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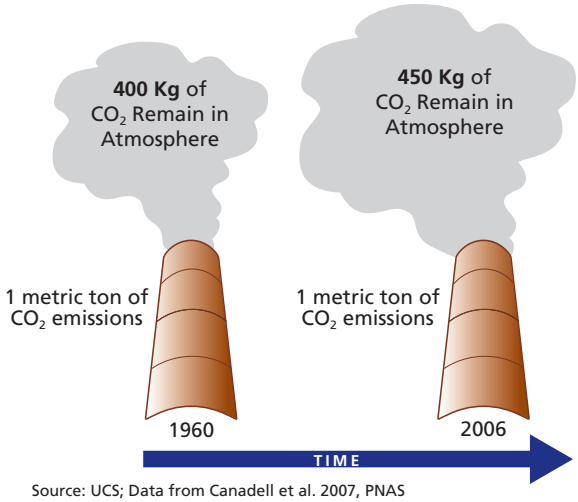
Latest Climate Science Underscores Urgent Need to Reduce Heat-trapping Emissions

Major developments in climate change science have been reported since the publication of the comprehensive 2007 Fourth Assessment Report (AR4) of the Intergovernmental Panel on Climate Change (IPCC).[1] Recent publications indicate that the consequences of climate change are already occurring at a faster pace and are of greater magnitude than the climate models used by the IPCC projected. A few of the most compelling findings are summarized below.

More CO_2 Remains in the Atmosphere

Human activities have pumped excessive amounts of carbon dioxide (CO_2) into the atmosphere. Natural processes that absorb CO_2 cannot keep up. As the ocean absorbs carbon dioxide, it becomes more acidic. This combined with increasing ocean temperatures, diminishes its ability to continue absorbing CO_2. As a result, more CO_2 stays in the atmosphere. In 1960, a metric ton (1,000 kilograms; ~2,205 pounds) of CO_2 emissions resulted in around 400 kilograms (~881 pounds) of CO_2 remaining in the atmosphere (Figure 1). In 2006, a metric ton of CO_2 emissions results in around 450 kilograms (~992 pounds) remaining in the atmosphere.[2] Hence a ton of CO_2 emissions today results in more heat-trapping capacity in the atmosphere than the same ton emitted decades ago.

FIGURE 1 **Today's Ton Is Worse Than a Ton Emitted Decades Ago**



Source: UCS; Data from Canadell et al. 2007, PNAS

The natural processes that have helped clean up the excess CO_2 pumped into the atmosphere by human activities have not been able to keep up at the same rate.

Increased Sea Level Rise

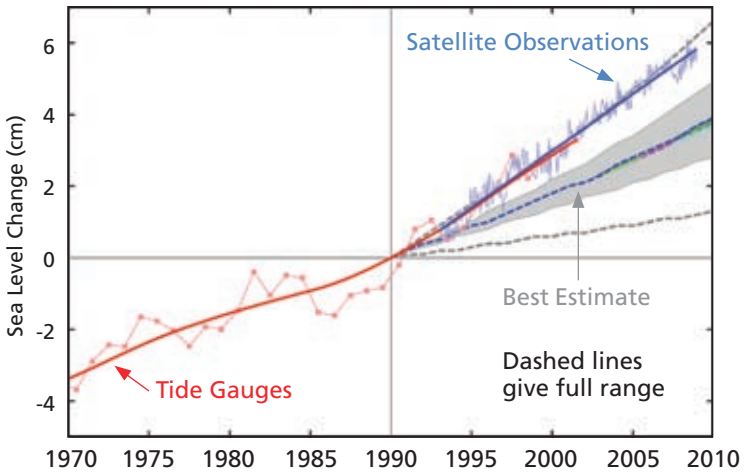
Increased contributions from melting mountain glaciers and ice sheets on land, as well as thermal expansion due to continued ocean warming, are resulting in higher sea level rise. The IPCC (AR4) noted that sea level has risen 50 percent faster than projected by models for the 1963–2001 period. Recent observations confirm that sea level rise is in the upper range projected by models used by the IPCC (Figure 2).[3]

The IPCC (AR4) estimated global average sea level rise for the end of this century (2090–2099) compared with the end of the last century (1980–1999) at between ~0.6–1.9 feet (~0.2–0.6 meter). These projections were based primarily on thermal expansion due to ocean warming with only modest contributions from mountain glaciers, leaving the potential contributions from ice sheets covering Greenland and Antarctica unclear.[4] Because understanding of ice sheet behavior is still evolving, future ice sheet disintegration was not included in models used by the IPCC at that time. Researchers have since examined plausible contributions from ice sheets given current understanding of accelerating ice sheet melt and other factors. New analysis indicates that meltwater from land ice could lead to sea level rise of ~2.6 feet (0.8 meter) by the end of the century; and although ~6.6 feet (2.0 meters) is less likely, it is still physically possible.[5] As depicted in Figure 3, when increased contributions from glaciers and ice sheets are taken into account, plausible twenty-first century sea level rise is higher than IPCC estimates.

