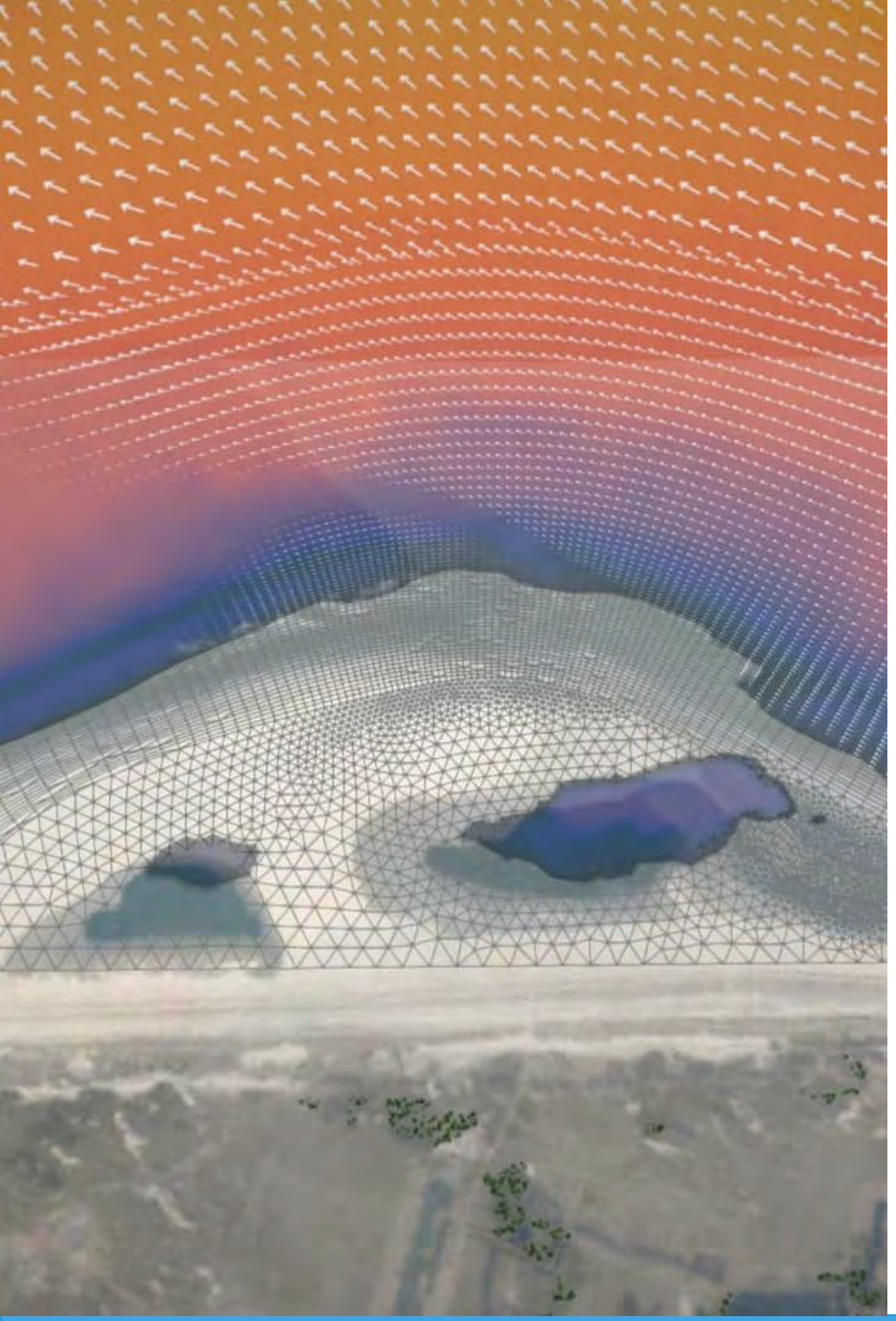


DIGISHAPE
DATASCIENCE
FOR
DELTAS

DigiShape

INNOVATIE PLATFORM VOOR DIGITALISERING VAN DE WATERSECTOR

Floris Langeraert – RWS
Fedor Baart – RWS
Gert-Jan Schotmeijer – Deltares

DigiShape Open Source Platform

De Nederlandse watersector heeft veel kennis, data en digitale modellen in huis. Toch wordt die kennis nog niet altijd makkelijk gedeeld of hergebruikt. Dat remt innovatie, zeker bij AI, digital twins en grote databestanden. D-OSP richtte zich daarom op drie centrale drempels:

- Vertrouwen
  Hoe werk je veilig met data, code en modellen van andere organisaties? En hoe zorg je dat gebruikers begrijpen wat een model of AI-toepassing doet?

- Interoperabiliteit
  Hoe voorkom je dat partijen telkens opnieuw data moeten opwerken, converteren of valideren? En hoe zorg je dat modellen en datasets beter op elkaar aansluiten?

- Gedeelde infrastructuur
  Hoe kun je grote datasets gebruiken zonder ze steeds te downloaden of te kopiëren? En welke cloudoplossingen zijn geschikt om veilig en efficiënt samen te werken?

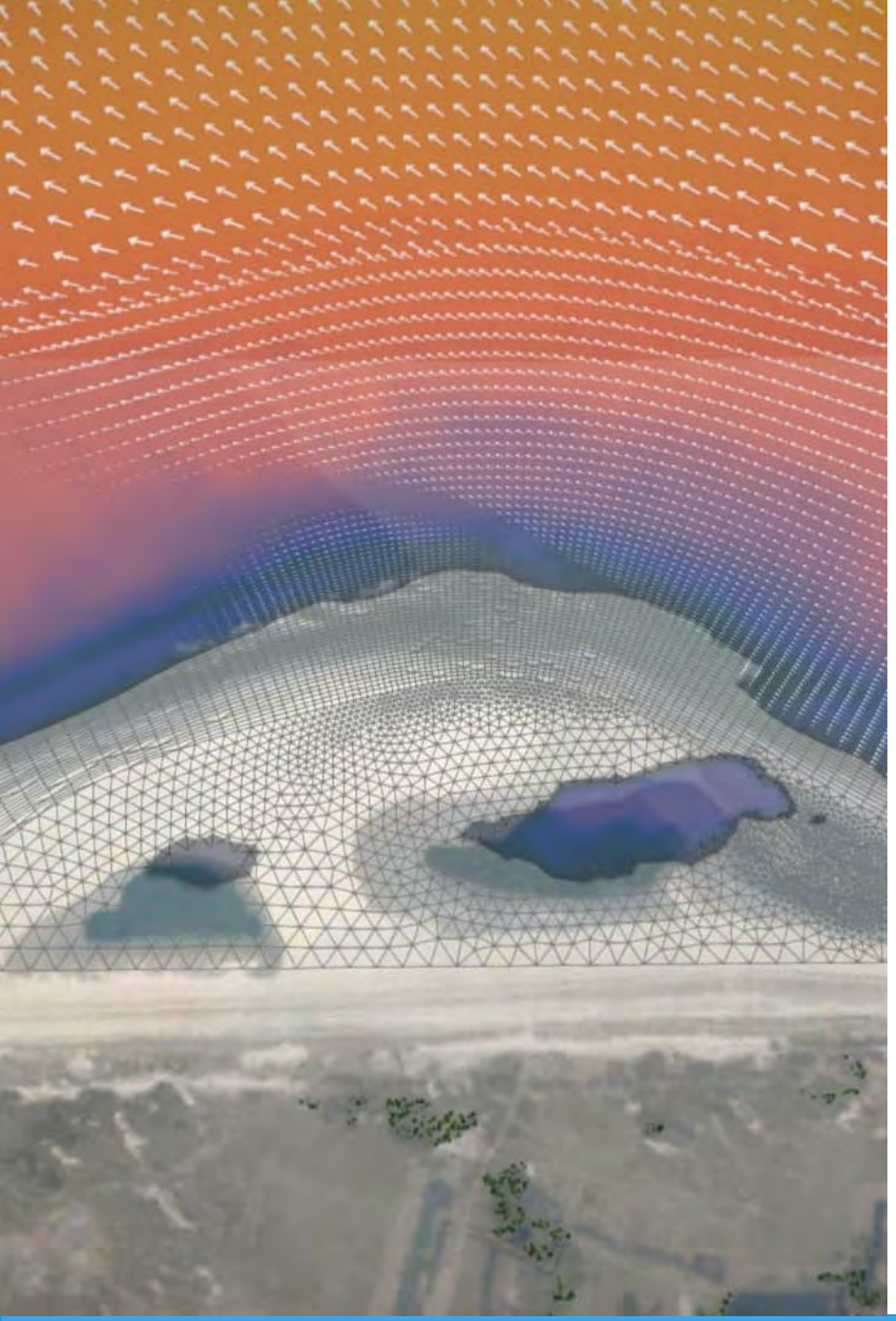
DigiShape Open Source Platform

Het doel van D-OSP was om digitale samenwerking in de watersector te versnellen door open source code, gedeelde data, modellen en infrastructuur beter op elkaar aan te laten sluiten.

Daarvoor zijn zes werkpakketten uitgevoerd. Sommige werkpakketten bevatten concrete use cases, zoals scheepvaartlogistiek, incidentreconstructies, digital twins voor vaarwegen en mangroveherstel.

Andere werkpakketten richtten zich op de randvoorwaarden, zoals training, dialoog en technische infrastructuur.

Vandaag 22 mei richten we ons op de resultaten van de technische infrastructuur en de use case incidentenreconstructies.



