach, General guidelines; Kick-off Presentation, Slides 5-9
- Across mission programs
  - See: 2024 Decadal Survey Study Approach, NASA-specific guidelines
- Project sizes
  - See: 2024 Decadal Survey Study Approach, NASA-specific guidelines; Kick-off Presentation, Slide 21; Question ChDS-2
- Extended mission portfolio
  - See: Kick-off Presentation, Slide 18
- Execution of spaceflight science investigations and laying the groundwork for investigations in the following decades

- See: 2024 Decadal Survey Study Approach, NASA-specific guidelines

As part of its definition and framing of portfolio balance, the DS could outline a strategy for the HSO that considers the above aspects and others identified by the DSC.

ChDS-5. **How does continuity fit in for the HSO? Would NASA welcome or want recommendations for something that looks operational because that is the need? Or does that go to the National Oceanic Atmospheric Administration (NOAA)/Air Force or whomever to put together what is needed?**

NOAA invests in operational activities, and funding those would be a big hit to the NASA budget. If there is compelling science for NASA that would also happen to enable the operational measurements, that falls within NASA's HSO.

Additional information: Recently, there have been additional NOAA-NASA collaborations on operational interests (NOAA) and science projects (NASA). Below are two sample collaborations. HPD does not have a policy on either, but they are offered as examples that the DSC can use in its consideration of cross-agency activities.

1. NOAA support for marginal increases in NASA projects' scope of work that would be helpful for operational activities (e.g. producing additional data sets).
2. The 2017 Earth Science Decadal Survey prioritized science goals that required the maintenance of long-term measurement continuity. One aspect of that maintenance is advancing scientific and measurement capabilities. Those capabilities are in NASA's domain. One particular activity that came out of the DS' implementation-agnostic science recommendation was Earth Venture Continuity, where NASA and NOAA established an agreement about the development and demonstration of innovative new technology and/or techniques.

In all potential collaborations, NASA and the partner agency would maintain clear lines of funding responsibility and authority. The project sponsor would support and control the mission's standard operations, and the partnering agency would fund the additional work effort. If a project's priority within the sponsor's portfolio fell to the point of termination, the two agencies could discuss a transfer of the mission's ownership.

ChDS-6. **How does NASA view the relationship between Artemis and heliophysics? Is it an additional resource to the Heliophysics program? How should we look at those opportunities in comparison to the core science program? Should**

there be a separate Artemis-related list as a "would be cool do to" or include it within the list?

Artemis is enabling and emerging. We also look at it as both there is great science that can be done on the Moon and what are we doing to find that great science. The DS should think about what science could HPD complete by using Artemis as a service (either robotically or with humans)?

Additional information: The Human Exploration, Artemis, Moon & Mars Supplemental Presentation discusses Lunar Infrastructure (Slides 13-16) and Gateway (Slides 17-20) that could be used to complete heliophysics science.

PoR-1. **How does NASA view the Program of Record? How should the DS handle it, especially the projects in pre-formulation and the accompanying budget assumptions?**

[This question was conveyed in email conversations between NASA and NASEM. The response below is a summary of comments NASA made at Steering Committee Meeting #2 in anticipation of the question being asked, with additional clarifying information.]

The Program of Record is those activities which will continue as planned through the next decade in the absence of recommendations from the Decadal Survey to make changes.

For projects in pre-formulation, NASA is in a planning phase and has not committed to those listed. NASA would determine whether to move into formulation (i.e., enter Phase A) based upon programmatic discussions and priorities.

The anticipated budget requirements for projects in pre-formulation are not captured in the future program budgets. Unless recommended otherwise, the Decadal Survey is expected to include the anticipated budget requirements into its enabling budget recommendations. If an activity does not lead to project formulation, NASA expects to assign any available budget to other projects, with consideration to programmatic needs and the Decadal Survey priorities and decision rules.

Note: NASA provided the Program of Record Supplemental Presentation, detailing the programs and projects for the Decadal Survey Committee (pre-formulation activities are on Slides 15-21). In the Decadal Survey Kick-off Presentation (Slides 16-18) NASA provided focused requests for Decadal Survey recommendations on the Program of Record.

