El Niño — should it take the blame for disasters?

Michael H. Glantz

Top: The floods of 1982 hit Cuba.
Below: The controversy rages on.

HEADLINES worldwide have been filled during the past year and a half with stories about 'severe,' 'bizarre,' 'extreme,' 'crazy' and 'anomalous' weather events that have disrupted human activities in many parts of the world and caused devastation to life and property on a local, national and regional scale.

Most, if not all, of these events have been linked (rightly or wrongly) to a phenomenon known as El Niño which is an atmospheric-oceanic phenomenon that occurs in the eastern equatorial Pacific. There is no regular cycle but these events seem to occur at intervals varying from two to ten years.

At a meeting concerned with the El Niño events of 1957-58, meteorologist Jerome Namias suggested that 'People want to ascribe abnormal weather to almost anything . . . . Each generation seems to espouse some theory as to the changing climate. Of course the present vogue [1958] is to blame things on nuclear tests.' Could it be that the El Niño phenomenon will become one of the focal points for our generation's popular theories about climatic variability?

What is El Niño?

Normally, off the coast of Peru cold, deep water wells up to the ocean's surface. This process, referred to as coastal upwelling, is the result of strong southeasterly winds blowing along the coast and of the rotation of the earth's surface. As the winds (plus the rotation) push surface water away from the coast, deep, nutrient rich, cold water wells up to replace the warm surface water. Coastal upwelling regions are ideal breeding grounds for pelagic fish. There are five major coastal upwelling regions around the world, centred off the coasts of California, Peru, Namibia, Mauritania and Somalia. Peru's is biologically one of the most productive.

Sometimes, however, the trade winds in the western and central Pacific relax or reverse, which in turn generates an eastward propagating internal ocean wave. Upon reaching the northwestern coast of South America, this wave causes the replacement of the cold upwelled water with warm surface

water. This invasion of warm water is commonly referred to as an El Niño event.

As the warm water invades the northern coastal regions of South America, it disrupts the usual local weather patterns as well as the marine biological processes (e.g., the food chain) that take place in the coastal upwelling region. Interruption of the food chain, in turn, has a major adverse effect on the fish populations that thrive in the upwelling environment, which in the Peruvian case is the anchoveta, a small pelagic, relatively short-lived, surface-dwelling shoaling fish.

Folklore suggests that the warming of these particular waters was named El Niño, after the Christ Child, because of short annual warming for a few months beginning in December. Although it originally referred to the local condition along Peru's northwestern coast, usage of the term 'El Niño' has been broadened by many to represent all sea surface warmings in the equatorial Pacific.

No two El Niño events nor their effects have been exactly alike. Some El Niño events are local phenomena of short duration with minimal rise in sea surface temperatures, mainly affecting countries along the northwestern coast of South America. Accompanying such events are local but often devastating effects, such as flooding that results from excessive rains along the usually arid coasts of northern Peru and Ecuador or reduced fish catches in their coastal waters.

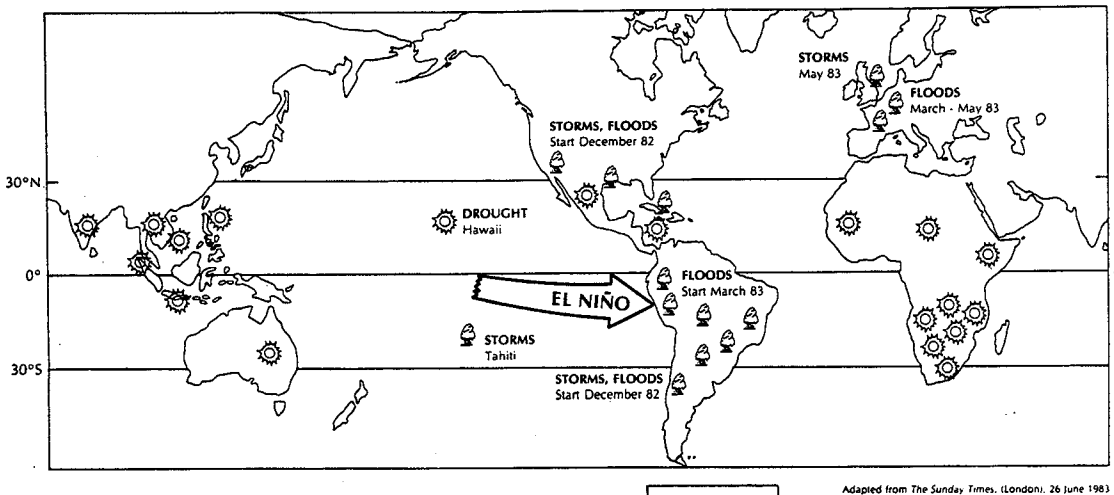
When the warming of the sea surface temperatures becomes extended in time (i.e., during two Southern Hemisphere winters and one summer), in space (sea surface temperatures become elevated over large expanses of the tropical Pacific Ocean), and in magnitude (the warming can be 3° to 7°C higher than in non-El Niño years), the effects of El Niño on atmospheric circulation and eventually on societies seem to extend well beyond the region of the southern Pacific basin. Thus, weather anomalies linked to El Niño have been suggested by both lay people and scientists to encompass a vast array of effects including droughts in Indonesia, Australia, the West African Sahel, Northeast and East Africa, the Brazilian northeast, Southern Africa, and parts of the Indian subcontinent, excessive rains in southern Brazil and in some Pacific islands, reduced hurricane activity in the North Atlantic and more typhoons in the Pacific, as well as the local effects mentioned earlier.

