



The Digital Twin of the Ocean



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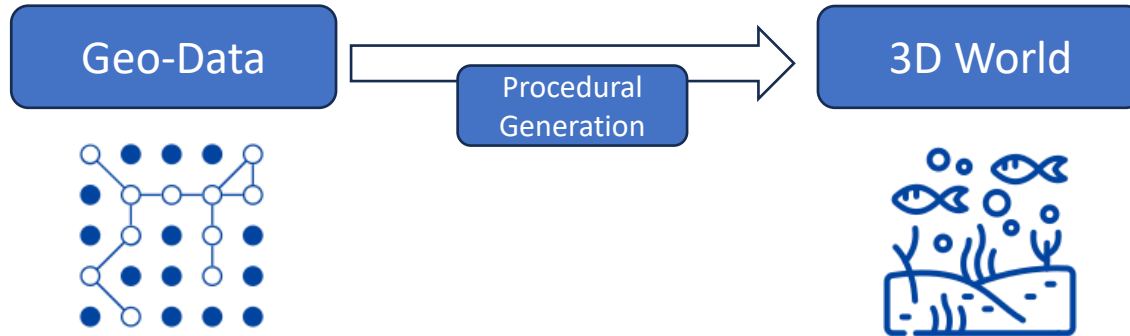




Procedural Ocean



Procedurally create a realistic 3D digital representation of an ocean area based on geo-data.



Goals



Fully data-driven.



Beyond 2D interfaces; Capture intricacies of 3D environments.



Realism, leveraging the representability of the systems



User perspective, provide sense of scale, tangible information in an intuitive way.

Generative AI vs. Procedural Generation



Generative AI

Create new content based on learned data patterns.
Relies on machine learning and large datasets for training.
Capable of complex and creative outputs, often unpredictable.

Examples: text, image generation, and music composition.



Procedural Generation

Creating content algorithmically rather than manually.
Based on predefined rules and algorithms.
Outputs are typically more predictable.

Examples: terrain, levels, and storylines (games dev).



Design

Identification of different content core elements.

Core elements are content that are thematically closely linked together and that may generated required different algorithmic treatment.



Environmental conditions

realistically depiction of the situation in a location: bathymetry, sediment layer, wave and weather conditions.



Biological conditions

realistic depiction of the situation of the fauna and flora, based on biology charts and biomass information.



Human Activity: Wind farms

Provide information about wind turbines, cabling, energy production and ecological pressures like noise.



Human Activity: Shipping

Provide information about shipping corridors, and traffic representation, and shipping vessels.

In Development



Unreal Engine 5.3

UNREAL
ENGINE



PC



VR

Core elements:

- Environmental: 95%
- HA-Wind farms: 90%
- Biological: 70%
- HA-Shipping: 50%



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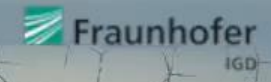
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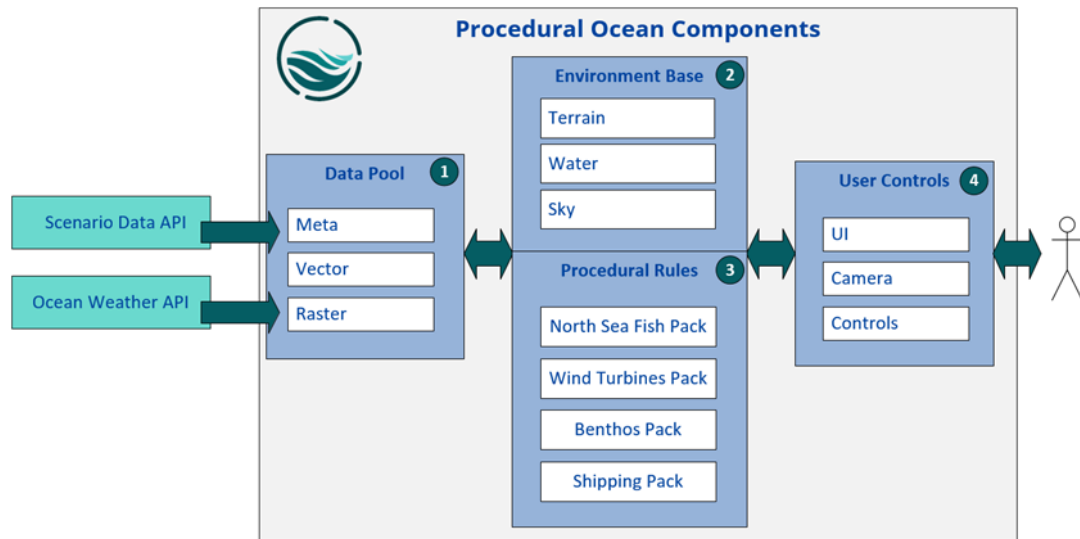
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Procedural Ocean View
In development footage



