Ocean surface waves

Marine Models

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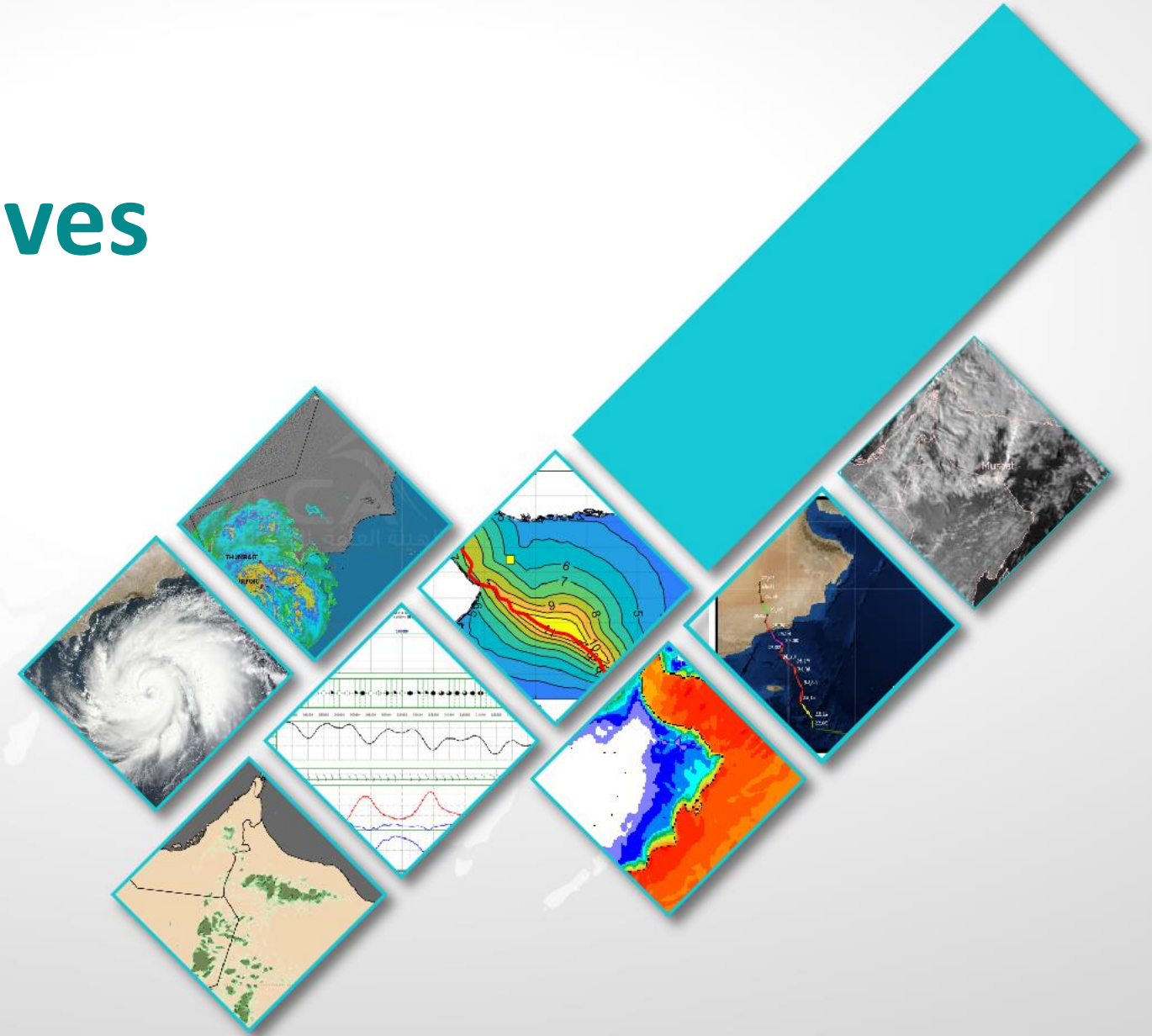

Content

- Basic of waves and currents
- Wave Modelling
- How to get knowledge of sea state.
- Predict wave state for the next three days
- Example of wave Impacts.

