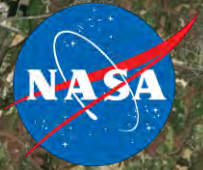


National Aeronautics and
Space Administration



EXPLORE EARTH

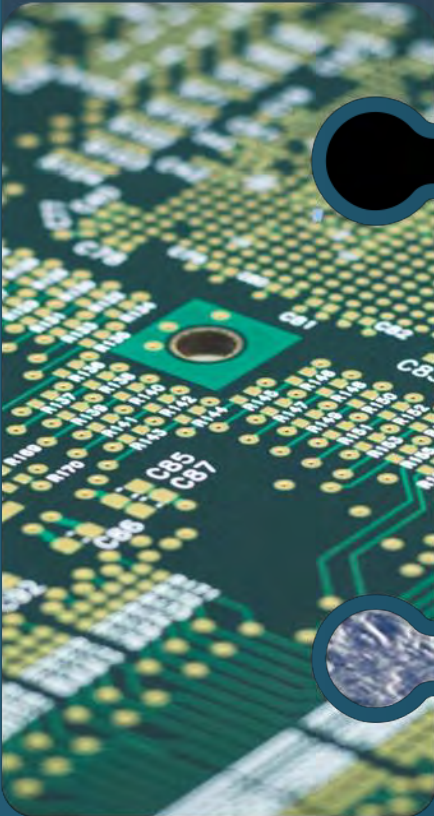
Earth Science Division Overview

Living Planet Symposium

May 23, 2022

Advancing Earth System Science End-to-end

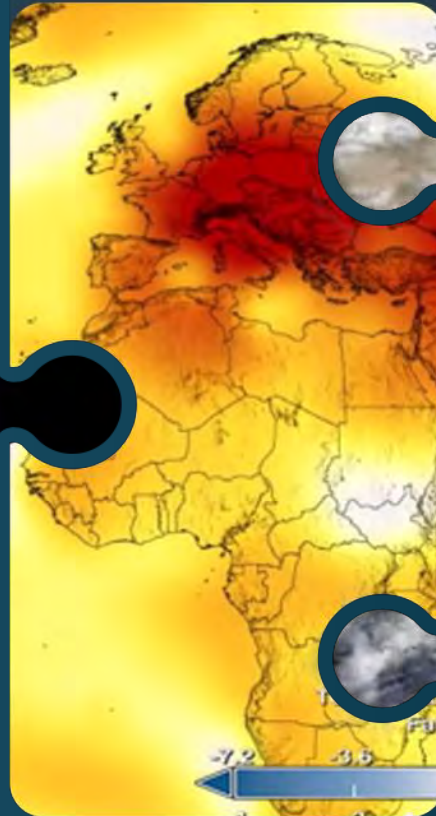
TECHNOLOGY



FLIGHT



RESEARCH
AND ANALYSIS



DATA
AND COMPUTE



APPLICATIONS





EARTH FLEET



INVEST/CUBESATS

