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

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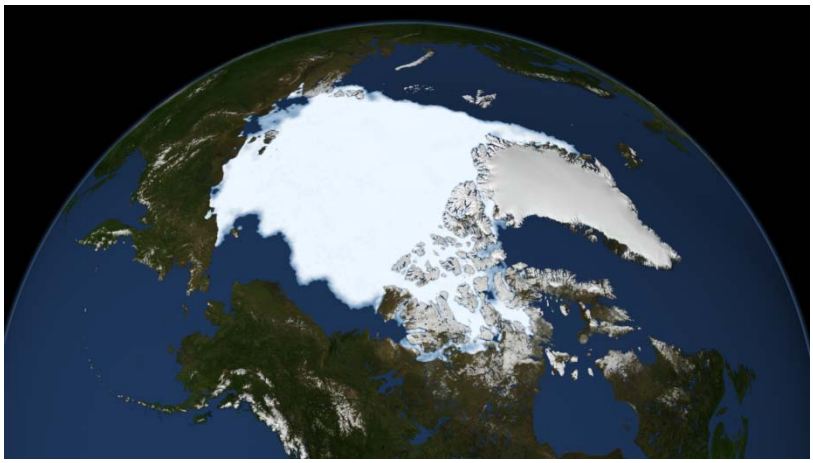
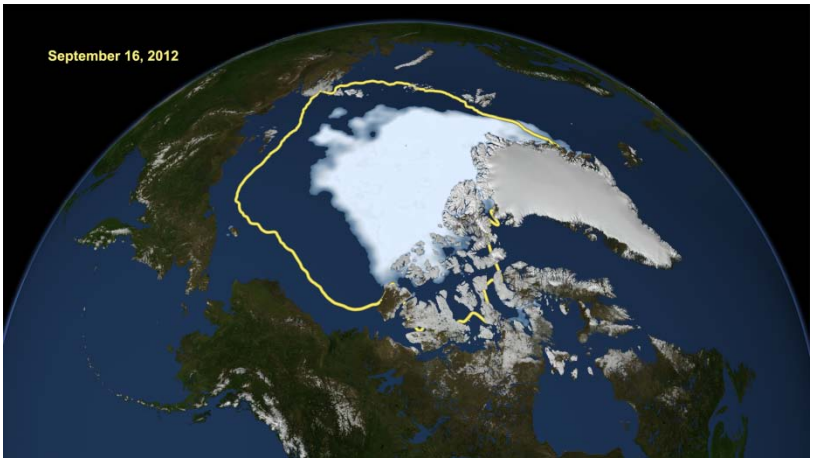
A Melting Arctic



Minimum Arctic Ice Area on September 21, 1979.



Minimum Arctic Ice Area on September 16, 2012.

Three months ago on September 16, the ice cover in the Arctic Ocean reached its lowest point of the year, and also the lowest since satellites began measuring the amount of ice in 1979.

There is still a fair amount of ice left in the Arctic, about 1.3 million square miles, give or take a few square miles; but it's melting much faster than predicted and what is left is also getting thinner, so it will melt faster in the future. Is there a problem with this, or might this be a good thing?

Well, it depends. If you are an oil company, the melting of more ice is gradually opening up the Arctic for oil exploration. There have been concerns with oil and the Arctic from the time petroleum was first discovered on the North Slope of Alaska in 1968 and a pipeline from Prudhoe Bay to Valdez was proposed. Oil that had to be kept warm enough to flow the 800 miles through the pipeline presented some major engineering problems as the route traversed hundreds of miles of frozen ground.

There was a long list of concerns that emerged as soon as the pipeline proposal surfaced although most of these were addressed during construction. On balance, because of the visibility of the project, the essentially untouched Alaska wilderness and the potential environmental impacts of oil on wildlife and permafrost, the pipeline was engineered and constructed to deal with the expected problems of transporting hot oil. There were clearly immense impacts of the pipeline construction, including important economic benefits but also significant environmental impacts and social repercussions.

Since completed in 1977, the pipeline has transported about 17 billion barrels of oil. This amounts to 28 months of the United States total oil consumption. The pipeline has also experienced several notable incidents of oil leakage, including those caused by maintenance failures, sabotage and even gunshot holes. Due to declining North Slope oil well production, however, it is expected by 2015 that the flow rate in the pipeline will drop to about 500,000 barrels per day, a fourth of its original design.

The British Petroleum blowout in the Gulf of Mexico in April 2010 raised serious doubts about the environmental commitment of the oil industry. Then on July 14 of this past summer, a 570-foot Shell Oil drill ship, part of a fleet heading north for exploratory drilling in a portion of the now ice-free Arctic, slipped its anchor and nearly ended up on the rocks in Alaska’s Dutch Harbor. This raised additional concerns in the minds of Alaskans and others about the safety of drilling in the extreme conditions found in the Arctic.

The larger question, however, has to do with the overall global effects of a rapidly shrinking Arctic ice cover. The extent of sea ice in the Arctic grows during the cold dark Arctic winters and retreats when the sun re-appears in the spring and summer. But the sea ice minimum summertime extent, which is normally reached in September, has been decreasing over the last three decades as Arctic Ocean and air temperatures have increased. This year's minimum extent is approximately half

the size of the average extent from 1979 to 2000. The coverage in September was 300,000 square miles less than the previous minimum in 2007. For some comparison, the state of Texas is about 269,000 square miles. And some would argue that Texas is really big.

Sea ice helps keep our planet cool by reflecting most of the sun's energy. Just like you get sunburned when skiing on a clear day due to sunlight reflecting off the snow, the Arctic ice cover also reflects sunlight back into the atmosphere. But as the amount of ice cover is reduced each summer, and the underlying ocean is exposed, that darker water absorbs an increasing amount of heat. This warms the ocean, which then leads to the melting of additional ice. This is known as a positive feedback mechanism.

It's not just the sea ice that's disappearing. The thawing of the permafrost is another problem. Permafrost is soil that is more or less permanently frozen. Nearly one-quarter of the land area in the Northern Hemisphere is underlain by permafrost, including most of Siberia, much of northern Canada and large parts of Alaska.

As the air in the Arctic warms, the permafrost is also beginning to thaw at a faster rate, allowing emissions from the organically rich subsurface sediments to increase. Think of broccoli that you've got in the freezer. As long as it's frozen, it will remain stable for years. But as soon as you pull it out, it gets mushy and soon begins to release the stench of decay. This is exactly what happens when the roots, leaves and other organic matter frozen into the permafrost of the arctic tundra and forests since the last Ice Age begin to thaw.

As the climate warms, the permafrost is thawing, releasing increasing amounts of carbon and methane. The nearly 25% of the Northern Hemisphere underlain by permafrost could potentially release twice as much carbon dioxide as is currently stored in the Earth's atmosphere. And methane traps about 21 times more heat per molecule than carbon dioxide, making methane a potentially greater concern. Of some minor consolation, the life of a typical methane molecule in the atmosphere is only about 12 years, compared to 50 to 200 years for carbon dioxide.

All of the signs are going in the wrong direction, and to be quite honest, we have wasted enough time debating. Global climate change is about physical science, not political science, and the science is becoming increasingly clear.