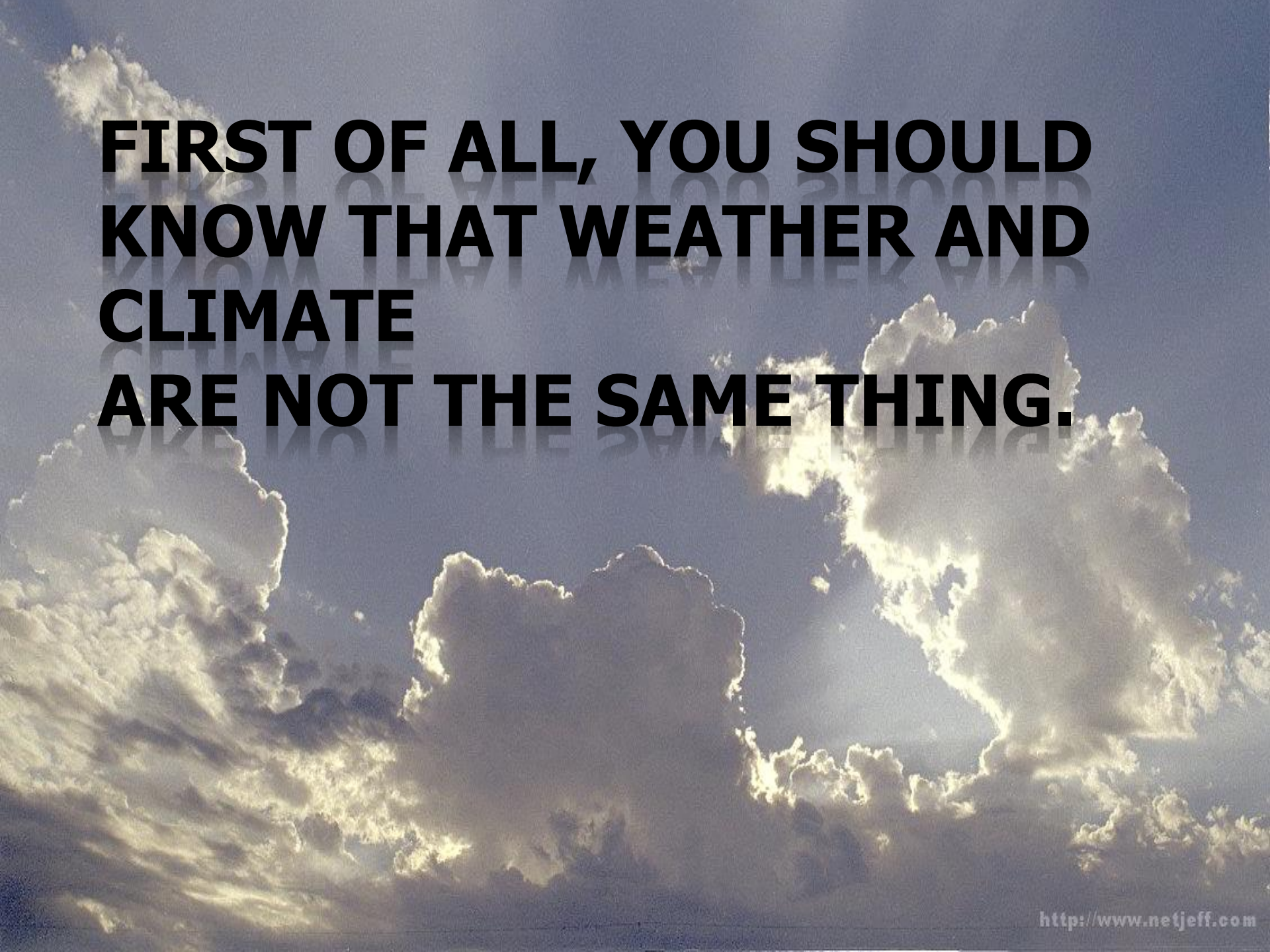


TODAY

- *assess environmental challenges facing Canadians, including*
- global warming
- ozone layer depletion
- fresh water quality and supply






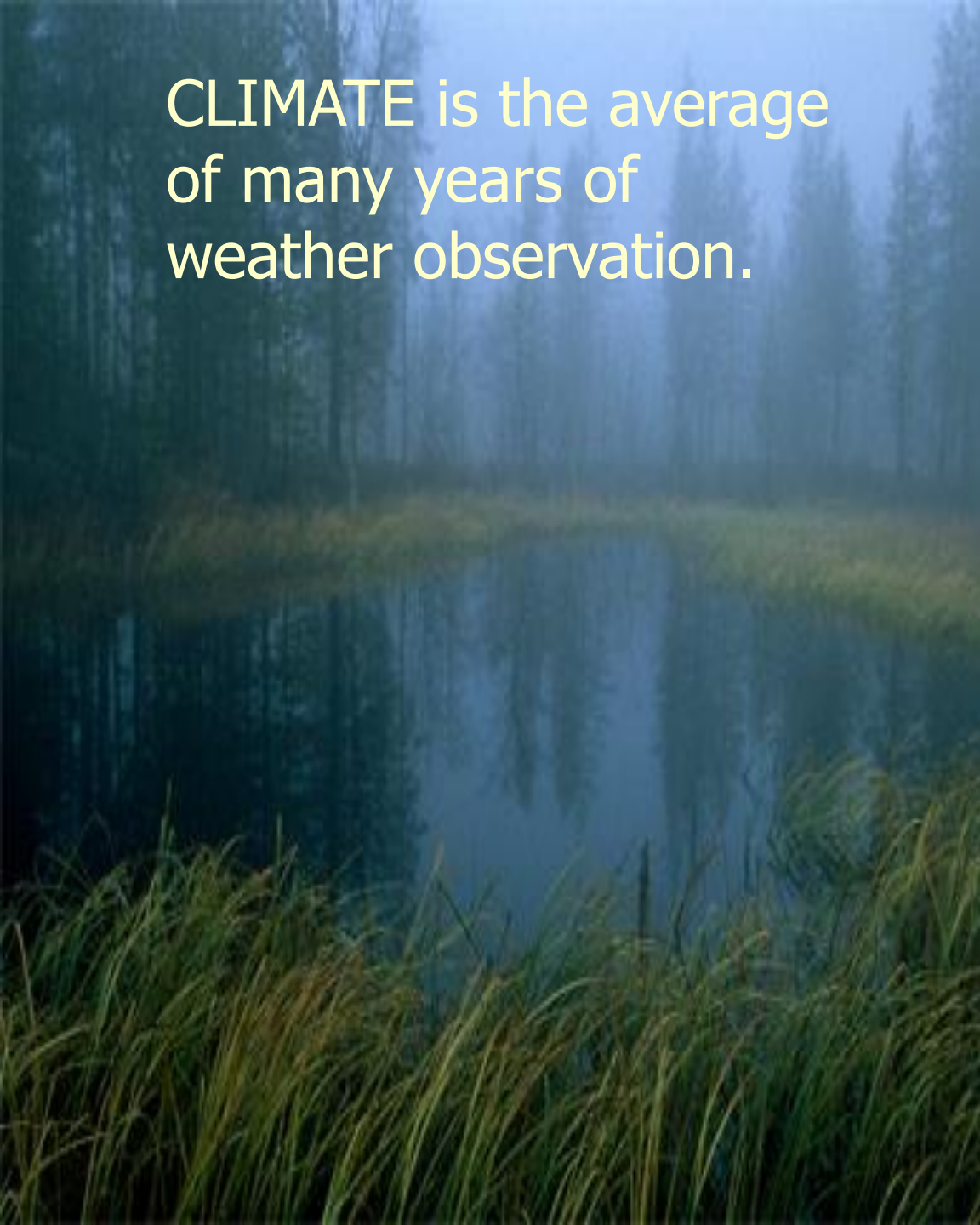
**FIRST OF ALL, YOU SHOULD
KNOW THAT WEATHER AND
CLIMATE
ARE NOT THE SAME THING.**

WEATHER IS:

- Short term
- Limited area
- Can change rapidly
- Difficult to predict

A small white and brown cat is peering over a white blanket, looking directly at the camera. The background is a soft, out-of-focus white, suggesting a bed or a cozy indoor setting.