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INNOVATIE PLATFORM VOOR DIGITALISERING VAN DE WATERSECTOR

Deskstudie Infrastructuur & architectuur
Floris Langeraert - RWS

Design Principles

1. Federation over Centralization	• No single point of failure • Partners keep autonomy
2. Open Source First	• No vendor lock-in • Community support
3. Layered Architecture	• Separation of concerns • Easy to upgrade parts
4. Security by Design	• Zero trust model • Audit everything
5. Developer Friendly	• Modern tooling • Good documentation
6. Cost Conscious	• Right tool for each job • Optimize continuously

Architectuur

Architecture full overview

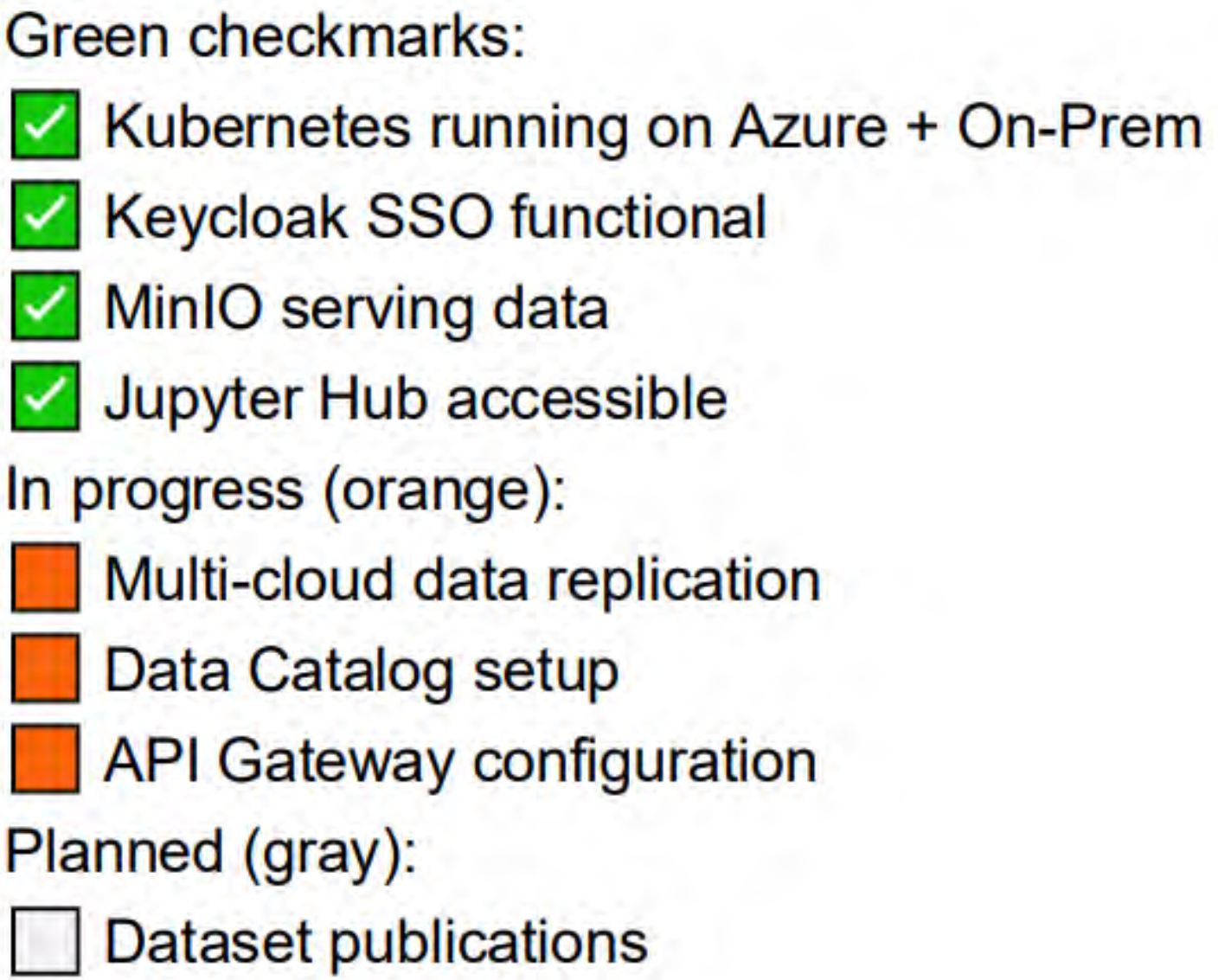
What's implemented

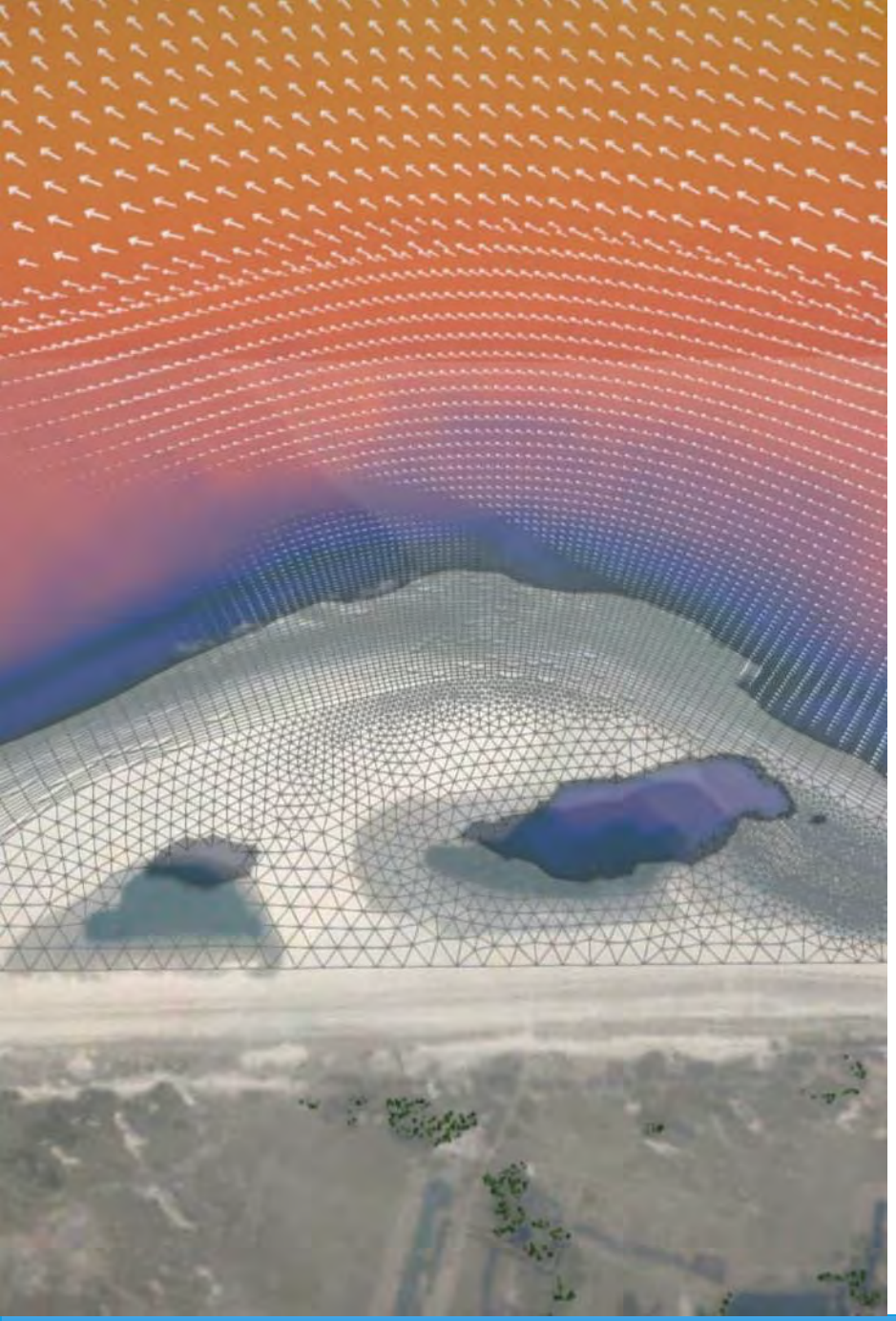
Location:

Deltares data center

Status:

Proof of Concept





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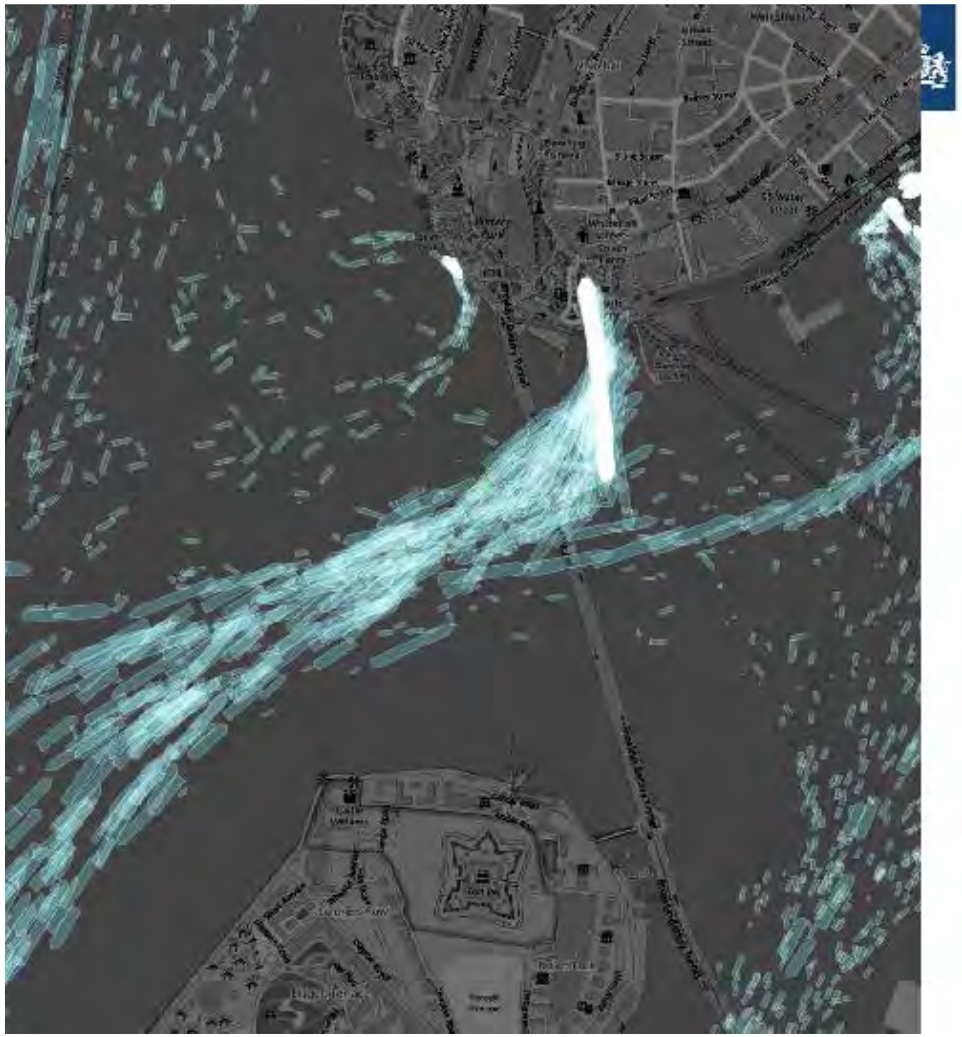
DigiShape

