NASA Heliophysics Space Weather Program

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NASA Heliophysics Objectives

Solve the **fundamental physics** mysteries of heliophysics: Explore and examine the physical processes in the space environment from the Sun to the Earth and throughout the solar system including the interface with the interstellar medium.

Build the **knowledge to forecast space weather** throughout the heliosphere: Develop the knowledge and capability to detect and predict extreme conditions in space to protect life and society and to safeguard human and robotic explorers beyond Earth.

Understand the **nature of our home in space**: Advance our understanding of the connections that link the sun, the Earth, planetary space environments, and the outer reaches of our solar system.

NASA Heliophysics Overview

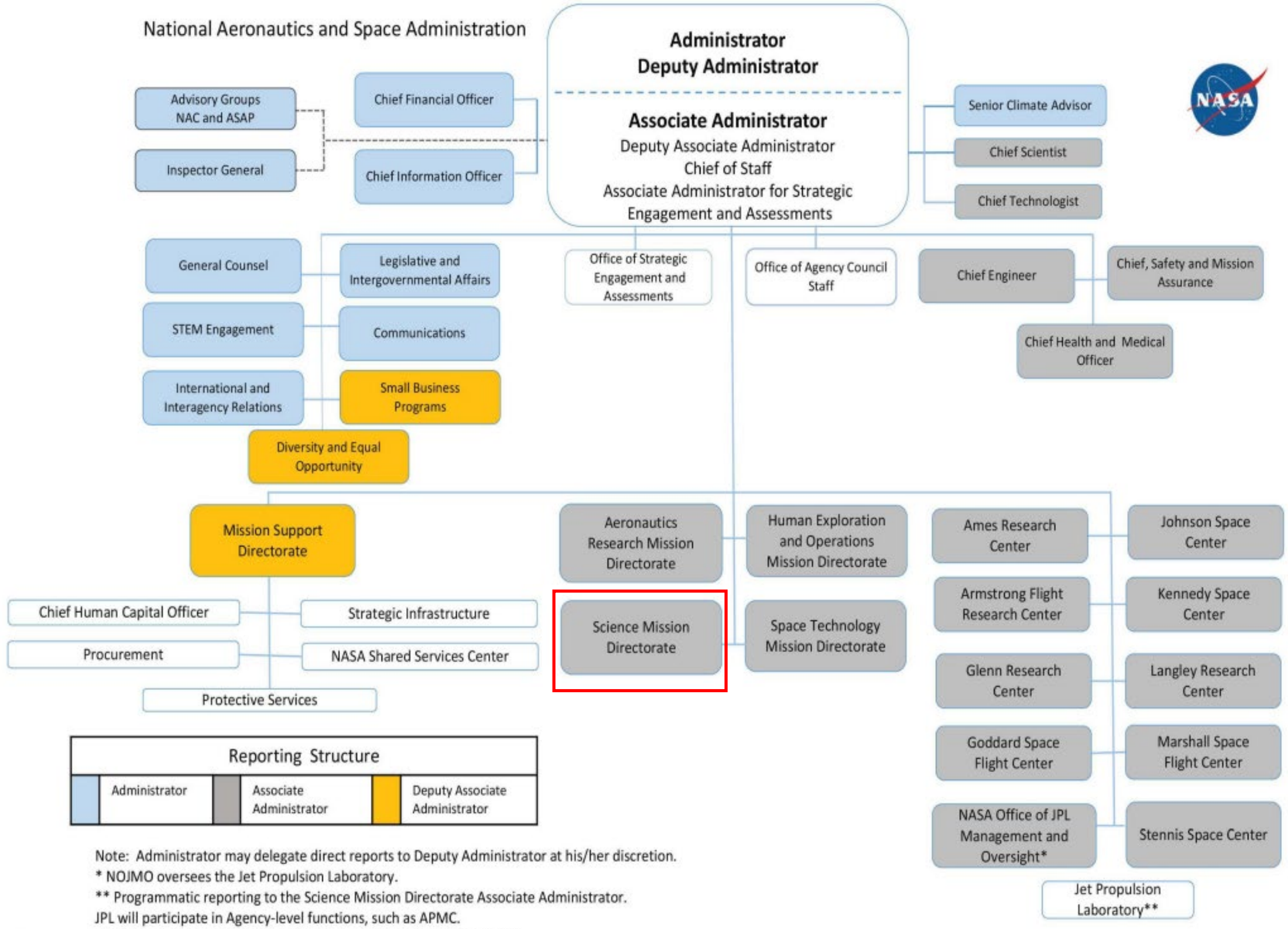
Heliophysics Division (HPD)

