

**Our Ocean Backyard — *Santa Cruz Sentinel* columns by Gary Griggs, Director, Institute of Marine Sciences, UC Santa Cruz.**

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Melting Ice and a Rising Ocean**



*Antarctica has enough ice to raise global sea level 200 feet were it all to melt.*

*Photo: NASA*

The Earth's climate is affected by the amount of greenhouse gases in the atmosphere. As the amount of carbon dioxide, methane and other greenhouse gases in the atmosphere increases, more heat is trapped and the Earth warms, just like putting another blanket on your bed or rolling up your car windows on a hot day.

Atmospheric carbon dioxide content is now higher than any time in at least the last 800,000 years. This can be traced back to our increased dependence on fossil fuels, as well as land use changes, such as burning of tropical rain forests. Fortunately for us, only about 44% of that carbon dioxide ends up in the atmosphere, with 26% being taken up by terrestrial plants, and 30% absorbed by the ocean (which produces other problems).

After about 8000 years of very little rise in sea level, things began to change about 150 years ago as the industrial revolution kicked into overdrive, fueled by coal initially, and then oil and gas. The last century witnessed an increase in the rate of sea-level rise to about 7-8 inches/100 years (1.7 mm/yr.), which, over the past 23 years of satellite measurements, increased to 13 inches/100 years (3.3 mm/yr.).

Throughout the late 1800s and most of the 1900s, warming or thermal expansion of the ocean water produced most of the rise the oceans we measured. The amount of rise for each degree C. is a straightforward calculation and one we can actually measure in the laboratory.

As the Earth continued to warm, however, and glaciologists began to observe and monitor the Polar Regions, it became increasingly clear that both Greenland and Antarctica were losing ice at more rapid rates than in the past. The contribution of ice melt to sea-level rise has now become the most important factor.

I need to say here that working in either of these two places is dangerous and not for the faint hearted. Step outside during a whiteout in Antarctica and you can get lost in seconds and frostbite and hyperthermia can happen in minutes. And there isn't any hazardous duty pay.

While calculating how much sea level will rise if the ocean warms a few degrees is relatively easy, trying to determine how the level of the oceans will be affected in the next 10, 20, or 50 years by ice melt is far more complicated.

Greenland is big, the size of Alaska and California combined. There are large areas where the melt water is flowing into the sea or descending through the ice into the subsurface. Calculating the ice loss is difficult although satellite imaging and other remote sensing are providing important data on Greenland's present contribution to sea-level rise. Were all of Greenland's ice to melt, global sea level would rise about 22 feet. No climate scientists believe that's going to happen in this century or even the next, but it's now melting at an increasing rate.

Antarctica is huge, one and a half times larger than the USA, and it sits directly over the South Pole, which makes working there extremely challenging. Floating shelf ice around the margins of Antarctica, much like a cork in a champagne bottle, is holding massive ice sheets back.

As the polar waters gradually warm and sea level continues to rise, the concern is with the breakup and loss of these floating buttresses. What will happen when they break loose and these huge ice sheets begin to collapse and calve off into the ocean. Antarctica contains the equivalent of about 200 feet of global sea-level rise, although again, we believe it will take many hundreds of years before this might happen. It wouldn't take 22 or 200 feet however, to create major problems for the world's coastal concentrations of people. Just three feet of rise would displace about 150 million people.