



EARTHDATA
EOSDIS NASA'S EARTH OBSERVING SYSTEM
DATA AND INFORMATION SYSTEM

FedGeo Day 2020

How We Work:
Unlocking NASA Earth Science Data and Evolving Our Teams

Who am I?



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System Architect,
NASA Earth Observing System, Data and Information Systems
(EOSDIS)



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NASA EARTH FLEET

OPERATING & FUTURE THROUGH 2023



SWOT (CNES)
LANDSAT-9 (USGS) SENTINEL-6 Michael Freilich/B (ESA)
TROPICS (6)
NISAR (ISRO)
TSIS-2
PREFIRE (2)
GLIMR

ISS INSTRUMENTS
EMIT
CLARREO-PF
GEDI
SAGE III
OCO-3
TSIS-1
ECOSTRESS
LIS

JPSS-2, 3 & 4 INSTRUMENTS
OMPS-Limb
LIBERA

MAIA
TEMPO
PACE (NSO)
ICESAT-2
GRACE-FO (2) (DLR)
CYGNSS (8)
NISTAR, EPIC (DSCOVR/NOAA)
CLOUDSAT (CSA)
TERRA (JAXA, CSA)
AQUA (JAXA, AEB)
AURA (NSO, FMI, UKSA)
CALIPSO (CNES)
GPM (JAXA)
LANDSAT 7 (USGS)
LANDSAT 8 (USGS)
OCO-2
SMAP
SUOMI NPP (NOAA) (JAXA)

INVEST/CUBESATS

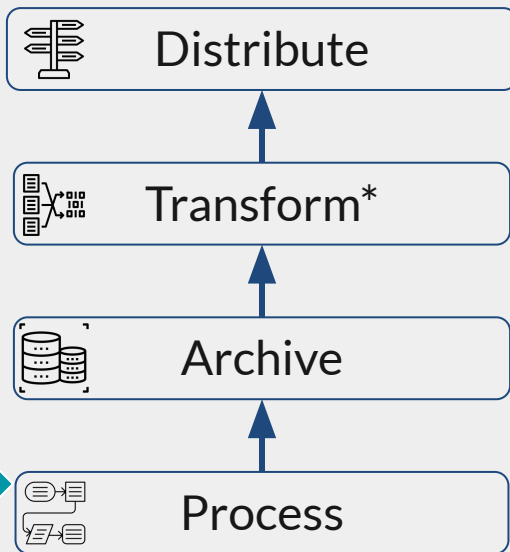
RainCube
CSIM-FD
CubeRRR
TEMPEST-D
CIRiS
HARP
CTIM
HyTI
SNoOPI
NACHOS

(PRE) FORMULATION ●
IMPLEMENTATION ●
PRIMARY OPS ●
EXTENDED OPS ●

EOSDIS in Context



Capture
and Clean



Commercial

Research

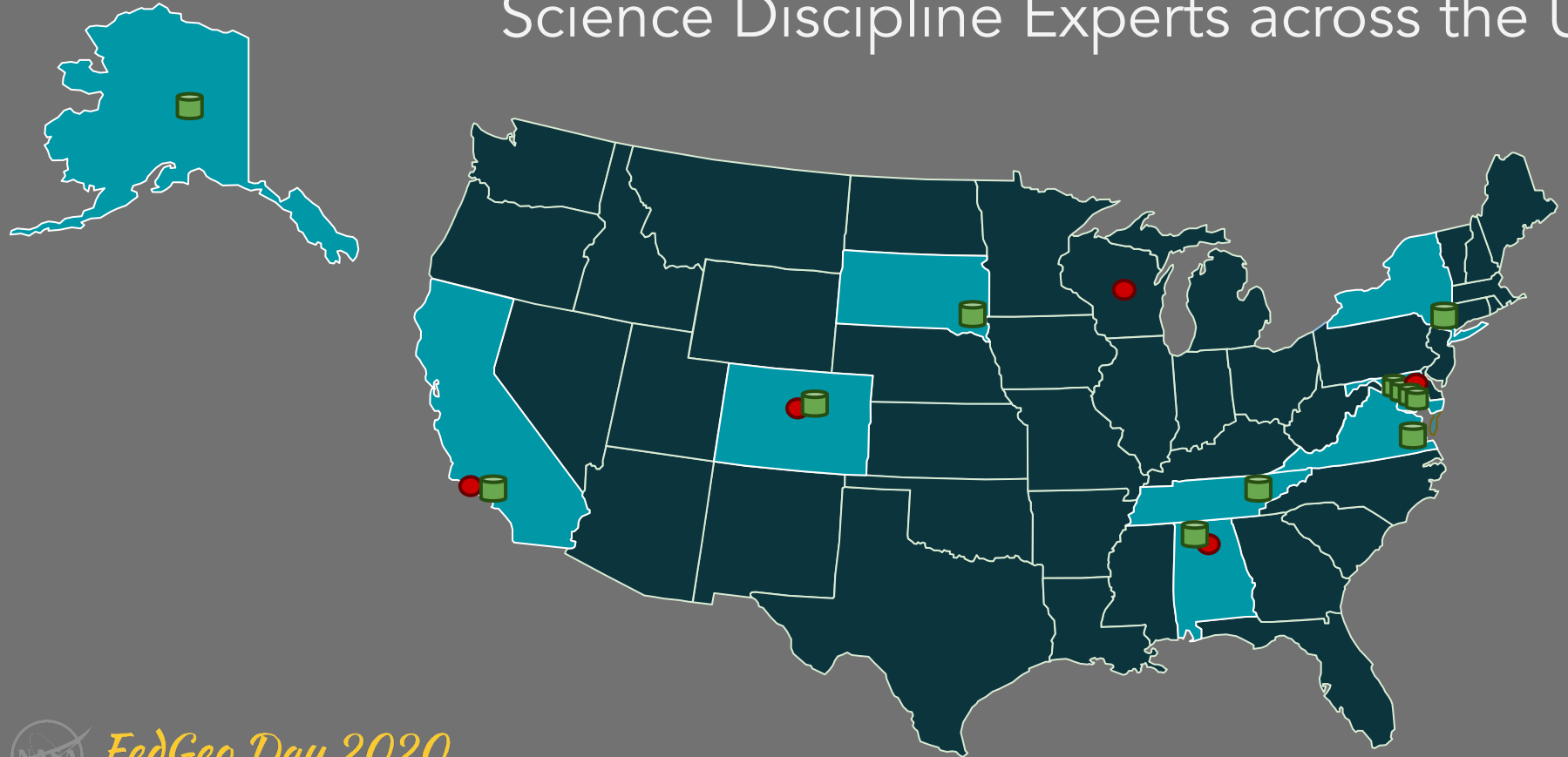
Applications

Education



*Subset, reformat, reproject

Data are Produced and Managed by
Science Discipline Experts across the US



Big Variety at EOSDIS

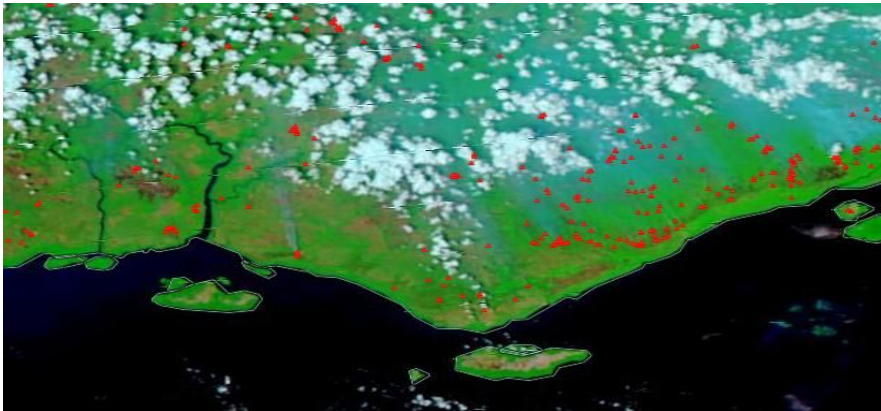
NASA Earthdata Datasets in 2020

- 12 NASA centers of domain expertise
- 6,800+ distinct data collections online
- 560 million cataloged files (granules)

