

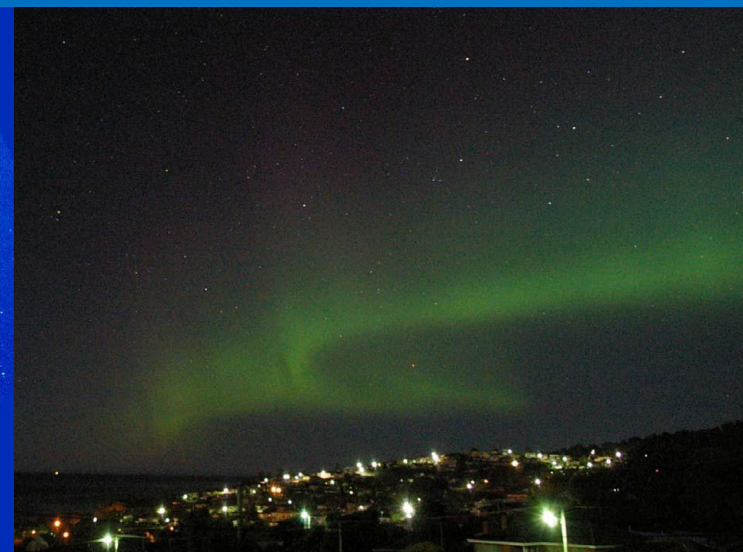
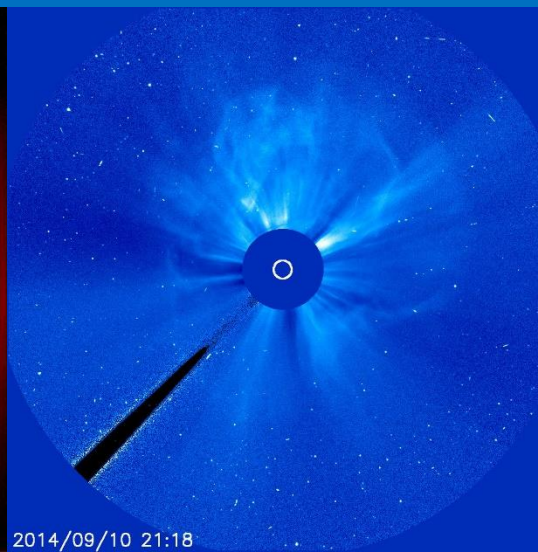
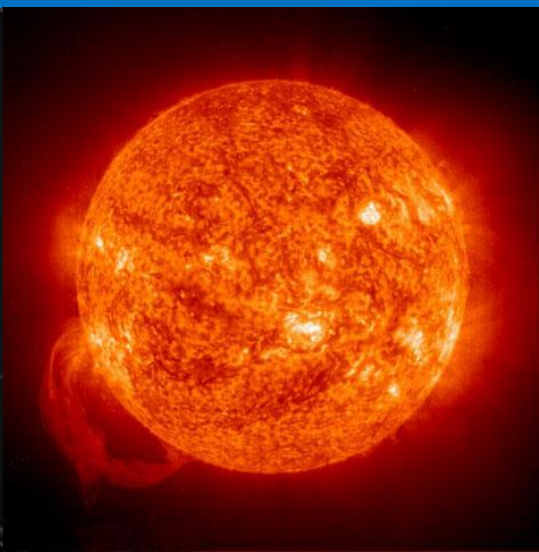
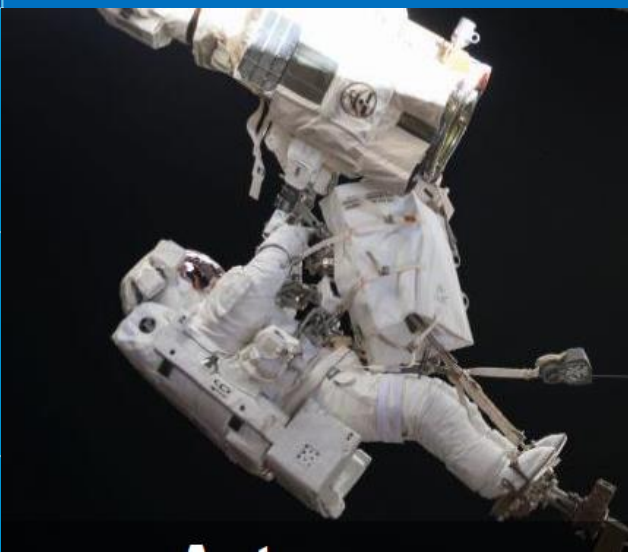