PoR-2. **On the Research Program slide in the Budget Supplemental Presentation, what caused the funding drop in 2022?**

Congress appropriated more money for the research program prior to 2022. In 2022, those appropriations dropped. If we received favorable appropriations, we would increase the R&A funding again.

SotP-1. **Regarding the State of the Profession expectations in the 2024 Decadal Survey Study Approach, is it that NASA does not want any recommendations for specific actions to improve the state of the profession, or that NASA does not want the DSC to try to solve all the challenges that the community is currently facing?**

The latter. There is no way the DSC can come up with actions to solve all the challenges, but NASA does want to know what those challenges are and the recommendations the Committee is able to develop.

Collabs-1. **Where are the lines drawn between the fundamental physics, applied science, transitioning, and operations of missions between the programs/agencies?**

NOAA and NASA interact on transitioning operational capabilities through the Research to Operations to Research (R2O2R) program. That uses a tri-agency agreement between NASA, the National Science Foundation (NSF), and NOAA. We are working on a quad-agency agreement to include Department of Defense (DoD).

We are asking what should our Space Weather Program should focus on. It is new since the last decadal survey. We want guidance and recommendations for what the program should be, similar to the request for the Technology Program.

Living With a Star (LWS) addresses the heliophysics science that impacts life and society.

Solar Terrestrial Probes (STP) addresses the high-level fundamental heliophysics science.

For our programs, we want to remove any constraints or cost caps that were imposed in the last decadal survey.

Additional information: One of the constraints imposed in the 2013 Decadal Survey was the link between the HPD programs and the project implementation. The 2013 Decadal Survey Mid-term Assessment (Section 6.2) identified this as not effective for long-term sustainability. In the *Strategic Space Flight Programs: Structures and Implementations* document, NASA agreed.

NASA sees these STP, LWS, and Space Weather projects being defined by the science objectives and science goals they are prioritized for. They are not defined by the measurements, instruments, or science capabilities involved. It is understood that a project in STP may produce data useful for non-STP investigations (e.g. GNSS-Radio Occultation data) or start a model capability that could be further developed for transition to operational use (as discussed in the *Structures and Implementations* document, Section 3).

Collabs-2. **To what extent should the DSC come up with recommendations as to what the agencies should work jointly on that falls between operational activities and research/investigations?**

That's exactly what NASA wants to see from the DS. There is a lot in the middle area between operational activities and research. Our partnerships and working groups with NSF and NOAA are pretty consistent, so recommendations on improving those collaborations are great.

Collabs-3. **How do you see heliophysics entering the exoplanetary research environment without contributing a mission that makes further inroads into studies astrophysics is doing? Should Astrophysics Division (APD) be coming to HPD asking for their support? What can HPD do in a meaningful, tangible way?**

HPD is the Division with the most cross-divisional abilities; it has overlap with Planetary Science Division (PSD), APD, and Earth Science Division (ESD). HPD wants to open those boundaries beyond the traditional "solar" application by asking: where else can we take heliophysics? What other Divisions can contribute to heliophysics?

Additional information: HPD participates in the Habitable Worlds and Exoplanets Research with PSD and APD. In those programs, it supports proposals that perform sun-star studies or otherwise leverage our heliophysics expertise to exoplanetary systems.

Collabs-4. **HPD's budget is half the size of APD's budget, which is half the size of PSD's budget. Would NASA be open to the DSC suggesting the conduit between various divisions and jointly sponsoring programs?**

NASA must be careful with that: HPD can't recommend to APD that they jointly fund something. The DS' focus is the science, not necessarily the mission implementation. If the science can be jointly recommended, that's good but

exercise caution in jointly recommending missions. This is especially true with a Division that has already had their DS recommendations published.

