

Better Science in Less Time? Yes it is possible!



April 25, 2025

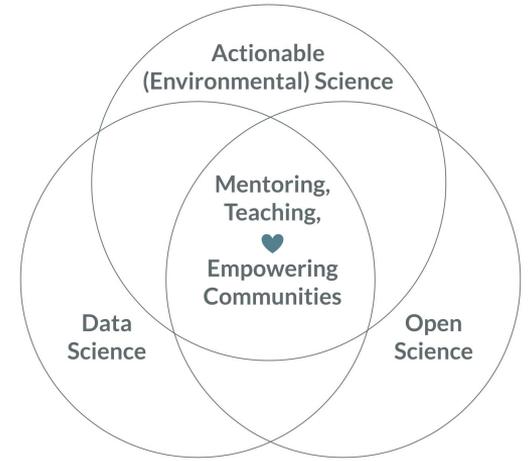
About us: We have a long history of actionable science & teaching



Julia Lowndes, PhD
Openscapes
10+ years marine ecologist



Eli Holmes, PhD
NOAA Fisheries
25+ years applied mathematician



Our collaboration started with small sparks, in 2021
Eric Ward (NOAA Fisheries)
Erin Robinson (Metadata Game Changers)

Outline

What does better science in less time look like?

NOAA Fisheries Openscapes perspectives, Spring 2025

Better Science

- more open, reproducible, efficient
- more diverse, equitable, inclusive, kind

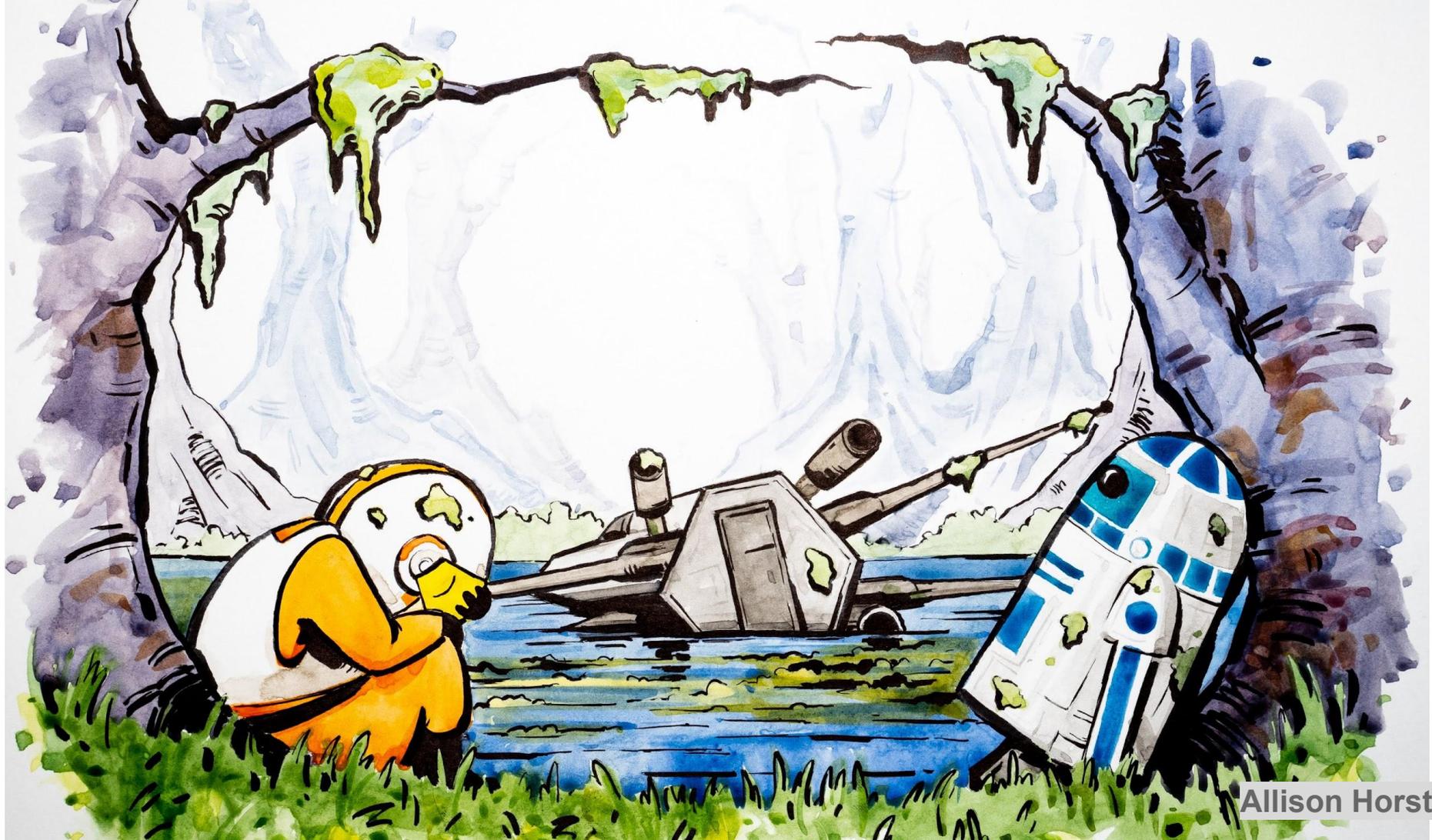
Future Us

- ourselves, teams, communities
- next hour, week, decades

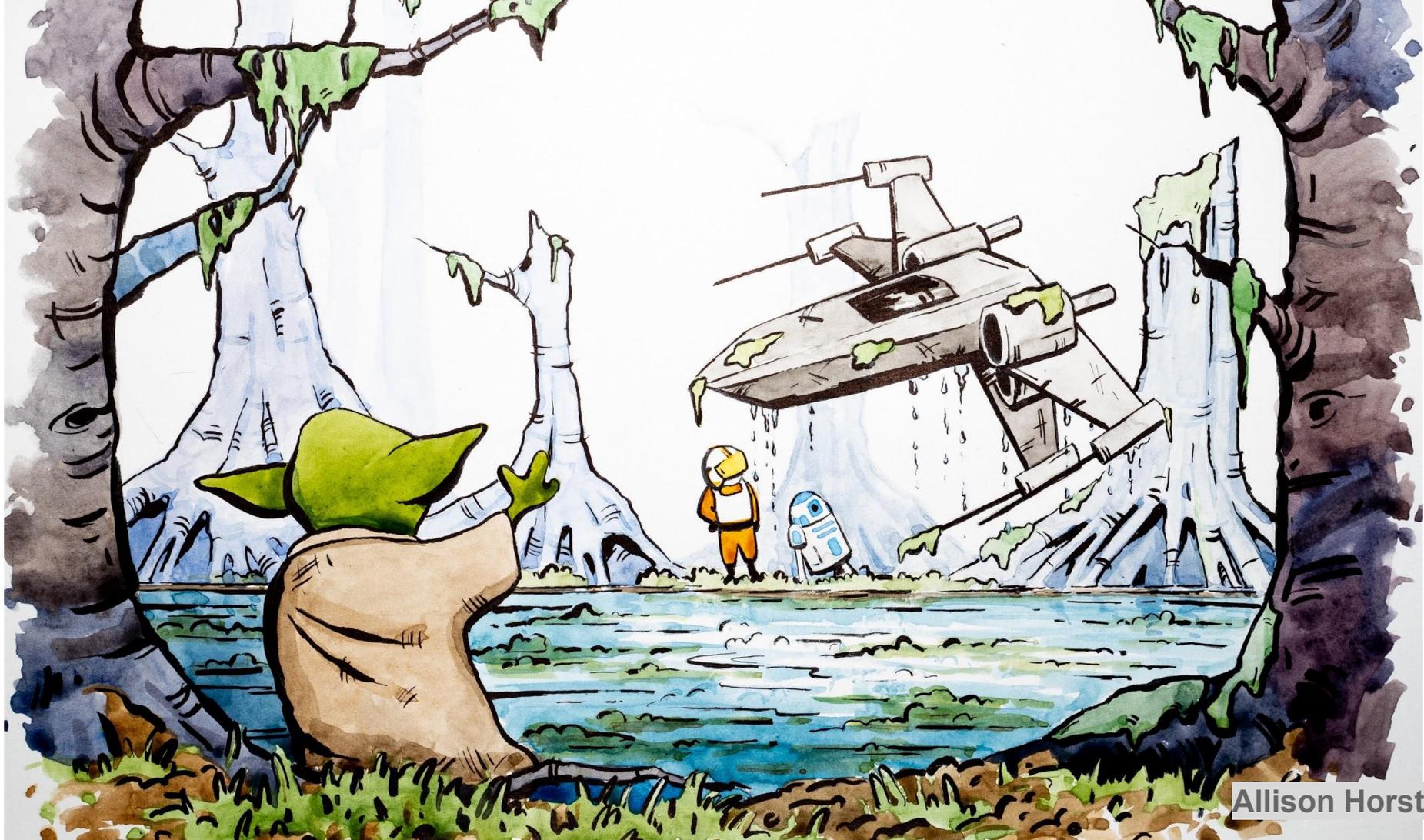
Stories from

- Ocean Health Index
- NOAA Fisheries

Resources & join us!



Allison Horst





A scientific method, tool, and community for channeling the best available scientific information into marine policy.



- Captures coupled system health, incorporates sustainability
- Boils into easy-to-understand metrics
- Is flexible to different contexts
- Stimulates actions to improve ocean health
- Is repeatable to track progress through time

Ocean Health Index Impact, 10 yrs later

In 2012, it took 30 people 4 years and several \$M to complete the 1st annual OHI report.

- Not sustainable if it costs \$MM each time

