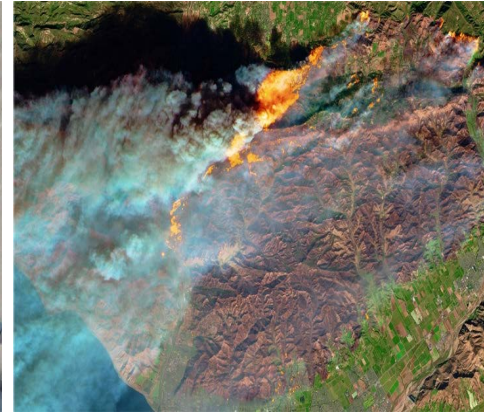
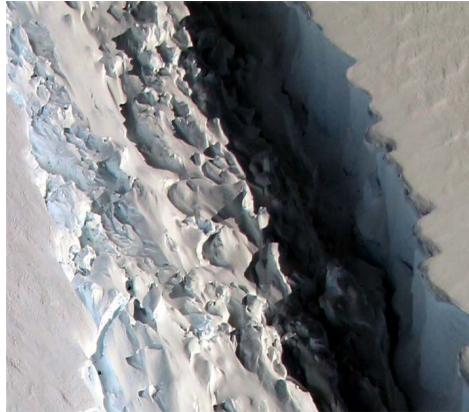




SCIENCE



BIG STORIES in Earth Science

Lin Chambers¹ and Theresa Schwerin²

¹Science Education Integration Manager
²PI, NASA Earth Science Education Collaborative

