ATMOSPHERIC SCIENCE

Does a Globe-Girdling Disturbance Jigger El Niño?

An unpredictable atmospheric oscillation that may help transform an ordinary El Niño into a monster could frustrate efforts to refine forecasts

In early 1997, after some rough years in the El Niño prediction business, forecasters thought they might have managed to scout out an El Niño well in advance: One model after another predicted a modest warming of the tropical Pacific Ocean by the winter of 1997–98—the start of a moderate El Niño. As it turned out, forecasters got their warming, but it was several times stronger than any model had predicted. The Pacific sizzled with record heat, driving weather disruptions that caused thousands of deaths and billions of dollars in damages and outdoing even 1982–83's "El Niño of the Century."

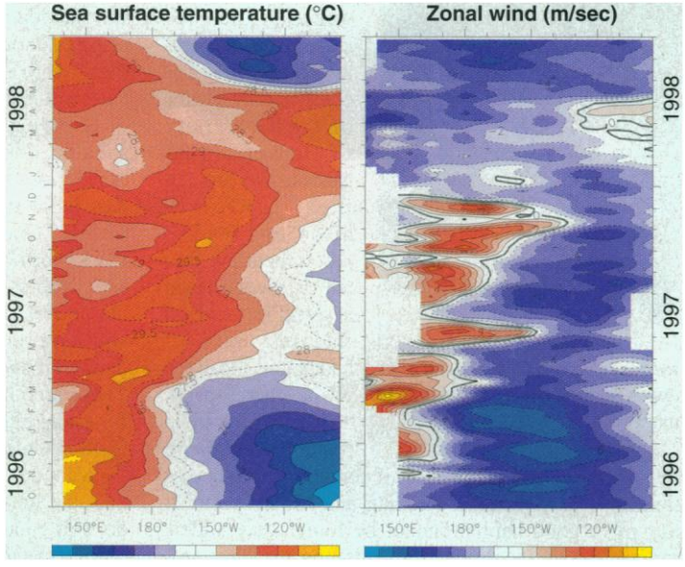
Researchers have since suggested that decades-long swings of temperature in other parts of the Pacific could have helped drive El Niño to extremes (*Science*, 19 February, p. 1108), but now many climate scientists suspect that a more mercurial factor may also help stoke the fires of Pacific warming: capricious bursts of wind along the equator, each lasting only a month or two.

This prime suspect for fogging up forecasters' crystal ball goes by the name of the Madden-Julian Oscillation or MJO, after the researchers who discovered it 30 years ago. Every 30 to 60 days, it sends bursts of wind across the western Pacific, where El Niño gets its start. New modeling and empirical studies suggest that these bursts of wind can trigger an El Niño already poised to strike or intensify one by changing temperature patterns in the western Pacific. The MJO doesn't cause El Niño, says oceanographer Michael McPhaden of the National Oceanic and Atmospheric Administration's (NOAA's) Pacific Marine Environmental Laboratory (PMEL) in Seattle, but it probably helps determine a warming's strength. Unfortunately, that knowledge may not make monster El Niños much easier to call, because the intensity of the MJO remains unpredictable. The MJO probably "adds a measure of unpredictability to El Niño," says oceanographer William Kessler of PMEL.

From a satellite, the MJO manifests itself as an eastward-moving patch of tropical clouds that extend high into the troposphere (*Science*, 7 September 1984, p. 1010). Spawned in an interaction between rising columns of air and high-altitude winds, the intensified updrafts marked by the cloud patch are part of a globe-circling oscillation of the atmosphere. The cloud patch appears in the Indian Ocean, races across Indonesia and the western Pacific, then peters out in the eastern Pacific. At the surface, a passing cloud patch first draws stronger trade winds out of the east, then triggers heavy rains under the clouds, and finally causes weakened trades or even westerly winds as it leaves. This surface expression of the MJO usually fades as it reaches the eastern Pacific, but 15 kilometers up the MJO's wave of high-altitude wind variations circles the globe in 30 to 60 days, when the next oscillation may begin.

Researchers are now looking closely at the MJO and related tropical wind shifts, because "every El Niño since 1950 has been associated with" particularly powerful bursts of winds in the western Pacific like those of the MJO, says McPhaden. The winds presumably help unleash warm western Pacific water into the eastern Pacific. And the official forecasting model developed by the Bureau of Meteorology Research Center in Melbourne, Australia, suggested that MJO-related winds may create the best sort of wind pattern for doing so, modelers Andrew Moore of the University of Colorado, Boulder, and Richard Kleeman of the Bureau of Meteorology reported in May's *Journal of Climate*.

