

# Global Fish Tracking System (GFTS): Harnessing Technological Innovations for Conservation and Sustainable Resource Management

Quentin Mazouni<sup>1</sup>, Anne Fouilloux<sup>1</sup>, Benjamin Ragan-Kelley<sup>1</sup>, Daniel Wiesmann<sup>2</sup>,  
Emmanuelle Autret<sup>3</sup>, Mathieu Woillez<sup>4</sup>, and Tina Odaka<sup>3</sup>

<sup>1</sup> Simula Research Laboratory, Oslo, Norway

<sup>2</sup> Development Seed, Lisbon, Portugal

<sup>3</sup> LOPS (Laboratory for Ocean Physics and Satellite remote sensing), UMR 6523, Univ Brest-Ifremer-CNRS-IRD, Plouzané, France

<sup>4</sup> DECOD (Ecosystem Dynamics and Sustainability), IFREMER-Institut Agro-INRAE, Plouzané, France



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Destination Earth

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Please click following for the  
version with video

<https://docs.google.com/presentation/d/1d1pBnLzamsysFi5uDyFLTzlaNKOmq1uRWiuuBVI7S9E/edit?usp=sharing>

# Destination Earth in a nutshell




**DESTINATION EARTH**

**A DIGITAL REPLICA OF OUR PLANET**

Destination Earth (DestinE) aims to develop a highly accurate digital model of Earth to monitor the effects of natural and human activity on our planet, anticipate extreme events and adapt policies to climate-related challenges.






 **Destination Earth**

Home Services Onboarding Updates About Support

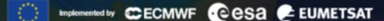
1 month of DestinE Climate DT (2025)

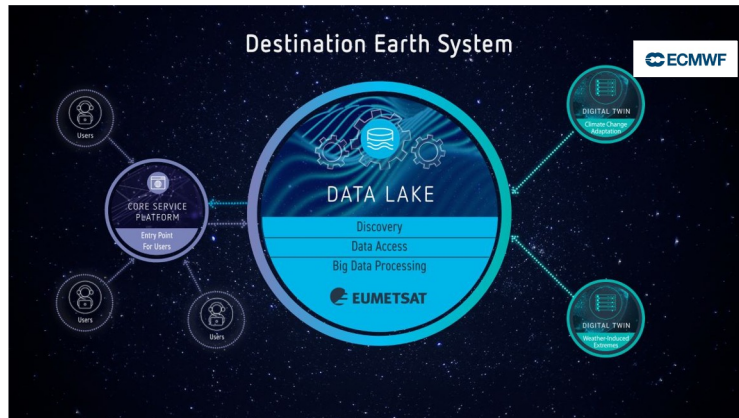
 **DestinE Platform**


Your gateway to a sustainable future

A unique ecosystem of services harnessing the power of Destination Earth.

**19**  
Services already available  
[Explore](#)

**Destination Earth** 



 **Destination Earth**

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**Use Cases Catalogue**

Discover the first set of selected End-to-End Use Cases in the DestinE Catalogue!

Each Use Case demonstrates the capabilities of the DestinE infrastructure to provide actionable information and decision support to its end users.

Search

1 results found

Organisation


Topic

☒ Fishery Management (1)


Scale

[Clear filters](#)

Topic: Fishery Management X

 **Global Fish Tracking System (GFTS)**

Helping to obtain accurate insights into fish population policies.

Procured by: 

**Global Fish Tracking System (GFTS)**

 **DestinE Platform**

Your gateway to a sustainable future

A unique ecosystem of services harnessing the power of Destination Earth.



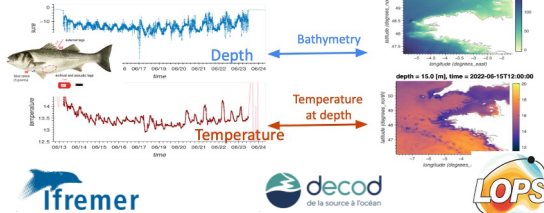
# GFTS Overview

Understanding fish migration is crucial for marine conservation, and for filling gaps in knowledge about fish habitats and spatial structure as highlighted by International Council for the Exploration of the Sea (ICES).

