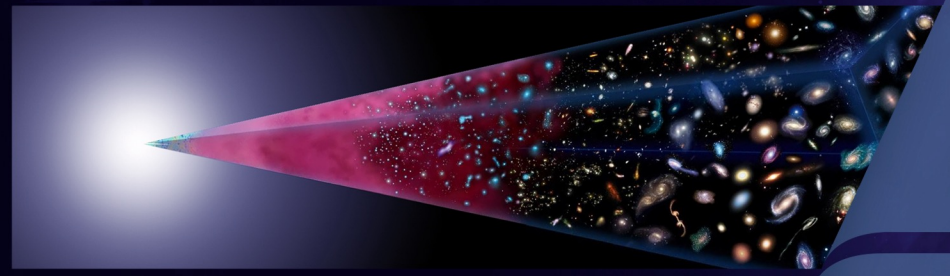
WHY ASTROPHYSICS?



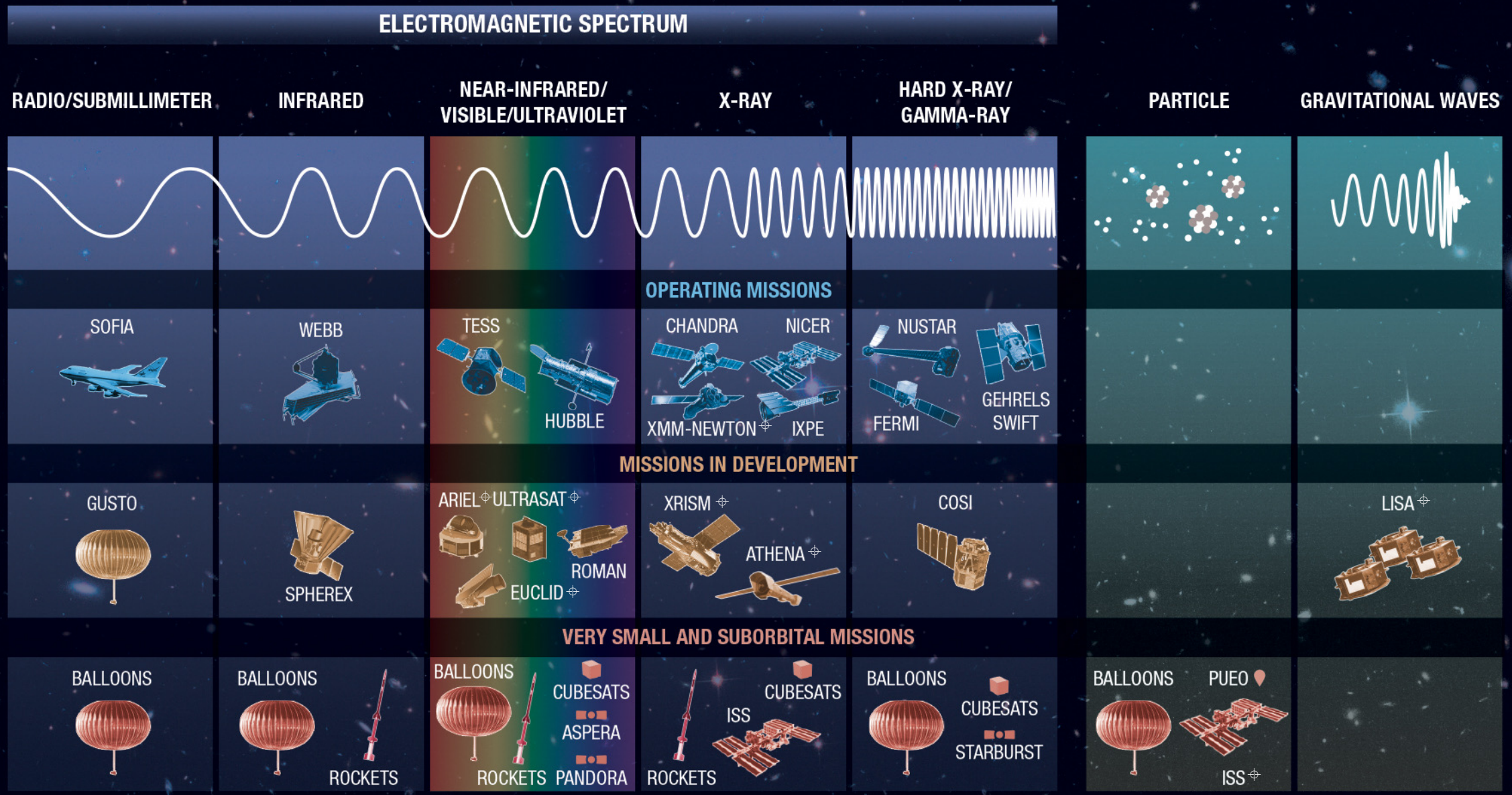
How did our universe begin and evolve?

How did galaxies, stars, and planets come to be?

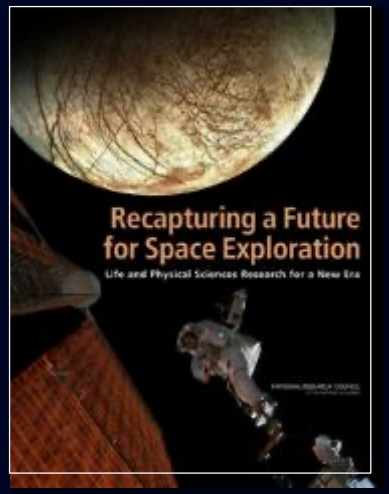
Are we alone?

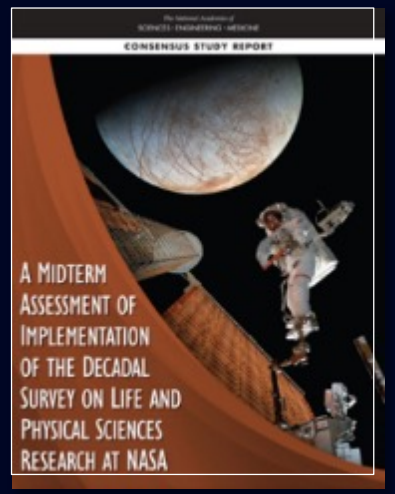
Enduring National Strategic Drivers

Astrophysics is humankind's scientific endeavor to understand the universe and our place in it.

