



NASA Open Data & Accessibility

National Aeronautics and
Space Administration




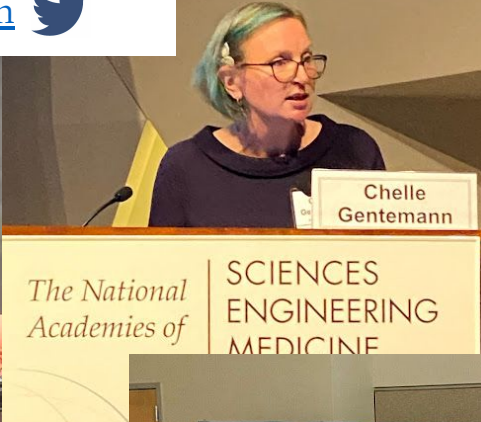
A NASA OPEN-SOURCE SCIENCE MISSION: **TOPS: TRANSFORM TO OPEN SCIENCE**

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Christian Reyes, OSSI Coordinator



Who am I? Dr. Chelle Gentemann
Why am I here talking to you?
More: [@ChelleGentemann](https://twitter.com/ChelleGentemann) 

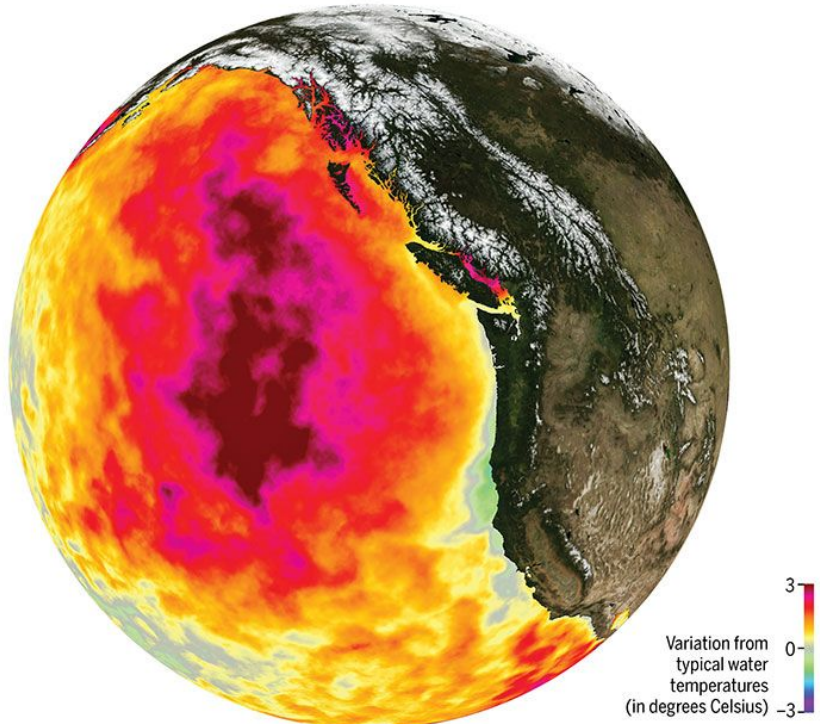




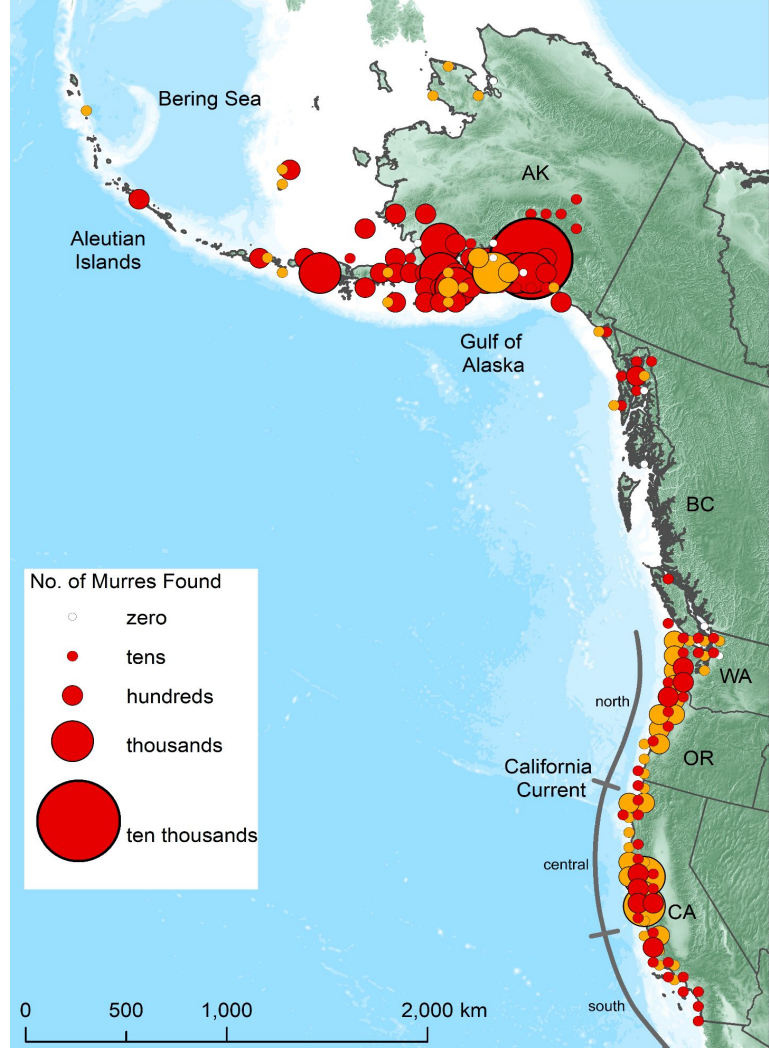
Mixed Marine Plankton - including
Mantis Shrimp Larva & Crab Zoea.
