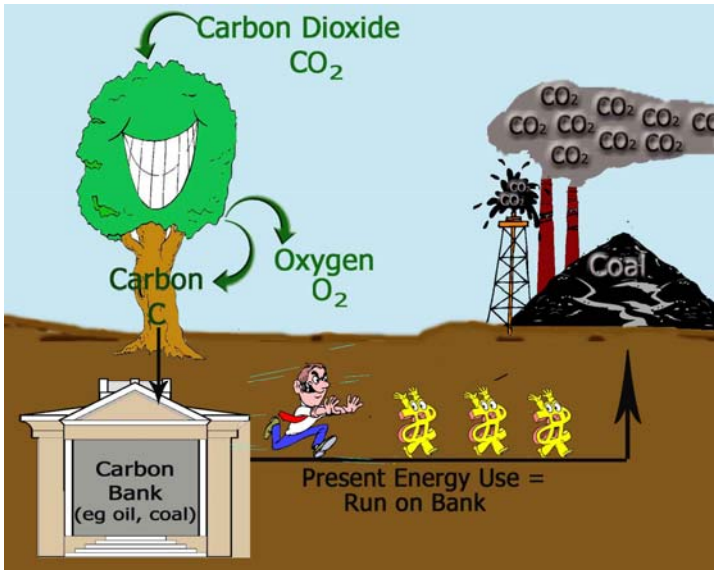
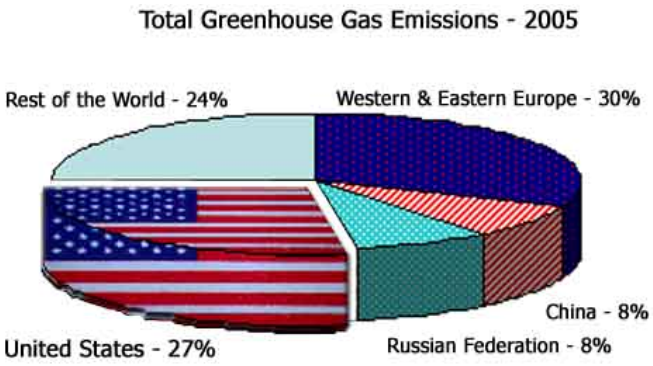
Greenhouse Gases -
What Are They & Where Do They Come From?

Greenhouse gases come from almost everywhere: Methane, which warms the planet 20 times more than CO_2, is released as cows expel gas (95% from burps and breath) and from their manure. (According to the U.N., 18% of human-caused greenhouse gases stem from farm animals and the livestock industry.) We humans breathe in oxygen and breathe out carbon dioxide. (Trees on the other hand "breathe" in carbon dioxide and breathe out oxygen.) But, our current problem comes mostly from the use of fossil fuels: We burn it our cars and trucks, in our planes and trains and ships; we use it to make electricity, to extract and ship oil, to power our computers and TVs; we use it to make our synthetic fabrics and our plastics. In fact, our entire lifestyle requires power and lots of it!

An easy way to think of it is this: When trees and plants use photosynthesis to grow, they are essentially taking carbon out of CO_2 and putting it in their tissues, sort of like putting money into a bank (sequestration). When plants decompose or are burned the carbon is released. Sometimes plants are buried for eons and they become coal. (When fatty tissues, from animals for instance, become buried over eons they become oil.) Our use of energy is like withdrawal from the bank… And we have not only spent all the interest, but have been spending the principle for a long time. Now, we are having a run on the bank!





