

SMILE Teacher Workshop  
2007 Winter Teachers Workshop  
Buoy Data

## Buoy Data

This activity includes information from Bigelow Marine Lab's buoy data information index [http://www.bigelow.org/virtual/index\\_buoy.html](http://www.bigelow.org/virtual/index_buoy.html), the National Data Buoy Center <http://seaboard.ndbc.noaa.gov/>, and NOAA Education's Adopt a Buoy website: <http://www.education.noaa.gov/books/adopt/adopt0.html>

### Introduction:

Data buoys are important tools for collecting data about ocean and weather conditions. In the United States buoy information is available through the National Data Buoy Center (<http://www.ndbc.noaa.gov/>), a part of the National Oceanic and Atmospheric Administration (NOAA). In this activity we will look at some of the data these buoys can provide, and discuss their role in meteorology and marine navigation. Students will then apply this knowledge to practical applications using real buoy data.

### Materials:

(Materials in bold are provided by SMILE)

#### **Buoy Type Handouts**

**Buoy Datasheets (3 sites: St. Georges, Stonewall Banks, Port Orford)**

**Coos Bay Data Handout**

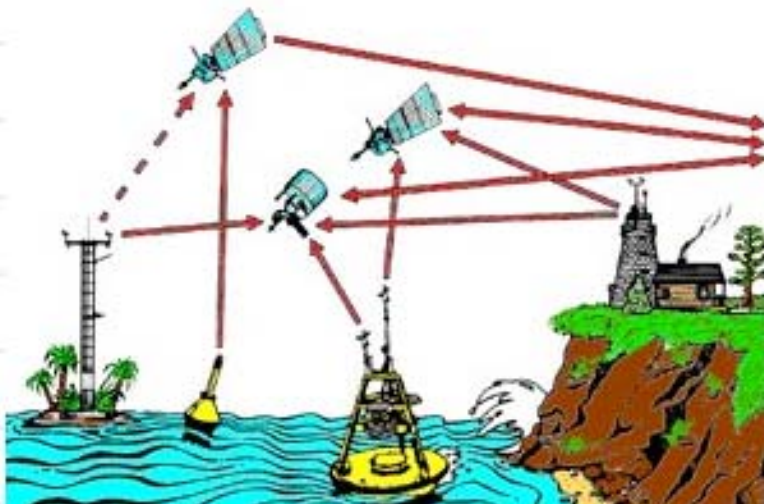
**Worksheets**

**Worksheet Key**

**Adopt a drifter info**

### Background:

The National Oceanic and Atmospheric Administration's (NOAA) National Data Buoy Center (NDBC) maintains approximately 60 moored buoys and 47 Coastal-Marine Automated Network Stations (C-MAN) to collect marine atmospheric and oceanographic data in support of the National Weather Service's (NWS) Warning and Forecast program. The buoys and C-MAN stations are located around the United States in the deep ocean and coastal zones. The data collected include wind speed and direction, peak wind gusts, air temperature, sea surface temperature, barometric pressure, and wave height. They are transmitted hourly via Geostationary Operational Environmental Satellite (GOES) to the National Center for Environmental



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Prediction in Suitland, MD, and are available to marine weather forecasters within 30 minutes. The data are now available on the Internet and can be easily accessed.

Data acquired by NDBC platforms are transmitted each hour through GOES and are monitored in real time. The data are transmitted to a ground receiving facility at Wallops Island, VA, and are relayed to the NWS for processing. The data go through human/machine quality-control checks before being released to the user. The data are then forwarded to operational forecasters and national meteorological centers for ingestion into computer models.

Standard Measurements

(These measurements are made from all NDBC stations.)

Wind Speed

Wind Direction

Barometric Pressure

Air Temperature

Sea Surface Temperature

Wave Height (Measured from all buoys and some C-MAN stations.)

Wave Direction (Measured from the discus-shaped buoys only.)

Special Measurements

(These measurements are made from selected NDBC stations.)

