NASA Openscapes Summary Report
February 1 - July 31, 2024

Openscapes LLC
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In line with priorities and values for Open Science, this report is publicly available at https://github.com/NASA-Openscapes/how_we_work.

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Executive Summary

NASA Openscapes is the main access point for NASA Earth science & tutorial development on the Cloud. Openscapes is not extra work, it's the "how" of doing Open Science work aligned with DAAC goals to enable users/science. Building from successes and momentum 2021-2023, in 2024 we will continue teaching staff & researchers, helping us all grow as open science leaders & aligned with DAAC activities. This is vital to the shift to Earthdata Cloud and to NASA's values for open science and equity. 2024 goals are to:

- Provide stability for and strengthen the DAAC Mentor community as we develop and teach a common set of tutorials and coordinate and lead learning events, in part through our twice monthly Openscapes Cohort Calls.
- Reuse and refine shared teaching resources, share stories and lessons learned at conferences and meetups
- Lead events together (workshops and Champions cohort) with research teams, with Mentors assisting to support researchers and learn new modalities of support
- Support transition for NASA Earthdata users to the Cloud via continued effort to maintain development for cloud infrastructure & earthaccess Python library, Earthdata Cloud Cookbook & Cheatsheets, give talks, tie-in better with NASA Earthdata website, and cross-learning with NOAA and other Openscapes Mentors & Open science community.

Openscapes' goal over this six month period was to provide stability for the NASA Openscapes Mentor Community (staff in user-support roles across the NASA Distributed Active Archive Centers (DAACs) in supporting their activities as we transitioned to a new funding arrangement. We have achieved this through continued work with the Mentors and the deliverables we met. In April one of the Mentors said "I had no idea that so much was going on in the background. Thank you for continuing to support the Mentors". Further, Mentor-defined focus were on 4 topics: earthaccess, Cloud infrastructure, Cookbook, Workshop planning. We supported recurring hackdays on each to make progress towards the broader goals and deliverables, and rolemodel how to host such meetings as we grow the number of contributors.

We met all deliverables and exceeded the number of events required. This includes supporting the EMIT Methane Webinar by NASA's LP DAAC in March, giving talks at several DAAC's user working group (UWG) meetings, and attending in person and presenting NASA Openscapes work at ESDSWG and ESIP, without travel support. The official deliverables we met are detailed in the Statement of Work Activities section. They include 4 "Imagine What's Possible" webinars, 2 coding skills workshops, 1 NASA-Specific Data Workshop to different scientific and data audiences, as well as defining Open Science in the Cloud Key Performance Indicators.

Additionally, we have collaborated on writing lessons learned from NASA Openscapes. Most impactfully, our paper co-authored in 2023 by Openscapes mentors across organizations – including NASA Earthdata, NOAA Fisheries, EPA, California Water Boards, Pathways to Open Science, Fred Hutch Cancer Center – was just published in June 2024: Shifting institutional culture to develop climate solutions with Open Science. From co-author Anna Holder, Cal EPA / Water Boards: "It's a short read and quite uplifting and inspirational and provides some more insight and what we're learning as we implement Openscapes across organizations." Two other blog posts include Openscapes Community Call: GitHub for NASA Openscapes community calendaring & project management that wrote up a screenshare-and-tell of how we're using GitHub Issues, Projects, and the new Roadmap feature to have an open, dynamic way for many people to use and contribute to a "calendar"; and on 2i2c's blog: Openscapes Host a Surface Biology and Geology Workshop with Shared Password Feature that describes our collaboration to create a "one-click-to-cloud" approach for hosting workshops – a frictionless login flow so that organizers can focus on the essential complexity of teaching with NASA Earthdata rather than the accidental complexity of managing Hub authorization.

Key Performance Indicators

These are defined and sources indicated in the Statement of Work Activities section 9.