Additional information: In the Kick-off Presentation, NASA charged the Decadal Survey Committee with determining the compelling science investigations to be completed in the next decade, and then to identify the budget necessary to support those investigations. It is expected that the Decadal Survey will recommend an ambitious but realistic budget for HPD (Slide 3). Further, NASA has requested decision rules for the cases where future budgets are more favorable and less favorable than recommended.

Collabs-5. Can HPD contribute to planetary missions, in a sense of contributing instruments or operation strategies? Has that been successfully done before?

It's possible but always challenging. PI-led missions are mass- and power-constrained, not only budget-constrained; this often leads to de-scope of instruments. However, we can do heliophysics science anywhere (space weather pipeline, for example). If there is an opportunity to contribute to a planetary mission and an ability to provide information on a potential HPD-contributed instrument on the necessarily timeline, we will.

Additional information: As stated during the DSC meeting, there are strong constraints on planetary missions, and proposers require information on potential contributions as early as possible (ideally more than two years before a proposal due date). However, this is a situation where DS strategic input is valuable for future planning. HPD has the ability to work with our PSD colleagues on offering heliophysics-relevant contributions in their AOs. If the DS recommends HPD hardware contributions to planetary missions, the useful information would be the strategic science/measurement goals (e.g. what kind of science/measurements, where in the heliosphere) and a level of support (e.g. budget, decision rules of what recommended activity the contribution would replace).

Collabs-6. Should the DSC be empowered to comment on HPD's interactions with planetary aspects [e.g., Radiation Assessment Detector (RAD) on Mars]?

Yes. HPD does want to see those recommendations/commentary and does want to hear the DS' views. This is both on the portfolio HPD currently has and on whether HPD should continue supporting those activities. HPD encourages the DSC to discuss hosted payloads and interactions with other SMD Divisions.

Collabs-7. Budget is the way philosophy is implemented. How do you see the budget being reflected by opening those cross-divisional pathways?

NASA seeks ground-breaking, barrier-breaking, aspirational science and encourages the DSC to not be constrained. If there's something new and exciting that will push the boundaries, the DSC should not say "X can't be done because it's not within Y lane."

Programs

GenPg-1. **Is it incumbent on the DSC to bucket recommendations under specific programs or can the DSC recommend the science and let NASA determine where it falls under the program?**

NASA wants to do as much science as possible. You can bucket it if it makes sense, but you don't have to. When making budget sandcharts, it is most helpful to assign projects to programs. But, if you explain in the recommendation what the assumption was around program/project assignments, NASA will work with that.

R&A-1. **What are the plans for Diversify, Realize, Integrate, Venture, Educate (DRIVE) Centers going forward? Are these plans reflected in the budget information?**

[This question was conveyed in email conversations between NASA and NASEM. The response below is a summary of comments NASA made at Steering Committee Meeting #2 in anticipation of the question being asked, with additional clarifying information.]

HPD intends to continue the DRIVE Centers in the future, and are expanding the use of that model to space weather research.

DRIVE Centers are funded out of the Research Program budget. The research funding line can support one Center cycle every eight years (or so) without disrupting the other programs.

LWS-1. **NASA sponsored a Living With a Star Architecture Committee and delivered their final report to the Decadal Survey Committee. How was this report generated and how is the DSC expected to use it?**

[This question was conveyed in email conversations between NASA and NASEM. The response below is a summary of comments NASA made at Steering Committee Meeting #2 in anticipation of the question being asked, with additional clarifying information.]

The 2013 Decadal Survey Mid-term Assessment recommended that NASA task the next decadal survey to "[define] distinct science goals and implementation strategies for NASA's Solar Terrestrial Probes and Living With a Star programs".

In NASA's response to the Mid-term Assessment, NASA agreed with the importance of distinct science goals and implementation plans, but identified

internal discussions to distinguish the scopes and boundaries of those programs. As promised in that response, NASA delivered the Strategic Space Flight Programs Structures and Implementations document for the Decadal Survey's use.

That document structured LWS' mission activities in a similar manner to the LWS competed research activities, using Focused Mission Topics (FMT) instead of Focused Science Topics (FST).