Ocean Current Speed and Direction

Subsurface Temperature

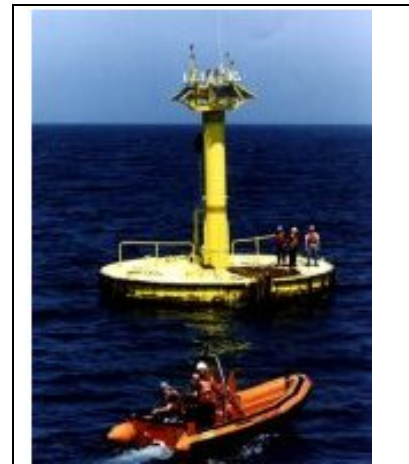
Salinity

Rainfall

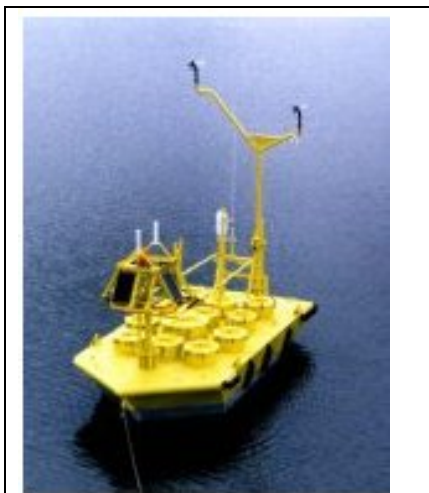
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Buoy Types

NDBC uses three types of buoys for data collection. The largest and oldest are the 12- and 10-m discus shaped buoys. These are primarily operated in deep-water areas where high waves are possible and where measurements dictate a large, stable buoy. Presently, these buoys are moored in water depths up to 3,300 m. Because of the expense in building these buoys, they are no longer made. They were originally designed to accommodate large diesel generators to power the instruments. These are no longer needed since NDBC now uses solar panels with battery backups for power.



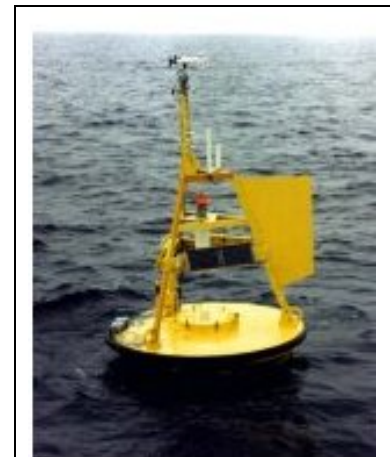
10 m Discus Buoy



6 m NOMAD

The next largest buoy is the 6-m Naval Oceanographic and Meteorological Automated Device (NOMAD). These have replaced the 12-m discus-shaped buoys. This buoy hull is boat shaped and has very good stability in rough waters. They are primarily moored in deep water at higher latitudes where directional wave measurements are not required. These buoys align themselves with wind direction, and because of their shape, directional wave measurements cannot be made.

A third type of buoy is the 3-m discus. These buoys were designed to operate in the near shore and continental shelf regions. However, they are presently located in water depths from 14 to 2,500 m. They are small, lower cost, and perfect for coastal and estuarine monitoring. Along with the standard weather data, both wave direction and wave height are measured using these buoys. They are affectionately known as the "workhorse" at NDBC.



3 m Discus Buoy

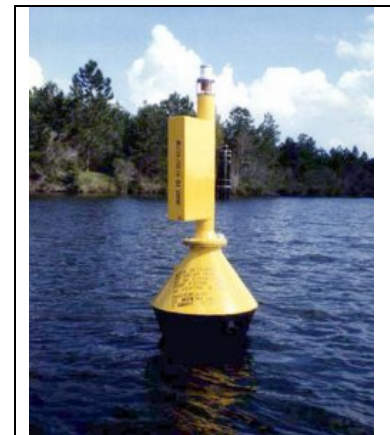
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Coastal-Marine Automated Network (C-MAN)

