# Buoy oh buoy: Comprehensive El Niño data

The El Niño Pacific warming of 1997 and 1998 shut down the nutritional conveyor belt to a vast swath of ocean surface, newly released data show. The 1998 La Niña cooling, in turn, switched this belt to fast forward, fertilizing the biggest bloom of microscopic plants yet measured in the equatorial Pacific.

"This is the largest El Niño–La Niña event ever observed, and it was observed in great detail," comments biological oceanographer Michael R. Landry of the University of Hawaii at Manoa in Honolulu. Landry says the new measurements provide a first overview of how ocean ecosystems, global carbon dioxide concentrations, and the physical forces behind El Niño interrelate. "This is a tremendous technical and conceptual achievement," says Landry.

The data come from two sources: buoy-mounted sensors, which transmit readings from 72 equatorial sites, and an optical satellite sensor. The combined systems report wind speed and direction, temperature, and marine concentrations of carbon dioxide, nutrients, and chlorophyll—the green, light-harvesting molecule that plants produce.

The measurements show that during the 1997–1998 El Niño, the equatorial Pacific ceased producing carbon dioxide and became a net absorber of that greenhouse gas.

While scientists had already surmised from scattered shipboard readings that such a transition had occurred, marine geochemist Taro Takahashi of Columbia University comments that the new data detail the phenomenon for the first time. He says these numbers will figure critically in global-warming predictions.

Other measurements confirm that across most of the equatorial Pacific, El Niño deepens the warm-water layer inhabited by the primary producers in the ocean food web—the photosynthetic plankton.

Earlier evidence suggested that this deepening would diminish the nutrient supply to these microbes by pushing the cold equatorial undercurrent downward and farther from the plankton. The cold water originates near South America and carries nutrients to the relatively infertile midocean region along the equator. Scientists have proposed that trade winds draw this cold water upward.

Multiple measurements confirm the basic elements of this system. During the last El Niño, nutrient upwelling halted as winds flagged, the undercurrent lost strength, and chlorophyll concentrations across the equatorial Pacific plummeted to their lowest recorded levels.

L. Stratton, Tropical Atmosphere Ocean Project, NOAA


*A buoy, carrying instruments above water and on an anchored line below, transmits readings via satellite.*

During the subsequent La Niña, these trends reversed, with a vengence.

"The dramatic bloom that occurred after El Niño was completely unexpected," says Francisco P. Chavez, a biological oceanographer at the Monterey Bay Aquarium Research Institute in Moss Landing, Calif. He and his colleagues describe the recent findings in the Dec. 10 SCIENCE. —*O. Baker*

# Laboratory-grown corneas come into sight

May Griffith of the University of Ottawa Eye Institute can't get her hands on any decent corneas. She and her colleagues need them to study how eyes heal after vision-correcting laser surgery, but the high-quality corneas donated to eye banks are grabbed for transplantation. "We got so desperate we said, 'Hey, let's make our own,'" she recounts.

The products of that desperation, corneas built from laboratory-grown human cells, are described in the Dec. 10 SCIENCE. Such artificial tissues may help in the study of eye-wound healing, replace animals in some drug and cosmetic toxicology tests, and one day even serve as replacement corneas for people, say Griffith, Mitchell A. Watsky of the University of Tennessee College of Medicine in Memphis, and their colleagues.

The cornea—the window into the eye—has three cell layers. The outer one, called the epithelium, keeps foreign material out of the eye and helps distribute nutrients. Below that layer lies the stroma, containing water, the fibrous protein collagen, and cells called keratocytes. The endothelium, the innermost layer, has cells that remove excess water from the stroma to maintain the cornea's transparency.

To duplicate this structure, Griffith and her colleagues engineered each type of corneal cell to grow endlessly in the laboratory. They then laid down a sheet of epithelial cells and topped them with keratocytes infused into a collagen-containing matrix. Finally, they covered the matrix with endothelial cells.

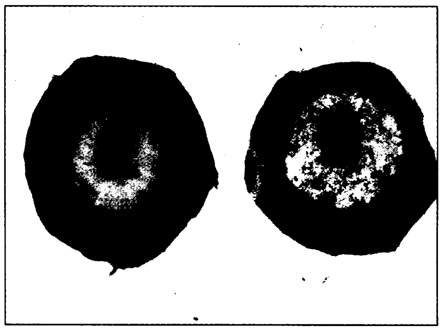
The investigators grew the layered cells for 2 weeks in a medium containing vitamin C, which stimulates collagen production, and protease inhibitors, which slow degradation of the original collagen matrix. The resulting cornea had a transparency and internal structure closely resembling normal human corneas.

Moreover, the artificial corneas responded to chemicals much as corneas of live rabbits or donor human corneas do. Procter & Gamble Co., which helped fund the research, has begun to evaluate whether artificial corneas can substitute for animals in any of its toxicology tests, says Griffith.

Don't expect the artificial corneas in the eye clinic soon. Their long-term viability remains one of many open questions. Griffith's group hasn't tested the artificial corneas' longevity beyond 3 weeks. "At this point, I don't think they would last the lifetime of a person," she says.

"To think that we're close to an implantable artificial cornea would be stretching things," agrees ophthalmologist David G. Hwang of the University of California, San Francisco.

Griffith *et al.*



*A human cornea (left) and an artificial one (right) each cover the letter E.*

Still, Griffith and her team are looking into ways of improving the artificial corneas, such as strengthening the matrix supporting the cells in the stromal layer.

As the elderly population continues to increase, the demand for transplantable corneas will rise, notes Griffith. The popularity of laser eye surgery, which can rule out use of a person's cornea for later transplantation, may further reduce the supply. "We're already starting to see a shortage," says Griffith.

As a result, patients may turn to artificial corneas, even if they don't last. "At least [people] would see until a donor becomes available," says Griffith. —*J. Travis*