



BRIEF ANALYSIS

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Sea Levels and Global Warming

The Clinton administration has committed to signing—but the Senate has yet to ratify—the Kyoto Treaty, which would impose legally binding, internationally enforceable limits on the production of greenhouse gases, primarily carbon dioxide (CO₂). Supporters of the treaty believe that human-caused gases are causing environmentally disastrous global warming and that only immediate government action can avert catastrophe. One of the catastrophes forecast is a rapid rise in ocean levels that would inundate coastal cities around the globe.

Global sea levels are rising. They have risen about 400 feet since the earth emerged from the last Ice Age 20,000 years ago. Rising sea levels are a natural phenomenon during interglacial periods (the times between ice ages). However, much more is unknown than is known about what impact global warming would have on sea levels. The

forecasts of future sea level changes, based on climate models, fluctuate wildly. In addition, scientists find it difficult to measure actual sea level rise accurately. And sea levels don't rise uniformly the world over.

Estimates vs. Observations of Sea Level Changes.

Coming out of the Ice Age, sea levels rose at an annual rate varying from 1/16 to 8/16 inches [see the table]. Over the last 7,500 years the rate has averaged 1/16 inch per year. The most recent report of the Intergovernmental Panel on Climate Change (IPCC) noted that there is no evidence of an acceleration in the rate of sea level rise over the past century.

The IPCC report presented a range of estimated rates of rise that average approximately 1/16 inch per year over the past 100 years. The median of the observed rises for the century was approximately seven inches, but scientists' measurements range from as low as four inches to as high as 10 inches. This six-inch range of observed sea level rise is almost as great as the median

rise of seven inches; which demonstrates the difficulty of measuring sea level rises. Since it is so difficult to measure past rates of rise, it will surely be far harder to predict future rates.

Explaining Continuing Sea Level Rise. The IPCC report asks whether the observed rise — however much it is — can be tied to the estimated average global temperature increase of 0.5 to 1.1 degrees Fahrenheit during the century. The IPCC examined five possible sources of sea level rise: thermal expansion of water as temperature rises, melting of inland glaciers, melting of Greenland's ice sheet, melting of Antarctica's ice sheets

and changes in surface and ground water levels.

■ The IPCC concluded that, except for data from inland glaciers, there were insufficient data to demonstrate a temperature effect on sea level rise for the past 100 years.

■ The available data indicated that, based on models, the temperature increase could have

caused anything from a 7 1/2-inch decline to a 14-inch rise in sea levels — amounting to a 22-inch range of uncertainty.

Since the 22-inch range of uncertainty in the IPCC's estimates of past sea level change is four times greater than the six-inch range of measured sea level rise, one could argue that our ability to forecast the effects of temperature on sea level rise is so limited as to be virtually worthless.

Forecasts for the Next 100 Years. Forecasts for temperature increases over the next 100 years, based on climate models, have fallen over time. So too have forecasts for sea level rise.

- In the early 1980s forecasters were predicting a 100-year sea level rise of 23 to 26 feet.
- By 1990 the predicted rise was less than three feet.
- Current IPCC forecasts are for a rise of about 1 1/2 feet, and other forecasts are lower [see the Figure].

	17-14	14-9	9-7.5	7.5-present
Rise, feet	65	195	50	50
Avg. inches annually	4/16	8/16	6/16	1/16

In spite of lowered forecasts and recognized uncertainties, apocalyptic predictions continue. For example, the Environmental Defense Fund and the Smithsonian Institution sponsored a touring exhibit at museums around the nation concerning the effects of global warming. One display in the exhibit showed the Washington Monument awash in a rising sea.

The Smithsonian and EDF researchers later reported that “by 2075 A.D. we could expect a 4-to-24 inch sea level rise. This rise, along with a major storm surge, would nearly encircle the Washington Monument.” However, a major storm, such as a Level IV hurricane, has a surge of 13 to 18 feet which would flood the monument whether or not sea levels are rising due to global warming.

How Much Rise in the Next Century?

As mentioned above, sea levels have risen about 400 feet since the last Ice Age — without any human-caused climate change. If all the earth’s frozen water melted, scientists say sea levels could rise about another 275 feet. The IPCC forecast, assuming a 4.5 degree F. temperature rise as a result of doubling the concentration of greenhouse gas, raises sea levels 19 inches — hardly an apocalyptic event. Even the 19-inch forecast is uncertain, with other forecasts showing a somewhat lesser rise. For example, an Environmental Protection Agency study forecasts a rise of approximately 13 inches. And recent reports of what many consider to be the best computer models indicate a rise of about 3.1 degrees F. with a sea level rise of approximately eight inches.

The Current State of the Science. While there is general agreement that the earth has seen a modest amount of surface warming over the past century — and thus an unsurprising sea level rise — a critical question remains: What fraction of the observed warming is due

to nature and what to human causes? Until human-caused warming can be distinguished from natural climate variability, we risk wasting vast amounts of resources by signing global warming treaties prematurely.

In light of scientific uncertainties, politicians are being unrealistic when they insist “the science is settled.” It is not clear that humans are causing rising sea levels. It is even less clear what we could do to slow sea level rise.

There are legitimate reasons to be concerned about sea level rise for several areas. These include low-lying island nations and coastal areas subject to subsidence or

beach erosion. These concerns should not be minimized, but more research is warranted before precipitous action is taken. This is especially true since signing the Kyoto Treaty could produce significant economic and environmental harm without any clear environmental benefits. In the meantime, regions that are considered vulnerable need to manage their affairs with an expectation that sea level

will rise by 1-2 feet over the next century. This could mean no additional efforts in some areas and possibly building or strengthening sea walls or dikes in other areas. It could also mean developing strong disincentives for living along the coast and even to relocating very vulnerable populations, such as those in Papua, New Guinea, who were devastated by the recent tsunami.

This Brief Analysis was prepared by Gerald T. Westbrook, the principal at TSBV Consultants, Houston. This is a modified version of a paper presented at the 1998 Offshore Technology Conference in Houston, Texas, May 4-7, 1998, entitled, “The Incredible Story of the World’s Oceans - Will Global Warming Have an Impact?” The original paper is copyrighted by the Offshore Technology Conference.