INNOVATIE PLATFORM VOOR DIGITALISERING VAN DE WATERSECTOR

Use case captain Hindsight
Fedor Baart - RWS

Captain Hindsight

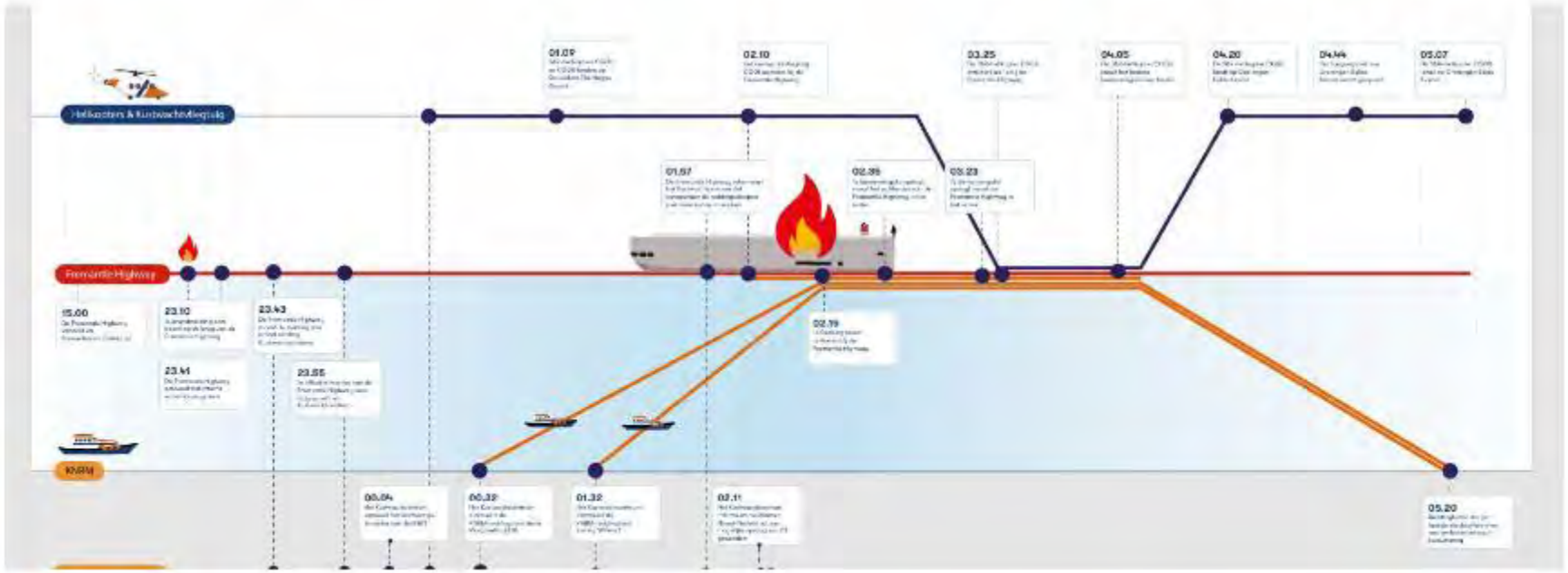


Fedor Baart

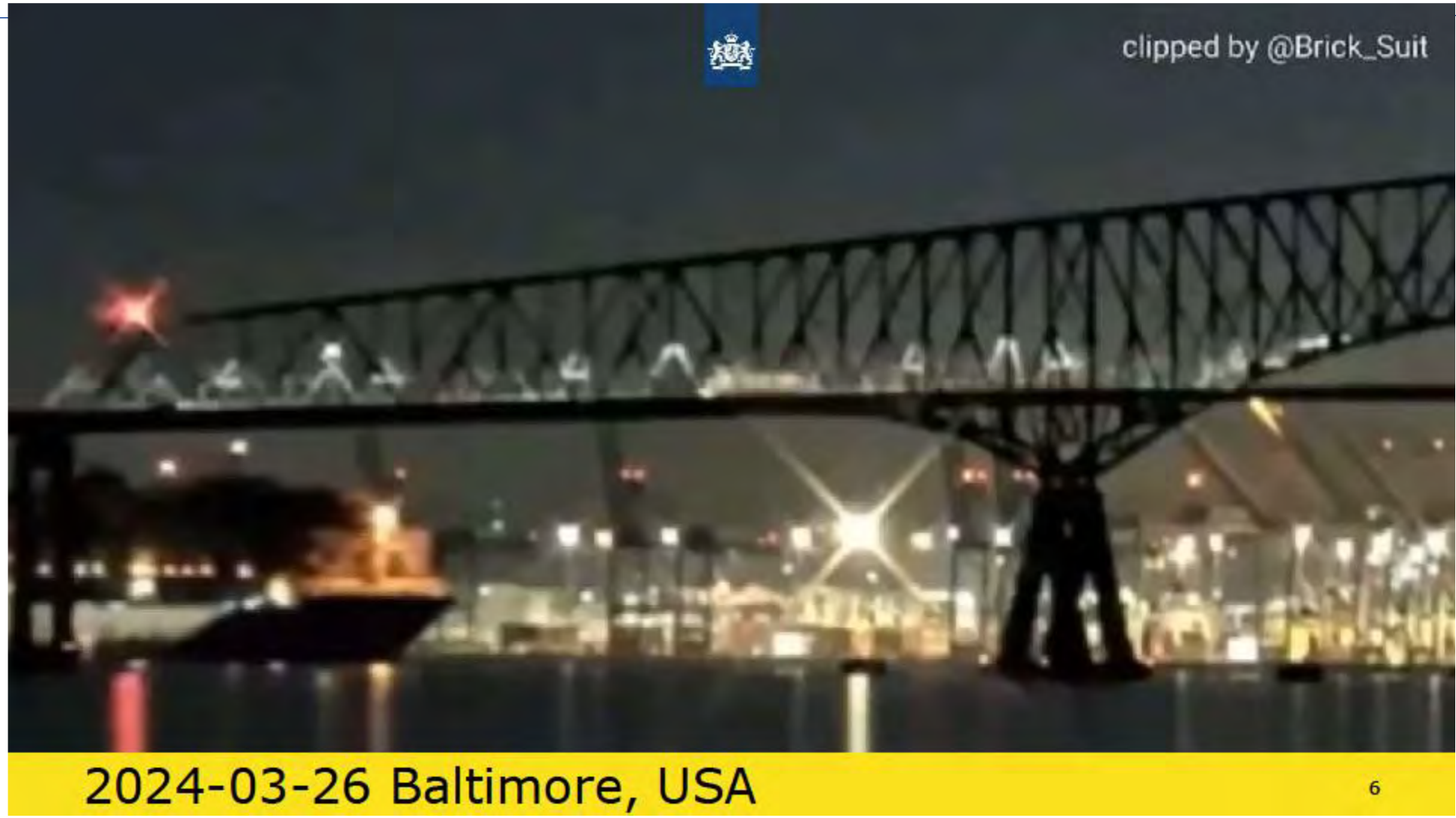
- Senior advisor shipping models and data
- Department: Information management, traffic models and mobility data
- Topics:
  - Modelling
  - Data science
  - Ships, water