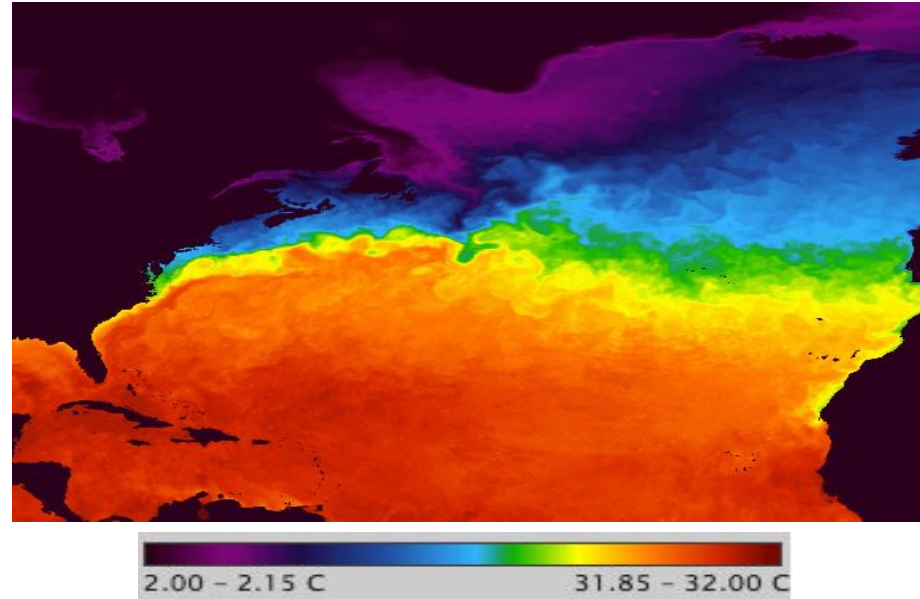


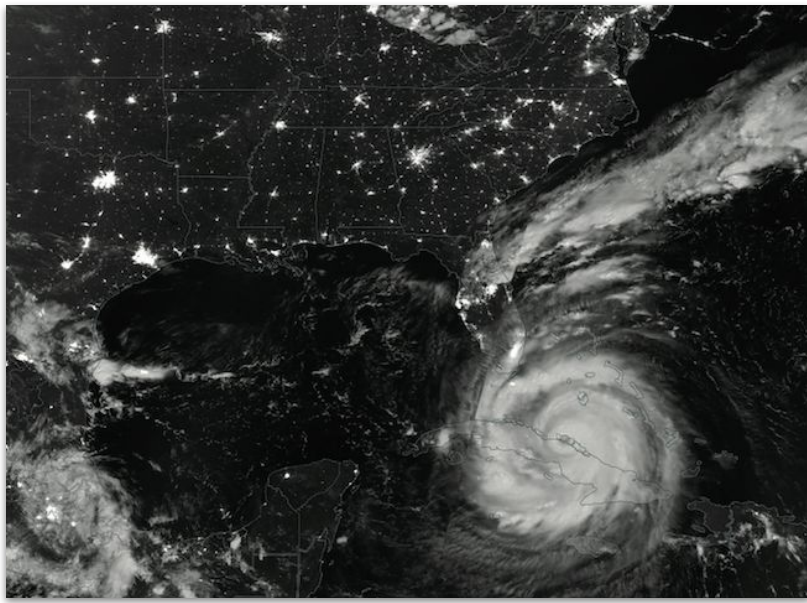
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Reflectance in different wavelengths + fire detections



Daily sea surface temperature over the course of a month

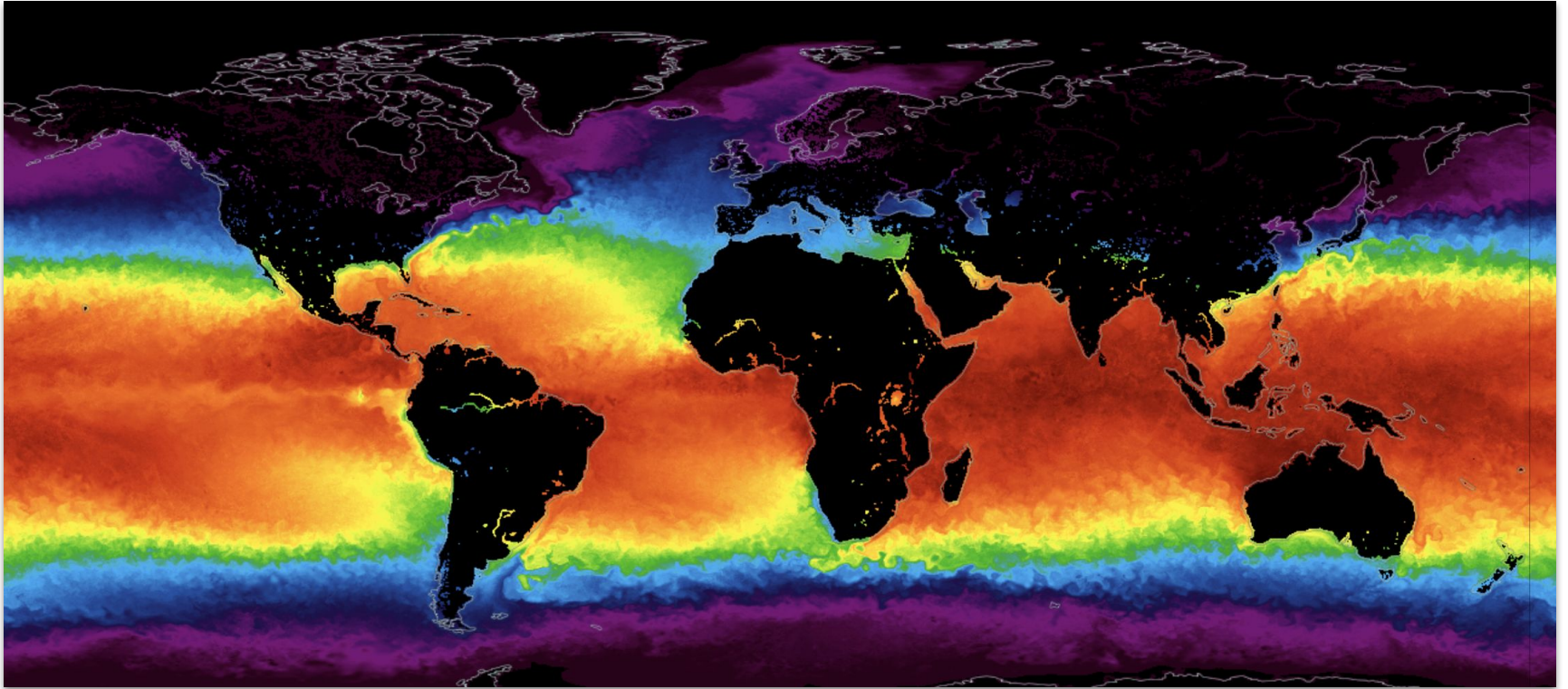




Nighttime imagery of Hurricane Irma approaching Florida on September 9, 2017; captured by the Visible Infrared Imaging Radiometer Suite (VIIRS) instrument on the Suomi National Polar-orbiting Partnership (NPP) satellite



Fires and smoke of the Thomas Fire near Santa Barbara, California on December 5, 2017; captured by the Moderate Resolution Imaging Spectroradiometer (MODIS) instrument on the Terra satellite



Global sea surface temperature on April 9, 2018 from the Group for High Resolution Sea Surface Temperature (GHRST) using a combination of satellite and in situ measurements

Zooming out for a moment

We are always working
towards a culture of
"open innovation" at



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Find your story here



42,946

Data Sets

555

Code Repositories

17

APIs



What describes you best?



