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Measurement Descriptions and Units

Real Time files generally contain the last 45 days of "Realtime" data - data that went through automated quality checks and were distributed as soon as they were received. Historical files have gone through post-processing analysis and represent the data sent to the archive centers. The formats for both are generally the same, with the major difference being the treatment of missing data. Missing data in the Realtime files are denoted by "MM" while a variable number of 9's are used to denote missing data in the Historical files, depending on the data type (for example: 999.0 99.0).

General

Units: Station pages display the current hour's measurements in English units by default, but can be changed by the viewer to metric units. When accessing Real Time and Historical data files, the **measurements are generally in metric units**, as described below, and cannot be changed.

Time: Station pages show current observations in station local time by default, but can be changed by the viewer to UTC (formely GMT). **Both Realtime and Historical files show times in UTC only**. See the Acquisition Time **help topic** for a more detailed description of observation times. For more information on the times in the files, see the changes page at **http://www.ndbc.noaa.gov/mods.shtml**.

Staion ID: Five-digit WMO **Station Identifier**, used since 1976. ID's can be reassigned to future deployments within the same 1 degree square.

Formats: Data are classified according to the following groups. The header lines are shown at the beginning of group. Note that in the Realtime files, non-data lines begin with "#". Such lines should be treated as comment lines.

Standard Meteorological Data

```
#YY  MM DD hh mm WDIR WSPD GST  WVHT   DPD   APD MWD   PRES  ATMP  WTMP  DEWP  VIS PTDY  TIDE
#yr  mo dy hr mn degT m/s  m/s     m   sec   sec degT   hPa  degC  degC  degC  nmi  hPa    ft
2007 04 15 13 50 120  4.0  6.0   0.4     3    MM  MM 1023.4  20.6  22.5  10.8   MM +1.7    MM
```

WDIR — Wind direction (the direction the wind is coming from in degrees clockwise from true N) during the same period used for WSPD. See **Wind Averaging Methods**

WSPD — Wind speed (m/s) averaged over an eight-minute period for buoys and a two-minute period for land stations. Reported Hourly. See **Wind Averaging Methods**.

GST — Peak 5 or 8 second gust speed (m/s) measured during the eight-minute or two-minute period. The 5 or 8 second period can be determined by payload, See the **Sensor Reporting, Sampling, and Accuracy** section.

WVHT — Significant wave height (meters) is calculated as the average of the highest one-third of all of the wave heights during the 20-minute sampling period. See the **Wave Measurements** section.

DPD — Dominant wave period (seconds) is the period with the maximum wave energy. See the **Wave Measurements** section.

APD — Average wave period (seconds) of all waves during the 20-minute period. See the **Wave Measurements** section.

MWD — The direction from which the waves at the dominant period (DPD) are coming. The units are

degrees from true North, increasing clockwise, with North as 0 (zero) degrees and East as 90 degrees. See the **Wave Measurements** section.

PRES Sea level pressure (hPa). For C-MAN sites and Great Lakes buoys, the recorded pressure is reduced to sea level using the method described in *NWS Technical Procedures Bulletin 291* (11/14/80). (labeled BAR in Historical files)

ATMP Air temperature (Celsius). For sensor heights on buoys, see **Hull Descriptions**. For sensor heights at C-MAN stations, see **C-MAN Sensor Locations**

WTMP Sea surface temperature (Celsius). For sensor depth, see **Hull Description**.

DEWP Dewpoint temperature taken at the same height as the air temperature measurement.

VIS Station visibility (nautica miles). Note that buoy stations are limited to reports from 0 to 1.6 nmi.

PTDY Pressure Tendency is the direction (plus or minus) and the amount of pressure change (hPa)for a three hour period ending at the time of observation. (not in Historical files)

TIDE The water level in feet above or below **Mean Lower Low Water (MLLW) (http://tidesandcurrents.noaa.gov/mllw.html)**.

Derived Met Values

HEAT For more information on heat index, please see the **NWS Heat Wave (http://www.nws.noaa.gov/os/heat/index.shtml)** page.

CHILL Please note that NDBC uses unadjusted winds to calculate wind chill. The winds are calculated at anemometer height. For more information on wind chill, please see the **NWS Wind Chill Temperature Index (http://www.nws.noaa.gov/om/windchill/index.shtml)**.

ICE Estimated ice accretion in inches per hour based on an algorithm developed by Overland and Pease at the Pacific Marine Environmental Laboratory in the mid-1980s. The algorithm relates icing to the presently observed wind speed, air temperature, and sea surface temperature. The method is designed for trawlers in the 20 to 75 meter length range, underway at normal speeds in open seas and not heading downwind. In general, NWS forecasters translate ice accretion rates to the following categories:

- light: 0.0 to 0.24 inches of ice accretion/hour;
- moderate: 0.25 to 0.8 inches/hour; and
- heavy: greater than 0.8 inches/hour.

