Introduction to WhaleMap

SMM22 Shiny Workshop

Overview

WhaleMap is a software tool designed to:

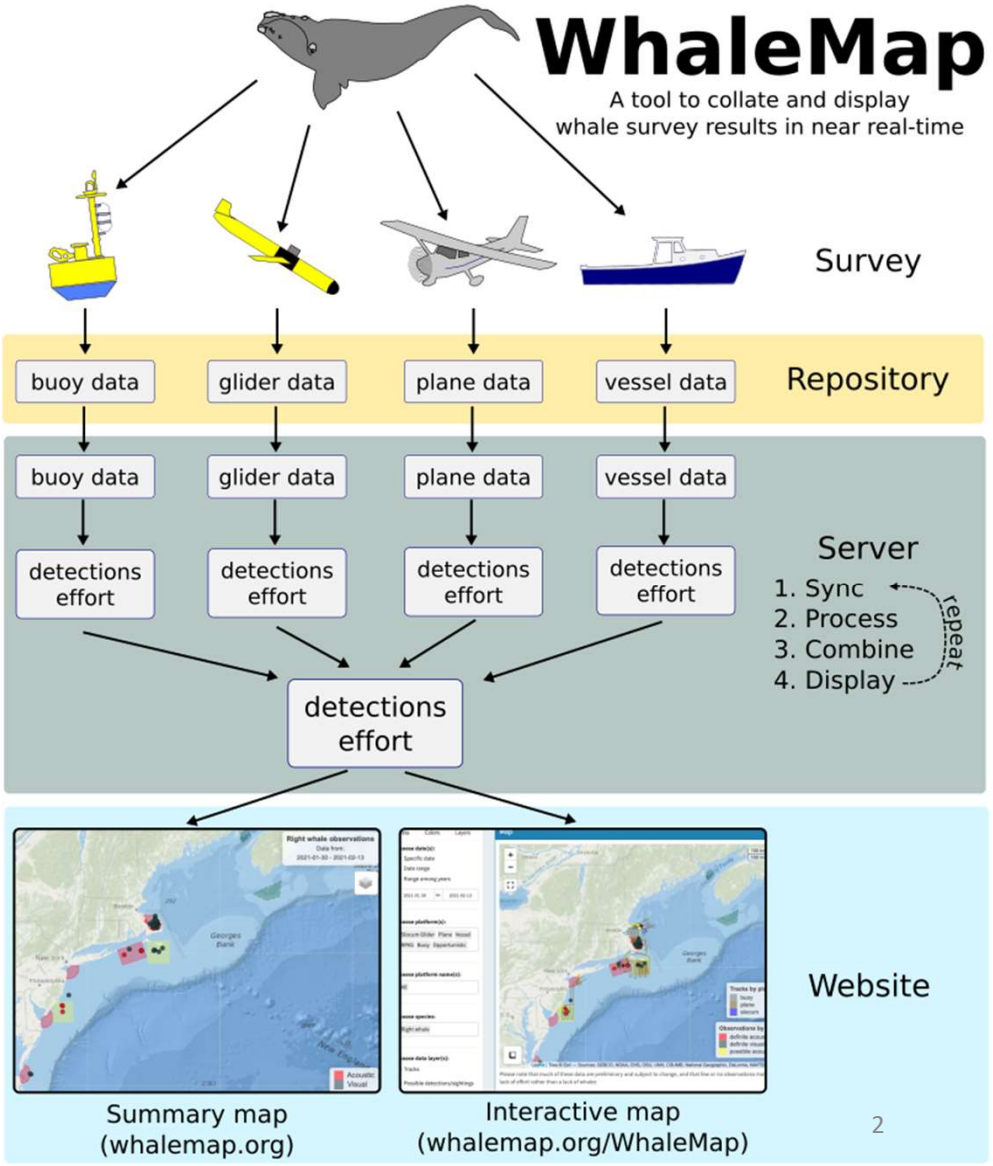
- Incorporate whale detection and survey effort from all survey methods in near real-time
- Allow survey teams to easily contribute and retain complete control over their data
- Provide the latest data in an accurate, user-friendly, and publicly accessible format
- Operate transparently using open-source tools and with limited supervision

WhaleMap does **NOT**:

- Perform any quality-control, or take responsibility for the veracity of contributions
- Provide a long-term database for survey results
- Allow access to raw or processed data without approval from the data originator

How it works

1. Raw survey data are uploaded to a remote repository (e.g., Google Drive) shared with WhaleMap
2. Data are copied to the WhaleMap server
3. Custom code extracts detections and effort from each survey
4. Data are combined and displayed on summary and interactive maps



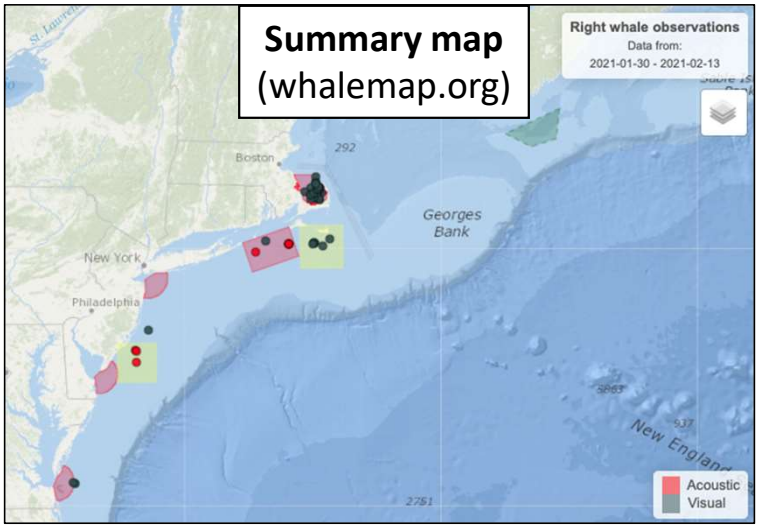
Johnson HD, Morrison D, Taggart CT. (2021). WhaleMap: a tool to collate and display whale survey results in near real-time. *Journal of Open Source Software*, 6(62), 3094, doi: 10.21105/joss.03094

