

Developing solid foundations in Metocean Data

Nick Elderfield
MD, DHI UK



Smarter data
Integrated software
Considered solutions



DHI:PUTTING
WATER INTO
COMPUTERS
SINCE 1971.

28 years in offshore wind

- Working in offshore wind since 1991
- Supporting wind farms in Europe, America and around the World
- R&D led approach to improve wind farm projects



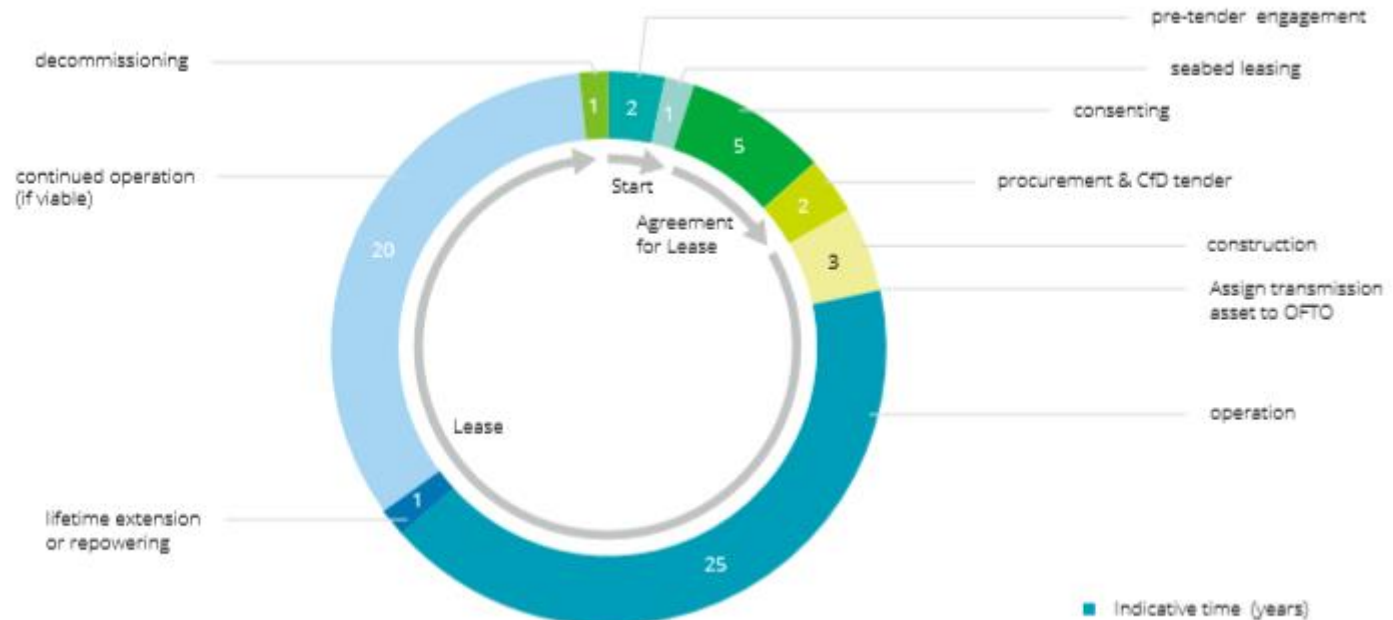
28 years in offshore wind

Our clients in the UK

- Consultants
- Contractors
- Utilities
- Developers
- Authorities



Offshore Wind Project Lifecycle



Source: The Crown Estate

Typical Wind Farm Service Requirements



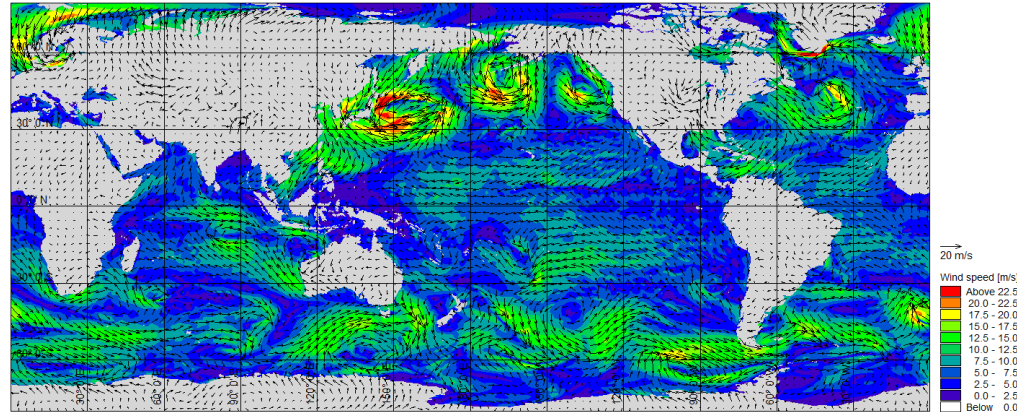
What is Metocean Data?

Meteorological and Oceanographic Data - Metocean Data

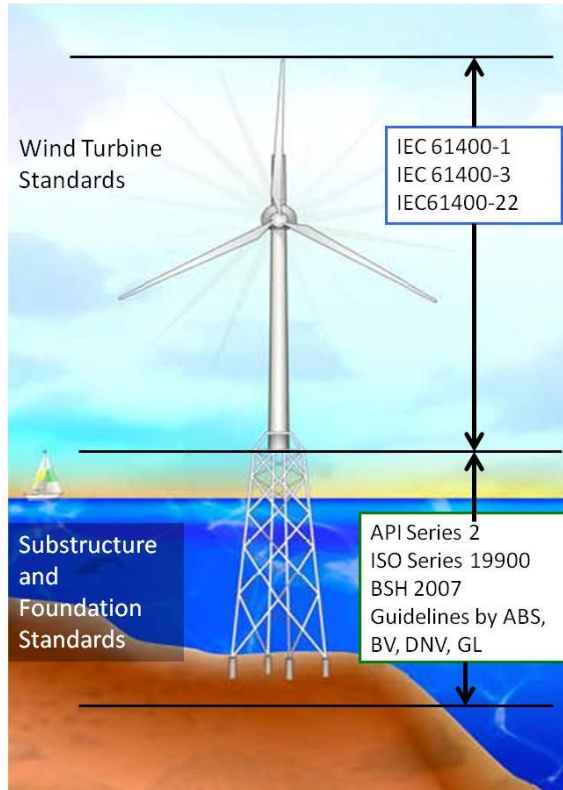
- Wind
 - Waves
 - Water levels
 - Currents
-
- Sea ice, marine growth, other oceanographic parameters

Meteorological and Oceanographic Data - Metocean Data

- Metocean data available as:
 - Measurements
 - Numerical model data
 - Hindcast
 - Forecast



Why is it important?



Innovation No.1

On Demand Access to Metocean data



Metocean Data Portal



Instant access to
worldwide Metocean
data



Data from high-
resolution local or
regional models, to
global coverage
datasets

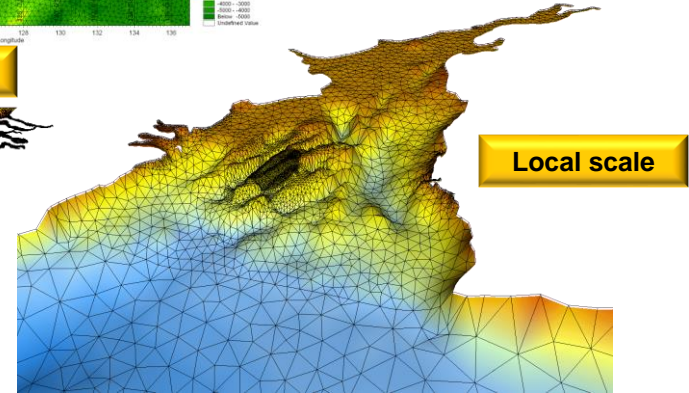
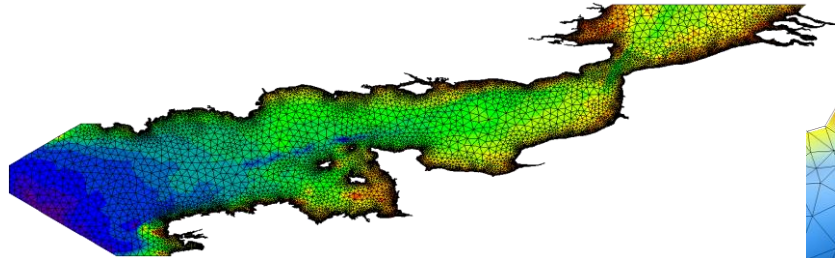
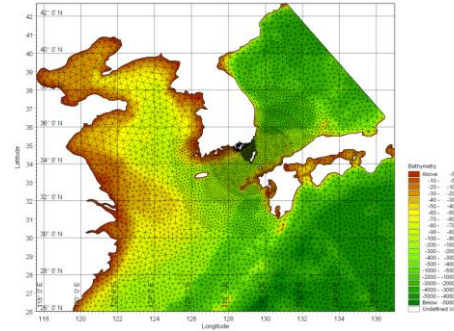
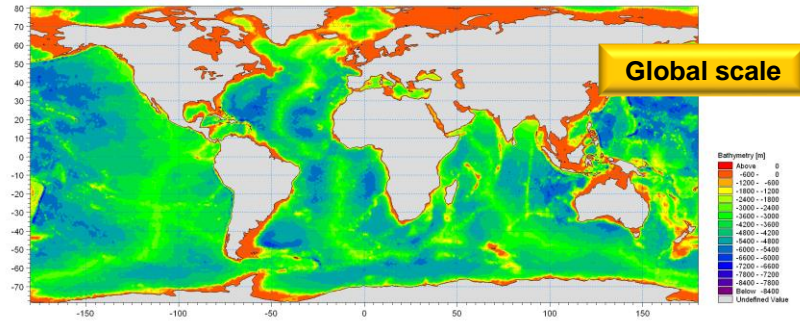


On-demand
calculations of
commonly requested
analytics



Continuously-
improving Metocean
data

DHI pioneered metocean down-scale modelling



Data on-demand or via an API

Quality Data
at your fingertips!

