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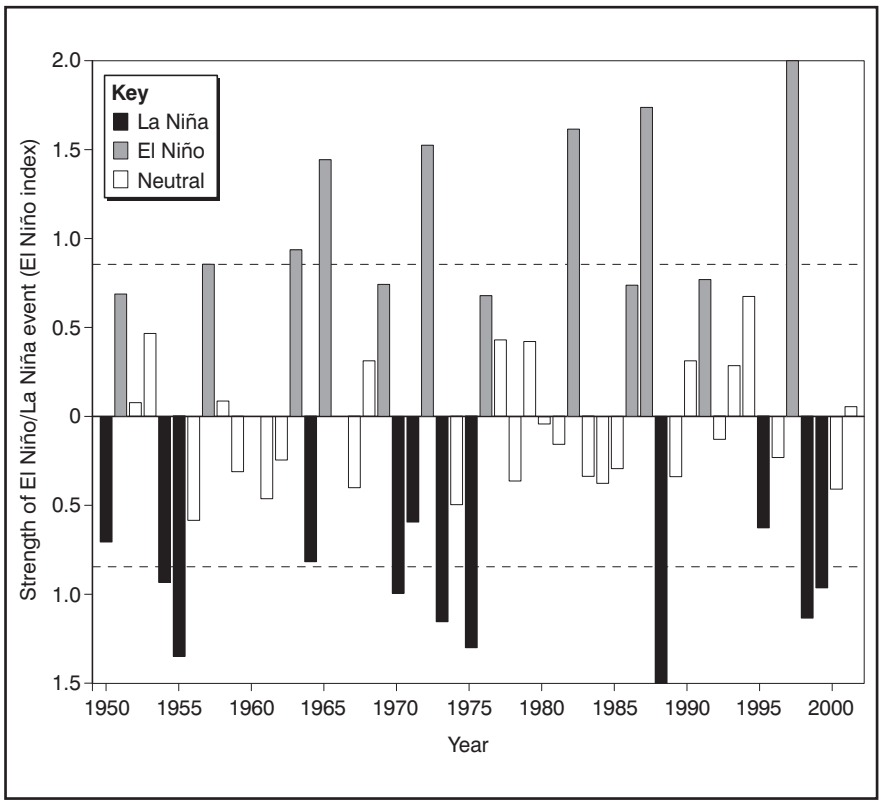
IMPACTS OF EL NIÑO AND LA NIÑA

What are El Niño and La Niña?

El Niño and La Niña are amongst the most powerful phenomena on Earth, affecting the climate across more than half the planet. El Niño (Spanish name for a male child) is used to refer to a weak, warm current appearing annually around Christmas along the coast of Ecuador and Peru. El Niño events occur every three to seven years (Figure 1) and may last from 12 to 18 months. In recent decades there have been several exceptional El Niño events which have had almost worldwide consequences. The term is now linked to these stronger events.

In contrast to El Niño, La Niña (female child) refers to an anomaly of unusually cold sea surface temperatures found in the eastern tropical Pacific. A La Niña episode may, but does not always, follow an El Niño.

Figure 1: Pattern of El Niño, La Niña and neutral conditions 1950 to 2001



Source: The International Research Institute for Climate and Society

Causes of an El Niño

In the tropical Pacific, trade winds generally drive the surface waters westward (Figure 2). The surface water becomes progressively warmer going westward, because of its longer exposure to solar heating. El Niño is observed when the easterly trade winds weaken (Figure 3), allowing the warmer waters of the western Pacific to migrate eastward and eventually reach the South American coast. The cool water normally found along the coast of Peru is replaced by warmer water. At the same time the area of warmer water further west near Australia and Indonesia is replaced by cooler water.