- CIRIS 2023
- CTIM* 2022
- HYTI* 2022
- SNOOPI* 2022
- NACHOS* 2022
- NACHOS2* 2022

JPSS INSTRUMENTS

- OMPS-LIMB 2022
- LIBERA 2027

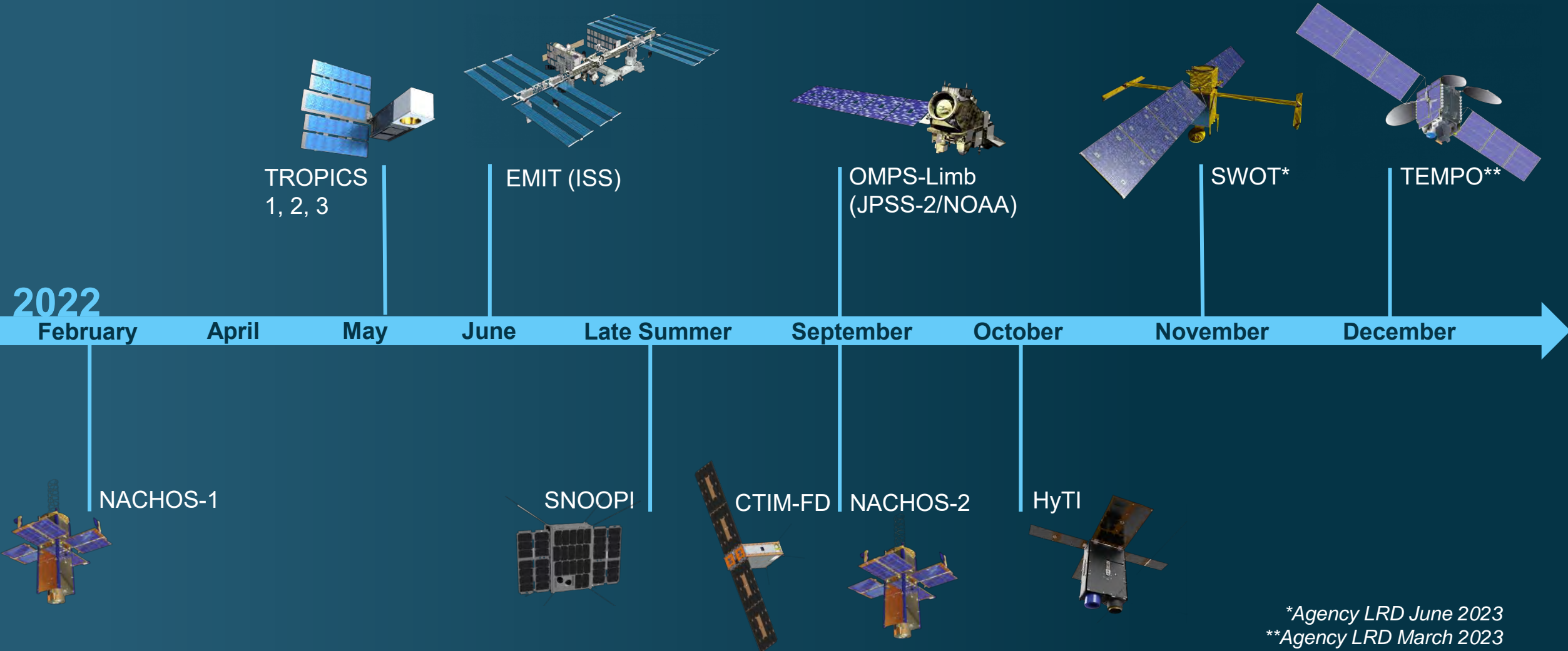
ISS INSTRUMENTS

MISSIONS

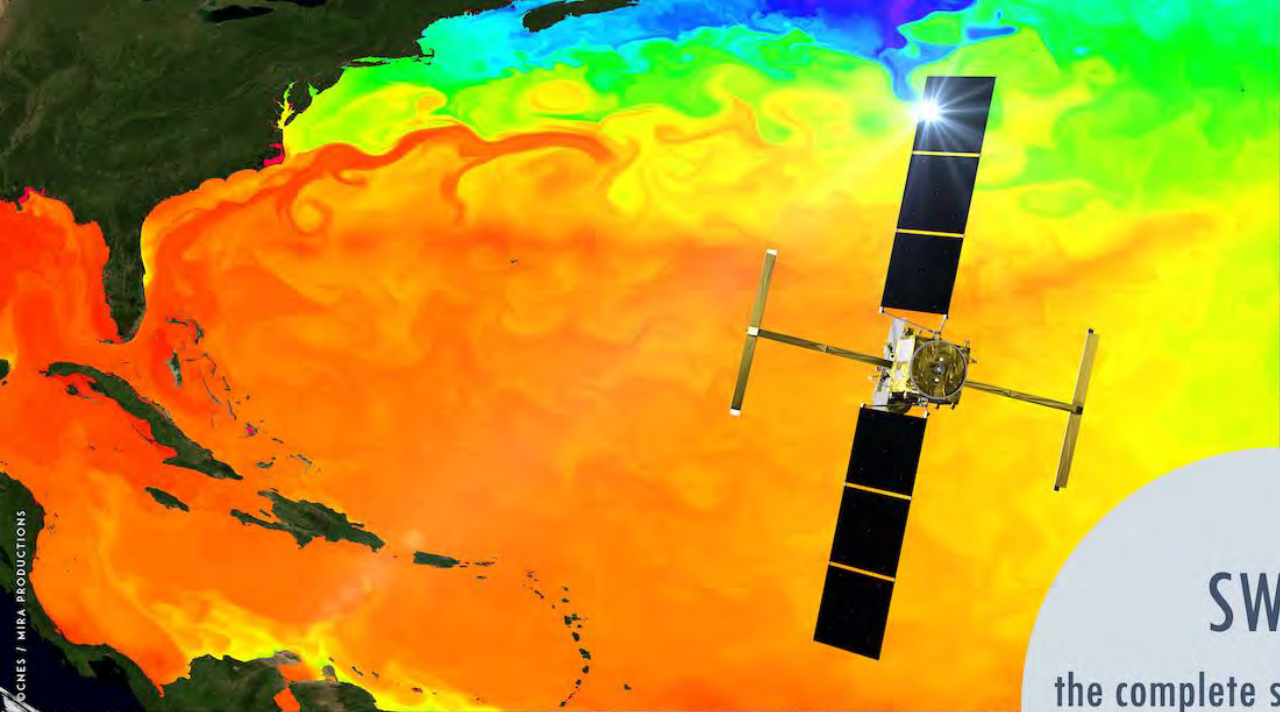
KEY

- INTERNATIONAL PARTNERS
- U.S. PARTNER
- ISS INSTRUMENT
- JPSS INSTRUMENT
- CUBESAT
- LAUNCH DATE TBD
- (PRE) FORMULATION
- IMPLEMENTATION
- OPERATING
- EXTENDED