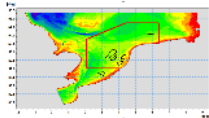
The screenshot displays the DHI Metocean Data Portal. The top navigation bar includes the DHI logo, the text 'Metocean Data Portal', and links for 'ABOUT', 'QUICK TOUR', 'PRICING', a shopping cart icon, and 'LOG IN/REGISTER'. The main content area is titled 'On-demand data and analytics globally'. On the left, there is a sidebar with several sections: 'Location' (with a search bar and a 'x' icon), 'Dataset (I)' (with a search bar and a 'x' icon), 'Time' (with 'Start Date' and 'End Date' fields and a calendar icon), 'Analytics (I)' (with a search bar), and 'Metadata'. Below these sections are 'EXTRACT' and 'CLEAR ALL' buttons. The main area features a world map with several regions highlighted in different colors: a large green box covering the Atlantic and parts of Europe and Africa, a blue box over the North Atlantic, a red box over the Middle East, an orange box over Southeast Asia, and a purple box over East Asia. A green line outlines the entire map area. A tooltip on the map says 'CLICK TO PLACE MARKER ON MAP'. The bottom of the map shows 'Google' and 'Leaflet' logos, along with copyright information: 'Map data ©2019 Imagery ©2019 NASA, TerraMetrics Terms of Use'. The footer of the portal contains the copyright notice 'Copyright © 2017 - 2019 DHI Group All rights reserved.' and links for 'Contact', 'Privacy', 'T&C', and 'Cookie'.

~ 40 years of
hindcast data!

www.metocean-on-demand.com



Database Area



Sign

Below

Percentile

50

Duration [hours]

1

Threshold(s) (up to 6 values, comma separated)

Conditional Dataset

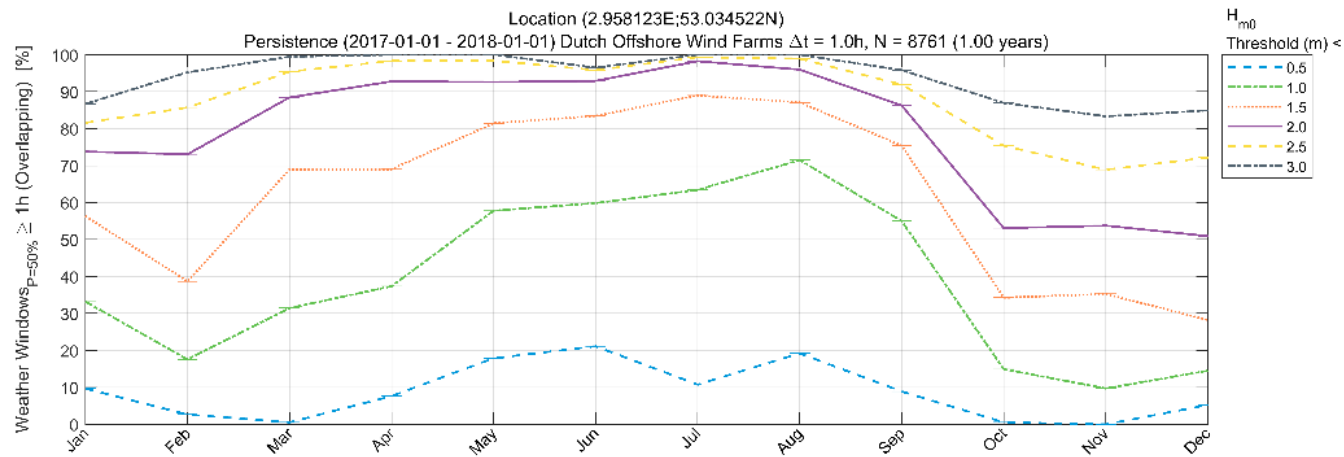
Conditional Variable

Sign

Threshold (1 value)

DOWNLOAD

UPDATE



“We challenged DHI to provide a world-class metocean database to allow developers to optimise their designs in the tender stage.

DHI exceeded our expectations.”

Ben de Sonnevile, Senior Consultant, BLIX Consultancy BV, On behalf of the client RVO.nl

On-demand data and analytics globally

Location 

Longitude [°E] × Latitude [°N] × 

Dataset (i) 

Global, Wave Parameters (Integrated), MIKE 21 Spectr ×

Time 

Start Date End Date
1/1/1979 × 31/3/2019 × 

EXTRACT

CLEAR ALL

Analytics (i) 