Teaching numbers

- 190 new participants in the workshops/champions using the Hub
- 14 new teaching slides and tutorials
- 4 talks "imagine what's possible"

Engineering numbers

- 32 contributors to earthaccess
- 33 contributors to Cookbook
- 10 contributors to Hub docker image
- 118 items in workshop-planning GitHub Issues (open cross-DAAC planning)
- 16 cloud infrastructure hackdays (2i2c, environments, etc)

Value statement

NASA Openscapes is the main access point for NASA Earth science & tutorial development on the Cloud. Openscapes provides a critical service of building the cross-DAAC mentor community with a shared user-centered teaching & development approach that is networked with the broader open science community – and further coordinates, role-models, and teaches Open Science through technical and leadership skillbuilding via Mentors and Champions programs, in this project to support the DAACs to achieve NASA's goals of data usage enablement through Open Science.

Background

NASA Openscapes is an activity through the NASA Earth Science Data and Information System (ESDIS) Project, which manages the science systems of the Earth Observing System Data and Information System (EOSDIS) that provides science data to a wide community of users for NASA's Science Mission Directorate. NASA Openscapes supports data usage enablement through Open Science with a focus on exploiting commercial cloud through training, mentoring, and community engagement (Category 5) – by building a teaching community across the NASA Distributed Active Archive Centers (DAACs) and collaborating with the broader open science community.

This Year 4 Q1-Q2 Summary Report builds upon the work of the NASA Openscapes initiative from 2021-2023 co-led by Julia Lowndes (Openscapes) and Erin Robinson (Metadata Game Changers), with these three main objectives:

- Train and develop leaders and champions to enable and advocate for the transition of the NASA science community toward Open Science goals and leveraging new capabilities in a cloud environment. Systematically develop and grow the skillsets of these leaders to increasingly participate in and conduct activities such that the Open Science initiatives continue to grow and expand into a sustainable process.
- Build and grow a community to motivate NASA researchers to transition their workflows to the cloud through routine engagement and training. The approach should be remote-by-design, extensible, scalable, and address the time constraints, hardware and processing constraints and other needs that confront researchers with varying computational capabilities and needs.
- Create opportunities to collaborate with working groups to develop cohesive cloud training materials and work with researchers to develop coding, cloud computing, and open science skills.

Statement of Work Activities

The following are numbered from the NASA Openscapes Statement of Work (SOW).

1. Manage & support activities in coordination with the DAACs

Host biweekly Mentor Calls with agendas co-designed with DAAC Mentors

- **Mentor Calls. Feb 7 & 21**: Onboarding & skill building, screensharing to parallelize code, planning for the Champions Program
- **Mentor Calls. March 6 & 20**: Onboarding & skill building, planning for Champions Program, starts April 3. 7 teams accepted, Mentors' teaching plan set with dry runs. We

have 7 science teams confirmed so far, teams that use data primarily from PO.DAAC, LP DAAC, OB.DAAC, GES DISC, LAADS DAAC. Mentors are signed up to teach in all 5 Calls, polishing and improving lessons from last year including data and coding strategies in the cloud, and the Earthdata Cloud Clinic that will be hands-on in 2i2c, using our improved bulk-adding policies and approaches.

- **Mentor Calls "take over" by Champions Program** - Mentors join Champions Calls in April-May to learn and support science team data users. Mentors learn facilitation techniques, support Champions in Chat and breakout rooms.

Host recurring Hackdays: 2i2c policy; earthaccess; workshop planning; Cookbook

- Earthaccess hackdays occur twice-monthly, and have consistently had ~10 people each time, from NSIDC and beyond. Creating open source community of practice. Priorities are set based on user requests (from Mentors and users) via GitHub and the community is developing code review processes that will be documented.
- 2i2c policy hackdays: we're working on bulk-adding users in and out of the hub, documenting process & governance. Developing similar open source community of practice for maintenance and development, following earthaccess model

2. Coordinate to host cloud hackathons and workshops

Events hosted & supported:

February

- **SWOT-PODAAC workshop AGU Chapman. Hawaii. Feb 13**: 30 scientists participating, teaching from shared tutorials & using 2i2c. We also used the automated approach for adding users to 2i2c, it was a very smooth experience for Mentors and participants.