Citizen Scientist



Developer



Citizen Activist



Govvie



Curious



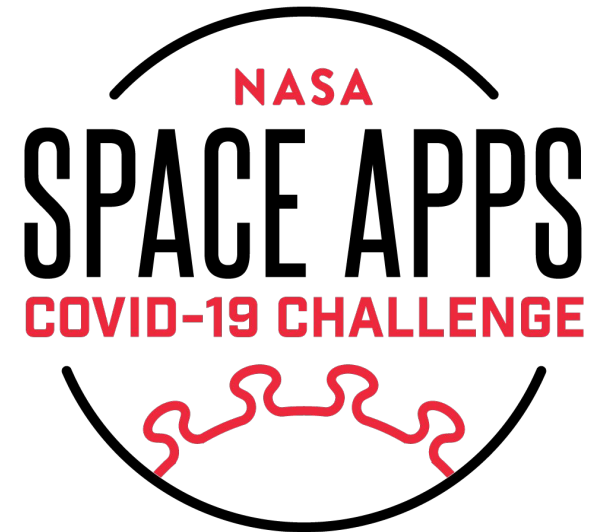
github.com/nasa:
278 public repositories

Top languages

● C ● Python ● C++ ● JavaScript
● HTML

NASA-Acronyms

● JavaScript MIT 15 ★ 21 ! 2 1 Updated 4 days ago



Of course at EOSDIS, we work in the open

4 repository results

[nasa/earthdata-search](#)

Earthdata Search is a web application developed by NASA EOSDIS to enable data discovery, search, comparison, visualiz...

[earthdata-search](#) [eosdis](#) [data-discovery](#)

☆ 525  JavaScript Updated 2 hours ago

[nasa/Common-Metadata-Repository](#)

[eosdis](#) [common-metadata-repository](#)

☆ 214  Clojure Apache-2.0 license Updated 6 days ago

[nasa/edsc-timeline](#)

[timeline](#) [eosdis](#) [earthdata-search](#)

☆ 13  CoffeeScript Updated on Jul 15, 2019

[nasa/edsc-echoforms](#)

A React component implementing the ECHO Forms specification.

[earthdata-search](#) [echo-forms](#) [eosdis](#)

☆ 5  JavaScript Updated 23 hours ago



14 repository results

[nasa/cumulus](#)

Cumulus Framework + Cumulus API

[cumulus](#) [nasa-cumulus](#)

☆ 106  JavaScript Updated yesterday

[nasa/cumulus-dashboard](#)

Cumulus API Dashboard

[cumulus](#) [nasa-cumulus](#)

☆ 31  JavaScript Updated 5 hours ago

[onearth](#)

High-performance web services for tiled raster imagery and vector tiles

 Python ☆ 129  40

[mrf](#)

GDAL-compatible file format driver designed for fast access to imagery

 Python ☆ 51  22

[gibs-web-examples](#)

Examples of using GIBS with various web mapping libraries

 JavaScript ☆ 130  56

[worldview](#)

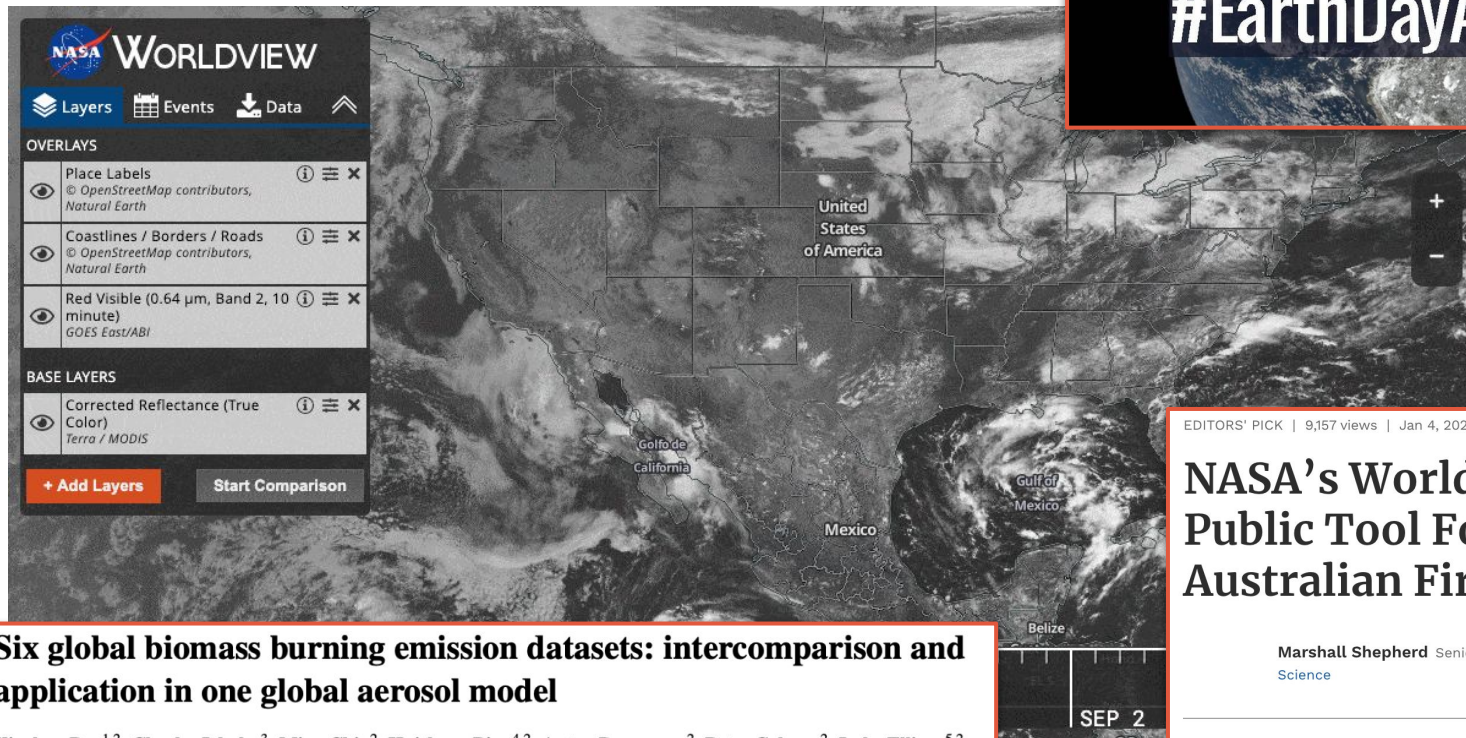
Interactive interface for browsing global, full-resolution satellite imagery

 JavaScript ☆ 457  130



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



Six global biomass burning emission datasets: intercomparison and application in one global aerosol model

Xiaohua Pan^{1,2}, Charles Ichoku³, Mian Chin², Huisheng Bian^{4,2}, Anton Darmenov², Peter Colarco², Luke Ellison^{5,2}, Tom Kucsera^{6,2}, Arlindo da Silva², Jun Wang⁷, Tomohiro Oda^{6,2}, and Ge Cui⁷

EDITORS' PICK | 9,157 views | Jan 4, 2020, 12:34pm

NASA's Worldview - A Useful Public Tool For Monitoring Australian Fires (And More)

Marshall Shepherd Senior Contributor @
Science

Most reasonable people are stunned by the ongoing fires in Australia. An infographic by Statista.com grabbed my attention this morning. It provided a comparison of acres burned by recent headline-grabbing wildfires.



