The following report is the first annual progress report for Openscapes (ROSES 80NSSC21K0564, PI Lowndes, co-lead Robinson) with NASA. This report covers the period from February 1, 2021 through January 31, 2022.

This project supports scientists using data from NASA Earthdata served from the Distributed Active Archive Centers (DAACs) as they migrate workflows to the cloud. Priorities throughout are promoting Open Science through skill development and role-modeling, and diversity, equity, and inclusion as part of daily work.

Table of Contents

Year 1 Summary

The overarching vision of our project is to support scientific researcher teams using NASA EOSDIS data as they migrate their workflows to the cloud. We are doing this working with NASA Distributed Active Archive Centers (DAACs) over three years by:

1. Developing a cross-DAAC Mentor community
2. Empowering science teams through the Champions program
3. Scaling the Champions program with DAAC Mentors

In Year 1 we focused on item (1) Developing a cross-DAAC Mentor community through developing the DAAC Mentors program, leading the DAAC Mentors program, and community engagement within NASA and beyond. These activities and products are detailed below.

In Year 1 we adapted our plans for items (2,3) the Champions program to better align with timelines for NASA Earthdata in the cloud, as well as for further development in the Mentors community and investment in Cloud curriculum (e.g. Earthdata Cloud Cookbook and 2021 Cloud Hackathon). We advertised for a Champions Cohort for summer 2021 but shifted to March 2022 instead. We describe preparations for this in more detail below and the Cohort itself will be detailed in Year 2.

Appendix 2 are slides from a 10-min presentation at the ESIP Winter meeting (January 2022) summarizing and visualizing some of these efforts.

Develop DAAC Mentors program

We are supporting and strengthening the community of DAAC folks that are already creating cloud learning resources. We designed the program with active engagement with NASA communities and using open source software for all communication. Developing the DAAC Mentors Program meant creating space (time) and place (through collaborative software) to build trust and find the common.

ESDSWG engagement

We gave a short talk in the opening session of ESDSWG 2021 about the idea of NASA Openscapes. Working with Justin Rice, we asked DAAC Managers to nominate members of their team to give paid time to join the NASA Openscapes DAAC Mentors program.

Nominations, selection, kick-off

Nominations came from 5 DAACs: PO.DAAC, NSIDC, ASDC, LP DAAC, GES DISC, as well as IMPACT and JPL.

We held 1:1 intro calls to meet the nominees and describe more about the program. We accepted all teams, and kicked off the DAAC Mentors Cohort in March 2021. Cohort Calls, as described more below, created space for Mentors across DAACs to start building relationships and seeing the common parts of their work.

Participating mentors

As of February 2022, these are the list of current and past mentors:

Current

- Andy Barrett, NSIDC
- Aaron Friesz, LP DAAC
- Shubhankar Gahlot, IMPACT
- Iksha Gurung, IMPACT
- Alexis Hunzinger, GES DISC
- Luis Lopez, NSIDC
- Catalina M. Oaida, PO.DAAC
- Jack McNelis, PO.DAAC
- Muthukumaran Ramasubramanian, IMPACT
- Christine Smit, GES DISC
- Amy Steiker, NSIDC
- Makhan Virdi, ASDC

Past Participants

- Jennifer Adams, GES DISC
- Vishal Bagadia, ASDC
- Cole Krehbiel, LP DAAC
- Paul Moth, NSIDC
- Matt Tisdale, ASDC

Create GitHub Organization: NASA-Openscapes

We created a place for Mentors to begin collaborating. Balancing discussions of GitHub vs GitLab and who knew or could use what, we decided on creating a new GitHub organization called NASA-Openscapes. It is a shared neutral space (i.e. not within any specific DAAC) and acts as a sandbox for us all to try things out, test things, and develop together. As described more below, we held GitHub clinics and co-working sessions to help everyone learn and share together so that all Mentors became confident GitHub users and confident collaborating and sharing imperfect work with each other.

GitHub Org: https://github.com/nasa-openscapes

Create NASA-Openscapes website

We created a website - a place to share updates about our project. Built with R (RStudio's Distill) and GitHub, this is also part of role modeling open science and how to communicate about open projects.

Website: https://nasa-openscapes.github.io/

Create JupyterHub 2i2c Cloud infrastructure

We created a JupyterHub partnering with 2i2c that is available to DAAC Mentors, Hackathon and AGU Workshop participants. Mentors have said this has been critical to support researchers migration to the cloud - without this hands-on experience it is very difficult to advise.

To extend the utility of this "sandbox" to others, we've made it available to other DAAC staff. See Appendix 1 of current participants.

