



NASA Space Weather Program Update

Heliophysics Advisory Committee (HPAC)
14-16 November 2023

Jamie Favors (Director, Space Weather Program)

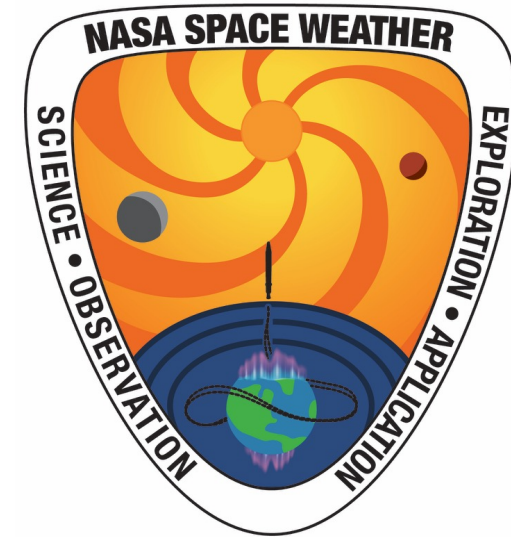
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Heliophysics Division
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NASA Space Weather Program Update

Talk Overview

- **Space Weather Program (SWxP) Overview**
- **R&A Highlights**
 - R202R and Transition Step
 - Centers of Excellence
- **Flight Highlights**
 - Vigil Instrument Solicitation
 - HERMES
- **SWxP organization**
- **Questions?**



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NASA Space Weather Program Insignia

NASA Space Weather Program

- NASA plays a vital role in addressing space weather research and applications, and is a critical partner for operational agencies like NOAA and Space Force
- NASA's contributions to observing and understanding space weather are critical for the success of the National and International space weather enterprise.
- NASA has a preeminent space weather capability through the pursuit of the following goals:

1. Observe

- Advance observation techniques, technology, and capability

2. Analyze

- Advance research, analysis, and modeling capability

3. Predict

- Improve space weather forecast and nowcast capabilities

4. Transition

- Transition capabilities to operational environments

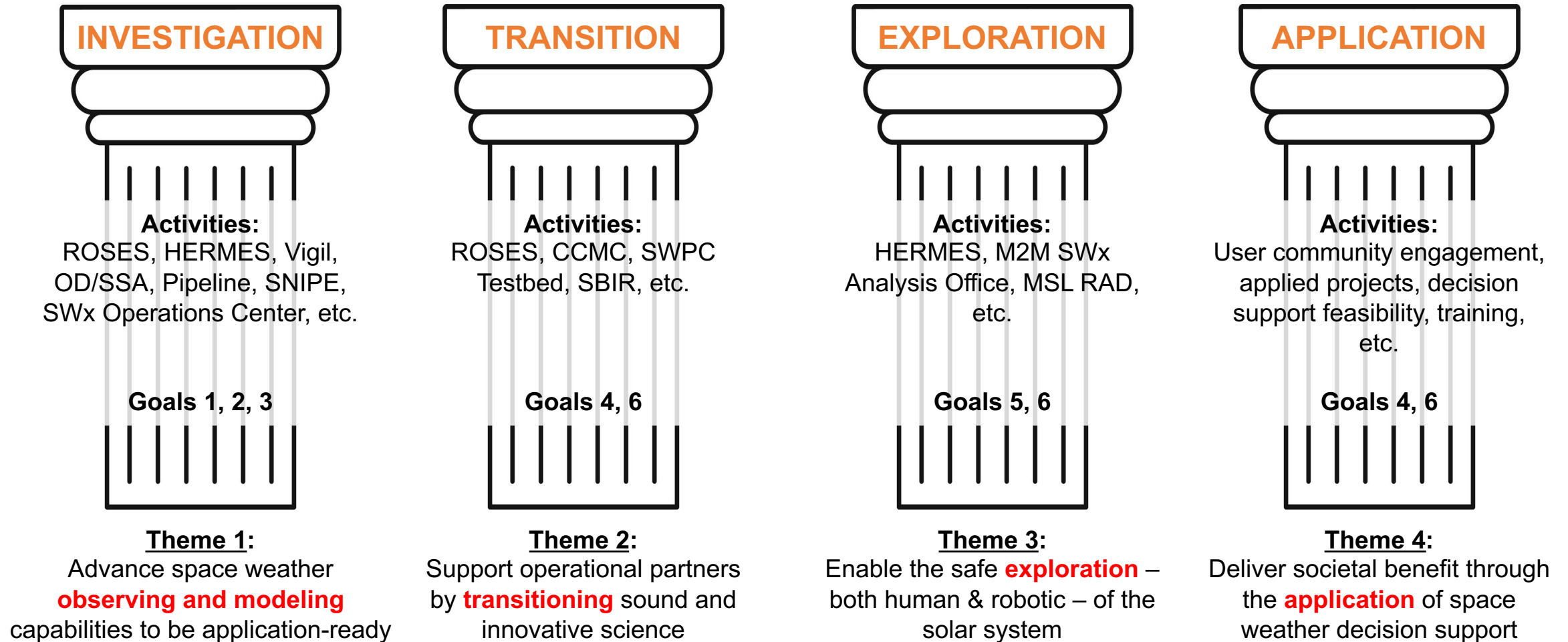
5. Support

- Support Robotic and Human Exploration

6. Partner

- Meet National, International, and societal needs consistent with Government directives

NASA Space Weather Program Pillars



Interagency Partnerships

NASA, NOAA, NSF, DAF work jointly to observe and understand space weather and how it impacts the solar system, Earth, and humanity

Interagency Coordination

- NASA is a voting member in the interagency **Space Weather Operations, Research, Mitigation (SWORM)–Working Group** established under the National Science and Technology Council
- Collaboration with NOAA, NSF & DAF via the **Space Weather R2O2R Framework** and under the **Quad Agency MOA**

Collaborative Efforts

- Annual coordination on the **ROSES** Space Weather solicitations
- **Space Weather with Quantified Uncertainties:** NSF runs solicitation for which NASA provides input and funding, including currently funding two proposals as well as co-funding one other
- **Quick Wins Efforts with NOAA:** GONG magnetic flux maps and WSA model improvements
- **Space Weather Tabletop Exercise:** APL leading inter-agency exercise to ensure the nation's resilience to an extreme space weather storm by walking through the day-in-the-life of a space weather event

The background of the slide is a composite of two astronomical images. The top half features a dark blue and black space filled with numerous bright, multi-pointed stars and a large, wispy blue nebula on the right side. The bottom half features a bright orange and yellow space filled with many smaller, bright stars and a large, wispy orange and yellow nebula on the right side. A dark blue horizontal band runs across the middle of the slide, containing the title text.

SWxP R&A Highlights

NASA Space Weather Program

R202R Annual Solicitation

- **Goal:** *To support research that advances scientific understanding while resulting in improved specification and/or forecasting capabilities that are of relevance to NASA space weather priorities and responsive to national space weather needs*
- NASA works with partner agencies to determine the Space Weather ROSES topic each year
- During the review and selection process, NASA meets with partner agencies to discuss proposal recommendations
- Partner agencies have option to fund non-selected proposals



Space Weather Research to Operations / Operations to Research (R2O2R)

ROSES-23

- Data Assimilation for Neutral Density Forecasting
- Open call

ROSES-22 (4 selections)

- High-Latitude Radiation Exposure and Impacts on Avionics and Air Travel
- Downstream Updating of Solar Wind and CME Forecasts

ROSES-21 (6 selections)

- Solar Flare Forecasts
- Cislunar Space Environment

ROSES-20 (9 selections)

- Ionospheric Disturbances
- Satellite Drag

ROSES-19: (17 selections)

- Open call

ROSES-18 (16 selections)

- Energetic particles and plasmas in the magnetosphere

ROSES-17 (8 selections)

- Solar wind forecasting

New in 2023 (ROSES-21): R2O2R “Transition Step”

An optional third year to support activities that facilitate transition to operations.

NASA Space Weather Program

R2O2R Transition Step

- Making a research product ready for transition to operation may not always be possible within the two years of the R2O2R award.
- R2O2R awardees may be given opportunity to receive additional time and support to perform activities associated with the transition to operations.
- A subset of awards may be selected to continue for a 1-year Transition Step: The intent of this step is to focus the efforts of those selected awards to transition the capability to a Proving Ground for continued evaluation.



