

Better Science in Less Time? Yes it is possible!



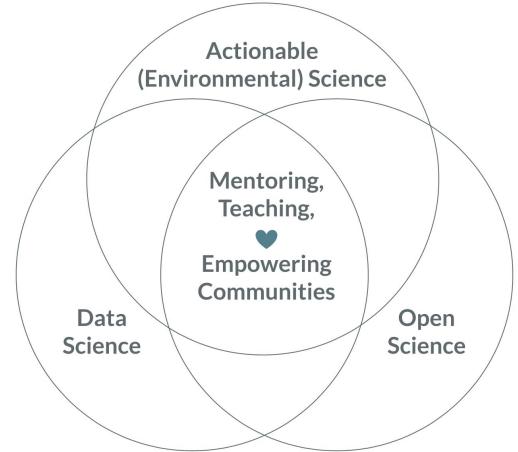
April 25, 2025

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

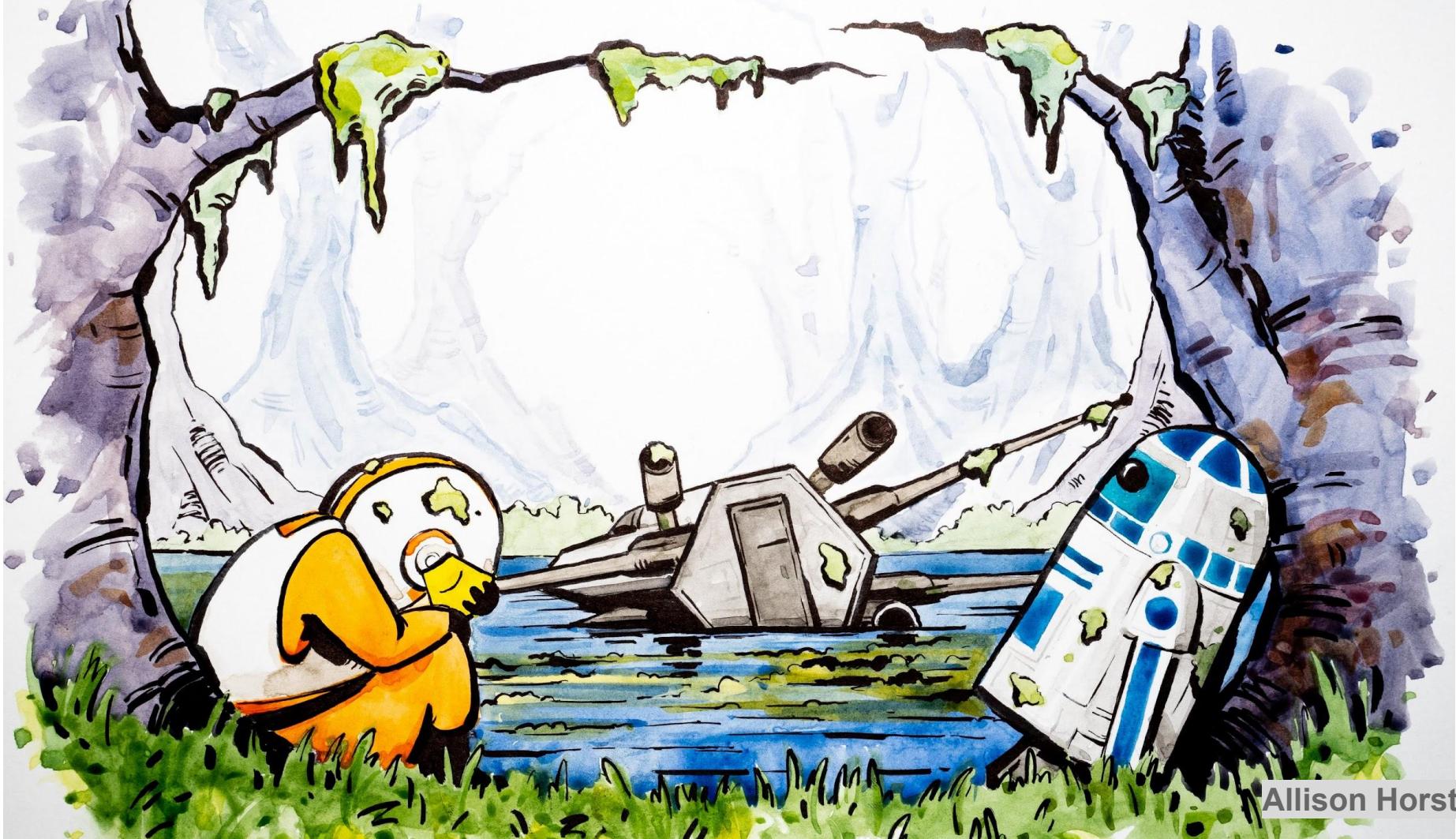
Future Us

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

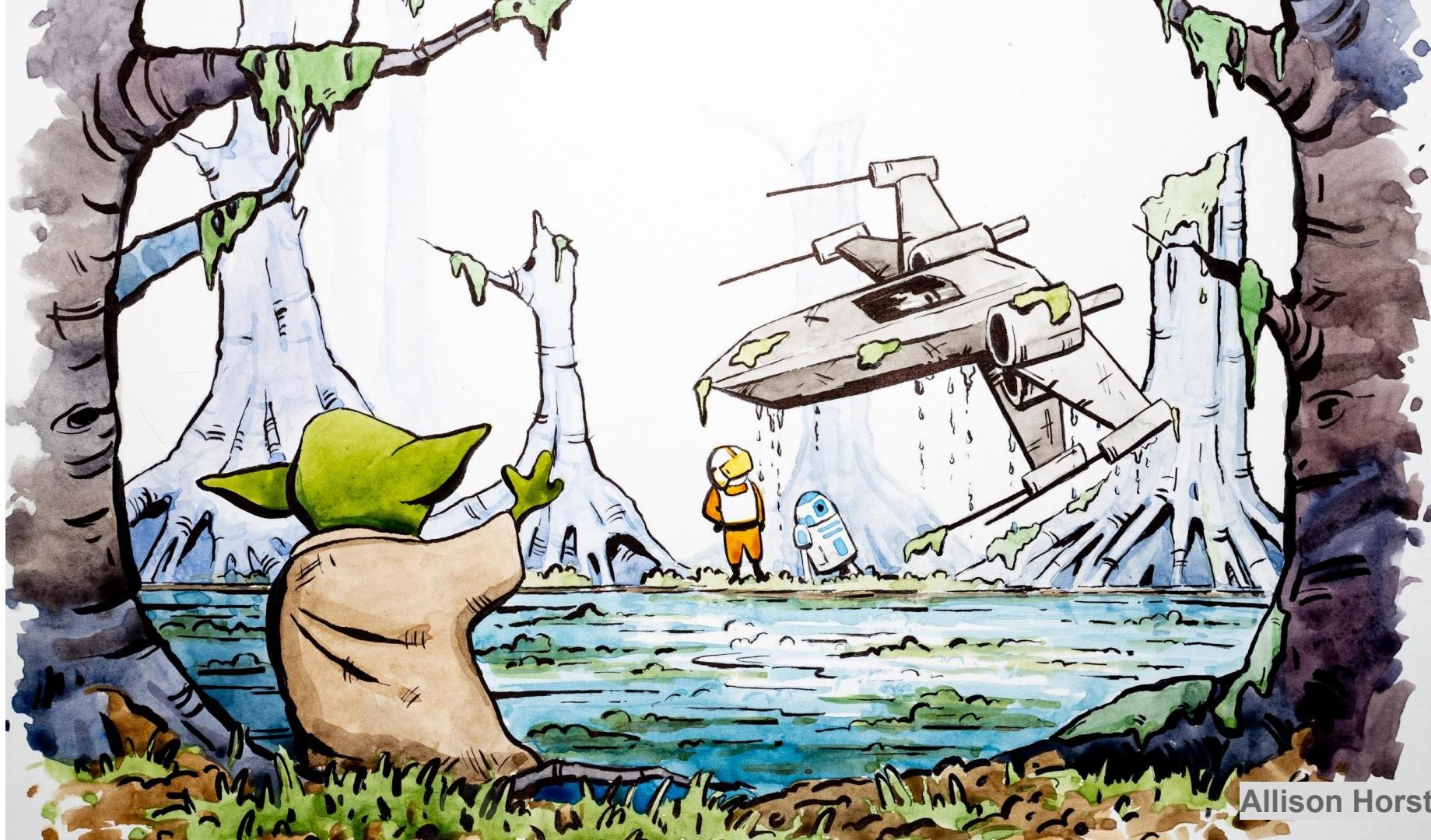
Stories from

- Ocean Health Index
- NOAA Fisheries

Resources & join us!