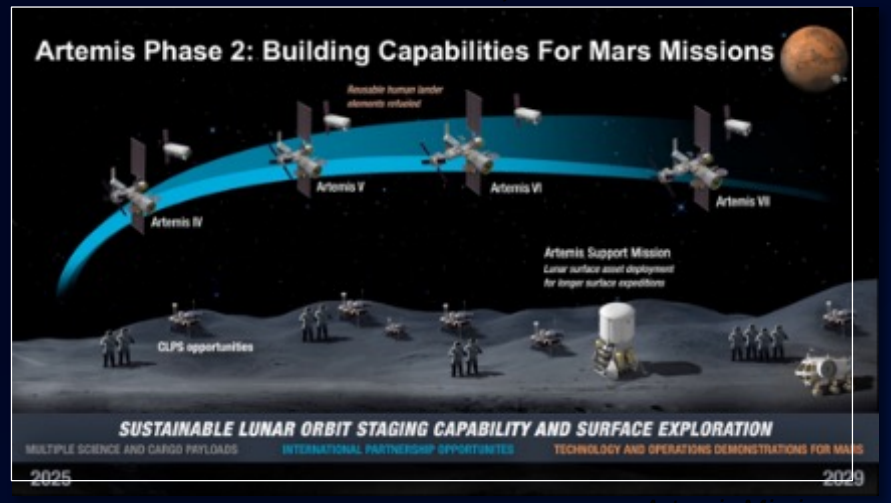

ELECTROMAGNETIC SPECTRUM
RADIO/SUBMILLIMETER
INFRARED
NEAR-INFRARED/ VISIBLE/ULTRAVIOLET
X-RAY
HARD X-RAY/ GAMMA-RAY
PARTICLE
GRAVITATIONAL WAVES
OPERATING MISSIONS
SOFIA
WEBB
TESS
HUBBLE
CHANDRA
NICER
XMM-NEWTON
IXPE
NUSTAR
FERMI
GEHRELS SWIFT
MISSIONS IN DEVELOPMENT
GUSTO
SPHEREX
ARIEL
ULTRASAT
ROMAN
EUCLID
XRISM
ATHENA
COSI
LISA
VERY SMALL AND SUBORBITAL MISSIONS
BALLOONS
BALLOONS
ROCKETS
BALLOONS
CUBESATS
ASPERA
ROCKETS
PANDORA
ROCKETS
CUBESATS
ISS
BALLOONS
CUBESATS
STARBURST
BALLOONS
PUEO
ISS
5 balloon payloads
2 sounding rocket payloads
2 Pioneers smallsats
6 balloon payloads
2 rocket payloads
3 cubesats
1 Pioneers smallsat
4 balloon payloads
4 sounding rocket payloads
2 cubesats 1 ISS experiment
1 Pioneers balloon
4 balloon payloads
1 ISS experiment
Partner-led
March 2022

BPS Mission





Decadal Survey



Artemis Missions

Pioneer Scientific Discovery

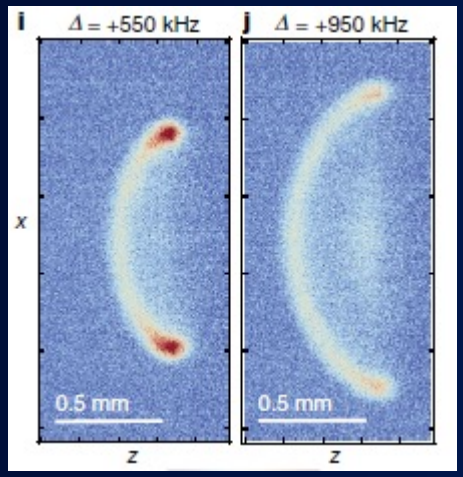
- Proactively seek out new ways to expand fundamental scientific knowledge
- Provide expertise and support to others seeking to utilize space

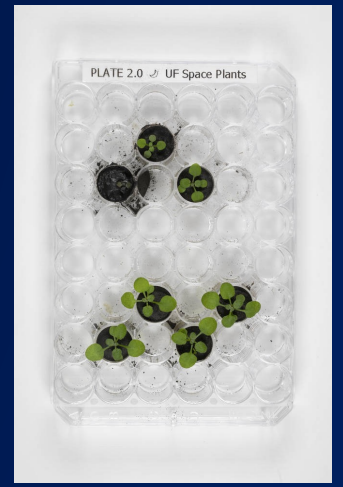
Enable Sustainable Exploration

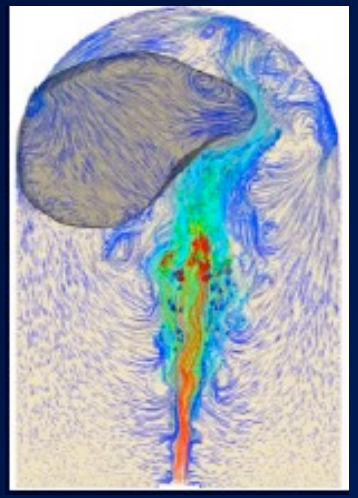
- Anticipate and investigate critical areas for scientific knowledge and technology development
- Deliver results to other NASA organizations and industry

Major BPS Disciplines

- Pioneer Scientific Discovery
  - Quantum Science
    - Cold atoms
  - Thriving In Deep Space (TIDES)
    - Animal biology
    - Plant biology
    - Microbiology
- Enable Sustainable Exploration
  - Fluid Physics
    - Cryogenic Fuel Management
  - Combustion
    - Solids, liquids, gases
  - Materials Science
    - In situ resource utilization
    - Additive manufacturing







Examples of BPS Research Platforms

*Future Platforms


CubeSat


International Space Station


Free Flyers (BION)