WEATHER is what's
happening outside your
window right now.

A misty forest scene with a pond and tall grasses in the foreground. The text is overlaid on the top left of the image.

CLIMATE is the average
of many years of
weather observation.

CLIMATE IS:

- Long term
- Wide area
- Seasonal changes
- Measured over long spans of time

Climate is affected by many factors

ABIOTIC FACTORS:

Latitude

Altitude

Ocean Currents

Topography

Solar Radiation

Evaporation

Orbital Variations

Volcanic Activity

BIOTIC FACTORS:

Transpiration

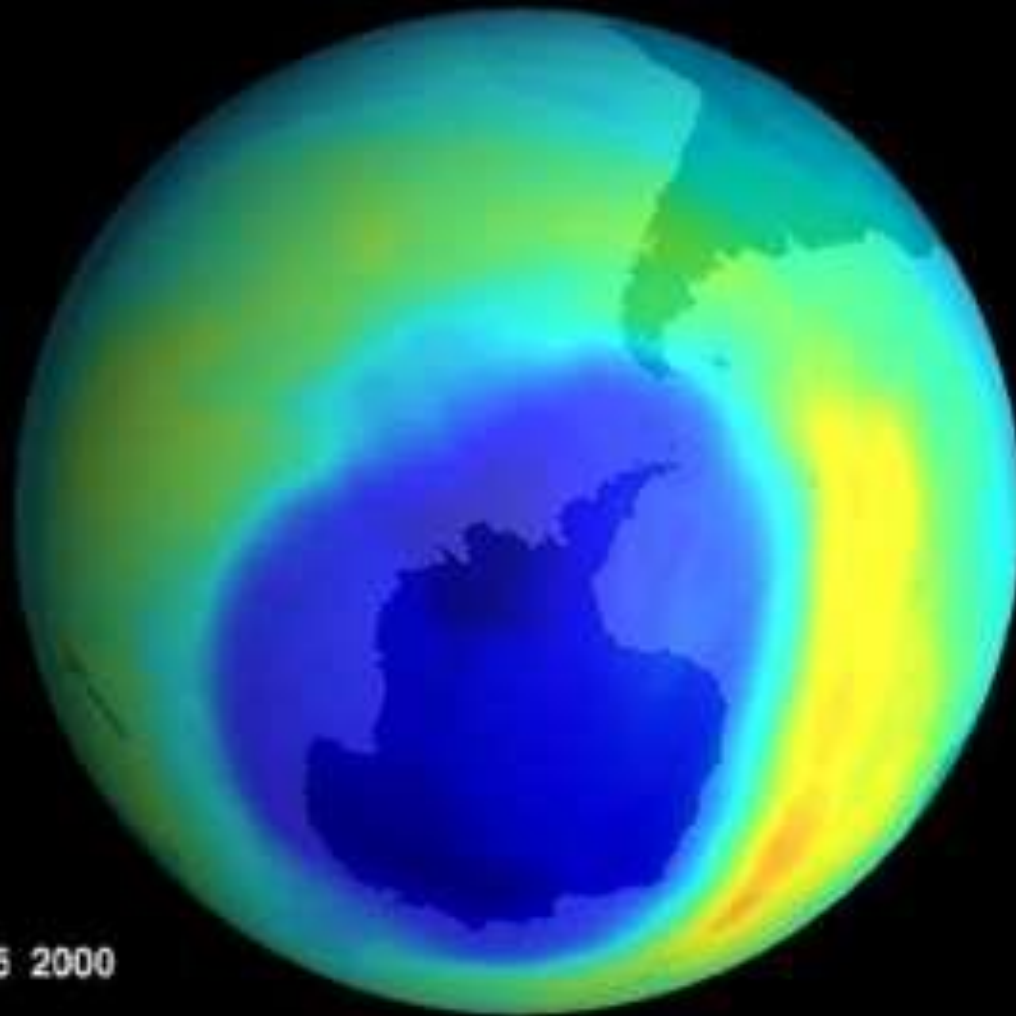
Respiration

Photosynthesis

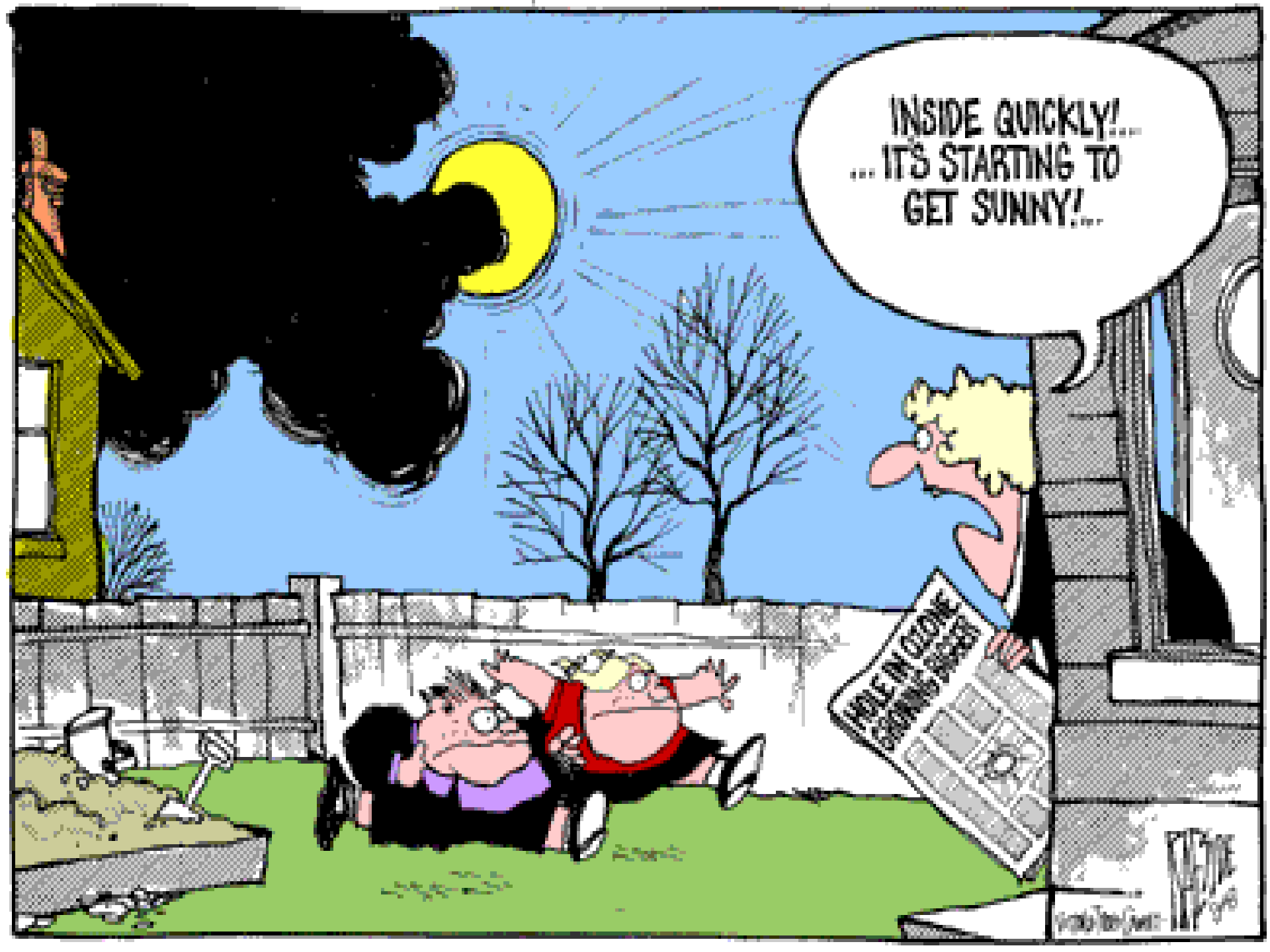
Decomposition

Digestion

Ozone Depletion

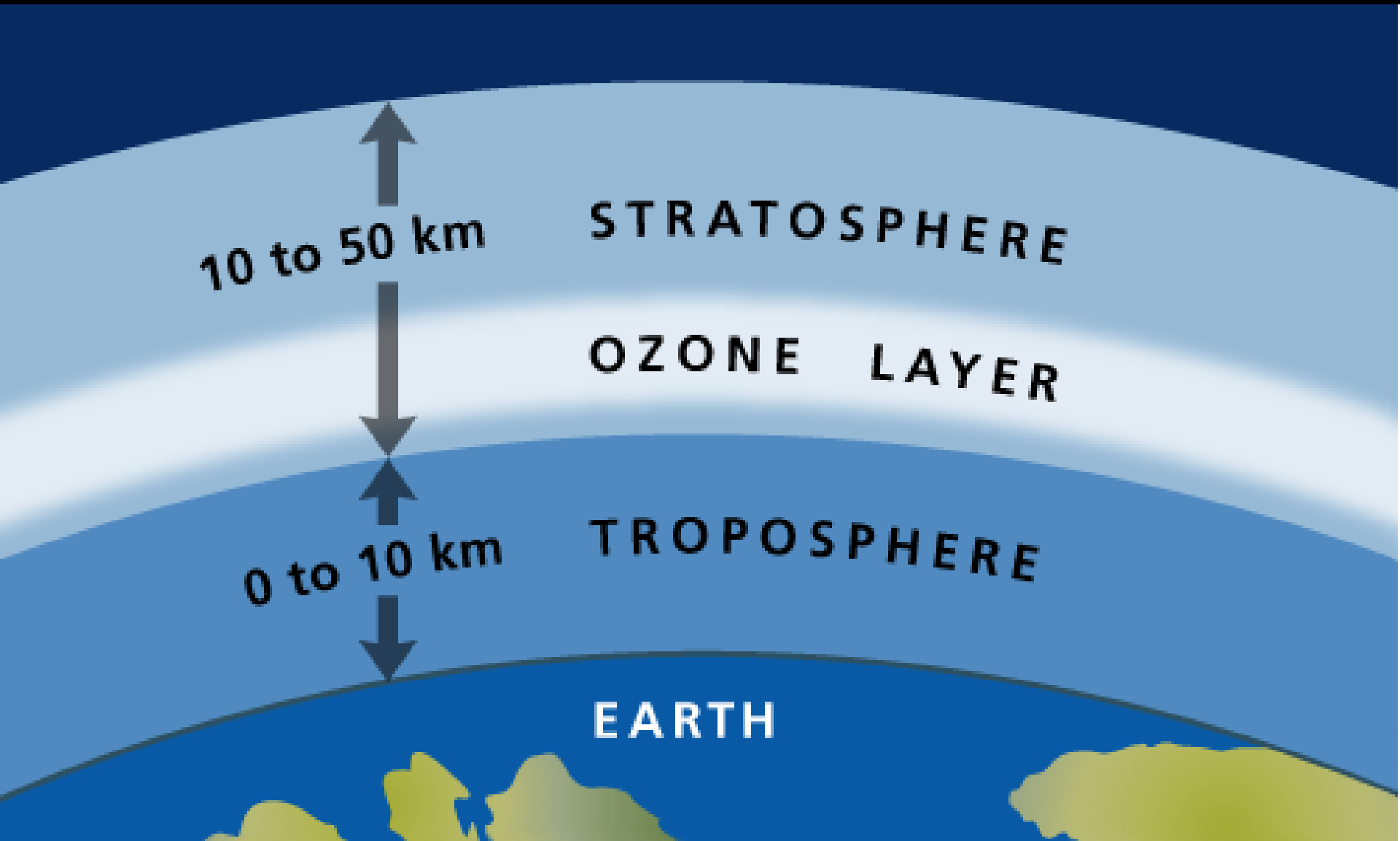


Sep 6 2000



INSIDE QUICKLY!...
... IT'S STARTING TO
GET SUNNY!...

WALKING DEAD
