

Project Title	Digital Twin of the Ocean for Offshore Wind Energy
Project Acronym	DTO4OWE
Project Number	SBEP2024-417 (under Grant Agreement no. 101086379)
Funding	Second Joint Co-funded Call for transnational research projects on "Unified Paths to Climate-Neutral, Sustainable, and Resilient Blue Economy: Engaging Civil Society, Academia, Policy, and Industry" (Sustainable Blue Economy Partnership)
Starting date of Project	1 August 2025
Duration of the project	36 months
Coordinator	Tallinn University of Technology (TalTech)
Website	<a href="http://www.dto4owe.eu">www.dto4owe.eu</a>

## MS4.1 - AI test cases are designed and algorithms for corresponding applications identified

Work Package	WP4   Data-driven models for forecasting, downscaling and data fusion
Tasks	T4.1-4.4
Lead author	Jun She (DMI)
Contributors	Johannes Schulz-Stellenfleth (HEREON); Bin Yuan (HEREON); Erik Mulder (SMHI), Philip Wallhead (NIVA); Jian Su (DMI), John Lavelle (DMI); Maxime Christian Jean-Marie Beauchamp (DMI); Henri Vuollekoski (FMI), Shakti Singh (TalTech); Juri Elken (TalTech), Sander Rikka (TalTech)
Peer reviewers	Rivo Uiboupin (TalTech); Beatrice Maddalena Scotto (SINDBAD)
Version	V1.0
Due Date	31/03/2026
Submission Date	31/03/2026
Dissemination Level	<input checked="" type="checkbox"/> Public, <input type="checkbox"/> Sensitive, <input type="checkbox"/> Confidential, <input type="checkbox"/> other

Partnership:

## Versioning History

Revision	Date	Editors	Comments
0.1	30/03/2026	Rivo Uiboupin	
0.2			
1.0	31/03/2026	Jun She	Submission
1.1			

## Glossary of terms

Item	Description
<b>4DVarNet</b>	Four-Dimensional Variational Neural Network.
<b>CAE</b>	Convolutional AutoEncoder
<b>CNN</b>	Convolutional Neural Network.
<b>GoF</b>	Gulf of Finland
<b>GoR</b>	Gulf of Riga
<b>GPR</b>	Gaussian Process Regression.
<b>OWF</b>	Offshore Wind Farm
<b>RNN</b>	Recurrent Neural Network
<b>BGC</b>	Biogeochemistry

## Keywords

Data-driven models, data fusion, forecast optimization, downscaling

## Disclaimer

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## Citation

She J. & DTO4OWE Consortium (2026). AI test cases are designed and algorithms for corresponding applications identified. DTO4OWE Milestone MS 4.1. Zenodo.  
<https://doi.org/10.5281/zenodo.20525136>

## Executive Summary

The objective of WorkPackage 4 is to develop data-driven solutions for generating reanalysis and forecast with better quality, resolution and low computational cost, which can be efficient tools for building up a digital twin of ocean applications. This includes (i) AI for improved local forecast for working window design; (ii) AI for downscaling; (iii) AI for data-simulation fusion; (iv) AI for assessing the impact of OWFs on sea ice. The main goal of WP4 is to test and improve relevant AI-models so that optimal schemes can be identified for different applications. To reach this goal, the first step is to design AI test cases and algorithms for the identified applications. The AI test cases were designed for generating local forecasts, historical and climate products to meet requirements from the offshore wind industry.

Table 1. Design of AI test cases and algorithms in DTO4OWE

	Objectives	Location /area	Variables	AI/ML methods	Responsible
4.1 AI/ML-based methods for local forecasting	Optimized wave forecast with reduced false and missing alarms in operation window planning for OWFs.	Kriegers Flak OWF	Significant wave height	XGBOOST, Random Forest	DMI
		German Bight	Significant wave height	NBEATS+ 3DVAR	HEREON
4.2 AI/ML-based methods for downscaling	Develop AI tools to produce high-resolution ocean products in OWF areas and test the transferability of the algorithm	Kriegers Flak OWF /W. Baltic Sea	Sea level, salinity, water temperature , significant wave height	Unet, Super-resolution, CNN, Latent diffusion model	DMI
		One nearshore application	Sea level, Waves, Currents	CNN	HEREON
4.3 AI/ML-based methods for data-simulation fusion	Improve quality of multi-year ocean products for testing areas	W. Baltic Sea	3D water temperature , salinity, chl-a (optional)	4DVARnet	DMI
	Bias corrected hindcasts/climate change scenarios	NE North Sea	T/S, BGC	GPR	NIVA
		Baltic Sea	Sea level, T/S, surface u,v	SRResNet, CAE-RNN,	SMHI
	Data-based multi-year product reconstruction	Baltic Sea	Sea level, T/S	EOF, K-mean clustering	TalTech
4.4 AI for assessing the impact of OWFs on sea ice	Develop large-scale 2D emulator that predicts sub-km ice field	N. Baltic	Sea ice thickness	Unet	FMI
		GoF, GoR	Sea ice thickness	CNN	TalTech

The AI test cases designed in Table 1 will be implemented in the following period of DTO4OWE project through Tasks T4.1 – T4.3



### Partnership:



Co-funded by the European Union through the Sustainable Blue Economy Partnership



### EUROPEAN PARTNERSHIP



Co-funded by the European Union through the Sustainable Blue Economy Partnership, Estonian Research Council (**ETAg**), Innovation Fund Denmark (**IFD**), Federal Ministry of Education and Research represented by Project Management Jülich (**BMBF/PIJ**), The National Centre for Research and Development (**NCBR**), Academy of Finland (**AKA**), Ministry of Universities and Research (**MUR**) The Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (**FORMAS**) and The Research Council of Norway (**RCN**). Views and opinions expressed, however, are those of the author(s) only and do not necessarily reflect those of the European Union or the national research agencies. Neither the European Union nor the granting authorities can be held responsible for them.