ANNEX VI

WORKING GROUP 55

PREDICTION OF "EL NINO"

The fifth meeting of WG 55 consisted of five sessions (totalling approximately 16 hours) held at the CIMAS conference room at the University of Miami's Rosenstiel School of Marine and Atmospheric Science from 30 September until 2 October 1982. WG 55 members, Lagos, Namias, O'Brien, Stuart and Wyrtki were present along with invited participants S. Zuta, David Enfield, Donald Hansen, A. Leetmaa and Rennie Selkirk.

The proposed agenda was adopted and a broad time schedule outlined. The chairman gave a brief history of this Working Group, recalled the various prior meetings and their main accomplishments, reviewed the terms of reference and read our definition of El Nino which was to be sharpened and clarified at this meeting.

UPDATING OF EL NINO RELATED ACTIVITIES

WG 55 members were brought up to date on activities related to El Nino via the following reports: Committee on Climatic Changes and the Oceans (CCCO) (Wyrtki), Joint IOC/WMO/CPPS Working Group on Investigations of El Nino (Zuta), Eastern Pacific Climate Studies (EPOCS) (Hansen, Leetmaa), Regional Study of the El Nino Phenomena (ERFEN) (Zuta, Lagos), Aerial Vigilance of Atmospheric and Oceanic Conditions (VACOM) (Stuart, Zuta), Eastern Boundary Undercurrent Studies (EBUC) (Enfield), workshop on El Nino Rapid Response (Wyrtki), plus announcements of upcoming meetings in Princeton, N.J. in October (study conference on Southern Oscillation and associated phenomena like El Nino) and in December (Long Range Prediction Meeting) by Wyrtki, O'Brien, Newell and Namias. These reports provided the WG members a good overview of the groups currently involved in El Nino studies. Many of the WG members are actively involved in these studies and/or are members of these various groups.

DATA

Stuart reminded the WG of their various prior recommendations concerning collection and prompt dissemination of data crucial to El Nino Prediction schemes. These data are mostly sea level, winds, sea surface temperature (SST), and XBT data. Considerable correspondence has been exchanged (involving WG 55 members and others) concerning SST analysis for the Tropical Pacific using a mix of in situ observations (ships, buoys, islands) and satellite derived SST. A group of leading oceanic and atmospheric scientists (10-20), as early as October 1981, addressed the Administrator of NOAA (Dr. Byrne) concerning this problem and no clearcut resolution seemed evident as of 15 July 1982. WG 55 feels as strongly as ever that the in situ data base and analyses must be kept separate from the remotely sensed data base and analyses. The recent volcanic eruptions in Mexico (El Chichon) give a very current example of our concern. The scientific community must maintain SST analyses based exclusively on in situ observations. Such in situ observations are necessary if we wish to be able to evaluate the impact (seasonally to climatically) of such an event on the world wide circulations of the ocean-atmosphere system.

The question of data surfaced again in our discussions of definition of El Nino, and prediction schemes. A specific recommendation concerning data is attached.

DEFINITION OF EL NINO

In our first meeting in April 1978 in Las Palmas, Gran Canaria, the Working Group clearly faced the question that before we try to predict El Nino we must be clear what we mean by El Nino. It was further agreed that our interest was in the 'rare' event which has associated climatic (oceanographic and meteorological) and economic effects. Our definition put forth in April 1978 is: "El Nino" is a massive influx of warm water into the coast of Ecuador and Peru as far south as Lima ($12^{o}S$). From our presently available data the coastal stations must have a positive temperature anomaly, ΔT, of $2^{o}C$ or greater. Here ΔT is defined as the difference of the monthly mean (arithmetic) Sea Surface Temperature (SST) at the coastal station from the long term monthly mean (arithmetic) SST for the coastal station. Using this definition, El Ninos are identified in 1973, 1972, 1969, 1958, and 1957 i.e. dates well known in the literature. Our emphasis was to focus on the 'rare' event and to predict the occurrence or non-occurrence of the event. The WG recognized, at that time, that sea level might be a better criterion to use in the definition, but SST data are available for more years and from more stations.