In 2024, it's 3 masters students in 3 months and \$200K.

Possible because it's reproducible, efficient, documented.

Team & collaborators can focus on new questions, making sense of results, and applications from this, not the assessment itself.



We found out the hard way that our default approaches for data analysis were not reproducible by even ourselves. So when we changed how we work, we shared & taught –

nature
ecology & evolution

PERSPECTIVE

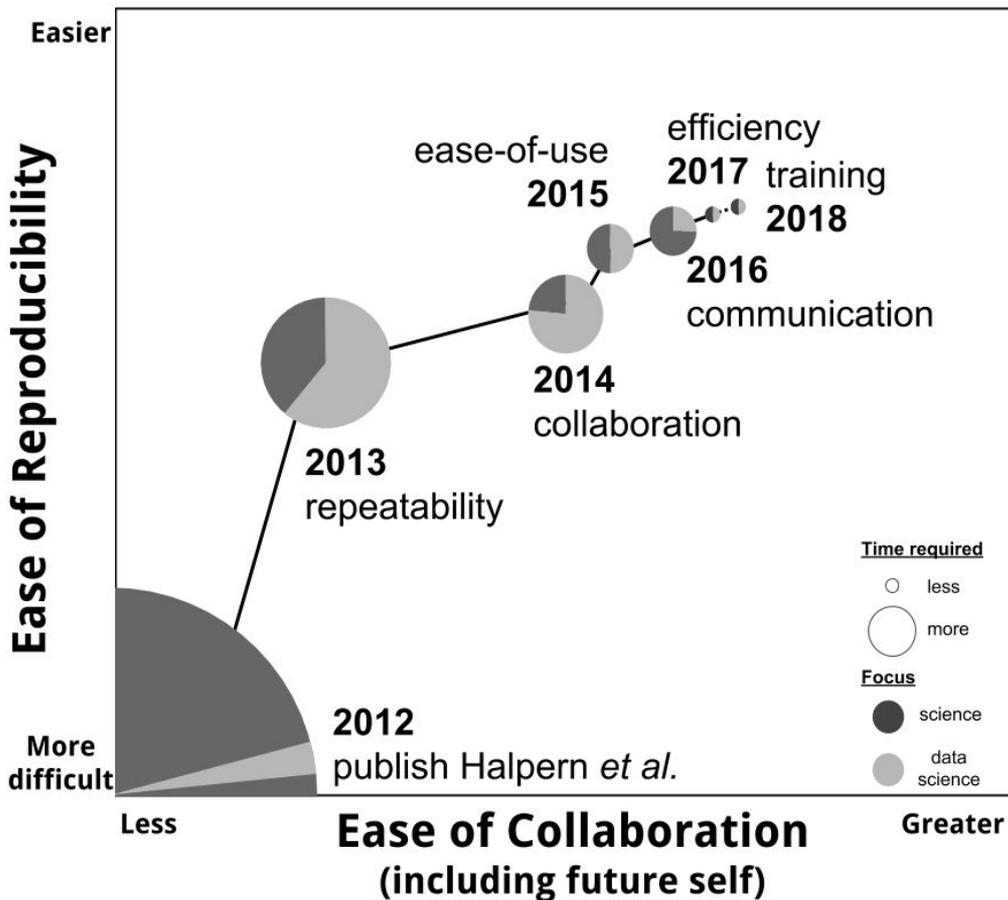
PUBLISHED: 23 MAY 2017 | VOLUME: 1 | ARTICLE NUMBER: 0160

Our path to better science in less time using open data science tools

Julia S. Stewart Lowndes^{1*}, Benjamin D. Best², Courtney Scarborough¹, Jamie C. Afflerbach¹,
Melanie R. Frazier¹, Casey C. O'Hara¹, Ning Jiang¹ and Benjamin S. Halpern^{1,3,4}

Slides from [R for better science in less time: Lessons from the Ocean Health Index and Openscapes](#) - November 21, 2019: [School of Aquatic and Fisheries Sciences, University of Washington](#), Seattle, Washington (45 minutes)

Ocean Health Index



Incremental: made progress where most needed while meeting annual deadlines

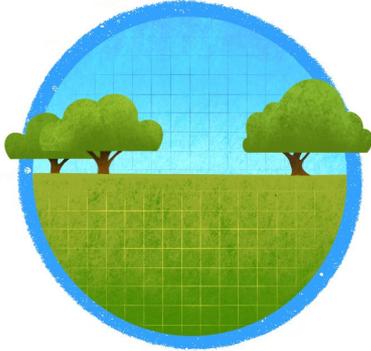
Habit building: paste text from email into GitHub Issues

Code Review in the Lab - Melanie Frazier slides
<https://ropensci.org/commcalls/2018-10-16/>

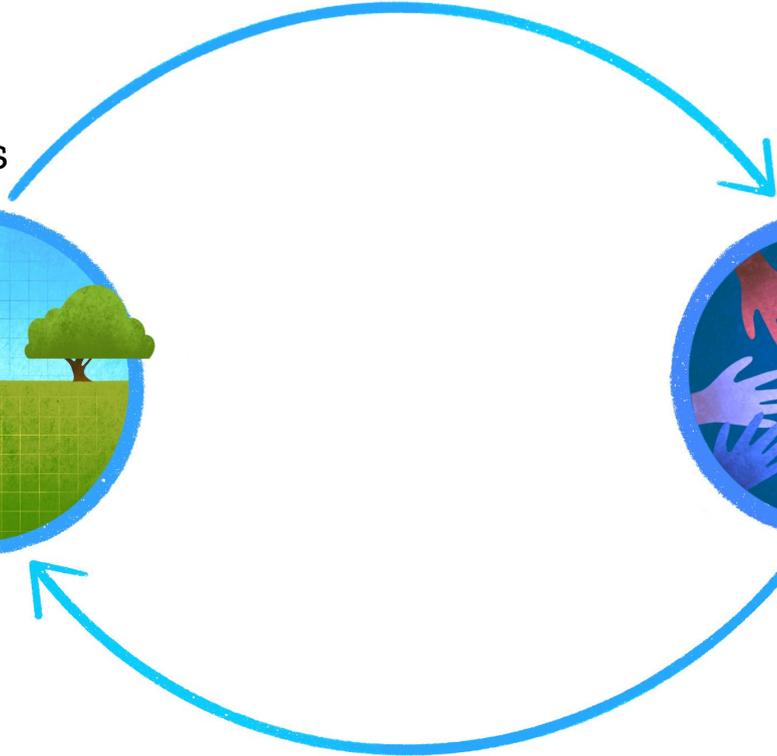
Our path to better science in less time using open data science tools ([Lowndes et al. 2017](#))

