Demand for accurate, timely, and actionable knowledge is more pressing than ever.
Atmospheric Composition
Carbon Cycle and Ecosystems
Climate Variability and Change
Earth Surface and Interior
Water and Energy Cycle
Weather and Atmospheric Dynamics
Earth System Science Informs Global and Regional Solutions

- Food Security and Water Management
- Sea Level Rise Mitigation
- Economic Prosperity
- Natural Hazard Warning and Recovery
2017 Earth Science Decadal Survey

- A guiding framework for space-based Earth science
- Emphasizes partnerships and innovation
- Identifies key questions and observations for:
  - Climate variability and change
  - Weather and air quality
  - Hydrogeological cycles and water resources
  - Ecosystems and natural resource management
  - Solid Earth dynamics and hazards
Advancing Earth System Science End-to-end
EARTH SYSTEM OBSERVATORY

SURFACE BIOLOGY AND GEOLOGY
Earth Surface & Ecosystems

SURFACE DEFORMATION AND CHANGE
Earth Surface Dynamics

CCP

CLOUDS, CONVECTION AND PRECIPITATION
Water and Energy in the Atmosphere

AEROSOLS
Particles in the Atmosphere

MASS CHANGE
Large-scale Mass Redistribution
INNOVATION & COMPETITION
Earth Explorer Missions

- Snow Depth and Water Content
- 3D Ecosystem Structure
- Ocean Surface Winds and Currents
- Greenhouse Gases
- Ozone and Trace Gases
- Atmospheric Winds
- Ice Elevation
Integrate observations and advance modeling to advance our understanding of the whole Earth system.
Accelerate the uptake of scientific understanding and deliver information in scalable ways.
Urgency Demands Action and Innovation

COMMERCIAL PARTNERSHIPS

OPEN SCIENCE AND A DIVERSE, INCLUSIVE WORKFORCE

U.S. GOVERNMENT PARTNERSHIPS

INTERNATIONAL PARTNERSHIPS
Two CubeSat missions successfully completed in 2020:

- Test and validate new space-based observing technologies
- CubeRRT demonstrated real-time RFI processing from space (reducing volume of data transmitted to ground)
- RainCube demonstrated first-use of radar on a CubeSat and validated Ka-band precipitation radar, and use of an ultra-compact, deployable antennae
Principles of Commercial Partnerships

• Strategic partnerships that leverage unique strengths to drive scientific progress
• Partnerships that innovate both in what we do with commercial partners and how we do it
• Evolving partnership models: experimentation is key and some experiments may fail
• Traditional and non-traditional partnerships for success in “enabling new science” and “more science per dollar”
• Leverage existing commercial capacity, demand, and expertise, while exploring emerging business areas
• Build on investments in partnerships across NASA and other parts of the government, sharing our own best practices

The SpaceX Falcon 9 rocket carrying the Sentinel-6 Michael Freilich spacecraft lifts off from Space Launch Complex 4 at Vandenberg Air Force Base in California, Nov. 21, 2020
Develop Open Science Ecosystem

**Shorten the time** it takes for a new user to find and learn how to use data

- Open access, availability, and discoverability of data

**Increase the community** of hands-on contributions

- Open access to and advancement of modeling and simulation code
- To improve models, assimilation, and prediction tools

**Explore and exploit data** in new ways

- Share knowledge and use current informatics and data science tools, in the same ecosystem as the data

**Incentivize and energize** innovation through prizes and challenges
ESD Priorities: Excellence in Earth Science

- **Dramatically advance our understanding of the Earth system** from vantage points of space, airborne and surface observations.

- **Initiate the Earth System Observatory, NASA’s next-gen advanced spaceborne systems**, to explore interactions between atmosphere, land, ocean, and ice processes that define climate change at regional and local levels, on near- to long-term time scales.

- **Launch the competitive Earth Explorer program** to rapidly develop innovative ways of observing additional key climate variables (greenhouse & trace gases, ice elevation & forest biomass), complementing the Observatory.

- **Accelerate the pace of scientific discovery and its practical utility to decision-makers** through Open Science principles and practices.

- Build a more **prepared and capable workforce**, and **meet the challenges of climate change in long-overlooked communities**, by expanding our Diversity and Inclusion efforts.
NASA Earth Observing Satellites Since 1958

Questions?