

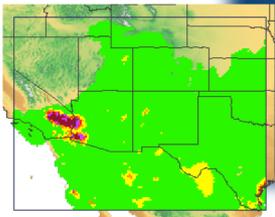
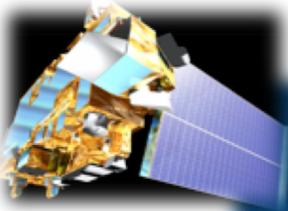
## How USGS, NOAA, and NASA Increase the Use and Value of Earth Science Data and Information

# Data in Action: Increasing the Use and Value of Earth Science Data and Information

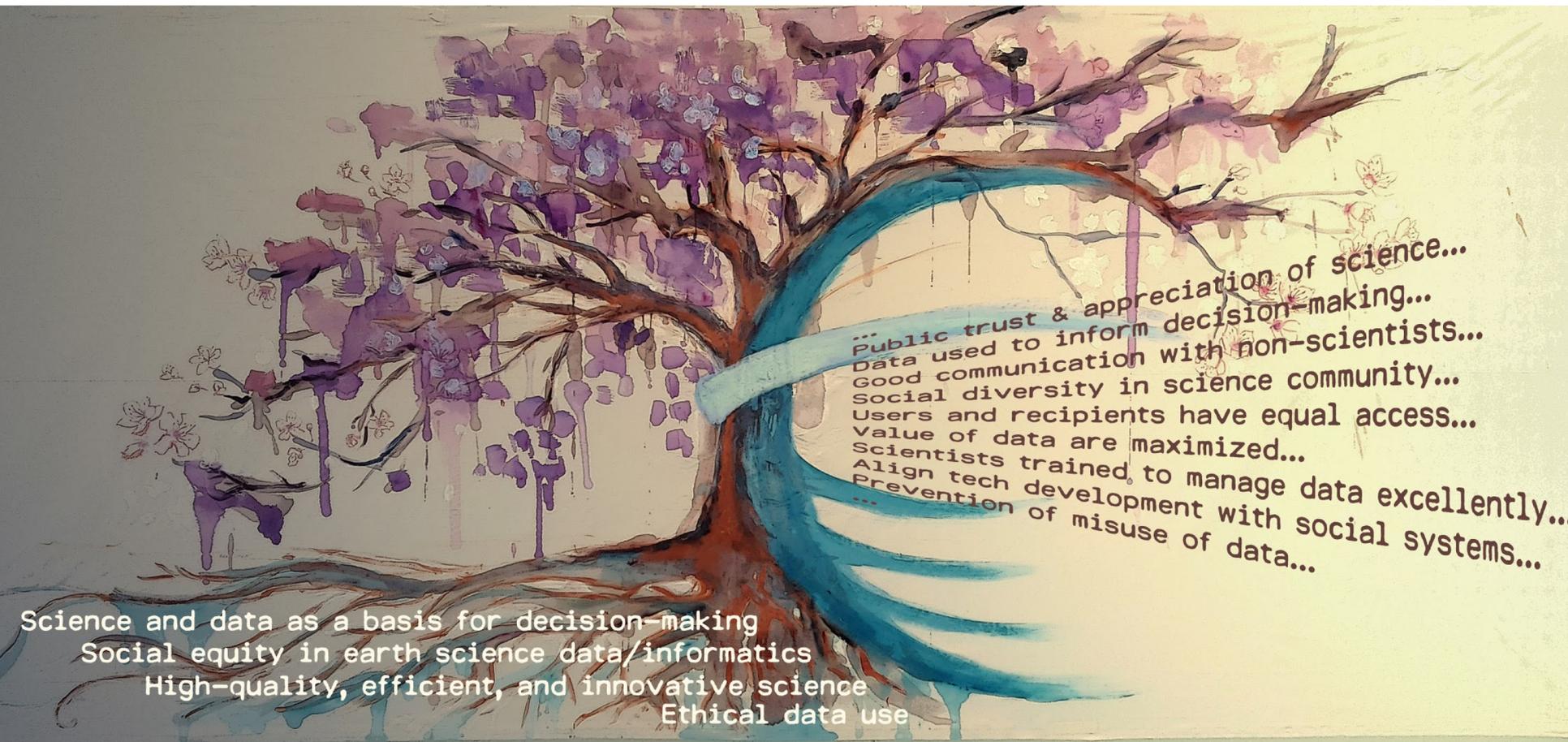
March 22, 2019 | Webinar #1

- **ESIP'S Value**

***ESIP helps members of the Earth Science data community find each other across organizations by fostering rich collaborative experiences like meetings and seed funding to further data interoperability***



# 20 Years of Making Data Matter, Together



- ... Public trust & appreciation of science...
- Data used to inform decision-making...
- Good communication with non-scientists...
- Social diversity in science community...
- Users and recipients have equal access...
- Value of data are maximized...
- Scientists trained to manage data excellently...
- Align tech development with social systems...
- ... Prevention of misuse of data...