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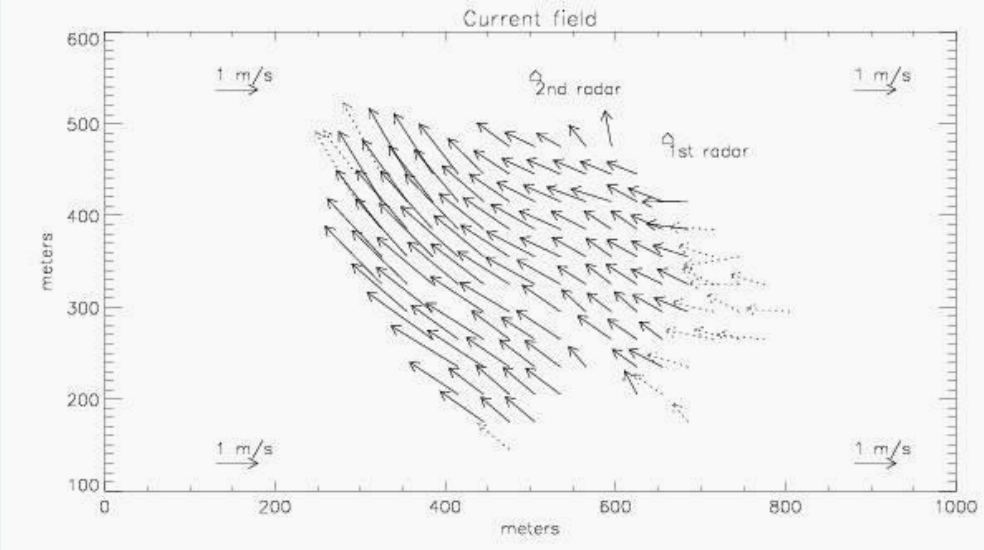
Basic of waves and Current:

What is a wave? What is current ?

- A wave is a periodic process.
- Current is a non-periodic process.

Basic of waves and Current

- Current is the transport of water particles along stream lines.
  - The individual particle never again reaches its original position.
  - For current no law of dispersion may be defined.



Current transports water particles
The current speed depends from the water depth:

$$c = \sqrt{gh}$$

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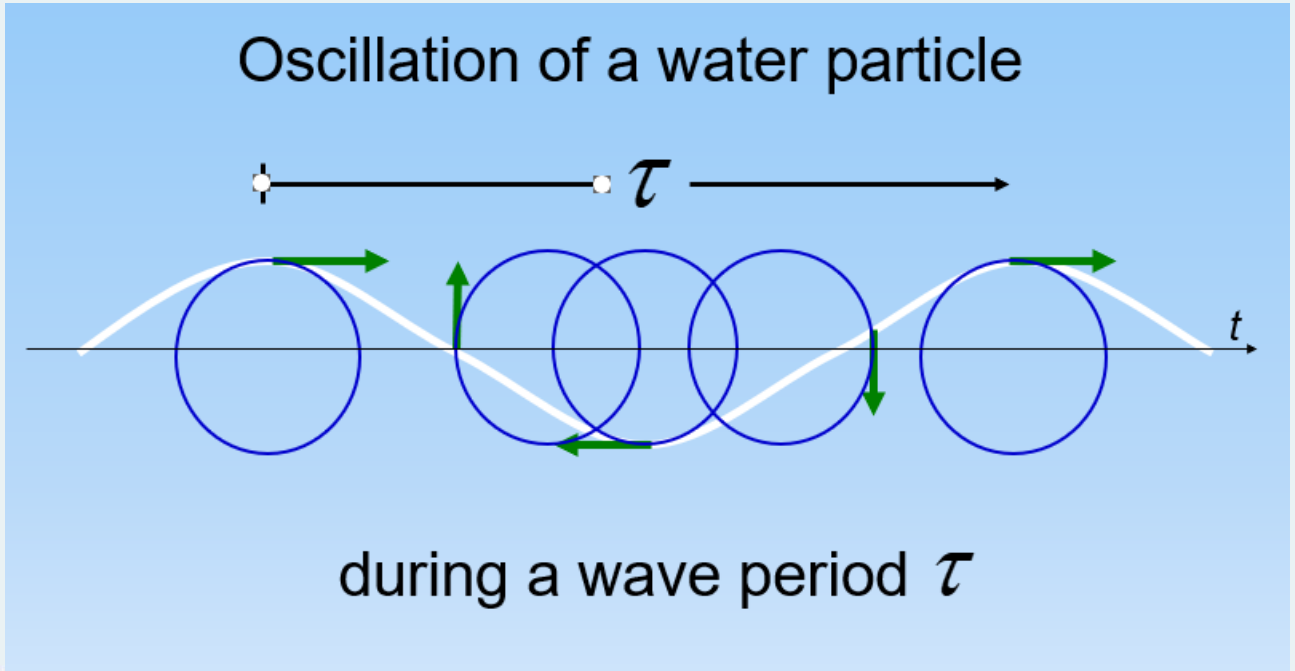
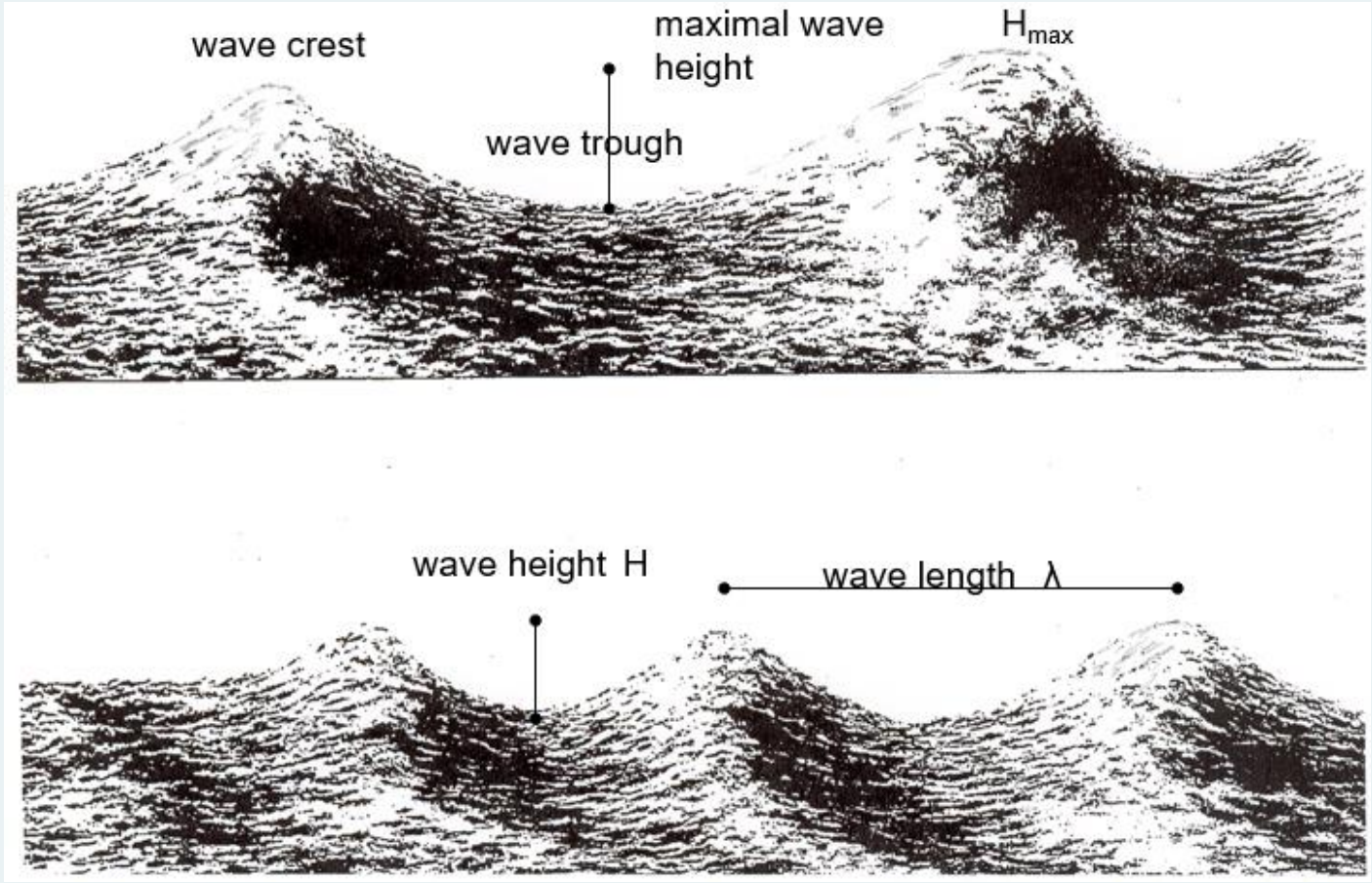
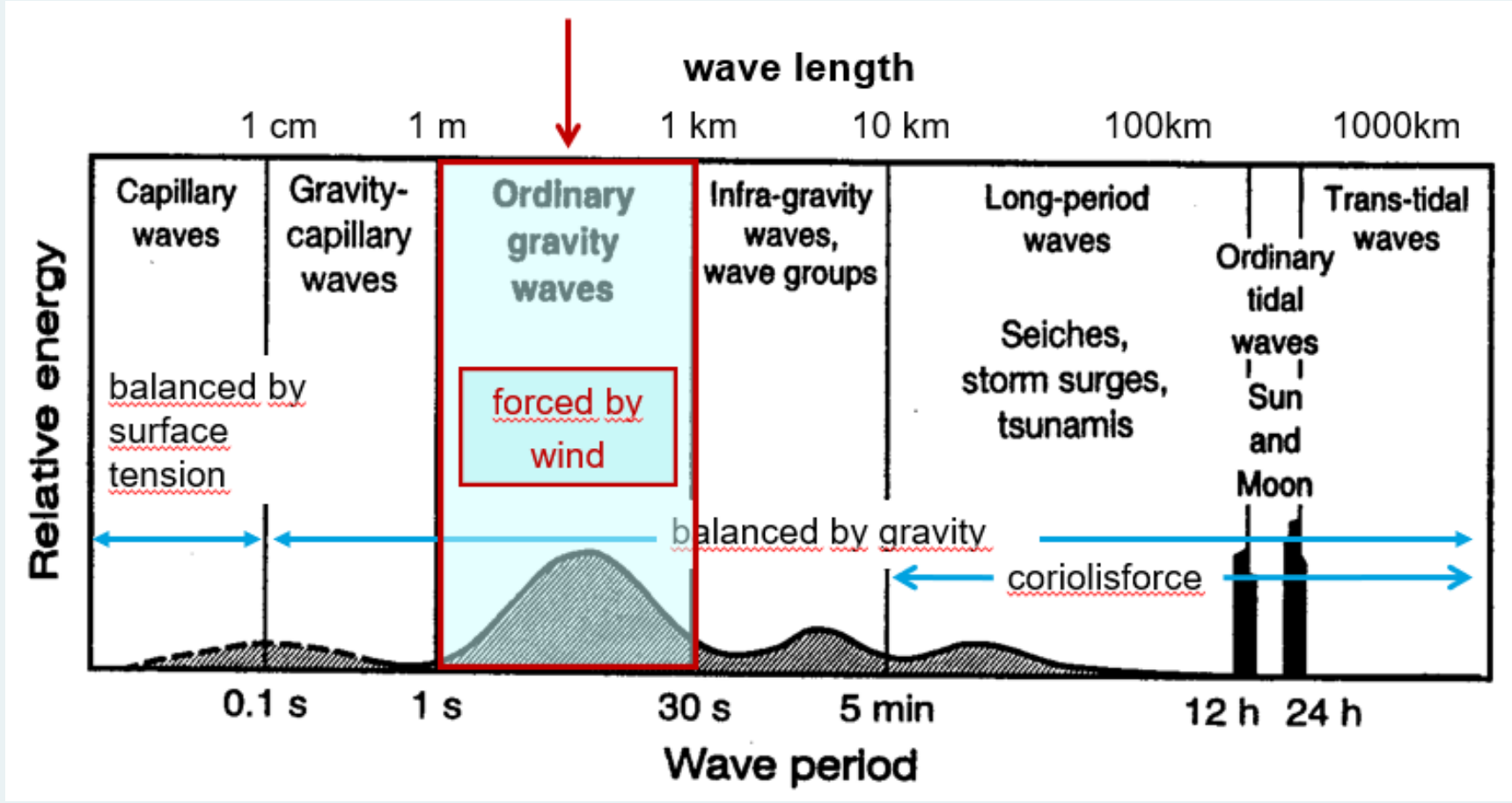
Basic of waves and Current

