Earth Science and Applications

Using our unique expertise to better understand how Earth works as a system for the benefit of society

Water Cycle

Sea Level

Natural Hazards

Carbon Cycle

Weather and Air Quality

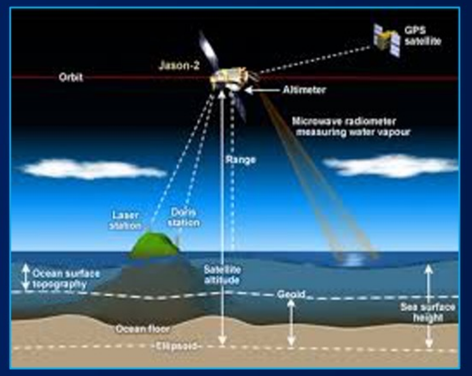
INNOVATE • IMPLEMENT • IMPACT

Jet Propulsion Laboratory
California Institute of Technology

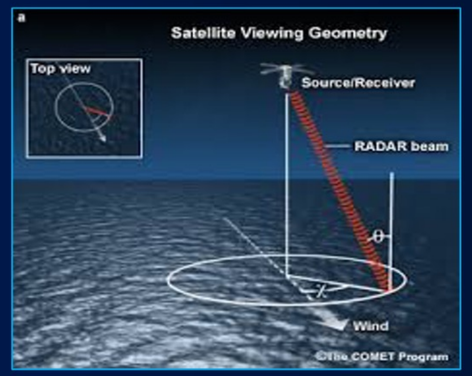
Authors: Duane Waliser & Jessica Neu

Four Decades of Innovation

