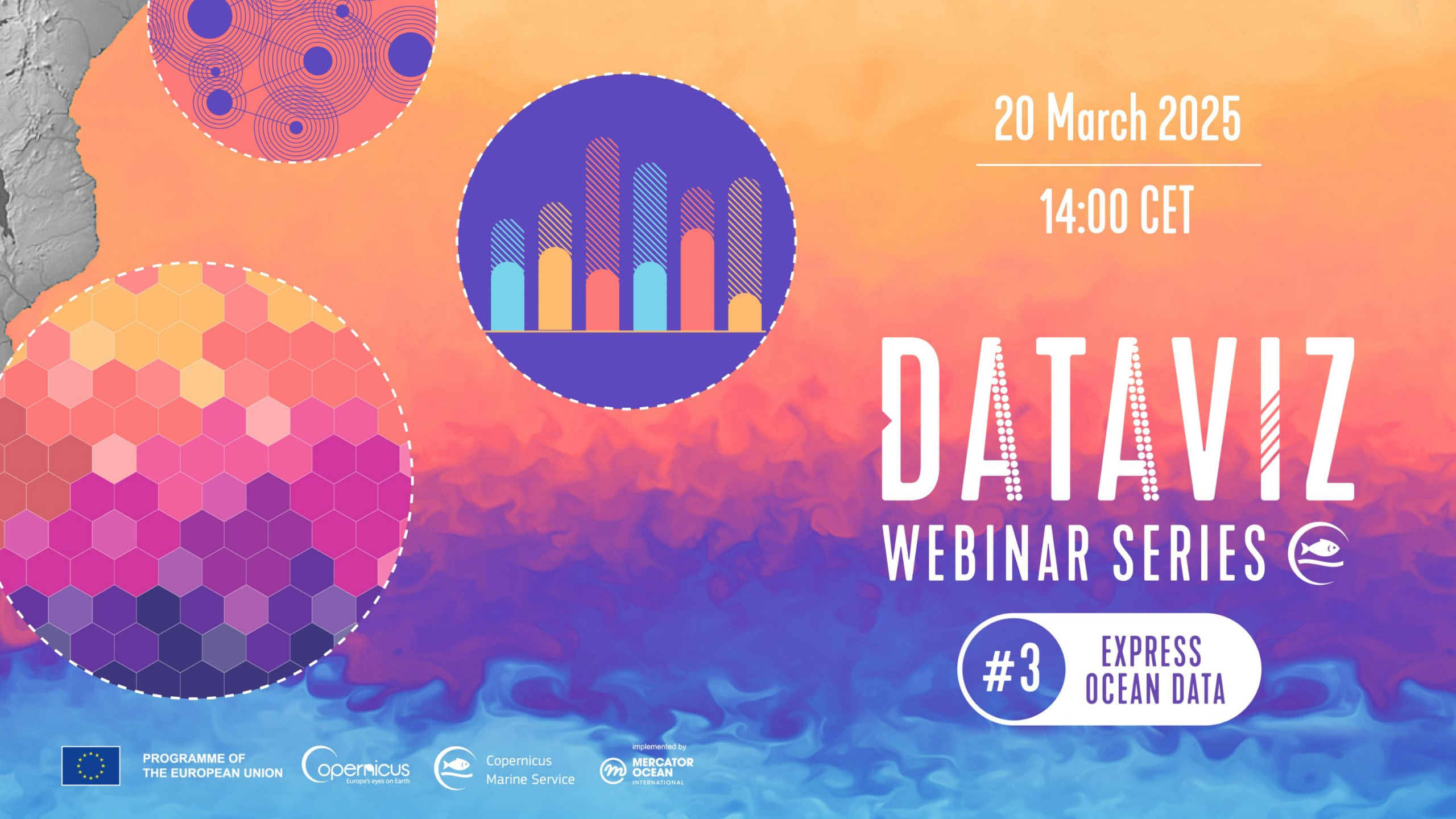

20 March 2025
14:00 CET
DATAVIZ
WEBINAR SERIES
#3
EXPRESS
OCEAN DATA
PROGRAMME OF
THE EUROPEAN UNION
Copernicus
Europe's eyes on Earth
Copernicus
Marine Service
implemented by
MERCATOR
OCEAN
INTERNATIONAL

Copernicus
Marine Service

#3 EXPRESS OCEAN DATA

Inspiration for
Data Visualisation
beyond the ordinary

1) Open Ocean Data
2) Open Source tools
3) Science & Creativity

OVERVIEW

I

Background

II

Importance of Data Visualisation

III

Open workflows for visualisations beyond the ordinary

IV

YOUR TURN

I.

Economics

Stats | Data

Geography | GIS

Art | Design

I.

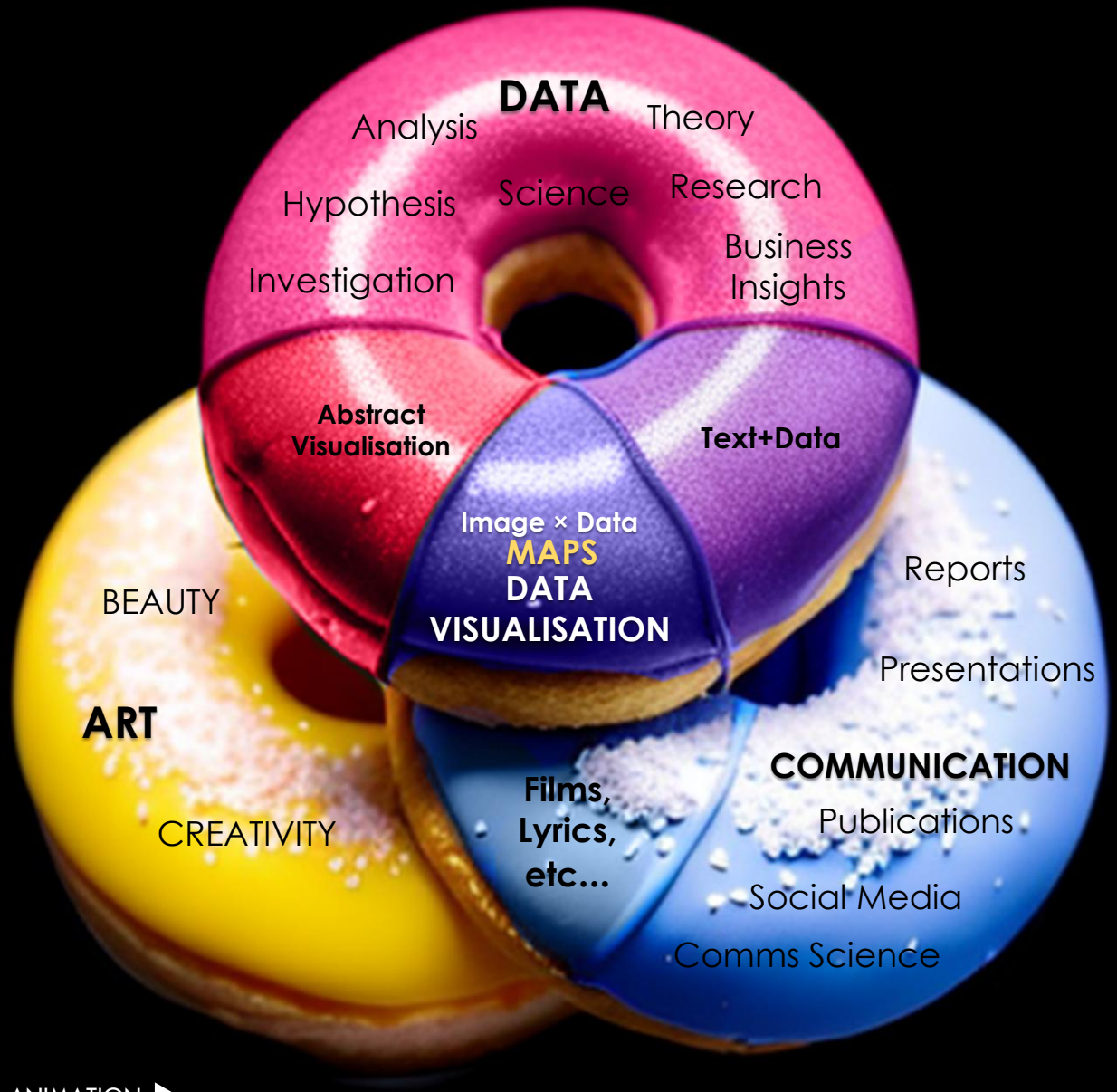
MULTIPLE HATS

- Researcher at UCL, London
- Freelancer: Data Science & Visualisation 3D / 2D
- Spatial Data Analyst
- Motion Graphics and Digital Art

MSc Urban Analytics and Smart Cities (UCL Bartlett CASA, London UK)

BSc Economics (ULB Solvay Brussels, Belgium)

II.



ANIMATION ▶

JULIAN HOFFMANN ANTON

The Spectrum of Dataviz | Maps

For
DATA
ANALYSIS

Exploration, analyse & convince **yourself or the team**

For
DATA
COMMUNICATION

- Understanding the data
- Sharing insights
- Explain to the viewer / user
- Engage with the audience
- Support decision making
- Convincing the **audience**
- Catch the attention
- Start a conversation
- Prove

For
ART

Sharing emotions, perspectives,

Creativity and beauty

For yourself

For audience

For
DATA
COMMUNICATION

II. WE WANT RESULTS !

BAD DATA	+	GOOD ANALYSIS	+	GOOD COMMUNICATION	=	WRONG RESULTS
GOOD DATA	+	BAD ANALYSIS	+	GOOD COMMUNICATION	=	WRONG RESULTS
GOOD DATA	+	GOOD ANALYSIS	+	BAD COMMUNICATION	=	**WEAK or NO RESULTS**
Copernicus Marine Service	+	GOOD ANALYSIS	+	GOOD DATA VISUALISATION	=	TRUE RESULTS

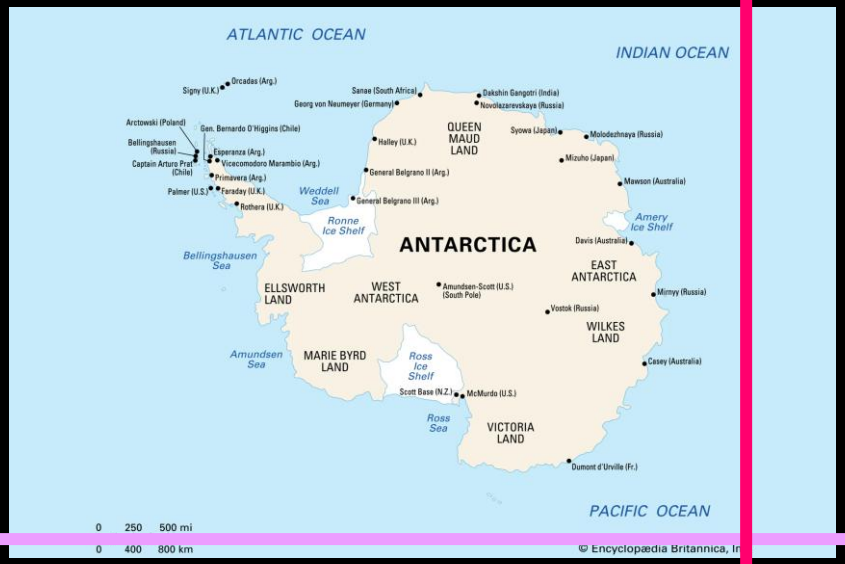
AUDIENCE

SCIENCE

BOTH

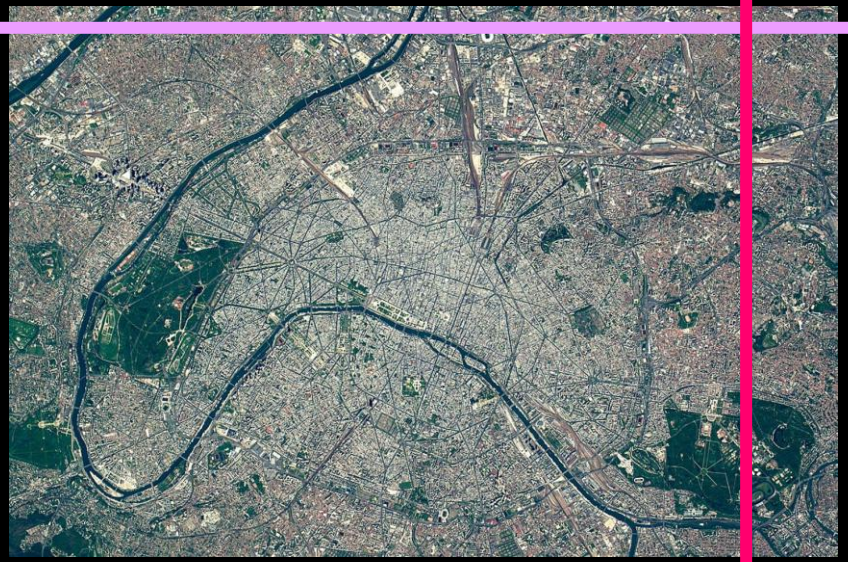
ART

SIMPLICITY



BALANCED

COMPLEXITY



Global Shipping Traffic Density

ANIMATION ▶

JULIAN HOFFMANN ANTON

Experimental visualisation with all observed ship movement from 2015-2020, at 500 m resolution from IMF's World Seaborne Trade Monitoring System & NASA's Black Marble satellite imagery. #30DayMapChallenge - Day 7 - Navigation - frame n°217 from animation, made in Blender. X: @Julian_h0ffmann