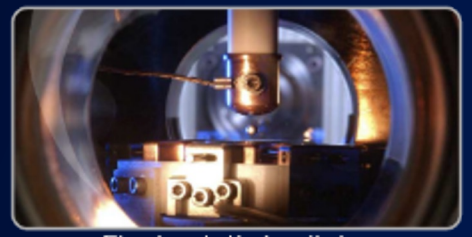

*Lunar Gateway


*Commercial Lunar Lander Services


Drop Tower

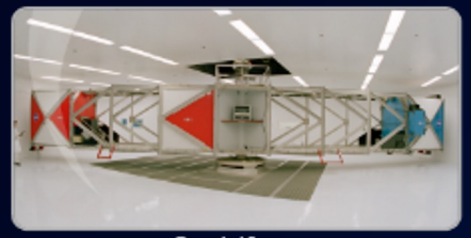

Parabolic Flight


Sounding Rocket
Sub-orbital Vehicle


Electrostatic Levitator


*Human Landing System


Rodent Unloading

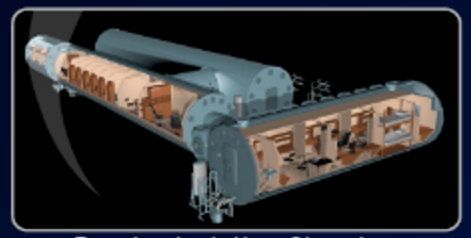

Centrifuge


Balloon Flight


NASA Space Radiation Lab


NASA Isolation Chamber


NSF Polar Station


Russian Isolation Chamber


Gravity Vector Averaging

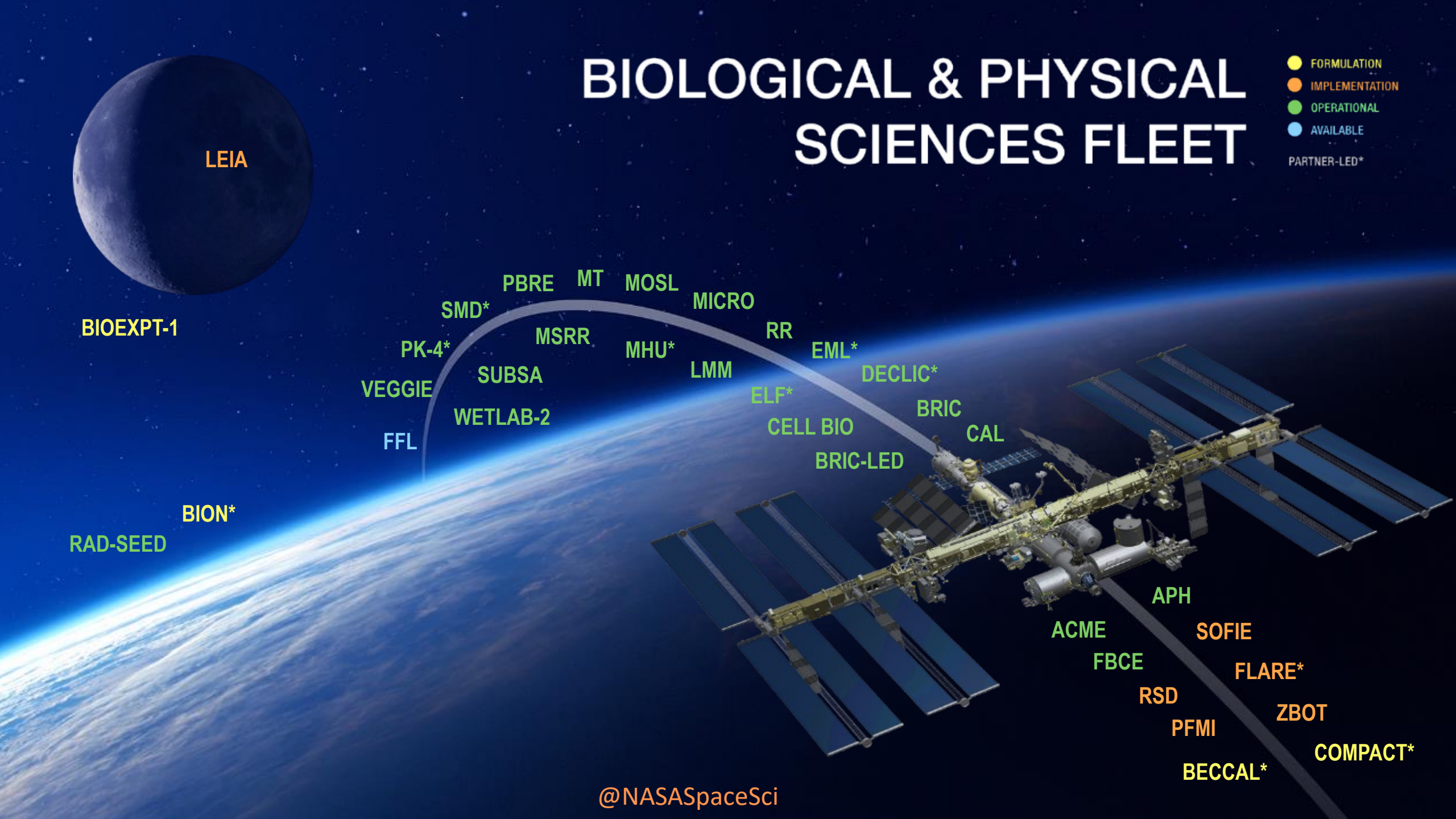

Physical Sciences
Informatics


GeneLab

BIOLOGICAL & PHYSICAL SCIENCES FLEET

- FORMULATION
- IMPLEMENTATION
- OPERATIONAL
- AVAILABLE

PARTNER-LED*



@NASASpaceSci

National Aeronautics and Space Administration

Heliophysics Division

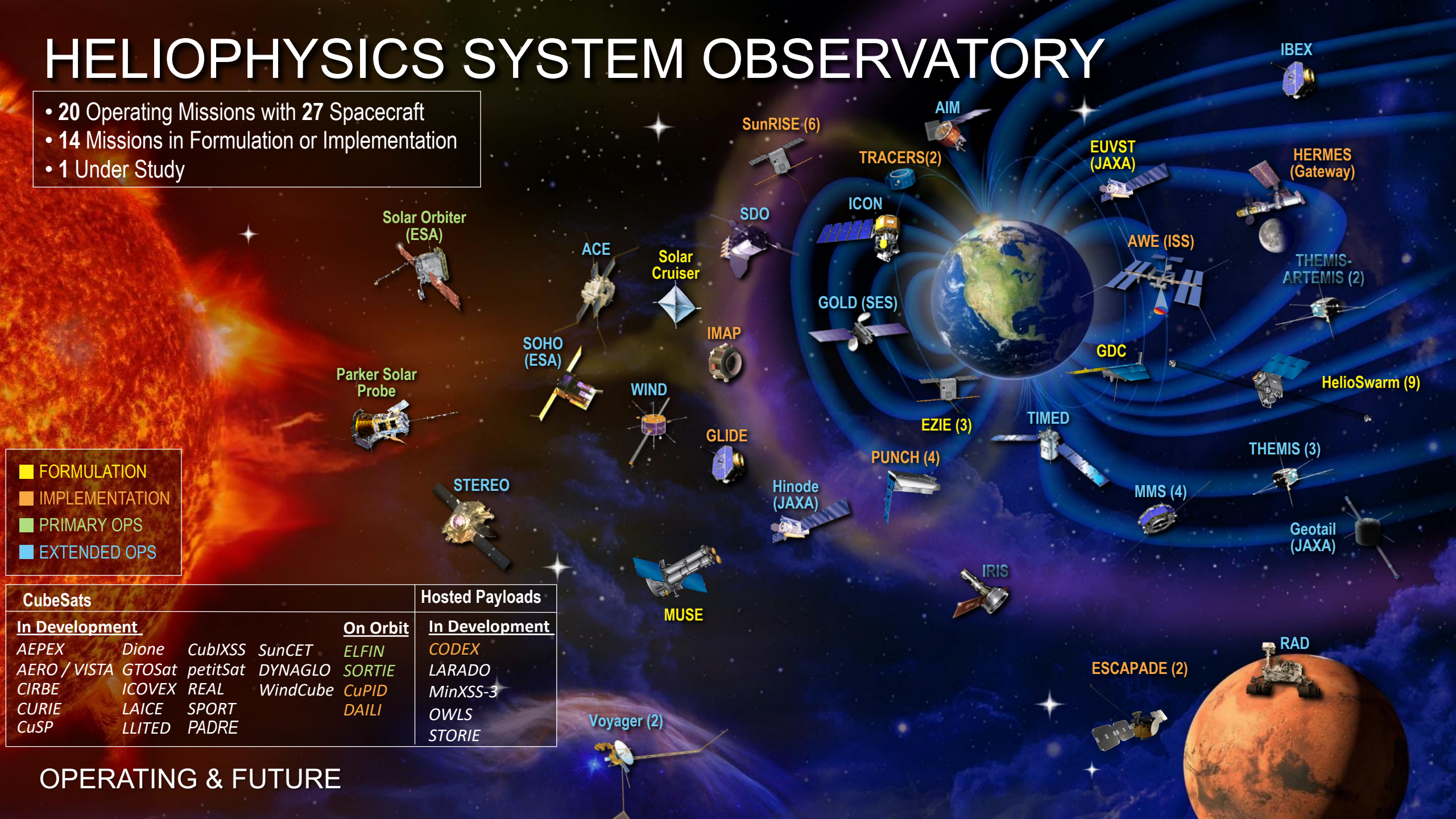
SMD New Hire Orientation

Dr. Nicky Fox
Heliophysics Division Director

May 2022

HELIOPHYSICS SYSTEM OBSERVATORY

- **20** Operating Missions with **27** Spacecraft
- **14** Missions in Formulation or Implementation
- **1** Under Study



- FORMULATION
- IMPLEMENTATION
- PRIMARY OPS
- EXTENDED OPS

CubeSats					Hosted Payloads
In Development				**On Orbit**	**In Development**
AEPEX	*Dione*	*CubIXSS*	*SunCET*	*ELFIN*	*CODEX*
AERO / VISTA	*GTOSat*	*petitSat*	*DYNAGLO*	*SORTIE*	*LARADO*
CIRBE	*ICOVEX*	*REAL*	*WindCube*	*CuPID*	*MinXSS-3*
CURIE	*LAICE*	*SPORT*		*DAILI*	*OWLS*
CuSP	*LLITED*	*PADRE*			*STORIE*

