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Wyrtki K. El Niño—the dynamic response of the equatorial Pacific Ocean to atmospheric forcing. *J Phys. Oceanogr.* 5:572-84, 1975.
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A new theory of El Niño demonstrates that El Niño is preceded by strong southeast trade winds over the Pacific that last more than a year and accumulate warm water in the western Pacific. The subsequent collapse of the wind field allows the warm water to surge eastward in the form of an equatorial Kelvin wave, which causes El Niño along the coast of South America. [The *SCI*® indicates that this paper has been cited in over 155 publications since 1975—the second most-cited paper published in this journal.]

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The North Pacific Experiment (NORPAX), started in 1970, was aimed at investigating the large-scale interactions of ocean and atmosphere over the Pacific. One of the most pronounced disturbances in this system is El Niño, the occasional appearance of abnormally warm water in the coastal waters of Peru, which has catastrophic consequences for the fishing industry. Bjerknes[1] had recognized that El Niño was not a local event, but was related to large changes in the ocean-atmosphere system over the entire Pacific. But an explanation of the mechanism involved in the formation of El Niño was still lacking.

When investigating the fluctuations of the trade winds based on data collected by millions of ship observations, we found that the largest variations occurred in the central equatorial Pacific and that the strongest winds preceded El Niño. This discovery formed the basis for the development of the El Niño theory that was reported in the paper.

Strong southeast trade winds lasting more than a year intensify the south equatorial current and move large amounts of warm water into the western Pacific, depressing the thermocline and increasing the sea level. When these trade winds subsequently relax, the accumulated water flows eastward in the form of an equatorial Kelvin wave. This Kelvin wave surges against the coast of South America, depresses the thermocline, and raises the sea level. This theory could be verified by records of thermocline displacements and of sea level.

As soon as the paper was published, O'Brien[2] and his students at Florida State University constructed a numerical hydrodynamic model and were able to verify the theory mathematically.

This idea about El Niño has formed the basis for all subsequent work on the subject, and that is why it has been frequently quoted. The importance of the idea was quickly recognized and is probably best expressed by Haney[3] in his review paper "Numerical models of ocean circulation and climate interaction," where he writes: "The first and perhaps most important contribution of the last four years is the establishment of a new theory for El Niño by Wyrtki (1975)" and "Wyrtki's theory, which involves the ocean's dynamic response to remote atmospheric forcing, puts to rest all theories based on local forcing mechanisms."

Although the theoretical concept for the generation of El Niño was simple, it was not easy to verify because of lack of adequate data. In the following years, a network of sea-level gauges was established on islands in the Pacific, which succeeded in monitoring the response of sea level during the 1976 and 1982-1983 El Niño events.

Developing this theory of El Niño was surely the main reason I received the Rosenstiel Award for Ocean Science from the University of Miami in 1981 and was elected a Fellow of the American Geophysical Union in 1982.

1 **Bjerknes J.** A possible response of Hadley circulation to equatorial anomalies of ocean temperature *Tellus* 18 820-9, 1966 (Cited 135 times.)
2 **Hurlburt H E, Kindle J C & O'Brien J J.** A numerical simulation of the onset of El Niño *J Phys Oceanogr* 6 621-31, 1976 (Cited 80 times)
3 **Haney R.** Numerical models of ocean circulation and climate interaction *Rev Geophys. Space Phys* 17 1494-507, 1979

