

GENERAL SCIENCE NOTES

THE EL NIÑO EVENT

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Unusual weather patterns were the rule from Adelaide to Quito. Australia experienced killing droughts and subsequent fires devastated large sections of land. In Ecuador, areas that normally receive 13 mm of rain during a dry-season month were inundated with 583 mm. Ocean temperatures along major portions of the west coasts of the Americas were in some areas 10° warmer than usual. These warm waters caused a marked drop in primary production of microorganisms, and as a result the usually enormous anchovy population disappeared. Animals which depended on the fish either starved or hunted elsewhere for food. On Christmas Island, for example, an estimated 17 million eggs and unfledged young of sea birds were abandoned because the food in surrounding waters literally disappeared.

The cause of these seemingly unrelated phenomena is blamed on El Niño (The Christ Child). El Niño historically has been a periodic warm-water current that starts moving along the coast of Peru near Christmastime. As coastal water is driven west by trade winds, a current of warm water from the north moves southward usually around February or March and covers the colder water along the coast. With the nutrient-rich water now very deep, fish which depend on the plankton and other organisms for survival move to other locations. In times past this yearly warming marked the end of the fishing season around February.

Currently, the term El Niño is much more limited in its use and presently describes the interannual catastrophic events which destroy much life caused by massive amounts of warm water flowing in from the mid-Pacific instead of the more normal northerly warm current. These events have a 6-8 year cycle, in contrast to the more mild yearly warming events described above.

Just what causes the El Niño event is somewhat like the chicken-or-the-egg question. Under normal conditions nearly constant westerly trade winds in combination with the Coriolis effect (phenomena related to the rotation of the earth) push the coastal surface water in the equatorial latitudes towards Asia. The water warms significantly as it moves across the Pacific.

Only recently have scientists begun to unravel why some seasonal changes are more devastating than others. It is now realized that the El

Niño is coupled to another atmospheric event in the eastern Pacific known as the Southern Oscillation.

In the Southern Oscillation major shifts in barometric pressure take place between two areas in the Pacific. One centers in Malaysia with a measuring station situated in Darwin, Australia. The other is in Tahiti. If the pressure is high in Darwin, it will be low in Tahiti. The converse is similarly true. Over a period of several years the pressure difference seesaws back and forth with periods varying from 2-8 years.

In the low-pressure area, a circular air current, known as the Walker Circulation, also develops. Water-laden air dumps its moisture as it rises into the upper atmosphere. After moving across large distances in the upper atmosphere, it then returns to sea level at the other end of the pressure cell. The location of the rising column of air controls where the heaviest rain fall will take place. The low-pressure area is additionally important because it attracts the westerly trades and determines their general direction of movement.

In the El Niño event of 1982-83, the low-pressure area, which should have been located at Tahiti, moved farther east. Record pressure differences were recorded between Darwin and Tahiti. This low-pressure area then drew the westerlys. To the west of this atmospheric basin, the normally westerly winds reversed themselves and blew in the opposite direction, probably attracted by the low-pressure area.

The current El Niño event was anomalous in that a second cell of warm water developed in the western Pacific in addition to the warm water which the wind pushed in from the coast of South America. As the water along the equator heated, the intensity of the trades decreased and ultimately stopped. This, combined with a greater-than-average heating, produced water temperatures at the equator much above normal. Conditions were now set for what has been called a once-in-a-century event.

The warm water, which was originally derived from South America, combined with the anomalous warm cell and started to return eastward to the South American coast because it was no longer held back by the westerly winds. Several months were required for the water to reach the South American coast. In some oceanic islands the sea level changed a foot or more as the warm water sloshed eastward.

Upon reaching the continental coast, the current divided into branches moving north and south along the coast and did its destructive work. Record high ocean temperatures were recorded as far north as Washington. Eventually, with the mixing of colder waters and the resumption of the trade winds now blowing toward Darwin again, the El Niño faded.

The anomalous weather patterns in the central Pacific affect significantly weather patterns in far distant portions of the globe. Known as teleconnections, these are statistically consistent changes that occur in El Niño years, causing large weather shifts in the northern latitudes and perhaps being partly responsible for the strange weather experienced on several continents.

When the next El Niño event will arrive is not known, of course, but one can be certain that the mammoth interannual weather shifts will be here sooner than some would wish. The El Niño event should also give one pause to consider that world-wide disturbances can be caused by seemingly small events such as the shifting of a low-pressure area or the elevation of water temperature by a few degrees. The earth is perhaps more fragile than most would suspect.

PERTINENT LITERATURE

- Gill AE, Rasmusson EM. 1983. The 1982-83 climate anomaly in equatorial Pacific. *Nature* 306:229-234.
- Halpern D, Hayes SP, Leetmaa A, Hansen DV, Philander SGH. 1983. Oceanographic observations on the 1982 warming of the tropical eastern Pacific. *Science* 221:1173-1175.
- Kerr RA. 1983. Fading El Niño broadening scientists' view. *Science* 221:940-941.
- Kerr RA. 1982. U.S. weather and the equatorial connection. *Science* 216:608-610.
- Philander SGH. 1983. El Niño Southern Oscillation phenomena. *Nature* 302:296-301.
- Philander SGH. 1983. Anomalous El Niño of 1982-83. *Nature* 305:16.
- Smith RL. 1983. Peru coastal currents during El Niño: 1976 and 1982. *Science* 221:1397-1399.
- Weare BC. 1983. The possible link between net surface heating and El Niño. *Science* 221:947-949.