GWF

GEOSPATIAL WORLD FORUM

Enhancing Access to Ocean Knowledge & Impact of Blue Economy

Dr Edward Steele

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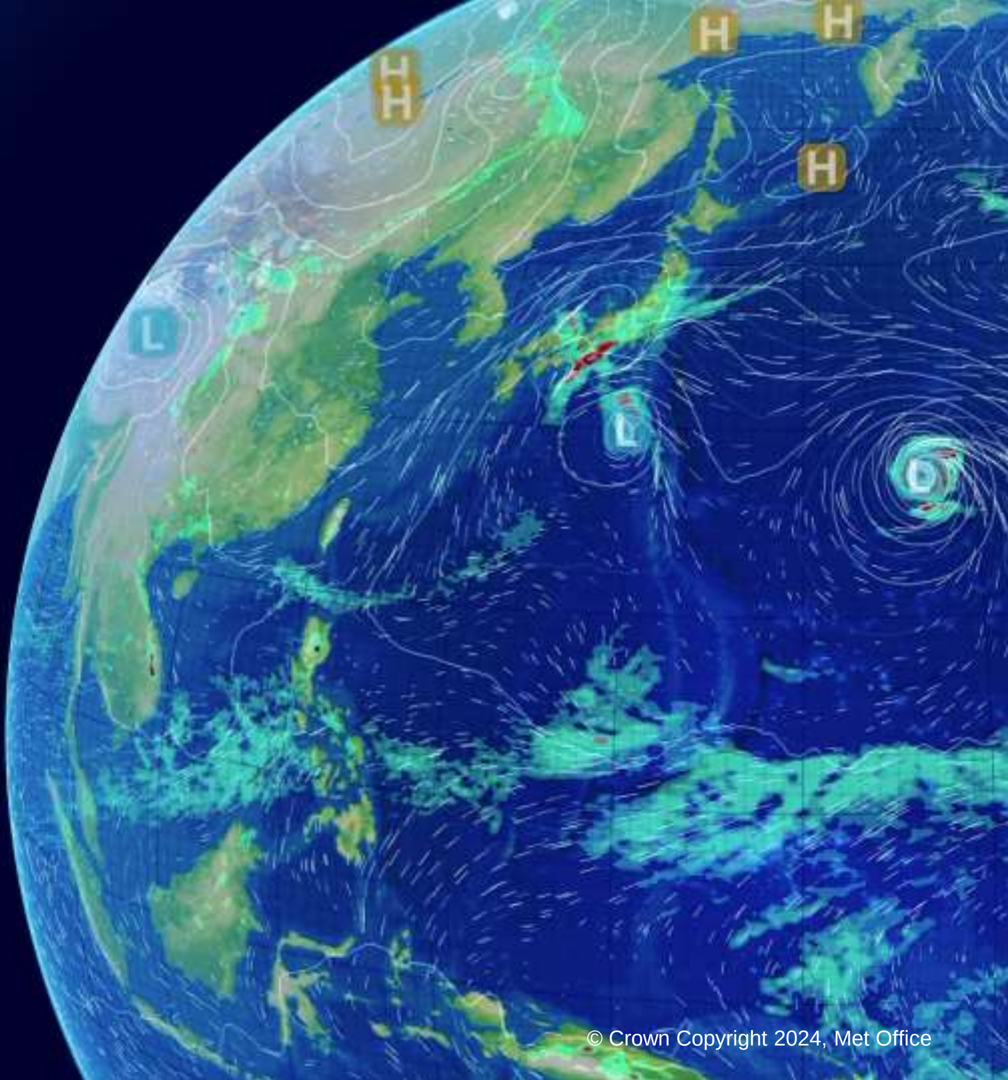

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About / Context

- The UK's National Meteorological Service.
- A Trading Fund of the UK Government Department for Science, Innovation & Technology.
- Recognised leaders in weather and climate – **helping you make better decisions to stay safe & thrive** – providing pioneering science, trusted services & global impact.
- Marine Applications team: tailored science solutions to make marine data more useful, usable & used.

Perspective

- **Data, information & knowledge** derived from ocean observations, measurements & modelling are **critical to enabling Blue Economy activities**.

All over the world

On all timescales

From the sea floor

To outer space

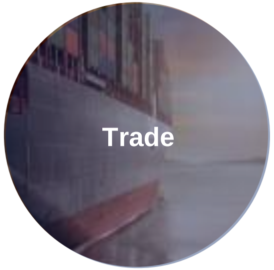
The UK's National Meteorological Service

Supporting citizens, government & industry

The Blue Economy

"Sustainable use of ocean resources for economic growth, improved livelihoods, and jobs while preserving the health of ocean ecosystem"

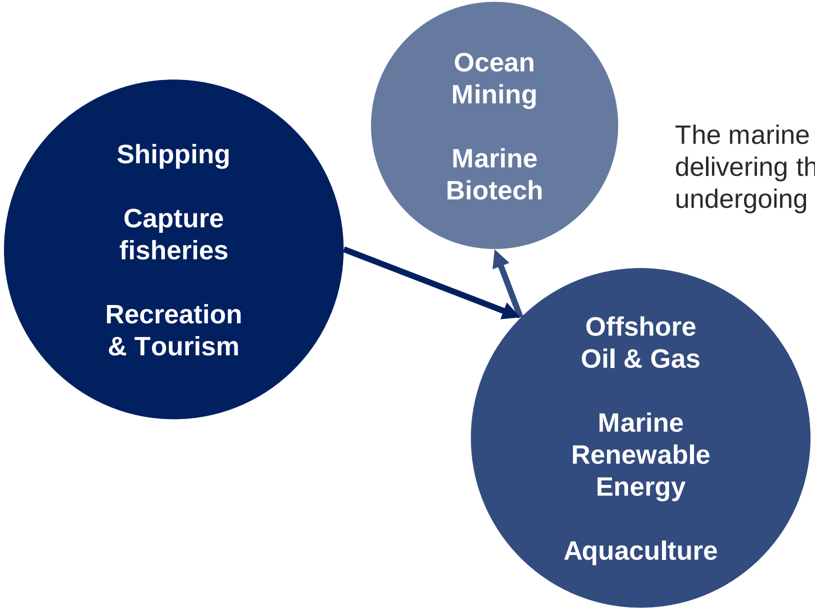
Ocean Importance



OECD estimated in 2010 economic activities associated with the ocean amounted to around US$1.5 trillion, with this projected to almost double - reaching over US$3 trillion between 2010 & 2030 - with ocean-based industries having the potential to outperform the growth of the global economy, both in terms of value added and employment.

