



# R for better science in less time

Julia Stewart Lowndes, PhD  
Marine Data Scientist & Mozilla Fellow  
National Center for Ecological Analysis & Synthesis  
University of California at Santa Barbara, USA

 @juliesquid  
 lowndes@nceas.ucsb.edu  
 jules32.github.io/useR-2019-keynote

# Lessons learned

Open data science is a mindset

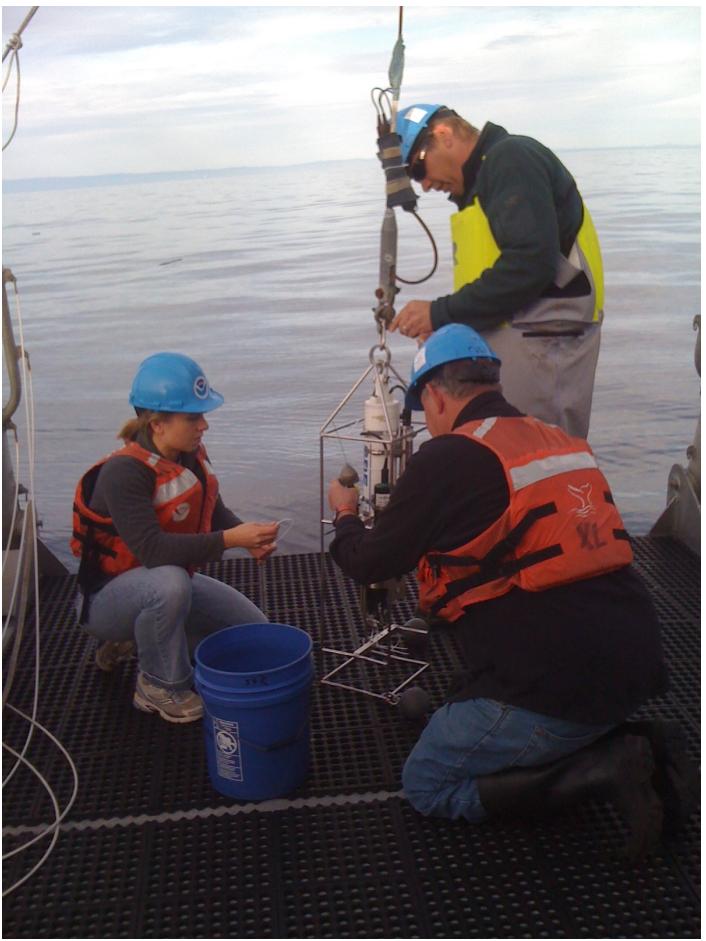
Teamwork starts with openness

Harness the power of welcome

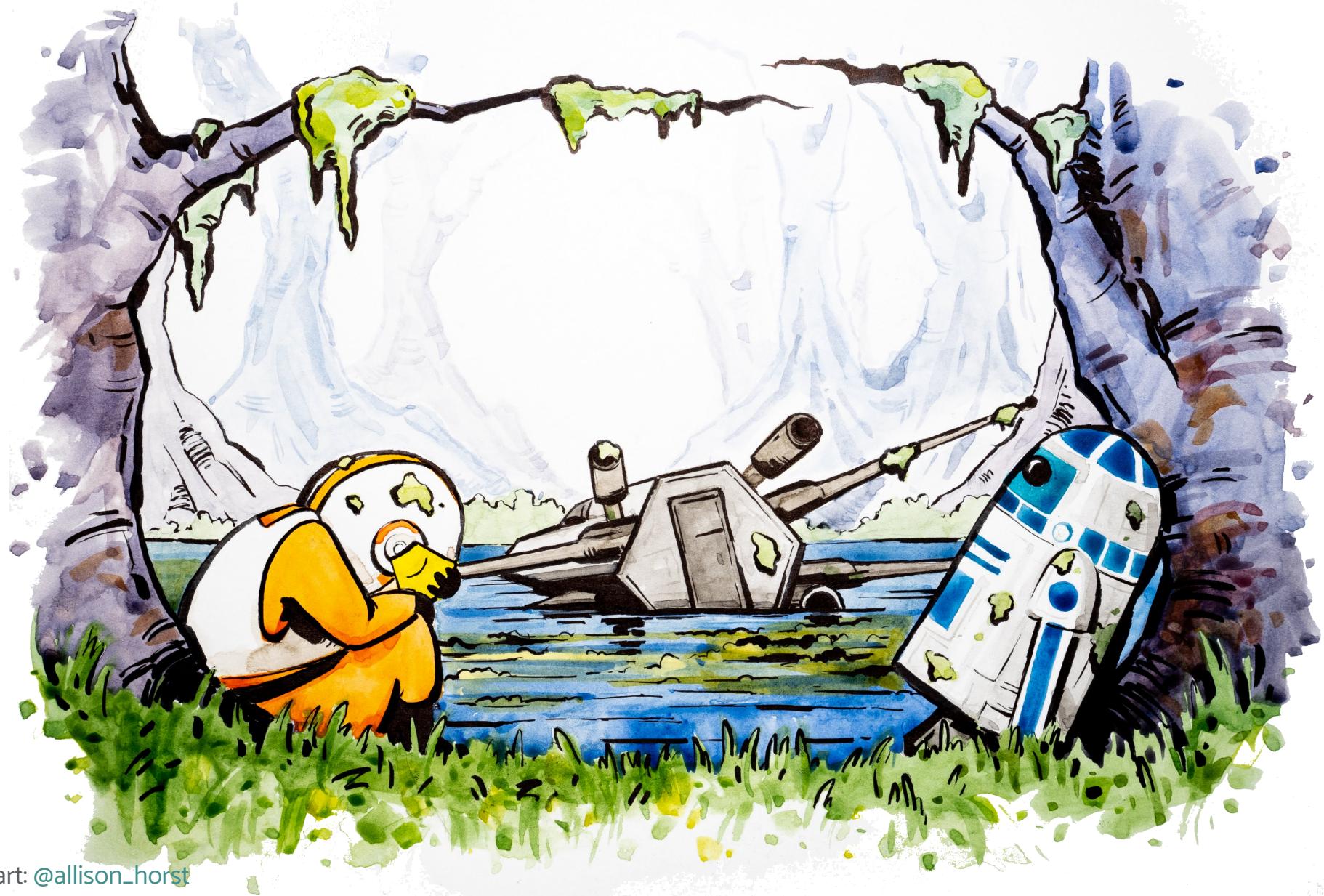
@juliesquid



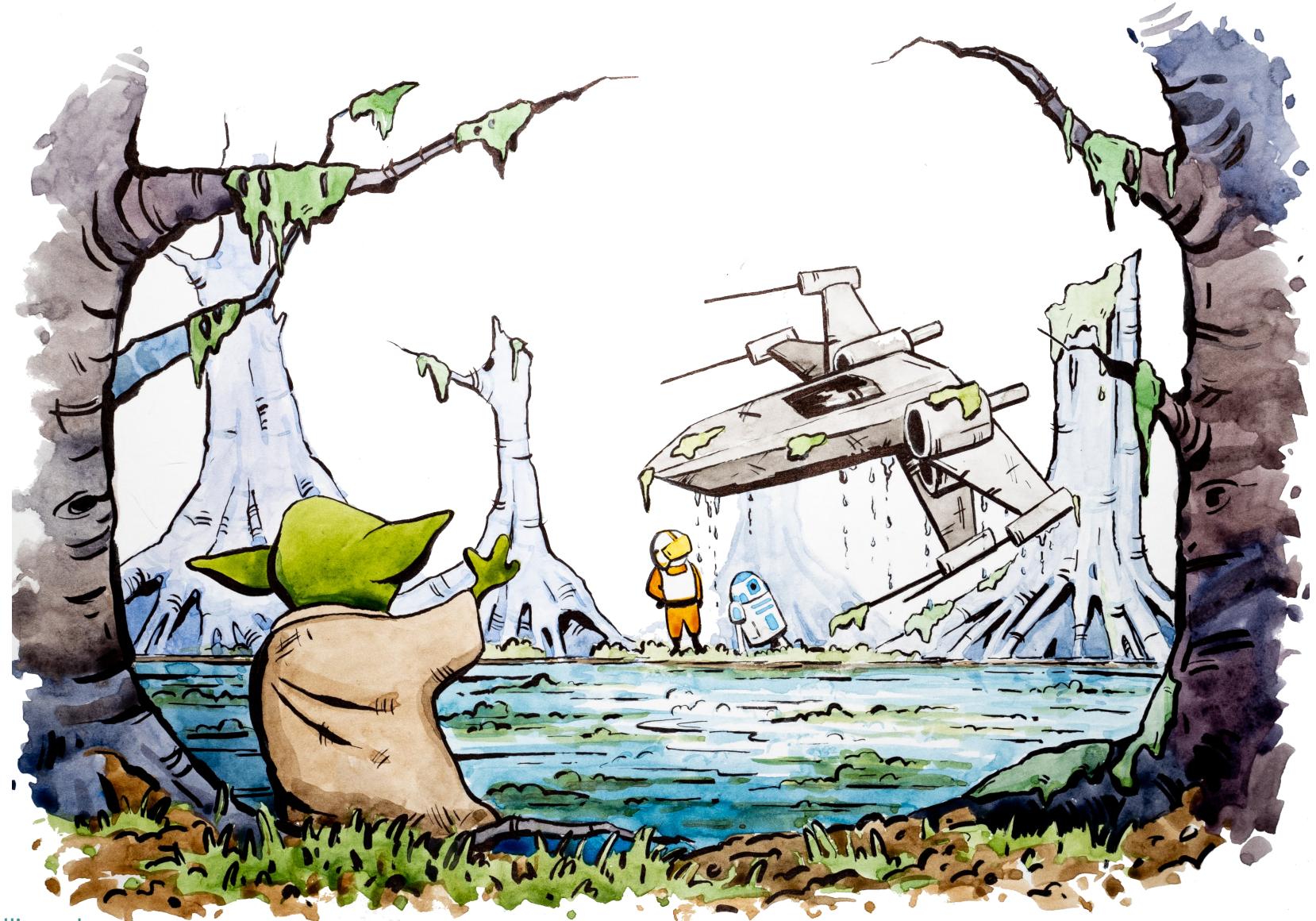
photo: Greg Auger



web: Gilly Lab



art: @allison\_horst



art: @allison\_horst



art: @allison\_horst



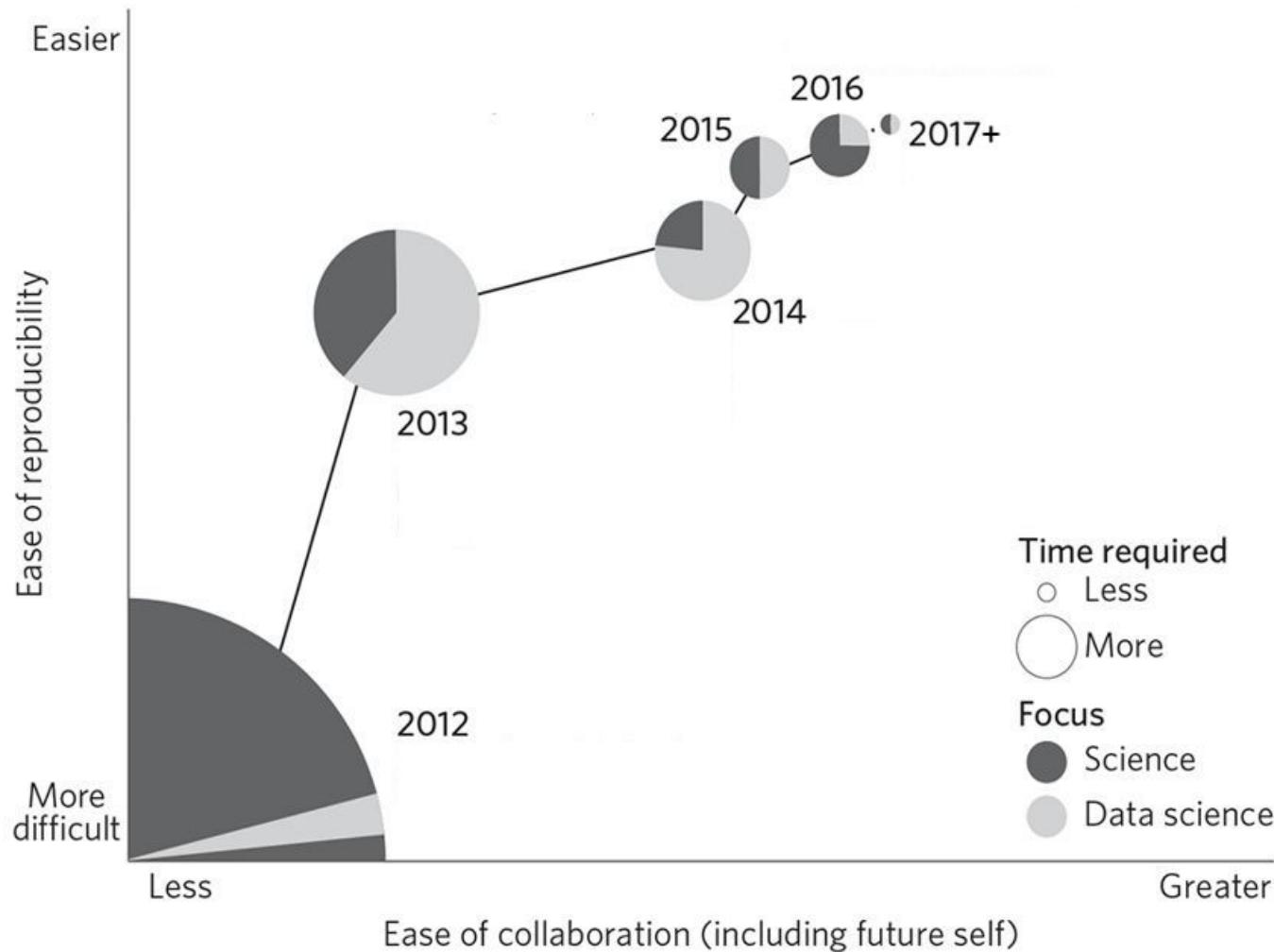