- The scope of heliophysics is vast, spanning from the Sun's interior to Earth's upper atmosphere, throughout interplanetary space, to the edges of the heliosphere, where the solar wind interacts with the local interstellar medium
- Innovative cutting-edge missions in strategic locations throughout our solar system
- Includes PI-led/team focused research - modeling, data analysis, suborbital, balloon and CubeSat investigations, experimental/laboratory, facilities and instrument development
- Vibrant in-house activities primarily at GSFC, with a smaller effort at MSFC
- Vibrant/growing external community
- Directed and competed approaches

HPD organization, guiding documents, and plans (near to long-term)

- Decadal Survey recommendations (2013) address research as well as science objectives for future missions
- SMD Science Plan (2020) – details HPD research organization, structure, objectives, and approaches (durable strategic objectives)
- National Space Weather Strategy and Action Plan inform research priorities and direction
- HPD Strategic Working Groups (SWGs)

NASA Organization



Note: Administrator may delegate direct reports to Deputy Administrator at his/her discretion.
* NOJMO oversees the Jet Propulsion Laboratory.
** Programmatic reporting to the Science Mission Directorate Associate Administrator.
JPL will participate in Agency-level functions, such as APMC.
JPL is a Federally Funded Research and Development Center (FFRDC).

SMD Organization

Embeds / POCs

Chief Engineer:
Nick Jedrich

