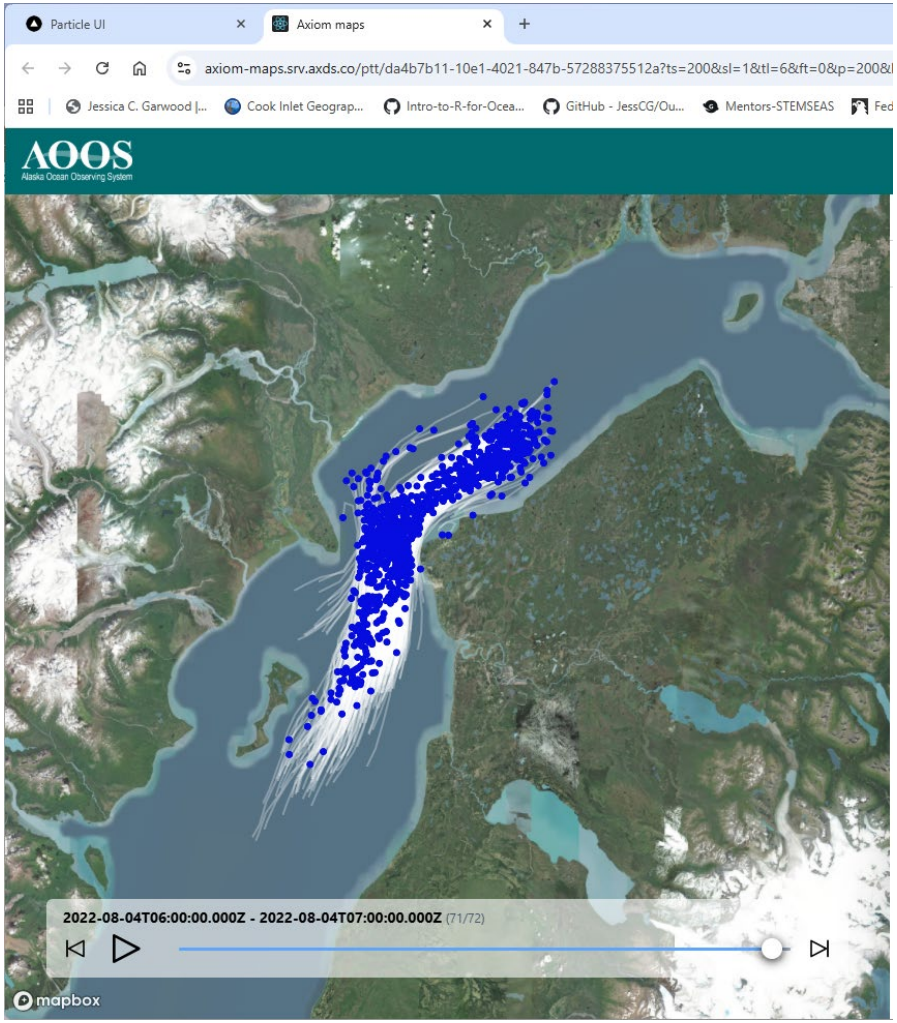
Cook Inlet ocean particle trajectory tool

Cook Inlet Harbor Safety Committee meeting October 22, 2026



Kris Holderied
NOAA Kasitsna Bay Laboratory
National Ocean Service (NOS)
National Centers for Coastal Ocean Science (NCCOS)

Carol Janzen
AOOS Alaska Ocean Observing System

Karina Khazmutdinova
Axiom DATA SCIENCE A TETRA TECH COMPANY
TETRA TECH

Scott Pegau
OSRI OIL SPILL RECOVERY INSTITUTE CORDOVA, ALASKA

Sue Saupe
CIRCAC

Funding & Operational modeling

IOOS Integrated Ocean Observing System

TIDES & CURRENTS
Office of Coast Survey

Cook Inlet Ocean Model Projects: Overview

AOOS-led Particle trajectory tool

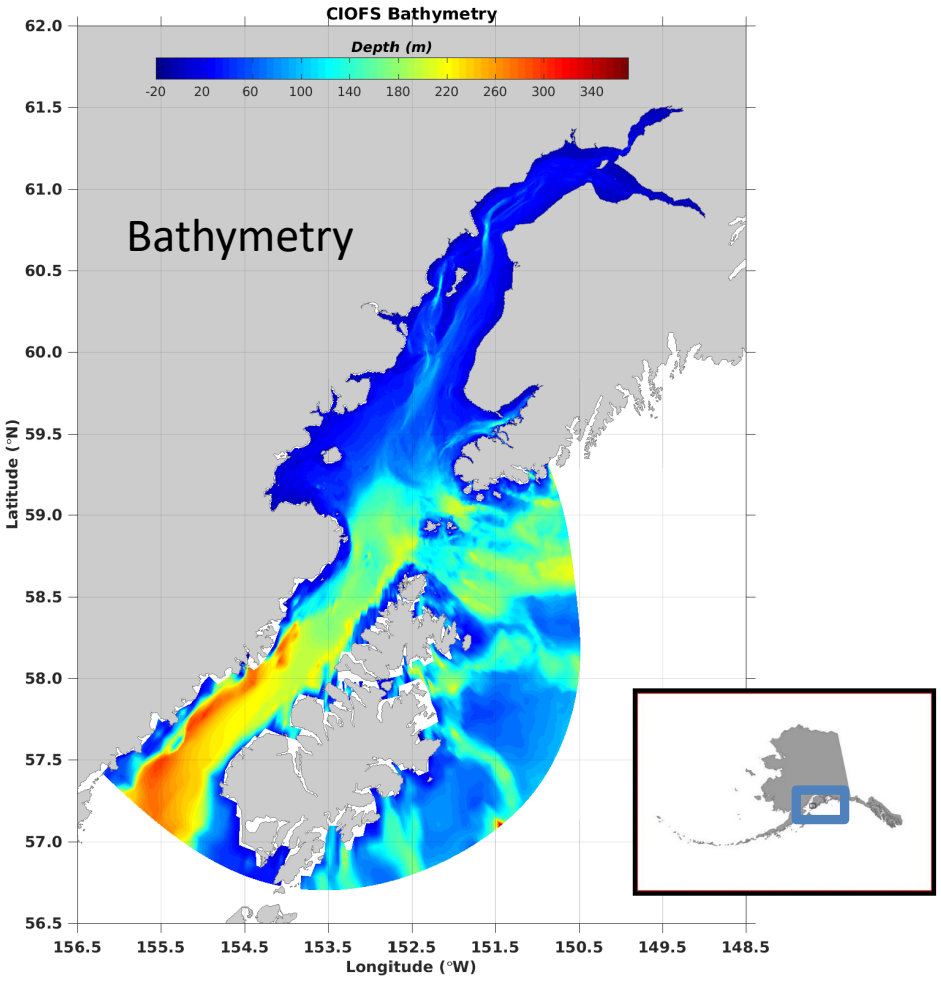
- NOAA IOOS Ocean Tech Transfer (OTT) grant – 2024-2026
- AOOS, Axiom (TetraTech), NOAA Kasitsna Bay Lab, OSRI, CIRCAC team
- User-friendly, on-line service for a wide variety of users
- 3 model options: CIOFS operational, CIOFS3 freshwater hindcast, UAF NWGOA

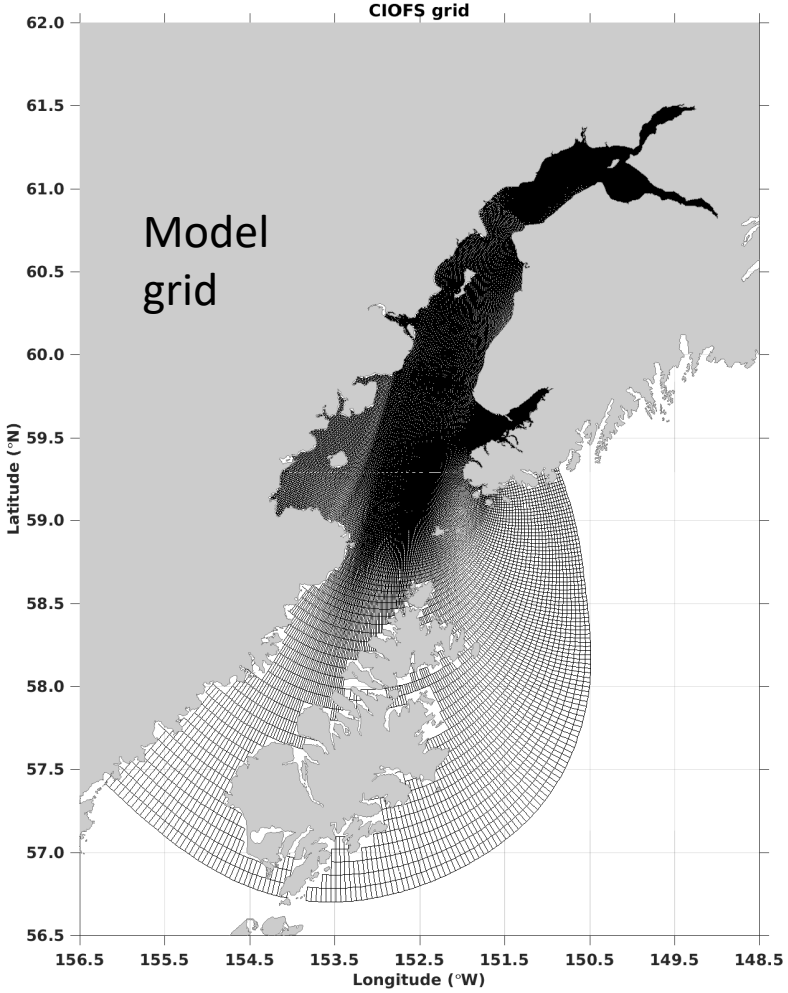
NOAA Kasitsna Bay Lab/Axiom Cook Inlet hindcast

- 4-year project to create retrospective 3-D Cook Inlet ocean hindcast, using the operational NOAA Cook Inlet Operational Forecast System (CIOFS)
- Developed/evaluated with many ocean obs (KBL, CIRCAC, OSRI, KBNERR, UAF)
- New CIOFS3 ocean hindcast (1999-2024), with better freshwater forcing
- Support oil spill response planning, resource management, research, etc.

