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EDITORIAL

Beach Erosion Trends and Shoreline Forecasting

A principal research objective in coastal geomorphology is to define trends of phenomena, be it sea level or shoreline change. Many coastal states are presently utilizing historical shoreline change data to predict erosional trends for use in establishing building setback lines. A major concern involves choosing the appropriate statistical technique for trend determination. Unfortunately, shoreline position data are very limited and irregularly spaced through time.

Sea-level change can serve as a possible surrogate data set for determination of the optimal predictor because it is temporally abundant, evenly spaced, and long term. Yearly mean sea-level values are obtained from water elevation measurements conducted at NOAA's 78 tide stations. This is an extremely rich data set as the yearly means are computed from observations taken every 6 to 20 minutes, and the record extends for nearly a century for some gauges. Short-term gauge records (a few decades or less), however, are of little use for determining the underlying long-term sea-level trend because of large interannual fluctuations. A minimum of 50 years of record is necessary to remove the effects of oceanographic and meteorological "noise" from the signal and obtain a trend value that reflects the long-term rise (DOUGLAS, 1991, as cited in CROWELL *et al.*, this issue, pages 1245–1255).

The problem of trying to infer long-term trends from short-term data is well illustrated by Figures 1 and 2. The 21-year record from the New York City tide gauge shows no statistically significant change in sea level, but the almost one hundred year record clearly shows a rising sea level (Figure 2). The sea-level rise trend using linear regression is calculated to be 2.7 mm/yr at the 95% confidence interval. Many mistakes have been made by researchers who try to infer sea level trends from data that is inherently noisy and not sufficient in length, and this is likely the case for those trying to determine erosional trends based on historical shoreline positions.

There is presently a controversy concerning the statistical technique to use in forecasting erosion rates for coastal planning. While some researchers use only the most recent data for predicting the erosional trend, accepted standards for forecasting state that one should not make forecasts for a longer period ahead than about half the number of past years

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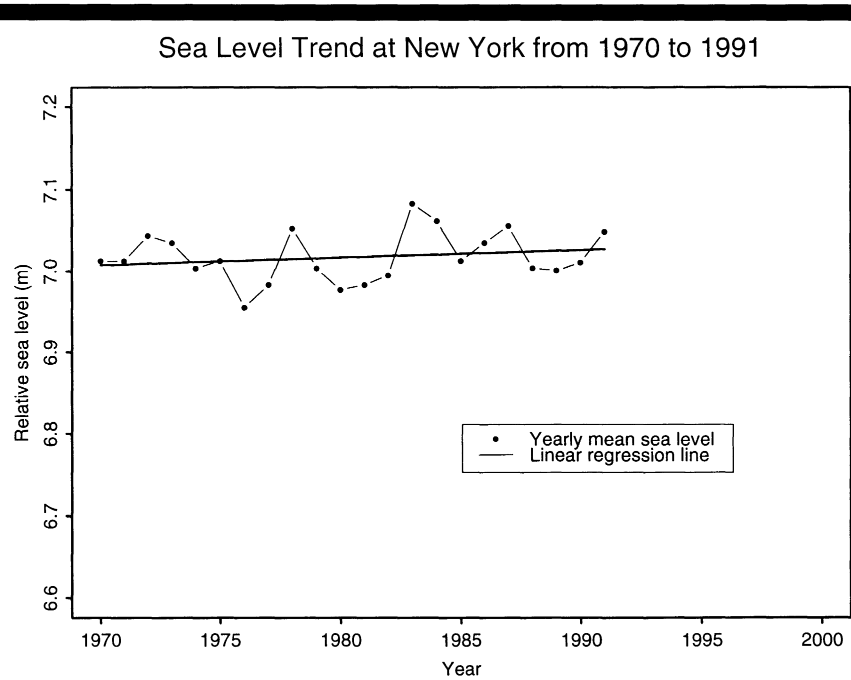

Figure 1. Sea level trend for New York based on a 21-year record (1970–1991).

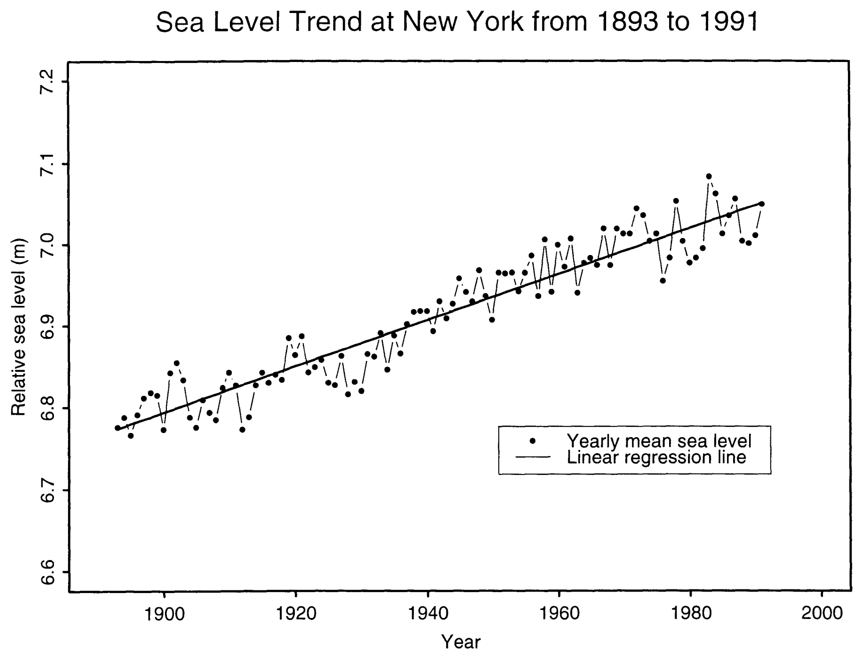

Figure 2. Sea level trend for New York based on almost a hundred year record (1893–1991).

for which data are available. Therefore, a 60-year erosional forecast should preferably be based on a 120 year period of record if available. The longest term, accurate data should be used to establish the erosional trend unless there have been fundamental changes in sediment supply, coastal geomorphic processes (*e.g.,* inlet breaching), or human interference through shoreline engineering.

Historical shoreline data are often widely dispersed through time with gaps of 30 to 40 years during the late nineteenth/early twentieth century. However, this valuable data set should not be ignored for long-term trend analysis, and no amount of modeling can ever take the place of real data. Often only six to eight shoreline positions are available over the entire period of record (mid 1800s to present) from which an erosional trend can be determined for forecasting purposes. By contrast, the sea-level change record is data-rich with annual values and up to 100 years of record. Therefore, a logical approach of determining the best statistical technique for erosion rate analysis might be to use sea-level change data as a *surrogate* and *experiment* with this data set to identify optimal predictors of shoreline trend. Such an analysis has been conducted by CROWELL *et al.* (this issue, pages 1245–1255) who concluded that linear regression provides the best forecast. However, each technique was found to have limitations, depending upon the length of desired extrapolation.

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