Science and data as a basis for decision-making  
Social equity in earth science data/informatics  
High-quality, efficient, and innovative science  
Ethical data use

# ESIP Shared Agenda

## 2016-2020 Strategic Plan

- **Increase the use** and value of Earth science data and information. (2019)
- **Strengthen the ties** between observations and user communities (2017)
- Promote techniques to **articulate and measure the socioeconomic value** and benefit of Earth science data, information, and applications. (2018)
- **Position ESIP** to play a major role in Earth science issues (Secondary focus all four years).

## Values

Agile | Collaborative | Collegial | Community-driven | Innovative  
Neutral | Open | Participatory | Voluntary



## How USGS, NOAA, and NASA Increase the Use and Value of Earth Science Data and Information



**Sky Bristol**  
Biogeographic  
Characterization Branch  
Chief, USGS



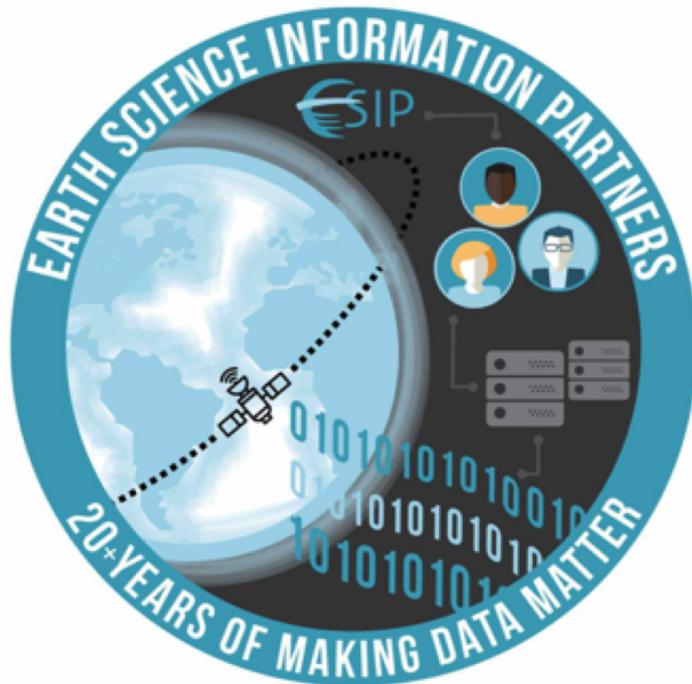
**Ed Kearns**  
Chief Data Officer,  
NOAA



**Kevin Murphy**  
Program Executive for  
Earth Science Data  
Systems, NASA



# Speaker Presentations



## Data in Action: Increasing the Use and Value of Earth Science Data and Information

March 22, 2019 | Webinar #1



## How the USGS Increases the Use and Value of Earth Science Data and Information



**Sky Bristol**  
Biogeographic  
Characterization Branch  
Chief, USGS

# State of the Federation USGS

March 22, 2019



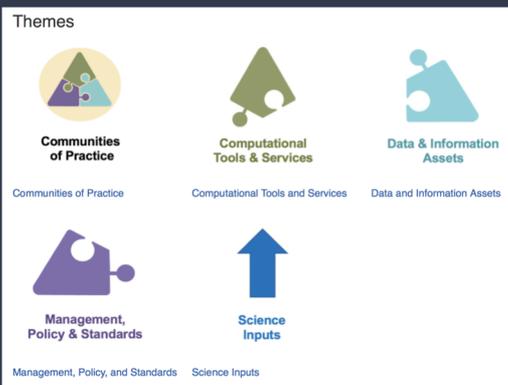
# ESIP Cooperative Agreement



- USGS continues to see investment (people and funding) in ESIP as a great benefit to our mission and a key enabler
- We operate a Cooperative Agreement with ESIP under a DOI legal authority - funded via the Biogeographic Characterization Branch, Science Analytics and Synthesis, Core Science Systems
  - Successfully “attracted” funding contributions from other groups in USGS
- In third funding year of a 3 year agreement with FY2019 funding covering work into 2020
- New longer term cooperative agreement in the works