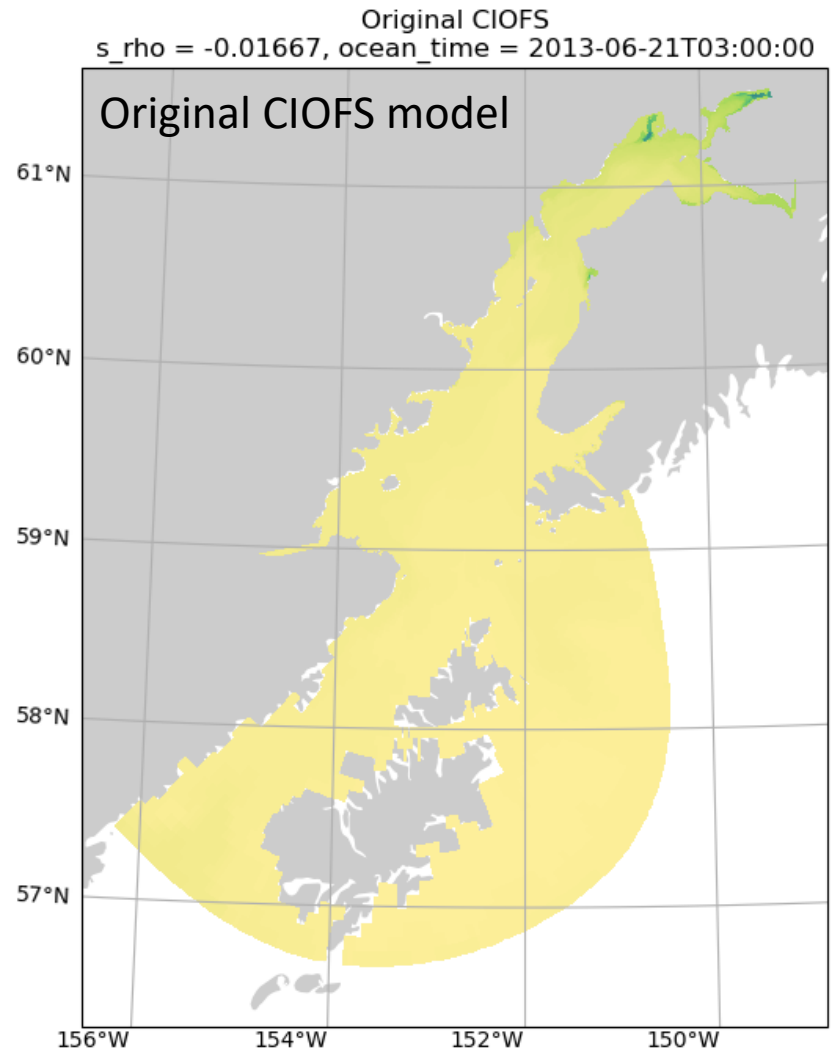
Cook Inlet Operational Forecast System (CIOFS)

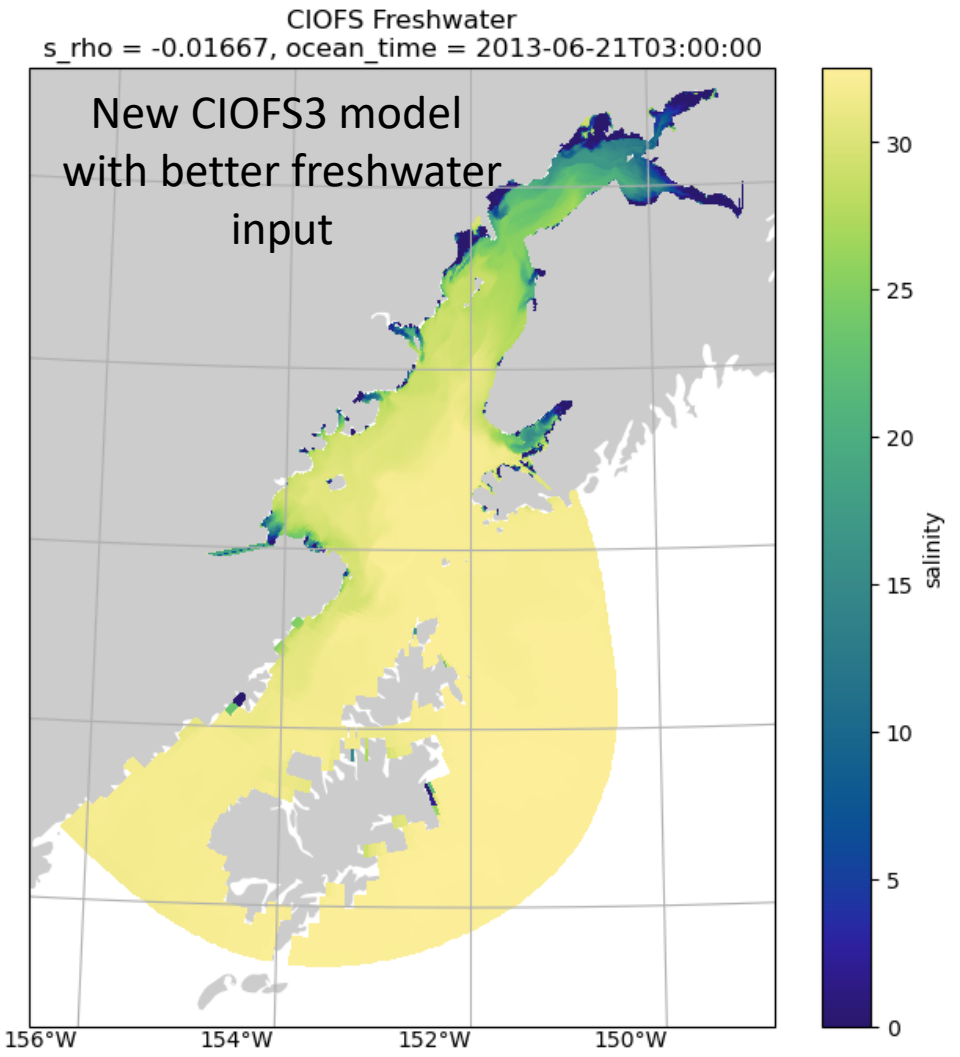
- NOAA National Ocean Service (NOS) ocean model
- Operational: Nowcasts & 48 hr forecasts; 10m to 3.5km horizonal resolution
- NEW 26-year retrospective hindcast (1999-2024) with improved freshwater inputs





