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Exercise 23.1 Impacts of El Niño and La Niña

The table shows a summary of weather statistics during recent El Niño and La Niña years.

	Year	Winter precipitation in San Francisco, CA	Total snowfall in Urbana, IL	Number of hurricanes in Atlantic Ocean
Average		**19.7″**	**26″**	**6**
El Niño years	1972–1973	27.1″	5″	3
	1982–1983	25.1″	15″	2
	1991–1992	15.2″	10″	4
	1997–1998	37.3″	12″	3
	2002–2003	23.3″	27″	4
	2004–2005	27.4″	13″	9
	2006–2007	15.0″	24″	5
La Niña years	1973–1974	14.5″	32″	5
	1988–1989	12.3″	24″	12
	1995–1996	21.4″	38″	11
	1998–1999	15.5″	29″	10
	1999–2000	20.3″	20″	8
	2000–2001	17.2″	23″	8

1. What relationship appears to exist between winter precipitation in San Francisco and El Niño/La Niña years?

2. What relationship appears to exist between snowfall in Urbana, IL and El Niño/La Niña years?

3. What relationship appears to exist between hurricanes in the Atlantic Ocean and El Niño/La Niña years?

4. The actual precipitation amount (rain and snow together) in Urbana, Illinois during El Niño years is about average. Why would there be less snow?

5. During El Niño years, the polar and subtropical jetstreams are often in a different location compared to other years. How could this lead to the conditions shown above?

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Exercise 23.2 ENSO and the Tropical Atmosphere and Ocean

Identify the statements as being either True (T) or False (F).

1. T F The Walker Cell is a *north-south* circulation extending from the surface to the upper troposphere.
2. T F The term "Southern Oscillation" refers to the east-west seesaw of sea level pressure over the tropical Pacific Ocean.
3. T F Tahiti is normally dominated by low pressure at the surface.
4. T F During the El Niño phase of the Southern Oscillation, the normal upward vertical motion over Darwin is reduced in intensity.
5. T F Upwelling normally occurs along the western coast of Peru and Ecuador.
6. T F Upwelling replaces ocean surface water with warmer water.
7. T F Upwelling is stronger during a La Niña than during an El Niño.
8. T F When the Walker Cell is stronger than normal, the trade winds are stronger than normal.
9. T F Ocean surface temperatures normally increase westward in the tropical Pacific Ocean because the trade winds blow from east to west.
10. T F When the Walker Cell weakens, the sea level pressure over Indonesia and northern Australia decreases.
11. T F In the trade wind region, the winds in the upper troposphere generally have an eastward component.
12. T F Winds near the equator are largely a response to the pressure gradient force because the Coriolis force is weak.

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Exercise 23.3 The Southern Oscillation Index (SOI)

The Southern Oscillation is based on the difference between the monthly sea level pressures at Tahiti in the central Pacific and Darwin, Australia. Specifically, the pressure's departure from normal at Darwin (PDN_{Darwin}) is subtracted from the pressure's departure from normal at Tahiti (PDN_{Tahiti}):

$$\text{Southern Oscillation Index} = PDN_{Tahiti} - PDN_{Darwin}$$

SOI values of –1 and +1 are generally regarded as the thresholds for El Niños and La Niñas, respectively.

The table below contains actual values of the departures from normal pressure and/or values of the Southern Oscillation Index from various months during the past 20 years. In each case, fill in the missing value and indicate whether an El Niño or a La Niña (or neither) is occurring.

	PDN_{Tahiti}	PDN_{Darwin}	SOI	El Niño or La Niña?
Jan. 1983	–3.3	+3.6	_____	_____
Jul. 1988	+1.2	–0.0	_____	_____
Jan. 1993	_____	+0.6	–2.0	_____
Jun. 1997	_____	+2.4	–3.2	_____
Nov. 1998	+0.3	_____	+1.7	_____
Jan. 2001	–2.7	+1.0	_____	_____
Aug. 2002	–1.5	+1.1	_____	_____
Nov. 2004	0.0	+0.5	_____	_____
Oct. 2006	_____	+2.3	–2.7	_____
Feb. 2007	0.0	_____	–0.7	_____