Image: Peter Parks/imagequest3d.com,
Peter Parks



“As the base of the food chain crumbled, the effects propagated upward”



<https://www.science.org/content/article/ocean-heat-waves-pacific-s-deadly-blob-could-become-new-normal>

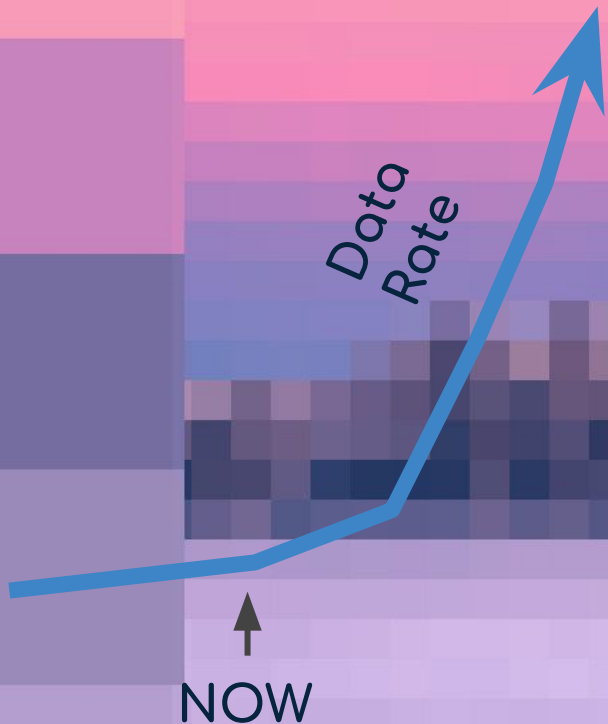


<https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0226087>





Data



Cloud-based data

Easier to collaborate

Easier to reproduce and build on

Access not bandwidth-limited

More Interdisciplinary research

Broadens participation



Why Open Science?

We are facing **Big Challenges**:

Covid, Climate change, ...

