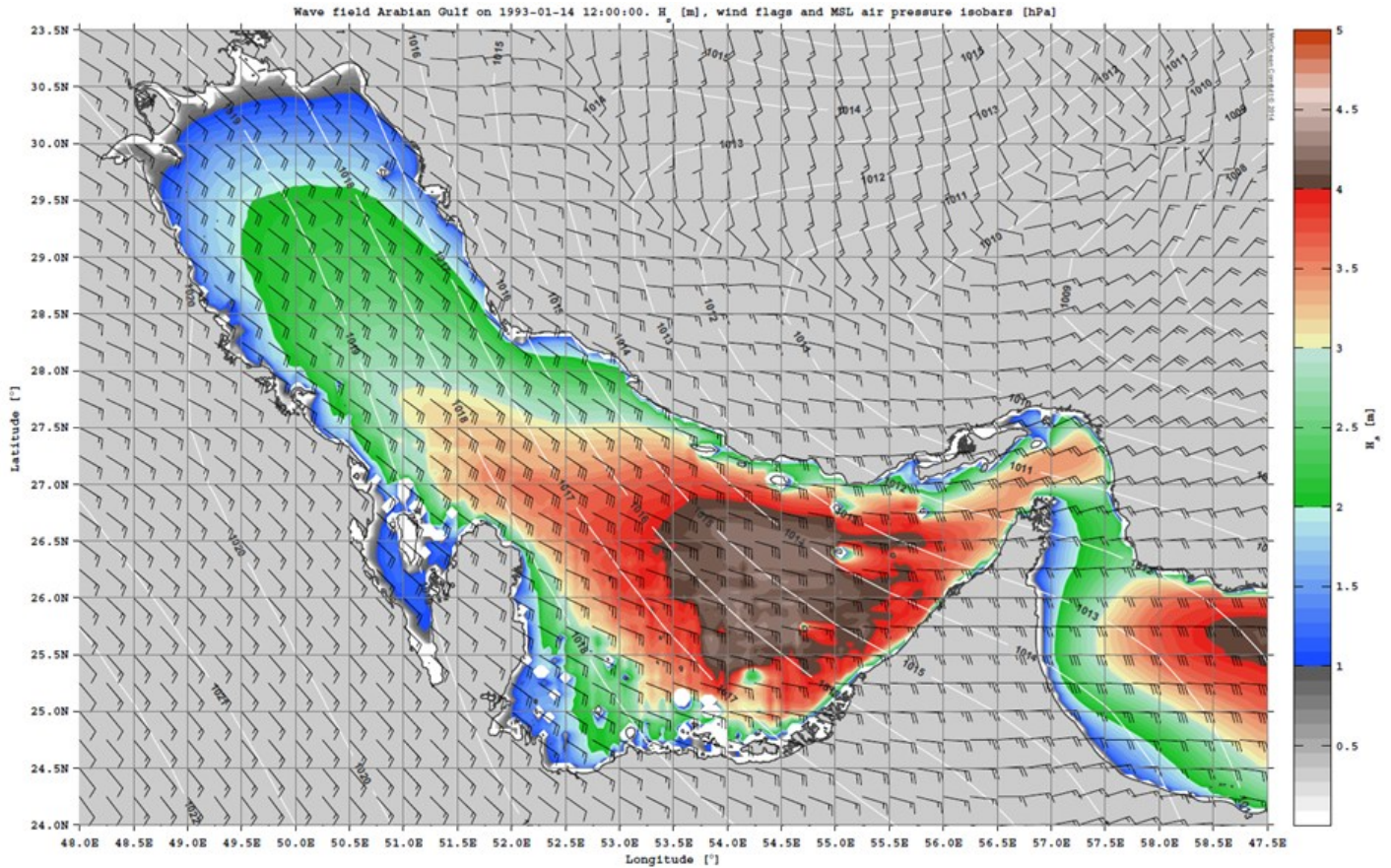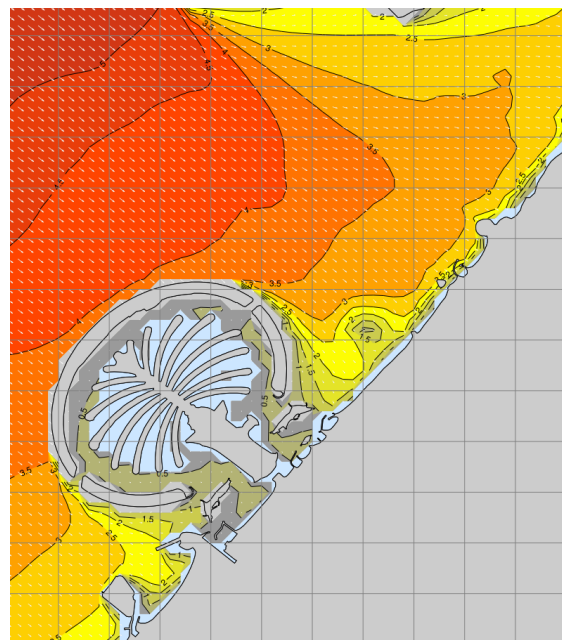