WSPD10 The estimation of Wind Speed (WSPD) measurement raised or lowered to a height of 10 meters. NDBC uses the method of Liu et al., 1979: Bulk parameterization of air-sea exchanges in heat and water vapor including molecular constraints at the interface, *Journal of Atmospheric Science*, 36, pp. 1722-1735.

WSPD20 The estimation of Wind Speed (WSPD) measurement raised or lowered to a height of 20 meters. NDBC uses the method of Liu et al., 1979: Bulk parameterization of air-sea exchanges in heat and water vapor including molecular constraints at the interface, *Journal of Atmospheric Science*, 36, pp. 1722-1735.

Supplemental Measurements Data

Lowest 1 minute pressure	Lowest recorded atmospheric pressure for the hour to the nearest 0.1 hPa and the time at which it occurred (hour and minute).
Highest 1 minute wind speed	Highest recorded wind speed for the hour to the nearest 0.1 m/s, its corresponding direction to the nearest degree, and the time at which it occurred (hour and minute).

Continuous Winds

```
#YY  MM DD hh mm WDIR WSPD GDR GST GTIME
#yr  mo dy hr mn degT m/s degT m/s hhmm
2007 03 05 06 20 314  8.0 320 10.0 0604
```

WDIR	Ten-minute average wind direction measurements in degrees clockwise from true North. (DIR in Historical files)
WSPD	Ten-minute average wind speed values in m/s. (SPD in Historical files)
GDR	Direction, in degrees clockwise from true North, of the GST, reported at the last hourly 10-minute segment.
GST	Maximum 5-second peak gust during the measurement hour, reported at the last hourly 10-minute segment.
GTIME	The minute of the hour that the GSP occurred, reported at the last hourly 10-minute segment.

Detailed Wave Summary (Realtime data files only)

```
#YY  MM DD hh mm WVHT  SwH  SwP  WWH  WWP SwD WWD  STEEPNESS  APD MWD
#yr  mo dy hr mn    m    m  sec    m  sec  -  degT     -      sec degT
2007 03 05 05 32  1.5  0.5 11.0  1.5  9.0   W  MM    AVERAGE   MM -99
```

WVHT	Significant Wave Height is the average height (meters) of the highest one-third of the waves during a 20 minute sampling period.
SwH	Swell height is the vertical distance (meters) between any swell crest and the succeeding swell wave trough.
SwP	Swell Period is the time (usually measured in seconds) that it takes successive swell wave crests or troughs pass a fixed point.
WWH	Wind Wave Height is the vertical distance (meters) between any wind wave crest and the succeeding wind wave trough (independent of swell waves).
WWP	Wind Wave Period is the time (in seconds) that it takes successive wind wave crests or troughs to pass a fixed point.
SwD	The direction from which the swell waves at the swell wave period (SWPD) are coming. The units are degrees from true North, increasing clockwise, with North as 0 (zero) degrees and East as 90 degrees.
WWD	The direction from which the wind waves at the wind wave period (WWPD) are coming. The units are degrees from true North, increasing clockwise, with North as 0 (zero) degrees and East as 90 degrees.
STEEPNESS	Wave steepness is the ratio of wave height to wave length and is an indicator of wave stability. When wave steepness exceeds a 1/7 ratio; the wave becomes unstable and

begins to break.

APD	Average Wave Period is the average period (seconds) of the highest one-third of the wave observed during a 20 minute sampling period.
MWD	The direction from which the waves at the dominant period (DPD) are coming. The units are degrees from true North, increasing clockwise, with North as 0 (zero) degrees and East as 90 degrees. See the **Wave Measurements** section.

Spectral Wave Data

```
#YY  MM DD hh mm Sep_Freq  < spec_1 (freq_1) spec_2 (freq_2) spec_3 (freq_3) ... >
2007 03 05 06 30 0.143 0.000 (0.033) 0.000 (0.037) 0.000 (0.043) 0.000 (0.048) ...>

#YY  MM DD hh mm alpha1_1 (freq_1) alpha1_2 (freq_2) alpha1_3 (freq_3) ... >
2007 03 05 06 30 999.0 (0.033) 999.0 (0.037) 999.0 (0.043) 999.0 (0.048) ...
```