JupyterHub: https://openscapes.2i2c.cloud/hub/

Open science & DEI summary

The design of the NASA Openscapes Framework builds on Openscapes' investment in increasing diversity, equity, and inclusion in all activities and facilitation style to create spaces that are psychologically safe for folks to learn together and share imperfect work. For example, see:

- openscapes.org/blog/2021/03/25/rebel-alliance-dr-dawn-wright
- openscapes.org/blog/2021/05/27/tara-robertson

There is diversity in the nominated mentors cohort across gender, race, job title, technical level.

Lead DAAC Mentors Program

Our 2021 activities included:

- Build a DAAC community of practice through our twice monthly Openscapes Cohort Calls, a Carpentries Intro Python/Git Workshop, and Carpentries Instructor Training
- Develop participating teams as Mentors and help them practice teaching in a style to prepare them for a AGU workshop (Dec) and the Openscapes Champions cohort with research teams (early 2022)
- Support Mentors towards establishing a common set of tutorials that they can then build off their DAAC-specific and science examples

All activities begin with a summary of our Code of Conduct: openscapes.org/code-of-conduct/.

Openscapes Mentorship: Cohort Calls, Clinics and Co-working

We established regular twice-monthly calls for for building trust, skills, and identifying and addressing common needs across DAACs. All calls conclude with Efficiency and Inclusion Tips. We posted summaries of each cohort call through the summer (https://nasa-openscapes.github.io/mentors) and then transitioned to using this time as focused co-working to prepare for the 2021 Cloud Hackathon.

Through a GitHub Clinic and co-working sessions, we skillshared and learned how to use GitHub collaboratively with branches, pull requests, and are beginning to formalize using it for code review.

Lead Carpentries Workshop: Intro to Linux/Shell, Python, Git

This workshop is open to NASA Earth science data users, hosted by Openscapes, NASA, and the NASA Atmospheric Science Data Center (ASDC) DAAC.

Workshop website: https://virdi.github.io/2021-05-17-openscapes-online/

Carpentries Instructor Training

Our Carpentries membership had 10 seats available for Instructor training.

9 DAAC Mentors took Carpentries Instructor Training in to learn teaching pedagogy and see and practice live coding when teaching. Live coding means typing live at a pace where your learners can follow along with you, and is a deeper learning experience than only seeing a demo scroll by that learners do not experience themselves.

Our final seat went to an Openscapes partner Ileana Fenwick, a second-year Ph.D. student at UNC Chapel Hill. Ileana is building community around a "Pathways to Openscapes" program for environmental researchers at Historically Black Colleges and Universities (HBCUs) and bridging open science communities with Black in Marine Science and Black Women In Ecology, Evolution, and Marine Science. From Ileana:

- I just wanted to say the Carpentries Instructor Training was AWESOME!!!!! I had so much fun and am so excited to start working through the checkout for formal instruction certification. I was in a breakout group where another instructor in training did such a cool job of explaining python (something that has intimidated me for wayyyy too long) that I am actually going to start going through the modules to learn! Super excited. Thank you so much for the opportunity. This is the coolest.

DAAC User Working Group Presentations

We were invited to present the NASA-Openscapes Framework is being shared at DAAC User Working Group meetings including:

- LP DAAC, August 12, 2021 (Slides)
- GES DISC, September 8, 2021
- NSIDC DAAC, September 16, 2021

Create Cookbook & tutorials page

We created a tutorial book architecture using Quarto, which combines Jupyter Notebooks into beautiful online books that can be easily shared, navigated, and used by learners of all skill levels (i.e. it is a friendlier experience than notebooks in a GitHub repository).

We partnered with RStudio as their first external testers using Quarto. Quarto builds from what RStudio learned from RMarkdown. It makes collaborating to create technical documentation streamlined because we

work in plain text documents that can have executable code (Python, R) and are rendered using Jupyter and Knitr engines.

Earthdata Cloud Cookbook: https://nasa-openscapes.github.io/earthdata-cloud-cookbook

We also created a tutorials page on the main NASA-Openscapes website - all available for reuse and remix. As NASA DAACs transition data to the cloud, tooling and workflows will evolve. We organize tutorials in books, with the idea that each teaching event has its own book that is developed for a concrete audience and is a snapshot in time, and that the Earthdata Cloud Cookbook will be a collection of the most up-to-date tutorials.

Tutorials page: https://nasa-openscapes.github.io/tutorials

Support 2021 Cloud Hackathon

This Hackathon is co-hosted by PODAAC, NSIDC DAAC, and LPDAAC. Additional support is provided by ASDC, GESDISC, IMPACT, and Openscapes. It was a 5-day event, 4-hours/day.

Support involved creating and managing the Quarto book, helping establish norms around scope and style (including live-coding) coordinating tutorial reviews and reviewing tutorials, coordinating dry runs for each teacher to practice live-coding and get feedback. We also were tech hosts for the Hackathon (managing Zoom breakout rooms, etc) working closely with Catalina Oaida from PO.DAAC.