We need *more* people - more hands, more eyes, more brains - with diverse experiences to participate so that we ask the best questions and find the best solutions

Open Science:

- Accelerates the pace of science
- Increases the impact of science
- Expands applications of data and science
- Shares hidden knowledge & expands participation in science



Image credit: NOAA



Image credit: Twentieth Century Fox



Why Now?

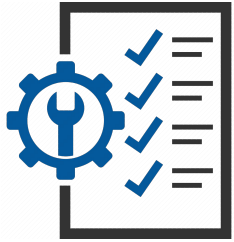
We **now** have the tools to make open science a reality. Advances in technology have created accessible, reproducible, inclusive science at a scale not possible a few years ago.

There is national and global momentum for the move to open science.

Equal and open access benefits the public

NASA's Open-Source Science Initiative

Unlocking the full potential of a more equitable, impactful, efficient, scientific future



Policy development, education, compliance tools
Updating NASA policies on scientific information to better enable the activation of open science



Core Services for Science Discovery
Developing core data and computing services to enable open science



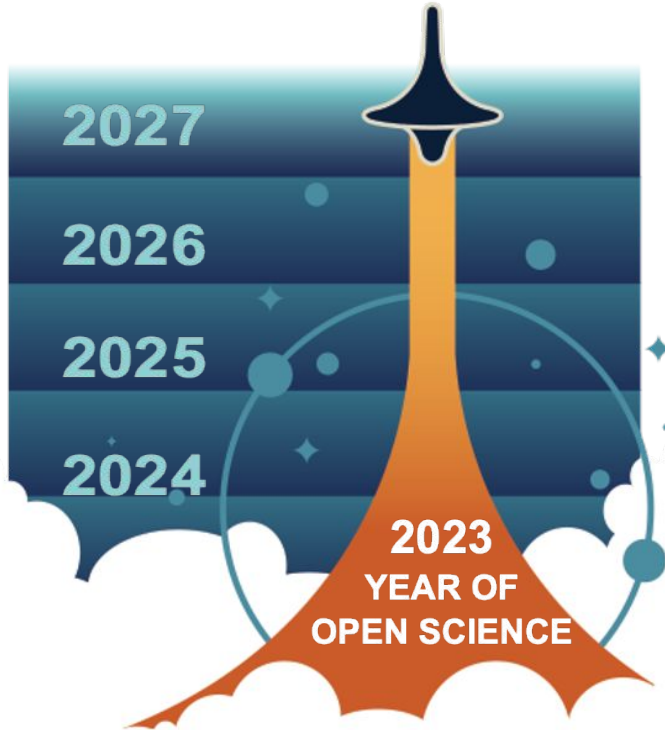
ROSES Elements
Supporting open-source software, tools, frameworks, libraries, platforms, and training with over \$5 million dollars in grants



Community Building & Partnerships - Transform to Open Science (TOPS)
Accelerating adoption of open science



Leading the Path to Open-Source Science



Transform to Open Science (TOPS) is a \$40 million* 5-year NASA Science Mission Directorate mission geared towards accelerating the adoption and understanding of open science

Key Goals:

- Increase understanding & adoption of open science
- Accelerate major scientific discoveries.
- Broaden participation by historically underrepresented communities

*pending appropriations

Increase understanding & adoption of open science

There are basic skills that all scientists need....

but rarely are trained on

How do you share your research to maximize its impact?

- Basic open science skills
- Discipline-agnostic



OpenCore



- Additional discipline-specific, advance modules available



Increase understanding & adoption of open science

- *OpenCore* - an introduction to open science
- Completed in person, independently, and in virtual cohorts
- Earn certification for completion

Gradually
mandate

What is open science, why does it benefit me, and why does it benefit the greater scientific community?



