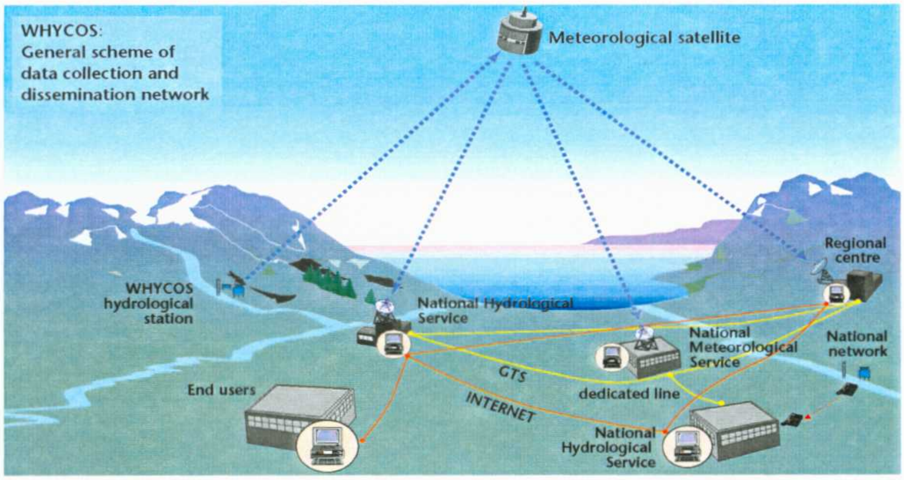

Figure 5 — WHYCOS: General scheme of data collection and dissemination network

3.2 Data Processing and Dissemination of Warnings

The data processing and dissemination of forecasting services form part of the WWW network which includes meteorological centres at the global, regional and national levels. Some of the regional centres specialize in the monitoring and prediction of natural disasters such as tropical cyclones.

The infrastructure that supports the preparation and dissemination of forecasts to the end-users including the public, national and local authorities, civil society and the media involves, among others, the WWW Global Data-processing System (GDPS) and Global Telecommunication System (GTS), which ensure the processing and operational exchange of data and products. These systems are vital for the early warning of disasters. The exchange of data is based on the adopted and promulgated WMO principle and policy of free and unrestricted exchange of meteorological and hydrological data and products.

3.3 Development of Methodologies for Improved Forecasting

As regards the development of methodologies for improved forecasting, WMO provides a global framework for collaboration in research in the fields of meteorology, hydrology and other geosciences. In particular, WMO's World Weather Research

Programme (WWRP) deals with improving forecasts of high-impact weather. The development of methodologies for forecasting natural disasters is also within the responsibility of other WMO programmes. In particular the Hydrology and Water Resources Programme addresses forecasting of floods and flash floods. The Tropical Cyclone Programme is implemented in close collaboration with the WMO Regional Tropical Cyclone bodies and Regional Specialized Tropical Cyclone Centres (Figure 6).

For seasonal forecasting, the WMO Climate Information and Prediction Services (CLIPS) project provides the necessary framework. The ability to forecast on time scales of a season or more depends on the fact that sea surface temperature (SST) anomalies may be associated with persistent atmospheric circulation patterns at locations which may be distant from their source. The best known of these anomalies is the El Niño, marked by a warming of the ocean surface in the eastern parts of the tropical Pacific. A particularly strong El Niño event occurred in 1997 and 1998. El Niño events in the Americas are marked by the following events, although it needs to be stressed that they do not occur during every El Niño event: excessively heavy rainfall along the west coast of South America and California; heavy rainfall in southern Brazil and northern Argentina; drought in