Upcoming Earth Science Launches



*Agency LRD June 2023
**Agency LRD March 2023



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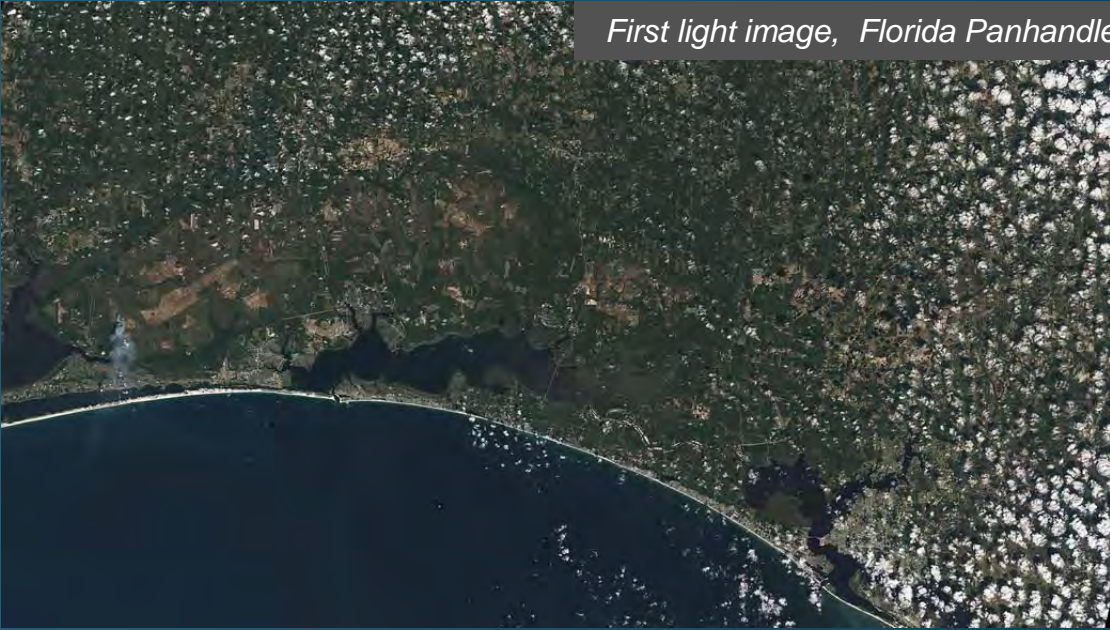
© CNES / MIRA PRODUCTIONS

SWOT
the complete story of Earth's
surface water
(from ocean to land and back)



© CNES / MIRA PRODUCTIONS

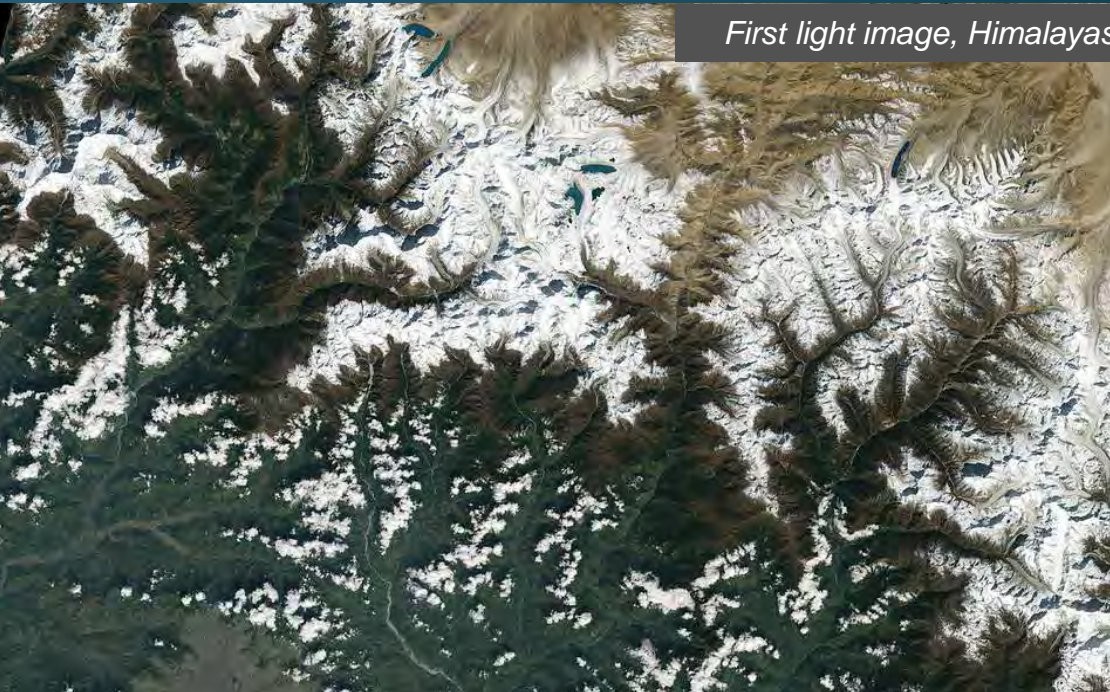
First light image, Florida Panhandle



Landsat 9 Data Released

- Data released to public in mid-February
- Instrument handover to USGS completed in February; spacecraft handover expected in late July

First light image, Himalayas



First light image, Detroit and Lake Erie



Other Recent Launches

STP-H8

- Launched Dec. 21, 2021 with the Compact Ocean Wind Vector Radiometer (COWVR) and Temporal Experiment for Storms and Tropical Systems (TEMPEST)
- Will evaluate these small instruments' data quality for assimilation into DoD weather models



NACHOS-1 (Credit: Los Alamos National Laboratory)

NACHOS-1

- Launched Feb. 19, 2022; deployment from ISS expected no earlier than June 2022
- 3U-sized, ultra-compact, high-resolution hyperspectral imager for measuring atmospheric trace gases (NO₂, SO₂, O₃, CH₂O, and more)

Earth Venture Mission-3: INCUS

PI: Susan van den Heever, Colorado State University

Addressing why convective storms, heavy precipitation and clouds occur exactly when and where they do



Three SmallSats

- JPL Ka-band radar with 5 beams (RainCube heritage)
- JPL cross-track scanning microwave radiometer (TEMPEST-D heritage)
- Tendeg deployable 1.6m Ka-band antenna
- Blue Canyon Technologies X-SAT Venus commercial bus



Colorado State University



JPL



EVI-6 Announcement of Opportunity (AO)

Final AO released April 19!