How to share software



Best practices for sharing all results and analysis, as well as peer reviewing

ETHOS OF OPEN SCIENCE

OPEN TOOLS & RESOURCES

OPEN SOFTWARE

OPEN DATA

OPEN RESULTS



How to use popular open science tools



How to effectively use and share open data



Earn Badges at Each Level

Complete All 5 & earn TOPS Open Science Badge & Certification

Increase understanding & adoption of open science

Engagement with the Community



TOPS Champions

Scientists to help teach modules at events and act as Open Science champions



Cohorts

Engage with learners through a virtual cohort model to increase Open Science Badge achievement



Summer Schools

Institutions selected to run ~6 weeks of teaching the 5 modules to selected science teams + open competitive under-represented researchers



Curriculum Expansion

Groups funded to migrate/create discipline specific modules and data science skills modules to Open edX TOPS platform



Hackathons

More hackathons that advance data science skills and open science



NASA's Open-Source science is the *activation* of an open science community

A continuum of open-source science

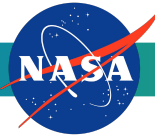
Data access (\$\$)
Accessible Publications (\$\$)
Siloed systems
Limited communication
Proprietary Software
"Closed-Tent" culture



Free unlimited data access
Fully documented open software and algorithms
Fully linked data and publications
Open Access Journal publications
Fully Transparent processes
Reproducible across platforms
"Teaching" culture
Open science meetings



FULLY CLOSED



FULLY OPEN



No public access data
No publications
No insight into processes
No reproducibility
"Black Box" culture



Free data access
Open software and algorithms
"Green" Journal publication
Documented processes
Reproducible in specific environments
"Open-Tent" culture



2023 Year of Open Science

High level visibility

- Publications, articles, working TOPS into HQ comms
- Announce new Open Science awards
- Announce recognition of Open Science activities

Conferences

- Targeting domestic meetings (EGU only exception)
- These meetings will have TOPS representation at NASA booth, town halls, OpenCore workshop, high-visibility in society comms and at conference
- We will also be at other meetings - eg. AAS winter with TOPS champions organizing activities and workshops (with support)

Virtual Cohorts

- Learners who complete part of OpenCore will be followed up with an enrolled in virtual cohorts to encourage completion of course

Summer Schools

- 3-4 institutions funded to run 6-8 weeks of OpenCore / Science Team summer schools - train entire science teams all together in 1 week.

Targeted Workshops

- In-person workshops with strong outreach to historically underrepresented communities to learn open science and build community at the same time

Conference	Date	Size	BPS	PDS	Helio	Earth	Astro	HUGS*
AGU Fall	Dec	25K	x	x	x	x	x	
AMS/AAS	Jan	6K			x	x		
AAAS	Mar	9K	x	x	x	x	x	
LPSC	Mar	2K		x				
EGU	Apr	18K	x	x	x	x	x	
AAS	Jun	3K		x	x		x	
IGARSS	Jul	3K				x		
Soc. Asian Sci&Eng	Oct	3K						x
Amer. Indian Sci&Eng	Oct	2K						x
SACNAS	Oct	6K						x
ASGSR	Nov	1K	x					
AGU Fall	Dec	25K	x	x	x	x	x	
Targeted workshops	May/ Sep	200						x
Totals		~100K	5	6	6	6	5	4

*HUGS- historically underrepresented groups



Accelerate major scientific discoveries....

"We're deeply grateful to all the open source contributors who made our work possible." –Dr. Katie Bouman



"The open source community is very important for scientists; imagine if we had to do everything from scratch every single time." –Dr. Chi-Kwan Chan

We "greatly improve[d] our own work by adopting well-tested community packages that contain the collected wisdom of many other projects." –Dr. Lindy Blackburn

"with the open source projects in NumFOCUS, we were able to iterate our algorithms so fast that they enabled us to finish our work in two years"

First image of black hole



Replying to @ChelleGentemann and @theNASEM

An aspect we should talk more about, open research practices as a driver to a real reform in the research endeavour. I try to depict it in this image :)



Replying to @ChelleGentemann @openscience and @theNASEM

Being an open scientist has:

- 1) accelerated my career. It has allowed me to choose projects which benefit more people.
- 2) Has created long lasting collaborations and friendships. When you are open you are... open!
- 3) Made me a better scientist. "Show your working!"