art: @allison\_horst



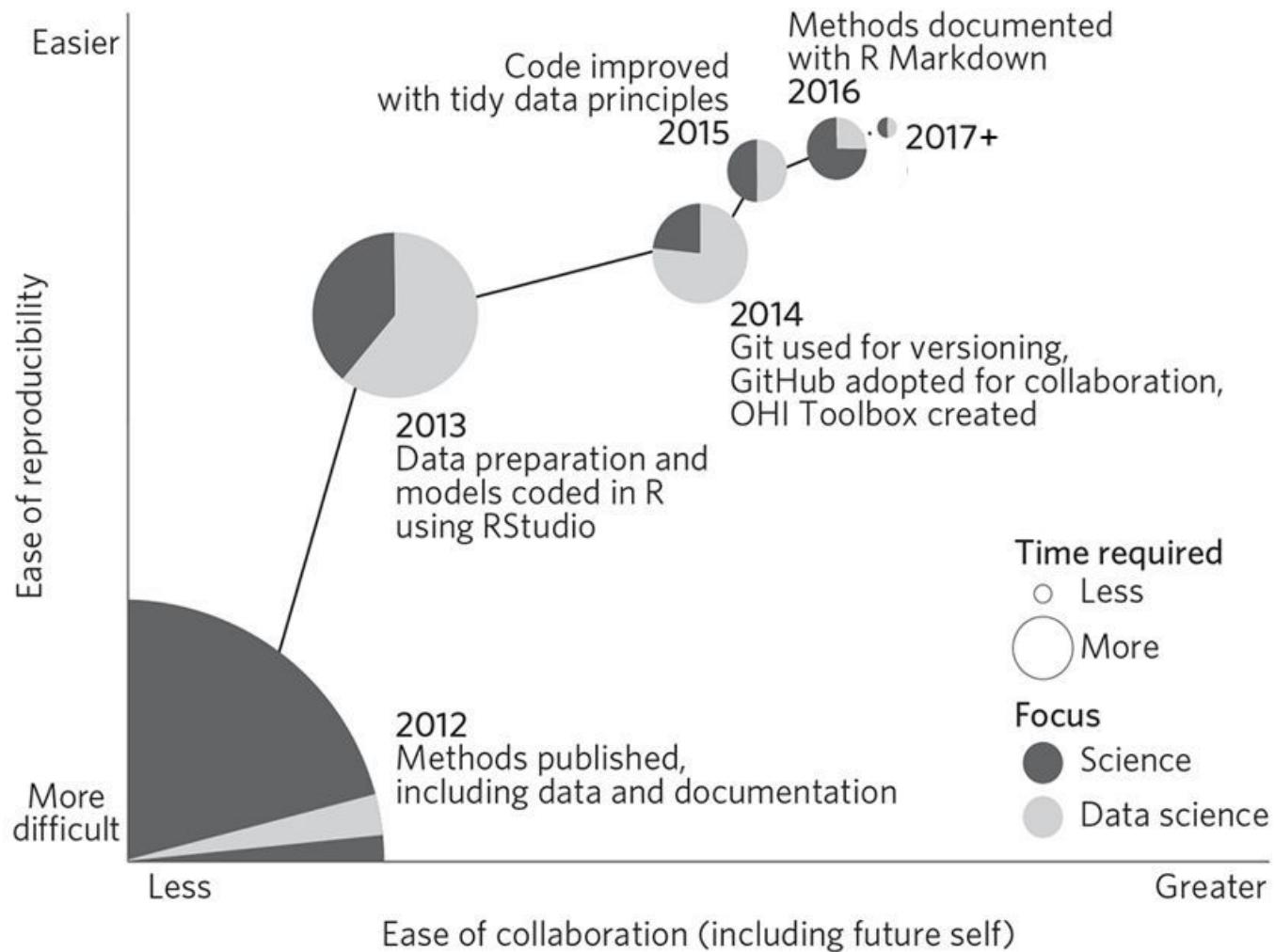
web: [ohi-science.org](http://ohi-science.org); @OHIscience

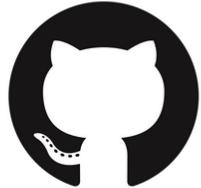
# Our path to better science in less time using open data science tools

Julia S. Stewart Lowndes<sup>1\*</sup>, Benjamin D. Best<sup>2</sup>, Courtney Scarborough<sup>1</sup>, Jamie C. Afflerbach<sup>1</sup>,  
Melanie R. Frazier<sup>1</sup>, Casey C. O'Hara<sup>1</sup>, Ning Jiang<sup>1</sup> and Benjamin S. Halpern<sup>1,3,4</sup>



source: [Lowndes et al. 2017](#)





# Eco-Data-Science & RLadies SB



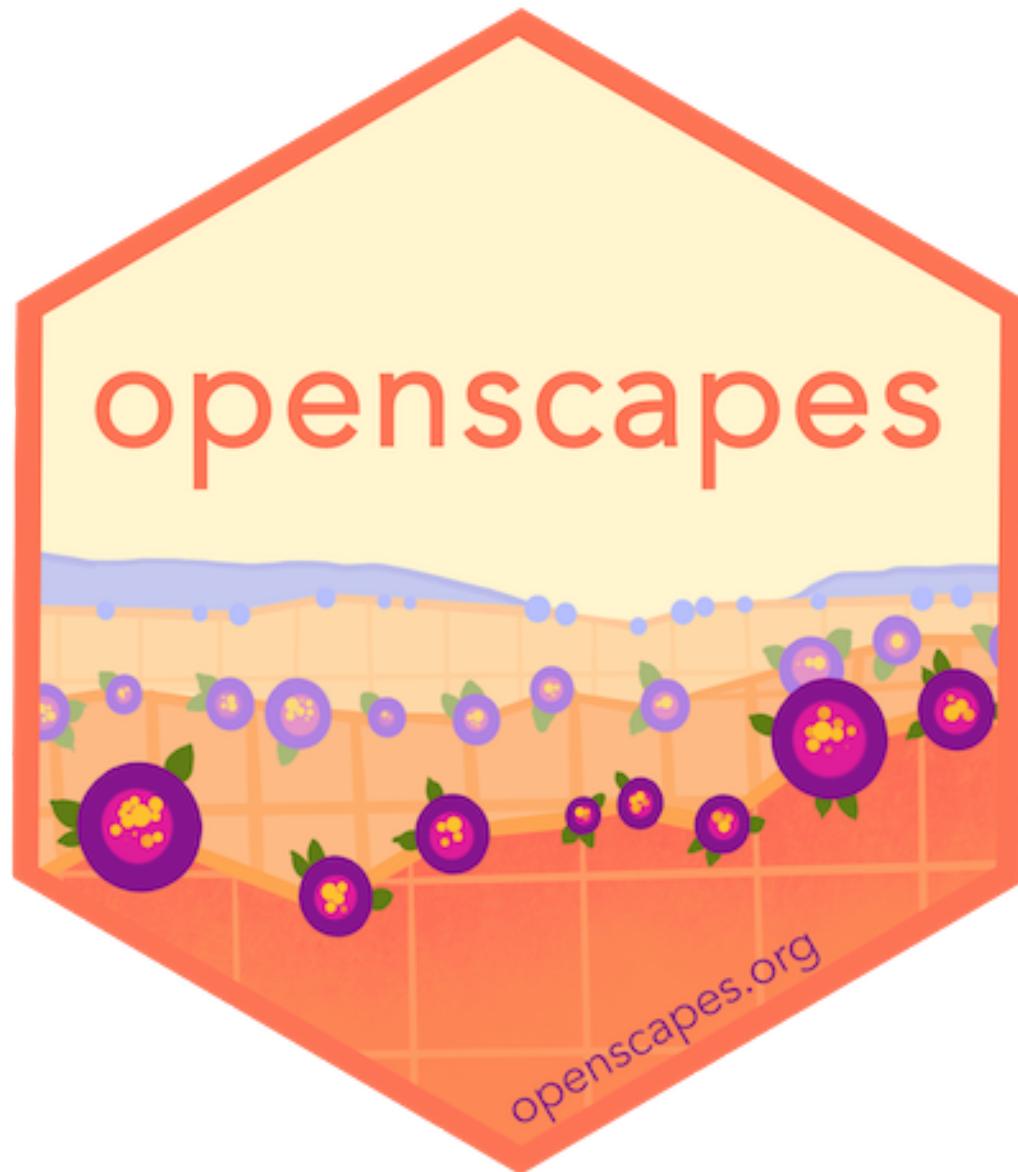
art: [@allison\\_horst](#); twitter: [@ecodatasci](#); [@RLadiesSB](#)



