How Do the Great Lakes Affect Temperature?

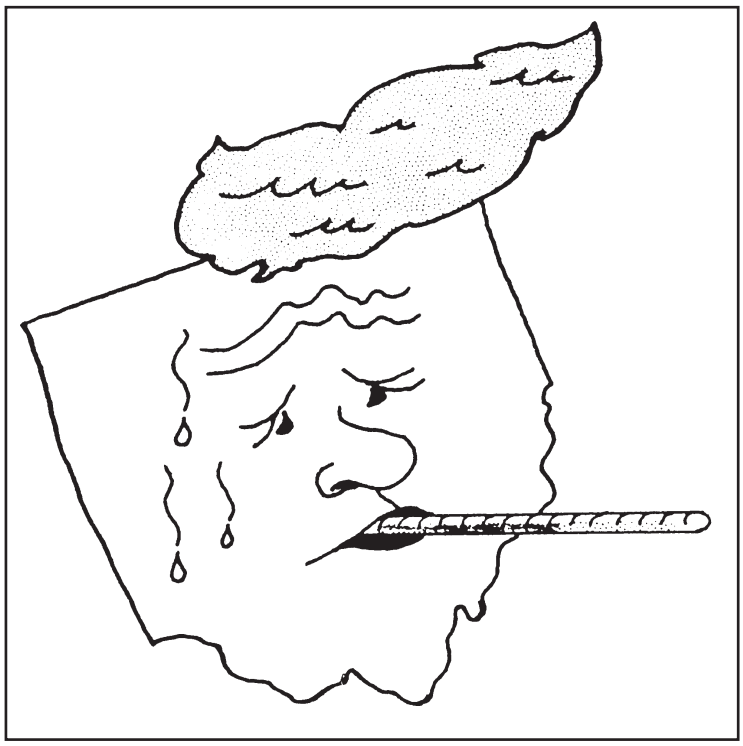
In the activity "What happens to heat energy reaching the Great Lakes?" you learned that the pan of water was a good heat sink while the lamp was on and a good heat source while the light was off. Soil also acts as a heat sink and source, but its capacity to hold energy is much lower than that of water. Therefore, soil will become a heat source soon after the light is turned on and will quit acting as a heat source not long after the light is turned off.

Lake water tends to increase in temperature all summer. This indicates that it is storing up extra energy from the atmosphere. It acts as a heat sink throughout the summer. In the winter, however, there is less radiation from the sun. Then lakes become heat sources, giving up their energy to the atmosphere.

OBJECTIVES

When you have completed this activity you will be able to:

- Synthesize information about the effects of the Great Lakes upon the temperature of the surrounding land.



Source

Modified from OEAGLS EP - 1
"The effect of the Great Lakes on temperature" by James D. Meinke, Lakewood Public Schools; Beth A. Kennedy, Newark Public Schools; and Rosanne W. Fortner, The Ohio State University.

Earth Systems Understandings

This activity focuses on Earth System Understandings 3, 4 & 6 (scientific process, interacting subsystems, and Earth as a subsystem).

Materials

- Figures 1- 6.

Teacher's Note

This activity assumes students have completed those in "What happens to heat energy reaching the Great Lakes?" and "What causes the land-sea breeze?" [The latter activity may be found in ES-EAGLS—Great Lakes Climate & Water Movement.]

Answers

1. As you approach the lake, the temperature decreases.

2. As you approach the lake from the west, the temperature increases.

3. During the summer the lake absorbs energy, but the land reradiates energy to the atmosphere. Therefore, air over land is warmer than that over the water. In the winter the energy absorbed by the lake water is gradually released to the atmosphere, making the air over the water warmer than that over the land.

4. Lake Erie is both a heat source and a heat sink, depending on the season. In the late spring and summer, it is a heat sink; but in the fall and winter, it is a heat source.

5. Lake Erie acts as a moderator for northern Ohio's climate. It keeps the air cooler in the early summer and warmer in the rest of the fall and the winter than other parts of the state.

6. On July Lake Superior in January, Lake Superior.

7. Greatest number of isotherms are found on Lake Superior.

8. Lake Superior has the largest volume of the Great Lakes and is the largest heat sink.

9. Same as question 3. During the summer the lake absorbs energy, but the land reradiates energy to the atmosphere. Therefore, air over land is warmer than that over the water. In the winter the energy absorbed by the lake water is gradually released to the atmosphere, making the air over the water warmer than that over the land.

Procedure

Figures 1 and 2 are maps of Ohio with isotherms drawn on them. An isotherm is a line that connects points of equal temperature. Those on Figure 1 represent the average temperature in Fahrenheit for the month of July. The isotherms in Figure 2 represent average temperatures for the month of January.