Hackathon book: https://nasa-openscapes.github.io/2021-Cloud-Hackathon

Blog summaries:

- https://earthdata.nasa.gov/learn/articles/2021-cloud-hackathon
- https://podaac.jpl.nasa.gov/announcements/2021-12-15-The-2021-Cloud-Hackathon

Support 2021 Cloud Workshop at AGU

This Workshop is co-hosted by PODAAC, NSIDC DAAC, and LPDAAC. Additional support is provided by ASDC, GESDISC, IMPACT, and Openscapes. It was a 1-day event, 4-hours.

Less than one month after the Hackathon, support and development build from the Hackathon preparation described above, and focused on down-scaling lessons and adapting the approach from the Hackathon.

AGU session Details: https://agu.confex.com/agu/fm21/meetingapp.cgi/Session/124026
AGU workshop book: https://nasa-openscapes.github.io/2021-Cloud-Workshop-AGU

Open science & DEI summary

All events (Mentor Cohort Calls and Hackathons) begin with a Code of Conduct. We work to normalize open, imperfect, reuse through building trust and psychological safety.

Community Engagement within NASA and Beyond

Our community engagement approach focuses on inspiring and attracting folks to join the open science movement, using original artwork, storytelling, and practical tips.
Full list of slides shared from our project are:

- https://nasa-openscapes.github.io/about.html#slides
- https://openscapes.org/media

Open Science in Action at AGU

We and several DAAC Mentors were invited to give talks at the Open Science in Action Session at the AGU Fall meeting, co-organized by Chelle Gentemann.

- NASA Earthdata Access in the Cloud Using Open-source libraries - December 17, 2021: invited talk by Amy Steiker at the Open Science in Action Session at the AGU Fall meeting (30 minutes)
- Open Project Design: Lessons from the NASA Openscapes Framework — December 17, 2021: invited talk at the Open Science in Action Session at the AGU Fall meeting (30 minutes)

ESIP session

We held our first cross-government agency session called Better Science for Future Us: Planning for the Year of Open Science at the ESIP Winter Meeting. Speakers included two DAAC Mentors from University of Colorado (NSIDC), and United States Geological Survey (USGS / LP DAAC), along with the University of North Carolina (UNC), National Oceanic and Atmospheric Administration (NOAA) Fisheries, and the California Water Boards. The goals of this session were to increase visibility and value of open science within government and support researchers and leaders that are already doing this within government organizations; to create more channels for inter- and cross-agency learning; and to share open science stories across agencies as we prepare for NASA's Year of Open Science initiative. Speakers shared stories about open science in government and their experiences with Openscapes.

Blog summary:

- https://www.openscapes.org/blog/2022/02/17/esip-winter-2022

NASA Open Source Science workshop

We were part of NASA's Open Source Science for Data Processing and Archives Workshop:

- Openscapes: Better Science for Future Us — October 14, 2021: NASA's Open Source Science for Data Processing and Archives Workshop

Pangeo Showcase

Our project was presented at the Pangeo Showcase, a weekly webinar that highlights relevant work around the Python/Earth science community.

The talk and slides can be found on their website.

Champions Program Preparation

We postponed our original plans for a summer 2021 Champions Cohort and instead are leading it in March 2022 to better align with timelines for data migrations to the cloud. We made this shift in discussion with the DAAC Mentors and Justin Rice.

We began recruitment at AGU in December and in February accepted 10 research teams (~36 researchers) to join our Mentors and plan migrating their workflows to the cloud.

Announcement website: https://nasa-openscapes.github.io/champions
Cohort website: https://nasa-openscapes.github.io/2022-nasa-champions

What's next

2022 will focus on leading the March 2022 Champions Cohort and assisting DAAC Mentors to use this teaching modality along with their Hackathons.

We will also be onboarding new Mentors from additional DAACs to the Mentor community - 2021 Mentors will not offboard but will continue to be part of the growing community and open science movement as NASA EarthData migrates to the cloud.

Appendices

1. JupyterHub List of participants

As of February 2022

GitHub username	First name	Last name	Purpose. If you're affiliated with NASA DAACs please specify in "Other"	Date added
battistowx	Christopher	Battisto	GES-DISC Cloud Documentation Team	2022-01-04
emilyscassidy	Emily	Cassidy	Learning from the tutorials for open science communications.	2022-01-04
faithgiguere	Faith	Giguere	GES DISC DAAC member	2022-01-04
kcbinita	Binita	KC	GES DISC	2022-01-04
kevinmarlis	Kevin	Marlis	podaac science use case	2022-01-20
thomasfrederikse	Thomas	Frederikse	PO.DAAC science use case	2022-01-20
jamrhein	Jim	Amrhein	GESDISC OPS Engineering	2022-01-20
catherinebuczek	Catherine	Buczek	GES DISC notebook tester for Alexis Hunzinger and Christopher Battisto	2022-01-20
jim.amrhein1@gmail.com	Jim	Amrhein	GESDISC OPS	Duplicate entry
msikka09	Munish	Sikka	podaac science use case	2022-01-20
nlenssen2013	Nick	Lenssen	GESDISC	2022-01-20
cassienickles	Cassandra (Cassie)	Nickles	PO.DAAC postdoc with Catalina Oaida. Developing science use case in the cloud for training workshop	2022-01-26