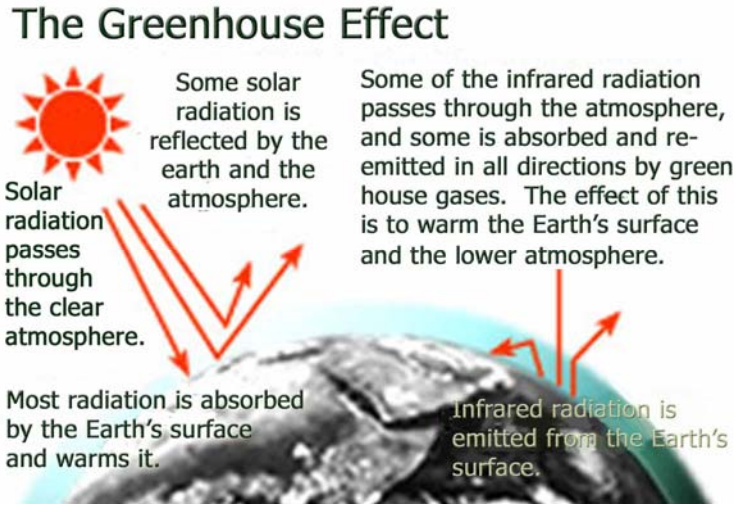
Greenhouse gas emissions in Texas are the highest in the nation. In fact, if Texas was its own separate country, it would rank 7th in the world in CO_2 emissions behind the US, China, Russia, Japan, India and Germany.

Wyoming's **coal**-fired power plants produce more CO_2 in just 8 hours than the power generators of more populous Vermont do in a year. Reason? Wyoming uses **coal**, Vermont does **not**.

Texas is the first in the nation in energy usage. It uses fully 12% of the *total* energy consumption of the US despite having only 7% of the total population.

On a per-person basis, Wyoming spews more CO_2 than any other state or any other country: 276,000 pounds of it per capita each year, *thanks to burning **coal***, which provides nearly all of the state's electrical power.

What is the Greenhouse Effect & What Does It Do?

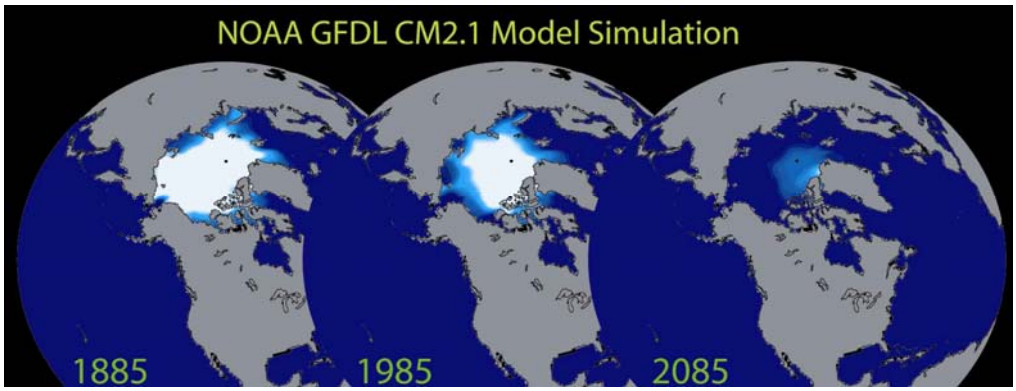


The "greenhouse effect" is the warming of our climate that results when heat radiating from Earth toward space is trapped by our atmosphere. Just like a greenhouse, light passes through the glass (our atmosphere), and the heat is mostly trapped inside. The gases that make up our "greenhouse glass" and contribute to the greenhouse effect include carbon dioxide (CO_2), methane, chlorofluorocarbons (CFCs), water vapor, and nitrous oxides. One obvious result of this warming is ice melt.

Ice Melt – Ice Caps

Approximately 69% of Earth's freshwater is held in ice caps and glaciers. As this begins to melt due to increased temperatures from the Greenhouse effect, ocean levels will rise.

As this ice begins to melt (above), less sunlight gets reflected into space. Instead, it is absorbed into the darker ocean, raising the overall temperature, and fueling further melting. Darker, soot-covered ice also reflects less light, further contributing to the warming effect.