Sep_Freq	The Separation Frequency is the frequency that separates wind waves (WWH, WWP, WWD) from swell waves (SWH, SWP,SWD). NDBC inserts the value 9.999 if Sep_Freq is missing.
Spectral wave density	Energy in (meter*meter)/Hz, for each frequency bin (typically from 0.03 Hz to 0.40 Hz).
Spectral wave direction	Mean wave direction, in degrees from true North, for each frequency bin. A list of **directional stations** is available.
Directional Wave Spectrum	= C11(f) * D(f,A), f=frequency (Hz), A=Azimuth angle measured clockwise from true North to the direction wave is from. D(f,A) = (1/PI)*(0.5+R1*COS(A-ALPHA1)+R2*COS(2*(A-ALPHA2))). R1 and R2 are the first and second normalized polar coordinates of the Fourier coefficients and are nondimensional. ALPHA1 and ALPHA2 are respectively mean and principal wave directions. In terms of Longuet-Higgins Fourier Coefficients • $R1 = (SQRT(a_1*a_1+b_1*b_1))/a_0$ • $R2 = (SQRT(a_2*a_2+b_2*b_2))/a_0$ • $ALPHA1 = 270.0-ARCTAN(b_1,a_1)$ • $ALPHA2 = 270.0-(0.5*ARCTAN(b_2,a_2)+\{0. \text{ or } 180.\})$ Notes: 1. The R1 and R2 values in the monthly and yearly historical data files are scaled by 100, a carryover from how the data are transported to the archive centers. The units are hundredths, so the R1 and R2 values in those files should be multiplied by 0.01. 2. D(f,A) can take on negative values because of the trigonometric sine and cosine functions. There are several approaches to prevent or deal with the negative values. For more information and discussion of some approaches see: Use of advanced directional wave spectra analysis methods, M. D. Earle, K. E. Steele, and D. W. C. Wang, Ocean Engineering, Volume 26, Issue 12, December 1999, Pages 1421-1434.

3. ALPHA2 has ambiguous results in using the arctangent function with the Fourier Coefficients,b 2 ,a 2 . When necessary, NDBC adds 180 degrees to ALPHA2 in order to minimize the difference between ALPHA 1 and ALPHA2.

For more information on the mathematics behind the measuring of surface water waves, see the **waves** help section.

Ocean Current Data

DEP01,DEP02,...	The distance from the sea surface to the middle of the depth cells, or bins, measured in meters.
DIR01,DIR02,...	The direction the ocean current is flowing toward. 0-360 degrees, 360 is due north, 0 means no measurable current.
SPD01,SPD02,...	The speed of the ocean current measured in cm/s.

Ocean Current Data (Expanded ADCP format)

Instrument Number	Stations may have more than one ADCP instrument. This field distinguishes these instruments by number. Valid values are 0-9, with 0 being reserved for surface measurements.
Bin	The bin number, ranging from 1 to 128, where 1 is the bin closest to the transducer head.
Depth	The distance from the sea surface to the middle of the depth cells, or bins, measured in meters.
Dir	The direction the ocean current is flowing toward. 0-360 degrees, 360 is due north, 0 means no measurable current.
Speed	The speed of the ocean current measured in cm/s.
ErrVl	The error velocity measured in cm/s.
VerVl	The vertical velocity of the ocean current measured in cm/s.
%Good3	The percentage of three-beam solutions that are good.
%Good4	The percentage of four-beam solutions that are good.
%GoodE	The percentage of transformations rejected.
EI1,EI2,EI3,EI4	The echo intensity values for the four beams. Valid values are 0 to 255. EI1 = Echo Intensity for beam #1; EI2 = Echo Intensity for beam #1; EI3 = Echo Intensity for beam #3; and EI4 = Echo Intensity for beam #4.
CM1,CM2,CM3,CM4	The correlation magnitude values for the four beams. Valid values are 0 to 255. CM1 = Correlation Magnitude for beam #1; CM2 = Correlation Magnitude for beam #1; CM3 = Correlation Magnitude for beam #3; and

CM4 = Correlation Magnitude for beam #4.

Flags

The nine quality flags represent the results of the following quality tests based on their position in the flags field.

Flag 1 represents the overall bin status.
Flag 2 represents the ADCP Built-In Test (BIT) status.
Flag 3 represents the Error Velocity test status.
Flag 4 represents the Percent Good test status.
Flag 5 represents the Correlation Magnitude test status.
Flag 6 represents the Vertical Velocity test status.
Flag 7 represents the North Horizontal Velocity test status.
Flag 8 represents the East Horizontal Velocity test status.
Flag 9 represents the Echo Intensity test status.

Valid values are:
0 = quality not evaluated;
1 = failed quality test;
2 = questionable or suspect data;
3 = good data/passed quality test; and
9 = missing data.

For more information on continuous winds and the timing of these measurements, see the **continuous winds** help section.

Marsh-McBirney Current Measurements

DIR Direction the current is flowing TOWARDS, measured in degrees clockwise from North.

SPD Current speed in cm/s.

Water Level

TG01, TG02,...,TG10 Six-minute water levels representing the height, in feet, of the water above or below Mean Lower Low Water (MLLW), offset by 10 ft. to prevent negative values. Please subtract 10 ft. from every value to obtain the true water level value, in reference to MLLW.

