which can be triggered only by relatively high-energy neutrinos produced by a rare side reaction in the sun. Skeptics can always argue that the "deficit" is really just some omission from the calculations by which theorists extrapolate from the side reaction to the whole sun.

By the end of this year, however, that situation should be clarified. The first results should be in from two new detectors in Europe and the Soviet Union, both of which look for the interaction of solar neutrinos with gallium. (*Science*, 16 March, p. 1291). This reaction is sensitive to the lower energy neutrinos produced by the fusion of protons into helium—the process that produces the vast majority of the sun's energy. Calculations made directly from the sun's known energy output show that proton-proton fusion should produce at least 70 SNUs in the gallium detectors. "If the gallium experiments see a lower rate," says Lande, "then something is definitely happening to the neutrinos."

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Who Will Win the El Niño Sweepstakes This Time?

Who makes the best forecasts of El Niño, man or machine? So far the machines—the computer models—have the upper hand. They won the first and only round 4 years ago when they correctly predicted the last El Niño, the occasional extreme warming of the tropical Pacific Ocean. Human forecasters at the time failed to see it coming. But now another test is under way and the positions are reversed. Will the models win again? Or will the human observers come out on top, reversing their decade-long string of embarrassing oversights and false alarms?

Much of the world's weather is riding on the answer. El Niño has been linked to a slew of weather extremes around the globe. It can bring unusually wet winter weather to the U.S. Gulf Coast, warm winters to Alaska and western Canada, heavy rains to Peru, and failure of the Indian monsoon rains.

Such crazy weather in the next year would not surprise human El Niño watchers. For a couple of months now, they have been saying it looks as if an El Niño will be here by winter. The tropical Pacific Ocean is already warming, they note, and wind shifts overhead should be sending in even more warm water. These same researchers failed to predict both El Niños of the 1980s, but the strength of the ongoing changes in the Pacific has brought them as close to making a forecast as they ever get. "The larger-scale pattern, to me, is clearly moving into a warm phase," says veteran El Niño watcher Eugene Rasmusson of the University of Maryland. "It looks like we're well into the transition" to a full-blown El Niño.

It may *look* that way, say researchers who use mathematical models to predict El Niños, but the humans may have been fooled by an ephemeral warming. Three of the four forecast models call for near normal conditions the rest of this year, not an El Niño. "My subjective feeling is that everything is going along [toward an El Niño]," says modeler Mark Cane of Columbia University's Lamont-Doherty Geological Observatory, "but [subjective judgments] have been wrong in the past. It's possible that, despite all the signs and portents, there won't be an [El Niño] event" and the three models, including Cane's, will be right after all. The other two are those of Tim P. Barnett at Scripps Institution of Oceanography and Jingsong Xu and Hans von Storch of the Max Planck Institute for Meteorology in Hamburg. The fourth model, run at Florida State University by James O'Brien, has come down on the side of the humans, however.

The last time the humans and the models went eyeball to eyeball over El Niño, the humans blinked first. In December 1985, Cane and Stephen Zebiak of Lamont went public with their model's prediction of an El Niño warming in the Pacific by the fall of 1986. The Lamont forecast was eventually confirmed by the Florida State and Scripps models. By February of 1986, most of the humans were also concluding that a warming then under way showed every sign of becoming an El Niño.

Then, in the face of what appeared to be imminent success for both subjective and objective forecasting, the tropical Pacific reversed itself and marched right back to normal conditions by late spring. The humans, blown by every changing wind, now saw little hope of an event by fall and in essence withdrew their El Niño prediction, while the modelers, stuck with their forecasts, wondered what might have gone wrong with their new toys. But, just when things looked bleakest for the model forecasts, the Pacific did another about-face and headed into a bona fide El Niño (*Science*, 13 February 1987, p. 744). The models had won after all.

Much rides on the outcome of the latest round of opposing El Niño forecasts. If the human forecasters prove to be wrong, they will have to confront the likelihood that their intensified monitoring of the Pacific in the 1980s has revealed unsuspected complexities in the canonical picture of El Niño originally developed in the 1970s.

If the models prove to be wrong, it would be a doubly severe blow because two types of computer models are being used to predict El Niños—and both would have failed. One type, as exemplified by the Lamont model, uses a crude simulation of the winds and currents of the tropical Pacific to predict sea-surface temperatures and sea levels several seasons into the future. The other objective forecast method, typified by the Scripps model, uses statistical techniques to look beyond the month-to-month variability in the tropical Pacific that has confused human observers in the past. Instead, these methods allow a search for patterns of long-term change that are harbingers of El Niño.

The current forecast confrontation also offers a newcomer to the model forecasting business a chance to win converts. Last November, before any signs of a Pacific warming had appeared, the Max Planck group announced—via the electronic mail network favored by El Niño researchers—that their statistical model was calling for a warming that would become evident during the coming winter. Other researchers initially paid little attention to the forecast from this newest of the models, but they have become intrigued after the recent warming in the tropical Pacific.

The Max Planck model could soon look even better. In an interview at press time, von Storch told *Science* that based on February's observations, their model has produced a new forecast. The current warming, according to the model, "will not fully develop. It will be an aborted El Niño similar to that of 1974," says von Storch. Ironically, it was February observations that finally drove the Florida State simulation model to call for an El Niño.

When will we know whether man or machine has won the El Niño sweepstakes? Not until fall, so don't make plans for a western Canada ski trip just yet.

■ RICHARD A. KERR