SUNSHINE BUNNIES



10 to 50 km

STRATOSPHERE

OZONE LAYER

0 to 10 km

TROPOSPHERE

EARTH

What is the Ozone Layer and why is it important?

- It is a thin layer of ozone (O³) in the earth's upper atmosphere.
- Ozone blocks the sun's **ultraviolet (UV) rays** and stops them from reaching the surface of the earth.
- This is important because UV radiation causes **skin cancer** in humans and kills other organisms such as **plankton** on the surface of oceans

What causes the Ozone Layer to Deplete?

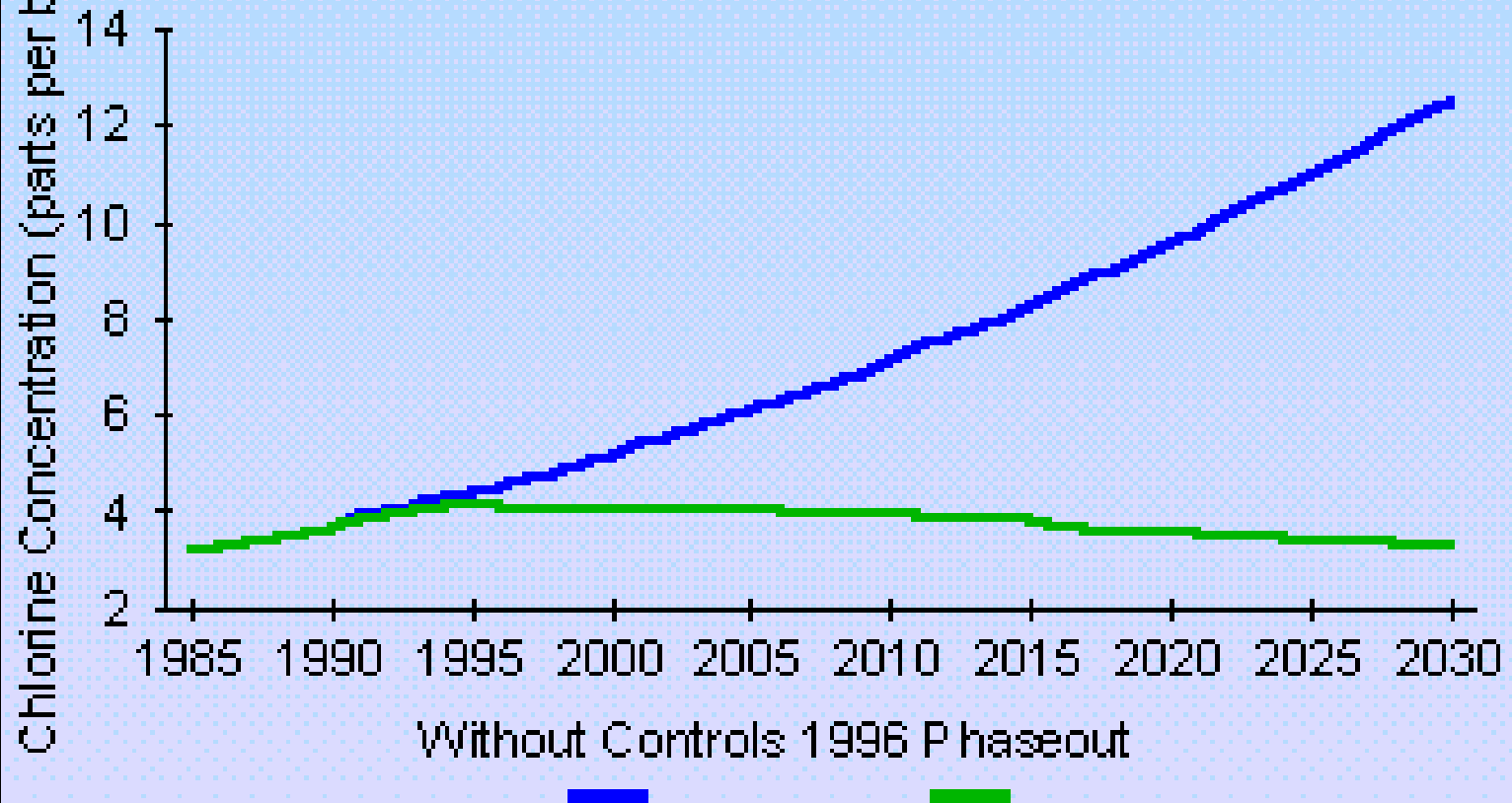
- Chemicals used by humans, especially **CFC's** (Chlorofluorocarbons) which are found in coolants, foam, and aerosol sprays.
- Because of the wide spread use of these chemicals, by the 1980s the Ozone Layer had developed holes over the North and South Poles.



