Weather & Climate

PHYS503 Physics Colloquium

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Warning

The information, graphs, and data shown in this presentation are not part of speaker’s original work, and are taken from various websites. Sources, wherever necessary, are shown at the bottom of the slide.
Outline

- Definitions
- Discussion on the building blocks of weather
- Yahoo weather of different places
- Wild weather
- Factors affecting climate
- Effects of global climate change
- Prevention of global climate change
Weather

Weather is a mix of events that happen each day in our atmosphere including temperature, rainfall, and humidity.

Climate

Climate in your place on the globe controls the weather where you live. Climate is the average weather pattern in a place over many years.
Building blocks of weather

» Clouds
» Precipitation
» Wind

The type and intensity of weather is controlled by changes in *air pressure*. Air pressure is caused by the weight of the air molecules above. Even tiny air molecules have some weight, and the huge numbers of air molecules that make up the layers of our atmosphere collectively have a great deal of weight, which presses down on whatever is below.

This pressure causes air molecules at the Earth’s surface to be more tightly packed together than those that are high in the atmosphere.
Effects of air pressure on weather

- **High pressure** causes air to flow down slowly and fan out, moving with clockwise rotation at the ground in the Northern Hemisphere and counterclockwise in the Southern Hemisphere. High pressure days generally have **clear skies** because sinking air prevents clouds from forming.

- **Low pressure** causes air to flow up slowly. As air rises, it cools and water vapor within the air is unable to remain a gas. It forms tiny water droplets, making clouds in the sky. These clouds might cause **precipitation**.
Humidity

Absolute

Relative

Specific

The quantity of water in a particular volume of air (g/cm³).

Relative humidity is defined as the amount of water vapor in a sample of air compared to the maximum amount of water vapor the air can hold at any specific temperature in a form of 1 to 100%.

or

The ratio of the partial pressure of water vapor in a gaseous mixture of air and water vapor to the saturated vapor pressure of water at a given temperature.

\[ RH = \frac{P_{(H_2O)}}{P^*_{(H_2O)}} \]

Specific humidity is the ratio of water vapor to dry air in a particular volume. It is expressed as a ratio of kilograms of water vapor, \( m_w \), per kilogram of mixture, \( m_t \), i.e.,

\[ SH = \frac{m_w}{m_t} \]
Measuring and regulating humidity

- A device used to measure humidity is called a **Psychrometer** or **Hygrometer**.

- A **humidistat** is used to regulate the humidity of a building with a dehumidifier.
Dew Point

• The temperature at which air can no longer hold all of its water vapor, and some of the water vapor must condense into liquid or solid (rain, snow, frost or dew).

• Dew point mostly occurs when the relative humidity is 100%.

• If the dew point is below freezing point, it is referred to as the frost point.
Effects of humidity

**Human body**: The human body dissipates heat by a combination of

» Evaporation of perspiration
» Heat convection in the surrounding air
» Thermal radiation

When humidity increases, the evaporation of sweat from the skin decreases, and the body’s efforts to maintain the acceptable body temperature impairs.

If the atmosphere is as warm as or warmer than the skin during times of high humidity, blood brought to the body surface cannot dissipate heat by conduction to the air, and results in a condition called **hyperpyrexia**.

Under such conditions, less blood goes to the active muscles, the brain and other internal organs, which results in **fatigue**, and eventually leads to a condition called as **hyperthermia** or **heat stoke**.
Effects of humidity

**Electronics**: Most of the electronic items have humidity specification.

High humidity can lead to:

- Electronics malfunctioning by increasing the conductivity of permeable conductors.
- Short circuit in electronics (may cause permanent damage if not dried).
- Excessive humidity can cause corrosion of electronics.

Low humidity can lead to:

- Static electricity and spontaneous shutdown of servers of in data centers. (Electronics, and more specific TTL technology, cannot handle voltages that exceed the supply voltage and blow)
Clouds

- The white or gray color of clouds is actually the light reflected by tons of little droplets of water and crystals of ice that are so small, they are able to stay in the atmosphere and not fall to Earth.

**How does a cloud form?**

- A cloud forms when humid air that contains water vapor is cooled. At cooler temperatures, air is unable to hold as much water as at warm temperatures, so some of the water is forced out of the air. It forms a droplet around a particle of dust in the atmosphere or, if cold enough, turns into ice crystals.

- Dust particles act as nucleation sites for rain droplet/ice to precipitate out of the supersaturated air. This processed is called as *heterogeneous nucleation*.