Procedural Ocean Component Breakdown



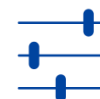
Data Pool: responsible for managing shared layer data



Environmental: Generation of all 3D components related to context



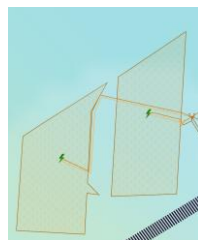
Procedural Rules Packs: Pluggable generative rules for sub-systems and visualizations



User controls: Unified user interaction, spatial navigation and information



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Data schema

Create a data using cascading system:

- Data description (json)
- Raster information
- Vector information
- Visualization models



Procedural Rule Packs



Procedural Rule Packs (PRPs) are pluggable content that contains rules for generating and coordinating the behavior of related assets.

Extensions to Procedural Ocean

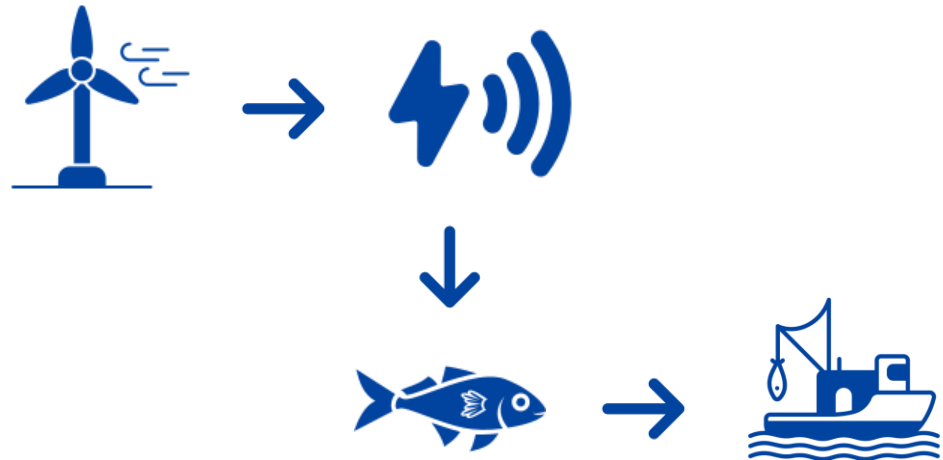
Pluggable Extension

Procedural Rules

3D Models & Materials

Display modes

Define behavioral dependencies



Next Steps

To be discussed & considered integration with other Human Activities.



1 Developing VR



2 Visualization modes
(shipping lanes, energy production)



3 Testing & Reporting

Underwater visualization: Sediment layer 



Thank you



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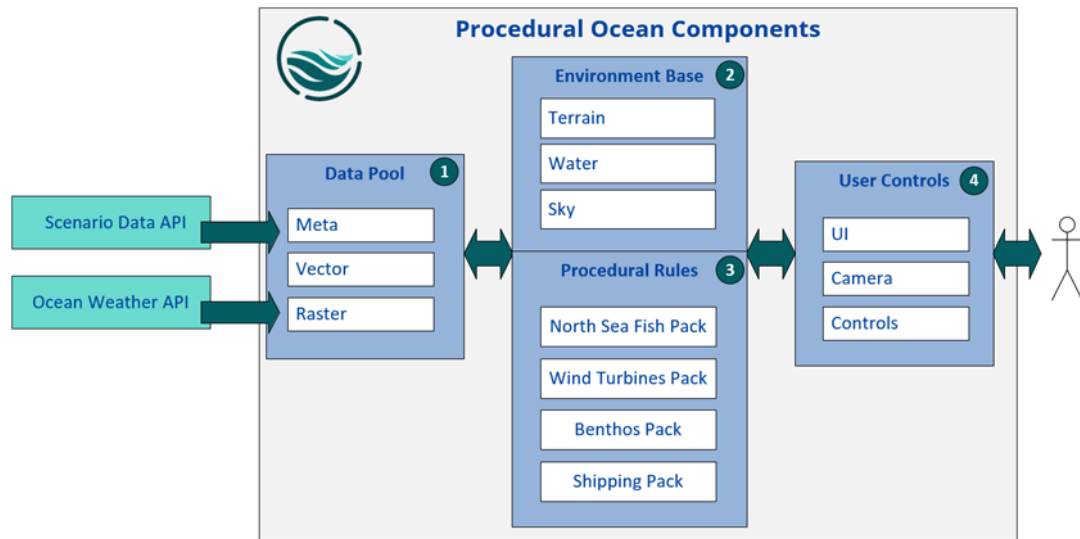


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Procedural Ocean Component Breakdown