El Niño means different things to different people. To a Peruvian fisherman an El Niño event can be two-edged sword; a sharp increase in fish catches for a few months as warm water pushes the fish (the anchoveta) into dense pockets close to the shore where local spots of cold upwelled water still prevail. After a few months, however, the fish become fewer and more difficult to catch for an extended period. To Peruvian politicians and planners El Niño is bad news in the long run as it means an abrupt decline in the fishing sector's productivity and, therefore, in sorely needed foreign exchange earnings that are used to support development programmes. This decline leads to increased unemployment, loss of markets, loss of tax revenue and labour unrest. In addition, flooding and mudslides resulting from heavy rains destroy the infrastructure (such as roads, bridges and rail lines) in the northern part of Peru while droughts plague the southern part.

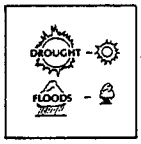
To a Chilean fisherman El Niño can sometimes be good news, as changes in ocean temperatures may cause pelagic fish

Guano workers on the Central Chincha Island.

IMPACTS MAP



Adapted from *The Sunday Times*, (London), 26 June 1983



populations to migrate from the usually rich Peruvian coastal waters to the south into the Chilean coastal waters. To American or Brazilian farmers who grow soybeans (or commodity speculators who buy them), El Niño could be good news as there would be a rise in the demand and price for soymeal, often used as an alternate protein feed supplement when fishmeal becomes unavailable. For people in the northeast United States, El Niño events, it has been suggested, can sometimes lead to lower wintertime temperatures and,therefore, to higher energy bills.

The North American weather patterns, however, vary from one El Niño year to another. In fact, the 1982-83 wintertime temperatures were higher rather than lower.

To the Indonesian farmer, El Niño is bad news as Indonesian droughts seem to be associated with major El Niño events.

What El Niño Does

Earlier this century El Niño events were seen only as having local phenomena and consequences. The main concern was that guano-producing birds perished in great numbers, dead birds littered the beaches, resulting in a sharp reduction in annual guano production. (Guano is mineral-rich bird droppings that has been used as fertilizer.) After the turn of the century, the Peruvian government established the Guano Administration Company to regulate the commercial exploitation of guano. The Guano Administration and the Peruvian farmers who used guano as fertilizer managed to block attempts to develop a fishing industry that would exploit the guano birds' main source of food, the anchoveta. Until the early 1950s, no commercial Peruvian anchoveta fishery was allowed to develop.

By the mid 1950s these groups were no longer able to block the development of the first fishmeal processing plants along the Peruvian coast. With new technological innovations, such as the nylon net, and increasing demand for fishmeal, the fishery underwent what might be called meteoric growth with catches doubling each year until 1960.

When a major El Niño took place in 1957-58, there was little direct reference to it in the press. Some scientists, however, considered it to be an interesting focus of research involving the atmospheric, oceanographic and biological sciences. With this El Niño, the term's usage was deliberately broadened suggesting that it was a phenomenon common to the other major upwelling regions, especially the one off the coast of California.

