Introduction to Geosat Wind/Wave CD-ROM

Physics Laboratory and launched in March 1985. The primary mission during the first 18 months was to map the marine gravity field for the U.S. Navy, after that mission was completed, the exact repeat mission was started to measure sea surface height, wind speed and significant wave height. Because the first 18 months of data (the Geodetic Mission, or GM) were classified, the wind and wave data were not readily available to the general research community. In 1988 the Navy released the radar backscatter (from which wind speed is derived) and the significant wave height data [Dobson et al., 1988]. This compact disc contains these data. In 1995 the Navy declassified the entire GM dataset, in the form of Geophysical Data Records (GDRs), but the wind/wave data on this disc are still unique in that the derived wind values are not available on the GDRs.

The radar backscatter from a nadir-pointing radar is related to the wind speed and is directly proportional to the normal incidence Fresnel power reflection coefficient and inversely proportional to the mean square slope of the low pass filtered version of the ocean surface [Brown, 1978]. Using an algorithm, radar cross section can be converted to wind speed. There are two wind speed fields on this disc, one computed using the Chelton-Wentz algorithm [Chelton and Wentz, 1986] and one using the Smoothed Brown algorithm [Goldhirsh and Dobson, 1985]. The data on this disc were extracted to form the larger Geosat data set in 1988, and at that time these were the two algorithms chosen to compute wind speed. In terms of rms (root mean square) accuracy, the Smoothed Brown is slightly more accurate but has the drawback that it should not be used for wind speeds greater than 14 m/s.

Since 1988 several additional algorithms have been proposed. Appendix B gives three of these algorithms which can easily be used to compute wind speed when using the radar cross section values contained herein. A bibliography is included in Appendix A, and the reader is encouraged to read some of the pertinent papers for further clarification of the differences of these algorithms. A general review can be found in Dobson [1993]. The general accuracy of wind speed measurements from Geosat is 1.8 m/s.

Significant wave height (SWH) data on this disc were derived from an algorithm used onboard the spacecraft during the Geosat mission. The SWH is related to the slope of the returned radar pulse. When there are waves present on the ocean, the surface appears rough causing the leading edge of the pulse to intersect the wave crests before the troughs, which results in a broadening of the pulse shape. As the distribution of wave heights broadens, so does the returned pulse shape. Thus from this knowledge, an algorithm was developed relating the pulse slope to SWH. SWH is defined to be that wave height for which there is a 33 percent probability of waves higher than that value. In addition, if the probability density of wave amplitudes is assumed to be a Rayleigh distribution, then it can be shown that SWH is 4 times the standard deviation of the surface waves [Borgman, 1982]. In the last few years several papers have been published that indicate the onboard SWH algorithm underestimates SWH [Mognard et al., 1991; Carter et al., 1992; Glazman, 1991]. The user may want to consult these publications before using the SWH data. A bibliography has been included which contains these three papers and many others that have used Geosat SWH and wind measurements.

How to Use this CD-ROM

The National Oceanographic Data Center is responsible for disseminating Geosat ocean data to the research community. This CD-ROM contains the data from Geosat's Geodetic Mission, March 30, 1985 to September 30, 1986. The data from years 1985 and 1986 are in separate subdirectories of the same name. The naming convention of the files is as follows:

1. **DAY_DDD.YY**

   Where: DDD is the year day , 001-365; and **YY** is the year, 85 or 86.

   The table below gives the format for the integer binary data records, which have a record length of 26 bytes.

2.

Wind/Wave File Data Records

Field	Bytes	Content
1	1-4	Geodetic Latitude in microdegrees
2	5-8	East Longitude in microdegrees
3	9-12	Time in seconds from 1985.000...
4	13-14	Time continued in units of .1 milliseconds
5	15-16	Significant Wave Height in centimeters
6	17-18	Radar Cross Section (Sigma Naught) in .01 db
7	19-20	Attitude Angle in .01 degrees
8	21-22	Flag Word
9	23-24	Chelton-Wentz Wind, cm/sec (divided by 1.06)
10	25-26	Smoothed Brown Wind, cm/sec

3. Also included on this CD-ROM is a C-program named WW_SWAB.C. For VAX and PC users, whose computers use "little-endian" byte order, this program will convert the "big-endian" data on this CD to the format used by their machines. This program should be uploaded to their computer and compiled with a command line such as: "cc -O -s -o ww_swab ww_swab.c". The program acts like a Unix "filter", reading from standard in and writing to standard out. A typical usage would be: "ww_swab < orginal.file > swapped.file".