Source code: https://github.com/hansenjohnson/WhaleMap

Displays

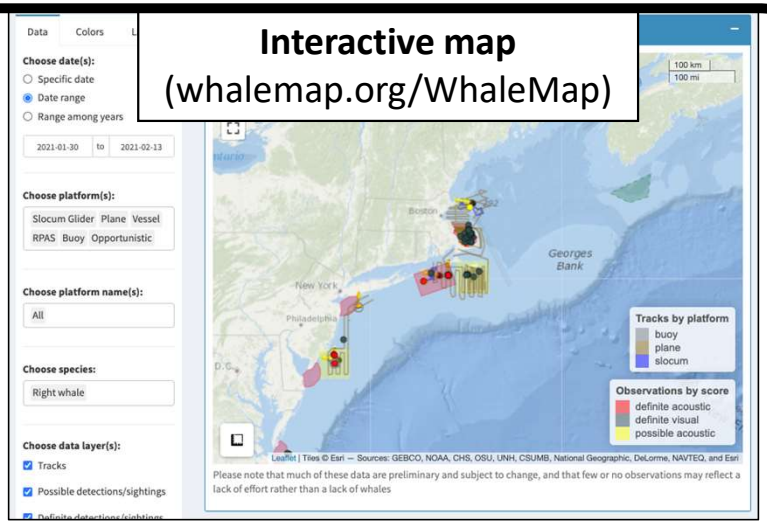
Summary map

- Available at the **whalemap.org** homepage and embedded on several other websites
- Provides a snapshot of last 14-days of right whale detections
- Easy to interpret, but limited functionality



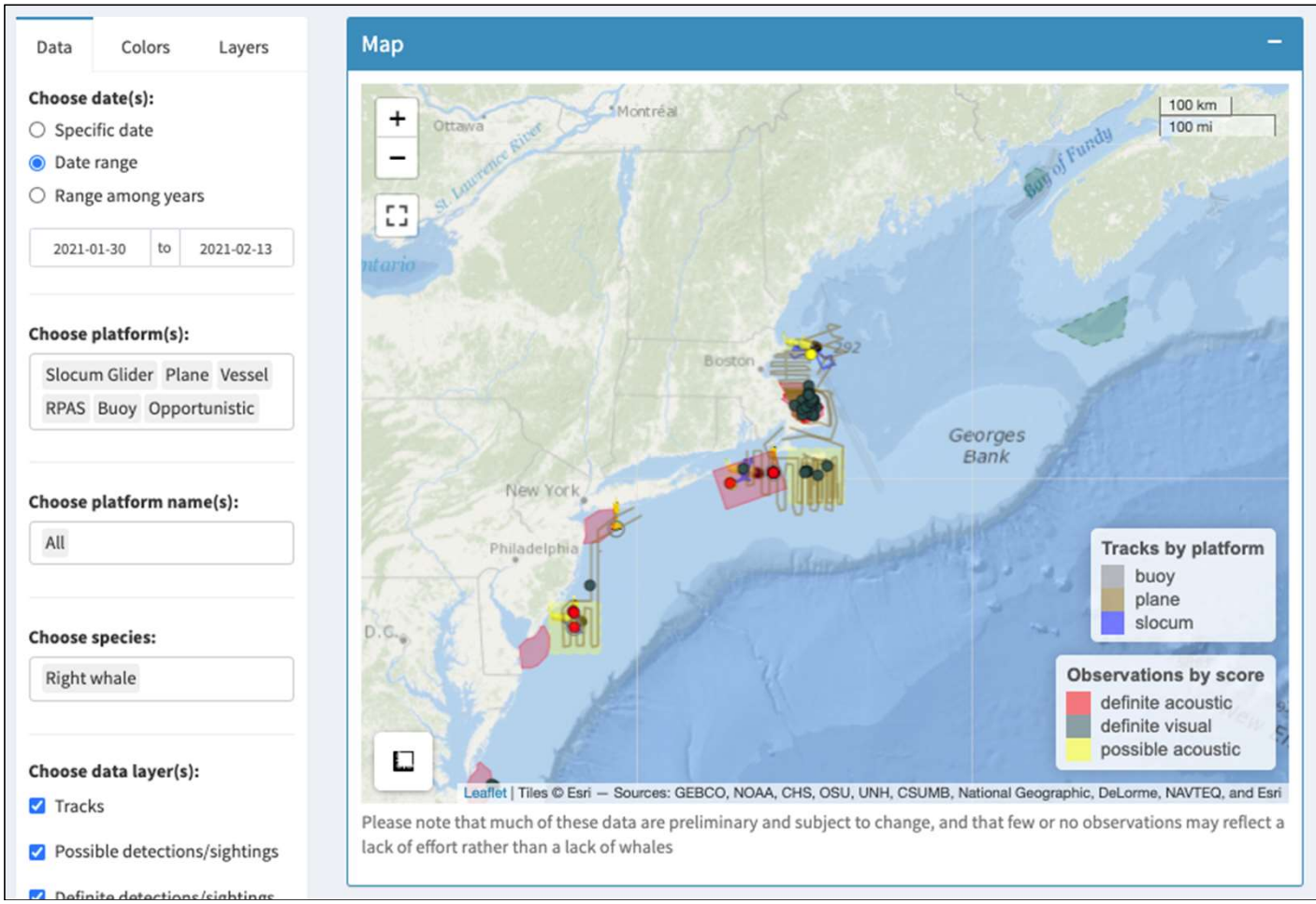
Interactive map (using Shiny!)