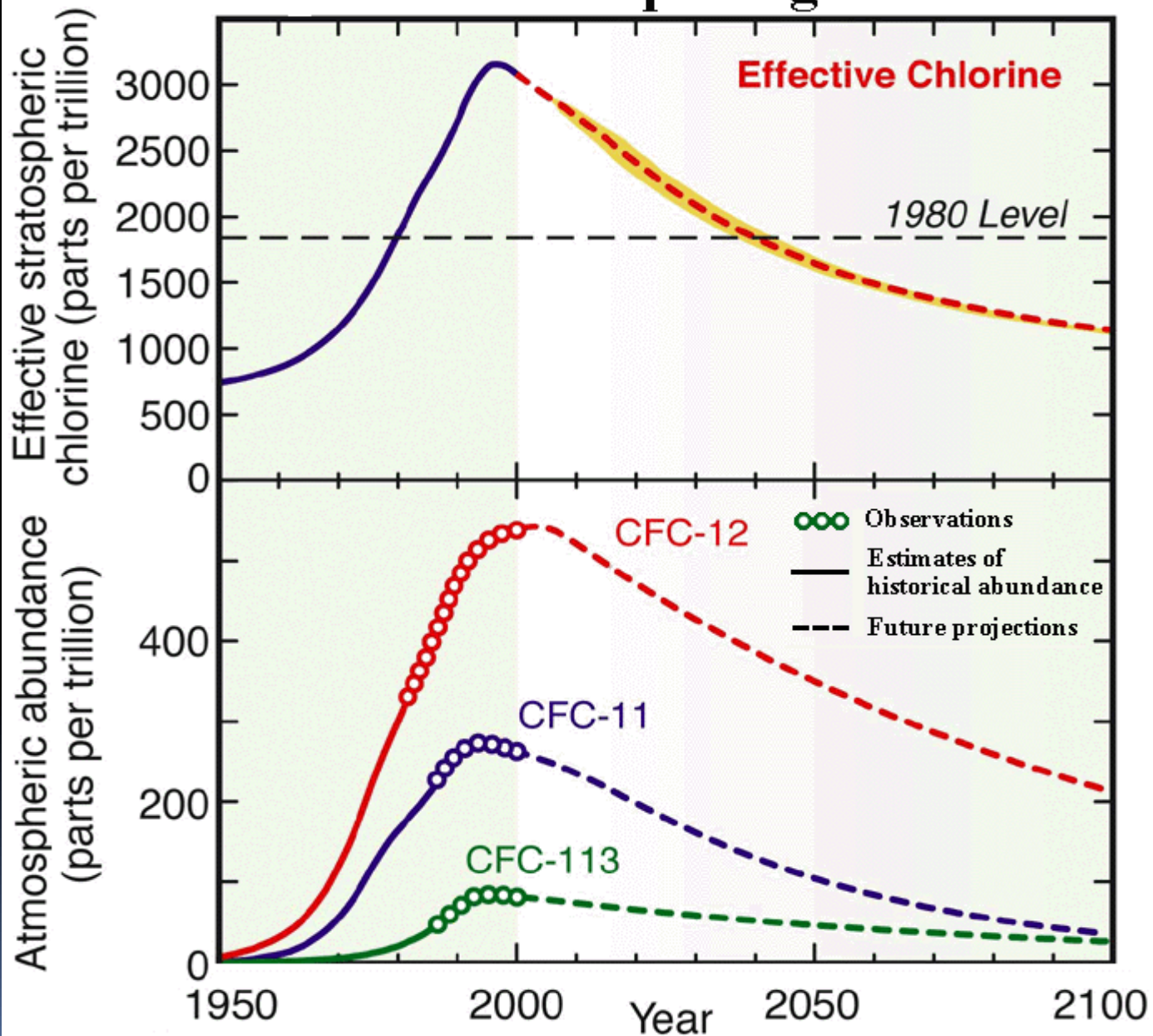
Result

- In 1987, all industrial countries met in Montreal.
- Here, they signed an agreement called the **Montreal Protocol**.
- They agreed to **cut their use of CFCs** and to allow the developing countries to use CFCs only until the year 2000.
- Today, scientists believe that the Ozone layer might be slowly repairing itself.

Impact of Montreal Protocol on Chlorine Content of the Stratosphere



Past and Future Abundance of Ozone Depleting Gases



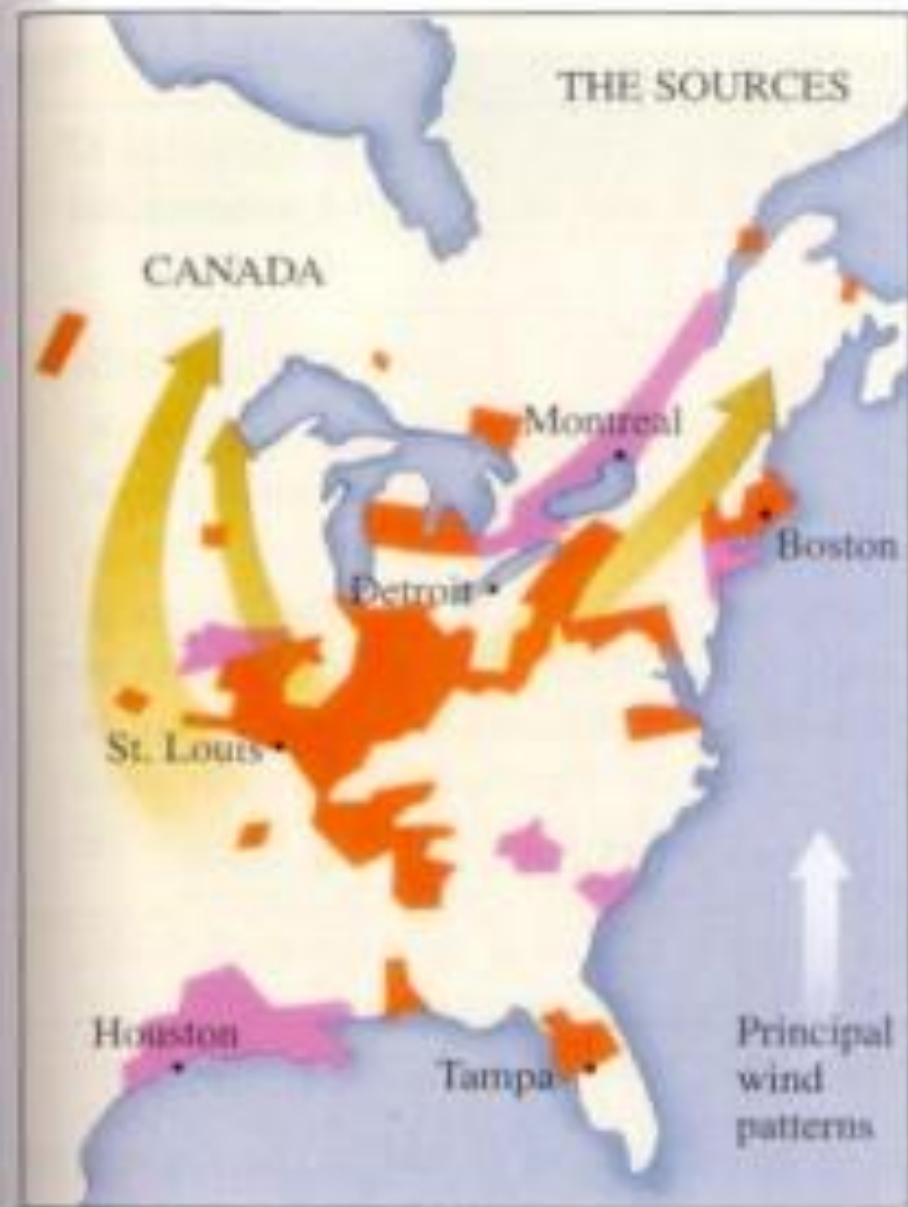
What causes acid rain?