celiaou-podaac	Celia	Ou	SWOT Ocean Cloud Workshop	2022-01-26
mike-gangl	Michael	Gangl	SWOT Ocean Cloud Workshop	2022-01-26
edshred2000	Ed	Armstrong	NASA Openscapes Team	2022-02-10
mtrimp2	Margaret	Trimpin	NASA DISC	2022-02-18
tjhearty	Thomas	Hearty	GES DISC	2022-03-02
briannapagan	Brianna	Pagán	GES DISC	2022-03-02
xpan2-gsfc	Xiaohua	Pan	GES DISC	2022-03-02
zhongliu95	Zhong	Liu	GES DISC	2022-03-02
jwei-openscapes	Jennifer	Wei	GES DISC	2022-03-02
liredell	Lena	Iredell	GES DISC	2022-03-02
aaarrmiinnn	Armin	Mehrabian	GES DISC	2022-03-02
zhangzhaohui2009	Zhaohui	Zhang	GES DISC	2022-03-02
mtrimp2	Margaret	Trimpin	GES DISC	2022-03-02
nasajay	Jay	Su	GES DISC	2022-03-02
igerasimov	Irina	Gerasimov	GES DISC	2022-03-02
mgreene1	Mary	Greene	GES DISC	2022-03-02
andrewmfisher	Andrew	Fisher	GES DISC	2022-03-02
keithbryant	Keith	Bryant	GES DISC	2022-03-02
j-m-adams	Jennifer	Adams	GES DISC	2022-03-02
aheath96	Ashley	Heath	GES DISC	2022-03-02
fengdinggithub	Feng	Ding	GES DISC	2022-03-02
psumeteo	David	Silberstein	GES DISC	2022-03-02
eugenegesdisc	Eugene	Yu	GES DISC	2022-03-02
cloeser1	Carlee	Loeser	GES DISC	2022-03-02
catherinebuczek	Catherine	Buczek	GES DISC	2022-03-03
briandannenmueller	Brian	Dannenmueller	GES DISC	2022-03-03
kruparami	Krupa	Rami	GES DISC	2022-03-03
joncarlson	Jon	Carlson	GES DISC	2022-03-03
sshencloud	Suhung	Shen	GES DISC	2022-03-03

faithgiguere	Faith	Giguere	GES DISC	2022-03-03
jmalfred	Jerome	Alfred	GES DISC	2022-03-03
benforshey	Ben	Forshey	GES DISC	2022-03-03
jejohns1	James	Johnson	GES DISC	2022-03-03
edesfandiari	Asghar (Ed)	Esfandiari	GES DISC	2022-03-03
guangdihlei	Guang-Dih	Lei	GES DISC	2022-03-03
miketheobald	Mike	Theobald	GES DISC	2022-03-03
aaljazra	Atheer	Al-jazrawi	GES DISC	2022-03-03
amfriesz			NASA Openscapes Team	2022-01-03
betolink			NASA Openscapes Team	2022-01-03
choldgraf			2i2c	2022-01-03
consideratio			2i2c	2022-01-03
damianavila			2i2c	2022-01-03
erinmr			NASA Openscapes Team	2022-01-03
georgianaelena			2i2c	2022-01-03
jules32	Julie	Lowndes	NASA Openscapes Team	2022-01-03
sgibson91			2i2c	2022-01-03
yuvipanda			2i2c	2022-01-03
deployment-service-check			2i2c	2022-01-03
virdi			NASA Openscapes Team	2022-01-04
alexishunzinger			NASA Openscapes Team	2022-01-04
andypbarrett			NASA Openscapes Team	2022-01-04
asteiker			NASA Openscapes Team	2022-01-04
cgangoda			NASA Openscapes Team	2022-01-04