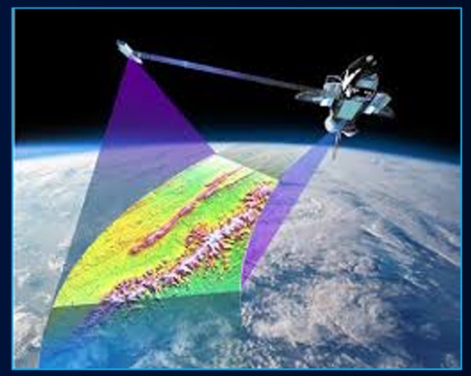
A SPECTRUM OF TOOLS



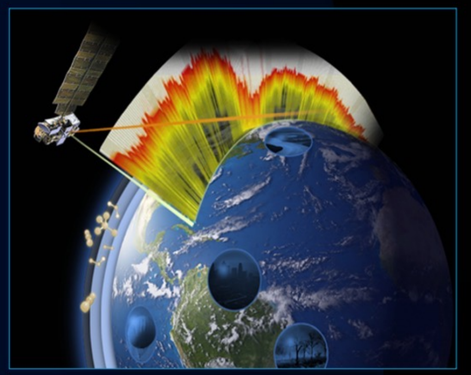
Sea Level Altimetry



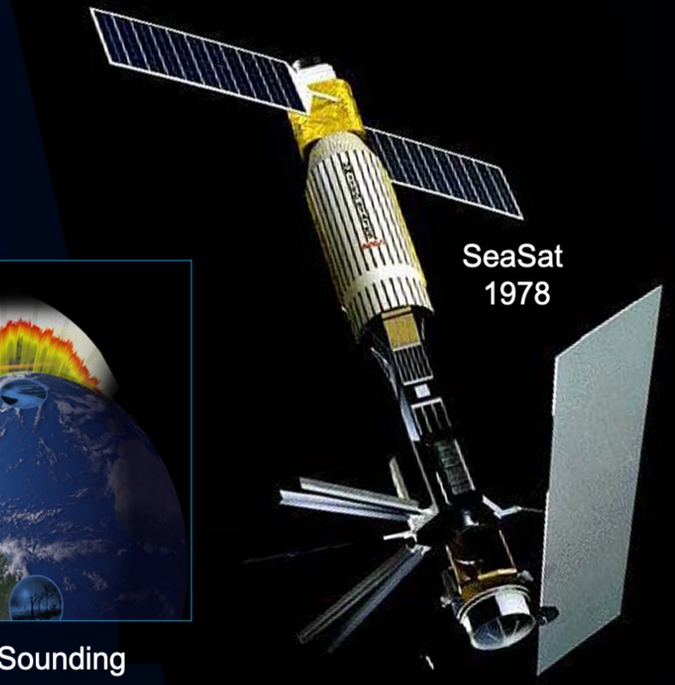
Ocean Wind Scatterometry

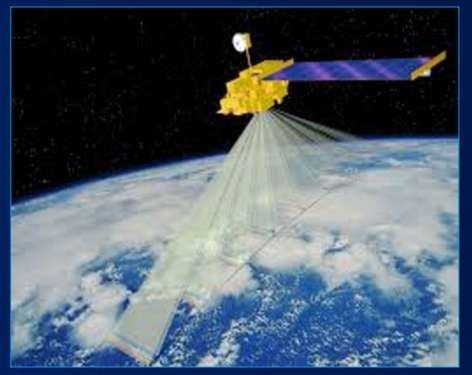


Radar for Surface Deformation

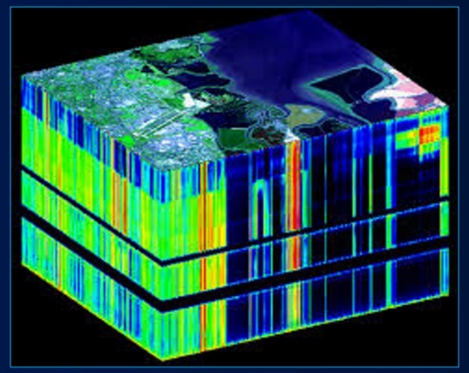


Atmospheric Sounding

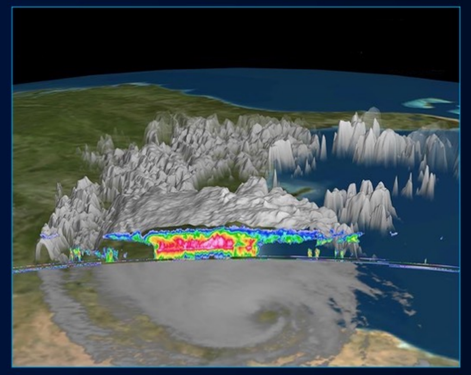




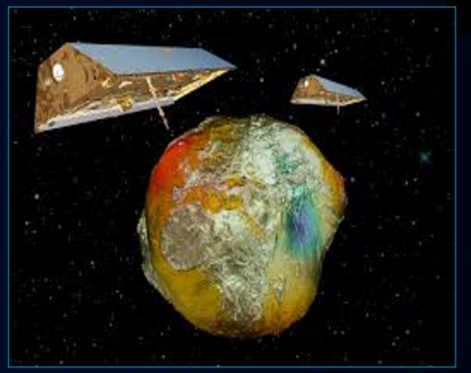
Multi-Angle Imagery