Figure 2: Normal conditions in the Pacific basin

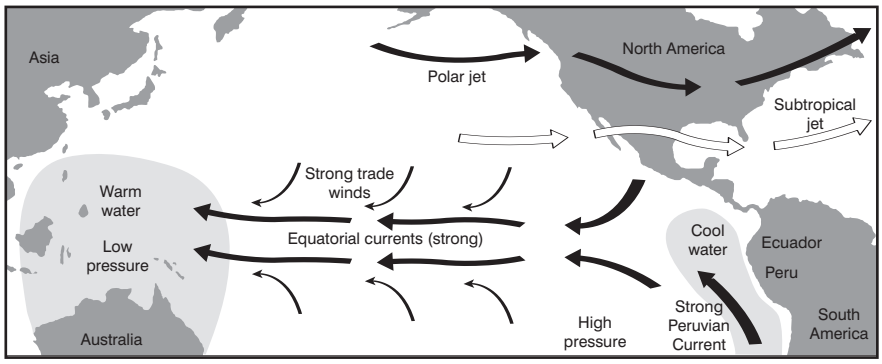
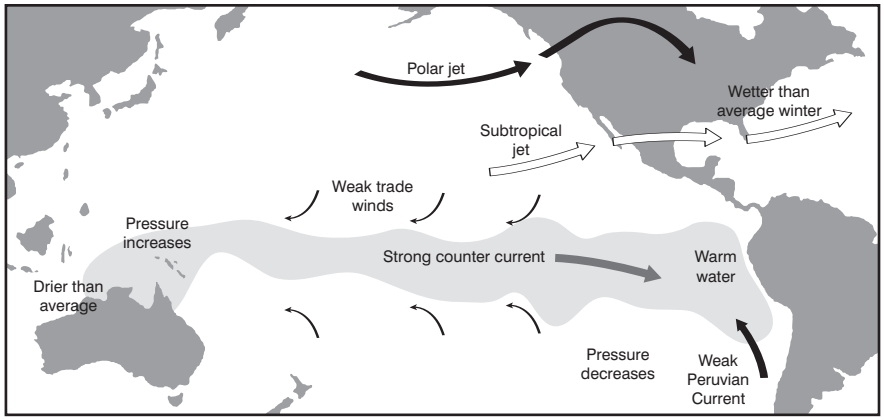


Figure 3: Conditions during an El Niño event



What is the difference between La Niña and El Niño?

Both terms refer to large-scale changes in sea-surface temperature across the central and eastern tropical Pacific. Usually, sea-surface readings off South America's west coast range from about 15°C to 21°C, while they exceed 25°C in the 'warm pool' located in the central and western Pacific. This warm pool expands to cover the tropics during El Niño, but shrinks to

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the west during La Niña. The El Niño Southern Oscillation (ENSO) is the coupled ocean-atmosphere process that includes both El Niño and La Niña.

What causes La Niña?

Typically, a La Niña is preceded by a build-up of cooler than normal subsurface waters in the tropical Pacific. Eastward-moving atmospheric and oceanic waves help bring the cold water to the surface through a complex series of events, still being studied. In time, the easterly trade winds strengthen, cold upwelling off Peru and Ecuador intensifies, and sea-surface temperatures (SSTs) drop below normal. During the 1988-89 La Niña, SSTs fell to as much as 4°C below normal. Both La Niña and El Niño tend to peak during the Northern Hemisphere winter.