The newly developed anchoveta fishing industry was in its early stages of growth and generally showed little concern about El Niño because there were no measurable effects on the productivity of the fishery due to that particular El Niño. The El Niño also brought about a sharp decline in the anchoveta-consuming guano bird population from about 30 million birds to about 16 million. Within a few years some international scientists as well as some Peruvian industrialists were to call for the deliberate destruction of the bird population for the sole purpose of 'freeing up' a few million more anchoveta for the fishmeal processing plants.

1972-73

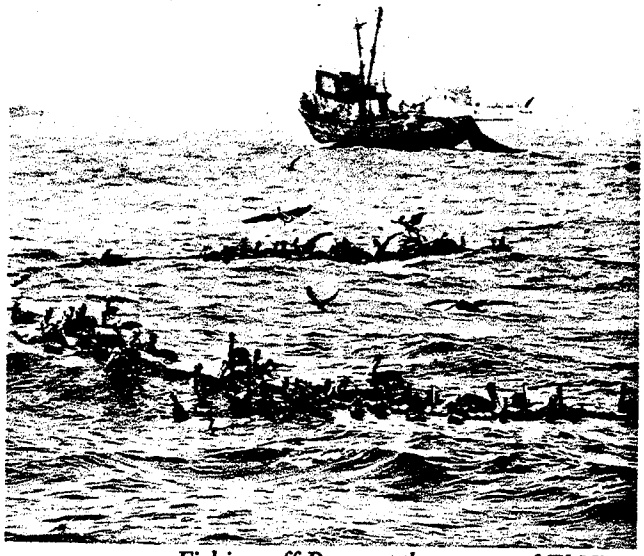
Another major El Niño took place in 1972-73. Unlike 1957-58, the world's press and politicians this time took notice as it was accompanied, firstly, by devastating droughts in West Africa, East Africa, Ethopia, the USSR, Australia, Central America, and severe floods in the Philippines, parts of Australia and Kenya.

The 1972-73 drought in the USSR led to a sharp decline in cereal production that prompted the Soviet Union to buy US grain (corn and wheat) in large quantities. This generated a grain shortage for other nations that were also plagued by drought-related declining crop production. In 1972 global food production declined for the first time since at least the late 1940s.

World fish catches, to the surprise of most observers, declined from 1970 to 1973 for the first time since the end of the Second World War, suggesting that living marine resources were possibly exploited at levels near their upper limits.

More than simply being associated with the 1972-73 El Niño, many of these weather anomalies and their effects were blamed on it. El Niño was seen by some observers to have stimulated or at least abetted a mammoth global food shortage of great magnitude.

Another reason for the attention to the 1972-73 El Niño was that, by the late 1960s, Peru had become the leading fishing nation in the world by volume. Its fishing was based mainly on the exploitation of a single species — the anchoveta — which was reduced to fishmeal (and oil) for export as a feed supplement for poultry, hogs and cattle. The 1972-73 El Niño contributed to (but was not the sole cause of) the near collapse of the Peruvian anchoveta fishery, and dealt a major blow to the Peruvian economy by making the fleet and fishmeal processing factories idle for the next decade. Using the El Niño-related reduction of biological productivity in its coastal waters



Fishing off Peru: at the mercy of El Nino.

as an excuse, the Peruvian government nationalised its fishing industry in 1973. However, in 1976, when fishing prospects had not improved, the government denationalised the fleet and today it is in the process of denationalising other parts of the industry.

Those interested in global food problems also later focused on the 1972-73 El Niño because when fishmeal either was not available or due to scarcity became too expensive as a feed supplement, farmers bought soymeal as their second choice. As the demand and price for soymeal increased, farmers took land out of corn and wheat production to grow soybeans. This transfer, in turn, exacerbated the global food shortages of the mid-1970s.

International interest in the scientific (especially forecasting) and societal aspects of El Niño was heightened by the adverse effects on the Peruvian economy and on the international commodities market of the 1972-73 El Niño. If El Niño events could be understood and forecast, and its connections with other climatic anomalies could be established, then it might be possible to forecast effects of the associated weather anomalies.

1982-83

The 1982-83 El Niño event has been labelled as one of the most extreme partly because of the unusually high sea surface temperatures in the eastern equatorial Pacific and also because of the unusual weather anomalies that have been associated with it. World leaders and the media have once again taken notice of the phenomenon.

