

Decadal Survey for Solar and Space Physics (2024-2033)
Integrating Ground- and Space-Based Observations
Meeting Summary
(July 11, 2023 Meeting)

This document is intended to summarize key points and information conveyed by the National Aeronautics and Space Administration (NASA) to the National Academy of Sciences, Engineering, and Medicine (NASEM). These were part of discussions from the 7/11/23 Decadal Survey Meeting for the Integrating Ground- and Space-Based Observations Working Group.

The Decadal Survey was charged with recommending a science strategy where ground- and space-based investigations were combined ([Statement of Task](#), Item 3.a). The framework for this was described in the Decadal Survey Statement of Task (including which recommendations go to which specific sponsors), the Study Approach (NASA-specific section), and the [Formulation of NASA Space Flight Investigations](#) document (under “coupled investigation”). The [Integrating Ground- and Space-Based Observations](#) presentation illustrated NASA’s expectations (Slides 10-14) for how the Decadal Survey would present the recommendation.

The sponsor agencies asked the National Academy of Sciences for a decadal strategy that combines ground- and space-based investigations to significantly advance progress on the prioritized science goals (Statement of Task, Item 3.a).

Functionally, the Decadal Survey should recommend the whole science objective involving combined ground- and space-based observations. The Decadal Survey is read by agency stakeholders that strongly benefit from having the bottom line up front. For those recommendations involving combined ground- and space-based investigations, it would be most impactful for the recommendation to specify the agencies involved in the combined investigation.

Underneath any top-level recommendation for such a combined investigation, per the Statement of Task’s direction, the Decadal Survey should recommend to NASA the appropriate space-based investigation, and should recommend to NSF and/or NOAA the ground-based investigation(s). These sub-recommendations would be accompanied by specific project-level cost and schedules in the agency-specific recommended-budget tables and sand charts.

In drafting any such recommendation (and sub-recommendations) for a combined ground- and space-based investigation, the Decadal Survey should be aware that inter-agency agreements take time (at least one year) and for the purpose of strategic alignment would need to be in place before NASA starts project formulation activities.

From a NASA point of view and assuming ground-based projects to have longer design lifetimes than space-based projects, the most effective scheduling would be for the non-NASA ground-based project to start before the NASA space-based project. This would enable NASA to take advantage of any decision rules or adjustments to prioritization if the ground-based project did not start as envisioned.

The Decadal Survey was encouraged to provide a strategy for ground-based investigations and infrastructure. NASA endorsed NSF’s specification that recommendations should address *ground-based capabilities*.

The Decadal Survey is the one single document that stakeholders look to for input to a National heliophysics strategy. However, there has never been a clear or coherent strategy for ground-based investigations or infrastructure.

The [2013 Decadal Survey](#) identified a small number of specific facilities and advocated for ground-based observations. The [2013 Decadal Survey Mid-term Assessment](#) recommended the coordination of ground- and space-based observations. Even the recent [Space Weather Advisory Group](#) recommendations addressed ground-based networks to support space-based missions.

An implementation strategy for ground-based infrastructure needs to contain specific details, including observation capabilities (including geographic distribution), the expected new starts, the expected lifetimes, and the enabling budget.

NOAA, NSF, and NASA all emphasized that a compelling strategy must have specific benefits for each involved agency. A recommendation for one agency to support a capability or project primarily (or solely) for the benefit of another agency lessens the compelling nature of a strategy.

The Heliophysics System Observatory (HSO), NASA’s fleet of heliophysics space flight missions, is developed through a combination of PI-led projects and NASA-managed projects. The 2013 Decadal Surveys explicitly prioritized the Explorers Program over strategic investments (e.g. Solar Terrestrial Probes, Living With a Star) for the HSO. The 2024 Decadal Survey was asked to recommend robust, sustainable strategies for the Solar Terrestrial Probes (STP), Living With a Star (LWS), and Space Weather Programs. This explicitly includes a range of science objectives and mission sizes, and invites leveraging NASA flexibility discussed in the *Formulation of NASA Space Flight Investigations* document.

There are two aspects to strategic HSO planning: the missions selected for development, and the missions approved for continued operations.

For selection for development, NASA does not place strong scientific constraints or requirements on proposals to an Explorers Announcement of Opportunity (AO), outside of addressing the Explorers Program high-level goals and objectives listed in the AO. When the 2013 Decadal Survey prioritized Explorers, it greatly diminished strategic options.

Further, the recommendations for the STP and LWS Programs were for moderate-scale and larger stand-alone projects. Programs that only have larger projects present challenges to sustainability.

In the Statement of Task package ([Study Approach](#), NASA-specific section), NASA requested a range of mission sizes and recommended investigations for each (non-Explorers) Program. The mission sizes were requested to cover the range from Missions of Opportunity to large missions,

and the investigations were requested to be in terms of science objectives (narrow aspects of broader science goals/questions that can be completed by single space flight projects). (The formulation paradigms for STP and LWS are discussed in the [*Strategic Space Flight Programs Structures and Implementations*](#) document, previously delivered to the Decadal Survey Committee.)

For STP, NASA requested program-level science objectives. NASA did not provide specific examples of the requested recommendations, but expects that the 2024 Heliophysics Decadal Survey could frame its recommendation(s) in a similar fashion to the 2011 and 2022 Planetary Science and Astrobiology Decadal Surveys' recommendations for the New Frontiers Program (although focused on science objectives, rather than the New Frontiers' mix of science objectives, measurements and other mission-implementation details, and operational capabilities).

For LWS, NASA envisioned "Focused Mission Topics" (FMTs), as described in the *Structures and Implementations* document. Before the Decadal Survey process began, NASA supported the Living With a Star Architecture Committee to assess the current state and potential future needs for the LWS Program (see [final report](#)). In that effort, the group produced example FMTs for the Decadal Survey's use. These FMTs were based on input from the science community, and some of the science objectives were written at a higher level in order to not prescribe or constrain the Decadal Survey Committee.

Within the *Formulation of NASA Space Investigations* document, NASA described different types of investigations. The "dependent" and "coupled" investigations are where NASA could most easily implement strategic decisions for the HSO. (NASA's formulation of DYNAMIC is an example of a dependent investigation. DYNAMIC requires GDC capabilities, but GDC does not require DYNAMIC.)

(One important note is that dependent and coupled investigations are expected to have prime science operations concurrent with the mission with which it is coordinated. The more separated the prime operations, the more risk NASA would be exposed to. The *Ground- and Space-Based Coordination* presentation shows an example of relative timing of two projects on Slide 14.)

For the approval for continued operations, NASA requested the Decadal Survey recommend a strategic approach for the HSO (NASA Decadal Survey Kick-off Presentation, Slide 18).