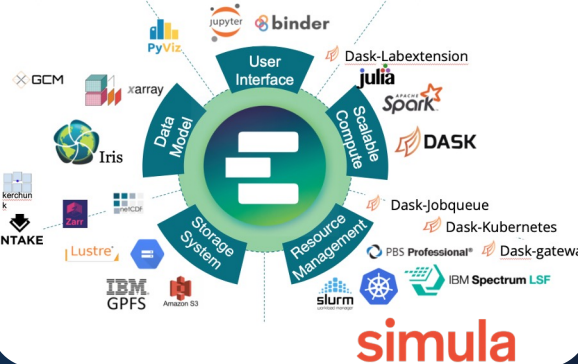
## Fish track modeling

Bio-logging data

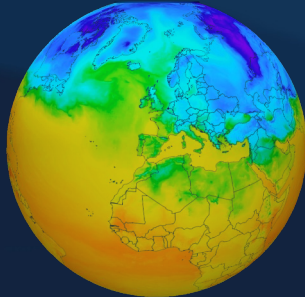
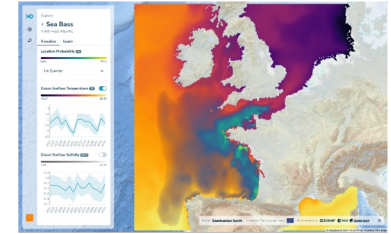
Earth science data



## Pangeo infrastructure



## Visualisation & Decision tool



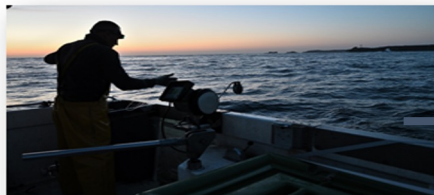
Fish tracking modeling helps understand fish movements. Our goal is to leverage DestinE's Climate Adaptation Digital Twin for environmental monitoring and conservation policy.





# Bio-Logging

**Fish capture**



**Stabulation, then anesthetize the fish**



**Implant the acoustic tag + Data Storage Tag (DST)**



**Fish release**



**Waking and housing fish**



**50€ or 100€ COMPENSATION\***

## Sea Bass & Pollack tagging

Blue tattoo (3 points)

Acoustic tag + Data Storage Tag

*If you find a tagged sea bass or a tagged pollack, note the date and the location of the recapture, the weight and the length of the fish and the tag's numbers.*

➡ Contact Ifremer :

merl@ifremer.fr  
Tel. +33 685 627 688  
<https://fishintel.ifremer.fr>

**Ifremer**

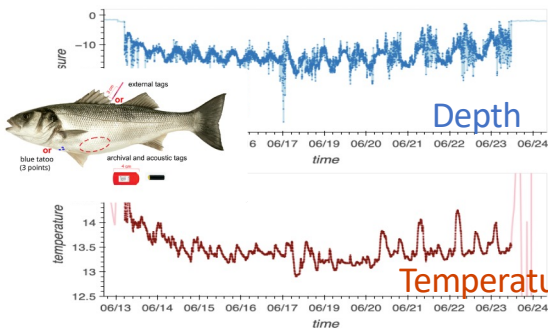
(\*) : 50€ tags only, 100€ tags + fish

**FISH INTEL** **Interreg** France ( Channel ) England

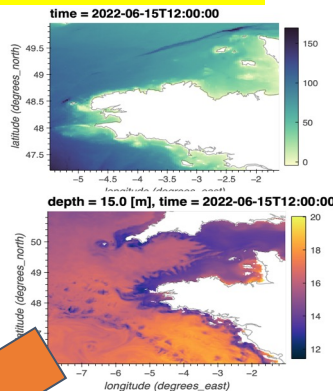
**Data Storage Tag:** Store time series of observed temperature, depth in a tag.  
**Acoustic Tag:** tag emits signal, detect tagged fish using acoustic telemetry network  
**Combine both approaches together with earth science data:** Infer fish trajectory from individual environmental data histories using geolocation models

# Pangeo-fish: Fish Tracking Modeling

## Bio-Logging data



## Earth science data



## Model: *Hidden Markov Method*

Geolocation model developed by Woillez et al. (2016), temperature and bathymetry as reference fields, adapted from Pedersen et al. (2008)