World Bank; OECD (2016); Rayner et al. (2019)

Data as an enabler of The Blue Economy



The marine & maritime industries delivering this economic activity are undergoing a **profound transition**.

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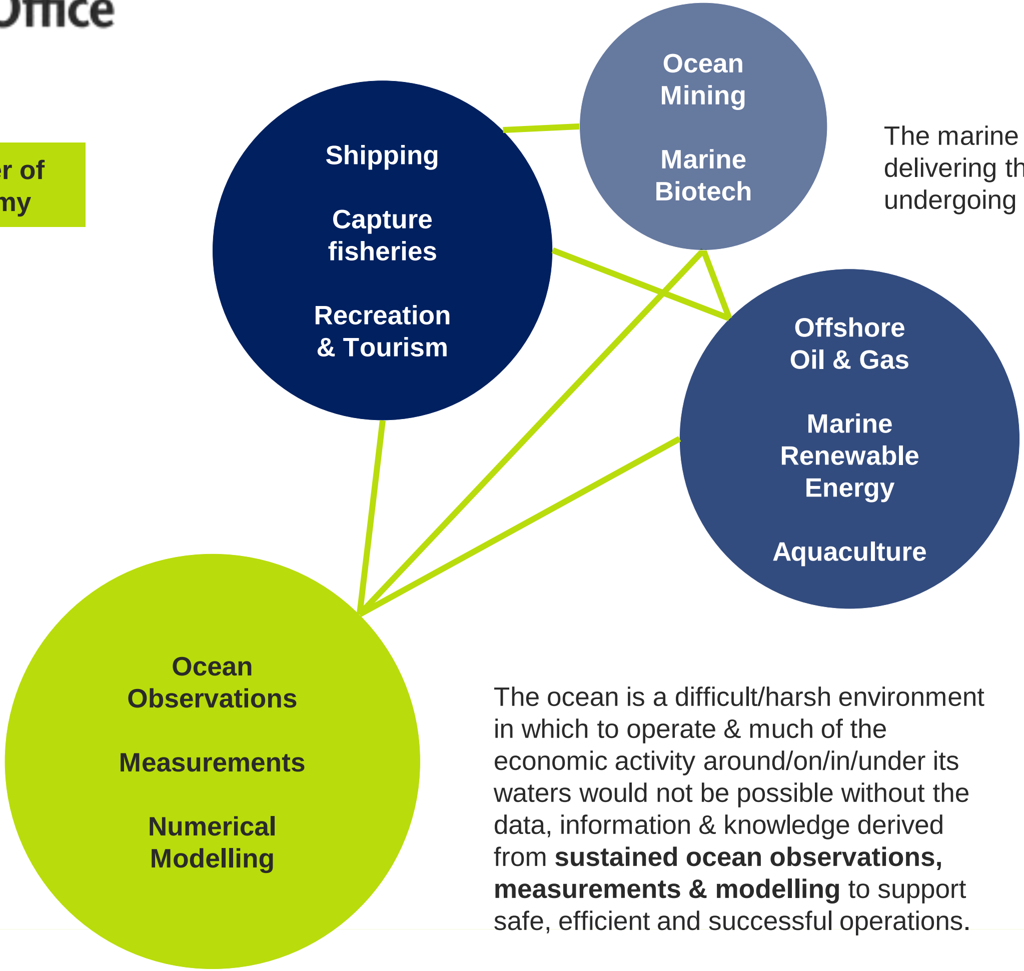
Data as an enabler of The Blue Economy



The marine & maritime industries delivering this economic activity are undergoing a **profound transition**.

The ocean is a difficult/harsh environment in which to operate & much of the economic activity around/on/in/under its waters would not be possible without the data, information & knowledge derived from **sustained ocean observations, measurements & modelling** to support safe, efficient and successful operations.

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Data as an enabler of The Blue Economy

Shipping

Capture fisheries

Recreation & Tourism

Ocean Mining

Marine Biotech

The marine & maritime industries delivering this economic activity are undergoing a **profound transition**.

Offshore Oil & Gas

Marine Renewable Energy

Aquaculture

Ocean Observations

Measurements

Numerical Modelling

The ocean is a difficult/harsh environment in which to operate & much of the economic activity around/on/in/under its waters would not be possible without the data, information & knowledge derived from **sustained ocean observations, measurements & modelling** to support safe, efficient and successful operations.

Users (whose activities/businesses benefit from these data/information):

- Research;
- Operations;
- Policy;
- Public;

Supported by:

- Providers of infrastructure;
- Producers of information;
- Intermediaries that offer specific tailoring;