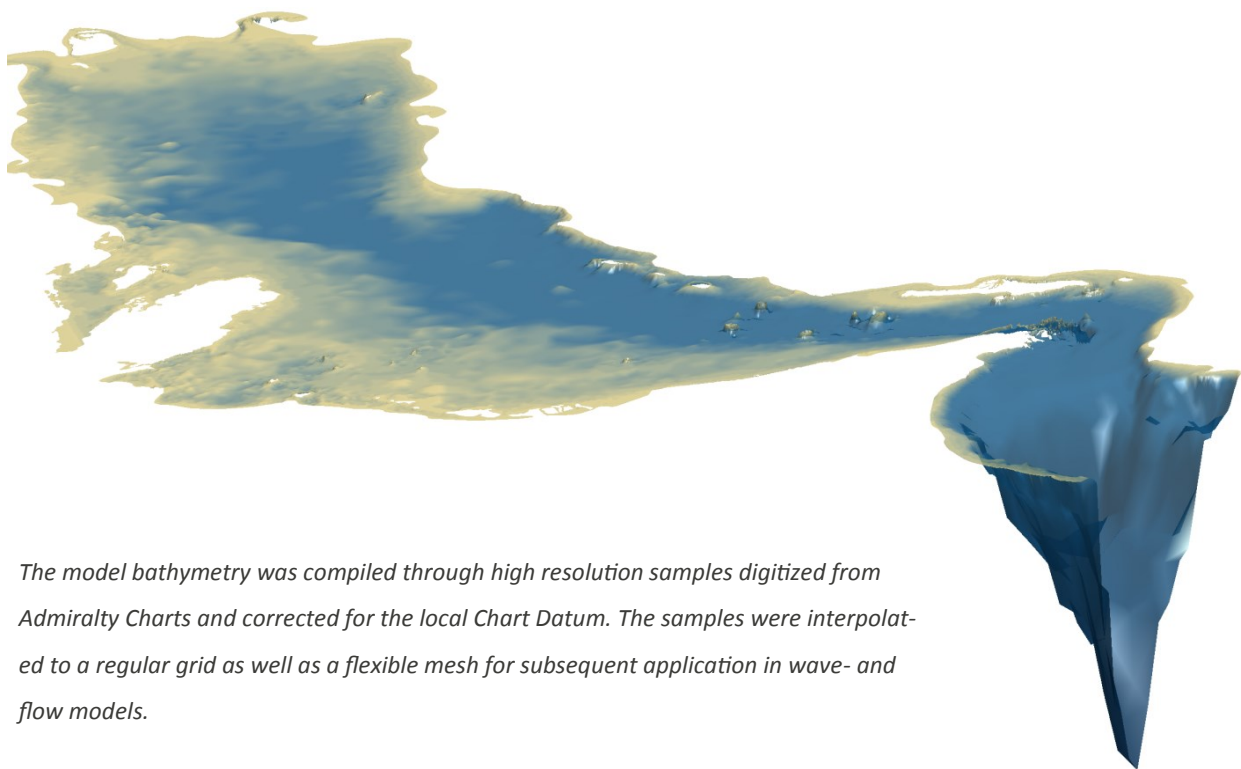# Hindcast Arabian Gulf