March

- **EMIT Methane Webinar by NASA's LP DAAC- March 14**
  - Link. 104 participants (link). This webinar involved teaching from shared tutorials & using 2i2c. This also sparked a new idea for further lowering the barriers to entry for bulk-adding people to 2i2c that we will explore for upcoming workshops. What if we could avoid using GitHub for some events completely?

3. Create common tutorials, host and managing communities of practice for teaching and mentoring

In addition to supporting Mentors' contributions to the NASA Earthdata Cloud Cookbook, we focused on development and tutorials for Cloud infrastructure, workshop planning & automating.

Cloud infrastructure, workshop planning & automating:

February

- **We created a shared GitHub Project Board** in the same place as cross-DAAC code & tutorial development: https://github.com/orgs/NASA-Openscapes/projects/7/views/1. This meets a need for Mentors to have a way to answer "what events are coming up across the DAACs?" "How can we help each other prepare and reuse common tutorials efficiently?" Now actively using this to get organized with upcoming workshops, events, and hackdays. Bri Lind from LP has been a lead co-designing and onboarding others
- **Automating adding users to 2i2c for workshops** - 2i2c uses GitHub Teams as authentication and access to the JupyterHub. Following the recommendations of 2i2c, we created a separate GitHub Organization specifically to add and 2i2c engineers. Makes it easier for workshop leads to add batch workshop participants

March

- **We improved our process for bulk-adding people to 2i2c JupyterHub**, and successfully used this in the EMIT webinar. We created a new GitHub organization `nasa-openscapes-workshops` that will ease permission issues for Mentors leading workshops. This was recommended by 2i2c based on other open communities they work with. Further documentation and automation in progress. This work includes coordinating and working closely with engineers at 2i2c, NASA Mentors leading workshops. We have been collaborating synchronously via regular hackdays and asynchronously via GitHub and Slack. This work includes policy changes discussed in GitHub, engineering time from 2i2c, and open documentation via Quarto in the Cookbook.

April

- **We further tested our process for bulk-adding people to 2i2c JupyterHub**, and working on further documentation and automation in progress. We added 32 new users to the JupyterHub with the process for the Champions Program Earthdata Cloud Clinic on April 17. This system will let us bulk-add and ultimately bulk-remove people from the hub, depending on the workshop they were a part of and how long they have access. We are working on the policies and communicating access to workshop groups (including "download your notebooks and other important files before you lose access" and then will be able to bulk-remove people. Part of this too is "fledging" - helping them have somewhere to go/resources to use so they can continue doing their science.

May

- **We are developing a policy & workflow to reduce storage costs in the Openscapes 2i2c JupyterHub.** More people are experimenting with Dask and parallel computing - which is really great and leverages the power of the cloud! - and this results in a lot of intermediate/orphaned files that are expensive to store. Progress includes demonstrating a S3 Bucket Storage tutorial, (included in the Earthdata Cloud Cookbook) with the Champions science teams in Call 3 as part of the "Data strategies in the Cloud" lesson taught by Alexis Hunzinger (GES DISC). We have also identified high-storage users and contacted them offering to help. So far we have reduced 1TB of data storage and associated costs. After this initial focus on reducing storage and associated costs and working with scientists to follow the tutorial, we will improve the tutorial, write up the policy in the Cookbook (for example, anyone with storage over some threshold [100GB to start] is contacted), and add automating checks to identify and contact those high-storage users. We are exploring auto-deleting temporary files from the communication, policy, and technical sides.

