OCEAN FLOW AND WHALE PRESENCE: DATA VISUALIZATION OF CETACEA PATTERNS AND SEA CURRENTS

Project for subject Interactivity and Information Design

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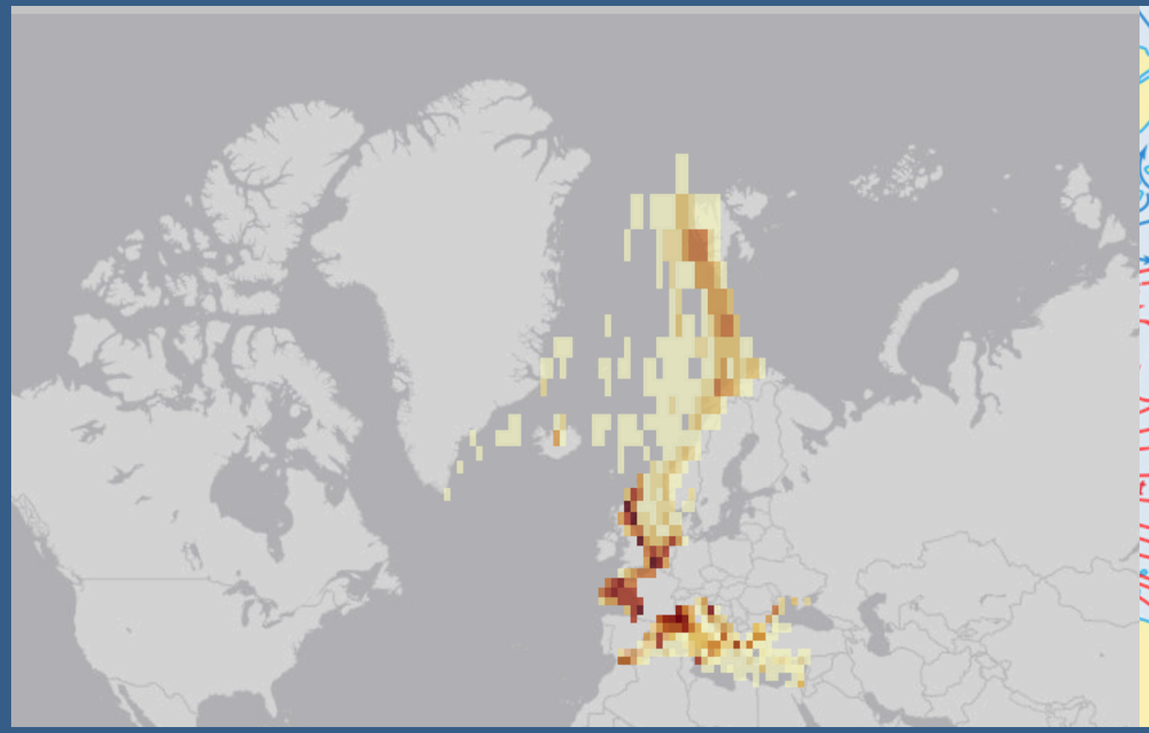
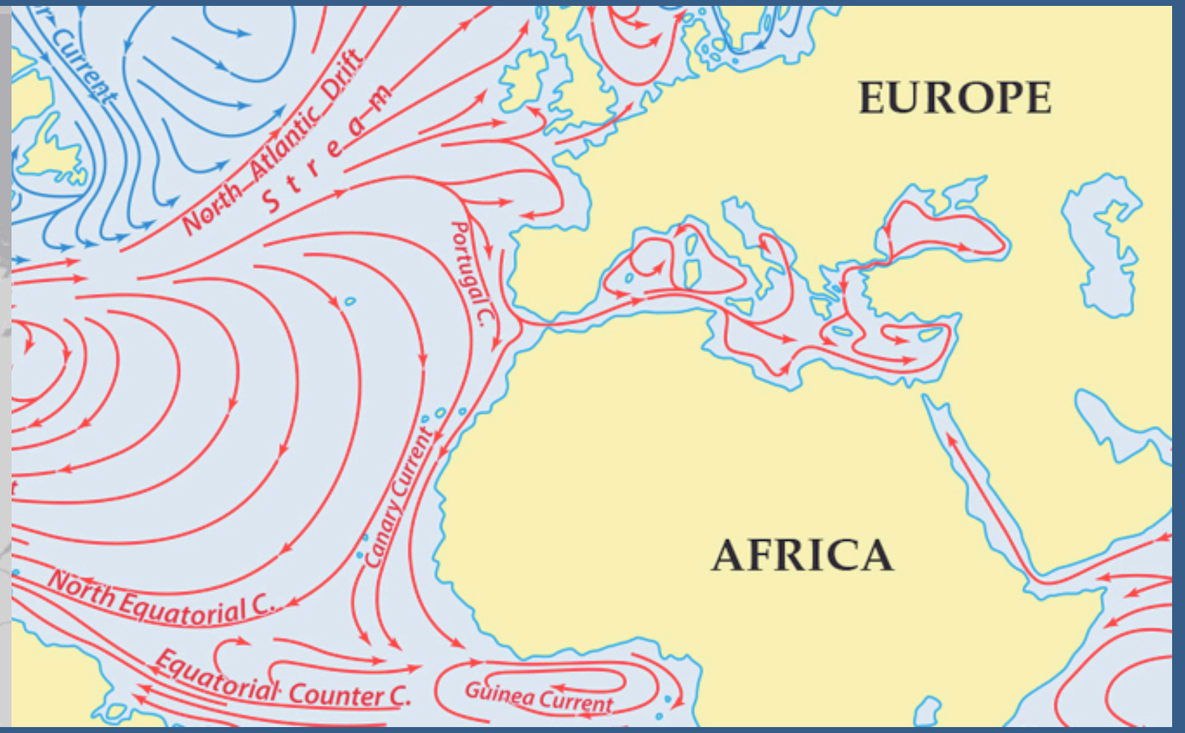