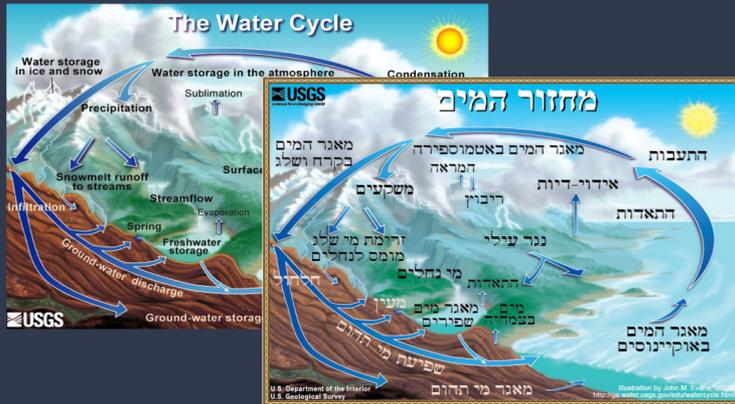


# Community for Data Integration



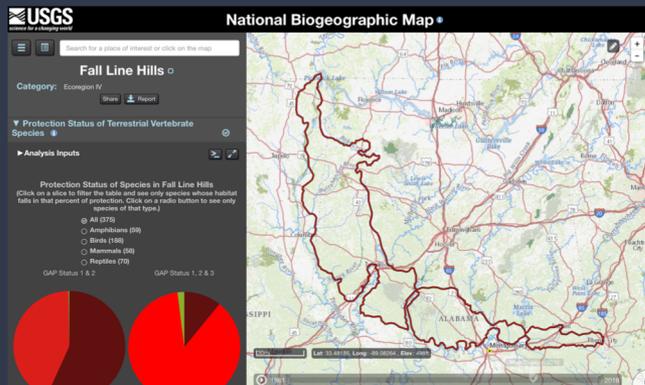
- Increased cross-pollination between ESIP and USGS CDI thanks to dedicated coordination efforts from Leslie Hsu working with ESIP org folks
- CDI continues to fund key innovative development efforts in data integration and synthesis and emerging technologies
- 2019 CDI Workshop
  - ***From Big Data to Smart Data***
  - **June 4-7, 2019, NCAR/UCAR Center Green Campus, Boulder, Colorado**

# Broader USGS Goings On



- USGS continues to play our major role in providing unbiased science and robust data to protect and enhance prosperity and wellbeing of the planet
  - Floods, earthquakes, and other acute and chronic hazards monitoring and response
  - Advances in invasive species and wildlife disease early detection, rapid response
  - Energy and mineral assessments of import to national prosperity and national security
- Program restructuring to better anticipate needs over the next 100 years
  - Includes relocating many headquarters functions to the West

# Projects I'm Excited About



- Redesigned infrastructure for a National Digital Catalog of physical collections across USGS, State Geological Surveys, and other organizations
- USGS National Biogeographic Map as a framework for decision analysis
- Major advances in marine biological observation data integration in the US and internationally
  - NOAA-IOOS, BCO-DMO, USGS partnerships
  - Robust online APIs
  - Essential Ocean Variables for Biodiversity and UN Sustainable Development Goals
- Systematic monitoring of the scientific literature stream and knowledge assembly methods
- Co-developing a vision for expressing the ecological and conservation values of Tribal lands, indigenous knowledge, and management policies



## How NASA Increases the Use and Value of Earth Science Data and Information



**Kevin Murphy**  
Program Executive for  
Earth Science Data  
Systems, NASA



# Earth Science Data Systems Update

Kevin Murphy

22 March 2019

# NASA/ESD Appropriation: FY19

- FY19 (1 Oct 2018 – 30 Sept 2019) funding approximately at the FY17/FY18 level (~\$1.93B)
  - Continues operations and development of FY18 Program of Record (including DSCOVR EPIC/NISTAR, PACE, CLARREO-PF, OCO-3 (to launch NET April 25))
  - Supports DO study activities, EVC-1 solicitation, and incubation planning
  - Supports ongoing operations and evolution of data systems