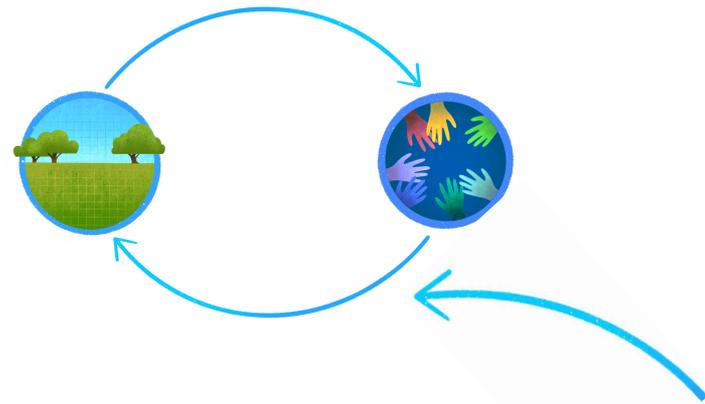
How we work: Technical & social infrastructure together

Tooling
tools & workflows



People
teams & community





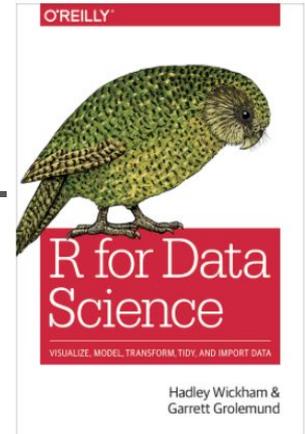
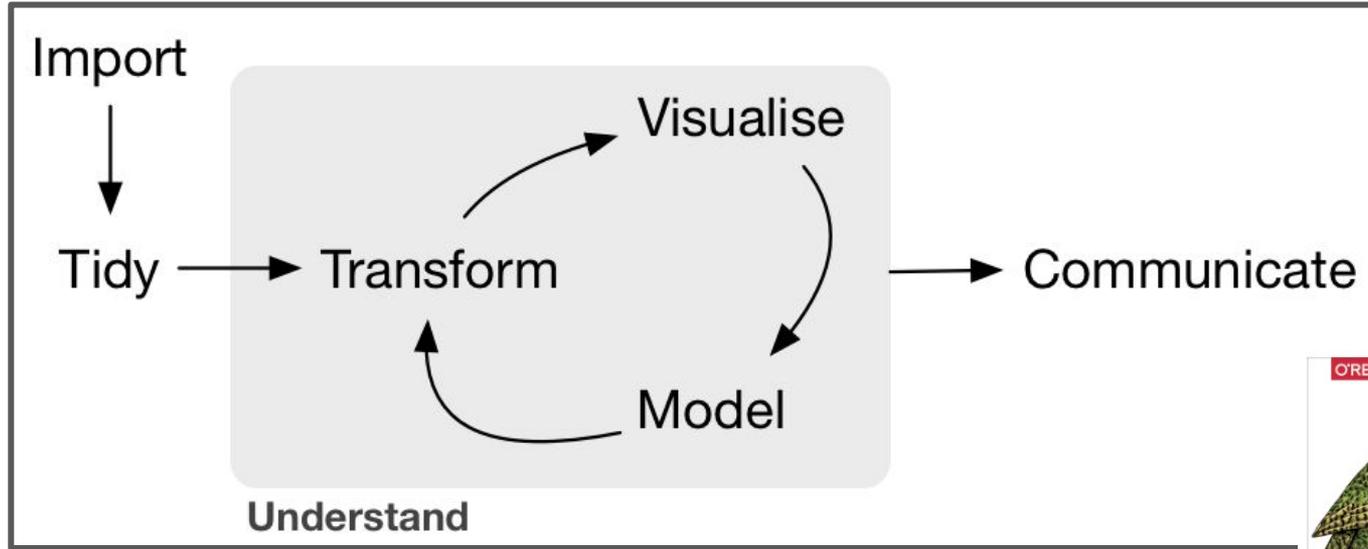
- Open source coding  R Studio
- Version control  git
- Collaboration & distribution  GitHub
- Real-time co-development   zoom 
- Connection to broader communities

- **Vertical & horizontal leadership**  
- **Trust, kindness, willingness, & learning**  NCEAS
- Create norms about data & docs, leverage overlapping skills, on/offboarding 
- Join global & create local communities

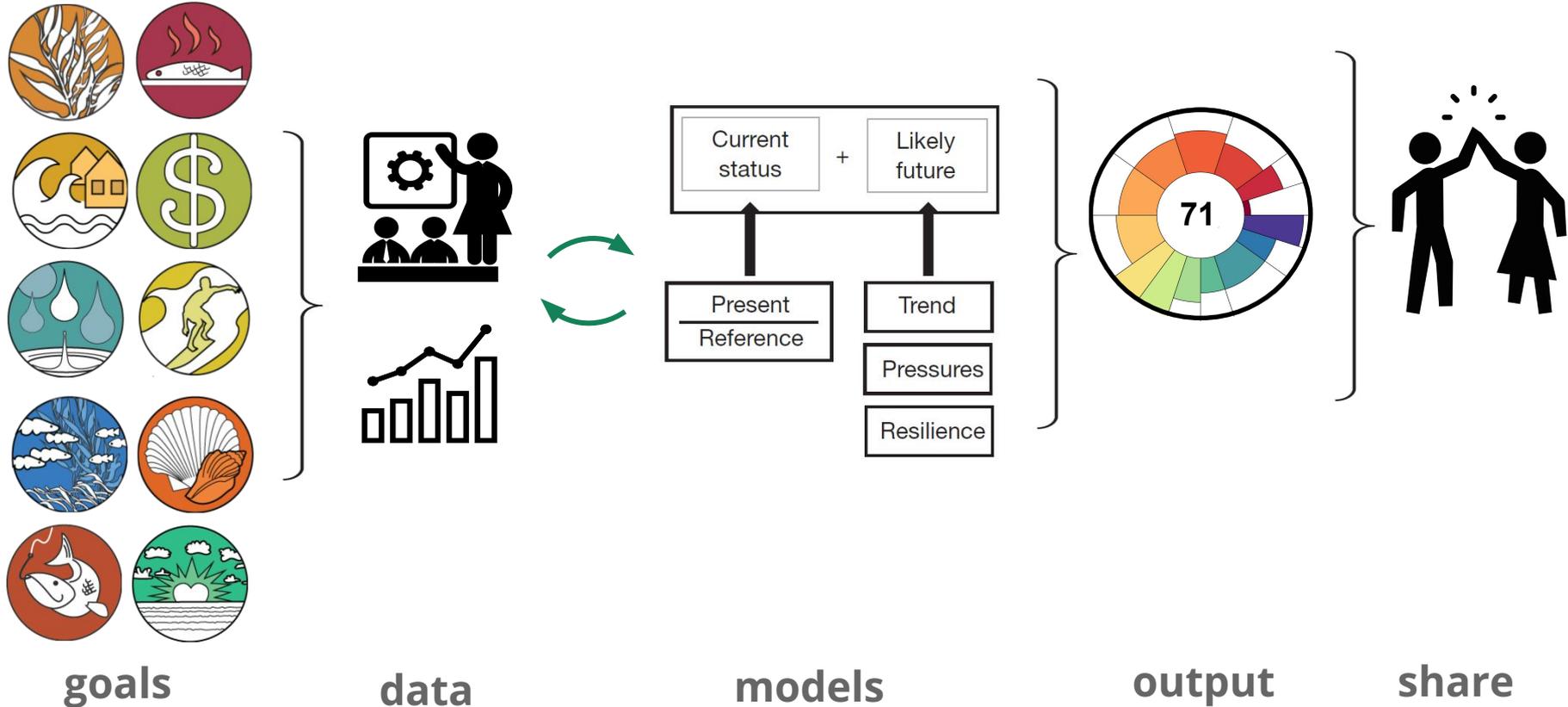


Our path to better science in less time using open data science tools
Lowndes et al. 2017, Nature Ecology & Evolution

