# Waves: an ocean of modelling options

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Half of the world's population lives within 60 km of the coastline, and 8 of the 10 most populated cities are located at the coast. All of these cities have major harbour infrastructure, which has to withstand the power of the ocean waves. Additionally, the ocean is a huge alternative energy source; ocean waves have a higher energy density than wind, and the first commercial tidal turbines are already operational. As coastal engineers, our goal is to design coastal and offshore structures, able to survive storm conditions; even those occurring only once in 100 or even 1000 years.

An optimal design of coastal and offshore structures is only achievable by having an as good as possible understanding of the physical properties of ocean waves, such as surface elevation, orbital velocities, dynamic pressure, wave energy. This is done by attempting to describe the real-life behaviour with mathematical models. There are several possibilities to model ocean waves, each one with its advantages and disadvantages. The goal of this research is to highlight the ones applied by coastal engineers.

Within the coastal engineering field, models are applied for several types of research: hydrodynamics, morphodynamics, wave-structure interaction, wave propagation, wave statistics…. Here, focus is put specifically on wave propagation models such as:
- Analytical models based on Airy wave theory
- Spectral wave models
- Phase-resolving wave models:
- Mild-slope equation models
- Boussinesq models
- Computation fluid dynamics (CFD) models
- Smoothed particle hydrodynamic (SPH) models
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The models listed above will be discussed based on their simplicity, computational cost, accuracy, applications but also limitations.

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