# Mozilla Announces 26 New Fellows in Openness, Science, and Tech Policy

Mozilla | August 21, 2018

*These technologists, activists, and scientists will spend the next 10 to 12 months creating a more secure, inclusive, and decentralized internet*

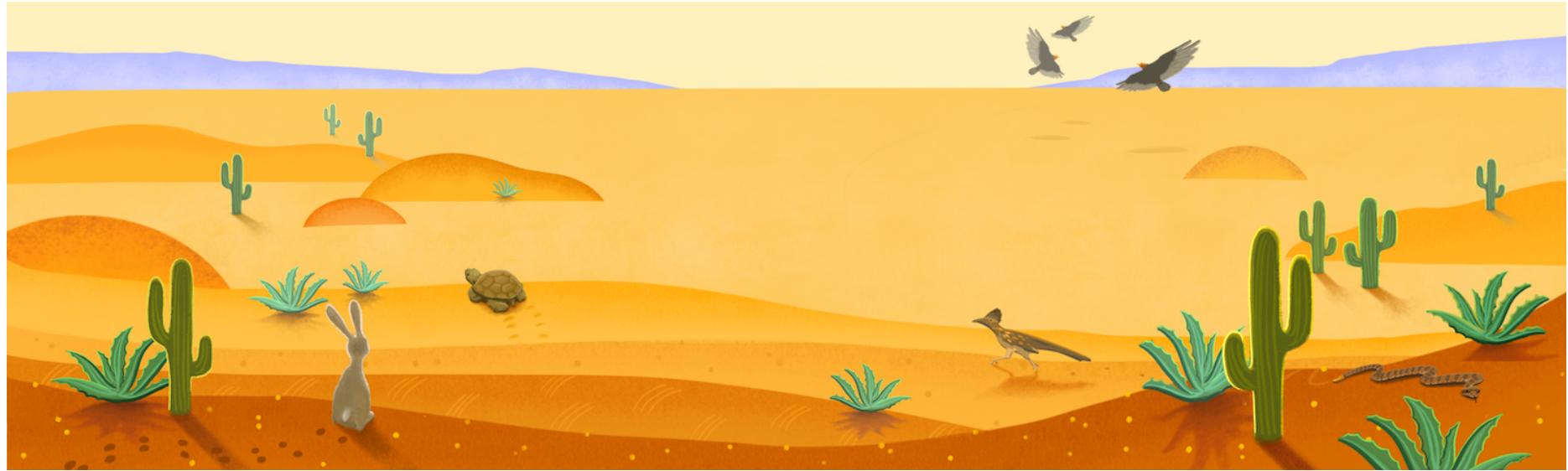


art: @allison\_horst; web: [openscapes.org](https://openscapes.org); @openscapes



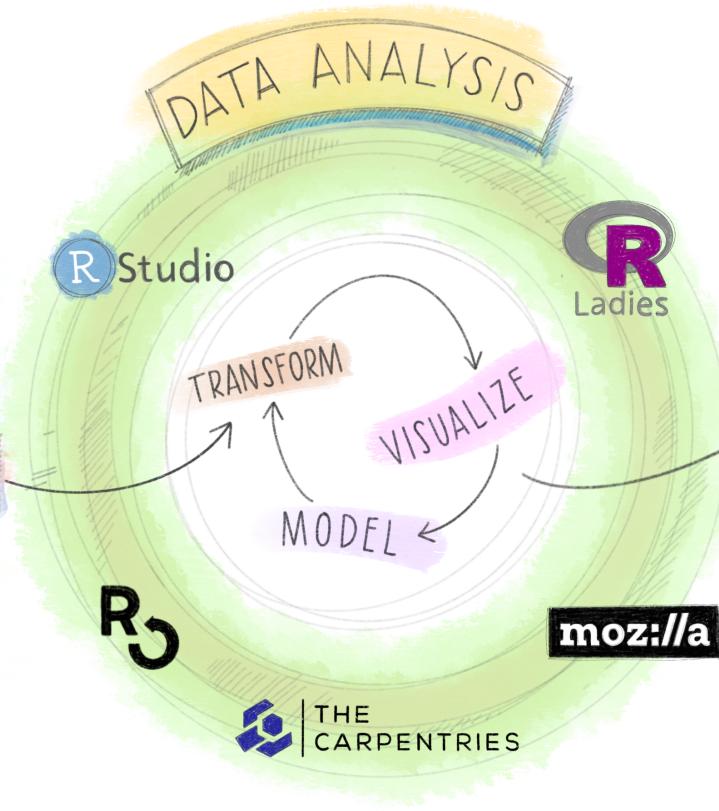
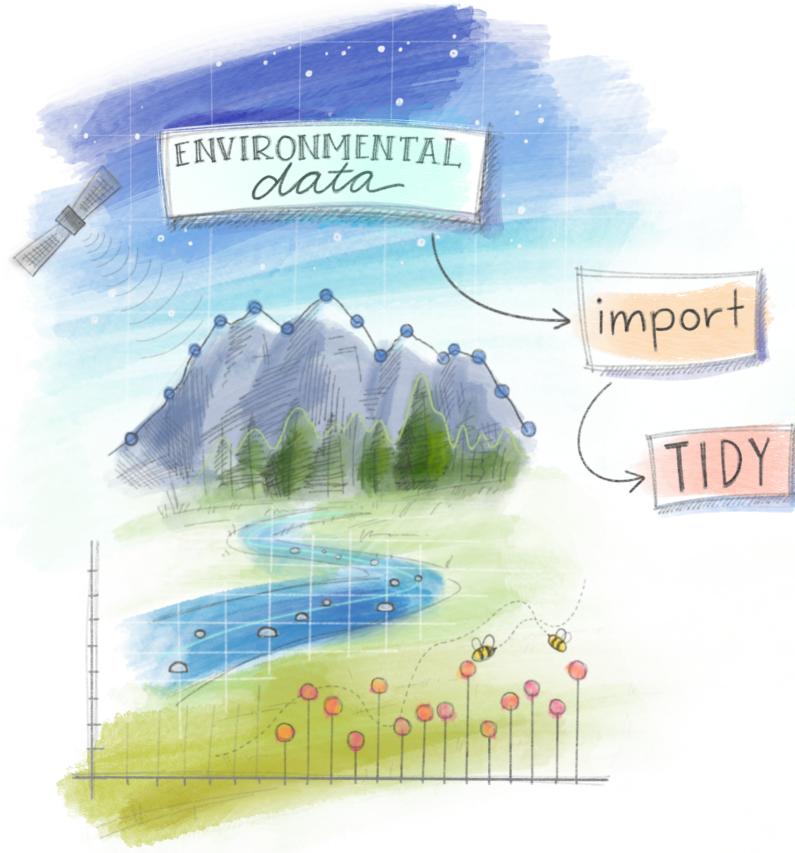
Welcome and empower  
scientists as labs

Increase visibility and value  
by amplifying labs

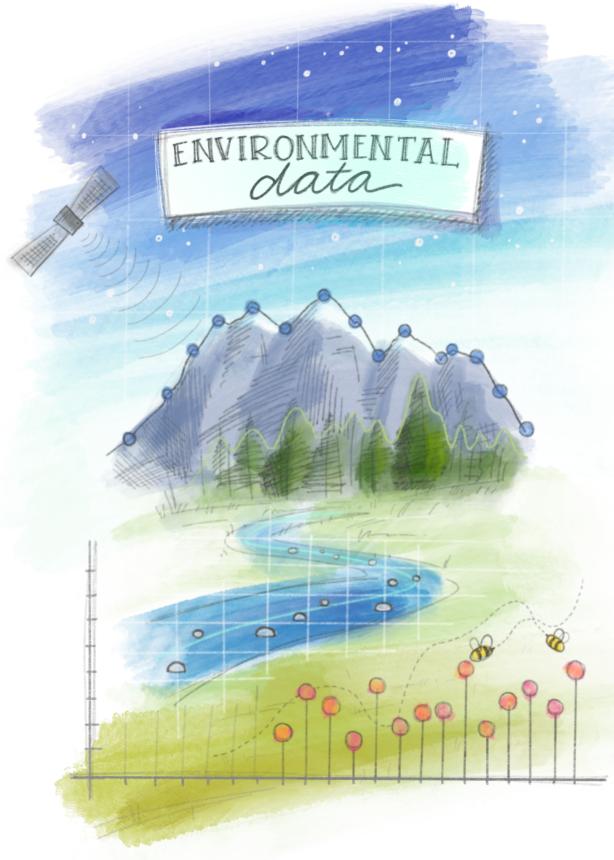


Mentorship program for  
early career scientists &  
their labs

Normalize open data  
science in the lab & seed  
change beyond



art: @allison\_horst; updated from Wickham & Grolemund



art: @allison\_horst

# Lessons learned

Open data science is a mindset

Teamwork starts with openness

Harness the power of welcome

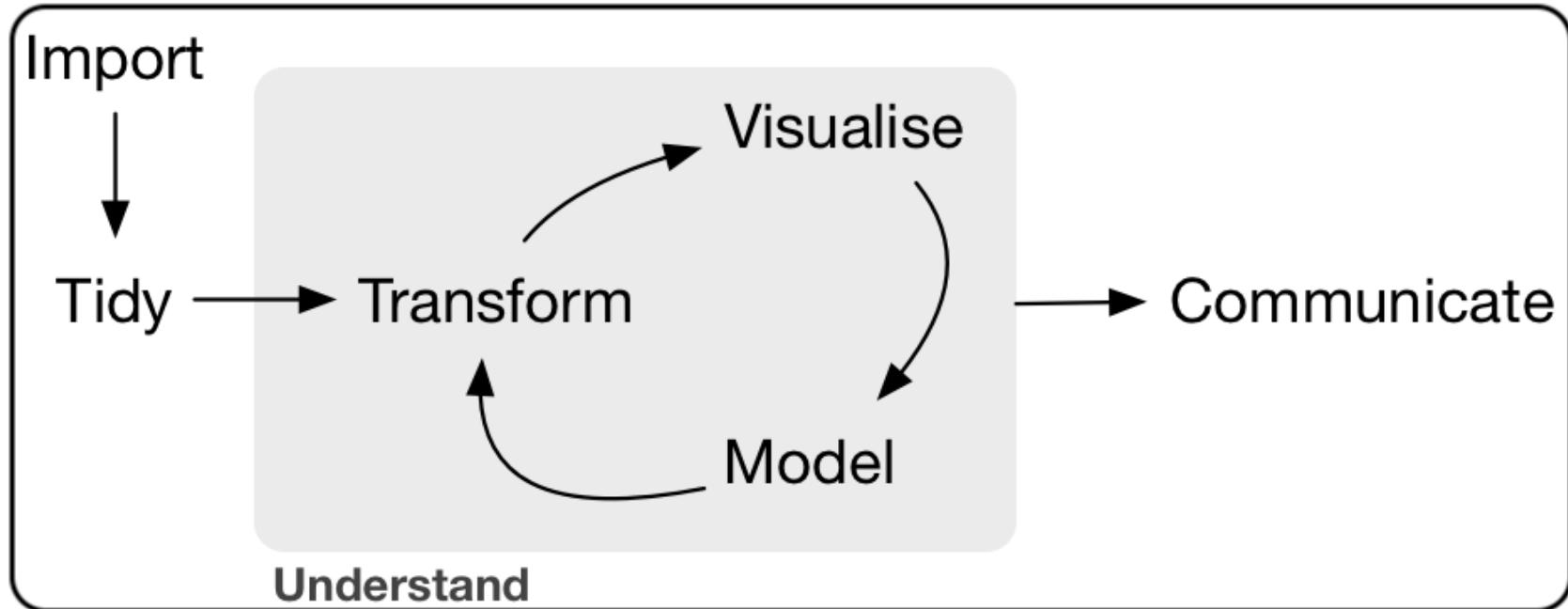
# Open data science is a mindset

expect a better way • build confidence & willingness •  
reimagine science communication