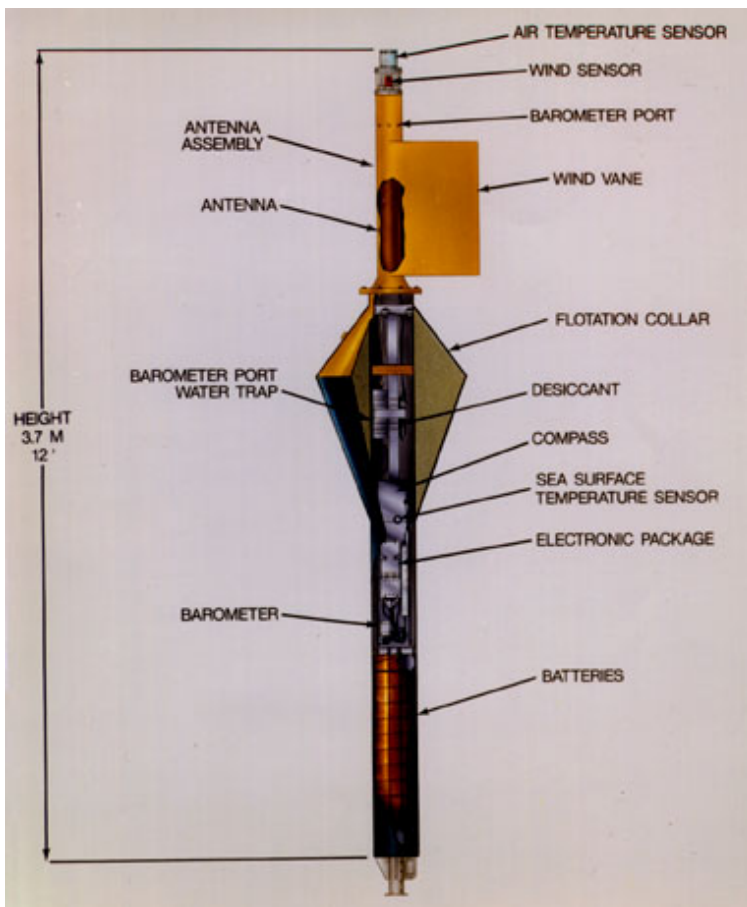
The C-MAN stations consist of fixed platforms located along our coasts on lighthouses, piers, and offshore towers. Strategically located in the coastal zone, they provide marine weather data in environmentally critical areas, and they are relatively easy to access. They are primarily weather stations, but oceanographic data can be collected on the offshore light towers.

Drifting Buoys

Another group of buoys that are operated by NDBC are called "Drifting Buoys." These buoys are designed to drift with the wind and continuously transmit data for 18 to 24 months until their power supply is depleted. They offer an excellent means to collect basic atmospheric and oceanic data from remote ocean areas. Drifting buoys have been deployed in the Southern Ocean around Antarctica, in the north Pacific Current, and in the track of hurricanes. They provide valuable information on winds in these areas that are not easily accessible by ships.



Drifting Buoy



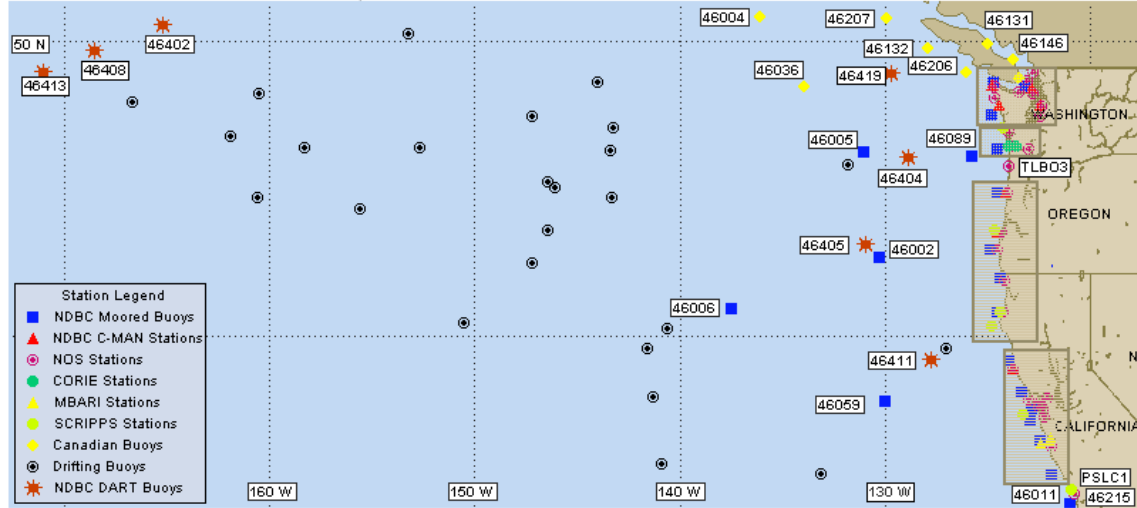
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Pacific Northwest Buoys

**Northwest USA Recent Marine Data**

Not All Stations Depicted are Operated by the National Data Buoy Center.

