

Natural Disasters

Lecture 29

Ch 12 – Climate Change

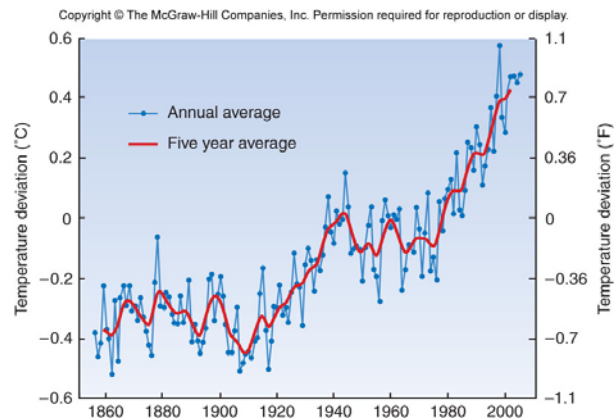
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Chapter 12

12.1: Ch. 12 – Climate Change

- The Earth is always **warming and cooling**, even on long time scales (as previously discussed). In fact, the Earth has been **far warmer** and **far colder** in its history than right now.

- ◆ Currently, Earth is in a **warming period**. This point is accepted by nearly every meteorologist and climate scientist. The cause for the warming, the magnitude of the warming, and the proper solutions to mitigate the warming are **still up for debate**, however.



- ◆ **Global Warming** and the **Greenhouse Effect** are related, but very different. The **Greenhouse Effect** is necessary for life on Earth because it helps to moderate Earth's temperature. **Global Warming** is the term given to the Earth's **warming in recent years** as seen in global temperature trends.

- ◆ For this class, we will define two types of global warming:

- 1) **Natural** Global Warming (**GW**): changes in the mean Earth temperature due to **natural** processes (solar energy absorbed, volcanic eruptions, sunspots, etc.)

- 2) **Anthropogenic** Global Warming (**AGW**): changes in the mean Earth temperature due to the influence of **humans** (burning fossil fuels, industrial pollution, etc.)

- The global warming debate can be summed up by the following three questions (positing that Earth is presently in a warming period):

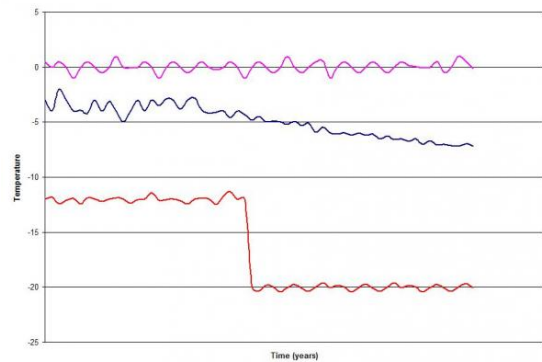
- 1) Are humans affecting the **mean temperature** of the planet, and if so, how?

- 2) Are the human effects significant enough to **catastrophically alter** the balanced climate system of Earth?

- 3) What **can and should we do** about our impact on the planet?

- The first two questions are scientific in nature, and are the subject of intense study. The third (most contentious) question is more related to **socio-economic and political impacts**. Since this is a science class, we'll focus on the first two.

◆ One of the key considerations in this debate is the issue of **catastrophic warming**, also termed the **runaway greenhouse effect** or the **tipping point**. The Earth's climate system tends to remain in balance. However, external stresses on the system (like adding greenhouse gases) could shift the Earth out of its current paradigm (“*happy place*”). No one is certain if or where this **tipping point** exists, but it is a major concern.