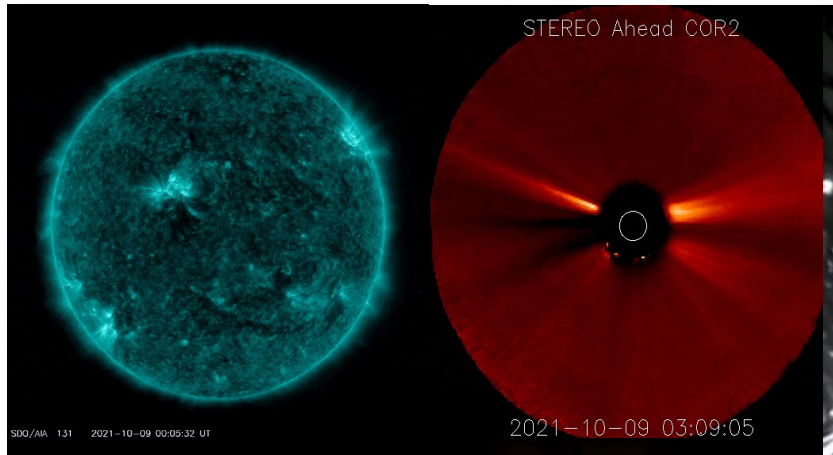
OPERATING & FUTURE

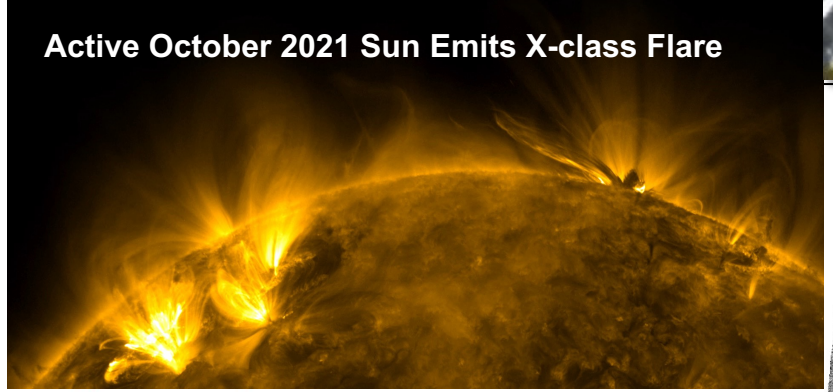
The Sun Wakes Up: Solar Cycle 25 Is Here

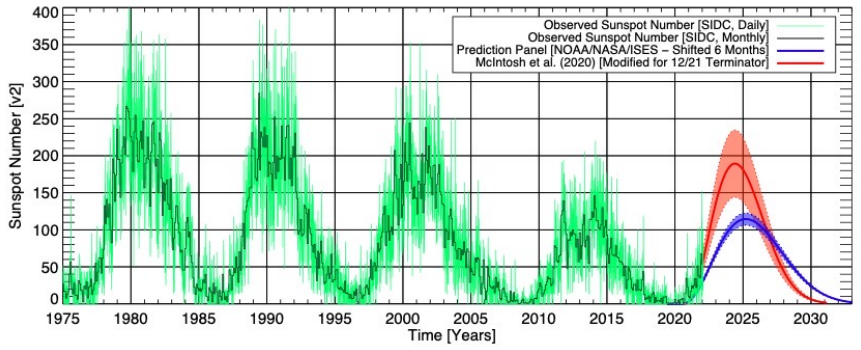
December 2019 marked the beginning of Solar Cycle 25, and the Sun's activity will once again ramp up until solar maximum, predicted for 2025.

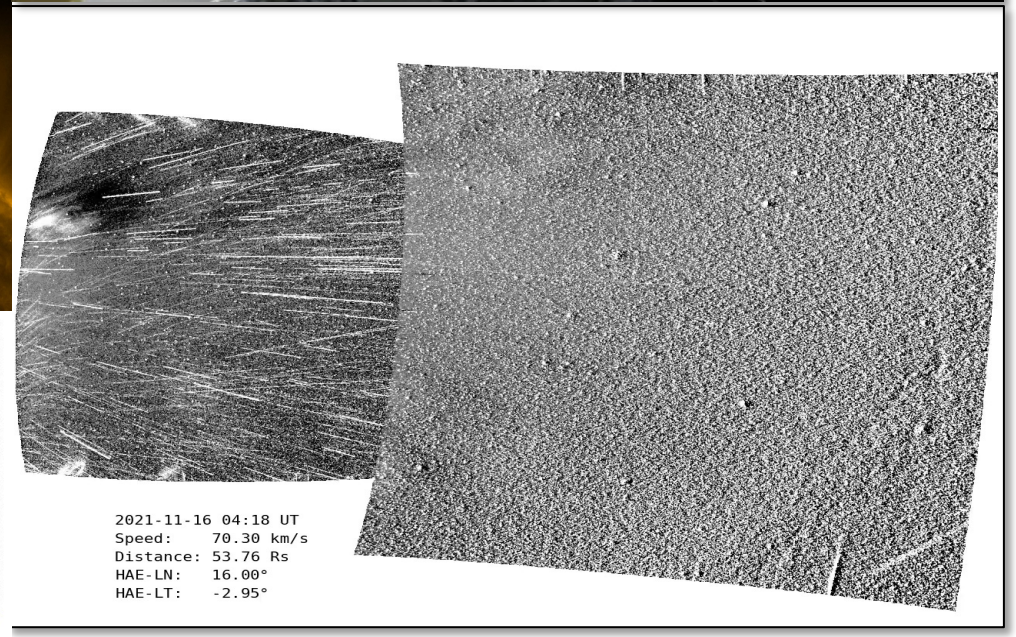
This new solar cycle, and anticipated increase in space weather events, will impact our lives and technology on Earth, as well as astronauts in space.

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









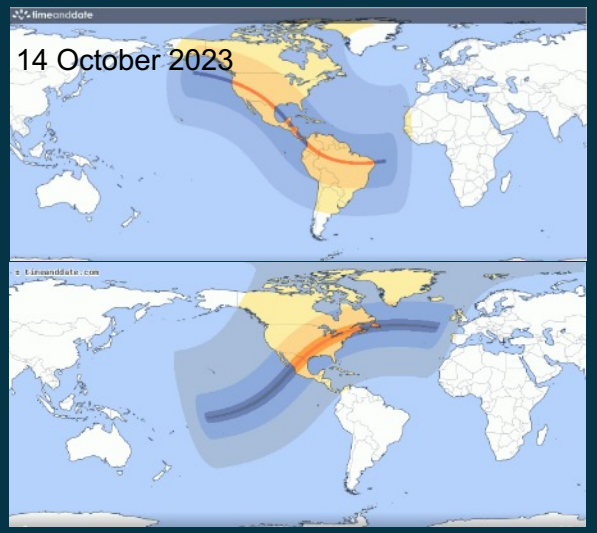
Heliophysics Big Year

What is the Heliophysics Big Year?
Ties together three major Heliophysics events in 2023-2025 (2 solar eclipses, solar maximum) to maximize participation in a coordinated incentivized citizen science campaign.

- NASA is developing a program to use these remarkable events to highlight and motivate solar system science
  - Two Solar Eclipses cross N. America (14 Oct 2023 and 8 April 2024)
  - The rising phase of the Solar Cycle 25 with Solar Maximum predicted to occur in 2025

- Look out for opportunities to be part of our Big Year
https://science.nasa.gov/heliophysics/programs/citizen-science

