

IEA Wind Task 49: Work Package 1 – Reference Site Conditions for Floating Wind Arrays



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Challenge

As Floating Offshore Wind (FLOW) expands into a global industry, water depths, met-ocean conditions, and geotechnical conditions will increasingly vary for projects located in different geographic regions. FLOW is particularly sensitive to these variables due to the wave-induced system motions and loads, as well as the anchoring system constraints imposed by the seafloor conditions. Uncertainty around site conditions will permeate through all aspects of project design, leading to suboptimal and overly conservative designs, increased costs, and adversely affected performance.

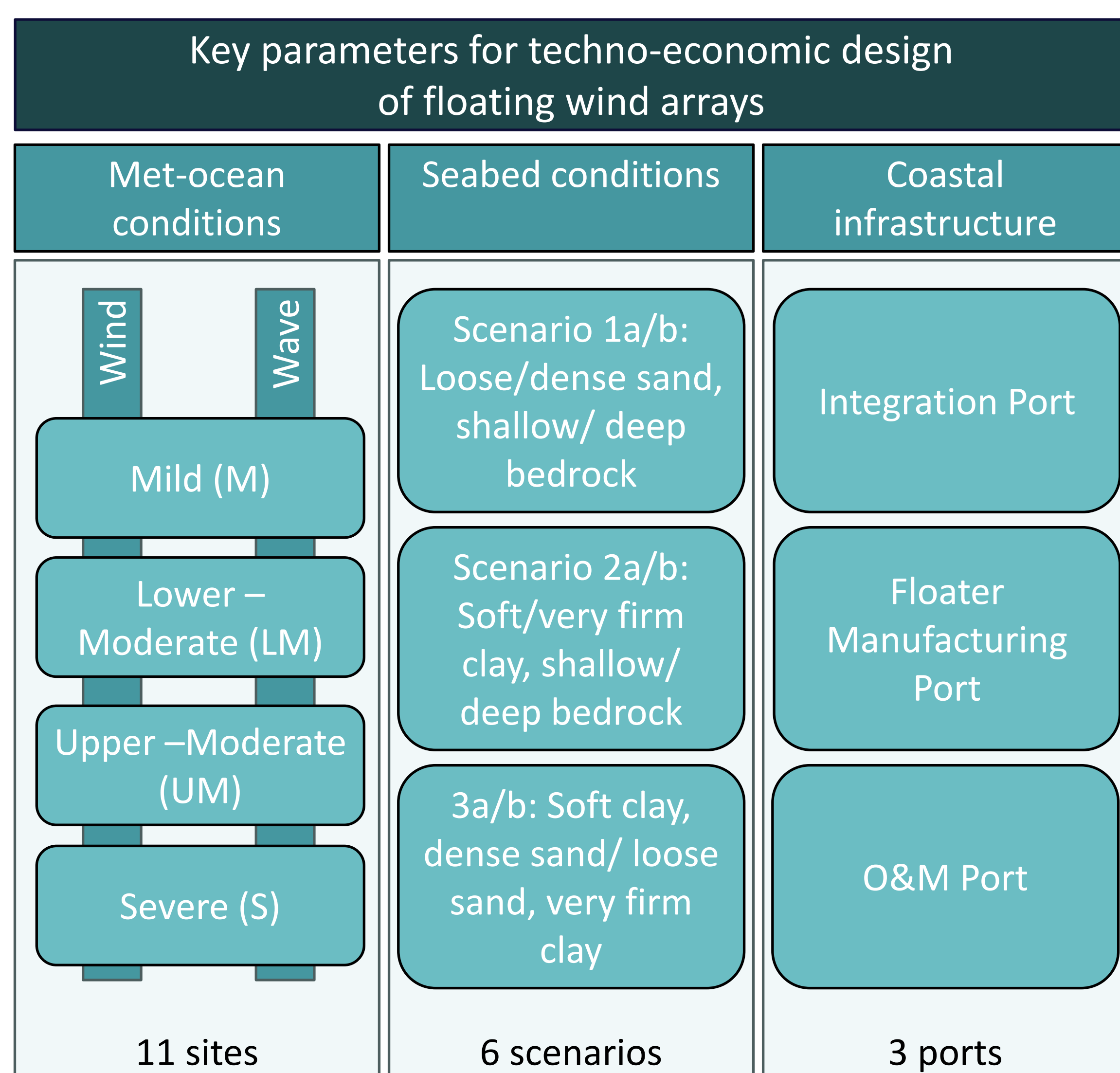
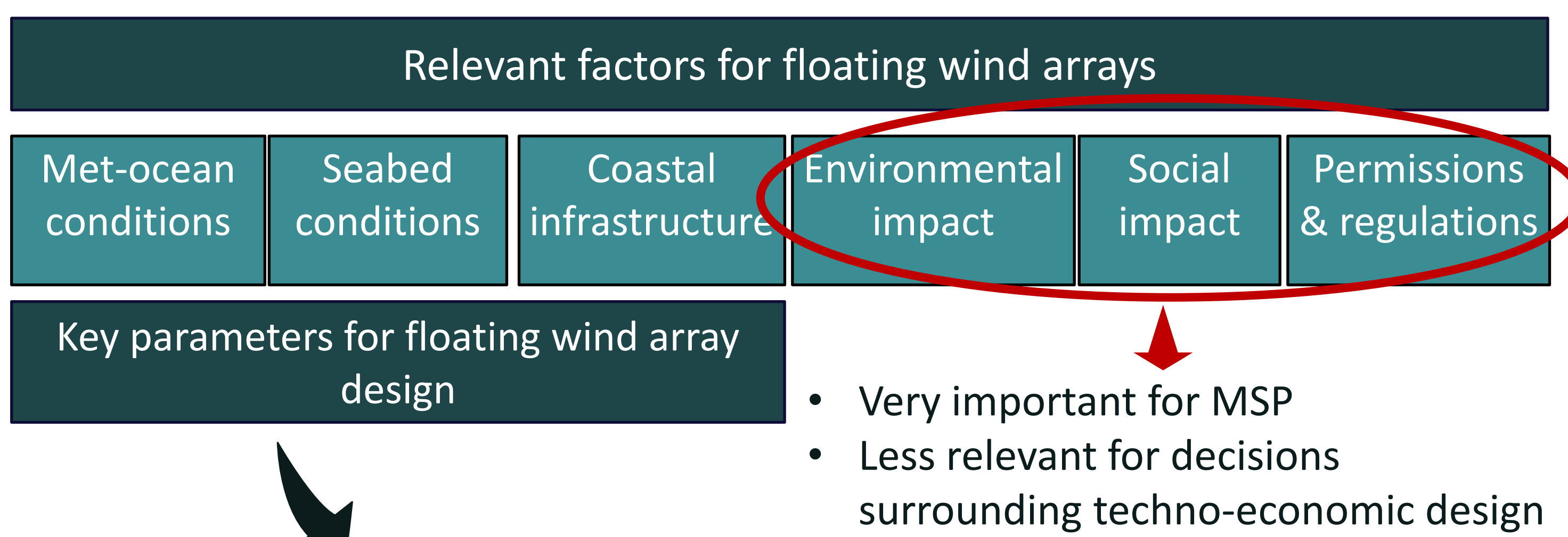
Objectives