### Constraints:

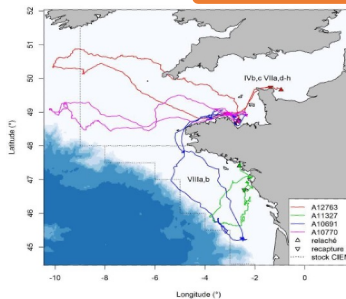
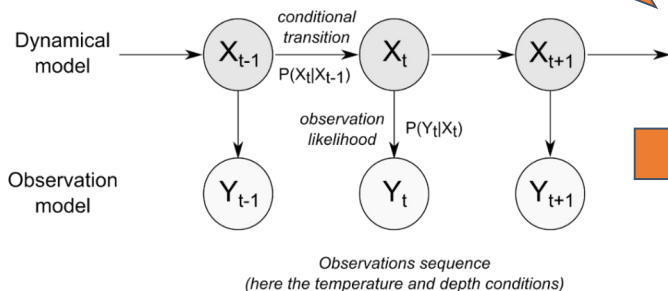
- acoustic detection,
- bathymetry
- release location
- recapture location



**Likelihood of Observed Temperature at depth by fish from *earth science data***

## Hidden Markov Method

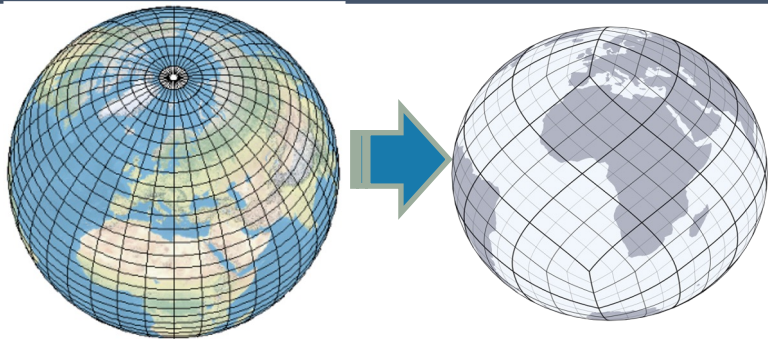
Hidden states sequence  
(here the daily fish positions)



Quality and resolution (both spatial and temporal) of Earth science data, such as sea temperature, are crucial for accurate track reconstruction.



# What/why HEALPix??



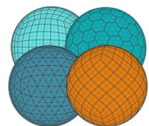
HEALPix is a type of DGGS

“A Discrete Global Grid System (DGGS) is a spatial reference system that uses a **hierarchical** tessellation of cells to partition and address the globe.” OGC Abstract Specification, 2017



**Equal Area**, Seamless Global Coverage, and Multi-Scale.  
Expand possible fish tracking system to global application!!!

**xdggs** : easily access, process, and visualise DestinE's ClimateDT/ pangeo-fish in HEALPix



xdggs



```
[20]: test_plot.dggs.explore(center=0, cmap="ocean", alpha=0.5)
```

```
[20]:
```





# Infrastructure for the GFTS

- **JupyterHub with Dask Gateway** based on the [Pangeo ecosystem](#) has been deployed on OVH for fish track modeling.
- **Development and deployment of [kbatch](#) [papermill](#)** to provide scientists with an easy-to-use interface (Jupyter Notebooks) for scaling fish track modeling. This tool enables users to submit parameterized notebooks as jobs using [papermill](#) and [kbatch](#) on Kubernetes cloud infrastructure
- **Pre-processing Climate Digital Twin (DT) data into Zarr** format to retain the native Healpix grid for the area of interest.
- **Creates virtual Zarr stores** for cloud-friendly access to archival data, using [Virtualizarr](#).
- **A s3-bucket for storing and sharing reconstructed fish tracks** to prepare future interfacing with the [European Tracking Network \(ETN\)](#) on [EDITO](#) ([European Digital Twin Ocean](#))-Infra.