NOAA

Space Weather Program Formulation

Dr. Elsayed Talaat

Director, Office of Projects, Planning, and Analysis





Agenda

- **Bottomline up front**
- **Background**
- **SWX program formulation drivers and assumptions**
- **SXX program formulation process**
- **SWX project formulation process**
- **SWX Plans**
 - **Program formulation plans**
 - **Project formulation plans**
- **Formulation Tasks**
 - **User Requirements**
 - **Partnership Development**
 - **Architecture Trades**
- **Summary**





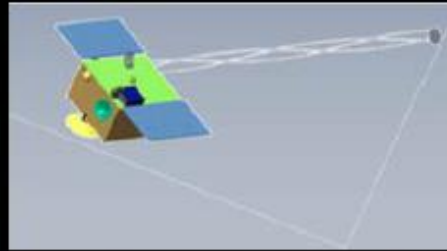
Bottomline up front

- Formulation process guidance per:
 - Department of Commerce, National Oceanic and Atmospheric Administration (DOC)
 - National Environmental Satellite, Data, and Information Service (NESDIS)
 - National Aeronautics and Space Administration Guidance (NASA)
 - NOAA/NASA Mission Control Plan (MCP)
- Program Pre-phase A is progressing. Notional completion date Q3 FY21
 - Extensive User requirements definition work
 - Societal and economic benefits identified
 - Tracing observations to user operational impacts which lead to societal and economic benefits in development
 - User engagements being planned
 - Initial program concept in development
- Program Phase A: Notional start Q3 FY 21
 - Partnership to be defined and established
 - Detailed program concept studies to be completed with identified projects
 - Detailed instrument, S/C and architecture concepts
 - Cost, schedules and associated risks developed
- Program Authority to Proceed Notional Q3 FY22
- Project Formulation guidance per DOC, NESDIS, NASA and MCP

Starting Point – Program of Record 2025



3-Axis
Stabilized ESPA
Class
Spacecraft

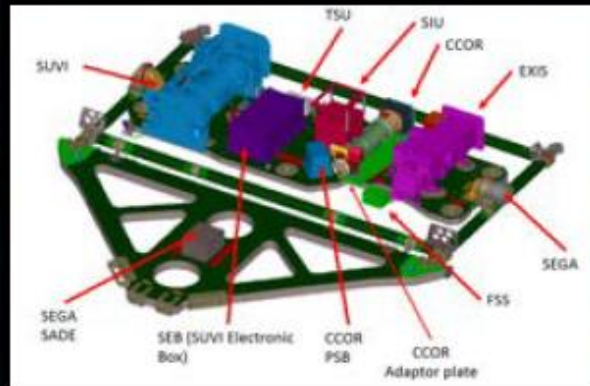


Compact
Coronagraph
(CCOR)



GOES-U Solar Pointing Platform (SPP)