1965

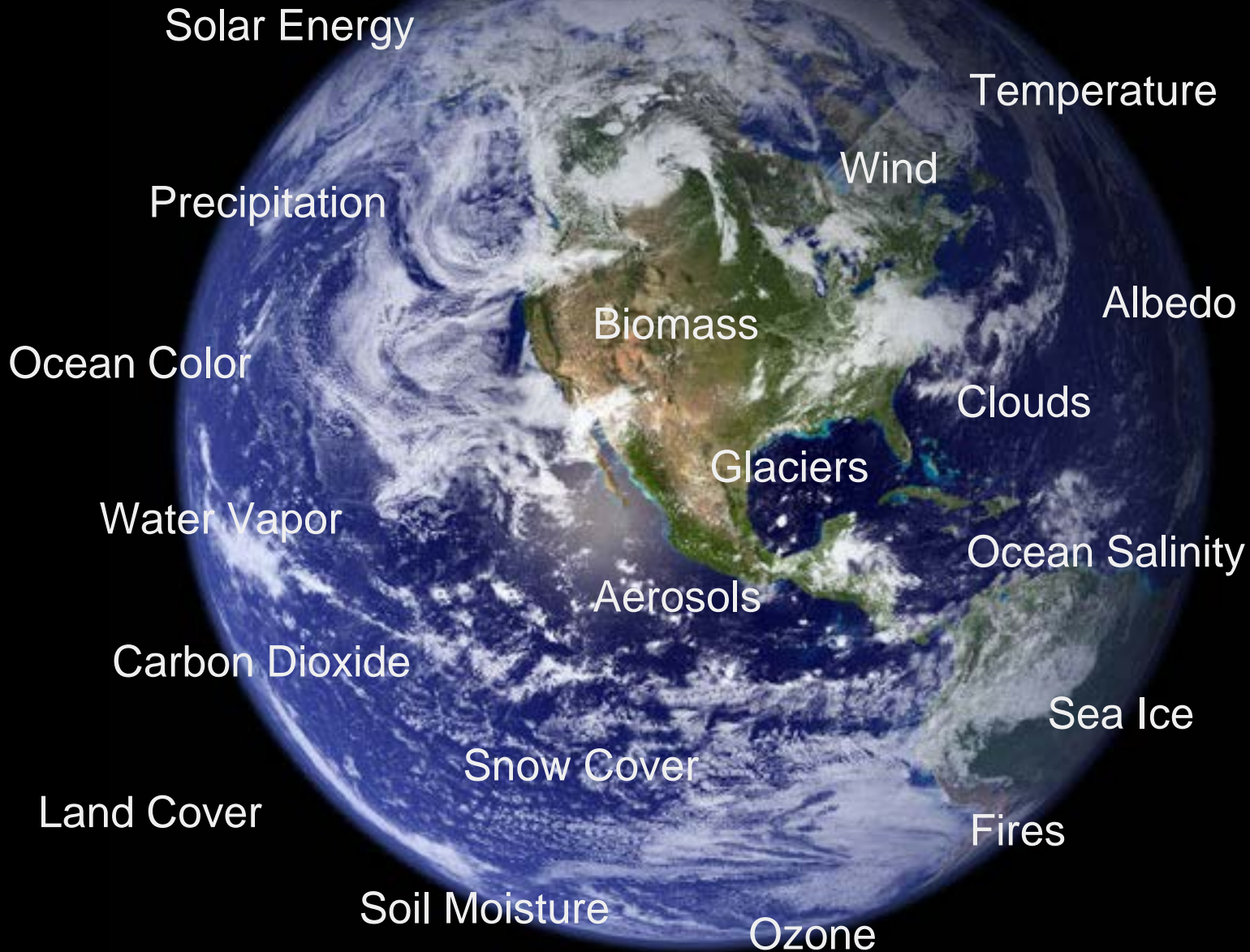


December 24, 1968

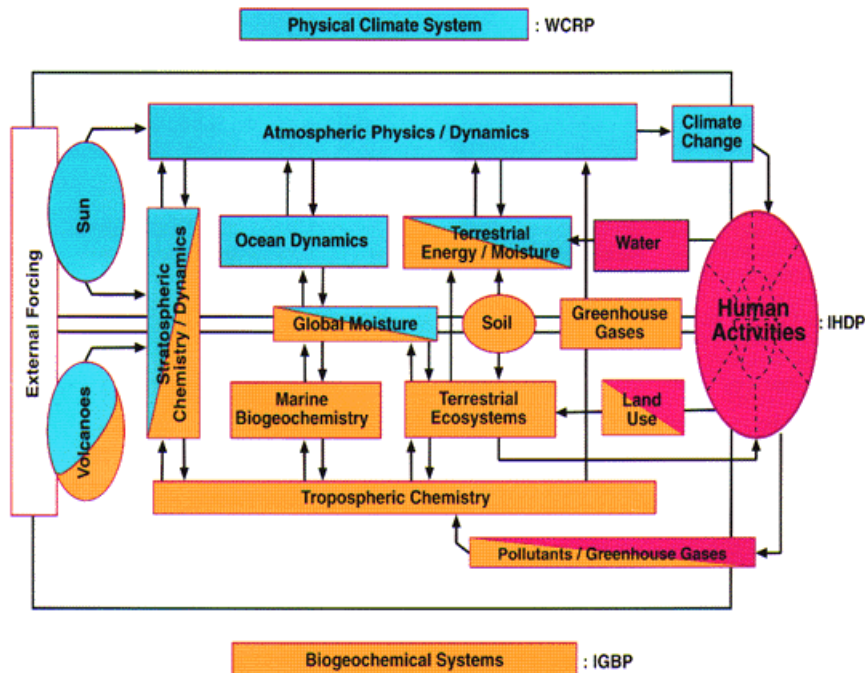


<https://svs.gsfc.nasa.gov/4593>

Increasing Focus on the Details



Big questions of NASA *Earth System Science*



- How is the global *Earth system* changing?
- What causes these changes in the *Earth system*?
- How will the *Earth system* change in the future?
- How can *Earth system* science provide societal benefit?

The Bretherton Diagram
(mid 1980's)

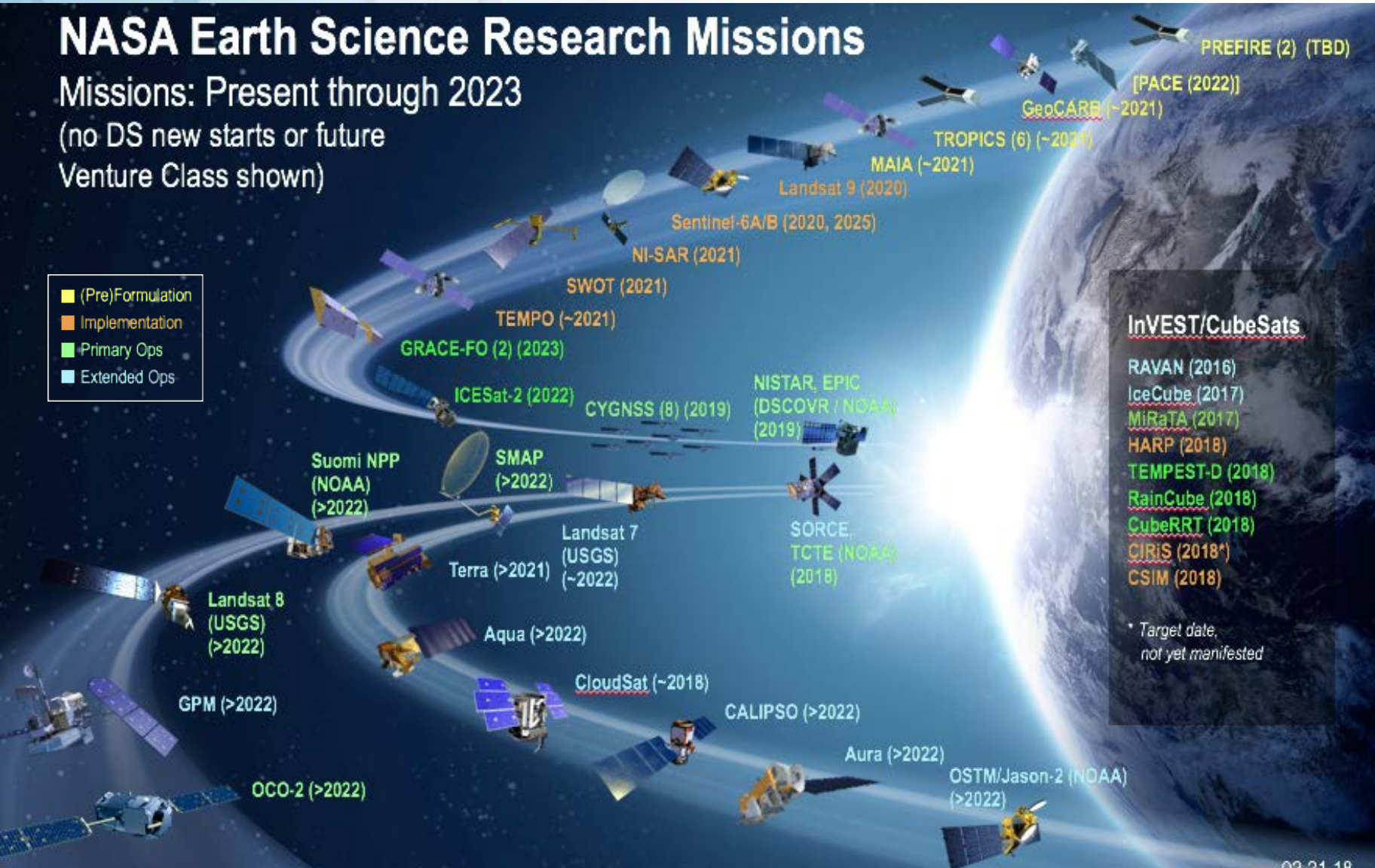
An Evolving System to Observe the Earth System

NASA Earth Science Research Missions

Missions: Present through 2023

(no DS new starts or future
Venture Class shown)