To McPhaden, the '97–'98 event reveals the handiwork of the MJO. Late in 1996, the tropical Pacific was apparently primed for a warming. The prevailing trade winds blowing from the east had piled more than the usual amount of warm water in the west—water waiting to slosh eastward in the next El Niño once the trades weakened or reversed. But the warming did not begin to spread eastward until powerful bursts of wind blew from the west in synch with the MJO in December 1996 and March 1997, says McPhaden. These westerlies pushed warm water eastward and also sent slow ocean waves to the east, cutting off the normal upwelling of deep, cold water to the surface there. In 12 months, while a half-dozen unusually strong westerly wind bursts struck the western Pacific, the warming across the Pacific quickly surpassed the predicted 1°C and peaked at 2.5° to 3°C.



A mere coincidence? Unusually warm waters in the western Pacific (hot colors, left panel) didn't spread eastward in the '97–'98 El Niño until bursts of westerly winds (hot colors, right panel) appeared.

SOURCE: W. KESSLER/PMEL

"That El Niño would probably have occurred anyway," says McPhaden, but "these wind events affect both the amplitude and timing of El Niños." They may do so not just by pushing warm water to the east, Kessler and Kleeman found when they modeled the effect of the winds, but also by cooling the western source region, largely by boosting evaporation. When they ran the Bureau of Meteorology's forecast model with and without the cooling effect of the MJO, they found that the MJO strengthened a feeble El Niño by 30%.

It might seem odd that cooling the western Pacific would strengthen an El Niño, but in this case, the cooler water weakened the temperature difference across the Pacific that drives easterly trade winds, which normally keep the warm water in the west. Weakening those winds allowed more water to spill westward. The resulting El Niño was "still not strong enough," says Kessler, "but [the MJO] is acting in the right direction."

And other factors could boost the MJO's push. Many of the MJO's wind bursts early

in the '97–'98 El Niño were unusually large, Kessler notes, enhanced by various forces, such as surges of cold air from the north. The cold surges fueled a pair of cyclones straddling the equator, which in turn funneled westerly winds between them, according to meteorologists Lisan Yu of the Woods Hole Oceanographic Institution in Massachusetts and Michele Rienecker of NASA's Goddard Space Flight Center in Greenbelt, Maryland.

Many of Kessler's colleagues cautiously endorse the notion that the MJO fine-tunes El Niño's strength. Meteorologist and longtime El Niño watcher Vernon Kousky of NOAA's Climate Prediction Center in Camp Springs, Maryland, agrees that the MJO "may very well be a feature that helps determine the character of a particular El Niño." And modeler Mark Cane of Columbia University's Lamont-Doherty Earth Observatory in Palisades, New York, thinks Kessler "makes a good case for the MJO being an amplifier." Still, at this point it's not clear just how big an effect the MJO exerts on El Niño, cautions modeler David Battisti of the University of Washington. "At some level these things matter," he says. "The question is, how large an impact do they have?" He thinks Kessler and Kleeman's simulation of how much MJO's cooling effect amplifies an El Niño may have been unduly sensitive.

But if the interaction of the MJO and El Niño is real, it "adds some level of unpredictability" to forecasting, says Kessler. "Nobody claims to predict the MJO," he notes, "and most [models] have a poor rendition of it. You may be able to predict an El Niño next year, but it will be much harder to predict its amplitude." Researchers may find out whether the MJO throws a wrench into the forecasts when they test their skills during the next El Niño, due no earlier than next year.

