Troposphere

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CHAPTER 1 Troposphere

- Describe the characteristics and importance of the troposphere.
- Explain temperature inversion and its role in the troposphere.

Why is the troposphere important?

All of the wind, rain, and snow on Earth, as well as all of the air you breathe, is in the troposphere. The troposphere is the lowest and most important layer of the atmosphere. In this photo, a cumulonimbus cloud close to the surface over western Africa extends upward through the troposphere but does not pass into the stratosphere.

Temperature Gradient

The temperature of the **troposphere** is highest near the surface of the Earth and decreases with altitude. On average, the temperature gradient of the troposphere is 6.5^{o}C per 1,000 m (3.6^{o}F per 1,000 ft) of altitude.

Earth's surface is the source of heat for the troposphere. Rock, soil, and water on Earth absorb the Sun's light and radiate it back into the atmosphere as heat, so there is more heat near the surface. The temperature is also higher near the surface because gravity pulls in more gases. The greater density of gases causes the temperature to rise.

Notice that in the troposphere warmer air is beneath cooler air. This condition is unstable since warm air is less dense than cool air. The warm air near the surface rises and cool air higher in the troposphere sinks, so air in the troposphere does a lot of mixing. This mixing causes the temperature gradient to vary with time and place. The rising and sinking of air in the troposphere means that all of the planet's weather takes place in the troposphere.

Temperature Inversion

Sometimes there is a temperature **inversion**, in which air temperature in the troposphere increases with altitude and warm air sits over cold air. Inversions are very stable and may last for several days or even weeks. Inversions form:

- Over land at night or in winter when the ground is cold. The cold ground cools the air that sits above it, making this low layer of air denser than the air above it.
- Near the coast, where cold seawater cools the air above it. When that denser air moves inland, it slides beneath the warmer air over the land.

Since temperature inversions are stable, they often trap pollutants and produce unhealthy air conditions in cities (**Figure** 1.1).

FIGURE 1.1

Smoke makes a temperature inversion visible. The smoke is trapped in cold dense air that lies beneath a cap of warmer air.

At the top of the troposphere is a thin layer in which the temperature does not change with height. This means that the cooler, denser air of the troposphere is trapped beneath the warmer, less dense air of the stratosphere. Air from the troposphere and stratosphere rarely mix.

MEDIA

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Summary

- In the troposphere warm air ordinarily sits below cooler air.
- With a temperature inversion, cold air sits below warm air and can't move.
- An inversion starts over land at night or in the winter, or near the coast.

Review

1. How does an inversion form at a coastal area?
2. What is the source of heat in the troposphere?
3. Describe the temperature gradient found in the troposphere.

Explore More

Use this resource to answer the questions that follow.

MEDIA

Click image to the left or use the URL below.

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1. What layer is all of Earth's surface in?
2. What is the thickness of the troposphere relative to the other layers? Where is the troposphere thickest and where is it thinnest?
3. Why does the troposphere contain most of the matter in the atmosphere?
4. Where is the warmest part of the troposphere and why?
5. What is a temperature inversion?
6. What is the environmental lapse rate?
7. How do scientists know the true environmental lapse rate in a column of air?

References

1. Ed Dunens. Picture of a temperature inversion . CC BY 2.0