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CODAR Data

CODAR (Coastal Ocean Dynamics Applications Radar) is a technology that allows the measurement of surface ocean current velocities at a distance using the Doppler shift of reflected radio waves. The term "CODAR" is frequently used as a generic term, but it is strongly associated with CODAR Ocean Sensors, a California company that manufactures them. A more general term for CODAR is "HF (High-Frequency) Coastal Radar"

How CODAR Works

CODAR works on the principle of Bragg scattering from ocean surface waves. Bragg scattering returns a signal to the transmitting antenna only when the ocean waves are moving either directly towards or directly away from the antenna.

Bragg scattering from ocean waves is also highly wavelength-specific; any given system is sensitive only to ocean waves with wavelengths one-half the wavelength of the radio waves it transmits. The Salish Sea / Strait of Georgia CODAR system (device details / documentation) used by ONC is a 25 MHz model. A radio frequency of 25 MHz corresponds to a radio wavelength of 12 metres, so the CODAR system is sensitive to ocean wavelengths of 6 metres. If ocean waves of this wavelength are entirely absent, the CODAR system is unable to measure surface currents. In practice, there is virtually always some wave energy in the 6-metre band, so this is generally not a problem. In extremely calm conditions, however, the data quality can be reduced because of the resulting lower signal-to-noise ratio.

The principle of Bragg scattering dictates that virtually all of the radio signal received by a CODAR antenna is being reflected back from ocean waves of a particular wavelength. The reflected signal is Doppler-shifted to higher or lower frequencies, depending on whether the ocean wave is moving, respectively, toward or away from the antenna. In the absence of ocean currents, this Doppler shift gives a measurement of the wave speed, just as a police radar gun measures the speed of a vehicle on the highway. If ocean currents are present, however, the Doppler shift gives a measurement of the wave speed PLUS the speed of the ocean current towards or away from the antenna. Because the speed of deep-water waves is known for a given wavelength, the wave speed can be subtracted from the total measured speed, resulting in a value for the speed of the ocean current alone.

The equations used in calculating ocean current velocities from the Bragg-scattering signal assume that the ocean waves being measured are "deep-water" waves--that is, that their wavelengths are less than twice the water depth. As depth decreases beyond this point, the waves will increasingly take on the character of "shallow-water" waves, and the assumptions used in calculating the ocean currents will become less and less valid. For a 25 MHz system, then, ocean currents measured in water depths of less than 3 metres should be viewed with suspicion. Note that the daily tidal range in the Strait of Georgia is on the order of 3 metres, so this effect will be time-varying for the current deployment.

CODAR Stations and Combiners

The individual CODAR stations are listed as individual devices. For example, the original two CODAR stations were at the Westshore Coal Terminal in Tsawwassen and at the Iona Wastewater Treatment Plant, near Vancouver Airport. The stations are displayed in the search tree under "Westshore Coal Terminal (VCOL)" and "Iona (VION)", respectively. Each station measures the radial velocities of ocean currents; that is, towards and away from the station's antenna. The stations have been placed in locations such that their areas of coverage overlap considerably. In the overlapping region, it is possible to combine the radial data from the two stations into "total" velocities that may be resolved into their true north-south and east-west components. In this way, the stations have radial and raw data, while we list the combined data products on a separate device, nominally found in the tree as "Marine Radar System" at the same level as the station search tree nodes (for example: http://qaweb2.neptune.uvic.ca/DataSearch?location=SOGCS&deviceCategory=RADAR). The breakdown of data product formats is as follows:

Stations: CSS.tar, RNG.tar, .tuv, .png, .gif (the PNG and GIF formats show the radial velocities only)

Combiners: .ruv, .png, .gif (the PNG and GIF formats show the combined surface velocities)

The data formats are described in detail below.

Revision History

1. 20150401: Initial CODAR data product released
2. 20160601: Updated CODAR scheme with station and combiner devices

Data Product Options

Formats

The CODAR data products, except the GIF format, are all stored in the archive and are retrieved on request. The GIF format is generated from the PNG files on the fly. The formats are described below.

RNG.tar and CSS.tar

These files are the CODAR's are one step removed from the raw, unprocessed data. These intermediate formats are retained in case it is decided to regenerate ocean-current data with changed parameters. These are known as "CSS" and "Range" files (originally, "CSQ" files were retained rather than the Range files, but the Range format has certain advantages. In December 2012, it was decided to switch to retaining Range files; see "Data Availability", below). Interpreting these files requires proprietary software from CODAR Ocean Sensors, so they will be of limited use to most users. See the manufacturer's documentation and/or contact us for more information.

RUV Data

RUV files are encoded in ASCII and contain radial current velocities. They are saved in the archive with file names ending in the source station. An RUV file for the Westshore Coal Terminal would be named with a suffix of -VCOL, e.g. CODARARRAY01_20111121T234733.000Z-VCOL.ruv. The data options allow selection of specific station files or all station files.

TUV Data

TUV files are encoded in ASCII and contain combined station current velocities. They are saved in the archive with file names ending in -TOTALS. An example of a TUV file name would be CODARARRAY01_20111122T234733.000Z-TOTALS.tuv.

PNG

PNG files contain a graphic representation of both station radial and combined total velocities. There are PNG files for both station and combined current velocities. Station files end in the four letter station code, while the combined files end in -TOTALS. The data options allow selection of specific station files, combined data files and all files.

GIF

GIF files are an animated collection of PNG files, with the same options and station codes/files. GIF files span a maximum of one day.

Data Availability

CODAR radial and total-current data is also available from HFRNet, a continent-wide repository of HF Radar measurements. An interactive mapping application there provides a graphical way to explore ocean currents, not only from Oceans 3.0, but from CODAR stations across the United States (and a single station in Mexico) as well.

Straight of Georgia Deployment

Radial data is available from the Westshore Coal Terminal station (VCOL) beginning on on November 24, 2011 and from the Iona Wastewater Treatment Plant (VION) beginning August 1, 2012. "Total" current data files are also available beginning August 1, 2012. Radial and total data files are generated hourly.

CSS and CSQ/Range data are available for each station for the same time period as the corresponding radial data. The exception to this is the CSQ files from the VCOL station in the five and half months between the date that acquisition started and June 10, 2012. An unnoticed default setting on the VCOL computer resulted in the CSQ files from this period being overwritten (apart from the CSQ files from February 6-7, 2012, which were recovered).

The VION station was switched from retaining CSQ files to retaining Range files on December 4, 2012. VCOL was switched to retaining Range files on December 19, 2012. Because VCOL is on a wireless router with limited bandwidth, CSQ/Range files are not fetched over the network, but rather are physically transferred via portable hard drive when site visits are made. As a result, there may be a lag of several months between acquisition and availability of CSQ/Range files from VCOL.

The range of high-frequency radio waves is greatly reduced over fresh water compared to the range over salty, highly-conductive water. For this reason, during the spring freshet, when the surface water in the Strait of Georgia is much less salty, one or both of the CODAR stations may return little or no current data in the area of overlap, resulting in no total current vectors being available. This will vary from year to year, but at the time of writing (May, 2013) it appears that total current vectors may be unavailable from early May to as late as July each year.

As of May 2016, the data acquisition framework was switched to the stations/combiners model. All of the formats will be available from then onward. The older files will migrate from the old scheme to the new devices over the next few months. The old scheme used a single device with multiple file mode fields to distinguish the stations. The new scheme is more flexible for expansion (we have added CODAR stations in Prince Rupert and there's potential for more).

Discussion

To comment on this product, click *Add Comment* below.