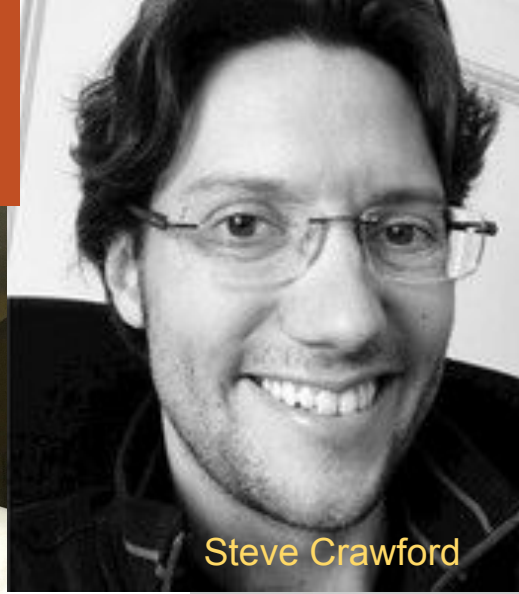
A NASA OPEN SOURCE SCIENCE INITIATIVE:
TOPS: TRANSFORM TO OPEN SCIENCE

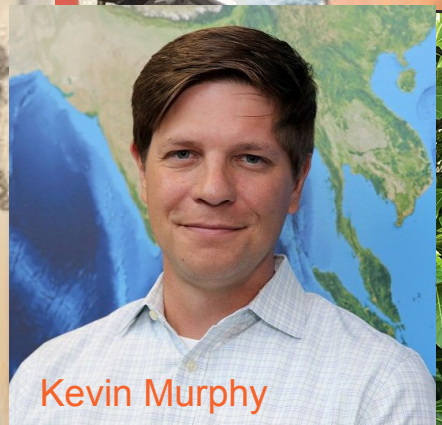
- WE HAVE LOST THE LUXURY OF TIME
- COVID-19, CLIMATE CHANGE, ...
- THE WORLD IS CHANGING RAPIDLY
- SCIENTISTS MUST ADAPT

"We need every solution and every solver. As the saying goes, to change everything, we need everyone. What this moment calls for is a mosaic of voices— the full spectrum of ideas and insights for how we can turn things around."

Ayana Elizabeth Johnson and Katharine Wilkinson (Eds.). All We Can Save: Truth, Courage, and Solutions for the Climate Crisis. 2021.

NASA TOPS team &
Why are we here talking to you?





Pangeo A

Ryan Abernathey
Nov 7, 2018 · 2 min

AGU 100 ADVANCING EARTH AND SPACE SCIENCE | FALL ME
Washington, D.C. |

how to use some of
for their own data a

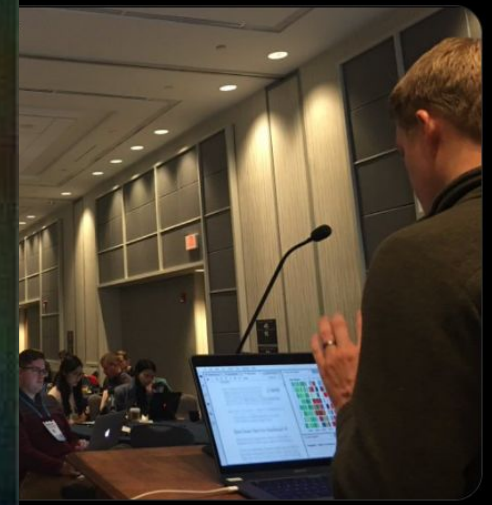
Scientific Worksh
You come to AGU Fall
advances, expand you
fallmeeting.agu.org

Pangeo

Following

12, 2018

gu18 workshop! Here @HammanHydro
peed up geoscience.



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The Details

Pangeo: Scalable Geoscience Tools in Python — Xarray, Dask, and

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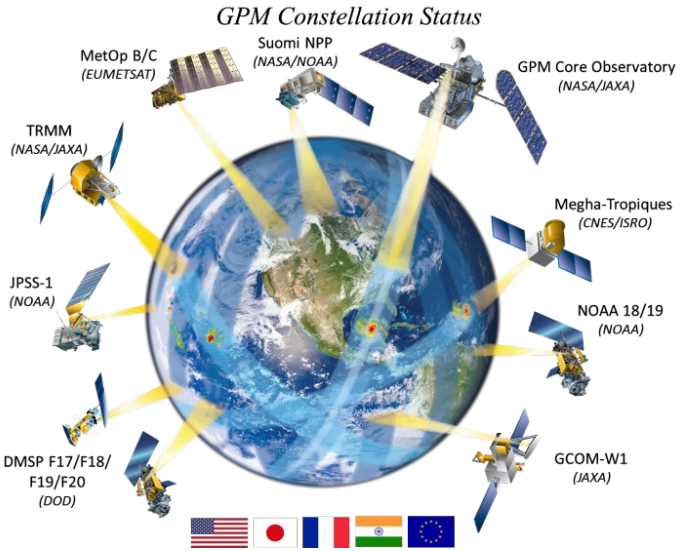
Why am I here? Business as usual is broken.