Impacts of El Niño

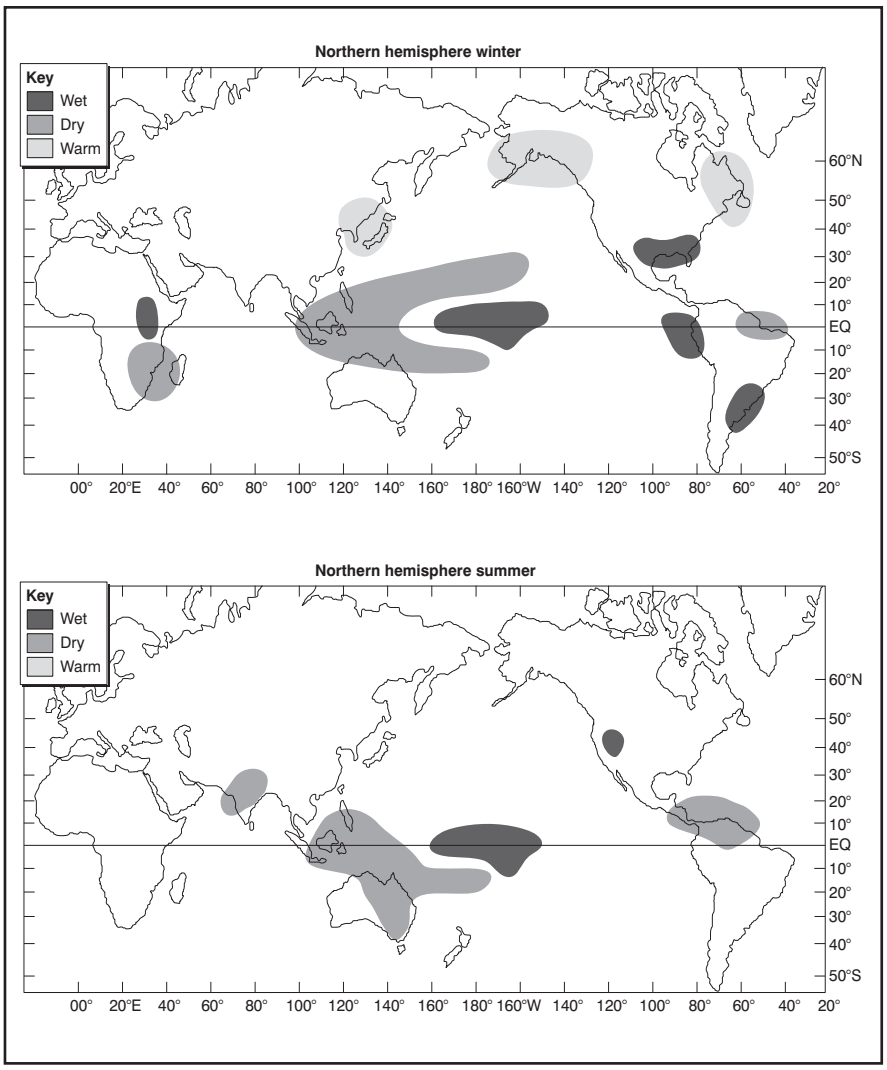
This article is far too short to cover the numerous impacts of both El Niño and La Niña. They vary both in type and spatially. Broadly, the impacts of La Niña are the opposite of those of El Niño, so we will consider those of La Niña more briefly. We will consider the impacts moving outwards from the countries immediately affected, to those further away.

Latin America

The warm water that builds up off the coast of South America leads to significant increases in evaporation and precipitation. 1982/83 saw one of the most severe El Niños on record: over 2500mm of rain fell over a six-month period in Ecuador and northern Peru, about 300 times the average figure. This led to devastating flooding that swept away people's homes and caused extensive damage to farming.

Under normal conditions, colder water, rich in nutrients, upwells off the coast of much of the west coast of South America. In an El Niño year this is replaced by warm water, less rich in nutrients, and consequently there is a decline in plankton and other aquatic life. The fisheries industry off the Pacific coast of South America lost about $290 million during the 1982/83 El Niño as catches, particularly of anchovy, declined. The loss of fish and plankton also caused the starvation of many seabirds.

Figure 4: Broad climate impacts of El Niño



El Niño also leads to human deaths, injuries and homelessness. As populations grow and are concentrated in high-risk areas like coastal zones and cities, their vulnerability to catastrophe increases. Large shanty towns with flimsy dwellings are often located on land subject to frequent flooding. In many areas the only places available to poor communities may be marginal land with few natural defences against weather extremes. In 1997 Central Ecuador and Peru suffered rainfall more than 10 times normal, which caused flooding, extensive erosion and mudslides with loss of lives, destruction of homes and food supplies. Nearly 10% of all health facilities in Peru were damaged.