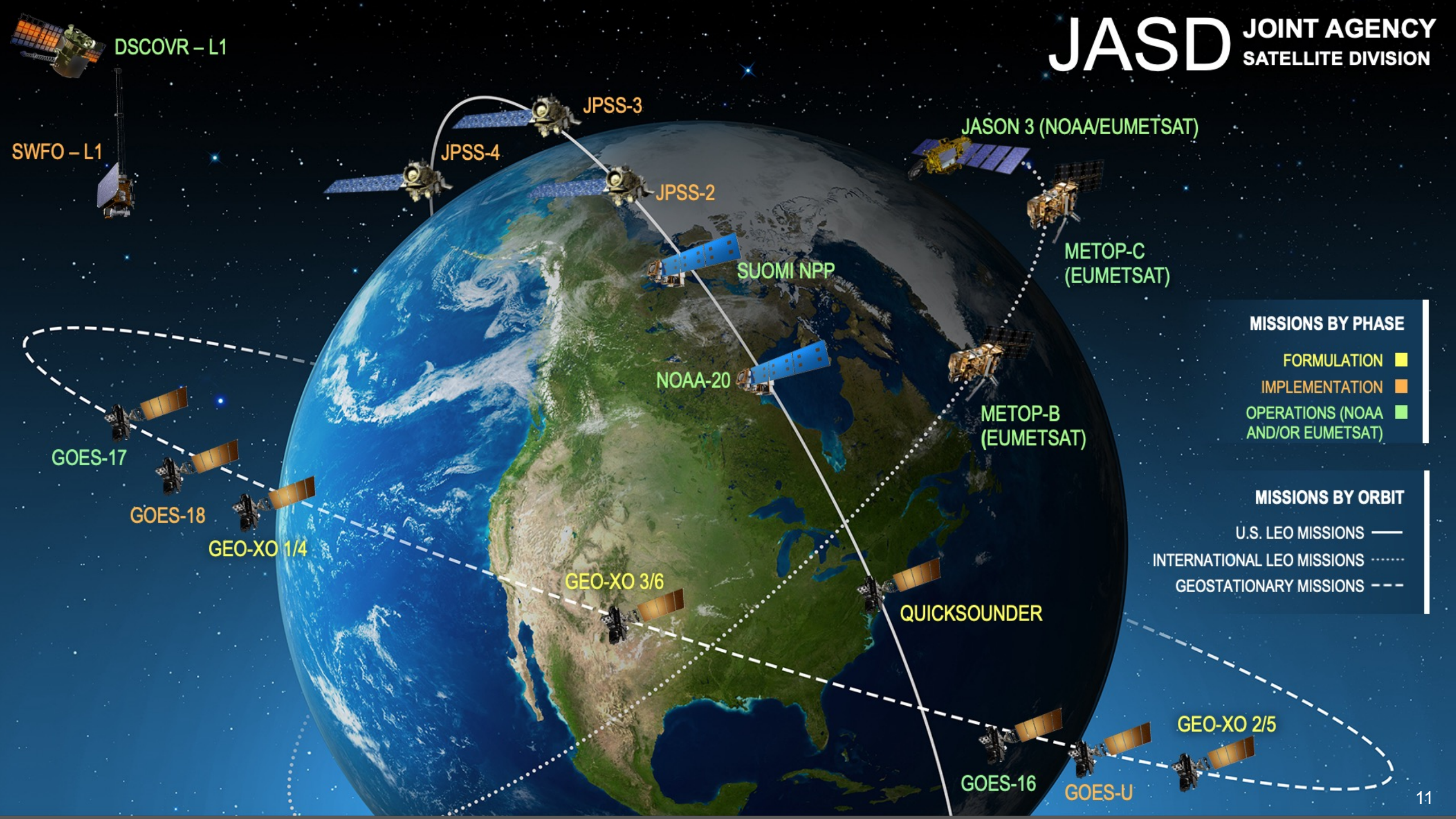
Totality during the solar eclipse in Australia's Tropical North Queensland on November 14, 2012. Getty Images.

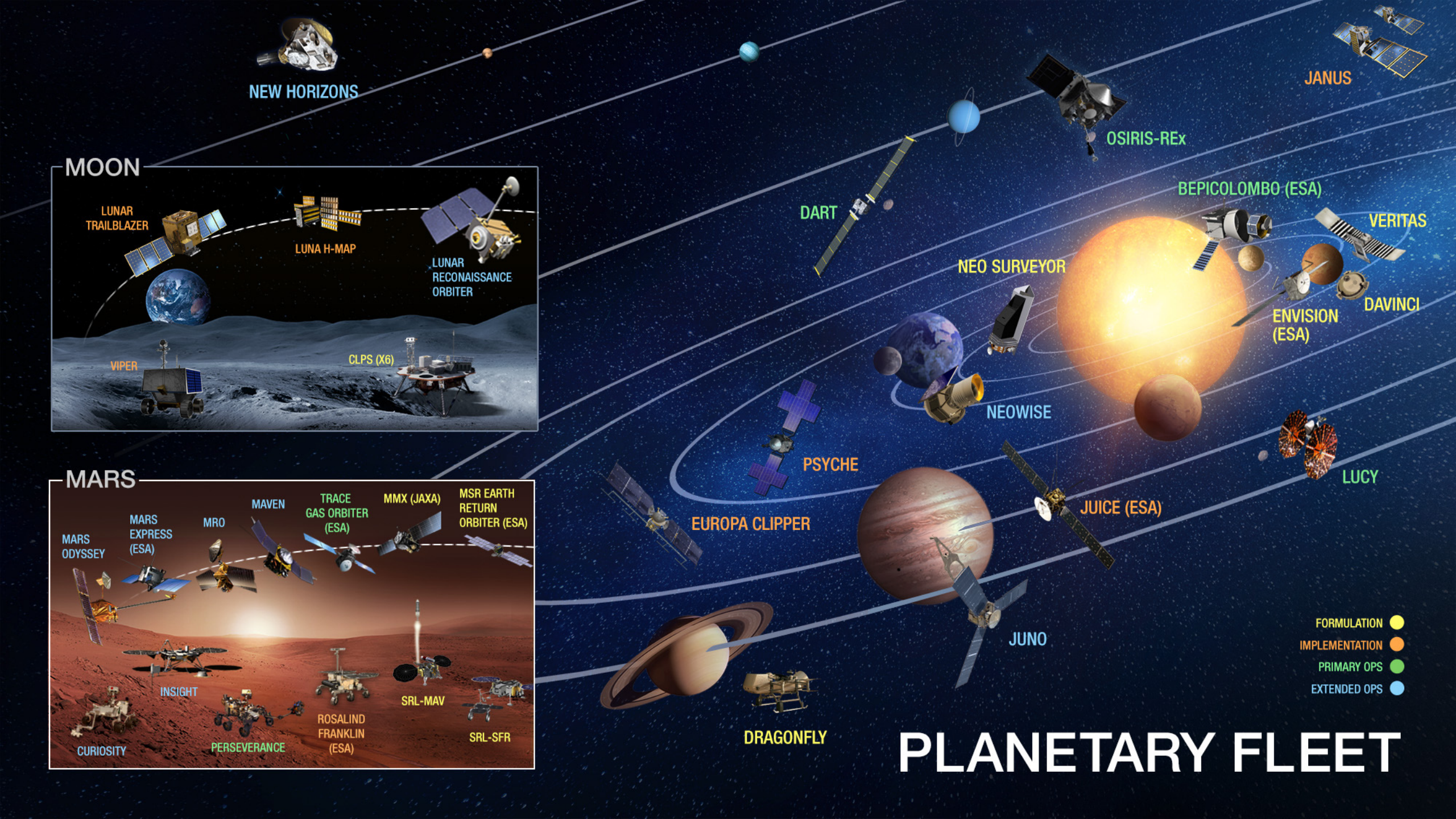


The paths of totality for total solar eclipses during the HBY.

Helio's Big Year is an opportunity to reach a new **generation** for Heliophysics.