For >20 years I've worked on satellite algorithm development, data production, and science applications.

All the algorithms I worked on pre-2018 were developed in completely closed environments with minimal sharing of knowledge and code.

Sharing knowledge and code will accelerate science.



Open knowledge ➡ Better data ➡ Better science ➡ Bigger impacts

Why am I here? We need a 'mosaic of voices'

Closed data.
Closed software.
Closed cyberinfrastructure.

How does the existing closed organization of science perpetuate barriers to participation?

Image credit: Twentieth Century Fox

Open science reduces power differentials and advances an inclusive community

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Why open science? -2021 UNESCO Recommendation on Open Science

How:

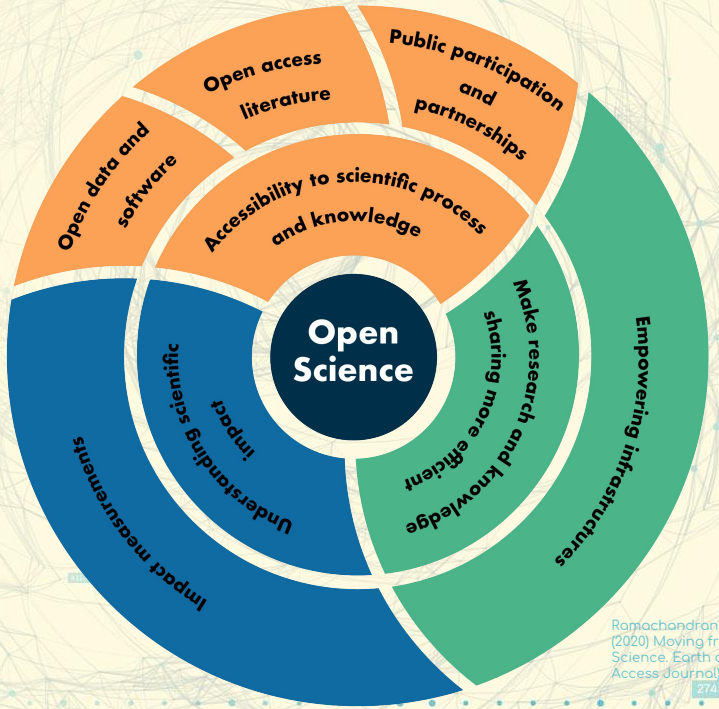
- Open, transparent, collaborative, and inclusive scientific practices

+

- More accessible & verifiable scientific knowledge subject to scrutiny and critique

Results:

- More efficient enterprise
- Improves quality
- Improves reproducibility
- Expands the impact of science
- Increases reliability
- Provides robust evidence for decision-making and policy
- Increase trust in science



Ramachandran, R., Bugbee, K., & Murphy, K. J. (2020) Moving from Open Data to Open Science. Earth and Space Science, (Gold Access Journal)

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Why now?

Current challenges:

- Climate change
- Protecting our interconnected world from extreme space weather events
- Identifying threats from interplanetary space
- Searching for life beyond Earth
- Unlocking the secrets of the Universe

What are we going to do about it?

- Recognize the transformative potential of open science to reduce inequalities AND advance science

Image credit: NOAA

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What is **NASA** going to do about it?

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> PROTECTING & IMPROVING LIFE ON EARTH
> LIFE ON OTHER PLANETS
> MYSTERIES OF THE UNIVERSE

Accelerating Scientific Discovery

These activities are designed to ***support and strengthen*** other NASA SMD initiatives on Inclusion, Diversity, Equity, and Accessibility (IDEA) and work for environmental justice.

Overview

- TOPS will act as a catalyst to ***jump-start*** a suite of coordinated activities designed to rapidly transform science
- Designate **2023 as the Year of Open Science** within a 5-year push to Transform to OPen Science.