Captain Hindsight

Reconstructing incidents: example timeline



Captain Hindsight

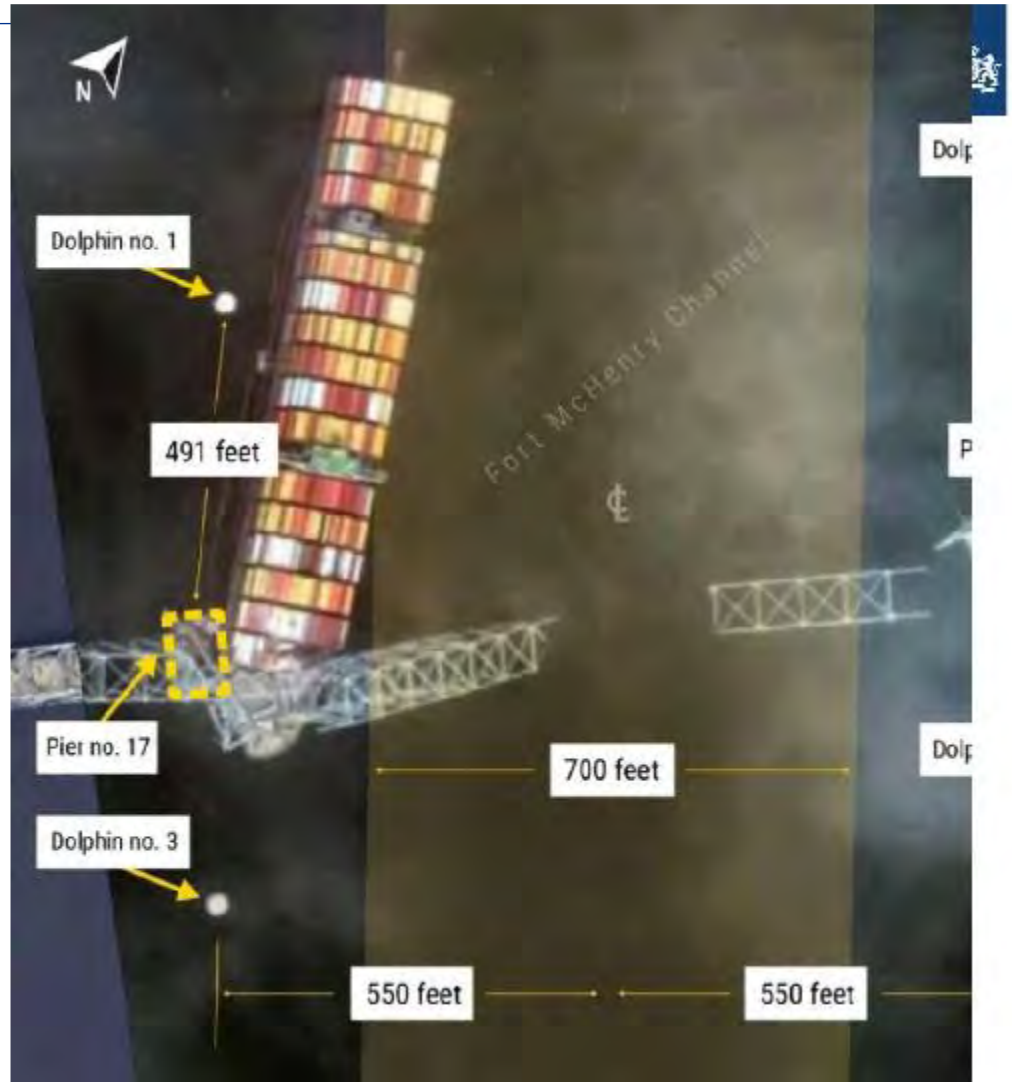


Captain Hindsight

Visualizing Baltimore

- Exploratory analysis
  - Notebook
  - Visualizations
  - Environment
- Background map
- Ship tracks
- Data of event
- Animation
- Annotation

Captain Hindsight



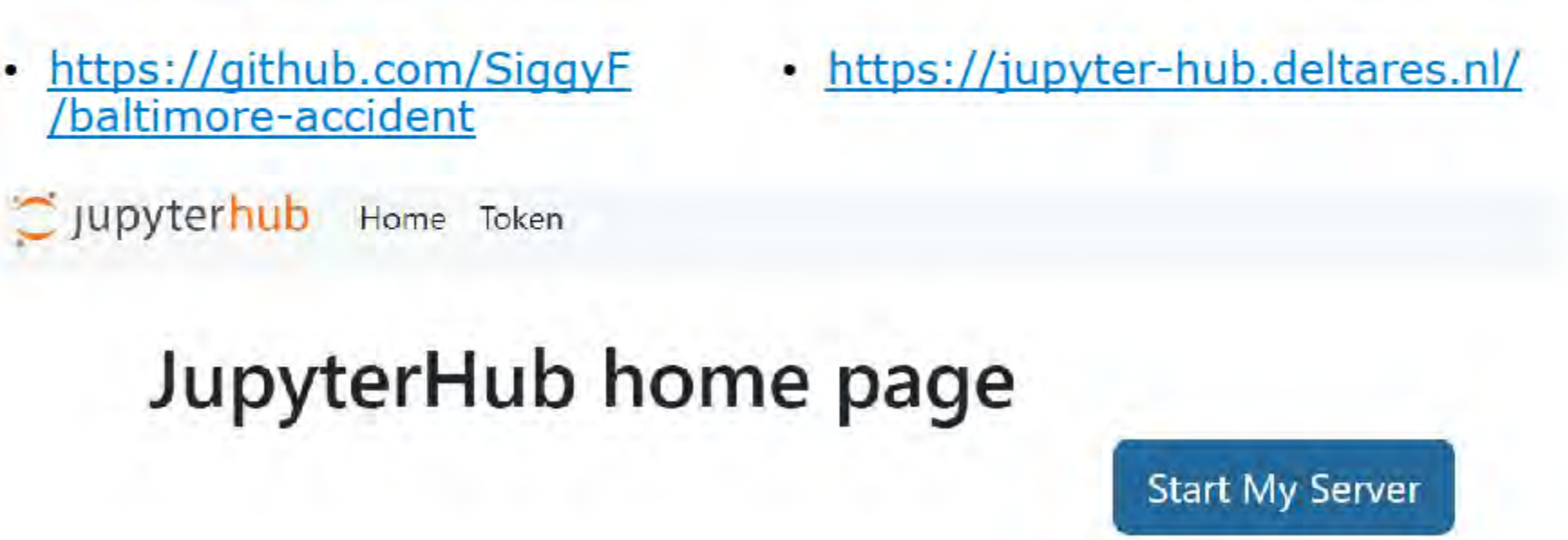
Consequences

- Bridge collapse
- 8 casualties (6 fatal)

Captain Hindsight

Example notebook

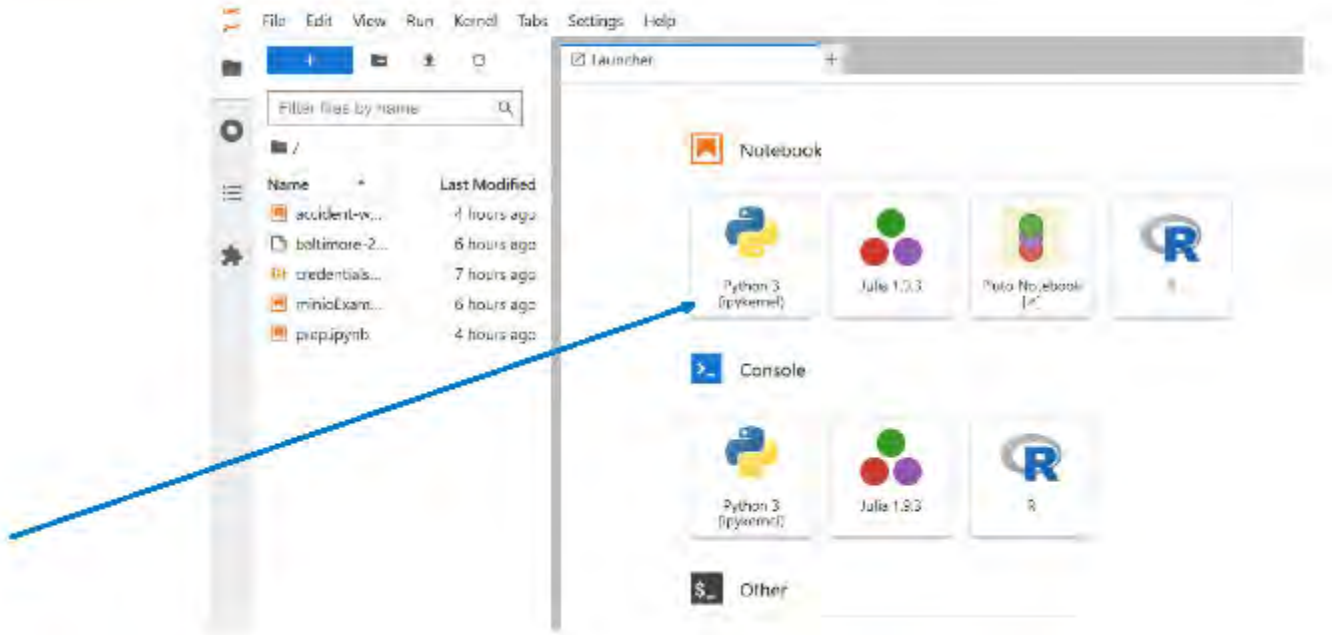
- https://github.com/SiggyF/baltimore-accident
- https://jupyter-hub.deltares.nl/



Captain Hindsight

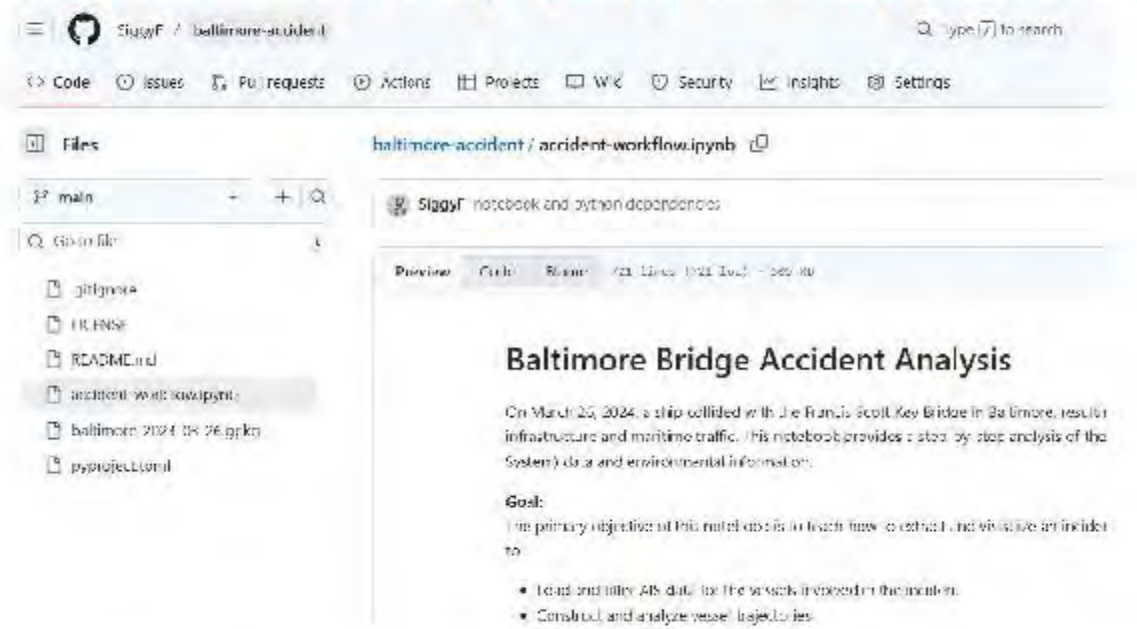
Captain Hindsight

Notebook environment



Captain Hindsight

Follow this notebook (open in separate tab)



https://github.com/SiggyF/baltimore-accident

Captain Hindsight

Import libraries

```
# datetime: For working with dates and times, such as definin
import datetime
# pathlib: For handling filesystem paths in an object-oriente
import pathlib
```