- A wave is an oscillation of water particles around a position of equilibrium.
  - The individual particle remains roughly at its original position.
  - The wave propagation follows a law of dispersion.



Basic of waves and Current





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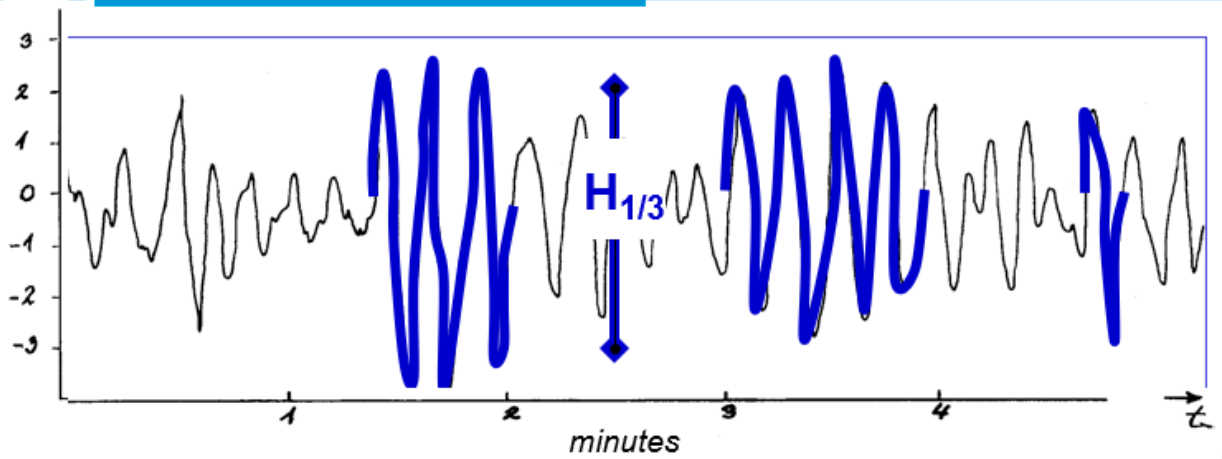
Definition of $H_{1/3}$

Helmholtz-Zentrum Geesthacht
Centre for Materials and Coastal Research



Example:

- You see 24 single wave trains.
- The blue marked waves are the 8 highest waves.
- These 8 waves correspond to 1/3 of the 24 waves observed in total.
- $H_{1/3}$ is defined as the average on that third of the highest waves.