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



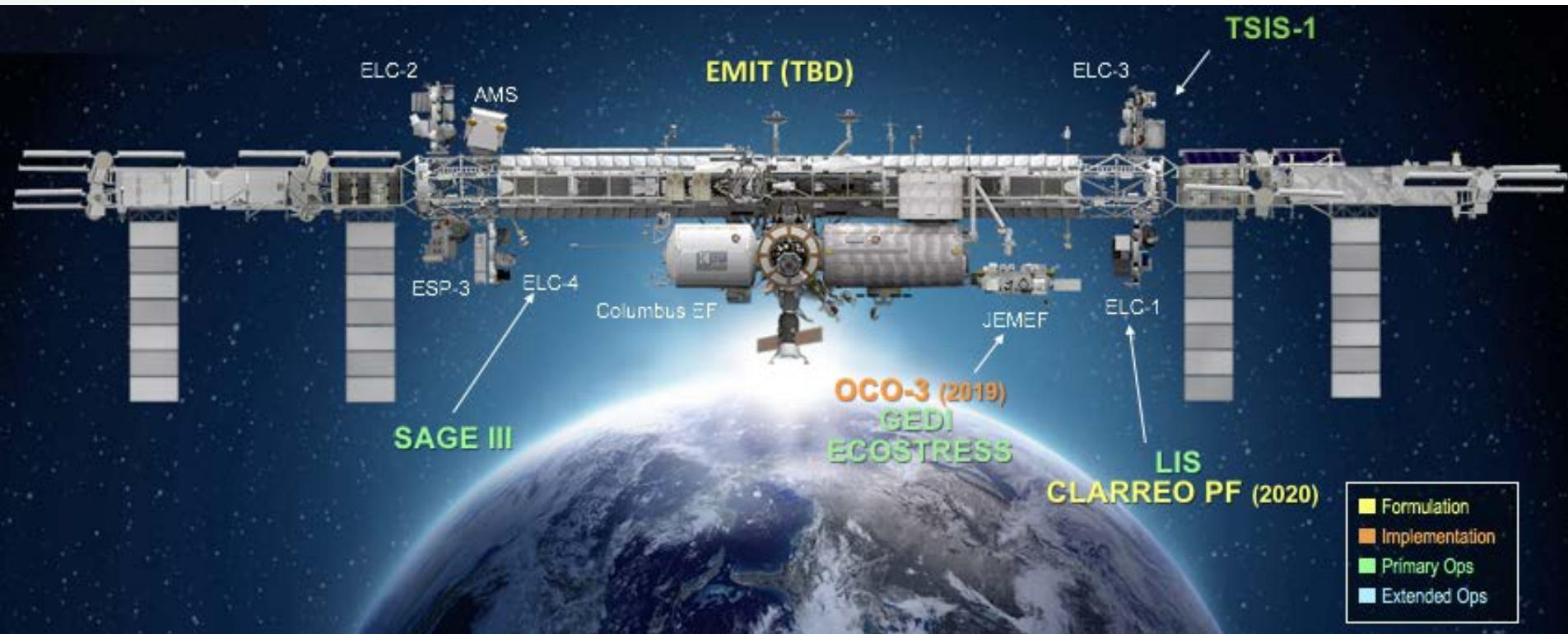
InVEST/CubeSats

- RAVAN (2016)
- IceCube (2017)
- MiRaTA (2017)
- HARP (2018)
- TEMPEST-D (2018)
- RainCube (2018)
- CubeRRR (2018)
- CIRIS (2018*)
- CSIM (2018)

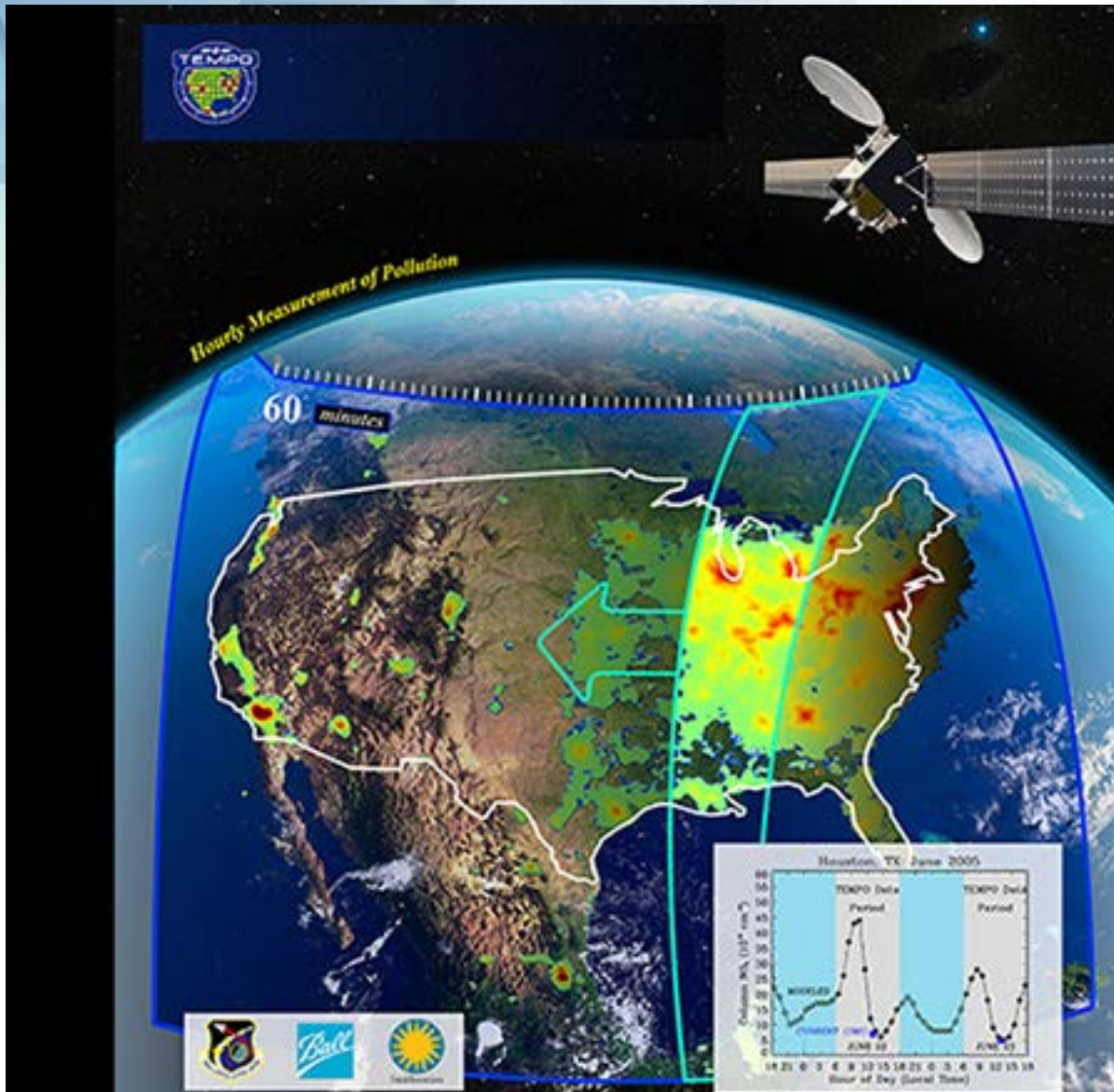
* Target date, not yet manifested

Emerging Approaches: Earth Science from the ISS

- Increasing number of Earth Observing instruments:
 - 2017: SAGE III, LIS, TSIS-1
 - 2018: GEDI, ECOSTRES
 - 2019: OCO-3