Captain Hindsight

Ship + AIS data

```
# geopandas: For reading, writing, and analyzing geospatial d
import geopandas as gpd
```

```
# MMSI (Maritime Mobile Service Identity) number of the DALI ship involved in the Balt
mmsi = 563004200

# URL to the processed AIS data (in GeoPackage format) from Marine Cadastre.
ais_url = "http://s3.deltares.nl/digishape/baltimore-2024-03-26.gpkg"
```

Captain Hindsight

Read and explore

```
ais_gdf = gpd.read_file(ais_url)
```

- Show ais_gdf
- What columns are available
- How many rows
- Is data from the correct area?

Captain Hindsight

Select our ship of interest

- Select our ship of interest
- Check time window
- Timezone?
- How many records?
- Frequency?

```
selected_ais_gdf = ais_gdf[ais_gdf['mmsi'] == mmsi].copy()
```

Captain Hindsight

Compute extra variables

```
traj.add_acceleration(overwrite=True)
traj.add_speed(overwrite=True)
traj.add_direction(overwrite=True)
traj.add_distance(overwrite=True)
```

- Check the data of the trajectory
- Maximum / minumum speed (units?)

Captain Hindsight

Plot the acceleration

```
|:
traj.hvplot(
    c="acceleration",
    cmap="PiYG",
    vmin=-0.01,
    vmax=0.01,
    width=800,
    height=400
)
```

Captain Hindsight

Tidal analysis

```
params = dict(
    product="predictions",
    begin_date=20240325,
    end_date=20240327,
    datum="MLLW",
    station=8574680,
    time_zone="GMT",
    units="metric",
    interval=6,
    format="json",
    application="NOS.COOPS.TAC.TidePred"
)

resp = requests.get('https://api.tidesandcurrents.noaa.gov/api/prod/datagetter', params)
tide_data = resp.json()
```

Captain Hindsight

Parse the data

- Visualize the tidal predictions
- When was ebb?
- What kind of currents do you expect at the moment of the incidents, based on the water levels?

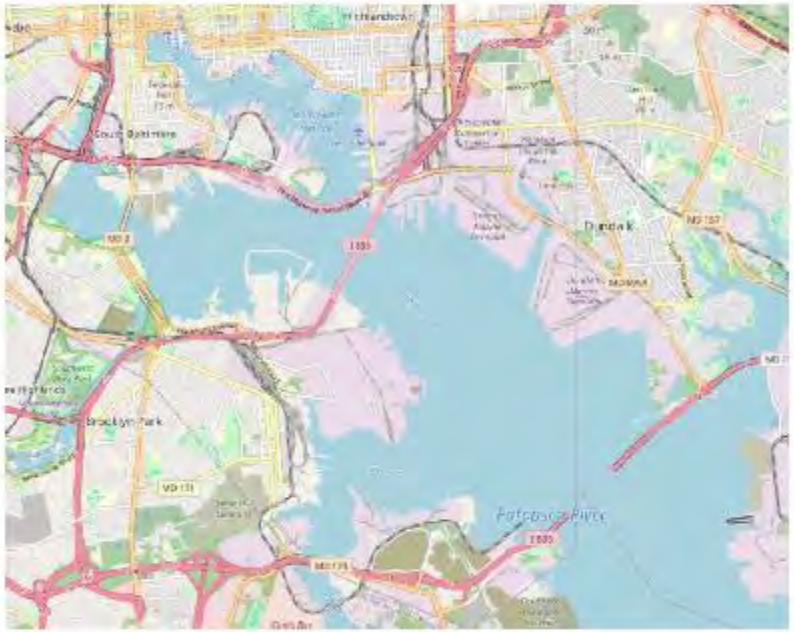
```
tide_df = pd.DataFrame(tide_data['predictions'])
tide_df['t'] = pd.to_datetime(tide_df['t'])
tide_df['v'] = pd.to_numeric(tide_df['v'])
```