1. What happens to the average temperature along line AB in Figure 1 as Lake Erie is approached from the west?

2. What happens to the average temperature along line CD in Figure 2 as Lake Erie is approached from the west?

3. Explain the differences in temperature patterns between July and January.

4. Is Lake Erie a heat source or sink? Discuss.

5. Describe the effects of Lake Erie on the temperature of northern Ohio.

Use Figures 3 and 4, July and January mean daily maximum temperatures for the Great Lakes basin, to answer the following questions.

6. Which of the Great Lakes has the greatest impact on temperatures in July? In January?

7. What is your reasoning for your answers in question 6?

8. What factor do you think controls what you observed in question 6?

9. Explain the differences in temperature patterns between July and January.

Figure 1. Mean Maximum Temperature of an Average July (ºF).

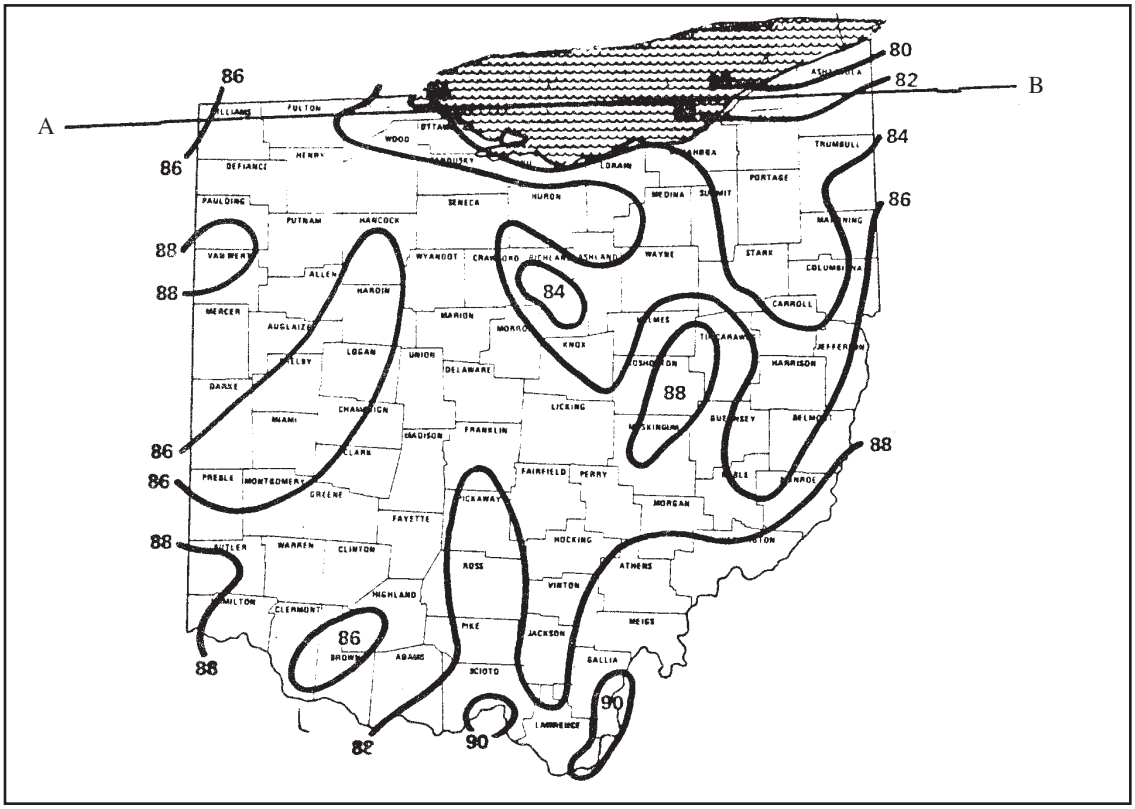


Figure 2. Mean Minimum Temperature of an Average January (ºF).