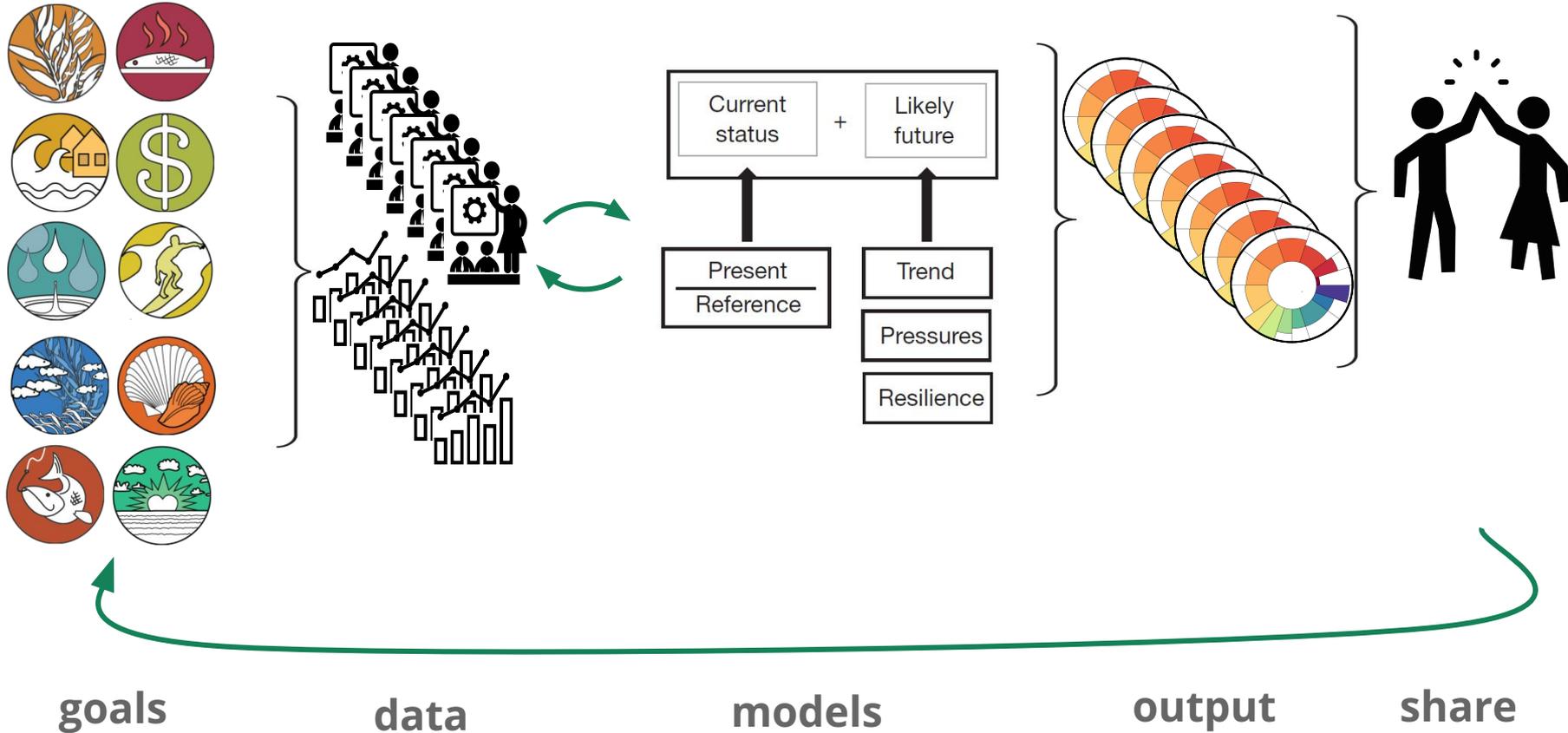
Learn from other groups: talk & draw our workflows



Big reports - visualize the steps



Big reports - find the common, where to automate



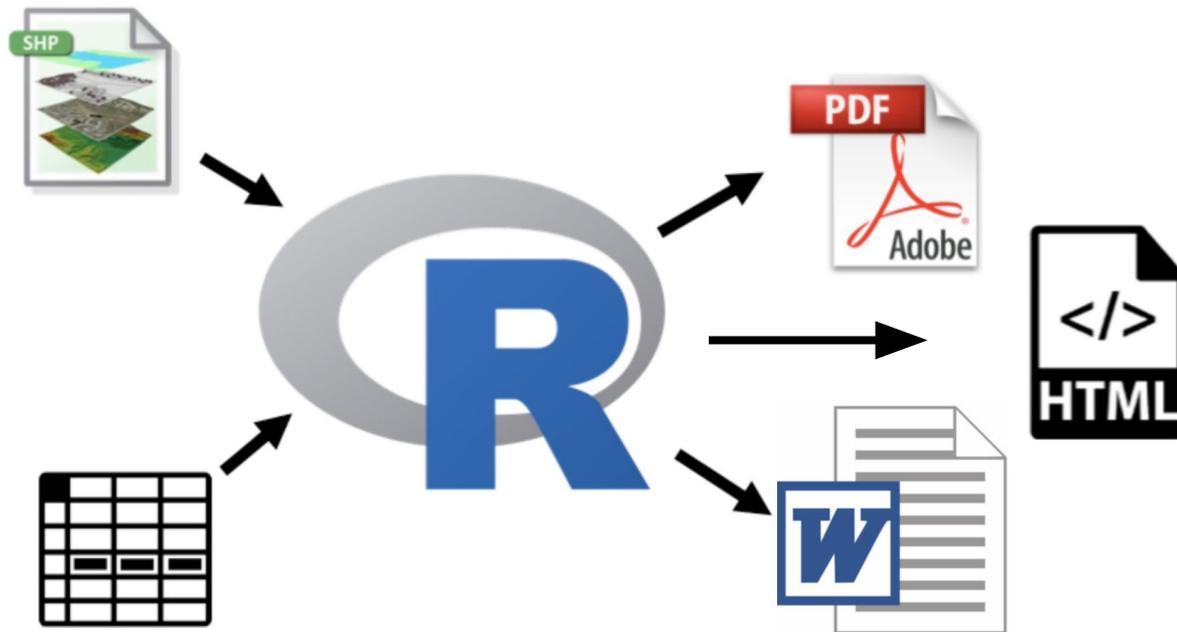
OHI's pathway to better science in less time

Table 1. Lowndes *et al.* 2017

| Task | Then |
|---------------------------------|---|
| Reproducibility | |
| Data preparation | Manually (that is, Excel) |
| Modelling | Multiple programming languages |
| Version control | File duplication and renaming |
| Organization | Individual conventions |
| Collaboration | |
| Coding | Separate languages and conventions |
| Workflow and project management | Individual conventions |
| Internal collaboration | e-mail |
| Communication | |
| Sharing data | ftp download |
| Sharing methods | Published manuscript and supplementary material |