# NASA Earth Science Missions: Present through 2023

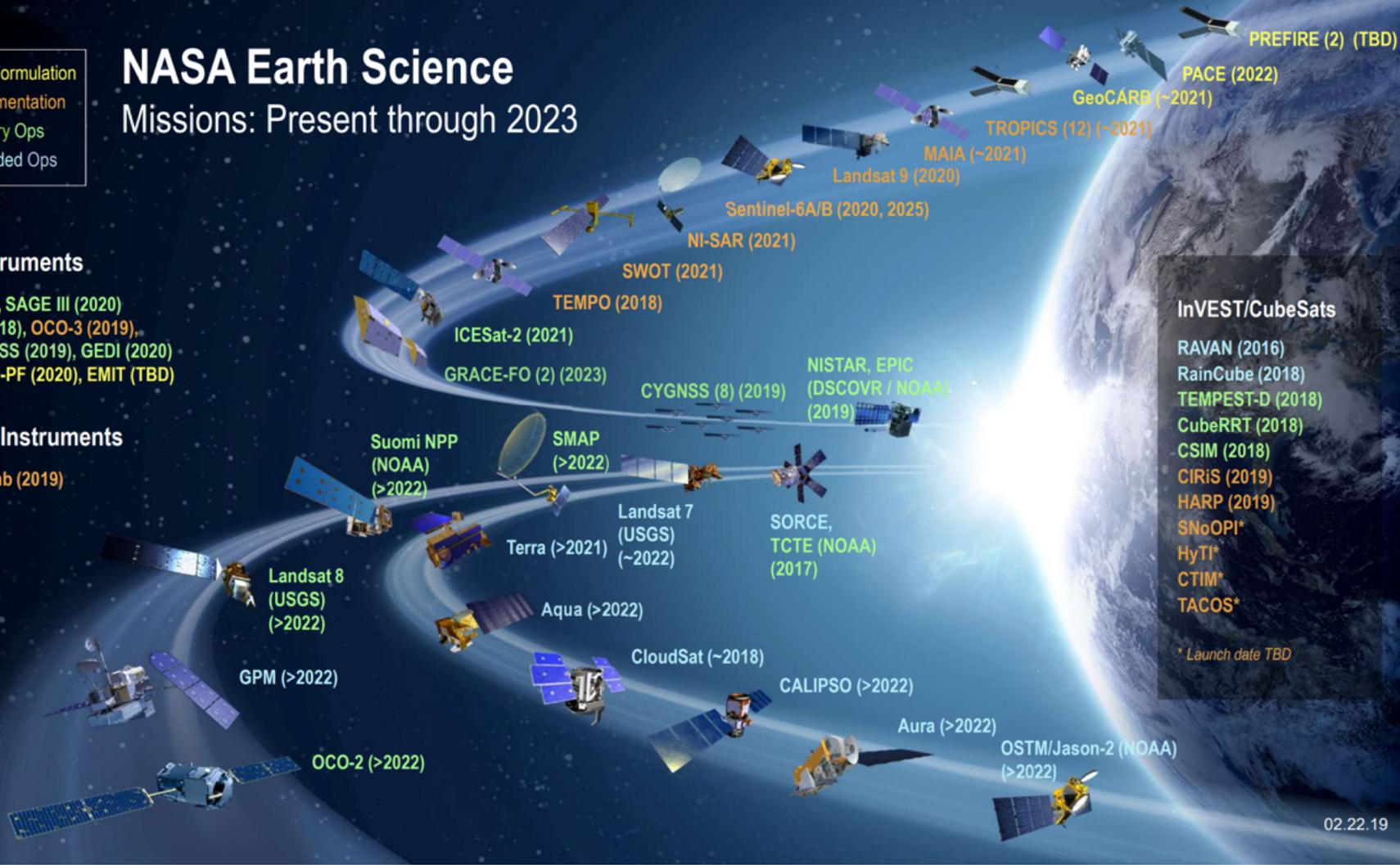
- (Pre)Formulation
- Implementation
- Primary Ops
- Extended Ops

## ISS Instruments

LIS (2020), SAGE III (2020)  
 TSIS-1 (2018), OCO-3 (2019),  
 ECOSTRESS (2019), GEDI (2020)  
 CLARREO-PF (2020), EMIT (TBD)

## JPSS-2 Instruments

OMPS-Limb (2019)



## Invest/CubeSats

- RAVAN (2016)
- RainCube (2018)
- TEMPEST-D (2018)
- CubeRRT (2018)
- CSIM (2018)
- CIRIS (2019)
- HARP (2019)
- SNoOPI\*
- HyTI\*
- CTIM\*
- TACOS\*

\* Launch date TBD

02.22.19

# Recent ESD Launches

**ICESat-2**



**September 2018**

**ICESat-2**

*Quantify polar ice-sheet contributions to sea-level change & measure vegetation canopy height as a basis for estimating large-scale biomass and biomass change*

**GED1**

*Characterize the effects of changing climate and land use on ecosystem structure and dynamics, providing the first global, high-resolution observations of forest vertical structure*