Ecuador, Peru and Bolivia suffered serious malaria epidemics after heavy rainfall in the 1983 El Niño. The epidemic in Ecuador was exacerbated by displacement of population owing to the flooding. The El Niño cycle is associated with increased risks of some of the diseases transmitted by mosquitoes, such as malaria and dengue fever. Malaria transmission is particularly sensitive to weather conditions. In normally dry climates, sudden heavy rainfall can create puddles, providing good breeding conditions for mosquitoes. Conversely, in normally very humid climates, droughts may turn rivers into strings of pools, preferred breeding sites of other types of mosquito.

Indonesia and Australia

While South America has wetter conditions, south east Asia experiences the opposite. The colder water in the western Pacific reduces evaporation, encouraging drier conditions. Eastern Australia endured one of its worst-ever droughts in 1982/83, resulting in a $2,000 million loss in agricultural production (Figure 5), as well as bushfires and dust storms.

Indonesia also had dry conditions in 1982/83, and many died as a result of crop failure and famine. Human

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error coupled with El Niño has led to environmental disaster in Indonesia and other south east Asian countries. Logging companies in Indonesia have been clearing areas of forest by deliberately setting fire to them. Normally, regular rainfall would dampen down the flames and prevent the spread of fires. El Niño has the effect of stopping rains from reaching Indonesia, so fires have spread out of control. Huge clouds of smoke have caused unprecedented levels of smog, and at times made the air in certain areas of southeast Asia extremely dangerous to breathe. There have also been devastating effects on wildlife, with thousands of creatures dying.

Other parts of the world

El Niño also disrupts climate much further afield (Figure 4). Other areas also experience unusual amounts of precipitation. In 1982/83 there were exceptional rainstorms in California, and storms in China and in Mexico, where the town of Guadalajara saw snow for the first time since 1881. Drier conditions also occur in parts of India as the monsoon pattern is disrupted. Austria and parts of central Europe experienced drought conditions, and forest fires burnt parts of south east Asia and Brazil.

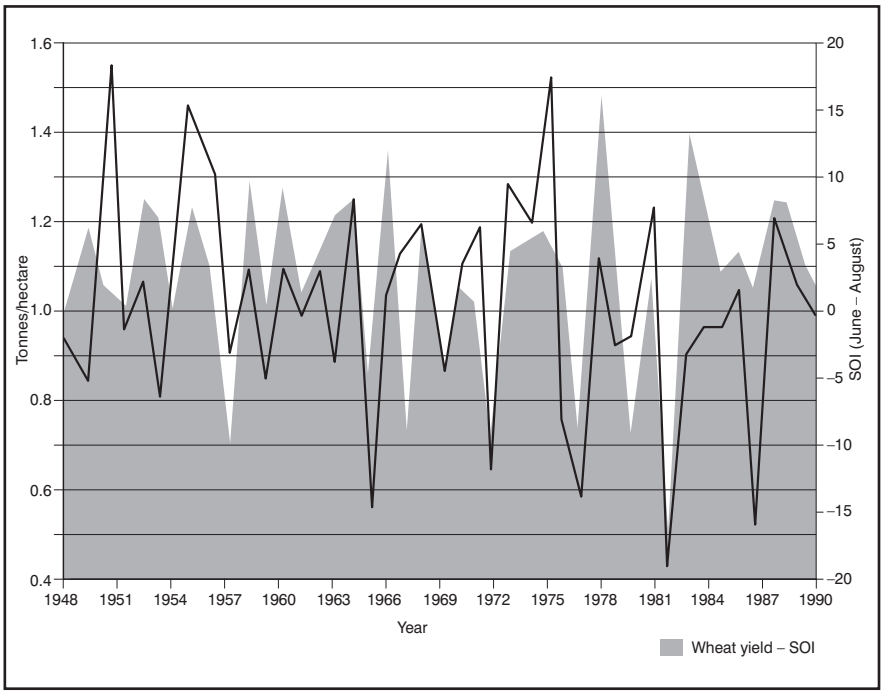
In MEDCs there are more varied impacts caused by El Niño, largely because there are more weather- and climate-sensitive industries (such as agriculture, construction, energy distribution, and outdoor recreation). In the USA these account for nearly 10% of GDP. Weather and climate indirectly affect an even larger portion of the nation's economy, extending to sectors such as finance and insurance, services, retail and wholesale trade, as well as manufacturing. Some analysts estimate that nearly 25% of US GDP, or $2.7 trillion, is either directly or indirectly affected by weather and climate.