Learn from other groups: streamlined workflows



Shared tools & practices

efficiency & reproducibility:
coding and version control
are the keystone

Reproducibility

Code

Version control

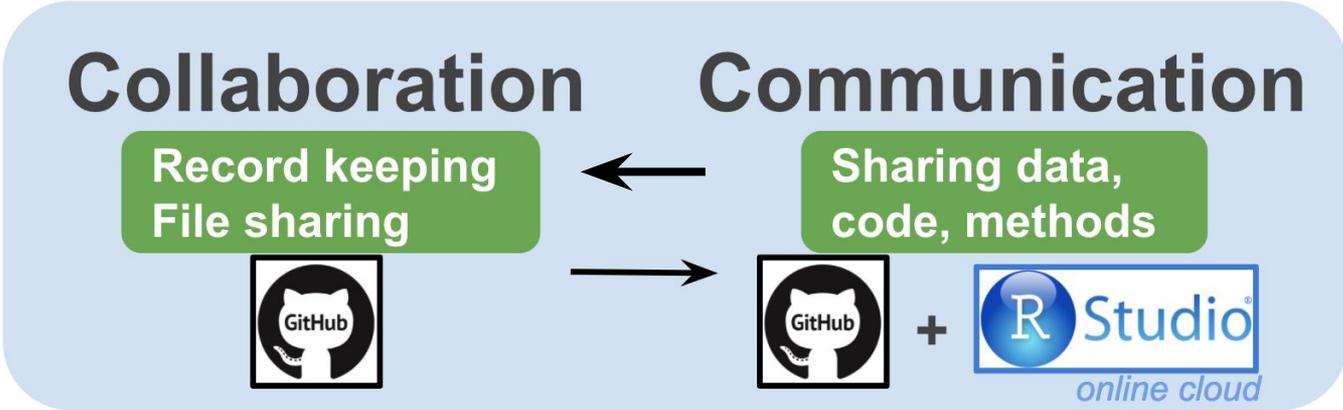


local computer



Shared tools & practices

but also for collab & comms like you've never seen



efficiency & reproducibility: coding and version control are the keystone

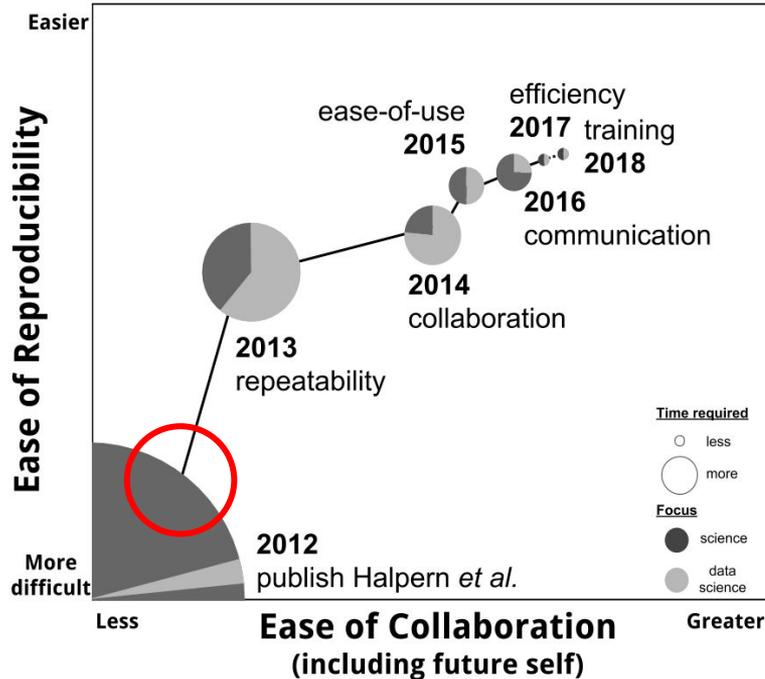


OHI's pathway to better science in less time

Table 1. Lowndes et al. 2017

| Task | Then | Now | Primary open data science tools |
|---------------------------------|---|--|---|
| Reproducibility | | | |
| Data preparation | Manually (that is, Excel) | Coded in R | R packages: tidyverse (dplyr, tidyr, ggplot2). Documentation: R Markdown |
| Modelling | Multiple programming languages | R functions and ohicore package | R packages: tidyverse, devtools, roxygen2, git2r |
| Version control | File duplication and renaming | Git | Git; interface with Git and GitHub primarily through RStudio |
| Organization | Individual conventions | Standardized team convention | RStudio projects, GitHub repositories. File structure protocols |
| Collaboration | | | |
| Coding | Separate languages and conventions | R and standardized team convention | Principles of tidy data; tidyverse |
| Workflow and project management | Individual conventions | Simplified GitHub workflow | GitHub, RStudio |
| Internal collaboration | e-mail | Centralized, archived conversations | GitHub issues |
| Communication | | | |
| Sharing data | ftp download | All versions and releases available online | http://ohi-science.org/ohi-global |
| Sharing methods | Published manuscript and supplementary material | Published on our website (http://ohi-science.org) | Website, with linked R Markdown outputs (webpages, presentations, etc.) |

But what was this transition *really* like?



- Trust and willingness
- Team buy-in and time to learn & build: supported as part of our jobs

"But I work alone. I'm not part of a team."

"But I'm not supported, I don't have time."

"But I don't know where to start."

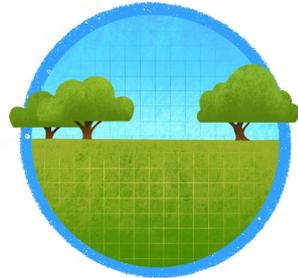


What's underlying Openscapes approach

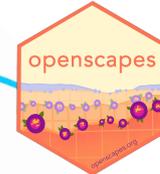
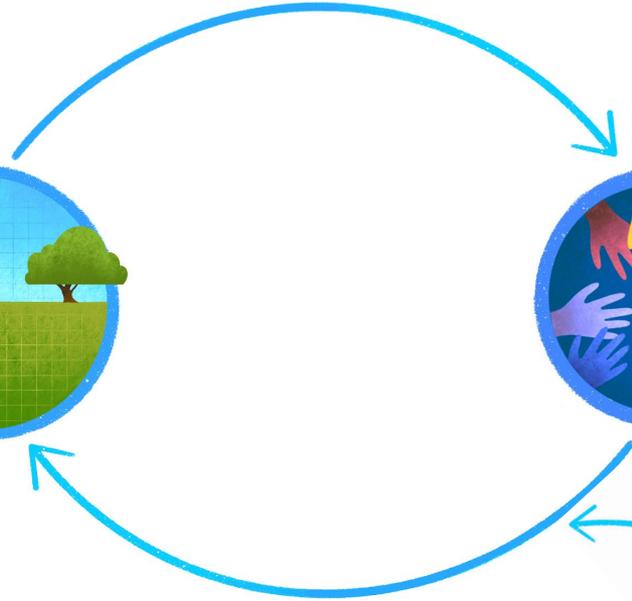
Openscapes is a mechanism that can rapidly identify needs and bring people together to solve them. Feedback loop between using & developing infrastructure and teaching & learning from people.



Infrastructure
tools & practices



People
teams & community



Open Science

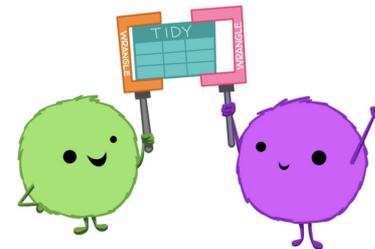
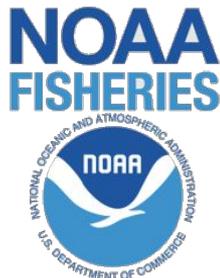
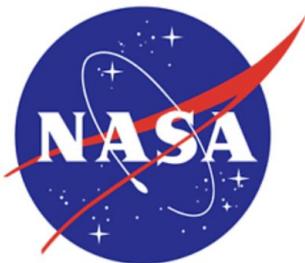
Global movement happening all across science

A fundamental change in how science is done towards practices and workflows that promote **reproducibility, transparency, sharing, and useability** of scientific innovation.



Movement building

What's possible because of all this



Data cloud migration

Since 2021, co-led with Erin Robinson (Metadata Game Changers)
nasa-openscapes.github.io

Data & workforce modernization

Since 2021, co-led with Eli Holmes (NOAA Fisheries)
nmfs-openscapes.github.io

Data & workforce modernization

Since 2021, co-led by Anna Holder; first org that “forked” internally
cawaterboarddatacenter.github.io/swrcb-openscapes

“How do I improve how my group collaborates with data & reports?”

Since 2019, 27 Cohorts, incl. EPA, Fred Hutch
openscapes.org/initiatives#champions-program

Big questions. Empowering that they can be approached with similar solutions: community

Openscapes Champions

2-month remote cohorts for teams

Lessons based from Lowndes et al. 2017

[Openscapes.org/series](https://openscapes.org/series)

Pathway tool helps teams talk through problems and while learning with, from, and for others

You're invited: Fall 2025: 3 Cohorts for 120 NMFS staff! Details in summer!