- Available at **whalemap.org/WhaleMap** (Or click “Interactive Map” on the WhaleMap homepage)
- Several data displays (map, timeseries, status)
- Numerous filters and layers to choose date range, species, platform, management layers, etc.



WhaleMap and Shiny

- **Shiny** allows users to interact with WhaleMap data
- App is currently live at: **whalemap.org/WhaleMap**
- Overview of:
  - Input data
  - Data filters / displays
  - Code
  - Workflow



Input data

- Observations (time, location, species, score, platform)
- Effort (time, location, platform)
- Management areas (time, location, definition)
- Platform status (time)

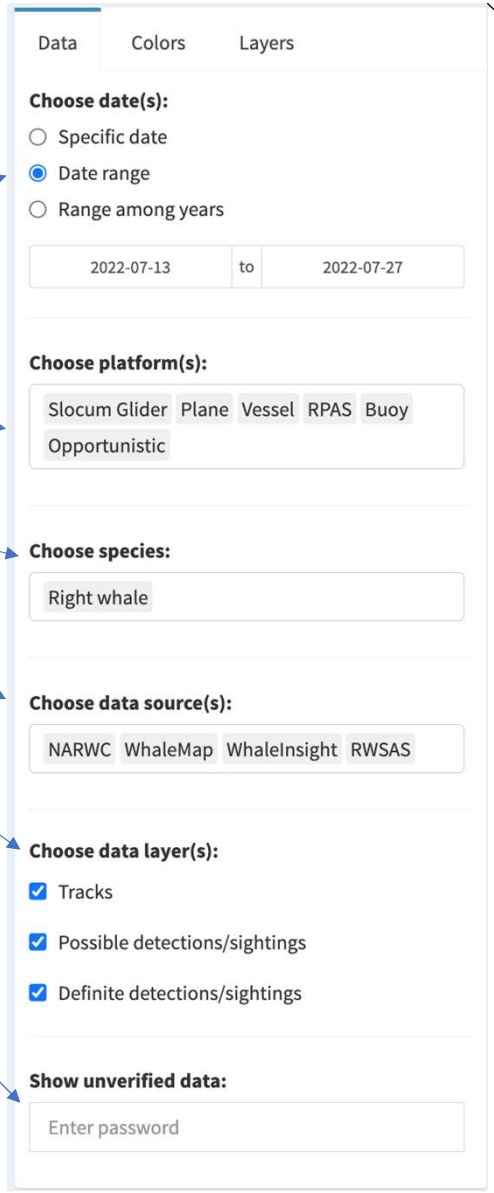
Updates every 15 min

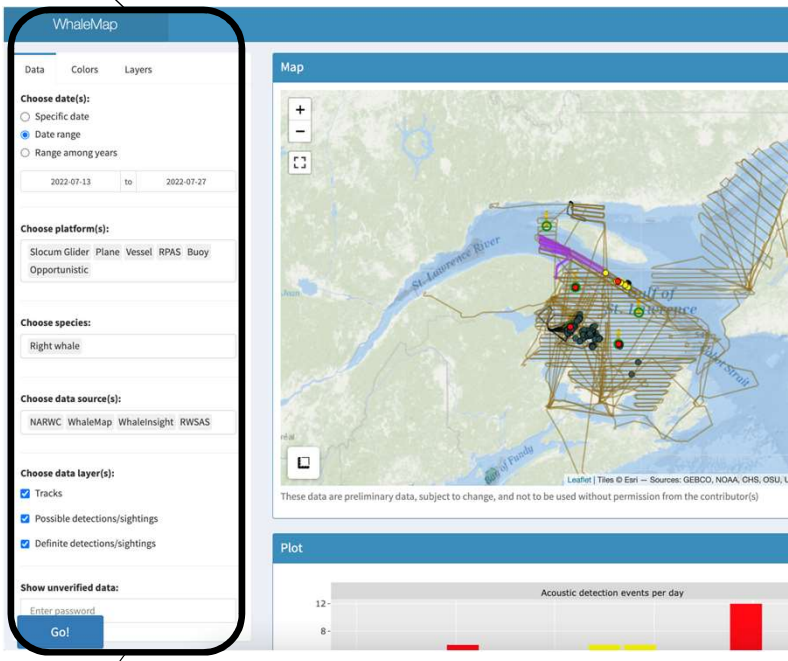
Observations

time	lat	lon	species	score	number	calves	platform	name	id	source
2022-07-26 18:44:21	42.2743	-70.4776	humpback	definite visual	4	*NA*	plane	noaa_twin_otter	2022-07-26_plane_noaa_twin_otter	WhaleMap
2022-07-26 18:37:40	42.4562	-70.4643	humpback	definite visual	2	*NA*	plane	noaa_twin_otter	2022-07-26_plane_noaa_twin_otter	WhaleMap
2022-07-26 18:36:17	42.4933	-70.4609	humpback	definite visual	1	*NA*	plane	noaa_twin_otter	2022-07-26_plane_noaa_twin_otter	WhaleMap
2022-07-26 18:31:21	42.6276	-70.4544	humpback	definite visual	1	*NA*	plane	noaa_twin_otter	2022-07-26_plane_noaa_twin_otter	WhaleMap
2022-07-26 18:30:30	42.6329	-70.4522	humpback	definite visual	1	*NA*	plane	noaa_twin_otter	2022-07-26_plane_noaa_twin_otter	WhaleMap
2022-07-26 17:10:13	42.9007	-70.5931	humpback	definite visual	1	*NA*	plane	noaa_twin_otter	2022-07-26_plane_noaa_twin_otter	WhaleMap
2022-07-26 15:51:07	43.1006	-70.3770	fin	definite visual	1	*NA*	plane	noaa_twin_otter	2022-07-26_plane_noaa_twin_otter	WhaleMap
2022-07-26 15:17:18	43.2005	-70.3737	fin	definite visual	1	*NA*	plane	noaa_twin_otter	2022-07-26_plane_noaa_twin_otter	WhaleMap
2022-07-26 14:17:56	42.6431	-70.5270	humpback	definite visual	2	1	plane	noaa_twin_otter	2022-07-26_plane_noaa_twin_otter	WhaleMap
2022-07-20 19:06:25	42.6005	-70.2850	humpback	definite visual	1	*NA*	plane	noaa_twin_otter	2022-07-20_plane_noaa_twin_otter	WhaleMap

Filters: data

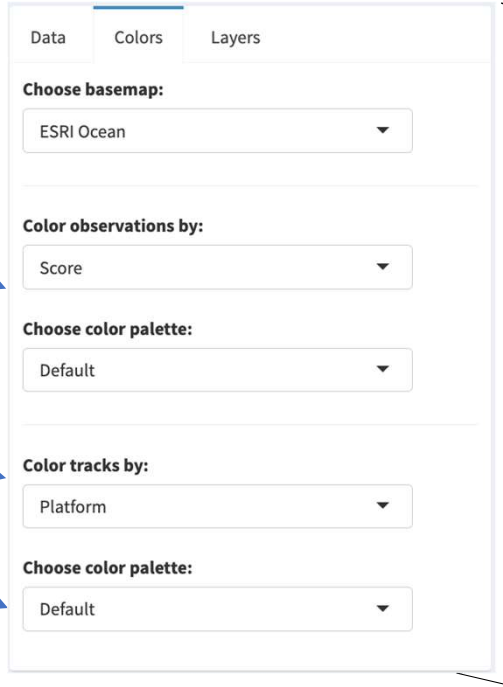
- Date range
- Platforms
- Species
- Data sources
- Data layers
- Password protected data