New Observation Modes: TEMPO (goal 2019/21? launch)



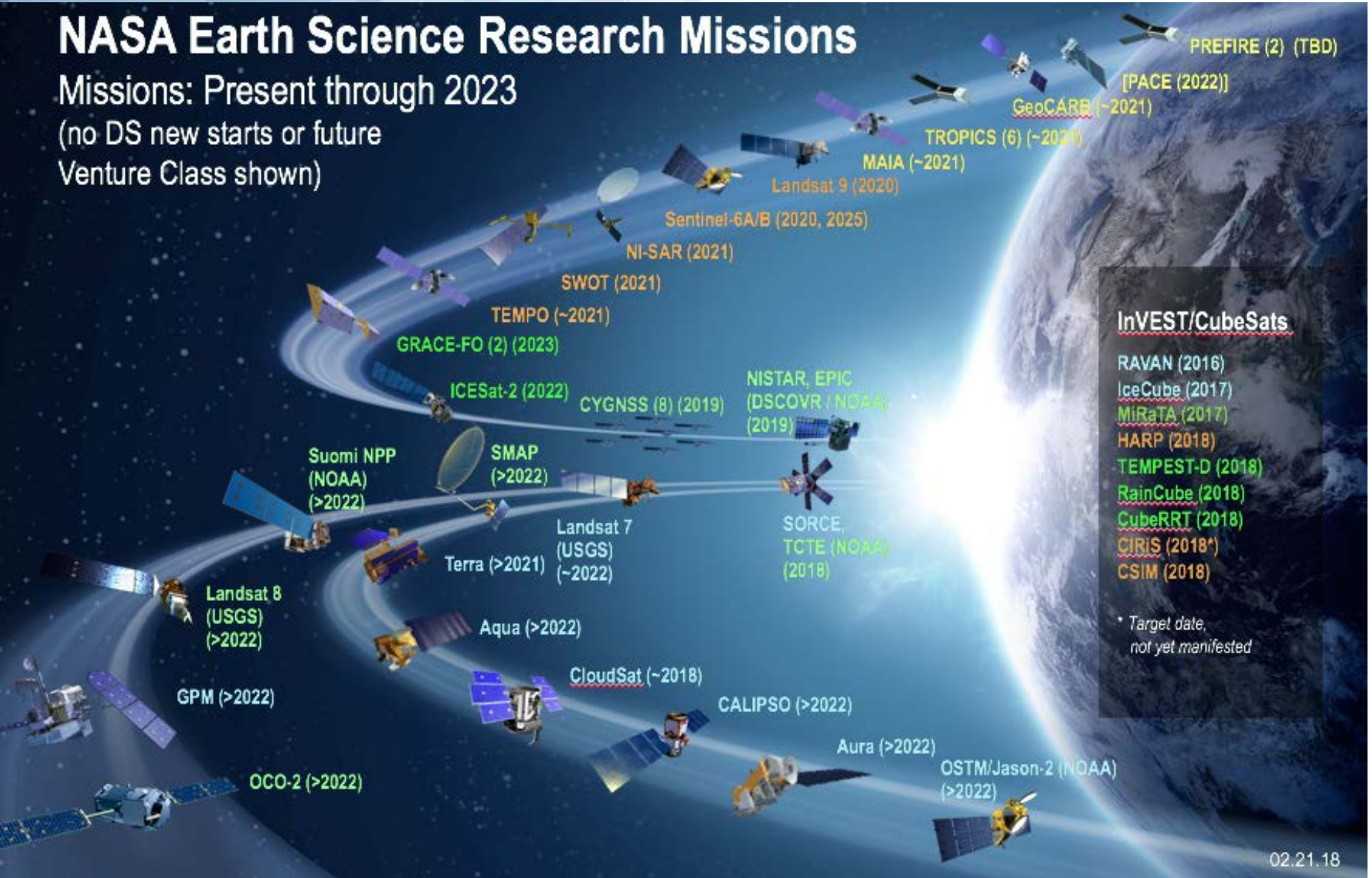
First space-based instrument to monitor major air pollutants across the North American continent every daylight hour at high spatial resolution.

Increasing role for CubeSats

NASA Earth Science Research Missions

Missions: Present through 2023

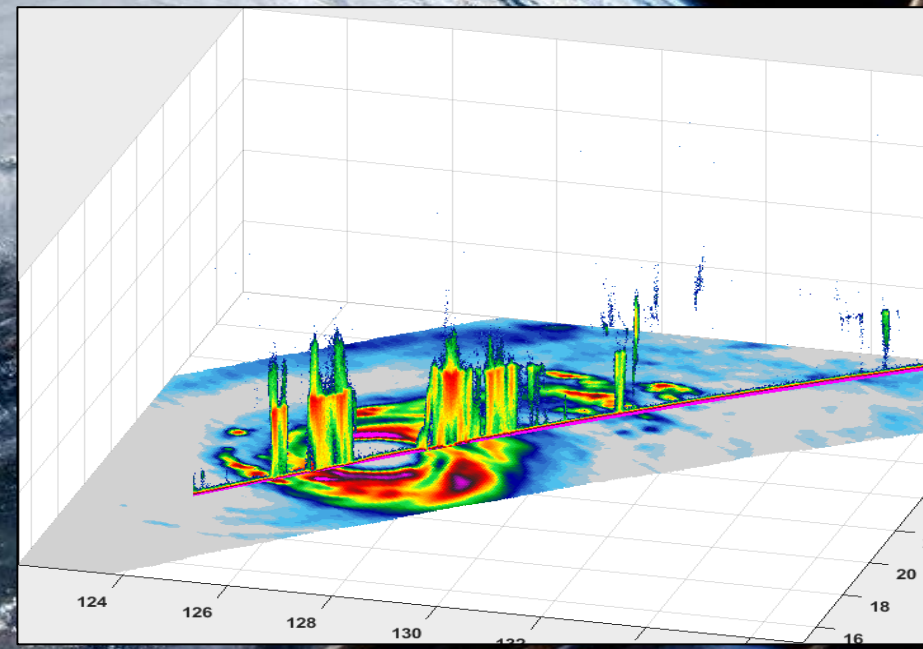
(no DS new starts or future
Venture Class shown)



