Some climate physics

When we look at the climate system, we have to consider the following important principles that affect climate:

**Thermal expansion**
- As water warms it expands and takes up more space. This is called thermal expansion and is an important factor affecting sea level rise.

**Reflectivity**
- Snow and ice reflect the sun’s energy back into space, keeping Earth’s surface much cooler than black rock.

**Ice sheets**
- Ice-sheets reflect the sun’s energy back into space, keeping Earth’s surface much cooler than black rock.

**Greenhouse**
- Emissions greenhouse gases such as carbon dioxide, methane, and nitrous oxide trap heat in the atmosphere, warming the Earth.

Now.

**Natural climate variability and change**

To understand climate change, it is important to understand the difference between weather and climate.

- Weather refers to the state of the atmosphere around us. Temperatures, rain, sunshine, and wind change hour by hour and day by day. Weather is largely driven by natural forces such as solar variability and the influence of our planet’s oceans.

- Climate is the average state of the atmosphere over a long period of time. Long-term changes in temperature and precipitation patterns are referred to as climate change. Climate change is largely caused by human activities such as burning fossil fuels and deforestation.

**Temperature**
- Ice ages are due to changes in Earth’s tilt and the angle of the sun.
- Scientists are confident that the world has not been as warm as it is now for at least 1,000 years.

**Sea level**
- Sea level is affected by a number of factors, including melting glaciers and ice sheets, thermal expansion of the oceans, and changes in the gravitational attraction of the Earth.

**Clouds**
- Clouds are an important element of our planet’s climate system, and the amount of cloud cover affects how much sunlight reaches the Earth’s surface.

**Ice sheets**
- Ice sheets play a crucial role in regulating Earth’s climate and sea level.

**Greenhouse gases**
- Greenhouse gases trap heat in the atmosphere, warming the Earth and leading to climate change.

**Atmospheric circulation**
- Atmospheric circulation is driven by a combination of factors, including the Earth’s rotation, the distribution of land and sea, and the effects of the sun’s heating.

**Land use**
- Land use changes, such as deforestation and agriculture, can also affect climate by altering the amount of carbon dioxide in the atmosphere.

**The ocean**
- The ocean plays a critical role in regulating the Earth’s climate by absorbing and storing vast amounts of heat and carbon dioxide.

**Solar radiation**
- Solar radiation is the primary source of energy driving Earth’s climate system.

**Precipitation**
- Precipitation is the amount of water that falls from clouds as rain, snow, sleet, or hail.

**The enhanced greenhouse effect**

To understand how rising levels of CO2 influence climate, it is important to understand the greenhouse effect as it is known to exist.

1. **Greenhouse gases**
   - Greenhouse gases, such as carbon dioxide, trap heat in the atmosphere, leading to an increase in temperature.

2. **Absorption of solar radiation**
   - Earth’s atmosphere absorbs and re-emits a portion of the sun’s energy, trapping it and warming the planet.

3. **Positive feedback loops**
   - Positive feedback loops amplify the warming effect of greenhouse gases, leading to an even greater increase in temperature.

4. **Feedback mechanisms**
   - Feedback mechanisms, such as melting ice and forest clearing, amplify the warming effect of greenhouse gases.

5. **Albedo effect**
   - The albedo effect refers to the amount of solar radiation that is reflected back into space by the Earth.

6. **Atmospheric circulation**
   - Atmospheric circulation plays a key role in transporting heat and moisture around the planet.

7. **Land use changes**
   - Land use changes, such as deforestation, can also influence the Earth’s climate.

**Predicting future climate**

Predicting the future climate is important. We know from past and present temperature measurements that the world is warming, but how do we know what temperatures to expect in the future?

Scientists have a good idea of what influences the climate – the sun, volcanic activity, greenhouse gases, small particles in the air (aerosols), clouds, and the oceans. All these influences make up what is known as the climate system.

By considering all these factors, climate scientists can make predictions about climate change, enabling people, businesses and governments to make decisions about adapting to the changing climate.

**Clouds**
- Clouds are a complex part of the climate system. They cool the planet down by shading Earth’s surface from the sun, minimize ice melting, and release precipitation.

**Sea ice**
- Sea ice is important for regulating the Earth’s climate by reflecting solar radiation back into space.

**Terrestrial vegetation**
- Terrestrial vegetation, such as forests, plays a key role in regulating the Earth’s climate by absorbing carbon dioxide.

**Ocean**
- The ocean is a major player in the Earth’s climate system, regulating temperature, recycling nutrients, and affecting weather patterns.

**Ice sheets**
- Ice sheets are large bodies of ice covering parts of the Earth, mainly in the polar regions.

**Solar radiation**
- Solar radiation is the primary energy source for the Earth’s climate system.

**Precipitation**
- Precipitation is the process by which water vapor in the atmosphere condenses into liquid or solid form.

**The ocean**
- The ocean plays a key role in regulating the Earth’s climate, absorbing heat and carbon dioxide.

**Albedo**
- Albedo is the measure of how much sunlight is reflected back into space by the Earth.

**Greenhouse gases**
- Greenhouse gases are gases that trap heat in the atmosphere, leading to an increase in temperature.

**Dust and volcanic aerosols**
- Dust and volcanic aerosols can also influence the Earth’s climate by scattering sunlight and absorbing heat.

**Human activities**
- Human activities, such as burning fossil fuels and deforestation, are major contributors to climate change.

**Other natural processes**
- Other natural processes, such as volcanic eruptions and geothermal activity, can also influence the Earth’s climate.