cgentemann			NASA Openscapes Team	2022-01-04
christine-e-smit			NASA Openscapes Team	2022-01-04
jjmcnelis			NASA Openscapes Team	2022-01-04
jrice0206			NASA Openscapes Team	2022-01-04
sciencecat18			NASA Openscapes Team	2022-01-04
arthur-e			Hackathon	2022-01-04
biavillasboas			Hackathon	2022-01-04
bilts			Hackathon assist	2022-01-04
chadagreene			Hackathon	2022-01-04
colinbrust			Hackathon	2022-01-04
csadlik			Hackathon	2022-01-04
danshapero			Hackathon	2022-01-04
eeholmes			Hackathon	2022-01-04
fadjimaina			Hackathon	2022-01-04
girishpatidar			Hackathon	2022-01-04
imcslatte			Hackathon	2022-01-04
jessicas11			Hackathon	2022-01-04
jjallaire			Openscapes assist	2022-01-04
jlriegle			Hackathon	2022-01-04
johnwilkin			Hackathon	2022-01-04
jtomfarrar			Hackathon	2022-01-04
kdohanesr			Hackathon	2022-01-04
kdrushka			Hackathon	2022-01-04
kehangit			Hackathon	2022-01-04
luddaludwig			Hackathon	2022-01-04
manuks481			Hackathon	2022-01-04
matthewarcher			Hackathon	2022-01-04
nayara2020			Hackathon	2022-01-04
ngachung			Hackathon	2022-01-04

nitish22011996			Hackathon	2022-01-04
pz-max			Hackathon	2022-01-04
sevfour			Hackathon	2022-01-04
tjhawbaker			Hackathon	2022-01-04
viviant100			Hackathon	2022-01-04
xpan2-gsfc			Hackathon	2022-01-04
jinbow			PO.DAAC, hackathon assist	2022-01-06

2. Presentation at ESIP winter 2022

Community Building: The NASA Openscapes Framework

Erin Robinson, Julia Lowndes, NASA Openscapes Mentors

All artwork by Allison Horst

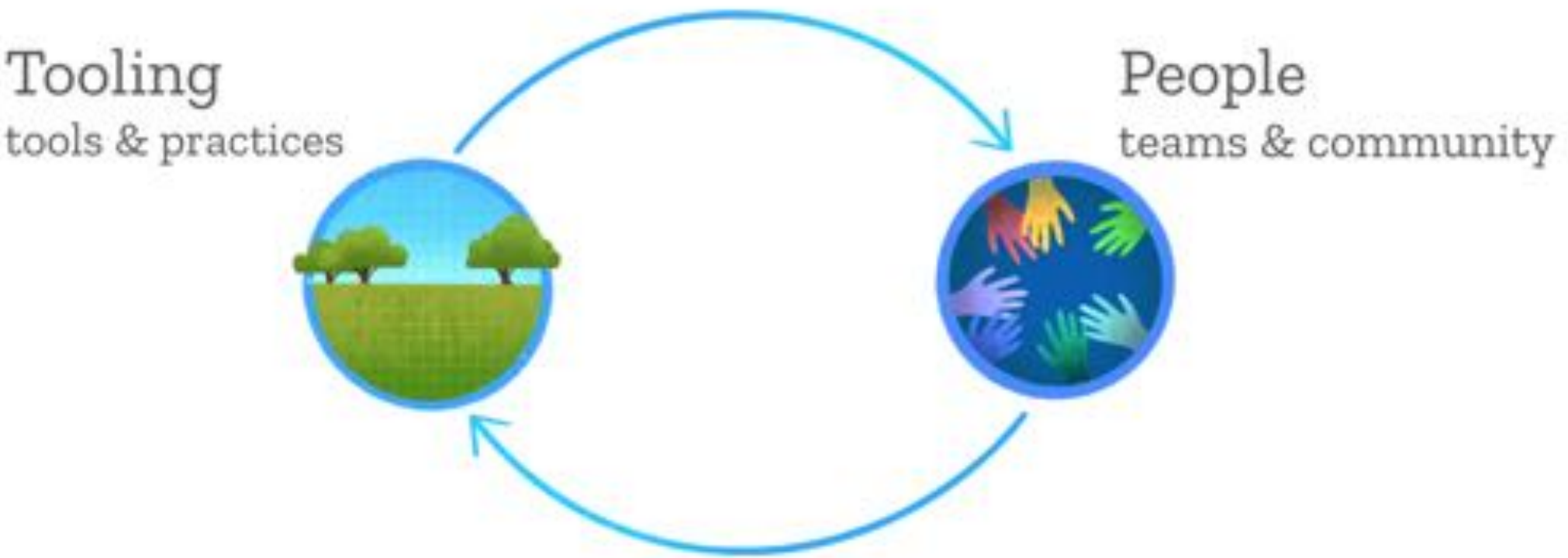
slides: https://nasa-openscapes.github.io