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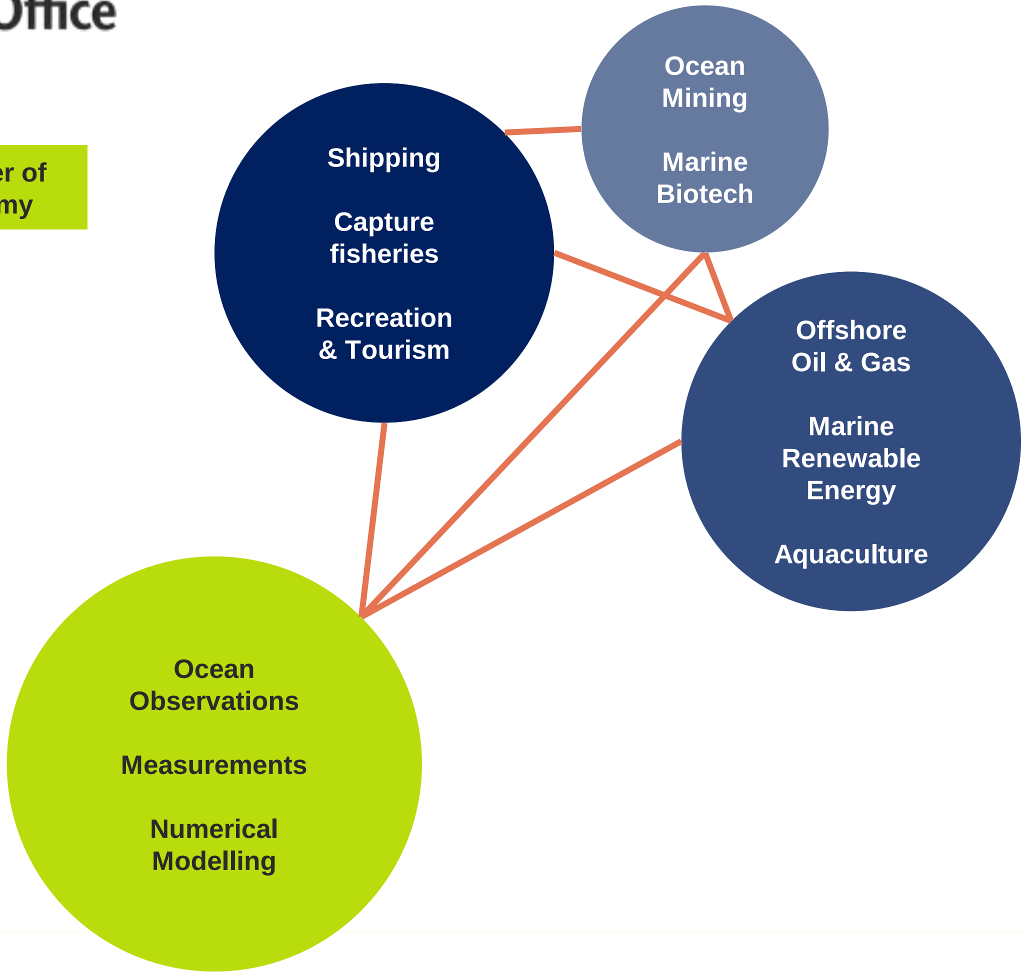
Data as an enabler of The Blue Economy



Opportunities for **technology as an integrator**:

- Cloud storage and compute – democratising access with FAIR principles;
- Artificial intelligence / machine learning – low-cost elicitation & prediction;
- Digital twins – real-time monitoring & simulation;

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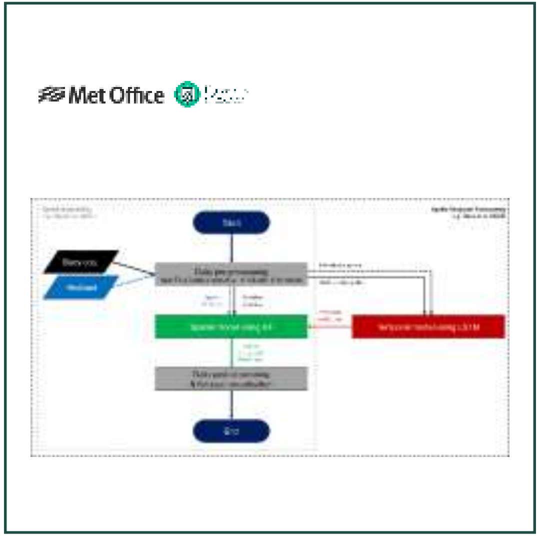
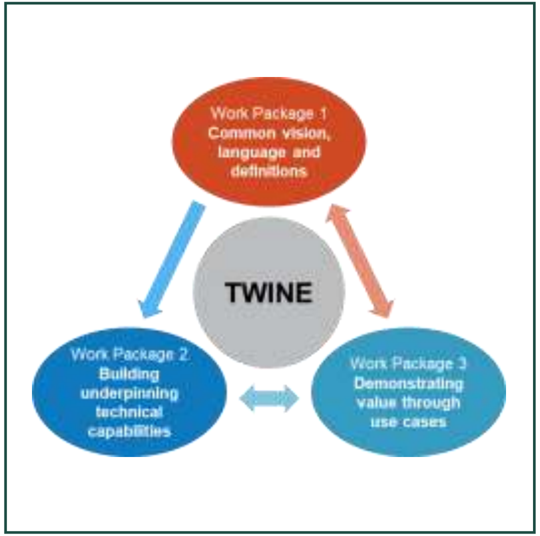
Examples of Technology

Cloud storage and compute
(e.g. Hyperscalers, Copernicus Marine Data Store, EMODnet, JupyterHub, etc.)



Artificial Intelligence / Machine Learning
(e.g. Chen et al., 2023; Steele et al., 2024)



Digital Twins
(e.g. TWINE Programme)

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An exciting new era of data-driven weather prediction

Forecast models trained on historical data offer an alternative to directly solving governing equations of fluid dynamics

