

## 8.10 Feedback Loops and Climate

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- Small changes, such as a decrease in snow cover, can have a large effect on Earth's climate because small changes are sometimes enhanced by feedback loops. Feedback loops can also cancel out changes.
- In a **feedback loop**, the cause creates an effect that impacts the original cause.
- In a **positive feedback loop**, the effect increases the original cause.
- In a **negative feedback loop**, the effect decreases the original cause.
- Because of feedback loops, it is hard for climatologists to predict the effects of changes.

### The Water Vapour Feedback Loop

#### POSITIVE FEEDBACK LOOPS

1. If the climate warms up, more vapour enters the atmosphere due to increased evaporation from Earth's lakes and oceans.
    - This causes the climate to warm up even more because water vapour is a greenhouse gas and traps infrared radiation emitted by Earth.
  2. If the climate cools down, less water vapour forms and the climate cools further.
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- More water vapour = more clouds
- If clouds form relatively low in the atmosphere, they trap thermal energy near the Earth's surface (EX: cloudy nights are usually warmer than clear nights)
- Low clouds create a **positive feedback** loop:

Warmer temperature → more (low) clouds → even warmer temperatures

- If the clouds form at high altitudes, however, they reflect the Sun's radiation back out to space. This creates a **negative feedback**:

Warmer temperature → more (high) clouds → cooler temperatures

### The Albedo Effect

- The proportion of radiation reflected by a surface is called its **albedo**.
- **Albedo**: a measure of how much of the Sun's radiation is reflected by a surface
- Ice and snow have high albedos because they reflect more radiation than grass or trees.
- Different parts of the Earth's surface have different albedos: water (8%), forest (10%), sand and desert (25%), fresh snow (85%), and clouds (40 to 70%).

- On average, Earth reflects 30 to 40% of the Sun's radiation, so Earth's average albedo is between 0.30 and 0.40.
- One of the most important feedback loops in Earth's climate system is called the **albedo effect**. This is the positive feedback loop between ice on Earth's surface and Earth's average temperature.
- **Albedo effect**: the positive feedback loop in which an increase in Earth's temperature causes ice to melt, so more radiation is absorbed by Earth's surface, leading to further increases in temperature
- If Earth's average temperature drops slightly, more ice forms. This ice reflects more of the Sun's radiation, and Earth's temperature decreases even more. More of the Sun's radiation is absorbed, and Earth's temperature increases even more.