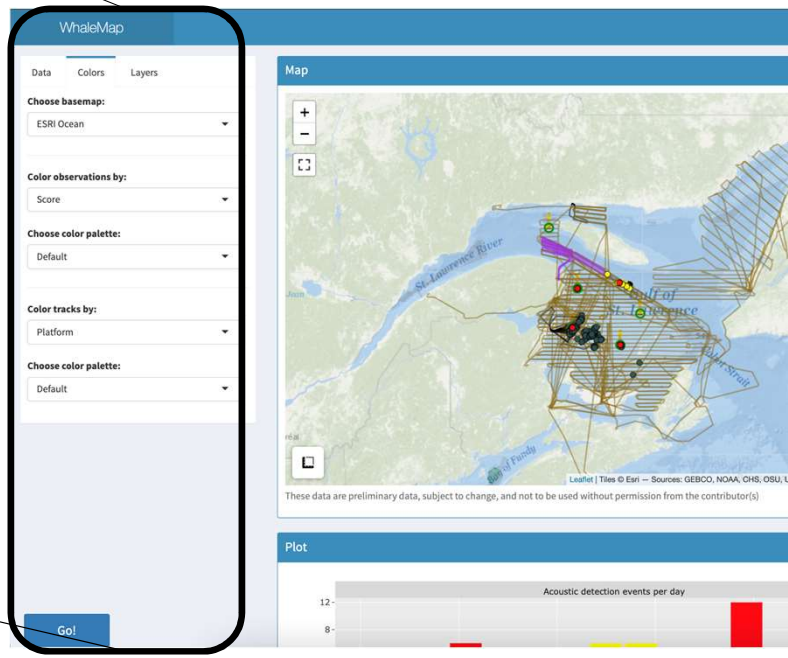




Filters: colors

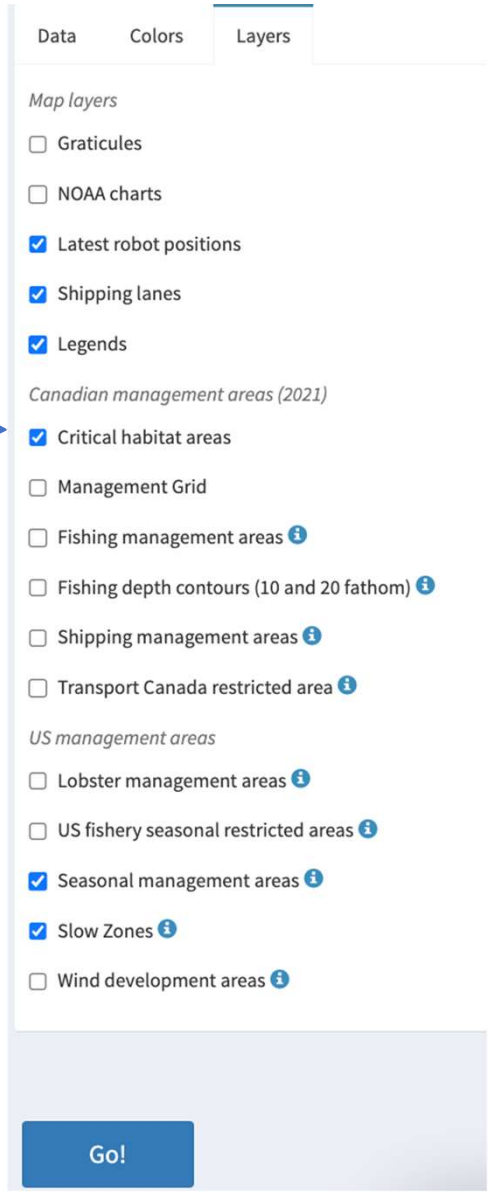
- Basemap
- Observation variable
- Observation palette
- Effort variable
- Effort palette