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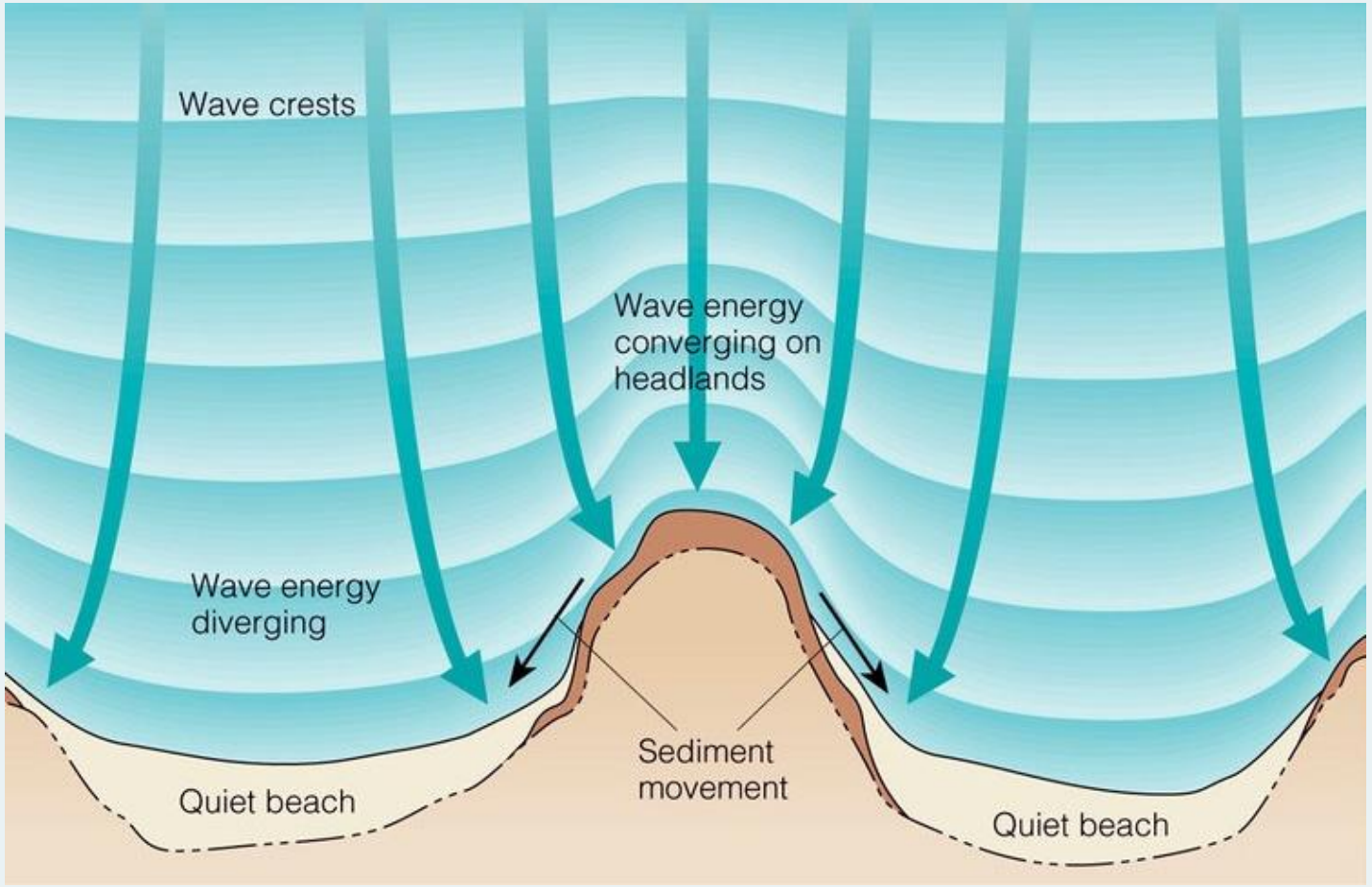
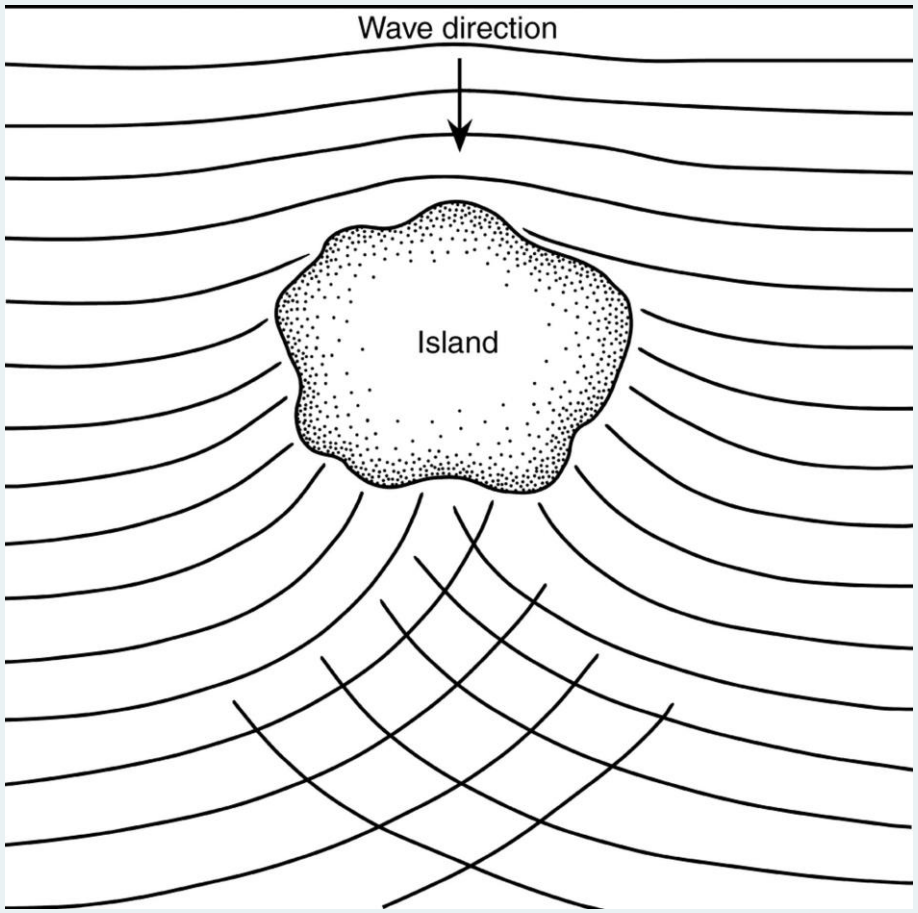
Refraction

