Climate Sensitivity
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It is an established fact that adding greenhouse gases to the Earth's atmosphere will increase the Earth's temperature (assuming all other radiative forces remain constant) and climate scientists generally use the metric "climate sensitivity" to specify how much warming to expect for a given amount of CO2. If you look at the various components of radiative forcing, you will notice that the total forcing is about the same as the forcing from CO2 alone and the rest of the forcings "cancel each other out". Since Earth's temperature does not instantaneously change in response to an increase (or decrease) in greenhouse gases, a number of metrics using just CO2 are used to specify how much warming to expect.

Sensitivity Metric	**Definition**	**Range of Values (in degrees C)**
Transient Climate Response	The temperature at the time of the doubling of CO2 to 550ppm when CO2 increases at 1 percent per year	1.2-1.7
Climate Sensitivity	The equilibrium temperature from of the instantaneous doubling of CO2 taking only fast feedbacks into account (decades)	1.5-4.5 (IPCC) 3 (paleoclimate)
Earth system sensitivity	The equilibrium temperature from of the doubling of CO2 taking all feedbacks into account (millennia)	3-6
Warming Commitment	For a given year, the difference between the temperature that year and the equilibrium temperature	

How fast the temperature changes in the short run is determined by radiative forcings and fast feedbacks

Fast Feedback	**Comments**
Water Vapor	By far the most important feedback – always positive
Clouds	Clouds can increase or decrease in response to climate change – recent studies are indicating a positive feedback
Albedo	(change in the reflectivity of the Earth)
Snow Cover	Will be reduced in a warmer world – always positive (not clear what the maximum snow cover reduction is included)
Arctic Sea Ice	Will be reduced in a warmer world – always positive (what is not clear is how much of the anticipated ice melting is included as a fast feedback)
Antarctic Sea Ice	Currently increasing (negative feedback) but will likely be reduced in the long run (positive)

How fast the temperature changes in the long run is also determined by slow feedbacks

Slow Feedback	**Comments**
Albedo	(change in the reflectivity of the Earth)
Arctic Sea Ice	Likely in the next 30-50 years (and possibly in the next 10 years) A summertime ice-free Arctic is equivalent to "instantaneously" adding about 160 ppm of CO2 to the Earth's atmosphere (http://arctic-news.blogspot.com/2012/07/albedo-change-in-arctic.html).
Snow Cover	Snow cover reduction beyond that included as a fast feedback – will be positive
Antarctic Sea Ice	Will likely be positive if the Earth warms significantly
Greening of the . tundra	The darker foliage will absorb more energy – will be positive

Additional sources of greenhouse gases As the temperature continues to rise, increasing amounts greenhouse gases will be emitted from the various organic stores of carbon on the Earth's surface Climate scientists cannot accurately predict the greenhouse gas emissions from these sources as a function of temperature, but given that at least a 5.4 degree F rise in temperature can be expected (and more in the Arctic, where most of the carbon stores reside), these emissions could easily surpass human-caused emissions. (there are about 820 GTC carbon in the atmosphere; the carbon emissions budget to keep within 2 degrees C warming is 280 GTC; fossil fuel reserves are about 810 GTC, with a potential of up to 3,500 GTC)	
Permafrost	Contains about 1,600 GTC carbon
Methyl hydrates	May contains about 5,000 to 20,000 GTC (on the margins of the continents, below the seafloor) (http://www.killerinourmidst.com/methane and MHs2.html)
Tropical Forests	The Amazon probably contains about 86 GTC
Temperate Forests	The US Forest Service now expects the forest to shift from their current status of net sequesters of CO_2 to become a significant emissions source in all future scenarios
Peat Bogs	Probably contains between 270 and 370 GTC (globalcarbonproject.org/global/pdf/pep/Limpens.2008.Peatlands&Carbon.BiogeosciencesDiscus.pdf)

When one looks at how sensitive the Earth's temperature is to CO_2, one usually assumes that that there is a steady, gradual increase in temperature as atmospheric CO_2 gradually increases and that all of the "new" CO_2 comes from human activities. Both of these assumptions may have been correct for the last 3 million years of the current ice age but are wrong when trying to predict future temperatures for two reasons.

1. We are at a point where the Earth's temperature is uniquely very sensitive to atmospheric CO_2, as the melting of the summertime Arctic ice will (which obviously can only occur once) will significantly affect the Earth's temperature in the short run. Thus the near-term climate sensitivity is likely larger than the long-term climate sensitivity (Earth system sensitivity) - the opposite of what we understood only a few years ago. For instance, the near-term climate sensitivity to 400 pm could be as high as 6° C (a 50% increase CO_2 could cause a 3° C temperature increase), even if the Earth system sensitivity is as low as 5° C.

2. As the Earth warms (and particularly if the Arctic warming is substantial, as is expected), significant amount of CO_2 and methane could be released from the various "carbon stores", resulting in a substantial temperature increases in the long run.

Because of the slow feedbacks, it is possible we may have already passed the point where humans can significantly influence the equilibrium temperature that the Earth will reach in centuries ahead, as the temperature increases that will result from natural climate feedbacks will occur even if CO_2 emissions were to stop tomorrow. The future temperature increase could easily be 20 degrees F and there might not be anything we can do to prevent it.

But, if we start reducing CO_2 emissions in the next few years and eliminate CO_2 emissions later this century, there is a reasonable chance that we can prevent this worst-case scenario.