anomalous warming of sea surface temperatures is first detected around the middle of the year (May) and the maximum anomaly of temperature is reached towards the end of the year. Generally by May of the following year the areas of significant sea surface temperature anomaly over the equatorial Pacific Ocean have vanished.

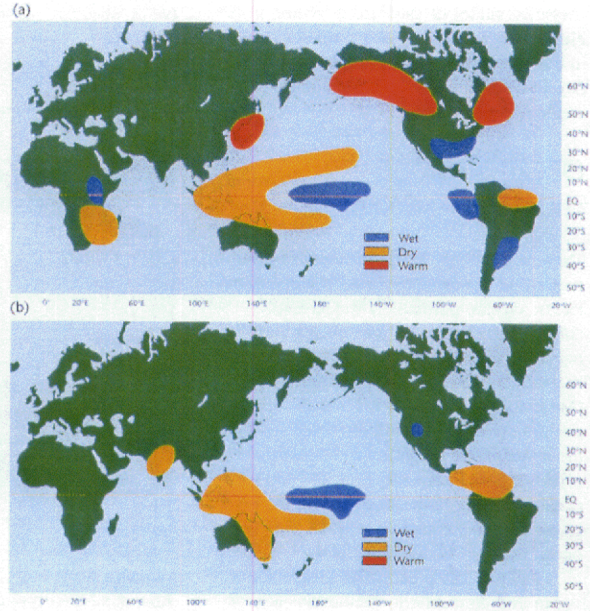
During a strong El Niño event the reversal of the Walker Circulation over the western and central Pacific Ocean can cause subsiding air and clear skies to dominate over the western Pacific Ocean and parts of Asia and Australia. The subsiding air inhibits convection and results in below average rainfall and even drought in parts of those regions. Over the eastern equatorial Pacific Ocean the anomalous convection often brings flood rains to coastal parts of Ecuador and Peru.

In addition to the direct impact on the Walker Circulation an El Niño event has other impacts on the global circulation of the atmosphere. Over the tropical Pacific Ocean region the changed pattern of atmospheric overturning and the changed equator to pole atmospheric temperature gradients impact on the subtropical westerly winds and the trough-ridge patterns of the mid-latitudes. Through teleconnections (see Appendix) there are downstream impacts on the seasonal weather patterns over both North America and South America and other parts of the globe.

Studies of historical records from island and land stations of the globe show that there is a degree of consistency in the precipitation and temperature anomaly patterns during El Niño events. The most dramatic and consistent change occurs across the tropical Pacific Ocean as convection and rainfall shift eastward and the intertropical convergence zone is drawn further south than usual, closer to the equator. At the same time there is suppressed seasonal rainfall over the western Pacific Ocean and often a late onset to a weak Asian summer monsoon.

An El Niño event generally reaches its mature phase during the Northern Hemisphere winter when the atmospheric westerly flow of the Northern Hemisphere is also at its peak. In addition to the precipitation anomalies of the Pacific Ocean, there is evidence of impacts reaching into the Indian Ocean basin and Africa, and into the middle and higher latitudes affecting East Asia and the Americas.

Not all patterns of anomalous precipitation and temperature attributed to



El Niño events are consistent from one event to the next. However, in some parts of the globe and for some seasons of the year there are characteristic patterns of rainfall and temperature anomaly that recur with each El Niño event. Anomaly patterns of rainfall and temperature that have been identified are shown in Figure I.8. These repeating patterns are the basis for providing alerts about dangers from potential climate extremes. Computer models of the global climate system that include forcing of the atmosphere by regions of anomalous sea surface temperature show skill at predicting some characteristics of the observed response of the atmosphere, including seasonal rainfall and temperature anomalies. Computer models that couple the dynamics of the oceans and atmosphere are being developed as the basis for more robust prediction schemes.

Global change

The development of knowledge about ENSO has been based on observations of the climate system covering more than a century, but especially with improved observations and data management methods of the past 50 years. Many characteristic attributes associated with the warm and cold phases of ENSO have been identified by