CubeSat example: TEMPEST-D and RainCube

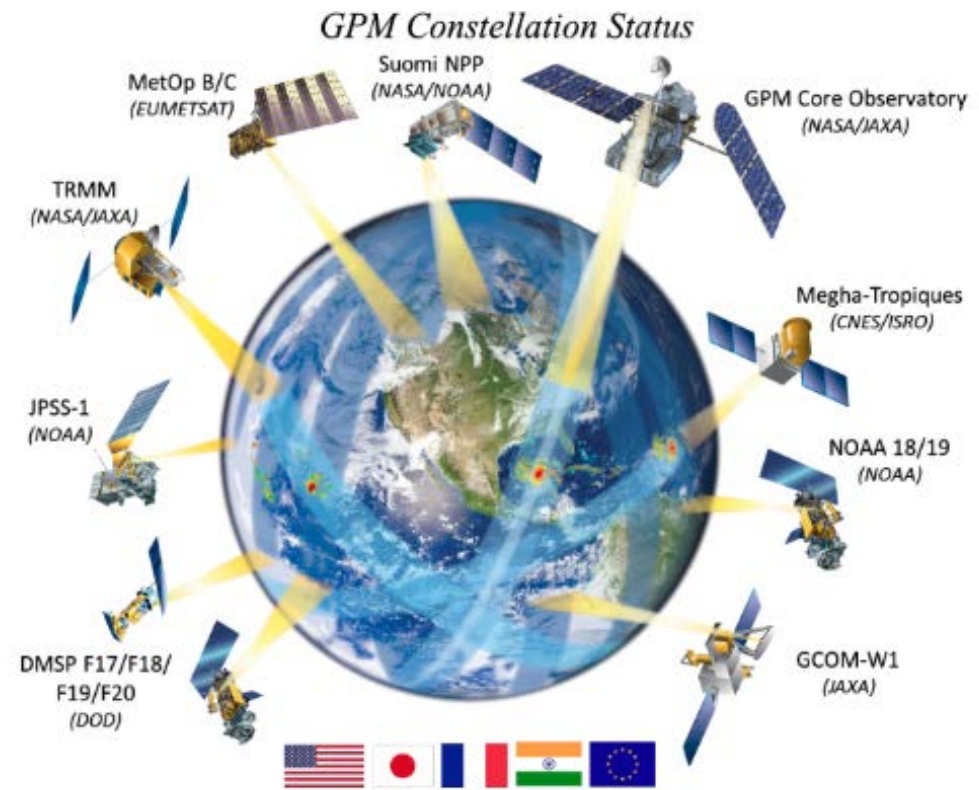


- September 28, 2018, TEMPEST-D and RainCube overflew Typhoon Trami < 5 minutes apart
- RainCube nadir Ka-band reflectivity shown overlaid on TEMPEST-D 165 GHz brightness temperature illustrating complementary nature of these sensors in constellation for observing precipitation
- Trami observed shortly after it had weakened from Cat 5 to Cat 2

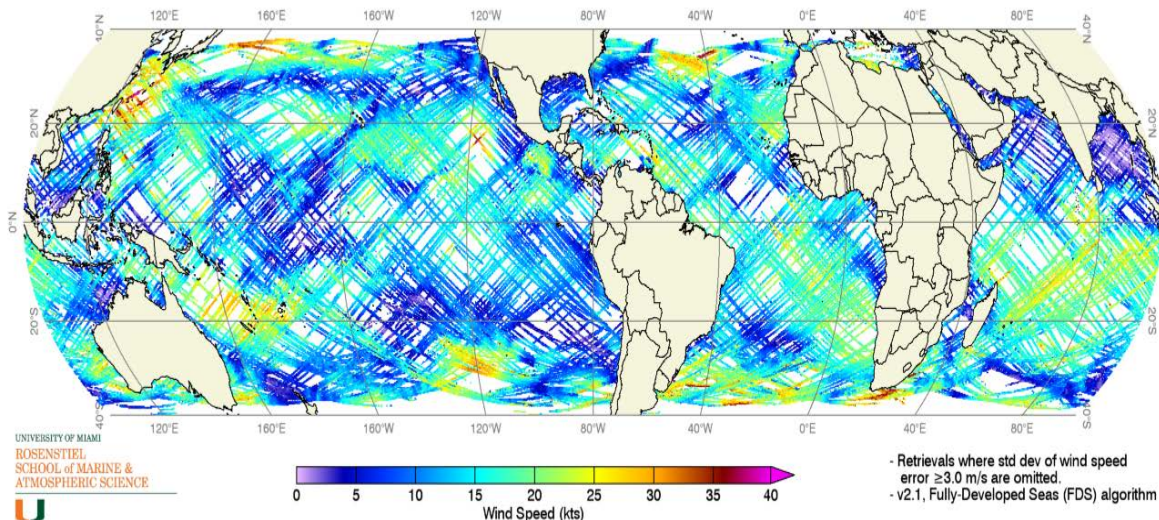


... and Constellations

GPM: International network of satellites anchored by the core observatory

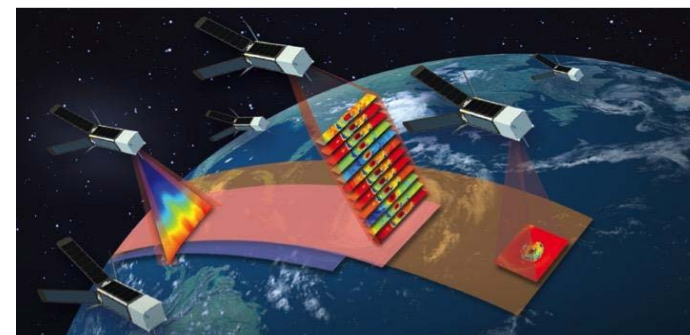


CYGNSS L3 WIND SPEED : 20180928 (0000Z-2300Z)



- Retrievals where std dev of wind speed error ≥ 3.0 m/s are omitted.
- v2.1, Fully-Developed Seas (FDS) algorithm

CYGNSS 8-satellite constellation



Increasing usability: EarthData

<https://search.earthdata.nasa.gov/search>

The screenshot displays the EarthData Search website interface. At the top, the NASA EarthData logo is on the left, and a search bar with the placeholder text "Type any topic, collectio" is in the center. To the right of the search bar are icons for a calendar, a map, a hamburger menu, a speaker, and buttons for "Show Tour" and "Earthdata Login".

