

Glossary of variables, symbols and acronyms (Sea waves)

Angular frequency (ω) the number of radians per second. As usual in wave theory the following definitions of k (wavenumber) and ω are used:

Bathymetry The measurement of depths of water in oceans, seas, and lakes;

Beaufort wind scale a scale that uses observations of the effects of wind to estimate its speed.

Great Circle path is the shortest distance between two locations on a spherical object.

Deep Water Wave - A wave for which water depth is greater than one half the wave length.

Dispersion of Waves - The tendency of longer waves to travel faster than shorter waves due to the proportionality between wave phase speed and wave length.

Directional Spectrum image depicts the period, direction and density of all waves present at a fixed location for a preset period of time. Spectral analysis data is produced from buoys that have height, period and directional sensors installed. The output from these buoys is very useful for getting a quick yet comprehensive analysis of the sea conditions at the buoys location. Unfortunately, such buoys are relatively rare

Dominant Wave Period - The period corresponding to the frequency of maximum variance as represented by a wave frequency spectrum.

Duration - In terms of wave growth, the time over which the wind blows at a constant velocity.

Fetch - In terms of wave growth, the distance on the ocean over which the wind blows at a constant velocity.

Forecasting has a meaning here which is slightly different from that which is common in meteorology. When issuing a wave forecast, one can forecast the propagation of wave energy, but the evolution (growth) of the wave energy is dependent on the wind and so a major part of the procedure is actually referring to the forecast of the winds that cause the waves. The wave growth is in fact *diagnosed* from the forecast wind.

Frequency - a measure of the number of oscillations or cycles per unit time; the reciprocal of the time duration (period) of an oscillation.

Fully-Developed Sea is the largest wave size theoretically possible for a specific wind speed, wind duration, and fetch. A sea state in which waves have reached maximum energy. Additional energy added to the spectrum is dissipated by wave breaking.

Gravity Wave - A wave in which the velocity of propagation is a function of gravity.

Group Velocity - The velocity at which wave energy propagates. In deep water, it is equal to half the velocity of the individual waves in the group

Hindcasting - refers to the diagnosis of wave information based on historical wind data. (The use of historical synoptic wind fields to calculate characteristics of waves that probably occurred at some past time).

JONSWAP Spectrum - was established during a joint research project, the "JOint North Sea WAve Project", and is presented in literature by K.Hasselmann & al., in "Measurements of Wind-Wave Growth and Swell Decay during the Joint North Sea Wave Project (JONSWAP)" Deutsche Hydrographische Zeitschrift, Reihe , No.12, 1973.

Kinetic energy - the energy of an object or parcel of fluid by virtue of its motion. Kinetic energy is proportional to mass and the square of the speed.

Knot - a unit of speed equal to 1 nautical mile per hour, approximately 51 centimeters per second.

Maximum wave height (H_{max}) - This is the largest peak to trough height seen during a record. Mean zero down-crossing wave height.

Mean Wave Direction - Overall mean wave direction in degrees obtained by averaging the mean wave angle (θ) over all frequencies with a weighting function $S(f)$. θ is calculated by the KVH method in the TriAxys Directional Wave Buoy. .

Period - A measure of wave repeatability. The wave period is usually considered as the time between two successive crests or the time between two successive zero crossings in the same direction.

Peak period (T_p) - The period with the maximum wave energy, determined from the wave spectrum.

Phase Velocity - Propagation velocity of an individual wave. In deep water it is proportional to the wave length, otherwise it depends on water depth.

Reflection - The process by which wave energy is returned in the opposite direction after a wave strikes an object or a water boundary.

Refraction - The process by which the direction of a moving wave is changed due to its interaction with the bottom topography. Wave heights may be increased or decreased by refraction

Sea (or wind waves) - Waves formed due to the direct action of local winds.

Shallow Water Wave - A wave for which the depth divided by the wave length is less than approximately 1/20. Equations for waves can be approximated by special equations for such shallow water where waves are strongly affected by bottom depth.

Shoaling - Changes in wave height as waves move into shallow water. Except for a limited depth region, shoaling increases wave heights. Shoaling occurs even if wave heights and directions do not change as a result of wave refraction.

Significant wave height is the average height of the highest one-third of the waves. It is about equal to the average height of the waves as estimated by an experienced observer.

Significant Wave Period (Ts) - The average period of the one-third highest waves in a wave record. The significant wave period is somewhat shorter than the dominant wave period. Calculated from moments of wave frequency spectrum as $T_s = \text{square root of } (m_0/m_1)$. In the TriAxys Directional Wave Buoy it is the average period of the significant zero down-crossing waves(s).

Spectrum - A method of representing the distribution of wave energy as a function of frequency.

Spectral density. An image that identifies the relative wave energy present at all frequency/periods at a fixed location for a predefined time period, regardless of the energy's directional heading. Though wave density charts don't show direction, they provide a good image of what period bands have the most energetic waves. And of greater interest, operational buoys with this capability are fairly common. If you are expecting arrival of a high energy swell, and there is lot's of low energy 'noise' wind waves present, monitoring wave density or spectral analysis data can provide early signs of the swells initial arrival

Swell waves are waves that have moved well away from the area where they were generated, and have settled into a regular traveling pattern. Swell has longer periods and a smoother appearance than wind waves in the storm area.

Trough - The lowest part of the wave between successive crests.

Wave chart - A map (or chart) showing spatial distribution of a selected number of wind and wave parameters is called a wave chart. For efficient transmission, a wave chart should be simple and uncluttered. Almost all wave charts show isopleths of significant wave height suitably labeled and a few additional parameters like peak period, wave direction, etc. The chart may provide sea state information in a diagnostic or in a prognostic form.

Wave Direction - The direction from which a wave approaches

Wave record - A wave record is a group of continuous data blocks.

Wavelength (L) expressed in meters, is the horizontal distance between successive crests.

Wave period (T), expressed in seconds, is the time between successive crests.

Wave height (H), expressed in meters, is the vertical distance between the top of a crest and the bottom of a trough.

Wavenumber (k) is a cyclic measure of the number of crests per unit distance

Wave sample - A single wave height measurement.

Wind speed is still often reported in **knots**. A knot is a nautical mile per hour, where a nautical mile is one minute of latitude. The conversion from knots (kts) to meters per second (m/s) is $1 \text{ kts} = 0.51 \text{ m/s}$.

Wind direction - The direction from which the wind is blowing.

Wind duration is the time over which the wind has been blowing.

Wind fetch is the distance upstream from the point of observation over which the wind blows with constant speed and direction.

Wave spectrum - a statistical property that describes ALL of the wave components present in the sea

Wave trains- Groups of swell waves with same origin and velocity (series of waves all having the same period and direction of movement)

Wind waves (local seas) are waves produced by the local prevailing wind.

Zero Crossings - Number of waves detected by zero crossing analysis of the demeaned wave elevation record.

Zero Crossing Wave Period (T_z , T_{av}) - The average time interval between similar direction crossings of mean water level for a wave record. The zero crossing period can also be calculated from the moments of wave frequency spectra. $T_z = \text{square root of } (m_0/m_2)$. Also called the Mean Spectral Period.