The FMTs are envisioned as scientific priorities for the LWS program that flow down from the LWS Strategic Science Areas. Each FMT is defined by strategic science needs from which one or more completable science objectives flows. Each FMT could be addressed by one or more projects, and a single project could address one or more FMTs. One goal with this formulation was to provide clear traceability while providing flexibility in NASA's implementation.

As part of its pre-decadal survey preparation, HPD tasked Johns Hopkins University/Applied Physics Laboratory to manage the LWS Architecture Committee in its production of sample FMTs based on community input (analogous to Heliophysics Mission Concept Studies for STP). This committee repeatedly solicited community input (e.g., community mailing lists) and briefed their effort at public meetings (e.g., NASA's Heliophysics Advisory Committee).

NASA intends the Architecture Study as a resource for the Committee. The DSC can leverage particular FMTs as written; it can add to, subtract from, or modify those FMTs; or it can refer to those FMTs when creating its own.

STP-1. **There has never been more than one STP mission in development at the same time. Has the limiting factor been budget or management? If the next decadal survey were to recommend more than one STP mission at a time, would NASA have the management capability for them?**

The limiting factor is budget. NASA has the management capability. When we need mission managers, we can draw upon the entire agency. We are NASA, and we have a deep bench.

Additional information: This is true for all programs, not just STP. For instance, LWS previously had both Parker Solar Probe and the Solar Orbiter Collaboration developing concurrently, and STP is currently developing both Interstellar Mapping and Acceleration Probe (IMAP) and Carruthers. With the recent growth in the Explorers portfolio, more individuals were hired as mission managers.

SpWx-1. **Is NASA looking for guidance on growing the Space Weather MIDEX program? SMEX program?**

We're open to recommendations. The DSC shouldn't get caught up in the existing budget and future "free energy" available. NASA doesn't want to constrain the DSC on their recommendations.

SpWx-2. We're expanding human presence beyond low Earth orbit. What does HPD view the role that NASA has in space weather for astronauts on the moon and ultimately Mars?

HPD's been involved with the Agency regarding how we're going to support it. By what kind of science is enabled by these activities and how to further that science through measurements and infrastructure put in place to protect the astronauts. NASA are asking the DS for specific recommendations on Artemis and Moon to Mars.

SpWx-3. Should the DSC continue the traditional divide between NASA and NOAA as it relates to space weather activities relevant to astronauts and human exploration?

NASA and NOAA recently signed an inter-agency agreement on radiation support to astronauts, so that provides some guidance as to the roles and responsibilities. NASA and NOAA are working closely together to determine the roles, and there was a summit to discuss them.

To summarize the split: Cutting edge development, research, and deep analysis is NASA. Operations is NOAA.

SpWx-4. Is HPD looking for how different space weather programs are working together or is there an overarching strategy?

There's synergy among the LWS and Space Weather Programs, but they have their separate goals and vision. Space Weather has its own program and goals, and LWS is fundamental science.

SSA-1. Does HPD have an obligation to advance and improve science for SSA and should topics in the obligations space be prioritized differently than the opportunity space?

HPD does not have a current obligation for SSA/OD. It is outside of the 2013 Decadal Survey because it is new/emerging, and wasn't mentioned during the last one (or, if it was, it was in Chapter 7).

Additional information: Orbital debris was discussed in the 2013 Decadal Survey as a motivating factor for studying space weather [Chapter 7, p. 135]:

> *Understanding space weather and climate is a prerequisite for fulfilling at least two directives of U.S. national space policy:*
>
> 1. *[…]*
>
> 2. *Preserve the space environment, in part by pursuing "research and development of technologies and techniques . . . to mitigate and remove on-orbit debris, reduce hazards, and increase understanding of the current and future debris environment" and by leading "the continued development and adoption of international and industry standards to minimize debris." Satellite drag is relevant to orbit and reentry prediction and to long-term mitigation of orbital debris. The recent inability, for example, to forecast the demise of the Upper Atmosphere Research Satellite (UARS) spacecraft underscores limitations in current capabilities for modeling and understanding the interaction of Earth-orbiting objects with the upper atmosphere. Space junk now exceeds 22,000 objects larger than a softball (Figure 7.1); collisions are expected to become more frequent (and may have propelled the UARS satellite into a less stable orbit).*

SSA-2. HPD supported a Tiger Team to study a potential SSA/OD mission concepts. Can NASA share the Tiger Team budget/costing study results with the DSC as they form recommendations around the science?