El Niño affects important business variables like sales, revenues, and employment in a wide range of climate-sensitive industries and sectors. Overall, total US economic impacts of the 1997/98 El Niño were estimated to be on the order of $25 billion. These economic impacts lead to both gains and losses among regions and within industries. For example, department store sales were up by 5-15% during the abnormally warm winter in the Midwest, but sales of snow equipment like snowmobiles were down by nearly 35%. Skiing increased in the West but fell in the Midwest. In the highly weather-sensitive energy sector, households and businesses saved $2-7 billion in heating costs, while energy production and distribution businesses suffered from reduced sales.

On balance, the effect of the 1997/98 El Nino in the US could well have been an economic benefit, taking into account gains and losses across regions and industries. While economic impacts tend to cancel each other out at the national level, El Nino does cause real economic losses such as storm damage or crop losses, which are not offset by gains elsewhere. These are losses that can't be prevented or reduced by a better forecast or mitigation. For example, on average, El Niños result in agricultural losses approaching $2 billion, or nearly 1-2% of total crop output. In the 1997/98 El Niño, property losses were estimated at nearly $2.6 billion. Fortunately, these real losses are generally only a small fraction of the economic impacts of El Niño.

The 1991/92 El Niño brought the worst drought of the 20th century in southern Africa, which affected nearly 100 million people. The 1997 El Niño droughts hit Malaysia, Indonesia and Brazil, exacerbating the huge forest fires. During 1982/83 El Niño is said to have led to the death of some 2000 people worldwide, and caused losses amounting to approximately $12 billion.

Figure 5: Australian wheat yields and SOI index (SOI is a measure of the intensity of an El Nino event)



Source: http://www.bom.gov.au/climate/glossary/elnino/elnino.shtml

Impacts of La Niña

Latin America

Higher yields and thus greater exports during cold events have had a positive influence on the fishing industry. For example, in 1996 the anchovy and sardine catches increased, with a corresponding increase in exports. Cool ocean temperatures are generally associated with increased catches of some species such as anchovy.

La Niña greatly impacts the health sector, because of the higher numbers of bronchial diseases and respiratory illnesses that occur, especially in central and southern Peru where the humidity is higher. Health problems also aggravate an already bad poverty and pollution situation.

La Niña is associated with severe drought conditions in coastal areas, as well as decreased temperatures. During normal years there is a reasonable amount of rain in the mountainous areas of Peru, as a result of the easterly trade wind flow over the Andes. But there is no rainfall along the coastal regions, unlike the situation during El Niño years.

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Indonesia and Australia
La Niña can bring some welcome relief to areas that normally experience drier conditions. Rains in late 2005 and early 2006 brought relief to Australia, which had been gripped by its worst drought in living memory since 2002. Australian farmers benefited from the best rain in 10 years, which fell throughout eastern and southern grain-growing areas towards the end of April, exactly the right time for planting of winter grains crops.