- When the number of droplets becomes so dense that the cloud looks gray or black in color, it will probably produce *precipitation*. The cloud becomes darker in color because the water droplets are so dense that no light gets through.
Types of Clouds – High Clouds (above 20,000 feet)

Cirrocumulus Clouds, Location unknown
Courtesy of Digital Stock

"Mare's Tails" Cirrus Clouds, Location unknown
Courtesy of Digital Stock

Cirrus and Cirrostratus Clouds, Location unknown
© 2003 UCAR

Cirrus Clouds, Flattop Mountain, CO
Courtesy of L. Gardiner
Types of Clouds – Mid Clouds (between 6000 & 20,000 feet)
Types of Clouds – Low Clouds (below 6000 feet)
Types of Clouds – Low Clouds (below 6000 feet)

Cumulus Cloud, Italy
Courtesy of A. Pharamond

Fog,
Location unknown
© 2003 UCAR

Stratus Below the Tundra, Longs Peak Trail, CO
Courtesy of Greg Thompson

Nimbostratus and Cumulus with Rainbow
Brittany, France
Courtesy of L. Gardiner
There are many different types of precipitation:

Rain, snow, hail, and sleet

They all have a few things in common:

• They all come from clouds.
• They are all forms of water that fall from the sky.
• They all affect life on Earth (causing some people to leap with glee while making others scowl, mumbling about umbrellas or snow shovels, causing garden flowers to grow or causing massive crop damage).
Precipitation

**Rain:** Drops of liquid water fall from the clouds when water vapor condenses around dust particles in the clouds, forming tiny droplets that eventually get too big for the cloud to hold so they fall, growing larger as they collect more water on their way down.

**Snow:** Snow is ice that falls from the sky. Each snowflake is a delicately complex arrangement of ice crystals. A snowflake forms when water vapor sublimates, or turns directly from a gas into its solid form, ice.

**Hail:** Hail is ice that falls from the sky, often in round shapes. Hailstones form within thunderstorm clouds when upward moving air keeps pellets of frozen water from falling. The pellets grow larger as drops of very cold water hit them and freeze. Eventually the balls of ice become so large and heavy that they fall to the ground as hailstones. *The largest documented hailstone weighted more than one and a half pounds!* Scientists estimate that it reached a speed of more than 80 mph as it fell toward Earth.

**Sleet:** Sleet is like slush falling from the sky. Sleet forms when raindrops freeze into ice as they fall to the ground. They are usually smaller and wetter than hailstones.
Wind

Wind is moving air and is caused by differences in air pressure within our atmosphere. Air under high pressure moves toward areas of low pressure. The greater the difference in pressure, the faster the air flows.
The Fastest Winds

• In 1934, on the roof of a little wooden building atop Mount Washington, in New Hampshire, an instrument to measure wind speed, called an anemometer, made history. It recorded a wind speed of 231 miles per hour (mph) during a huge spring storm, the fastest wind gust ever recorded with the instrument!

• More recently, sophisticated Doppler radar has been used to measure winds, recording a wind speed of 318 mph in an Oklahoma tornado in 1999. That’s faster than the top speeds of Japanese bullet trains and over three times quicker than the fastest baseball pitch.

• UTSI to Memphis: 290 miles!
Describing winds

- Wind is described with direction and speed.

- The direction of the wind is expressed as the direction from which the wind is blowing. For example, easterly winds blow from east to west, while westerly winds blow from west to east.

- Winds have different levels of speed, such as “breeze” and “gale”, depending on how fast they blow.

- Wind speeds are based on the descriptions of winds in a scale called the Beaufort Scale, which divides wind speeds into 12 different categories, from less than 1 mph to more than 73 mph.
## Beaufort Scale