**PANGEO**



kbatch

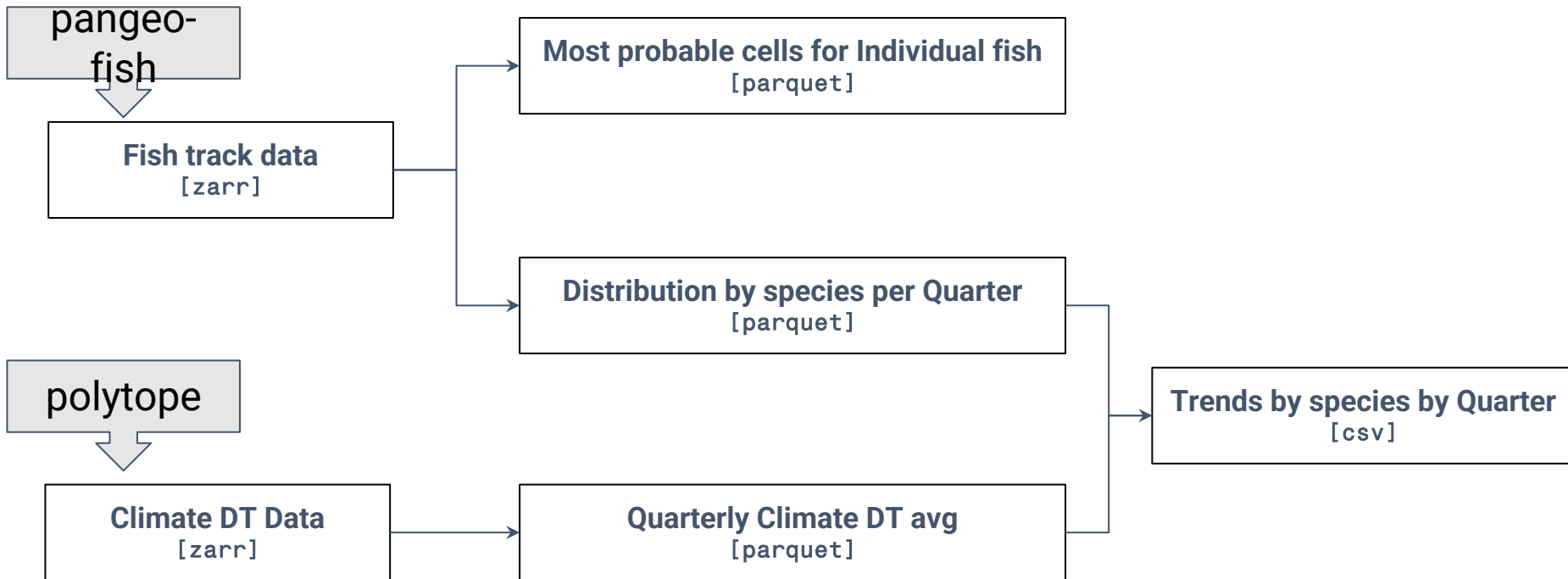


**Zarr**





# Preparing for Decision support tool



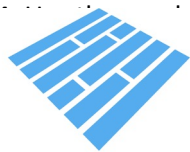
Data for computation

Data ready for Visualisation

# Rendering Healpix in JS

**For GFTS, we developed software to render raw healpix data directly in JS applications**

1. Read the data from the parquet files into javascript objects
2. Use the healpix js package to convert the data to lat/lon polygons
3. Use the deckgl package to handle the rendering of the data
4. Use the mapbox-gl package to display the data



Parquet

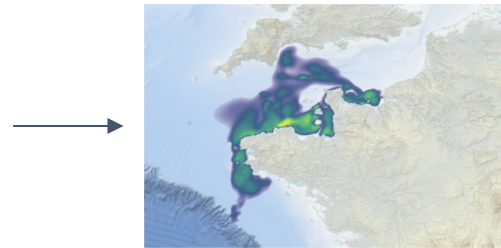
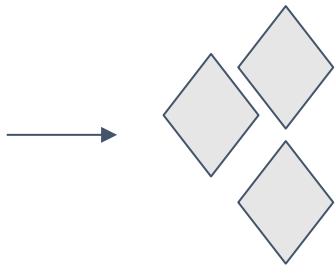
@hscmap/healpix 



deck.gl

Mapbox GL JS

Healpix ID	Probability
2342344	12.5
2342344	10.2
2342344	14.0
...	...