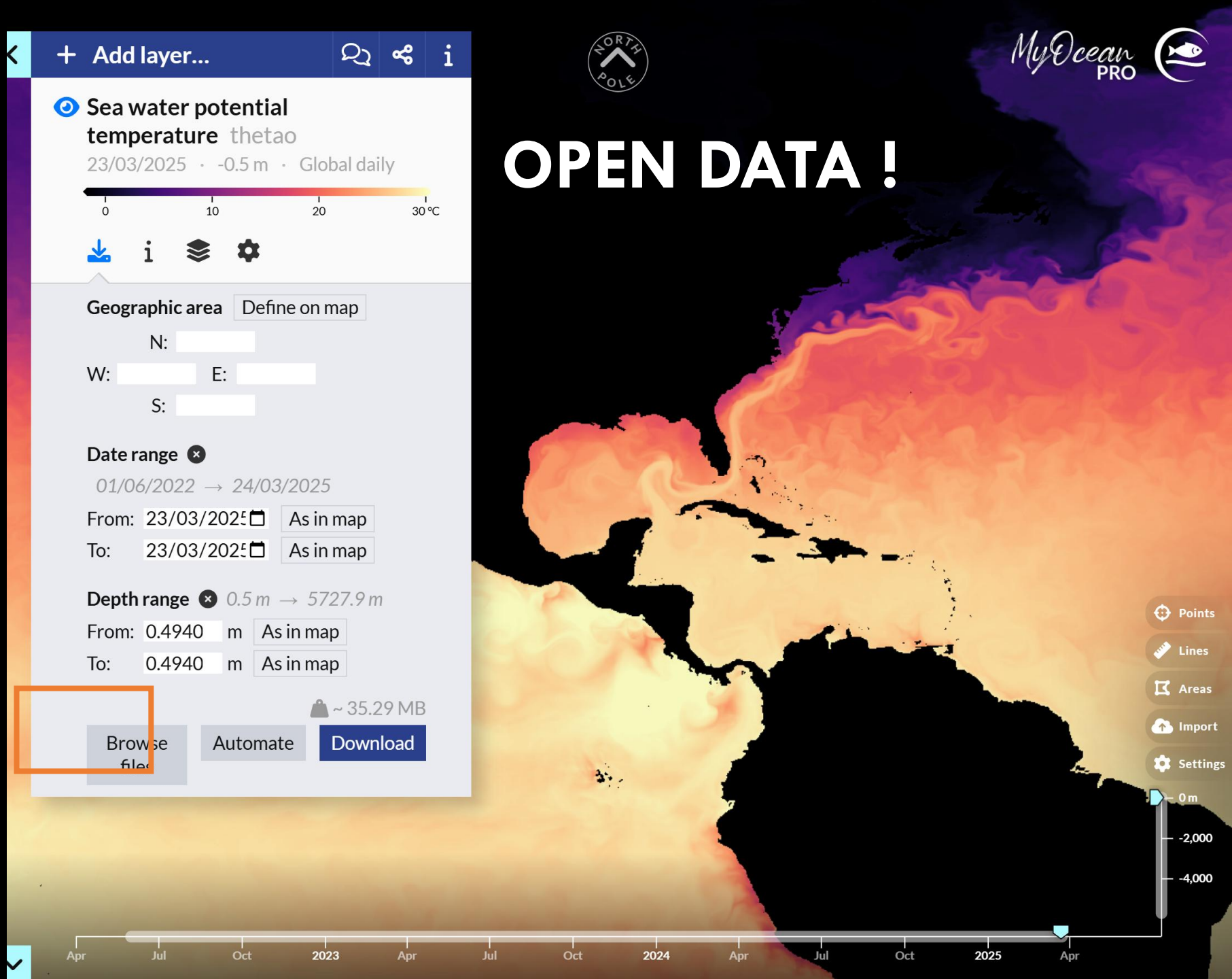
III.

GOAL: show possibilites of

1. Open Data + your data

2. Free Tools Open Source
+ your tools of choice

3. One step further to <u>stand out</u>
communicating Science effectively



Copernicus Marine Data Store

Copernicus Marine Service

Filters

FREE-TEXT SEARCH

wind

TIME RANGE

dd/mm/yyyy dd/mm/yyyy

Covering full interval

WITH DEPTH 4

DEPTH RANGE

UNIVERSE

- Blue Ocean 68
- White Ocean 6
- Green Ocean 3

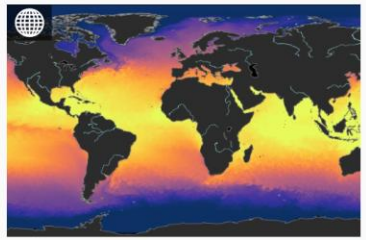
MAIN VARIABLES

- Carbonate system 3
- Mixed layer thickness 1
- Nutrients 2
- Optics 1
- Oxygen 2
- Plankton 2
- Salinity 1
- Sea ice 5
- Sea surface height 6
- Temperature 14
- Velocity 22
- Wave 26
- Wind 18

AREA

- Global Ocean 24
- Arctic Ocean 11

Products 73



Global Ocean Physics Analysis and Forecast

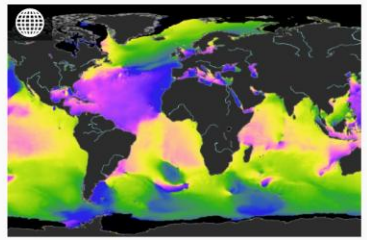
GLOBAL_ANALYSISFOR... 001_024

Models

Global, 0.083° × 0.083° × 50 levels

1 Nov 2020 to 25 Mar 2025,...

Temperature, salinity, sea surface



Global Ocean Waves Analysis and Forecast

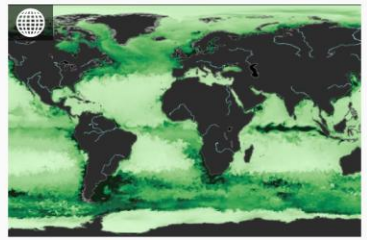
GLOBAL_ANALYSISFOR... 001_027

Models

Global, 0.083° × 0.083°

1 Nov 2022 to 25 Mar 2025,...

Velocity, wave



Global Ocean Biogeochemistry...

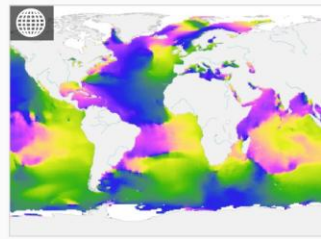
GLOBAL_ANALYSISFOR... 001_028

Models

Global, 0.25° × 0.25° × 50 levels

1 Oct 2021 to 21 Mar 2025, daily...

Plankton, nutrients, oxygen,



Global Ocean Waves Reanalysis

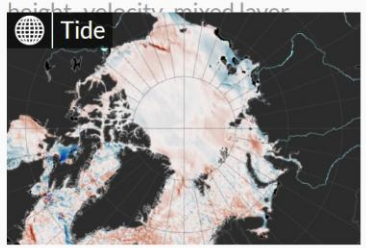
GLOBAL_MULTIYEAR_... 001_

Models

Global, 0.2° × 0.2°

1 Jan 1980 to 31 Jan 2025, hou

Velocity, wave



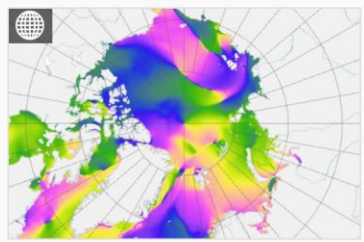
Arctic Ocean Tidal Analysis and Forecast

ARCTIC_ANALYSISFORE...002_015

Models

Arctic, 3 × 3 km

Since 19 Dec 2017, sub-hourly



Arctic Ocean Wave Hindcast

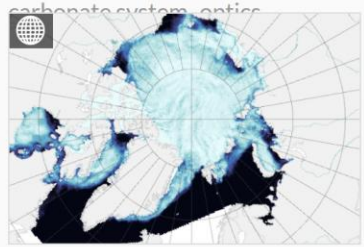
ARCTIC_MULTIYEAR_W... 002_013

Models

Arctic, 3 × 3 km

1 Jan 1977 to 30 Nov 2022,...

Velocity, wave, sea ice



Arctic Ocean Sea Ice Reanalysis

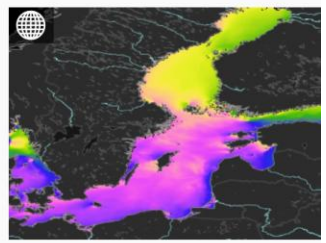
ARCTIC_MULTIYEAR_P... 002_016

Models

Arctic, 3 × 3 km

1 Jan 1993 to 31 Dec 2023, hour...

Velocity, wave, sea ice



Baltic Sea Wave Analysis and Forecast

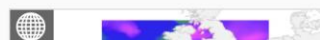
BALTICSEA_ANALYSISF... 003_

Models

Baltic, 2 × 2 km

1 Oct 2021 to 24 Mar 2025,...

Velocity, wave



Copernicus Marine Service

Many tutorials online

Tools to read Open Data in NetCDF format

Libraries: ncdf4, rhdf5, terra, etc

Packages: ncdf4, etc.

QGIS plugin Netcdf

blender

Or after analysis as raster tif, png, svg, jpg, csv

III. WHERE CAN **YOU** ADD THINGS TO YOUR CURRENT WORKFLOW?

LONG PROCESS IN SHORT :

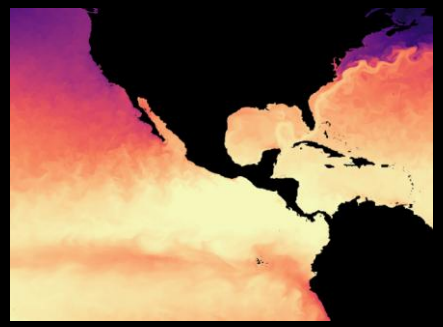
Data

Analysis/ GIS/ 2D Visualisation

ISO3 Alpha-code	ISO2 Alpha-code	SDMX code**	Type	Parent code	Year	Total Population, as of 1 January (thousands)
ZWE	ZW	716	Country/	910	1950	2 746
ZWE	ZW	716	Country/	910	1951	2 836
ZWE	ZW	716	Country/	910	1952	2 927
ZWE	ZW	716	Country/	910	1953	3 020
ZWE	ZW	716	Country/	910	1954	3 116
ZWE	ZW	716	Country/	910	1955	3 213
ZWE	ZW	716	Country/	910	1956	3 314
ZWE	ZW	716	Country/	910	1957	3 417
ZWE	ZW	716	Country/	910	1958	3 524

```r
## ---- NEW BOUBBLE CENTRES ----
    #### ---- LOOP FOR MAP CREATION ----
    # Set number of iterations
    num_iters <- 157

for (i in 7:num_iters) {
  #local_max <-max(hot_world_sf_wide %>% as_tibble() %>% select(colnames(hot_world_sf_wide)[i]))

  pop_dorling_cartogram <- cartogram_dorling(hot_world_sf_wide%>%
                                               st_transform(crs ="+proj=eqc +datum=WGS84"),
                                             colnames(hot_world_sf_wide)[i], k=3)

  pop_dorling_cartogram_sp <- as(pop_dorling_cartogram, "Spatial")

  circle_centres_sp <- SpatialPointsDataFrame(gCentroid(pop_dorling_cartogram_sp, byid = TRUE),
                                              pop_dorling_cartogram_sp@data,
                                              match.ID = FALSE
  )


  # choose Robinson projection
  circle_centres_sp <- spTransform(circle_centres_sp, CRS = ("+proj=eqc"))


  circle_centres_sf <- circle_centres_sp %>% st_as_sf(region = "ISO3", keep = T)
```

Netcdf, CSV, .SHP



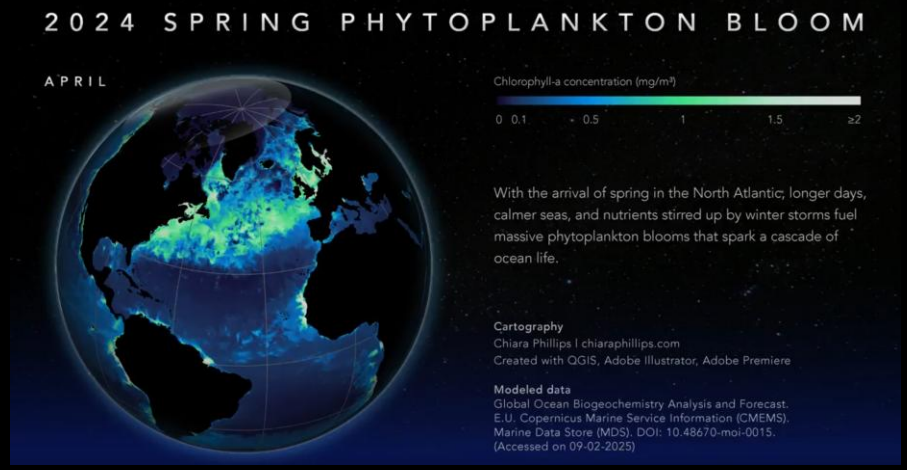
Copernicus Marine Service

EXPORT IN THE RIGHT FORMATS:
.SVG or .PNG, ,TIF, etc.

IT'S WORTH to enhance your work with free vector & image editing software for a final touch

Webinar 2:

by Chiara Phillips!



Webinar 3:

today

Or test meaningful 3D Visualisations and animations in Blender

Softare to produce my work for FREE (or similar payed alternatives)

non - exhaustive list !

MS Excel

FREE Analytics

- R - RStudio
- Python - Jupyter, Spyder
- Google Sheets
- etc.

Photoshop

FREE Image editor

- GIMP
- Paint.NET
- Krita
- Photopea
- Darktable

AfterEffects

FREE Video & Effects

- DavinciResolve
- Blender + 3D VFX
- etc.

Notion

FREE Note Taking & Planning, Lists & Organising

ArcGIS

FREE GIS

- QGIS
- R - RStudio
- Python - Jupyter, Spyder
- etc.

Illustratior

FREE Vector Graphics editor

- Inkscape
- BoxySVG
- Vectr
- Krita

ChatGPT pro

FREE Assistant

- ChatGPT
- Bing Chat
- etc.

Midjourney

FREE Generative AI

- Stablediffusion
- Dall-e
- etc.

3D Beauty = More impact?

CONS

I. OFTEN TAKES **MORE TIME TO CREATE** (NOT ALWAYS!)

II. CAN BE **TERRIBLY UNECESSARY** **(if it doesn‘t add anything)**

III. CAN BE **TRULLY COUNTERPRODUCTIVE** **(if done badly)**

IV. Please, use it wisely or for fun, don‘t use 3D without reason, or just call me.

3D Beauty = More impact ?