Search for or select an analytics

Metadata

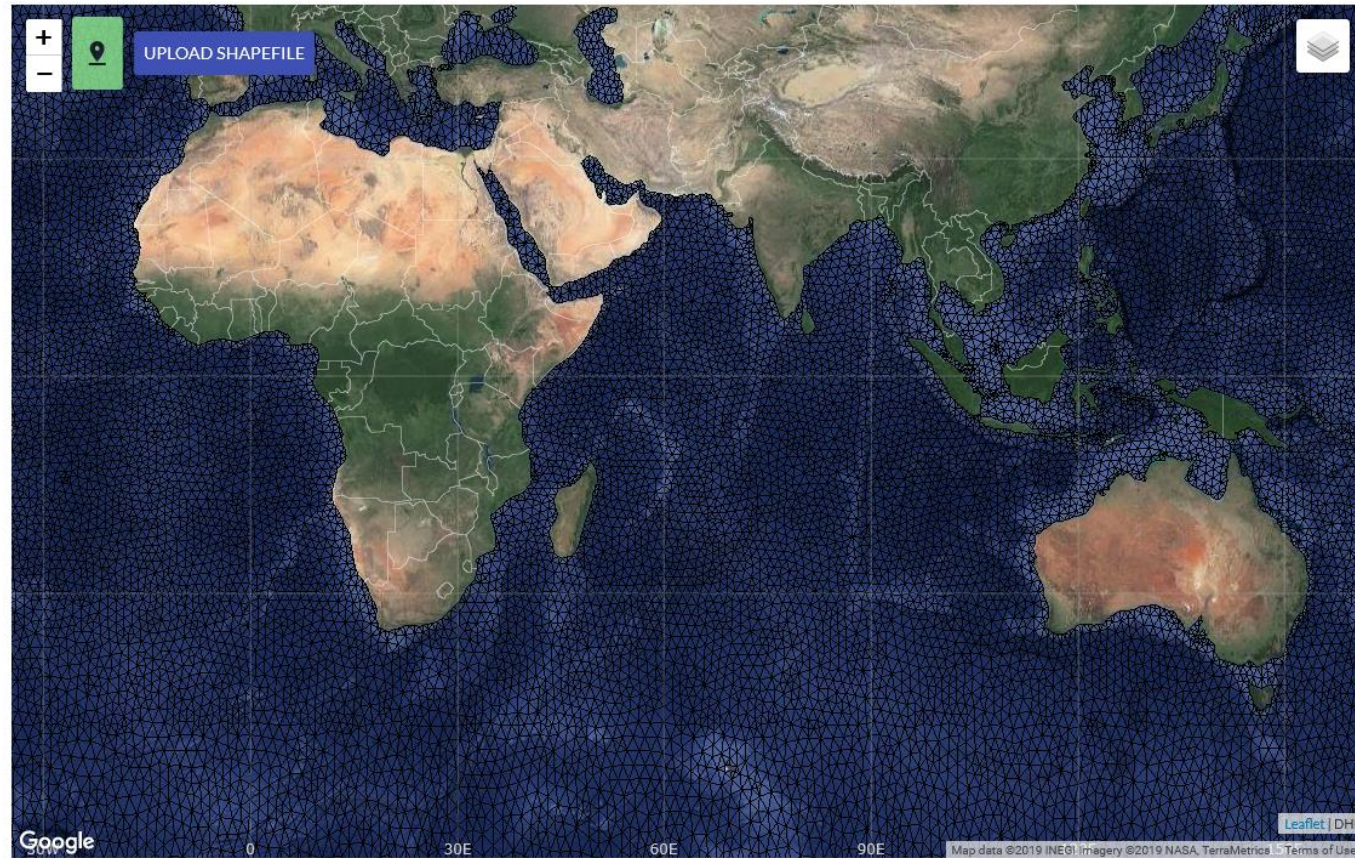
General

Coverage

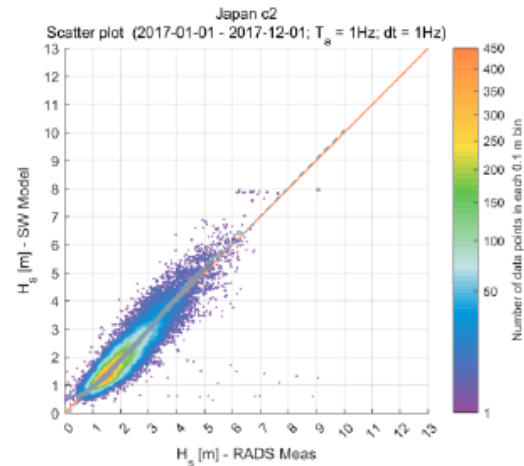
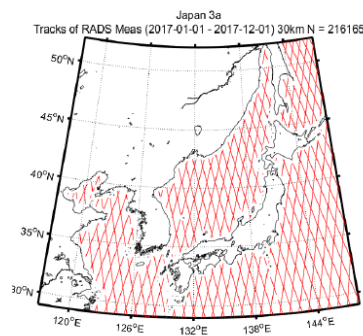
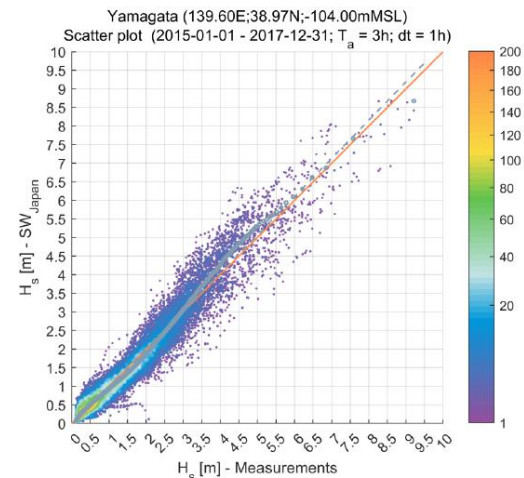
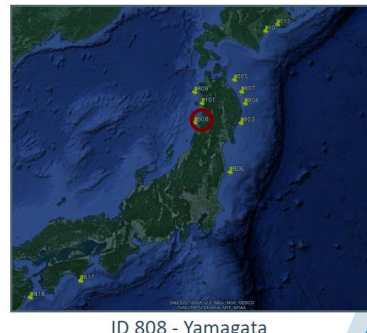
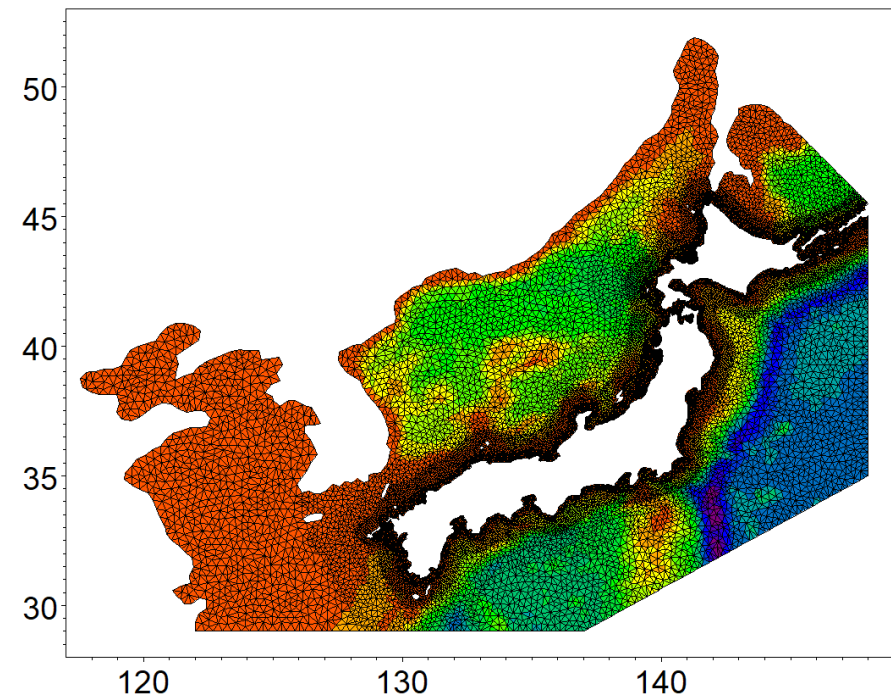
Variables

Title Global, Wave Parameters (Integrated), MIKE 21 Spectral Wave Model (SW), DHI