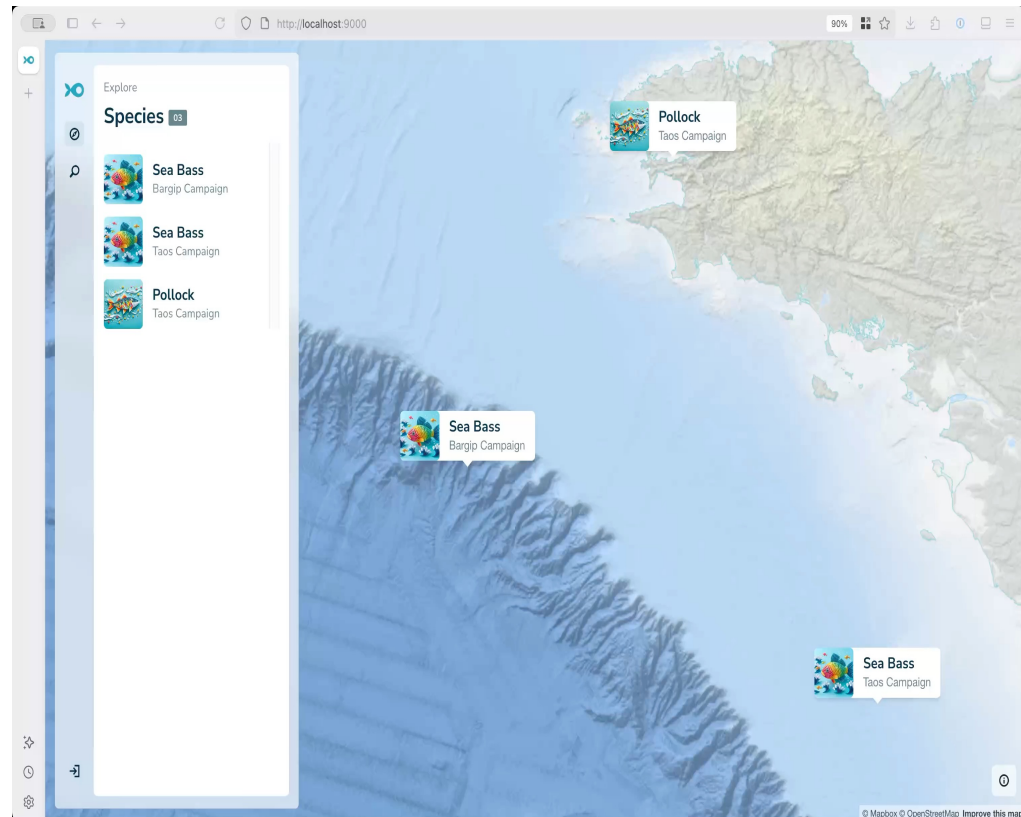
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# GFTS: Decision support tool