Allison Horst



Allison Horst



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

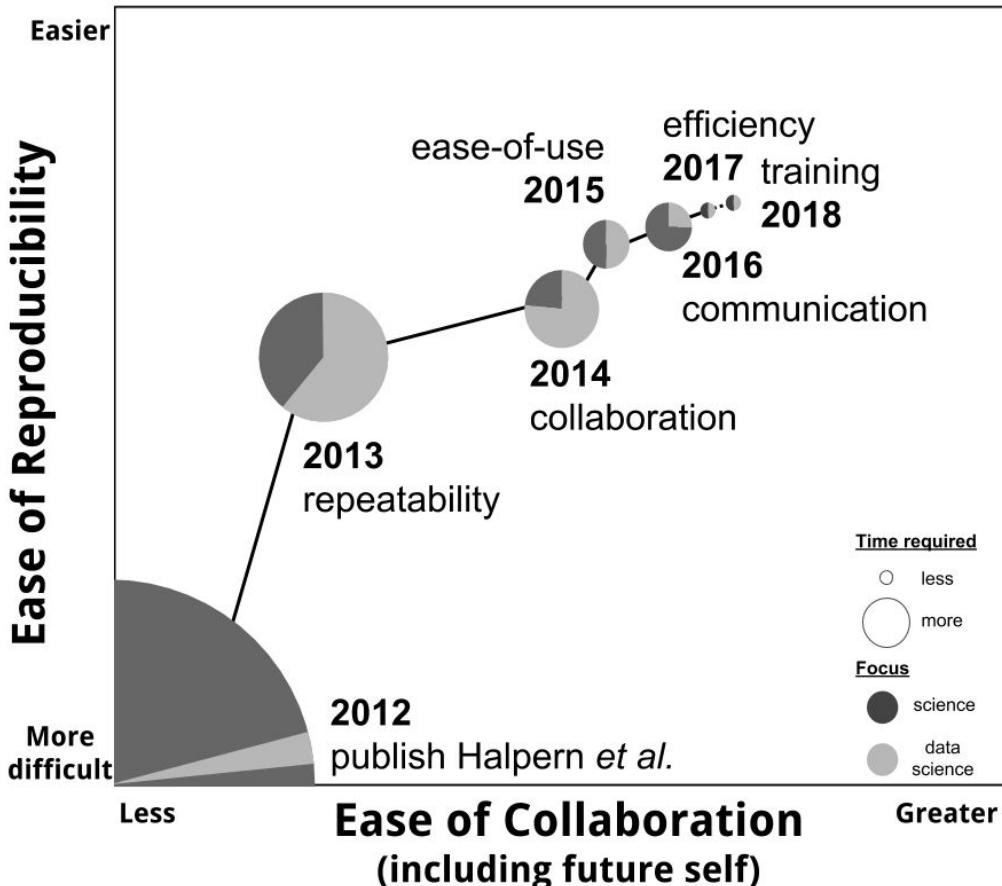
PERSPECTIVE

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}

Ocean Health Index



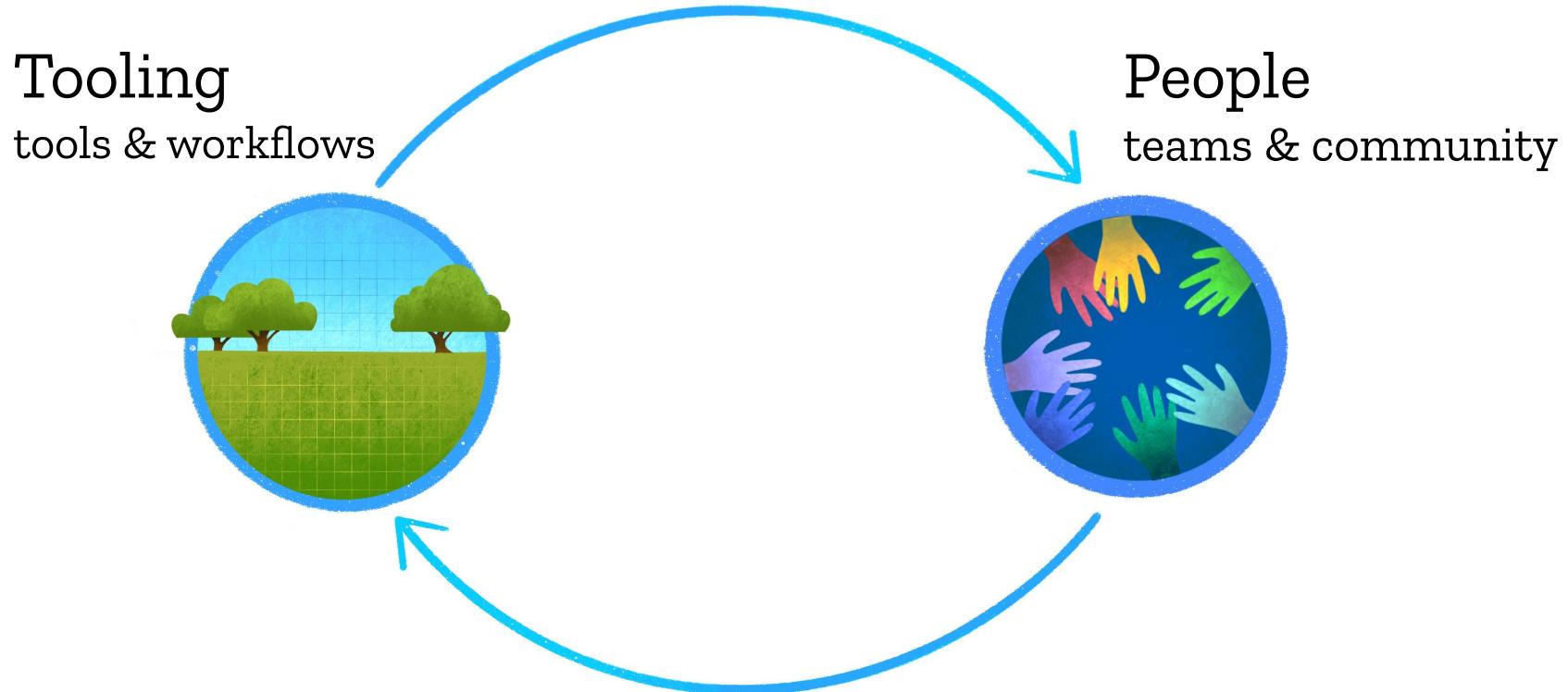
Incremental: made progress where most needed while meeting annual deadlines