Why improve freshwater forcing? Better surface layer salinity





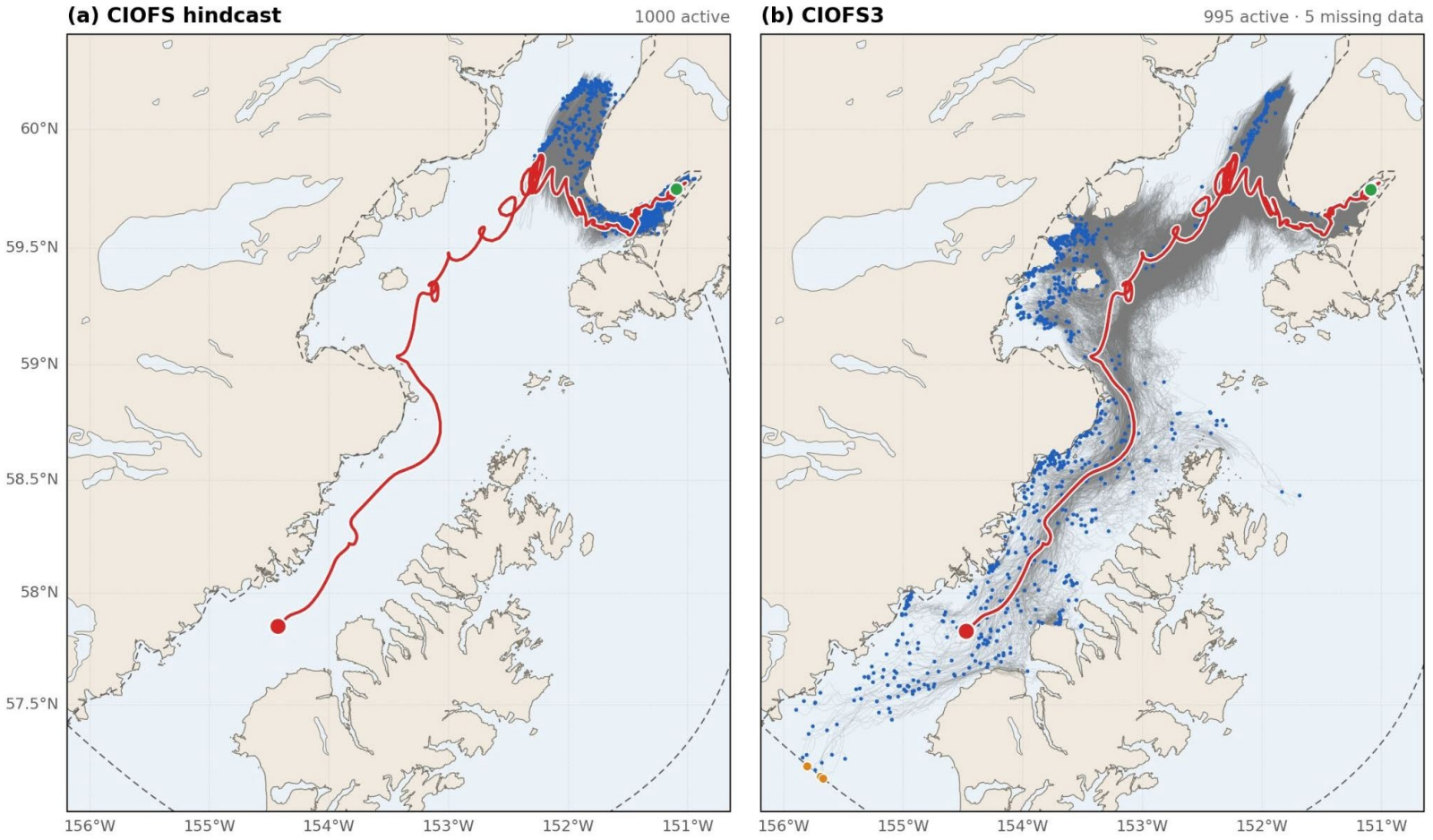
Freshwater from gauged streams:
Not many in Cook Inlet!

Freshwater from watershed runoff:
streams, precipitation, snowpack observations

Why improve freshwater forcing? Better subtidal ocean currents

Original CIOFS model

CIOFS3 model with better freshwater input



Aug 2013, 1000 particles, released within 500 m of the drifter buoy start in Kachemak Bay

Red line: Drifter buoy track (Microstar, 1 m depth)

Blue dots: End points of trajectory simulation

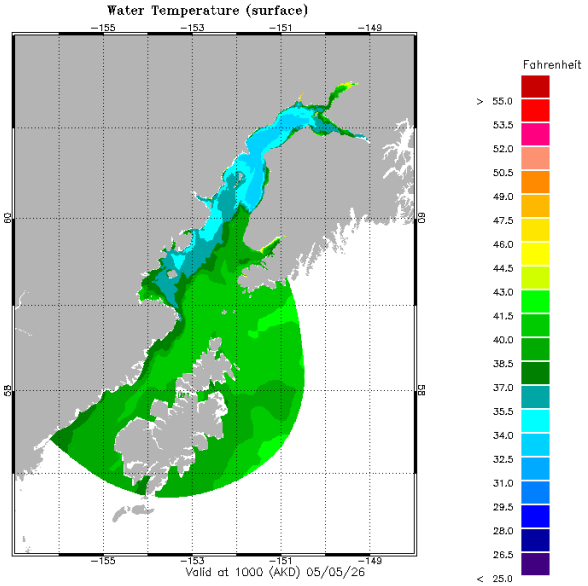
Gray lines: Simulated trajectory tracks

Particle trajectory tool: 3-D model options

CIOFS operational

48-hr forecasts

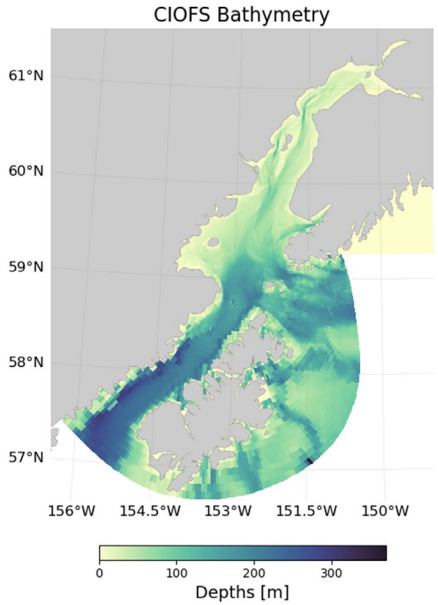
Nowcasts: 2021 to present



- NOAA model outputs hosted in AOOS data system
- Freshwater from streams

CIOFS3

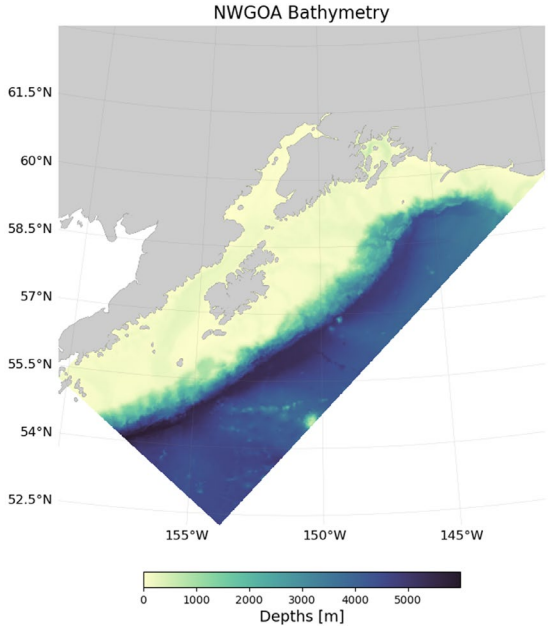
1999-2024 hindcast



- Same CIOFS grid
- Freshwater from watershed runoff

UAF NW Gulf of AK

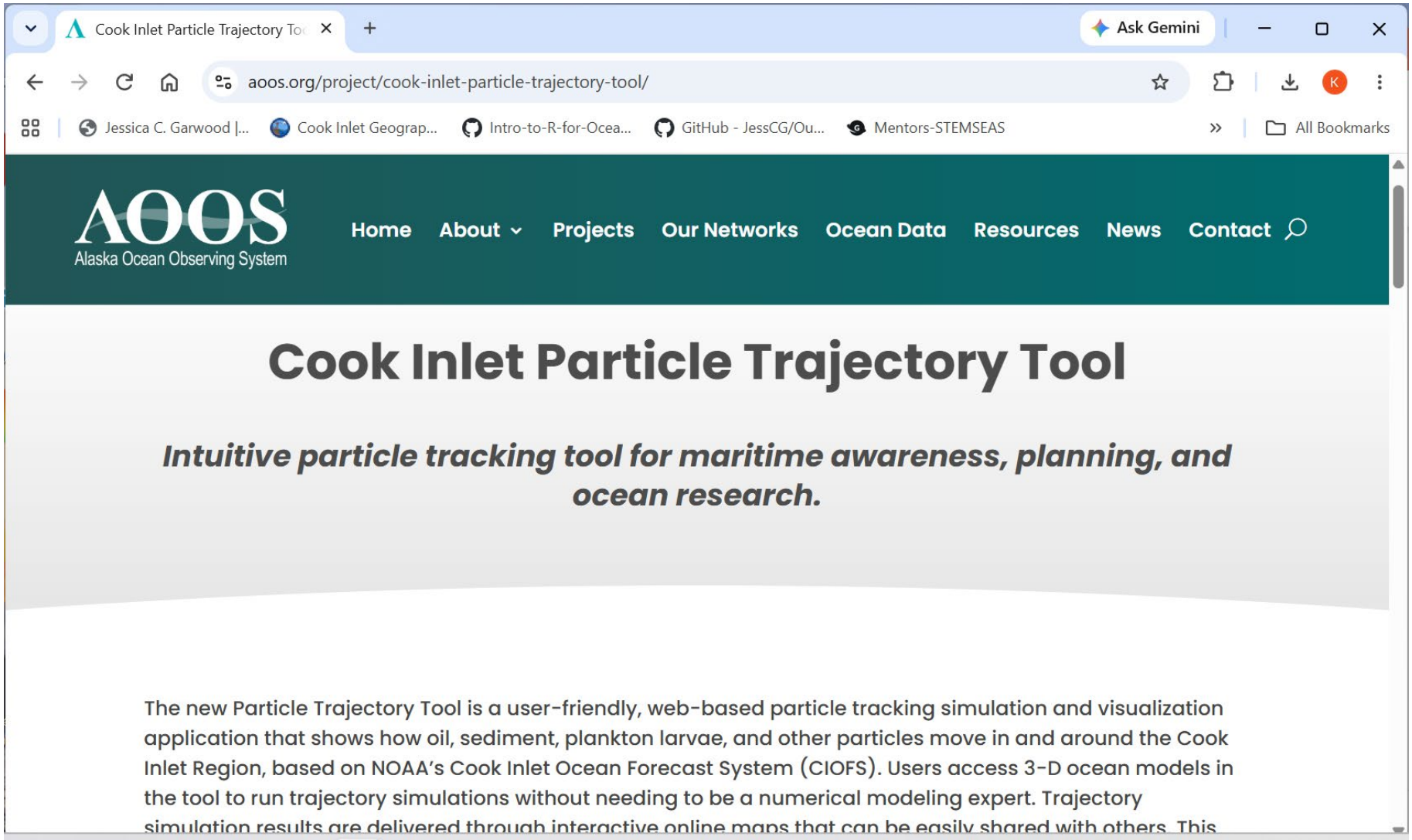
1999-2008 hindcast



- Lower spatial resolution
- Freshwater from watershed runoff

Particle trajectory tool hosted on AOOS website

- Users create an account to save and share results online
- Tool leverages AOOS cyberinfrastructure
- More info: aoos.org/project/cook-inlet-particle-trajectory-tool/



