

A Climate Change Primer

The ABCs of what science and Earth are trying to tell us

*By Dr. Steven C. Amstrup, Senior Scientist
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Basic laws of physics dictate that when levels of greenhouse gases increase, the world warms. How does this work? Energy from the sun that reaches Earth is balanced by energy that radiates back into space.

Atmospheric gases like CO₂, however, temporarily trap the energy that arrives from the sun as short-wave radiation. This energy then radiates back into space in the form of long-wave radiation.

The greenhouse effect of this temporarily trapped energy is the reason that Earth's temperature range allows life to exist. That's a good thing.

But when we keep increasing these heat-trapping greenhouse gases (GHGs), we increase the amount of time that the sun's energy stays in Earth's atmosphere, which means that Earth warms.

Logically, a world with higher GHG concentrations is going to be warmer than it would with lower GHG concentrations. Although it's uncertain how sensitive Earth's climate is to the increase in GHGs—and therefore we don't know the precise rate of warming—there is no uncertainty that Earth will warm.

GHGs, Climate, and Weather

Although the laws of physics says that Earth will warm as GHGs are added to the atmosphere, natural chaos in the climate system adds to uncertainty about how fast Earth will warm. Natural fluctuations can mask the warming trend. *It's important to remember that climate is not the same as weather.*

Natural fluctuations in atmospheric circulation patterns, such as El Nino (the Southern Oscillation) and the Arctic Oscillation, have huge effects on short- and medium-term weather, as well as regional weather and even the global climate.

Natural fluctuations in ocean circulation patterns such as the Gulf Stream (or North Atlantic Drift) also have longer-term effects on weather and climate.

But what's important to remember about these natural fluctuations is that as GHGs increase, they will occur over a higher and climbing baseline. Eventually, the effects of increases in GHGs will become clear. It's not a matter of whether it will become clear—only when it will become clear.

Crossing Climate Thresholds

Because global warming is a certainty in an increasing GHG world, it's guaranteed that we will exceed certain thresholds (such as the global mean temperature increase of two degrees, or ice-free summers in the Arctic) at some point. Again, we can't predict exactly when these things will happen, but if GHGs keep rising, they most certainly will.

We can also be sure that the more time that passes, the more likely that we'll have exceeded particular thresholds.

What Are We to Think?

Without question there are uncertainties regarding global warming. But it's unquestionable that Earth will warm as GHG levels rise. It's a basic law of physics. And, ominously, the longer GHG levels are allowed to increase, the less sea ice will remain.

Because all available data indicate that polar bear populations as we know them will not be sustained in an ice-free Arctic, the longer GHG levels are allowed to increase, the greater the threat to polar bear welfare.

"The longer we wait to do something," says Dr. Steven C. Amstrup, "the more thresholds we will have exceeded, and the bigger the problems we will have created for our children and grandchildren. They will increasingly be the ones forced to attempt to cope with a world that is very different than the one in which humans became the dominant life force on Earth."

Dr. Steven C. Amstrup is retired from the USGS as senior polar bear scientist and is the past chair of the IUCN Polar Bear Specialist Group. He is known worldwide for his 30 years of research on polar bears. In August 2010, he joined the staff of PBI as senior scientist.

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Climate Change: Fact and Fiction

Did you know that ...

- A new poll by the National Academy of Sciences shows that 97% of climate scientists—the experts in their field—agree that global warming is very likely mainly caused by human activity
- An independent review of the much-trumpeted errors in the IPCC report found only a few minor mistakes in hundreds and hundreds of pages of text. What's more, the errors don't undermine the panel's overall conclusions.
- A review of 11 different methods of measuring the planet's temperature—on the land, in the sea, in the air—dovetails to show a warming planet. Each indicator is based on three to seven data sets.
- Three highly respected independent panels have cleared the climate scientists involved in so-called Climate Gate of wrongdoing. They found that the statements were taken out of context.
- Data confirms that global temperatures in the first half of 2010 were the hottest since record keeping began more than a century ago.
- Satellite observations of sea ice from 1979 through 2009 show that September sea ice extent has declined by 8.9% *per decade*. Data for 2010 is not yet available.

The science is clear. What's more, a switch to green energy makes sense on so many levels: To create green jobs. To avoid environmental catastrophes from oil spills. To reduce our dependence on foreign oil. And, finally, to leave our children and grandchildren with a planet rich with wildlife and intact ecosystems, including the land of snow and ice where the polar bear roams.

~ Barbara Nielsen, Director of Communications, Polar Bears International



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