EMBARGOED UNTIL 0000 UTC ON 1 NOVEMBER 1998
No. 7 (November 1998)

El Niño/La Niña Update

Weak La Niña conditions in the tropical Pacific have started to develop. A rapid succession of climate extremes can occur when the pattern swings from El Niño to La Niña conditions, bringing severe stress to the environment. In Indonesia, the drought of the past year followed by heavy rains this year provides a cogent example: last year's drought contributed to extensive forest fires that left large areas denuded of vegetation, while this year's heavy La Niña related rains in those areas have resulted in flash floods and mudslides. Because it is often associated with ample monsoon rains in southern Asia and the maritime countries between the Pacific and Indian Oceans (the "maritime continent"), La Niña's impacts in that region are typically viewed as less disruptive than those of El Niño. However, La Niña's relatively benign image may not be entirely appropriate.

The 1997–1998 El Niño/Southern Oscillation (ENSO) warm episode dramatically illustrated the global character of the phenomenon and at the same time clearly demonstrated the promise of seasonal climate prediction. However, because many computer forecasting models for predicting tropical Pacific sea-surface temperatures (SSTs) were developed with a focus on warm episodes, and because the coupled dynamics of warm and cold episodes are somewhat different, prediction models generally have not performed as well with La Niña/cold episodes. Nonetheless, by late 1997 through early 1998, virtually all of the forecast tools were suggesting the development of a La Niña during 1998. This provides encouraging evidence of the robustness of the improvements in forecasting skill on seasonal time scales.

LA NIÑA

Although El Niño and La Niña represent opposite phases of ENSO, the La Niña phase has been less well studied than the El Niño phase. In part, this is because La Niña episodes during the past two decades have been relatively less frequent. La Niña evolves in a manner similar to that of El Niño but with anomalies of opposite sign. During La Niña, the generally cool SSTs in the eastern and central Pacific Ocean (the equatorial cold tongue) become even cooler than usual, while the generally warm SSTs in the western tropical Pacific tend to become somewhat warmer than usual. This pattern of SSTs is accompanied by stronger than average equatorial trade winds (blowing from east to west), a shoaling (raising) of the equatorial thermocline*, particularly in the eastern and central equatorial Pacific, and enhanced convective rainfall in the western Pacific.

* A zone of ocean water of rapidly changing temperature, between the surface layer, where temperatures are relatively uniform throughout the layer, and the fairly uniformly cold depths below.

The great shifts in the ocean-atmosphere climate system associated with La Niña are qualitatively complementary to those experienced during the El Niño phase of ENSO, but the impacts on global precipitation and temperature patterns are not simply mirror images of those associated with El Niño. Generally, La Niña is associated with above-normal rainfall in the western Pacific and the maritime continent; southern Asia (during the southwest monsoon); northern and northeastern Australia; southern Africa; northern South America (including northeastern Brazil) and Central America; and the Hawaiian Islands. Drier than normal conditions are frequently experienced in equatorial islands in the central Pacific; central east Africa (during the Short Rains); North America along the Gulf of Mexico, southwestern US and northern Mexico; and parts of southeastern and southwestern South America.

While these impacts are typical of La Niña in general, it is unlikely that all of them will occur with any particular La Niña episode — as with an El Niño episode, other factors, including internal atmospheric dynamics, regional sea-surface temperature patterns and land-surface conditions, also influence regional climate variability. Coupled numerical ocean-atmosphere models are starting to provide the prediction tools that will enable climate forecasters to take into account these other influences when preparing seasonal outlooks.

CURRENT STATUS AND EARLY IMPACTS

La Niña conditions appear to be evolving at a pace consistent with earlier predictions. The start of the current La Niña cold episode was heralded by extremely rapid decreases in the equatorial sea-surface temperatures during May and June 1998 (Figure 1). The rate of cooling has since slowed, but by October cooler than normal SSTs were evident from the west coast of South America to well west of the Dateline. Sea-surface temperatures in the western and central Indian Ocean have also cooled from their record levels during 1998. Meanwhile, SSTs in the western tropical Pacific and eastern Indian Ocean have warmed somewhat (Figure 2). There have been accompanying changes in the ocean circulation in the tropical Pacific where, by the end of August, the equatorial thermocline was much closer to the surface than usual (within 40 metres) from the South American coast to west of 140°W.

The shift in convective instability back to its normal location in the far western Pacific, maritime continent and eastern Indian Ocean associated with these changes in SSTs has stimulated the heavy rainfall observed over Indonesia and Borneo since August of this year. In addition, most of Australia has been experiencing wetter than average conditions. Other La Niña related precipitation impacts are expected to develop as the cold episode continues to evolve (see Figure 3).

OUTLOOK

There is general agreement among most dynamical and statistical prediction models that tropical Pacific SSTs will continue to decline slowly through the end of the year. The forecasts of SSTs in the tropical Indian and Atlantic Oceans are produced operationally by only a few centres and are known to be less accurate (in general) than those for the tropical Pacific. Further, it is known that Indian Ocean and Atlantic Ocean SSTs play an important role in modulating precipitation changes over parts of Africa and South America, and most likely are important in contributing to climate variability in other regions as well. Thus, the uncertainties in Indian Ocean and Atlantic Ocean SST values during the forecast period lead to additional uncertainties in the forecasts for those regions.

RECENT CLIMATE FORECAST FORUM OUTLOOKS

Since the previous El Niño Update issued in June of this year, several climate forecast fora have been held. The most recent were in Africa and are summarized below. Other fora are being planned for West Africa and other regions of the globe over the coming months.