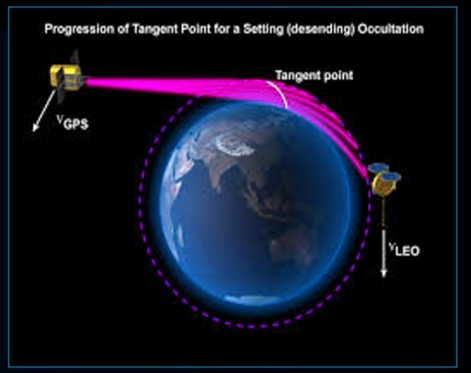
Imaging Spectroscopy



Cloud Radar



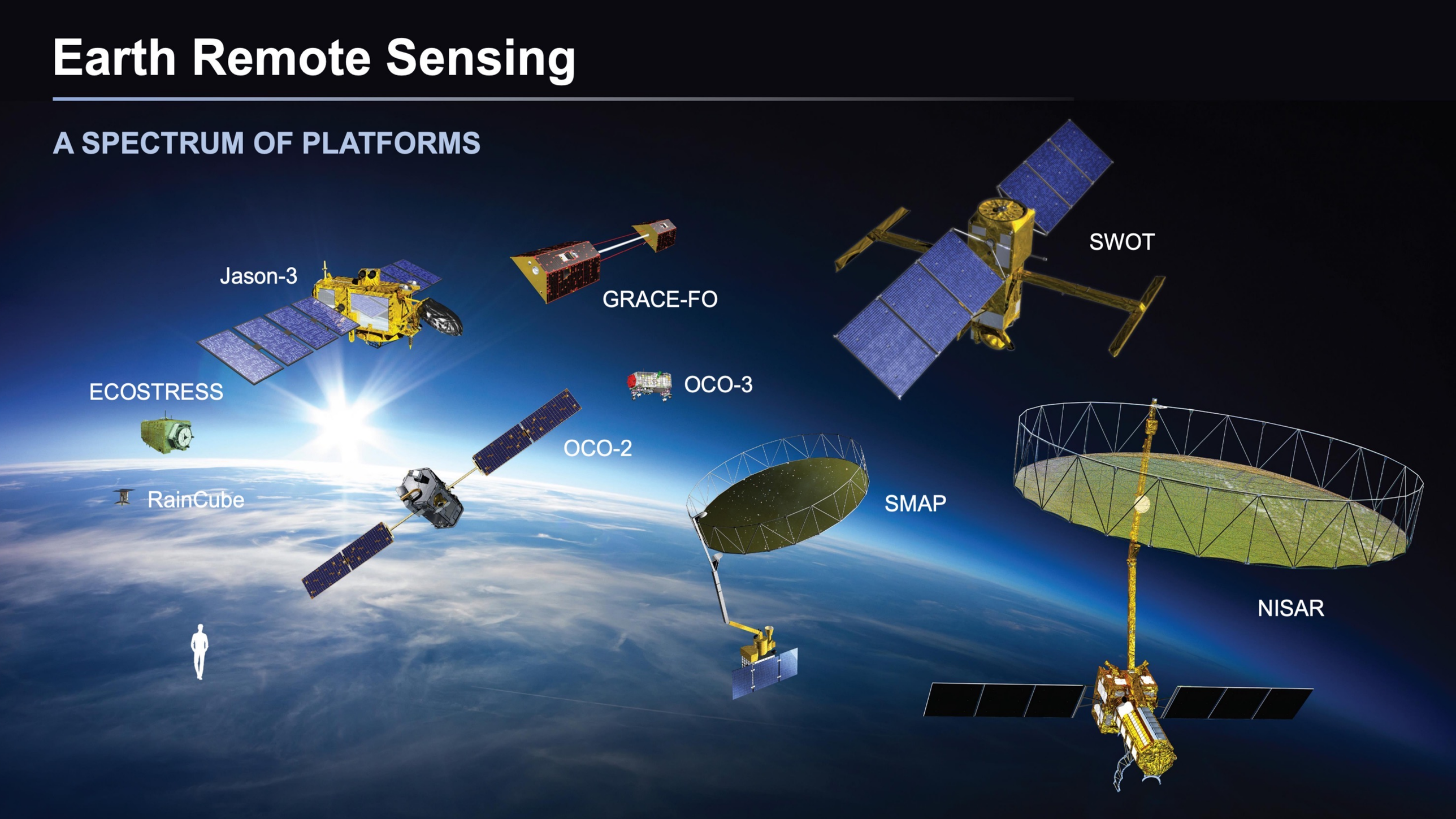
Gravity



Radio Occultation

Earth Remote Sensing

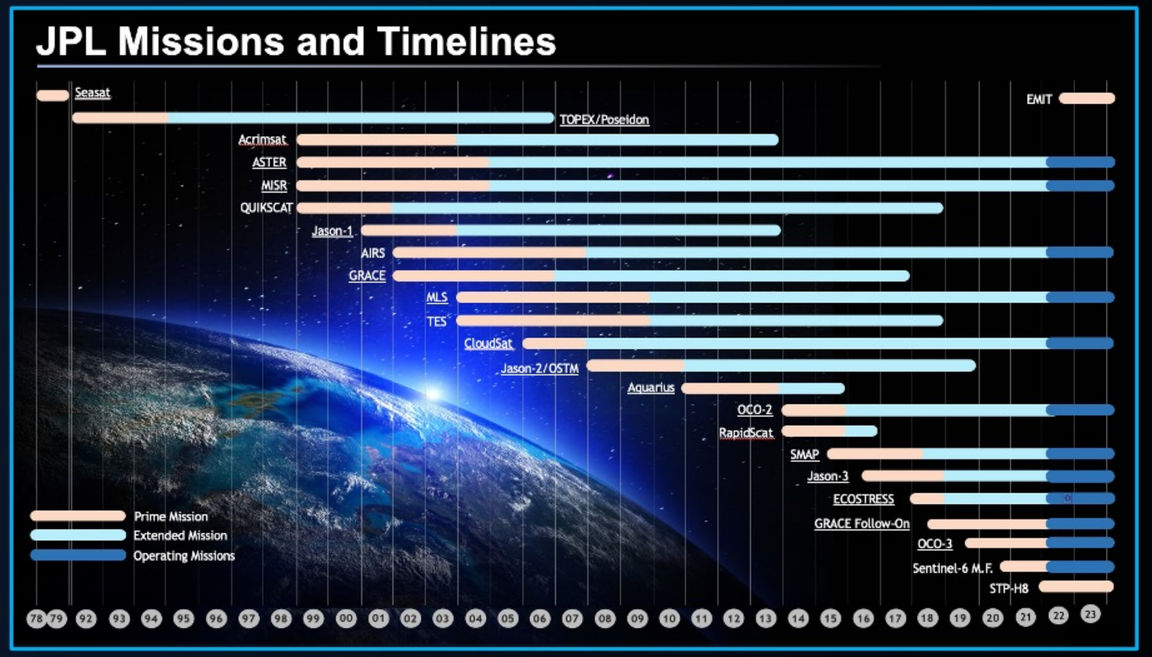
A SPECTRUM OF PLATFORMS



Successful Mission Implementation

PARTNERSHIPS AND EXPERTISE SPANNING FOUR DECADES OF EARTH OBSERVATIONS

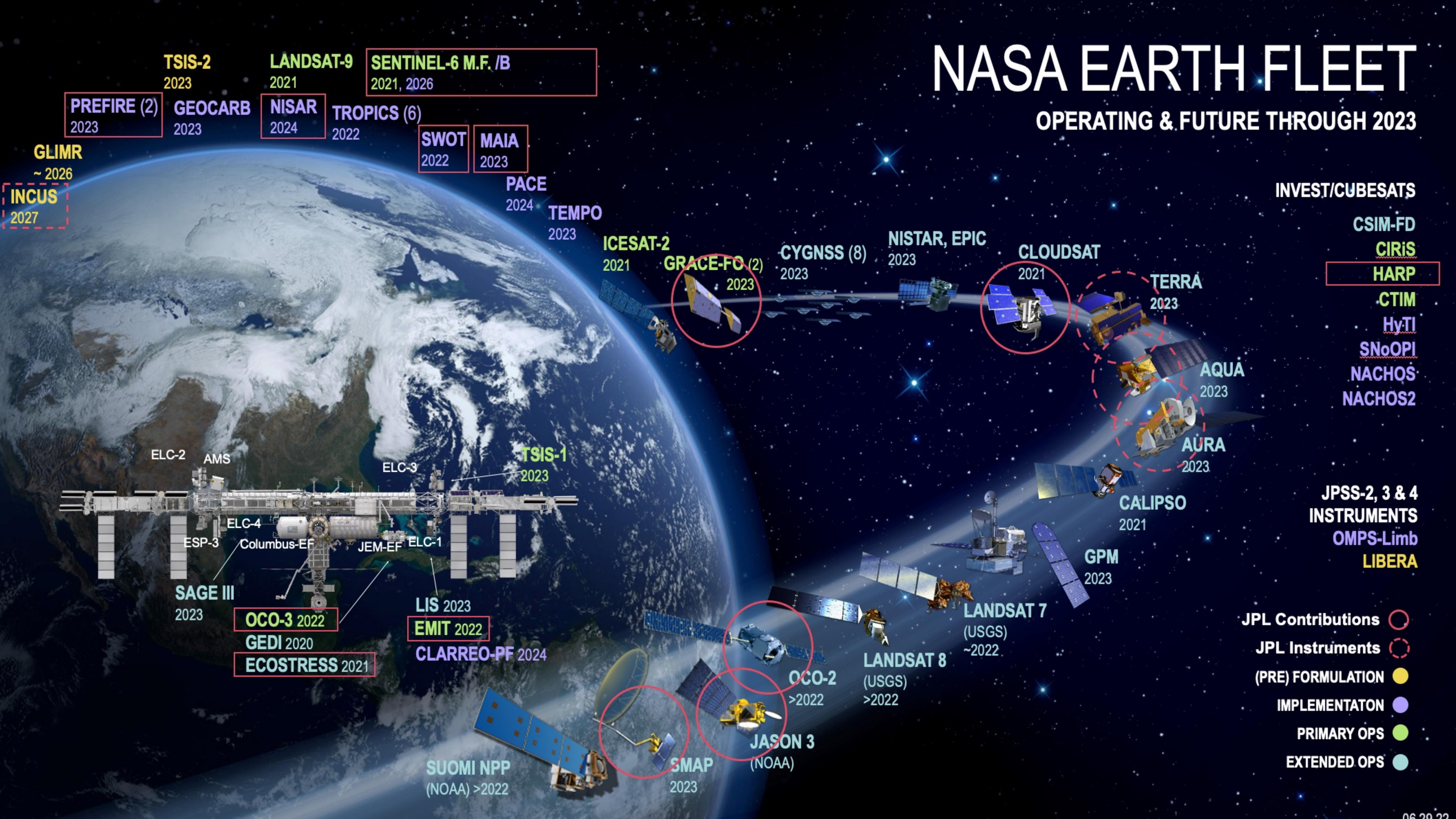
Major contributions to NASA's Earth observing fleet of satellites