Expect there is a better way

# *Data science*

*Data science is the discipline of turning raw data into understanding*



Build confidence & willingness

*Open science*

*Open science is the concept of transparency at all stages of the research process, coupled with free and open access to data, code, and papers*



Reimagine science communication

# *Communication tools*

# *Communication tools*



open coding language

- shared practices
- streamlined tools



collaboration platform

- bookkeeping
- display, publication, & distribution



docs, slides, sheets

- coordinate
- co-develop
- share



connection to broader communities

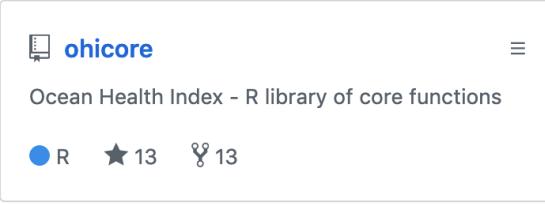
- listen
- learn
- contribute

 Search or jump to... / Pull requests Issues Marketplace Explore

 Ocean Health Index - Science  
Open science with the Ocean Health Index  
 Santa Barbara, CA  <http://ohi-science.org/>

 **Repositories 114**  Packages  People 40  Teams 18  Projects  Settings

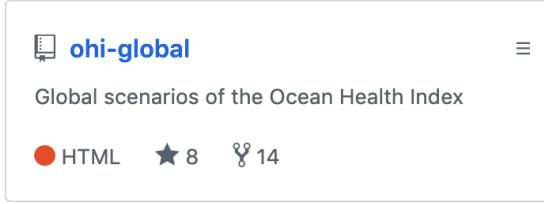
Pinned repositories Customize pinned repositories



 **ohicore** 

Ocean Health Index - R library of core functions

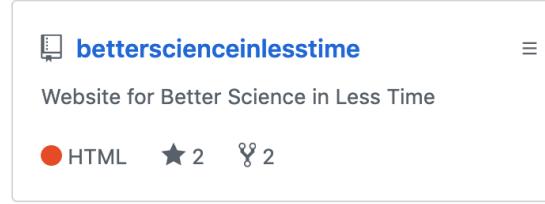
 R  13  13



 **ohi-global** 

Global scenarios of the Ocean Health Index

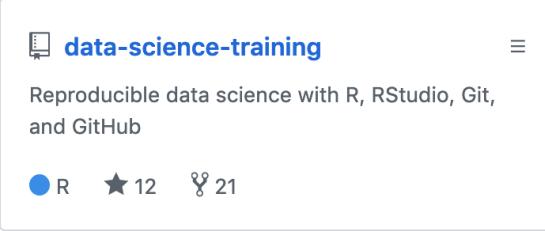
 HTML  8  14



 **betterscienceinlesstime** 

Website for Better Science in Less Time

 HTML  2  2



 **data-science-training** 

Reproducible data science with R, RStudio, Git, and GitHub

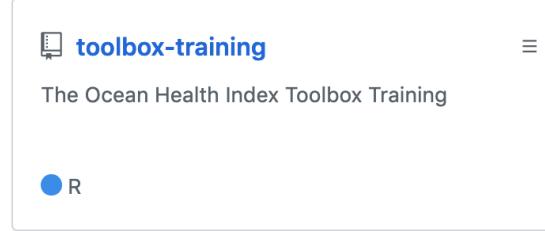
 R  12  21



 **ohiprep** 

Ocean Health Index data layer preparation

 HTML  10  9



 **toolbox-training** 

The Ocean Health Index Toolbox Training

 R



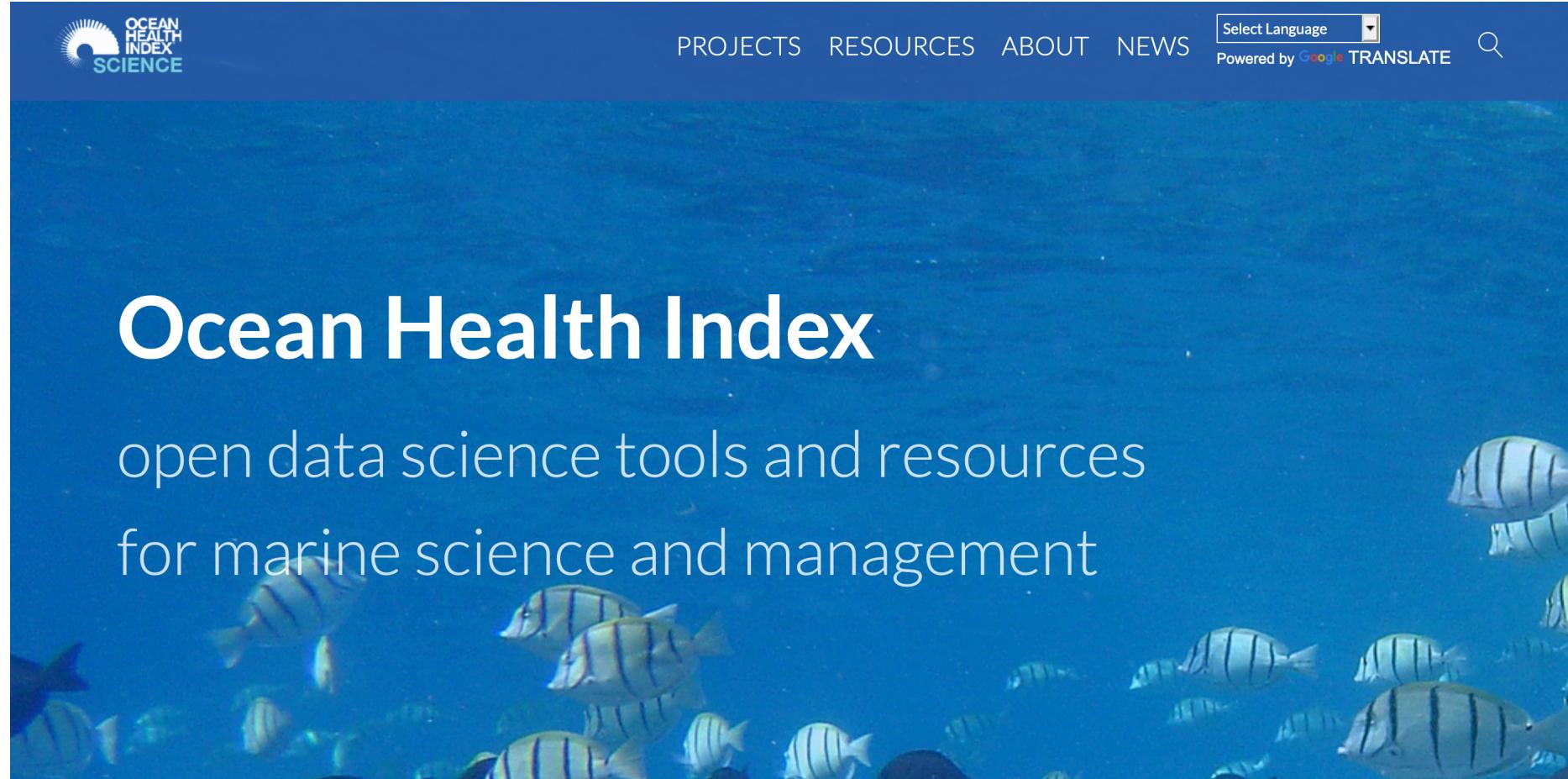
PROJECTS RESOURCES ABOUT NEWS

Select Language  
Powered by Google TRANSLATE



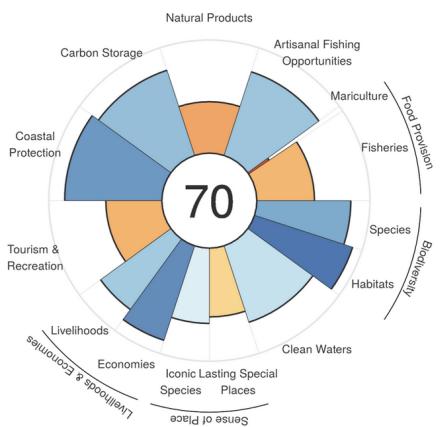
# Ocean Health Index

open data science tools and resources  
for marine science and management



## Annual OHI global assessments

Ocean Health Index scores provide invaluable, comprehensive, and quantitative assessments of progress towards healthy and sustainable oceans. Such assessments are particularly valuable when repeated annually. 2018 marks the seventh year of annual global Ocean Health Index (OHI) assessments, with scores representing ocean health for 220 coastal nations and territories. For detailed description of our up-to-date data and methods, see the [Supplemental Information](#). And visit our [Story Map](#)!



**The average 2018 Index score was 70 out of 100.** Average Index scores have not dramatically changed over seven years, which could be expected at a global scale. However, some individual goals and regions have had significant changes.

- [Learn about the goals](#)
- [Read the 2018 results summary](#)
- [Explore scores by region and goal](#)
- [Download data](#)
- [Dig deeper with the 2018 methods](#)
- [Learn more at \[oceanhealthindex.org\]\(#\)](#)

The OHI framework has not changed since its inception in 2012 ([Halpern et al. 2012](#)). We continue to assess ocean health based on the sustainable delivery of a suite of goals that are important to humans. We score each goal on a scale of 0-100 based on current status, trend, and external pressures and resilience measures. Scores are calculated for each coastal nation before being

# An Ocean Health Index for South West England



©Owen Exeter

## ⌚ The Ocean Health Index

The Ocean Health Index (OHI) is a tool to measure the benefits and services that the ocean provides for people now and into the future. Assessments are developed with the support of local stakeholders to better understand how to sustainably balance current and future ocean use. Discover more at [ohi-science.org](http://ohi-science.org).