ESIP Winter Meeting, January 18, 2022

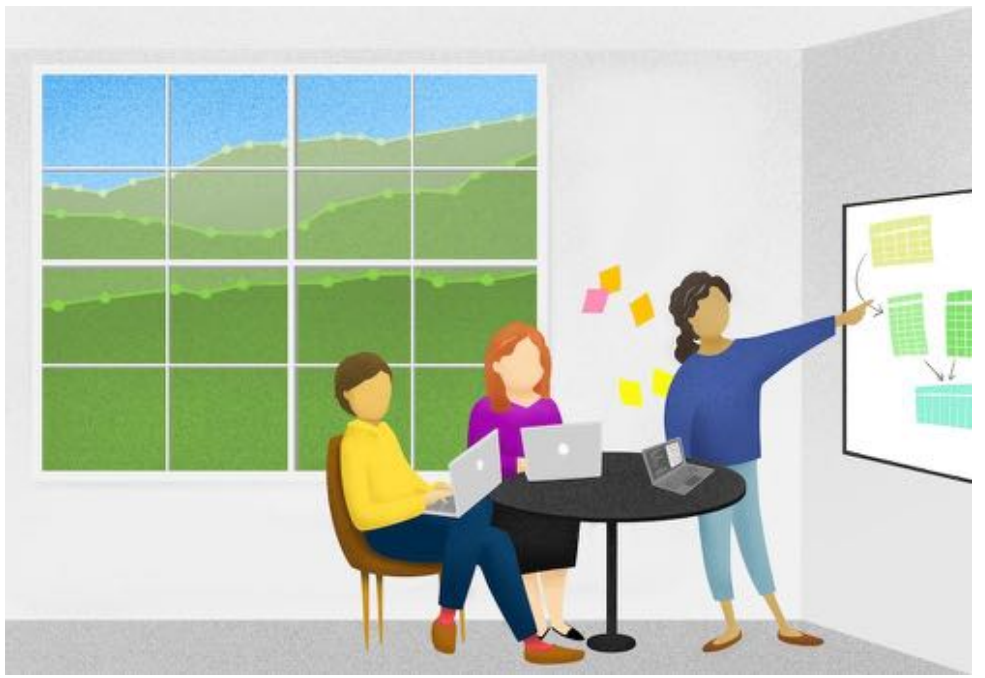

WELCOME!

Open data science

The tooling and people enabling reproducible, transparent, and inclusive practices for data-intensive science



Create space for discussions



Champions Cohort Calls

~7 research teams

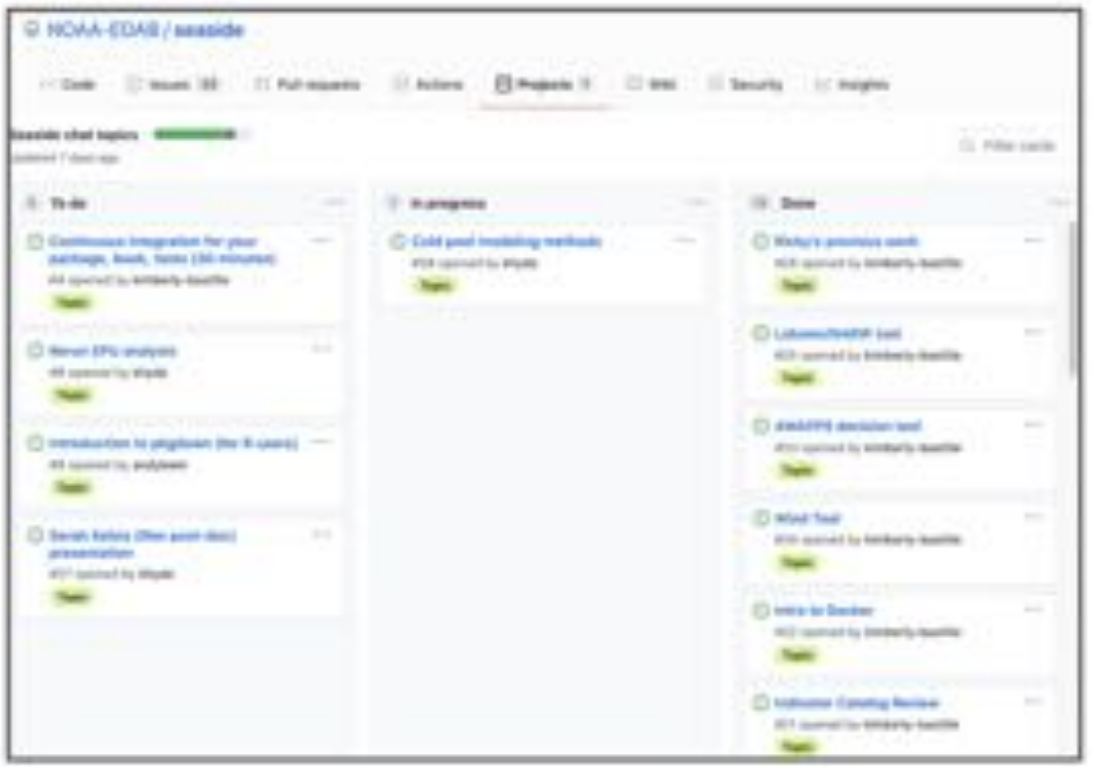
2x/month

Seaside Chats

Individual teams

2x/month

Create place for collaboration



Lab GitHub Organizations

Code, practices, resources, conversations

Open data science in action

GitHub

- Collaborative version control, archive, bookkeeping, search
- Project management
- Publishing with Markdown