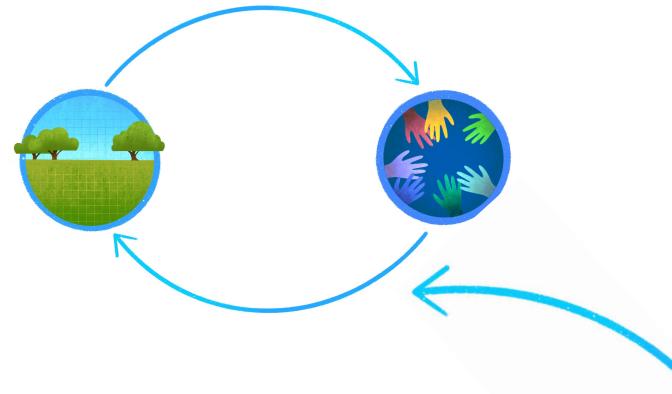
Habit building: paste text from email into GitHub Issues

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





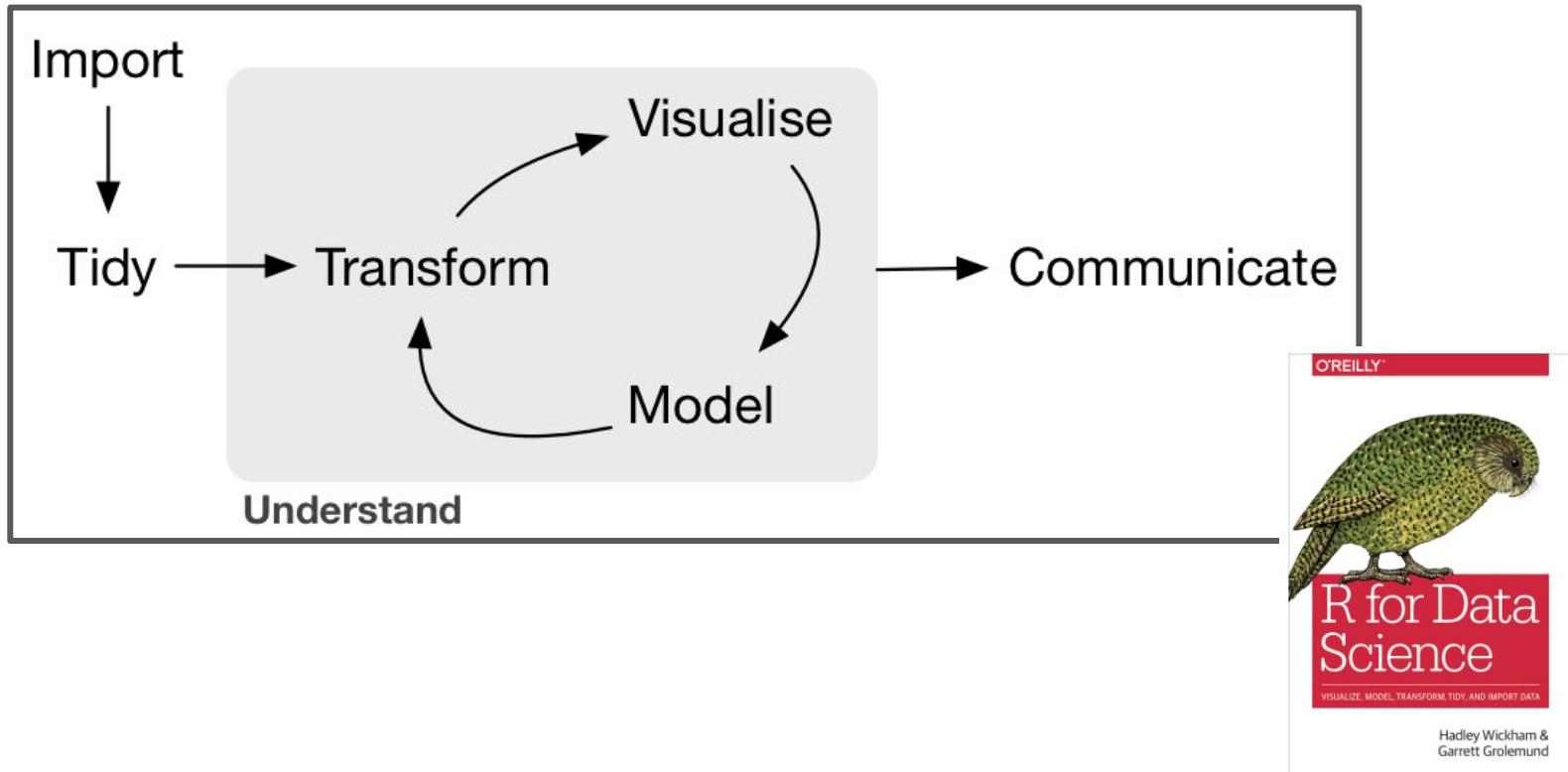
- Open source coding  
- Version control 
- Collaboration & distribution 
- Real-time co-development   
- Connection to broader communities

