

CRIBSHEET #2

CLIMATE CHANGE

How much will the earth's temperature rise as humans double the amount of carbon dioxide in the atmosphere through use of fossil fuels?

THE GREENHOUSE EFFECT

1 SOLAR RADIATION

Radiation from the sun enters the atmosphere. Some of it is reflected back into space, but a good portion is absorbed by the atmosphere and the earth's surface.

2 INFRARED RADIATION

The surface, in turn, heats up and emits infrared radiation.

3 GREENHOUSE GAS

Greenhouse gas molecules absorb radiation from the sun and earth, heat up, and emit infrared radiation. Some infrared radiation is directed back toward the earth, contributing to the warming of the surface.

7 CLOUDS

As the earth warms, more water evaporates, creating more clouds. Since clouds are white and reflective, they bounce a lot of sunlight into space, which would have warmed the earth. This is negative feedback. At the same time, clouds are made up of concentrated greenhouse gas, and can also provide positive feedback. Clouds will play an important role in climate change, but no one is sure yet whether they will ultimately end up warming or cooling the earth.

6 SEA ICE

Ice is reflective. When sunlight is reflected into space, it doesn't contribute to the greenhouse effect. So the ice caps help to limit warming. As things heat up, the ice melts, revealing the darker ocean beneath, which absorbs more radiation and warms, melting more sea ice. This cycle is a positive feedback loop.