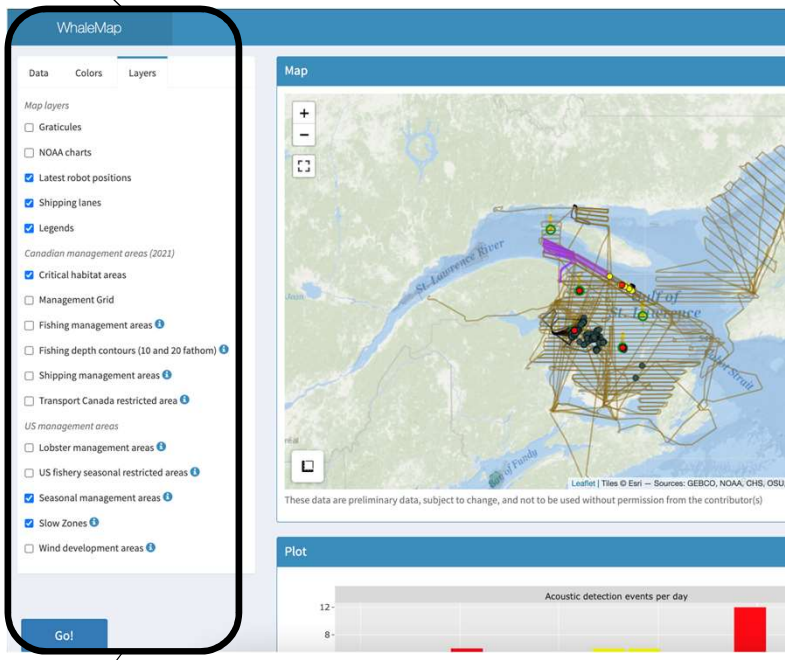




Filters: layers

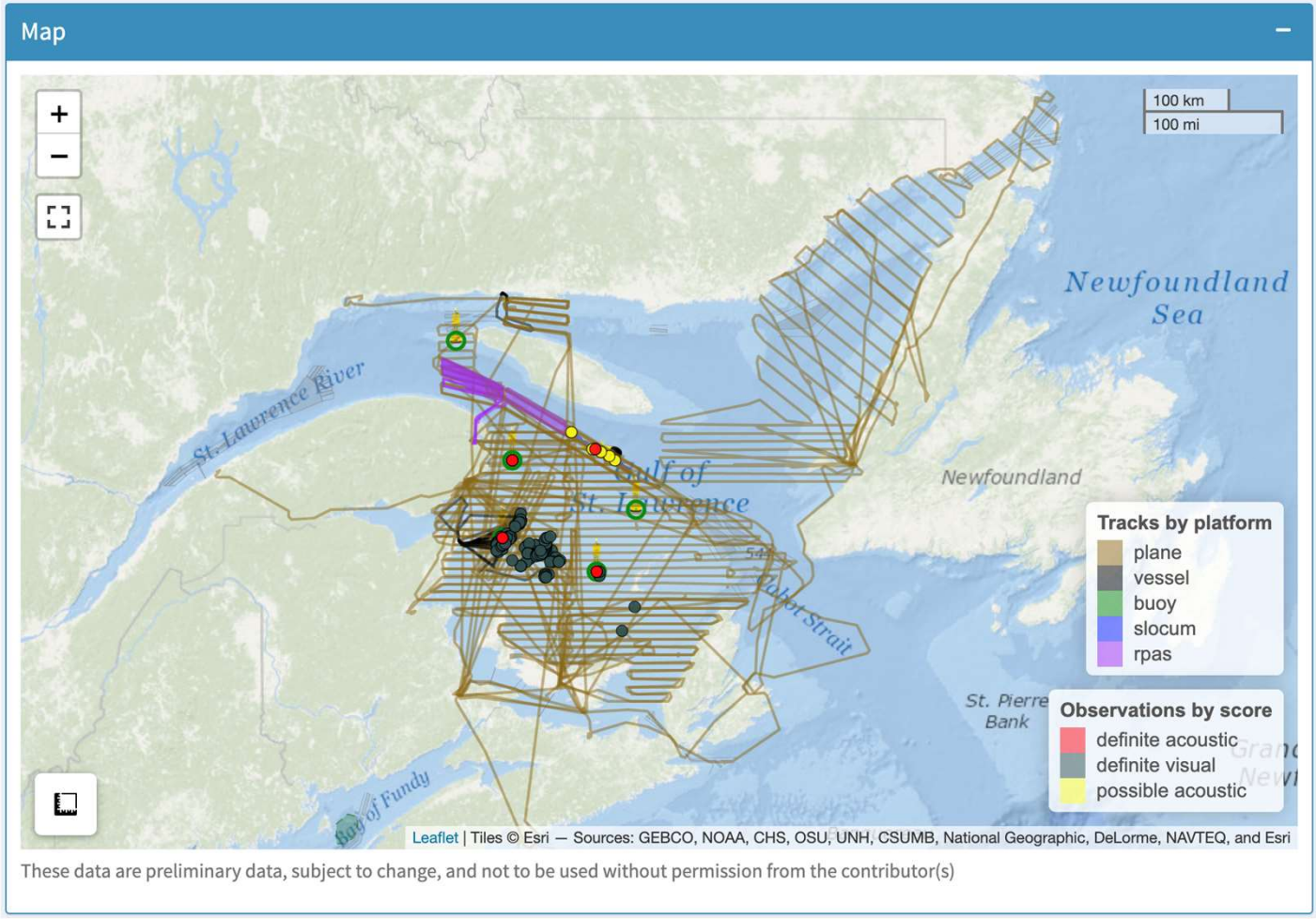
- Misc map layers
- Canadian management layers
- US management layers





