

TEMPERATURE & EXPANSION

Unit 19 Dr John P. Cise, Professor of Physics, Austin

Community College, 1212 Rio Grande St., Austin Tx 78701 jpcise@austincc.edu & NYTimes March 14,2012 by Justin Gillis .Please send Dr Cise an e-mail on how you used this NYTimes physics application. Thanks! Dr Cise

Rising Sea Levels Seen as Threat to Coastal U.S.



Manteo, N.C., residents navigate streets that were flooded by Hurricane Irene in August. Rising tides are likely to mean more frequent coastal flooding.

INTRODUCTION: The average depth of oceans is 4,267 meters. Below 1000 m the temperature on average is 3.8° C. Quite cold! But, the upper 1000 m has a temperature from the exterior air temperature to 8° C(at 1000 m). So, Any exterior air change affects this upper 1000 m. The area of all earth's oceans is $3.6 \times 10^8 \text{ km}^2$. Some useful conversions: $10^6 \text{ m}^2 = \text{km}^2$, β = coefficient of volume expansion of water = $12 \times 10^{-5} / ^\circ\text{F}$, 3.28 ft = 1 meter

HINT: $\Delta V = \beta V \Delta T$, $\Delta V = A \Delta h$

QUESTIONS (a) Find the area A of all oceans in m^2 ? (b) Find V(volume in m^3) of the top 1000 m of all the oceans? (c) If the oceans rise 3°F in 100 years, find the volume change ΔV . Find in units of m^3 . (d) Find Δh (change in height) of oceans due to a 3°F change in temperature? Compute (d) in meters and feet.

ANSWERS: (a) $A = 3.6 \times 10^{14} \text{ m}^2$ (b) $V = 3.6 \times 10^{17} \text{ m}^3$ (c) $\Delta V = 1.296 \times 10^{12} \text{ m}^3$, (d) $\Delta h = .36 \text{ m}$, or 1.18 ft.

About 3.7 million Americans live within a few feet of high tide and [risk being hit](#) by more frequent coastal flooding in coming decades because of the sea level rise caused by [global warming](#), according to new research. If the pace of the rise accelerates as much as expected, researchers found, coastal flooding at levels that were once exceedingly rare [could become an every-few-years occurrence](#) by the middle of this century. By far the most vulnerable state is Florida, the new analysis found, with roughly half of the nation's at-risk population living near the coast on the porous, low-lying limestone shelf that constitutes much of that state. But Louisiana, California, New York and New Jersey are also particularly vulnerable, researchers found, and virtually the entire American coastline is at some degree of risk. "Sea level rise is like an invisible tsunami, building force while we do almost nothing," said Benjamin H. Strauss, an author, with other scientists, of two new papers outlining the research. "We have a closing window of time to prevent the worst by preparing for higher seas."

Dr. Strauss said he hoped this would spur fresh efforts to prepare for the ocean's rise, and help make the public more aware of the risks society is running by pumping greenhouse gases into the air. **Scientists say those gases are causing the planet to warm and its land ice to melt into the sea. (((The sea itself is absorbing most of the extra heat, which causes the water to expand and thus contributes to the rise.)))))**

The ocean has been rising slowly and relentlessly since the late 19th century, one of the hallmark indicators that the climate of the earth is changing. **The average global rise has been about (((eight inches since 1880,)))))** but the local rise has been higher in some places where the land is also sinking, as in Louisiana and the Chesapeake Bay region. **(((The rise appears to have accelerated lately, to a rate of about a foot per century)))))**, and many **scientists expect a further acceleration as the warming of the planet continues. One estimate that communities are starting to use for planning purposes suggests the ocean (((could rise a foot over the next 40 years.)))))** Experts say a few inches of sea level rise can translate to a large incursion by the ocean onto shallow coastlines. **Sea level rise has already cost governments and private landowners billions of dollars as they have pumped sand onto eroding beaches** and repaired the damage from storm surges.