<table>
<thead>
<tr>
<th>#</th>
<th>MPH</th>
<th>Description</th>
<th>International Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>&lt; 1</td>
<td>Calm</td>
<td>Calm; Smoke rises vertically.</td>
</tr>
<tr>
<td>1</td>
<td>1-3</td>
<td>Light Air</td>
<td>Direction of wind shown by smoke drift not by wind vanes.</td>
</tr>
<tr>
<td>2</td>
<td>4-7</td>
<td>Light Breeze</td>
<td>Wind felt on face; Leaves rustle; Vanes moved by the wind.</td>
</tr>
<tr>
<td>3</td>
<td>8-12</td>
<td>Gentle Breeze</td>
<td>Leaves and small twigs in constant motion; Wind extends light flag.</td>
</tr>
<tr>
<td>4</td>
<td>13-18</td>
<td>Moderate</td>
<td>Raises dust, loose paper; Small branches moved.</td>
</tr>
<tr>
<td>5</td>
<td>19-24</td>
<td>Fresh</td>
<td>Small trees in leaf begin to sway; Crested wavelets form on inland waters.</td>
</tr>
<tr>
<td>6</td>
<td>25-31</td>
<td>Strong</td>
<td>Large branches in motion, Whistling heard in telegraph wires, Umbrellas used with difficulty.</td>
</tr>
<tr>
<td>7</td>
<td>32-38</td>
<td>Near Gale</td>
<td>Whole trees in motion; Inconvenience felt walking against the wind.</td>
</tr>
<tr>
<td>8</td>
<td>39-46</td>
<td>Gale</td>
<td>Breaks twigs off trees; Impedes progress.</td>
</tr>
<tr>
<td>9</td>
<td>47-54</td>
<td>Strong Gale</td>
<td>Slight structural damage occurs.</td>
</tr>
<tr>
<td>10</td>
<td>55-63</td>
<td>Storm</td>
<td>Trees uprooted; Considerable damage occurs.</td>
</tr>
<tr>
<td>11</td>
<td>64-72</td>
<td>Violent Storm</td>
<td>Widespread damage.</td>
</tr>
<tr>
<td>12</td>
<td>73-82</td>
<td>Hurricane</td>
<td>Widespread damage.</td>
</tr>
</tbody>
</table>

Source: [http://home.comcast.net/~garyt1/wind.html](http://home.comcast.net/~garyt1/wind.html)
# Wind Chill chart

| wind speed mph | 35  | 30  | 25  | 20  | 15  | 10  | 5  | 0  | -5 | -10 | -15 | -20 | -25 | -30 | -35 | -40 | -45 |
|----------------|-----|-----|-----|-----|-----|-----|----|----|----|-----|-----|-----|-----|-----|-----|-----|
| 5              | 33  | 27  | 21  | 16  | 12  | 7   | 1  | -6 | -11| -15 | -20 | -26 | -31 | -35 | -41 | -47 | -54 |
| 20             | 12  | 3   | -4  | -9  | -17| -24 | -32| -40| -46| -52 | -60 | -68 | -76 | -81 | -88 | -96 | -103|

Source: [http://home.comcast.net/~garyt1/wind.html](http://home.comcast.net/~garyt1/wind.html)
Weather

Tullahoma
Current conditions as of 7:20 pm CDT
Fair
Feels Like: 12°
Barometer: 30.10 in HG
Humidity: 47%
Visibility: 16.09 km
Dewpoint: 1°
Wind: N 21 kph
Sunrise: 6:45 am
Sunset: 6:59 pm

Partly Cloudy
Feels Like: 12°
Barometer: 30.10 in HG
Humidity: 47%
Visibility: 16.09 km
Dewpoint: 1°
Wind: N 21 kph
Sunrise: 6:45 am
Sunset: 6:59 pm

Source: YAHOO! NEWS Weather
Date: March 22, 2008

Boston
Current conditions as of 7:54 pm EDT
Partly Cloudy
Feels Like: 5°
Barometer: 1010 mb and rising
Humidity: 27%
Visibility: 16.09 km
Dewpoint: -13°
Wind: W 16 kph
Sunrise: 6:43 am
Sunset: 6:59 pm

Partly Cloudy
Feels Like: 5°
Barometer: 1010 mb and rising
Humidity: 27%
Visibility: 16.09 km
Dewpoint: -13°
Wind: W 16 kph
Sunrise: 6:43 am
Sunset: 6:59 pm

Tampa
Current conditions as of 8:27 pm EDT
Light Rain
Feels Like: 19°
Barometer: 29.92 in HG
Humidity: 100%
Visibility: 16.09 km
Dewpoint: 19°
Wind: Calm
Sunrise: 7:31 am
Sunset: 7:43 pm

Partly Cloudy
Feels Like: 19°
Barometer: 1022 mb and steady
Humidity: 62%
Visibility: 16.09 km
Dewpoint: 7°
Wind: NW 37 kph
Sunrise: 7:09 am
Sunset: 7:24 pm