Almost from the beginning the WG has been considering the sharpening of this definition of El Nino. Points of contention have been:

1) How long should the SST anomaly ($\Delta T > 2^{o}C$) last,
2) How many stations must exhibit the SST anomaly of $\Delta T > 2^{o}C$,
3) How crucial is the choice of $\Delta T > 2^{o}C$, and
4) Perhaps some phrases in the definition should be changed.

At this latest meeting in Miami, we had available monthly mean SST data for a common 25 year period (1956-1981) for five (5) Peruvian Coastal Stations. These data allowed us to extend our analysis through 1981. Also we decided to deal with normalized SST anomalies. Our new definition is: "El Nino is the appearance of anomalously warm water along the coast of Ecuador and Peru as far south as Lima ($12^{o}S$). This means a normalized sea surface temperature (SST) anomaly exceeding one standard deviation for at least four (4) consecutive months. This normalized SST anomaly should occur at least at three (3) of the five (5) following stations." The data give the monthly mean SST and the standard deviation computed over the period 1956-1981 for each month for each coastal station. This revised definition identifies Los Ninos in 1957-58, 1965, 1972-73, and 1976 i.e. dates well known in the literature. This revised definition identifies most of the same 'rare' events as the earlier definition, but now we are not 'wed' to a somewhat arbitrary SST anomaly (i.e. $\Delta T > 2^{o}C$), but rather to a normalized SST anomaly equal to or exceeding one standard deviation for each respective station. Stations meeting this definition for the period 1956-1982 were identified.

EL NINO PREDICTION SCHEMES

During the Miami meeting presentations were made of several methods for simulating and forecasting El Nino events. From these presentations and others obtained since, Table I was created to summarize the results. The various schemes are identified by the associated researcher and the open literature contains numerous papers giving the specifics of each group's methods.

From Table I, and especially from the discussion, it is obvious that all methods make use of similar select data. The WG members were unanimous in their call for prompt flow of the data (generally monthly means of each variable) in order for the issuance of timely forecasts. This has lead WG 55 to formulate the attached recommendations concerning data and an El Nino International Center (ENIC).

The proposed ENIC would have the charge of acquisition and dissemination of the relevant data.

Finally, from Table I we note that most El Nino Prediction techniques give a forecast generally only 1-3 months in advance. For good Fisheries management, a forecast of an El Nino event is needed 1-2 years in advance. It is obvious that we need a deeper insight into the mechanisms of El Nino and/or a good extended length forecast of some of the critical variables (i.e. SST, winds, S.L., etc.).

WORKING GROUP 55 - ITS FUTURE

The WG had a healthy and broad-ranging discussion concerning its future. The Chairman pointed out that the SCOR Executive Committee reconsiders each working group each two years, and at this time WG 55 is likely to end within the next year. WG 55 members felt much work needs yet to be done on El Nino Prediction. Actually, we are entering the most important phase, especially with the emphasis on Climate, Southern Oscillation and related phenomena, and an El Nino Rapid Response field programme. The WG 55 members believe a WG with 8-10 members actively involved in El Nino Prediction is needed and has attached a specific recommendation on this. The WG felt, if its members were all actively working on El Nino problems, biannual meetings funded by SCOR would be sufficient since the WG members would also hold at least annual workshops related to their own research. Finally, the members requested the chairman to continue in his current role if the WG is continued.

SCOR WG 55 (EL NINO PREDICTION) RECOMMENDATIONS

Data: El Nino is a climate type fluctuation which requires long term data bases for its understanding and prediction. The currently employed prediction schemes depend on several variables (i.e. in situ SST, winds via ship and satellites, sea level, and XBT's) which are needed promptly on a continuing basis. Hence, we recommend the following:

1. Sea level observations at coastal and island stations throughout the North and South Pacific must be continued, expanded, and the data made available promptly.
2. The World Meteorological Organization (WMO) should expand and strengthen its reporting system for real time reporting of ship reports of the weather (S.L. pressure, SST, winds) throughout the North and South Pacific.
3. Analyses of SST over the North and South Pacific using exclusively in situ (ships, buoys, islands) reports must be continued. El Nino studies have become dependent on this good data base which already exists. Future studies and predictions of El Nino depend on such analyses of in situ SST data. Such studies are unable to use satellite SST data especially since such satellite data can be nearly useless if the atmosphere suffers a rapid pollution like during the latest El Chichon eruptions in Mexico.

