The World's Longest Observational Sea-Level Record

Reference
Ekman, M. 1999. Climate changes detected through the world's longest sea level series. *Global and Planetary Change* **21**: 215-224.

What was done
The author utilizes the sea level data set from Stockholm, Sweden, on the Baltic Sea, which stretches back over two and a quarter centuries to 1774, to investigate long-term sea level changes and their relationship to various climatic factors, noting that "long-term changes recorded at Stockholm represent, to a very large extent, the long-term behavior of the entire Baltic Sea as well as the adjacent part of the North Sea."

What was learned
Near the end of the Little Ice Age, the Stockholm record suggests that sea level was in a state of equilibrium, with a mean rate-of-change of 0.0 mm/yr. In fact, the author concludes, on the basis of other studies he reviews, that "sea level changes due to northern hemisphere climate variations since 800 A.D. have probably always kept within -l.5 and +1.5 mm/yr, with an average fairly close to zero." Over the past century, however, the sea-level rate-of-rise as measured at Stockholm has been approximately 1.0 mm/yr.

Interannual variability in sea-level was also investigated; and a number of interesting relationships were discovered between sea level and the persistent winter winds of the region, which have been shown to produce deviations in annual mean sea level of as much as 100 mm from the smoothed trend of the long-term record. Specifically, extreme low water years were found to have persistent winter winds from the northeast, while extreme high water years were found to have persistent winter winds from the southwest.

What it means
In the words of the author, "there is an understandable wish to identify a possible accelerated sea level rise due to the greenhouse effect." However, as he notes, "we should point out here that this is very difficult," the main reason being that "during a shorter time interval, say one or a few decades, an apparent acceleration (or retardation) might very well be caused by anomalous winter wind conditions."

In this regard, the author notes that from the end of the 1700s to the beginning of the 1900s, there was a *rapidly decreasing* number of dominating winter winds from the northeast, which winds typically tend to reduce the sea level at Stockholm; and, hence, the gradual disappearance of these winds should have led to a gradual *increase* in the rate-of-rise of sea level there, which just happens to be what occurred over this period of time, i.e., the mean rate-of-rise of sea level rose from 0.0 mm/yr to something significantly higher. After that, the winter winds gradually shifted to where the dominant mode was from the southwest, which winds tend to promote *high* sea levels at Stockholm, so that the rate-of-rise in sea-level would have to continued to increase. The net result of these wind regime changes would thus have been a continual increase in the rate-of-rise of sea-level over the entire two-century period, resulting in a mean sea level trend of 1.0 mm/yr over the 20th century.

In light of these observations, there appears to be no need to invoke an inordinate amount of global warming to account for the historical increase in the rate of sea-level rise at Stockholm over the past two centuries, although some of the late 19th and early 20th century rise could well have come from the amelioration of cold Little Ice Age conditions. In addition, the author states that "values of present secular sea level rise approaching 2 mm/yr, suggested by some authors, are unlikely;" and this remark leads us to question the 1930-present value of 2.2 mm/yr derived from the tide gauge measurements reported in our Journal Review Six Thousand Years of Sea Level Change in Eastern Maine.

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