Community norms

- Organization, documentation, READMEs to help onboard new folks
- Issues, Projects to discuss, coordinate
- New era of SciComm

https://github.com/nmfs-openscapes/.github/wiki

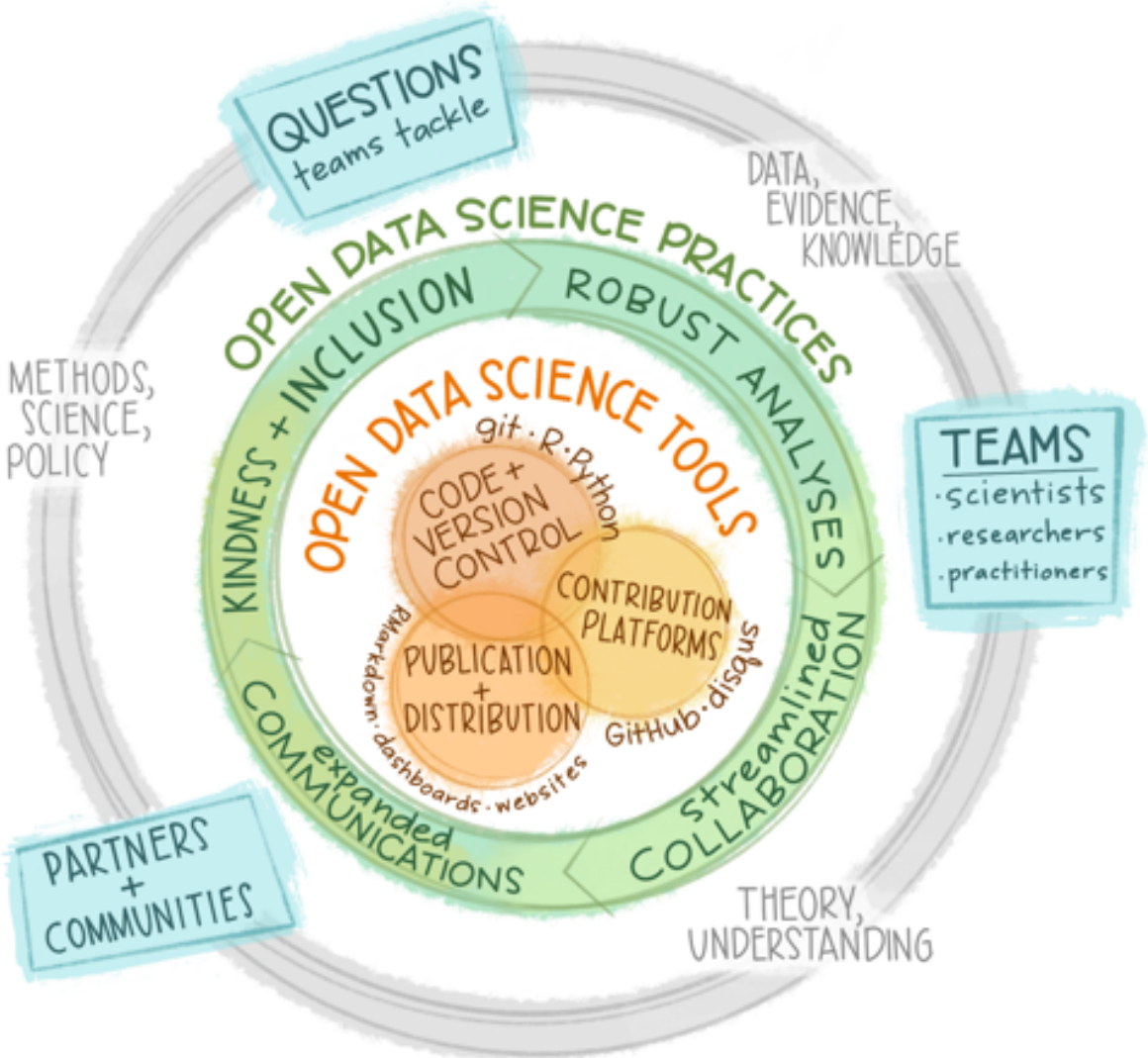
Reduces occurrences of analysis_final_final_final.R AND re: fwd: FWD: analysis_final_final_final.R

“This isn’t just about coding & GitHub, it’s about changing the way we do science” - Dr. Malin Pinsky, Rutgers*

“Openscapes has created a new way of thinking about merging empathy and science. That’s an invaluable gift to me.” - Dr. Halley Froehlich, UCSB

“Openscapes gave me a perspective of how all these open data science tools work together and can be used to bring natural resource conservation and ecology into the 21st century.” - Researcher, NOAA National Marine Fisheries Service

Working more openly and inclusively



Openscapes approach

https://openscapes.org/approach

Researcher-centered, focused on teams. Practice and feel safe working openly w/ yourself & your team; then ease into more.