PROs

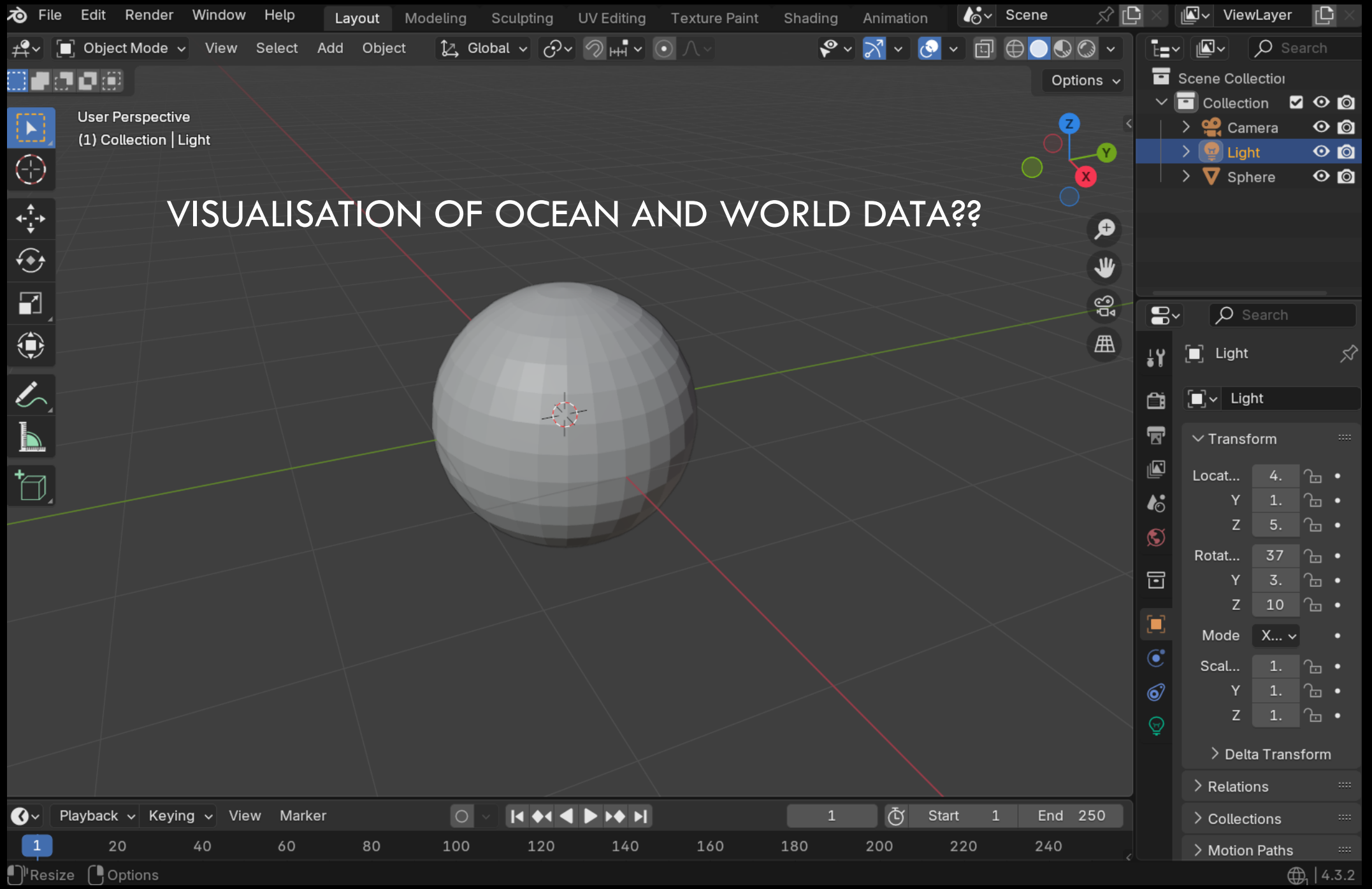
- WE ARE **SPATIAL BEINGS LIVING IN A 3D WORLD**
- More memorable in a fast-paced world
- Awaken emotions and senses
- Compelling (short attention span of humans)
- Drives curiosity
- More entertaining
- Attractive
- More dimensions to play with
- Art = ART

- Emotional and involves feelings
- Can add Beauty and Style
- Infinity of angles
- An Incentive to explore !
- More accessible
- Realistic & physical: Intriguing
- Cinematic & cool
- Playful
- Innovative
- „Feel the insights“
- „Nourishing the mind“
- „Savour the insights“