Particle trajectory tool results

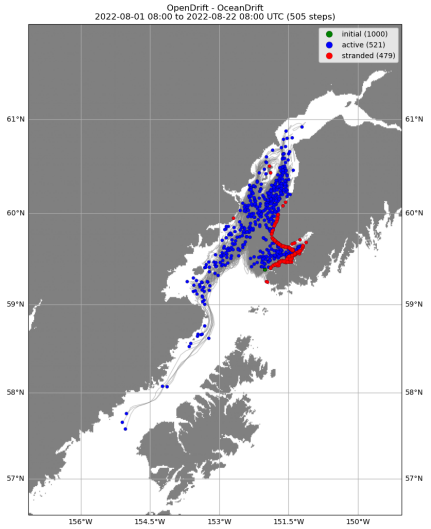
Output interactive map animations and plots can be shared as links & graphics

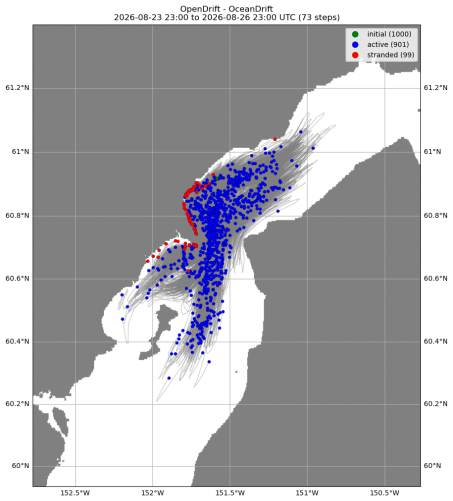
Nanwalek, Cook Inlet. 15 m depth release, 1000 particles, Aug 2022, 21 days
(CIOFS3 model hindcast)

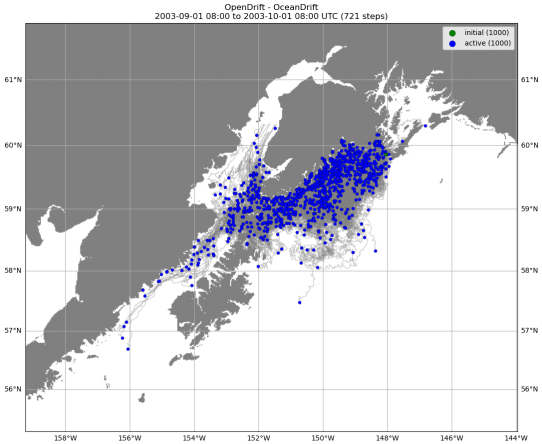
Trading Bay, Cook Inlet. Surface release, 1000 particles, Aug 2026, 72 hrs
(CIOFS operational model nowcast/forecast)

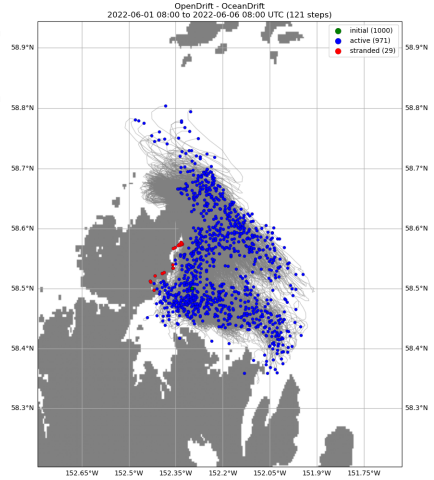
Montague entrance, Prince William Sound. Surface release, 1000 particles, Sep 2003, 30 days
(UAF NWGOA hindcast)

NE Kodiak. Bottom release (HAB cysts), 1000 particles, Jun 2022, 72 hrs
(UAF NWGOA hindcast)









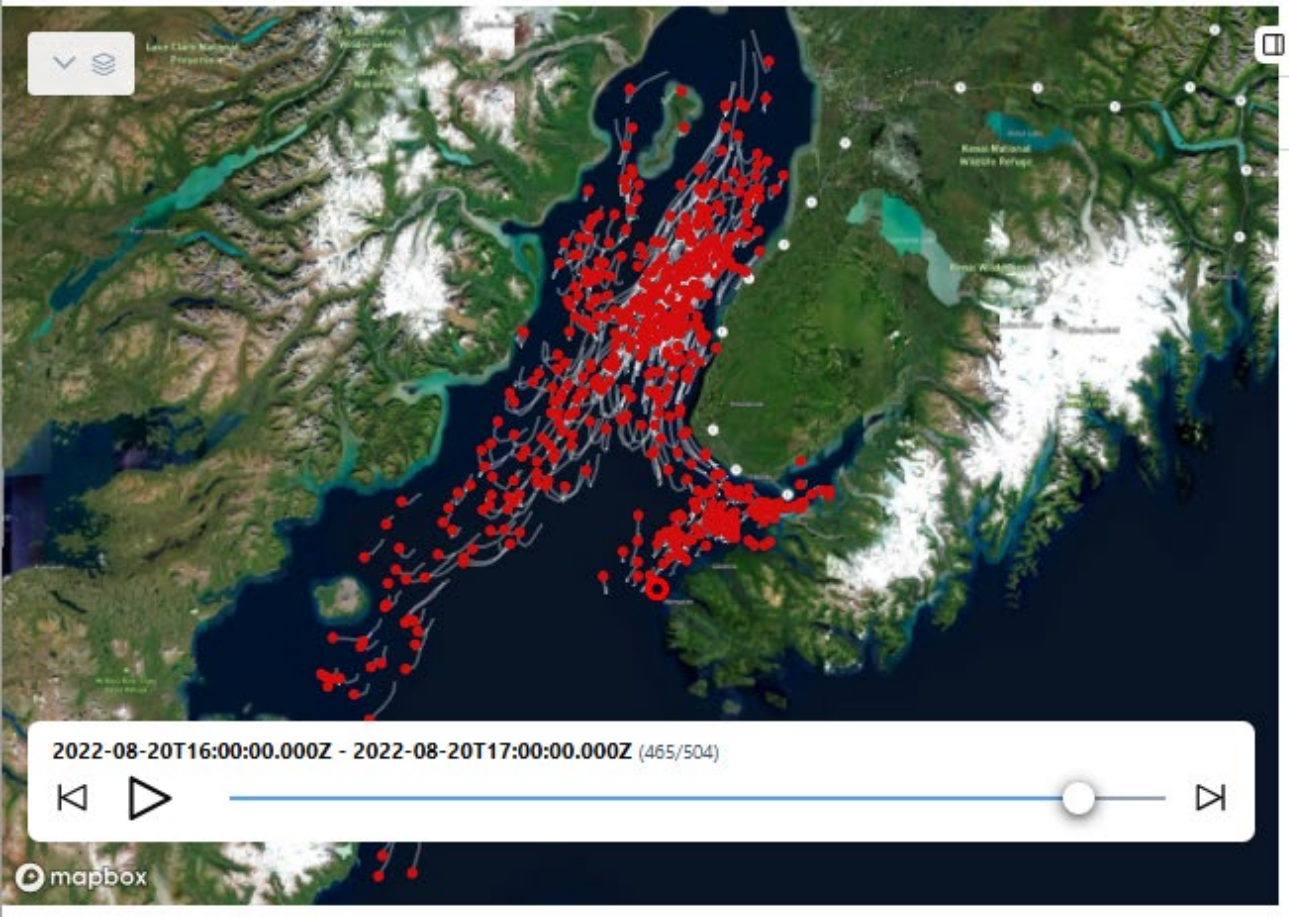
Particle U | Particle U | Axiom m | Axiom m | Particle U | Ask Gemini
particle-ui.srv.axds.co/public/simulation/670ca04f-3374-42a9-b827-1e5337a8cd08...
Jessica C. Garwood |... | Cook Inlet Geograp... | Intro-to-R-for-Ocea... | GitHub - JessCG/Ou... | All Bookmarks