Captain Hindsight

Background maps

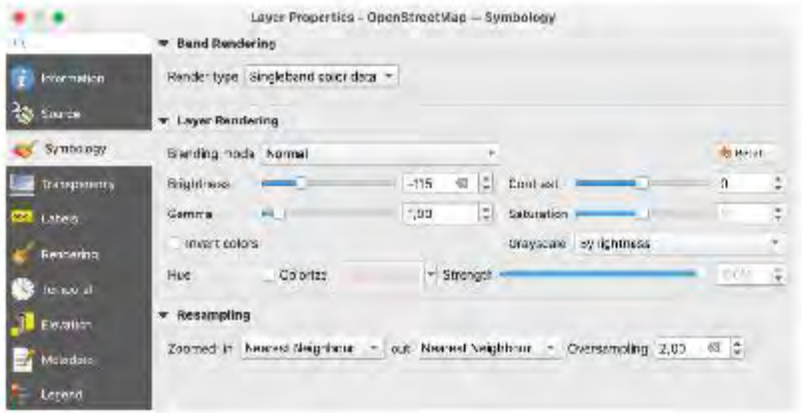
Captain Hindsight

Background map

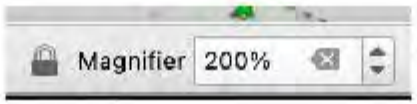


Captain Hindsight

Restyle

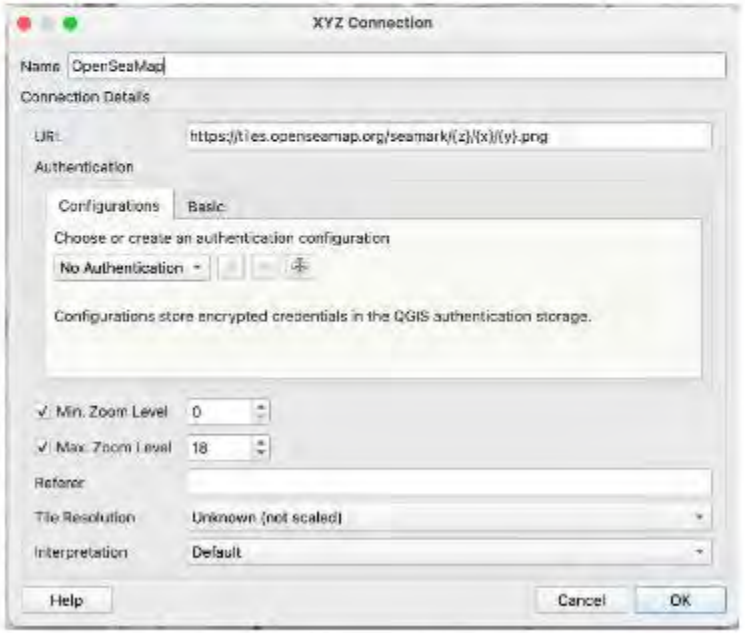


brightness
saturation
grayscale
colorize



Captain Hindsight

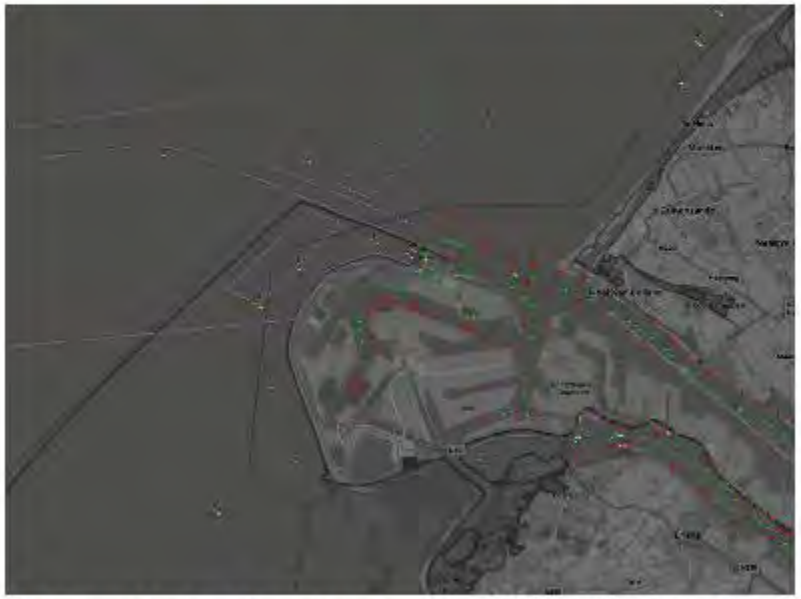
OpenSeaMap



https://tiles.openseamap.org/seamark/{z}/{x}/{y}.png

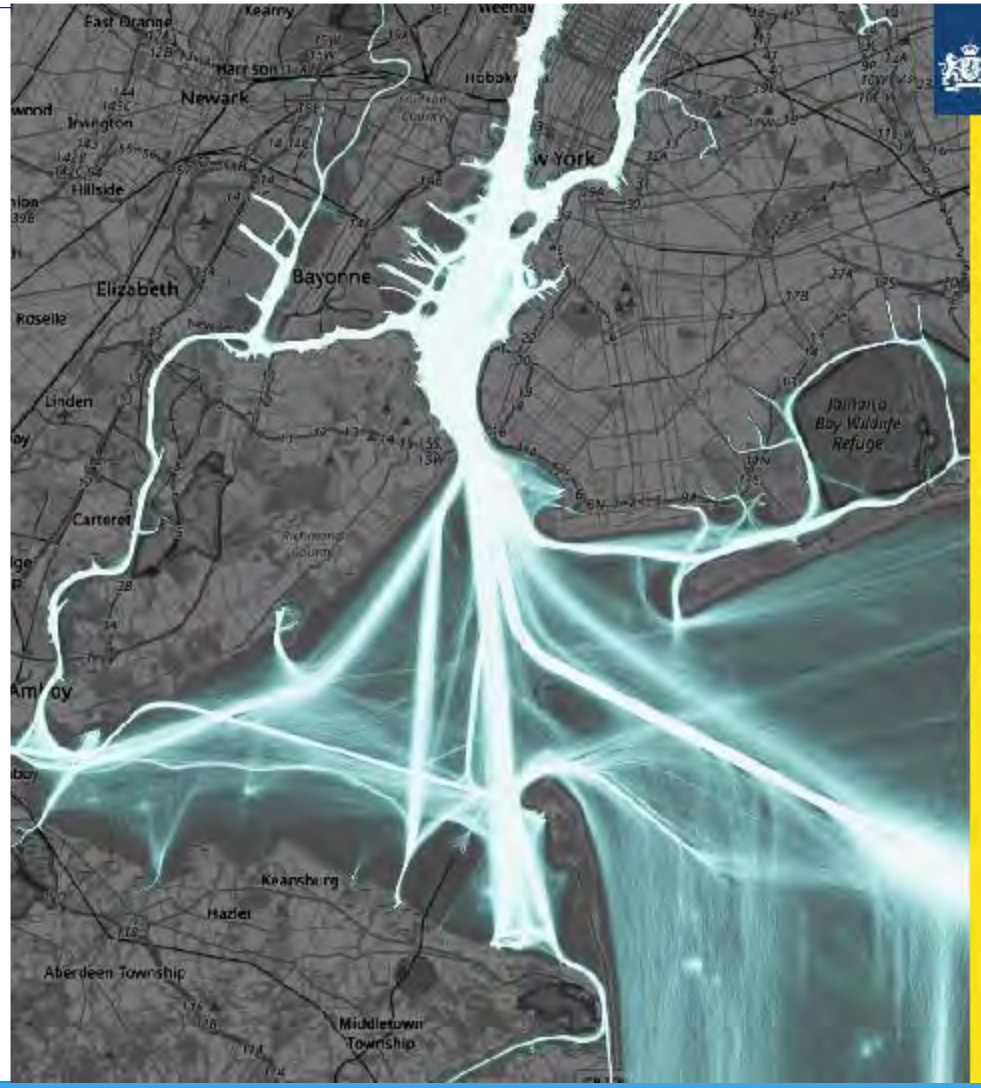
Captain Hindsight

NOAA Public ENC server / Meso American-Caribbean Sea Hydrographic Commission (MACHC)



https://gis.charttools.noaa.gov/arcgis/rest/services/MACHC/MACHC_ENCOnline_Public/MapServer/exts/MaritimeChartService/WMSServer

Captain Hindsight

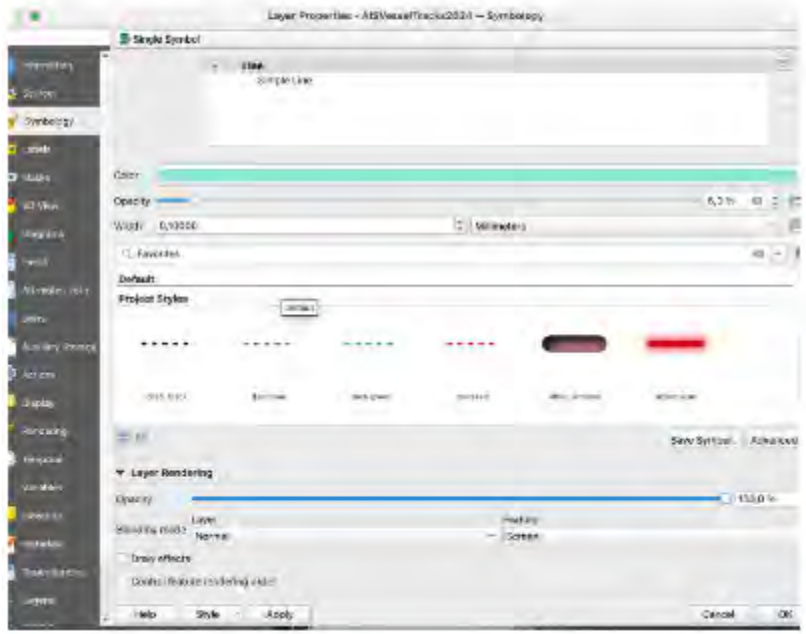


Tracks

Captain Hindsight

Poor man's heatmap

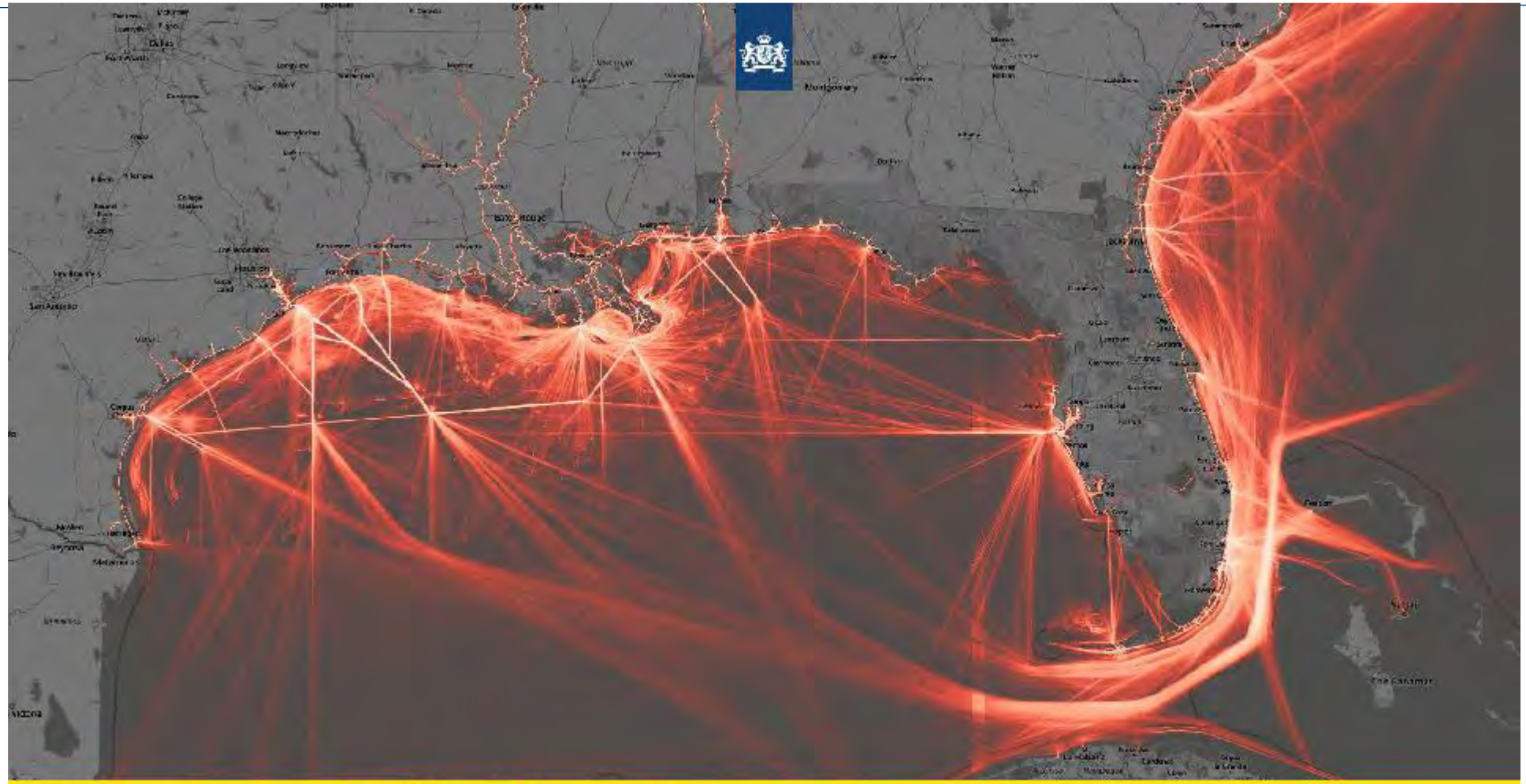
- Quick rendering trick to create heatmaps
- Very thin line (0.1mm)
- Very low opacity (>6% < 10%)
- Feature blending: screen