6:36 AM · Mar 12, 2022 · Twitter Web App



Replying to @ChelleGentemann and @theNASEM

Congrats Chelle!

The welcoming, inclusive, collaborate-and-reuse culture of the #rstats community is something that changed my science-life and my life-life. Hard to distill but here are a few attempts:

- openscapes.org/blog/2020/02/2...
- openscapes.org/blog/2019/02/1...
- openscapes.org/blog/2019/08/2...

3:15 PM · Mar 11, 2022 · Twitter Web App

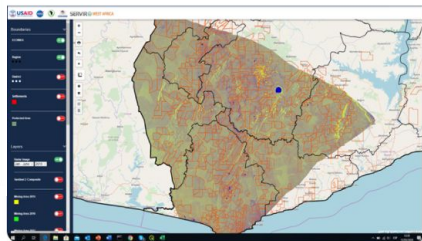


Replying to @ChelleGentemann and @theNASEM

Our friends @SERVIRGlobal have many examples of how algorithms + code from one region have been customized for use in another. An example is gold mining monitoring, where Amazonia + W. Africa have collaborated in an #OpenScience context, leveraging #GEE. 🇵🇳



Reducing illegal gold mining in the tropical forests of Ghana and Peru: A forthcoming collaboration across the Atlantic #SERVIRamazonia servir.ciat.cgiar.org/illegal-gold-m...
@USAIDPeru @SERVIRGlobal @CERSGIS.GH @NovoaSidney @amazonacca @sig_gis @BioIntCIAT_eng



Replying to @ChelleGentemann and @theNASEM

Probably the most common answer, but using @xarray_dev, @dask_dev, @ProjectJupyter, and @matplotlib has been the backbone of my research since day 1. Working with these tools also motivates me to make the data and code for my plots open source, making my science more reproducible

7:41 AM · Mar 11, 2022 · Twitter Web App



Replying to @ChelleGentemann and @theNASEM

In remote sensing: using @PyTrollOrg satpy as a comparison point for reading geostationary satellite data, @scitools_iris and panoply from @NASA for plotting said data.

12:15 PM · Mar 11, 2022 · Twitter Web App



Replying to @ChelleGentemann and @theNASEM

In computer science, research moves very fast. It would not be possible to keep up with the latest work if not for the arXiv and open-access conferences.

1:47 PM · Mar 14, 2022 · Twitter Web App



Replying to @ChelleGentemann and @theNASEM

I've briefly returned to the public-private sector (between 2019-21) and the nicest thing about working with OSS during all my career was the ability to show new methods to be applied in that company, which was of clear understanding, helping auditing efforts.

7:56 AM · Mar 12, 2022 · Twitter Web App



Replying to @ChelleGentemann and @theNASEM

Here's a great use-case of @Py ART , which is funded by @doesscience @armnewsteam ! Over 200 citations so far, with many including awesome code like this paper which enables #OpenScience !



The power of open source software! The authors (@jehcssou and @deeplycloudy) also provide a clean code to encourage reproducible science. I could apply their technique to my dataset within a few hours. Neat! Yes to #OpenScience





New Funding Opportunity!

~\$3 Million/yr

F.14 Transform to Open Science Training ([TOPST](#))

- 1) Develop ScienceCore
- 2) OpenCore Summer Schools
- 3) OpenCore virtual cohorts

Oct 13, 2022 – Ask questions at forum ([Register](#))

Nov 10, 2022 – (Optional) Notice of Intent Due

Dec 8, 2022 – Proposal Due

Scan to Learn





How YOU can Get Involved:

To change everything we need everyone.

Scientists and Mission partners to co-develop activities

- Propose open science hackathons
- Participate in *OpenCore* development
- Signup your science team for *OpenCore* summer school
- Develop mission open science action plans

Learn more and collaborate with us - we're working on GitHub!



TOPS Email List



TOPS Website



Q&A

Learn more and
collaborate with us!



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