The wetter conditions were welcomed by farmers in Vietnam, the world's largest robusta coffee producer and the second-largest exporter of rice. Heavy rains associated with La Niña can also bring problems, though. Oil palm, rubber, coffee and cocoa plantations can all experience reduced crops, and rice fields experience too much rainfall and be flooded. In late 2005 into early 2006, the Philippines, the world's largest coconut oil shipper, was hit by La Niña and experienced above-average rainfall. The heavy rains caused mudslides, entombing a community of 1,800 in Guinsaugon on Southern Leyte province, about 675km (420 miles) south east of Manila, in February 2006.

Other parts of the world
In the US, winter temperatures are warmer than normal in the south-east and cooler than normal in the north-west during a La Niña year. Snow and rain is experienced on the west coast, and unusually cold weather in Alaska. There is also a higher than normal incidence of hurricanes in the Atlantic. La Niña effects are more pronounced during the Southern Hemisphere winter (July-August), when one can observe lower than average temperatures. For example, a few years with low temperatures (around 12°C), and rice crops are badly affected. However, cotton production experiences an increase of 45% during cold event years. This actually took place in 1963, 1964 and 1996.

ENSO also has an influence on hurricane strikes on US and Caribbean shores. During La Niña periods, hurricane and tropical storm landfalls are twice as common over much of the Caribbean and Gulf of Mexico. Again the recent active Atlantic hurricane seasons of 1998-2001 illustrates this. El Niños tend to suppress tropical cyclones.

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Since 1983, forecasts of the next rainy season have been issued each November, based on observations of winds and water temperatures in the tropical Pacific region and the output of numerical prediction models. The forecasts are presented in terms of four possibilities:

- near normal conditions;
- a weak El Niño with a slightly wetter than normal growing season;
- a full-blown El Niño with flooding; and
- cooler than normal waters offshore, with higher than normal chance of drought.

Once the forecast is issued, farmers' representatives and government officials meet to decide on the appropriate combination of crops to sow in order to maximise the overall yield. 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.

Other countries that have taken similar initiatives include Australia, Brazil, Ethiopia, and India. Although tropical countries have the most to gain from successful prediction of El Niño, for many countries outside the tropics, such as Japan and the United States, more accurate prediction of El Niño will also benefit strategic planning in areas such as agriculture, and the management of water resources and reserves of grain and fuel oil.

Encouraged by progress over the past decade, scientists and governments in many countries are working together to design and build a global system for observing the tropical oceans, predicting El Niño and other irregular climate rhythms, and making routine climate predictions readily available to those who have need of them for planning purposes, much as weather forecasts are made available to the public today. The ability to anticipate how climate will change from one year to the next will lead to better management of agriculture, water supplies, fisheries, and other resources. By incorporating climate predictions into management decisions, people are becoming better adapted to the irregular rhythms of climate.

Finally, a word of caution. Climate is very complex and unpredictable and it is still a subject where there is a huge amount of ongoing research. The media often make links between extreme weather events and El Niño and La Niña; some may have a sound scientific basis, while others merely make eye-catching headlines. Further study is needed and patterns need to be clearly established so that we can make statements with increasing confidence.

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http://ess.geology.ufl.edu/usra_esse/ENSO_Impacts.html
http://www.atmos.washington.edu/gcg/RTN/rtnt.html
http://www.yptenc.org.uk/docs/factsheets/env_facts/el_nino.html
http://www.pmel.noaa.gov/tao/elnino/nino-home.html#
Animated explanation of El Nino
http://www.guardian.co.uk/flash/0,,641890,00.html
Health aspects of El Nino
http://www.who.int/mediacentre/factsheets/fs192/en/index.html

Focus Questions

1. Classify the positive and negative impacts of El Niño events in two separate tables. Use the following headings: Climatic, Other environmental, Economic, Social.

2. Describe and explain the trends shown in Figure 5.

3. Outline how El Niño and La Niña could affect tourism.

4. ESSAY
Examine the effects of an El Niño cycle on the environment with reference to different areas of the world.