Image of isobars of atmospheric pressure and hindcast wind- and wave field over the Arabian Gulf during a storm in January 1993.

Detailed wave studies are supported by nesting of high resolution grids into the overall model

MetOcean Consult
Metocean and Hydraulic Concultancy

Contents

The model bathymetry was compiled through high resolution samples digitized from Admiralty Charts and corrected for the local Chart Datum. The samples were interpolated to a regular grid as well as a flexible mesh for subsequent application in wave- and flow models.
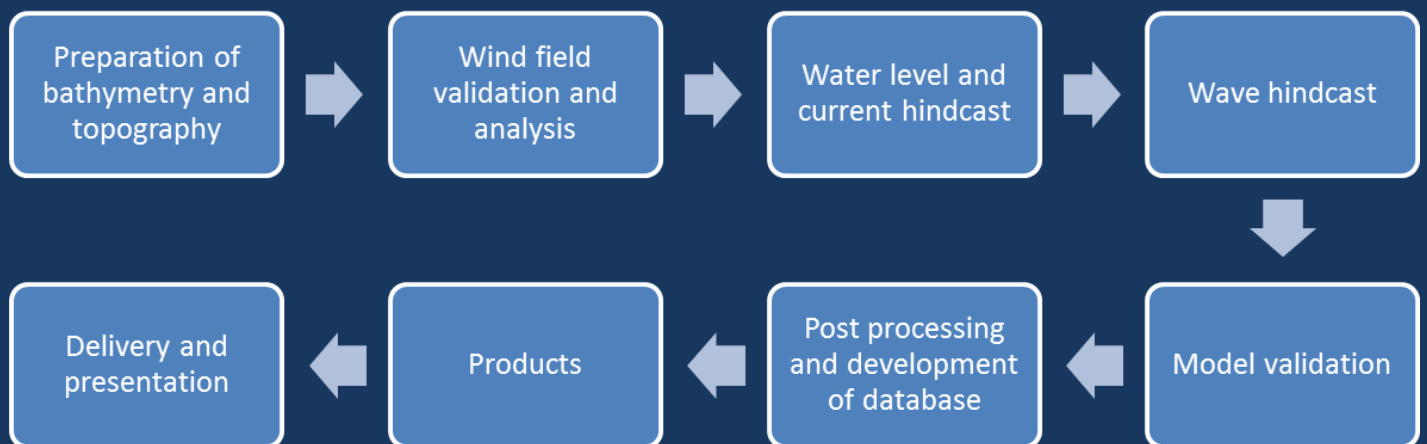
Introduction

MetOcean Consult has developed a detailed hindcast wave and flow model framework providing longterm time series of high quality wind, waves, water levels and currents.

A range of state-of-the-art technologies was applied for setting up the hindcast, model validation and processing of derived products .

Products

- Time series of wind -and wave parameters and 2D wave spectra at hourly intervals

- Time series of tidal and non-tidal (residual) water levels and currents

- Climatic tables (annual, seasonal, monthly) of arbitrary combinations of wind, waves, water levels and currents

- Wind, wave and current roses

- Extreme statistics (directional, seasonal)

- Customized products (upon request)

Preparation of bathymetry and topography → Wind field validation and analysis → Water level and current hindcast → Wave hindcast

↓

Delivery and presentation ← Products ← Post processing and development of database ← Model validation

A systematic approach was followed when developing the hindcast. The steps mentioned above are further described in this brochure.

Atmospheric forcing

One of the most important aspects in wave- and surge hindcasting, is the application of accurate wind fields.

Therefore, as atmospheric forcing of the wave- and flow models, we used the wind– and pressure fields from the Climate Forecast System Reanalysis (CFSR) by NOAA and validated these with satellite scatterometer data collocated in space and time.

Application of validated hourly wind fields ensures the application of high accuracy model inputs.

The hindcast covers the period January 1979 to date and is updated on a monthly basis.