Space Weather Centers of Excellence

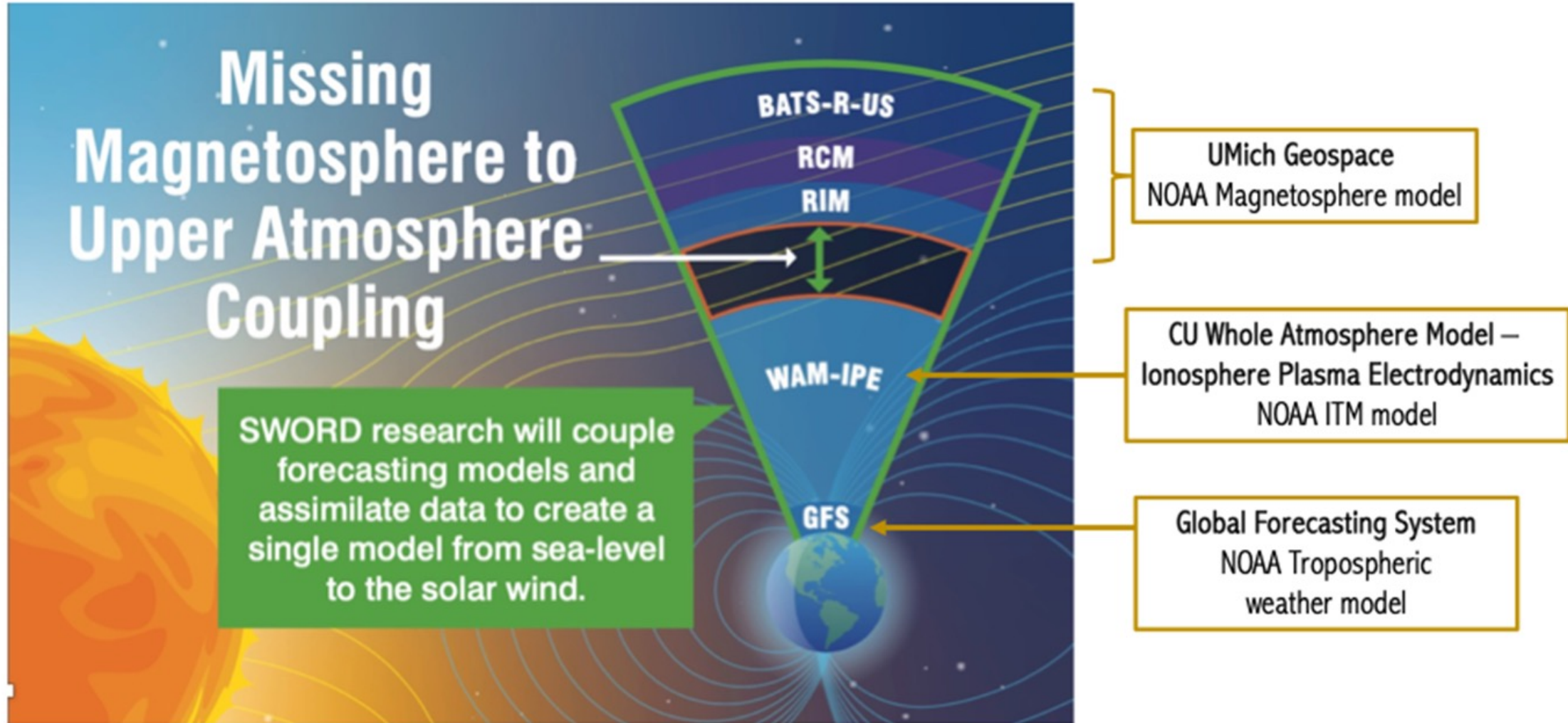
The purpose of these Centers is to provide significant long-term investment in research and infrastructure development to address major challenges in space weather in an integrated multidisciplinary fashion, explicitly and fundamentally incorporating R2O and O2R

- Efforts are highly ambitious and address critical challenges in space weather
- Supports research that cannot be effectively done by individual investigators or small teams, & requires synergistic, coordinated efforts of a research center
- Selections were publicly announced August 2023
- NASA selected three Space Weather Centers of Excellence
 - SWORD (T. Berger/CU), SPARTA (K. Groves, BC), CLEAR (L. Zhao/UM)
- NASA partnering with the Department of Commerce on the joint selection of a fourth proposal addressing forecasting of orbital drag (UWV, P. Mehta)

SWORD: "From Sea-Level to the Solar Wind"

