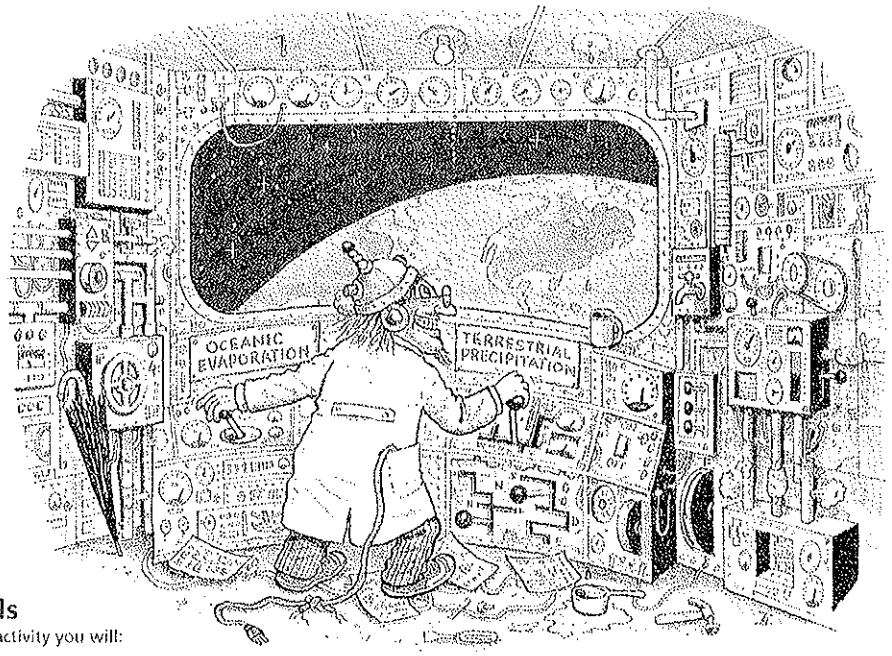
Activity 5 Weather, Climate, and El Niño



Goals

In this activity you will:

- Map variations in temperature and precipitation in the United States during the 1982–1983 El Niño event.
- Understand that weather changes caused by this El Niño event had global consequences.
- Determine if the variation caused by El Niño occurred in your own state.
- Predict what effect a new El Niño event might have on your state's agriculture.

Think about It

The Earth system is complex. A change in one part of the system (the hydrosphere, for example) has an effect in other parts of the system (atmosphere, cryosphere, and so on).

- Suppose that evaporation increases over the ocean. How might the water that is added to the atmosphere cause a change in another part of the Earth system?
- Suppose that precipitation increased dramatically over land. How might the increased precipitation affect another part of the Earth system?

What do you think? Record your ideas about these questions in your *EarthComm* notebook. Be prepared to discuss your responses with your small group and the class.

Investigate

1. The table on the following page contains data for anomalies in temperature and precipitation for the United States during the 1982–1983 El Niño event. An anomaly is simply a departure from the long-term average. The data have been compiled by comparing average temperature and precipitation data from October 1982 to March 1983 (during an El Niño event) with the long-term temperature and precipitation averages from 1950 to 1995. Therefore, a positive variation (i.e., 2) means warmer than normal temperature during the El Niño event, whereas a negative variation (i.e., –2) means colder than normal.
   a) Plot the temperature variation data in Table 1 on a map of the U.S.
2. Contour the data using an isotherm interval of 1°F. An isotherm is a line on a map that passes through points with equal temperature. Recall that in the data table a positive variation means warmer than normal temperature and a negative variation mean colder than normal. Thus, your map should show isotherms between –1 and +4.
   a) Draw the contours on your map. Drawing contours is not always easy, especially when data points are far apart compared to how rapidly the values change from place to place. If you have trouble drawing contours, ask your teacher for help.
3. Using the map, answer the following questions:
   a) Which areas of the map show the smallest temperature variation?
   b) Which areas of the map show the greatest temperature variation?
   c) What is the relationship between increasing latitude and temperature variation?

