though, models will never make perfect climate forecasts. A heavy dose of chaos infects the streams of air and water coursing around the planet, explains Latif.

"There was an enthusiasm that went through the community a few years ago when we initially realized that we can predict El Niño. People overdid it a bit and were too optimistic. I think the claims that were made that ENSO may be predictable a few years in advance are probably not correct," he says. He estimates that unstable fluctuations of the ocean and atmosphere limit the predictability of ENSO to about 1 year.

For meteorologists, forecasting El Niño is only half the battle. Once they predict how the ocean will behave a half year hence, they must look into how something in the middle of the Pacific will affect the weather thousands of kilometers away, where more people live.

El Niño has such a long reach because it coaxes thunderstorms from the vicinity of Indonesia out into the middle of the Pacific. Like giant boulders in a river, these towering clouds redirect the atmospheric jet streams, shifting the normal track of storms over North and South America.

In the tropics, El Niño has an obvious influence. It tends to bring droughts to Indonesia, Australia, and northeast Brazil, as it inundates coastal Peru and Ecuador.

Meteorologists are now gaining insight into how the equatorial waters of the Pacific skew weather outside the tropics. Robert E. Livezey of the CPC has combed through 102 years' worth of U.S. temperature and precipitation records to document long-distance links between Pacific warmth and the weather in regions of each U.S. state.

The knowledge of these links, coupled with the record El Niño, has boosted CPC meteorologists' confidence in their ability to predict U.S. weather for this winter. "These factors have led us to make stronger forecast statements than we've ever done before," says Livezey.

The certainty shows up in CPC's map predicting U.S. precipitation for January through March 1998. The center has had to add a new hue to its maps to reflect the extremely high odds of dry conditions in the Ohio River Valley and of enhanced precipitation in parts of Texas and South Florida. The prediction also calls for a wet Southwest and Gulf Coast. The northern states will bask in unusual warmth, say the forecasts.

In the past, the weird weather spawned by strong El Niños has taken a heavy toll on people around the globe. Aside from direct effects, such as desiccated crops and flooded cities, the extreme conditions have also indirectly fostered the spread of diseases. Researchers have linked past occurrences of El Niño to outbreaks of cholera in Peru, malaria in Colombia, and hantavirus in the U.S. Southwest.

This year, however, the timely forecasts have provided advance warning of many of the upcoming disruptions. Last month, Antonio D. Moura of the newly created International Research Institute for Climate Prediction at Lamont-Doherty spent 2 hours briefing the president of Brazil on how El Niño and Atlantic Ocean temperatures could spur a drought in the northeast part of that nation. At the same time, U.S. meteorologists met with representatives of southern African nations in Zimbabwe to discuss the potential problems associated with El Niño. This month and next, researchers will carry their message to Peru and Uruguay.

More than in the past, politicians and emergency planners seem to be listening. "I can see that in many regions, governments are starting to worry about this," says Moura. "They are beginning to believe the forecasts and explore what is their best strategy for decreasing the negative impacts." □

Chemistry

Understanding how proteins fold

Scientists long to figure out the rules for how protein strands curl into their particular three-dimensional shapes. Understanding these principles could provide insight into biological processes and enable scientists to make proteins for specific uses.

Two recent studies move researchers closer to those goals. One boosts the basic knowledge of how proteins fold; the other offers a practical way of putting such knowledge to use.

Many scientists think that the formation of weak bonds between hydrogen and other elements, especially nitrogen and oxygen, helps proteins lock into their final shapes. To test this idea, Jeffrey S. Moore and Peter G. Wolynes of the University of Illinois at Urbana-Champaign and their colleagues synthesized short chains of phenylacetylene molecules, which don't contain elements that form hydrogen bonds, and dissolved them in a liquid.

The researchers found that the chains folded into spiral structures resembling alpha helices in proteins, suggesting that hydrogen bonds are not central to the folding of alpha helices. The chains wrap around themselves in order to minimize contact with solvent molecules, the researchers argue in the Sept. 19 SCIENCE.

In the second study, Bassil I. Dahiyat and Stephen L. Mayo of the California Institute of Technology in Pasadena reversed the usual strategy, which is to predict a protein's three-dimensional structure from its amino acid sequence. Instead, they developed a way to find the best string of amino acids to make a chosen shape.

As a target, the researchers chose a structure called a zinc finger, which helps certain proteins bind to DNA. This small module of 28 amino acids folds into a well-defined shape that contains many of the features found in larger proteins. Using a supercomputer, Dahiyat and Mayo sorted through the many possible combinations that could make up a 28-amino-acid segment. They combined available theoretical models and empirical results to predict each sequence's three-dimensional structure.

After finding the closest match to the target shape, the researchers synthesized that sequence in the lab and determined that its structure was nearly identical to that of the actual protein. "By combining theory, computation, and experiment," the researchers say, "[the method] has improved our understanding of the physical chemistry governing protein design." They report their findings in the Oct. 3 SCIENCE. —*C. W.*

Fuel chemistry advance wins prize

The National Academy of Engineering has awarded the 1997 Charles Stark Draper Prize to Vladimir Haensel, a chemical engineer at the University of Massachusetts at Amherst. The biennial award, engineering's highest honor, was given to Haensel for his development of a widely used method of producing high-octane fuels that burn cleanly and efficiently.

Until the 1940s, the only practical way to fragment the long hydrocarbon molecules in unrefined petroleum used heat and clay catalysts. The resulting fuel burned inefficiently, however, so gasoline companies added lead to improve its quality.

In 1947, while at Universal Oil Products in Des Plaines, Ill., Haensel developed much better, platinum-based catalysts, eliminating the need for leaded gasoline. The reusable catalysts produce more gasoline from the same amount of petroleum, while removing sulfur and many other contaminants. The result was cheaper, cleaner-burning fuel, which sparked an explosion of the transportation industry.

The process also yields large quantities of aromatic hydrocarbons, the raw materials for many plastics. Now, more than 4 million barrels of petroleum per day and 200 billion pounds of aromatic hydrocarbons per year are produced with Haensel's catalysts. —*C. W.*