Deputy Chief Engineer:
Synthia Tonn

Safety & Mission Assurance:
Ariel Pavlick/Glen Lockwood

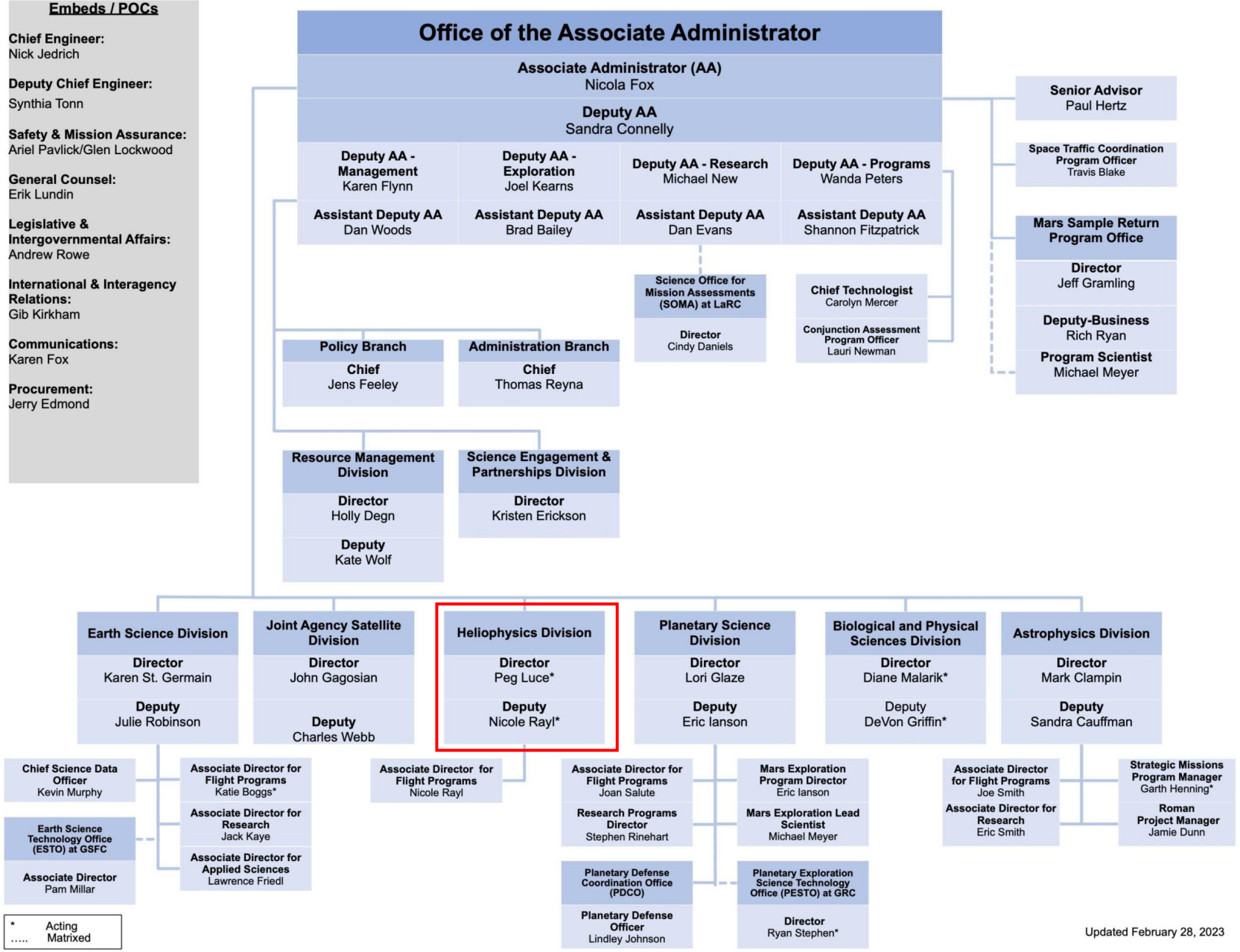
General Counsel:
Erik Lundin

Legislative & Intergovernmental Affairs:
Andrew Rowe

International & Interagency Relations:
Gib Kirkham

Communications:
Karen Fox

Procurement:
Jerry Edmond



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Heliophysics Missions

Heliophysics Mission Fleet

Heliophysics missions are strategically placed throughout our solar system, working together to provide a holistic view of our Sun and space weather, along with their impacts on Earth, the other planets, and space in general. NASA's heliophysics mission fleet includes 19 operating missions using 26 spacecraft, 13 missions in development, 1 mission under study, a robust sounding rocket program and a variety of CubeSat missions.

- ESA = European Space Agency
- JAXA = Japan Aerospace Exploration Agency

*Numbers in parentheses indicate how many spacecraft each mission includes.

*Objects Not to Scale

UNDER DEVELOPMENT

- AWE (ISS)
- Carruthers Geocorona Observatory
- ESCAPADE (2)
- EUVST (JAXA)
- EZIE (3)
- GDC (6)
- HelioSwarm (9)
- HERMES (Gateway)
- IMAP
- MUSE
- PUNCH (4)
- SunRISE (6)
- TRACERS (2)

PRIMARY OPERATION

- Parker Solar Probe
- Solar Orbiter (ESA)

EXTENDED OPERATION

- ACE
- AIM
- GOLD (SES-14)
- Hinode (JAXA)
- IBEX
- ICON
- IRIS
- MMS (4)
- RAD (Curiosity)
- SDO
- SOHO (ESA)
- STEREO
- THEMIS-ARTEMIS (2)
- THEMIS (3)
- TIMED
- Wind
- Voyager (2)