June

- **We made more progress developing policy & workflows for the Openscapes 2i2c JupyterHub**. We added a Policies & Administration section to the Earthdata Cloud Cookbook, including content about 2i2c Access (previously in a separate repository) and data storage policies (new content). This work helps users understand and reduce computing costs, and also helps mentors and other administrators teach good practices when supporting users.
- **We worked with 2i2c to create a Shared Password way to access the Hub**. This enables a frictionless login flow so that organizers can focus on the essential complexity of teaching with NASA Earthdata rather than the accidental complexity of managing Hub authorization. GitHub authentication is our default option for most workshops where we also teach GitHub as a workflow for open science, but for an educational event with this large number of participants and the short duration of the workshop, a "one click to cloud" approach without GitHub was needed. This was posted in a blog post: https://2i2c.org/blog/2024/openscapes-sbg-workshop that we will link to from https://nasa-openscapes.github.io/news. We will continue to work with Mentors to consider and improve this approach as they plan upcoming workshops.
- **Key Performance Indicators.** We developed draft definitions and provided numbers for teaching and engineering, publicly available at https://github.com/NASA-Openscapes/how_we_work.

4. "Imagine What's Possible" talks

These talks connect and build the open science community, highlighting researchers who are already working in the cloud.

February

- **Earthdata Webinar - Feb 28. "Community Developed Resources—Explore the Openscapes Earthdata Cloud Cookbook"** ("imagine what's possible" webinar, ETD-218)
    - Link. 106 attendees! NASA Openscapes Mentors from 4 data centers shared how to use the Openscapes Earthdata Cloud Cookbook—a compilation of open-source tutorials, workflows, libraries, and cheatsheets that help users find, access, and work with Earth science data. This was really exciting to have the opportunity for the Mentors to share about this work on a big stage! Presenters were Bri Lind from the Land Processes Data Active Archive Center(LP DAAC); Luis Alberto Lopez Espinosa, from the National Snow and Ice Data Center (NSIDC); Cassie Nickles from the Physical Oceanography Data Active Archive Center (PO.DAAC); and Alexis Hunzinger from the Goddard Earth Sciences Data and Information Services Center (GES DISC). To prepare for this, we met with Jennifer Brennan for one tech check and one dry run; she graciously reduced the number of dry runs since this group was comfortable and practiced talking about this work.

April

- **"First Forays into the Cloud"** - guest teacher Aronne Merrelli (U Wisconsin) shared experiences from 2023 Champions Cohort and "fledging" with Coiled and using his own credit card. 40 attendees (9 science teams). Blog post & recording upcoming; Call 1 Digest ("imagine what's possible" webinar, ETD-220) *note this is also listed in the Champions Program

May

- **"How the NASA Openscapes community supports Earthdata users migrating workflows to the Cloud" - CDDIS User Working Group** - Lowndes co-presented with Ian Carroll (OB.DAAC). This was our second time presenting at the CDDIS UWG; CDDIS is the final of the 12 DAACs to engage with the NASA Openscapes community. We shared about NASA Openscapes, highlighting earthaccess as a current project and Ian shared how it has helped OB.DAAC learn and troubleshoot across the DAACs and connect with the larger open source community. ~20 attendees (May 14, imagine what's possible webinar; screenshot below. (ETD-220))
- **"How the NASA Openscapes community supports Earthdata users migrating workflows to the Cloud"** - JPL Brown Bag seminar (slides). Lowndes co-presented with Celia Ou (PO.DAAC), ~40 attendees. Building on what we had co-presented previously at CDDIS User Working group, we shared about NASA Openscapes, highlighting earthaccess as a current project. Celia Ou from PO.DAAC shared specific PO.DAAC connections and how much she has learned from being in close contact with staff from other DAACs in NASA Openscapes community, helping develop content and troubleshoot and also sharing specifically about how she developed more empathy for supporting users (May 23, imagine what's possible webinar (ETD-221)).

5. Coordinate cloud coding skills workshops

The workshops focus on hand-on training including “hackathons”, leveraging, to the extent possible, resources from the DAACs.

February

- **SWOT Data Access Workshop by NASA’s PO.DAAC - Feb 13** (Coding skills workshop, ETD-222)
    - Link. 45 participants (list; note this link will change as we shift to new process). This in-person workshop involved teaching from shared tutorials & using 2i2c. While the focus is SWOT data, developing coding skills was also part of this workshop as Mentors live-coded in Python and introduced using earthaccess for accessing SWOT data.