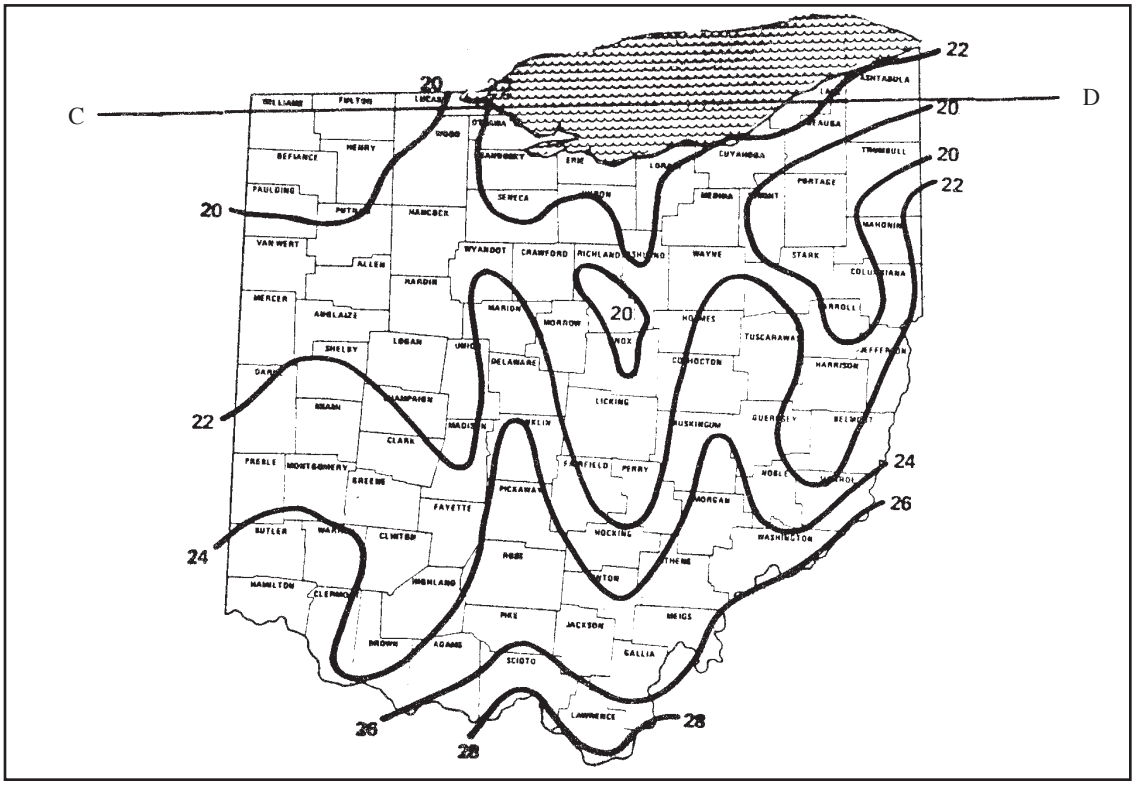


Figure 3. July Mean Daily Maximum Temperature.