In the months preceding the onset of this El Niño, scientists believed that they had described *the* typical El Niño. Yet, the 1982-83 El Niño did not develop in the 'typical' pattern of earlier events. In fact, most scientists investigating El Niño failed to recognise its onset, until months after it had begun. Scientists later postulated that this El Niño formed in a different sequence from previous ones; anomalously warm sea surface temperatures were first observed in the cental and western Pacific Ocean instead of along the Peruvian coast. However, on closer inspection of individual El Niño events, each evolves somewhat differently from others. This most recent El Niño showed how much is yet to be learned about the phenomenon.

Most, if not all, weather anomalies around the world during these two years have been linked by one observer or another to this El Niño. Several maps and charts have appeared in the popular press suggesting the worldwide, continental and national effects of the 1982-83 El Niño.

A few selected examples of effects of the 1982-83 El Niño are as follows:

- Australia had its worst drought of the century. Agricultural and livestock losses, along with widespread bushfires mainly in the southeastern part of the country, resulted in billions of dollars in lost revenues. An Australian journalist wrote that 'the drought is not just a rural catastrophe, it is a national disaster.'
- Indonesia, too, was plagued with severe drought, resulting in reduced agricultural output, especially rice, and in famine, malnutrition, disease and hundreds of deaths. This drought came at a bad time for Indonesians, as this country had made great strides toward self sufficiency in food production. In the few years immediately preceding the 1982-83 El Niño, Indonesia was emerging as a rice exporter. This drought, however, coupled with worldwide recession, huge foreign debts, and declining oil revenues, has set back Indonesia's economic development goals for the near term.
- The United States was favourably affected by its warmest winter in 25 years in terms of reduced energy needs. The opposite was the case, however, during the cold winter that occurred during the 1976-77 El Niño. The United States was adversely affected, during the recent El Niño, by devastating coastal storms and mudslides along the California coast, flooding in the southern states, and drought in the north central states (reducing corn and soybean production). Fish landings along the Pacific Northwest coast also declined sharply during this past year.
- Large expanses in Africa have been affected by drought. The drought situation across the African continent has prompted the Economic Commission for Africa (ECA) to pass a resolution requesting assistance from relevant UN organs, among them the World Meteorological Organisation, to set up a 'Scientific Roundtable on the Climatic Situation and Drought in Africa.' Its purpose is to address various aspects of African droughts (e.g., causes, periodicities, trends and effects).
- Zimbabwe, usually a surplus producer and regional exporter of some foodstuffs, was adversely affected by drought in 1983. It has been called Zimbabwe's worse drought this century, causing the depletion of its food stocks, the enforced slaughter of its herds and the need to accept foreign food assistance.
- The Republic of South Africa has been a major exporter of maize. As a result of its worst drought in two centuries, however, that government had to import 1.5 million tons of maize in 1983 for use as animal feed, for the first time this century. Wheat, also an export crop in 1982, had to be imported in 1983. The black populations in the 'self governing and independent Black Nations' within South Africa have been especially hard hit by drought. They

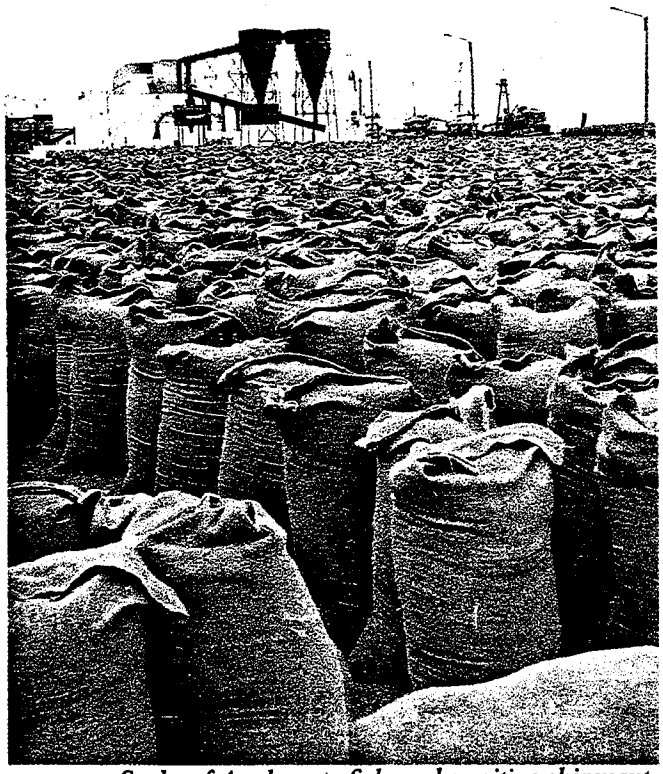
have been faced with increasing food production failures, malnutrition, livestock deaths, and dry boreholes and reservoirs.