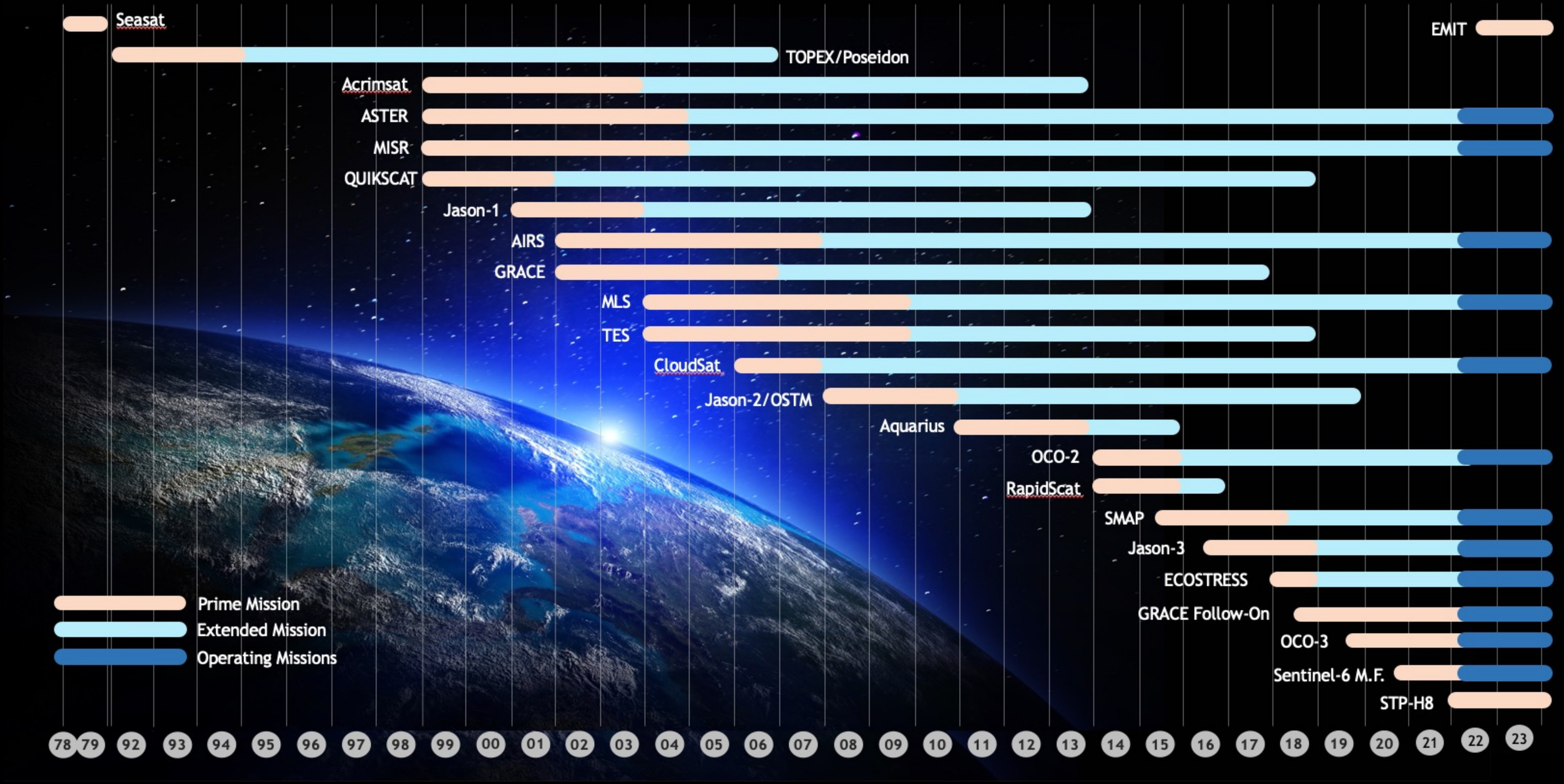
History of successful mission implementation and extended missions