San Francisco
Current conditions as of 4:56 pm PDT
Partly Cloudy
Feels Like: 14°
Barometer: 1022 mb and steady
Humidity: 62%
Visibility: 16.09 km
Dewpoint: 7°
Wind: NW 37 kph
Sunrise: 7:09 am
Sunset: 7:24 pm

Partly Cloudy
Feels Like: 14°
Barometer: 1022 mb and steady
Humidity: 62%
Visibility: 16.09 km
Dewpoint: 7°
Wind: NW 37 kph
Sunrise: 7:09 am
Sunset: 7:24 pm

Source: YAHOO! NEWS Weather
Date: March 22, 2008
Weather

Moscow

Current conditions as of 3:00 am MSK

Cloudy
Feels Like: -2°
Barometer: 1002 mb and steady
Humidity: 75%
Visibility: Unlimited
Dewpoint: -4°
Wind: SSE 6 kph
Sunrise: 6:27 am
Sunset: 6:49 pm

» Detailed Forecast
» Records & Averages
» Get Yahoo! Weather on your desktop

Shanghai

Current conditions as of 8:00 am CST

Unknown
Feels Like: 11°
Barometer: --
Humidity: 88%
Visibility: 1.4 km
Dewpoint: 9°
Wind: W 14 kph
Sunrise: 5:54 am
Sunset: 6:08 pm

» Detailed Forecast
» Records & Averages
» Get Yahoo! Weather on your desktop

Sao Paulo

Current conditions as of 9:00 pm LST

Light Rain
Feels Like: 22°
Barometer: --
Humidity: 88%
Visibility: 7 km
Dewpoint: 19°
Wind: SSE 5 kph
Sunrise: 6:11 am
Sunset: 6:15 pm

» Detailed Forecast
» Records & Averages
» Get Yahoo! Weather on your desktop

Dar es Salaam

Current conditions as of 3:00 am EAT

Partly Cloudy
Feels Like: 28°
Barometer: --
Humidity: 94%
Visibility: 9.99 km
Dewpoint: 24°
Wind: Calm
Sunrise: 6:27 am
Sunset: 6:33 pm

» Detailed Forecast
» Records & Averages
» Get Yahoo! Weather on your desktop

Source: Yahoo! News Weather

Date: March 22, 2008
QUIZ

Stratocumulus Clouds from Above, Location unknown
Courtesy of the National Weather Service

Low Clouds

Cumulus Clouds, Independence Pass, CO
Courtesy of L. Gardiner
Wild Weather

**Cyclone:** An area of low atmospheric pressure characterized by inward spiraling winds that rotate *counter-clockwise* in the northern hemisphere and *clockwise* in the southern hemisphere of the Earth.

It has 6 major categories: Polar cyclone, Polar low, Extratropical, Subtropical, Tropical and Mesoscale.

» Hurricanes and Typhoons (Tropical)

» Tornadoes and Waterspouts (Tropical)

» Thunderstorms

» Blizzards
Wild Weather

• Hurricanes and Typhoons

These are among Earth’s *largest* and *fiercest* storms. Each storm is able to, for a week or more, travel thousands of miles stirring seas, toppling trees, leveling buildings, and killing thousands of innocent *homo sapiens* and related species.

• Tornadoes and Waterspouts

Called tornadoes over land and waterspouts over ocean, these wild weather events churn air at the fastest speeds ever recorded on Earth. While they are often short-lived, often only existing for a few minutes, the intense winds and flying debris from tornadoes can destroy everything in their path.
Hurricane Catarina: March 24 – 28, 2004 | Speed: 100 mph
Region: Southeastern Brazil
Wild Weather

• Thunderstorms

These storms are common in the spring and summer when there is warm air near the ground and cool air above. Small thunderstorms may only exist for an hour while large Supercell storms can last for several hours spawning tornadoes, hail, intense lightning, and flash flooding.

• Blizzard

A severe winter storm condition characterized by low temperatures, strong winds, and heavy blowing snow. Blizzards are formed when a high pressure system, also known as a ridge, interacts with a low pressure system; this results in the advection of air from the high pressure zone into the low pressure area.
Climate

How does climate change?

- Climate, the average weather over a period of many years, differs in regions of the world that receive different amounts of sunlight and have different geographic factors, such as proximity to oceans and altitude.

- Climates will change if the factors that influence them fluctuate.