- When fossil fuel is burned, **SO₂ (Sulphur Dioxide)** and **NO_x (Nitrogen Oxide)** are released into the atmosphere.
- Most SO₂ and NO_x emissions come **from industry and power plants that burn coal**.
 - These gasses are carried by wind currents and spread over a wide area.
 - Eventually, when it rains, they are deposited on the ground by the precipitation.
 - In **eastern Canada**, acid rain is caused by the heavily industrialized areas of the eastern USA.
 - In **Scandinavia**, acid rain occurs because wind currents bring polluted air from Britain.

ACID RAIN







THE SOURCES



THE FALLOUT



-  High sulfur dioxide
-  High nitrogen oxides

-  High acidity
-  Moderate to high acidity

What is acid rain?

- Acid rain basically results in water that is **acidic**.
- On the pH scale, pure water has a reading of 7. Anything higher is basic and anything lower is acidic.
- Normal rainfall has a pH level of 5.5. Acid rain, with a pH of 4.5 is ten times more acidic than normal rain.

♪ I'M SING-ING IN THE ACID RAIN,
JUST SING-ING IN THE ACID RAIN... ♪



Results of Acid Rain:

- **Plant leaves are burned.**
- **Root systems are poisoned.**
- **Vegetation becomes weak - more susceptible to damage from pests.**
- **Agricultural crops suffer - yields are lower.**
- **When snow melts in large quantities, acid levels in lakes and rivers rise abruptly killing aquatic life. This is known as acid shock and results in dead lakes.**

Results of Acid Rain:

- **Buildings, monuments and vehicles are damaged.**
- **Humans suffer. Acid rain has been connected to colds, allergies and asthma.** Eating food that comes from contaminated water can also be **poisonous** - acid rain contains toxic metals such as mercury!







■ How can acid rain be reduced?

- Produce **electricity from environmentally friendly sources.**
- Use **less fossil fuel** (especially gasoline) in vehicles.
-
- **Burn only high quality coal** as this releases less sulphur into the atmosphere.
- Install **scrubber systems** in chimneys to remove SO_2 and NO_x before they are released into the atmosphere.
- **Energy conservation**

Global Warming





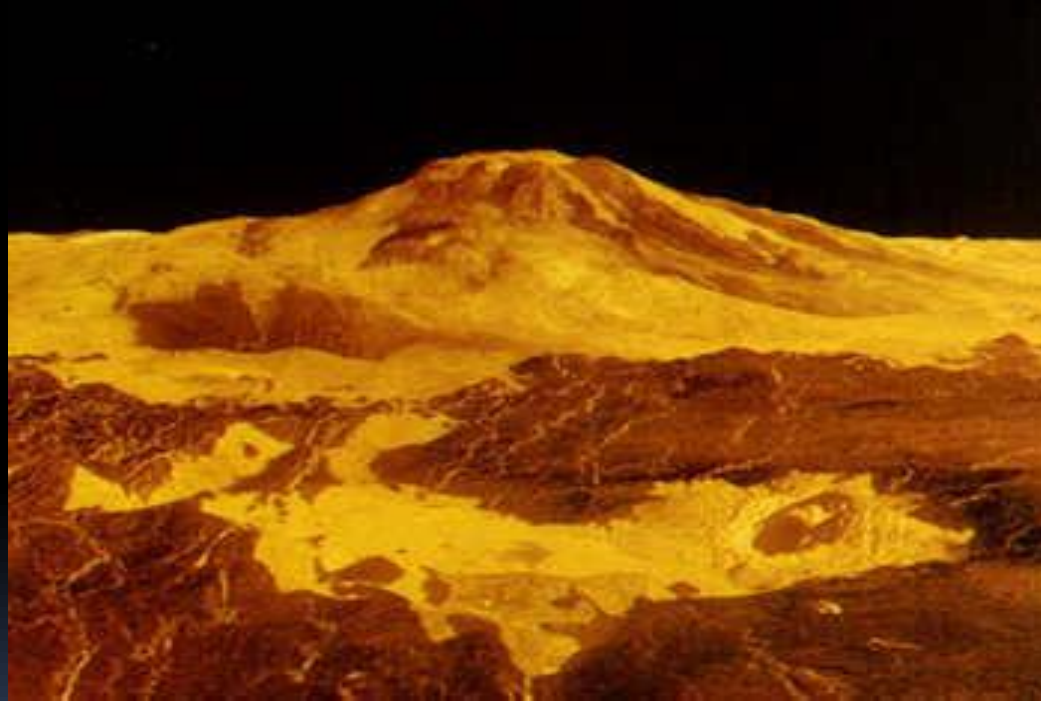
<http://www.windows.ucar.edu/tour/link=/pluto/statistics.html>

The image shows a reddish-brown, rocky landscape on Mars. In the upper right corner, a portion of the reddish planet Mars is visible against a dark, starry sky. The foreground consists of layered, reddish-brown rock formations.

On Mars, there is about a 300 degree F difference between high and low temperatures

(<http://quest.nasa.gov/aero/planetary/mars.html>)

Planets with abundant greenhouse gases are very hot



The average temperature on Venus is about 855° F!

...and then there's Earth....