Objective

- **Normalize** open science for the next generation of scientists that will participate in ESO missions
- **Accelerate** science by motivating and supporting the community's move towards open science
- **Broaden participation** in science and empower historically excluded groups and institutions

Implementation

- **2022** - Targeted capacity building to enable open science
- **2023** - Year of Open Science - Kick off challenges, summer schools, etc. to engage scientists
- **2024 and beyond** - Continue to harden support for open science
- **Coordinate** activities with scientific associations, institutions, philanthropic organizations, & move forward together

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Areas of Action from the 2021 UNESCO Recommendation on Open Science

Open Vision

- Designate 2023 as Year of Open Science
- Colloquia, speaking engagements, outreach, articles

Capacity building: Infrastructure

- Create FAIR - Analysis-Ready Cloud-Optimized (ARCO) data
- Support cloud hubs, open source software, open cloud-agnostic software platform infrastructure

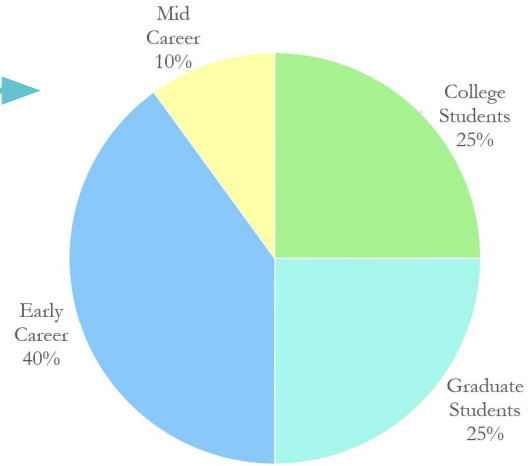
Capacity building: Education

- Initiate long-term activities to advance literacy in open source science methods, data science, tools and practices with dedicated summer schools, trainings, bootcamps, massive open online courses and colloquia.
  - Filling the gap: targeted outreach with early career/mid career
  - Leveraging current partnerships to reach other audiences

Incentives

- Develop NASA Open Source Science Awards program
- Prizes and challenges and cross-division science use cases

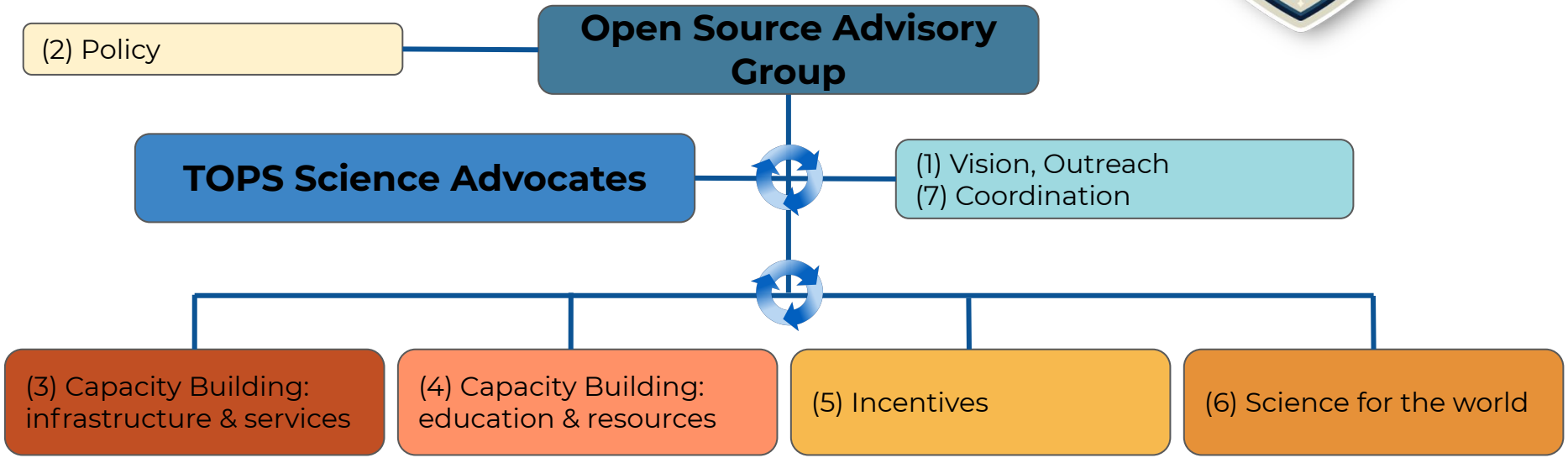
Targeted Outreach



Who is involved?

Organizational Structure:

- Teams for each UNESCO "Areas of Action"



to change everything, we need everyone

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Next Steps

> Survey your institution for barriers to open science

> Read the UNESCO report

> Create a team that can develop a plan to address all 7 areas of action

> Collaborate with TOPS, share solutions, share resources, share knowledge

Contact: TOPS Program Manager
Yvonne Ivey: yvonne.ivey@nasa.gov

Open Science Resources

- 2021 UNESCO Recommendation on Open Science
- NASEM Open Science by Design
- NASEM Best Practices for a Future Open Code Policy for NASA Space Science
- From open data to open science: article

Some Educational Resources

- Guidance for authors: Jupyter Notebooks
- The Turing Way handbook to reproducible, ethical and collaborative data science
- A Guide to Using GitHub for Developing and Versioning Data Standards and Reporting Formats
- Open coding and data learning materials: The Carpentries
- Openscapes open science mentorship program
- Online resource list
- Python for astronomers
- Scientific *python*


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