<https://github.com/nasa-gibs/worldview>

Open APIs for quick access to metadata and imagery

Common Metadata Repository (CMR)

<https://cmr.earthdata.nasa.gov/search/site/docs/search/api.html>

<https://cmr.earthdata.nasa.gov/cmr-stac/docs/index.html>



Exciting!
(but still in beta and STAC v0.9)

Now with GOES-East,
GOES-West, and Himawari-8
geostationary imagery
updated every 10 minutes

Global Imagery Browse Services (GIBS)

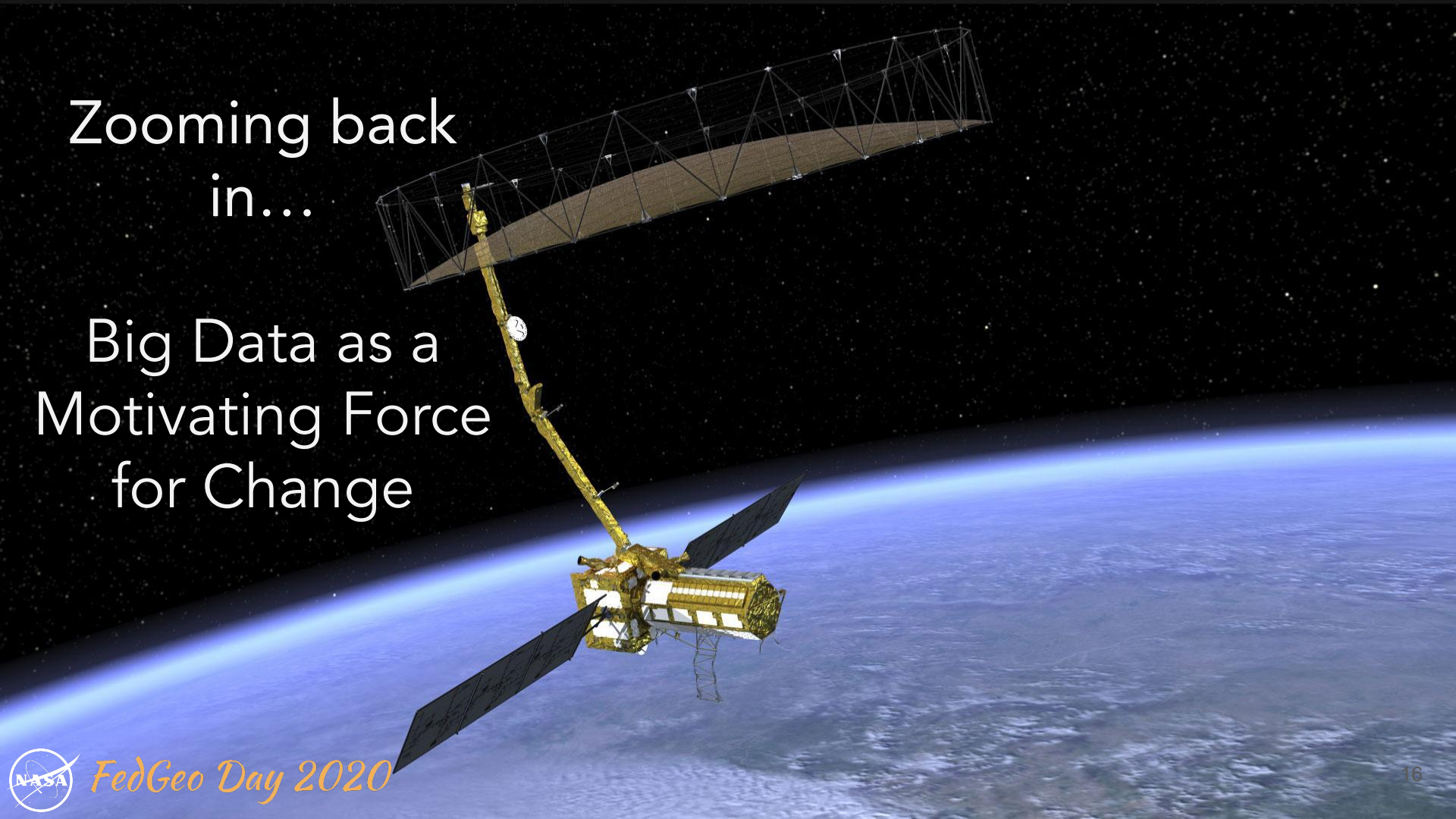
<https://gibs.earthdata.nasa.gov/>

<https://wiki.earthdata.nasa.gov/display/GIBS/GIBS+Available+Imagery+Products>

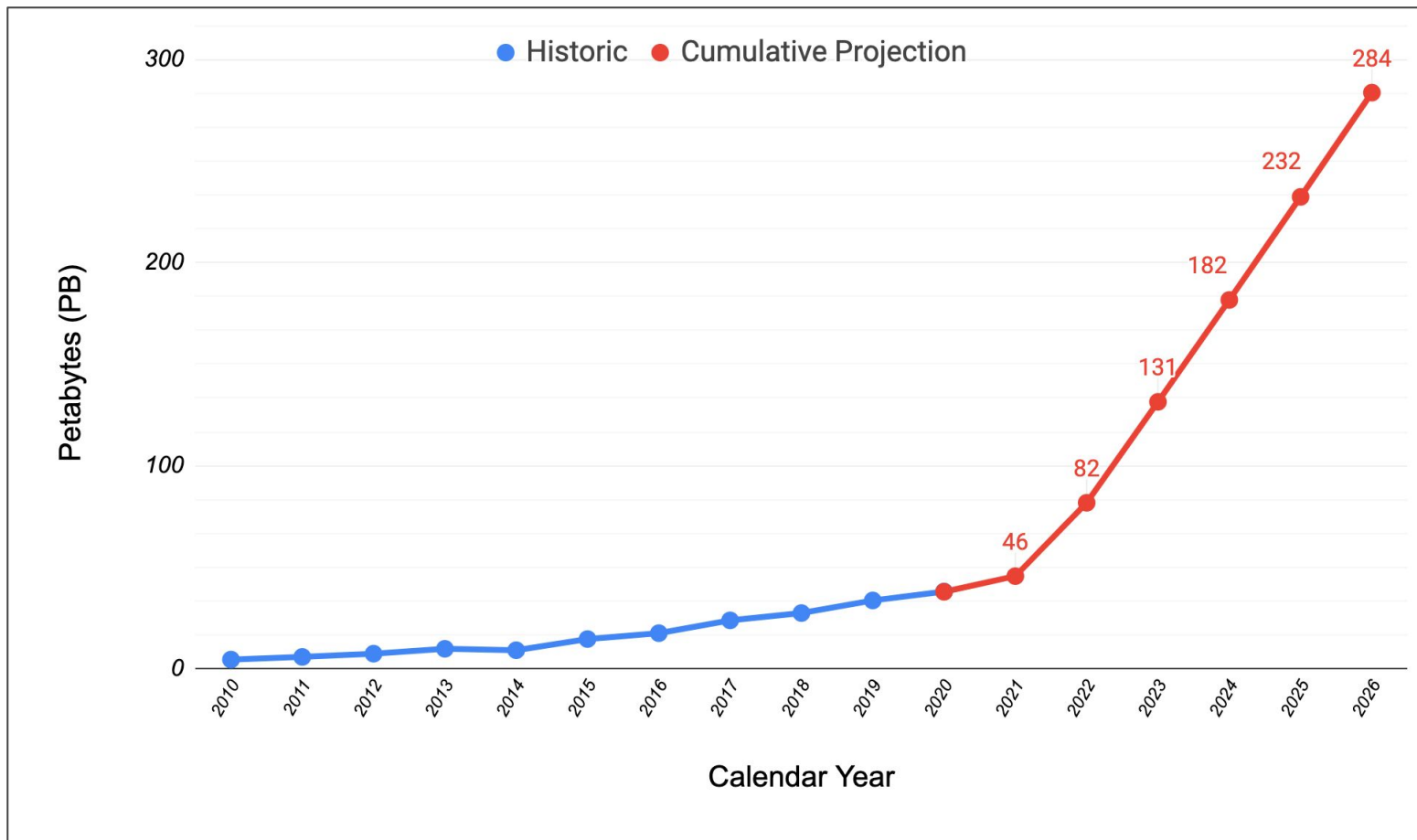


Zooming back