Openscapes Pathway
Lab & context:

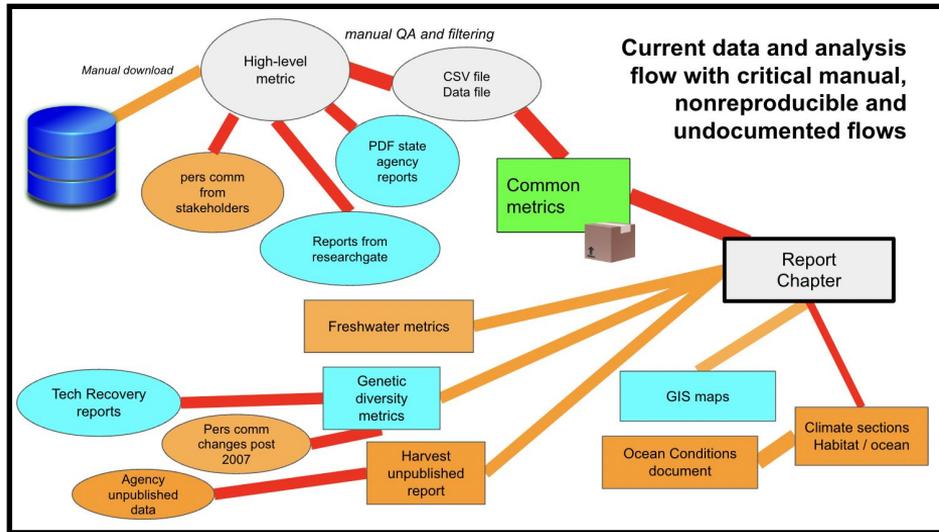
| | Now | Next steps |
|--|-----|------------|
| Reproducibility data prep, analysis, version control, organization | | |
| Collaboration coding, storing data, project mgmt, internal discussions | | |
| Communication sharing data, sharing methods, talks, teaching | | |

Purpose: to deliberately identify data workflow practices in your lab and next steps to facilitate efficiency and open culture. It will help create protocols for shared lab practices (also important for onboarding). See also Lowndes et al. 2017 Table 1.

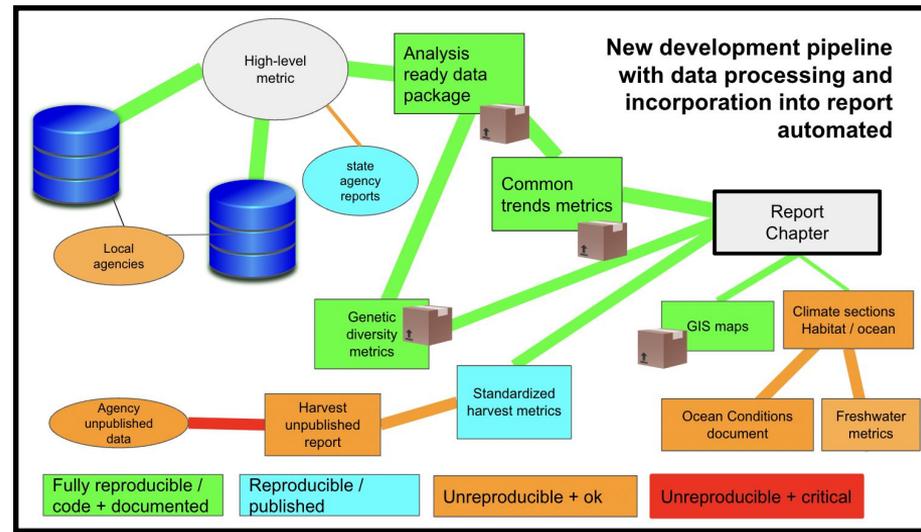
Workflow analysis by a NOAA Fisheries 2022 Openscapes team

“Our report feeds into another report but we don’t really talk with each other”

Current workflow



New workflow



Red lines (left) were critical workflows of data or analyses that the team identified as the key targets for improving their workflow.

Green lines (right) are reproducible & documented steps that save the team time.

Kourtney Burger, Biological Science Technician, NOAA Southwest Fisheries Science Center

2022 Openscapes Champion, shared her story in a blog post

Living documentation, regularly updated

Summary

The ADRIFT project uses drifting acoustic buoys that are composed of a deep hydrophone array (cable with two hydrophones, recorder, depth sensor, and weight at bottom), a weighted High Flyer pole buoy (containing 2 satellite geo-locators and a radar reflector), and a floating line/surface float to facilitate retrieval (see Figure 1). The hydrophone array and High Flyer are connected by ~100m $\frac{1}{4}$ " line with two hard trawl floats (one at the surface, and a subsurface float at depth), a dampener plate with bungees and a drogue (at depth).

On this page
[Summary](#)
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- Home
- Hardware >
- Summary
- Pole Buoy
- GPS Solar
- Tote Contents
- Array
- ST4300 Recorder
- ST640 Recorder
- Sensus Depth Sensor
- Field Methods >
- Data Download
- Additional Information >



[ADRIFT Field Methods website](#) - “... a living document where we can outline our methodology and update/archive specific components of our methods and hardware as changes are made.”

[Blog post](#),
[Documentation website](#) &
[source on GitHub](#)

Josh London, Wildlife Biologist, NOAA Alaska Fisheries Science Center

An Openscapes Mentor since 2022, shared his story at ESIP 2023

- **Building new skills builds morale**
 - People feel like they're making a difference, advancing science, instead of feeling stagnant
- **Small cultural shifts; it's not just about the tools**
 - Collaborative meeting notes & better documentation
 - More inclusive communication
 - Fundamental changes in how we get things done
- **Move away from hero mentality**
 - I'm not alone
 - It's ok to ask for help early
- **Finding the right moments to build things out**
 - Along with doing our daily work



[Blog post](#) with [recording](#) of ESIP 2023 panel.

AST Lab Manual - Acoustics for IWCPS

Manual Outline for IWCPS:

- **How to Set Up Acoustics Lab**
- **Daily Operations**
 - Sunrise and sunset tasks
 - Processing tasks
- **Accessing Data and Real Time Survey Updates**

Goals:

- Inclusive conversations – *everyone* is up to date on changes
- Help track all the details
- Make tasks approachable and teachable



AST Lab Manual - Acoustics for IWCPS

3. Setting up the EK80:

EK80 software is run on two computers: (1) The ship's EK80 PC, located in server rack, and (2) AST's PC, located on the port side of the Acoustic's Lab across from ship EK80 PC. The ship's EK80 PC operates the non-18-kHz WBTs. AST's EK80 PC is operating the 18-kHz WBT and the EC150-3C. **Confirm version of EK80 software is the most recent version on both computers.**

3.1. Networking:

A SyncbackFree profile on the Echoview PC backs up data from both PCs to the NAS drive (\\192.168.123.24\ast-data\2407RL\ACOUSTIC_DATA) every 15 minutes.

3.2. Settings for both the Ship EK80 PC and the AST EK80 PC:

- [Ping Mode](#) set to **maximum**.
- [Recording Range](#) set to **on**.
- [Drop Keel](#) sensor configuration should reflect the centerboard's current position. Confirm with the ship Survey Tech that drop keep is updated.
- Set files to save as the maximum allowable file size (Output -> File Setup -> File Size -> check [Maximum](#)).

3.3. Settings for AST EK80 PC - 18 kHz WBT PC:

Set Save Location:

- The AST 18-kHz PC is set save files directly to an external 4-TB HDD.