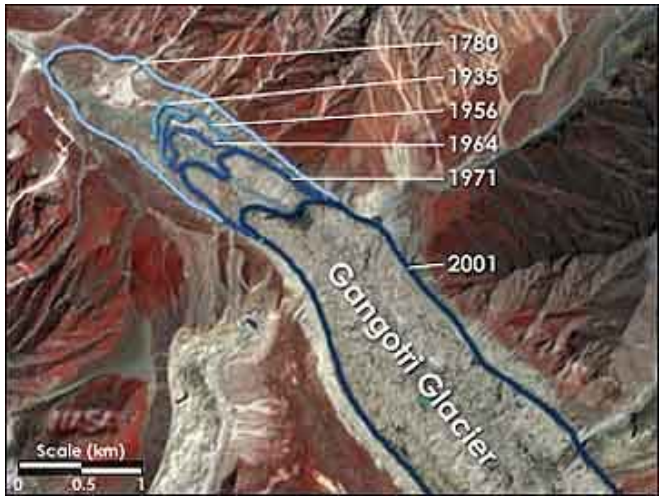
According to a new report in the *Proceedings of the National Academy of Sciences,* atmospheric CO_2 has soared 35 times faster than expected over the last seven years. This means that the climate models now in use will have underestimated the increase of predicted temperature rise. The surge is apparently due to construction of **coal**-fired power plants, the expansion of Chinese and Indian economies, and a drop in the ability of the ocean to absorb CO_2.

Ice Melt - Glaciers

Of particular concern is the world- wide ***rapid loss of glaciers***. Until recent decades ice melt in the summers and ice formation in the winters remained reasonably balanced.

NSIDC/WDC for Glaciology, Boulder, compiler. 2002, updated 2006. Online glacier photograph database. Boulder, CO: National Snow and Ice Data Center/World Data Center for Glaciology. Digital media.

http://www.flickr.com/photos/nishita/569104298/



I the Himalayas, 67% of glaciers are retreating at a startling rate, and the major causal factor has been identified as climate change. The Gangotri glacier (above), lying between Kashmir and Nepal, feeds the Ganges River in India and is a good example of accelerated glacial retreat. The Gangotri has lost one-third of its 15-mile stretch in the last 50 years.

According to the *Stern Review*, "Melting glaciers will increase flood risk during the wet season and strongly reduce dry-season water supplies to **one-sixth** of the world's population, predominantly in the Indian sub-continent, parts of China, and the Andes in South America." Argentina's Upsala Glacier (left) was once the biggest in South America, but it is now disappearing at a rate of 200 meters a year leaving this glacial lake behind.

Glacial Time Bombs

Many glacial lakes are dammed by blocks of ice or moraines that have an ice core. When this ice melts (an increasing likely scenario with increased melting from climate change), it can release a torrent of water called a glacial lake outburst flood (GLOF). One GLOF in Iceland released damned water from a glacial lake at the rate of 45,000 cubic meters of water per second. Nor is the water release alone the only worry, water moving at these rates can carry boulders and ice chunks the size of cars. They are literally time bombs waiting to go off.

While all countries with glaciers are susceptible to GLOFs, central Asia, the Andes regions of South America and those countries in Europe that have glaciers in the Alps, have been identified as the regions at greatest risk as well as certain areas of Alaska and Canada. The degree of damage any one GLOF is capable of inflicting will depend upon the population density downstream.

Nepal and Bhutan have the highest concentration of glacial lakes with 20 potentially dangerous lakes in Nepal and 24 in Bhutan. This glacial lake in Nepal is constrained by a moraine (see left hand side).

According to the Byrd Polar Research Center, the Ohio State University, the Qori Kalis glacier in Peru (see below) is disappearing at an accelerating rate -- between 1998 and 2001 the terminus retreated an average of 155 metres per year--three times faster than average annual retreat from 1995 to 1998 but an alarming 32 times faster than the average annual retreat from 1963 to 1978. During the season of high glacier melt rate, the region suffers landslides and outburst floods.