There is an internal report, but HPD would need to check if it can be shared with the DSC. The mission concept study done at Goddard is a high-level mission concept study and was done in response to an Office of the Inspector General (OIG) action. Since SSA/OD is new and has emerged since the last Decadal, HPD wants DS recommendations around how to deal with SSA/OD and other new and emerging issues.

Additional information: The SSA/OD report is an internal document and was not written for release. The budget that HPD provided (in the Budget Workbook, under *HPD Prog. of Rec., future costs*) is an enveloping profile that the study showed would support the highest-priority aspects without tailoring to specific providers or implementations.

SSA-3. Does HPD anticipate a new strategic mission line for SSA/OD, or would it fall under the NASA Space Weather Program? If it's prioritized in the DS, will it take funding away from another source/mission?

This is where NASA wants the DSC to enable the cutting-edge science and develop the recommendations. If a new strategic mission line for SSA/OD seems like the best recommendation, that is what NASA wants to see.

Additional information: This discussion used the term "strategic mission line" to mean a new program (like LWS, Space Weather, Technology, etc.). In the Decadal Survey recommendations' budget requirements, the SSA/OD program would need to be shown separately and fully capture all SSA/OD funding needs.

SSA-4. For SSA/OD, can NASA do anything by itself without collaborating with the other space agencies, particularly the Chinese agency?

It's an international effort. For instance, there are requirements levied on orbital assets. NASA is asking the DS what recommendations would help HPD further the science and knowledge of orbital debris.

Additional information: As stated in the discussion, fully solving the orbital debris problem is an international effort. However, NASA follows requirements on orbital assets and has internal activities related to orbital debris.

HPD approaches orbital debris with a focus on furthering scientific understanding. These include the National Orbital Debris Research and Development Plan's general topical areas and the National Orbital Debris Implementation Plan's recommended efforts on orbital debris-associated plasma waves (Action 2.2.7), new technologies to characterize the orbital debris environment (Action 2.3.1), and developing collaborative open science platforms (Action 2.7.2). Through other activities, such as the Orbital Debris Program Office (under the Office of Safety and Mission Assurance), NASA has taken the lead in developing the technical consensus for adopting mitigation measures.

Projects

GenPj-1. **For Partner Institution (PI)-led missions, where do things like the management office get captured?**

It's in the budget spreadsheet as a separate line under each program and it needs to be included. Program Management is a background cost that is always there.

GenPj-2. **Is there a single number we should assume for missions that move into extended missions? There are a lot of missions in development now. Is there a cap for extended missions in the next decade? Is the main concern budget creep? Is NASA looking for decision rules for extended missions?**

NASA is not trying to prescribe how the DS treats extended missions. The conservative position is to plan a flat budget for any mission that moves into extended missions.

All missions are invited into Senior Review. In principle, if the budget is available and the science is good, any and all missions could continue into an extended mission.

The DS should think of all of the ramifications of the recommendations. They must balance all of the strains when NASA extends a mission.

Additional information: In this and previous discussions with the DSC, HPD referenced historical decreases in extended mission budgets (see the provided document, *NASA Space Flight Programs and Projects: Budget Elements*), a flat budget in current dollars (not adjusted for inflation), and a flat budget in constant dollars (adjusted for inflation). Further, HPD created the HSO Infrastructure category to decrease demands on long-lived missions (Program of Record Supplemental Presentation, Slide 7).

HPD does not prescribe what combination of these or other options the DS recommends for extended missions. However, the recommendation must be clearly stated and budgeted for.

