

Sea Level Rise Calculations

Rodger Farley Oct 27, 2007

$R := 3959$ Average Earth radius, statute miles

$Area_{earth} := 4 \cdot \pi \cdot R^2$ $Area_{earth} = 196961284$ square miles

$Area_{land} := 57800000$ square miles, Rand McNally Universal World Atlas

$Area_{oceans} := Area_{earth} - Area_{land}$ $Area_{oceans} = 1.392 \cdot 10^8$ square miles

$\frac{Area_{oceans}}{Area_{earth}} = 0.707$ Oceans make up 70.7% of the earth's surface

$Area_{Antarctica} := 5400000$ square miles, Rand McNally Universal World Atlas

$Area_{Greenland} := 840004$ square miles, Rand McNally Universal World Atlas

Basic relationship, volume of water conversion is constant, volume = height x area
 so, height x area in one place = height x area in the next place

The volume of ice must be reduced by ~9% to get the equivalent water volume

$$\frac{height_{ice} \cdot area_{ice}}{1.09} = Volume_{water} = height_{SeaLevelRise} \cdot area_{seas}$$

The Basic Equation For Sea Level Rise:

$$height_{SeaLevelRise} = \frac{height_{ice} \cdot area_{ice}}{1.09} \cdot \frac{1}{area_{seas}}$$

Greenland's Total Contribution if Ice Melts:

$area_{seas} := Area_{oceans} = 1.392 \cdot 10^8$ square miles of ocean area

$height_{ice} := 5000$ Average thickness of the Greenland ice mass, feet

$area_{ice} := 0.8 \cdot Area_{Greenland}$ The Greenland ice area is about 80% of the Greenland surface area

$$height_{SeaLevelRise} := \frac{height_{ice} \cdot area_{ice}}{1.09} \cdot \frac{1}{area_{seas}} \quad height_{SeaLevelRise} = 22.2 \text{ feet}$$

Antarctica's Total Contribution if Ice Melts:

$height_{ice} := 7000$ Average thickness of the Antarctic ice mass, feet

$area_{ice} := 0.98 \cdot Area_{Antarctica}$ The ice area is about 98% of the continent

$$height_{SeaLevelRise} := \frac{height_{ice} \cdot area_{ice}}{1.09} \cdot \frac{1}{area_{seas}} \quad height_{SeaLevelRise} = 244.2 \text{ feet}$$

The basic idea is that ice volume sitting on a continent melts and goes into the oceans, where the melted water volume is now added to the ocean volume. Ice volume reduces 9% when converted to water, so with a known volume of ice you can figure the height (depth) change of water:

Ice volume = top projected surface area of ice x average height of ice

Water volume added = Ice volume / 1.09 Volume = area x height

Water rise = height = Volume / area area = surface area of oceans

surface area of oceans = 0.707 x surface area of earth

surface area of earth = $4 \pi R^2$ $R = 3959$ statute miles

These calculations are almost spot-on with similar calculations done by climate scientists. This is basic high school math, nothing complicated. So there.

References

The **Greenland Ice Sheet** is a vast body of ice covering roughly 80% of the surface of [Greenland](#). It is the second largest ice body in the world, after the [Antarctic Ice Sheet](#). The [ice sheet](#) is almost 2,400 kilometers long in a north-south direction, and its greatest width is 1,100 kilometers at a latitude of 77° N, near its northern margin. The mean altitude of the ice is 2,135 meters. ^[1] The ice sheet covers 1.71 million km², or roughly 80% of the surface of Greenland. The thickness is generally more than 2 km (see picture) and over 3 km at its thickest point. It is not the only ice mass of Greenland - isolated [glaciers](#) and small [ice caps](#) cover between 76,000 and 100,000 square kilometers around the periphery. Some scientists believe that global warming may be about to push the ice sheet over a threshold where the entire ice sheet will melt in less than a few hundred years. If the entire 2.85 million km³ of ice were to melt, it would lead to a global [sea level rise](#) of 7.2 m (23.6 ft.)^[2]. This would inundate most coastal cities in the world and remove several small island countries from the face of Earth, since island nations such as [Tuvalu](#) and [Maldives](#) have a maximum altitude below or just above this number.

*also called **Inland Ice**, Danish **Indlandsis*** single ice cap or glacier covering about 80 percent of the island of Greenland and the largest ice mass in the Northern Hemisphere, second only in size to the Antarctic ice mass. It extends 1,570 miles (2,530 km) north-south, has a maximum width of 680 miles (1,094 km) near its northern margin, and has an average thickness of about 5,000 feet (1,500 m).

Antarctica is a desert. The average yearly total precipitation is about two inches. Yet, 98% of the continent is covered with a thick, ancient sheet of ice. The average thickness of this ice is 7,000 feet with a maximum depth of nearly 3 miles (15,000 feet).

The current icy period of Antarctica's history began about 25 million years ago in the Miocene epoch. The oldest and deepest parts of the ice are believed to be 15 million years old. The total volume of ice is 7.5 million cubic miles and has pushed the land down about 2,000 feet. This ice represents 90% of the world's ice and 70% of the world's fresh water. If the ice would totally melt, there would be enough water to raise the level of all the world's oceans by over 200 feet.