4. In summary, the files included on this CD-ROM are as follows:

Root directory:

- o READ.ME (information and general explanation)
- o WW_SWAB.C (byte-swapping program)

1985 subdirectory:

- o 1985 data files from day 090 to day 365

1986 subdirectory:

- o 1986 data files from day 001 to day 273

5. Changes from the First Release of Wind/Wave Data

This CD-ROM constitutes the second release of the Geosat GM Wind/Wave data. Long after the first CD was released, it was discovered that 29 of the first 30 days of data were corrupted (days 90-119, excluding day 109). Each of the affected files had two extra space characters inserted at the ends of records 20165 and 40330, causing the data fields to become misaligned. In the process of repairing this error it became apparent that the record length on the original CD was 27 bytes vs. 26, since a line-feed delimeter had been inserted after each 26-byte record. These unnecessary line-feeds were stripped from all the data files, so that the record length is truly 26 bytes. The space savings from this step made it possible to store all the wind/wave data on a single disc, without compression. By contrast, the original wind/wave files were first compressed with the PKZIP utility before being written to CD-ROM.

Click here for an example listing program that will do byte-swapping if needed for PC or VAX users.

For More Information

Technical questions about reading the CD-ROM or about scientific applications should be addressed to:

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Appendix A: Bibliography

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Appendix B:

Algorithms to Compute Wind Speed from Radar Cross Section

Modified Brown Algorithm

Modified Brown Algorithm

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6.6	25.5680
6.8	23.7010
7.0	22.0450
7.2	20.5720
7.4	19.2580
7.6	18.0800
7.8	17.0240
8.0	16.0720
8.2	15.2130
8.4	14.4360
8.6	13.7310
8.8	13.0890
9.0	12.4509
9.2	11.7923
9.4	11.1745
9.6	10.5933
9.8	10.0446
10.0	9.52479
10.2	9.03052
10.4	8.55883
10.6	8.10740
10.8	7.67366
11.0	7.25583
11.2	6.85210
11.4	6.46129
11.6	6.08195
11.8	5.71337
12.0	5.35477
12.2	5.00570
12.4	4.66582
12.6	4.33492
12.8	4.01336
13.0	3.70079
13.2	3.39790
13.4	3.10481

13.6	2.82246
13.8	2.55095
14.0	2.29109
14.2	2.10000
14.4	1.90000
14.6	1.59000
14.8	1.40000
15.0	1.15300
15.2	1.09200
15.4	1.03600
15.6	0.98500
15.8	0.93900
16.0	0.89700
16.2	0.85900
16.4	0.82400
16.6	0.79200
16.8	0.76200
17.0	0.73500
17.2	0.71000
17.4	0.68700
17.6	0.66500
17.8	0.64500
18.0	0.62700
18.2	0.61000
18.4	0.59400
18.6	0.57900
18.8	0.56600
19.0	0.55200
19.2	0.54100
19.4	0.53000
19.6	0.51900
19.8	0.50900
20.0	0.50000
20.2	0.49100
20.4	0.48300
20.6	0.47600
20.8	0.46900
21.0	0.46200
21.2	0.45600
21.4	0.45000
21.6	0.44400

Witter-Chelton Algorithm

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7.0	20.154
7.2	19.597
7.4	19.038
7.6	18.463
7.8	17.877
8.0	17.277
8.2	16.655
8.4	16.011
8.6	15.348
8.8	14.669
9.0	13.976
9.2	13.273
9.4	12.557
9.6	11.830
9.8	11.092
10.0	10.345
10.2	9.590
10.4	8.827
10.6	8.059
10.8	7.298
11.0	6.577
11.2	5.921
11.4	5.321
11.6	4.763
11.8	4.252
12.0	3.792
12.2	3.378
12.4	3.014
12.6	2.708
12.8	2.447
13.0	2.208
13.2	1.992
13.4	1.818
13.6	1.676
13.8	1.547
14.0	1.419
14.2	1.292
14.4	1.167
14.6	1.056

14.8	0.972
15.0	0.915
15.2	0.873
15.4	0.833
15.6	0.794
15.8	0.755
16.0	0.716
16.2	0.677
16.4	0.637
16.6	0.599
16.8	0.559
17.0	0.520
17.2	0.481
17.4	0.442
17.6	0.403
17.8	0.363
18.0	0.324
18.2	0.285
18.4	0.246
18.6	0.207
18.8	0.167
19.0	0.128
19.2	0.089
19.4	0.050
19.6	0.011

Wu Algorithm

Radar Cross Section = -4.0 - 10(logbase10[0.009 + 0.012 ln U(sub10)])

Where U(sub10) = U sub 10 = wind speed at 10 meters above the surface and Radar Cross Section is in decibars.

Note: All algorithms are referenced to 10 meters height above the surface.