Geographical Global

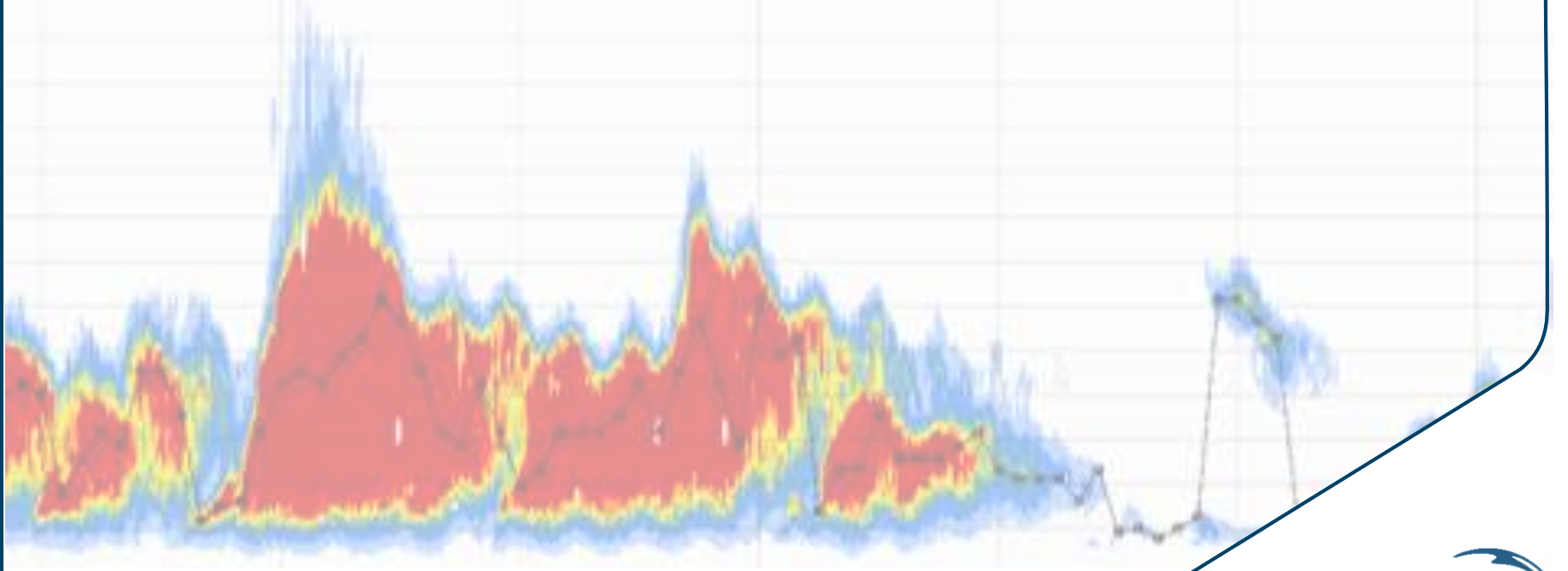


Breaking News: Japan & South Korea Coverage Extended



Innovation No.2

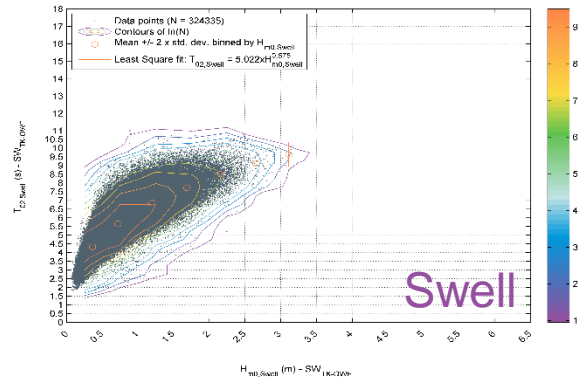
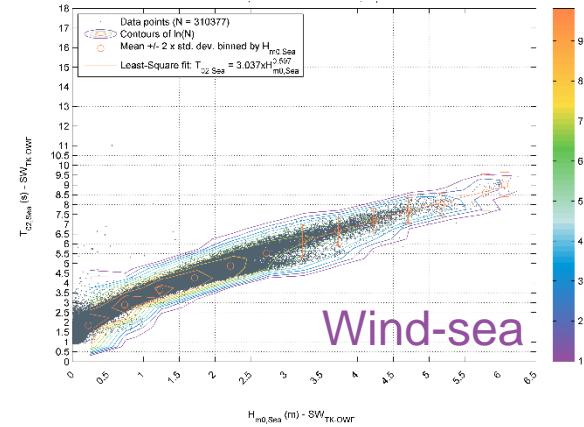
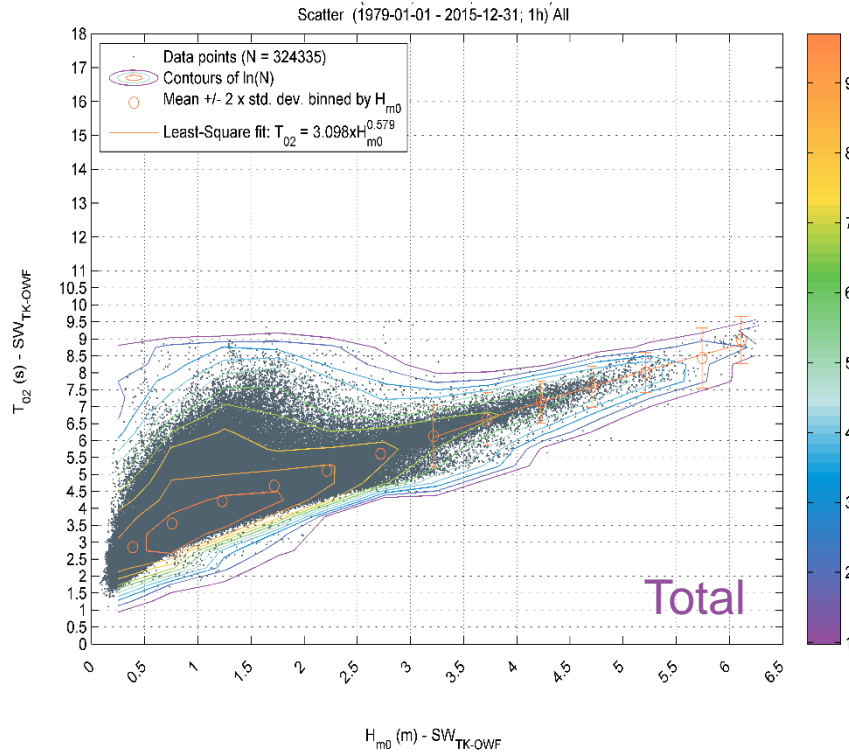
Moving away from “Parameters”



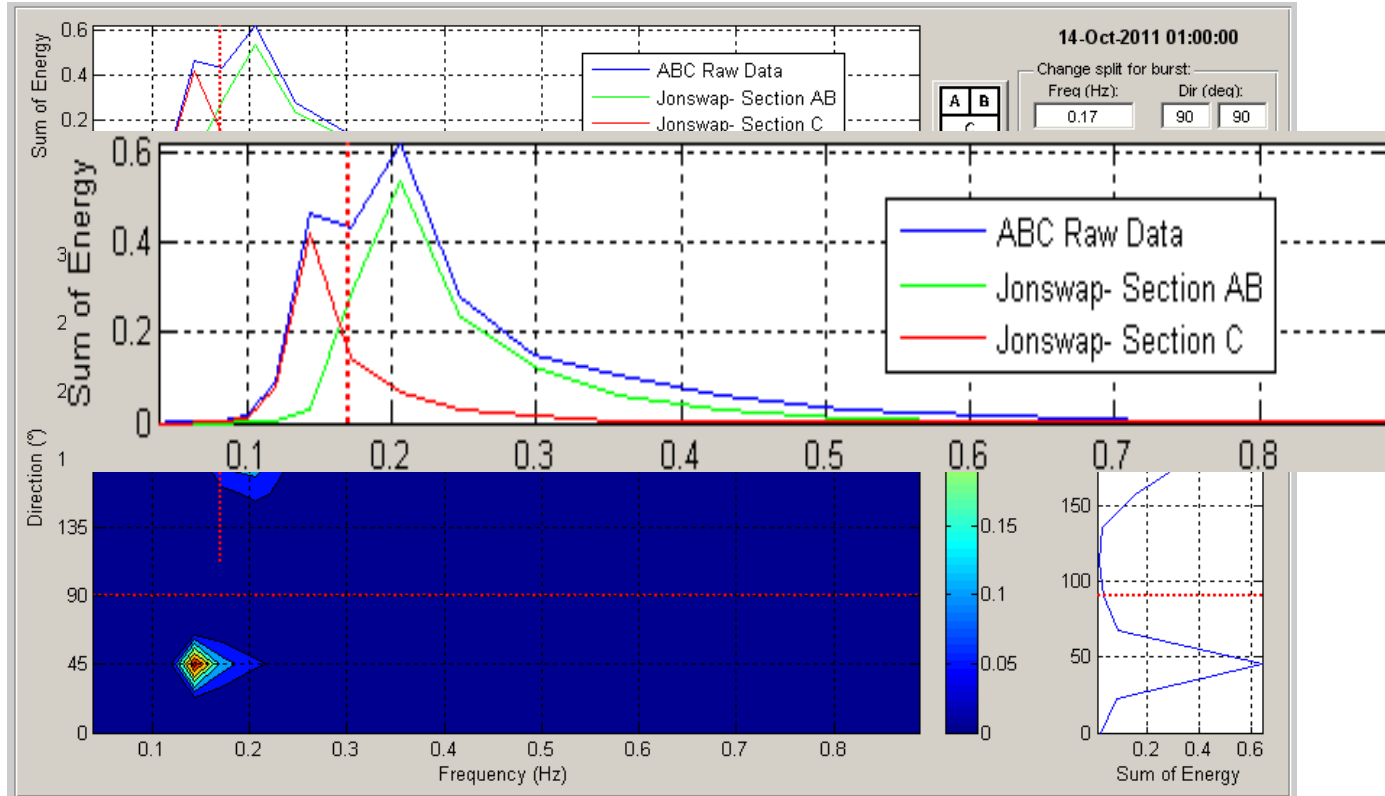
Typical list of parameters for waves

Item	Description	Parameter	Unit	Notes
1	Sign. Wave Height	Significant wave height	meter	
2	Peak Wave Period	Wave period	second	
3	Wave Period, T01	Wave period	second	
4	Wave Period, T02	Wave period	second	T02 ~ Tz, where Tz is the mean crossing period
5	Mean Wave Direction	Mean Wave Direction	degree	defined with respect to true North (coming from)
6	Dir. Stand. Deviation	Directional Std. Dev	degree	
7	Sign. Wave Height, w	Significant wave height	meter	wind-sea partition of sea state
8	Peak Wave Period, w	Wave period	second	wind-sea partition of sea state
9	Wave Period, T01, w	Wave period	second	wind-sea partition of sea state
10	Wave Period, T02, w	Wave period	second	T02 ~ Tz, where Tz is the mean crossing period, wind-sea partition of sea state
11	Mean Wave Direction, w	Mean Wave Direction	degree	defined with respect to true North (coming from), wind-sea partition of sea state
12	Dir. Stand. Deviation, w	Directional Std. Deviation	degree	wind-sea partition of sea state
13	Sign. Wave Height, s	Significant wave height	meter	swell partition of sea state
14	Peak Wave Period, s	Wave period	second	swell partition of sea state
15	Wave Period, T01, s	Wave period	second	swell partition of sea state
16	Wave Period, T02, s	Wave period	second	T02 ~ Tz, where Tz is the mean crossing period, swell partition of sea state
17	Mean Wave Direction, s	Mean Wave Direction	degree	defined with respect to true North (coming from), swell partition of sea state
18	Dir. Stand. Deviation, s	Directional Std Dev	degree	swell partition of sea state
19	Surface elevation	Surface Elevation	meter	relative to mean-sea-level
20	Wind speed	Wind speed	m/s	CFSR modelled wind speed at 10m above mean-sea-level
21	Wind direction	Wind Direction	degree	CFSR modelled wind speed at 10m above mean-sea-level, defined with respect to true North (coming from)