AOOS
Alaska Ocean Observing System

3D Particle Tracking: Off Nanwalek, 1000 particles, 15m depth, 21days

Duration: 21 days

Interactive Map | Plots | Details



Charts | Layers | **Settings**

Trajectory display | Animation

Tail Length (hr) 6

☐ Show Full Tail

Map tail opacity 0.3

Dot color | Dot stroke | Tail color

Dot color variable

Select one

☐ Show map dot stroke

Map dot size (px) 4

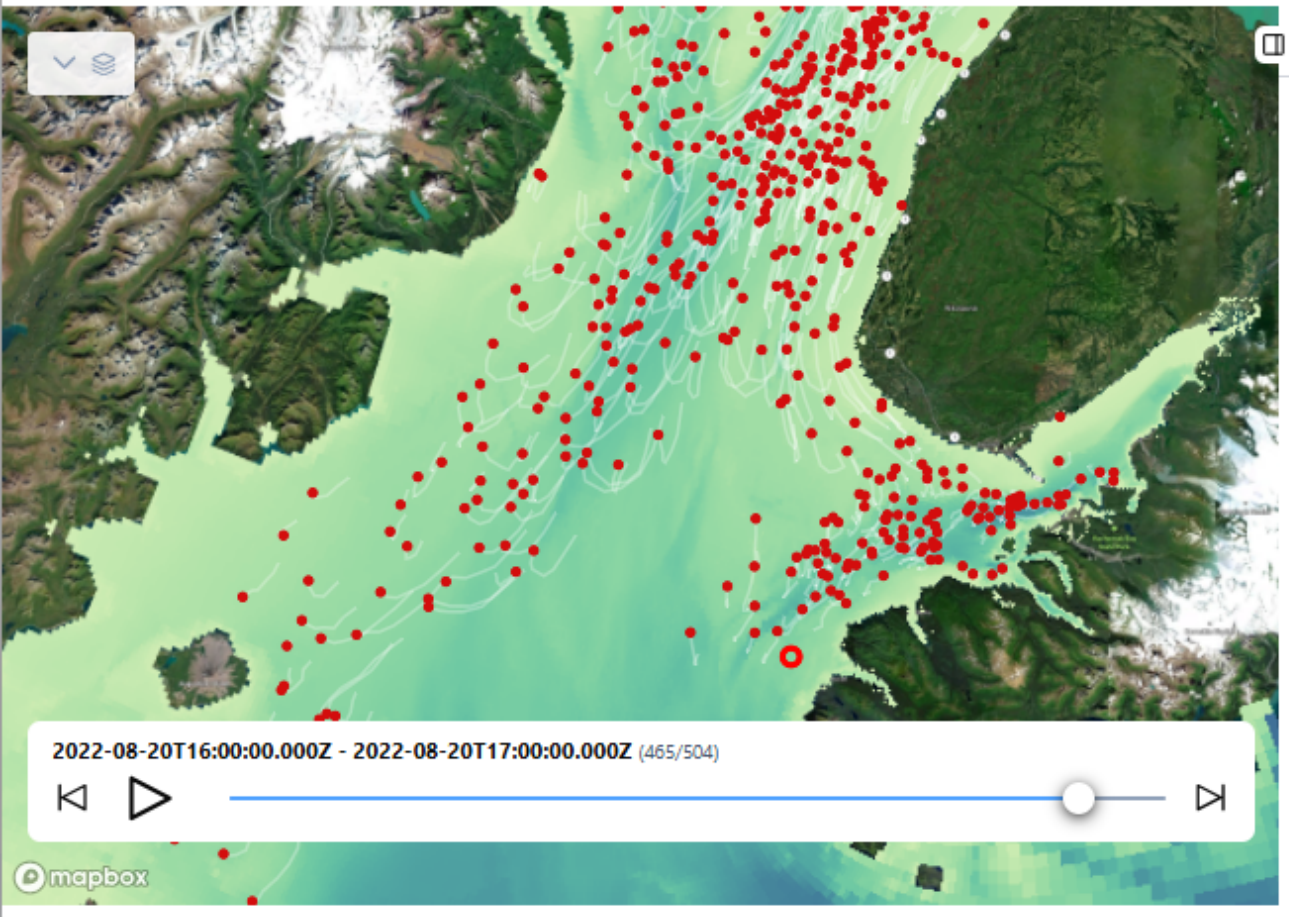
Particle U | Particle U | Axiom m | Axiom m | Particle U | Ask Gemini
particle-ui.srv.axds.co/public/simulation/670ca04f-3374-42a9-b827-1e5337a8cd08...
Jessica C. Garwood |... | Cook Inlet Geograp... | Intro-to-R-for-Ocea... | GitHub - JessCG/Ou... | All Bookmarks

AOOS
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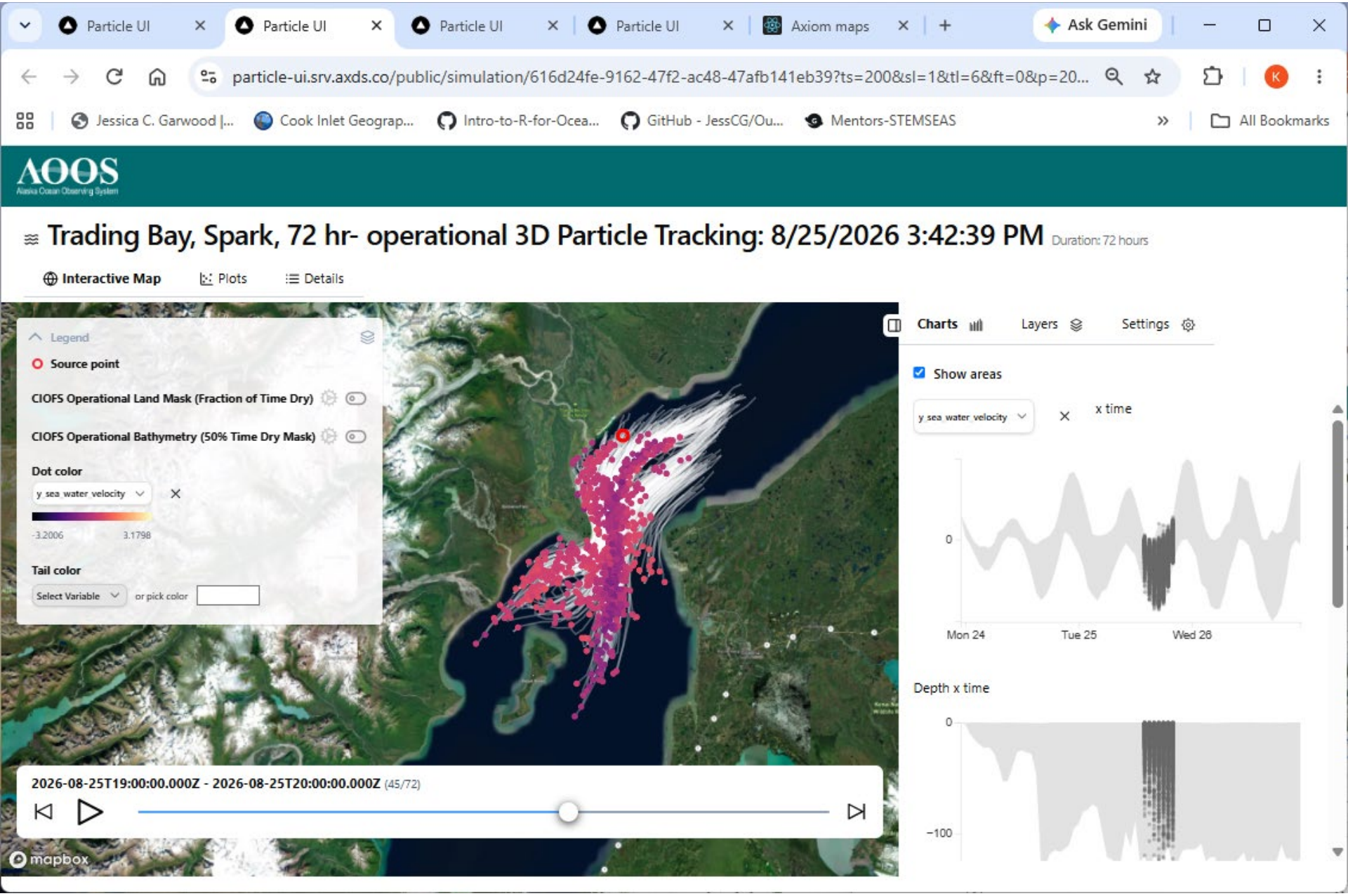
Interactive Map | Plots | Details