## ⚑ The project

The application of OHI to the [South West](#) aims to provide a regional baseline for marine health and to assess the impact of management policies. The project specifically coincides with development of the Marine Management Organisation's [South West Marine Plan](#). Results will help inform management decision making with all data openly available.

## 👤 The team

The South West Ocean Health Index is being conducted by [researchers](#) from the University of Exeter. The project began in 2018 and results are expected to be made available early 2020.

For further information please visit our [FAQ](#) page and a link for email updates will be available here shortly.

**1 Welcome**

**2 Introduction**

**2.1 Overview**

**2.2 What to expect**

**2.3 Tools and Resources**

**3 Planning and Gathering Data**

**3.1 Overview and Resources**

**3.2 Where to start**

**3.3 Goals: modeling status and tr...**

**3.4 Resilience**

**4 OHI Planner**

**4.1 Overview**

**4.2 Data Planner spreadsheet**

**4.3 Status Data tab**

**4.4 Chapter Recap**

**5 OHI Toolbox**

**5.1 The OHI Toolbox and open da...**

**5.2 How you will work**

**5.3 Requesting OHI repositories**

**6 Toolbox Ecosystem**



# Ocean Health Index Toolbox Training

***Ocean Health Index Team***

**2018-08-22**

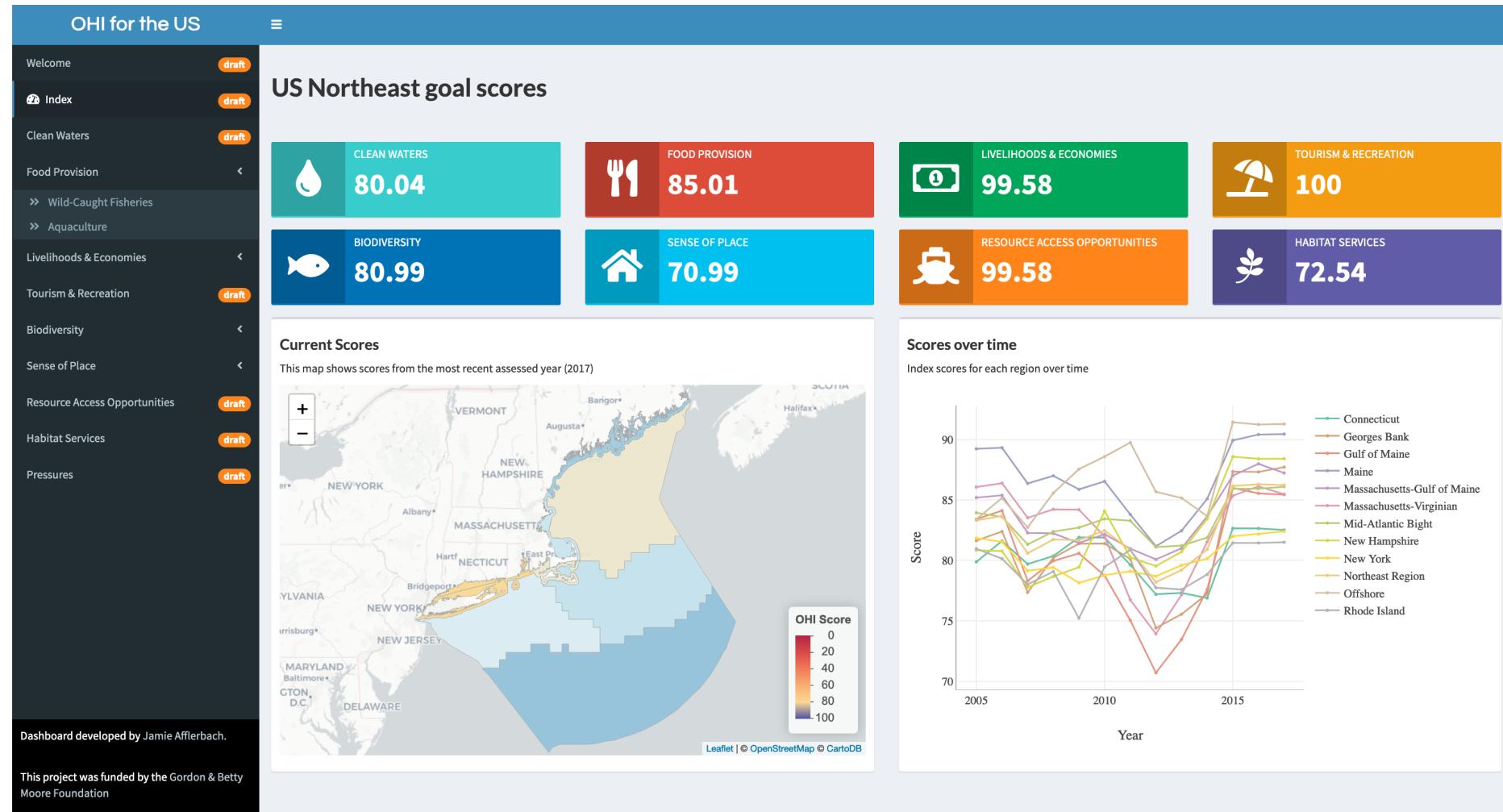
## Chapter 1 Welcome

**Welcome. This training program is under active development and testing.**

The single biggest motivation of the Ocean Health Index is to use science to inform marine management. And not just any science, the best available science, data, methods, and tools. OHI assessments use collaborative open software so that they are transparent and reproducible; we call this software the OHI Toolbox.

Openness is an important part of how we work; we describe how and why in Lowndes *et al.* 2017, *Nature Ecology & Evolution: Our path to better science in less time using open data science tools*. Using the OHI Toolbox requires coding and using data science software; you can learn this in OHI's [Intro to Open Data Science](#) training book.

This Toolbox Training book will train you to prepare for and use the OHI Toolbox. It can be used to teach workshops or for self-paced learning.



dashboard (Shiny): [@jafflerbach](#), work in progress. inspiration: [Imagine Boston](#)



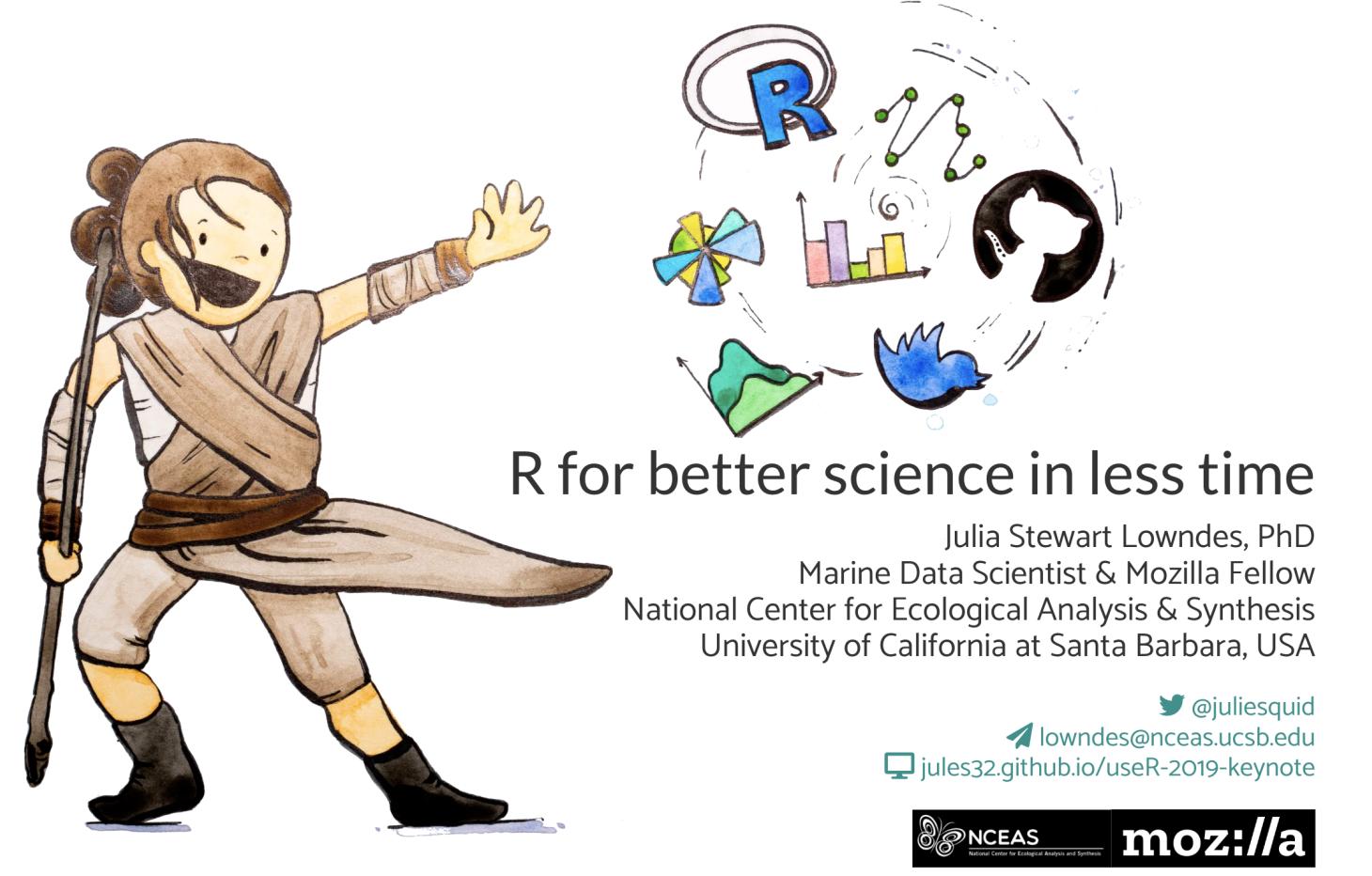
[CHAMPIONS PROGRAM](#) [RESOURCES](#) [BLOG](#) [ABOUT](#) [GET INVOLVED](#)