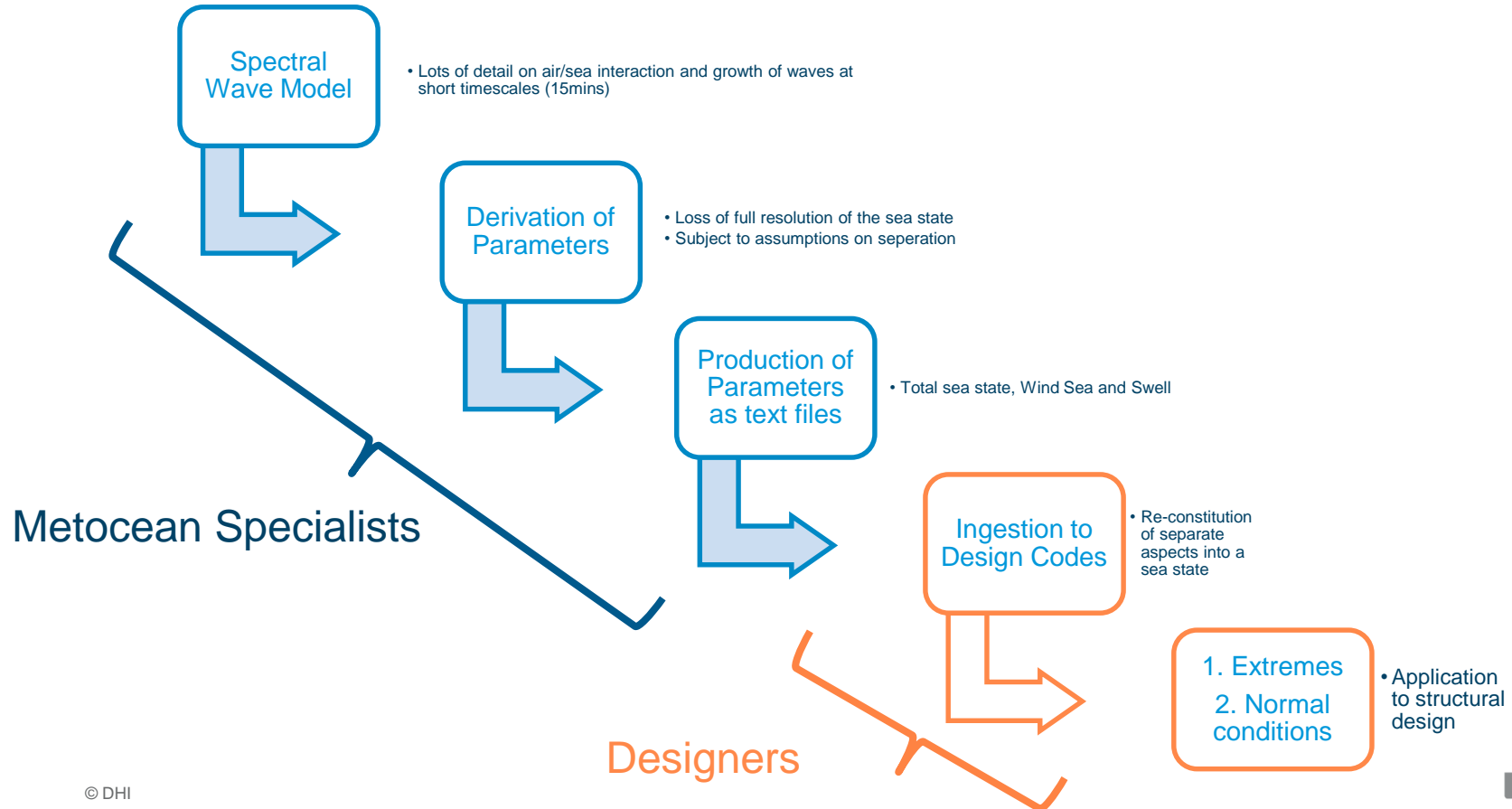
Typical list of parameters



Spectrum from spectral wave model



Process tree for interaction between specialisms

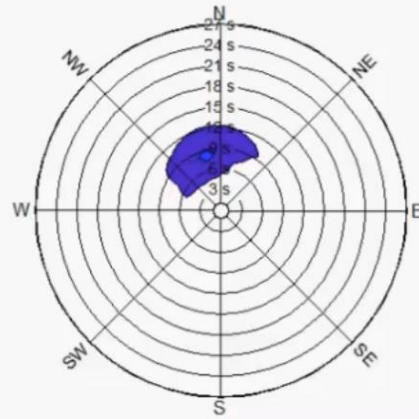


IEC 61400-3-1

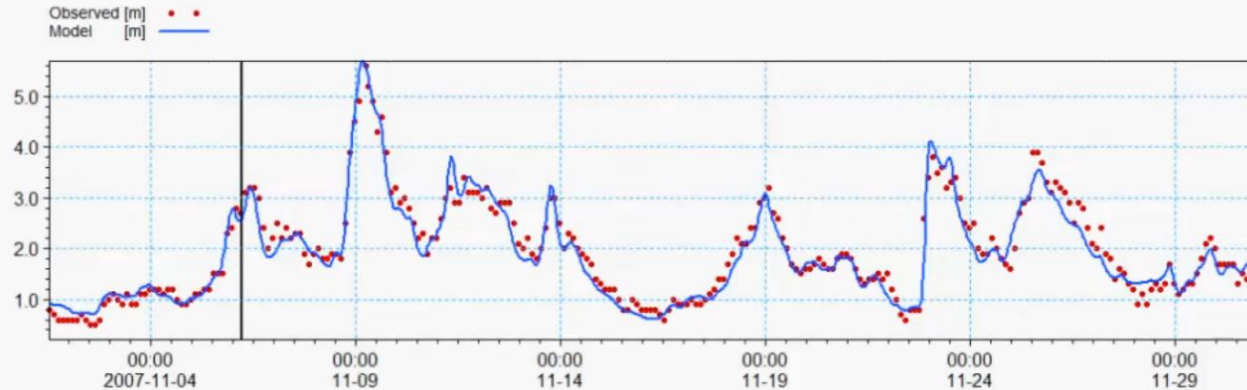
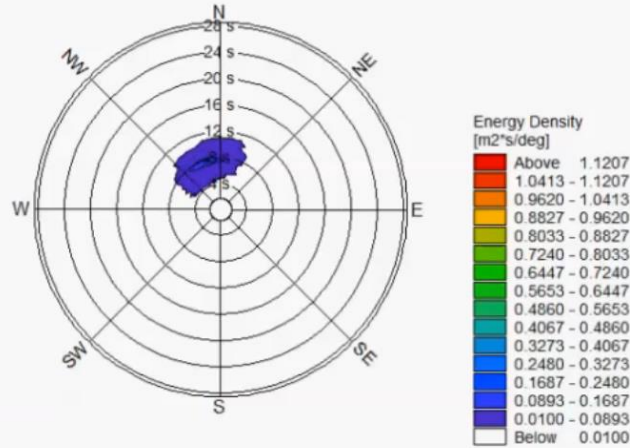
6.4.4.2 Assessment of normal wave conditions

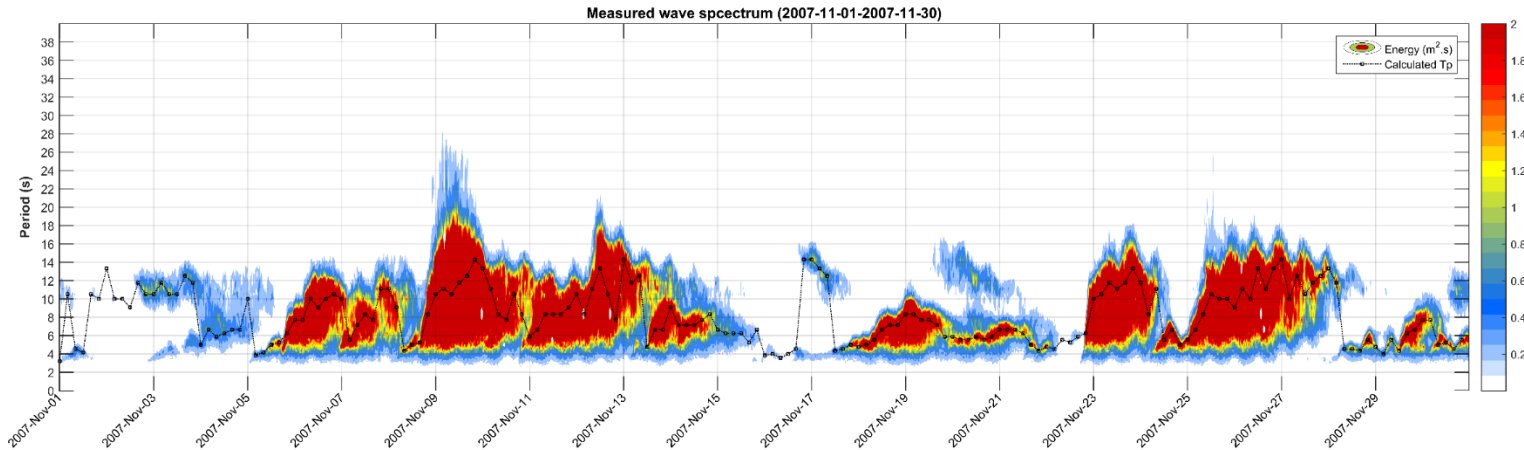
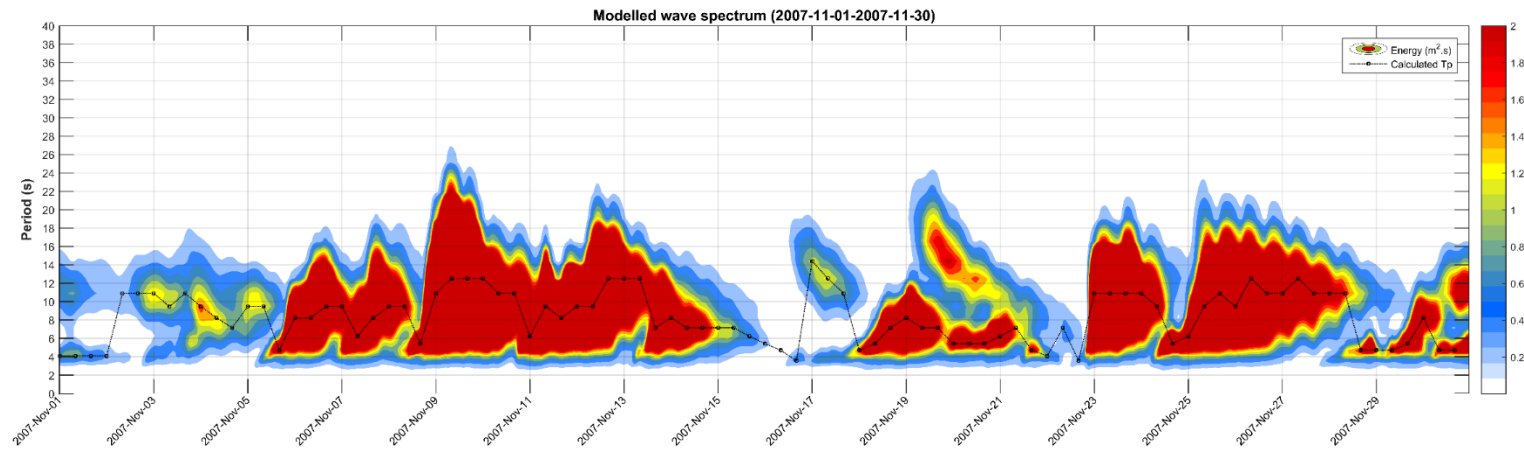
There is no requirement for assessment of site-specific wave spectra and directional spreading and the standard formulations provided in ISO 19901-1 may be assumed. Where appropriate and reliable measurements exist, site-specific wave spectra and the directional spreading function may, however, be assessed as the basis of design and/or design verification of an offshore wind turbine.