4. Use your map of the U.S., and the data in Table 1.

   a) Plot the data on precipitation variation from Table 1.

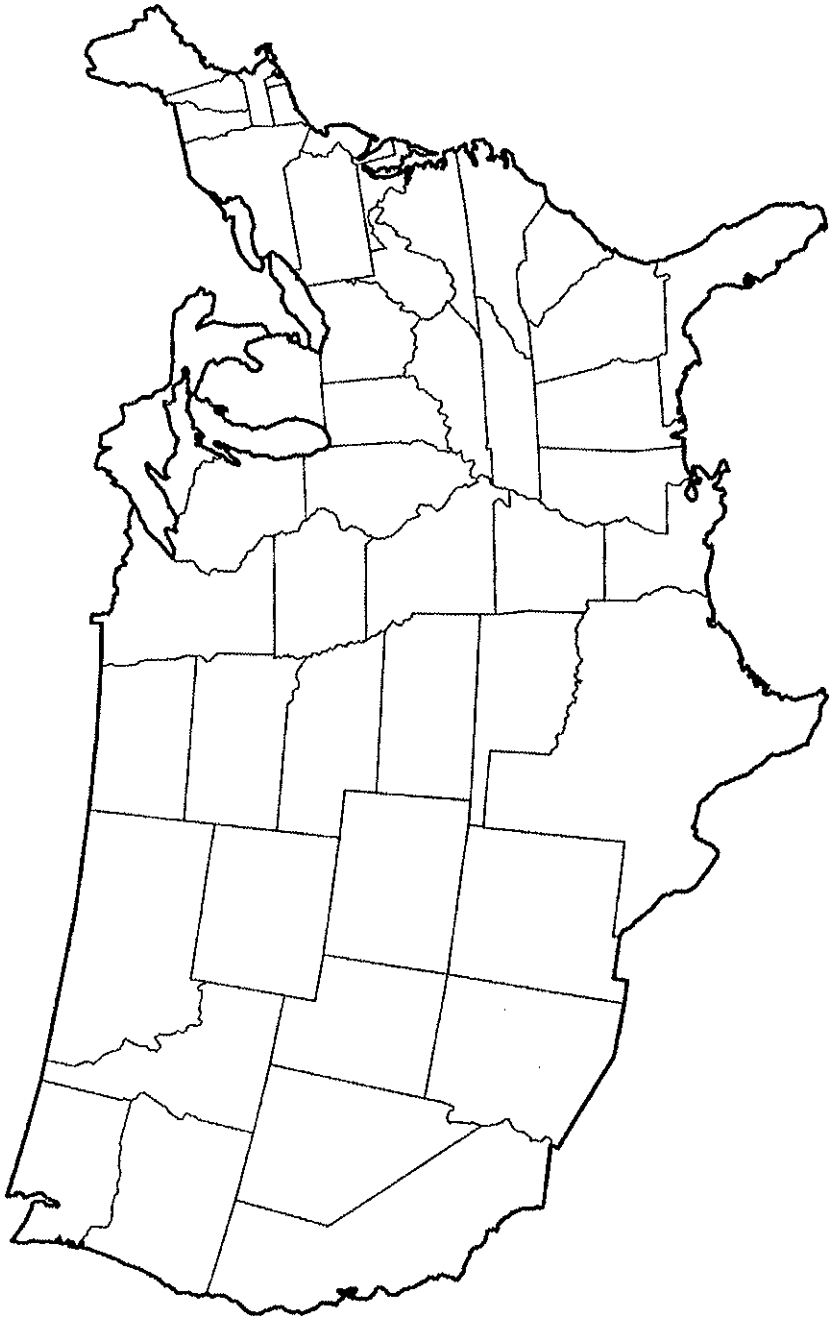
   b) Contour the data using a 5-inch isohyet interval. An isohyet is a line of equal precipitation. Note that a positive variation means wetter than normal and a negative variation mean dryer than normal. Thus, your map should show isolines that range from minus 5 inches to plus 20 inches.