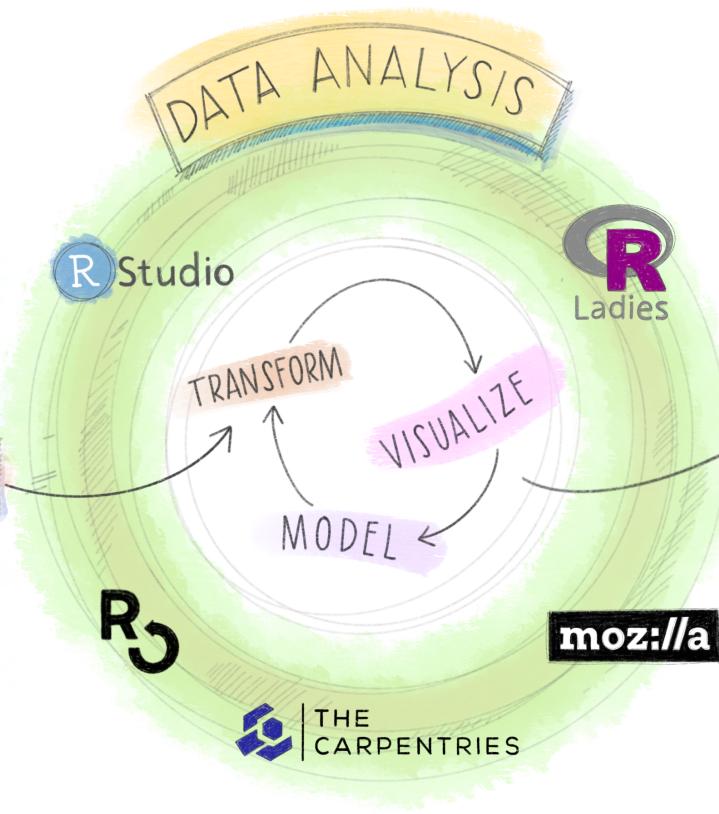
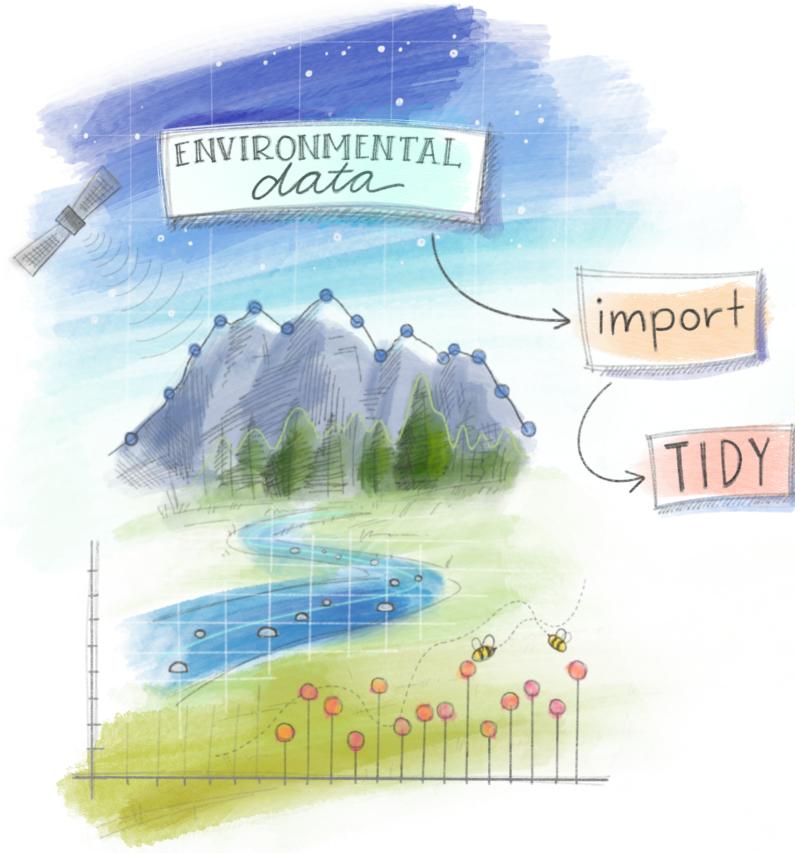
# OPENSCAPES

LET'S DO BETTER SCIENCE  
IN LESS TIME  
TOGETHER

## WHAT WE DO

At Openscapes, we champion open practices in environmental science to help uncover data-driven solutions faster. Regardless of research question, environmental scientists are united by the need to analyze data — and to do so in a way that is efficient, reproducible, and easily communicated. With tools specifically created to meet modern demands for collaborative data science, we help create a positive open culture to enable better science in less time. Here's how:





art: @allison\_horst; updated from Wickham & Grolemund

# Teamwork starts with openness

working openly • vertical & horizontal leadership •  
community

# Working openly

# Ocean Health Index team

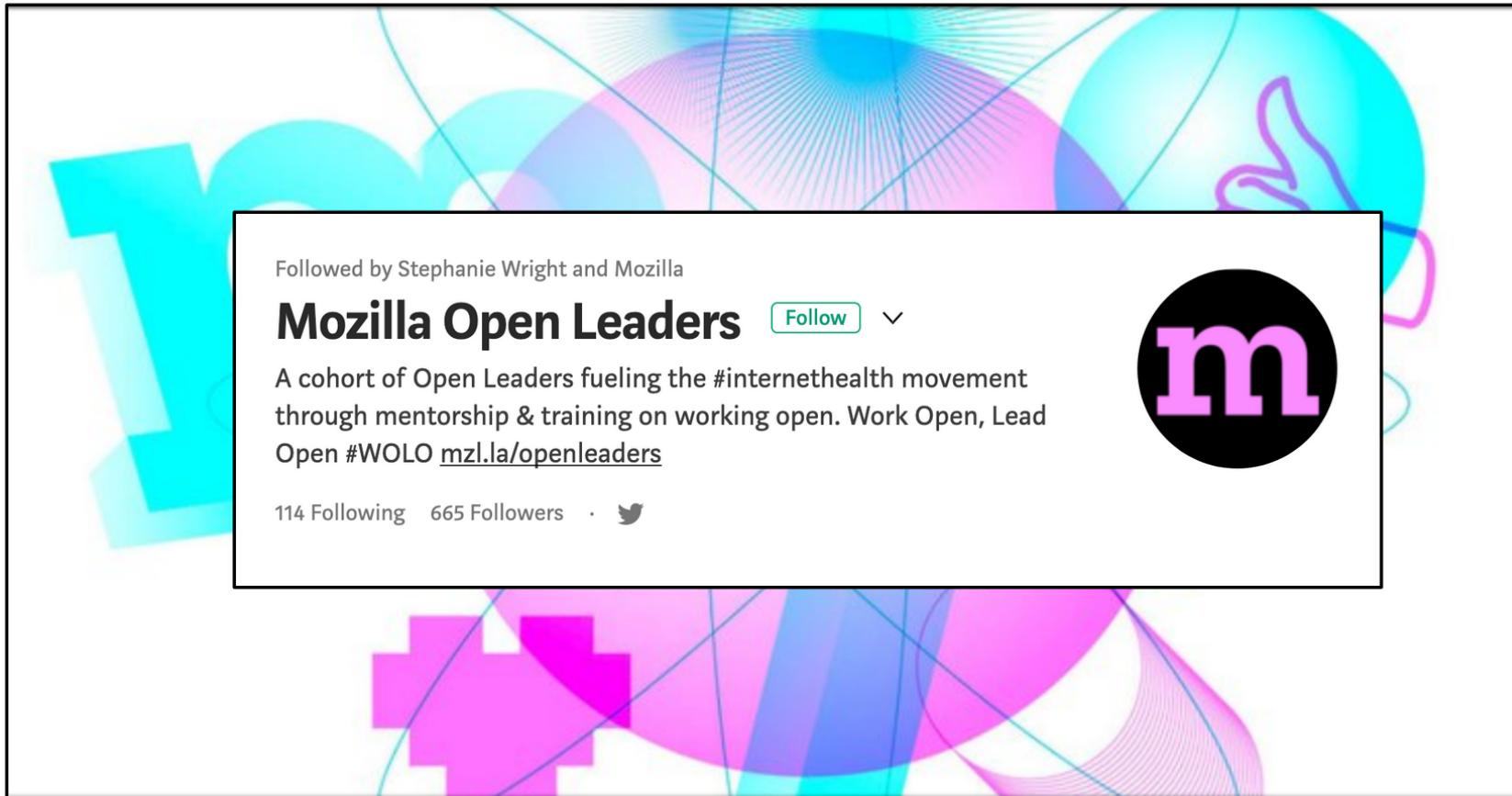


# Ocean Health Index team



# Openscapes Cohorts





web: Mozilla Open Leaders (Apply for OLX by August 1!)

# [Sea]side chats & hackathons

## Bayside Chats - Wood Lab

### **Welcome to Bayside Chats with the Wood Lab!**

Here, we eat lunch and chat about reproducible research, coding problems, and cool new packages/software/computational methods that are applicable to our research.

# Openscapes lesson series

The screenshot shows a website for the 'Openscapes Champions Lesson Series'. The left sidebar contains a navigation menu with sections 1, 2, and 3, each with several sub-items. The main content area displays the title 'Openscapes Champions Lesson Series' by Julie Lowndes, dated 2019-05-14. Below the title is the 'Chapter 1 Welcome' section, which includes a paragraph about the program's purpose and a detailed description of its mission and goals.

Openscapes Champions Series  
← Back to openscapes.org

**1 Welcome**  
1.1 Agendas

**2 Overview**  
2.1 Why we're here  
2.2 What to expect  
2.3 What's possible with open dat...  
2.4 What we'll learn  
2.5 Deliverables  
2.6 Additional reading

**3 Openscapes Mindset**  
3.1 Data science as a discipline  
3.2 Open data science tools exist  
3.3 Open as a way to work  
3.4 Lab members as a team

**Openscapes Champions Lesson Series**  
Julie Lowndes  
2019-05-14

## Chapter 1 Welcome

This book is a lesson series for the Openscapes Champions program. *It is under heavy development; some chapters are only notes at this point.*

Openscapes Champions is a mentorship program that empowers scientists with open data science tools and grows the community of practice. We mentor early career researchers in leadership roles – faculty, lecturers, program managers, and others who want to establish open data science practices in their labs and on their campuses. It is designed to meet scientists where they are and help identify incremental steps to make their data workflows more efficient and open. We've been building Openscapes from an open data science angle, but along with that comes the mindset of openness, collaboration, good intentions, and creating the culture we want in science. Note: "lab" is broadly defined.

The screenshot shows a tweet from the account @openscapes. The tweet features a profile picture of a colorful, stylized desert landscape. The text of the tweet reads: 'Tomorrow our Openscapes Champions will present their accomplishments 🎉! These 24 scientists have spent the last 5 months learning together & bringing open data science to their labs. We'll share after their presentations, but thought we'd recap the topics we covered (thread):' Below the tweet is a decorative graphic of a desert scene with cacti, birds, and a sunset, with the text 'CHAMPIONS PROGRAM' overlaid. Two bullet points follow the graphic: '• Mentorship program for early career scientists & their labs' and '• Normalize open data science in the lab & seed change beyond'.

Openscapes  
@openscapes Following

Tomorrow our Openscapes Champions will present their accomplishments 🎉!  
These 24 scientists have spent the last 5 months learning together & bringing open data science to their labs. We'll share after their presentations, but thought we'd recap the topics we covered (thread):

- Mentorship program for early career scientists & their labs
- Normalize open data science in the lab & seed change beyond

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

tweet thread: [@openscapes](https://twitter.com/intent/tweet?text=@openscapes)

# Vertical & horizontal leadership

# Ocean Health Index team



web: National Center for Ecological Analysis & Synthesis;

tweet: @juliesquid

# Ocean Health Index team



web: National Center for Ecological Analysis & Synthesis;

tweet: @juliesquid

# Openscapes Champions



**Halley Froehlich, PhD**  
University of California at Santa Barbara

Dr. Froehlich is a marine aquaculture & fisheries scientist studying [global food systems and climate change](#). She inspires and empowers audiences of all kinds, including through Netflix's [Bill Nye saves the world](#).