Oceanographic Data

```
#YY  MM DD hh mm DEPTH  OTMP   COND   SAL   O2% O2PPM  CLCON  TURB    PH    EH
#yr  mo dy hr mn     m  degC  mS/cm   psu     %   ppm   ug/l   FTU     -    mv
2007 04 27 11 00     2 25.13  55.18 36.45  33.1  2.21   0.06    MM  0.00 98.28
```

Depth (DEPTH)	Depth (meters) at which measurements are taken.
Ocean Temperature (OTMP)	The direct measurement (Celsius) of the Ocean Temperature (as opposed to the indirect measurement (see WTMP above)).
Conductivity (COND)	Conductivity is a measure of the electrical conductivity properties of seawater in milliSiemens per centimeter.

Salinity (SAL)	Salinity is computed by a known functional relationship between the measured electrical conductivity of seawater (CON), temperature (OTMP) and pressure. Salinity is computed using the Practical Salinity Scale of 1978 (PSS78) and reported in Practical Salinity Units.
Oxygen Concentration (O2%)	Dissolved oxygen as a percentage.
Oxygen Concentration (O2PPM)	Dissolved oxygen in parts per million.
Chlorophyll Concentration (CLCON)	Chlorophyll concentration in micrograms per liter (ug/l).
Turbidity (TURB)	Turbidity is an expression of the optical property that causes light to be scattered and absorbed rather than transmitted in straight lines through the sample (APHA 1980). Units are Formazine Turbidity Units (FTU).
pH (PH)	A measure of the acidity or alkalinity of the seawater.
Eh (EH)	Redox (oxidation and reduction) potential of seawater in millivolts.

Solar Radiation Data

Shortwave Radiation (SRAD1, SWRAD)	Average shortwave radiation in watts per square meter for the preceding hour. Sample frequency is 2 times per second (2 Hz). If present, SRAD1 is from a LI-COR LI-200 pyranometer sensor, and SWRAD is from an Eppley PSP Precision Spectral Pyranometer.
Longwave Radiation (LWRAD)	Average downwelling longwave radiation in watts per square meter for the preceding hour. Sample frequency is 2 times per second (2 Hz). If present, LWRAD is from an Eppley PIR Precision Infrared Radiometer.

DART (Tsunameters) Measurements

T (TYPE) Measurement Type:

- 1 = 15-minute measurement;
- 2 = 1-minute measurement; and
- 3 = 15-second measurement.

HEIGHT Height of water column in meters.

tt = Tsunami Trigger Time, see the **Tsunami Detection Algorithm (http://www.ndbc.noaa.gov/dart/algorithm.shtml)**
ts = data Time Stamp(s)

24-Hour Rain Measurements

24-Hour Rain Rate	Average precipitation rate in units of millimeters per hour over 24-hour period from 00:00 to 23:59.99 GMT.
24-Hour Rain Accumulation	Total accumulation of precipitation in units of millimeters on

	station over 24-period from 00:00 to 23:59.99 GMT.
Percent Time Raining in 24-Hour Period	Percentage of 144 ten-minute periods within a 24 hour period with a measurable accumulation of precipitation.
Flag	In the case of 24-hour rainfall measurements, a flag is assigned when over half of the 10-minute measurements from which it is derived are flagged.

Hourly Rain Measurements

Hourly Rain Accumulation	Total accumulation of precipitation in units of millimeters on station during the 60-minute period from minute 0 to minute 59:59.99 of the hour.
Flag	In the case of one-hour accumulation, a flag is assigned when over half of the 10-minute measurements from which it is derived have been flagged.

10-Minute Rain Measurements

10-Minute Rain Rate	Rain rate in units of millimeters per hour on station over the 10-minute period from 5 minutes before to 4 minutes 59.99 seconds after the time with which it is associated.
Flag	In the case of 10-minute rainfall measurements, a flag is assigned to any measurement when either the -5 or +5 minute rain measurement from which it is derived is missing or obviously an error.

Discontinued Measurement Abbreviations

Some historical files have column heading abbreviations that have changed over time. The old abbreviations are listed below with links to the new standardized abbreviation description.

Old	New Abbreviation
WD	**WDIR** - Wind Direction
DIR	**WDIR** - 10 Minute Wind Direction
SPD	**WSPD** - 10 Minute Wind Speed
GSP	**GST** - Gust in Continuous Winds data
GMN	**GTIME** - Time of Gust in Continuous Winds data
BARO	**PRES** - Pressure
H0	**WVHT** - Significant Wave Height
DOMPD	**DPD** - Dominant Wave Period
AVP	**APD** - Average Wave Period
SRAD	**SWRAD** - Short Wave Solar Radiation
SRAD2	**SWRAD** - LI-COR Short Wave Solar Radiation
LRAD	**LWRAD** - Long Wave Solar Radiation

LRAD1 **LWRAD** - Long Wave Solar Radiation