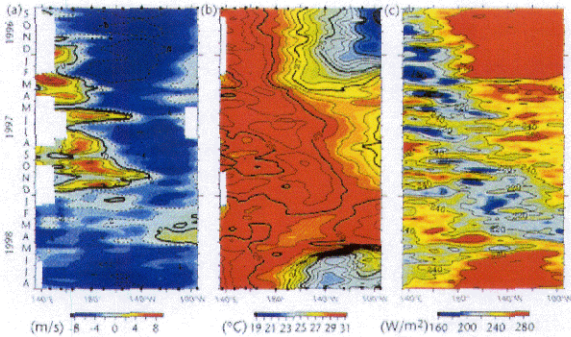

Figure II.3
Mean monthly surface zonal wind (a), sea surface temperature (b) and outgoing longwave radiation (c) from September 1996 to August 1998 along the equator across the Pacific Ocean.
(McPhaden, 1999a)

calibration. The TOPEX/Poseidon satellite is expected to continue operation until May 2000 and then to be replaced by its successor, JASON-1. Surface wind speeds over the oceans were measured for about nine months using the NSCAT system mounted on the ADEOS satellite before it failed in June 1997.

It was fortuitous, therefore, that prior to the onset of the 1997–98 El Niño event the Global Observing System for weather forecasting had been augmented by the new instruments for climate research. Not only were the systems for observing the phenomenon unprecedented but the data were rapidly made available to the scientific community and national meteorological services. The development and intensification of the El Niño phenomenon and the spatial extent of many climate anomalies were well monitored and accurate advice was available, through national meteorological services, as a basis for action by governments and individuals.

The El Niño cycle

Overview

The evolution and decay of the equatorial characteristics of the 1997–98 El Niño event can be visualised from concurrent equatorial longitude-time sections (or Hovmöller diagrams) for zonal wind, sea surface temperature and outgoing longwave radiation shown in Figure II.3. Each of the panels represents values along the equator (horizontal axis — Date Line 180) with time along the vertical axis commencing September 1996 and ending in August 1998.

A period of easterly winds persisted over the central and eastern equatorial Pacific Ocean (shaded blue in Figure II.3a) throughout 1996. This led to the formation of a warm pool in the western Pacific Ocean with raised sea level and deeper than normal thermocline. The period of westerly wind bursts over the western equatorial Pacific Ocean associated with Madden-Julian Oscillations, which is suggested as being an important factor in the initiation of the 1997–98 El Niño event, can be seen in the wind field from December 1996 through April 1997 (shaded red). Periods of westerly winds recur over the western Pacific Ocean through most of 1997 but do not extend the full width of the Pacific Ocean at any time.

Kelvin waves initiated by the westerly wind bursts propagated eastwards along the equator and acted to raise sea level and lower the depth of the thermocline. Sea surface temperatures exceeding 27°C (shaded red in Figure II.3b) appeared at most longitudes across the central and eastern Pacific Ocean between April and May 1997. The warm sea surface temperatures were maintained over the central and eastern equatorial Pacific Ocean until rapid cooling set in about May 1998.

The changing outgoing longwave radiation fields are consistent with eastward progress of the focus of deep atmospheric convection across the equatorial Pacific Ocean (see Figure II.3c). There is consistency between the eastward progress of the region of reduced outgoing longwave radiation and the eastern edge of the region of sea surface temperature in excess of 28°C to 29°C. The anomalous warming under the influence of the developing El Niño event meant that sea surface temperatures over the central equatorial Pacific Ocean provided a heat and moisture source necessary to support deep atmospheric convection.

Sea surface temperatures over the eastern equatorial Pacific Ocean did not exceed the 28°C to 29°C threshold until about October 1997, and in coastal regions of South America these temperatures were not exceeded until December 1997. During the Southern Hemisphere summer of 1997–98, when the intertropical convergence zone was normally at its most southern extent, the warm waters were a strong source of heat and moisture. The significantly reduced values of outgoing longwave radiation over the eastern equatorial Pacific Ocean at this time identified deep atmospheric convection adjacent to the South American coast.

As the focus of deep atmospheric convection moved eastward across the