**GED1**



**November 2018**

# Planned for Launch in 2019

OCO-3



February 2019

OCO-3

*Investigate important questions about the distribution of carbon dioxide on Earth as it relates to growing urban populations and changing patterns of fossil fuel combustion.*

# Earth Science Division's Venture Opportunities

**EVS**  
Sustained Sub-Orbital  
Investigations  
(~4 years)

**EVM**  
Complete, self-  
contained, small  
missions  
(~4 years)

**EVI**  
Full function, facility-class  
instruments Missions of  
Opportunity (MoO)  
(~18 months)

| Mission                 | Mission Type   | Release Date | Selection Date | Major Milestone   |
|-------------------------|--|--------------|----------------|-------------------|
| EV-1, aka EVS-1         | 5 Suborbital Airborne Campaigns                        | 2009         | 2010           | N/A               |
| EVM-1, CYGNSS           | Smallsat constellation                                 | 2011         | 2012           | Launched Dec 2016 |
| EVI-1, TEMPO            | Geosynchronous hosted payload                          | 2011         | 2012           | Delivery NLT 2017 |
| EVI-2, ECOSTRESS & GEDI | Class C & Class D ISS-hosted Instruments               | 2013         | 2014           | Delivery NLT 2019 |
| EVS-2                   | 6 Suborbital Airborne Campaigns                        | 2013         | 2014           | N/A               |
| EVI-3, MAIA & TROPICS   | Class C LEO Instrument & Class D Cubesat Constellation | 2015         | 2016           | Delivery NLT 2021 |
| EVM-2, GeoCarb          | Geostationary hosted payload                           | 2015         | 2016           | Launch ~2021      |
| EVI-4, EMIT, PREFIRE    | Instrument Only  | 2016         | 2017           | Delivery NLT 2021 |
| EVS-3                   | Suborbital Airborne Campaigns                          | 2017         | 2018           | N/A               |
| EVI-5                   | Instrument Only  | 2018         | 2019           | Delivery NLT 2023 |
| EVC-1                   | Radiation Budget Measurement                           | 2018         | 2019           | Delivery NLT 2024 |
| EVM-3                   | Full Orbital   | 2019         | 2020           | Launch ~2025      |
| EVS-4                   | Suborbital Airborne Campaigns                          | 2021         | 2022           | N/A               |
| EVI-6                   | Instrument Only  | 2020         | 2021           | Delivery NLT 2026 |
| EVC-2                   | Continuity Measurement                                 | 2021         | 2022           | Delivery NLT 2027 |

5 investigations  
selected for EVS-3

Open solicitation - In Review  
Completed solicitation

# Private Sector Small-Satellite Constellation Pilot - Update

- Awarded contracts to three companies to buy **existing** data products related to ECVs, derived from private sector-funded small-satellite **constellations** (3-satellite minimum constellation, full longitude coverage); **for evaluation by NASA researchers to determine value** for advancing NASA research and applications activities and objectives;
  - Planet – three satellite constellations including 200+ satellites supplying imagery and derived products over the entire Earth
  - DigitalGlobe – operates five satellite constellations that provide very high-resolution (31-50-cm) images
  - Spire – constellation of 48 satellites collecting Radio Occultation soundings and ship reports
- Provides a cost-effective means to augment and complement the suite of Earth Observations
- Acquires data sets, and information products and associated meta-data, through industry partners
- **Have engaged broad set of ESD-funded researchers who will assess the value of the geophysical information in the data products for advancing NASA research and applications objectives**
  - 1 year evaluation period
  - Participants primarily chosen from existing ESD-funded community – evaluation support as budget augmentation
  - Written reports to ESD (not scientific papers)
  - Quality of geophysical information
  - Data availability (latency) and subdistribution rights vs. cost
  - Vendor plans for constellation maintenance/evolution
- Expect on-ramps in the future

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# Decadal Survey

- ESD is actively developing plans for addressing the Decadal Survey Recommendations



## Recommended NASA Flight Program Elements

**Program of Record.** The series of existing or previously planned observations, which **should be completed as planned**. Execution of the ESAS 2017 recommendation requires that the total cost to NASA of the Program of Record *flight missions from FY18-FY27 be capped at \$3.6B*.

- **Designated.** A new program element for ESAS-designated cost-capped medium- and large-size missions to address **observables essential to the overall program** and that are outside the scope of other opportunities in many cases. Can be competed, at NASA discretion.
- **Earth System Explorer.** A new program element involving competitive opportunities for medium-size instruments and missions serving specified ESAS-priority observations. **Promotes competition among priorities.**
- **Incubation.** A new program element, focused on investment for priority observation opportunities needing advancement prior to cost-effective implementation, including an Innovation Fund to respond to emerging needs. **Investment in innovation for the future.**
- **Venture.** Earth Venture program element, as recommended in ESAS 2007 with the addition of a new Venture-Continuity component to provide **opportunity for low-cost sustained observations**.