**Allison Horst, PhD**  
University of California at Santa Barbara

Dr. Horst is a data science and statistics lecturer in an environmentally-focused graduate program. Dr. Horst was awarded the student-appointed Bren School of Environmental Science & Management Distinguished Teaching Award in 2018.



**Nishad Jayasundara, PhD**  
University of Maine

Dr. Jayasundara is a physiologist studying organismal adaptation to their habitat and effects of [external environmental factors](#). His ongoing research includes capacity building to address [environmental health](#) in Sri Lanka.



**Malin Pinsky, PhD**  
Rutgers University

Dr. Pinsky is an ecologist studying the [impacts of climate change on ocean life](#). With expertise on shifting habitats of ocean animals, Dr. Pinsky leads [OceanAdapt](#), a website used by governments and NGOs for climate adaptation planning.



**Adrian Stier, PhD**  
University of California at Santa Barbara

Dr. Stier is a marine ecologist studying the [recovery and resilience of ocean ecosystems](#). Included in the systems he studies are coral reefs, and he recently was a Keynote Speaker at the [4th Coral Reef Symposium](#).



**Nina Therkildsen, PhD**  
Cornell University

Dr. Therkildsen is an evolutionary biologist using genomic analyses to [improve marine conservation and fisheries management](#). Dr. Therkildsen studies [genetic adaptation](#) using current, historic, and ancient DNA.



**Chelsea Wood, PhD**  
University of Washington

Dr. Wood is an ecologist studying marine and freshwater [parasites in a changing world](#). Her work was recently featured in a bioGraphic video, [Protected by prawns](#), by the California Academy of Sciences.

# Openscapes Champions



**Halley Froehlich, PhD**  
University of California at Santa Barbara

Dr. Froehlich is a marine aquaculture & fisheries scientist studying [global food systems and climate change](#). She inspires and empowers audiences of all kinds, including through Netflix's [Bill Nye saves the world](#).



**Allison Horst, PhD**  
University of California at Santa Barbara

Dr. Horst is a data science and statistics lecturer in an environmentally-focused graduate program. Dr. Horst was awarded the student-appointed Bren School of Environmental Science & Management Distinguished Teaching Award in 2018.



**Nishad Jayasundara, PhD**  
University of Maine

Dr. Jayasundara is a physiologist studying organismal adaptation to their habitat and effects of [external environmental factors](#). His ongoing research includes capacity building to address [environmental health](#) in Sri Lanka.



**Malin Pinsky, PhD**  
Rutgers University

Dr. Pinsky is an ecologist studying the [impacts of climate change on ocean life](#). With expertise on shifting habitats of ocean animals, Dr. Pinsky leads [OceanAdapt](#), a website used by governments and NGOs for climate adaptation planning.



**Adrian Stier, PhD**  
University of California at Santa Barbara

Dr. Stier is a marine ecologist studying the [recovery and resilience of ocean ecosystems](#). Included in the systems he studies are coral reefs, and he recently was a Keynote Speaker at the [4th Coral Reef Symposium](#).



**Nina Therkildsen, PhD**  
Cornell University

Dr. Therkildsen is an evolutionary biologist using genomic analyses to [improve marine conservation and fisheries management](#). Dr. Therkildsen studies [genetic adaptation](#) using current, historic, and ancient DNA.



**Chelsea Wood, PhD**  
University of Washington

Dr. Wood is an ecologist studying marine and freshwater [parasites in a changing world](#). Her work was recently featured in a bioGraphic video, [Protected by prawns](#), by the California Academy of Sciences.



twitter: @stuart620



R-Ladies Highland Park

@RLadiesHPNJ

Following



We had the first meeting of the first R-ladies group in New Jersey last night over drinks @PinosHP. 🍷 These women are so cool, fun, and wonderful to talk to. (Of course I forgot to take a picture). Next meeting in July with laptops! 💻

5:09 AM - 15 Jun 2019

tweet: @RLadiesHPNJ

# Community

# #rstats

Julia Stewart Lowndes  
@juliesquid

@jafflerbach teaching spatial analysis in  
#rstats!! @brenucsb @ecodatasci  
@MozillaScience

A photograph of a woman with long brown hair and glasses, wearing a dark patterned sweater, standing in front of a large projection screen. She is pointing her right hand towards the screen. The screen displays a heatmap of sea surface temperature (SST) over a geographic area from approximately -140 to -100 longitude and 30 to 50 latitude. A color bar on the right indicates temperatures from 2.4 to 30. Above the heatmap, R code is visible: 

```
rppCrop = crop(rppProj,sstAvg) #crop rppProj to the extent of s  
plot(rppCrop,col=cols);plot(cc,add=T)
```

 To the left of the projection screen, a navigation menu for a spatial analysis application is visible, with "Crop" highlighted in blue. Below the menu, a section titled "Resample" contains text about aligning SST and OA data. The timestamp "1:52 PM - 5 May 2016" is at the bottom of the slide.

1:52 PM - 5 May 2016

tweet: @juliesquid

 **Karthik Ram @\_inundata** · 17 Jun 2015  
@jcheng Awesome work Joe!

1 ↗ ⚡ ❤️ 📧

 **Jamie Afflerbach @jafflerbach** · 17 Jun 2015  
 @\_inundata @jcheng yay this is so great!!! cc: @juliesquid @ben\_d\_best

1 ↗ ⚡ ❤️ 📧

 **Joe Cheng @jcheng** · 17 Jun 2015  
 @jafflerbach @\_inundata @juliesquid @ben\_d\_best This isn't the feature we did at rOpenSci (dynamic tiles). That was cooler but less useful

2 ↗ ⚡ ❤️ 📧

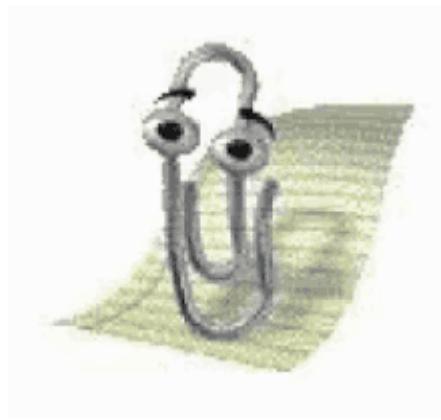
 **Joe Cheng @jcheng** · 17 Jun 2015  
 @jafflerbach @\_inundata @juliesquid @ben\_d\_best We could do that feature too but this seemed higher priority.

1 ↗ ⚡ ❤️ 📧

 **Ben Best @ben\_d\_best** · 17 Jun 2015  
 @jcheng @jafflerbach @\_inundata @juliesquid Dynamic tiles will be great, esp for high res global rasters, addRasterImage() a sensible start

1 ↗ ⚡ ❤️ 📧

tweet: [@jcheng](#)





**Julia Stewart Lowndes**

@juliesquid



4-year-old niece: who's @hadleywickham?  
Husband of this #rstats #openscience girl:  
he's a wizard who lives on the internet

2:19 PM - 30 Apr 2016

tweet: [@juliesquid](#)



**Halley E. Froehlich** 🐟

@DocFroehlich

Following



Um 'rnoaa' package is an absolute game changer. Thanks @juliesquid @openscapes for the intro! 😲

[cran.r-project.org/web/packages/r ...](https://cran.r-project.org/web/packages/rnoaa/)

12:02 PM - 17 Jan 2019

4 Retweets 31 Likes



**Julia Stewart Lowndes** @juliesquid · Jan 17

Replying to @DocFroehlich @openscapes

Cc: @rOpenSci @sckottie



1



2



**Scott** @sckottie · Jan 17

woot woot. glad you like it.



1



4



**Allison Horst** @allison\_horst · Jan 17

That was news to me too and I'm fired up.



4



tweet: @DocFroehlich

# rOpenSci & RStudio

Jamie Afflerbach  
@jafflerbach

Following

Getting raster data into @LeafletJS at #runconf15 @jcheng @juliesquid



3:08 PM - 27 Mar 2015

tweet: [@jafflerbach](#)

Julia Stewart Lowndes  
@juliesquid

Thanks @rstudio! #rstats heroes at #shinydevcon: @hadleywickham @jcheng @winston\_chang; @jafflerbach @ben\_d\_best



11:16 AM - 1 Feb 2016

tweet: [@juliesquid](#)



*This isn't just about coding and GitHub, this is  
about changing how we do science*  
— Malin Pinsky

# RLadies



# #tidytuesday hacky hours

 **Allison Horst**  
@allison\_horst

Following ▾

My students have been asking for #rstats hacky hours ❤️😭🎉🍕. Thanks to @GracieGW for the brilliant suggestion that we start a coding club by socially participating in #TidyTuesday! Tuesday evenings next quarter, we'll be wrangling and visualizing data. For fun. Together. 🍕💻📊



11:10 AM - 25 Mar 2019



art: @allison\_horst; blog: [openscapes.org](http://openscapes.org)

# ESM 206 & 244

Allison Horst  
Bren School of Environmental Science and Management (UCSB)

