February 1999

Heat Waves and Floods across Asia: Was El Niño, then La Niña the Cause?

R. H. Kripalani
Indian Institute of Tropical Meteorology

Ashwini Kulkarni
Indian Institute of Tropical Meteorology

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Unprecedented heat wave conditions occurred during May–June 1998 across Asia. Unusually high temperatures were recorded in western India, Pakistan, eastern China, Japan, and Southeast Asia. Even the United States, western Africa, eastern Canada, and western Australia experienced the blistering heat spell.

Some reports blame people for the global warming. The world is warming because of the burning of fossil fuels and deforestation, resulting in an increase in carbon dioxide in the atmosphere. The 1998 heat wave prompted the United Nations Environment Programme to issue an urgent warning and a wake-up call to limit the emission of global warming gases. The year 1998 may in fact be the hottest year of this millennium.

While one view clearly suggests “a discernible human influence on climate,” another view blames the recent El Niño for the 1998 heat wave. Besides being associated with floods and droughts in its severe forms, El Niño can also affect other meteorological phenomena, possibly including abnormal increases in temperature. Scientists at the National Oceanic and Atmospheric Administration (NOAA) say that the recent El Niño is largely responsible for the record high temperatures in 1998. NOAA scientists also say that the El Niños are occurring more frequently and are progressively warmer. There is evidence to suggest that global temperature may be linked to stronger and more frequent El Niños.

During an El Niño, excess heat is concentrated in the waters of the tropical Pacific. The current El Niño reached its maximum peak around December 1997, when sea surface temperature (SST) anomalies (actual temperature minus the mean temperature) were maximum. Thereafter, SSTs continued to decrease, and after May 1998, the decrease was sharp. Figure 1 illustrates this point. This figure depicts SST anomalies from November 1997 through November 1998 for the region designated as NINO

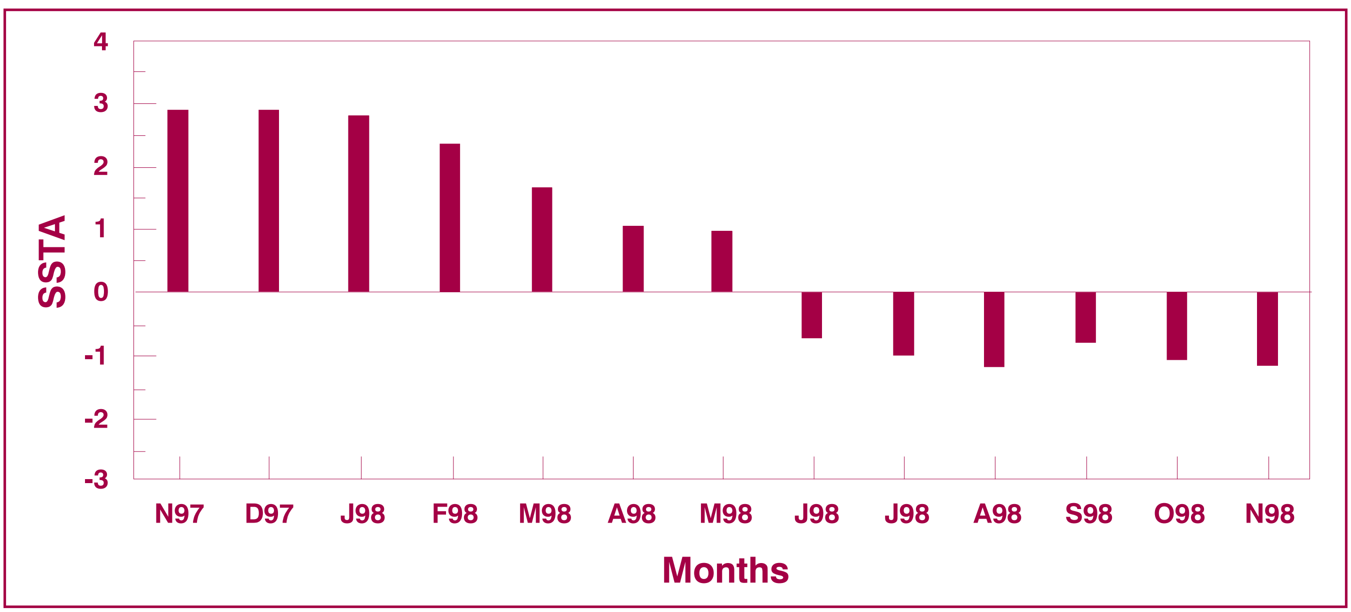

Figure 1. Monthly sea surface temperature anomalies (SSTA) over the NINO 3.4 (5° N–5° S, 170° W–120° W) region, November 1997–November 1998. Source: NOAA/NWS/NCEP, *Climate Diagnostics Bulletin 1998,* No. 98/11.