On the left side, there is a navigation menu with the following items: "Browse Collections", "Features", "Keywords", "Platforms", "Instruments", "Organizations", "Projects", and "Processing levels".

The main content area shows a search results summary: "5932 Matching Collections". A modal dialog box titled "Search" is open in the center, containing the following text:

Search

Use Earthdata Search's natural language processing-enabled search tool to quickly narrow down to relevant collections. An example search phrase could be *Land Surface Temperature over Texas last month*. Results will be displayed in the collection panel below.

You can also add filters to refine your search:

- Pick a temporal range from a calendar
- Manually set spatial boundaries
- Clear all of your filters

At the bottom of the modal dialog are buttons for "End Tour", a checkbox for "Do not show again", and a "Next" button with a right arrow.

The background of the page is a satellite map of the Middle East and surrounding regions, with country labels such as Italy, Turkey, Iraq, Iran, Saudi Arabia, Libya, Egypt, Sudan, Ethiopia, and others. A scale bar in the bottom right corner indicates 1000 km and 500 mi.



Connecting the Public to NASA Earth Science Stories, Data, People



Images

Global Maps

Articles

Blogs



earth
observatory

Topics

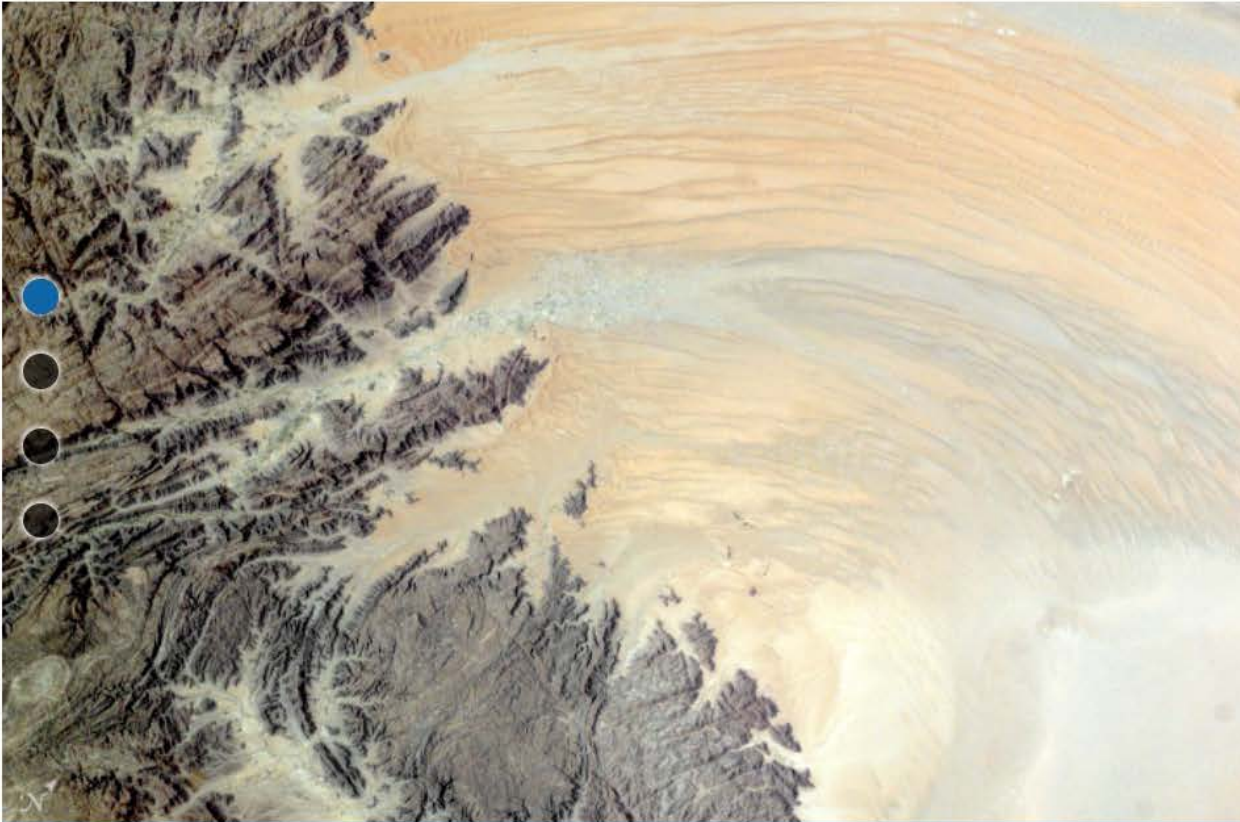
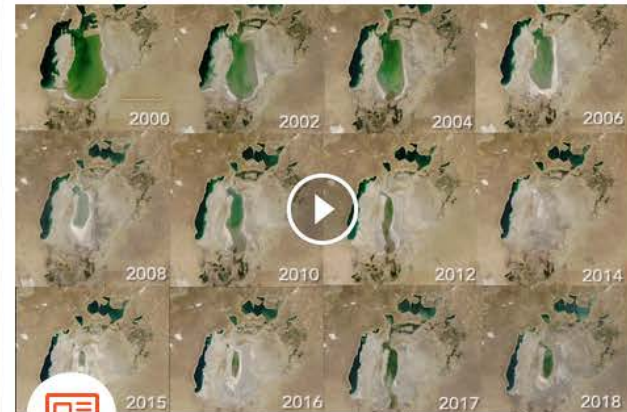


Image of the Day for Feb 10, 2019



Ancient Rocks, Modern Dunes

In the arid interior of Yemen, ancient rocks stand astride dry river beds and mighty sand dunes.