Plummeting Arctic Sea Ice

Arctic sea ice models used by the IPCC are in general agreement with the observed decline over the last 50 years and indicate that heat-trapping gases are a major factor in the area decrease. Current observations show a much steeper drop in ice area than expected.[6] Global warming and natural cycles combine to create the observed Arctic sea-ice trend.

FIGURE 2 **Sea Level Rise in Line with Highest Projection**



Changes in sea level since 1973, compared with IPCC scenarios (dashed lines and gray ranges), based on tide gauges (red) and satellites (blue). From Rahmstorf et al. (2007) updated by Rahmstorf (personal communication).

FIGURE 3 **Sea Level Rise by End of This Century**

New analysis provides estimates for sea level rise by the end of this century between a plausible level and a physically possible though less likely level. Source (IPCC 2007 and Pfeffer et al. 2008).[4, 5]

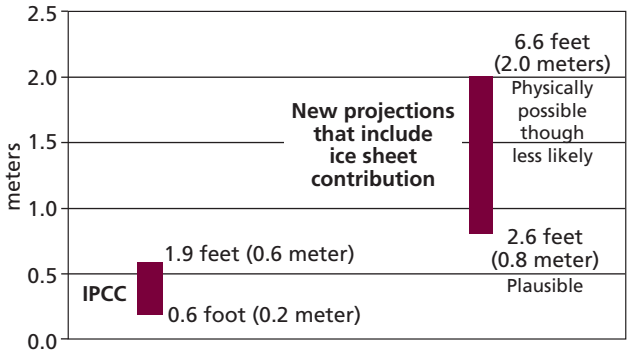
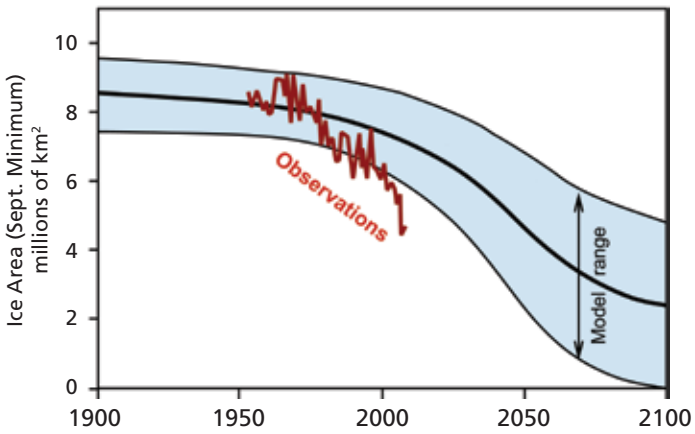


FIGURE 4 **Shrinking Summer Arctic Sea Ice Area**



Arctic models of September sea ice area underestimate the rate of observed sea ice retreat. Based on Stroeve et al. 2007.

Source: Dirk Notz from Hamburg adapted figure from *http://www.nsidc.org/news/images/20070430Figure1.png.*

When sea ice would naturally rebound, global warming limits the full sea ice area achieved. When sea ice naturally would be less extensive in area, global warming exacerbates this natural tendency and contributes to sea ice plummeting. For example, the atmospheric pressure and wind patterns in 2007 have naturally ocurred in a similar fashion at various times in decades past. However, this type of weather pattern occurring after several decades of ice thinning combined to create a record breaking lowest summer sea ice area since satellite observations began.[7]

Recent evidence shows that periods of rapid Arctic sea ice loss lead to faster warming over land in the polar region.[8] As sea ice retreats it exposes dark ocean, which absorbs more of the sun's heat than white ice. Toward the end of summer this ocean heat dissipates to the atmopshere as the region enters winter and the ocean freezes again into sea ice. This warmer air extends over land and allows bacteria more time to decompose thawing plant and other organic matter that had been long frozen.[9] This process can lead to a release of heat-trapping gases (CO_2 and methane) into the atmosphere amplifying global warming.

CO_2 Effects Will Be Felt for Generations

Studies indicate that even after excess human-caused CO_2 emissions stop, the planet will experience the resulting warming for at least a thousand years. The higher the peak of atmospheric concentrations of CO_2, the greater is the level of irreversible consequences, such as species loss and sea level rise.[10] These and other peer-reviewed studies published since the release of the IPCC (AR4) provide ever more compelling evidence that swift and deep reductions of heat-trapping gasses are needed if we are to avoid catastrophic climate change. United States leadership is essential, and there is no time to waste.

Union of Concerned Scientists
Citizens and Scientists for Environmental Solutions

The Union of Concerned Scientists is the leading science-based nonprofit organization working for a healthy environment and a safer world.

A fully referenced version of this fact sheet is available on the UCS website at *www.ucsusa.org/global_warming*.

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