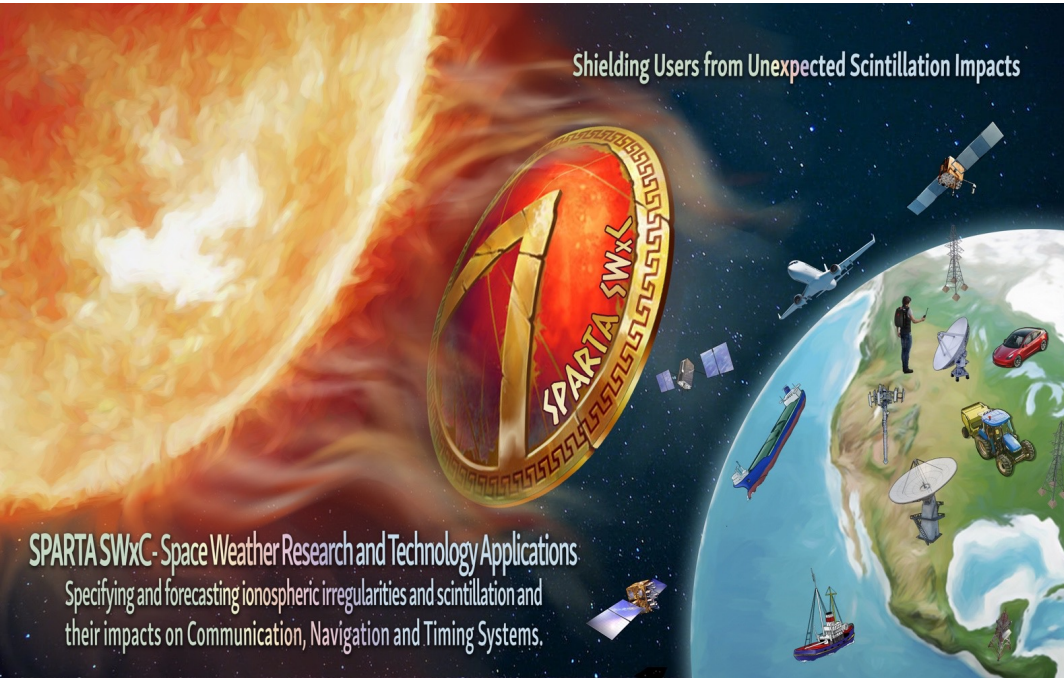


A five-year project to create an **accurate and reliable orbital geospace forecasting model**





Space Weather Research & Technology Applications (SPARTA)



PI: Keith Groves, PM: Kathleen Kraemer,
Boston College

Co-I institutions:

Cornell, CU Boulder, MIT Haystack, BU, Aerospace
Corp, USU Space Dyn. Lab, CU Boulder, UNB Canada

Vision: Reduce societal vulnerabilities to space weather through world-class research and technology development and fostering relationships across all domains encompassing science, operations and users

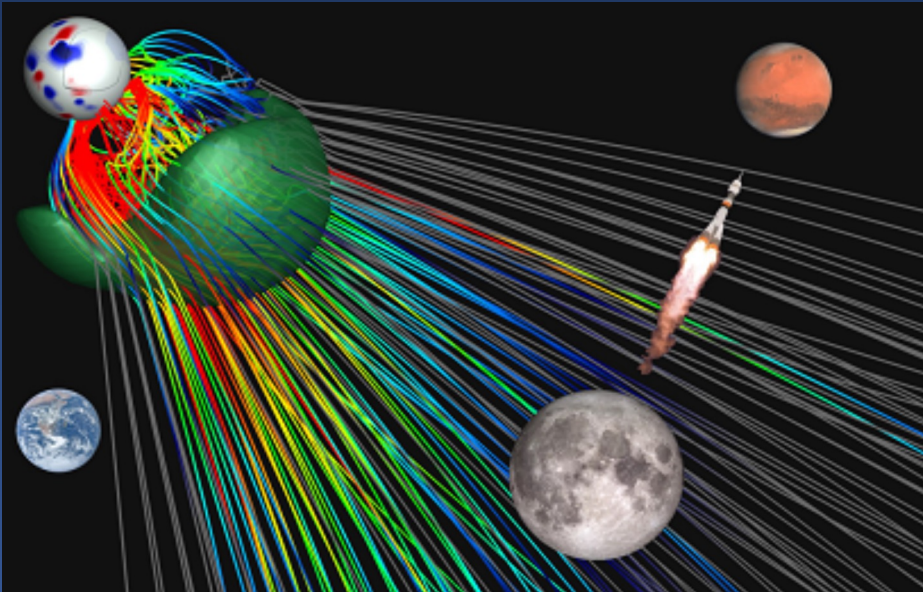
Objectives:

- Develop efficient algorithms to assess stability and characterize irregularities in the ionosphere
- Integrate algorithms with an operational background model and document forecast skill as a function of model input parameters and their uncertainties
- Demonstrate GNSS user impact products that are timely, quantitative and geographically specific
- Develop a roadmap for future data collection architectures and model improvements specific to scintillation forecasting

Benefits:

- Global scintillation forecasting capabilities for GNSS users prevents unanticipated disruptions to PNT applications
- Supports alerts for civilian and military users of other RF systems, such as SATCOM and HF
- Guide improvements to GNSS technology
- Machine learning methodologies applicable to other domains

CLEAR: All-Clear SEP Prediction SWxC



Vision: Build a comprehensive prediction framework for a space radiation environment

Objective: Deliver nowcast and forecast capabilities for space radiation levels of up to 24 hours, with quantifiable uncertainties

CLEAR Center will provide:

- 1) Probabilistic forecasts of solar eruptive events
- 2) Nowcast and forecast the time intensity profiles of energetic particles
- 3) Predict periods of SEP intensities below preset threshold to issue an all-clear forecast

Benefits:

- Mitigate impact of space radiation on humans & human-made systems
- Create new multi-institution, multi-interdisciplinary community
- Directly engage with communities and integrate R2O and O2R

PI: Lulu Zhao, PM: Tamas Gombosi
University of Michigan

Co-I institutions:

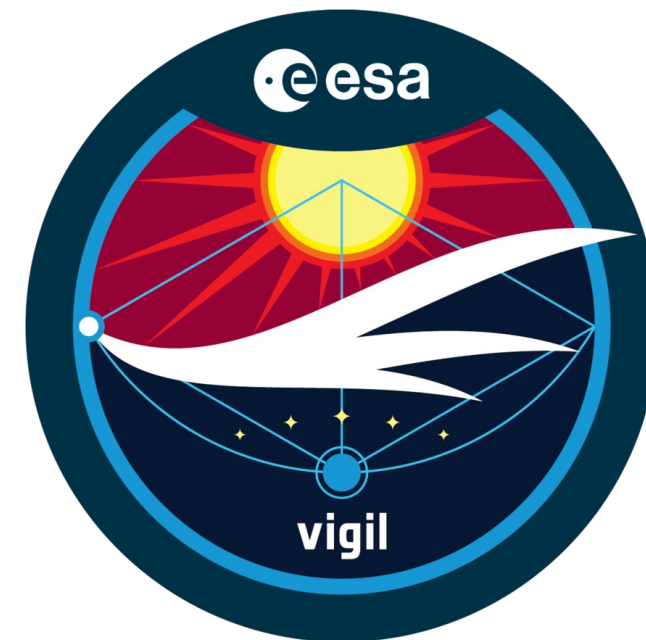
Caltech, CUA, NASA GSFC,
Lockheed Martin, SSI, UAH, UMD

The background of the slide is a composite of two astronomical images. The top half shows a dark blue and black space with a bright blue nebula on the right and several bright stars with diffraction spikes. The bottom half shows a golden-yellow and green nebula with many bright stars. A dark blue horizontal band is overlaid across the middle of the image, containing the title text.