The bending of a wave-front as it travels at different speeds over water of different depths



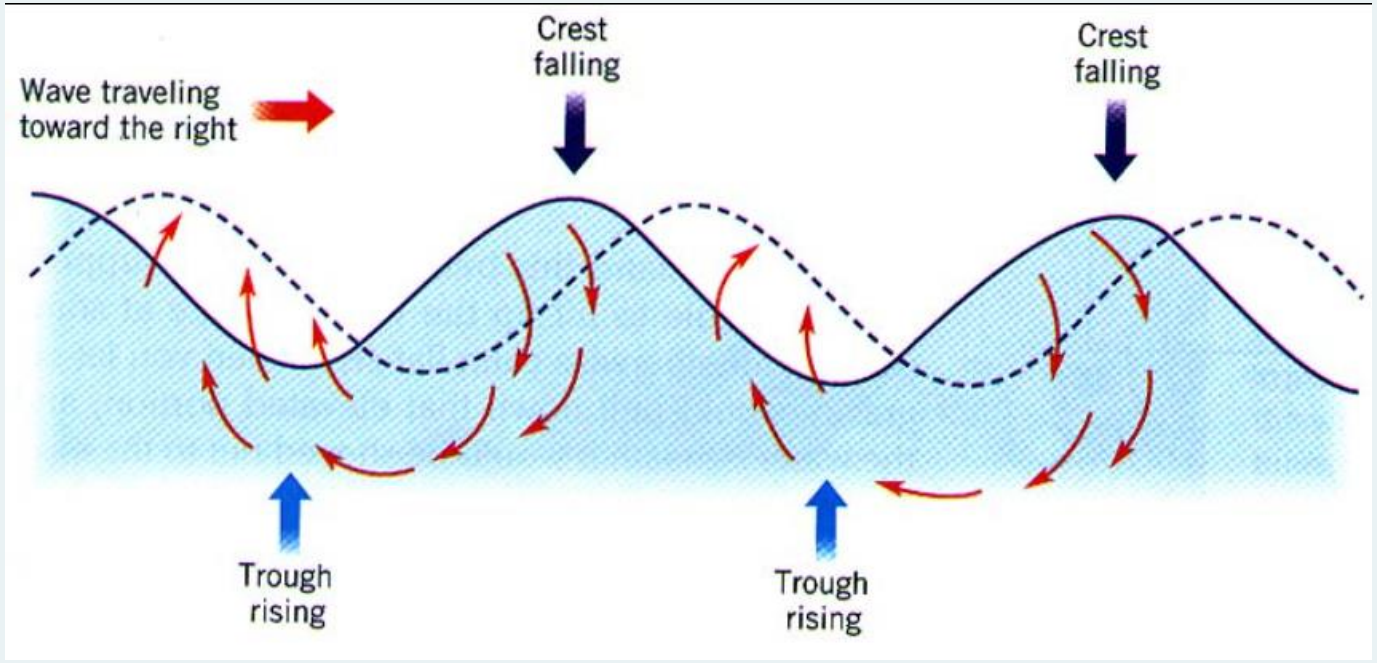
Diffraction

A sudden change in the direction and intensity of waves after passing by a coastal feature or offshore obstruction.