GREATER HORN OF AFRICA CLIMATE OUTLOOK FORUM,

Mombassa, Kenya, 2–4 September 1998

Among the principal factors taken into account were the evolving La Niña episode and cooling SSTs in the western Indian Ocean. These SST patterns have been associated with below-normal rainfall conditions over the southern half of the subregion, and with above-normal rainfall conditions in the northern half of the subregion. In comparison with March–April–May, rainfall during the September–December season has relatively high predictability over the central and southern parts of the region.

It should be noted (see Figure 4) that in the southern half of the region, several of the forecasts indicated increasing probabilities of below-normal rainfall as the season progresses. A second point of note is that the enhanced probabilities of above-normal rainfall in northern and central Sudan are principally the result of rainfall in the early part of the forecast period.

SOUTHERN AFRICA CLIMATE OUTLOOK FORUM,

Harare, Zimbabwe, 29 September–2 October 1998

The Forum was convened to formulate consensus guidance for the October 1998–March 1999 season in southern Africa. The Forum noted that SST anomalies in the Atlantic Ocean are weak; SST patterns in the equatorial Pacific Ocean have been associated with above-normal rainfall conditions over much of the southern part of the continent, and with below-normal rainfall conditions in the far north-eastern part of the region. However, Indian Ocean and Atlantic Ocean sea-surface temperature anomalies can significantly modulate the signal from the equatorial Pacific.

October to March constitutes an important rainfall season over southern Africa. An exception is northeastern Tanzania, where the rainfall season usually is divided in two (October–November–December and March–April–May), and the extreme southwestern part of South Africa, which experiences its dry season throughout this period. No forecast information is provided for countries that were not represented at the Forum. The Outlook produced by the Forum covers two seasons, namely October to December 1998 and January to March 1999. The forecast for the latter period is shown in Figure 5.

October-December 1998

Over eastern Tanzania there is a high probability of below-normal rainfall. West and central Tanzania, northern Zambia, the northern half of Malawi, and Mauritius have enhanced probabilities of normal to below-normal rainfall. Normal to below-normal rainfall is expected over the northern part of Mozambique, southern half of Malawi and central Zambia. Southern Zambia, central Mozambique, and Zimbabwe, excluding the southwestern portion, have enhanced probabilities of near-normal rainfall. The southwestern portion of Zimbabwe, Botswana, the southern part of Mozambique, Swaziland, central and eastern South Africa, Lesotho, and northern Namibia have enhanced probabilities of normal to above-normal rainfall.

January-March 1999

Eastern Tanzania usually experiences a dry season during January–March and so climatology is predicted for this region. There are increased probabilities of normal to below-normal rainfall in West and central Tanzania. For the rest of the subcontinent and for Mauritius, there are enhanced probabilities of normal to above-normal rainfall. Climatology is also predicted for the far southwestern part of South Africa and for the western coastal regions of Namibia.

LA NIÑA AND TROPICAL CYCLONE ACTIVITY

There were eight named storms (Danielle, Earl, Frances, Georges, Hermine, Ivan, Jeanne and Karl) in the Atlantic in September and for the first time this century, on 24 September, four Atlantic hurricanes were active at the same time. Such enhanced hurricane activity is consistent with developing La Niña conditions.
Chinese researchers have indicated that extreme rainfall over central China is more likely in the year following an El Niño, but this has yet to be fully documented.

NOTES:

The current status of seasonal-to-interannual climate forecasting allows prediction of spatial and temporal averages, and does not fully account for all factors that influence regional and national climate variability. Outlooks shown above are only relevant to seasonal time scales and relatively large areas; local variations should be expected. The Climate Outlooks were prepared with input from the International Research Institute for Climate Prediction (IRI); African Centre of Meteorological Applications for

Development (ACMAD), Niamey, Niger; Caribbean Meteorological Institute; Centre for Weather Prediction and Climate Studies (CPTEC), Brazil; Climate Prediction Center/National Oceanic and Atmospheric Administration (NOAA), USA; Drought Monitoring Centre, Nairobi; Drought Monitoring Centre, Harare; European Centre for Medium-range Weather Forecasts (ECMWF); Queensland Department of Natural Resources; South African Weather Bureau; and the United Kingdom Meteorological Office (UKMO); and took advantage of information produced by national Meteorological Services and other agencies and universities at various consensus climate forecast fora around the world (see http://iri.ucsd.edu/forecast/sup). For further information concerning this Update and other guidance products, users are strongly advised to contact their national Meteorological Services.

Forecast contributors to the Southern Africa Climate Outlook Forum included representatives from national Meteorological Services of ten Southern African Development Community (SADC) countries (Botswana, Malawi, Mauritius, Mozambique, Namibia, South Africa, Swaziland, United Republic of Tanzania, Zambia and Zimbabwe) and climate scientists and other experts from national, regional and international institutes (Drought Monitoring Centre, Harare; Cooperative Institute for Mesoscale Meteorological Studies (CIMMS), University of Oklahoma; International Research Institute for Climate Prediction (IRI); NOAA/National Centers for Environmental Prediction (NCEP) Climate Prediction Centre; UKMO; and Universities of Pretoria and Zululand).

Contributors to the Greater Horn of Africa Climate Outlook Forum included representatives of national Meteorological Services from nine countries (Burundi, Djibouti, Eritrea, Ethiopia, Kenya, Rwanda, Sudan, Uganda and United Republic of Tanzania) and climate scientists and other experts from national, regional and international institutes (ACMAD; Climate Information and Prediction Services (CLIPS), WMO; Disaster Prevention and Preparedness Commission, Ethiopia; Drought Monitoring Centre, Nairobi; North Carolina State University; University of Nairobi; CIMMS, University of Oklahoma; IRI; NOAA/NCEP; and Office of Global Programs, NOAA). Additional input was supplied by the United Kingdom Meteorological Office.