News from the CLIMAS El Niño-Drought Initiative

END InSight

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Predicting El Niño

Not long ago, the term El Niño was seldom associated with flooding in South America, drought in the Pacific Northwest, and unusual weather in many other places, except within research offices. Now, almost everyone is aware of its status, thanks to news reports, comic strips, and even late-night TV shows. But name recognition doesn't necessarily equate with understanding, and there is a lot that researchers still don't know about El Niño. Predicting El Niño events is of particular concern because advance warning provides the opportunity to avert negative impacts on, for example, agriculture, human health, and the economy.

Predicting weather is a tricky thing; it's common knowledge that weather forecasts rapidly become less reliable when projected more than a few days in advance (and sometimes even sooner!). Predicting climate patterns, such as El Niño, is a different story. The aim is not to foretell the day-to-day weather one or several seasons in advance, but to predict some aspect of the statistics of weather. For example, during a strong El Niño event, climatologists might predict that total winter precipitation in the Southwest will be higher than average.

These generalized projections are possible in part because the ocean plays a large role in determining climate at longer time scales (like seasons). El Niño-Southern Oscillation (ENSO) results from a tight coupling between the ocean and atmosphere. Because of the ocean's great mass and capacity to retain heat, it changes slowly, and thus climatologists can be fairly certain that closely associated atmospheric conditions will not change rapidly. This allows climatologists to predict ENSO conditions at time scales that are impossible for weather prediction (1).

El Niño: A Refresher

A quick glance at a globe will show that about 50 percent of the Earth's equatorial region is located in the Pacific Ocean. Changes in the ocean and atmosphere in this area have a large influence on the rest of the Earth. When the trade winds that blow from east to west across this region weaken during an El Niño event, warm surface-water conditions can expand eastward from near Indonesia across the tropical Pacific; these are accompanied by tropical showers and thunderstorms. The vigorous rising air from the storms helps steer upper-level winds and impacts climate all over the world (2). The combined ocean-atmosphere linkages are known as ENSO.

ENSO Prediction Efforts

The first ENSO predictions in the 1970s were simple; scientists would observe changes in the trade winds and infer the ocean's response. By the 1980s, as computer-modeling capabilities grew, more sophisticated and skillful methods of ENSO prediction became possible. One set of methods is statistical in nature, whereas the other uses dynamical computer modeling of the atmosphere and oceans (including Global Climate Models [GCMs]) to forecast equatorial Pacific sea surface temperatures (SSTs).

Typically, El Niño events begin between March and September and end in February or March (3). However, many events are not typical and develop differently through the seasons and from year to year. The peak strength of ENSO events is in the northern hemisphere winter, and it is during this time of the year that ENSO predictions typically have the most skill.

Figure 1 illustrates how forecast skill improves during the winter. Figure 1a shows a series of 6-month predictions made in July 2002 from a linked ocean and atmosphere model, and the predictions in Figure 1b were made in November 2002. Each solid line is a daily forecast made the month before; the predictions are combined together to form an ensemble forecast. Notice that the spread of solid lines in the forecast of December conditions (indicated by an arrow), made during July (Figure 1a), is quite large—spanning almost 2 °C, whereas in the forecast made during November (Figure 1b), the lines are much tighter for all months (spanning a little more than 1 °C). In other words, the model ensemble is in much greater agreement for the prediction made during late fall.

Predicting El Niño Impacts in the Southwest

Although climatologists have made great strides in predicting the timing and strength of ENSO events, they are challenged to forecast the precise impacts of an event at any given place. This is because El Niño impacts on the Southwest result from a complex chain of interacting processes—warm SSTs creating rising air and storms, storms and rising air steering high-level winds, high-level winds influ-

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El Niño, continued

encing storm tracks, and storm tracks bringing (or not bringing) moisture to particular regions.

Not only are ENSO conditions in the equatorial Pacific more skillfully forecast during the northern hemisphere winter, so are ENSO impacts on precipitation. Although land temperature also is impacted by ENSO, the impacts are more variable and, as a result, much more difficult to predict.