Modelled Spectra



Measured Spectra

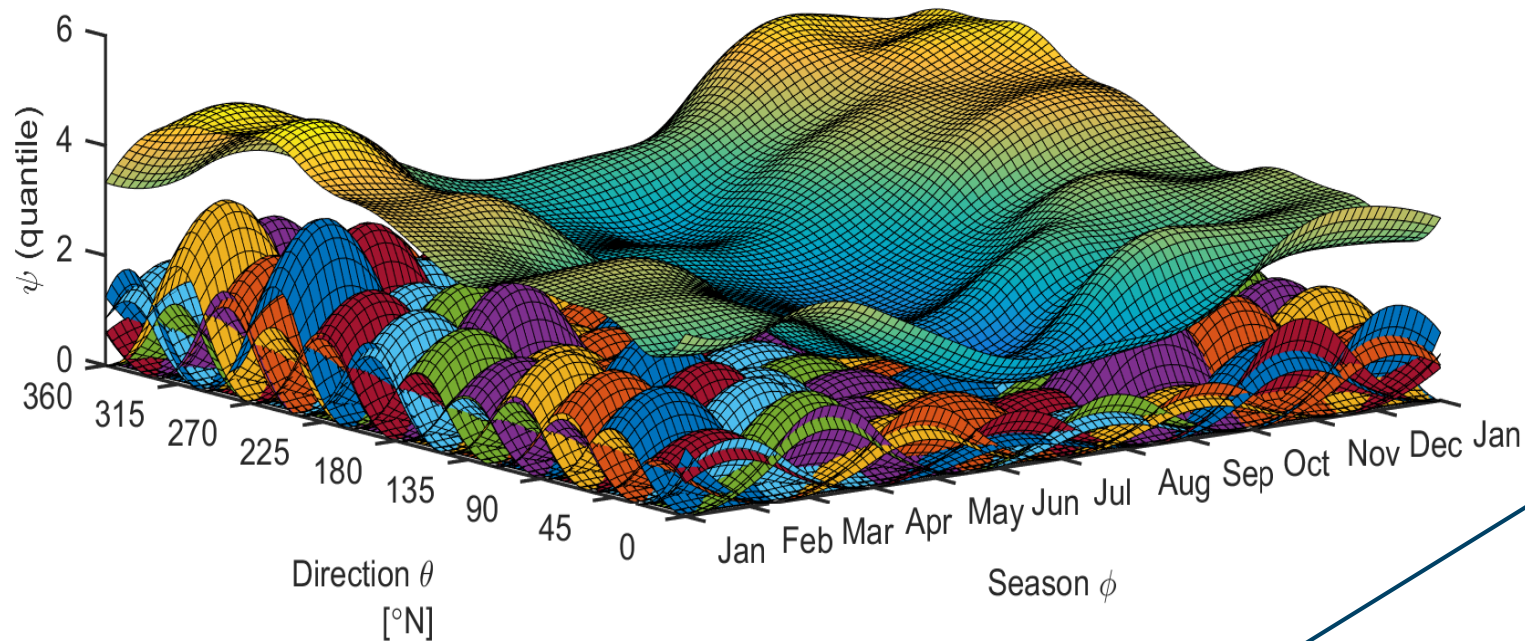




Innovation No. 3

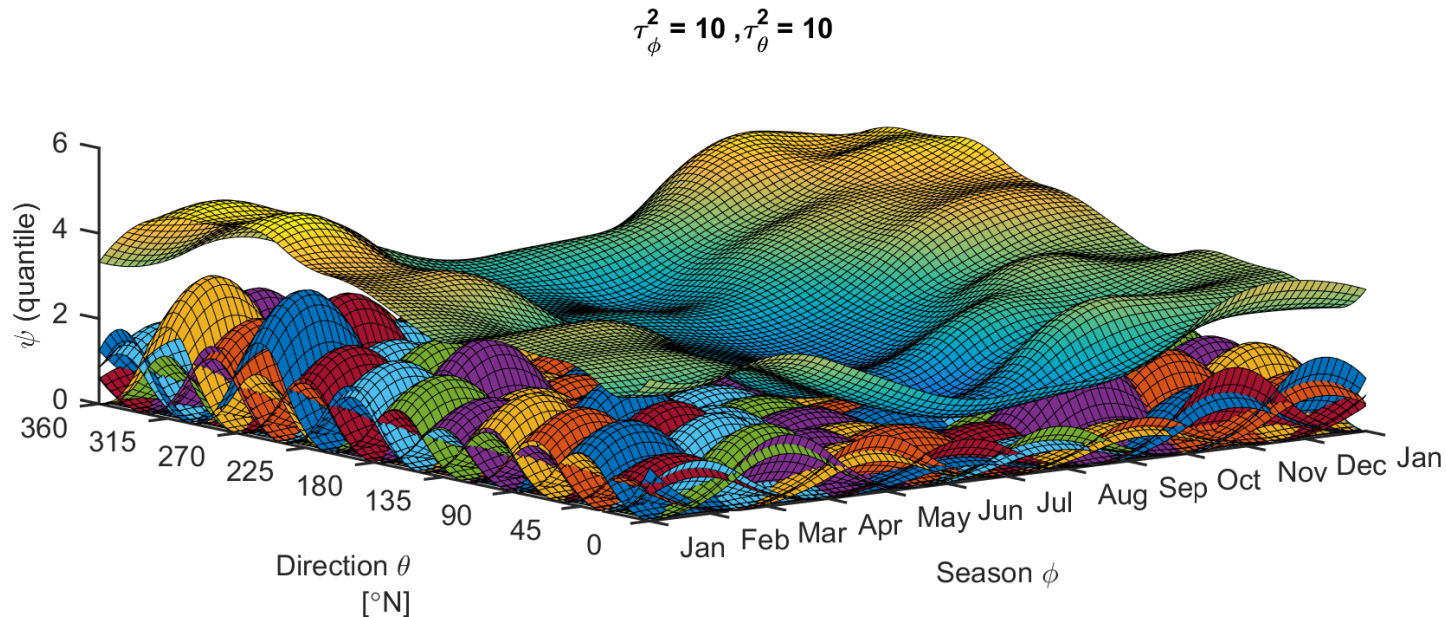
Advanced Extremes

J-EVA



Advanced Extremes Analysis

DHI J-EVA

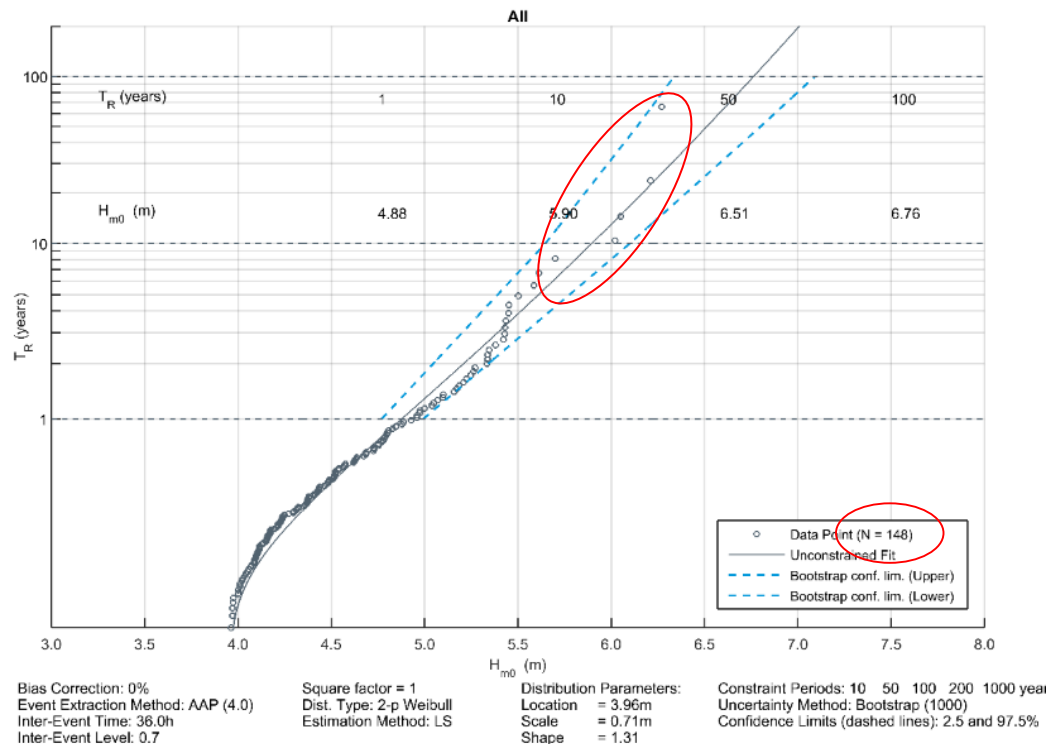


Directional-seasonal extreme value analysis of North Sea storm conditions
Hans Fabricius Hansen, David Randell, Allan Rod Zeeberg, Philip Jonathan

Advanced Extremes Analysis