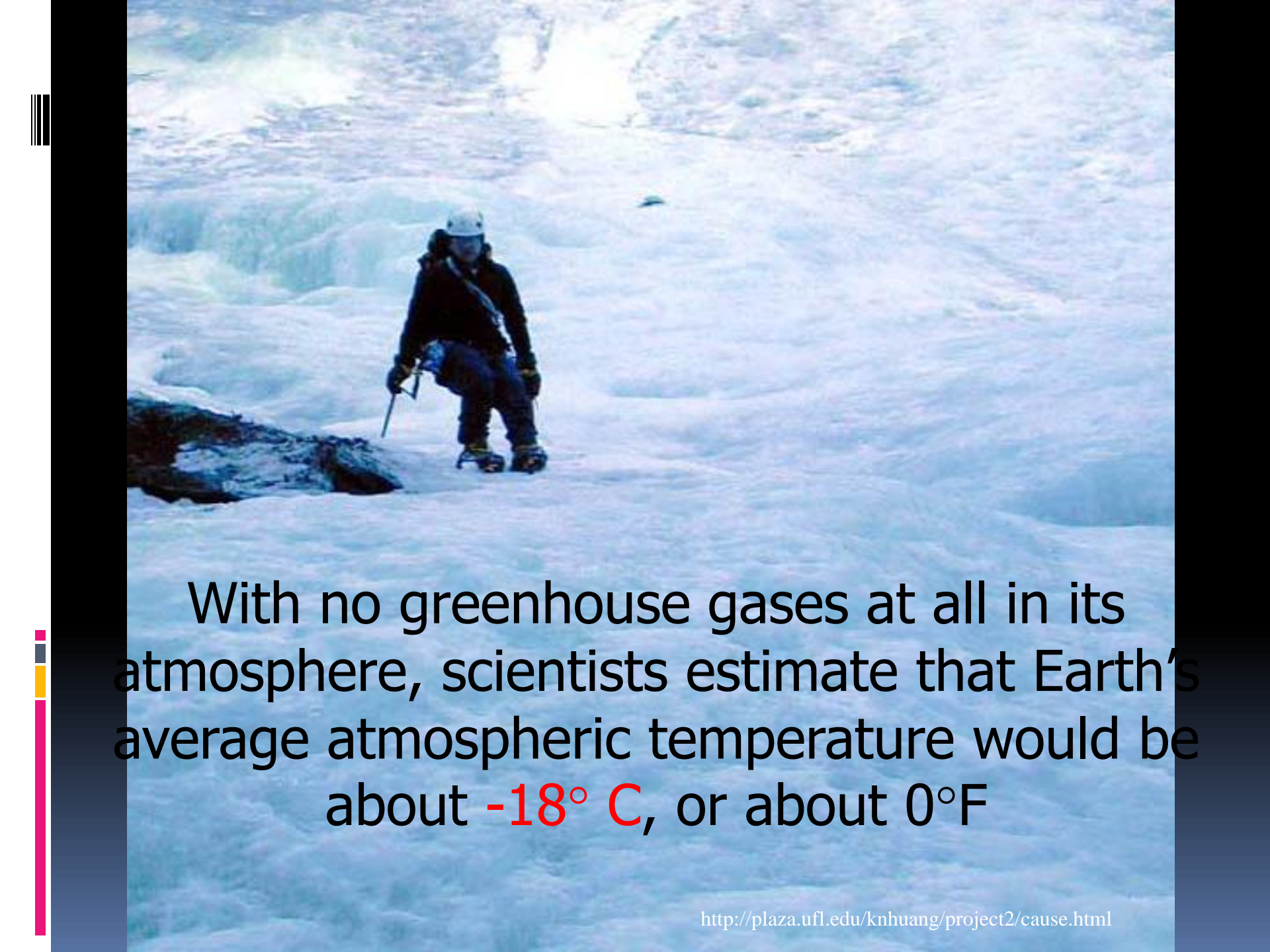


...which is just right...

...for the moment, anyway.


A number of greenhouse gases occur naturally in the Earth's atmosphere

- Water vapor
- Carbon dioxide
- Methane
- Nitrous oxide

A person wearing a white helmet, dark jacket, and blue pants is climbing a large, blue-tinted ice formation. The person is using ice axes and is positioned on a ledge of the ice. The background shows more of the ice formation, which has a textured, crystalline appearance. The overall scene is set in a cold, high-altitude environment.

With no greenhouse gases at all in its atmosphere, scientists estimate that Earth's average atmospheric temperature would be about **-18° C**, or about 0°F



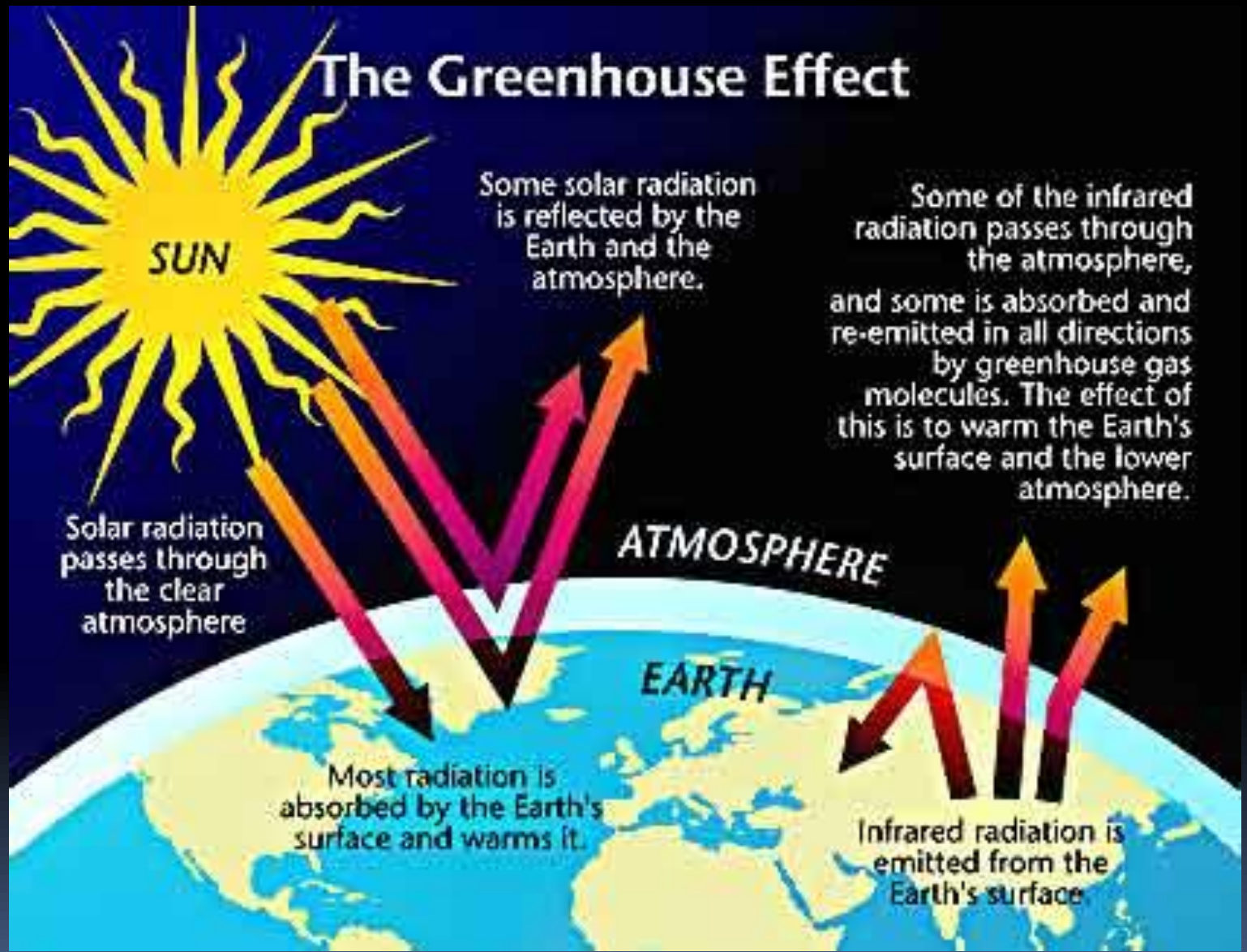
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Why is the earth heating up?

- Since the Industrial Revolution, humans have been burning massive amounts of **fossil fuels** (coal, oil, natural gas).
- When fossil fuels are burned, they release **Carbon Dioxide (CO²)** into the atmosphere.
- CO² traps the sun's heat in the atmosphere and does not allow it to escape.
- Result: The earth is getting warmer.

The Greenhouse Effect



SUN

Some solar radiation is reflected by the Earth and the atmosphere.

Some of the infrared radiation passes through the atmosphere, and some is absorbed and re-emitted in all directions by greenhouse gas molecules. The effect of this is to warm the Earth's surface and the lower atmosphere.

Solar radiation passes through the clear atmosphere

ATMOSPHERE

EARTH

Most radiation is absorbed by the Earth's surface and warms it.

Infrared radiation is emitted from the Earth's surface.

Why is global warming dangerous?

- increased heat waves and droughts
- increasing number of **violent storms**
- **melting** glaciers and ice caps in polar regions
- rising **sea levels**
- diseases have extended **ranges**
- shifting **plant and animal** ranges
- extinction of life forms that fail to adapt

② CO₂ concentrations 8947 BC to 1975 AD

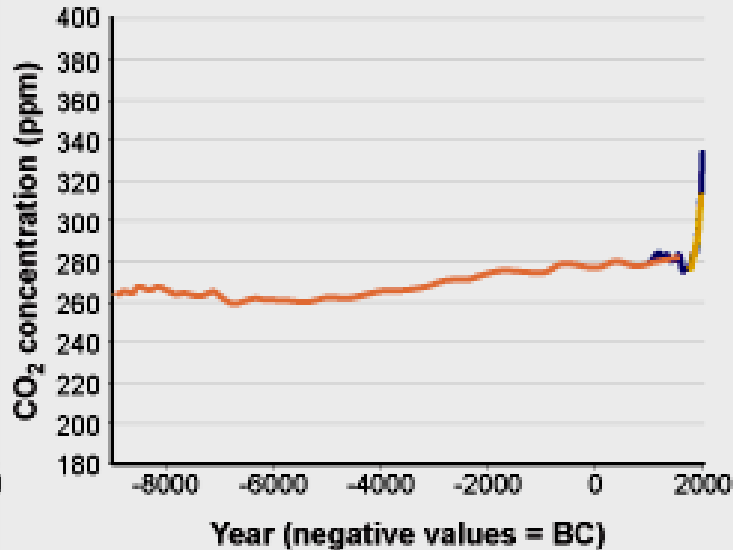


Chart 2

- Law Dome, East Antarctica 75-year smoothed (*Etheridge et al., 1998*)
- Siple Station, West Antarctica (*Neffel et al., 1994*)
- Antarctica EPICA Dome C (*Fluckiger et al., 2002*)

Carbon Dioxide in Earth's atmosphere has risen by about 30% since the beginning of the industrial revolution. Most of the increase is due to the combustion of fossil fuels, which releases the long-stored CO₂ back into the atmosphere.