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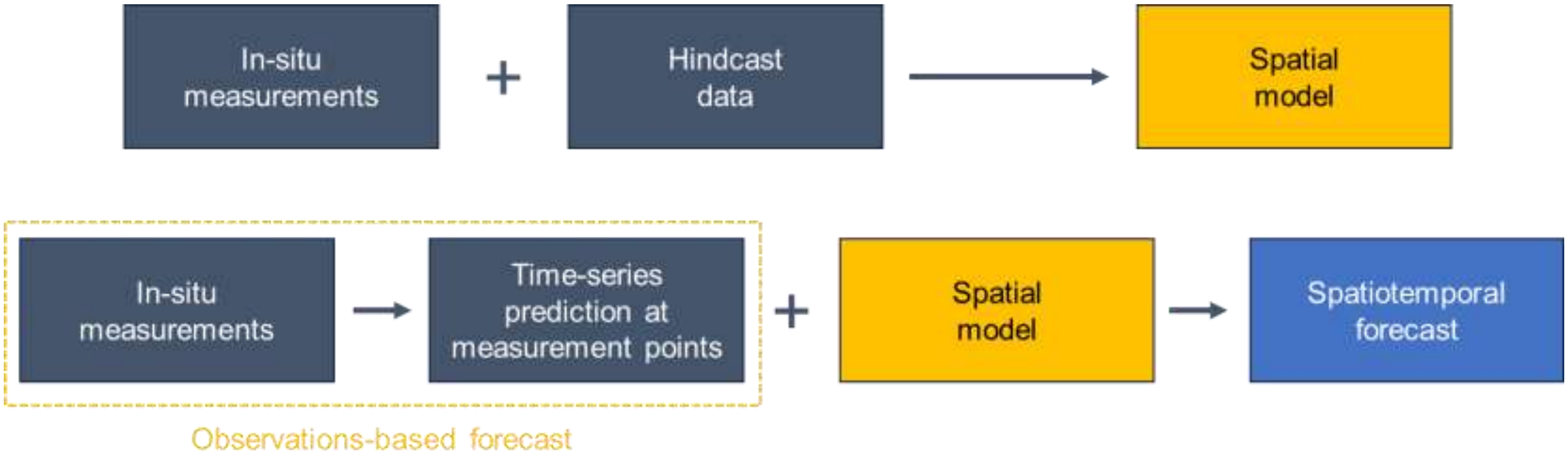
Machine Learning



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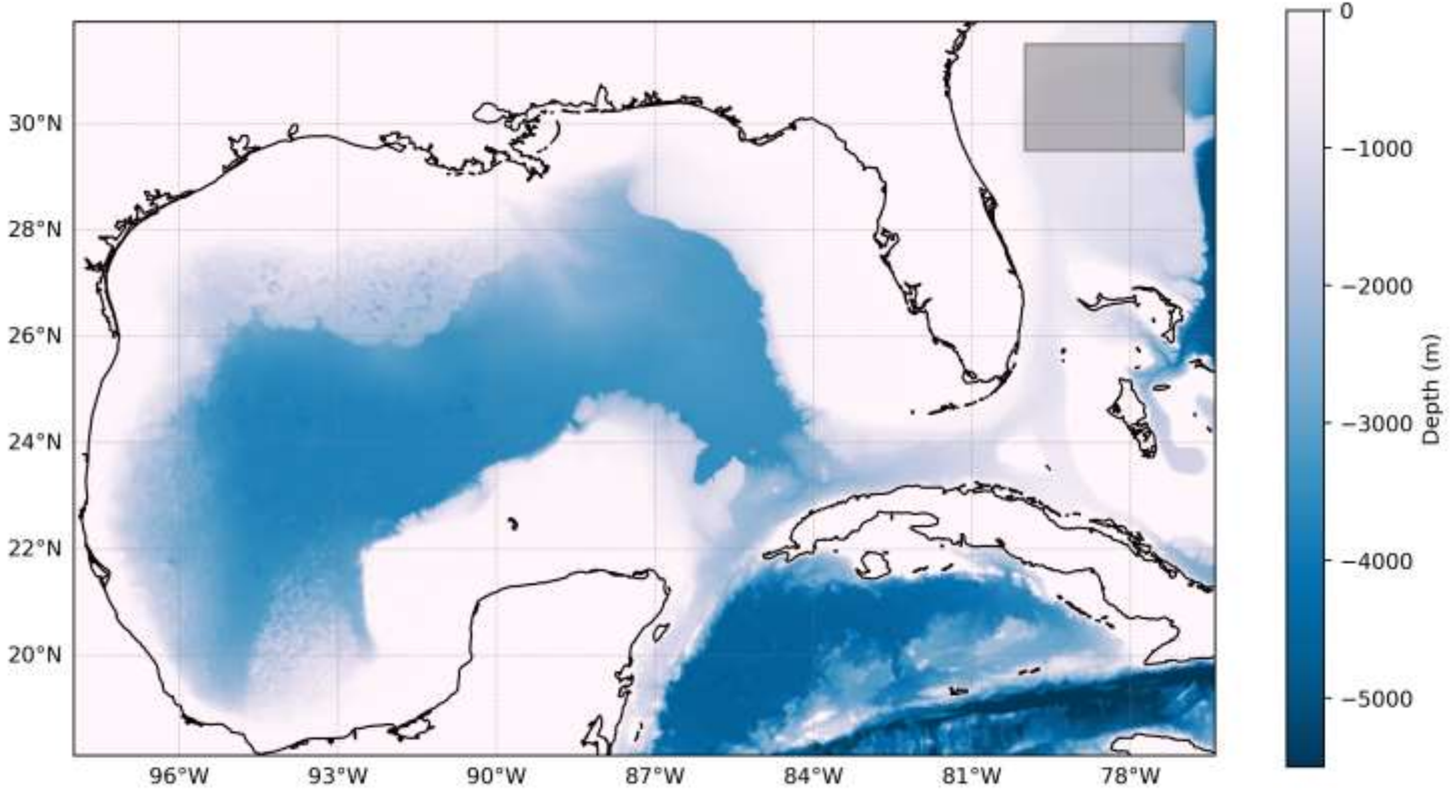
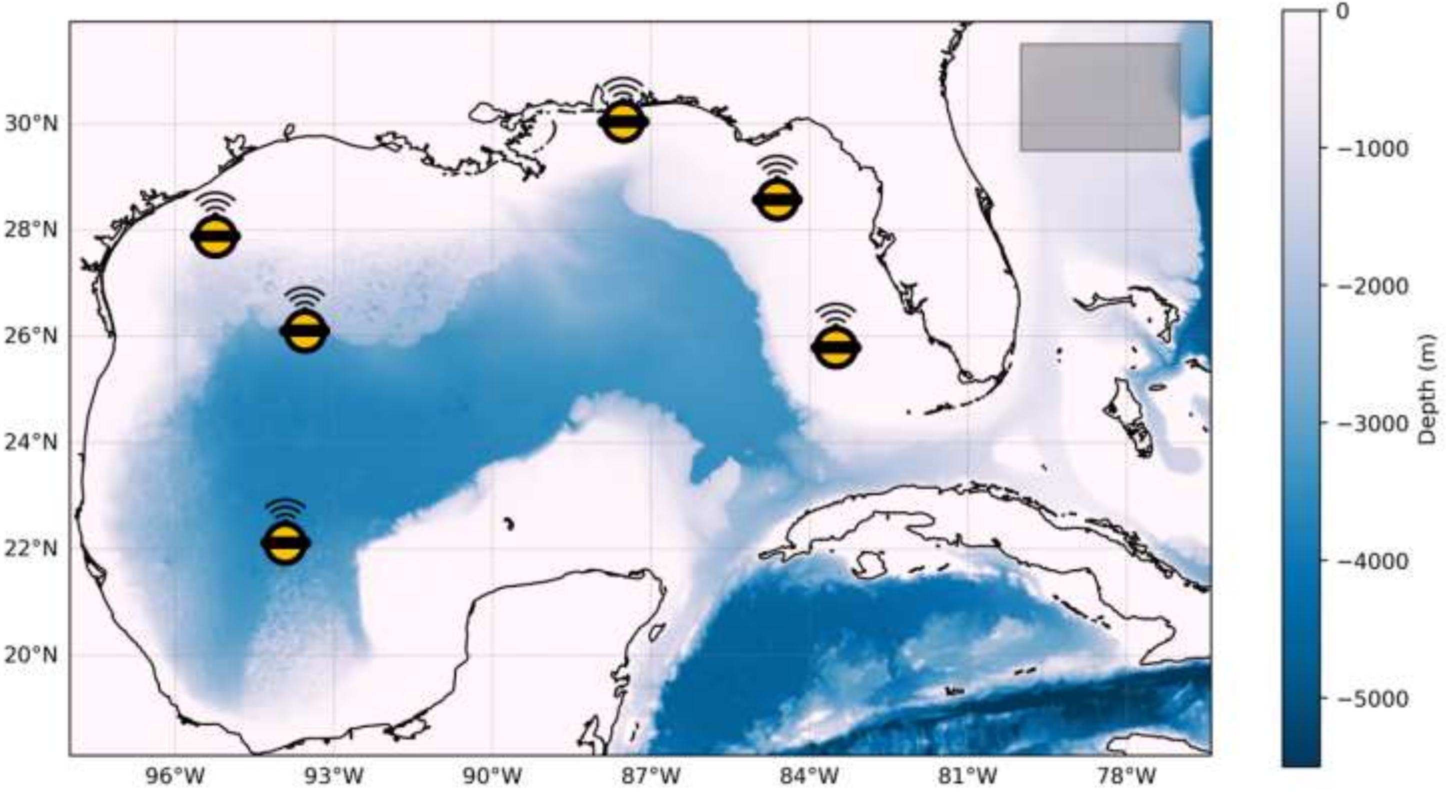