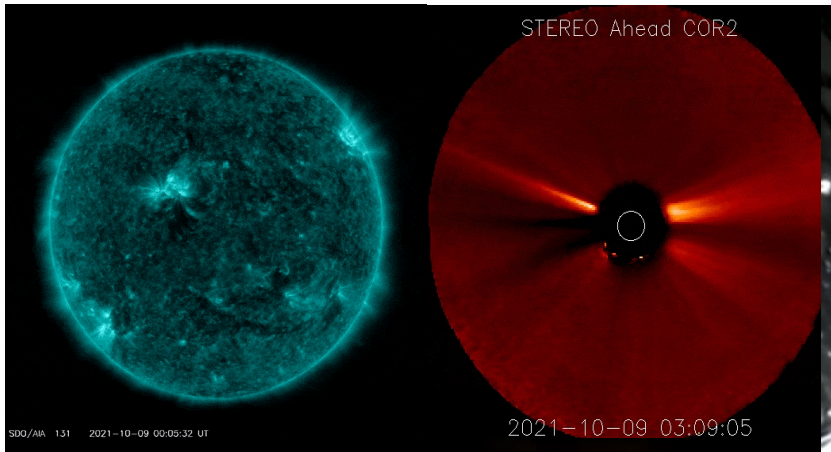
science.nasa.gov/heliophysics

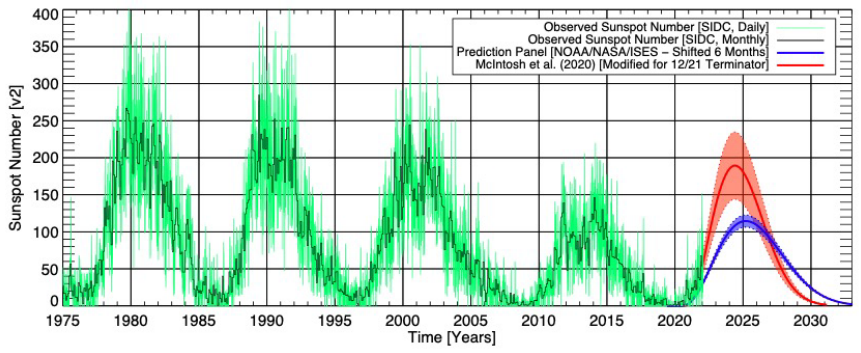
The Sun Wakes Up: Solar Cycle 25 Is Here

December 2019 marked the beginning of Solar Cycle 25, and the Sun's activity will once again ramp up until solar maximum, predicted for 2025.

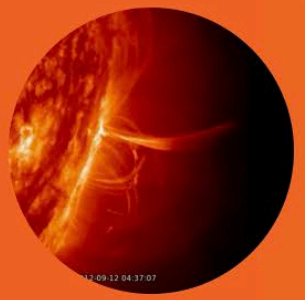
This new solar cycle, and anticipated increase in space weather events, will impact our lives and technology on Earth, as well as astronauts in space.

This is the first solar cycle that many new commercial and government stakeholders will navigate.





HELIOPHYSICS
BIG YEAR



*Inspired by the birding concept to view as many species of birds in one geography in one year!

The Sun will have a very Big Year from **Oct 2023 – Dec 2024**! And we want you to **bring your joy and curiosity to this opportunity of a lifetime** to participate with NASA Heliophysics!

go.nasa.gov/HelioBigYear

Follow us on Twitter @NASASun & Facebook @NASASunScience as we journey closer to our star

Join us for solar eclipses in October 2023 and April 2024

Take part in @doNASAScience with NASA citizen science as we rise to solar maximum

Find out how you can participate with event planning activities, outreach, and funding around citizen science projects, contests, and more.

Email

hq-heliobigyear@mail.nasa.gov

Contact: Ha-Hoa Hamano,
Presidential Innovation Fellow
@ NASA

SPACE WEATHER GRAND CHALLENGE

A two-part challenge in the spirit of the Heliophysics Big Year that will fundamentally advance the nation's space weather capability

SPACE WEATHER GRAND CHALLENGE

Step One: Identify the next low-latency data stream that would significantly advance space weather forecasting capability to meet national needs.

- This critical data stream may be a single observation or a combination of simultaneous observations, may be ground and/or space based, and may be of the solar-heliosphere system and/or of geospace.
- The Step 1 of this challenge would be met with quantitative evidence of the significance of the currently-not-available low-latency data stream in advancing space weather forecasts that meet national needs.

