Disc Contents Contents Search

Polymodal Deep-Water Wave-Rider Buoy Data

William F. Tanner

Geology Dept., Florida State Univ., Tallahassee, FL 32306-4100

Deep-water wave-rider buoy data provide near-real-time information about air parameters and water waves. Tens of these buoys have been deployed to the east, south, and west of U.S. coasts. The wave data are listed in three classes, which have been separated from each other by statistical methods: significant waves, wind waves, and swell. A new report is issued each hour, 24 hours/day. This information is available on the Internet, using this address: <http://www.nws.fsu.edu/B/buoy?station=xxxxx> where xxxxx is a five-digit buoy number (such as 42003, 42036, 42039, 42040). The present paper is concerned with data from these four buoys in the Gulf of Mexico.

Waves in this area, at any given moment, are polymodal, typically with two to four modes, or more, in either period or height, or both. Rarely is the wave spectrum unimodal. This indicates that mean values do not represent the spectrum very well: the mean wave usually does not exist at all.

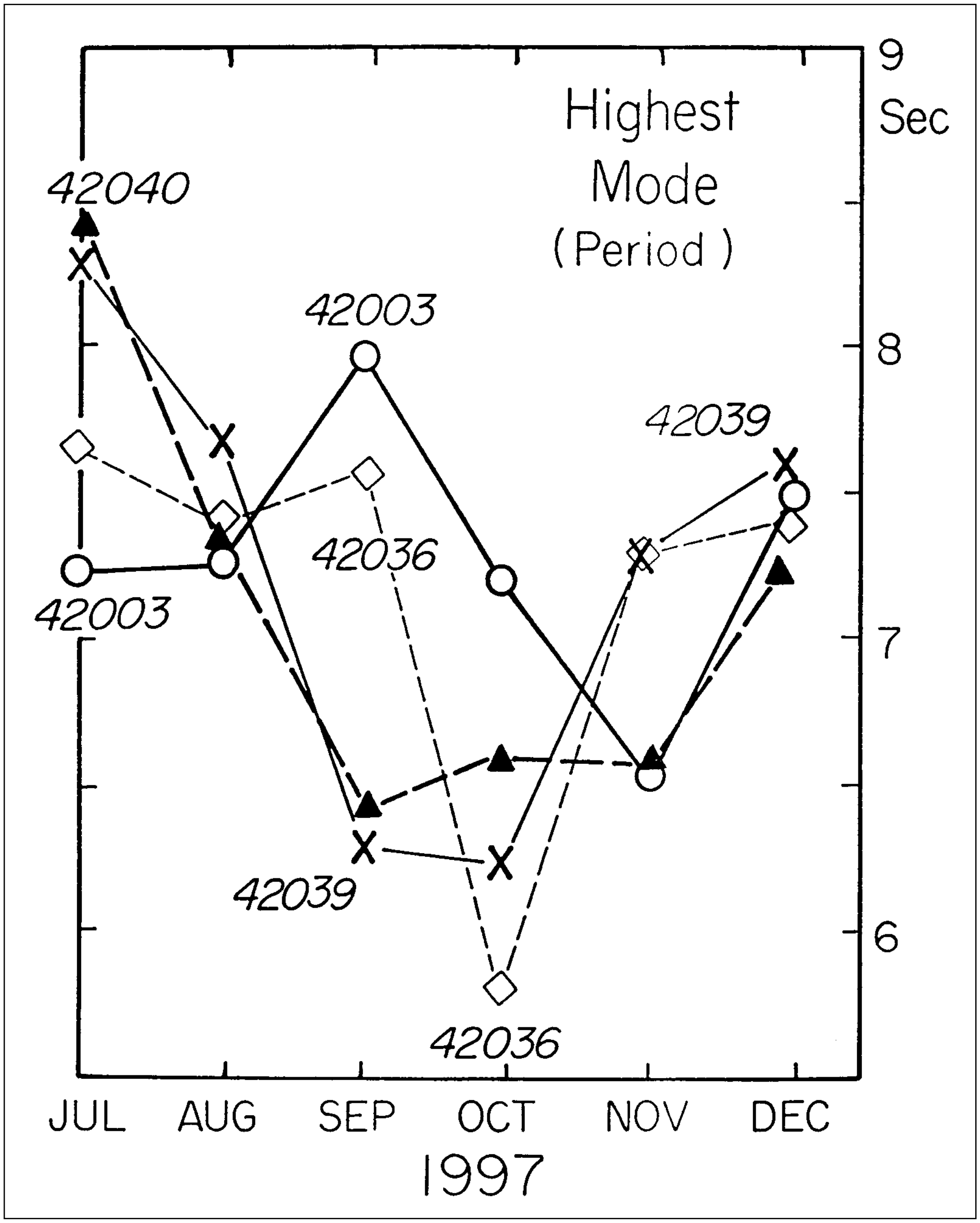

Figure 1. Periods of highest modes for deep-water waves, for four buoys in the eastern Gulf of Mexico, each identified by a five-digit number. The data are summarized by months, for the last six months of 1997. These modes are, in each case, larger than the means. The periods are identified by seconds.