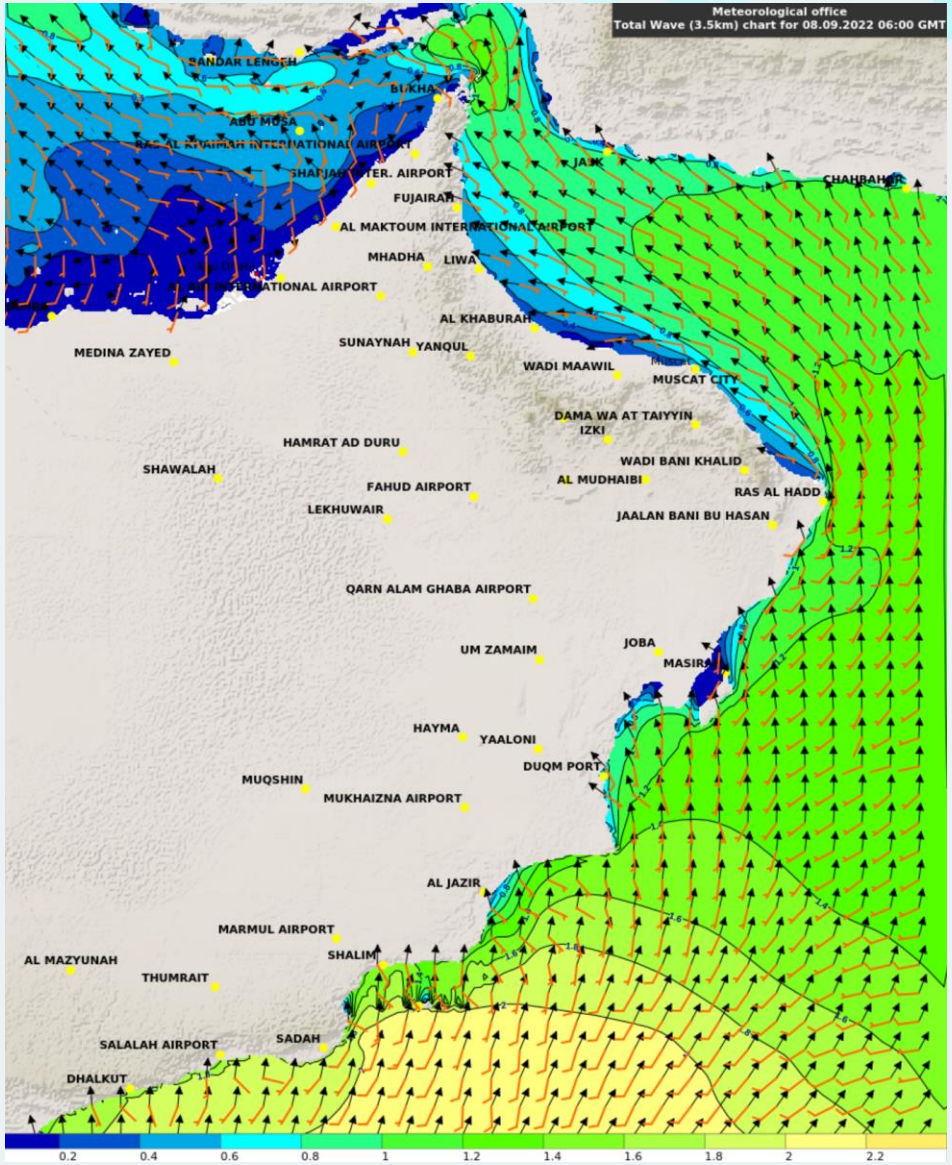


Reflection

The result is when two equal waves are going in opposite directions and in this case, you get the usual up/down motion of the water surface but the waves don't progress.



Wave Modelling:



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Wave Modelling: (Types)

Phase resolving or deterministic models

- Sea surface evolution in space and time
- Very high resolution (much less than a wave length or period)
- Typical application in small basins, e.g. harbours

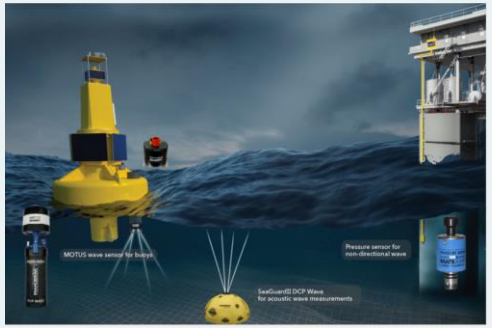
Phase averaged or spectral or statistical models