Table 1 Anomalies for October 1982–March 1983 El Niño event. The data has been compared to 1950–1995 long-term average. No data are available for Alaska and Hawaii.

State	Temperature Anomaly (in degrees F)	Precipitation Anomaly (in inches)	State	Temperature Anomaly (in degrees F)	Precipitation Anomaly (in inches)
Alabama	0	8	Nebraska	2	4
Arizona	0	4	Nevada	0	3
Arkansas	1	6	New Hampshire	3	0
California	0	16	New Jersey	2	1
Colorado	1	1	New Mexico	–1	2
Connecticut	3	1	New York	3	–2
Delaware	2	1	North Carolina	1	6
Florida	0	10	North Dakota	4	4
Georgia	0	5	Ohio	4	–2
Idaho	1	2	Oklahoma	0	2
Illinois	3	4	Oregon	1	8
Indiana	4	–1	Pennsylvania	3	–3
Iowa	3	5	Rhode Island	2	2
Kansas	1	2	South Carolina	0	7
Kentucky	2	–5	South Dakota	3	3
Louisiana	0	15	Tennessee	2	–3
Maine	3	–1	Texas	–1	3
Maryland	2	–1	Utah	0	3
Massachusetts	2	3	Vermont	3	–1
Michigan	4	1	Virginia	1	0
Minnesota	4	4	Washington	2	5
Mississippi	0	14	West Virginia	2	–4
Missouri	2	2	Wisconsin	4	4
Montana	3	0	Wyoming	1	0

(Data adapted from NOAA-CIRES Climate Diagnostics Center)

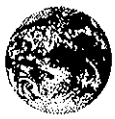
Blackline Master Oceans 5.1
Outline Map of the United States



5. Using the map, answer the following questions:
   a) The wettest areas occurred in which areas of the U.S.?
   b) The driest areas occurred in which areas of the U.S.?
   c) The greatest variation in precipitation (wettest) occurred in which state?
   d) The least variation in precipitation (driest) occurred in which state?

Reflecting on the Activity and the Challenge

In this activity you determined that during the El Niño event of 1982–83, most of the United States experienced temperatures that departed noticeably from the long-term average. This variation increased northward, with the greatest variation in the northeast and the least variation in the southwest. Precipitation variation also shows a definite pattern, with the wettest areas along the west and southeast coasts of the U.S. and the driest areas in the northeast. You are now aware of the relationship between an El Niño event and weather and climate.



Digging Deeper

EL NIÑO EVENTS AND CLIMATE

Weather and Climate

Weather is what the atmospheric conditions are like at a particular time, day to day. **Climate** is the long-term average of weather in a particular region of the Earth, over years, decades, or centuries. **Meteorologists** (scientists who study the weather) are fairly good at predicting the weather a few days in advance, but predicting the weather a month ahead is still very uncertain. Most **climatologists** (scientists who study the Earth's climate) are predicting that the Earth's climate will continue its warming trend at an increasing rate, probably because of the buildup of carbon dioxide in the atmosphere by burning of coal, oil, and natural gas.

There are also cycles of climate over times of several years, which are difficult to predict. The cycle of El Niño conditions and non–El Niño conditions in the equatorial Pacific is the clearest example of such short-term climate change. Climatologists who specialize in the study of El Niño are trying to develop ways of predicting the onset of an El Niño event long before it happens.

Teleconnections

The term **teleconnections** is used by climatologists for the effects that climate change in one region of the Earth have on the climate in distant regions (*tele-* means far or distant, as in *television*, "distant seeing"). El Niño conditions in the equatorial Pacific can cause major changes in climate in distant regions of the Earth. Understanding such teleconnections is very difficult, because interactions within the atmosphere and between the atmosphere and the oceans are very complex. During El Niño years, the jet stream changes its pattern. Variations in the jet stream, which is a current of fast-moving air in the upper atmosphere, lead to changes in overall weather patterns. As shown in the map in *Figure 1*, the 1982–1983 El Niño event caused weather-related disasters on almost every continent.