A range of wind analysis products can be provided upon request as described further on.
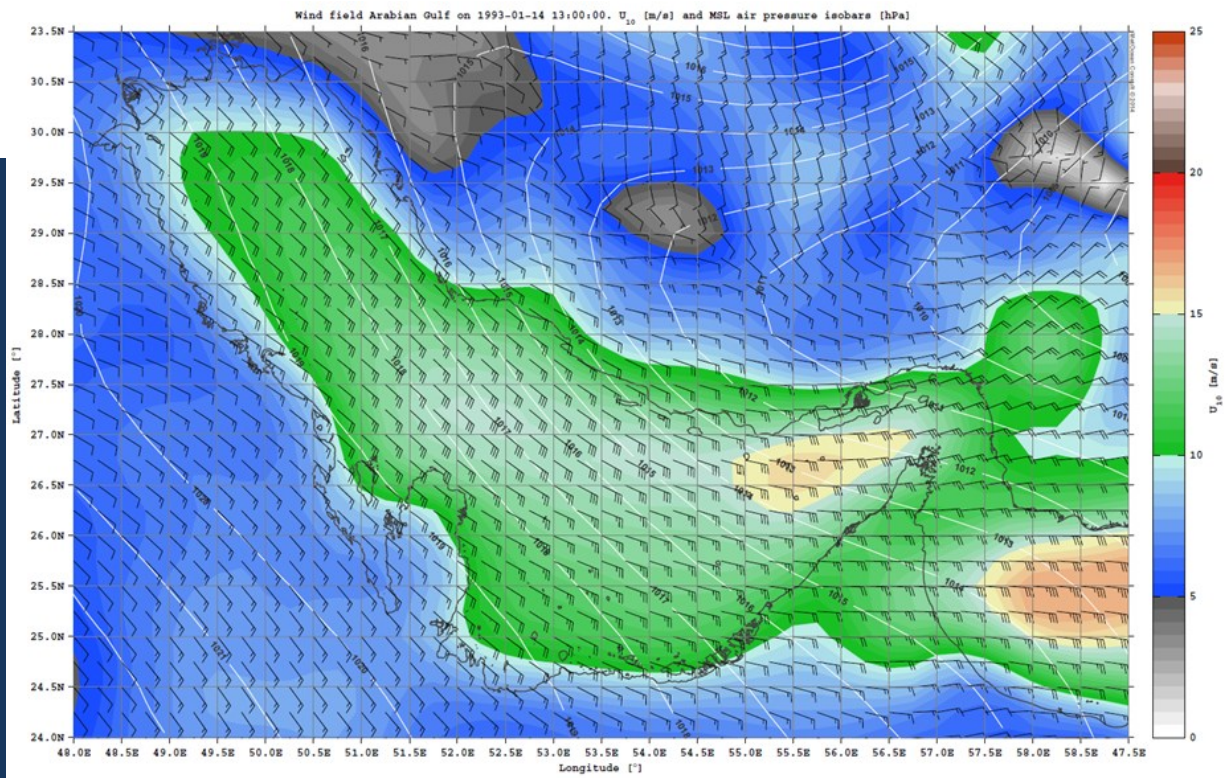
Snapshot of wind– and pressure field over Arabian Gulf as applied in