- PI-Managed Mission Cost Cap of \$37M (FY24)
- NASA will determine platform and launch vehicle
- Solicits Class D instruments and SmallSats
- Mandatory notices of intent due June 2
- Selection anticipated in early 2023



EVI-1
TEMPO



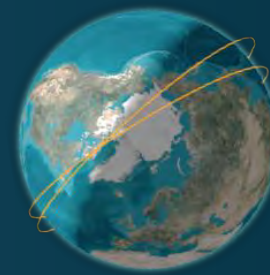
EVI-2
GEDI &
ECOSTRESS



EVI-3
TROPICS



EVI-3
MAIA



EVI-4
PREFIRE



EVI-4
EMIT



EVI-5
GLIMR

EVI-6
TBD



EARTH SYSTEM OBSERVATORY

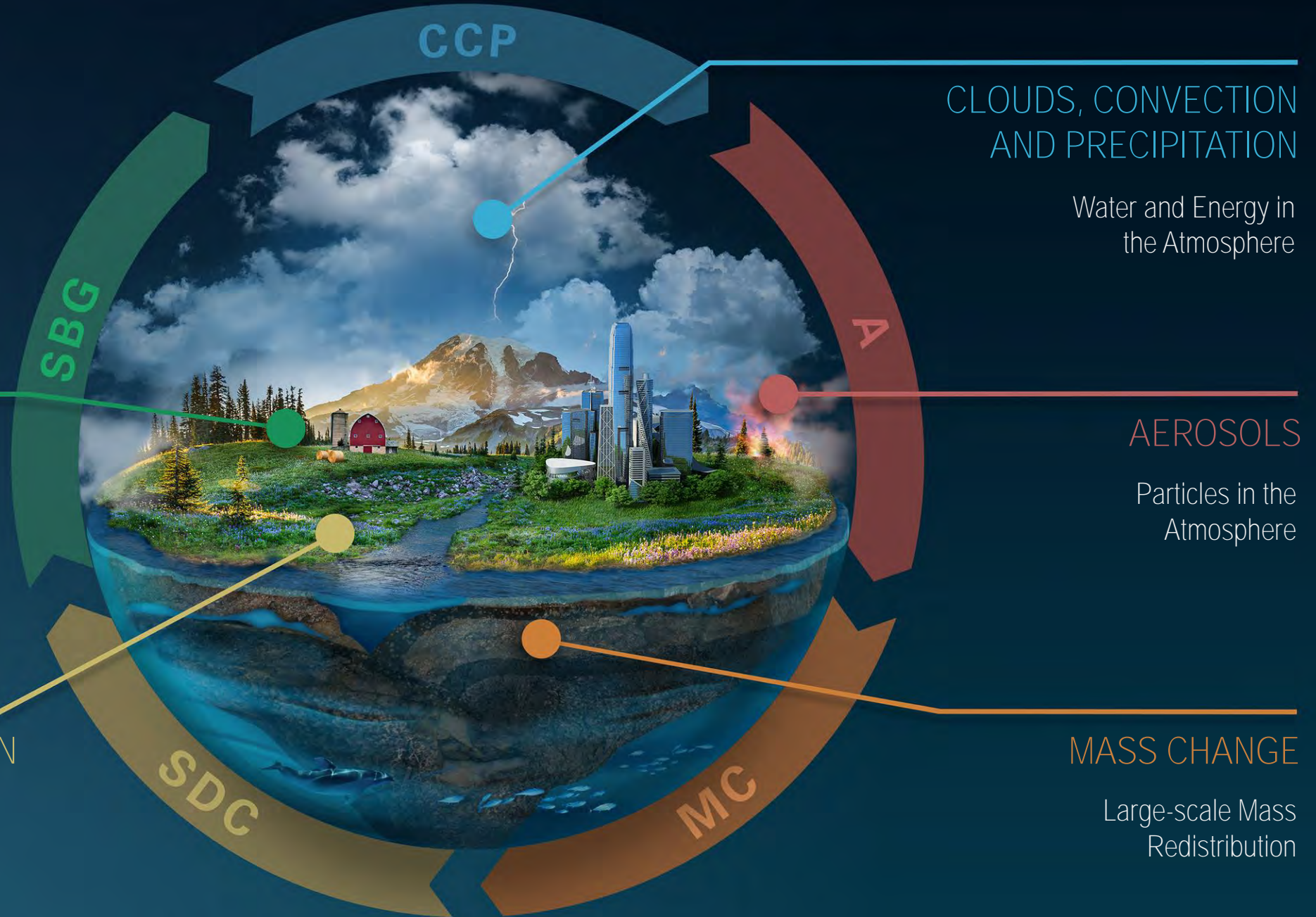
INTERCONNECTED CORE MISSIONS

SURFACE BIOLOGY AND GEOLOGY

Earth Surface & Ecosystems

SURFACE DEFORMATION AND CHANGE

Earth Surface Dynamics



CLOUDS, CONVECTION AND PRECIPITATION