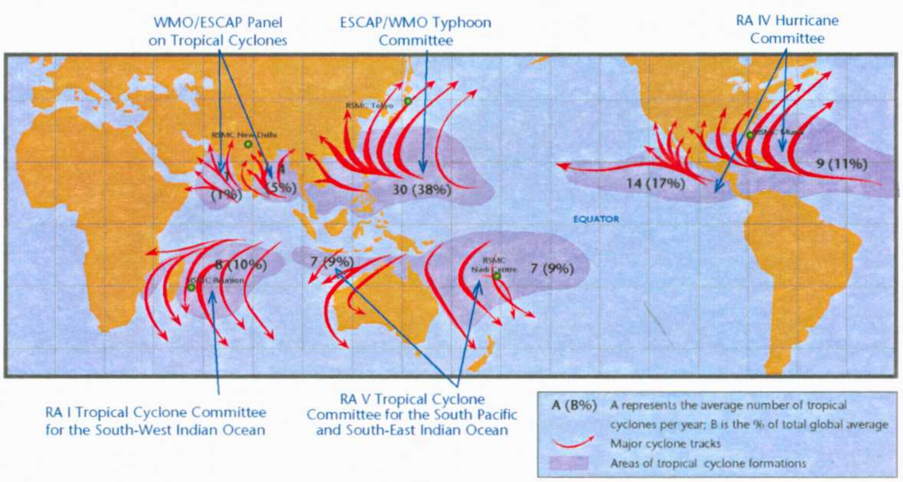

Figure 6 — Tropical Cyclone Centres and some statistics regarding tropical cyclones/typhoons/hurricanes

northeast Brazil; and changes of the tracks and frequency of Atlantic hurricanes and tropical cyclones in the Pacific.

Skills of extended-range forecasts for tropical Pacific Ocean SSTs have improved markedly. Numerical and statistical models were in general agreement on the behaviour of El Niño/La Niña. In Figure 7 an example of the forecast, a year ahead, of sea surface temperatures anomalies in the tropical areas of the Indian Ocean and the Pacific is given. Such forecasts are produced operationally by a few centres. At present, the most accurate forecasts are, in general, those for the tropical Pacific.

Current seasonal prediction models range from simple statistical approaches, through intermediate models, which combine the statistical and numerical approaches, to complex numerical coupled models, which use basic physical laws to predict the future state of both the atmosphere and the oceans. Much of the success in the development of models to predict these climate anomalies is based on the results of the Tropical Ocean and Global Atmosphere (TOGA) programme (1985-1994) and the Climate Variability and Predictability Study (CLIVAR) of the World Climate Research Programme (WCRP) co-sponsored by WMO.

TOGA provided fundamental insight into the mechanisms of the El Niño event and also facilitated the development of an observing network of moored buoys across the tropical Pacific Ocean, which provide invaluable real-time data for input to the prediction models. CLIVAR includes the development of seasonal to interannual prediction models under its GOALS (Global Ocean Atmosphere Land System) sub-programme.

3.4 THE BASIS OF CONFIDENCE IN PREDICTION MODELS

Weather and climate models incorporate mathematical descriptions of the atmosphere, ocean, land, biosphere and cryosphere in various degrees of complexity. Several factors provide confidence in these models including:

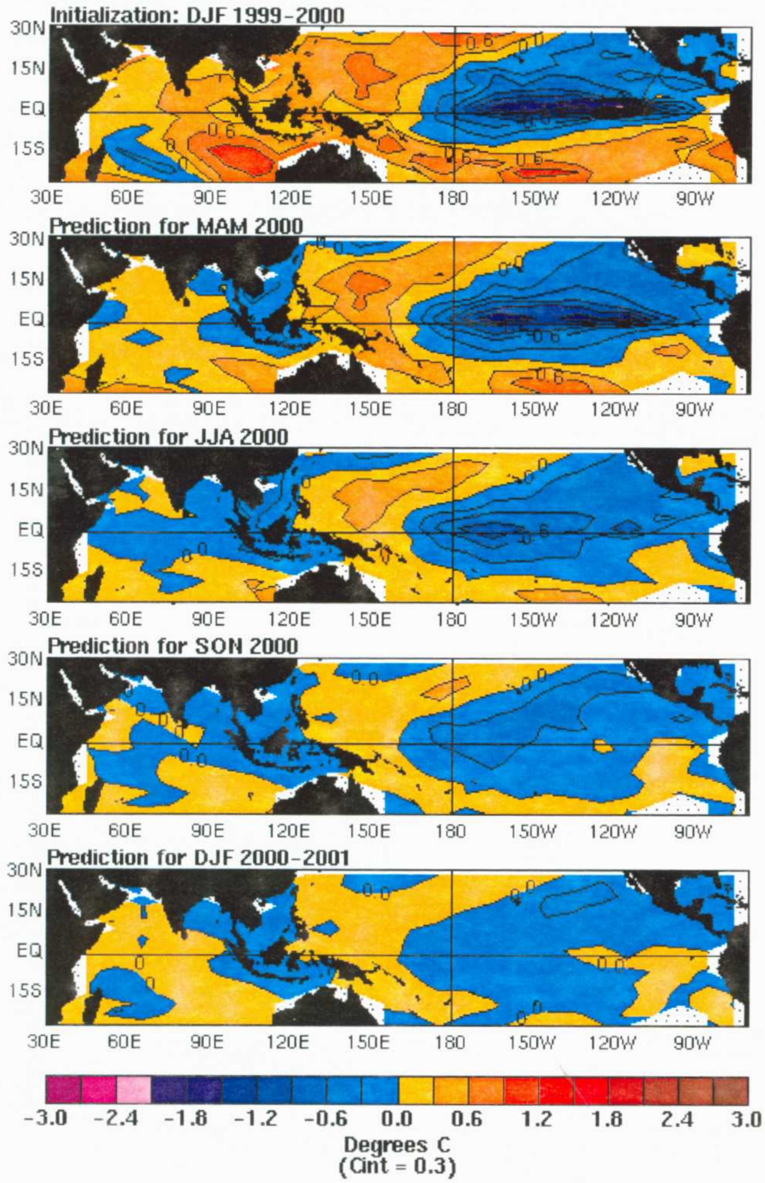

Figure 7. Interannual forecast of Sea Surface Temperature (SST) for the tropical Pacific and Indian Ocean

(i) Acknowledged ability to predict weather phenomena on a routine basis including extreme events (hurricanes, extra-tropical storms, tornadoes, etc.) several days in advance;

(ii) The ability to simulate large-scale features of the components of the climate system. For example Figure 8 shows the observed and model predicted geographic distribution of December to February surface temperature and June to August precipitation, simulated by comprehensive coupled atmosphere-ocean models;

(iii) The use of these coupled models in the succesful prediction of El Niño (1997-1998) and La Niña (1998–) phenomena, and their possible impacts, several months ahead of their occurences; and

(iv) The ability to predict global temperature variations between the time of eruption of Mt. Pinatubo (June 1991) and the end of 1994. The result agreed closely with the observations (see Figure 9).

4. SUCCESS IN REGIONAL USE OF EL NIÑO FORECAST

Climate information and prediction services are frequently aimed at alleviating or mitigating negative impacts of extreme climate

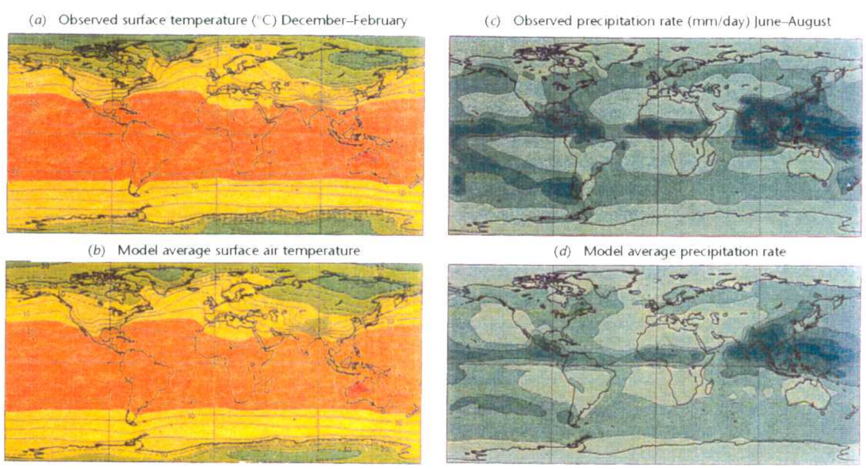

Figure 8 — The geographic distribution of December to February observed surface temperature (a); June to August observed precipiation (c); compared respectively to (b) and (d) which were simulated by comprehensive coupled models of the type used for climate prediction.
(*Source*: IPCC, 1995*a*)