CCOR +
SUVI +
EXIS



2025 NOAA Space Weather
Observing Program of Record
Starting point for Infrastructure Workshop

SWFO – L1 platform

GOES – U

COSMIC-2

GOLD

Metop – C, SG A1, SG B1

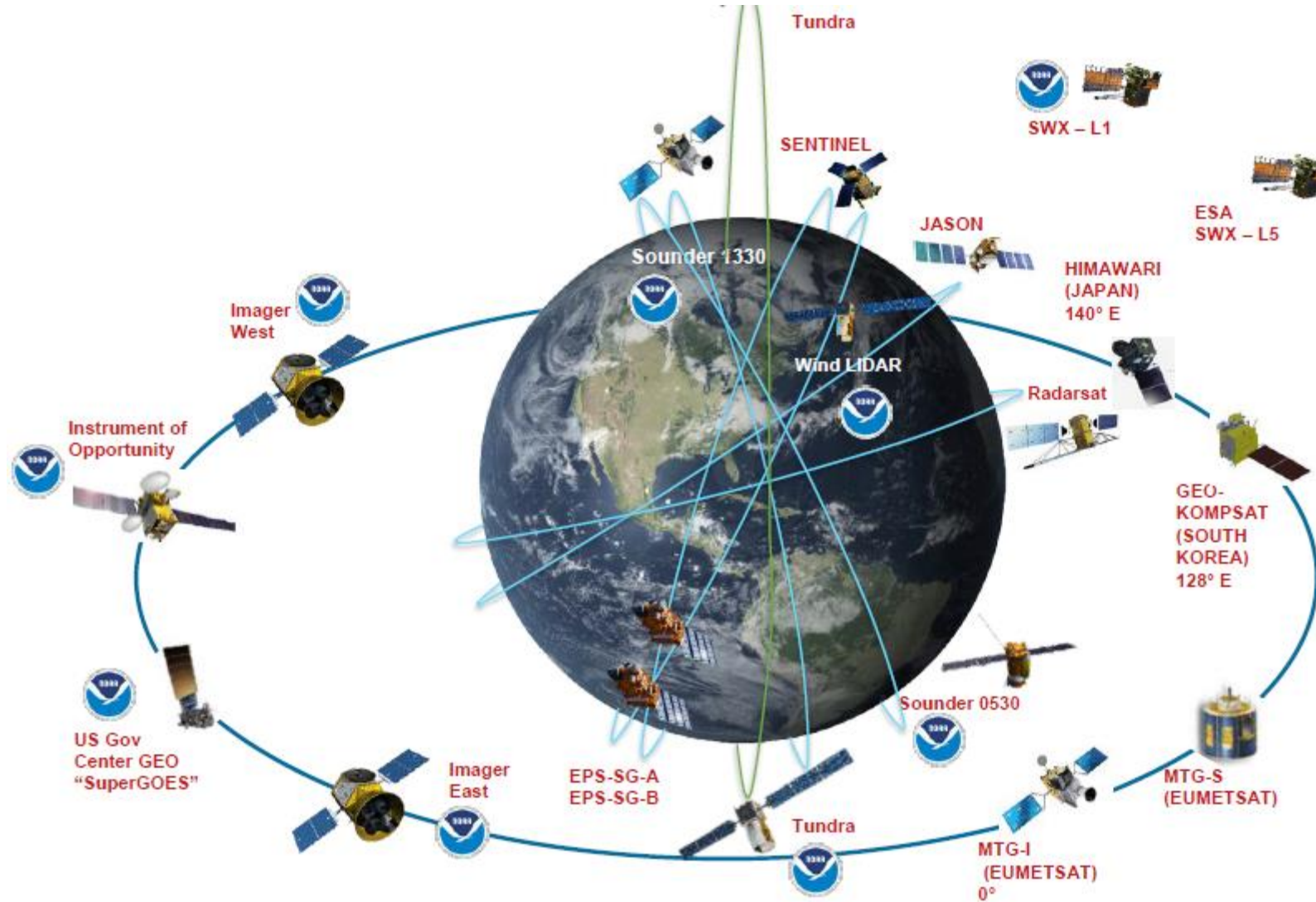
ESA – L5 (2027)



What's next for 2030 and beyond?



Evolution of NOAA and Partner Space Architecture



SWX formulation drivers and assumptions for planning



- Approach to formulation process development
 - Program process for formulation
 - Project process
- Requirements Process
 - XORWG
 - User Needs
 - Benefits analyses
 - DOC/NASA according to NOAA/NASA MCP, DOC docs, NASA NPR 7120.5E
- Objectives and Requirements
 - Driven by need date to maintain Imager continuity
 - Key Performance Parameter: Solar geomagnetic storm warning, etc....
 - Low risk tolerance for **KPP** (NASA Class B)
 - More risk tolerance for other elements (Class C or D)
 - Requirements are observations (L1b data); data products (L2) will be developed separately (NCEI, STAR, SWPC?)
 - More autonomous operations and lower operational cost
 - Ground will employ NESDIS enterprise ground system and mission unique elements