Water and Energy in the Atmosphere

AEROSOLS

Particles in the Atmosphere

MASS CHANGE

Large-scale Mass Redistribution

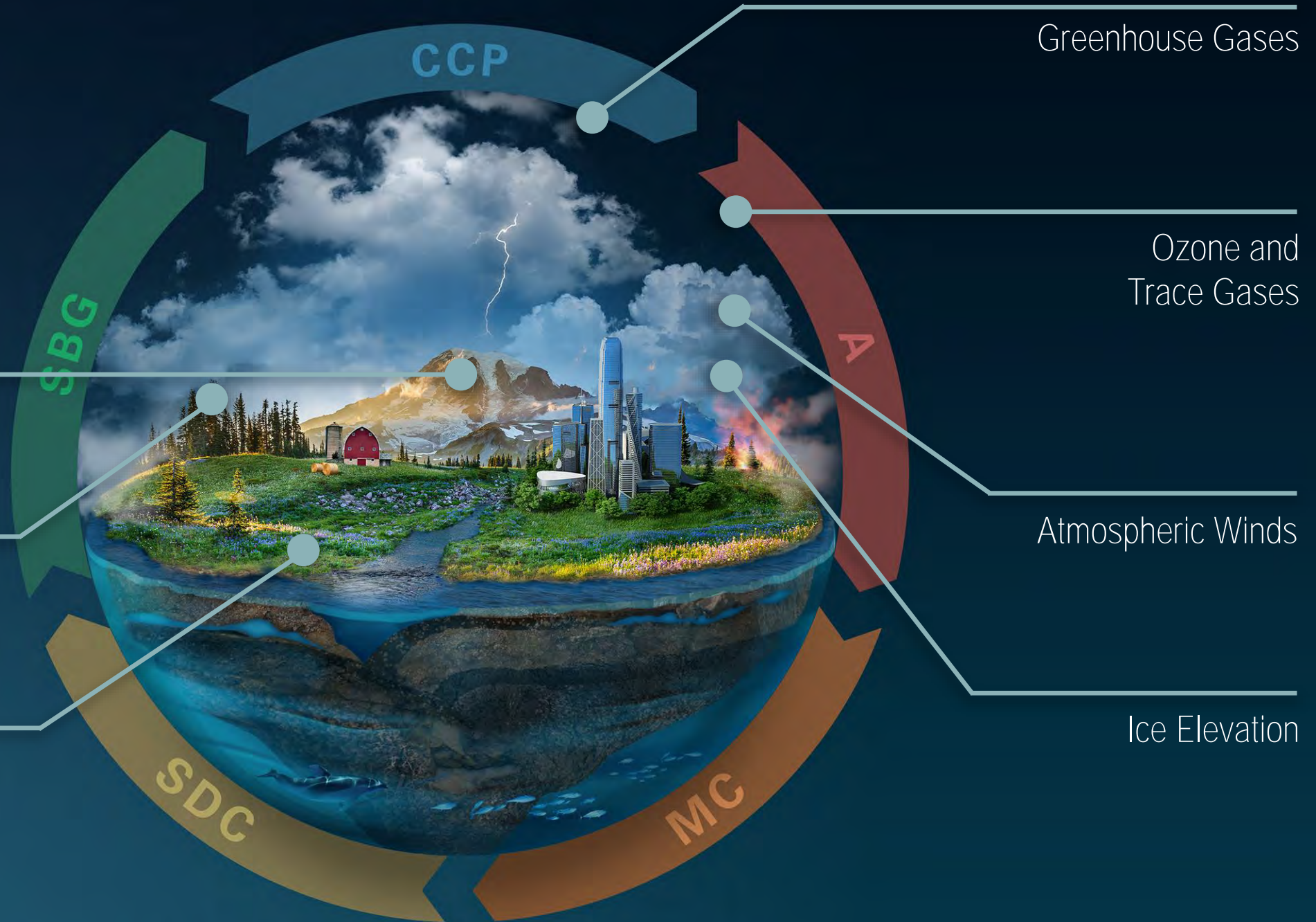
EARTH SYSTEM OBSERVATORY

INNOVATION & COMPETITION
EARTH EXPLORER MISSIONS

Snow Depth and
Water Content

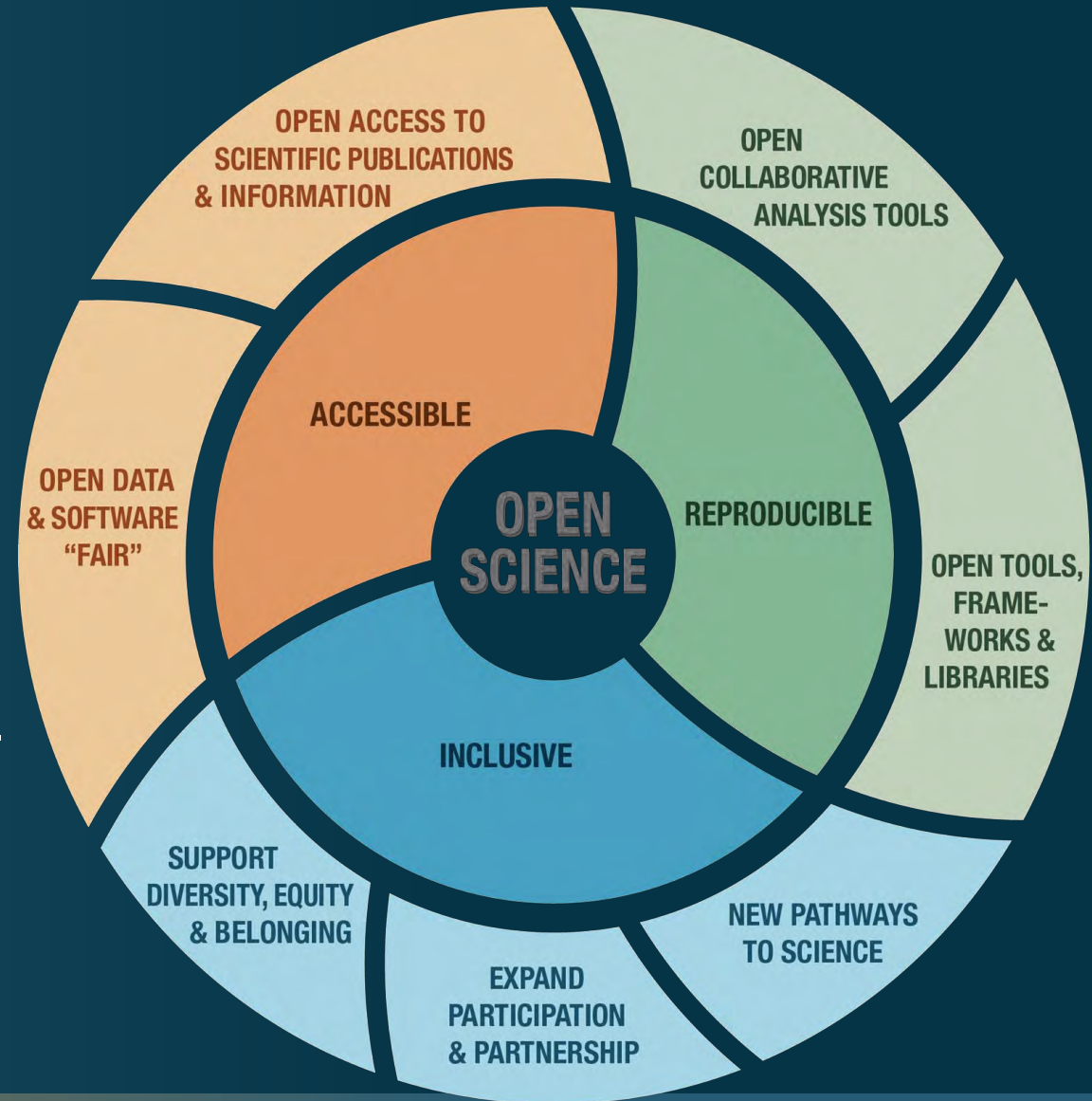
3D Ecosystem
Structure

Ocean Surface
Winds and Currents



NASA's Open-Source Science Initiative

- **Initiate** new missions, research and applied activities as open-source science projects.
- **Implement clear policies** for software, publications and data.
- **Integrate and improve** data management, access, computing, analytics and scientific collaboration.