in...

Big Data as a
Motivating Force
for Change



EOSDIS Data Holdings Evolution



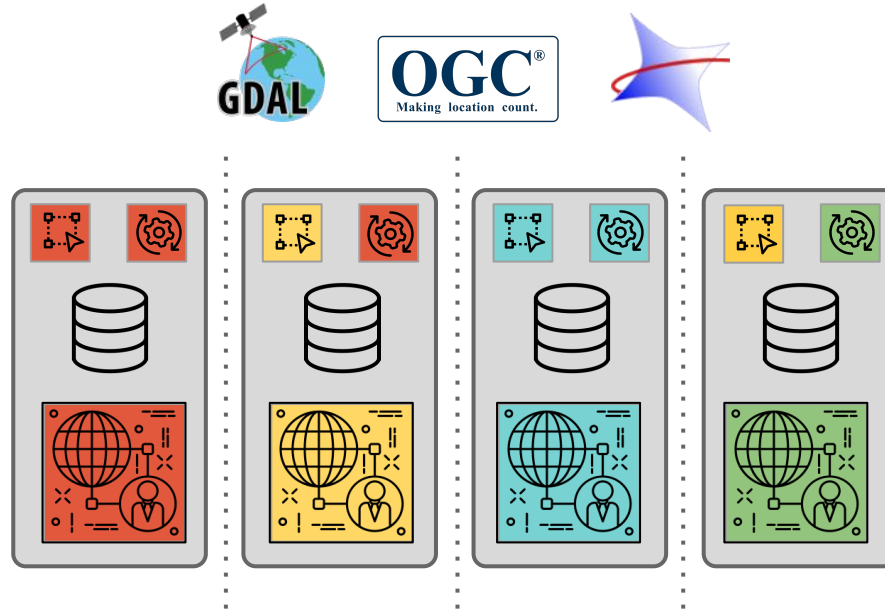
We *need* to move new mission data to the cloud.

This is a great time to look at other opportunities for streamlining and improving access.

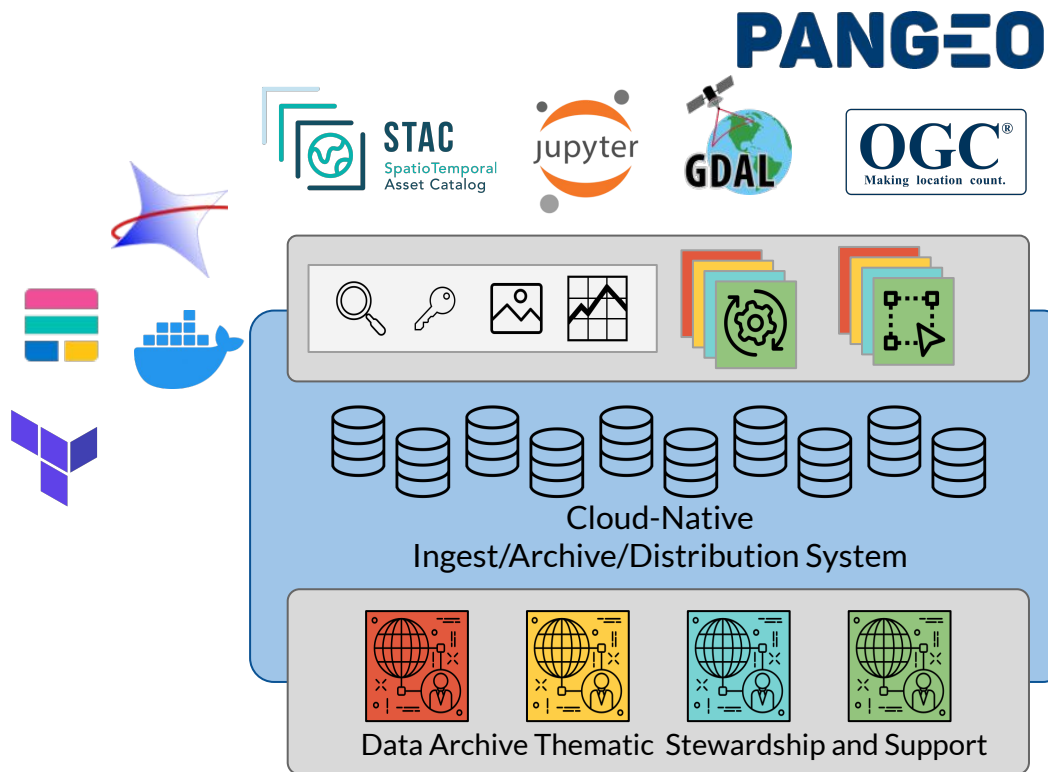
Let's see where we've been.



Historic EOSDIS Over-Simplified Architecture



Semi-siloed Development, Tools,
and Science



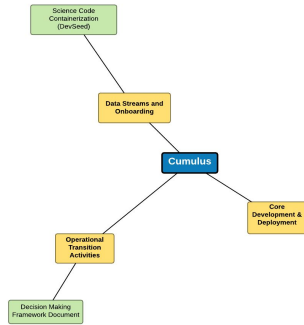
EOSDIS of the Future

Great, so how do you do that?

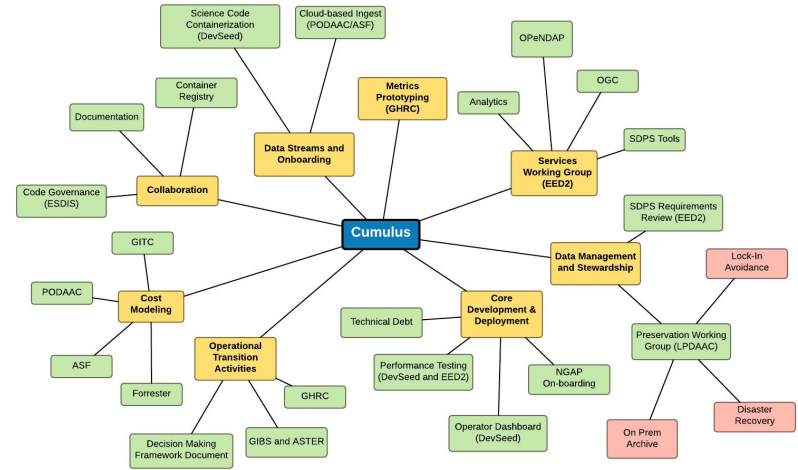
Create a scalable, stable, and secure
Earth science open source ecosystem.