Captain Hindsight

Heatmap NYC

Captain Hindsight



Heatmap Gulf of America

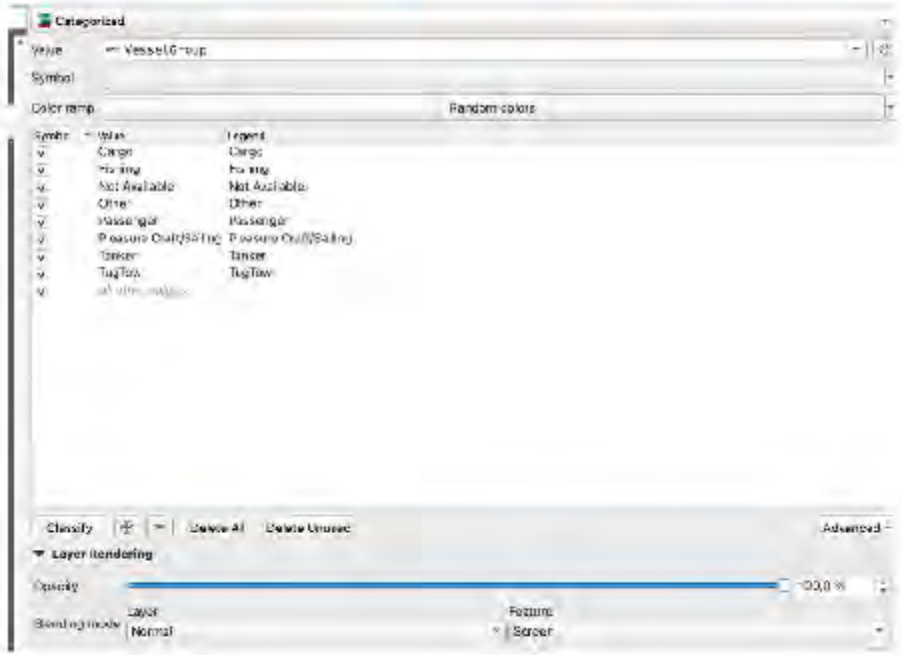
Captain Hindsight

Blending modes (svg, canvas, webgpu)

Src: www.visualcinnamon.com

Captain Hindsight

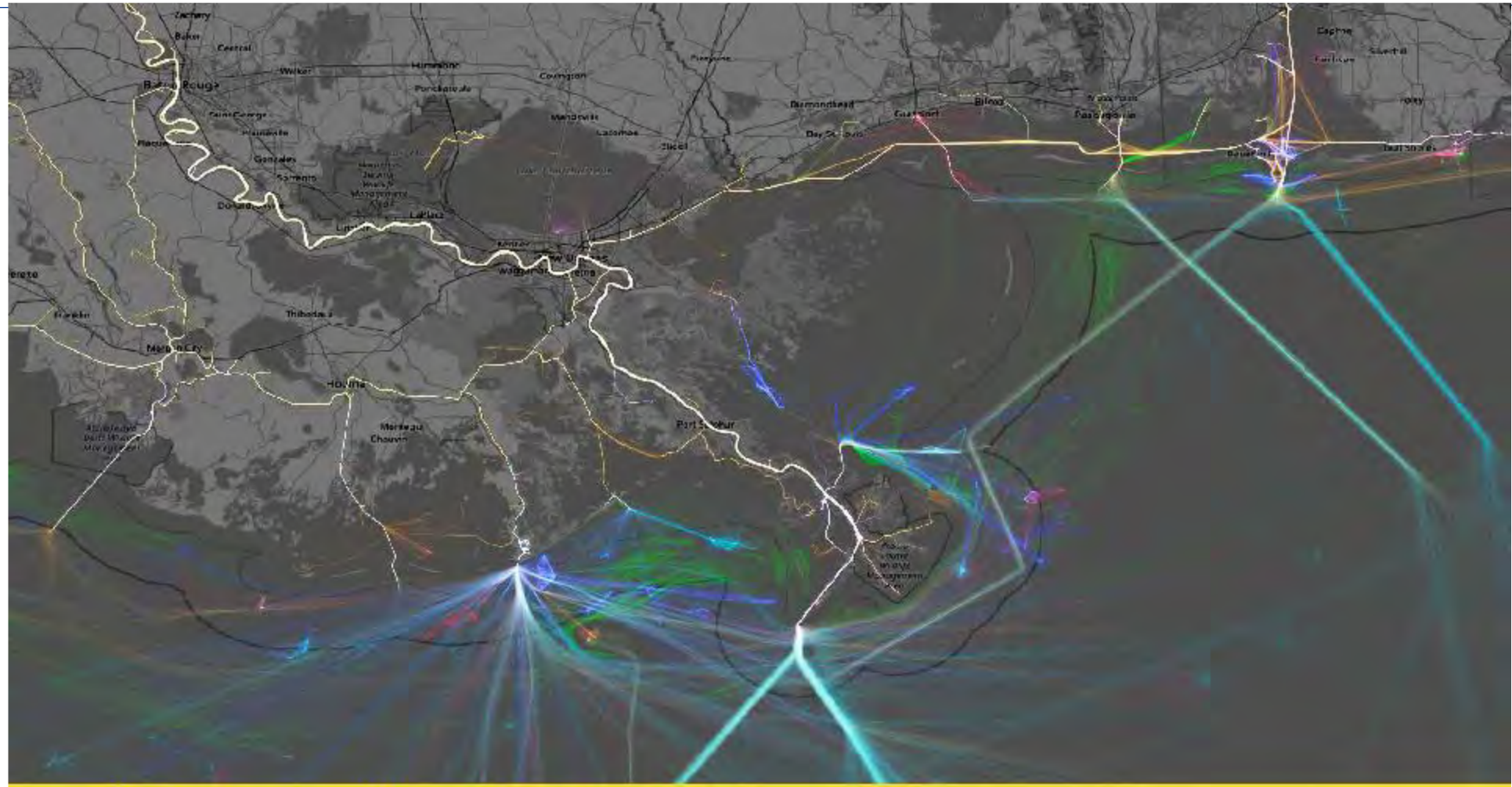
Color per vessel group



Vessel Group (2018) key

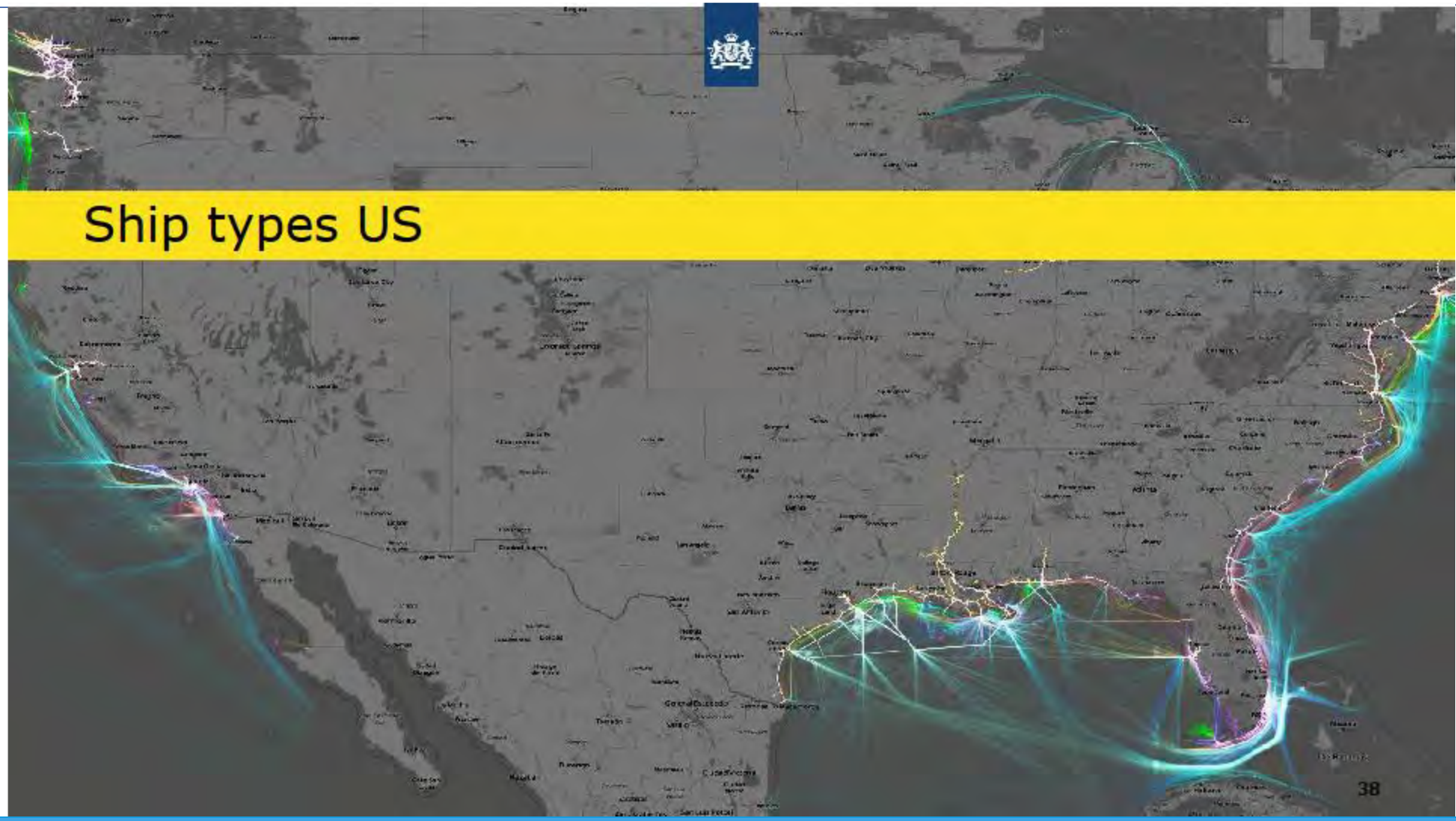
- Cargo
- Fishing
- Military
- Not Available
- Other
- Passenger
- Pleasure Craft/Sailing
- Tanker
- Tug Tow