- **Transform to OPen Science (TOPS)** is a 5-year effort focused on capacity building, partner engagement, and incentives to help accelerate scientific discovery through open science.



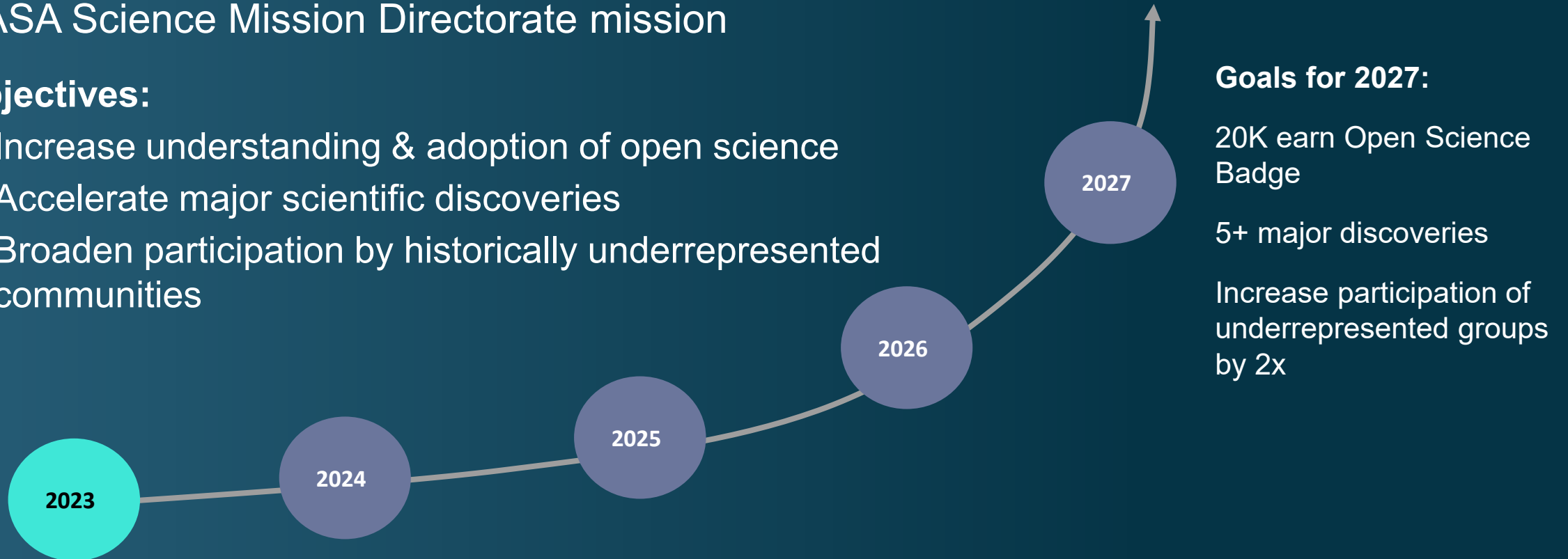


Leading the Path to Open-Source Science

Transform to Open Science (TOPS) is a \$40 million* 5-year NASA Science Mission Directorate mission

Objectives:

- Increase understanding & adoption of open science
- Accelerate major scientific discoveries
- Broaden participation by historically underrepresented communities



The **2023 Year of Open Science** will build momentum and support to move towards more openness in science.