Create space & place to explore & learn. Cohort Calls, Seaside Chats, Co-Working; GitHub, R, Python, Quarto, Google Drive, Slack; Efficiency Tips & Inclusion Tips.

Cultivate relationships & real connections. Welcoming folks with diverse backgrounds; meeting where they are; skills to empower immediate work; kinder science.

Learning & iterating, openly. Not a checklist but a continual practice. Imperfect and messy.

NASA Earthdata & Openscapes

Supporting Earthdata research teams' migration to the cloud

The overarching vision is to support scientific researcher teams using NASA EOSDIS data as they migrate their workflows to the cloud. We are doing this working with NASA Distributed Active Archive Centers (DAACs) over three years by:

- **Develop a cross-DAAC Mentor community**
- **Empower science teams through the Champions program**
- **Scale the Champions program with DAAC Mentors**

https://nasa-openscapes.github.io

NASA DAAC Openscapes Mentors

Support Mentors towards establishing a common set of NASA Earthdata tutorials that they can then build off their DAAC-specific and science examples

- **Create space & place**
- **Focus on the common**
- **Reuse existing**
- **Contribute to fill gaps - and do so openly**

2021 Cloud Hackathon

65 Openscapes 2i2c JupyterHub AWS instances

50 forks of the Cloud Hackathon GitHub repo

8 hack-team projects presented on Day 5

2021 Cloud Hackathon Book

https://nasa-openscapes.github.io/2021-Cloud-Hackathon/

“It was a really great week. The tutorials were AMAZING. Everyone did a great job, and everyone was very nice. I really appreciated welcoming environment. I don’t have a strong python background. But I was supported in learning all around” - Hackathon Participant

It’s worth investing the extra time required to become familiar with cloud computing and the newer python libraries to access and manipulate satellite data. The few hundred lines of code I wrote this week will replace several thousand lines of old code using just numpy! It’s also a heck of a lot easier to read and use. - Hackathon Participant

Blog summaries & future work

earthdata.nasa.gov

podaac.jpl.nasa.gov

The tutorials were fantastic, but I struggled to figure out **when** to use the various methods we learned in the tutorials.

Tooling & norms for co-creating

Co-created teaching resources

- GitHub org: NASA-Openscapes
- Jupyter Hub: 2i2c
- Tutorial notebooks: python/jupyter
- Notebook collections: quarto

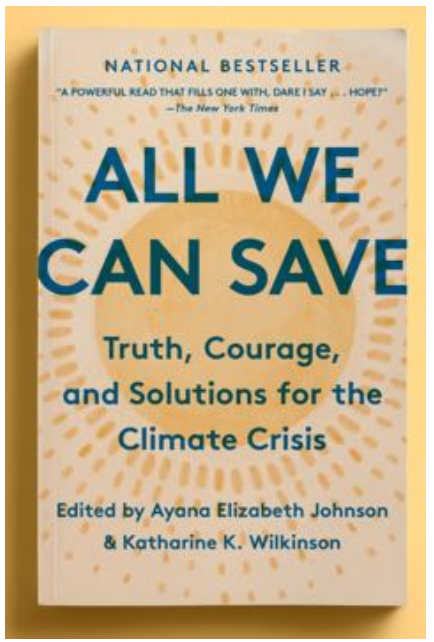
Mentor Cohort norms

- Issues, branching & pull requests
- Finding & re-using common parts
- Notebook review & teaching feedback

Emerging themes:

- A big time investment, very grateful for Mentors and DAAC Managers
- Open science is a critical piece of research in the Cloud
- Teaching-oriented documentation: documentation is easier to prioritize when it's for real people (Hackathon book vs Cookbook)

Open science as part of the climate movement



"**We** speaks to the collective, to collaboration, to community. Addressing the climate crisis…will take everyone."

"**We** speaks to justice…We cannot, we must not, go it alone"


WELCOME!

Join us!

NASA Champions Cohort March-April 2022.

Learn with your team with a cohort of peers

Nominate your team by February 1!

nasa-openscapes.github.io/champions

ESIP Session: Better Science for Future Us

Open science in government

Friday, Jan 21, 2022 11-12:30 EST

Details: *https://sched.co/qkp5*

Thank you to the DAAC Mentors!

Thank you!

We’re looking forward to working together!

slides: https://nasa-openscapes.github.io/about

Twitter: @openscapes

Web: openscapes.org; nasa-openscapes.github.io

Openscapes artwork by Allison Horst

Erin Robinson, MSc

Co-Director, Openscapes

Metadata Game Changers

@connector_erin

Julia Stewart Lowndes, PhD

Co-Director, Openscapes

NCEAS, UCSB

@juliesquid