April

- **Earthdata Cloud Clinic** - NASA Openscapes Mentor Catalina Taglialatela (PO.DAAC) taught hands-on NASA Earthdata access in 2i2c Hub using earthaccess python library. 32 new users in JupyterHub. Call 2 Digest (Coding Skills Workshop #2, ETD-223). Note this is also listed in the Champions item.

6. Coordinate NASA-specific data cloud workshops

The workshops focus on hand-on training including “hackathons”.

- **Data strategies in the Cloud** - Alexis Hunzinger (GES DISC) (May 1, NASA-Specific Data Workshop (ETD-224)) and **Psychological safety** - Matt Fisher (NSIDC) Call 3 Digest (May 1). Note this is also included in the Champions SOW item.

7. Provide coordinated workshops to raise the skill levels

These are specific events to support emerging leaders with the goal to expand the skills to teach and support users with why and when to use the cloud.

February

- **Community Call. Feb 20**: GitHub for NASA Openscapes community project management & calendaring. 25+ attendees, open/public event, with many NASA Openscapes Mentors attending. Bri Lind from LP DAAC presented & led discussion.

June

- **Quarto Contributing workshop. June 28.** Quarto + GitHub Pull Requests Clinic to build skills for contributing to the Earthdata Cloud Cookbook. Pilot with 4 attendees; we set up a system that is partially automated for setup (GitHub repositories and adding usernames) and will lead again in the Fall with a bigger group/

8. Lead & manage Champions mentorship program

Openscapes Champions Program - We lead this program remotely over 2 months; we helped NASA Openscapes Mentors from the DAACs recruit science teams that were interested in transitioning workflows to the cloud that Mentors wanted to work with. We met individually with the 9 teams that signed up and helped them prepare. We have Mentors teaching all lessons, collaborating to adapt core lessons for Cloud based, and getting feedback asynchronously and via dry runs. We also invited a guest teacher for the kick-off call: a real-life example of a scientist working in the Cloud. We continue to plan/practice/give feedback on the lessons for the remaining calls.

April Calls focused on hearing from a scientist who has made the transition to cloud to imagine what's possible, and then a hands-on skill-building clinic for the 9 science teams.

- **"First Forays into the Cloud"** - guest teacher Aronne Merrelli (U Wisconsin) shared experiences from 2023 Champions Cohort and "fledging" with Coiled and using his own credit card. 40 attendees (9 science teams). Blog post & recording upcoming; Call 1 Digest ("imagine what's possible" webinar, ETD-220)
- **Earthdata Cloud Clinic** - NASA Openscapes Mentor Catalina Taglialatela (PO.DAAC) taught hands-on NASA Earthdata access in 2i2c Hub using earthaccess python library. 32 new users in JupyterHub. Call 2 Digest (Coding Skills Workshop #2, ETD-223)

May calls involved updated lesson material to support the Mentors' enhanced understanding of cloud storage costs. We are developing a policy and teaching strategy to help users understand storage costs and develop good habits to not accrue costs for intermediate/orphaned files and Mentors prepared workflows and slides, and received feedback asynchronously and via several planned dry runs for each lesson. These Mentors adapted previous lessons and also personalized them for their unique experiences and teaching styles, and all lessons are open source.

    - **Data strategies in the Cloud** - Alexis Hunzinger (GES DISC) (May 1, NASA-Specific Data Workshop (ETD-224)) and **Psychological safety** - Matt Fisher (NSIDC) Call 3 Digest (May 1).
    - **Coding strategies in the Cloud** - Mahsa Jami (LP DAAC) and **Open communities & the Cookbook** - Bri Lind (LP DAAC), Cassie Nickels (PO.DAAC) Call 4 Digest (May 15)

- **Pathways Presentations by science teams** Call 5 Digest (May 29) - we concluded the 2-month cohort with science teams sharing their progress experimenting with workflows in the cloud. Highlights include: NOAA IEA team felt more confident speaking to their IT about cloud needs, PACE Hackweek team confident using and teaching earthaccess; NOAA Coastwatch team taught Cloud Clinic resources (in python and R!) at NOAA Enterprise Data Mgmt Workshop; EcoGRAPH team shifting to GitHub, R, Jupyterhub

9. Define Key Performance Indicators

This is publicly available at https://github.com/NASA-Openscapes/how_we_work.