*pending appropriations



Equity & Environmental Justice

Our commitment that NASA investments in satellites and science will inform decisionmakers and help people in all communities

<https://science.nasa.gov/earth-science/equity-and-environmental-justice>

Landsat 8-derived mean land surface temperature in central Sacramento, California for prioritized urban cooling interventions.

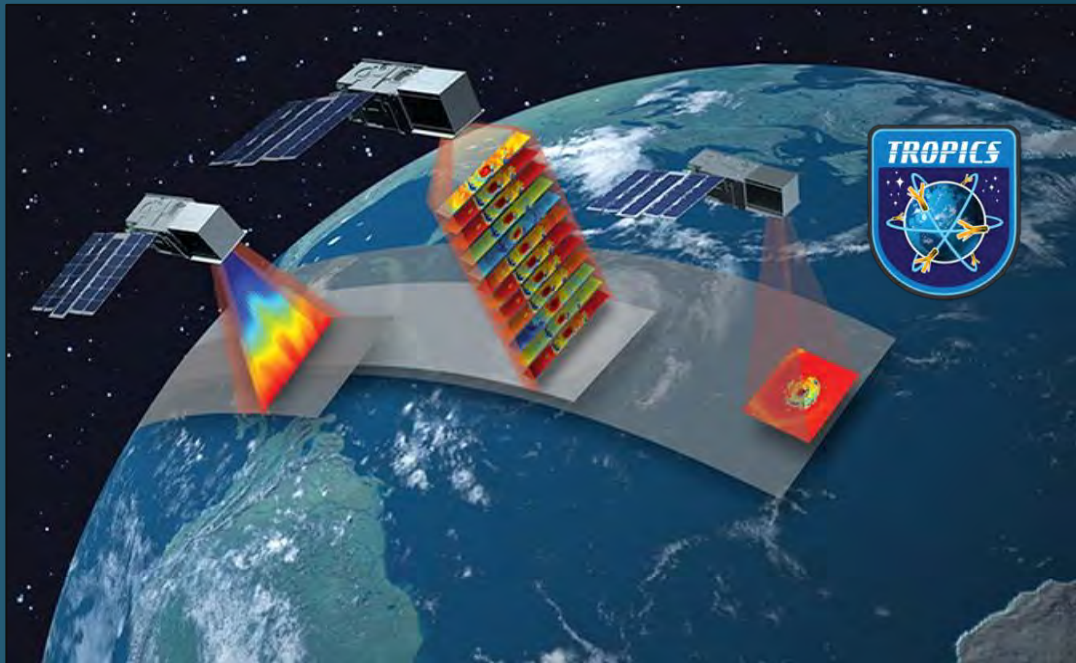


NASA EARTH
Your Home. Our Mission.

Upcoming Launches

TROPICS Constellation

Each launch will carry two CubeSats to three orbital planes (6 total) to study tropical cyclones

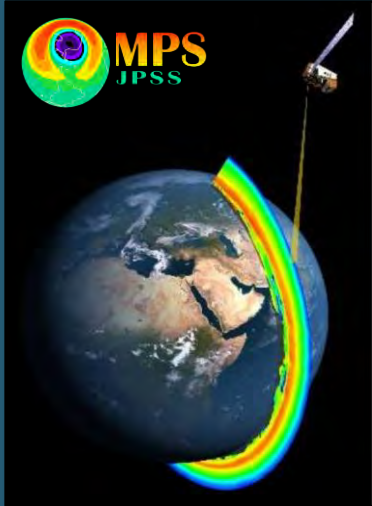


EMIT on the ISS

Will use NASA-invented technology to measure the composition of Earth's arid land dust source regions