The event was blamed for 1300 to 2000 deaths and more than $13 billion in damage to property and livelihoods. On September 24, in just 24 hours, sea surface temperatures along the coastal village of Paita, Peru shot up 7.2°F. There were also secondary problems caused by the 1982–1983 El Niño event. Encephalitis outbreaks occurred on the east coast of the U.S., attributed to a warm, wet spring (perfect for mosquitoes). Increases in snakebites were reported in Montana, as the hot, dry weather drove mice from high elevations downward in search of food and water, and the rattlesnakes followed. A rise in bubonic plague occurred in New Mexico

Geo Words

weather: the atmospheric conditions at a particular time, day to day.

climate: the long-term average of weather in a particular region of the Earth, over years, decades, or centuries.

meteorologists: scientists who study the weather.

climatologists: scientists who study the Earth's climate.

teleconnections: the effects that climate change in one region of the Earth have on the climate in distant regions (*tele-* means far or distant, as in *television*, "distant seeing").

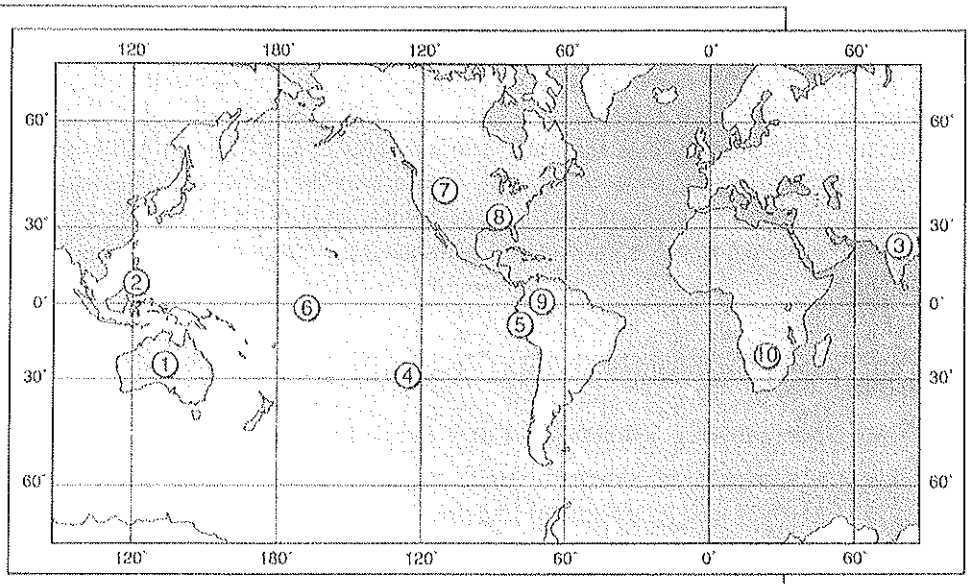
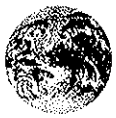


Figure 1 The impacts of the 1982–1983 El Niño were far-reaching, affecting almost every continent on the globe.

KEY
① Australia – drought and bush fires
② Indonesia, Philippines – crops fail, starvation follows
③ India, Sri Lanka – drought, fresh water shortages
④ Tahiti — six tropical cyclones
⑤ South America – fish industry devastated
⑥ Pacific Ocean – coral reefs die
⑦ Colorado River basin – flooding, mud slides
⑧ Gulf States – downpours cause deaths, property damage
⑨ Peru, Ecuador – floods, landslides
⑩ South Africa – drought, disease, malnutrition

as a cool, wet spring provided favorable conditions for flea-ridden rodents. There was an increase in shark attacks off the Oregon coast, because of unseasonably warm sea temperatures. There even was a rash of spine injuries in California, as weather-altered coastal sea floors fooled surfers. Some climatologists have connected El Niño to above-normal temperatures recorded in Alaska and northwestern Canada, and a reduction in the salmon harvest. In the eastern U.S., it was the warmest winter in 25 years.