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



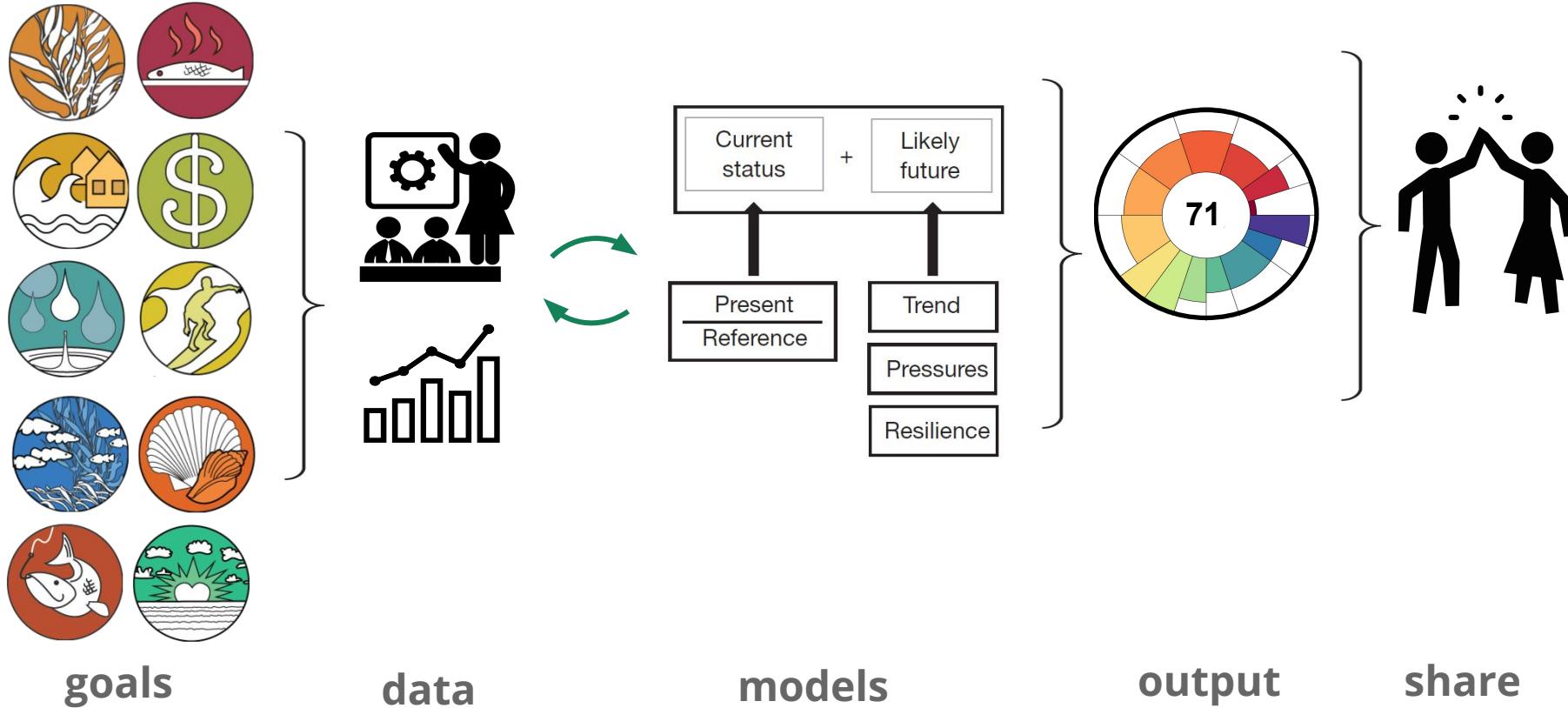
Our path to better science in less time using open data science tools
Lowndes et al. 2017, Nature Ecology & Evolution