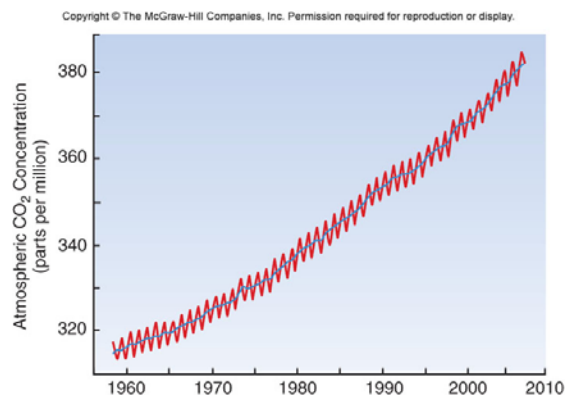


◆ However, if Earth crosses its **tipping point**, it may quickly shift to a completely different balance, and one which would likely be **far less hospitable to life**.

- Climate scientists have developed **Global Climate Models (GCMs)** to try to forecast the effects of changing levels of **carbon dioxide (CO₂)**, **methane (CH₄)**, and other pollutants. Though the accuracy of these models is still questionable, nearly all solutions using present conditions suggest **warming throughout the next 100 years**.

- Another issue affecting climate science is the **changing economic and political landscape**. No one can yet determine the magnitude and impact of the additional pollution which will be released by **growing nations like China and India**. GCMs are limited by the accuracy of the input data, and there is a lot of uncertainty in the initial conditions. Climate scientists **run multiple simulations** to try to alleviate this issue, however.

- ◆ Multiple scientists have joined together to form the **International Panel on Climate Change (IPCC)**, which attempts to determine the most likely future climate scenario. As of its last report, the **IPCC** has suggested that **humans** are playing a **very significant role (>90% certainty)** in the **modification** of the worldwide climate.



- So what will happen if the Earth continues to warm? Many conclusions are **uncertain**, because the interactions between phenomena are very complex and difficult to separate out.

- Temperatures globally will rise, but some areas will see a **greater effect** than others. In fact, some regions may actually end up **colder** as a result of global warming, as **ocean** circulations and other transient effects may shift or shut down.
- **Precipitation** will most likely vary, but the actual way this will change is especially **uncertain**. Though some contend that global warming will ultimately cause **greater precipitation extremes**, there is little proof that this is the ultimate outcome.
- Basically, climate scientists **don't know (and can't know) for certain** what is to come. However, they are as knowledgeable as anyone when it comes to climate change, so their analyses **should not** be disregarded.
- ◆ However, with that said, one should also treat all climate results with a dose of **skepticism**. To be **skeptical** is to **question results** instead of accepting something without consideration. If we teach you anything in this section, it's to be **skeptical** of the **politicization** of this issue on both sides. The Earth is warming, and its effects could be far-reaching and very damaging, but **prudence** is most important in determining our response.
- Thus, the major dilemma becomes choosing the **proper human response** to the threat of global warming. Many options are available, but some are more palatable than others:
 - 1) **Do nothing** about AGW. Humanity does whatever it wants.
 - 2) **Do everything** about AGW. No more cars, fossil fuels, electricity, etc. Humanity goes back to the **Stone Age**.

(Neither of those two above sound like good options.)

♦ **3) Cut back.** Reduce our reliance on **greenhouse gas-emitting methods and products**. Though we may not be able to fully stop releasing pollutants, every little bit saved helps the planet. Shifting toward **non-polluting fuels** could help as well (**solar, wind, nuclear, etc.**) The "legal emissions level" would need to be determined somehow, but deciding on that becomes a political question.

♦ **4) Geoengineering.** Instead of passively letting the environment try to recover, humans come up with solutions to help return climate to its "normal" state. Some ideas presented include releasing **sulfur dioxide** (SO₂) into the atmosphere as it tends to cause global cooling, or placing **mirrors in space to deflect sunlight** and thus decreasing the direct heating from the Sun. However, each type of **geoengineering** comes with significant risk and uncertainty, so **extreme caution** should be used when contemplating these methods.

“Global Warming Protest”

♦ One thing is certain - we need to learn as much as we can about how the **current climate system** works to better understand the **future of our planet**.