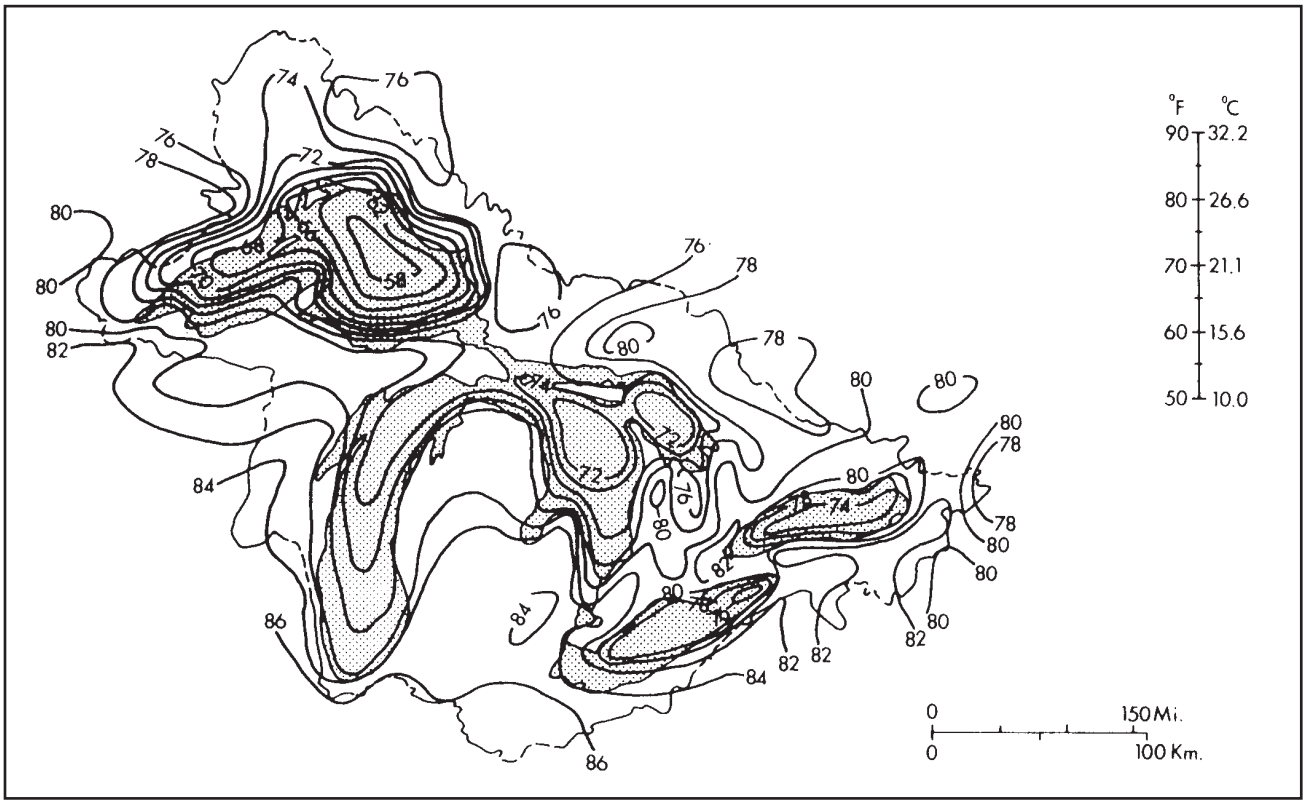
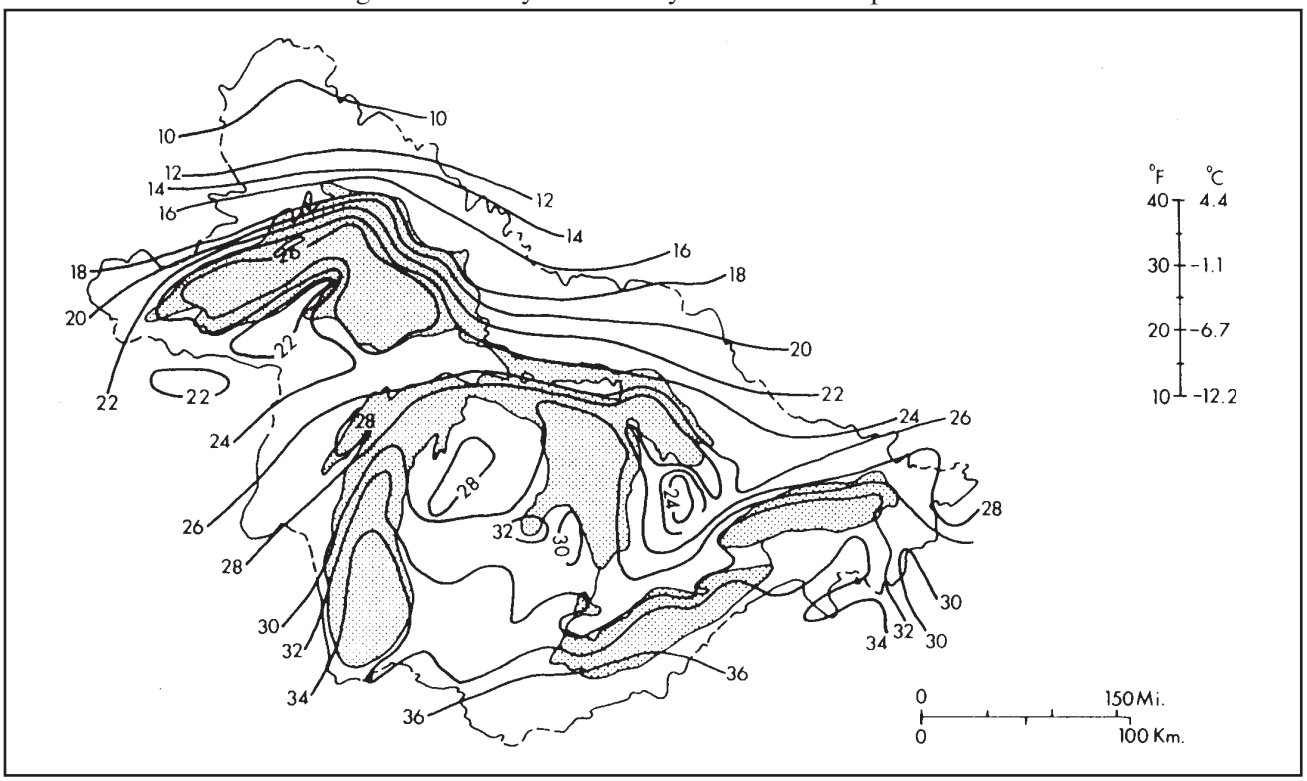


Figure 4. January Mean Daily Maximum Temperature.