The primary goals of WP1 of IEA Wind Task 49 are:

- To establish the type of parameters and constraints required to characterize FLOW array reference sites;
- To provide a realistic and publicly available set of reference site conditions to the FLOW community as a baseline set of data for individual research projects;
- To identify and categorize any critical gaps in the existing data or methodologies required to define reference site characteristics;
- To inform and support the design of reference FLOW arrays.

Methods

A building block concept was developed for the synthesis of reference sites for the design of FLOW arrays. The building blocks include three classes of site conditions: met-ocean conditions, seabed conditions and coastal infrastructure.



Results

Met-ocean Conditions

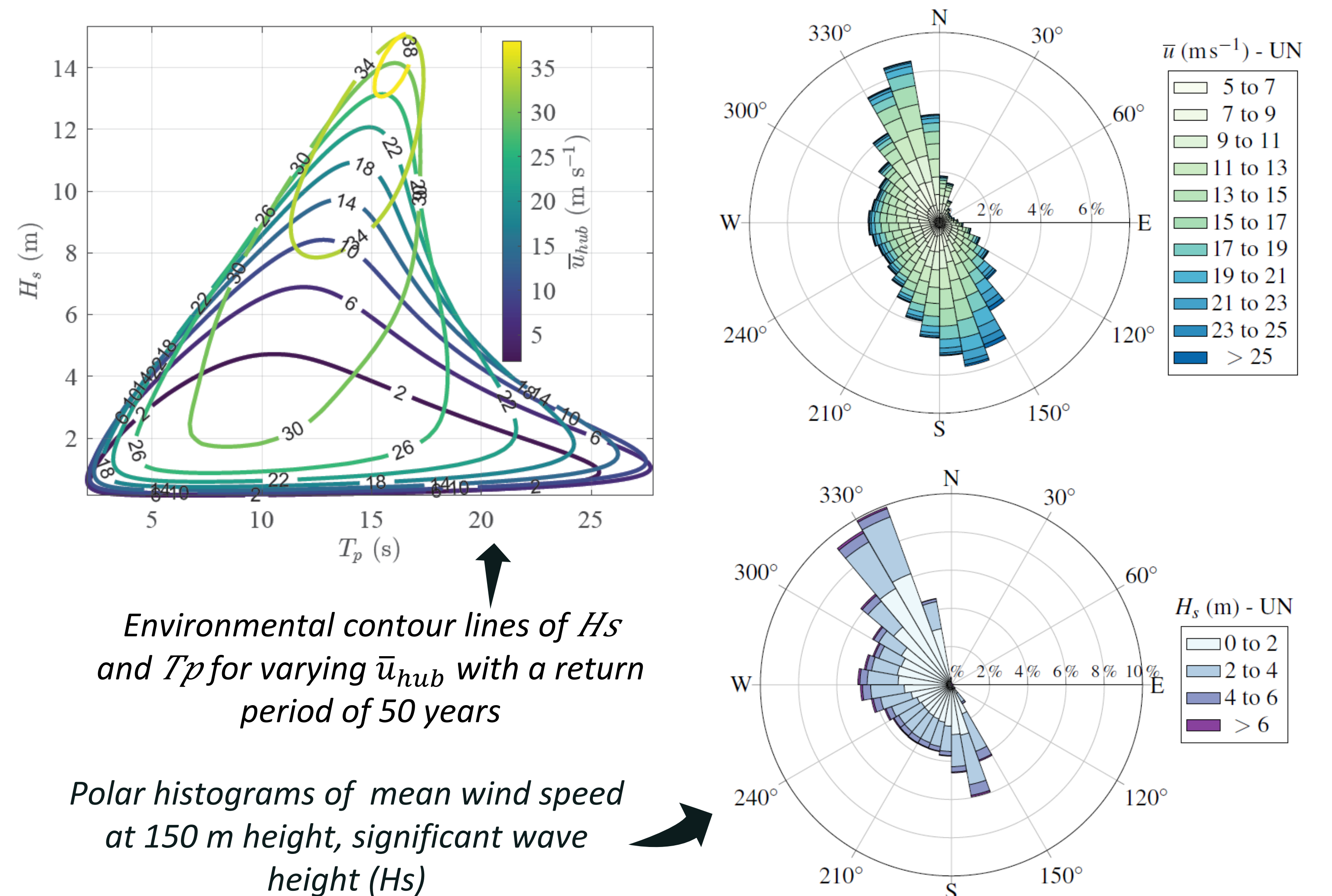
The blocks for the met-ocean conditions are based on met-ocean data from 11 real sites (Table 1), representative of the global pipeline. By leveraging the ERA5 climate reanalysis dataset [1], these sites were selected based on several severity categories describing wind and sea states separately. These severity categories are mild, lower-moderate, upper-moderate, and severe conditions.