Most commonly, impacts from past ENSO events are used as a guide to how an area might be affected. For example, Figure 2 shows rainfall at Organ Pipe Cactus National Monument, Arizona for El Niño, La Niña, and neutral months. Winter precipitation is particularly sensitive to ENSO conditions (although less so during January), unlike spring and fall rainfall. This strong ENSO wintertime influence is typical for many parts of the world. With moderate-to-strong El Niño conditions prevailing right now, Australia, for example, is suffering from extreme drought conditions, and recently California has been deluged by El Niño-related storms.

–Nan Schmidt, CLIMAS

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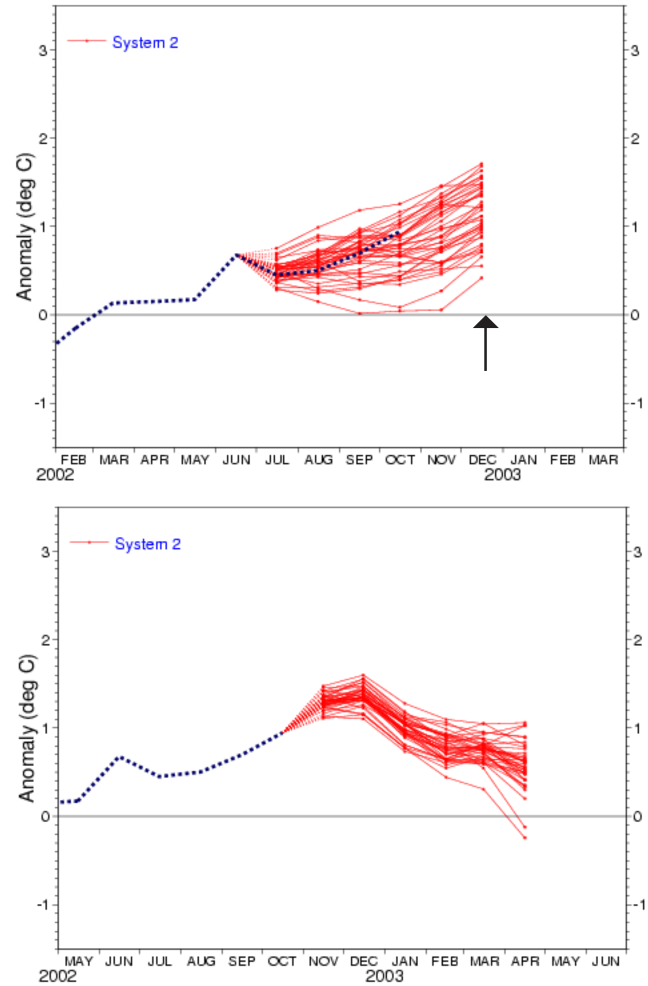

Figure 1. Niño Region 3 sea surface temperature anomaly forecast from the European Centre for Medium-Range Weather Forecasts (4). The dotted line is the observed SST anomaly (SSTA) for the year, up to the date the forecast was made. The solid lines represent forecasts made on each successive day of the month that forecast was made. A) The six-month forecast made in July 2002. B) The six-month forecast made in November 2002. Note: Positive SSTAs are associated with El Niño events.

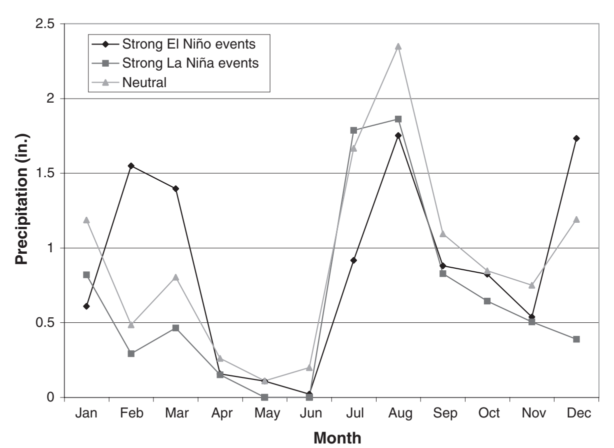

Figure 2. Average monthly precipitation for strong El Niño, strong La Niña, and neutral events from 1950 through 2002 for Organ Pipe Cactus National Monument, Arizona.

About END InSight

END InSight is a year-long project to provide stakeholders in the Southwest with information about current drought and El Niño conditions. As part of the Climate Assessment for the Southwest (CLIMAS) project at the University of Arizona, END InSight is gathering feedback from stakeholders to improve the creation and use of climate information.

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