International Partners

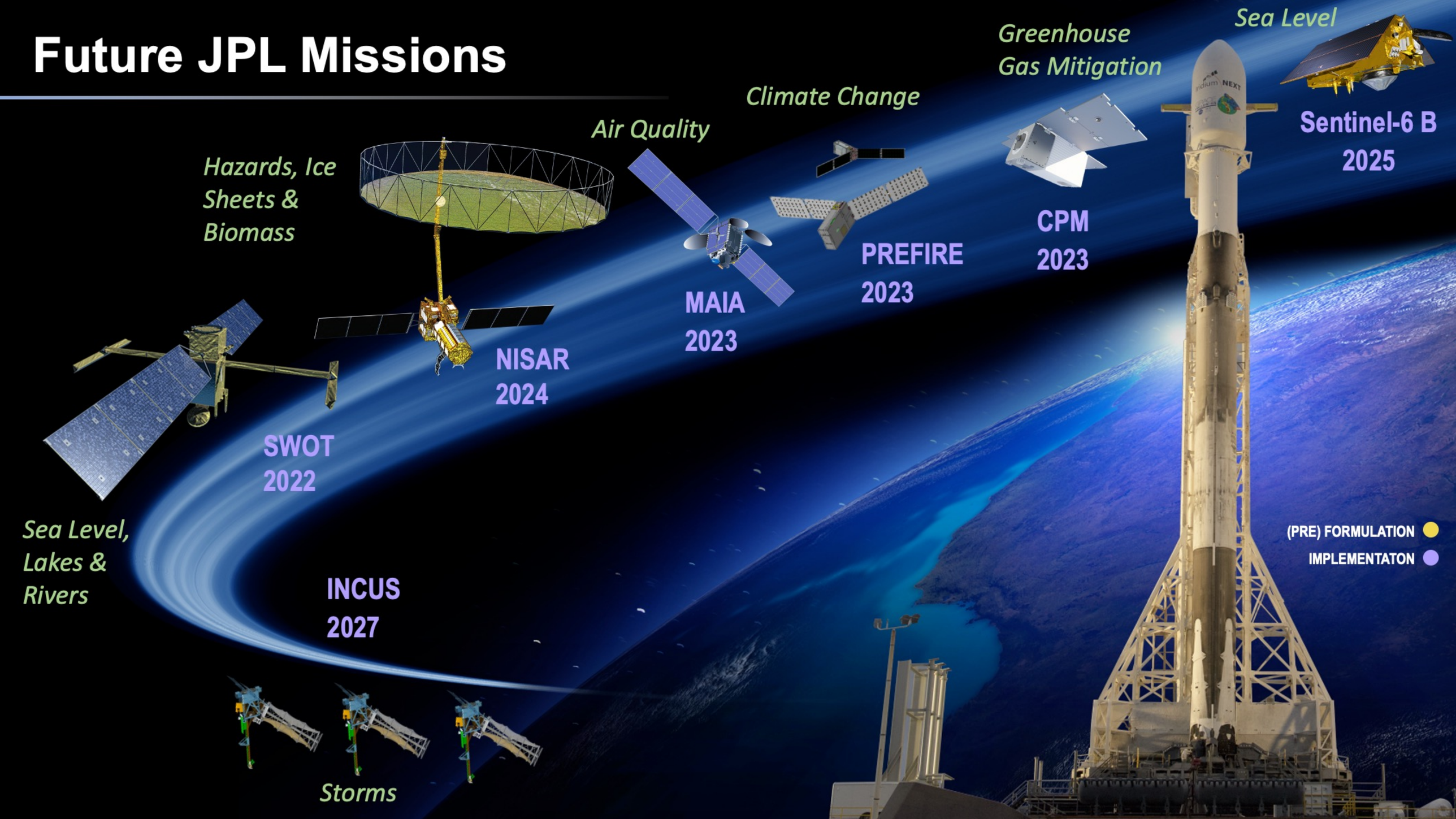
cnes · esa · DLR · JAXA · CSA ASC · इसरो isro · CONAE · GFZ


NASA EARTH FLEET
OPERATING & FUTURE THROUGH 2023
TSIS-2 2023
LANDSAT-9 2021
SENTINEL-6 M.F. /B 2021, 2026
PREFIRE (2) 2023
GEOCARB 2023
NISAR 2024
TROPICS (6) 2022
SWOT 2022
MAIA 2023
GLIMR ~ 2026
INCUS 2027
PACE 2024
TEMPO 2023
ICESAT-2 2021
GRACE-FO (2) 2023
CYGNSS (8) 2023
NISTAR, EPIC 2023
CLOUDSAT 2021
TERRA 2023
AQUA 2023
AURA 2023
CALIPSO 2021
GPM 2023
LANDSAT 7 (USGS) ~2022
LANDSAT 8 (USGS) >2022
OCO-2 >2022
JASON 3 (NOAA)
SMAP 2023
SUOMI NPP (NOAA) >2022
TSIS-1 2023
ELC-2
AMS
ELC-3
ELC-4
ESP-3
Columbus-EF
JEM-EF
ELC-1
SAGE III 2023
OCO-3 2022
GEDI 2020
ECOSTRESS 2021
LIS 2023
EMIT 2022
CLARREO-PF 2024
INVEST/CUBESATS
CSIM-FD
CIRiS
HARP
CTIM
HyTI
SNoOPI
NACHOS
NACHOS2
JPSS-2, 3 & 4 INSTRUMENTS
OMPS-Limb
LIBERA
JPL Contributions
JPL Instruments
(PRE) FORMULATION
IMPLEMENTATON
PRIMARY OPS
EXTENDED OPS

JPL Missions and Timelines



Future JPL Missions

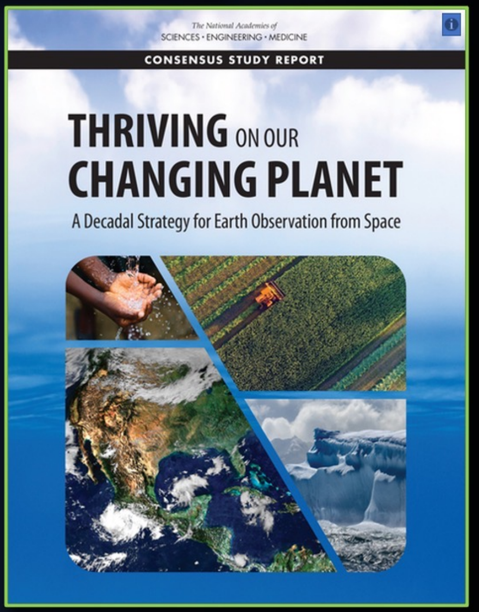


Mission Impacts

ENABLING FUNDAMENTAL ADVANCES IN EARTH SCIENCE

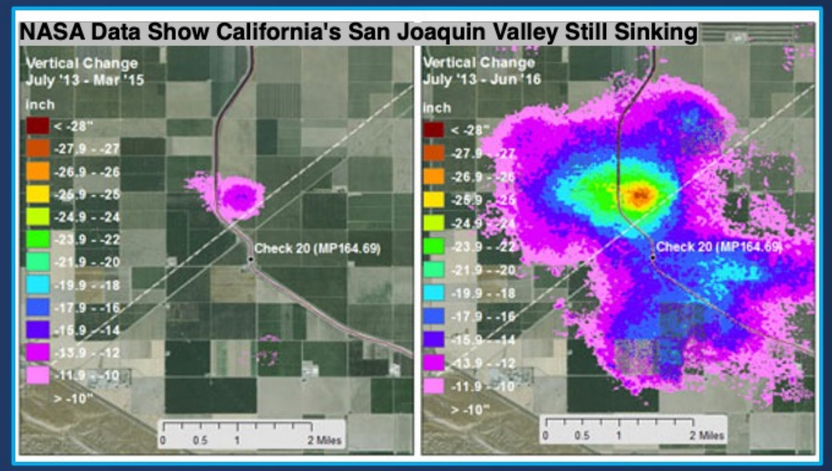
- Peer-reviewed science publications
  - > 400 publications/year involving JPL scientists
  - > 1000 publications/year based on JPL missions
- Training next generation Earth Science leaders
  - ~50 postdoctoral scientists
  - Over 700 summer interns annually
- Participation in the National Academy of Science and Engineering studies