These are a draft definition of Key Performance Indicators (KPIs) to evaluate the progress of the Enabling Science in the Cloud initiative including the impact on targeted communities. In the subsections below we define the KPIs and thinking behind them (including critique to consider whether these are the best way to capture what we want to), and then provide numbers for February 1 - July 31 2024. For previous work about describing impact of NASA Openscapes beyond-the-numbers, see Communicating impact: NASA Openscapes by Lowndes, Robinson, & Rice, ESDSWG 2023.

Definition

Teaching numbers

- # new participants in the workshops/champions using the Hub - this reflects the number of hands-on workshops hosted by the NASA Mentors. Note that with the new Shared Password Feature we have co-developed with 2i2c, this number will not capture all users who interacted with the Hub.
- # new teaching slides and tutorials - this reflects the Champions program lessons as well as two new tutorial books. Since we focus so much on reuse and adapting, it can be difficult to decide what to include. Also, do you could a workshop or the individual tutorials within it? Below we have included the number of individual tutorials.
- # talks “imagine what’s possible” - this reflects talks that are not hands-on (and do not provide access to 2i2c JupyterHub). It’s important to share the science and teamwork of what’s possible

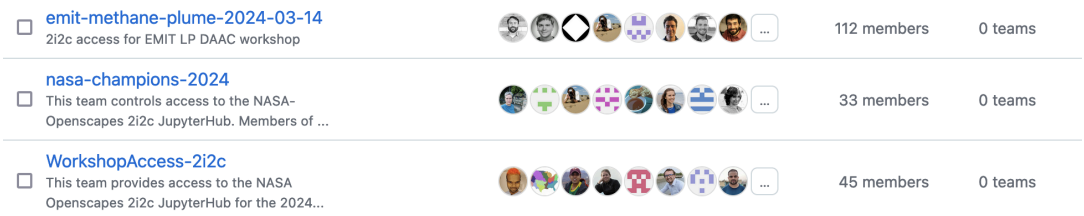
Engineering numbers

- # contributors to earthaccess - this is from GitHub contributor count, which has been criticized for not including contributions that are notGitHub commits. For example, scientists who have posted Issues/Discussions on GitHub asking questions that have led to engineering to fix a bug or add a feature are not included on this list.
- # contributors to Cookbook - this is also from GitHub contributor count, with challenges listed above
- # contributors to Hub docker image - this is also from GitHub contributor count, with challenges listed above

- # items in workshop-planning GitHub Issues (open cross-DAAC planning) - this shows activities proposed and pursued across the community. Does not distinguish between which were completed versus considered but gives an idea of scope
- # cloud infrastructure hackdays (2i2c, environments, etc) - this gives an idea of engagement and regular progress across the NASA Openscapes community goals

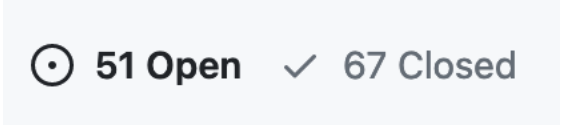
Numbers & sources

Teaching numbers

- 190 new participants in the workshops/champions using the Hub
    - source: https://github.com/orgs/nasa-openscapes-workshops/teams (private)
    - 

    - Note: “WorkshopAccess-2i2c” is a legacy name; going forward we will separate names for each workshop.
- 14 new teaching slides and tutorials
    - 8 from source: (https://nasa-openscapes.github.io/2024-nasa-champions)
    - 5 from source: https://nasa.github.io/VITALS/
    - 1 from source: https://podaac.github.io/2024-SWOT-Hydro-Workshop/
- 4 talks “imagine what’s possible”
    - source: SOW deliverables

