



The Coastal Data Information Program
Integrative Oceanography Division



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LATEST NEWS: Data updates will be affected by a planned power outage Wednesday 20 March 7am - 10am

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Frequently Asked Questions: General Queries

1. What do Hs values represent?

The wave height (Hs) represents a 30-minute average of the 1/3 highest waves at a sensor. The height is the distance between the trough and the crest of the wave. Statistically, the highest wave during the measurement period is likely to be approximately twice the reported wave height ($1.8 \cdot H_s$).

2. What are Tp and Dp? Why are there different values given in different products?

The period of waves is the time it takes two consecutive crests to pass a single spot, and the direction is the compass angle (0-360 degrees clockwise from true North) that the waves are coming from. In the ocean, however, no two waves are perfectly identical - they are constantly coming from different directions at different frequencies.

Since there is never just a single direction or period for ocean waves, we can only measure the peak period (Tp) and peak direction (Dp). The peak period is the most common period between consecutive waves, while the peak direction is the most common direction. To come up with these values, all of the wave energy for a station over a specified period of time - approximately 30 minutes, in most cases - is grouped into different bands. For instance, in CDIP's 9-band products, all waves with periods from 6 to 8 seconds go into the 7-second band, those from 8 to 10 secs go into the 9-second band, etc. After all of the wave energy has been divided into these bands, the band with the most energy is selected as the peak band.

The cutoffs between bands, however, are arbitrary, and changing the cutoffs and/or number of bands affects the resulting Tp and Dp values. At CDIP we use two formats for analysis, 9-band and parameter. In the 9-band products, all of the wave energy is divided into 9 broad bands. In the parameter products, the energy is split into 64 (or 128) narrow bands. As a result, the 9-band Tp and Dp give more general, broad values, while the parameter Tp and Dp identify finer, subtler peaks.

So which Tp/Dp values are better? It depends what you're looking for. For instance, the broad bands of the 9-band values are better for addressing general questions about the sea state (e.g. which is currently predominant - local seas or ground swell?). To pick up more subtle features - like the arrival of long-period swell from a distant storm - the parameters values may be more helpful.

3. Although the wave height is staying pretty stable, the peak period and peak direction are jumping all around. Which of those Tp and Dp values are really correct?

Over any given period, the waves at a point in the ocean are actually coming from a number of different sources. There may be short-period waves from local winds, long-period waves from one or more distant storms, and a range of other wave fields originating from different weather systems. The peak period and peak direction describe

the strongest of all the sources of wave energy. When one source becomes stronger than another, the T_p and D_p values can suddenly change dramatically. And when two sources of wave energy have near-equal strength, the T_p and D_p values may bounce back and forth between them.

For instance, in summer on the US west coast we often have long-period swell from large storms in the southern hemisphere and short-period seas from local winds off the coast. Whenever the south swell is the stronger the peak period could be 18 seconds and the peak direction 180 degrees. Whenever the seas are a bit stronger, the T_p could be 5 seconds and the D_p 290 degrees. And if these two sources have near equal energy, we may find that from hour to hour the T_p and D_p values jump up and down repeatedly, showing whichever of the two sources is briefly the more energetic.

4. Are your sea temperatures correct? At the beach the lifeguards are reporting 63F, but the buoy says 70F!

There are often big differences between inshore and offshore temperatures due to various phenomena. In the surfzone, for instance, mixing may result in temperatures much colder than in calm surface waters offshore. Our buoys are all located offshore and measure sea surface temperature using a sensor located about 18 inches directly below the buoy.

5. What causes wave sets?

Very often waves from different parts of a distant storm arrive here at the same time. Their period (or lengths) can be nearly the same size. For a while the crests of the two wave trains begin to coincide. The two trains adding together result in waves that grow bigger. Later, the troughs of one begins to coincide with the crests of the other. The combination wave grows smaller. We see this as a "set" of large waves, followed by an interval of smaller waves. (**figure**)

6. Why are wave heights sometimes underestimated on windy days?

Local winds generate very short-period, high frequency waves, and not all of CDIP's instruments can measure these waves effectively. This is especially true of pressure sensors positioned deep underwater. At Kings Bay, for example, the sensors are mounted at a depth of 55 feet. Due to attenuation, these sensors do not feel high frequency waves, and so on windy days the high frequency energy will not be reflected in the reported H_s .

7. Why are the times on your buoy data often an hour or more old? Can't the data be more up-to-date?

To determine the wave conditions, you can't simply look at the ocean for a few seconds. Instead, you need to sample data over a long period. For most of CDIP's wave calculations, a data sample of approximately 30 minutes is used. And unlike the NDBC and other data providers who use sample end times on their spectra, CDIP uses sample start times.

This means that when we update our site based on a data sample that ended just a few minutes ago, the time assigned to the data - the start time - will already be more than 30 minutes old. For Datawell buoys, at the end of a 30-minute sampling period, the sensor calculates a wave spectrum and starts to transmit it; it's repeatedly sent in 4-minute blocks over the next half-hour.

This means that the when a CDIP station updates, the new spectrum will have a time that is at least 35 or 40 minutes old (30 min sample + 4 min transmission + a few minutes to process). But sometimes newly-updated data may have a start time that is up to 1 hour and 10 minutes old; it simply depends on which point in the half-hour cycle the buoy is contacted. (I.e. CDIP only grabs the data from stations once each half-hour, and it may

happen that we're grabbing the spectrum near the end of its transmission cycle.)

8. Is the wave direction from the SF/IB Nearshore Buoy correct? All the buoys show a northwest swell, but that buoy is reporting the same swell from the west-southwest!

When looking at buoy data, it's important to distinguish between deep-water measurements and shallow-water measurements. In deep water, swell direction is primarily determined by the location of the fetch that produced the swell. So deep-water buoys on the West Coast register swells from the Gulf of Alaska as NW swells, and swells from the South Pacific as S or SW swells.

In shallow water, on the other hand, the swell direction is determined primarily by the local bathymetry; swell is refracted such that wave crests approach the coast parallel to shore. I.e. whether it's a NW swell or S swell, at your local beach the waves always come in and line up at nearly the same angle, with only slight shifts to the N or S.

For example, the San Francisco Bar buoy is a shallow-water buoy at a location where the shore normal points to the WSW. Thus all long-period swell, regardless of source, has been refracted to the WSW at that spot. So the readings you see are correct given the water depth (15m) at the buoy's location.

For a more in depth discussion of wave measurements and standards, we recommend the **Coastal Engineering Manual (CEM)**, published by the United States Army Corps of Engineers' Coastal and Hydraulics Laboratory.

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