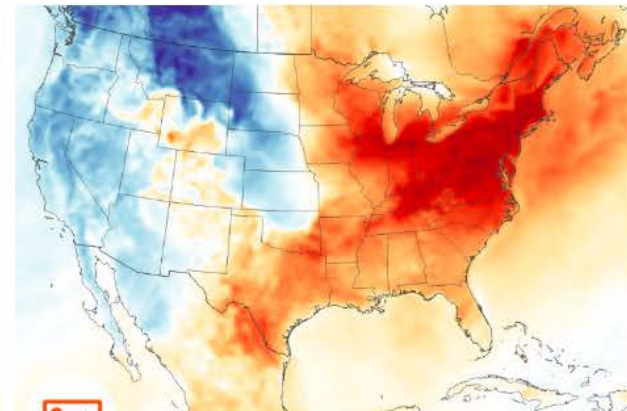


Featured Article Published Dec 5, 2018

Shrinking Aral Sea

Once the fourth-largest lake in the world, the Aral Sea has been slowly disappearing since the 1960s. View how the lake has shrunk over the past few decades.

Land Water



Natural Event Published Feb 6, 2019



Images

Global Maps

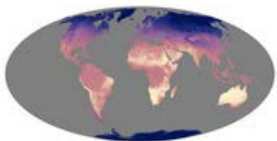
Articles

Blogs



earth
observatory

Topics



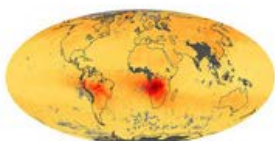
Global Maps

Feb 2000 – Nov 2018

Land Surface Temperature

Land surface temperatures rise and fall with the heat of the Sun, and they represent how hot or cold the surface would feel to touch. These maps show daytime land temperatures as measured from space.

Heat Land



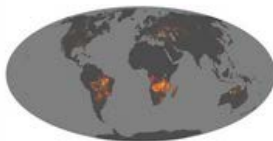
Global Maps

Mar 2000 – Feb 2017

Carbon Monoxide

When fuels such as coal, wood, and oil burn incompletely, they produce carbon monoxide. The gas is spread by winds and circulation. These maps show monthly averages of CO in the lower atmosphere.

Atmosphere



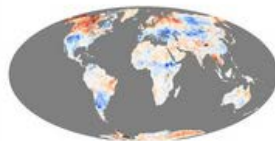
Global Maps

Mar 2000 – Nov 2018

Fire

Whether started by humans (farming, logging, or accidents) or by nature (lightning), fires are always burning somewhere on Earth. These maps show the locations of fires burning around the world each month.

Land



Global Maps

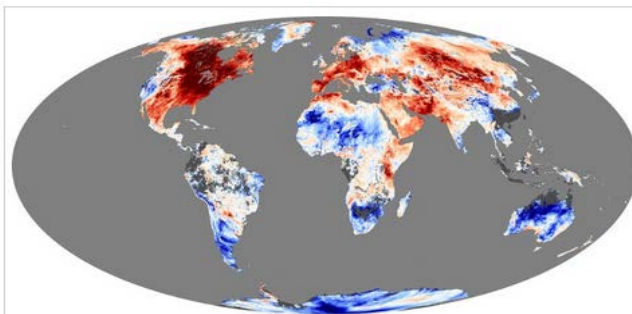
Feb 2000 – Nov 2018

Land Surface Temperature Anomaly

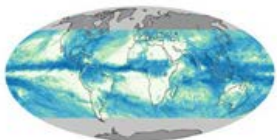
These maps depict anomalies in land surface temperature (LSTs); that is, how much hotter or cooler a region was compared to the long-term average. LST anomalies can indicate heat waves or cold spells.

Heat Land

Land Surface Temperature Anomaly



Land Surface Temperature Anomaly

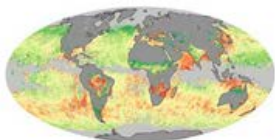


Global Maps

Jan 1998 – Aug 2016

Total Rainfall

These maps depict monthly total rainfall around the world. Rainfall is the primary source of fresh water for humans,



Global Maps

Jan 2005 – Sep 2016

Aerosol Size

Sea salt, volcanic ash, dust, wildfire smoke, and industrial pollution are types of airborne aerosols. Natural aerosols tend to be larger than human-made

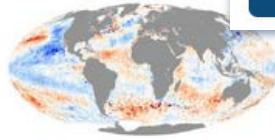


Global Maps

Feb 2000 – Nov 2016

Net Primary Productivity

These maps show the 'metabolism' of Earth's plants and trees. Net primary productivity is the difference between the amount of carbon



Global Maps

Jun 2002 – Sep 2011

Sea Surface Temperature Anomaly

These maps depict how much hotter or cooler an ocean basin was compared to the long-term

NASA Earth Observations (NEO)

Browse datasets by broad category.

Zoom, analyze, and compare up to 3 datasets.

Download different file formats and resolutions (CSV, PNG, Google Earth, GeoTIFF).

About this dataset: 3 levels provided—Basic, Intermediate, Advanced.

LAND SURFACE TEMPERATURE ANOMALY [DAY] (1 MONTH)

Currently viewing: February 2017

Downloads 0

File Type:

Color Grayscale

1.0 degrees	360 x 360
0.5 degrees	720 x 360
0.25 degrees	1440 x 720
0.1 degrees	3600 x 1800

View by date: 1 day 8 day 1 mo

Download color table

Dataset you are currently viewing: February 2017

Select Year: 2017

2017 March 2017 April 2017 July 2017

• Data • No Data • Currently Viewing

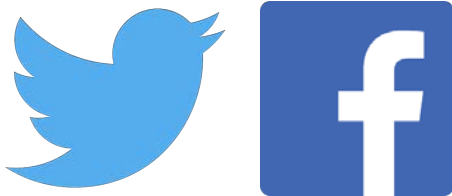
About this dataset Basic Intermediate Advanced

12.00 °C
Lat=40.1 Lon=-101.7

1000
500
0
-500
-1000

Related Websites
MODIS
Terra
MODIS Land Group

Follow NASA Earth on Social



@NASA-EARTH

This block contains a screenshot of the NASA Earth social media profile and a tweet. The profile header features a circular profile picture of Earth and the text 'EXPLOREREARTH YOUR HOME, OUR MISSION'. Below this, statistics for Tweets (14.9K), Following (154), Followers (1.3M), and Likes (344) are shown, along with a 'Following' button. The tweet, dated Feb 1, discusses the polar vortex and Australian summer weather, accompanied by two maps: one of Australia showing land surface temperature anomalies and another of the globe showing air temperature at 2 meters.