Slowly build a culture
of trust and empowerment.

"If you want to go far, go together."



(several iterations later)



2016

small tight-knit team

2020+

growing collaborative community

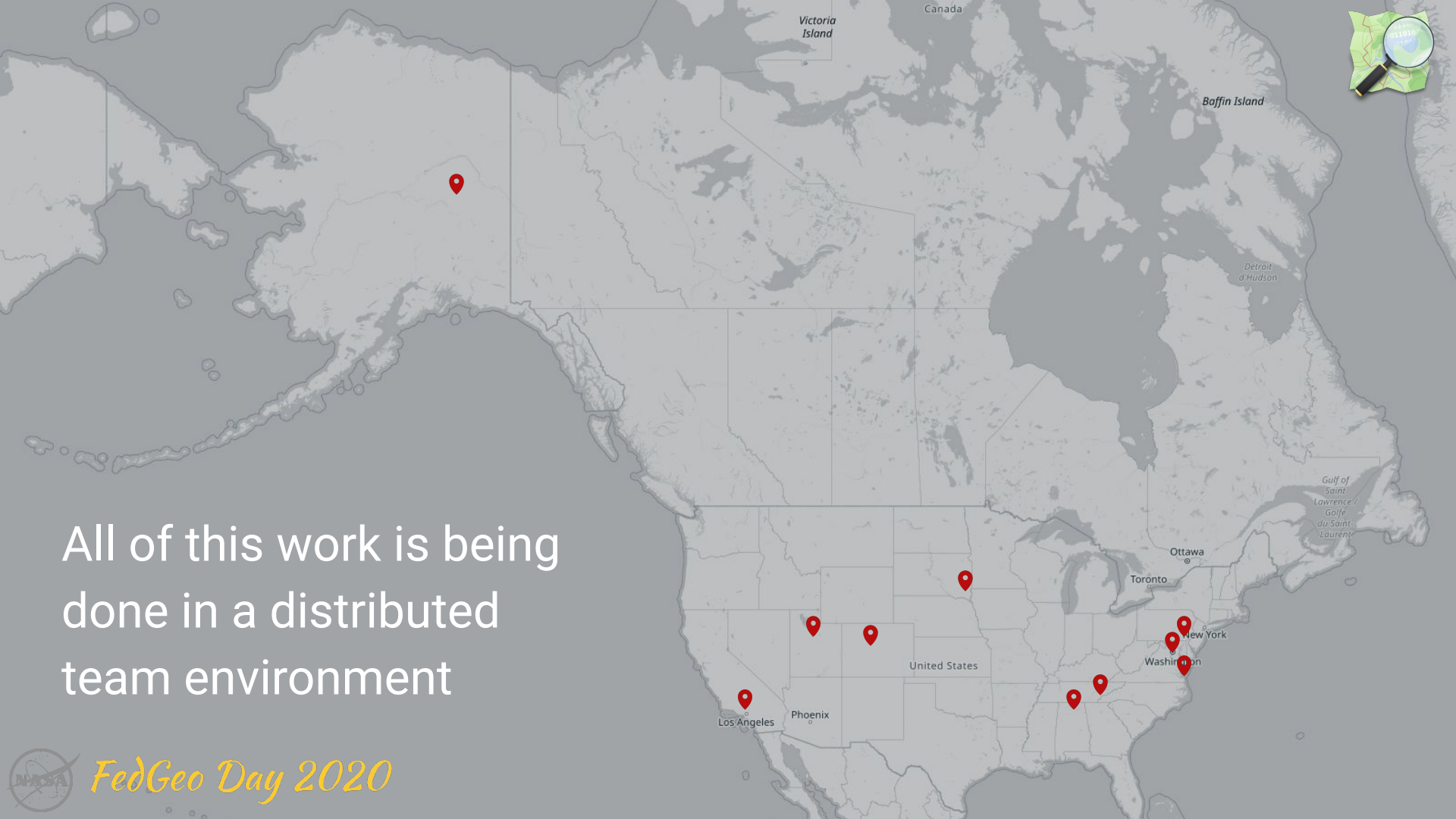


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All of this work is being
done in a distributed
team environment



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We also meet IRL
from time to time



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Creating a Culture of Trust and Empowerment

Cumulus, Code Sharing and Development Ecosystems I

Kirk Hogenson • Lauren Frederick

Developer Lightning Talks

Brian Buechler

Cumulus Integrators F2F

Design for reuse; Architect for Change

DAAC Implementations of Geospatial Web Services

Brian Tisdale

Community Development Model for Cumulus and Harmony (Data Services)

Patrick Quinn • Kirk Hogenson • Lauren Frederick

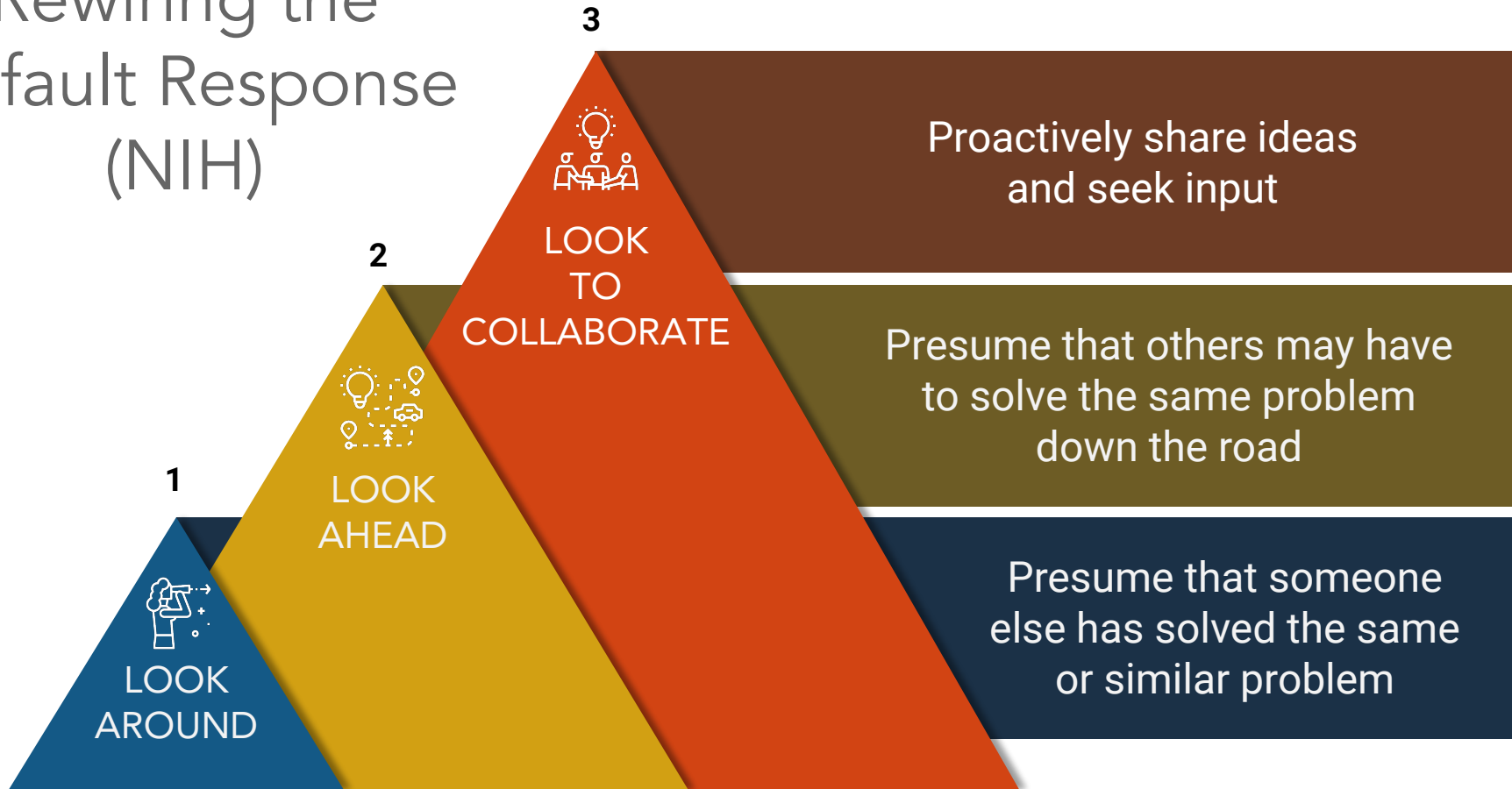
We have an annual, 3-day, in-person meeting:

- 200+ registrants
- crowd-sourced agenda
- targeted sessions (tech/non-tech)
- session voting ← stolen from FOSS4G!
- ad hoc breakout time
- group retrospective



Collaboration First!

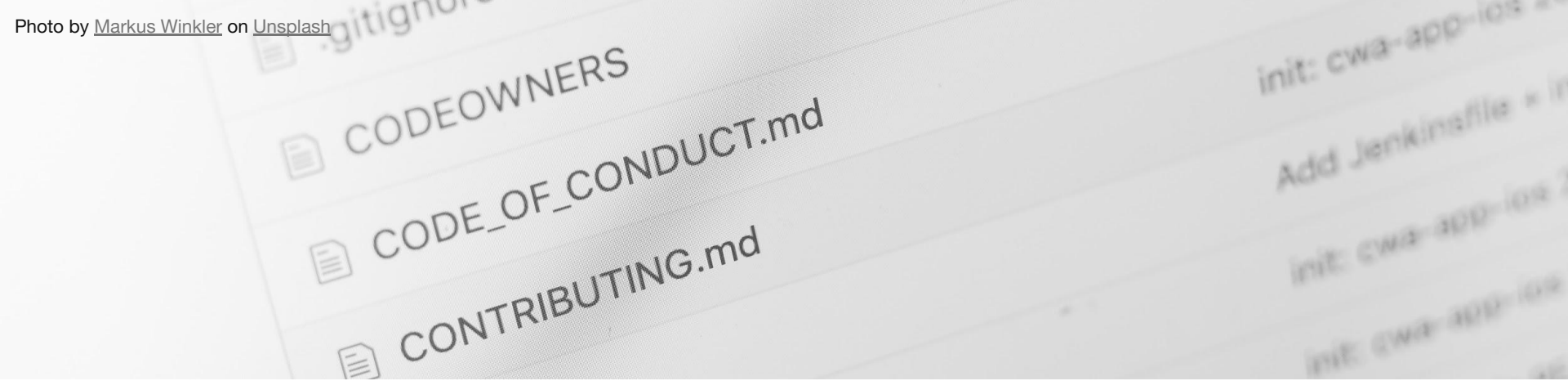
Rewiring the Default Response (NIH)



Since 2016, our core tools have been open sourced and developed in the open.

Building out our new cloud ecosystem is no different.





CODEOWNERS
CODE_OF_CONDUCT.md
CONTRIBUTING.md

Moving to the cloud has driven our actions.

OSS, Open Processes and Distributing Teaming
have enabled us to evolve our organization.



This wouldn't be possible
without open software, open
data, and transparent processes.

We are building
core teams using
cross-archive
developers and
users.

We work together
to focus on
common use
cases.



We have always
been largely
distributed, but we
are now 100%
remote.

It's been largely a
seamless transition.

In some ways, it's
better.



In March our quarterly planning meeting, usually face-to-face, was remote.

We were prepared. Our teams were rock solid and the planning went off without a hitch

(muting issues aside)





Of course things are
not perfect. We are
always working on that.

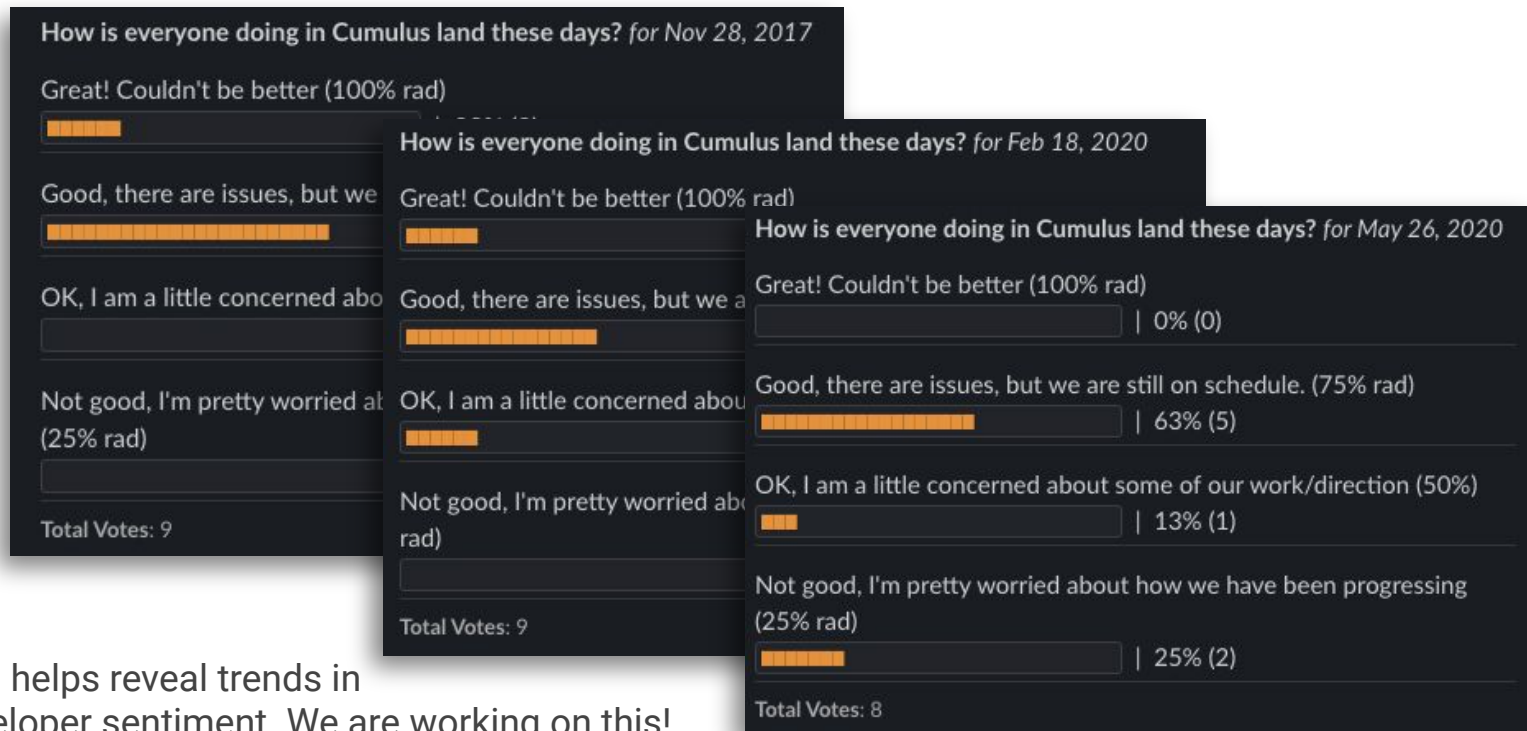


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Retrospection 🙌 is 🙌 key 🙌

Every sprint planning, technical working group, conference presentation, or training we conduct offers an opportunity to reflect, learn, and grow.