- To change climate on a global scale, either the amount of heat that is let into the system changes, or the amount of heat that is let out of the system changes. For instance, warming climates are either due to increased heat let into the Earth or a decrease in the amount of heat that is let out of the atmosphere.
The heat that enters into the Earth system comes from the Sun. Sunlight travels through space and our atmosphere, heating up the land surface and the oceans. The warmed Earth then releases heat back into the atmosphere. However, the amount of sunlight let into the system is not always the same. Changes in Earth’s orbit over thousands of years and changes in the Sun’s intensity affect the amount of solar energy that reaches the Earth.

Heat exits the Earth system as the Earth’s surface, warmed by solar energy, radiates heat away. However, certain gases in our atmosphere, called greenhouse gases, allow the lower atmosphere to absorb the heat radiated from the Earth’s surface, trapping heat within the Earth system.
Greenhouse gases, such as water vapor, carbon dioxide, methane and nitrous oxide, are an important part of our atmosphere because they keep Earth from becoming an icy sphere with surface temperatures of about 0°F.

However, over the past century or so the amounts of greenhouse gases within our atmosphere have been increasing rapidly, mainly due to the burning of fossil fuels, which releases carbon dioxide into the atmosphere. Consequently, in the past one hundred years global temperatures have been increasing more rapidly than the historic record shows.

Scientists believe this accelerated heating of the atmosphere is because increasing amounts of these greenhouse gases trap more and more heat.
Climate: Complicating Factors

- **Clouds**: Clouds reflect sunlight, providing shade, which keeps Earth’s surface cool. However, the water vapor within clouds is a greenhouse gas. It traps heat in the atmosphere by bouncing energy back towards the Earth, trapping heat. Scientists still disagree about whether the net effect of cloud cover is to cool or warm the Earth. If global warming continues, there will be an increased amount of clouds in our atmosphere, which may help or hurt.

- **Forest Fires**: Wildfires release carbon dioxide, a greenhouse gas, into the atmosphere. By trapping heat, carbon dioxide contributes to the planet’s warming. However, if a forest of similar size grows again, about the same amount of carbon that was added to the atmosphere during the fire will be removed. So, fires affect atmospheric CO$_2$ in the short term, but not on long timescales.

- **Volcanic Eruptions**: Eruptions send ash particles into the stratosphere, blocking sunlight from reaching the Earth’s surface and contribute to cooling. Ash from volcanoes can have a worldwide effect, as ash in the stratosphere is able to travel great distances. For example, Mount Pinatubo erupted in 1990 sending enough ash into the atmosphere to lower Earth’s average temperature for several years. However, volcanoes also release carbon dioxide, which, over millions of years, causes warming.
Climate: Complicating Factors

- **Oceans**: Heat is absorbed by ocean water and transported by currents worldwide. Due to their ability to absorb and broadly distribute heat, the oceans help to slow the process of temperature change in the atmosphere.

- **People**: Living things both produce and consume greenhouse gases, especially carbon dioxide. Because human activities use huge quantities of fuels that release carbon dioxide, currently far more greenhouse gases are produced than consumed, contributing to global warming.

1. **Carbon dioxide**: Carbon, the building block of life, is released as carbon dioxide gas when fossil fuels, the remains of ancient plant and animal bodies, are burned. Carbon dioxide is taken out of the atmosphere by plants during the process of photosynthesis.

2. **Methane**: Methane gas is produced by microbes in natural wetlands and rice paddies and by the digestive tracts of farm animals such as cattle and sheep.

3. **Nitrous oxide**: This gas is produced when nitrate and ammonium in human-produced fertilizers breakdown in the soil.
The Intergovernmental Panel on Climate Change (IPCC) is a group of scientists from around the world, brought together by the United Nations to assess our understanding and the potential impacts of climate change. Every five years they do a follow-up study to assess recent findings. Most important, they are identifying our options for lessening the rate of change and describing how societies can adapt to it.

According to the IPCC’s current findings, the world’s surface air temperature has increased an average of 0.6°C (1.0 °F) during the 20th Century. That may not sound like very much, but even one degree can cause changes around the world. Additionally, given the accelerating rate of temperature rise, the IPCC projects that during the 21st century, temperatures will rise much more than they did during the past century.
Projected changes in global temperature:
global average 1856-1999 and projection estimates to 2100

Actual global temperatures are plotted on the graph for years 1856-1999 and IPCC estimates of temperature are plotted for years 1999-2100. Different lines on the graph between 1999 and 2100 indicate high, low, and best estimates of future temperature.