EXPLOREREARTH
YOUR HOME, OUR MISSION

Tweets **14.9K** Following **154** Followers **1.3M** Likes **344** More ▾ **Following**

NASA Earth ✓ @NASAEarth · Feb 1
@NASAEarth
NASA uses the vantage point of space to increase our understanding of Earth and improve lives.
📍 Washington, DC
🌐 nasa.gov/earth
📅 Joined March 2009

NASA Earth ✓ @NASAEarth · Feb 1
It may be #polarvortex cold 🌡️ in parts of the United States right now, but #Australia is sweating through a sweltering summer. 🌞
[earthobservatory.nasa.gov/images/144498/...](https://earthobservatory.nasa.gov/images/144498/) [earthobservatory.nasa.gov/images/144489/...](https://earthobservatory.nasa.gov/images/144489/) #NASA #weather #temperature ✓

Land Surface Temperature Anomaly (difference from 2000-2012 average, °C)
Air Temperature at 2 Meters (°C)

NASA EXPLORERS

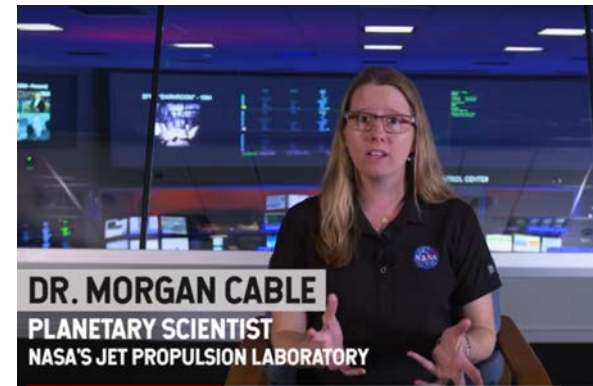


NASA Explorers: Glacial Pace

https://www.youtube.com/watch?v=oFH8vaP_Bw



DR. JOSH WILLIS
CLIMATE SCIENTIST
NASA'S JET PROPULSION LABORATORY



DR. MORGAN CABLE
PLANETARY SCIENTIST
NASA'S JET PROPULSION LABORATORY

Earth & Space Toolkit Connections:



NASA Earth Science Education Collaborative

Creating **authentic STEM** experiences & resources, based on **NASA Earth Science**, delivered through **strategic partnerships and collaborations**

- Institute for Global Environmental Strategies (PI)
- NASA Goddard (Co-I)
- NASA Langley (Co-I)
- NASA JPL (Co-I)

Partners & Collaborators Include:



Smithsonian
Science Education Center



Choose your protocol:



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Citizen Science: Engaging the Public in NASA Science






ARE YOU UP FOR A CHALLENGE?
Collect observations of clouds to win!
 March 15 - April 15, 2018





LAND COVER CHALLENGE
SEPT 22 - OCT 1



Top 10 WIN a NASA shout out and certificate!



observer.globe.gov



Diseases carried by mosquitos kill millions of people every year.

Learn how people within high-risk countries are fighting back this Thursday.

Tune in July 5, 2018
 10:30 am EDT/3:30 pm UTC
 facebook.com/NASAearth




"I do citizen science with GLOBE OBSERVER because I love making STEM a reachable dream for anyone to achieve."
 - Marilé Colón Robles






PEDER NELSON
LAND COVER SCIENTIST & CITIZEN SCIENTIST

Read about his work:
<https://bit.ly/2MvFwvh>




NASA GLOBE Observer
 February 11 at 9:00 AM · 🌐

#MeetACitizenScientistMonday Meet Dr. Rusty Low! She puts the scientist in #citizenscientist and she needs your #mosquito observations to help with her research.
<https://observer.globe.gov/.../obsscients.../19589576/rusty-low>

NASA - National Aeronautics and Space Administration, NASA Earth, The GLOBE Program... See More

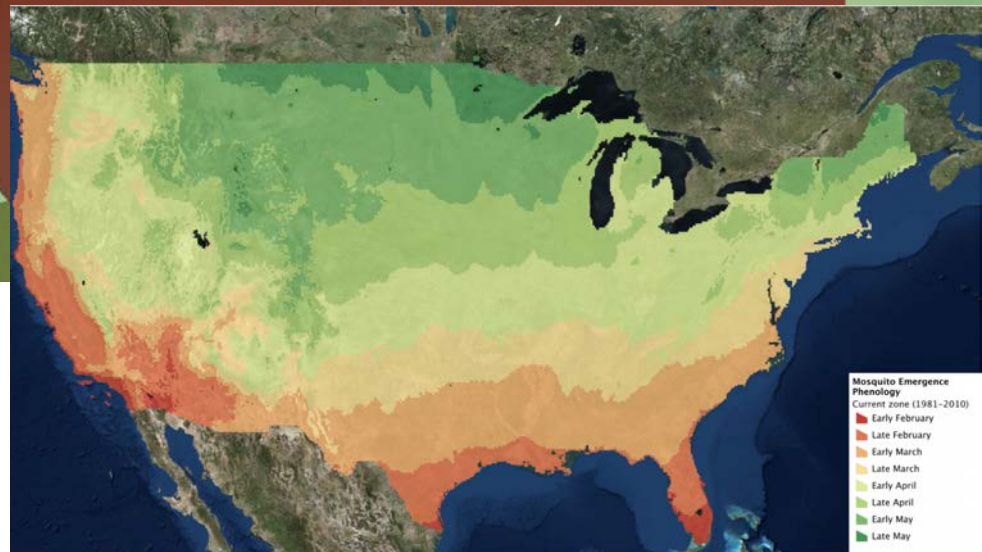


Follow us!  

GLOBE Mission Mosquito

Upcoming Webinar: Join the Mosquito Mapping Project and build a mosquito trap!
February 20, 2:00 p.m. ET / 11:00 a.m. PT

This webinar launches the GMM Phenology project where citizen scientists in this campaign will create a map of first appearances of mosquitoes in USA- and changes in the mosquito season in the Southern Hemisphere. We will provide a short tutorial on how to use the app and make a mosquito trap.



GLOBE Observer

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NASA Earth Observatory

earthobservatory.nasa.gov

NASA Earth Observations (NEO)

neo.sci.gsfc.nasa.gov/

NASA Earth on Social

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NASA Explorers

Facebook Watch and Youtube (<https://youtu.be/4IjlUbP2cgs>)