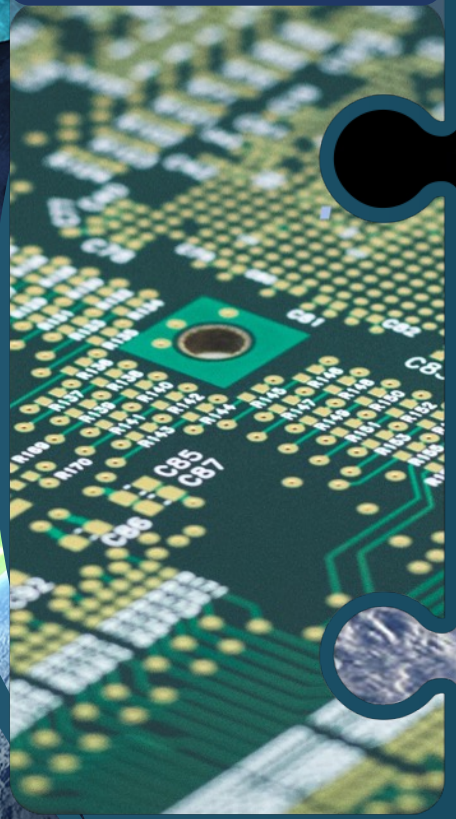
What is a "Big Year"? A big year is a birding term for maximizing a birder's number of species.


JASD
JOINT AGENCY
SATELLITE DIVISION
DSCOVR – L1
SWFO – L1
JPSS-3
JPSS-4
JPSS-2
SUOMI NPP
NOAA-20
JASON 3 (NOAA/EUMETSAT)
METOP-C
(EUMETSAT)
METOP-B
(EUMETSAT)
GOES-17
GOES-18
GEO-XO 1/4
GEO-XO 3/6
QUICKSOUNDER
GOES-16
GOES-U
GEO-XO 2/5
MISSIONS BY PHASE
FORMULATION
IMPLEMENTATION
OPERATIONS (NOAA AND/OR EUMETSAT)
MISSIONS BY ORBIT
U.S. LEO MISSIONS
INTERNATIONAL LEO MISSIONS
GEOSTATIONARY MISSIONS


NEW HORIZONS
MOON
LUNAR TRAILBLAZER
LUNA H-MAP
LUNAR RECONAISSANCE ORBITER
VIPER
CLPS (X6)
MARS
MARS ODYSSEY
MARS EXPRESS (ESA)
MRO
MAVEN
TRACE GAS ORBITER (ESA)
MMX (JAXA)
MSR EARTH RETURN ORBITER (ESA)
INSIGHT
CURIOSITY
PERSEVERANCE
ROSALIND FRANKLIN (ESA)
SRL-MAV
SRL-SFR
JANUS
OSIRIS-REx
DART
BEPICOLOMBO (ESA)
VERITAS
NEO SURVEYOR
ENVISION (ESA)
DAVINCI
NEOWISE
PSYCHE
LUCY
EUROPA CLIPPER
JUICE (ESA)
JUNO
DRAGONFLY
FORMULATION
IMPLEMENTATION
PRIMARY OPS
EXTENDED OPS
PLANETARY FLEET

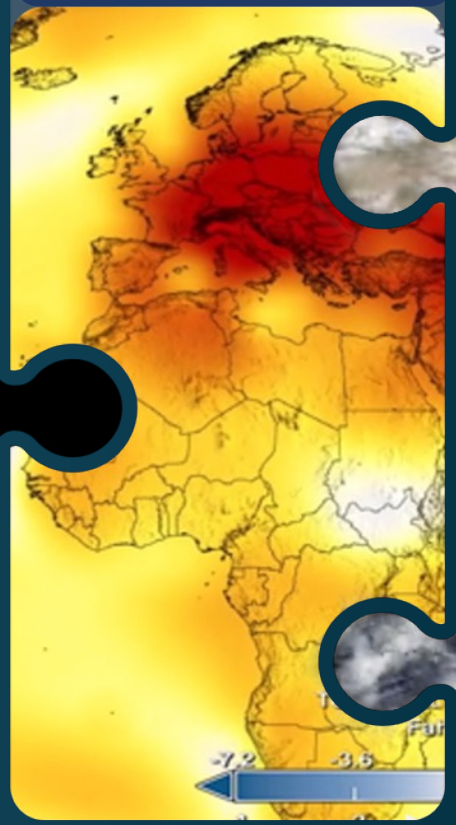
Advancing Earth System Science End-to-End