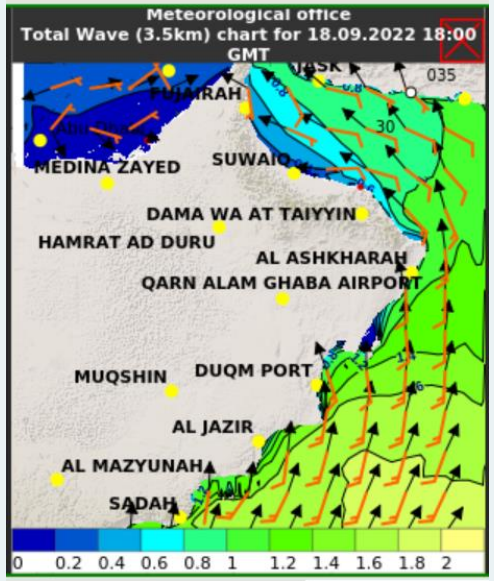
- Sea surface is an ensemble of elementary waves
- Prognostic variable is the wave spectrum
- Resolution larger than wave length or period
- Typical application scales are: global, shelf seas, lagoons, lakes

How get knowledge of sea state :

Obs. (marine station - tide gauges - wave radar - ship – Satellite)

Model – WAM, SWAN and WATCHIII





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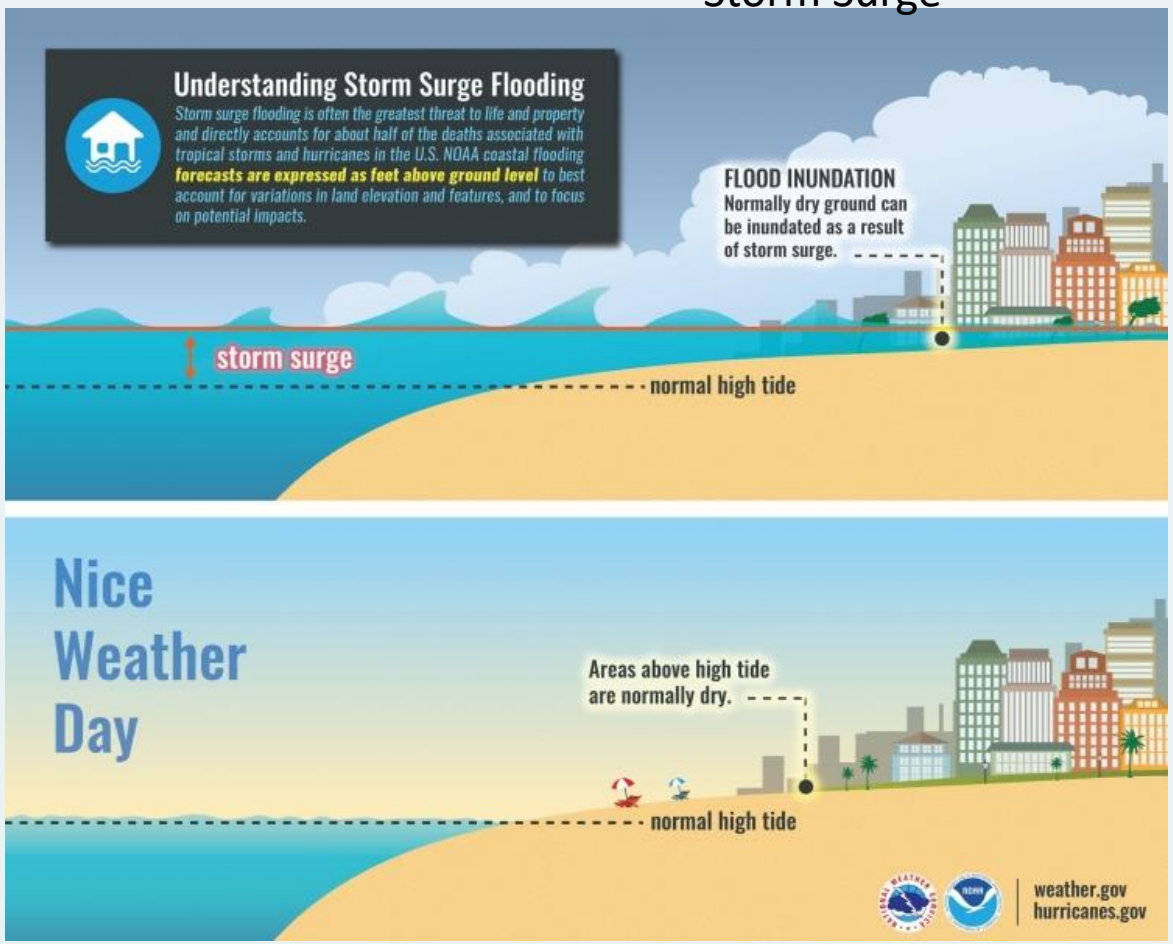
Example of sea wave Impacts:

High waves

Storm Surge



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