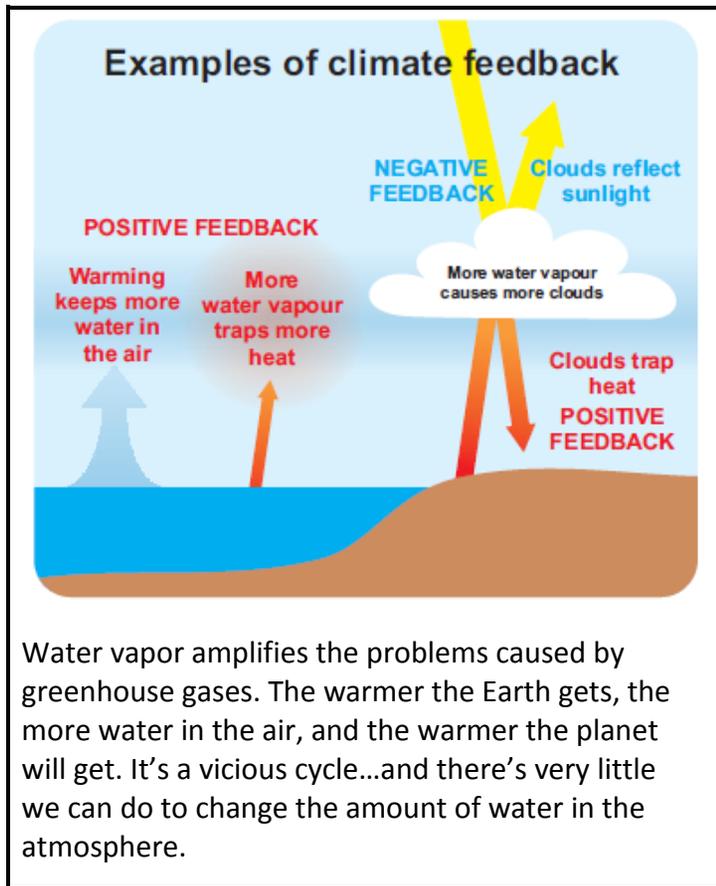


Greenhouse Gases

What's Up with Water?

When it comes to greenhouse gases, many people talk about carbon dioxide. But, have you ever heard anyone mention water? Water—in the form of water vapor—is actually Earth's most abundant greenhouse gas.



Water vapor amplifies the problems caused by greenhouse gases. The warmer the Earth gets, the more water in the air, and the warmer the planet will get. It's a vicious cycle...and there's very little we can do to change the amount of water in the atmosphere.



WATER AS CLOUDS: Almost no water is stored in the atmosphere; it just continues to change forms. The tiny amount of water in the air forms clouds, makes rain, and is an important part of our weather.



WATER AS HUMIDITY: Near the ground, the amount of water in the air is called humidity. When there's lots of humidity, you are more likely to see rain, fog, and dew.



WATER AS ICE: When water vapor is in a solid form, we see it as snow or ice. At certain temperatures, it can melt into water or even evaporate directly into water vapor.

Overview of Greenhouse Gases

Ok. So, water is a heavy hitter.

What other greenhouse gases are there?

In order, Earth's most abundant greenhouse gases are:



1) water vapor (H_2O)

2) carbon dioxide (CO_2)

3) atmospheric methane (CH_4)

4) nitrous oxide (N_2O)

5) ozone (O_3)

6) chlorofluorocarbons (CFC)

Getting to Know Greenhouse Gases

A gas contributes to the greenhouse effect based on both how strong it is and how much there is.

For example, methane is about twenty to sixty times stronger as a greenhouse gas than carbon dioxide, but there are much smaller amounts of methane in the atmosphere. Therefore, methane's contribution to the greenhouse effect is smaller than carbon dioxide.

When greenhouse gases are ranked according to their contribution to the greenhouse effect, the order of importance is:

- 1) water vapor
- 2) carbon dioxide
- 3) methane
- 4) ozone

Where Do Greenhouse Gases Come From?

Most greenhouse gases are released into the atmosphere from both natural and anthropogenic (human-caused) sources. When the gases that the Earth *releases* are balanced with the gases that the Earth *uses*, then the climate on Earth remains livable.

The main source of natural greenhouse gases is:



Volcanic eruption. When a volcano erupts, carbon emerges from the volcano in the form of carbon dioxide and thus enters the atmosphere.

The main sources of greenhouse gases due to human activity are:



Burning fossil fuels adds a tremendous amount of carbon dioxide (CO_2) to the atmosphere. Industrial emissions also add chlorofluorocarbons (CFCs) and other gases to the atmosphere.

When **land use changes** remove forests and natural vegetation, they remove parts of the biosphere that store carbon. This means extra carbon goes into the atmosphere.

Livestock digestion and manure add methane (CH_4) to the atmosphere.

Rice farming adds methane (CH_4) to the atmosphere.

Particulates Cool the Climate... but at a Cost

Greenhouse gases contribute to the warming of our planet, but particles in the air called **particulates** actually help cool it. Unfortunately, particulates are hazardous to human health and the health of the rest of the biosphere.



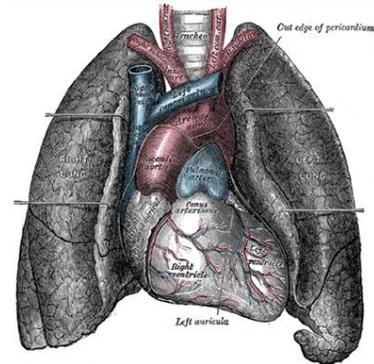
Some cities have such bad air pollution, you can almost see the particles hanging in the air. The particulates reflect solar energy away from the planet. This keeps some of the heat away from Earth and helps to cool the Earth. While particles are added to the air by nature, more particulates are produced by anthropogenic (human-caused) sources. There are many ways that humans can minimize the amount of particles they emit into the air.



Particulates occur naturally. Extra particles are emitted (placed) into the air when a volcano erupts, a dust storm is formed, or when a forest fire rages. Even when an ocean wave crashes on shore, extra particles are added to the air.



Particulates are also created by people. Power plants as well as other industrial processes put many particles in the air. Our vehicles (cars, trucks, airplanes) add to the problem as they burn fossil fuels and put toxic chemicals into the air.



Particulates make our water and air unhealthy causing problems for our hearts and lungs. Researchers have figured out how to remove toxic stuff from fossil fuels before they're burned. They've also figured out that we can add things to our gasoline to minimize the hazardous particles that are emitted.

Ozone

Ozone is created and destroyed naturally in the stratosphere the second layer of the atmosphere. In the stratosphere, it protects us from harmful UV radiation from the sun. This is often referred to as the 'good ozone'. The ozone in the troposphere is often referred to as the 'bad ozone' due to its harmful effects to humans.

Increases in the troposphere's ozone near the earth surface is caused by human pollution.

Near the Earth's surface, ozone is produced in chemical reactions involving naturally occurring atmospheric gases with sunlight. Ozone is also produced from human pollution sources. Fossil fuel (coal, oil, and natural gas) combustion is a main source of man-made ozone in the troposphere.