On this page

1. Networking Overview:
2. Setting up the Echoview PC:
3. Setting up the EK80:
 - 3.1. [Networking](#):
 - 3.2. Settings for both the Ship EK80 PC and the AST EK80 PC:
 - 3.3. Settings for AST EK80 PC - 18 kHz WBT PC:
 - 3.4. Settings for the Ship EK80 PC:
4. Setting up K-Sync:
5. Setting up the Trawl PC:
6. [DRAFT] Setting up TD50
7. [DRAFT] Setting up SX90
8. [DRAFT] Setting up ME70
9. [DRAFT] Setting up MS70

-  [Edit this page](#)
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Report & Track Issues

Prioritized backlog | Status board | Roadmap | Bugs | In review | My items | + New view

Filter by keyword or by field [Discard] [Save]

Novem: December 2024 [Markers] [Sort] [Date fields] [Month] Today < >

30 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

- 1 create pages and copy existing text from re... #1
- 2 add info on how to use page #2
- 3 data workflow diagram of acoustic data #3
- 4 copy quarto template and make repo #4
- 5 EV Processing Dataflow Diagram #7
- 6 Reach goals for Echo Class #8
- 7 Feedback from LHP 11/16 #10
- 8 Feedback from AST 12/18 #14
- 9 Complete nasc.r section #11
- 10 Add photos to front page #12

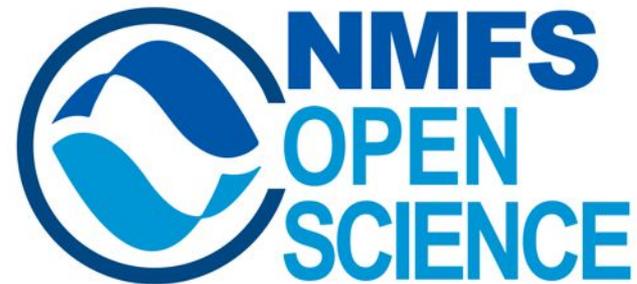
+ Add item

- Throughout survey & year after year
- Notification when new procedures are changed
- Tracking changes year after year
- File management for survey related documents
- Training for volunteers & employees

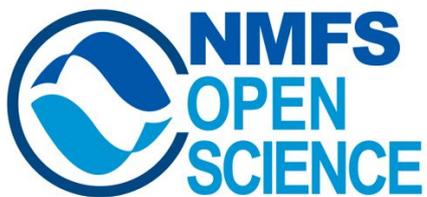
NOAA Fisheries Open Science

Elizabeth Eli Holmes, Ph.D (lead)

Jonathan Peake, Ph.D (co-lead)



RESOURCES & TRAININGS



Community Building and Skill Building

Openscapes

NOAA
FISHERIES



Support for 'mentors',
organizers, leads

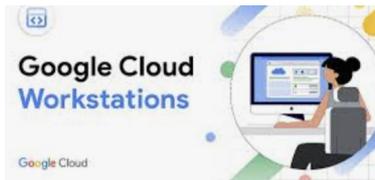
Data Science academy

Training Infrastructure



training and workshop hub
for intra-mural or
extra-mural activities

Help for on-boarding to Cloud Computing



Trainings and Hack Events

[Training Page](#)

- GitHub
- Quarto Reports
- R
- Python
- Cloud Computing
- Remote Sensing Data

**Join one of the
NMFS Open
Science Google
Spaces to get
updates**

1:1 and Team Support

AMA Help Desk with
Jon Peake every
Wednesday. Sign up
for a slot!

[Training Page](#)
has link

Team trainings.
Email Jon and Eli
and we will set up a
time to work with
your team.

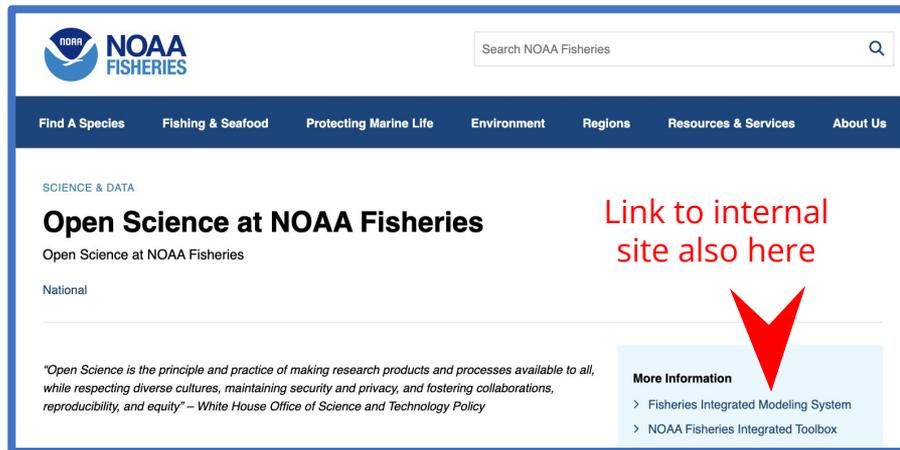
Coworking with Stef

Fall 2025
Openscapes
Champions cohort

NMFS Open Science - Communications hub

Internal:

<https://sites.google.com/noaa.gov/nmfs-hq-st-open-science>



NOAA FISHERIES

Search NOAA Fisheries

Find A Species Fishing & Seafood Protecting Marine Life Environment Regions Resources & Services About Us

SCIENCE & DATA

Open Science at NOAA Fisheries

Open Science at NOAA Fisheries

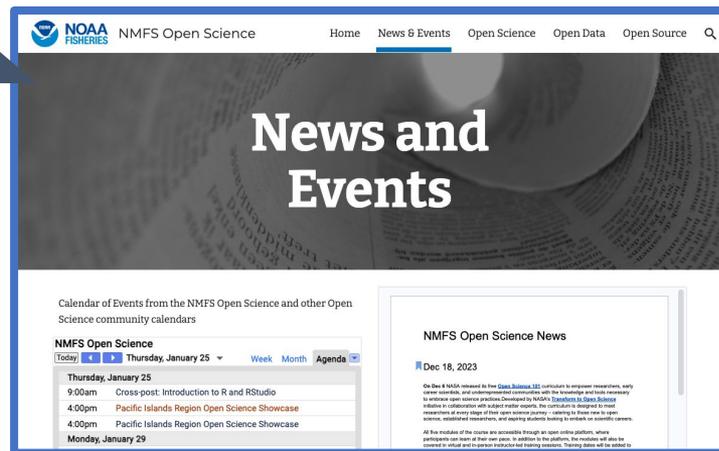
National

"Open Science is the principle and practice of making research products and processes available to all, while respecting diverse cultures, maintaining security and privacy, and fostering collaborations, reproducibility, and equity" – White House Office of Science and Technology Policy

More Information

- > Fisheries Integrated Modeling System
- > NOAA Fisheries Integrated Toolbox

Link to internal site also here



NOAA FISHERIES NMFS Open Science Home News & Events Open Science Open Data Open Source

News and Events

Calendar of Events from the NMFS Open Science and other Open Science community calendars

NMFS Open Science

Today Thursday, January 25 Week Month Agenda

| | |
|--------|--|
| 9:00am | Cross-post: Introduction to R and RStudio |
| 4:00pm | Pacific Islands Region Open Science Showcase |
| 4:00pm | Pacific Islands Region Open Science Showcase |

Monday, January 29

NMFS Open Science News

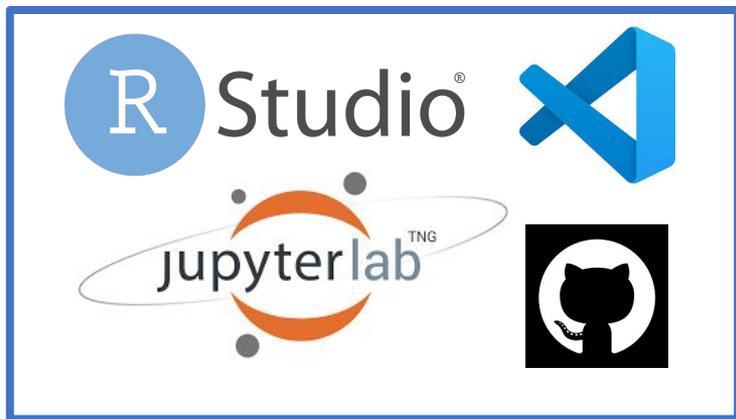
Dec 18, 2023

On Dec 8 NOAA released the [Open Science 101](#) curriculum to empower researchers, early career scientists, and interdisciplinary collaborators with the knowledge and tools necessary to advance open science practices. Developed by NOAA's [Open Science In-Open Science](#) Institute in collaboration with subject matter experts, the curriculum is designed to build researchers at every stage of their open science journey – catering to those new to open science, established researchers, and aspiring business leaders to establish an open science.