*Tools for analyzing reconstructed fish track together with Digital Twin data.*

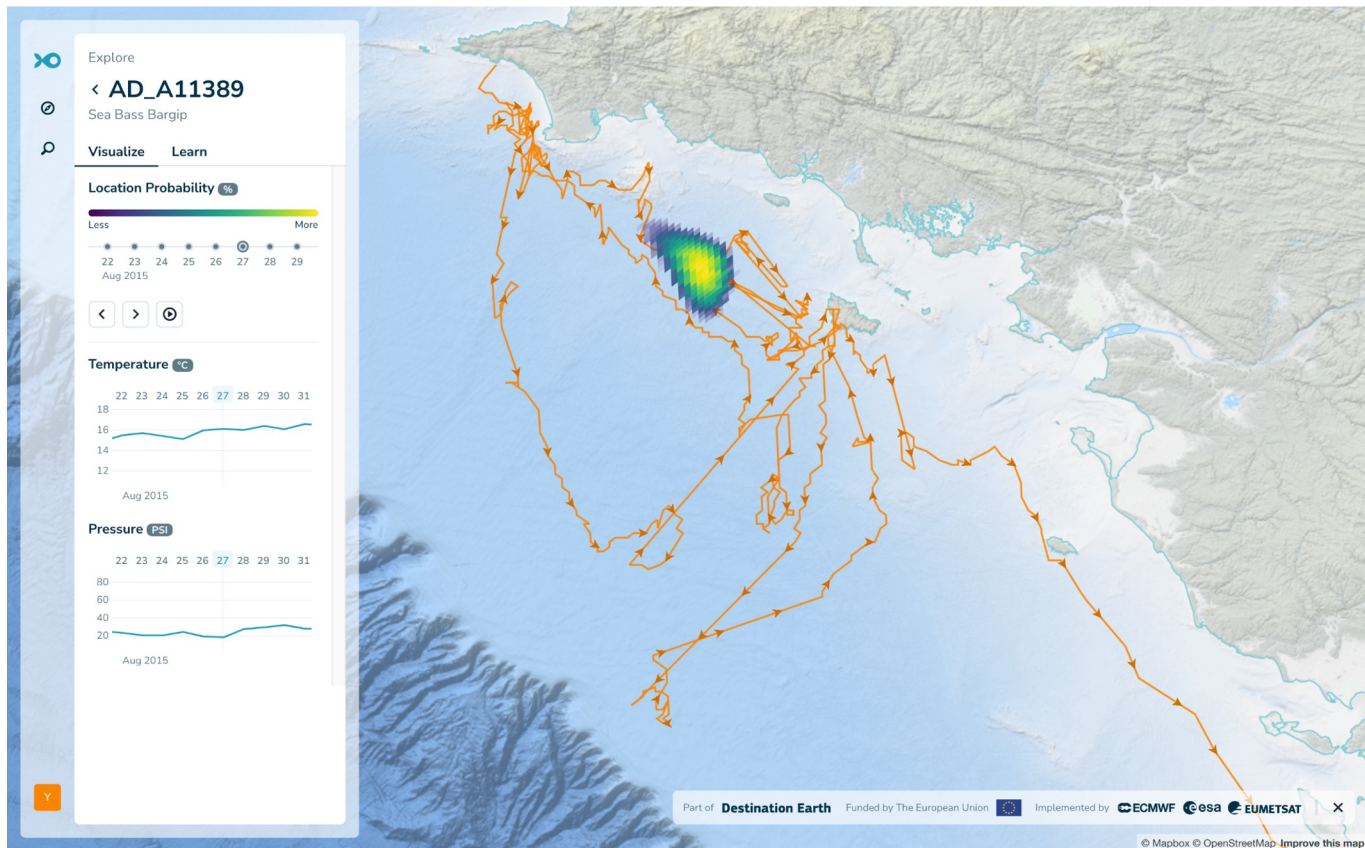
Answer questions and help decision-making:

- Where do fish spawn ?
- Where are the fish swimways ?
- Are these essential fish habitats stable over years ?
- How robust is the positioning of these habitats to errors and biases from reference geophysical fields ?
- Which ocean conditions fish encounter during their journey ?