# ESAS Observing System Priorities

| TARGETED OBSERVABLE                 | SCIENCE/APPLICATIONS SUMMARY  | CANDIDATE MEASUREMENT APPROACH  | Designated | Explorer | Incubation |
|-------------------------------------|---|---|------------|----------|------------|
| Aerosols                            | Aerosol properties, aerosol vertical profiles, and cloud properties to understand their direct and indirect effects on climate and air quality                                      | Backscatter lidar and multi-channel/multi-angle/polarization imaging radiometer flown together on the same platform | X          |          |            |
| Clouds, Convection, & Precipitation | Coupled cloud-precipitation state and dynamics for monitoring global hydrological cycle and understanding contributing processes  | Radar(s), with multi-frequency passive microwave and sub-mm radiometer  | X          |          |            |
| Mass Change                         | Large-scale Earth dynamics measured by the changing mass distribution within and between the Earth's atmosphere, oceans, ground water, and ice sheets                               | Spacecraft ranging measurement of gravity anomaly   | X          |          |            |
| Surface Biology & Geology           | Earth surface geology and biology, ground/water temperature, snow reflectivity, active geologic processes, vegetation traits and algal biomass                                      | Hyperspectral imagery in the visible and shortwave infrared, multi- or hyperspectral imagery in the thermal IR      | X          |          |            |
| Surface Deformation & Change        | Earth surface dynamics from earthquakes and landslides to ice sheets and permafrost   | Interferometric Synthetic Aperture Radar (InSAR) with ionospheric correction  | X          |          |            |
| Greenhouse Gases                    | CO <sub>2</sub> and methane fluxes and trends, global and regional with quantification of point sources and identification of source types  | Multispectral short wave IR and thermal IR sounders; or lidar**   |            | X        |            |
| Ice Elevation                       | Global ice characterization including elevation change of land ice to assess sea level contributions and freeboard height of sea ice to assess sea ice/ocean/atmosphere interaction | Lidar**   |            | X        |            |
| Ocean Surface Winds & Currents      | Coincident high-accuracy currents and vector winds to assess air-sea momentum exchange and to infer upwelling, upper ocean mixing, and sea-ice drift.                               | Radar scatterometer   |            | X        |            |

|                                    |   |  |  |   |   |
|------------------------------------|---|--|--|---|---|
| Ozone & Trace Gases                | Vertical profiles of ozone and trace gases (including water vapor, CO, NO <sub>2</sub> , methane, and N <sub>2</sub> O) globally and with high spatial resolution   | UV/IR/microwave limb/nadir sounding and UV/IR solar/stellar occultation  |  |   | X |
| Snow Depth & Snow Water Equivalent | Snow depth and snow water equivalent including high spatial resolution in mountain areas  | Radar (Ka/Ku band) altimeter; or lidar**   |  |   | X |
| Terrestrial Ecosystem Structure    | 3D structure of terrestrial ecosystem including forest canopy and above ground biomass and changes in above ground carbon stock from processes such as deforestation & forest degradation                       | Lidar**  |  |   | X |
| Atmospheric Winds                  | 3D winds in troposphere/PBL for transport of pollutants/carbon/aerosol and water vapor, wind energy, cloud dynamics and convection, and large-scale circulation   | Active sensing (lidar, radar, scatterometer); passive imagery or radiometry-based atmos. motion vectors (AMVs) tracking; or lidar**  |  | X | X |
| Planetary Boundary Layer           | Diurnal 3D PBL thermodynamic properties and 2D PBL structure to understand the impact of PBL processes on weather and AQ through high vertical and temporal profiling of PBL temperature, moisture and heights. | Microwave, hyperspectral IR sounder(s) (e.g., in geo or small sat constellation), GPS radio occultation for diurnal PBL temperature and humidity and heights; water vapor profiling DIAL lidar; and lidar** for PBL height |  |   | X |
| Surface Topography & Vegetation    | High-resolution global topography including bare surface land topography ice topography, vegetation structure, and shallow water bathymetry   | Radar; or lidar**  |  |   | X |

\*\* Could potentially be addressed by a multi-function lidar designed to address two or more of the Targeted Observables

**Other ESAS 2017 Targeted Observables, not Allocated to a Flight Program Element**

|                           |                            |
|---------------------------|----------------------------|
| Aquatic Biogeochemistry   | Radiance Inter-calibration |
| Magnetic Field Changes    | Sea Surface Salinity       |
| Ocean Ecosystem Structure | Soil Moisture              |