TECHNOLOGY



FLIGHT

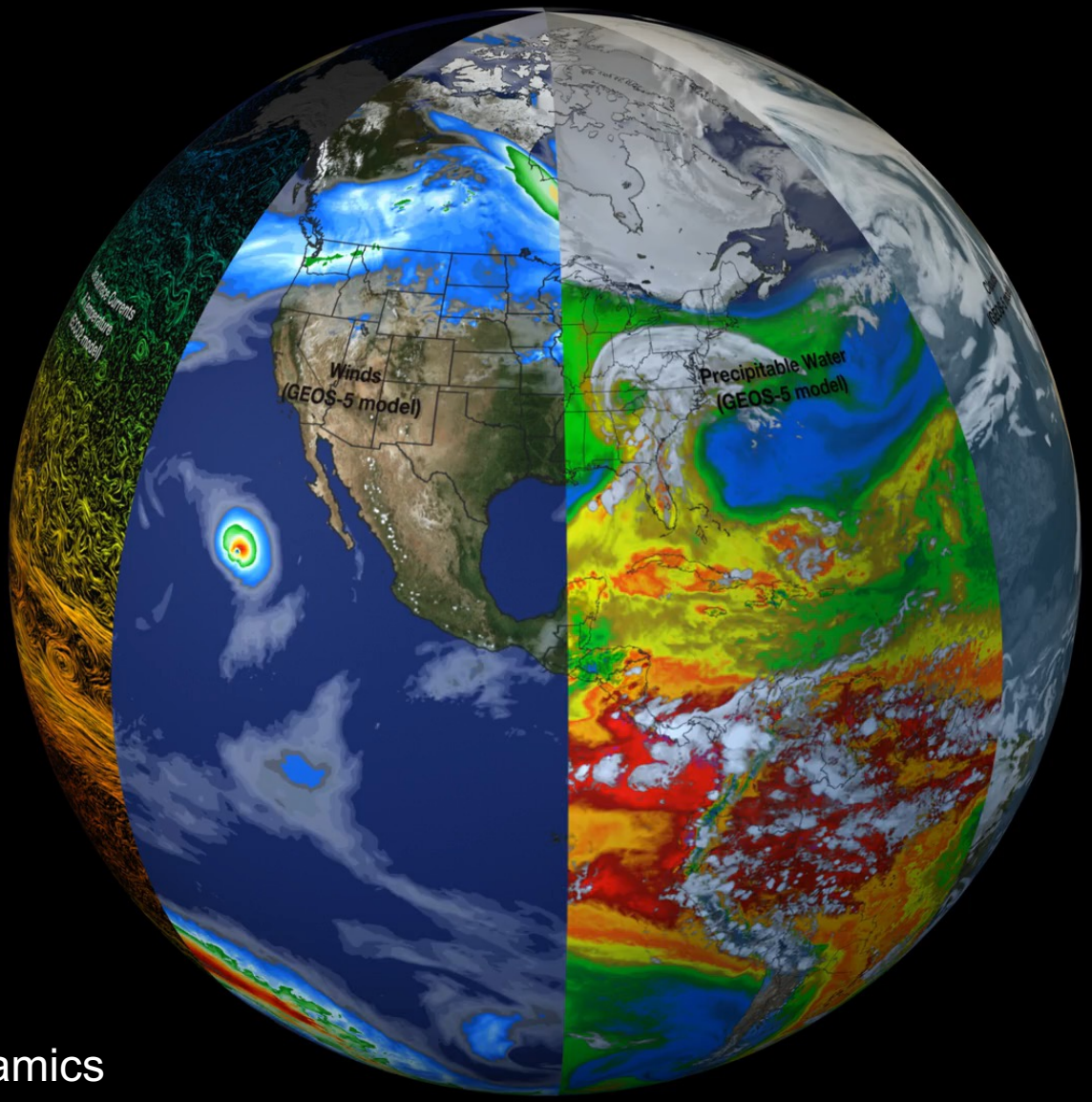
RESEARCH AND ANALYSIS



DATA AND COMPUTE

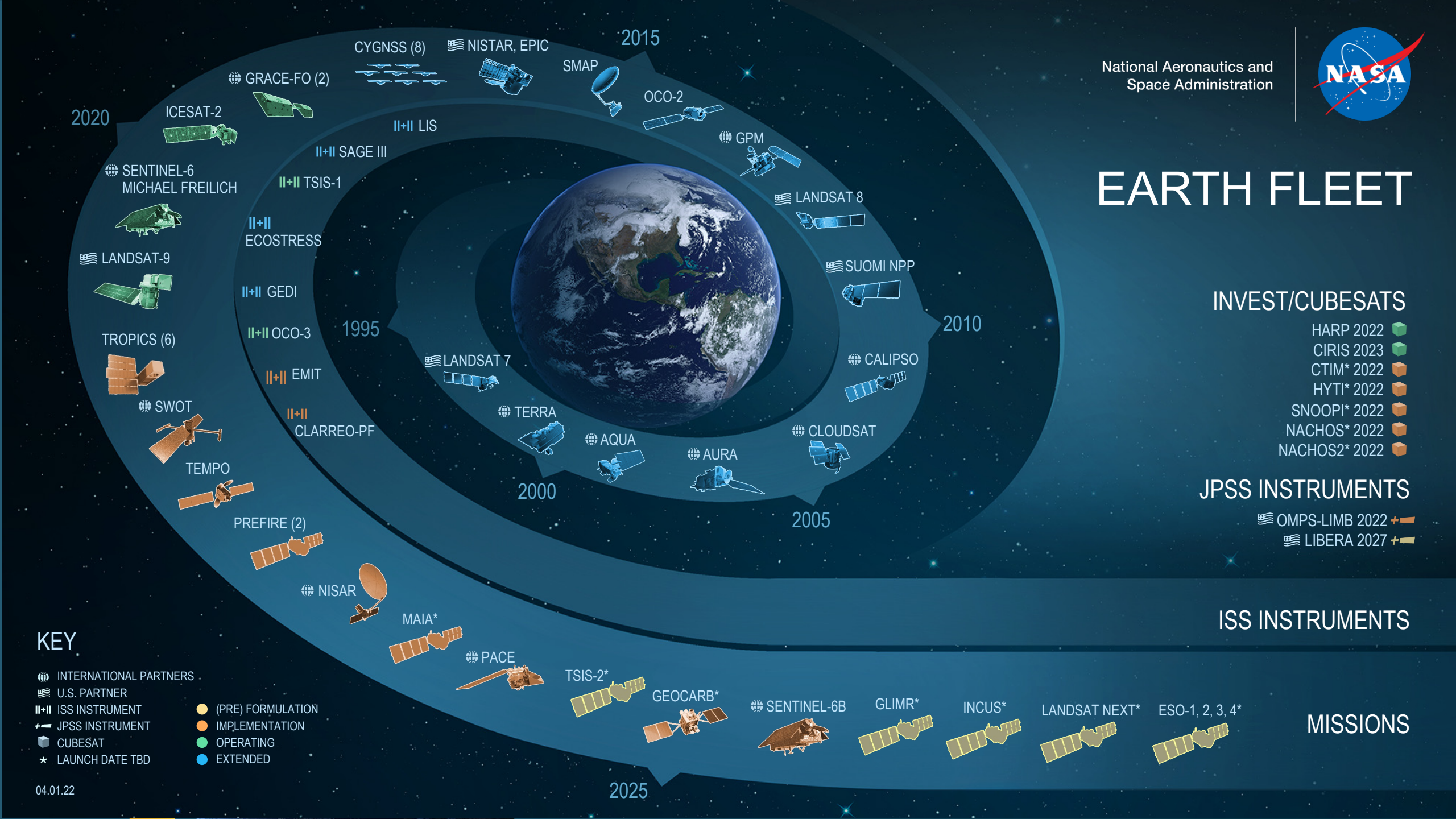
APPLICATIONS

NASA Earth System Science

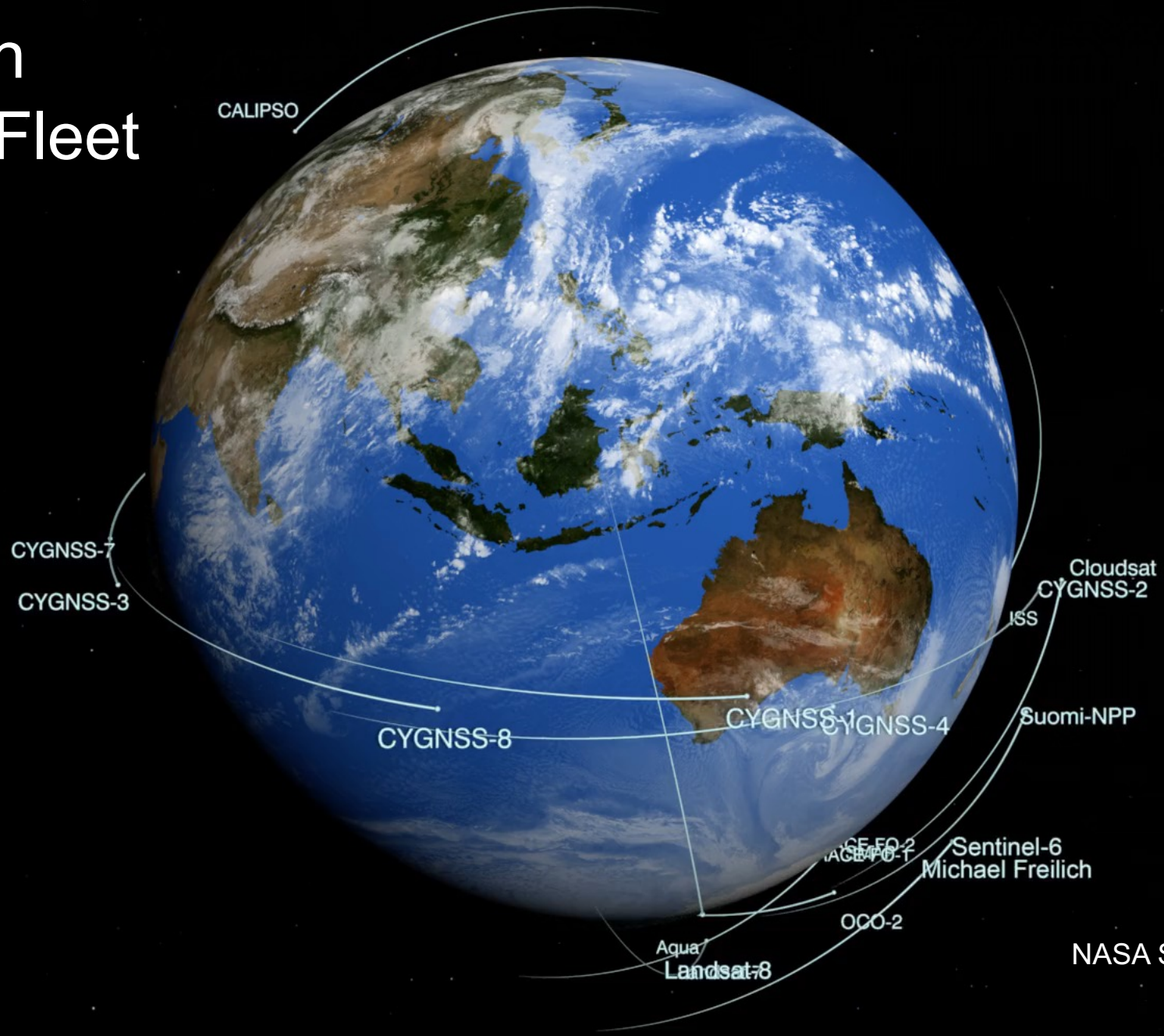


Atmospheric Composition
Carbon Cycle and Ecosystems
Climate Variability and Change
Earth Surface and Interior
Water and Energy Cycle
Weather and Atmospheric Dynamics