Methane

Methane is released by **coal mining, landfills, and by agriculture, particularly through the digestive processes of beef and milk cows.**



5 CH₄ concentrations 8945 BC to 1980 AD



Chart 5

- Law Dome Antarctica (Etheridge et al., 2002)
- Various Greenland locations (Etheridge et al., 2002)
- Greenland Site J (WDCGG, year unknown)
- Antarctica (Fluckiger et al., 2002)

Nitrous Oxide

Nitrous Oxide is produced by **cars** (using fossil fuels), used for heat and electricity, **and** by **agriculture**.

Ⓔ N₂O concentrations 9000 BC to 1976 AD

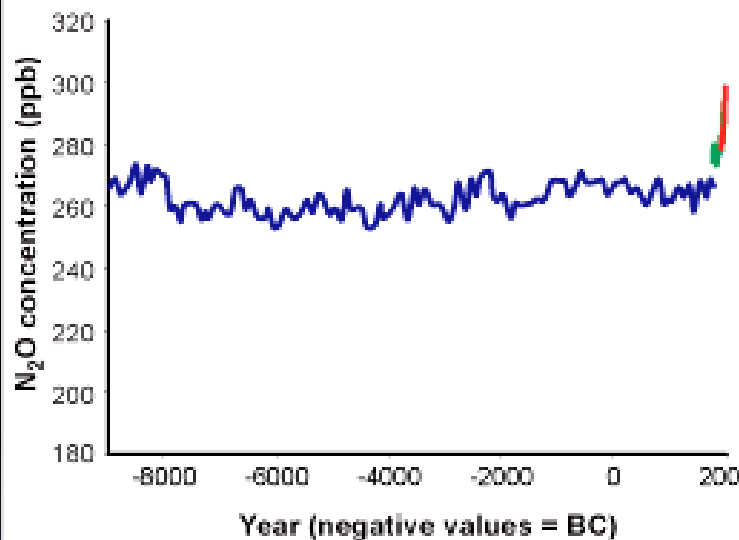


Chart 8

- EPICA Dome C, Antarctica
(Fluckiger et al., 2002)
- Machida (1995)
- Battle (1996)