wave- and flow hindcast model. Before application, the reanalysis wind fields (CFSR) were validated with satellite scatterometer wind speeds.
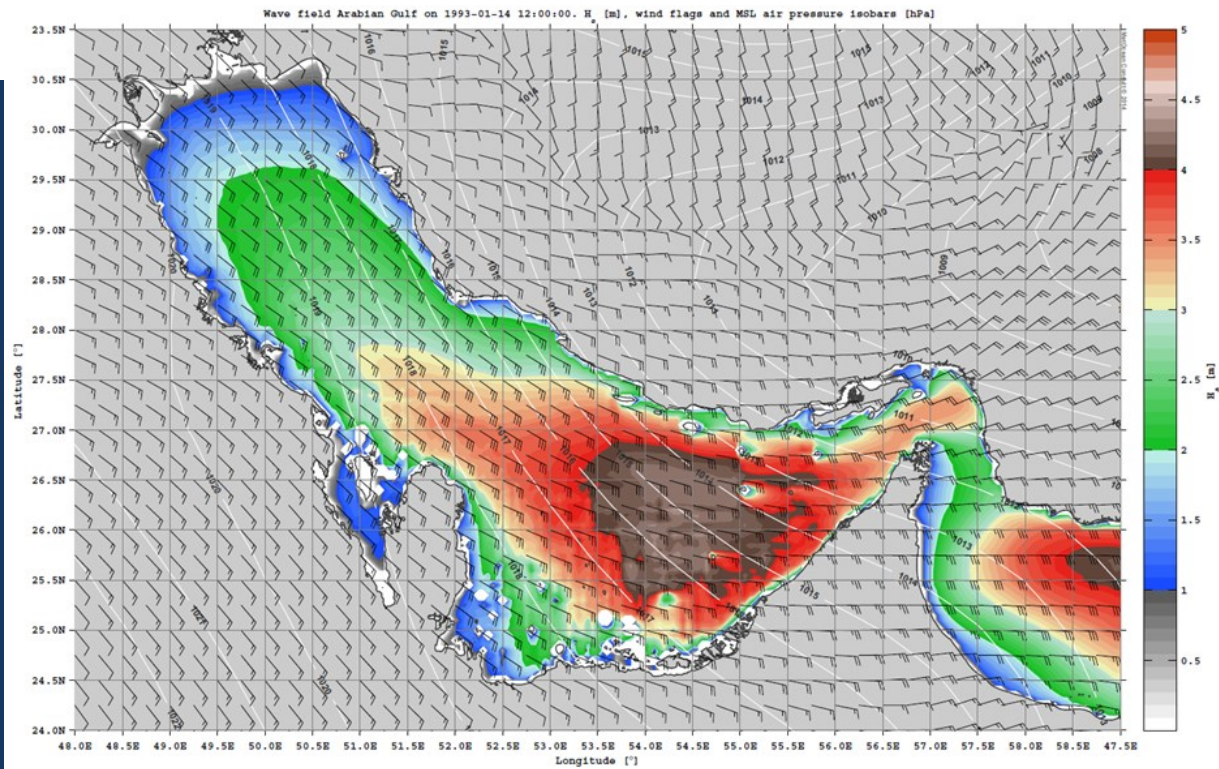
Wave hindcast