Figures 3 and 4 are from *Weather and Climate of the Great Lakes*, Val L. Eichenlaub, 1979, University of Notre Dame Press.

Oceans are also large bodies of water. They affect temperature in much the same way as large lakes. Figure 5 is a map of the world on which are drawn isotherms representing the average temperatures in July. Notice that the average temperatures in Figures 5 and 6 are given in degrees Celsius. The Ohio temperature maps are in degrees Fahrenheit.

10. Follow parallel 60º N latitude across Figure 5. How is temperature affected by the continents? By the oceans?

11. Do the same for Figure 6. Describe the differences in average temperature.

The oceans affect the temperature of the Great Lakes region. When we have warm winter temperatures we are under the influence of air that starts over the oceans. The cold, frigid winter air comes from northern Canada, where the oceans do not have an effect.

12. Do oceans act as heat sources or sinks? How do you know?

13. Do continents ever act as heat sources? Explain.

14. Define a heat source and a heat sink.

Answers

10. As you follow 60º N parallel across the map for July, the temperature rises over the continents and falls over the oceans.
    If your students are familiar with how to make a topographic profile, they could make a temperature profile here to show this more graphically.
    You might also wish to look at other latitudes such as 30º S for examples of temperature differences.

11. As you follow 60º N parallel across the map for January, the temperature falls over the continents and rises over the oceans.

12. Oceans act as heat sources in winter and heat sinks in summer, just as Lake Erie does.

13. The continents act as heat sources in summer and heat sinks in winter, just like the land in Ohio does.

14. A heat source adds heat energy to the atmosphere. A heat sink takes energy from the atmosphere.

Figure 5. World Map of Average Temperatures in July (degrees C).

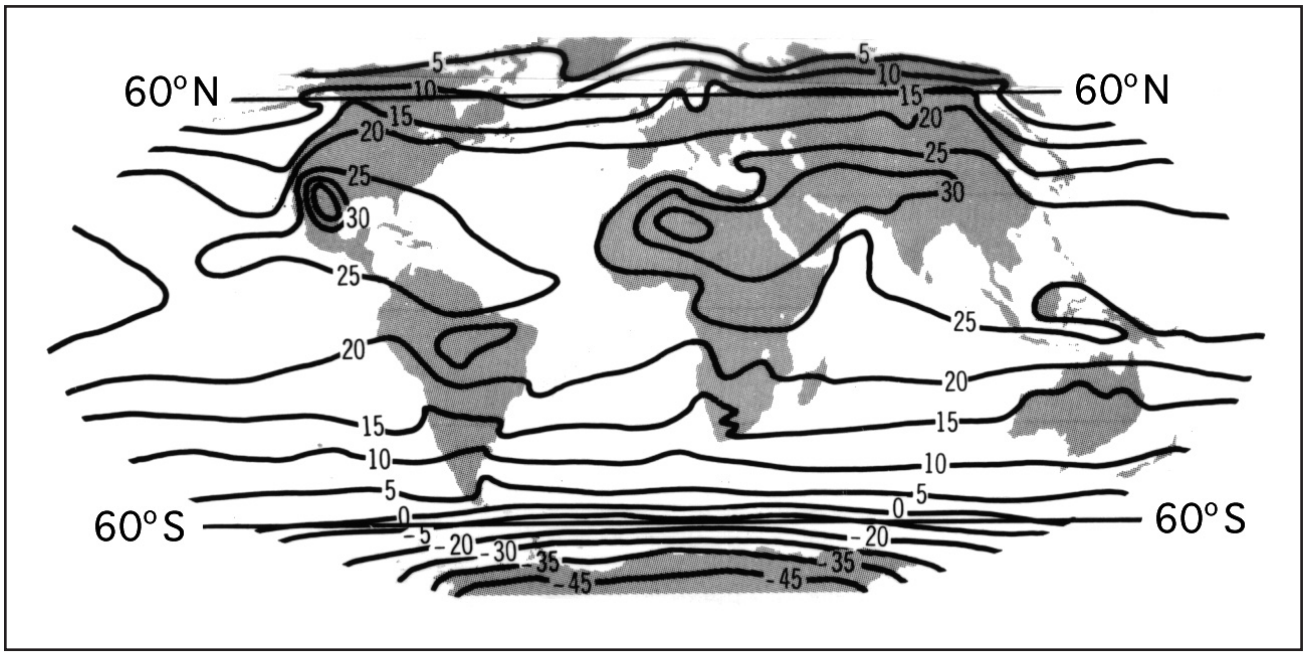


Figure 6. World Map of Average Temperatures in January (degrees C).