Learn from other groups: talk & draw our workflows

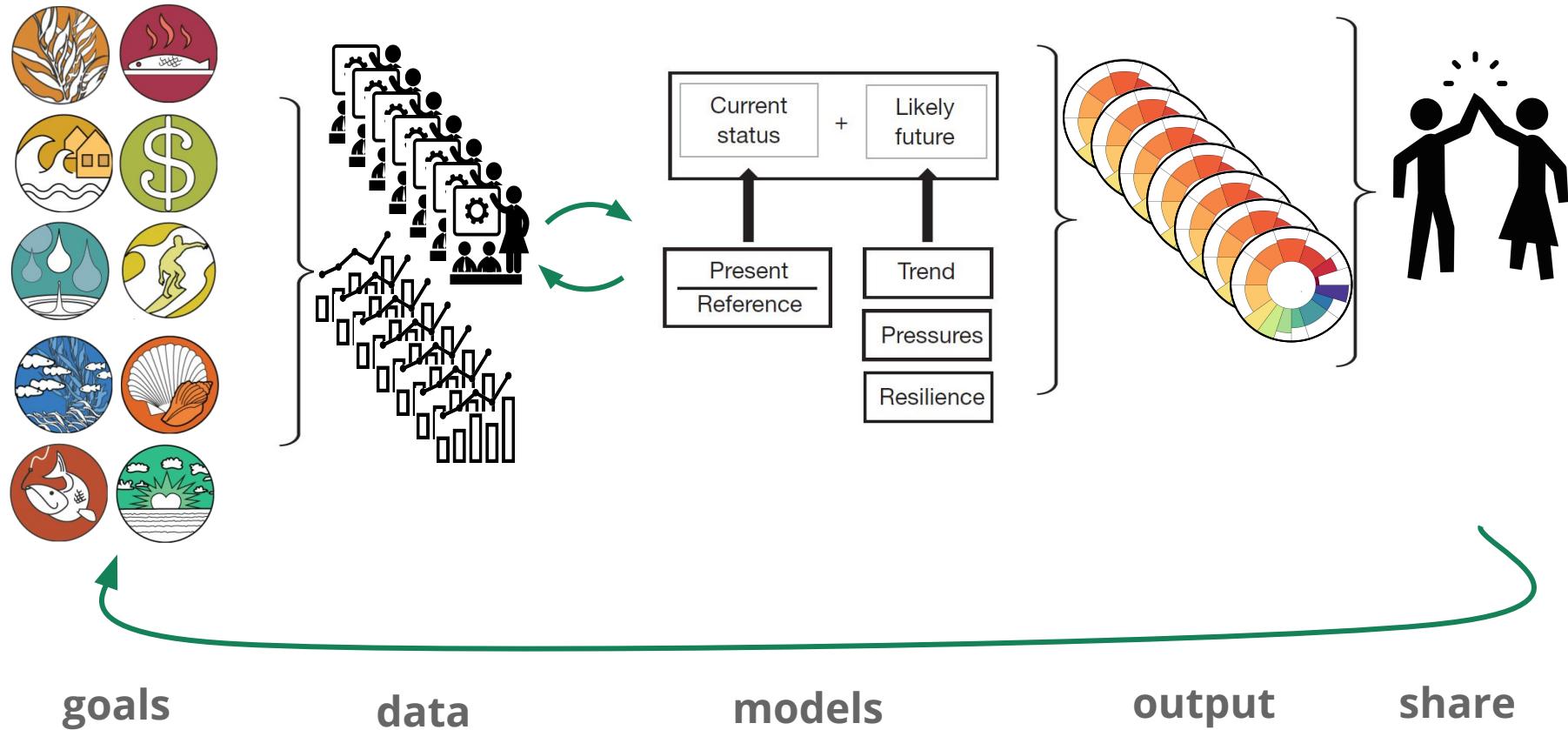


Wickham & Grolemund 2016

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



@allison_horst

Learn from other groups: streamlined workflows

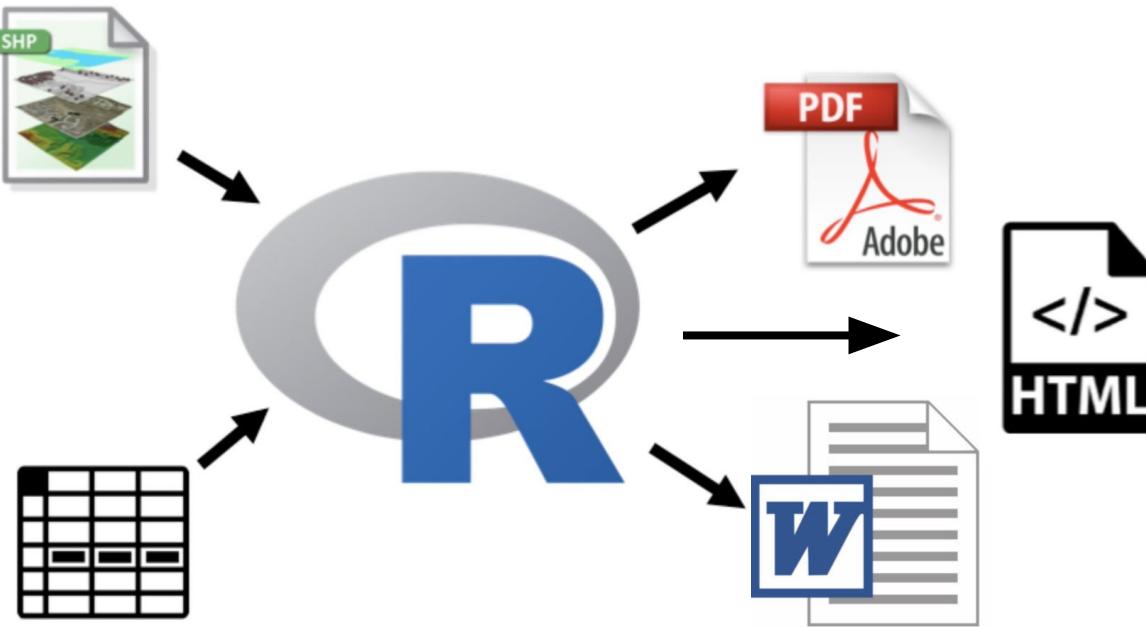


Figure adapted from
Teucher 2018

Shared tools & practices

efficiency & reproducibility:
coding and version control
are the keystone

Reproducibility

Code
Version control



R Studio[®]