A high resolution (at 0.05° regular grid) wave hindcast was produced using the state-of-the-art third generation spectral wave model SWAN (developed by Delft University of Technology).

A longterm hindcast was produced, forced with hourly wind fields and water levels fields produced by DFLOW-FM.

Products

- Archived 2D wave energy density spectra

- Time varying field data of various wind- and wave parameters

- Point time series of wave parameters

- Ambient wave climate: climatic tables and wave roses for arbitrary locations

- Persistence statistics

- Extreme (directional, seasonal) statistics

Snapshot of wave field and corresponding wind- and pressure field during a storm in January 1993. The Arabian Gulf hindcast database provides climatology of ambient and extreme metocean statistics based on more than 35 years of highly accurate wind, wave and surge hindcast.

Validation

The figure on the left shows a comparison of wind speeds on a reference location for the year 1992.

Clearly visible in the CFSR data (Model) are the fluctuations in wind conditions e.g. caused by day-night temperature differences between land and sea.
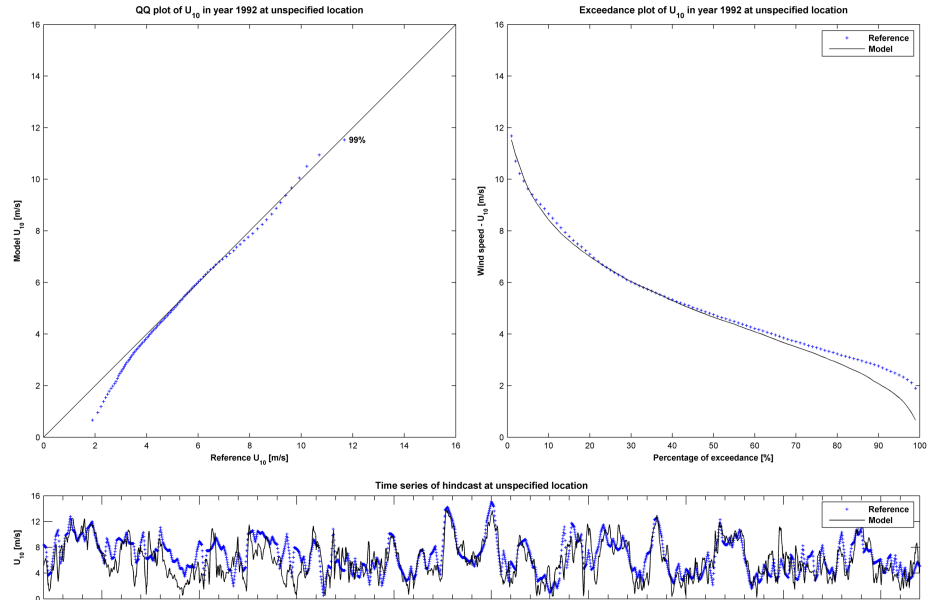
Wave height comparison of hindcast with reference data at unspecified location. Both the normal and the tail (peaks) of the distribution show good agreement.