SWxP Flight Highlights

ESA Vigil Mission

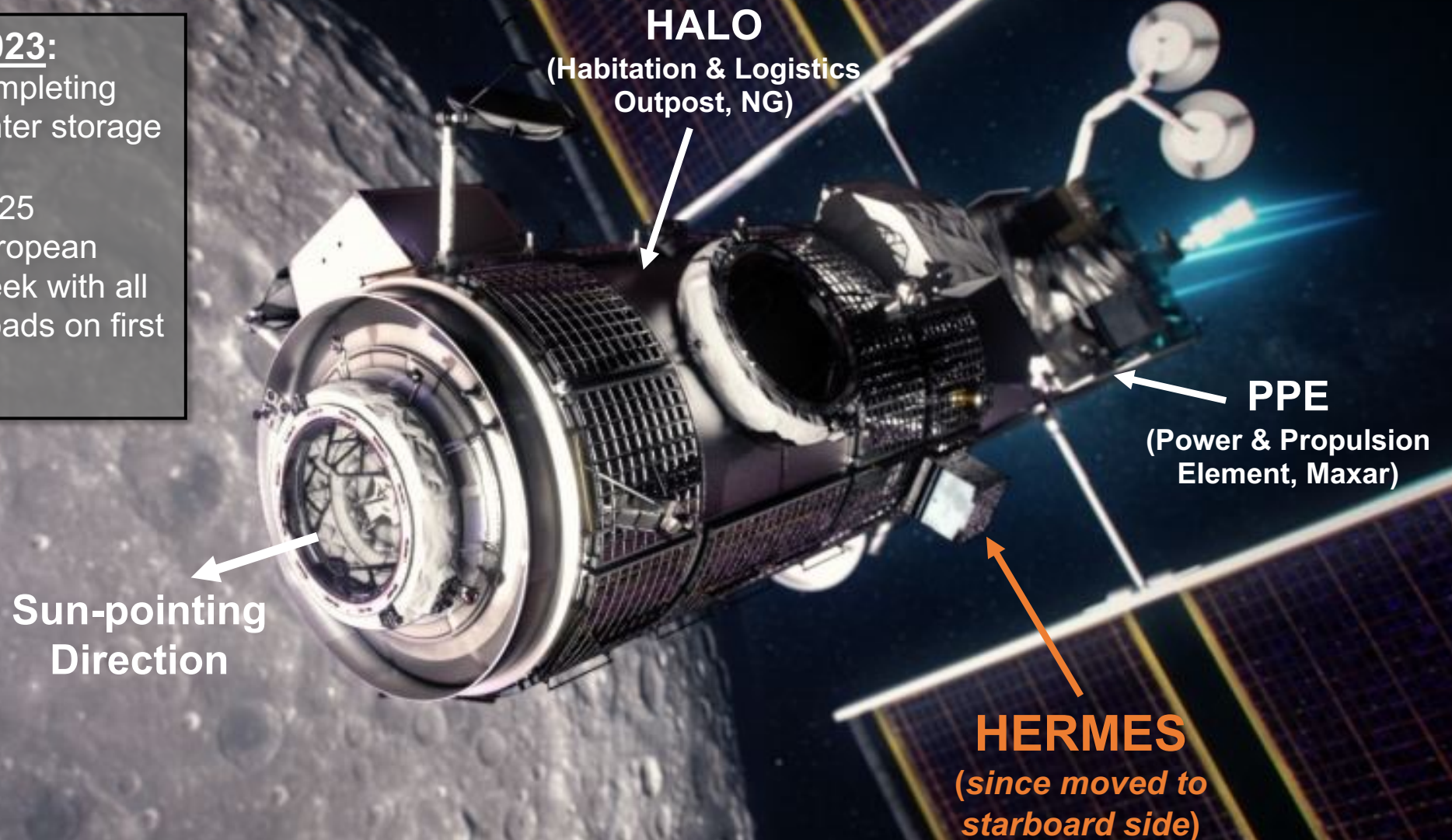
- Vigil is an ESA Space Safety Programme space weather mission to observe the Sun from the Sun-Earth Lagrange Point L5
- NASA is currently soliciting for a PI-led instrument to be part of the Vigil payload
 - **Instrument:** EUV imager
 - **Proposal Due Date:** 27 September 2023
 - **Selection:** Early 2024
 - **Vigil LRD:** November 2029



HERMES: NASA's First Science Payload on Gateway

Status as of Nov 2023:

- Instruments are completing final I&T and will enter storage by Jan 2024
- LRD is NET Oct 2025
- Joint session at European Space Weather Week with all three science payloads on first Gateway elements



The background of the slide is a cosmic scene. The top half features a dark blue and black space filled with numerous small, bright stars and a prominent, glowing blue nebula on the right side. The bottom half is dominated by a bright orange and yellow nebula on the left, transitioning into a greenish-blue nebula on the right. The overall effect is a vibrant, multi-colored starfield.

SWxP Organization

CONGRATULATIONS JIM!!!!



NASA Space Weather Program Team



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Science, Interagency,
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Questions? Suggestions?

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