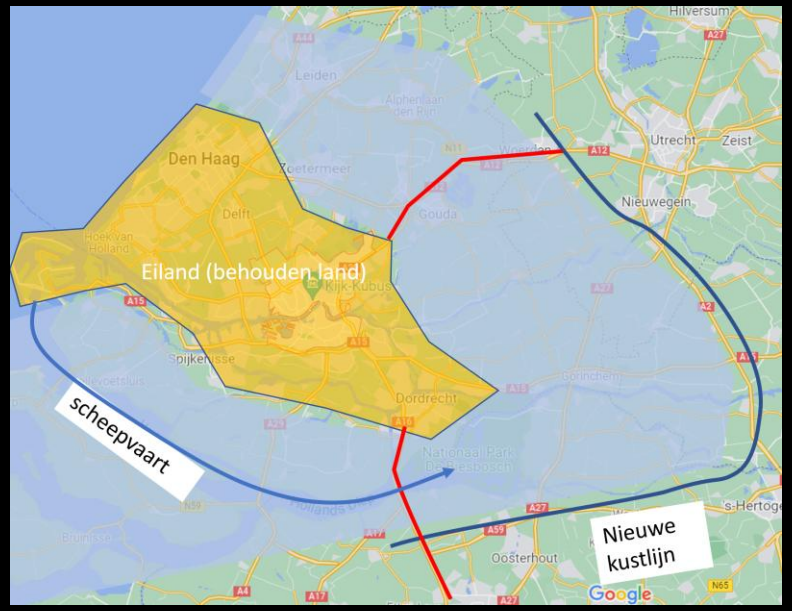
... The list goes on

Open-source

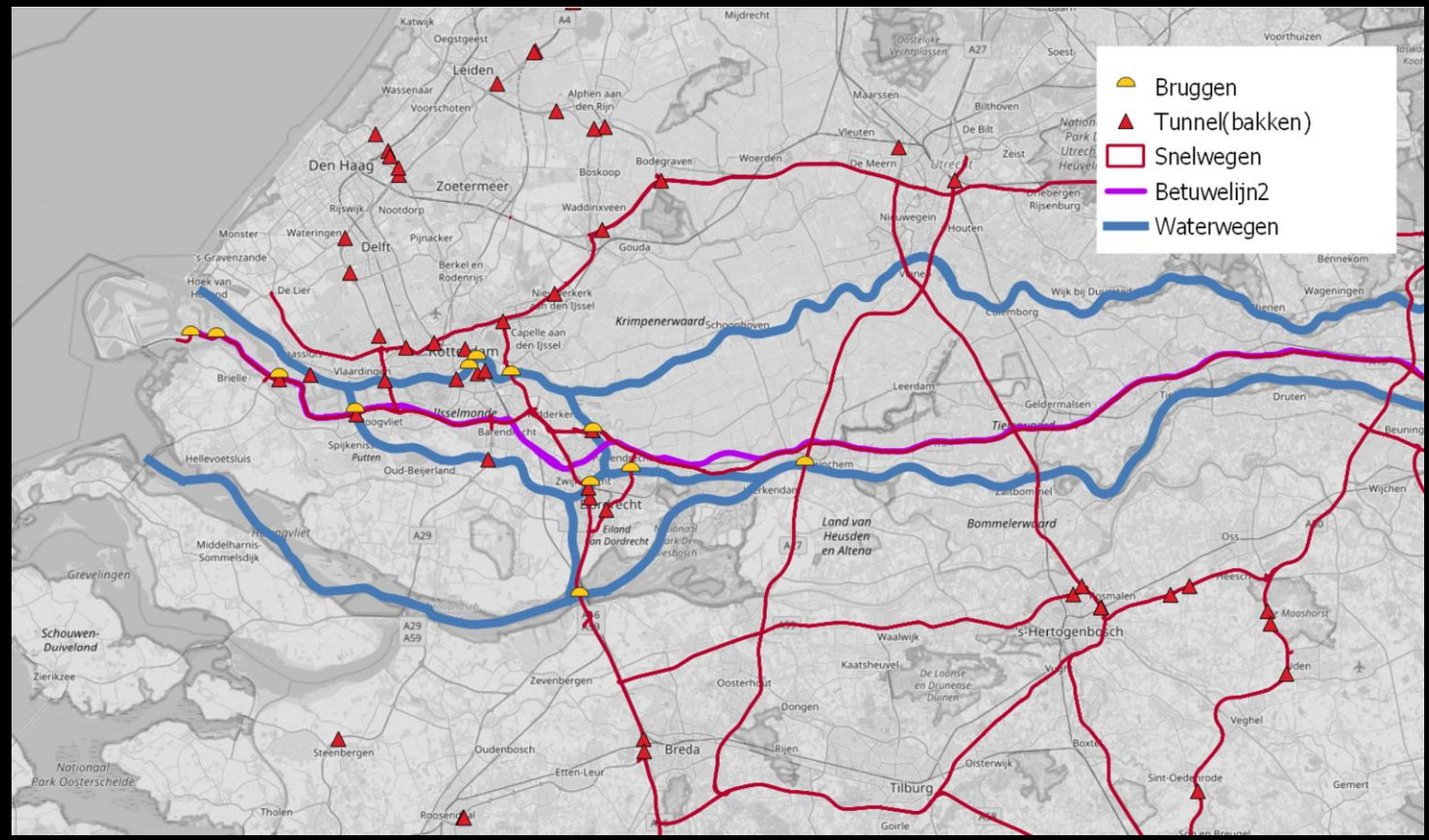
3D Software

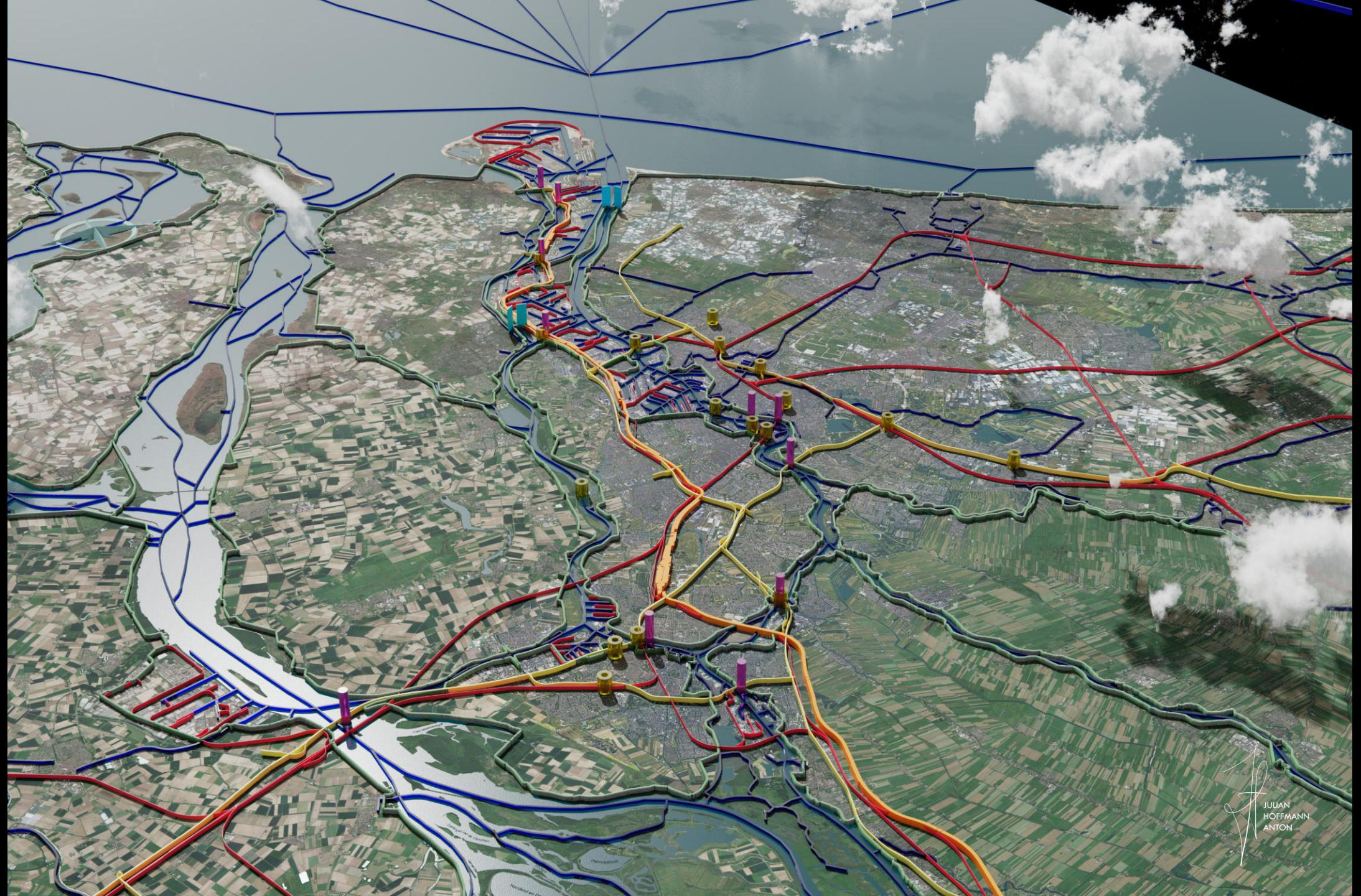


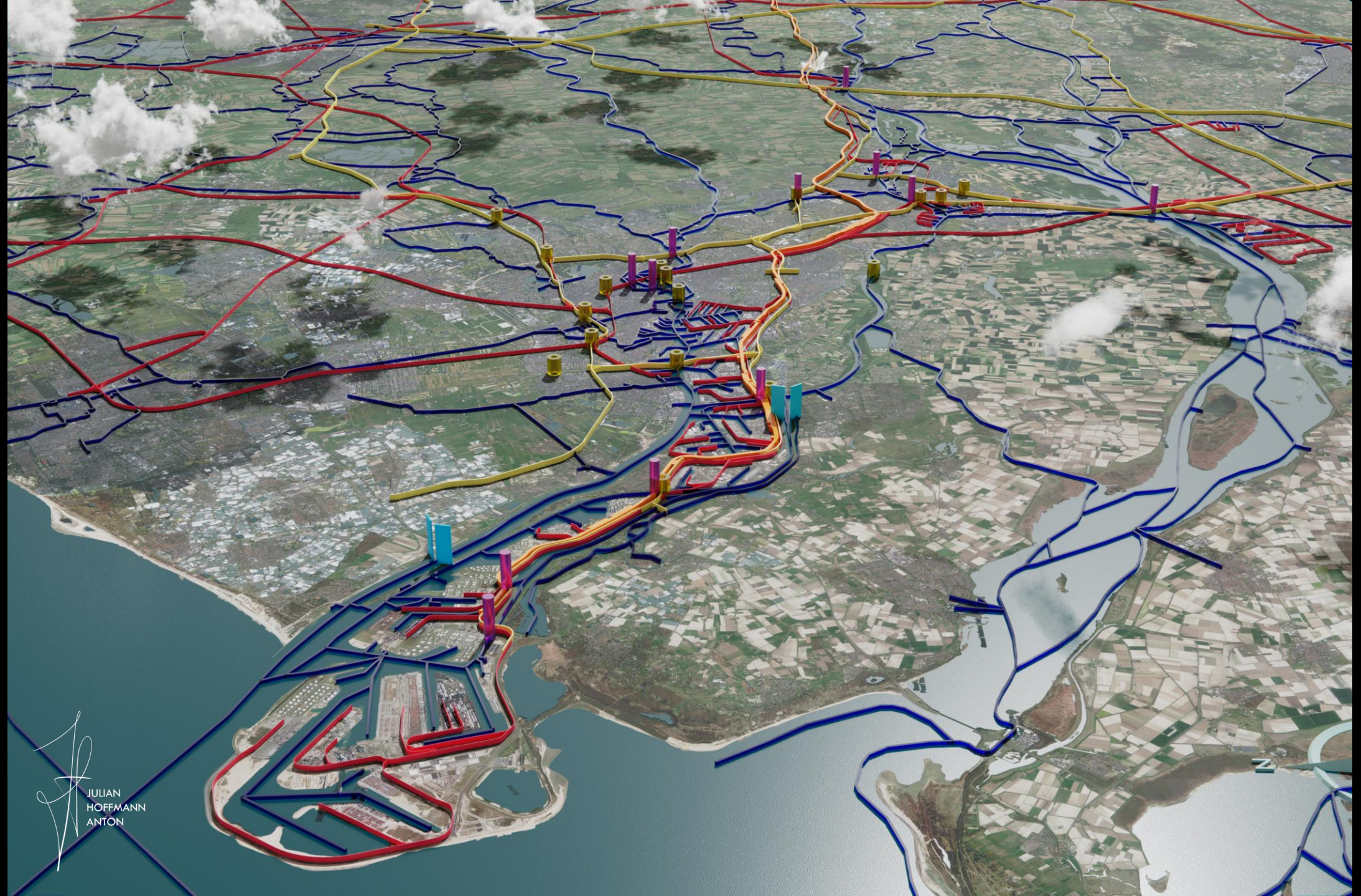
AUDIENCE?

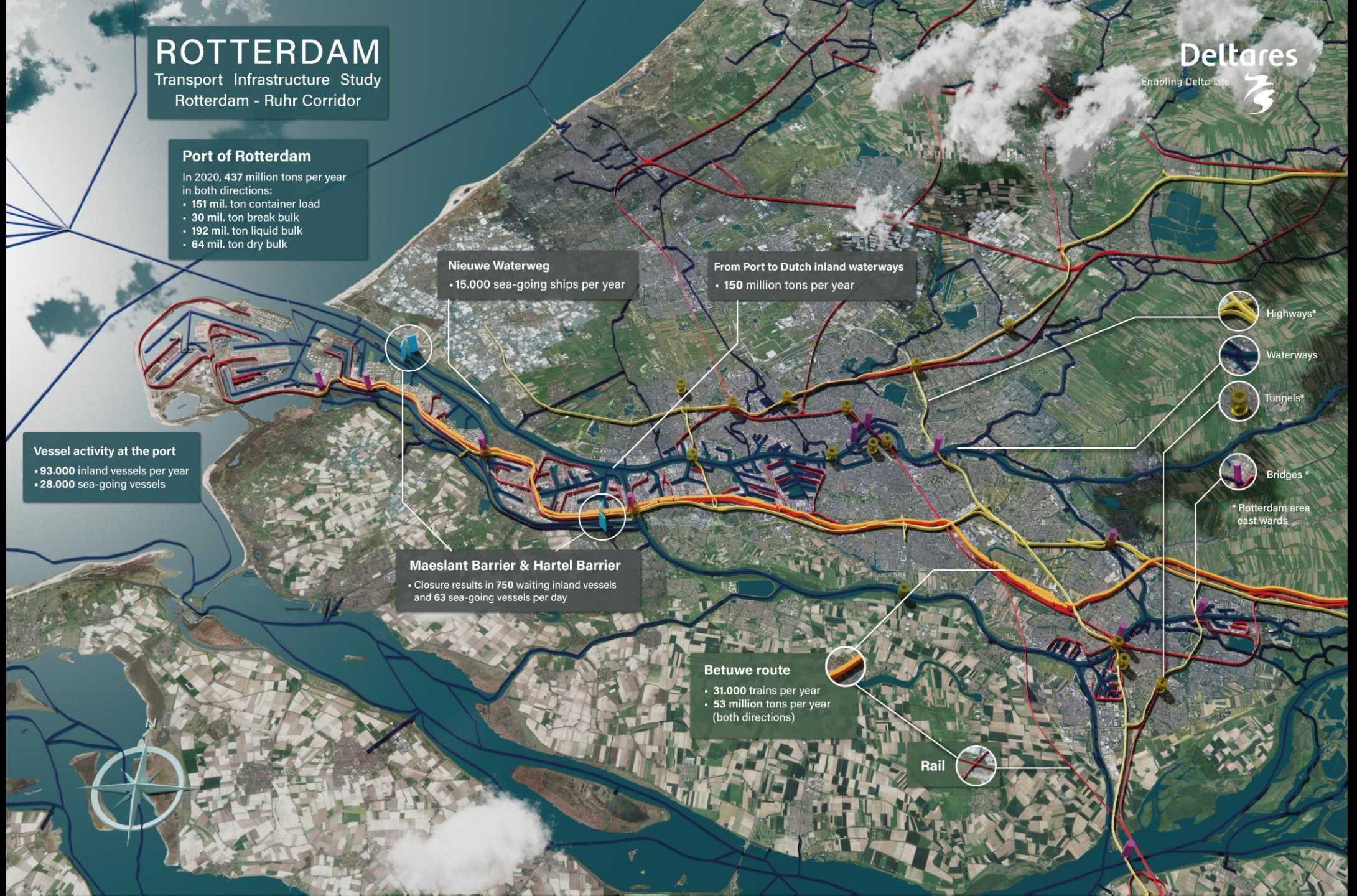


SEA RISE, Climate change and flooding scenarios
EXAMPLE CASE:
in Rotterdam for Deltares, a brilliant Dutch thinktank



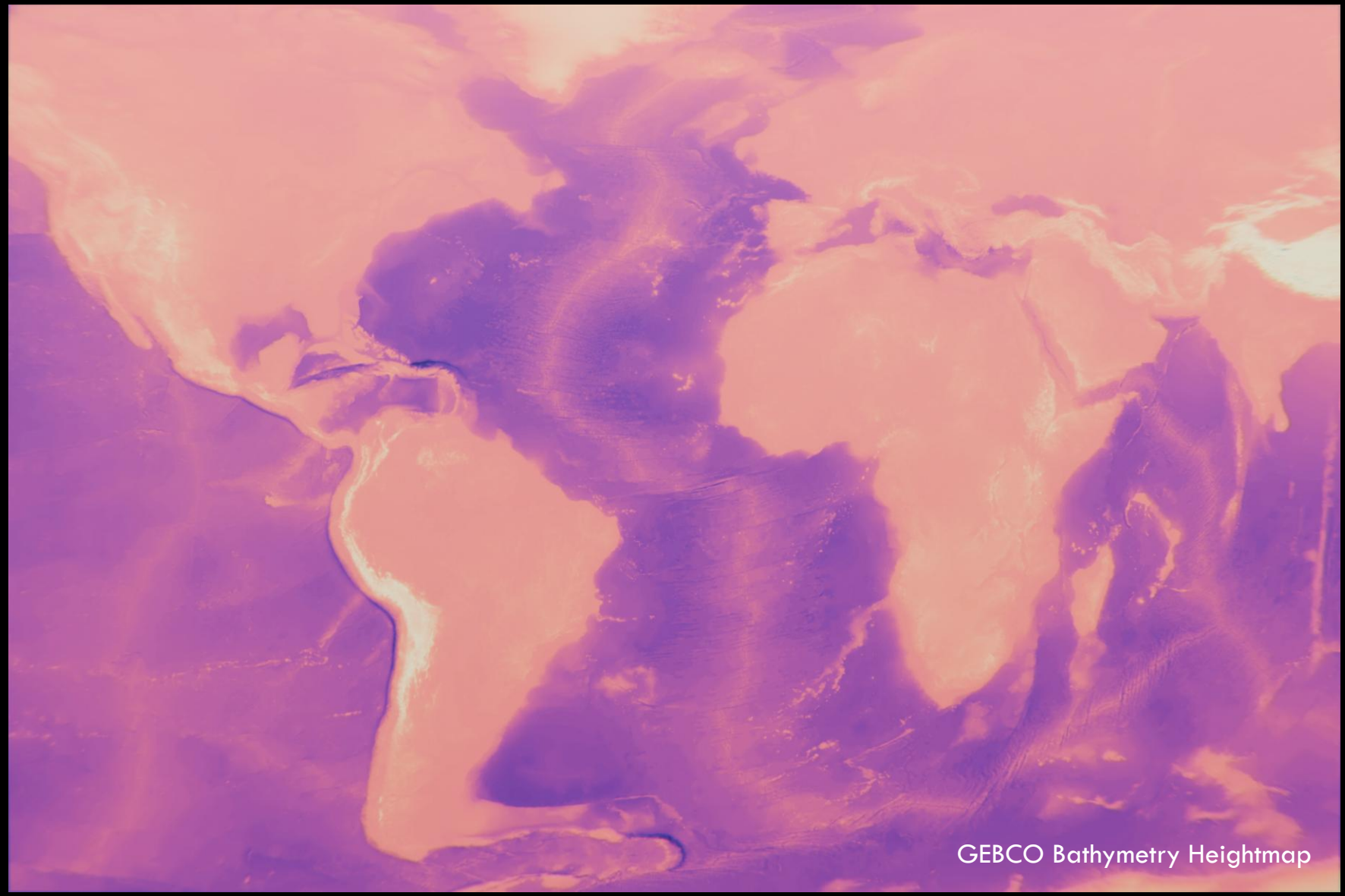

JULIAN
HOFFMANN
ANTON


JULIAN
HOFFMANN
ANTON
N

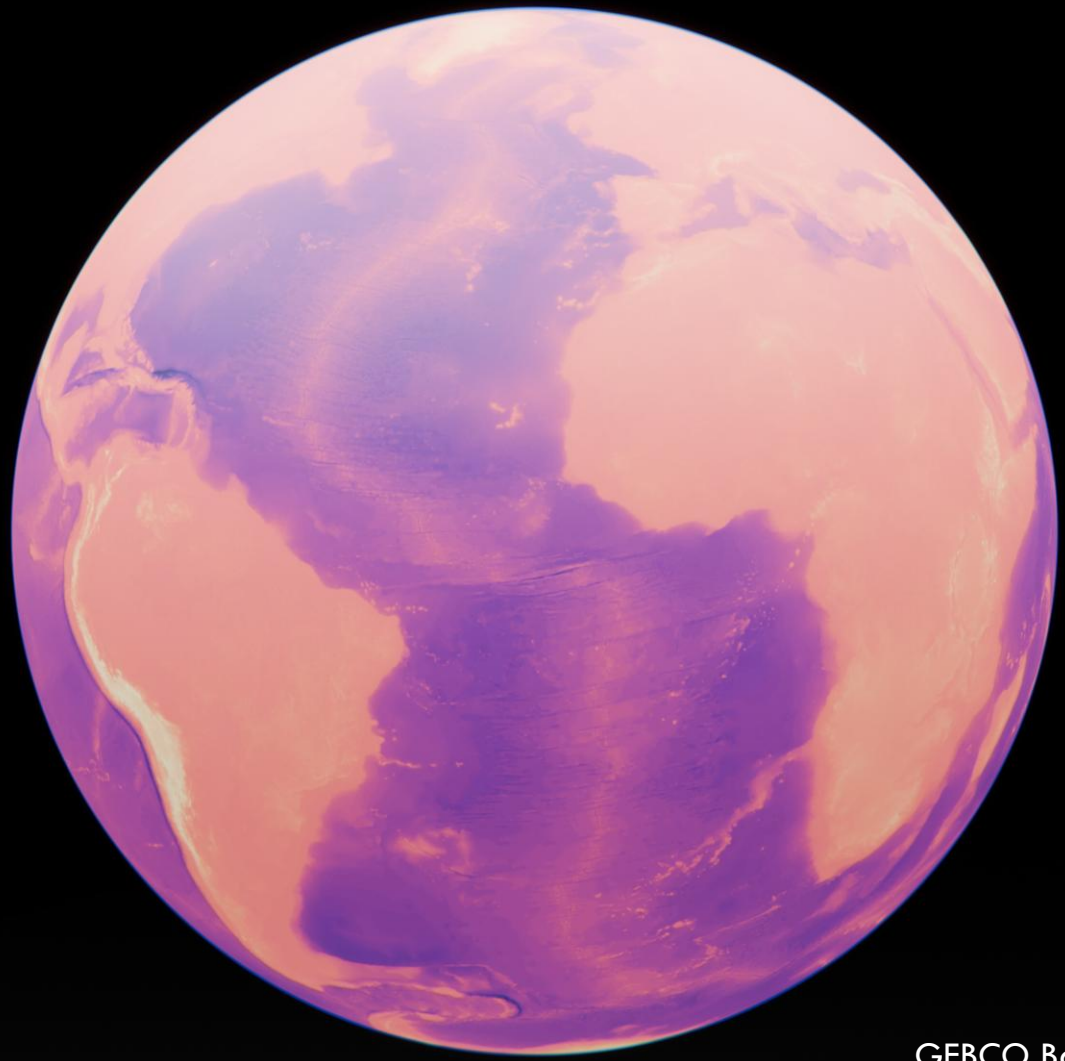

ROTTERDAM
Transport Infrastructure Study
Rotterdam - Ruhr Corridor
Deltares
Enabling Delta Life
Port of Rotterdam
In 2020, 437 million tons per year in both directions:
• 151 mil. ton container load
• 30 mil. ton break bulk
• 192 mil. ton liquid bulk
• 64 mil. ton dry bulk
Nieuwe Waterweg
• 15.000 sea-going ships per year
From Port to Dutch inland waterways
• 150 million tons per year
Highways*
Waterways
Tunnels*
Bridges *
* Rotterdam area east wards
Vessel activity at the port
• 93.000 inland vessels per year
• 28.000 sea-going vessels
Maeslant Barrier & Hartel Barrier
• Closure results in 750 waiting inland vessels and 63 sea-going vessels per day
Betuwe route
• 31.000 trains per year
• 53 million tons per year (both directions)
Rail
N

Open Ocean and Planet Data: Pathymetry and Topography

The right colour palette matters!