Tracking the team heartbeat

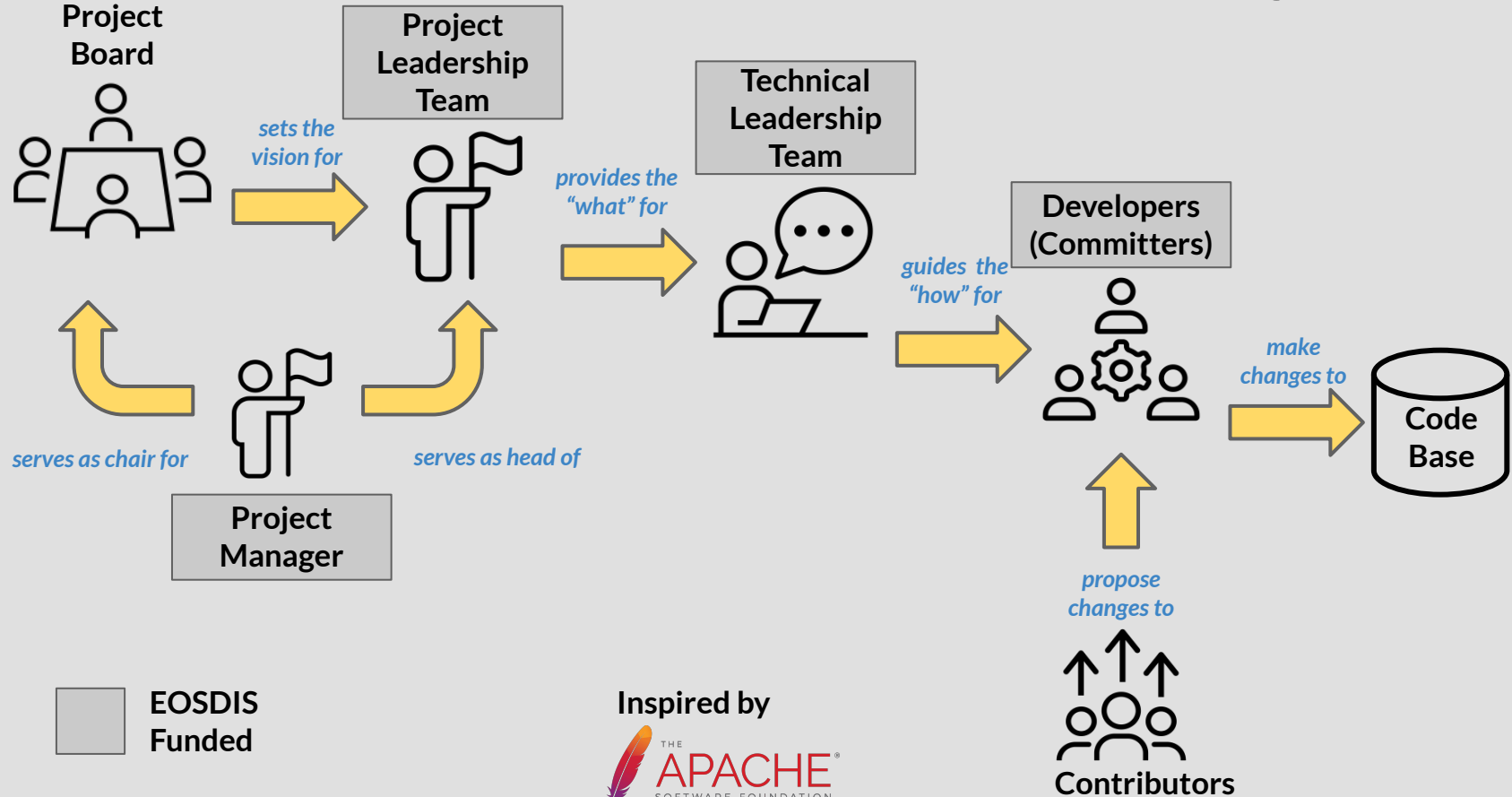


This helps reveal trends in developer sentiment. We are working on this!



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Clarify Roles



EOSDIS is building the system we need together. Always bringing an agile mindset.

But with guidelines to prevent confusion.
And sustaining engineering planning.
And a relentless pursuit of simplification.



So What's Next?



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Photo by [Matt Howard](#) on [Unsplash](#)

Our cloud-native ingest and archive system is in production at two (out of 12) archives now.

We have 6 other archives working towards production level releases over the next 3-12 months.

Two high data rate missions launch in 2022.
Several other missions are close behind.

We will be ready.

Zooming back out
to bring it home

So, what else is going on at



Other than the obviously amazing stuff...





"The Earth Science Data Systems (ESDS) Program requires that all software developed through research and technology awards ... or other government-funded development is to be made available to the public as Open Source Software (OSS)."



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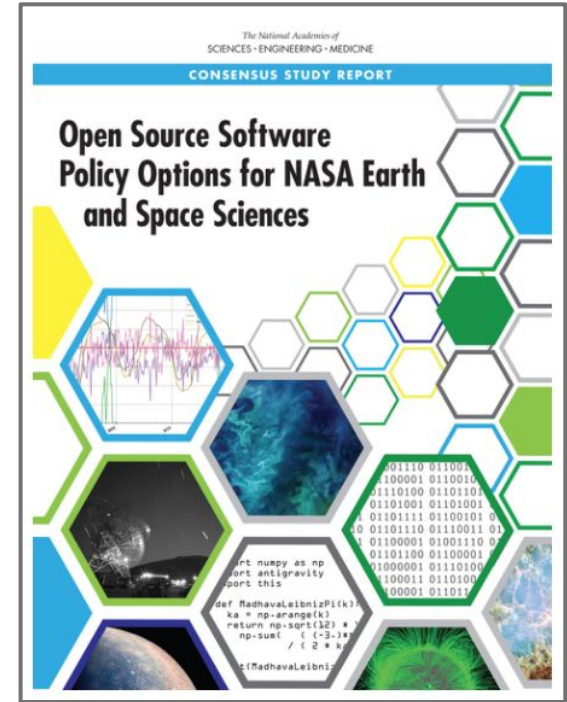
<https://earthdata.nasa.gov/collaborate/open-data-services-and-software/esds-open-source-policy>

Recommendations for Bigger Change at the Agency level

Recommendation: NASA Science Mission Directorate should consider a variety of policy options depending on discipline and software type and transition to greater openness over time.

Recommendation: NASA Science Mission Directorate should encourage the use of standard open source licenses, but not mandate a particular license. Nonstandard licenses should be justified in the software management plan.

Recommendation: NASA Science Mission Directorate should develop internal policies and external legal language conducive to the swift release of open source scientific software, and the full participation of NASA employees in internal and external open source projects, without jeopardizing national security or incurring legal liability.



<https://doi.org/10.17226/25217> (2018)

While not requirements, these recommendations are driving the strategy for NASA Science data in the decades to come.

NASA has been working in the open for years,
and will only do more going forward.

We aren't perfect, we are always pushing
ourselves to do better.

I can't wait to see how far we will go.

Thanks!



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@steadyflux



[/in/kathleenebaynes/](https://www.linkedin.com/in/kathleenebaynes/)



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