Additionally, any decision rules regarding how to treat extended mission budgets that grow faster than anticipated would be helpful.

GenPj-3. **For the 2013 Decadal Survey's budgeting of the Explorers program, what contributed to the underbudgeting aside from launch vehicle cost? How can the budget be so wrong in a cost-capped profile (in the previous DS)? Would it be helpful to provide the DSC with NASA's launch costs?**

[This question was rolled into the surrounding discussion. The Committee noted that the launch vehicle costs provided in the supplemental documents cover a wide range, and they asked for clearer bounding cases.]

Additional information: The Committee noted that the launch vehicle costs provided in the supplemental documents cover a wide range, and they asked for clearer bounding cases.

It is NASA's expectation that the Technical Readiness and Cost Evaluation (TRACE) process (like in previous decadal surveys) will provide a launch vehicle cost for any project they study.

Therefore, the NASA-provided launch vehicle costs would only be useful for developing budget requirements for MO-, SMEX-, and MIDEX-class recommendations for the Explorers, STP, LWS, SpWx, and Technology programs. This information is being included as part of the response to the Committee's question on sustainable Explorers cadences.

DYN-1. Should the Committee assume that Dynamical Neutral Atmosphere Ionosphere Coupling (DYNAMIC) is going forward and include it in the current program?

DYNAMIC was confirmed by the 2013 Decadal Survey Mid-term Assessment as the highest priority science to move forward with. There is a community announcement coming out soon that will go through solicitation details.

However, NASA does invite the DS to comment on whether it is still endorsed as a priority. NASA doesn't expect DYNAMIC to be reprioritized as a project, but rather a confirmation that the science involved in it is still a high priority.

NASA invites the DS to talk about the contribution in the recommended science strategy.

DYN-2. Beyond the commitment to affirm the continued priority of the DYNAMIC science, which is mentioned in the Midterm Assessment, what does NASA want the committee to recommend? The DSC has been tasked to not reprioritize missions that have gone past Key Decision Point (KDP) B at the time of the report publication. What is the schedule for DYNAMIC so that Committee can ensure their comments are useful?

NASA asks the Decadal Survey Committees to affirm the Program of Record, which includes those missions in early formulation. Additionally, NASA is asking for recommendations around the methods we used to complete the previous

Decadal Survey's recommendations, such as using a slightly different implementation but achieving the science.

DYNAMIC KDP B will be close to the report publication, and likely around the same time as Geospace Dynamics Constellation's (GDC) KDP B. We invited the Committee's comments for transparency, but also to help inform future mission formulations.

Additional information: In the Decadal Survey Kick-off Presentation (Slide 17), NASA invited the DSC to provide input on the formulation of recommended missions. DYNAMIC is being formulated with a dependence on GDC-provided measurements. SMD has this flexibility for missions that will be in science operations concurrently (see the provided document, *Formulation of NASA Space Flight Investigations: A Framework to Enable Discussions*). This cost-effective implementation enables 2013 Decadal Survey-recommended science with a smaller-than-anticipated budget, and could be leveraged in and following the 2024 Decadal Survey.

DYN-3. When the decadal survey report is published, would DYNAMIC be at a stage implementation could be changed?

It would be a significant change, and it would mean GDC and DYNAMIC likely wouldn't fly at the same time.

GDC-1. The Decadal Survey Committee has been tasked to not reprioritize missions that have gone past KDP B at the time of the survey publication. What is the schedule for GDC so that Committee can ensure their comments are useful?

GDC KDP B will occur close to publication. It may have just gone through KDP B before the report is published, but the current schedule would have it going through KDP B right after the report is published. NASA invited the Committee's comments for transparency, but also to help inform the formulation of future missions.

Additional information: In the Decadal Survey Kick-off Presentation (Slide 17), HPD invited the DSC to provide input on the formulation of recommended missions. For instance, GDC is being formulated with the consideration of space weather interests, such as the provision of low-latency data products and the development of science capabilities necessary for GDC but could later be transitioned to operations. Input to inform future mission formulations that could similarly realize cross-agency benefits is welcome.