Displays: map

- Interactive map built using leaflet
- Displays observations, effort, and various spatial data layers
- Zoom in/out, measure distances, clickable layers, customize layer colouring

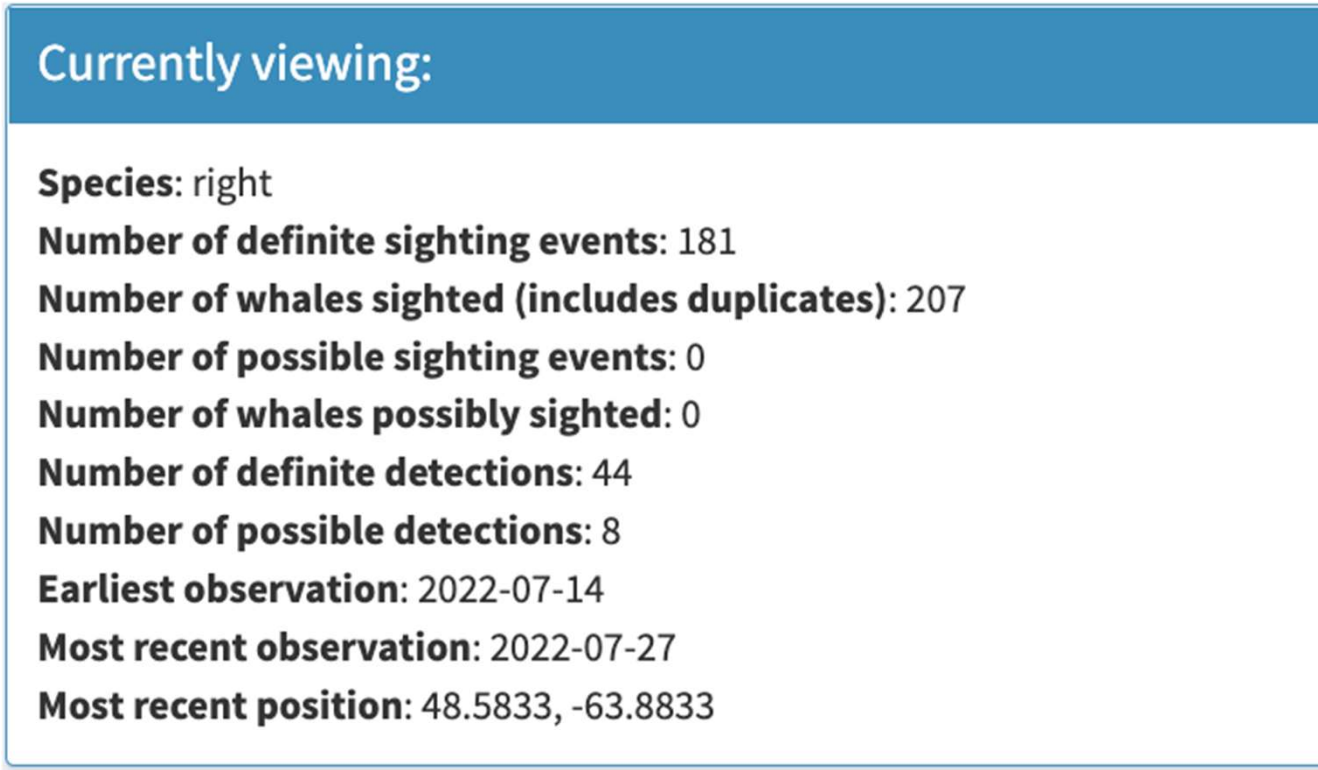


Displays: plot

- Interactive plot built using ggplot and plotly
- Displays daily timeseries of acoustic and visual detections
- Indicates daily presence of effort
- Select data in map bounds (or not)
- Numerous plotly widget features