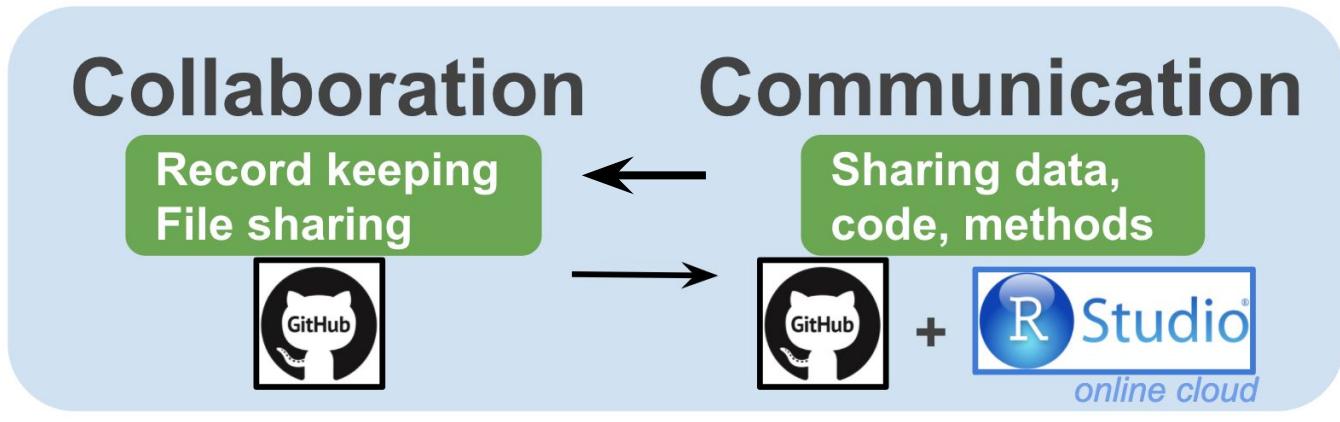
local computer



Shared tools & practices

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

efficiency & reproducibility:
coding and version control
are the keystone



Reproducibility

Code
Version control



local computer

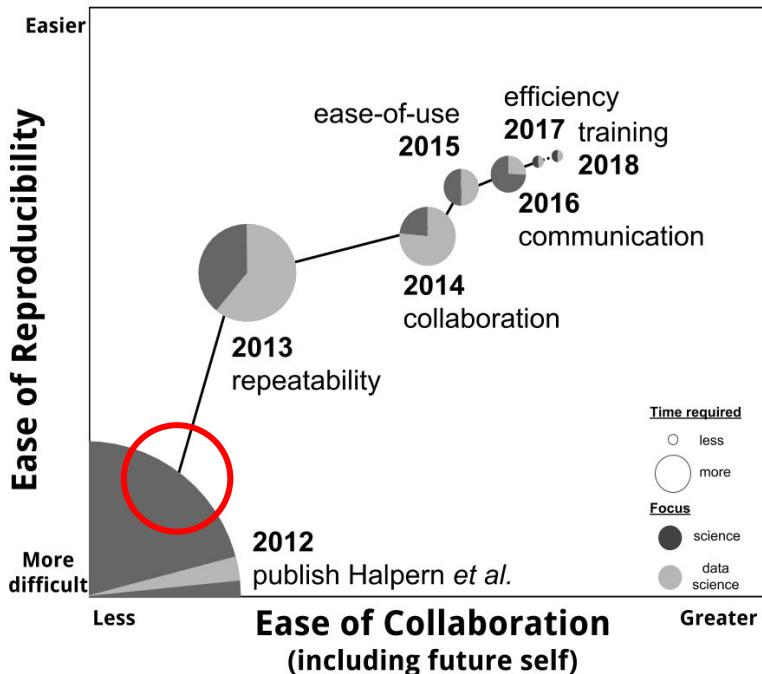
OHI's pathway to better science in less time

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.”

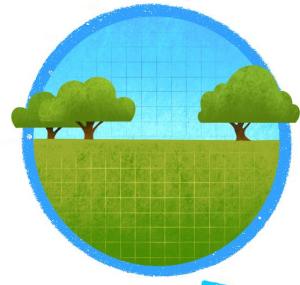


What's underlying Openscapes approach

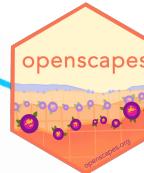
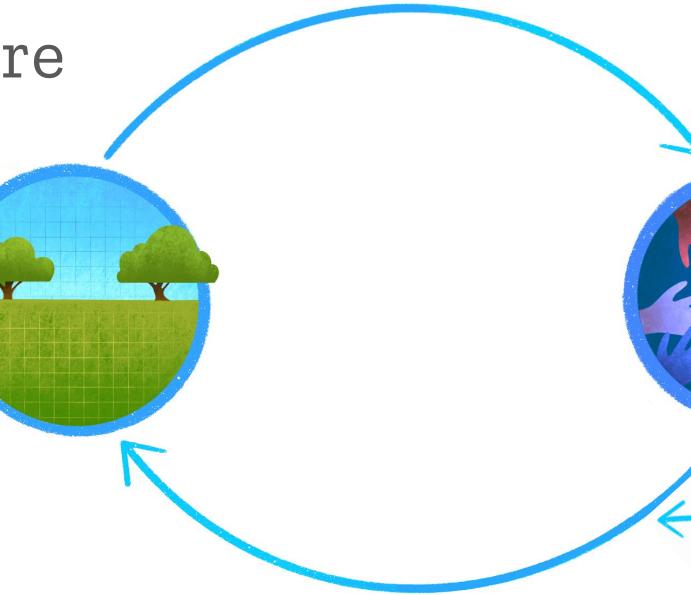
Openscapes is a mechanism that can rapidly identify needs and bring people together to solve them.
Feedback loop between using & developing infrastructure and teaching & learning from people.



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 usability** of scientific innovation.



moz://a

NOAA FISHERIES
National Oceanic and Atmospheric Administration



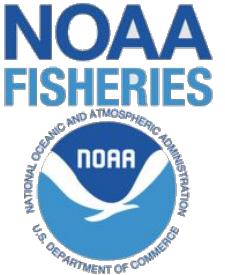
PANGEO
A community platform for Big Data geoscience

Fred Hutch
Cancer Center



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

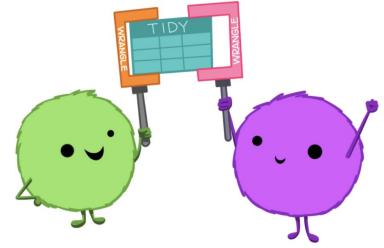
Data & workforce modernization

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](https://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!



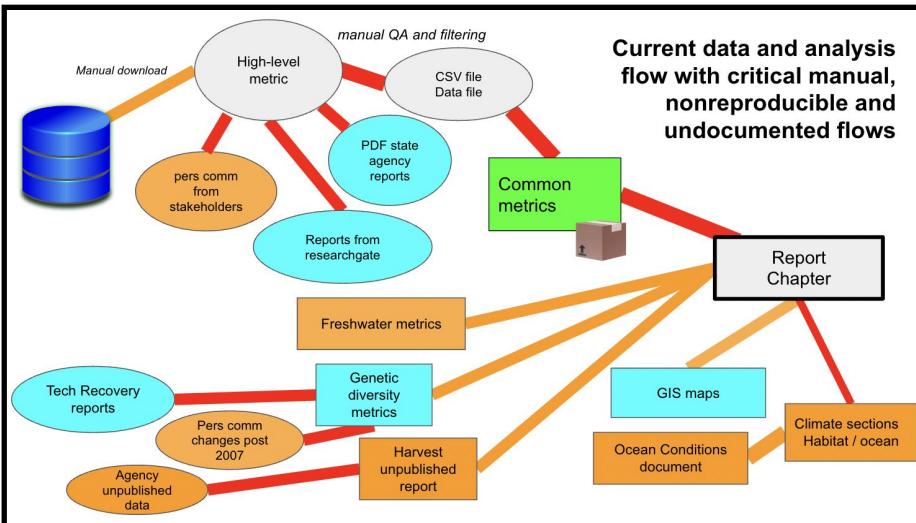
Openscapes Pathway Lab & context:		Now	Next steps
Reproducibility data prep, analysis, version control, organization			
Collaboration coding, storing data, project mgmt, internal discussions			
Communication sharing data, sharing methods, talks, teaching			

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.