ENL-1. What should the DSC do about ESA/NASA Lower Thermosphere-Ionosphere Science (EN-LoTIS)?

EN-LoTIS is not a project right now. It is a joint study with the European Space Agency (ESA). The study is looking at the science priorities, technologies required, etc.

NASA invites the DS to discuss the potential contribution of EN-LoTIS to recommended science strategy.

Additional information: EN-LoTIS is a potential partnership that is being organized between ESA and NASA from the beginning. The EN-LoTIS study is listed in Program of Record as a project in pre-formulation as part of NASA's transparency with the Decadal Survey Committee.

For the DSC's reference, here are links with additional information on the state of EN-LoTIS.

- ESA-NASA Working Group webpage (ESA)
- EN-LoTIS Working Group Town Hall presentation (CEDAR Workshop)

Acronyms

Acronym	Term
AO	Announcement of Opportunity
DoD	Department of Defense
DRIVE Centers	Diversify, Realize, Integrate, Venture, Educate Centers
DS	Decadal Survey
DSC	Decadal Survey Committee
DYNAMIC	Dynamical Neutral Atmosphere Ionosphere Coupling
ENLoTIS	ESA-NASA Lower Thermosphere-Ionosphere Science
ESA	European Space Agency
ESD	Earth Science Division
FMT	Focused Mission Topic
FST	Focused Science Topic
GDC	Geospace Dynamics Constellation
HPD	Heliophysics Division
HSO	Heliophysics System Observatory
IMAP	Interstellar Mapping and Acceleration Probe
KDP	Key Decision Point
LWS	Living With a Star
MIDEX	Medium-class Explorer
MO	Mission of Opportunity
NASA	National Aeronautics and Space Administration
NASEM	National Academy of Sciences, Engineering, and Medicine
NOAA	National Ocean and Atmospheric Administration
NSF	National Science Foundation
OIG	Office of Inspector General
R2O2R	Research to Operations to Research
SMD	Science Mission Directorate
SMEX	Small-Class Explorer
SpWx	Space Weather
SSA[/OD]	Space Situational Awareness[/Orbital Debris]
STP	Solar Terrestrial Probes
TRACE	Technical Readiness Assessment and Cost Estimate
UARS	Upper Atmosphere Research Satellite

Cited Documents

Document	Associated Questions
2013 Decadal Survey Mid-term Assessment	Collabs_1, LWS_1, DYN_1
2024 Decadal Survey Study Approach	ChDS_2, ChDS_4
EN-LoTIS Working Group Town Hall presentation	ENL_1
Exoplanets Research	Collabs_3
Formulation of NASA Space Flight Investigations: A Framework to Enable Discussions	DYN_2
Habitable Worlds	Collabs_3
Human Exploration, Artemis, Moon & Mars Supplemental Presentation	ChDS_6
Kick-off Presentation	ChDS_2, ChDS_4, PoR_1, DYN_2, GDC_1
Living With a Star Architecture Study	LWS_1
NASA's Efforts to Mitigate the Risks Posed by Orbital Debris [NASA OIG]	ChDS_1
NASA Response to Mid-term Assessment	LWS_1
NASA Space Flight Programs and Projects: Budget Elements	GenPj_2
National Orbital Debris Implementation Plan	ChDS_1, SSA_4
National Orbital Debris Research And Development Plan	ChDS_1, SSA_4
National Space Weather Strategic Action Plan	ChDS_1
Program of Record Supplemental Presentation	PoR_1, GenPj_2
PROSWIFT Act	ChDS_1
Space Situational Awareness/Orbital Debris (SSA/OD) Supplemental Presentation	ChDS_1
Space Weather Council	ChDS_1
Space Weather Operations, Research and Mitigation Subcommittee [SWORM] publications	ChDS_1
Space Weather Roundtable	ChDS_1
Space Weather Supplemental Presentation	ChDS_1
Strategic Space Flight Programs: Structures and Implementations	Collabs_1, LWS_1