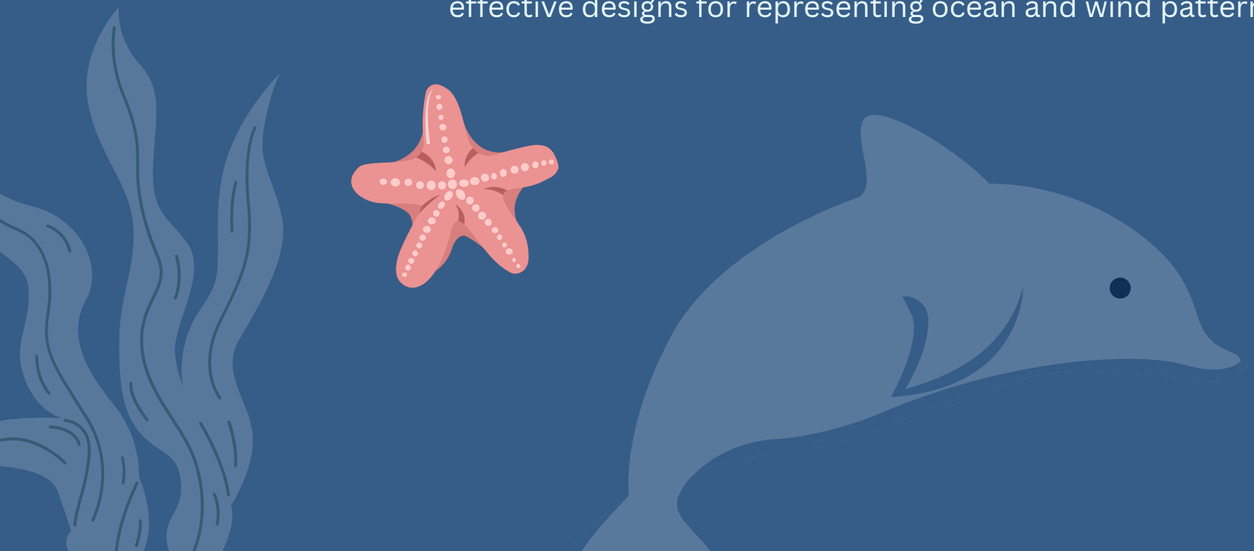
This project aims to visualize and analyze the relationship

between **ocean dynamics** and **marine mammal distribution** by combining two large-scale datasets: the **ECCO LLC4320 ocean simulation** (part of the IEEE SciVis Contest 2026) and **occurrence data of the infraorder Cetacea (Brisson) obtained from the OBIS Mapper**. The goal is to create an interactive visualization that enables users to explore how variations in ocean current velocity, temperature, salinity, and depth relate to the presence and movement of *Cetacea Brisson* species (whales & dolphins) across major European seas, including the Mediterranean, North, Norwegian, Black, Skagerrak, and Greenland Seas.