NASA Scientific Visualization Studio
svs.gsfc.nasa.gov/30701


National Aeronautics and Space Administration
NASA
EARTH FLEET
2015
2020
1995
2010
2000
2005
2025
CYGNSS (8)
NISTAR, EPIC
SMAP
OCO-2
GRACE-FO (2)
ICESAT-2
LIS
SAGE III
GPM
SENTINEL-6 MICHAEL FREILICH
TSIS-1
LANDSAT 8
ECOSTRESS
LANDSAT-9
SUOMI NPP
GEDI
TROPICS (6)
OCO-3
LANDSAT 7
CALIPSO
EMIT
SWOT
TERRA
CLOUDSAT
CLARREO-PF
AQUA
AURA
TEMPO
PREFIRE (2)
NISAR
MAIA*
PACE
TSIS-2*
GEOCARB*
SENTINEL-6B
GLIMR*
INCUS*
LANDSAT NEXT*
ESO-1, 2, 3, 4*
INVEST/CUBESATS
HARP 2022
CIRIS 2023
CTIM* 2022
HYTI* 2022
SNOOPI* 2022
NACHOS* 2022
NACHOS2* 2022
JPSS INSTRUMENTS
OMPS-LIMB 2022
LIBERA 2027
ISS INSTRUMENTS
MISSIONS
KEY
INTERNATIONAL PARTNERS
U.S. PARTNER
ISS INSTRUMENT
JPSS INSTRUMENT
CUBESAT
LAUNCH DATE TBD
(PRE) FORMULATION
IMPLEMENTATION
OPERATING
EXTENDED
04.01.22

NASA Earth Observing Fleet

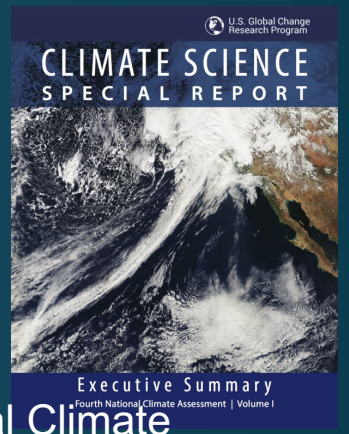


August 2021

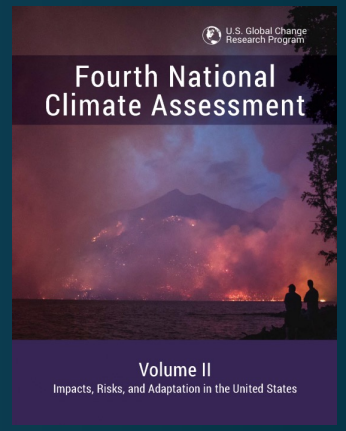
NASA Scientific Visualization Studio
svs.gsfc.nasa.gov/4931

NASA Earth Science Guiding Documents

USGCRP Updated Research Plan (2017)

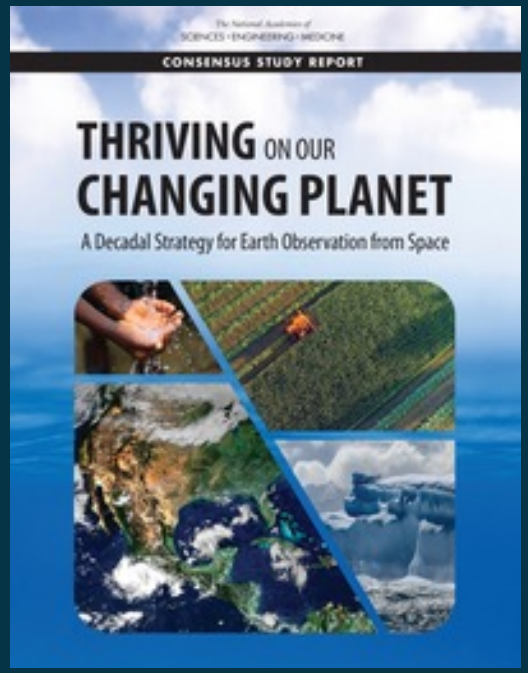


US National Climate Assessment (V1, 2017)

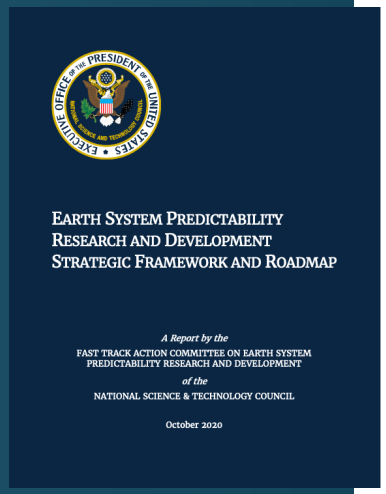


US National Climate Assessment (V2, 2018)

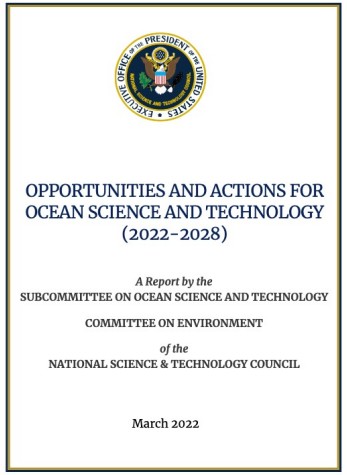
NASEM Decadal Survey for Earth Science (2018)



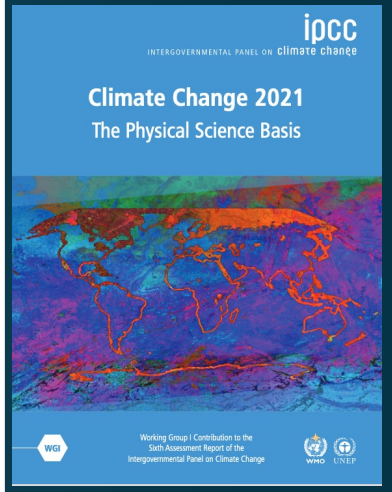
Arctic Research Plan (2022)

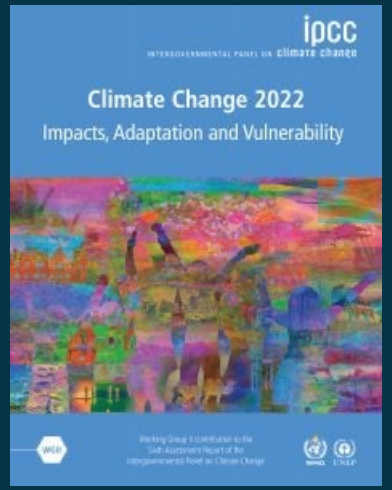


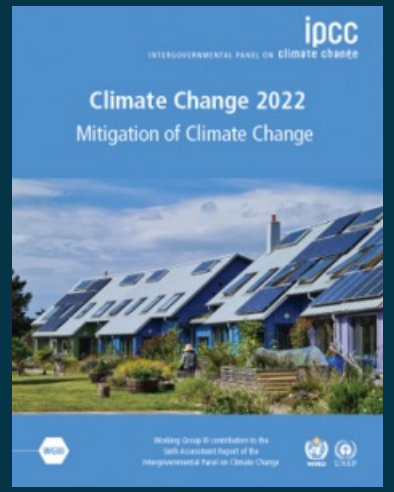
Earth System Predictability (2020)



Ocean Science and Tech. (2022)







IPCC AR6 Climate Change Assessments (2021-22)