30°N
28°N
26°N
24°N
22°N
20°N
96°W
93°W
90°W
87°W
84°W
81°W
78°W
0
−1000
−2000
−3000
−4000
−5000
Depth (m)

Met Office



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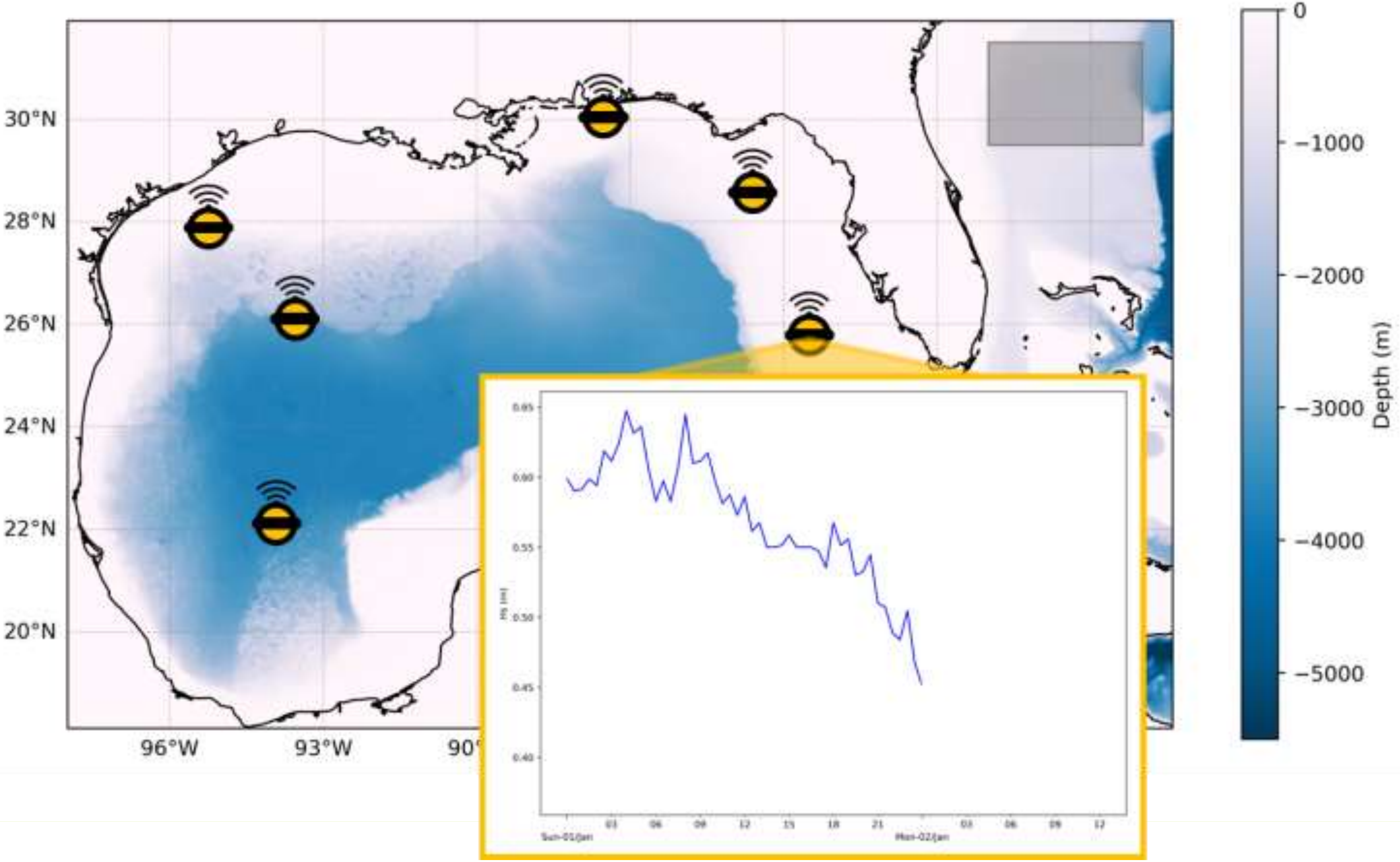
Depth (m)