Charts | Layers | Settings

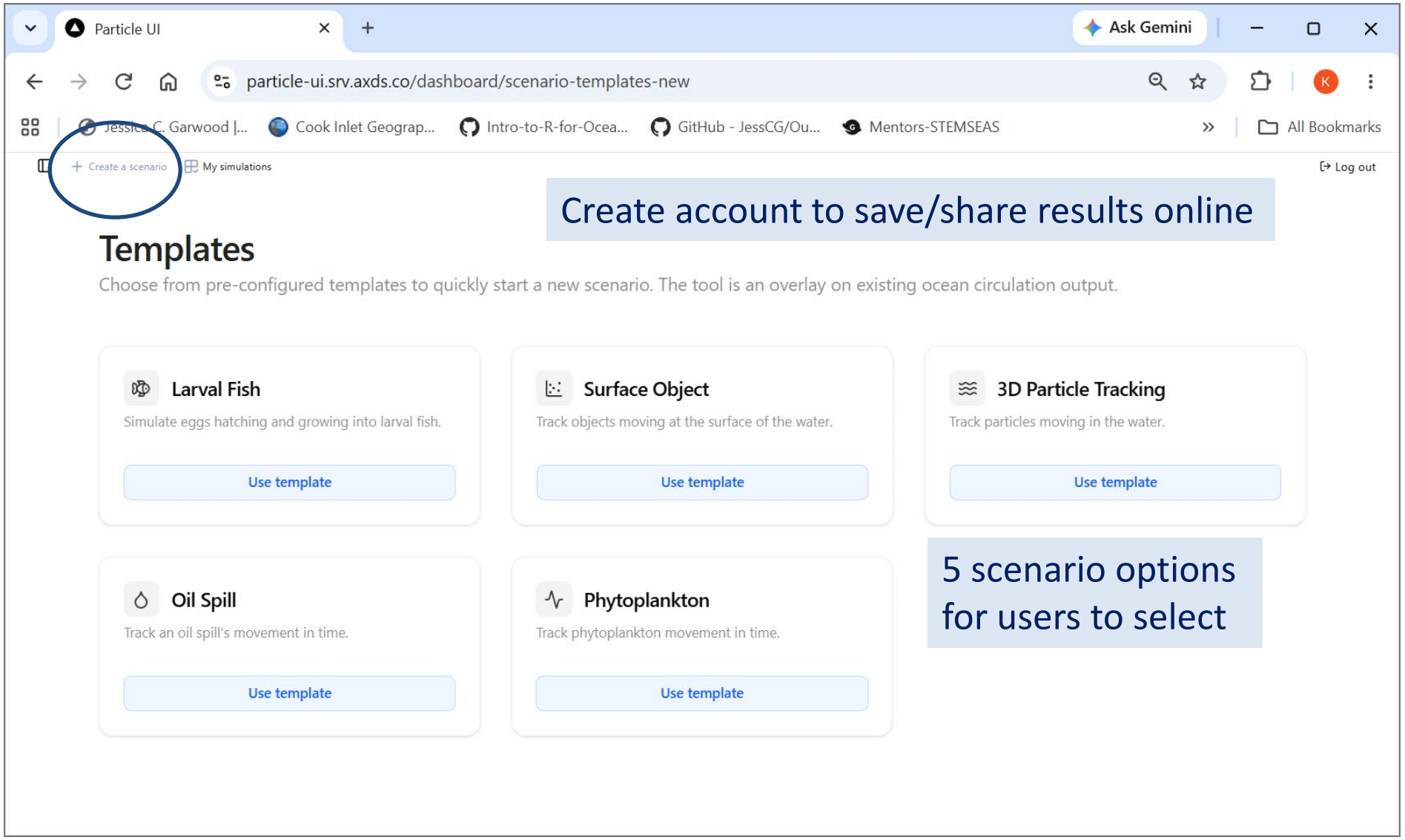
- Blue Mussels (Alaska Shorezone)
- Barnacles (Alaska Shorezone)
- Pacific Herring Spawning Areas
- Herring Spawn (Kamishak Bay, Alaska [1978-2001])
- CIOFS3 Land Mask (Fraction of Time Dry)
- CIOFS3 Bathymetry (50% Time Dry Mask)
- NWGOA Land Mask (Fraction of Time Dry)
- NWGOA Bathymetry (50% Time Dry Mask)
- CIOFS Operational Land Mask (Fraction of Time Dry)
- CIOFS Operational Bathymetry (50% Time Dry Mask)

Visualization options: water velocity example

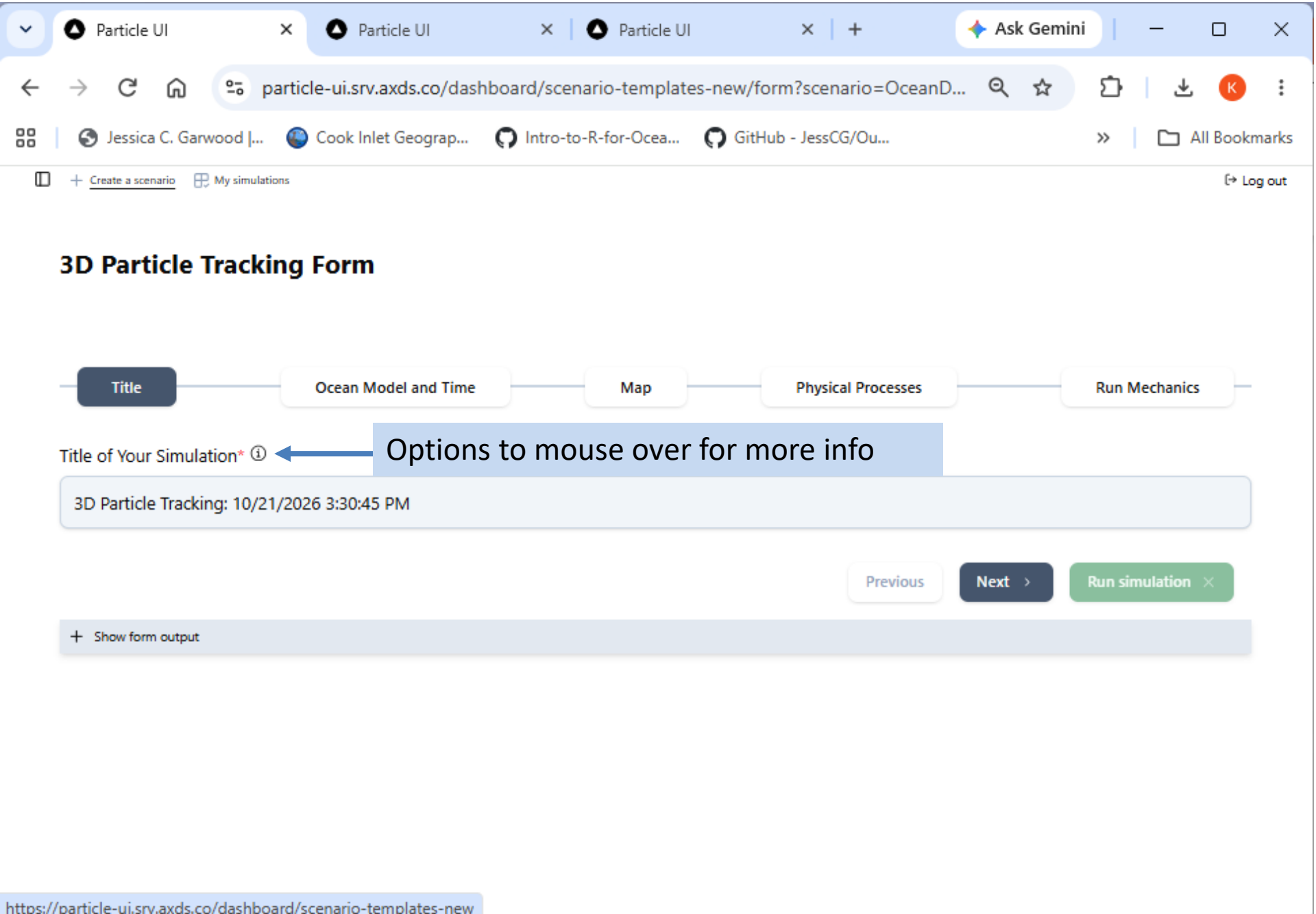


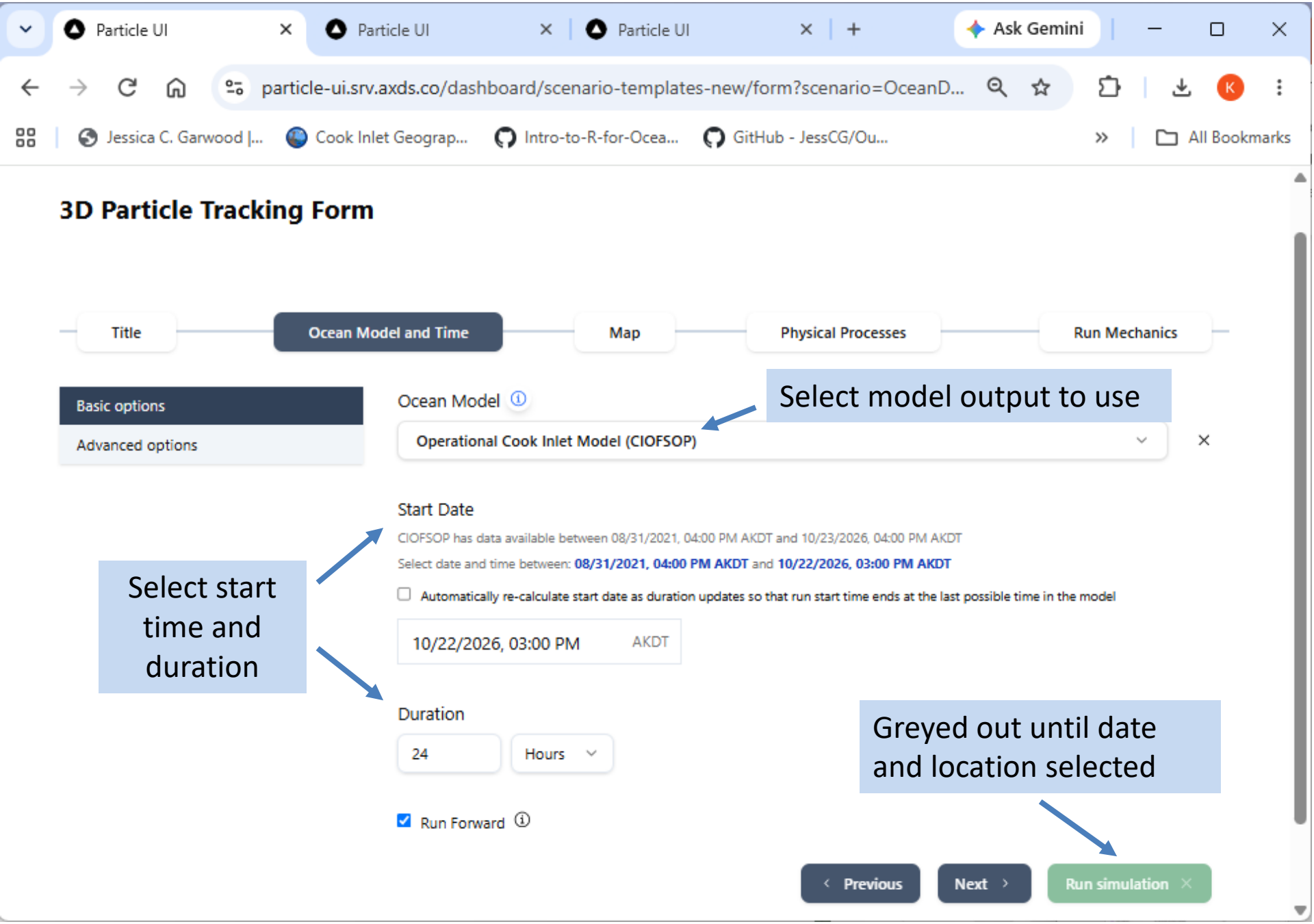
Particle trajectory tool: Running simulations