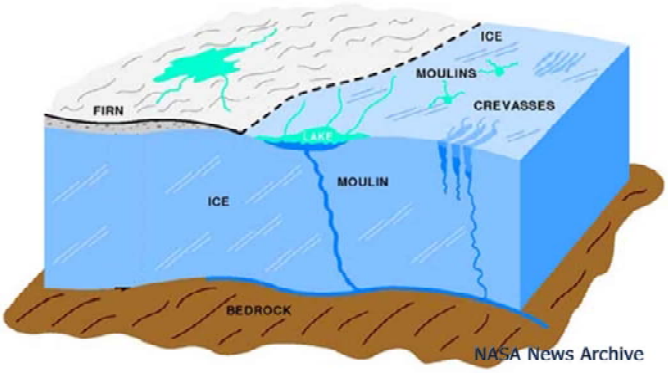
For a short video about GOLFs, hit the "control" key on your keyboard while clicking your mouse on the following: 4 min sample clip from Meltdown film * (If you would like to skip the first minute and a half you won't miss anything about glacial lake outburst flooding.)

*(The Meltdown DVD from which this clip comes can be purchased at http://www.slackjaw.co.uk/documentaries/meltdown.html).

Ice Melt – Ice Sheets

"There is some confusion and uncertainty in the predictions of sea level rise. The latest UN IPCC report predicted a conservative 18 to 59 cm sea level rise (.6 to 2 ft) by 2099. However, the report **does not** account for changes in the rate of melt from the world's major ice sheets."[1]

How Does This Happen?

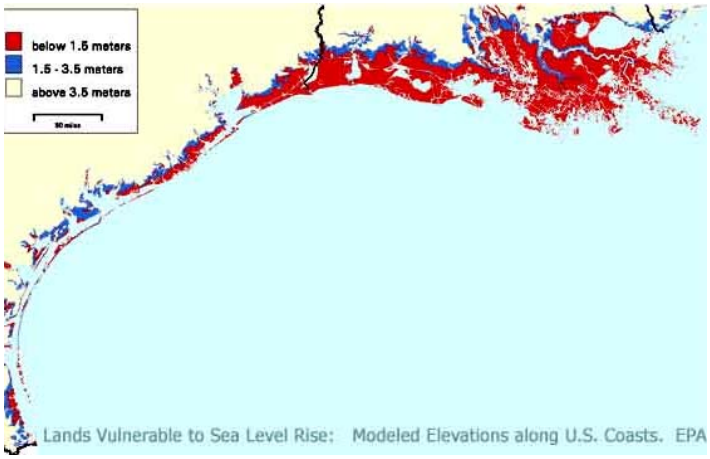


This schematic highlights glaciological features of the ice sheet including surface lakes, crevasses, and large openings called moulins that stretch up to ten meters in diameter and drain to the bedrock. Meltwater descends through the moulins, down to the bedrock, contributing to the movement of the ice sheet.

Meltwater stream flowing into a moulin in the ablation zone (area below the equilibrium line) of the Greenland ice sheet (see schematic to rt.)

As temperatures rise, ice will melt more quickly. New satellite measurements reveal that the Greenland and West Antarctic ice sheets are shedding about 125 billion tons of ice per year. If the melting were to accelerate, the rise in sea level could be significantly higher. For instance, the last time global temperatures were a degree or so warmer than today, sea levels were about 6 meters (20 feet) higher, with the water mainly coming from the melting of the Greenland and the West Antarctic ice sheets."[1] James Hansen, a physicist and astronomer by training and head of NASA's Goddard Institute, also predicts a sea level rise measured in meters *if greenhouse gas emissions continue unchecked*. The process, he states, is non-linear (it is accelerating).