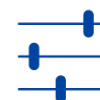
Data Pool: responsible for managing shared layer data



Environmental: Generation of all 3D components related to context



Procedural Rules Packs: Pluggable generative rules for sub-systems and visualizations



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Environmental Conditions



Sea Floor

Bathymetry

Sediment Types

Water

Waves

Currents

Turbidity

Sky

Clouds

Visibility

Wind

All values are parameterized

Link to an API to provide current conditions



Marine Weather

Wave Height
Wave Direction
Wave Period
Swell Height
Swell Direction
Swell Period
Secondary Swell
Wind Waves
Wind
Water Temperature
Ice Coverage
Visibility



Marine Bio

Chlorophyll
Salinity
PH
Oxygen
Phytoplankton
Bathymetry
Sea Depth



Open-Meteo

* stormglass.io

Manually controls the conditions.





Energy



Wind turbines

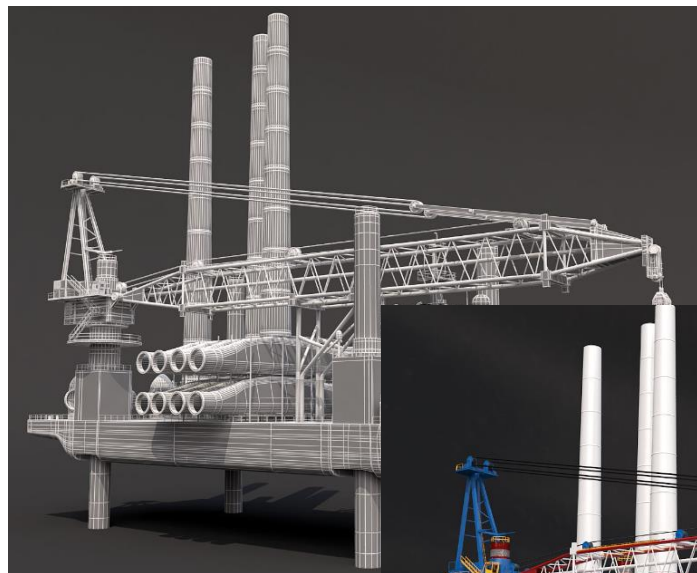
Monopile

Jacked

Floating

Cabling

Transformer stations





Biology

Benthic Layer

Crabs Starfish, Algae, Shellfish

Commercial Species

Atlantic Cod

Atlantic Mackerel

Atlantic Herring

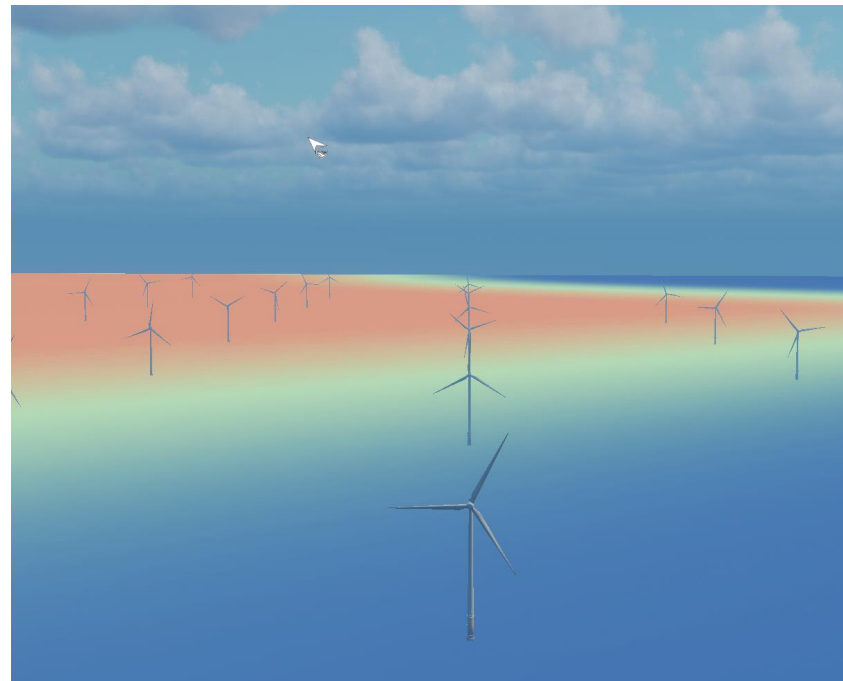
Bass

Cetaceans

Harbor Porpoise

Birds

Seagulls



Experimenting with different visualization modes: Heatmaps & Height Maps



Shipping



Shipping lanes

Cargo Ship

- Tanker
- Container
- LNG

Fishing

- Trawler
- Fishing Dredgers
- Recreational Fishing

Passenger

Ferry