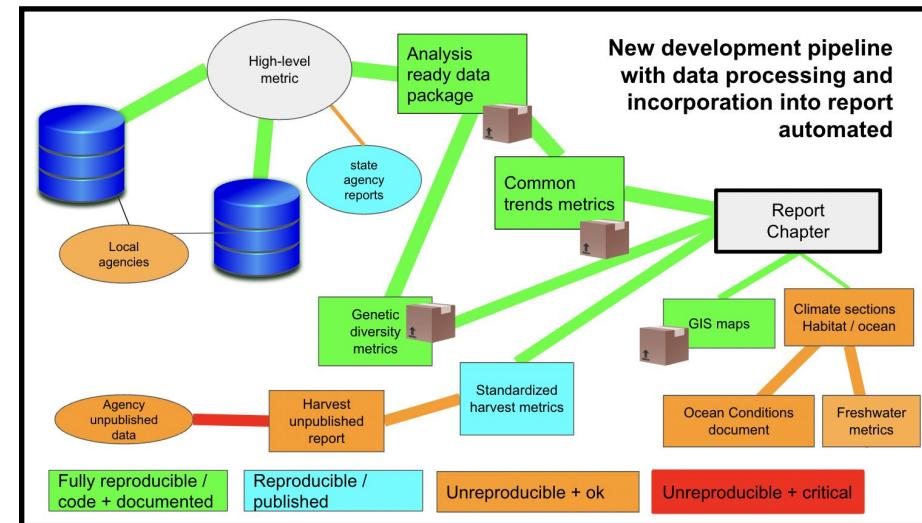
Workflow analysis by a NOAA Fisheries 2022 Openscapes team

“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

The screenshot shows the NOAA ADRIFT Field Methods website. The top navigation bar includes the NOAA logo, a search bar, and links for Home, Hardware, Summary, Pole Buoy, GPS Solar, Tote Contents, Array, ST4300 Recorder, ST640 Recorder, Sensus Depth Sensor, Field Methods, Data Download, Additional Information, and Contact. The main content area has a 'Summary' section with a detailed description of the ADRIFT project's hardware, mentioning a deep hydrophone array, a High Flyer pole buoy, and a floating line/surface float. To the right is a 'On this page' sidebar with links to Summary, Edit this page, View source, and Report an issue. Below the summary text is a schematic diagram of the drifting acoustic buoy hardware, showing its components: Weight, Surface Float (100m line), Drogue, Subsurface Float, Bungee, Dampener Plate, and Recorder (+ 2 hydrophones). A vertical scale indicates a depth of 100 m.

[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

[View source](#)

[Report an issue](#)

Report & Track Issues

The screenshot shows a project management interface with the following features and data:

- Top Navigation:** Prioritized backlog, Status board, Roadmap (selected), Bugs (with a green icon), In review, My items, + New view.
- Search Bar:** Filter by keyword or by field.
- Date Range:** November 30 to December 18, 2024.
- Toolbar:** Markers, Sort, Date fields, Month, Today, navigation arrows.
- Task List:** A list of 10 tasks for November and 4 tasks for December, each with a checkbox and a link.
- Task Details:** A modal window shows details for a task: "copy quarto template and make repo #4" (checkbox checked, blue circular icon), "EV Processing Dataflow Diagram #7" (checkbox checked, blue circular icon), and "Complete nasc.r section #11" (checkbox checked, blue circular icon).
- Buttons:** Discard, Save, Add item.

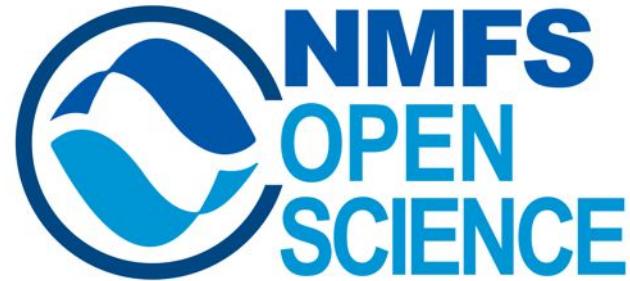
Month	Date	Task Description	Link
November	30	1. create pages and copy existing text from re...	#1
	1	2. add info on how to use page	#2
	2	3. data workflow diagram of acoustic data	#3
	3	4. copy quarto template and make repo	#4
	4	5. EV Processing Dataflow Diagram	#7
	5	6. Reach goals for Echo Class	#8
	6	7. Feedback from LHP 11/16	#10
	7	8. Feedback from AST 12/18	#14
	8	9. Complete nasc.r section	#11
	9	10. Add photos to front page	#12
+ Add item			
December	10	copy quarto template and make repo	#4
	11	EV Processing Dataflow Diagram	#7
	12	Complete nasc.r section	#11
	13	Add photos to front page	#12

- 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

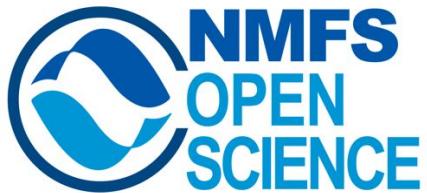
NOAA Fisheries Open Science

Elizabeth Eli Holmes, Ph.D (lead)

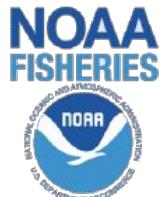
Jonathan Peake, Ph.D (co-lead)



RESOURCES & TRAININGS



Community Building and Skill Building Openscapes



Support for 'mentors',
organizers, leads

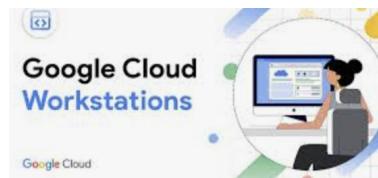
Data Science academy

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>

The screenshot shows the NOAA Fisheries Open Science homepage. At the top left is the NOAA Fisheries logo. A search bar is at the top right. Below the header are navigation links: Find A Species, Fishing & Seafood, Protecting Marine Life, Environment, Regions, Resources & Services, and About Us. Under the "SCIENCE & DATA" section, there's a heading "Open Science at NOAA Fisheries" with a sub-section "Open Science at NOAA Fisheries" and a "National" link. A quote from the White House Office of Science and Technology Policy is displayed. At the bottom, there's a "More Information" section with links to "Fisheries Integrated Modeling System" and "NOAA Fisheries Integrated Toolbox". A red arrow points from the text "Link to internal site also here" to the "More Information" section.