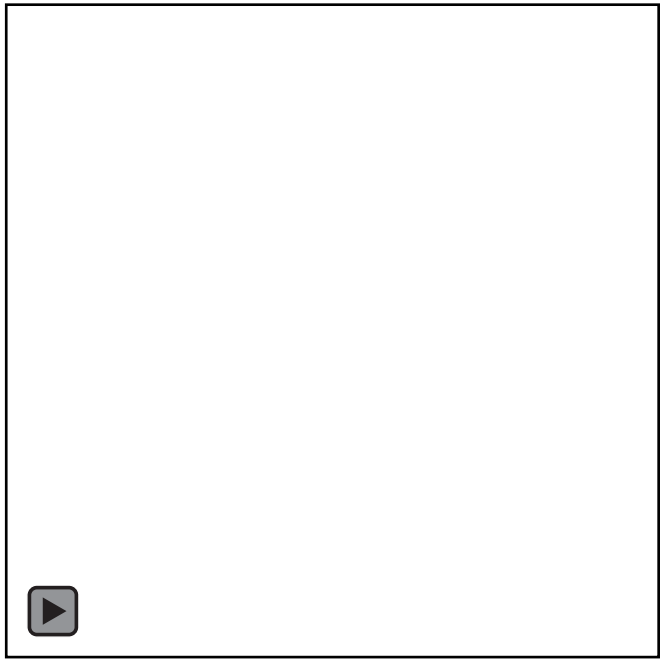
Step Two: Explore a Space Weather Mission concept that demonstrates and validates the improved space weather forecasting capability including the new low-latency data stream.

- This mission would provide the low-latency data stream to researchers to quantitatively validate in near-real time the nationally significant advancement in space weather forecasting.
- This demonstration would lead to an operational space weather capability that would eventually be transitioned to the nation's operational space weather entities

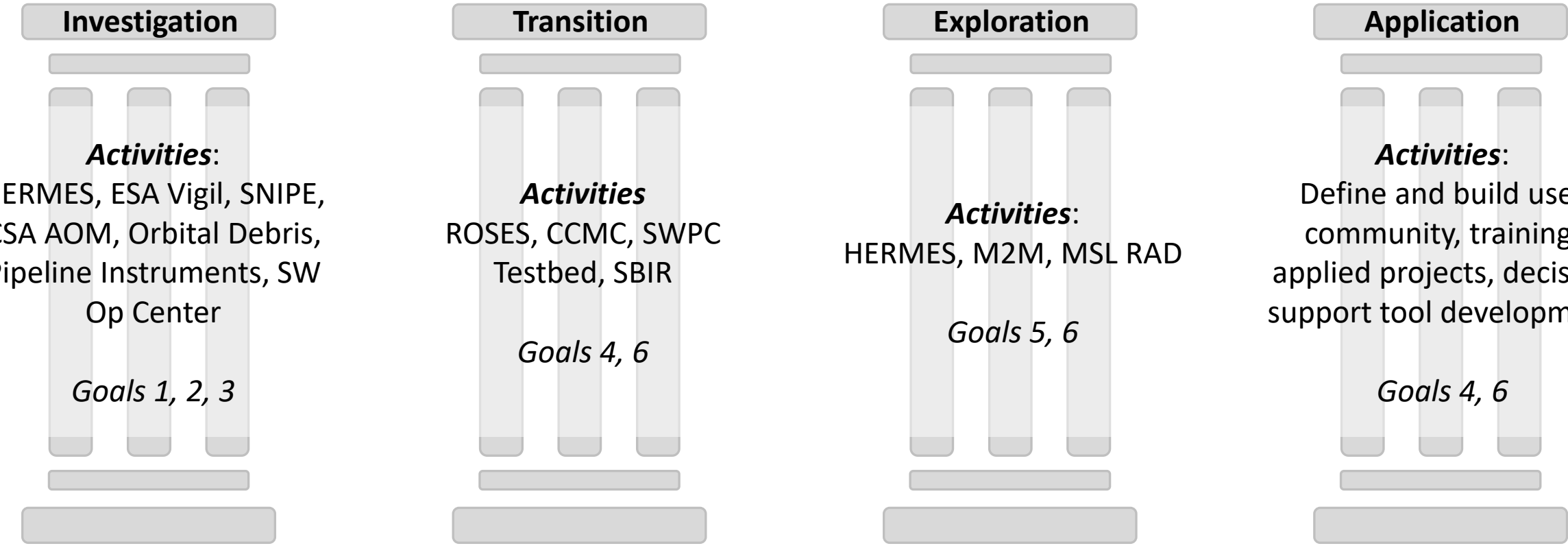
NASA Space Weather Program (NSWx)

Space Weather Program Vision: Advance the science of space weather to empower a technological society safely thriving on Earth and expanding into space.