The scientific research papers backing our project

Zhang, C., Uenaka, T., Sakamoto, N., & Koyamada, K. (2016)
Visualization and Analysis of Currents and Temperature Distribution Based on Ocean Data. Procedia Computer Science, 80, 1610–1620
→ Proposes 3D visualization techniques (streamlines, volume rendering) for exploring large-scale ocean current and temperature data.

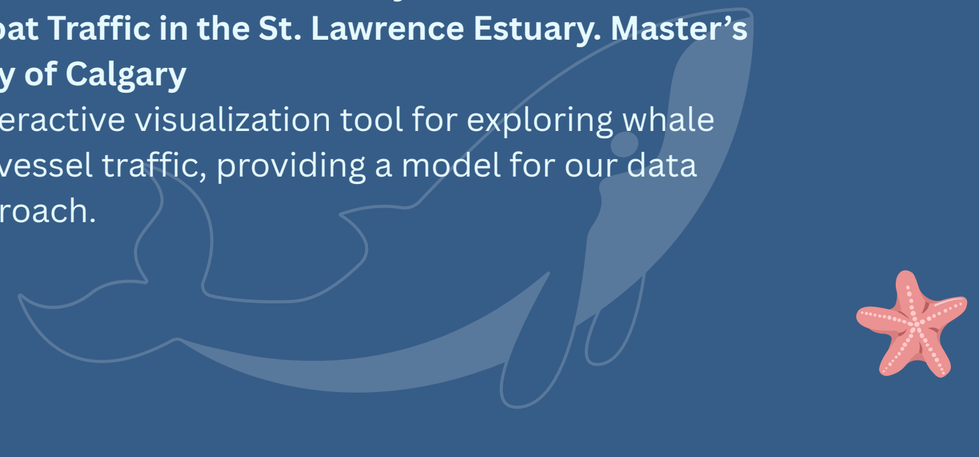
Ware, C., Bolan, D., & Miller, R. (2014)
Improving the Display of Wind Patterns and Ocean Currents. Bulletin of the American Meteorological Society, 95(12), 1953–1961
→ Evaluates how people perceive flow visualizations and recommends effective designs for representing ocean and wind patterns.



Tynan, C. T., Ainley, D. G., Barth, J. A., Cowles, T. J., et al. (2005)
Cetacean Distributions Relative to Ocean Processes in the Northern California Current System. Deep-Sea Research II, 52(1–2), 145–167
→ Examines how temperature, salinity, and upwelling currents shape whale and dolphin distributions — the main conceptual base for our project.

Pittman, S. J., & Costa, B. (2009)
Linking Cetaceans to Their Environment: Spatial Data Acquisition, Digital Processing, and Predictive Modeling for Marine Spatial Planning in the Northwest Atlantic. In Spatial Complexity, Informatics, and Wildlife Conservation (Springer), pp. 387–414
→ Demonstrates how to integrate biological sightings with environmental datasets to model cetacean habitats and guide marine planning.

Zheng, B. (2013)
Interactive Visualization to Reveal Activity Patterns of Marine Mammals and Boat Traffic in the St. Lawrence Estuary. Master's Thesis, University of Calgary
→ Presents an interactive visualization tool for exploring whale movements and vessel traffic, providing a model for our data visualization approach.



Tools

Visualization & Interaction

- **Vega-Lite / Vega** – for creating declarative and interactive visualizations
- **D3.js** – for custom visual interactions and dynamic map elements
- **Leaflet.js or Mapbox GL JS** – for geographic mapping and layering Cetacea points with ocean current fields
- **ColorBrewer** – for perceptually balanced color scales
- **TopoJSON / GeoJSON** – for geographic boundaries and regions

Data Sources

- **ECCO LLC4320 dataset** – ocean current parameters (U, V, depth, temperature, salinity)
- **OBIS Mapper** – whale and dolphin occurrence data (Cetacea Brisson)

Data Processing & Analysis

- **Python** – for preprocessing, filtering, and merging datasets
- **Pandas / NumPy** – for handling tabular and numerical data
- **xarray** – for working with multidimensional oceanographic data (e.g., ECCO LLC4320 NetCDF files)
- **GeoPandas** – for spatial operations and geographic filtering
- **Git + GitHub** – for code versioning and repository submission
- **Canva / Figma** – for slide design and visual presentation layout