# Designated Observables Summary as Described in the Decadal Survey

| Observable                                   | Science/Applications Summary   | Candidate Measurement Approach   | ESAS maximum cost  |
|--|--|--|--------------------|
| <b>Aerosols</b>                              | <b>Aerosol properties, aerosol vertical profiles, and cloud properties</b> to understand their effects on climate and air quality                                | Backscatter lidar and multichannel/multi-angle/polarization imaging radiometer flown together on the same platform | CATE Cap<br>\$800M |
| <b>Clouds, Convection, And Precipitation</b> | <b>Coupled cloud-precipitation state and dynamics</b> for monitoring global hydrological cycle and understanding contributing processes including cloud feedback | Radar(s), with multi-frequency passive microwave and sub-mm radiometer   | CATE Cap<br>\$800M |
| <b>Mass Change</b>                           | <b>Large-scale Earth dynamics</b> measured by the changing mass distribution within and between the Earth's atmosphere, oceans, ground water, and ice sheets     | Spacecraft ranging measurement of gravity anomaly  | Est Cap<br>\$300M  |
| <b>Surface Biology and Geology</b>           | <b>Earth surface geology and biology,</b> ground/water temperature, snow reflectivity, active geologic processes, vegetation traits and algal biomass            | Hyperspectral imagery in the visible and shortwave infrared, multi- or hyperspectral imagery in the thermal IR     | CATE Cap<br>\$650M |
| <b>Surface Deformation and Change</b>        | <b>Earth surface dynamics</b> from earthquakes and landslides to ice sheets and permafrost   | Interferometric Synthetic Aperture Radar (InSAR) with ionospheric correction                                       | Est Cap<br>\$500M  |



# Earthdata Cloud 2021

- Improve the efficiency of NASA's data systems operations – continues free and open access to data
- Prepare for planned high-data-rate missions
- Increase opportunity for researchers and commercial users to access/process PBs of data quickly without the need for data management
- Transparent/extendable open source processing framework

# Interagency Implementation and Advanced Concepts Team (IMPACT)

Initiated IMPACT – Rahul Ramachandran Manager

*Improve data acquisition, management, analysis, and exchange*

- Build **partnerships** with other agencies, the applications community, decision makers, NGOs, etc. to encourage the adoption of NASA's Earth observation data
  - Satellite Needs Working Group request.
- Provide informatics, data systems and domain science expertise needed to **assess and evaluate** specific elements of the Earth Science Data Systems Program.
- Strategic, technical, and management expertise for **rapid prototyping, development, and testing** of advanced ideas in data and information systems for Earth observations.
- Airborne Data Management Group

Enable and encourage broader use of NASA's data by all users.

# ACCESS Program

- Program aims to develop tools and technology to improve the management, utility and use of NASA data for scientists and other users within a 5 year window.
- Historically **very few** funded projects have been ‘infused’ into multiple DAACs or EOSDIS core systems (*includes programs outside of ACCESS*).
  - Projects have to be refactored for ‘operational’ use
  - Tools often address edge cases
- ACCESS17 attempts to address this issue by targeting development of cloud native capabilities building on open source core software – *forward looking*.
  - Machine learning
  - Advanced search capabilities
  - Cloud optimized preprocessing and data transformation
- ACCESS19 will be released in mid-fall 2019 – expect a similar approach.

# Citizen Science for Earth Systems Program

- **Initiated the CSDWG**
  - Use citizen science and crowdsourcing platforms or techniques
    - for advancing scientific knowledge of the Earth system
    - complementing research currently conducted using NASA's Earth-observing satellites.
  - Aim to address real-world problems at the local, regional, continental, or global scales, by
    - increased temporal or spatial sampling,
    - contributing to the validation of NASA data products derived from satellite observations,
    - deploying innovative sensors about our environment,
    - a combination of the above, or other innovative ways to enhance the utility of NASA's observation systems from space, air, land, and water.
- ✓ 6 Proposals selected for implementation from 16 prototype projects