Engineering numbers

- 32 contributors to earthaccess
    - source: https://github.com/nsidc/earthaccess, accessed July 8, 2024
- 33 contributors to Cookbook
    - source: https://github.com/nasa-openscapes/earthdata-cloud-cookbook, accessed July 8, 2024
- 10 contributors to Hub docker image
    - source: https://github.com/nasa-openscapes/corn, accessed July 8, 2024
- 118 items in workshop-planning GitHub Issues (open cross-DAAC planning)
    - source: https://github.com/NASA-Openscapes/workshop-planning/issues
    - 

- 16 cloud infrastructure hackdays (2i2c, environments, etc)
    - source: earthaccess (n=10) https://github.com/nsidc/earthaccess/discussions

- source: 2i2c (n=3) https://github.com/NASA-Openscapes/2i2cAccessPolicies/issues/7
- source: JupyterHub hackdays led by Tasha Snow (n=3)

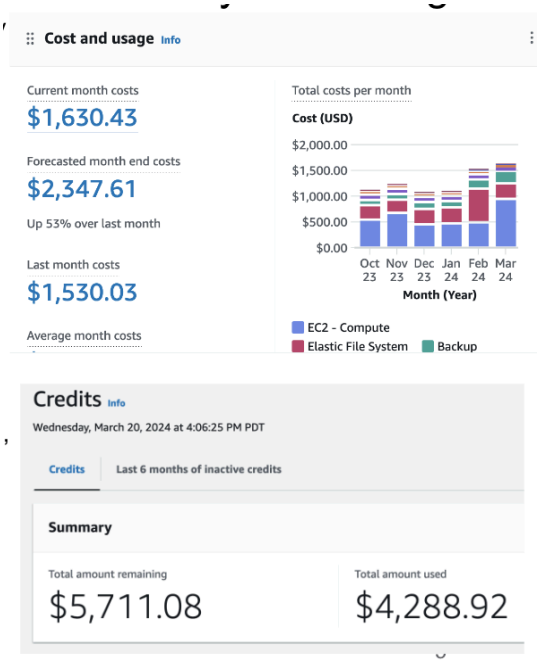
10. Maintain a web presence

We maintained the web presence and the web accessible resources provided through the current Openscapes website (openscapes.org), as well as the NASA project website https://nasa-openscapes.github.io. We contributed to the NASA Earthdata Cloud Cookbook https://nasa-openscapes.github.io/earthdata-cloud-cookbook.

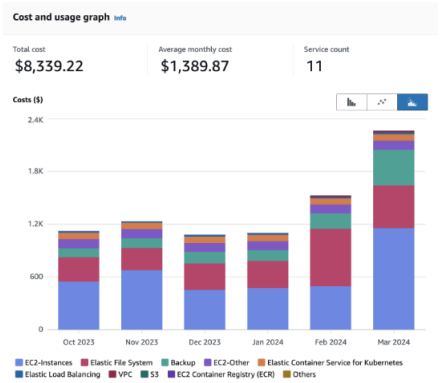
11. Ensure AWS costs are within allocated NASA funding