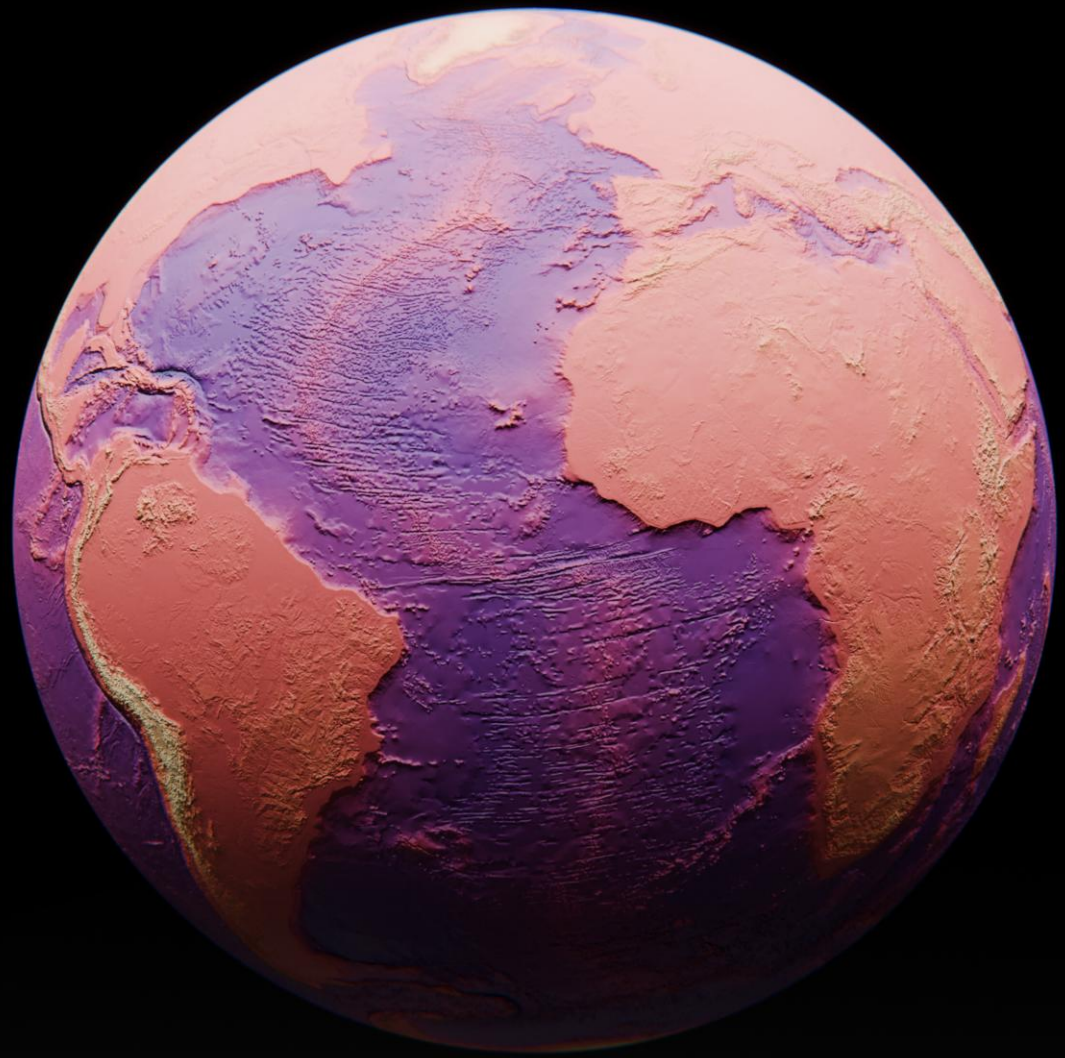
Global shape with less projection distortion?



GEBCO Bathymetry Heightmap

Exaggerated the geographic features, improved lighting,

creating physical illusion and realism



Exaggerated GEBCO Bathymetry Heightmap

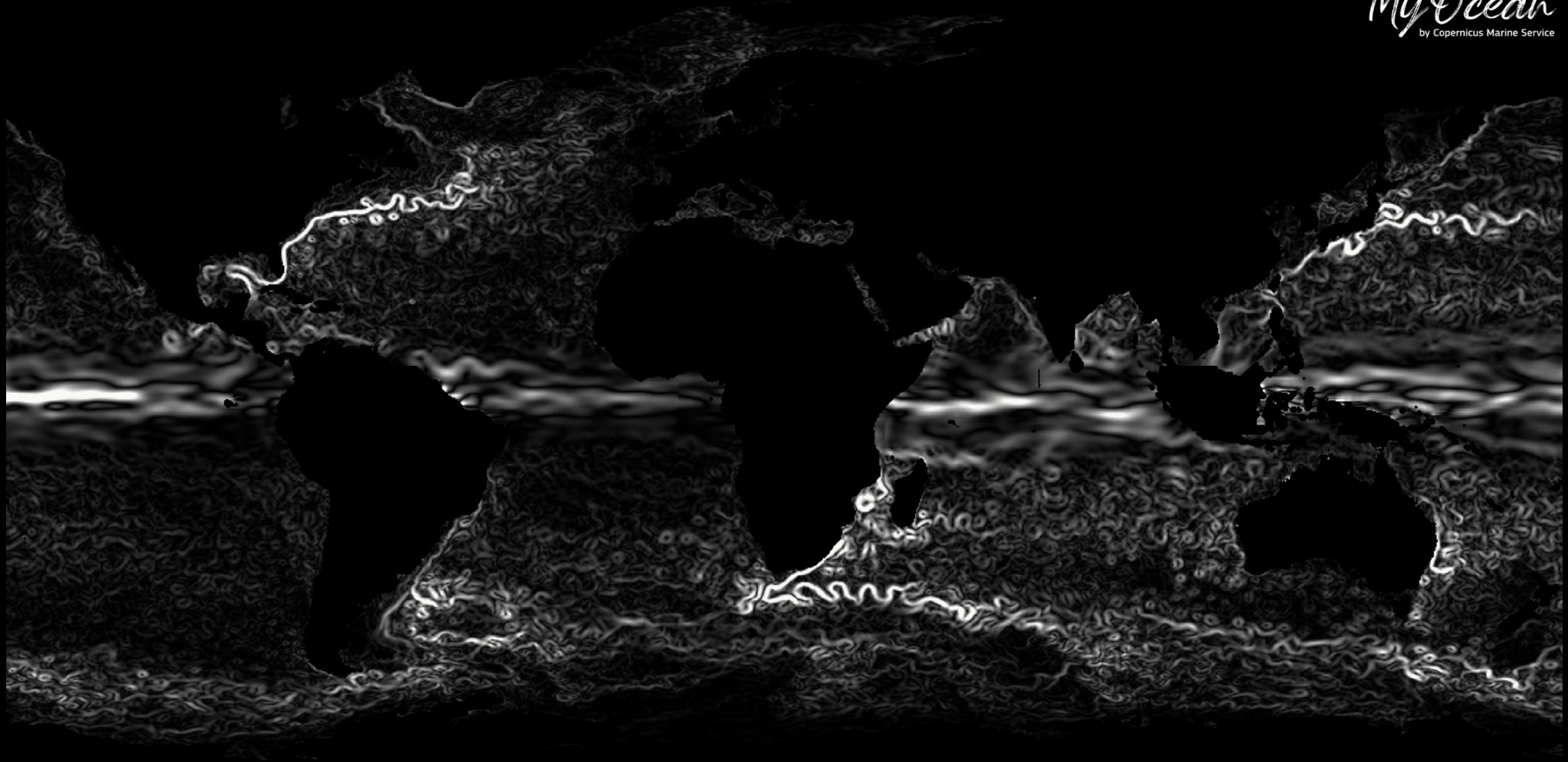
Ocean Bathymetry
&
Land Topography

ANIMATION ▶

JULIAN
HOFFMANN
ANTON

Exaggerated GEBCO Bathymetry Heightmap

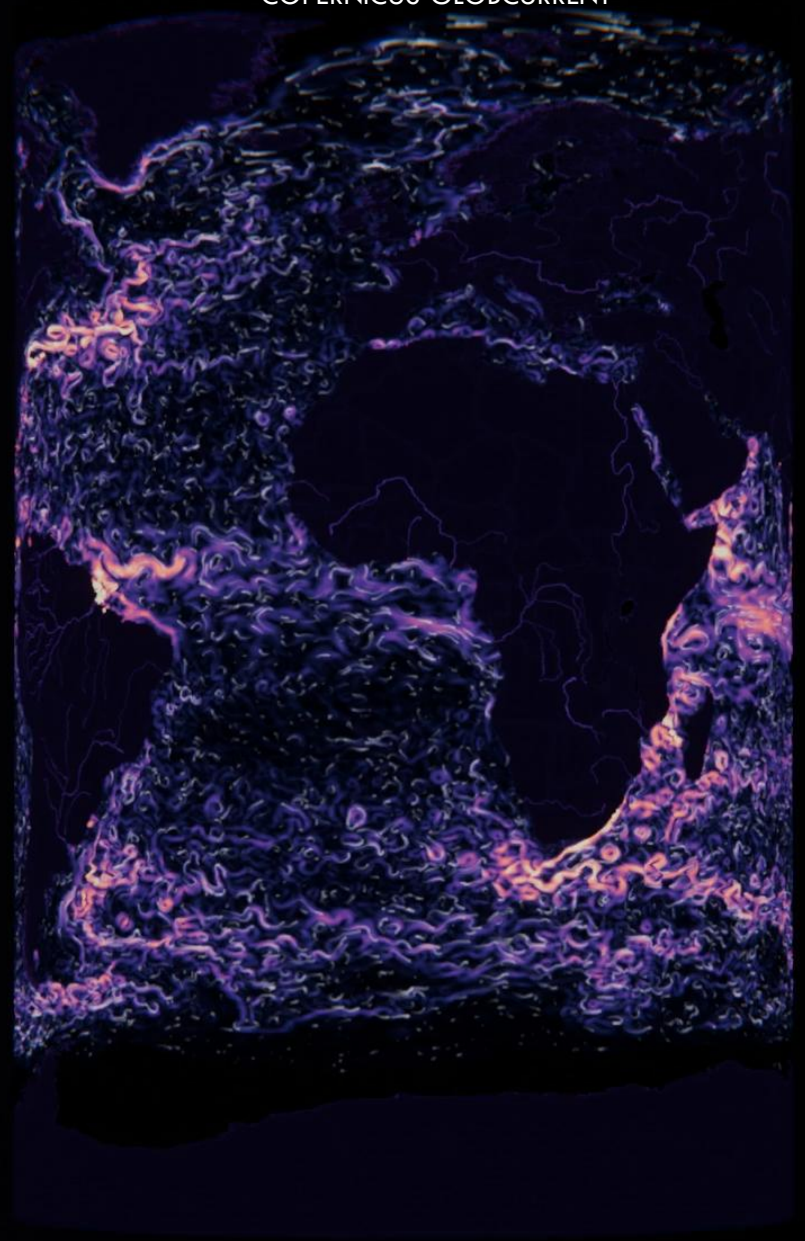
LET'S PUT THE WATER BACK IN : COPERNICUS-GLOBCURRENT!