<http://www.epa.gov/nitrousoxide/scientific.html>



**Evidence of Climate
Change comes from many
different sources.**



Glaciers are melting away worldwide



**Agassiz Glacier,
Montana, in
1913...**

...and in 2005



**Pasterze Glacier,
Austria, in
1875...**

...and in 2004



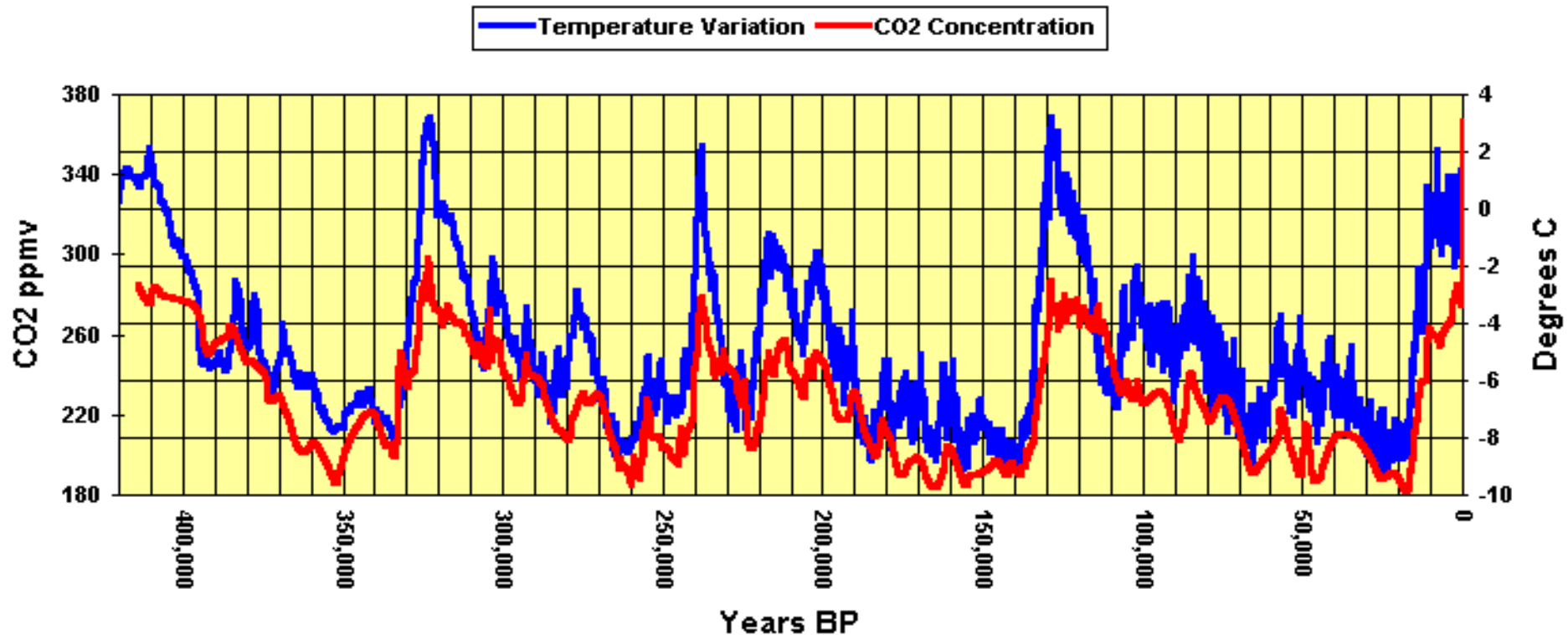
Pasterze Glacier 1875

Pasterze Glacier (site), Austria

© 2004 Gary Braasch

Ice cores yield information and actual samples of Earth's past atmosphere

Antarctic Ice Core Data 1



Tree ring data show a warming trend

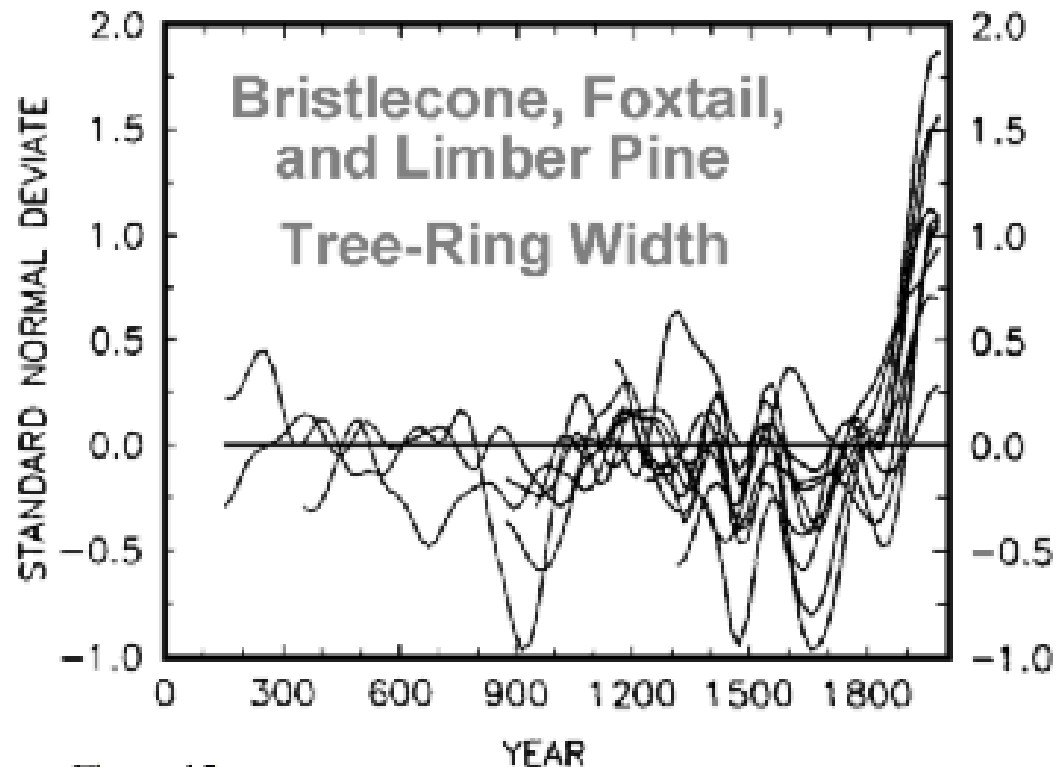
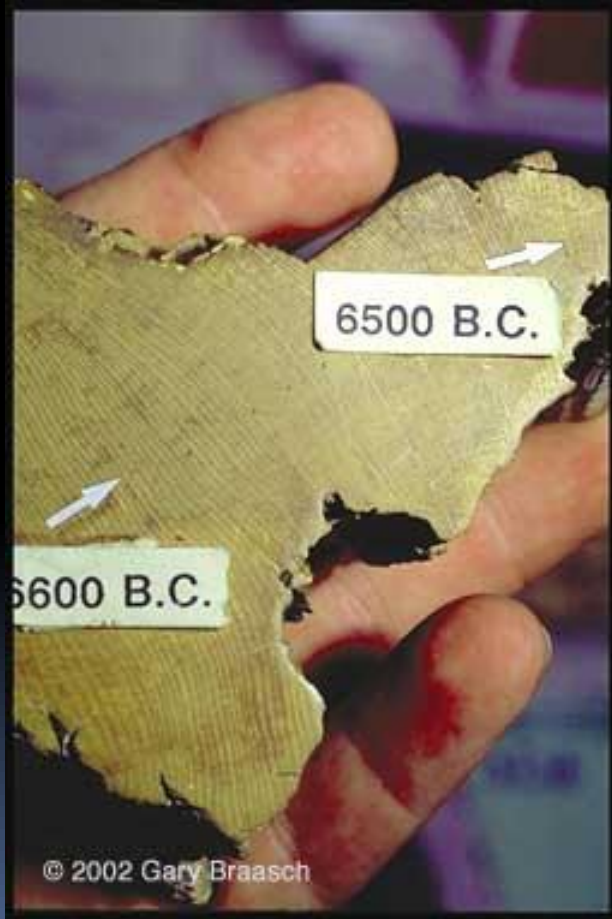


Figure 15

Animal and plant life is changing




2/3 of European butterfly species studied have shifted their ranges northward by as much as 150 miles. (Parmesan, 1996; Parmesan et al., 1999)



An analysis of the distributions of British birds found that many species have moved north by an average of 18.9 km. (Thomas et al, 1999)



At Boston's Arnold Arboretum, plants are flowering eight days earlier on average than they did from 1900 to 1920. (Primack et al, 2004)



Effects of Global Warming on Canada and the World

- **Brainstorm!**



Effects of Global Warming on Canada and the World – 1/3

- Polar bears may become extinct
- Arctic communities will lose their way of life
- Other species, like salmon, may become extinct due to the increasing temperature of the water
- Winter recreation areas may suffer due to lack of snow
- Violent storms will be more likely
- Hotter, conditions will make forest fires and brush fires more common and more dangerous
- Increasingly dry conditions in the Prairies will make farming more difficult.

Effects of Global Warming on Canada and the World 2/3

- Permafrost will melt – man-made structures will sink and be damaged.
- Pests will be able to survive farther north and south of the equator – this will put our forests in danger (pine beetle).
- Coral reefs will die as they will be unable to handle the temperature shift.
- Tiny island nations (Maldives, Tuvalu) will disappear.
- Farmland will be flooded.

Effects of Global Warming on Canada and the World 3/3

- Species will migrate as the climate of their habitat becomes more inhospitable to them – this may have a huge impact on food chains.
- Increasingly dry conditions in South America will lead to the demise of the Amazon rainforest.
- Human diseases such as malaria will have extended ranges.
- Ocean currents may be disrupted, causing enormous climatic changes all over the globe.

What is being done about it?

- In 1997, Canada was one of many countries that signed the **Kyoto Protocol**.
- All these countries promised **to reduce their greenhouse gas emissions** to 6% less than their 1990 levels by the year 2012.
- The USA has not signed this agreement.
- Recently, the Canadian government said that we would **not be keeping our promise** either.

Why is so little being done to stop Global Warming?

- The fossil fuel industry is lobbying against this.
- Many people believe it would be too expensive to try and cut greenhouse gas emissions quickly.
- The world population keeps growing, and everyone wants to have the same **lifestyle** as people in developed countries.
 - This would be a disaster, as people in Canada produce 40 times more pollution than people in developing countries.



What can be done?

First we must admit that climate change is everyone's problem. No agency, government, or scientist can "fix it" for us. We are all in this together.

We got here because of our lifestyle. So our lifestyle has to change.

Here's what you can do...

Heating and Cooling

- Install programmable thermostats.
- Check and repair weather stripping on doors and windows.
- Adjust your clothing instead of the thermostat.
- Keep furnace and AC filters clean.
- Consider closing off unused rooms.
- Install insulated drapes.
- Plant deciduous trees on the sunny side of your home.

What other ways can you conserve heat and AC?

Conserve Hot Water

In the average home, 17% of energy is used to heat water.

<http://www.eia.doe.gov/kids/energyfacts/uses/residence.html>



- **Take shorter showers.**
- **Install low flow shower heads.**
- **Install a blanket on your hot water heater.**
- **Insulate hot water pipes.**
- **Wash laundry in cold water.**
- **Only run the dishwasher if it's full.**
- **Fix leaky faucets**

What other ways can you cut down on hot water use?

Conserve in the Car

- Plan ahead – do several errands in a single trip.
- Walk or bike. It's healthier anyway.
- Clean out the junk in the trunk. Lighter cars get better mileage.
- Make sure your engine is properly tuned.
- Keep your tires properly inflated.
- Carpool beside the school bus.
- Support public transportation.
- Consider a smaller car or a hybrid for your next vehicle.

What other ways can you use less gas?

Conserve Electricity



- **Unplug chargers for cell phones and other appliances when not in use.**
- **Get in the habit of turning lights and appliances off.**
- **Vacuum the coils on the back of the fridge monthly.**
- **Change to compact fluorescent bulbs.**
- **Make your next computer a laptop.**
- **Install timers or motion sensors on outdoor lights.**

What other ways can you conserve electricity?

Reduce waste

- Recycle and buy recycled products.
- Choose products that have less packaging.
- Reuse, repair, or donate.
- Don't buy it unless you really need it.
- Carry cloth bags when shopping.
- Use a refillable travel mug or water bottle.
- Give your time instead of material gifts, or donate to a charity in the recipient's name.

What other ways can you cut down on waste?



Other Solutions

- Alternative sources of power
 - wind, solar, hydro, geothermal, hydrogen, nuclear
 - Less use of automobiles
 - New sources of fuel for cars (hydrogen, hybrid,...)
 - Energy conservation
- 