Met Office


30°N
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Depth (m)
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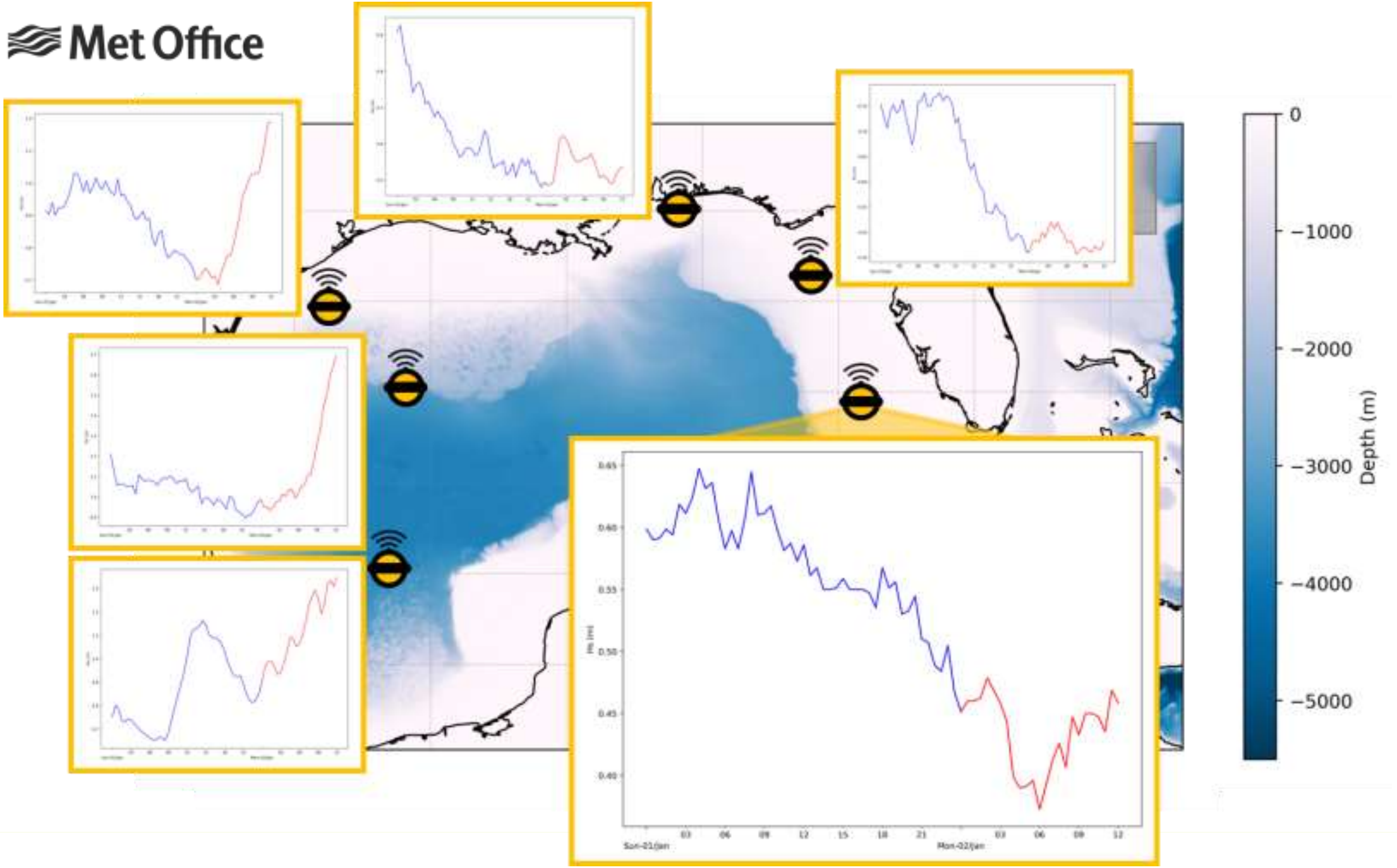
18
21
Sun-01/Jan
Mon-02/Jan

Met Office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Depth (m)
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0.45
0.40
Hs (m)
Sun-01/Jan
03
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21
Mon-02/Jan
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12