Captain Hindsight



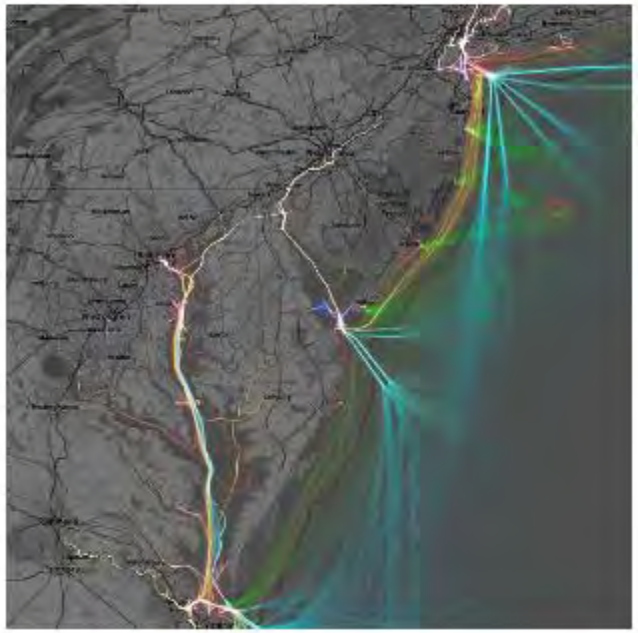
Ship types New Orleans

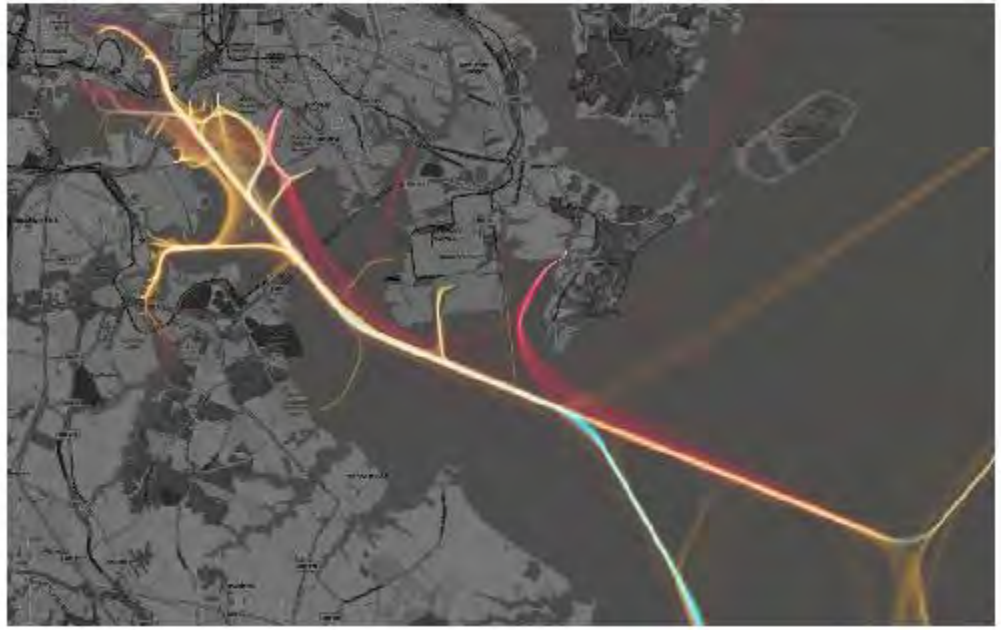
Captain Hindsight



Captain Hindsight

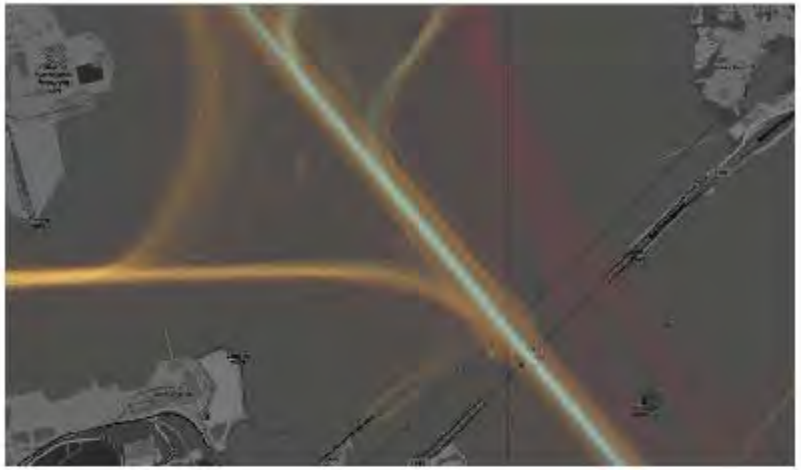
Baltimore

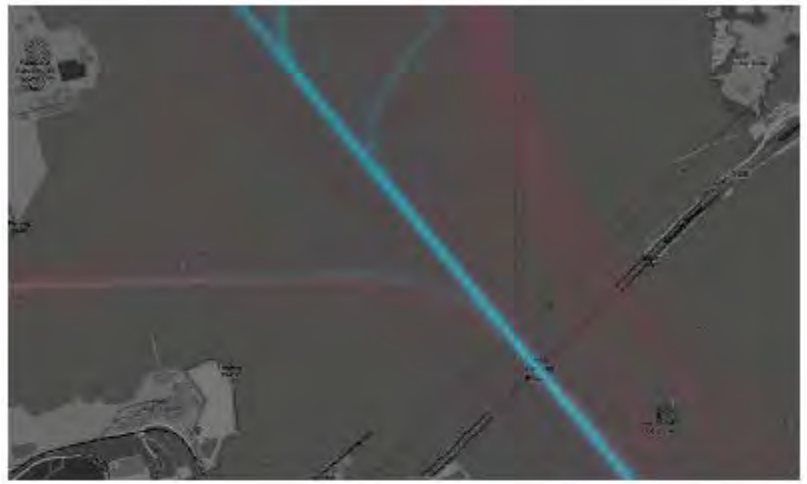




Captain Hindsight

Filter out non-cargo vessels





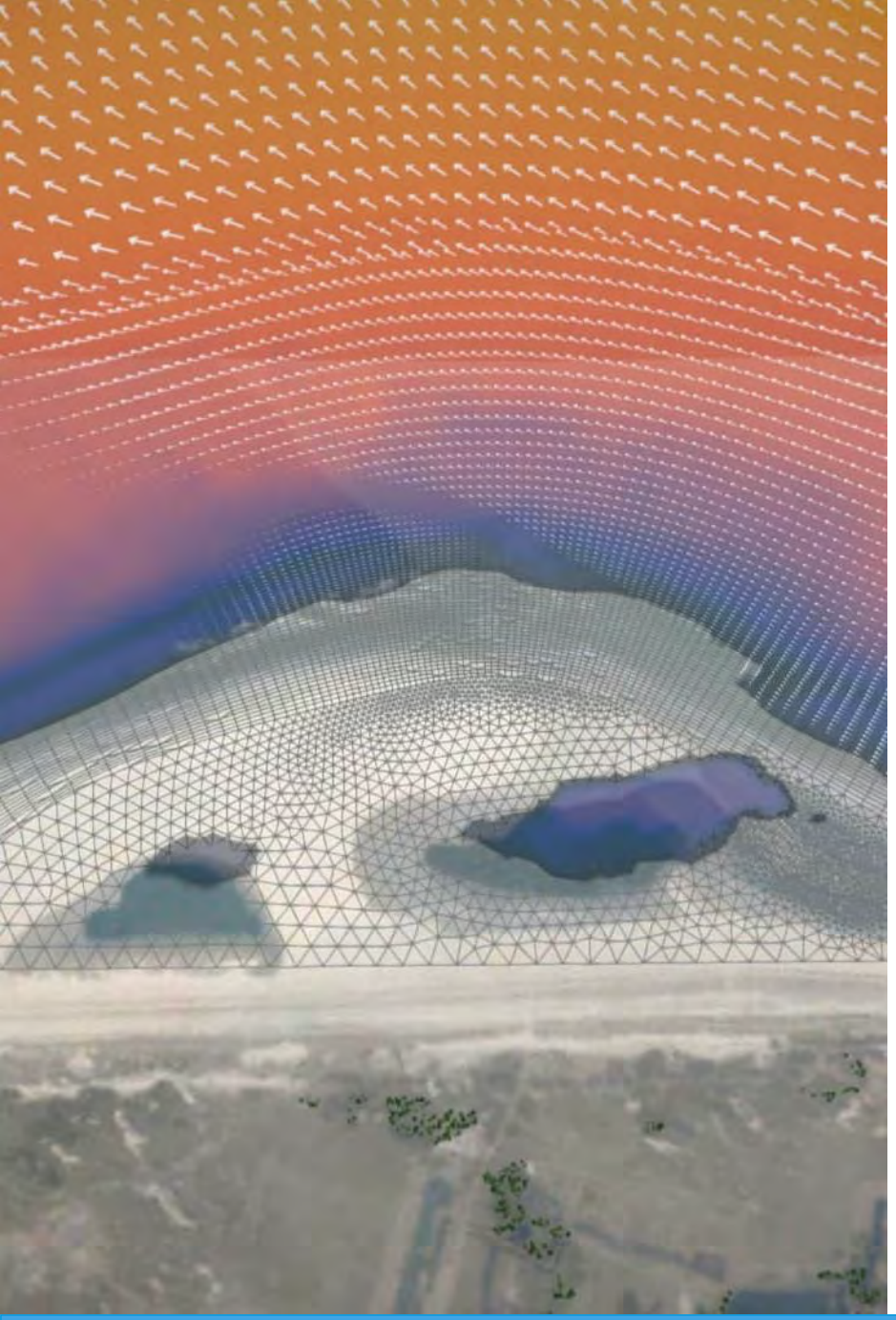
Captain Hindsight

Vessel track distribution

- Compare vessel track to previous sailed ship tracks of the same type
- Safety margins (time, distance, maneuvres)

Captain Hindsight

Complete presentation on the DigiShape website



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Thank you

Floris Langeraert

Fedor Baart

Gert-Jan Schotmeijer

www.digishape.nl