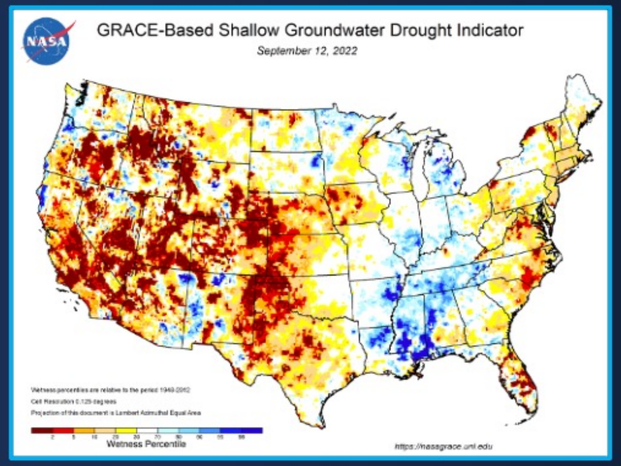
Diversity & Inclusion at JPL

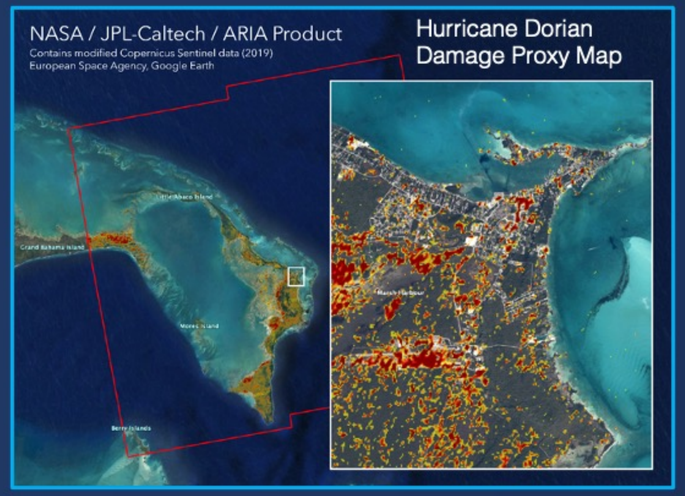


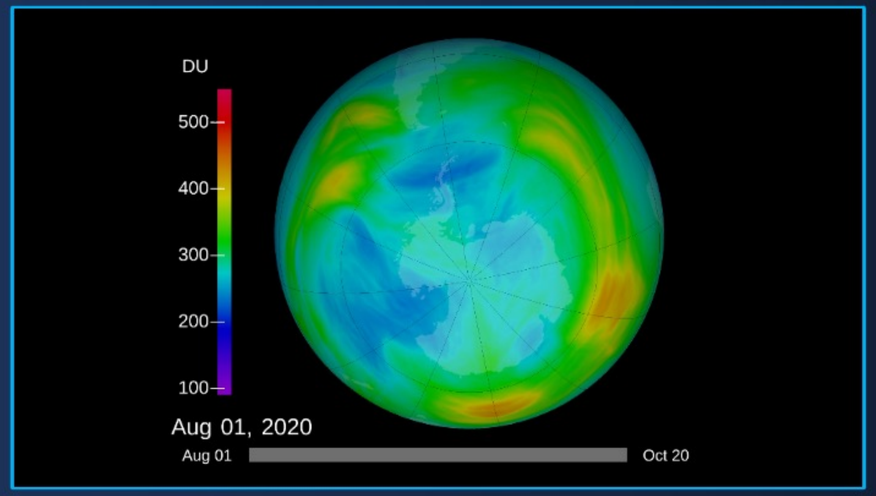
Mission Impacts

APPLYING OBSERVATIONS FOR REAL WORLD BENEFITS







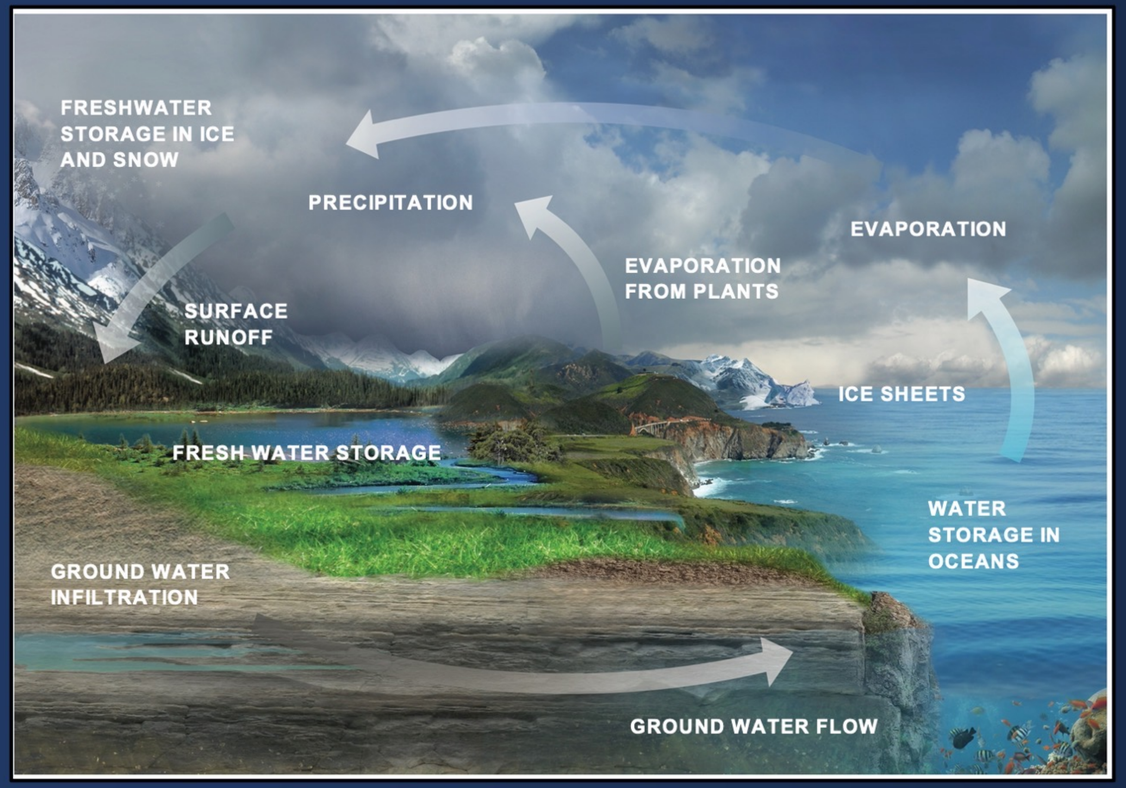


- FEMA and U.S. Homeland Security
- National Drought Monitor
- California Seismic Safety Commission
- World Meteorological Organization (WMO)
- National Climate Assessment
- California Department of Water
- Contributor to the IPCC Assessments

Water Cycle

DEVELOP AND ENABLE PREDICTIONS FOR REGIONAL WATER SHORTAGES

INNOVATE • IMPLEMENT • IMPACT



Challenge

Develop useful predictions of regional water shortages for lead times from weeks to years

Approach

- Design and build first-of-a kind instruments/satellites
- Measure the components of the Earth's water cycle
- Understand and model the flow of water through the Earth system
- Develop integrated programmatic approach between science and engineering
- Partner with international, federal, state and local agencies to improve predictions of water

Satellite Missions

GRACE-FO, SMAP, ECOSTRESS, SWOT, AIRS, CloudSat, Jason-2/3, NISAR

Other Activities

Western Water Applications Office