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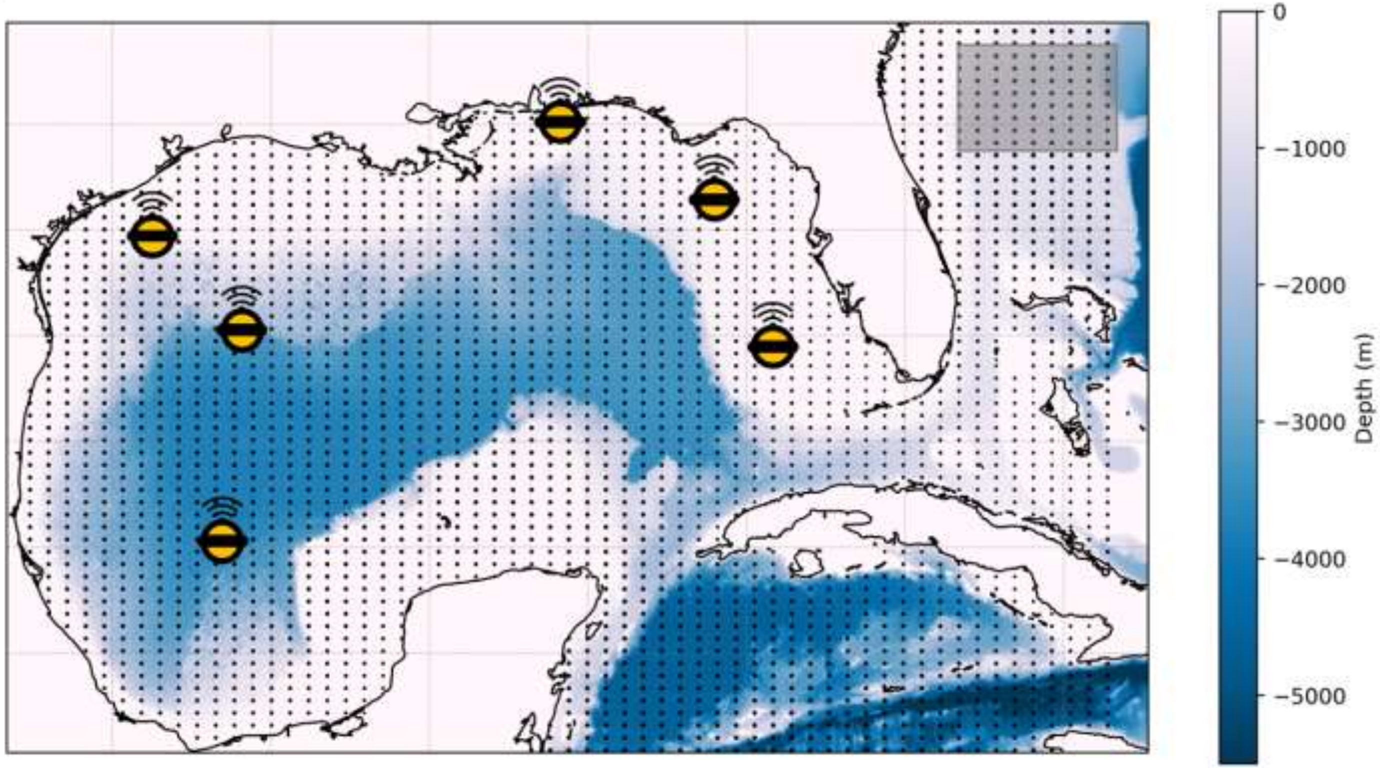