This comparison was made for different years and between various data sources and geographic areas.
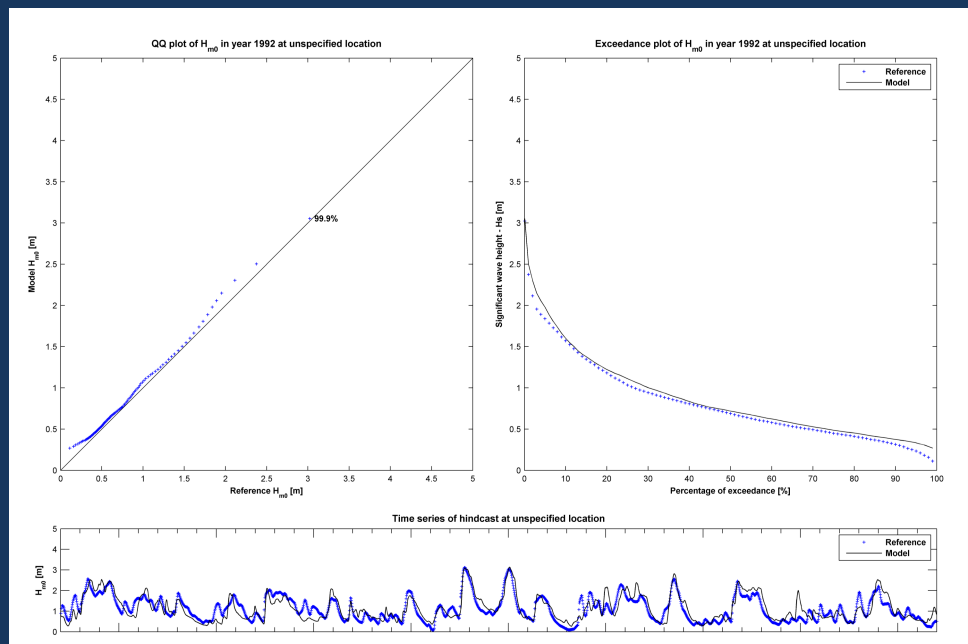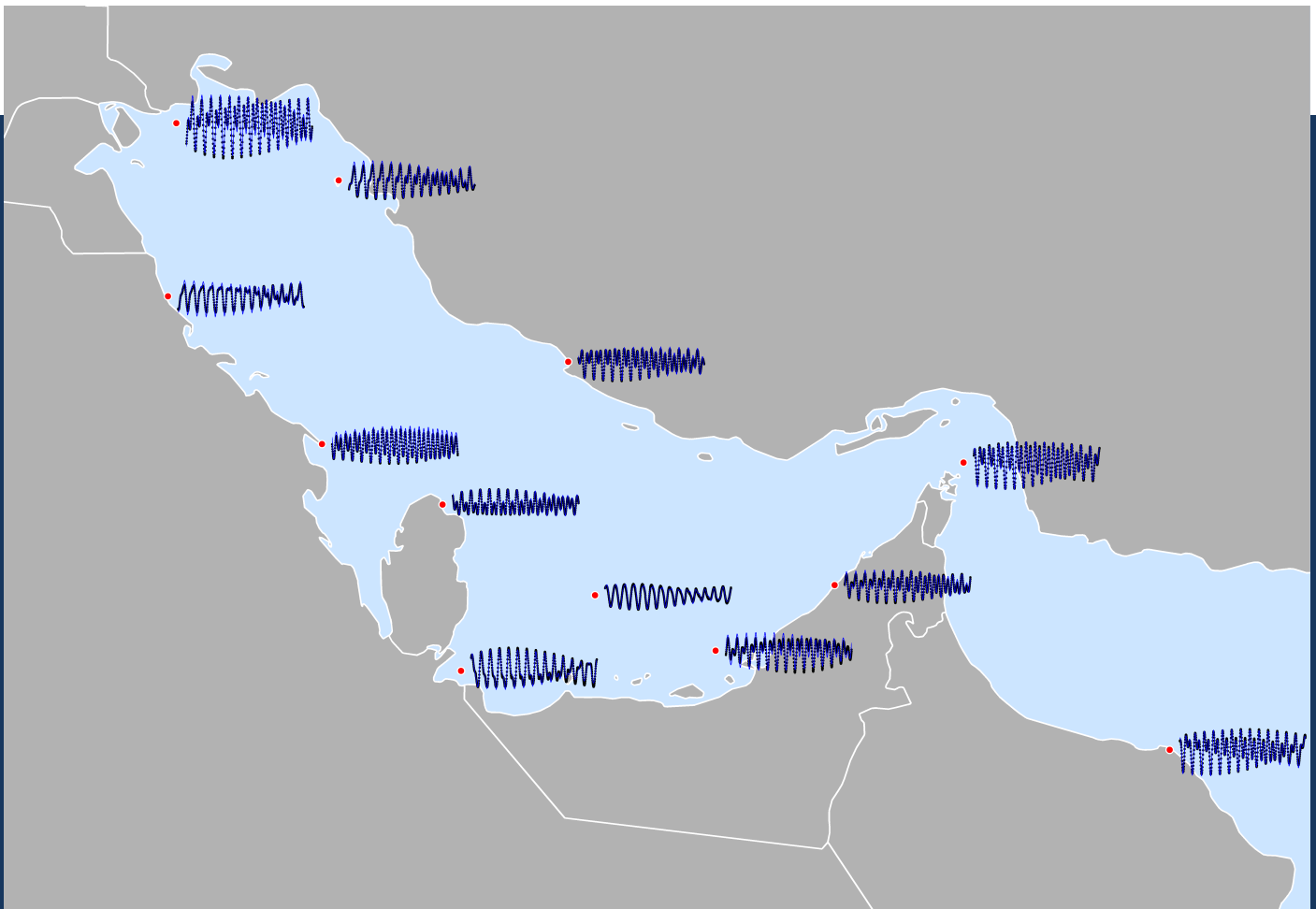
Water level and Current hindcast