Weather and Air Quality

ENABLE IMPROVEMENTS IN WEATHER FORECASTS AND AIR QUALITY ATTRIBUTION & FORECASTS

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Other Activities

Cubesats (RainCube, Tempest-D), FIREX-AQ, atmospheric composition state and flux estimates, A-CCP Designated Observable Study, PBL Incubation Study, HAQAST, Subseasonal Atmospheric River Forecast Development.

Challenge

Increase the lead-time and accuracy for weather (Wx) for safeguarding life and property, and provide accurate air quality (AQ) attribution to improve health and environmental conditions.

Approach

- Develop new remote sensing capabilities to characterize atmospheric physical and chemical processes.
- Develop and improve data assimilation methods to better exploit Wx and AQ relevant satellite observations.
- Use these capabilities to enable more skillful Wx and AQ forecasts and improve AQ attribution to inform adaptation and mitigation efforts.

Satellite Missions

AIRS, GNSS-RO, MISR, Quikscat, MLS, RapidScat, SMAP, CloudSat, TES, MAIA

Sea Level

IMPROVE PREDICTIONS OF SEA LEVEL NEAR URBAN POPULATIONS

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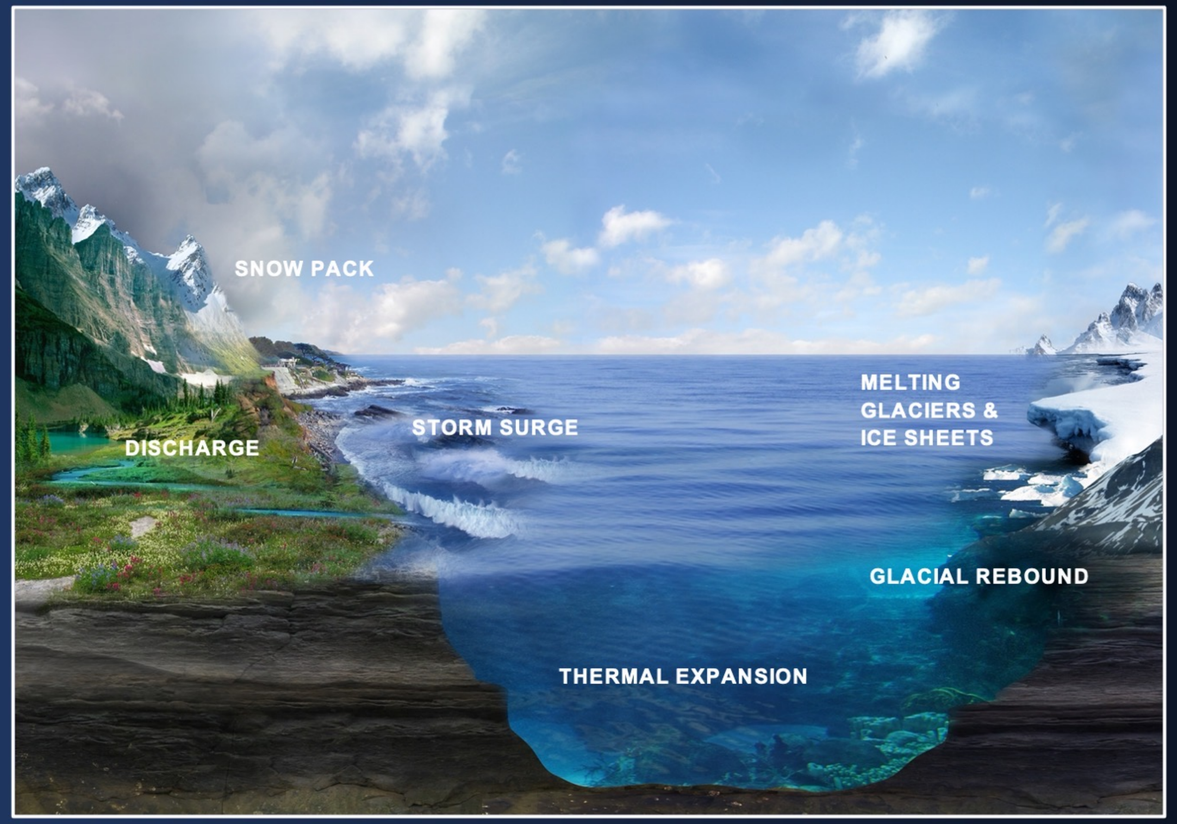