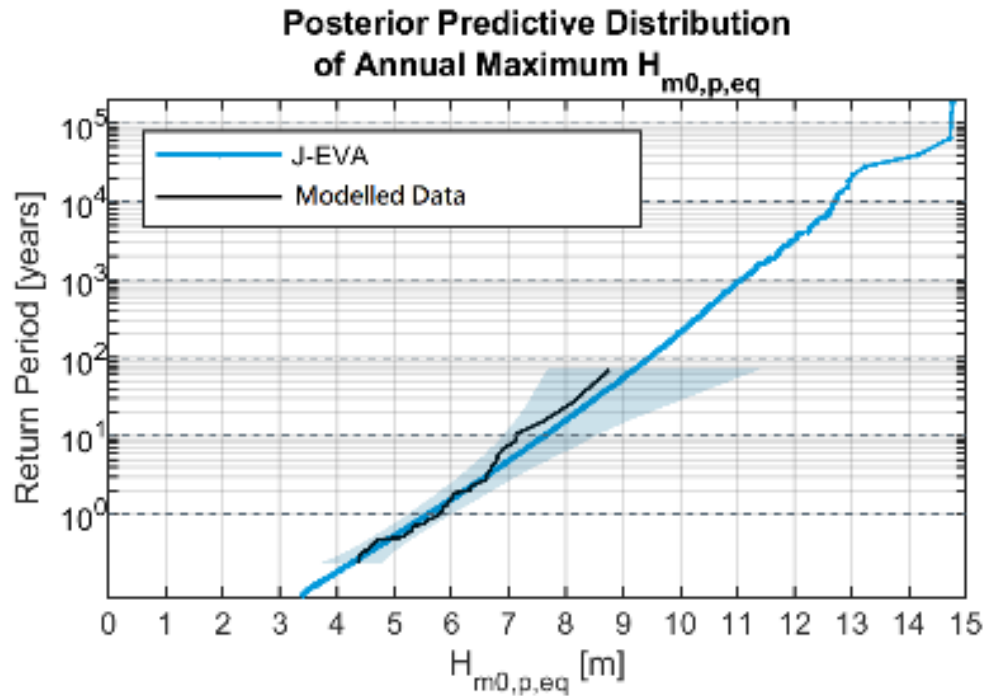
DHI J-EVA

- Dealing with the tail of a distribution
- High or unknown uncertainty in the estimates
- Typically deal with this by providing bootstrapped confidence intervals



Advanced Extremes Analysis

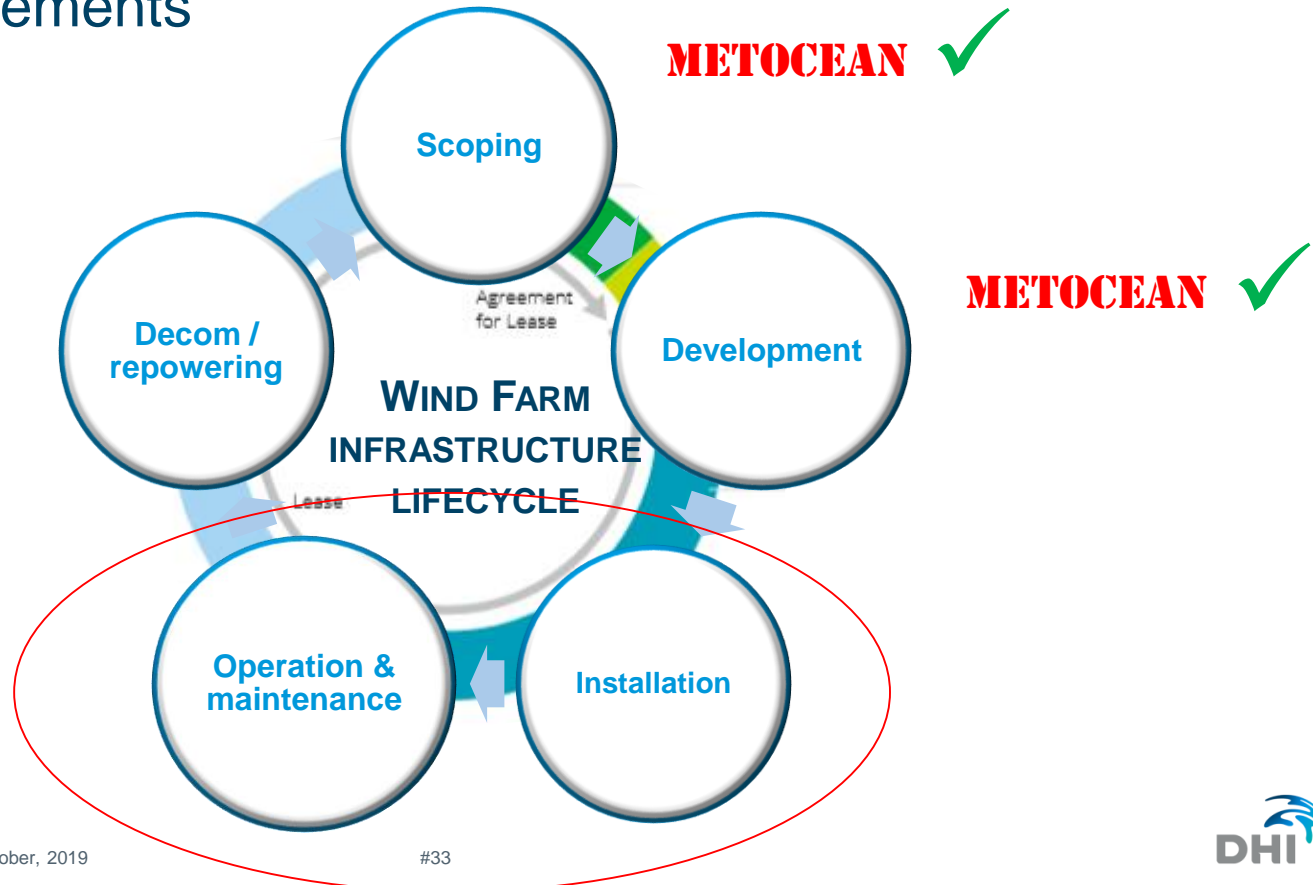
DHI J-EVA



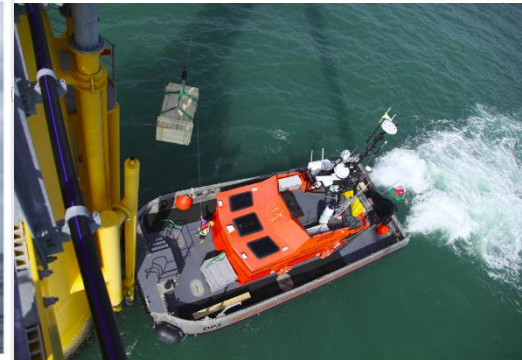
Innovation No. 4

Making more of data

Typical Wind Farm Service Requirements



The art of staying still....