Copernicus Marine Service – Geostrophy Sea water (ocean circulation data)
Ekman and Geostrophic currents at the Surface and 15m 10.48670/mds-00327

COPERNICUS-GLOBCURRENT

Copernicus Marine Service



ANIMATION ▶

Surface geostrophic sea water velocity m/s

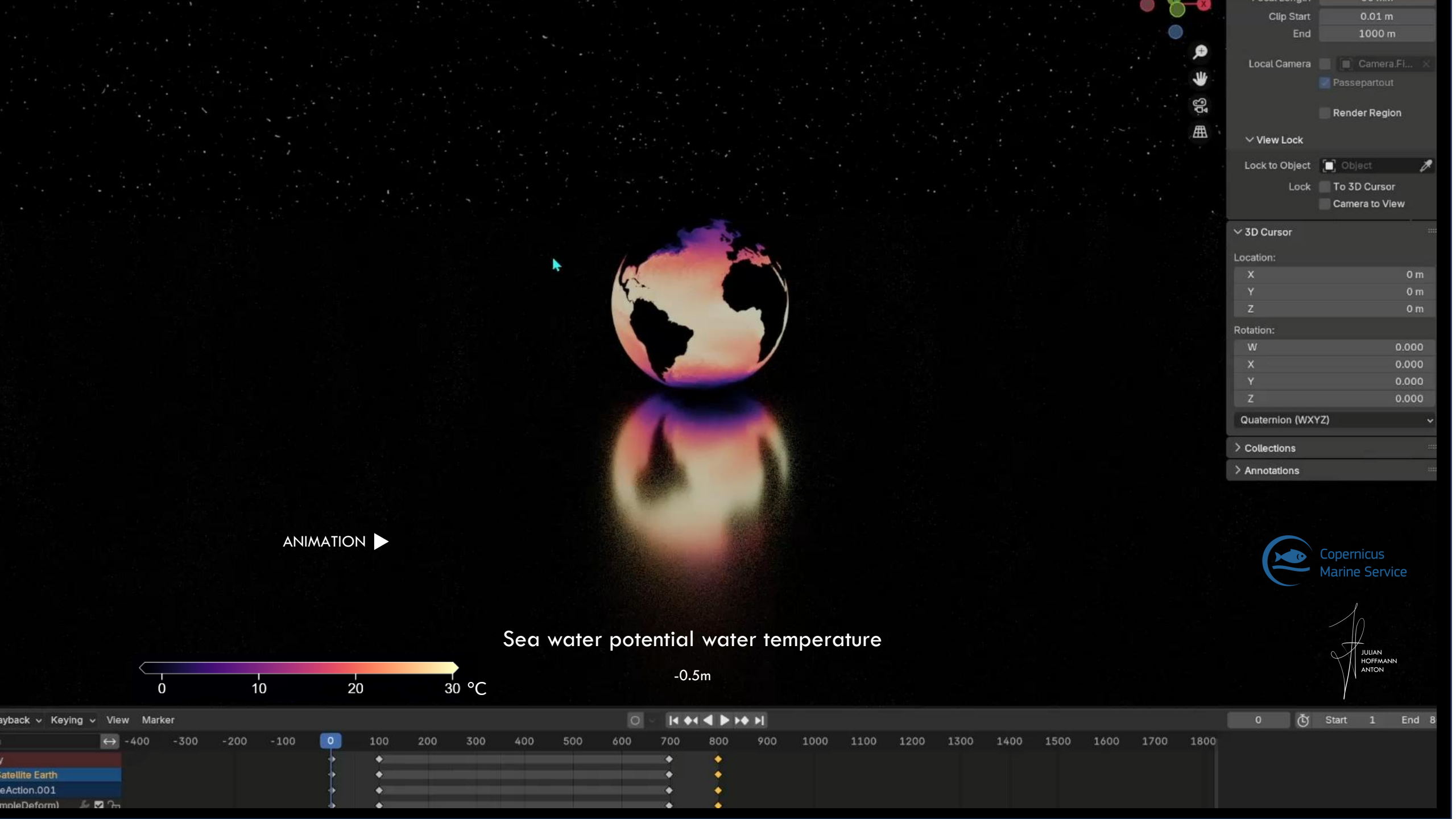
0 0.5 1

Copernicus Marine Service – Geostrophy Sea water (ocean circulation data)
Ekman and Geostrophic currents at the Surface and 15m 10.48670/mds-00327

Sea water potential water temperature

-0.5m

Global Ocean Physics Analysis and Forecast – DOI - 10.48670/moi-00016

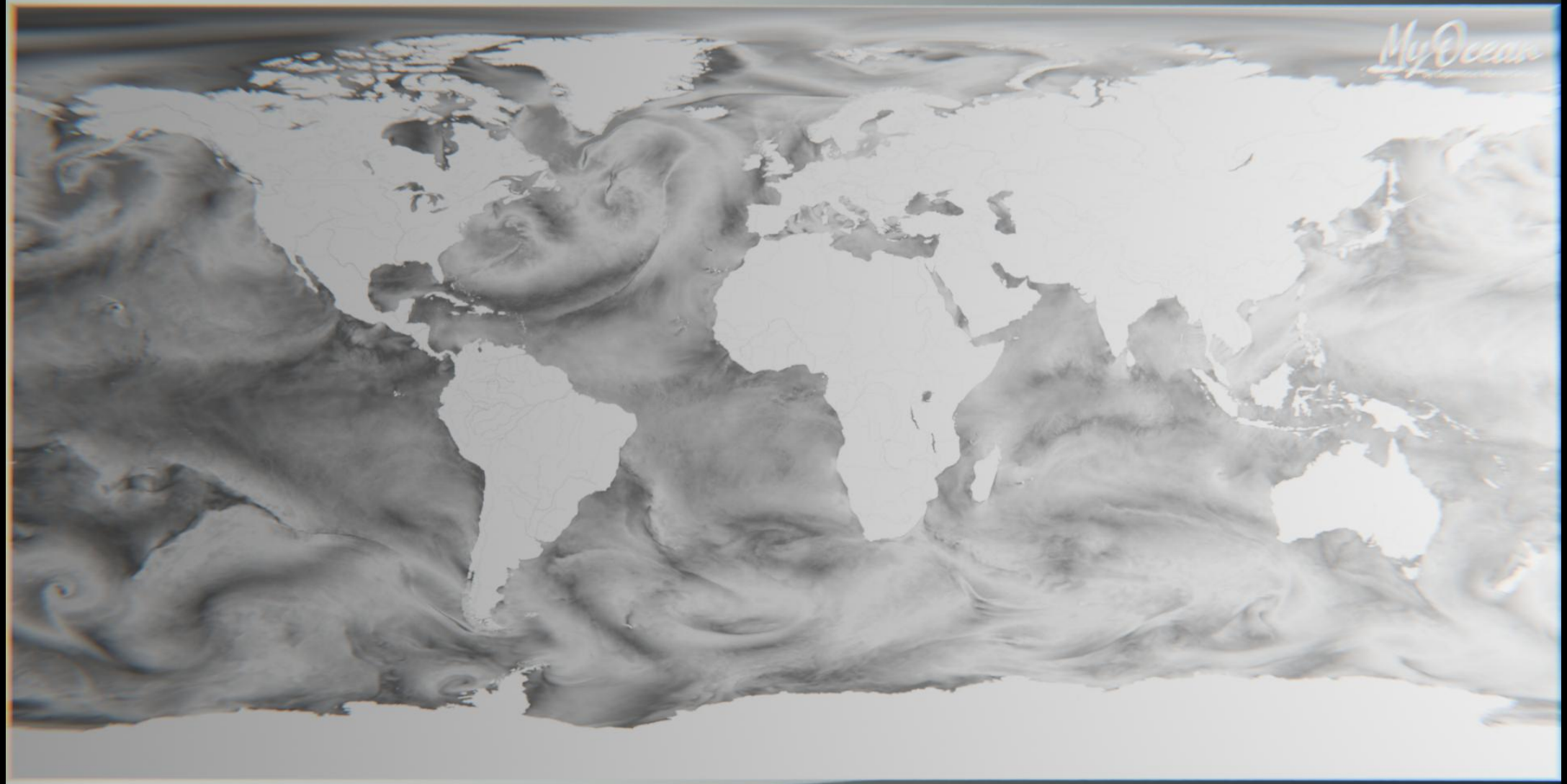

Clip Start 0.01 m
End 1000 m
Local Camera
Camera.Fi...
Passepartout
Render Region
View Lock
Lock to Object
Object
Lock
To 3D Cursor
Camera to View
3D Cursor
Location:
X 0 m
Y 0 m
Z 0 m
Rotation:
W 0.000
X 0.000
Y 0.000
Z 0.000
Quaternion (WXYZ)
Collections
Annotations
ANIMATION
Copernicus Marine Service
Sea water potential water temperature
-0.5m
0 10 20 30 °C
JULIAN HOFFMANN ANTON
Keying View Marker
Start 1 End
-400 -300 -200 -100 0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800
Satellite Earth
eAction.001

ONE LAST ONE

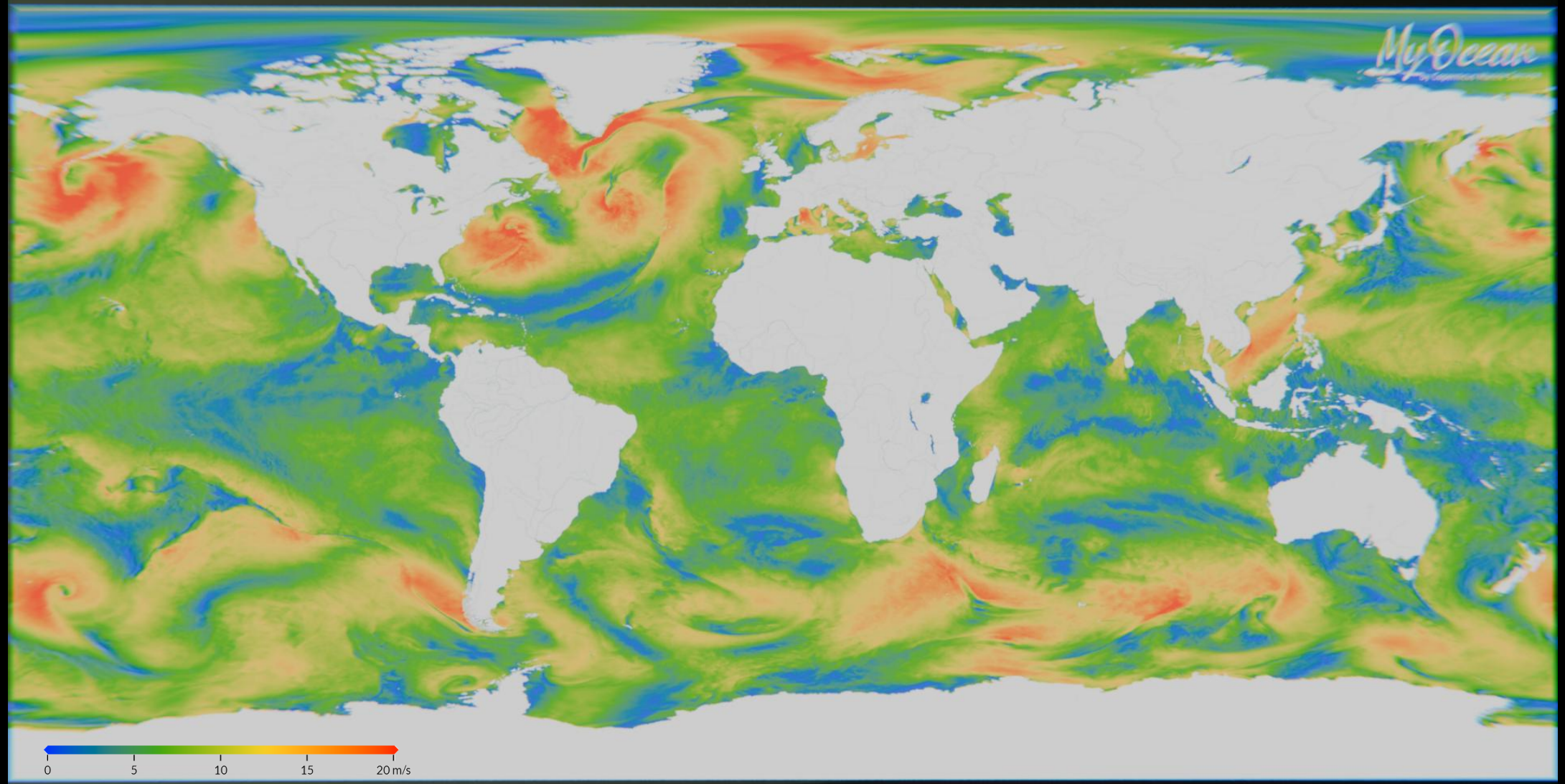
GLOBAL WIND SPEED ?

WIND SPEED ?

