

# Long-term ambient noise statistics in the Gulf of Mexico

Mark A. Snyder, Anthony I. Eller and Peter A. Orlin

Long-term omni-directional ambient noise was collected at several sites in the Gulf of Mexico during 2004 and 2005. The Naval Oceanographic Office (NAVOCEANO) deployed bottom moored Environmental Acoustic Recording System (EARS) buoys approximately 170 nautical miles south of Panama City, Florida in water depths of 3200 meters. The hydrophone of each buoy was 265 meters above the bottom. The data duration ranged from 10 months to 14 months. The data were sampled continuously at a rate of 2500 Hz and have a bandwidth of 10–1000 Hz. Data were processed in eight 1/3-octave frequency bands, centered from 25 to 950 Hz, and monthly values of the following statistical quantities were computed from the resulting eight time series of noise spectral level: mean, median, standard deviation, skewness, kurtosis, coherence time, and the 10<sup>th</sup> and 90<sup>th</sup> percentiles.

Trends in the data (plotted versus time and frequency) show that the mean and median noise levels had monthly global peaks at 25–50 Hz due to shipping. The mean and median monthly values never varied by more than 1.5 dB. Noise levels at higher frequencies (400–950 Hz) peaked during extremely windy months (summer hurricanes and winter storms). The standard deviation was minimized in the region 100–200 Hz but increased at higher frequencies, especially during periods of high wind variability (hurricanes). Skewness was positive from 25–400 Hz and negative from 630 to 950 Hz. Kurtosis was closest to 3 (consistent with a Gaussian distribution) from 630 to 950 Hz. The coherence time was highest during extreme wind conditions and at higher frequencies.

The temporal coherence of noise level was also analyzed. The coherence at a single hydrophone over a 14-month period was investigated, comparing each of the eight 1/3-octave time series to each other. Spatial coherence between hydrophones was also analyzed for hydrophone separations of 2.29, 2.56 and 4.84 km over a 10-month period.

In addition, fluctuations of each time series were analyzed for threshold crossing statistics (as described by number of times and duration noise falls above or below designated thresholds) and to determine time scales of greatest variability. The 14-month data show clearly that variability occurred primarily over three time scales: 8–12 hours (shipping-related), 80–500 hours (3–21 days, weather-related) and over a 1-year period.

M. A. Snyder is with the Naval Oceanographic Office, Stennis Space Center, MS 39522 USA (phone: 228-689-8019; fax: 228-689-8057; e-mail: Mark.A.Snyder1@navy.mil).

A. I. Eller is with Science Applications International Corporation, McLean, VA 22102 USA (e-mail: Anthony.I.Eller@saic.com).

P. A. Orlin is with the Naval Oceanographic Office, Stennis Space Center, MS 39522 USA (e-mail: Peter.Orlin@navy.mil).