ESM 206: Introduction to environmental data analysis & stats in R



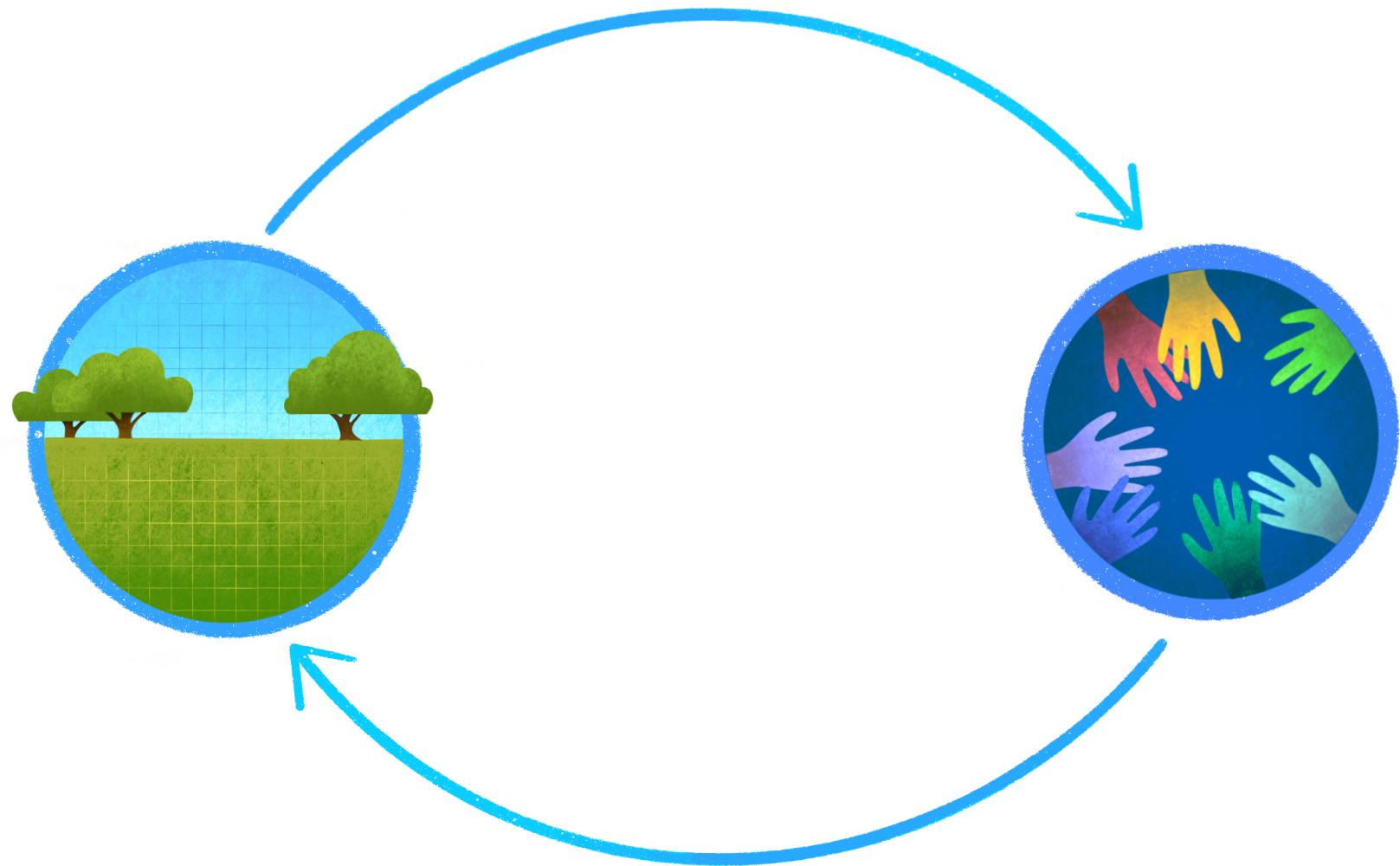
ESM 244: Advanced methods for environmental data analysis in R





Mindset shifts in individuals  
Increase in skills & practice

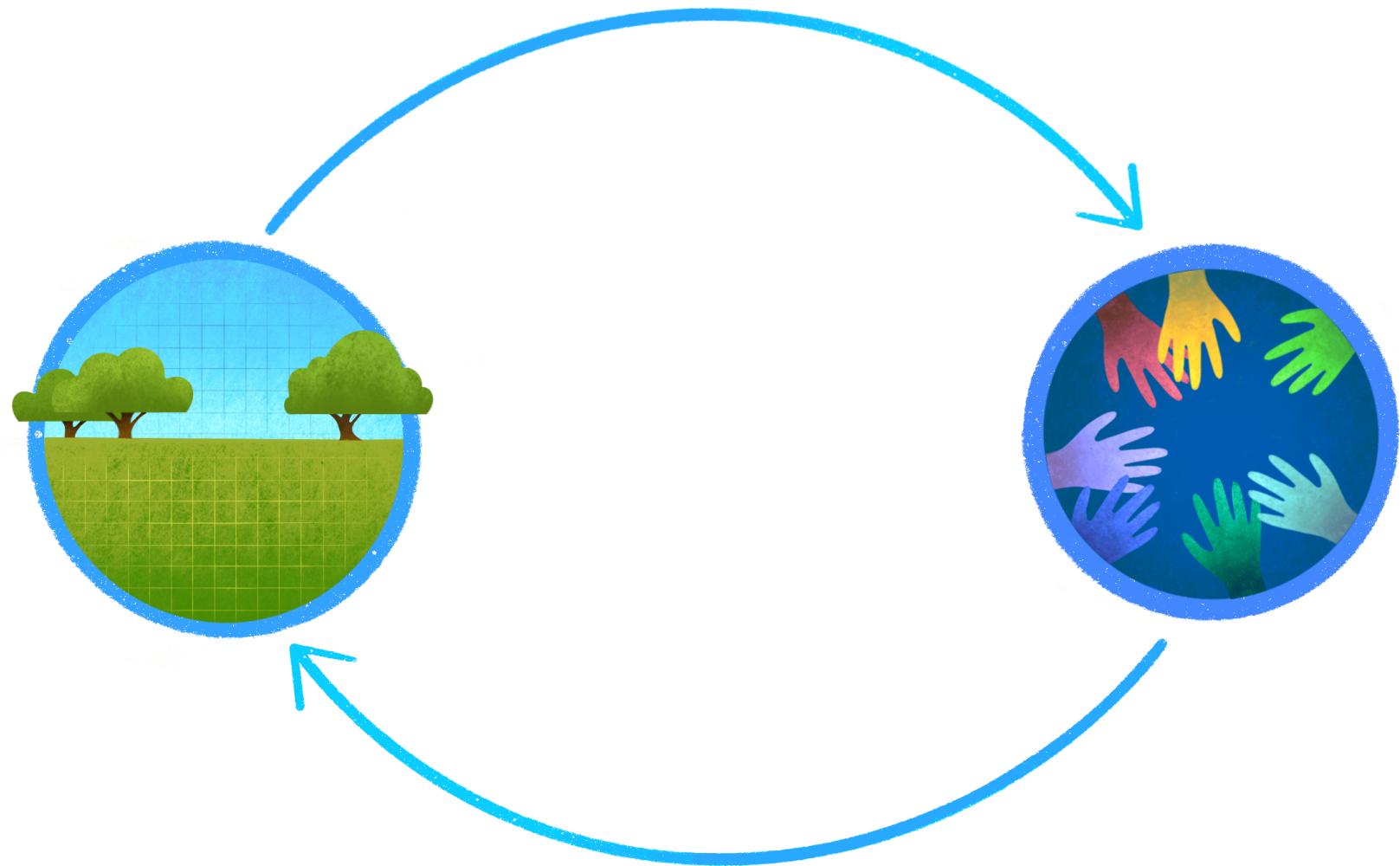
Culture shifts in labs  
Leadership & championing



art: [@allison\\_horst](#)



tweet: @dataandme



art: [@allison\\_horst](#)

Harness the power of welcome

# The Value of #Welcome

Stefanie Butland 

July 18, 2017

# Lessons learned

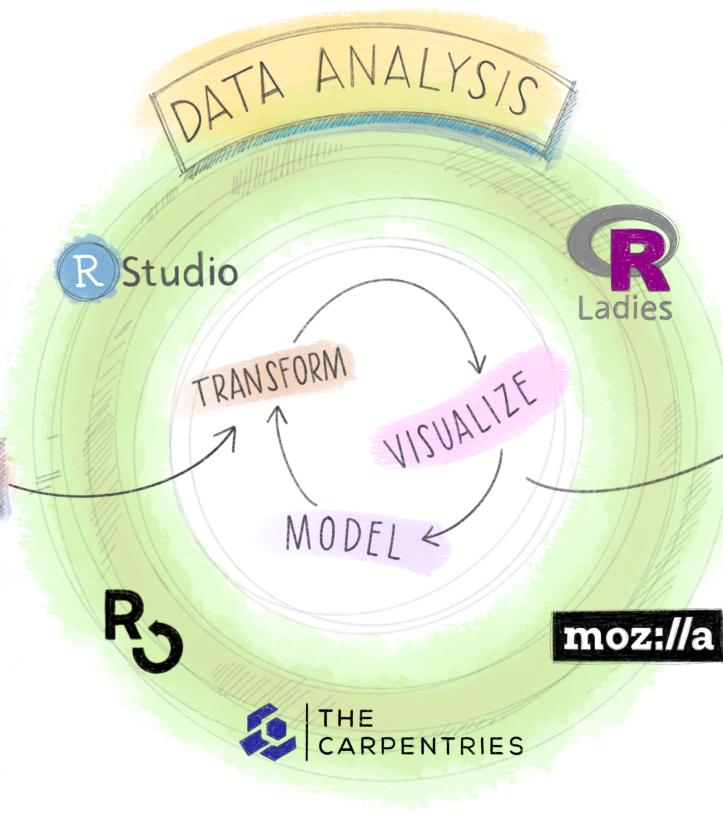
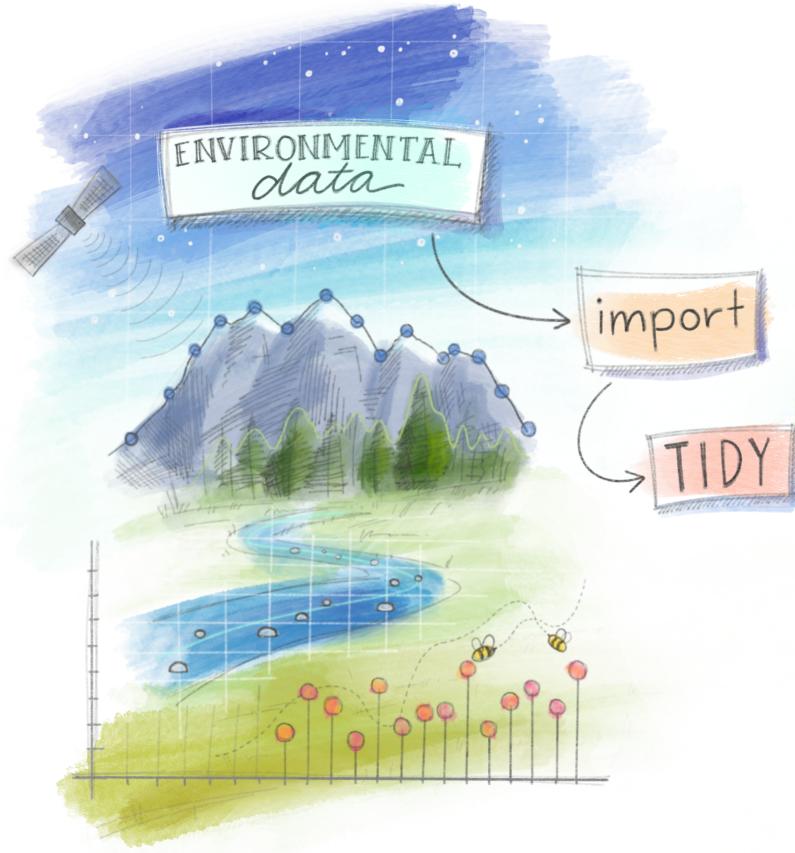
## Open data science is a mindset

expect a better way • build confidence & willingness • reimagine science communication

## Teamwork starts with openness

working openly • vertical & horizontal & leadership • community

## Harness the power of welcome



art: @allison\_horst; updated from Wickham & Grolemund

# Thank you all so much

especially for this talk:

OHI team  
Mozilla team  
Openscapes labs  
Allison Horst  
RLadies team

Please get involved:  
[openscapes.org/contact](https://openscapes.org/contact);  
[@openscapes](https://twitter.com/openscapes)

all artwork: [@allison\\_horst](https://twitter.com/allison_horst)

xaringan theme: [@apreshill](https://twitter.com/apreshill)