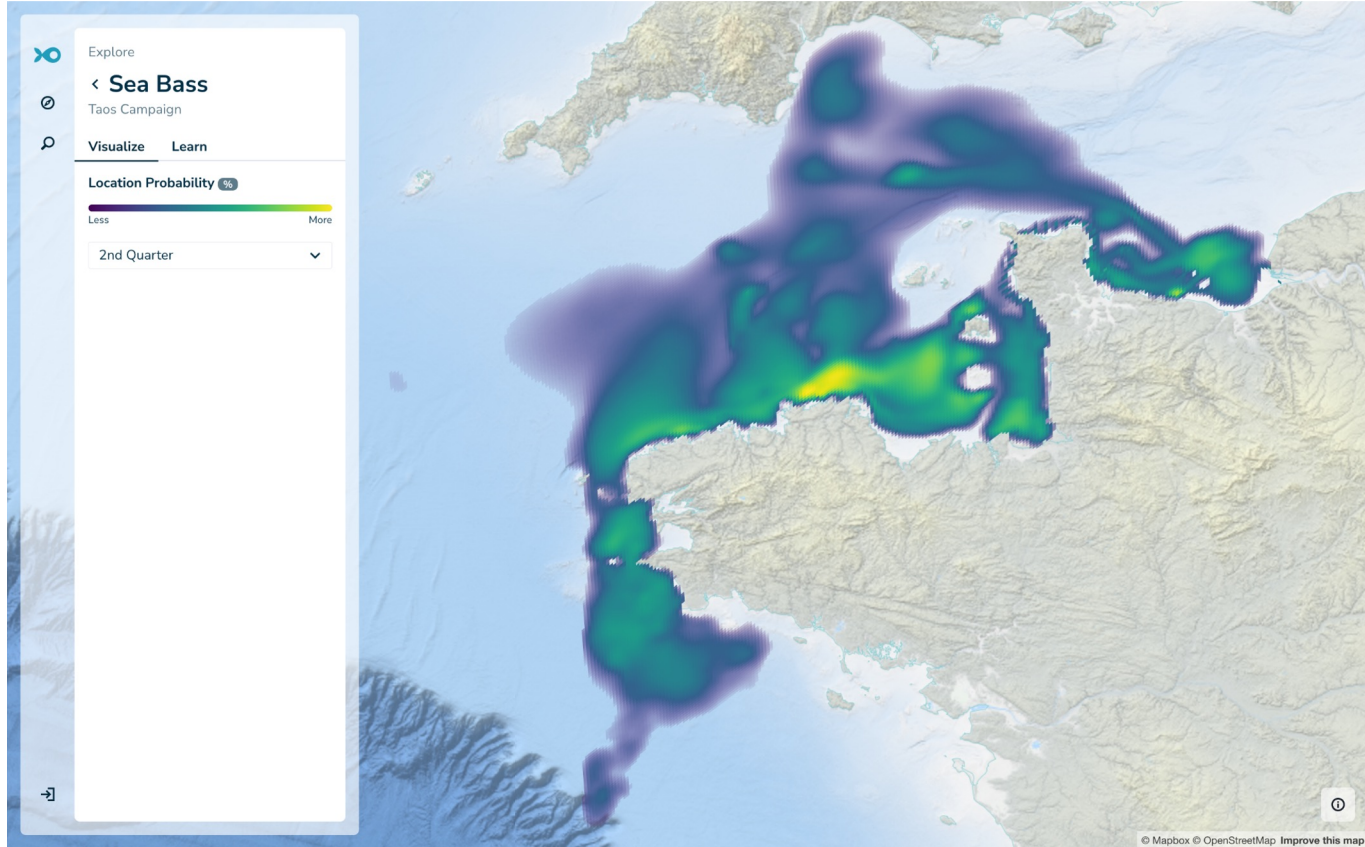
# Visualising individual Fish





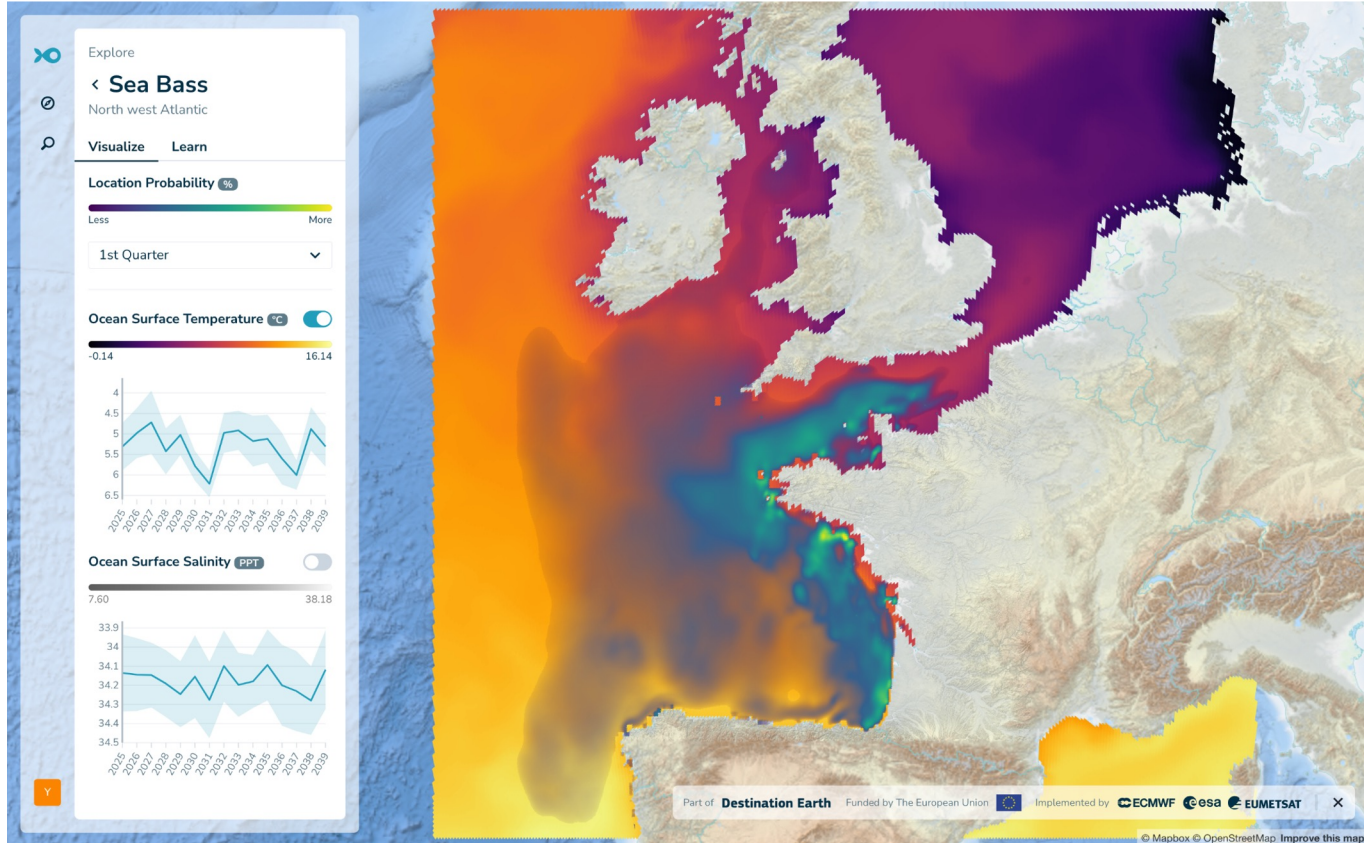


# Visualising species groups





# Visualising DT Data

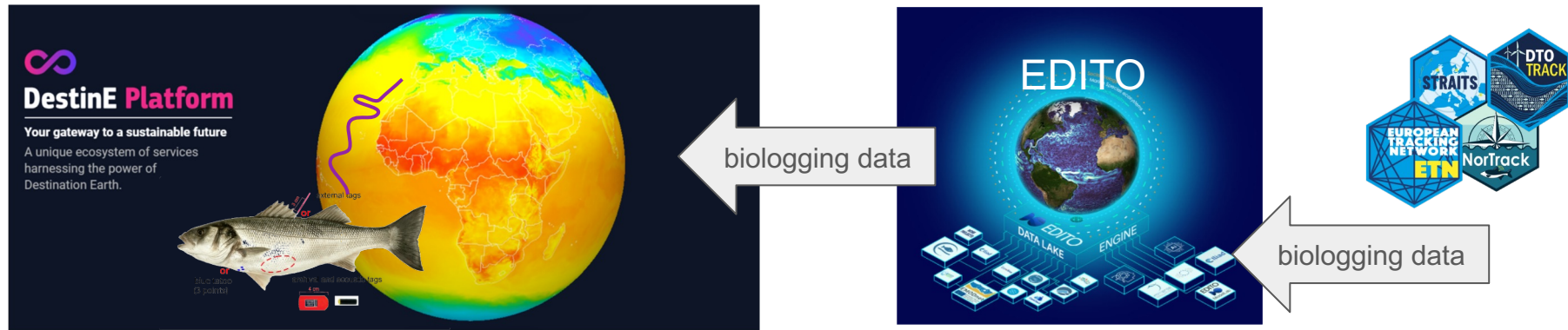


# Summary and future work

## On-going work:

- Integrate DestinE's Climate Digital Twin data
- Finalise the decision tool based on user inputs
- Deploy our service on the DestinE user support platform

## Future work:



Connect to the EDITO (European Digital Twin Ocean) infrastructure and/or European Research Infrastructure hosting biologging/geospatial biology information and expand to include more species and regions.



# THANK YOU

## Contact us

**Tina Odaka<sup>1</sup>**, [tina.odaka@ifremer.fr](mailto:tina.odaka@ifremer.fr)

**Anne Fouilloux<sup>2</sup>**, [annef@simula.no](mailto:annef@simula.no)

**Daniel Wiesmann<sup>3</sup>**, [danielwiesmann@developmentseed.org](mailto:danielwiesmann@developmentseed.org)

**Benjamin Ragan-Kelley<sup>2</sup>**, [minrk@simula.no](mailto:minrk@simula.no)

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