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Accurate Wave Measurement

HOW TO SELECT THE BEST METHOD FOR MEASURING OCEAN & COASTAL WAVES

Accurate wave measurements are critical in applications such as offshore wind farm development, navigation, cable laying, breakwater building, and bridge construction. Waves also result in continuous loads on marine structures, including docks, moorings, and offshore platforms.

Waves are challenging to measure. Variables to consider when collecting wave data include the depth of the measuring device, proximity to shore, wave types, and available infrastructure from which to measure.

Several methods for measuring waves are available, and careful selection of the best approach is needed to get the optimal result.

Measurement Methods

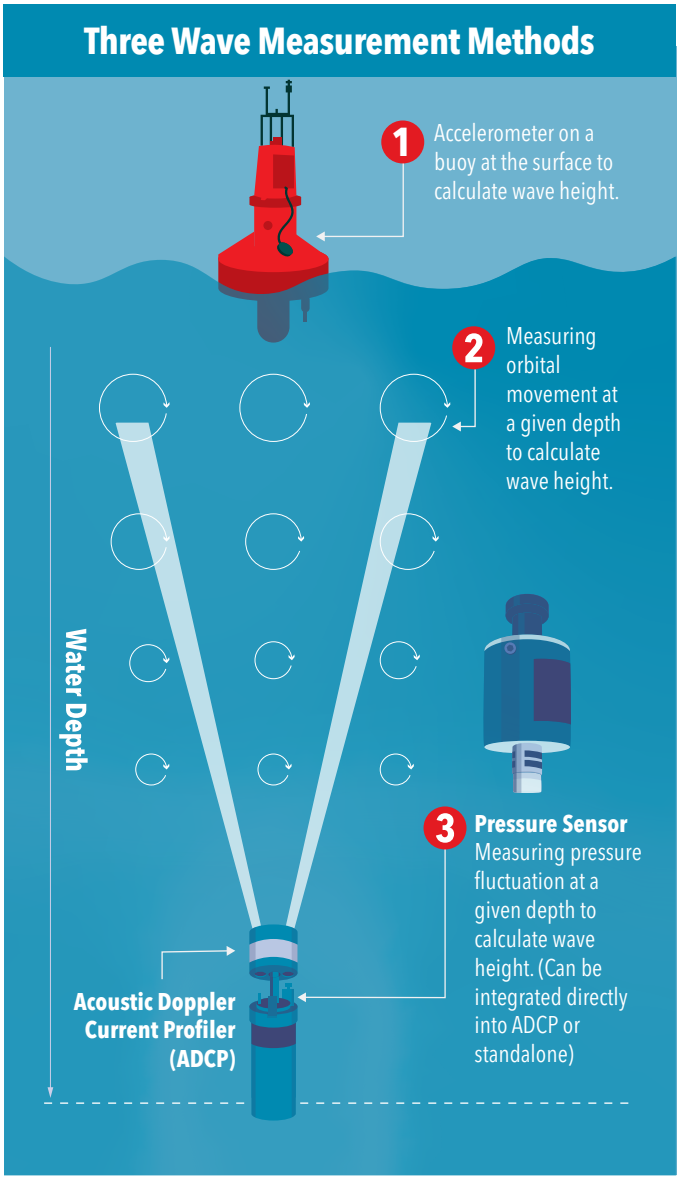
There are three different methods available to measure wave characteristics:

1.) Surface buoys can be equipped with sensors that measure the buoys' movement.

2.) Acoustic profilers can measure orbital currents in the water column.

3.) Pressure sensors can be placed in the water column.

Pressure-based wave measurements only provide wave height data, while buoy and acoustic profiler methods provide both height and direction. So, how do you choose between these three methods?



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Different Types of Waves

Wind-generated waves can be divided into longer swells and shorter wind waves of different heights. Smaller waves are more challenging to measure than larger waves, but are also of less impact to operations. Waves less than 10 cm impact recreational activities like canoeing and kayaking, but are less interesting for marine operations.

When selecting the method to measure waves, it is important to have an idea of what wave heights would affect the application. This is a good first step in choosing the method of measurement.

Buoy Sizing

When using a buoy, some factors impact the accuracy of the measurements. Smaller buoys that move with the waves can measure smaller waves better than larger buoys.

Higher-end wave sensors offer tuning algorithms for different sized buoys and tools to determine how accurate your measurements will be from a specific buoy.

By knowing the smallest wave height you need to measure, these tools can help determine the maximum size buoy to use in your application.

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Going Rogue

Mariners returning home often told stories of unpredictable, monstrous waves. Scientists dismissed the idea of rogue waves until 1995, when a wave measuring 85 feet (26 meters) crashed into an oil-drilling platform 100 miles off the coast of Norway.

American Physical Society, *This Month in Physics History January 1, 1995: Confirmation of the Existence of Rogue Waves*

Depth Considerations

The advantage of buoys is they measure the waves directly, irrespective of the depth.

Acoustic profilers must be able to measure the orbital currents that are near the water surface, so they cannot be placed in deep water or they lose accuracy.

For pressure-based measurements, the pressure variations are dampened as the water depth increases. The deeper they are positioned, the larger the waves must be for the sensors to report accurate data.

Take Advantage of Existing Infrastructure

Existing infrastructure can make wave measurements lower cost and more robust. For non-directional waves, pressure sensors mounted on poles is a robust method. The weakest point here is the cabling – care should be taken to ensure the cables do not move with the waves. Cables that move will eventually break!

An existing navigational buoy can also be utilized as a wave measuring device. Higher-end buoy wave sensors that are watertight can be mounted in many different locations and offer algorithms for off-center positioning. Some of these can also be connected directly to the Automatic Identification System (AIS) or other modems and dataloggers.

Selecting the Best Method

This table summarizes the different factors to consider when choosing the best method for wave measurements. While it can be used as a starting point, please contact us to discuss the best method for your specific application.

Method	Wave Height	Wave Direction	0-20m Depth	20m - 40m Depth	40m+ Depth	Cost
Buoy	X	X	All Wave Periods	All Wave Periods	All Wave Periods	Higher
Acoustic Profiler	X	X	All Wave Periods	All Wave Periods	●	Higher
Pressure	X	--	All Wave Periods	●	●	Lower

● **Note:** Installation will reduce the accuracy for measuring smaller wind-driven waves

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