Upcoming Launches



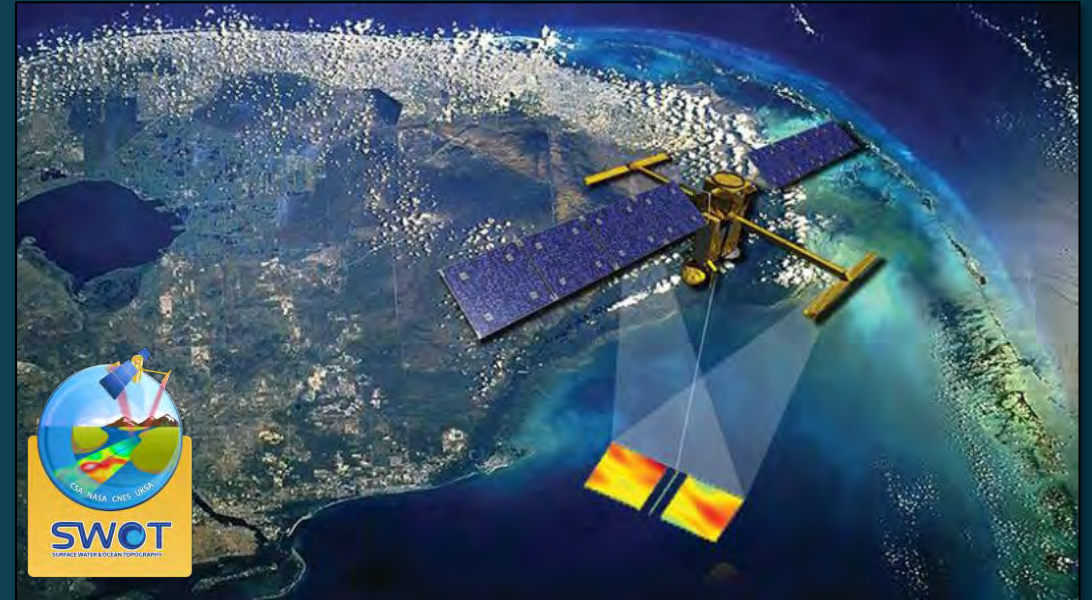
OMPS-Limb on JPSS-2

Will provide high resolution ozone and aerosol profiles and contribute to understanding ozone trends



TEMPO

First space-based instrument to monitor air pollutants hourly across the North American continent during daytime



SWOT

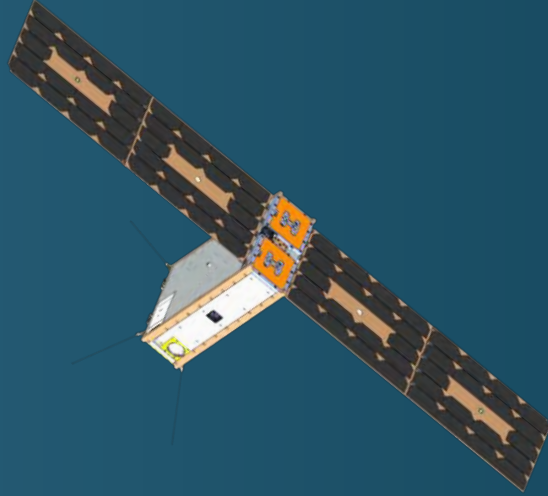
Will observe Earth's surface water, fine details of the ocean's surface topography, and changes in water bodies

SWOT Observatory: Integration and Testing

- NASA ESD visited the SWOT I&T team at the Thales facility in February
- Radiated Electromagnetic Interference/Electromagnetic Compatibility test completed April 14
- Thermal vacuum testing beginning in June



Upcoming ESTO Launches

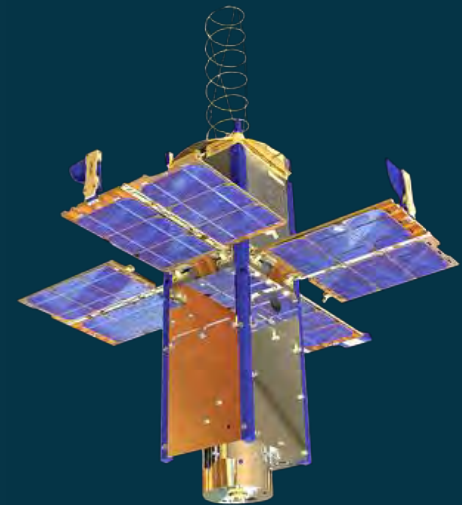


CTIM-FD: Compact Total Irradiance Monitor – Flight Demonstration

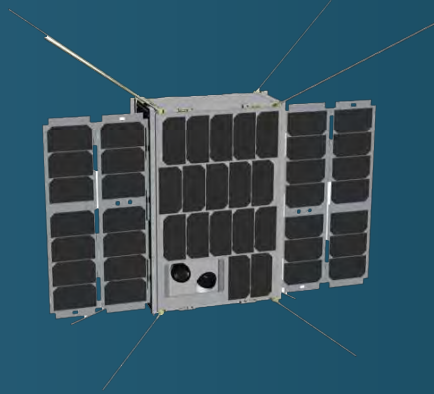
- Will demonstrate technology to enable the measurement of total solar irradiance from a CubeSat

NACHOS 2: NanoSat Atmospheric Chemistry Hyperspectral Observation System

- 3U-sized, ultra-compact, high-resolution hyperspectral imager for measuring atmospheric trace gases (NO_2 , SO_2 , O_3 , CH_2O and more)



Upcoming ESTO Launches

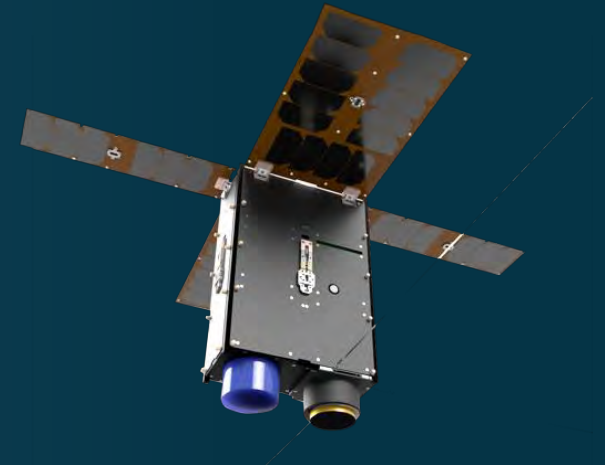


SNOOPI: Signals Of Opportunity P-band Investigation

- Will demonstrate technology to measure root zone soil moisture and snow water equivalent from a CubeSat

HyTI: Hyperspectral Thermal Imager

- Thermal infrared imager on a CubeSat with high-spatial, spectral, and temporal resolution, using onboard data processing



SNOOPI and HyTI have synergy of measuring closely coupled soil moisture and evapotranspiration