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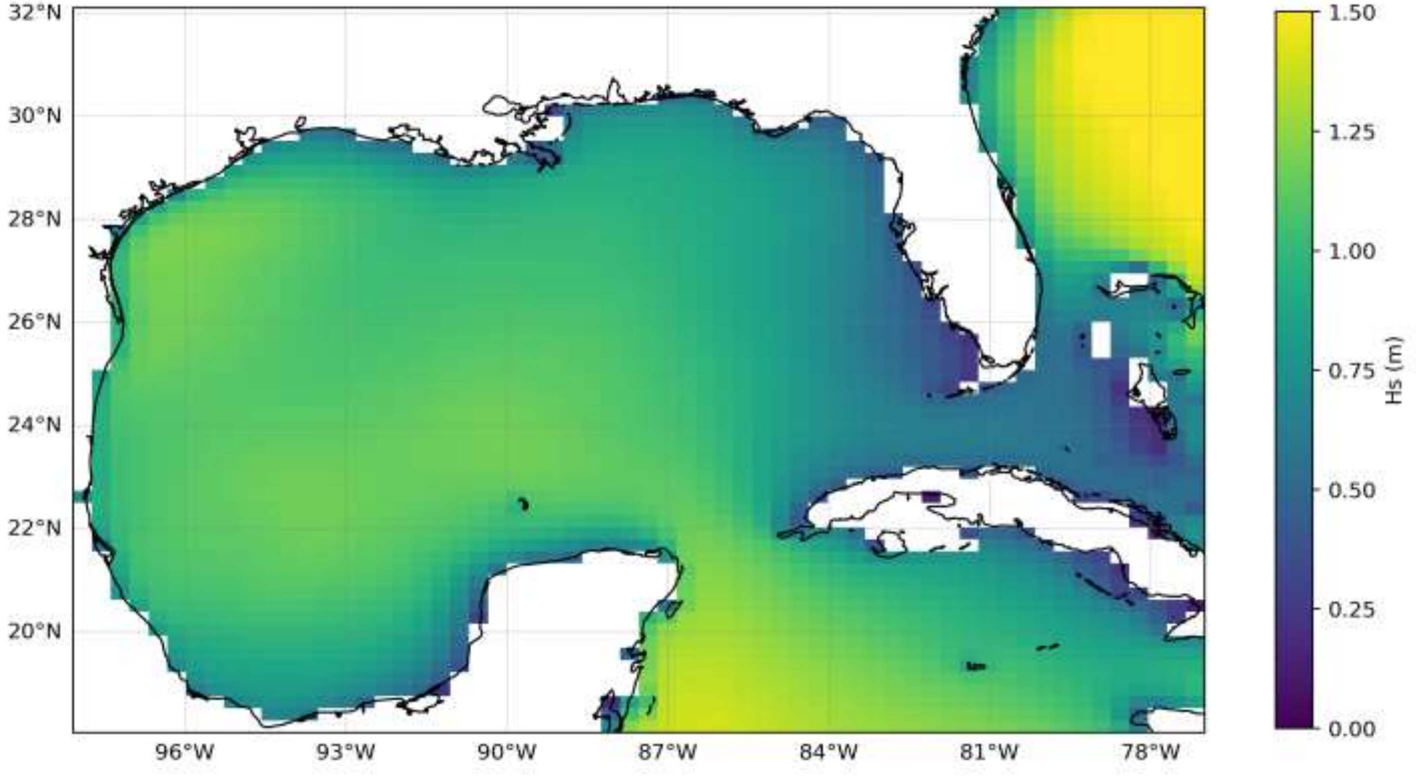
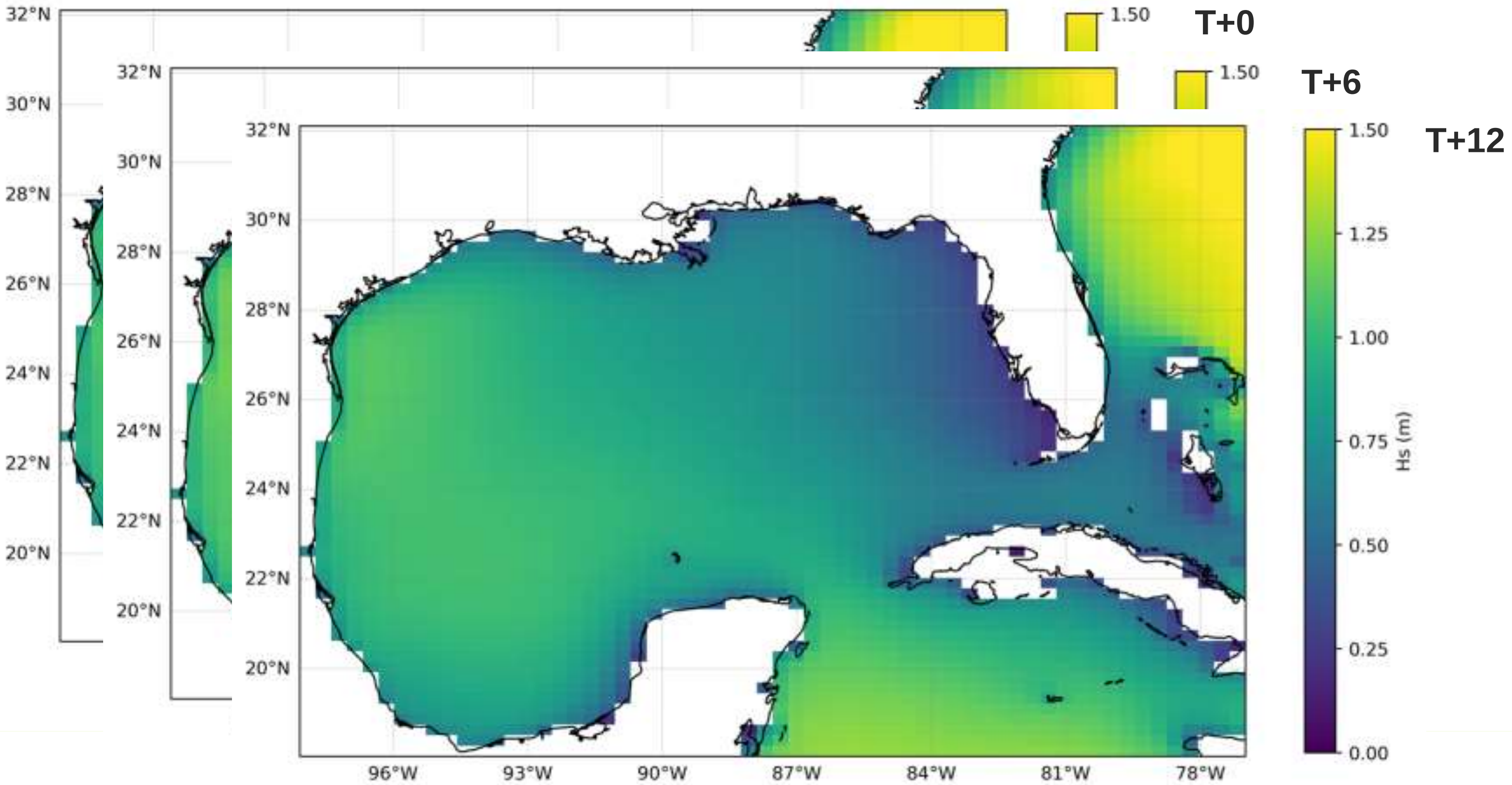


32°N
30°N
28°N
26°N
24°N
22°N
20°N
96°W
93°W
90°W
87°W
84°W
81°W
78°W
1.50
1.25
1.00
0.75
0.50
0.25
0.00
Hs (m)


T+0
T+6
T+12
32°N
30°N
28°N
26°N
24°N
22°N
20°N
96°W
93°W
90°W
87°W
84°W
81°W
78°W
1.50
1.25
1.00
0.75
0.50
0.25
0.00
Hs (m)

Machine Learning

- The results show the real potential for the application of a spatiotemporal machine learning approach, combining both an LSTM-RNN and an RF-based surrogate model, using publicly available data / tools.
- Once trained, the persistence model can be run at low computational cost, taking advantage of both rapidly updating observations (which enable the model to issue more frequent forecasts) and existing regional physics-based hindcasts (which enables the model to achieve higher spatial resolution).
- While opportunities for the further development of the machine learning model are acknowledged, this is deemed an important tool in supporting offshore planning and workability – including (but not limited to) applications linked with better resolving spatial variability across renewable energy sites, predicting ocean current regimes in the proximity of oil & gas platforms, as well as informing adaptive sampling strategies conducted by autonomous vessels – where the adoption of such a machine learning approach, that can be run on a laptop computer, has the potential to revolutionize data-driven decision-making by the industry.

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Thank You

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References

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- Steele E.C.C., Chen J., Ashton I.G.C, Pillai A.C., Jaramillo S, Leung P, & Zarate L. (2024) A Spatiotemporal Machine Learning Framework for the Prediction of Metocean Conditions in the Gulf of Mexico, *Proc. Offshore Technology Conference*, 6-9 May, Houston, USA. https://doi.org/10.4043/35104-MS.