- The West African Sahel has, once again, been plagued by a major drought. While the human livestock deaths resulting from this drought appear to be much less than those in 1972-73, the food production situation is poor.

In addition to the effects mentioned above, the 1982-83 El Niño has been attributed with having caused droughts in Sri Lanka, the Philippines, Southern India, Mexico, Northeast Brazil and Hawaii; floods in Peru, Ecuador, Bolivia and Southern Brazil; severe, unseasonal hurricanes in French Polynesia and Hawaii, and suppressed hurricane activity in the Atlantic. Many of these events have set records for the worst hurricane, the most intense rainfall, the warmest winter, the first drought and the longest drought. At local levels secondary effects have also been attributed to El Niño, ranging from, for example, major dust storms in Australia to, in the United States, outbreaks of encephalitis in the northeast, of rattlesnake bites in the west and of bubonic plague in the southwest.

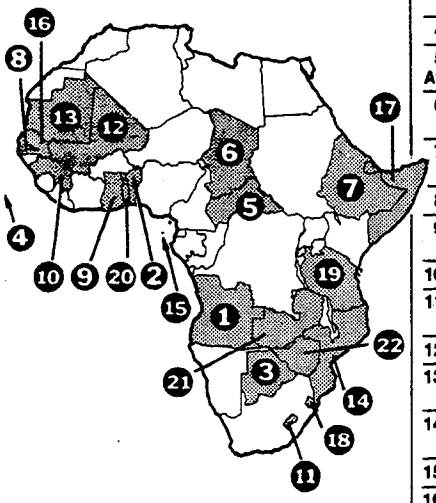
Teleconnections

Meteorologists have coined the phrase 'teleconnections' to describe climatic anomalies occurring at long distances from



Sacks of Anchoveta fishmeal awaiting shipment.

The Drought's Toll In 22 African Nations



Countries suffering from or threatened with food shortages approaching in severity the famine of 1973-74. Information about crop and weather conditions is from a report issued in June by the Food and Agriculture Organization of the United Nations. Rinderpest is an acute infectious disease of cattle and other farm animals.

Source: United Nations Food and Agricultural Organization

Country	Prevailing conditions in 1982-83	Major effects on agriculture
1 Angola	Continued drought from 1982.	Crop failures and shortages.
2 Benin	1983 rainy season delayed; rinderpest outbreak at borders.	Below-average crop yields expected; slowed maize planting; cattle losses.
3 Botswana	Rainfall at 50-60 percent of normal in central and southern areas.	Sharply reduced cereal yields expected for 1983; deterioration in livestock.
4 Cape Verde	Drought in 1982 crop season.	40 percent losses in yields in 1982.
5 Central African Republic	Extreme drought in 1983; electricity disruption.	Food shortages in several rural areas.
6 Chad	Severe drought in north for two consecutive years combined with civil war.	1982-83 food deficit of about 188,000 tons; disruption of food aid through Nigeria.
7 Ethiopia	Delayed rains, pervasive drought during 1982; military operations and influx of refugees.	3 million people affected; economic and food production activities severely reduced.
8 Gambia	Prolonged drought from 1982.	Irreversible crop damage.
9 Ghana	Below-average rain; brush fires; influx of settlers from Nigeria; rinderpest outbreak.	Staple cereal crop losses of about 260,000 tons; reduced crop area; livestock losses.
10 Guinea	Continued drought; mealybugs and other pests.	Irreversible crop damage, reduced yields.
11 Lesotho	Continued drought; seasonal rainfall about 50 percent of average; river flow down sharply.	1983 cereal production expected to be 25 percent of normal.
12 Mali	Below-average rain in 1982; low river levels.	Cereal production far below average.
13 Mauritania	1982 rainfall 40-80 percent below average; extremely low river levels.	1982 cereal production down about 40,000 tons; deterioration and losses of livestock.
14 Mozambique	Below-average rainfall since 1982; guerrilla activities disrupting agriculture.	Serious food shortages for 4 million in rural areas; deterioration and loss of livestock.
15 São Tomé	Continued drought from 1982.	Significant food shortages and crop damage.
16 Senegal	Below-average rain in 1982; low river level.	Localized drought affecting 270,000 people.
17 Somalia	Above-average 1982 crop production; late 1983 planting and rainfall; influx of 700,000 refugees.	1983 crop season delayed; crop outlook uncertain.
18 Swaziland	Continued drought; 1983 rainfall less than 50 percent of normal; severe water shortage.	Projected 1983 maize production at 40 percent of normal; cotton shortage.
19 Tanzania	1983 crop prospects average or better than 1982.	Persistence of rural food shortage.
20 Togo	Drought in 1982, delayed rains in 1983; prolonged winds causing brush fires.	1982 secondary maize crop failed; other crops damaged; 1983 outlook uncertain.
21 Zambia	Continued drought, especially in south; spread of infectious diseases.	Maize production above 1982 level but still below average; livestock losses.
22 Zimbabwe	Drought limited in 1982, country-wide in 1983; lack of irrigation water.	1983 maize crop cut; other crop failures; 50 percent drop expected in wheat crop.