All the modules of the course are accessible through an open online platform, which participants can view at their own pace. Additional to the platform, the modules will also be covered in virtual and in-person educational training sessions. Training dates will be added to calendar as critical and in-person educational training sessions. Training dates will be added to calendar as critical and in-person educational training sessions.

Public: <https://nmfs-opensci.github.io>

NMFS Openscapes Jupyter Hub for learning, training and workshops



A compute platform where you can try out tools without having to install things. Create things and share!

Quarto, GitHub, RStudio, JupyterLab, QGIS, ASAR, VAST, ML

File Edit View Run Kernel Git Tabs Settings Help Share

Terminal 3

```

As always, we'll start by importing xarray

[1]: import xarray as xr
      xr.set_options(keep_attrs=True)
      import hvplot.xarray

I'm going to use one of xarray's tutorial datasets. In this case, air temperature from the NCEP reanalysis. I'll assign the result of the open_dataset to ds. I may change this to access a dataset directly

[2]: ds = xr.tutorial.open_dataset("air_temperature")

As we are in an interactive environment, we can just type ds to see what we have.

```

Jupyter Lab

OS
rocker/geospatial
with R 4.2 + suite
of packages

Rocker/verse
TMB
VAST, sdmTMB, etc

OS
pangeo +
machine-learning
tools + one of our
python modules

acoustics
pipelines

python™
qlime2
microbiome
bioinformatics

File Edit Code View Plots Session Build Debug Profile Tools Help

2-subset-and-plot.qmd | multifile_raster.qmd | sst-gdal.qmd

Environment History Connections Build Git Tutorial

Staged Status Path

- content/sst.nc
- docs/coc.html
- docs/index.html
- docs/overview.html
- docs/robots.txt
- docs/schedule.html
- docs/search.json
- docs/setup.html
- docs/sitemap.xml

Files Plots Packages Help Viewer Presentation

- New Folder
- New Blank File
- Upload
- Delete
- Rename
- More

home > rstudio > EDMW-EarthData-Workshop-2024

93.11 | Chunk 9 | Quarto 5

Console Terminal Background Jobs

```

R 4.2.2: /home/rstudio/EDMW-EarthData-Workshop-2024/
* 13 'tree' software and comes with absolutely no warranty.
You are welcome to redistribute it under certain conditions.
Type 'license()' or 'licence()' for distribution details.

R is a collaborative project with many contributors.
Type 'contributors()' for more information and
'citation()' on how to cite R or R packages in publications.

Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.
> |

```

RStudio

Try it out now!

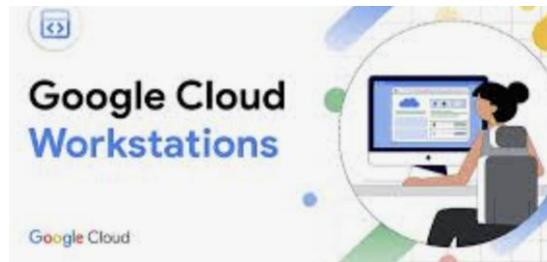
<https://noaa.nmfs-openscapes.2i2c.cloud/>

Ok what about when we want to start working?

Install the tooling locally



*Heavier duty
computations*



NASA Earth Sciences & UW Hackweek 2024

19 Aug - 23 Aug [University of Washington, Seattle, USA](#)

Tutorials + peer-to-peer learning + project based teamwork

Logistics

About NASA Earth Sciences & UW Hackweek

The eScience Institute at the University of Washington is excited to present the next evolution in our annual hackweek program. 2024 will be our first combined event, with projects using data from the NASA ICESat-2 and SnowEx missions, and with specialists from the NSF GeoSMART program providing training in Machine Learning

JupyterBooks:

SnowEx Track

ICESat-2 Track

GeoSMART Track

[CryoCloud: Accelerating Discovery for NASA Cryosphere Communities with Open-Cloud Infrastructure](#)

Example of how of how a community JupyterHub accelerates collaboration: CryoCloud for the CryoSphere community



CryoCloud JupyterBook

All the content! More about us, resources, training, and tutorials all found here!



CryoCloud

CryoCloud JupyterHub

Get onto the cloud. Our shared cloud platform for NASA Cryosphere communities.

NMFS Open Science News and Events

<https://sites.google.com/noaa.gov/nmfs-hq-st-open-science/news-community>

NMFS Open Science News

Apr 21, 2025

Announcement: Stock Assessment Workflows Office Hours 🗣️

The Workflows team (Sam, Sophie, and Steve) will be holding two weekly "office hours" to answer your questions about using (asar) and (stockplotr) to write stock assessment reports. The hours will be on [Mondays from 4-5pm EST/1-2pm PST](#) and [Wednesdays from 2-3pm EST/11am-12pm PST](#). If you would like to add either meeting to your calendar, please click the respective link for your preferred time and day in the previous sentence.

Feel free to drop in whenever you'd like some help! Here are the meeting details:

Mondays:

Monday, April 21 · 4:00 – 5:00pm

Time zone: America/New_York

Google Meet joining info

Video call link: <https://meet.google.com/pjc-hbvf-yhp>

Or dial: (US) +1 505-738-1320 PIN: 751 897 859#

More phone numbers: <https://tel.meet/pjc-hbvf-yhp?pin=4419846167618>

Wednesdays:

Wednesday, April 23 · 2:00 – 3:00pm

Time zone: America/New_York

Google Meet joining info

Video call link: <https://meet.google.com/uwp-umci-tcy>

Or dial: (US) +1 469-300-9629 PIN: 385 219 102#

More phone numbers: <https://tel.meet/uwp-umci-tcy?pin=9116627183996>

< > Apr – Aug 2025 ▾



25 APR, FRI

● 11am NOAA HackHours: Intro to echopye for acoustics data

30 APR, WED

● 9:30am Open Science Help Desk

● 12pm FIS Coder PSG

1 MAY, THU

● 10am Cross-post: GitHub for Data Analysis Projects – FMWG PIT Tag Data

2 MAY, FRI

● 11am NOAA HackHours: Coiled demo for big data pipelines

7 MAY, WED

● 9:30am Open Science Help Desk

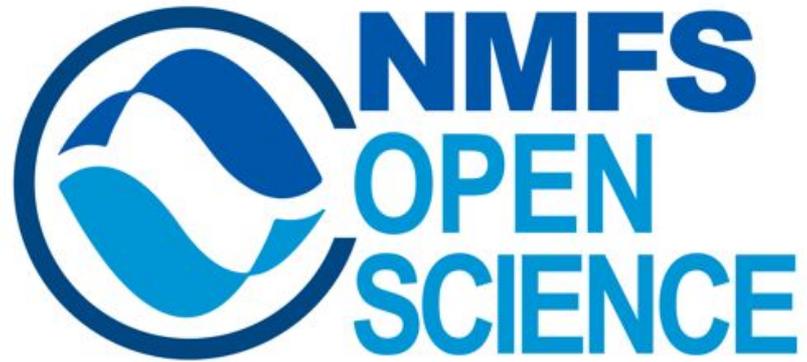
8 MAY, THU

NMFS Open Science Google Spaces & Groups

- NMFS R User Group
 - Google Space
 - Calendar
- NMFS Python User Group
- Coder PSG
- GitHub User Group
- NMFS Open Science
 - Google Space
 - Calendar
- NMFS AI Slack

How to find?

- <https://sites.google.com/noaa.gov/nmfs-hq-st-open-science/events-community>
- Search Google Groups and Calendars
- fisheries.noaa.gov search for “open science” and look at links on right



<https://nmfs-opensci.github.io/>

Look for link to our internal site!