Courtesy GRID/UNEP
Effects of global climate change

- **Sea level rise**: Sea level has risen 10-20 cm (4-8 inches) during the 20th century. The increased volume of water is a result of both the *melting of glaciers* and the *expansion of water* with heat. Models predict that sea level may rise as much as 85 cm (33 inches) during the 21st century.

![Sea level rise due to global warming](chart)

*The upward trend in the graph on the left indicates that sea level has increased more than 12 cm since 1890. On the right, predictions of sea level change over the next 100 years indicate a continued rise of 10-90 cm.*

Courtesy GRIDA/UNEP
Effects of global climate change

- **Melting Arctic Sea Ice:** Today, summer sea ice in the Arctic is about half as thick as it was in 1950. Melting Arctic sea ice may eventually lead to global changes in water circulation. Additionally, melting sea ice speeds up warming of the Arctic because water absorbs 80% of sunlight.
Effects of global climate change

Other factors:

- Warmer oceans
- Floods
- Droughts
- Heat waves
- Warmer winters
- Ecosystems change
- Agriculture
Changes in cereal production under different scenarios (measured in percent of 2060 estimate).
Prevention

What can we do?

To slow the rate of climate change, we can decrease the amount of carbon dioxide that we release into the atmosphere. This greenhouse gas is released into the atmosphere each day as fossil fuels are burned, promoting accelerated global warming.
Ten Things We Can Do to Fight Global Warming

1. Use Public Transportation, Car Pool, Walk, or Ride a Bike. Anything you do that reduces the amount of gasoline you burn can make a difference.

2. Purchase Only Fuel Efficient Automobiles. Buying a fuel-efficient car you saves money at the pump while saving the environment. A 45 mpg car, such as the the Toyota Prius, emits about half the carbon dioxide of a 20 mpg car and will save you about $2,300 at the pump. If automakers made a 40 mpg sport utility vehicle, you would save about $3,300 at the pump over the life of a vehicle.

3. Purchase Energy Efficient Appliances. Most major appliances now are labeled with their energy consumption. A refrigerator uses the most energy in a home and models today are about 75 percent more efficient than those made in the 70s. The Environmental Protection Agency awards the Energy Star mark to appliances that are highly efficient.

Source: http://uspirg.org/uspirg.asp?id2=7629&id3=USPIRG&id4=USPIRGFS&
Ten Things We Can Do to Fight Global Warming

4. Use Energy Efficient Light Bulbs. Changing your traditional light bulbs to compact fluorescent bulbs would avert 1.5 tons of global warming pollution per household annually. You will also reduce your energy bills and need to replace the bulbs less often.

5. Plant Trees Around Your Home. Scientists have found that trees remove carbon dioxide from the air. Trees also provide shade, windbreaks, and evaporative cooling, which will lower your heating and cooling bills.

6. Weatherize Your Home. A small investment will allow you to cut your heating and cooling bills and reduce carbon dioxide emissions. Seal drafts around windows and doors and check for adequate insulation. If you aren't sure how to do this yourself, you can have an energy audit done by your local electric or gas utility.

Source: http://uspirg.org/uspirg.asp?id2=7629&id3=USPIRG&id4=USPIRGFS&
Ten Things **We** Can Do to Fight Global Warming

7. **Write to National Decision-makers.** As an individual you can make a difference by taking the steps listed here, but also by insisting that the utilities, automakers, and other industries do their part. So visit [www.newenergyfuture.com](http://www.newenergyfuture.com) to send a letter to your Senator or express your own opinion by creating your own letter.

8. **Think Locally.** Visit your state PIRG's webpage to find out about local work to achieve a clean energy future. Write to your governor, state legislature and local public utility regulators to ask them to promote energy efficiency, clean renewable sources of energy, and non-polluting transportation alternatives.

9. **Write Your Newspaper.** Express your own ideas about the need to address global warming by sending letter to the editor of your local paper.

Source: http://uspirg.org/uspirg.asp?id2=7629&id3=USPIRG&id4=USPIRGFS&
Ten Things **We** Can Do to Fight Global Warming

10. **Support Public Interest Organizations.** Public interest organizations need your help to continue to fight for progress on this issue. By supporting the groups in your area and the national groups, you can help them make a difference.

US PIRG: United States Public Interest Research Groups

Source: http://uspirg.org/uspirg.asp?id2=7629&id3=USPIRG&id4=USPIRGFS&
Questions ??

( don’t ask, can’t tell )
Thank You!