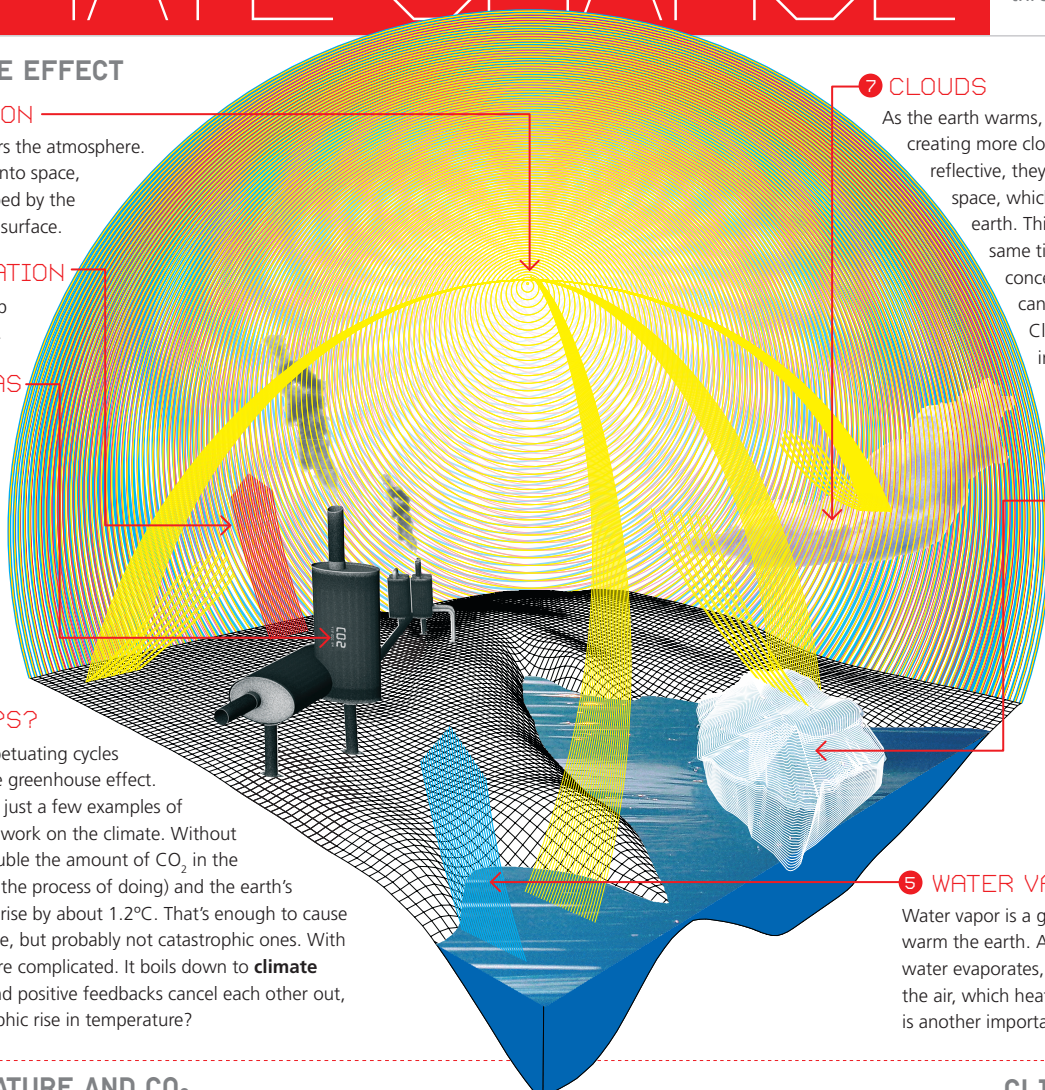
5 WATER VAPOR

Water vapor is a greenhouse gas, and helps to warm the earth. At higher temperatures, more water evaporates, putting more water vapor into the air, which heats the earth even more. This is another important positive feedback loop.

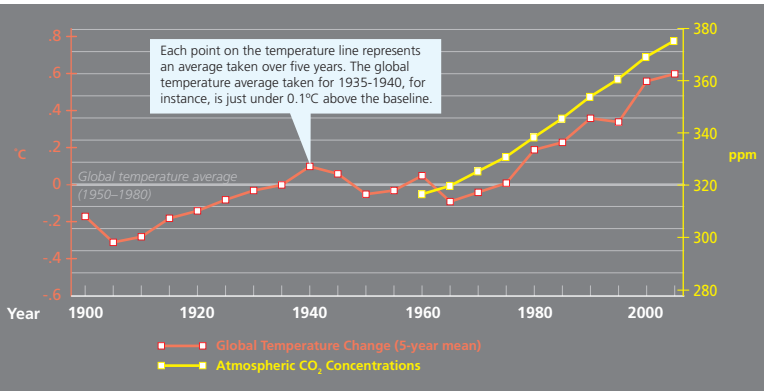
FEEDBACK

4 WHAT ARE FEEDBACK LOOPS?

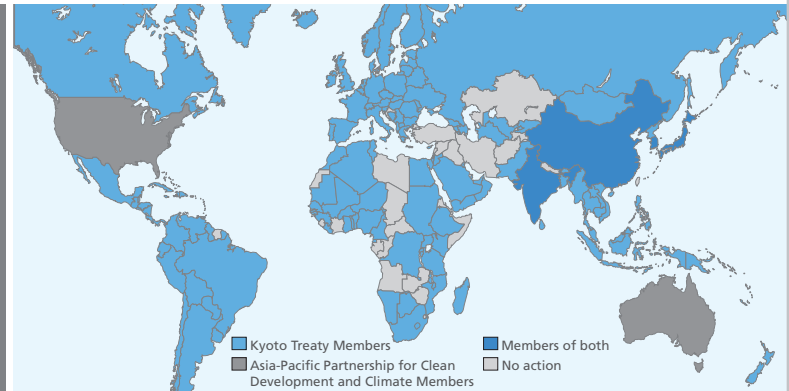
Feedback loops are self-perpetuating cycles that enhance or dampen the greenhouse effect. The ones illustrated here are just a few examples of the many feedback loops at work on the climate. Without feedback, humans could double the amount of CO₂ in the atmosphere (which we're in the process of doing) and the earth's average temperature would rise by about 1.2°C. That's enough to cause noticeable changes in climate, but probably not catastrophic ones. With feedback the problem is more complicated. It boils down to **climate sensitivity**: Will negative and positive feedbacks cancel each other out, or will they cause a catastrophic rise in temperature?



GLOBAL TEMPERATURE AND CO₂



CLIMATE TREATY MAP



THE ISSUE: WHAT IS THE BEST WAY TO DEAL WITH THESE CHANGES?

The earth's average temperature is likely to rise by 2° to 6° C as a result of a projected doubling of the amount of CO₂ in the atmosphere from preindustrial levels, to 560 parts per million by mid-century. The effects could be severe. Sea levels could rise by as much as 6 meters as the icecaps melt; deserts may become larger, storms more severe, heat waves more common, and snow could turn to rain, reducing our ability to collect water for drinking and irrigation. The Kyoto Protocol, effective this year, is an agreement by member nations to limit their carbon emissions. The alternative supported by the U.S. and Australia, the Asia-Pacific Partnership, seeks to incentivize the creation and deployment of green technologies, but doesn't limit carbon emissions and sets no target dates.

SOUNDBITE

More carbon dioxide was added to the atmosphere in the past 200 years than between the last Ice Age and the Industrial Revolution.