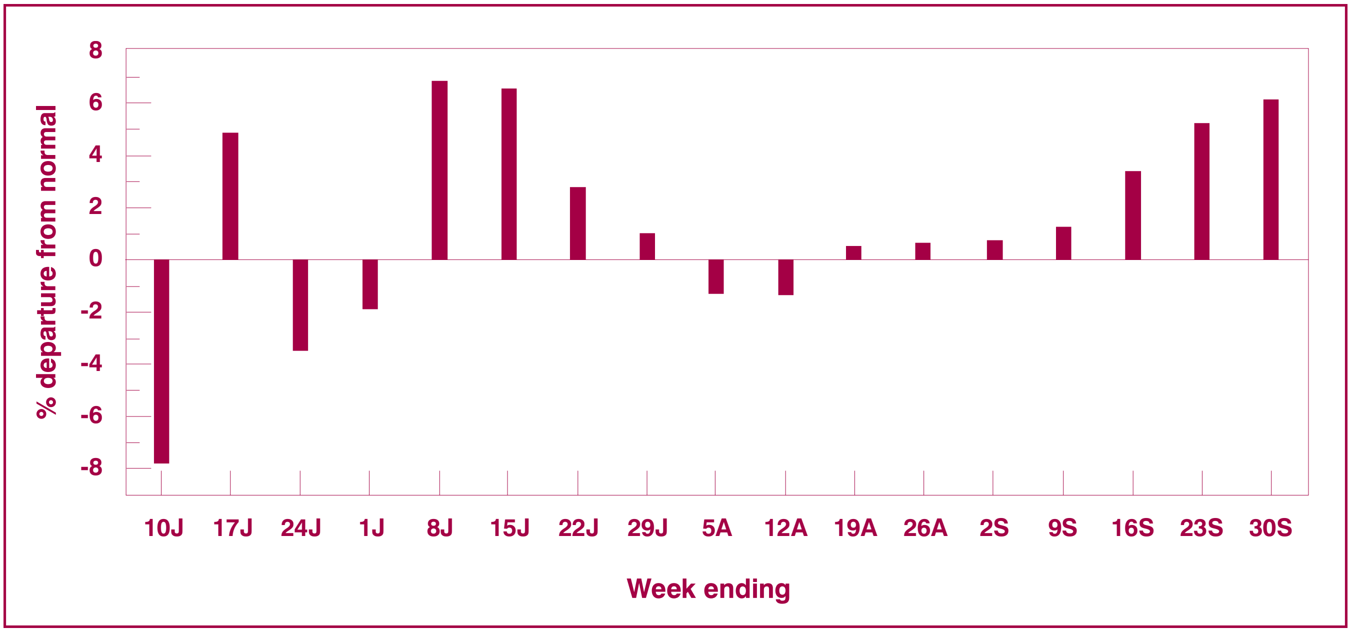

Figure 2. Weekly cumulative area weighted Indian monsoon rainfall (percentage departure from long-term mean) for week ending 10 June through 30 September 1998. Source: India Meteorological Department.

3.4 (5° N–5° S, 170° W–120° W). It shows that the temperatures have been declining, and after June 1998, moderate cold episode (La Niña) conditions commenced. Thus the weakening of the warm episode (El Niño) and the entry of the cold episode (La Niña) must have liberated a huge amount of heat from the tropical Pacific. The effects of this heat are carried around the globe by atmospheric circulation. This could be one reason for the unprecedented 1998 heat wave.

After the heat wave, which claimed thousands of lives in May and June, monsoon floods during July–September 1998 left a trail of death and destruction in their wake. Monsoon rains played havoc with parts of northern India, particularly the northeastern region. The world-famous Kaziranga National Park for animals was submerged under 18 feet of water, leaving no animals behind in the 430 square kilometers of the Park. Many other animals perished in the flooding, which was worse than the great flood of 1988. Floods in July–August 1998 inundated three-quarters of Bangladesh—the worst flooding in Bangladesh's history. China also experienced its worst flooding in decades. The flood peak in the Yangtze River was the second largest since 1954. In South Korea, flooding was caused by the heaviest August rains in 27 years. In Japan, the heaviest rain in more than 80 years (since 1914) deluged the north central part of the country. Borneo also reported floods after the torrential rains. Indonesia, which suffered devastating droughts and forest fires because of El Niño, was hit by heavy rains and floods. The entry of La Niña may have triggered these floods.

The Indian monsoon rainfall (IMR) was normal up to the end of July 1998. After that, the cumulative area weighted rainfall for India showed a monotonic increase. Figure 2 illustrates this point; it shows the cumulative rainfall, as percentage departure from normal, at the end of each week. The total seasonal IMR for the period June–September 1998 was 106% of the long-term average (905 mm, compared to the normal of 852 mm). The tropical Pacific entered into a La Niña phase after June (Figure 1), and the IMR showed a monotonic increase in rainfall after August (Figure 2). In a recent article published in *Drought Network News* (Kripalani and Kulkarni, 1998b), it was suggested that following the severe 1997 El Niño, the IMR for 1998 could be more than 900 mm.

An analysis of IMR for the period 1871–1998 reveals that the IMR exhibits epochal variability. The periods 1880–95 and 1930–63 are characterized by above-normal rainfall with very few droughts, while the periods 1895–1930 and 1963–90 depict below-normal rainfall with frequent droughts (see Kripalani and Kulkarni, 1996 and 1997). A study by Kripalani and Kulkarni (1997) has shown that whereas the impact of El Niño is more severe on IMR during the below-normal rainfall epochs, the impact of La Niña is more severe during the above-normal rainfall epochs. The IMR has entered into an above-normal epoch, with a turning point around 1990. This may be one reason that the impact of El Niño on IMR after the 1990s has not been severe (see Kripalani and Kulkarni, 1997 and 1998a). If the current La Niña conditions over the tropical Pacific continue until the 1999 monsoon (June–September), it will be conducive to very good monsoon activity over India since the above-normal rainfall epoch and the state of the ENSO (El Niño/Southern Oscillation) phenomenon in the tropical Pacific will be in the same phase.

From the above considerations, it appears that El Niño and La Niña were dominant factors in the blistering heat wave and the devastating floods.

R. H. Kripalani and Ashwini Kulkarni
Indian Institute of Tropical Meteorology
Pune 411008
India
e-mail: rhksup@tropmet.ernet.in

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