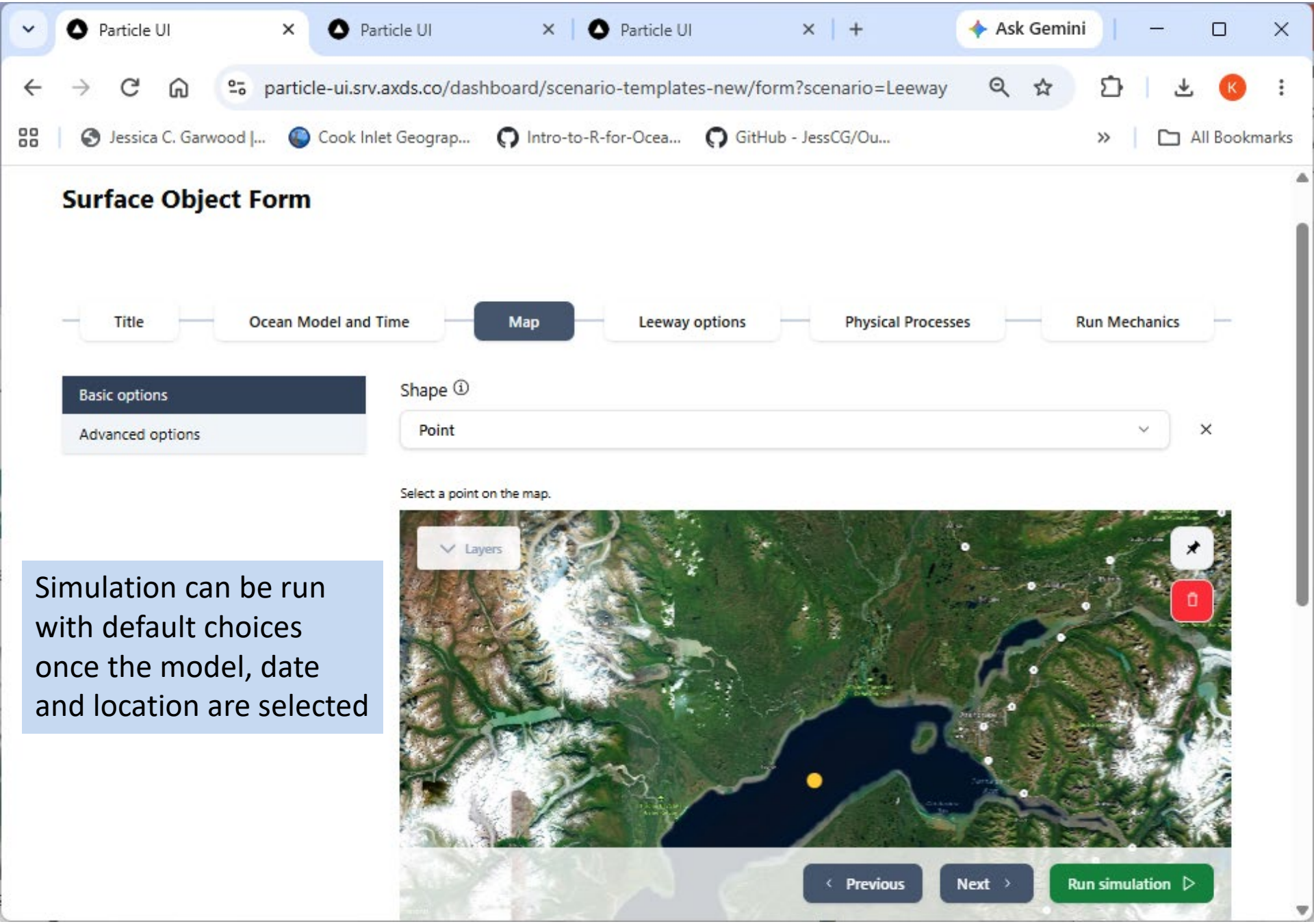
On AOOS website: https://aoos.org/project/cook-inlet-particle-trajectory-tool/



3D Particle tracking scenario

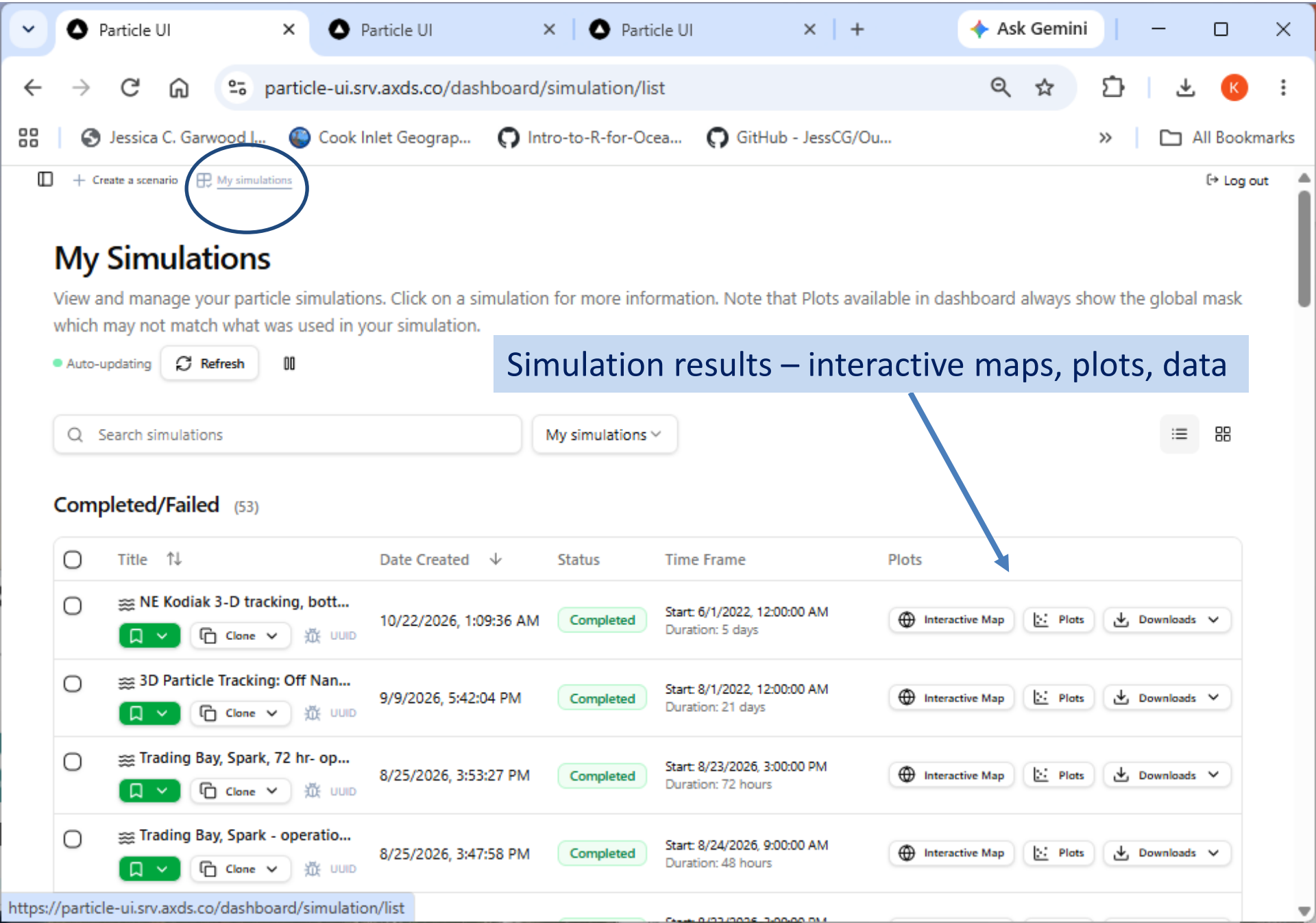



Particle UI
Particle UI
Particle UI
Ask Gemini
particle-ui.srv.axds.co/dashboard/scenario-templates-new/form?scenario=OceanD...
Jessica C. Garwood |...
Cook Inlet Geograp...
Intro-to-R-for-Ocea...
GitHub - JessCG/Ou...
All Bookmarks
3D Particle Tracking Form
Title
Ocean Model and Time
Map
Physical Processes
Run Mechanics
Basic options
Advanced options
Ocean Model
Select model output to use
Operational Cook Inlet Model (CIOFSOP)
Start Date
CIOFSOP has data available between 08/31/2021, 04:00 PM AKDT and 10/23/2026, 04:00 PM AKDT
Select date and time between: 08/31/2021, 04:00 PM AKDT and 10/22/2026, 03:00 PM AKDT
Automatically re-calculate start date as duration updates so that run start time ends at the last possible time in the model
10/22/2026, 03:00 PM
AKDT
Select start time and duration
Duration
24
Hours
Run Forward
Greyed out until date and location selected
Previous
Next
Run simulation



Simulation can be run with default choices once the model, date and location are selected

Saving and sharing trajectory simulation results



Particle UI | Particle UI | Particle UI | Particle UI | Ask Gemini

particle-ui.srv.axds.co/dashboard/simulation/616d24fe-9162-47f2-ac48-47afb141eb39/...