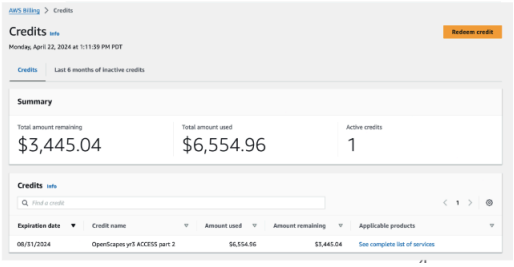
AWS Costs By Month

February 24 - March 22, 2024

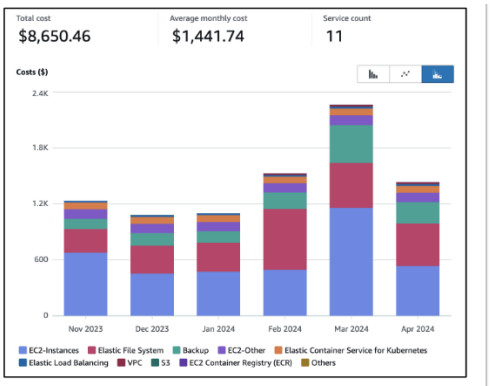


March 23 - April 22, 2024

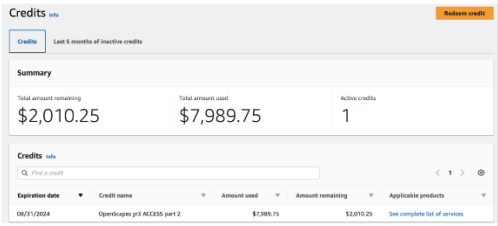




April 23 - May 20, 2024

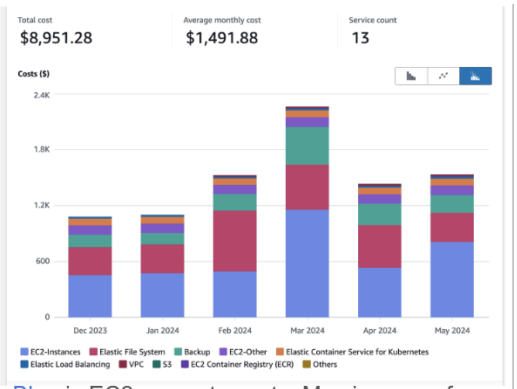


Blue is EC2 compute costs. Big peak in March for EMIT workshop

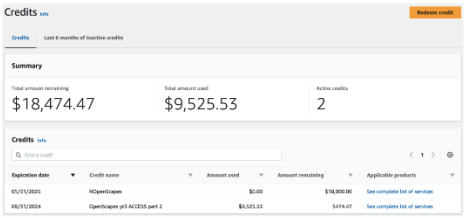


$15K of credits requested April 26; requested status update May 15

May 21 - June 24, 2024



Blue is EC2 compute costs; May increase for 2024-SBG Workshop (EMIT+ECOSTRESS)
Red is EFS storage costs; reduced from active cleanup & teaching good practices.
Green is backup; deleted unaccessed after 6mo



$18K of credits secured June 4 following temporary (1-day) Hub shutdown

Cloud Credits - Issues and Risks

In June we secured $18K Cloud Credits to support users from NASA-AWS Space Act Agreement. As directed by Elizabeth Francher (NASA) and Chris Stoner (AWS), we submitted a request to https://aws.amazon.com/earth/research-credits/ on April 26. We secured credits on June 4, but only after further emails cc'ing Justin Rice (NASA) and having to temporarily pause the 2i2c Hub from June 3-4 because credits were so low ($400). Here are Issues & Risks:

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- In May our risk was that AWS credits were low; we requested $18K credits on April 26 and followed up on May 15. **On June 3, unfortunately, we temporarily paused the 2i2c Hub until we secured more cloud credits.** AWS/NASA were aware that we had just ~$400 left and were pausing until we have more credits. We received credits on June 4 and restarted the Hub.
- We documented this process openly on GitHub: 2i2cAccessPolicies/discussions/11. We worked closely with 2i2c to shut down the hub and also communicated with all NASA Mentors, including 1:1 with those who were actively using the Hub. To prevent this situation again, we need to:
    - Learn: requesting credits from AWS/NASA
        - How long in advance should we request credits? Is 5 weeks not enough

advance?
        - Is $18,000 too much, too little? Currently we use $10,000 in ~9 months. We're reducing unnecessary storage costs and teaching users so we can get better estimate.
    - Set up a Failsafe: what additional failsafe we need to prevent overspend, and so that there is not this gap again?
        - Could part of the Openscapes contract include something like "up to $5K will be reimbursed from contract to Julie/Openscapes if her credit card is billed due to a gap in credits"?