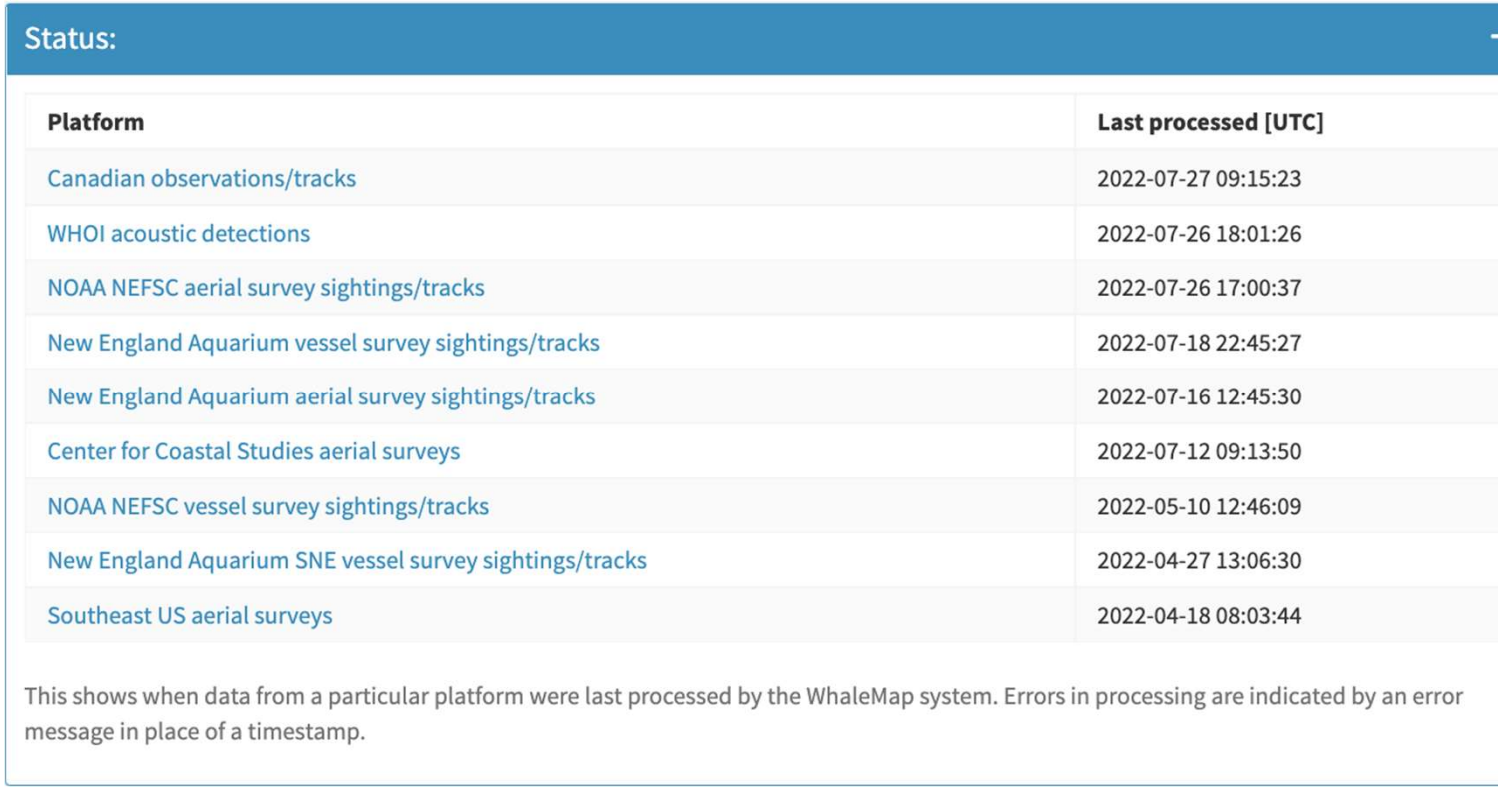
Displays: summary

- Simple text output with summary statistics
- Restricted to viewing area in map



Displays: status

- Provides a list of data providers and links for additional information
- Shows when the data from each platform were processed last
- Indicates if there's an error in processing



Status:

Platform	Last processed [UTC]
Canadian observations/tracks	2022-07-27 09:15:23
WHOI acoustic detections	2022-07-26 18:01:26
NOAA NEFSC aerial survey sightings/tracks	2022-07-26 17:00:37
New England Aquarium vessel survey sightings/tracks	2022-07-18 22:45:27
New England Aquarium aerial survey sightings/tracks	2022-07-16 12:45:30
Center for Coastal Studies aerial surveys	2022-07-12 09:13:50
NOAA NEFSC vessel survey sightings/tracks	2022-05-10 12:46:09
New England Aquarium SNE vessel survey sightings/tracks	2022-04-27 13:06:30
Southeast US aerial surveys	2022-04-18 08:03:44

This shows when data from a particular platform were last processed by the WhaleMap system. Errors in processing are indicated by an error message in place of a timestamp.

