Wave Buoys: Using the Right Tool for the Right Job
Robert G. Williams 1), C. Reid Nichols 1) and Tony Ethier 2)
1) Marine Information Resources Corporation, Ellicott City, MD
2) AXYS Technologies Inc, Sidney, British Columbia, Canada
*Corresponding author: rwilliams844@gmail.com

1. Introduction
Wave buoys measure water level fluctuations that are caused by astronomical forces, winds, and events such as earthquakes. The water level fluctuations are the manifestation of energy being transferred across the surface of the ocean [1]. Wave buoy data are used to determine factors such as wave height, period, and direction. The data support wave forecasting over spatially extensive regions and products that are useful to save lives and protect property. Data from the wave buoys are used to verify and validate information from platforms such as wave gliders or numerical models. Information from properly sited wave buoys improves severe weather forecasting. There are also many types, sizes, and configurations of wave buoys since they may be used for a variety of purposes [2]. They are large and small, directional and non-directional, and drifting and moored. Modern wave buoys measure and transmit automatically, in a predictable and controlled way, communicating in real time via radio, cell phone, or satellite.

Regardless of size and type, floating wave buoys, the most widely used, move in synchronization with the wave motion. All wave buoys measure the frequency and amount of wave energy, usually the wave height. Processing of the collected data is accomplished by spectral analysis and the zero crossing method, where parameters such as significant wave height, peak wave period, and average wave period are derived for the buoy location. The size and type of buoy are determined based on environmental conditions associated with the deployment location. There are small air-deployed wave buoys, larger coastal buoys, and heavy and durable deep sea wave buoys. Some examples are provided in Fig. 1. In general, raw data is processed onboard the buoy and then transmitted to a receiving station. Operational buoys, regardless of size, make wave data available immediately after acquisition and processing.

It is important to remember that the size of the buoy will determine the size of the wave that can be measured effectively. A small buoy can measure shorter wavelengths. Thus, deploying a large buoy designed to respond to long deep-ocean waves would provide insufficient information in an estuary. Providing a mooring designed to minimize impacts on anchored buoy data is also an important consideration. A buoy suited to measuring tides will do a poor job of recording high-frequency gravity waves, which would be of interest to radar engineers.

The shape of the buoy will also impact the quality of the wave information. Dimensions for some standard buoys that are used operationally are listed in Table 1. In essence the buoy shape will determine the overall response of the buoy to wave motions, i.e., heave, pitch, and roll. The frequency responses of the individual sensors must also be matched to that of the buoy to provide the desired environmental information. Scientists, engineers and naval architects may be very interested in using the data to assess the response of electromagnetic or acoustic radiation, structures, and vessels to wave forces.

Table 1. Standard buoy diameters.

<table>
<thead>
<tr>
<th>Name</th>
<th>Standard Buoys</th>
<th>Diameter</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waverider Spherical</td>
<td>0.9m</td>
<td>212Kg</td>
<td></td>
</tr>
<tr>
<td>TRIAXYS™</td>
<td>1.0m</td>
<td>197Kg</td>
<td></td>
</tr>
<tr>
<td>Seawatch Discus</td>
<td>1.76m</td>
<td>710Kg</td>
<td></td>
</tr>
</tbody>
</table>

2. Conclusion
Wave buoys by their nature follow the waves. In so doing they measure the basic characteristics of a number of surface gravity waves, which in general are described by their wavelength. Examples include sea, swell, seiches, tsunami, and tides. An important measure, often overlooked, is the ability for the wave buoys to measure the approximate location of the air-sea interface. The interface is a complex and important region to understand. The process of wave breaking, as evidenced by white-caps and surf, impacts the wave measurement process. Correct wave buoy selection and employment requires a basic understanding of the location’s environmental conditions and the inventory of available commercial wave buoys.

References