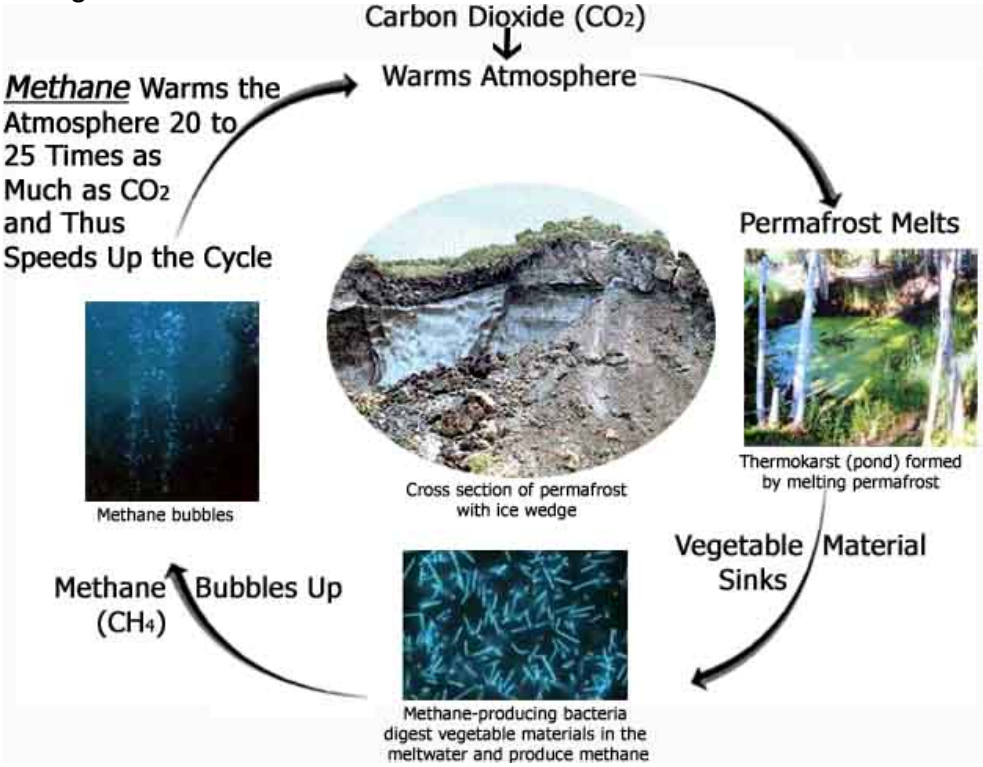
[1] http://earthobservatory.nasa.gov/Library/GlobalWarmingUpdate/printall.php



Simulation of US coasts & sea level rise: http://geongrid.geo.arizona.edu/arcims/website/slrus48prvi/viewer.htm
Simulation of world coasts & sea level rise: http://geongrid.geo.arizona.edu/arcims/website/slrworld/viewer.htm
For more info on sea level predictions: http://environment.newscientist.com/article/mg19526141.600.html or http://earthobservatory.nasa.gov/Library/GlobalWarmingUpdate/printall.php

What is So Scary About Permafrost Melt?

Permafrost, which covers about one fifth of the world's land surface, is soil which remains frozen year round and is covers large areas of Alaska, Northern Canada and Siberia. Even though summer air temperatures are quite warm (summers, however, are short and winters long), the upper layers of soil insulate the permafrost, preventing them from thawing. Permafrost is usually just pore ice or interstitial ice that fills the small spaces between individual grains of sand, silt or gravel, but sometimes it occurs in much larger forms referred to as massive ice. Permafrost varies in depth from a few centimeters to 300 centemeters. Lareas of discontinuous and unstable permafrost in interior Alaska have been degrading for some time and are expected to continue to do so as the global climate warms. Thawing of permafrost destroys the physical foundations of boreal forest ecosystems causing dramatic changes.



Methane Warms the Atmosphere 20 to 25 Times as Much as CO_2 and Thus Speeds Up the Cycle

One scary scenario, seen at left, involves a speed up of permafrost melt and global warming due to methane-producing bacteria in meltwater from thawed permafrost.

Permafrost melt can cause severe consequences for surface vegetation (see drunken trees below) and construction like roads, houses and buildings, railroads and coastlines.