–RICHARD A. KERR

SCIENTIFIC PRIZES

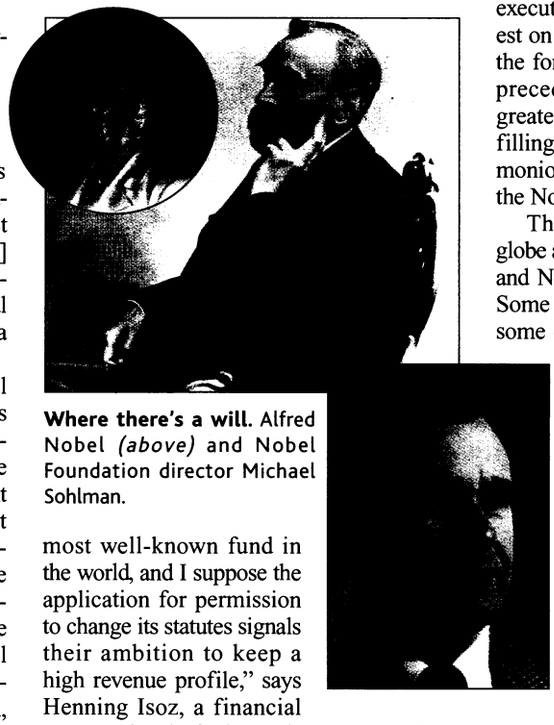
Nobel Foundation Seeks Looser Financial Reins

Long hamstrung by the stipulations of Nobel's will, the world's most famous prize fund wants the freedom to beef up its awards

STOCKHOLM—The Nobel Foundation generates a flood of publicity in October, when it announces the winners of the world's most prestigious science prizes, and it usually operates for the rest of the year well out of the limelight. Not so this year. In April, Sweden's newspapers carried warnings that the foundation was facing economic hardship. "Direct returns [from the Nobel Foundation's assets] do not cover the prize money any longer," reported *Dagens Industri*, a Swedish financial newspaper, under the headline "Nobel—a case for the government."

This sudden concern over the financial wellbeing of the foundation, which bankrolls five of the Nobel awards (excluding economics), was prompted by a request from the fund's managers for the Swedish government to relax the rules regulating its investment policies. The publicity sent foundation officials scrambling to reassure the public that the foundation is not in any peril. "As for our ability to finance our current expenditures, there is no problem whatsoever," says Michael Sohlman, executive director of the foundation. The proposed changes, says Sohlman, would simply do away with outdated restrictions and give fund managers more flexibility to invest in equities rather than fixed-interest bonds. The aim, says Sohlman, is not to stave off erosion of the foundation's finances, but to improve the prospects for increasing the prize money in future years.

Nevertheless, the very idea of changing the rules governing the high-profile award fund has caused some alarm and highlighted the Nobel Foundation's almost iconic status in Sweden. "The Nobel Foundation is the most well-known fund in the world, and I suppose the application for permission to change its statutes signals their ambition to keep a high revenue profile," says Henning Isoz, a financial expert who drafted Sweden's current fund legislation and now works for the consulting firm Ernst & Young. The discussion has also focused a spotlight on the foundation's financial management and on the bizarre circumstances surrounding the creation of the fund. These involved spiriting Nobel's fortune from Paris to Scotland and overcoming the resistance of patriotic Swedes to giving any of the awards to foreigners.



Where there's a will. Alfred Nobel *(above)* and Nobel Foundation director Michael Sohlman.

Alfred Nobel, millionaire businessman and inventor of dynamite, signed his final will at the Swedish-Norwegian Club in Paris on 27 November 1895 and died a year later in San Remo, Italy, on 10 December 1896. The part of the will relating to the prize is not much longer than a page. It states that: "The whole of my remaining realizable estate shall be dealt with in the following way: the capital, invested in safe securities by my executors, shall constitute a fund, the interest on which shall be annually distributed in the form of Prizes to those who, during the preceding year, shall have conferred the greatest benefit on mankind." However, fulfilling Nobel's wish became a long and acrimonious process that lasted until 1900 when the Nobel Foundation was established.

The will attracted attention across the globe and caused great controversy in Sweden and Norway, which were united at that time. Some of Nobel's relatives contested it, and some of the bodies designated by Nobel to award the prizes (the Royal Swedish Academy of Sciences for chemistry and physics, the Karolinska Institute for physiology or medicine, and the Swedish Academy for literature) were reluctant to assume the task. However, the Storting, Norway's parliament, which the will called on to appoint the peace prize committee, took on the job without hesitation. But in Sweden Nobel's insistence on an international prize drew severe criticism. King Oscar II declared that the money should remain in the Nobel family, or at least not be spent on a dubious "Peace Prize." Hjalmar Branting, a famous social-democratic leader and himself later a Nobel peace laureate, expressed his disgust with a capitalist easing his bad conscience by giving away money.

Political acceptance wasn't the only problem. According to the will, all of Nobel's shareholdings in companies around the world had to be liquidated. This required some nimble—and risky—footwork on the part of Ragnar Sohlman (Michael Sohlman's

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