Code: ui.R

Defines the user interface for the app

https://github.com/hansenjohnson/WhaleMap/blob/master/ui.R

```r
# ui.R
# WhaleMap - a Shiny app for visualizing whale survey data

# header ----------------------------------------------------------------------

header <-  dashboardHeader(title = 'WhaleMap',

                           # data
                           dropdownMenu(
                             type = "notifications",
                             icon = 'More Information',
                             badgeStatus = NULL,
                             headerText = "",
                             notificationItem("Cite",
                                              icon = icon('education', lib = 'glyphicon'),
                                              href = "https://whalemap.org/#cite"),
                             notificationItem("Contact",
                                              icon = icon('envelope', lib = 'glyphicon'),
                                              href = "https://whalemap.org/#contact"),
                             notificationItem("Code",
                                              icon = icon('console', lib = 'glyphicon'),
                                              href = "https://github.com/hansenjohnson/WhaleMap"),
```

Code: server.R

Defines the data processing/plotting for the app

https://github.com/hansenjohnson/WhaleMap/blob/master/server.R

```
# server.R
# WhaleMap - a Shiny app for visualizing whale survey data

function(input, output, session){

  # read in data ----------------------------------------------------------

  # tracklines
  tracks = readRDS('data/processed/effort.rds')

  # latest dcs positions
  lfile = 'data/processed/dcs_live_latest_position.rds'
  if(file.exists(lfile)){
    latest = readRDS(lfile)
  }

  # sightings / detections
  observations = readRDS('data/processed/observations.rds')

  # dynamic map polygons
  load('data/processed/dma.rda')
  load('data/processed/sma.rda')
```

Code: global.R

Conveniently define objects that are used in both the UI and server scripts

https://github.com/hansenjohnson/WhaleMap/blob/master/global.R

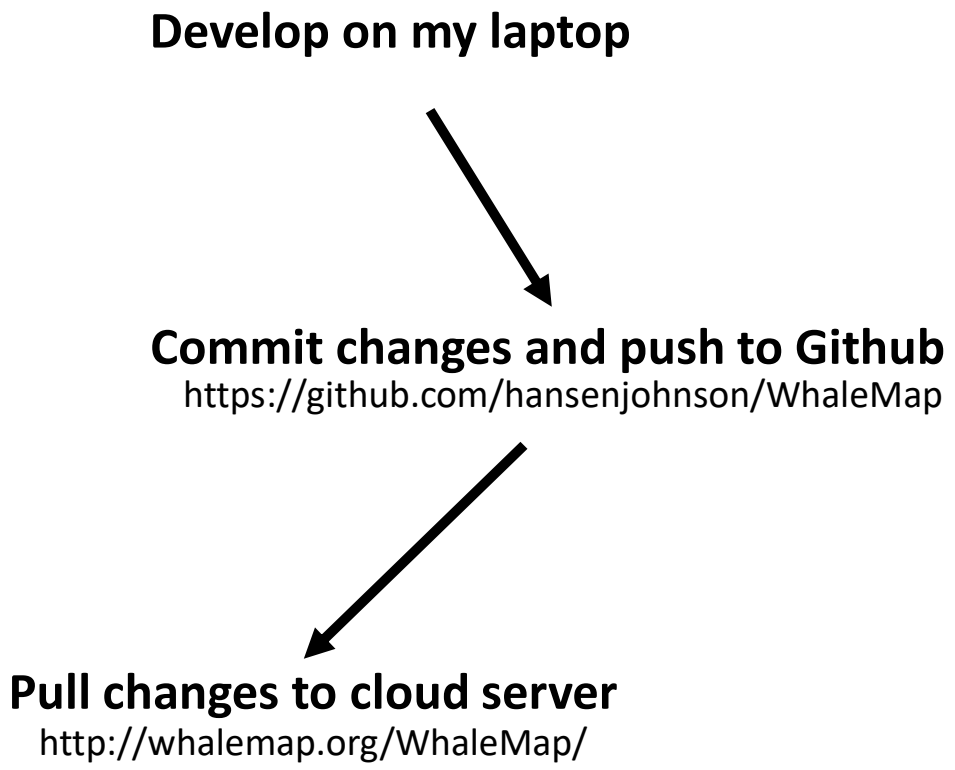
```
# global.R
# WhaleMap - a Shiny app for visualizing whale survey data


# setup ----------------------------------------------------------------

suppressPackageStartupMessages(library(shiny))
suppressPackageStartupMessages(library(leaflet))
suppressPackageStartupMessages(library(rgdal))
suppressPackageStartupMessages(library(htmltools))
suppressPackageStartupMessages(library(htmlwidgets))
suppressPackageStartupMessages(library(maptools))
suppressPackageStartupMessages(library(lubridate))
suppressPackageStartupMessages(library(oce))
suppressPackageStartupMessages(library(shinydashboard))
suppressPackageStartupMessages(library(ggplot2))
suppressPackageStartupMessages(library(plotly))
suppressPackageStartupMessages(library(leaflet.extras))
suppressPackageStartupMessages(library(shinybusy))
source('R/functions.R')
```

Workflow

- Interactive development on my laptop using Rstudio
- All changes tracked using git and github
  - Review all changes ever (>1200!)
  - Easily revert if something breaks
  - Share code across machines
  - Collaborate with anyone
- Live app is hosted on a cloud server (Linux virtual machine on Azure cloud) running free Shiny server



Questions?

Contact me:

hansen.johnson@dal.ca

More information:

WhaleMap publication: https://joss.theoj.org/papers/10.21105/joss.03094

Thank you!