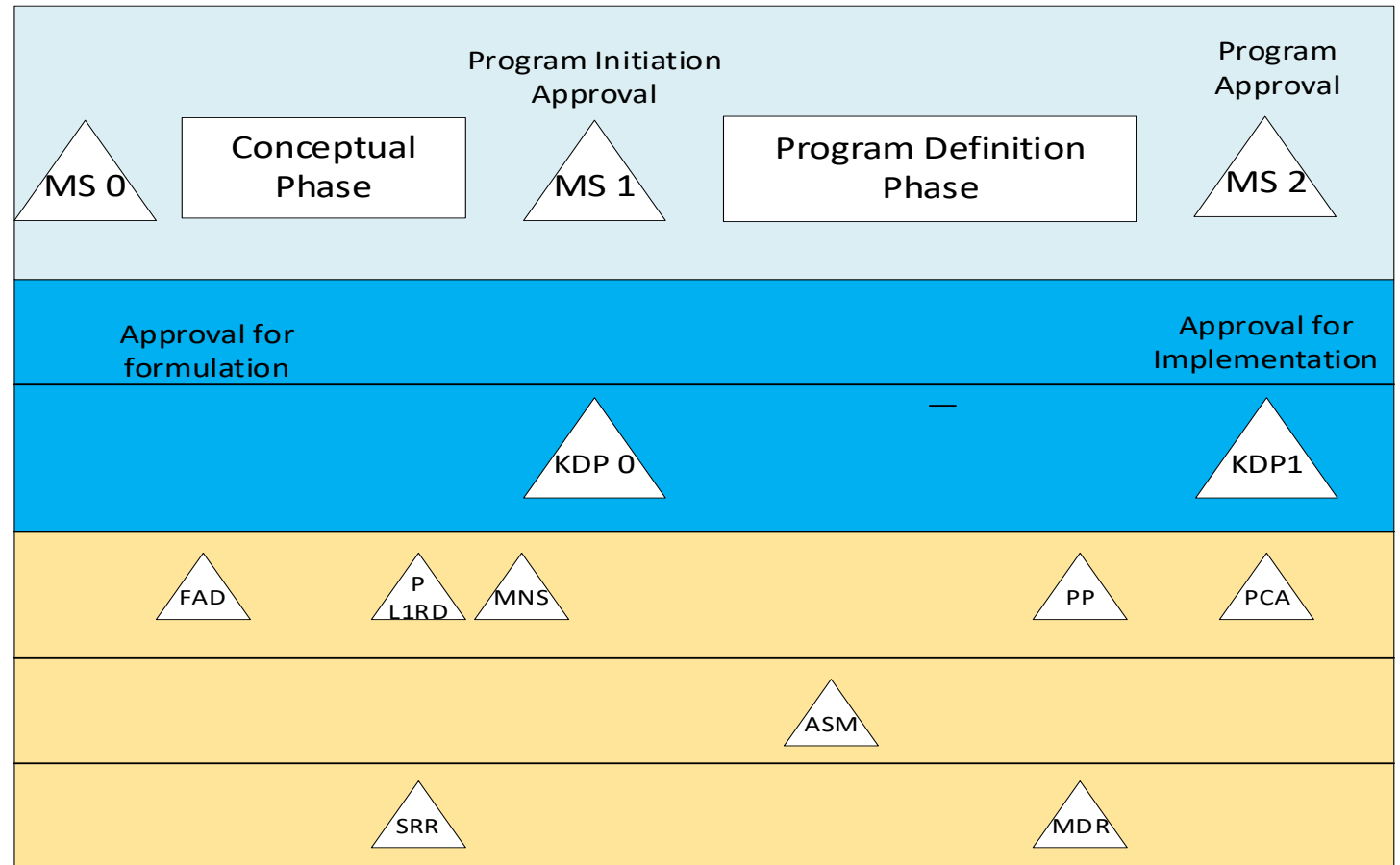
Program formulation per DOC, NESDIS, & NASA guidance



DOC Milestone and Phases for a program formulation

NASA NPR-7120.5E Key Decision Points and Phases for Loosely Coupled Program

Program Major Documentation and Reviews



MS: Milestone; KDP: Key Decision Point; FAD: Formulation Authorization Document; P-L1RD: Preliminary Level 1 Requirements Document
MNS: Mission Need Statement; PP: Program Plan; PCA: Program Commitment Agreement; ASM: Acquisition Strategy Meeting; SRR: System Requirements Review; MDR: Mission Definition Review

SWX Formulation Notional Planning FY21-FY23



SWX Formulation Event/Activity	Timeframe	Note
Detailed concept studies	2Q FY 21	Instrument, Spacecraft and architectures
User Requirements Finalized	2Q FY21	
Program Level 1 Requirements Approved	3Q FY21	
System Requirements Review	3Q FY21	
Initial Cost Estimate (ROM)	3Q FY21	
DOC Milestone 1/Key Decision Point 0 Review	3Q FY21	Detailed Studies approval
Detailed system concept studies	2Q FY21	
Detailed AOA	4Q FY21	
Independent Review	2Q FY22	
System Definition Review	2Q FY 22	
DOC Milestone 2/Key Decision Point 1 Review	3 Qt FY22	Program Approval
L1 system acquisition project approval	3Q FY22	
GEO system acquisition project approval	4Q FY23	