This information cannot be obtained by extrapolation, seaward, of measurements on the coast. Therefore one starts with deep-water data, and tracks these waves (by machine) into the surf. This method permits one to (1) calculate the percentage of deep-water wave energy delivered to the surf, and (2) calculate the energy expenditure on the bottom, meter by meter, along the wave ray, during shoaling. From this work one can estimate sediment transport rates.

The work reported here covers the interval 1 July through 31 Dec. 1997, with 15-20 days sampled each month. For each sample day, the hours from 0800 to 2000 were covered (roughly, daylight). The three classes of wave data (periods and heights for each) were combined for each buoy (for preliminary reports, see Tanner 1997a, 1997b.)

The four study buoys are located as follows: 42003, southeastern Gulf (approx. Lat. 25° 56' N, Long. 85° 55'); 42036, west of Tampa (approx. Lat. 28° 30' N, Long. 84° 30'); 42039, south of Pensacola (approx. Lat. 28° 48', Long. 86° 2'); 42040, south of Mobile (approx. Lat. 29° 12' N, Long. 88° 16').

The daily highest modes for the periods for each of these buoys have been averaged for each month, thus producing a wave climate index. For the first six months of the detailed study (July through December, 1997), the results are 7.2 or 7.3 sec in each case, and the range of monthly highest modes is 5.7 sec (buoy 42036, October) to 8.4 sec (buoy 42040, July) (Fig. 1).

The popular statement that all of the deep-water wave energy density is preserved through the shoaling process and hence delivered to the surf, is far from correct as is shown by comparing open-sea data with numbers obtained along the coast. Percentages obtained in this fashion are typically between 30% and 70%, depending in good part on the bottom slope. Without measurements of open-sea waves, one is not able to calculate (or estimate) what percentage of deep-sea wave energy is actually spent in the surf, and what part is extracted in shoaling.

Because of the polymodality, calculations of mean period and mean height may not be useful. Instead, one needs individual modes, especially the largest ones. The mean value (for period or height) may indicate a wave which does not exist in the study area at the time of measurement. For example, on a given day at a specific buoy, the periods may include 10 sec and 5 sec, with an average value of 7.5 sec, which is not actually in the record, and presumably not present.

The significant wave is also suspect; in addition to the usual problem with definition, there is no reason to think that it represents any mode at all.

A listing of the "largest mode" for the wave period at each buoy, for each day, shows that this value ranges from a low of 4 sec to a high of 14 sec (day by day, for the last six months of 1997). The daily extremes of the "largest period" for the combined data from the four study buoys, month by month, are as follows: July, 10 sec, 6 sec; August, 10, 4; Sept., 14, 4; Oct., 9, 4; Nov., 9, 4; Dec., 11, 5.

Difficulties: 1) The deep-water wave data do not correlate well with wind and fetch. Part of this may be due to Langmuir circulation which provides an important water surface motion that is due to neither waves nor currents (Socci and Tanner, 1980). 2) a set of observations of 14 seconds each, taken on the beach of southeastern Alabama during the passage of a hurricane (19 July 1997), was not matched by data from any of the buoys which showed maximum periods of 7 or 8 seconds at that time. This large discrepancy has not been resolved. 3) There is also the problem that many modes have been truncated.

REFERENCES

Socci, A., and W.F. Tanner, 1980, The coastal Langmuir cell project: Preliminary Report; Proc. 5th Symp. on Coastal Sedimentology: Florida State Univ., Tallahassee, FL, 745 p.

Tanner, W.F., 1997a, Wave-rider-buoy overview: Journal of Coastal Research, vol. 12 no. 6 (Oct.), p. 1-4.

Tanner, W.F., 1997b, Changing wave parameters, due to shoaling, and sediment transport: Gulf Coast Association of Geological Societies Transactions, v. 47, p. 579-583.