Jessica C. Garwood |... | Cook Inlet Geograp... | Intro-to-R-for-Ocea... | GitHub - JessCG/Ou... | All Bookmarks

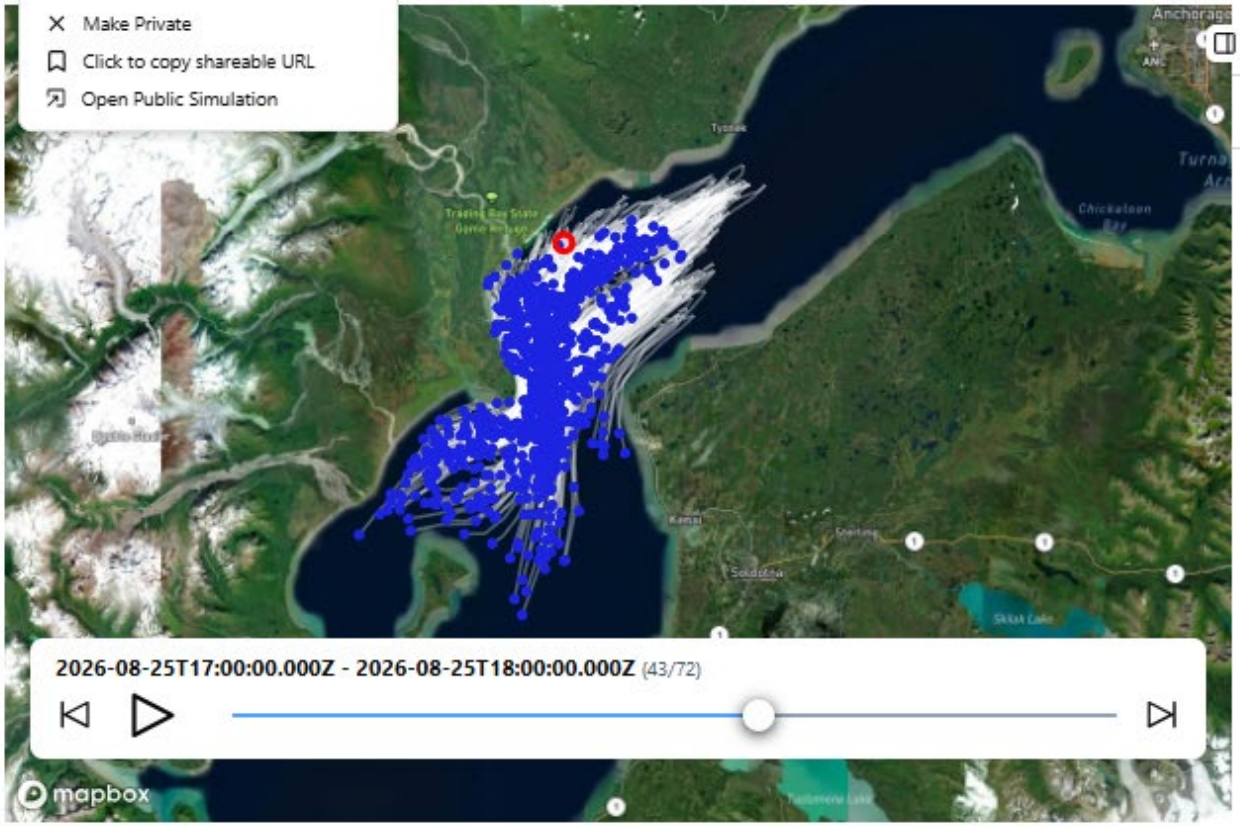
Create a scenario | My simulations | Log out

Trading Bay, Spark, 72 hr- operational 3D Particle Tracking: 8/25/2026 3:42:39 PM

Duration: 72 hours | Completed

Downloads | Clone | UUID

- Make Private
- Click to copy shareable URL
- Open Public Simulation



Charts | Layers | Settings

Trajectory display | Animation

Tail Length (hr) 6

Show Full Tail

Map tail opacity 0.3

Dot color | Dot stroke | Tail color

Dot color variable

Select one

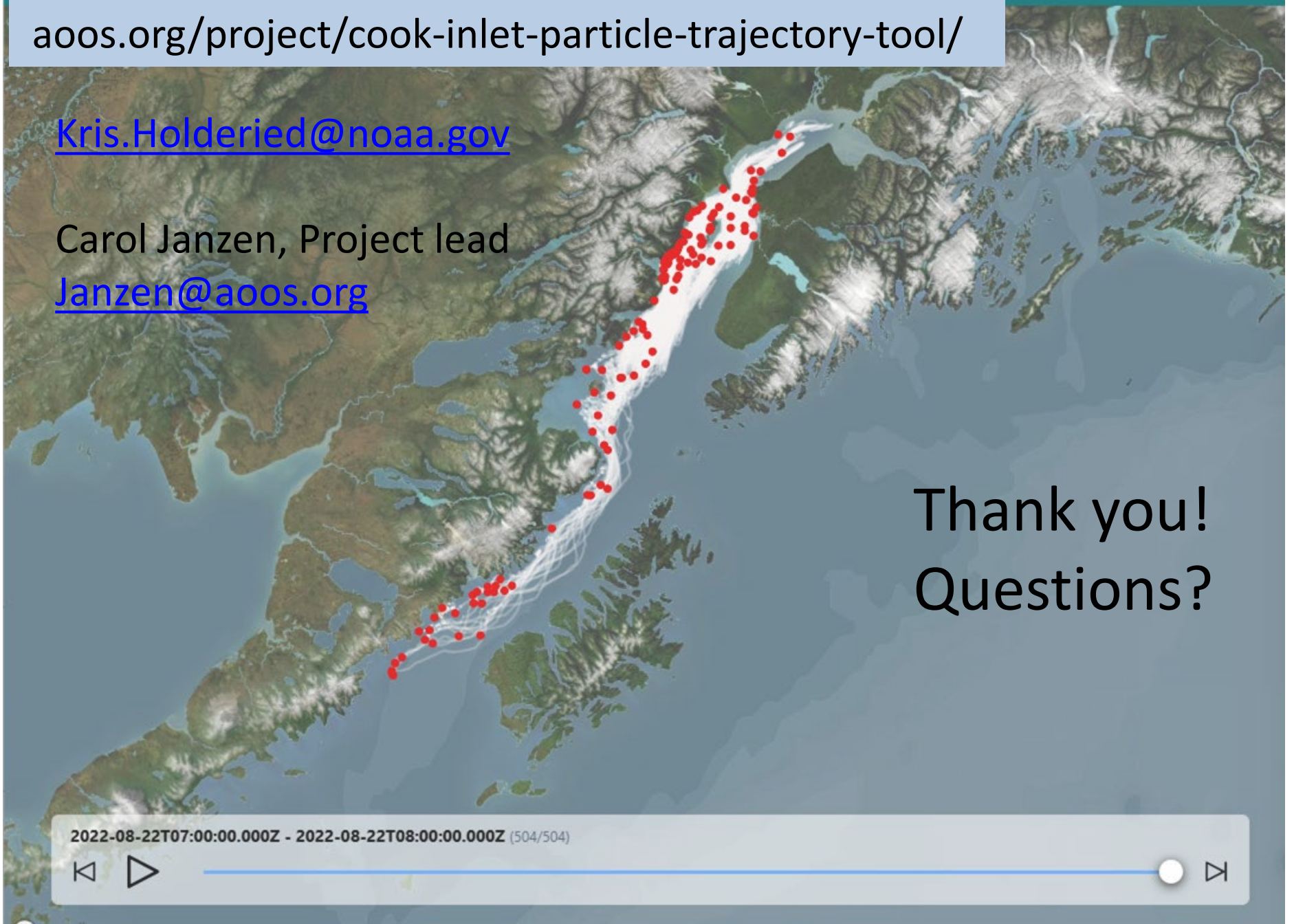
Show map dot stroke

AOOS
Alaska Ocean Observing System

aoos.org/project/cook-inlet-particle-trajectory-tool/

Kris.Holderied@noaa.gov

Carol Janzen, Project lead
Janzen@aoos.org



Thank you!
Questions?