Copernicus Marine Service

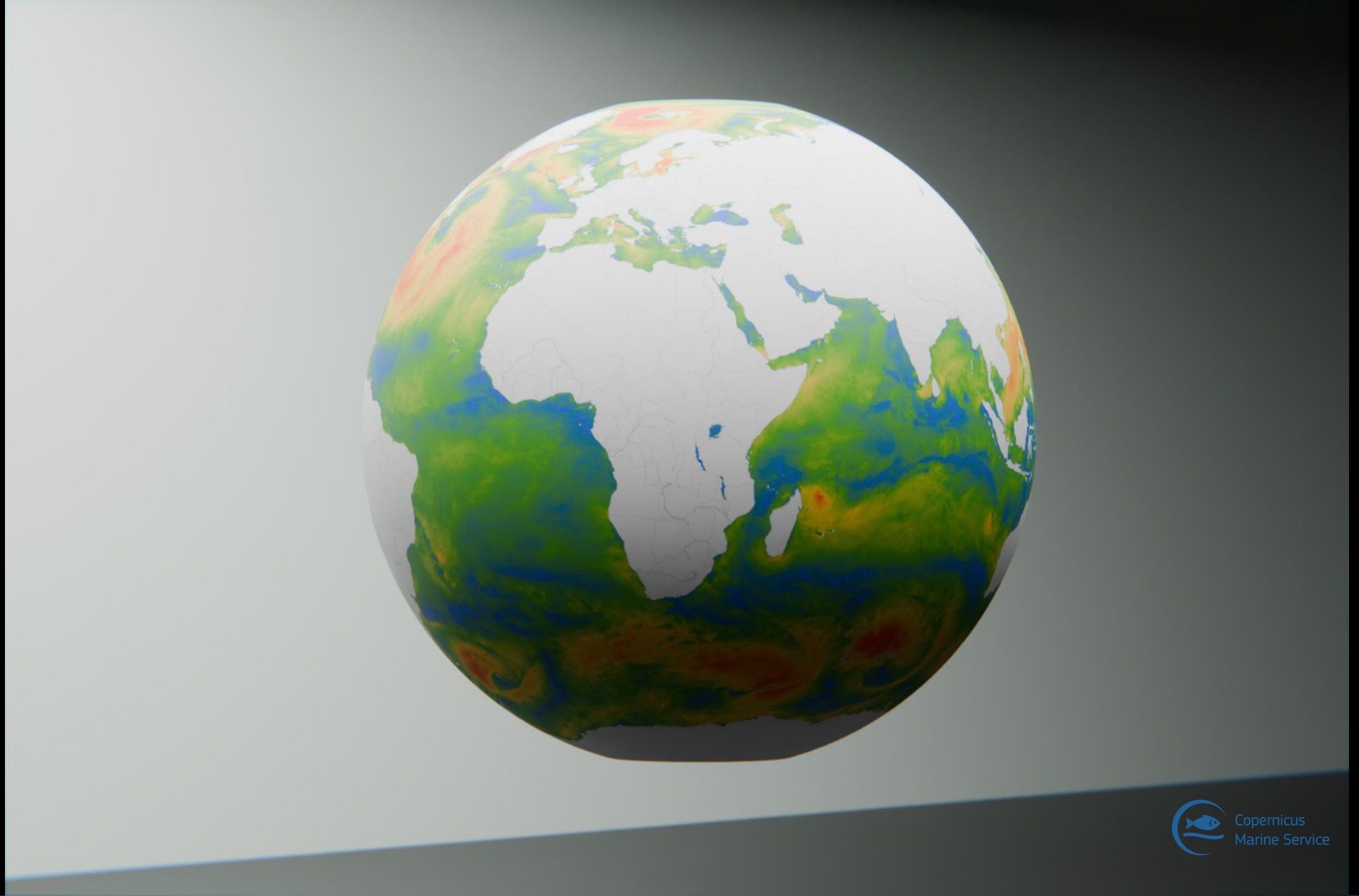


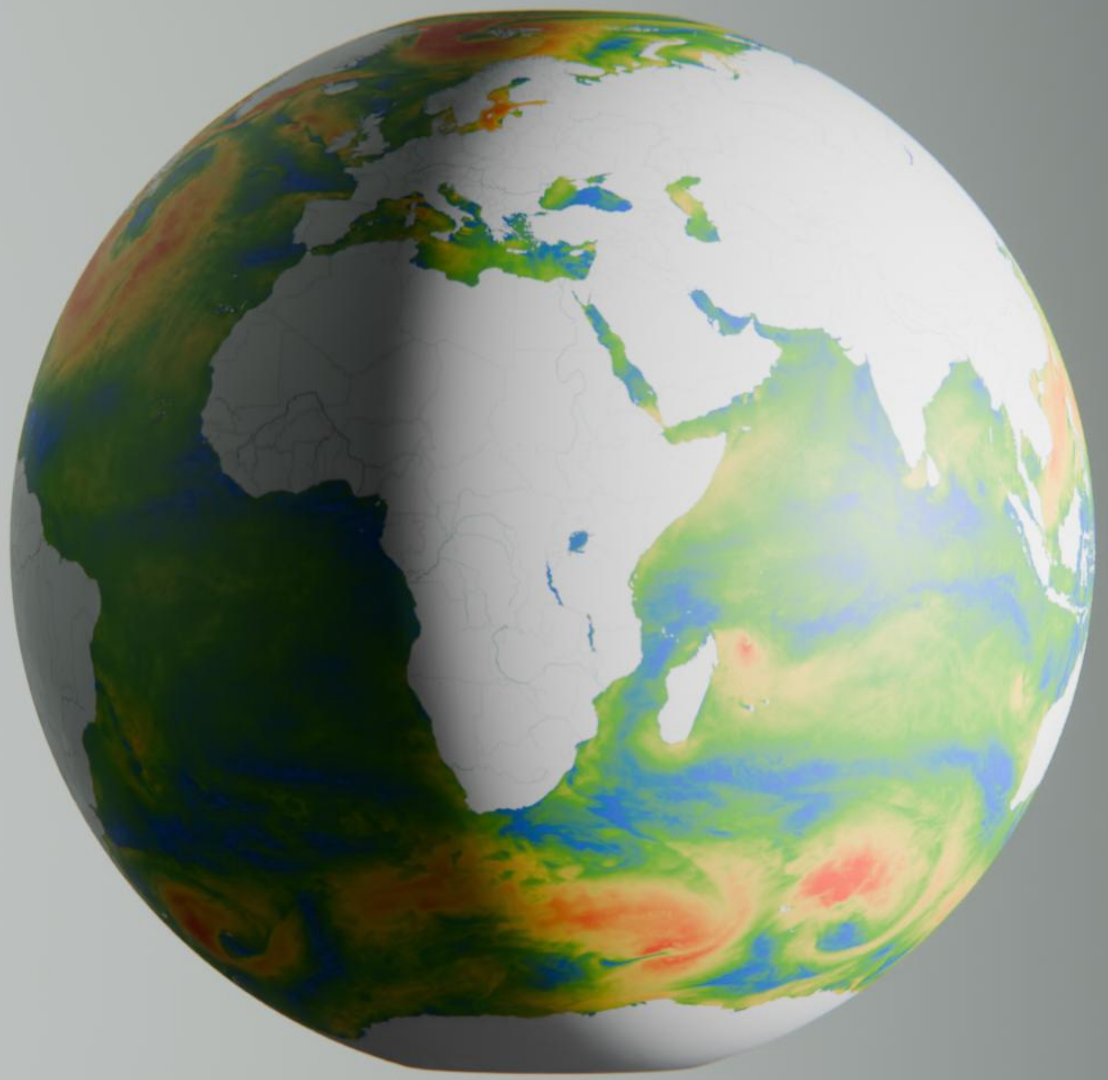
Global Ocean Hourly Sea Surface Wind and Stress from Scatterometer and Model – Hourly Jan 10-12 2025



Global Ocean Hourly Sea Surface Wind and Stress from Scatterometer and Model – Hourly Jan 10-12 2025

Copernicus Marine Service


Copernicus
Marine Service



- Different light
- Interesting contrast

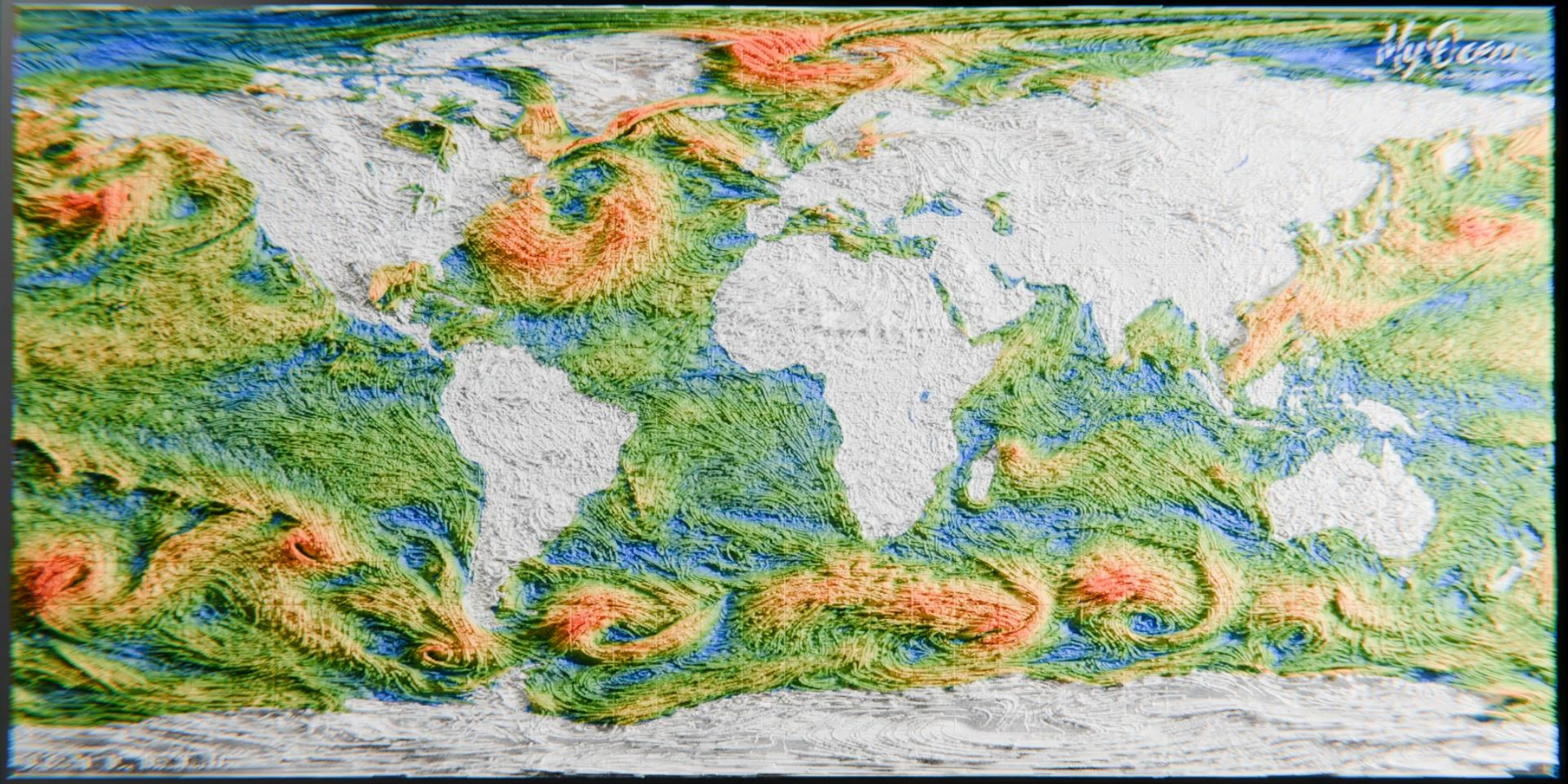
Can we do more?

Copernicus
Marine Service

- Encoding wind speed into exaggerated elevation
- with added particle simulations
  - Physical texture
  - Details
  - Photo realism
  - Art Gallery style
  - Mysterious
  - Surprising

JULIAN
HOFFMANN
ANTON

Copernicus
Marine Service



ANIMATION ▶

0 5 10 15 20 m/s

Copernicus Marine Service

Global Ocean Hourly Sea Surface Wind and Stress from Scatterometer and Model – Hourly Jan 10-12 2025

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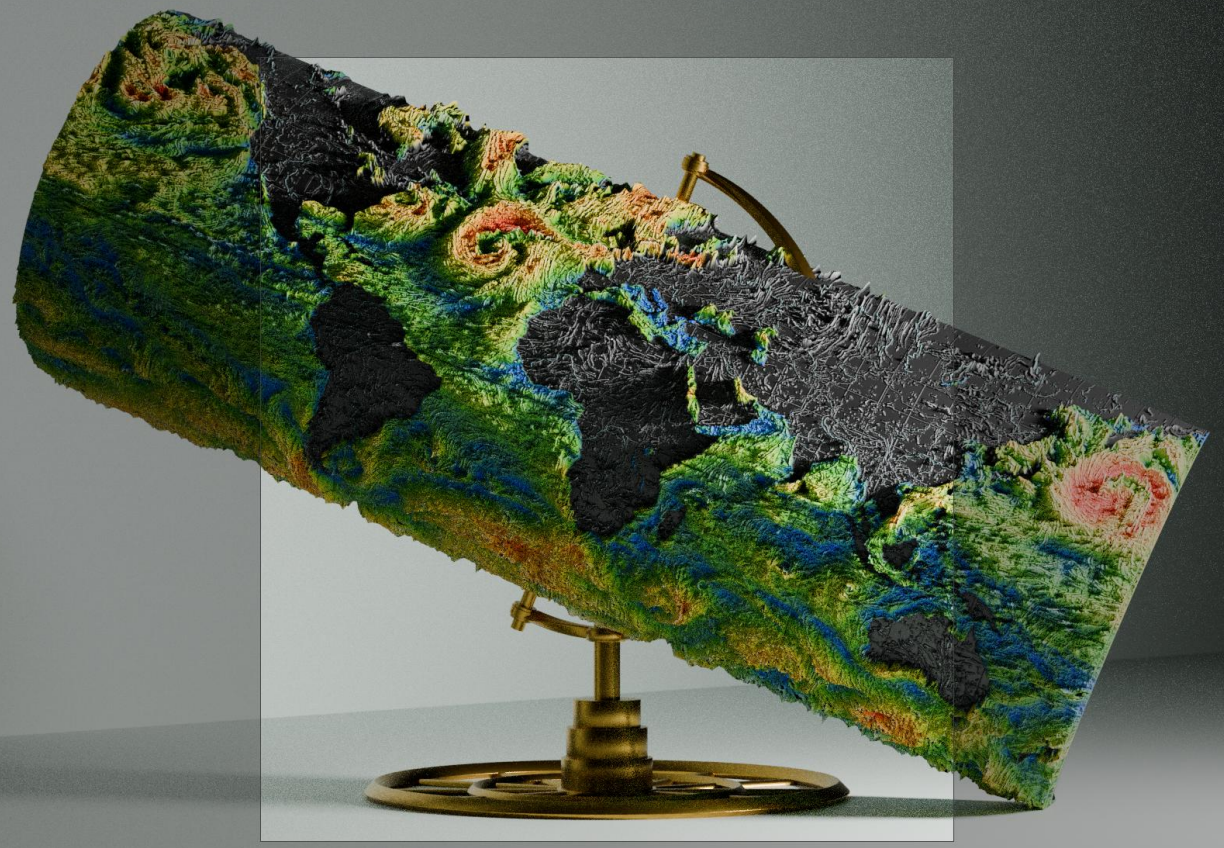
BEHIND THE SCENES