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Lifelines to safety after hurricanes turned a Rio de Janeiro street into a 'Highway of Hell'.

each other but which may be linked. There is mounting evidence for such connections and various statistical techniques may be used to establish some degree of correlation between such 'teleconnected' events. Different scientists have proposed different connections that, in fact, encircle the globe: between El Niño along the Peruvian coast and droughts in Northeast Brazil; droughts in Northeast Brazil and those in West Africa; West African droughts and sea levels of Lake Chad; Lake Chad sea levels and droughts in India; droughts in India and droughts in Indonesia and Australia.

Some of these connections may hold promise for long-range forecasting such as, perhaps, correlations between droughts in Australia, Indonesia or Brazil and El Niño events. These have been associated with the so-called Southern Oscillation, which is characterised by large-scale fluctuations of pressure and winds between the Australasian region and the central and eastern tropical Pacific, as well as climatic anomalies on a global scale.

Other teleconnections might be more difficult to link to El Niño (such as the timing of the onset of South Asian monsoons, droughts in various parts of the African Continent, or even a host of abnormal seasonal weather patterns in the United States). Such hypothesised teleconnections will require a great deal more scrutiny before they can be used by decision makers in their policy planning.

Conclusion

When assessing the impacts on society of climatic anomalies that have been associated with the 1982-83 El Niño event, it is important to remember that newspaper accounts often present a combination of spectacular effects as well as 'guesstimates' of damage in various parts of the world. To gain a more accurate picture of climatic impacts on society, scientific research assessments are required.

First of all, anomalies occur in different places around the globe each year. In some years their impacts may appear more devastating than in others; in some years they may appear to be more numerous than in others. It is important to assess the impacts of weather anomalies in non-El Niño years as well as in El Niño years to determine more accurately what damages are indeed connected with El Niño events.

In addition to this word of caution (that is, not to blame everything that happens in an El Niño year on El Niño), it is important to remember that seldom are weather events alone the cause of the society's ills which are blamed on them. Decisions that are made at the various levels of government, for example, can minimise or magnify those impacts. It is not sufficient to add up numbers related to the destruction associated with floods or droughts. It is also necessary to determine the contribution to that devastation of social, political and economic factors. For example, when a flood takes place in a floodplain, its impacts and costs to society are usually blamed on nature. Yet, policy makers allowed urban growth and development to take place in that high risk, flood prone area.

Finally, although many climatic anomalies have been associated with the simultaneous occurrence of El Niño, most of these connections need to be explored in more detail. In the midst of speculation about El Niño teleconnections, meteorologist Namias reminds scientists and policy makers that 'El Niño events must be considered not alone, but against a background of other modulating (sometimes overwhelming) influences that are taking place elsewhere.'

With each El Niño episode scientists gain more knowledge (if not consensus) about this phenomenon. The 1982-83 El Niño has stimulated researchers to reexamine earlier El Niño events. With continued research, scientists in time should be able to determine with more confidence which of these 'teleconnected' impacts may be blamed on, or linked to, El Niño. Only then will scientists be able to use more successfully knowledge about the phenomenon known as El Niño for the purpose of reliable long-range (e.g., seasonal) climate-related forecasting. □

Suggested Reading:

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