- NASA plays a vital role in space weather research by providing unique, significant, and exploratory observations and data streams for theory, modeling, and data analysis research, and for operations.
- NASA's Heliophysics Division is uniquely poised to support needs of the National and International space weather enterprise and the Agency's Artemis.
- Various executive (NSW SAP) and legislative (PROSWIFT Act) mandates direct NASA to address research and application aspects of space weather which allows NASA to do what NASA does best – push the envelope by pursuing forward-leaning developmental activities.
- Making use of NASA's unique capabilities and directly addressing the legislative mandate, HPD has established the new NASA Space Weather Program, a national resource to unify space weather research and drive our understanding of its risks, impacts and mechanisms into new realms.



Space Weather Program Pillars



Theme 1:
Coordinate a whole-of-solar-system approach to **observing and modeling** space weather

Theme 2:
Support operational partners by **transitioning** sound and innovative science

Theme 3:
Enable the safe **exploration** – both human & robotic – of the solar system.

Theme 4:
Deliver societal benefit through the **application** of space weather decision support

Space Weather Program Activities

Flight Missions

HERMES & Gateway

- The NASA space weather instrument suite, led by HPD, will observe solar particles and the solar wind. A second scientific payload is a radiation instrument package, built by the European Space Agency.
- Serves as a pathfinder mission for future missions to establish an earth-independent space weather capability for long duration missions beyond the earth-moon system
  - NASA Suite: HERMES (Heliophysics Environmental and Radiation Measurement Experiment Suite)
  - ESA Suite: ERSA (ESA Radiation Sensors Array)
  - ESA/JAXA Suite: IDA (Internal Dosimeter Array)

GDC

- Near real-time space weather data

IMAP

- I-ALiRT

Artemis Program

- Ongoing conversations with potential international partnerships

International Collaborations

- Vigil: ESA
- AOM: CSA
- SPORT: NASA/AEB
- SNIPE: KASI
- Aditya: ISRO

NOAA/Interagency Partnerships

- R2O2R Framework and Quad-Interagency Agreement

Space Weather Council

Space Weather Program Activities Cont.

Competed Research

Heliophysics Supporting Research (HSR)

- Two ROSES-23 Special Topics:
  - Heliophysical Transfer Functions
  - Environmental Signatures of Objects

Small Business Innovation Research (SBIR)

- NASA's SBIR program seeks to transform scientific discovery into products and services through innovations that have the potential for infusion into NASA programs and missions, the potential for commercialization into NASA relevant commercial markets, and that have a societal benefit.

Space Weather Pipeline Instruments

Space Weather and Science Agile Platforms (SWAPS) RFI

Research to Operations to Research (R2O2R)

- One ROSES-23 focused topic:
  - Data Assimilation for Neutral Density Forecasting
- And a ROSES-23 *Open Call*

Space Weather Centers of Excellence

- The purpose of these Centers is to provide significant long-term investment in research and infrastructure development to address major challenges in space weather in an integrated multidisciplinary fashion, explicitly and fundamentally incorporating R2O and O2R.
  - Proposed Center efforts will need to be highly ambitious and should address critical challenges in space weather.
  - This program is intended to support research that cannot be effectively done by individual investigators or small teams, instead requiring the synergistic, coordinated efforts of a research center.
  - First solicited as part of ROSES-22

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Stay in touch and help us find new ways to highlight your work and keep you in the loop!

Stay up to date with what's happening at Headquarters:

- https://science.nasa.gov/researchers/virtual-townhall

Let us know what you've been working on:

- https://bit.ly/SubmitHelioScience

Learn more about the next solar eclipse:

- https://solarsystem.nasa.gov/eclipses/home/

Volunteer for a panel:

- https://science.nasa.gov/researchers/volunteer-review-panels

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