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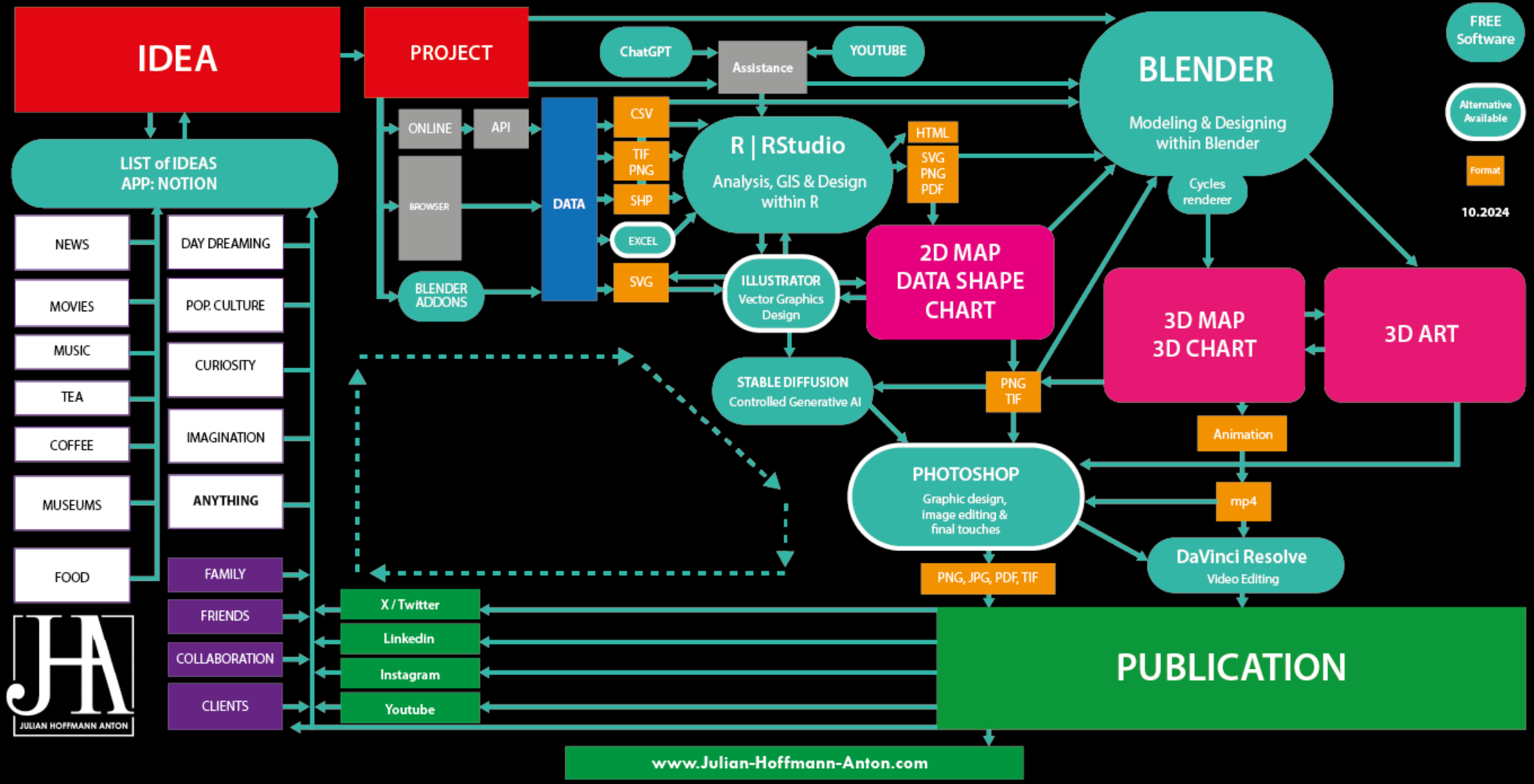
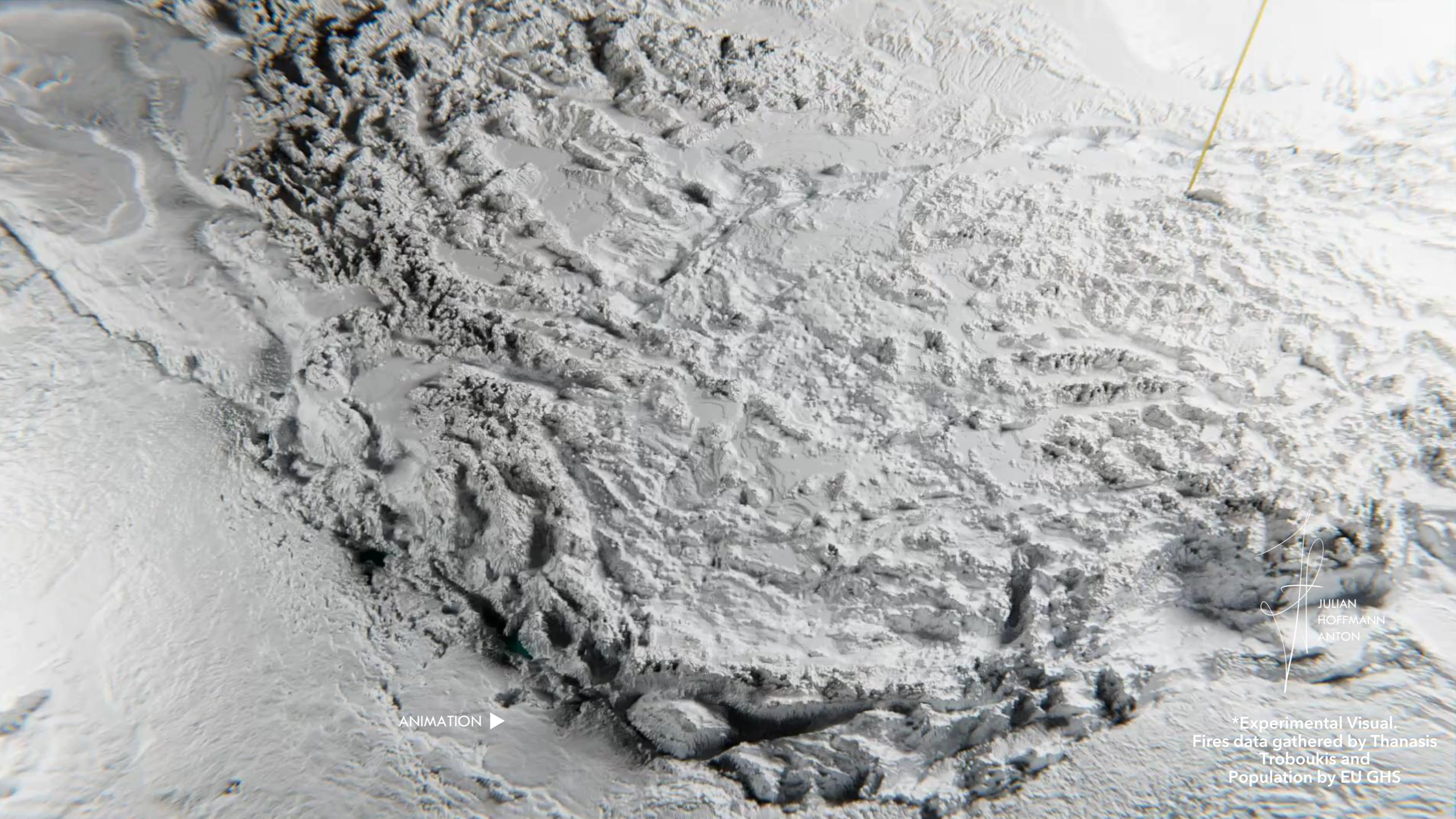
CREATIVE WORK FLOW LOOP

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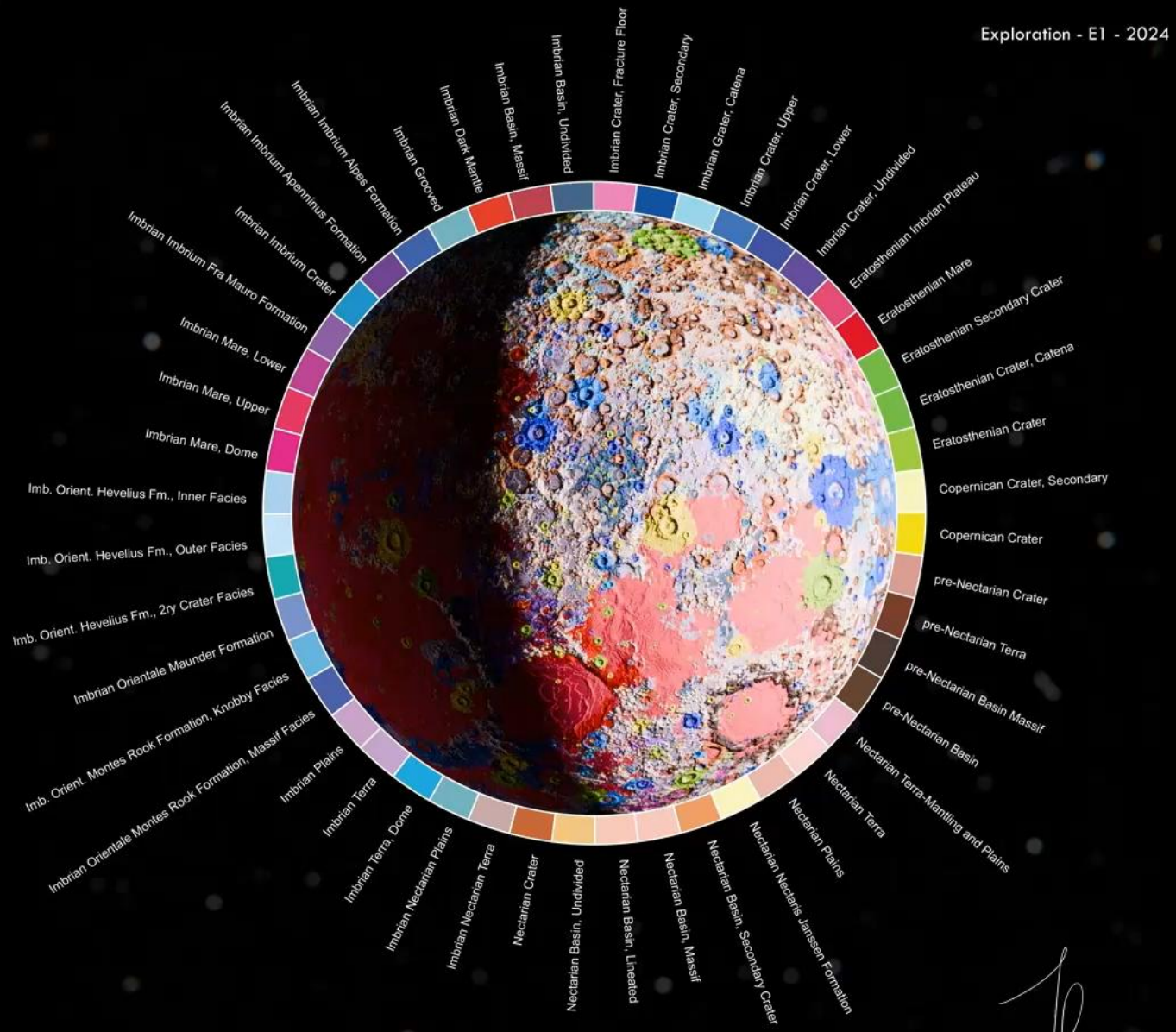
*Experimental Visual.
Fires data gathered by Thanasis
Troboukis and
Population by EU GHS

Exploration - E1 - 2024



ANIMATION ▶

Selenology

3D concept adapted from 2D
"Unified Geologic Map of The Moon"
by C.M. Fortezzo, P.D. Spudis, and S.L Harrel, 2019

Geology Of The MOON

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4 Key Takeaways

I. Explore and experiment to stand out, the sky is not the limit

II. Science needs visual communication

III. Open source tool and open data are powerful and are evolving extremly quickly

IV. Beautiful information is memorable and impactful

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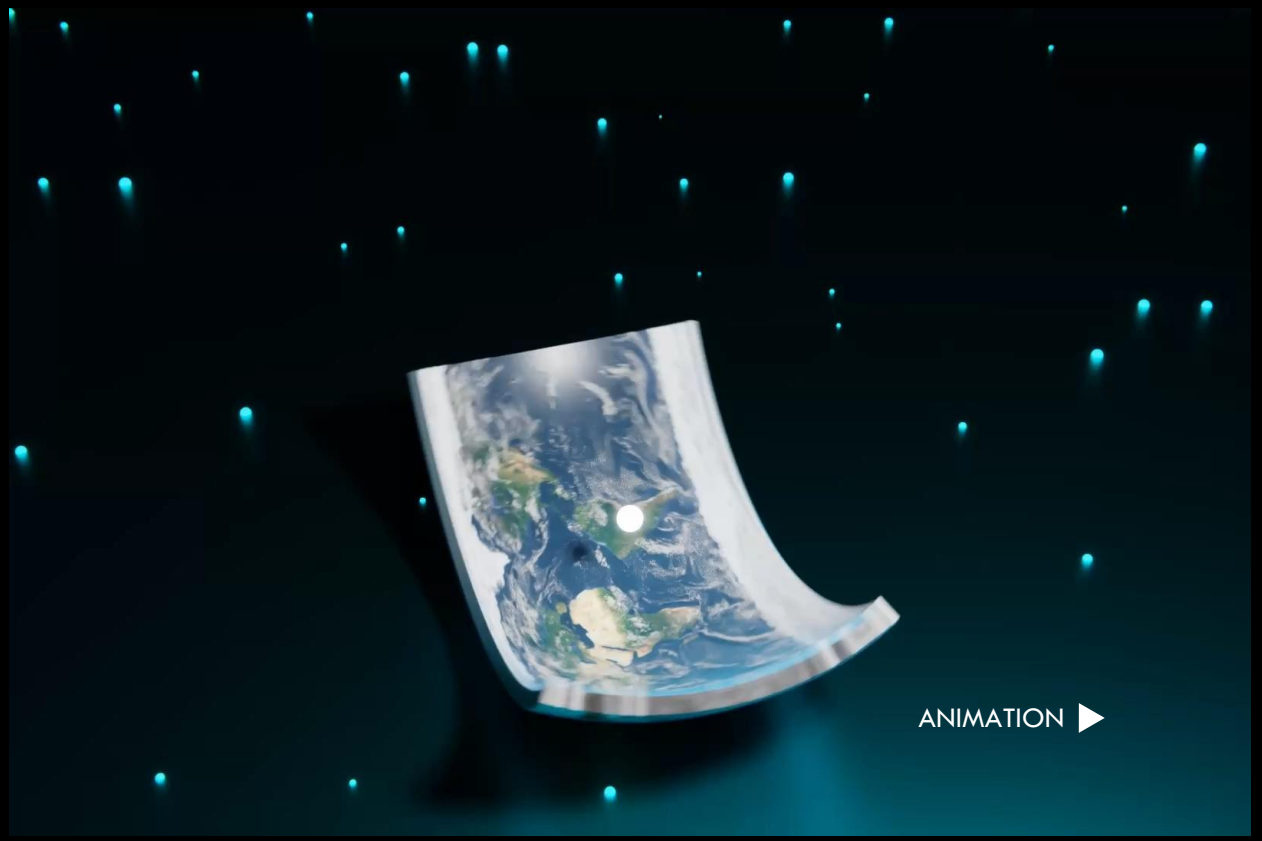
YOUR turn to explore, explain and express Data visually in new ways



THANK YOU
FOR THE
OPORTUNITY

Copernicus
Marine Service

We can connect:

E-Mail: Julian.hoffmann.anton@gmail.com

Explore: www.julian-hoffmann-anton.com