Link to internal site also here

The screenshot shows the NMFS Open Science News page. At the top right is the NOAA Fisheries logo and the text "NMFS Open Science". Navigation links include Home, News & Events (which is underlined), Open Science, Open Data, and Open Source. Below the header is a large "News and Events" section featuring a grayscale image of scientific data. To the right of this are two boxes: one for the "Calendar of Events" and another for "NMFS Open Science News". The news box contains a link to "Dec 18, 2023". A blue arrow points from the "Link to internal site also here" text in the first screenshot to the "News and Events" section of this screenshot.

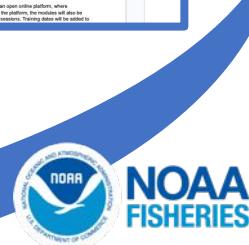
News and Events

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

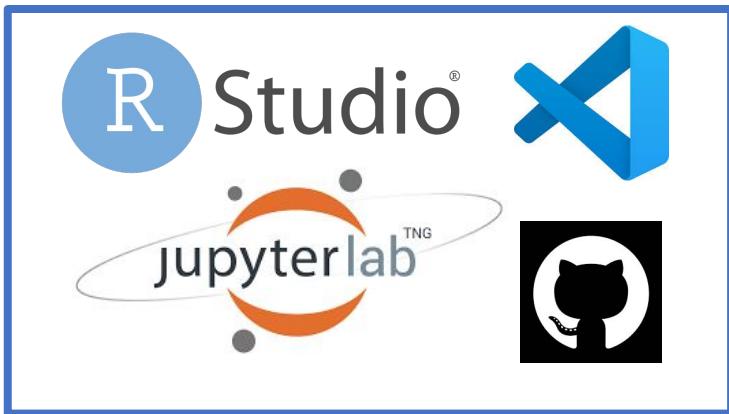
NMFS Open Science News

Dec 18, 2023

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

Jupyter Lab

The screenshot shows the Jupyter Lab interface. On the left is a file browser with a search bar. The main area has a terminal window titled "Terminal 3" containing Python code to import xarray and hvplot, and a code editor window titled "Xarray_hvplot.ipynb" showing a snippet of code to open a dataset. A central panel displays a cloud icon with various icons representing data and connectivity.

```

File Edit View Run Kernel Git Tabs Settings Help Share
+ Filter files by name
/ 2021-Cloud-Hackathon / tutorials /
Name Last Modified
data a year ago
img 3 years ago
00_Setup.md a year ago
01_Data_Discovery_CMR.ipynb 3 years ago
02_Data_Discovery_CMR... 3 years ago
03_Xarray_hvplot.ipynb a year ago
03_Xarray.ipynb 3 years ago
04_NASA_Earthdata_Auth 3 years ago
05_Data_Acc...
06_S6_OPeN...
07_Harmony...
08_On-Prem...
09_Zarr_Acc...
Additional_Resources__Da... a year ago
Additional_Resources__Dir... a year ago
Additional_Resources__Dir... 3 years ago

```

```

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

As always, we'll start by importing xarray

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

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

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

* lon (lon) float32 200.0 202.5 205.0 207.5
* time (time) datetime64[ns] 2013-01-01 ...
Data variables:
air (time, lat, lon) float32 ...

```

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



RStudio

The screenshot shows the RStudio interface. On the left is a file browser with a search bar. The main area has a code editor window titled "2-subset-and-plot.qmd" showing R code for subset and plot, and a plot window titled "analysed_sst" and "analysis_error". A terminal window at the bottom shows the R command line.

```

File Edit Code View Plots Session Build Debug Profile Tools Help
2-subset-and-plot.qmd multifile_raster.qmd sst-gdal.qmd
Source Visual
analysed_sst analysis_error

```

```

R 4.2.2 .. /home/studio/EDMW-EarthData-Workshop-2024/
R is free 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.

```

OS
rocker/geospatial
with R 4.2 + suite
of packages

Rocker/verse
TMB
VAST, sdmTMB, etc

Try it out now!

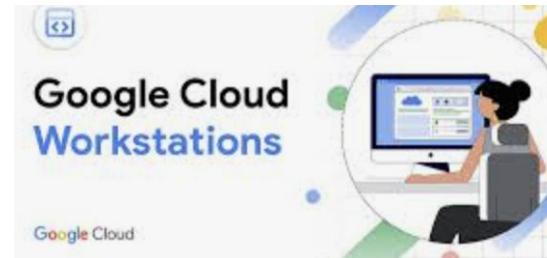
<https://noaa.nmfs-openscapes.2i2c.cloud/>

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 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-vhp>
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 echopype 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

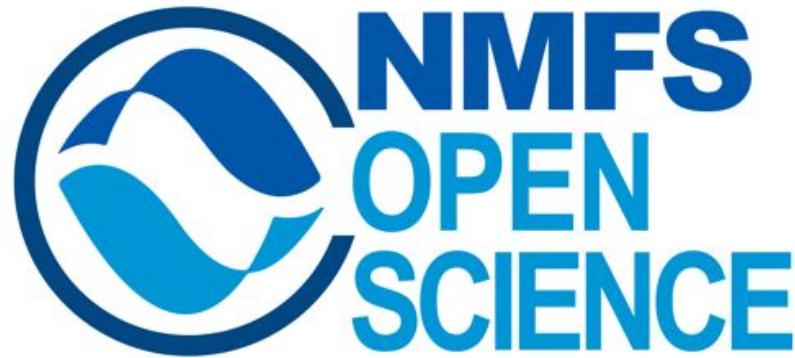
8 MAY, THU

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!