Next solicitation in ROSES2020



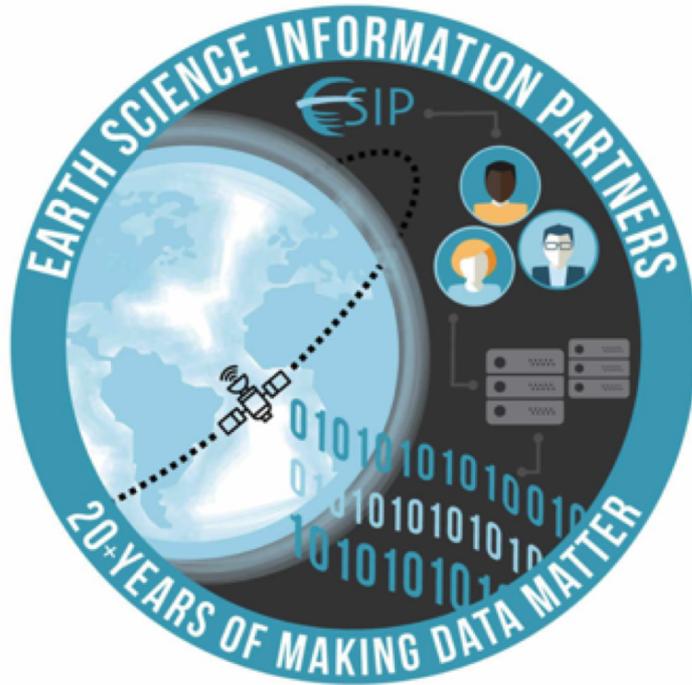
## How NOAA Increases the Use and Value of Earth Science Data and Information



**Ed Kearns**  
Chief Data Officer,  
NOAA



# Closing Remarks



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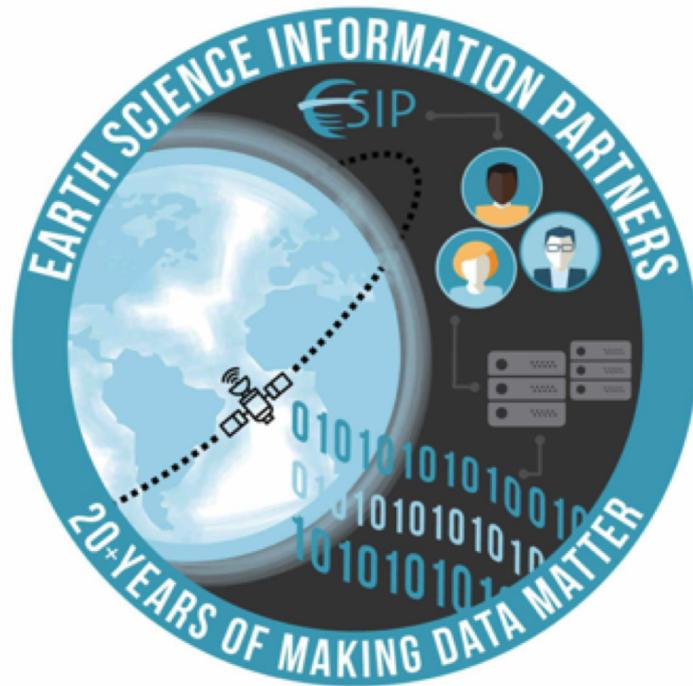
# • Data in Action Webinar Series

## **Upcoming Webinars**

- April 19th, 1 pm ET: ESIP Collaboration Area Highlights
- May 17th, 1 pm ET: The Fourth National Climate Assessment: Translating Data to Inform Decisions
- More webinars will be announced soon:  
<https://www.esipfed.org/webinars>.
- Webinar recordings will be shared on the ESIP YouTube Channel.



**Call for Sessions closes 4/26**



**Learn more, submit  
sessions, & register:**  
[esipfed.org/summermeeting](https://esipfed.org/summermeeting)

# 2019 Summer Meeting

July 16-19, 2019

Greater Tacoma Convention Center, Tacoma, WA

# Engagement Ops.



## DISCOVER

Find people and tools to make your data findable, accessible, interoperable, and reusable.



## COLLABORATE

Join-in or create a new collaboration area around your Earth science data challenges.



## INNOVATE

Utilize small-grant funding to build or expand Earth data technologies.



## NETWORK

Extend your network. Build connections across federal agencies, the private sector, and academia.

## JOIN

Encourage your organization to join ESIP's 110+ member organizations. Unlock membership benefits: start new collaborations, apply for funding, and more.

Stay up-to-date on all things ESIP by signing up to receive Monday Updates:  
<http://eepurl.com/rJQYn>.

- Thank you!



SUMMER MEETING 2019

JULY 16-19, 2019

TACOMA, WA

[ESIPFED.ORG/SUMMERMEETING](http://ESIPFED.ORG/SUMMERMEETING)

**DATA IN ACTION**  
INCREASING THE USE  
AND VALUE OF EARTH SCIENCE  
DATA AND INFORMATION

ESIP is supported by NASA, NOAA, and USGS