To view marine data, click a station on the map below:



Above is a map from the National Data Buoy Center that shows buoy locations off the west coast of the United States. There are many buoys off U.S. coasts. We will focus on buoys located off the Oregon coast.

**West Coast Recent Marine Data**

Not All Stations Depicted are Operated by the National Data Buoy Center.

To view marine data, click a station on the map below:



Station 46050: Stonewall Banks; Station 46015: Port Orford; Station 46027: St. Georges

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What buoys cannot do is give scientists a "bird's eye" view large areas of the ocean. This is one reason that scientists also use data collected by Earth-orbiting satellites.

Below an example of the Station Information available from the National Data Buoy Center.

**Station 46022 - EEL RIVER - 17NM West-Southwest of Eureka, CA**

Owned and maintained by National Data Buoy Center

3-meter discus buoy

ARES payload

40.78 N 124.54 W (40°46'53"N 124°32'31" W)

Site elevation: sea level

Air temp height: 4 m above site elevation

Anemometer height: 5 m above site elevation

Barometer elevation: sea level

Sea temp depth: 0.6 m below site elevation

Water depth: 509.1 m

Watch circle radius: 548 yards

**"Potential Explosion Hazard Exists for this Buoy"**

[Latest NWS Marine Forecast](#)

[Important Notice to Mariners](#)

[Search And Rescue \(SAR\) Data](#)

[Meteorological Observations from Nearby Stations and Ships](#)

[Latest Satellite Wind Map for this Area](#)



The buoy's latitude and longitude are given as 40.78 N, 124.54 W

Note that the buoy is called "Eel River," and the station number for this buoy is #46022. There are several instruments on this buoy. Their location on the buoy platform is described alongside the photo.

Discuss the instruments found on the buoy and what they can tell us.

**Anemometer** (measures **wind speed**, either directly, e.g. with rotating cups, or indirectly, e.g. via pressure differences or the propagation speed of **ultrasound** signals)











Barometer: Air Pressure

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Conditions at 46022 as of  
(9:50 am PST)  
1750 GMT on 11/13/2006:

Unit of Measure:  Time Zone:

Click on the graph icon in the table below to see a time series plot of the last five days of that observation.

	Wind Direction (WDIR):	S ( 170 deg true )
	Wind Speed (WSPD):	23.3 kts
	Wind Gust (GST):	29.1 kts
	Wave Height (WVHT):	14.1 ft
	Dominant Wave Period (DPD):	14 sec
	Average Period (APD):	8.4 sec
	Atmospheric Pressure (PRES):	29.86 in
	Pressure Tendency (PTDY):	-0.01 in ( Steady )
	Air Temperature (ATMP):	55.6 °F
	Water Temperature (WTMP):	54.3 °F
	<a href="#">Combined plot of Wind Speed, Gust, and Air Pressure</a>	

The table above is entitled "Conditions at 46022 as of (9:50 am PST) 1750 GMT on 11/13/2006." These data show conditions at the "Eel River" buoy on November 13, 2006.

Time is given in two ways:

GMT or Greenwich Mean Time. Greenwich, England is globally accepted as a reference standard for both time and longitude (its location marks zero degrees longitude) and is based on a 24-hour clock. It may also be called "Zulu" time (Z) or Universal (UTC). PST or Pacific Standard Time is GMT minus 8 hours (or minus 7 hours during daylight savings).

In addition to the summary chart, the web site has links to other information, including graphs of recent trends and relevant satellite data like wind maps. If you have the time and opportunity, take the students to a computer lab and have them explore real-time data on the NDBC site: <http://www.ndbc.noaa.gov/>. They can check buoys from around the world from this site.

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**Activity: Exploring Buoy Data**

Divide the class into groups and give each group a data packet for either Station 46050: Stonewall Banks, Station 46015: Port Orford, or Station 46027: St. Georges. Have the students work in teams to interpret the data and answer the questions on the worksheets.

Finish up with the handout on Buoy 46002, West of Coos Bay. The handout includes two days of data summarized. Have the students plot Wave Height (WVHT) vs. Wind Speed (WSPD) for the data period. How are wave height and wind speed related?