Evidence of past El Niño events goes back for hundreds of years. This evidence includes historical accounts from early settlers and indirect evidence about climate from tree rings, sediment cores, ice cores, and coral reefs. El Niño events have occurred in the past and will occur in the future. The time between events varies, typically ranging from two to seven years. In addition, some El Niño events are strong and some are weak. Typically, an event lasts from 14 to 22 months, but it can be much longer or shorter.



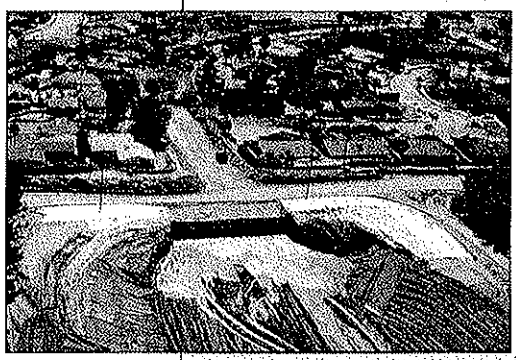


Figure 2 Heavy rains in southern California associated with the 1997–1998 El Niño resulted in extensive damage, causing landslides and debris flows.

The country of Peru provides a good example of how El Niño forecasts can be valuable. El Niño years tend to be warm and thus unfavorable for fishing, and some of them have been marked by damaging floods along the coast. Fishermen welcome cold years, but farmers do not because these years have frequently been marked by drought and crop failures. Such cold years often come on the heels of strong El Niño years. Peruvians have reason to be concerned, not only about El Niño events but also about both extremes of the El Niño cycle.

Since 1983, forecasts of the upcoming rainy season have been issued each November on the basis of observations of winds and water temperatures in the tropical Pacific region and the output of computer models. Once the forecast is issued, farmers and government officials meet to decide on the appropriate combination of crops to plant. Rice and cotton, two of the primary crops grown in northern Peru, are highly sensitive to the quantities and timing of rainfall. Rice thrives on wet conditions during the growing season followed by drier conditions during the ripening phase. Cotton, with its deeper root system, can tolerate drier weather. Hence, a forecast of El Niño weather might induce farmers to sow more rice and less cotton than in a year without El Niño.

Check Your Understanding

1. Give two examples of how the El Niño event in the equatorial Pacific caused a change in another location.
2. Describe how predicting an El Niño is valuable to an economy.
3. What is the difference between climate and weather?
4. What evidence exists for past El Niño events?

Understanding and Applying What You Have Learned

1. Describe the effect that El Niño has on your state in terms of temperature and precipitation.
2. In your particular area of the country, which agricultural crops would be adversely affected by conditions like those of the 1982–83 El Niño?
3. List three industries that are dependent on long-term weather forecasting.
4. Ski areas in many parts of the country depend on snowfall.
   a) In which areas of the country would the ski industry be hit hardest from an El Niño like that of 1982–83?
   b) Which ski industry would have benefited from the 1982–83 El Niño?
5. How might El Niño affect the mosquito population?

6. Use the precipitation map you created to propose a hypothesis for why coastal areas had the greatest amount of precipitation.

7. What kind of weather event could have affected the additional amount of precipitation in Florida during the 1982–83 El Niño event?

Preparing for the Chapter Challenge

Make a chart showing the relationship between recorded El Niño events and yearly precipitation in your area. Your teacher may have this information available to you.

If not, collect precipitation data from your local weather service or visit the *EarthComm* web site for web links to help you collect the data.

Inquiring Further

1. El Niño and hurricanes

   Research the relationship between El Niño and the occurrence of hurricanes in the Atlantic. Go to the *EarthComm* web site for help with your research.

2. El Niño and crop prices

   Investigate the fluctuations in wheat prices over the last 20 years. Can you find any relationships between crop prices and El Niño events?

3. El Niño events and the Earth system

   How does an El Niño event demonstrate the interrelationship between the hydrosphere and the atmosphere?

   How might severe weather associated with an El Niño event affect the biosphere? the geosphere?