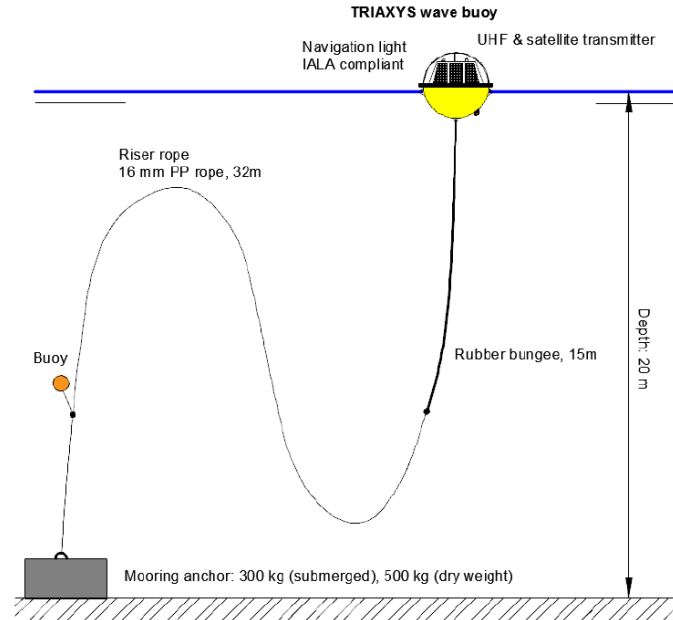
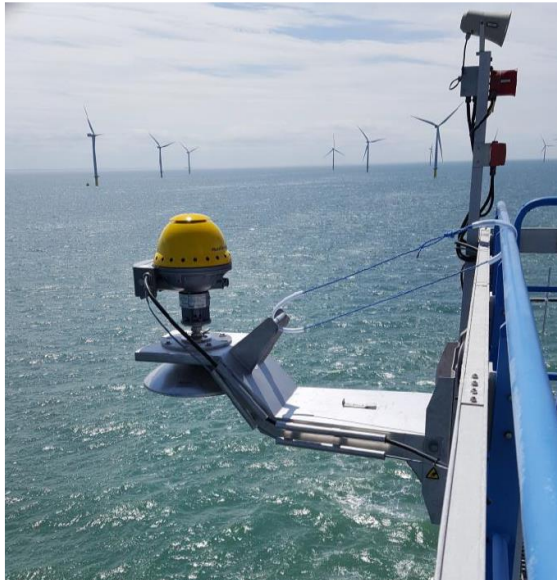
Forecasting for Installation and Operation

- Metocean *prediction* (wind, currents, waves)
- Vessel characteristics
- Requirements and thresholds for operations
- Informed decision on
 - Location
 - Timing
 - Equipment and vessel requirements
 - Man-time



Smarter data

London Array



A 3D perspective view of a topographic map. The terrain is rendered in shades of green and brown, showing a mountain range with a prominent ridge. A red dashed rectangular box is drawn on the map, highlighting a specific area of interest on the right side of the ridge. The map is tilted, showing the spatial relationship between the highlighted area and the surrounding terrain.



Considered solutions



NEWS FROM STORMGEO GUIDE GLOSSARY EMAIL ADMIN PORTAL ADMIN CONTACT US LOGOUT

Home Primary Forecasts ▾ Daily Lightning Assessment Turbine Forecasts ▾ Observation vs forecast ▾ Current & Tidal forecasts ▾ Routing ▾ Video Brief

Primary1_Knock Deep North ▾

Wave Graph ▾



Primary1_Knock Deep North : Forecast Graphs

0400 forecast issued at 0317 UTC

Christopher Munro, Forecaster



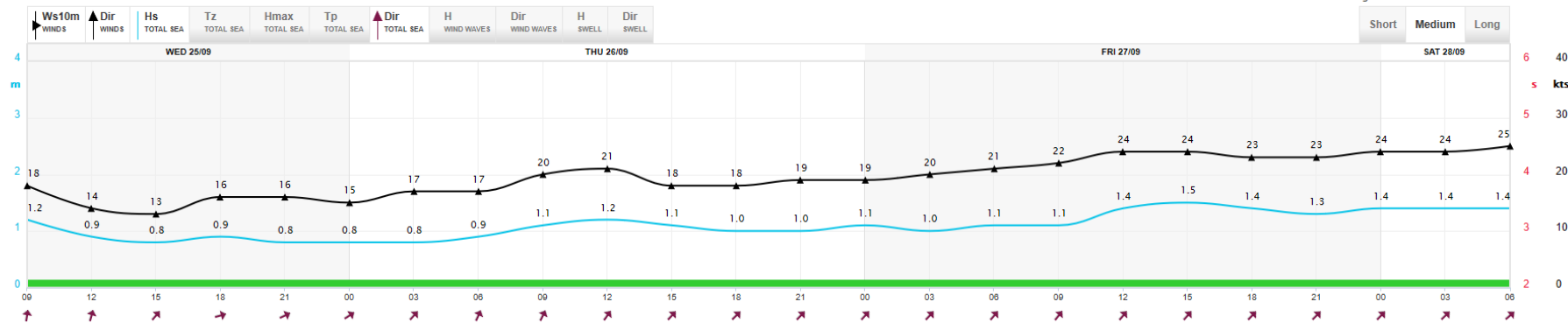
Sunrise
05:44 UTC

Sunset
17:46 UTC

Position
51.618° / 1.506°

Confidence ■ high ■ medium ■ low

Short Medium Long



Considered solutions

[Home](#)[Primary Forecasts ▾](#)[Daily Lightning Assessment](#)[Turbine Forecasts ▾](#)[Observation vs forecast ▾](#)[Current & Tidal forecasts ▾](#)[Routing ▾](#)[Video Brief](#)[NEWS FROM STORMGEO](#)[GUIDE](#)[GLOSSARY](#)[EMAIL ADMIN](#)[PORTAL ADMIN](#)[CONTACT US](#)[LOGOUT](#)[Primary1_Knock Deep North ▾](#)[Ensemble Waves ▾](#)

Primary1_Knock Deep North : Ensemble Probability Forecast

0400 forecast issued at 0317 UTC

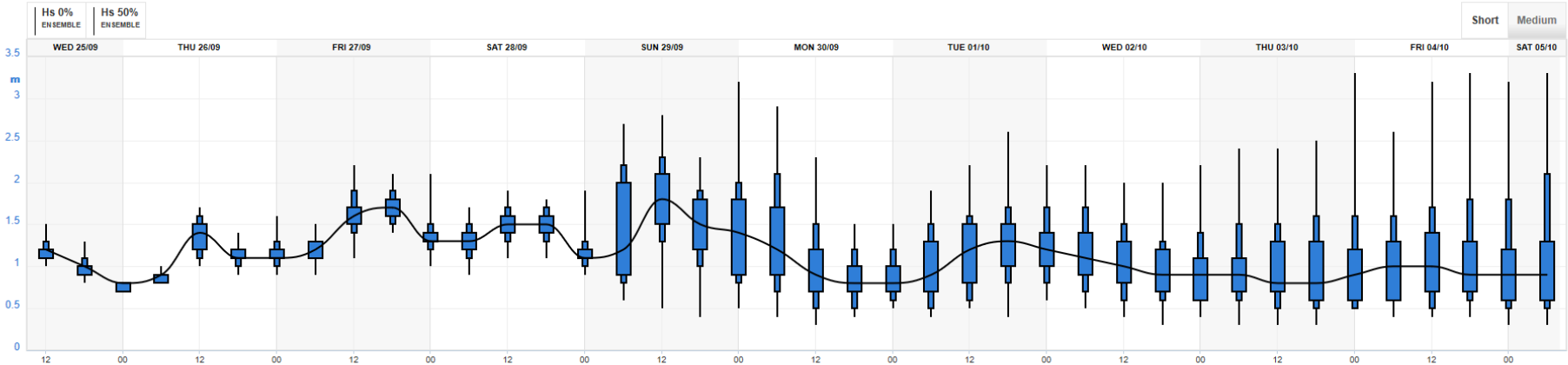
Christopher Munro, Forecaster



Sunrise
05:44 UTC

Sunset
17:46 UTC

Position
51.618° / 1.506°



Considered solutions

Waterforecast by DHI



London Array Ltd. API Documentation

The HTTP API is read-only and have these methods.

- Stations - `/lal/stations`
- Variables - `/lal/variables/{station}`
- Timeseries data - All variables `/lal/values/{station}`
- Timeseries data - Selected variable `/lal/values/{station}/{variable}`

Stations

A10

Variables

Sign. Wave Height (Hm0/Hs) - Total

Timeseries data

Datetime is formatted according to the ISO 8601 standard e.g. 2019-09-25T10:06:30.099Z

Chart JSON

A10



Chart

JSON

```
{
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    "slug": "a10",
    "longitude": 1.45765,
    "latitude": 51.578557
  },
  "name": "Sign. Wave Height (Hm0/Hs) - Total",
  "unit": "m",
  "forecastids": [
    {
      "forecastId": "2019-09-25T00:00:00Z",
      "start": "2019-09-24T00:30:00Z",
      "end": "2019-09-28T12:00:00Z"
    },
    {
      "forecastId": "2019-09-24T12:00:00Z",
      "start": "2019-09-28T12:30:00Z",
      "end": "2019-09-30T12:00:00Z"
    }
  ],
  "data": [
    [
      "2019-09-24T00:30:00Z",
      0.97
    ],
    [
      "2019-09-24T01:00:00Z",
      0.94
    ],
    [
      "2019-09-24T01:30:00Z",
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    ],
    [
      "2019-09-24T02:00:00Z",
      0.89
    ],
    [
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    ],
    [
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    ],
    [
      "2019-09-24T03:30:00Z",
      1
    ],
    [
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      1.04
    ],
    [
```



Considered solutions



Thank you for your attention ...

nje@dhigroup.com