A high resolution oceanographic hindcast for the entire Arabian Gulf was performed producing long-term tidal and non-tidal water levels and currents.

A flexible mesh (DFLOW-FM), covering the entire Arabian Gulf with similar resolution as the wave model, was developed to produce tidal- and wind driven water levels and currents at hourly intervals.

Time and spatially varying water level fields were used as input in the wave hindcast.

Products

- Time varying water level and current fields at regular 0.05^o grid

- Point time series of tidal and non-tidal (residual) water levels and currents

- Ambient current climate: climatic tables and current roses for arbitrary locations

- Extreme (directional, seasonal) statistics

Tidal levels at various locations compared with measurements

Water level and Current hindcast

Storm surge levels simulated with DFLOW-FM

Results

The products of the hindcast and the model framework developed to produce the hindcast can be used for

- Detailed wave and flow modeling studies

- Hydraulic boundary conditions in design studies

- Workability assessments

- Flood risk assessments

- Wave penetration and port downtime studies

- Regional wave and surge forecasts
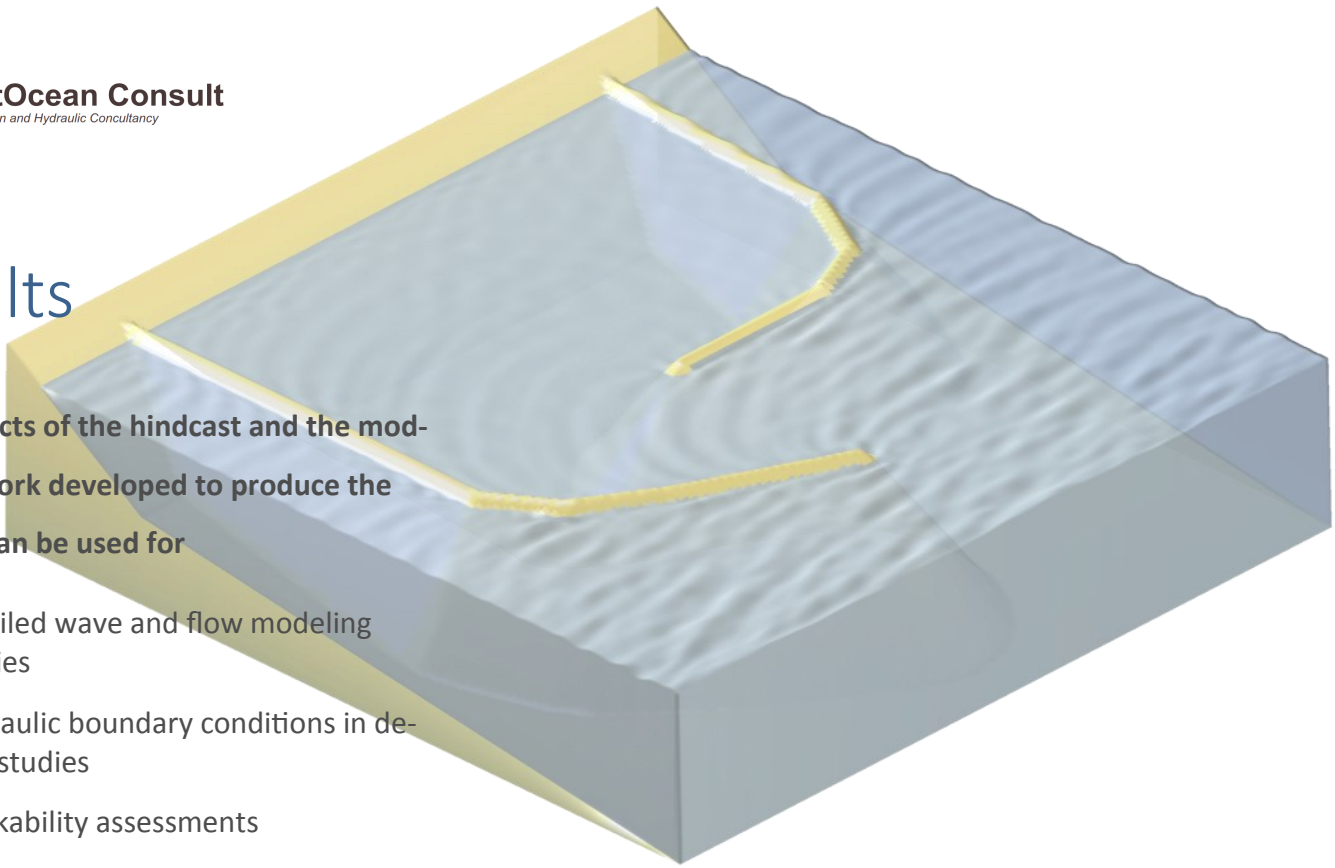
MetOcean Consult provides design criteria for port design and coastal planning through detailed numerical wave and flow modeling studies using state-of-the-art software.

Products

Time series

- Hourly wind and wave parameters
- Hourly 2D energy density spectra
- Total, tidal and non-tidal (surge) water levels
- Total, tidal and non-tidal (residual) depth averaged currents
- Data can be delivery in common formats, such as MIKE21 dfs0, netcdf, ascii, excel

In addition to the standard products, we also provide customized products upon request

Statistics

- Ambient wind, wave and current climate: climatic tables and roses for the whole year, each month or arbitrary combination of months.

- 3D scatter tables of arbitrary combinations of wind, wave, water level or current parameter providing information on e.g. joint probability of wave height, direction and water level.

- Extreme (directional, seasonal) statistics of wind, waves and surges

- Annual and monthly persistence of wind, waves, currents and surges

MetOcean Consult
Metocean and Hydraulic Consultancy

Worldwide project experience

With its office located in Rotterdam, The Netherlands, **MetOcean Consult** is an independent international engineering and consultancy provider.

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