Challenge

Improve long-term projections of regional sea level rise to help mitigate the consequences to urban populations

Approach

- Measure global sea level variations, maintaining a record for continuity
- Develop measurement capabilities for regional sea level variations and rise
- Identify contributing processes to global and regional sea level variations
- Partner to improve predictions of sea regional level variations and global sea level rise

Satellite Missions

Jason-2/Jason-3, GRACE-FO, NISAR, SWOT

Other Activities

NASA Sea Level Portal, Oceans Melting Greenland, Delta-X

Natural Hazards

INCREASE DECISION SUPPORT INFORMATION FOR NATURAL HAZARD RESPONSE

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Challenge

Develop forecast potential for natural hazard events and improve our capabilities for hazard response and preparedness

Approach

- Measure changes over the Earth surface to identify and characterize earthquakes, volcanoes, landslides, wild fire, etc.
- Improve our physical understanding of the Earth surface process to better model and predict natural hazards when/where possible
- Develop and provide decision support products for natural hazards preparation and response

Satellite Missions

GRACE-FO, ECOSTRESS, SWOT, NISAR, MISR, TES, EMIT

Other Activities

Advanced Rapid Image Analysis (ARIA)

Carbon and Ecosystems

PROVIDE ESTIMATES AND PROJECTIONS OF THE CARBON CYCLE AT DECISION-RELEVANT SCALES

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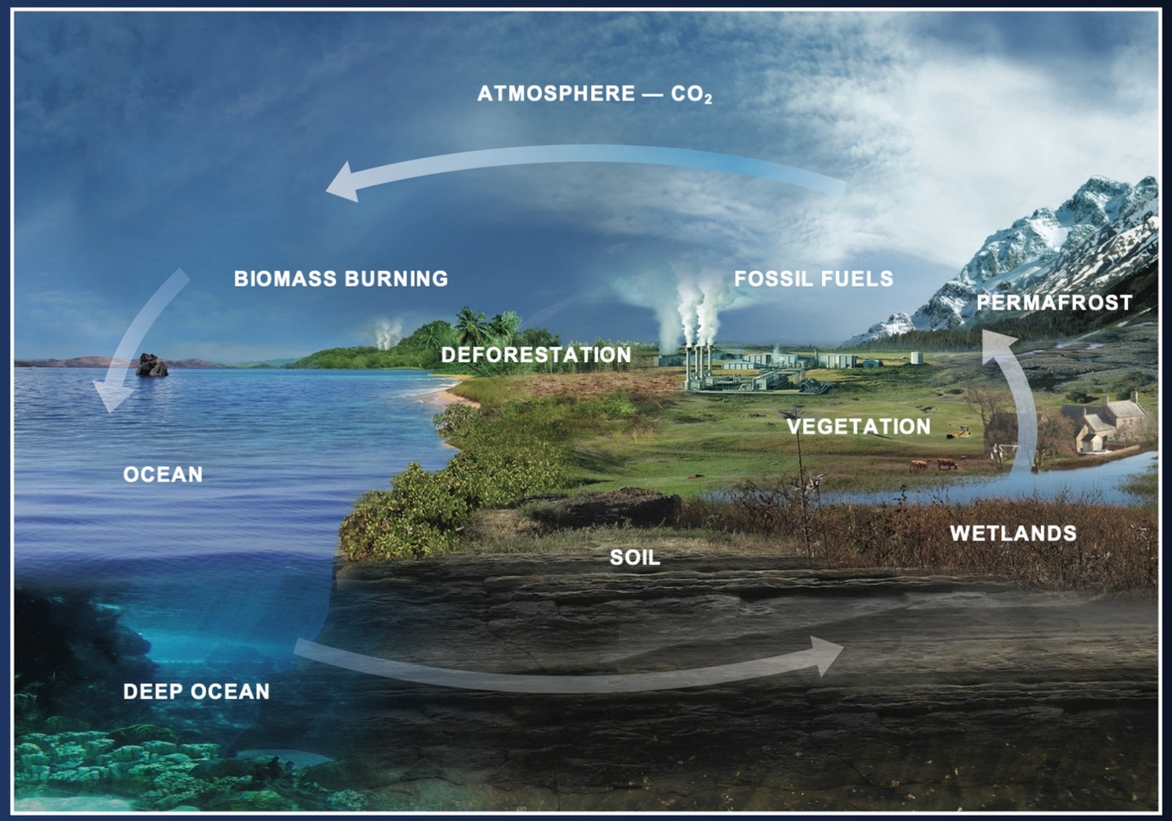

Challenge

Provide actionable estimates and projections of the global carbon system, considering natural ecosystems and anthropogenic emissions

Approach

- Measure the components of the Earth's carbon cycle
- Understand and model the flow of carb on through the Earth system
- Partner to develop predictions of land, ocean and atmospheric carbon for decision-relevant scales (e.g. seasonal to decadal)

Satellite Missions

OCO-2, OCO-3, ECOSTRESS, TES, SMAP, NISAR

Other Activities

Carbon Management System, California Methane Survey, CORAL, Delta-X