Results

Table 1. Selected representative sites for which a design basis was produced

Name	Latitude [deg]	Longitude [deg]	Water depth [m] (GEBCO) [2]	Distance from shore [km] [3]	Severity* (Wind)	Severity (Wave)
Hannibal	37.54	12.12	-353	35	LM	M
Humboldt	40.93	-124.71	-707	43.8	LM	LM
Ulsan	35.34	129.84	-188	32	S	UM
MoneyPoint One	52.52	-10.28	-102	23.4	UM	S
Havbredey	58.84	-5.58	-91	41.6	S	S
Fukushima	37.31	141.25	-90	19.4	S	S
Utsira Nord	59.41	4.43	-273	42.4	UM	UM
Gulf of Maine	42.76	-68.58	-148	138	LM	UM
Geomundo	34.03	127.70	-70	47	S	UM
Sud de la Bretagne II	47.33	-3.66	-94	30.7	S	UM
Sørilige Nordsjø II	56.78	4.92	-60	180	S	UM

Example Site: Utsira Nord [4]



Seabed Conditions

Three blocks with two sub-scenarios each are defined, representing different combinations of soil conditions. For one specific anchor type, certain soil conditions might be favorable, while others might be unfavourable. Therefore, a specific scenario can be chosen based on the anchor type utilized.

- Depth of top of the strata
- Bulk density
- Undrained shear strength
- Poisson Ratio
- Friction angle
- Elastic Modulus
- Permeability

Coastal Infrastructure

Includes three building blocks of different ports: i. integration port, ii. floater manufacturing port, iii. O&M port. Example outlined in Table 2.

Table 2. Port requirements for the Floater Manufacturing Port

Parameter	Min	Max
Distance to OWF	Unlimited	Unlimited
Channel Width (m)	160	310
Channel Depth (m)	11.25	13.75
Air Draft (m)	50	-
Turning Basin Diameter (m)	270	550
Water Depth at Berth (m)	10	12.1

Parameter	Min	Max
Quay Wall Length (m)	≈310	≈485
Laydown Area (Ha)	20	40
Wet Storage Area in Sheltered Waters (Ha)	4	70
Bearing Capacity at Quayside (t/m ²)	20	50
Bearing Capacity at Laydown Area (t/m ²)	10	20

Conclusions

- Report and supplementary data feeds directly into WP2: Reference Array Designs
- All outputs will be made publicly available upon project completion

References

- Copernicus Climate Data Store <https://cds.climate.copernicus.eu/cdsapp#!dataset/reanalysis-era5-single-levels?tab=overview>
- GEBCO Bathymetry Dataset https://www.gebco.net/data_and_products/gridded_bathymetry_data/
- 4C Offshore <https://map.4coffshore.com/offshorewind/>
- Cheyne, Etienne and Li, Lin and Jiang, Zhiyu, Metocean Conditions at Two Norwegian Sites for Development of Offshore Wind Farms. <http://dx.doi.org/10.2139/ssrn.4408728>