Program Pre-Phase A: Concept Development

- Define Program and Requirements leading up to System Requirements Review
- Defined at System Requirements Review :
 - Initial Program Level 1 Requirements
 - Understanding of User needs and space weather value
 - Observations planned, from NOAA systems and commercial sources
 - Instrument performance baseline and options
 - Space architecture
 - Observational needs from orbital domains
 - Detailed trades with number of observatories, their orbits and payload complements.
 - Use of NOAA satellite hosting, commercial hosts, free flyer trades
 - Cost, schedule and risk assessment
 - Ground system roles and feasible system concepts
 - Technology Readiness Assessment with rough cost and schedule estimates
- Mission Needs Statement
 - User Engagements, Societal and Economic Benefits Studies, Previous and new requirements studies
- MS1/KDP0 Review: Program Initiation Approval





Program Phase A: Concept Definition

- Defined at Mission Definition Review :
 - Initial Program Level 1 Requirements
 - Observations planned, from NOAA systems and commercial sources studies
 - Instrument concept and performance baseline studies
 - Detailed space architecture studies
 - Number of NOAA spacecraft, their orbits and payload complements
 - Use of NOAA satellite or commercial hosts
 - Detailed communication architecture concepts
 - Detailed ground system roles and feasible system concept studies
 - Technology Readiness Assessment with rough cost and schedule estimates
 - Program Management Plan
- Acquisition Strategy
- Architecture societal and economic benefits studies
 - User engagements and use of STAR ASPEN tool
- MS2/ KDP1
 - Acquisition approval for program to proceed
- Project acquisition cycle for each project



Project formulation: Pre-phase A and Phase A

- For each candidate project, pre-phase A
 - Conduct competitive industry studies for each candidate concepts
 - Prioritizing the instrument studies ahead of spacecraft and ground, as they are expected to be critical path
 - Identify project risks, costs, and schedules
 - Hold a Mission Concept Review prior to MS1/KDP A
 - Prepare for MS1/KDPA review, approval for phase A start
- For each candidate Project, the Phase A study will:
 - Detailed studies to develop baseline concept
 - Evaluate concepts against program measures of effectiveness, cost, schedule and risks
 - Develop Concept of Operations and next level requirement documentation
 - Finalize initial project requirements with System Requirements Review
 - Prepare for MS 2 DOC project.
 - Develop Project Management Plan and System Engineering Plan
 - Hold an Acquisition Strategy Meeting
- User needs assessments will continue for possible instrument concept changes.





User Requirements Studies

- ***Economic Benefit Analysis of NOAA's Space Weather Products and Services to the Electric Power Industry***, Eastern Research Group, Inc. (ERG), August 2020
- ***Customer Needs and Requirements for Space Weather Products and Services***, Abt Associates, Inc., March 2019
- ***Social and Economic Impacts of Space Weather in the United States***, Abt Associates, Inc, September 2017
- *Space Weather Prediction Center study on user uses of space weather products and potential enhancements with improvements in space weather products. Ongoing as part of the SWX formulation effort*
- *Future focus user engagements anticipated to fill in the gaps*



Partnership Development Activities

- Formalizing partnership effort with European Space Agency (ESA)
 - Presently working the hosting of NESDIS Compact Coronagraph (NRL) on ESA L5 mission
 - Investigating additional potential collaborations
 - Held an initial ESA/NOAA workshop where several other collaborative opportunities were identified
 - Future workshops planned to discuss potential details
- Investigating potential collaboration and partnerships with the Department of Defense Space Weather group
 - DoD space weather plans were briefing at the SWX requirements working group
 - Continuing to work with DoD representatives to coordinate formulation efforts.
- Plan to continue data product research activities with joint NOAA-NASA technology studies
 - Global Dynamics Constellation
 - Polarimeter to Unify the Corona and Heliosphere, (PUNCH)
 - Global-scale Observations of the Limb and Disk (GOLD)
- Participating in study with Environment Canada on potential arctic mission
- Continue user needs assessments including partner inputs



Architectural Trades

- Prioritizing observations
 - Prioritizing the observations against societal and economic benefits
 - Prioritizing observations at different orbital domains options
- Investigating potential partnerships and commercial space weather data
- Initial AOA Objectives
 - Identify architecture drivers
 - Requirements
 - Technologies
 - Costs
 - Risks
 - Scope a feasible architecture to implement in the next 15 years
 - Develop a rough order of magnitude cost estimate for planning purposes only
 - Identify critical technologies and risks
- Phase A studies will go into much more detail and define the program architecture and elements
 - Detailed instrument, Spacecraft, and architecture concepts
 - Architecture impact analyses, use of STAR ASPEN tool
 - Societal and Economic Benefits analyses





SWX Formulation Summary

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