EL NINO INTERNATIONAL CENTER (ENIC)

The eventual prediction of El Nino events requires the acquisition of several variables (in situ SST, winds, sea level, XBT's, sea level pressure) from over most of the North and South Pacific and perhaps into neighbouring ocean and continental regions. Such data are needed to provide an ongoing monitoring of the ocean-atmosphere system, for development of new prediction schemes, for input to current real time prediction schemes, for model development and verification, and for the general climatological data base. Even though only monthly means of the variables are needed, frequently they are received too late to be used for monitoring and prediction since the data must be received from such a vast region involving numerous countries. Furthermore, since El Nino Events are so widely spaced in time, interest in the crucial data often wanes and many years may pass before it is recognized that important data have not been taken and/or that proper quality control was not maintained.

Aware of the data and communication problems, we recommend the establishment, as soon as possible, of an El Nino International Center (ENIC) whose primary charges would be:

1. Acquisition - on a timely basis - of the relevant data needed for monitoring and prediction of El Nino.
2. Quality control, archival and dessimation of the relevant data to those groups (countries and individuals) involved in studies and predictions of El Nino and related phenomena.
3. Real time monitoring and analysis of key variables related to El Nino.
4. Evaluation and verification of El Nino predictions which would be issued by numerous groups - worldwide - not directly associated with the ENIC. ENIC would not be a forecast group.
5. A center for exchange of ideas concerning El Nino accomplished by providing a location for groups to meet and by arranging workshops.

We further recommend that such an ENIC be located near to the tropical Pacific, that it have good data communication facilities, that it be located where airline transportation is good to excellent, that it have access to computers, and that it have a small dedicated staff. Most importantly, it must be International in scope, philosophy, and practice. Finally, basic data must flow promptly into ENIC and ENIC must promptly provide reduced data.

SCOR WORKING GROUP 55 - EL NINO PREDICTION

Aware that El Nino is a climate type fluctuation with time scales nearing a decade,

Aware that there are several working groups involved in climatic type problems but with El Nino type phenomenon as a secondary or tangential interest and not specifically addressing the forecasting problem,

Aware that the general scientific community is becoming more interested in El Nino studies and such studies are being planned,

Aware that El Nino events can have important impact on the economics of countries of South America and perhaps many other countries of the world,

We recommend that SCOR continue a working group devoted to El Nino - escpecially its prediction. We recommend the terms of reference to include the following:

1. Evaluations of ongoing prediction schemes
2. Evaluation of proposed new prediction schemes
3. Recommendations of future research needed for the prediction of El Nino especially to yield El Nino forecasts 1-2 years in advance
4. Evaluation of why frequency of Los Ninos is different in various decade periods

Furthermore, we recommend a working group of 8-10 members who are actively working on El Nino problems. Membership should be selected from persons involved in observing, modelling, and predicting El Nino including persons in meteorology as well as oceanography. At least one interested biological oceanographer should be on the WG. Geographical distribution of members is not as important as being involved in El Nino problems. The chairman should be involved in El Nino but able to act somewhat neutrally. The working group should be prepared to meet annually (biannually at SCOR's expense) on a fixed schedule and such meetings should be held at the site of the proposed ENIC at a time critical for the forecast (or occurrence) of El Nino.

TABLE I - SUMMARY OF EL NINO PREDICTION TECHNIQUES

	INPUT		PREDICTION	
Group	Variables*	Where	What	When Issued
Wyrtki	Winds (ship or satellite); SST (ship or buoy) S.L. and AXBT	20°N - 20°S Whole Pacific 20°N - 20°S W. of 180° in Pacific	Yes or No to the occurrence of a strong or moderate El Nino Event	1 Oct of each year using data through August
Quinn	S.L. Pressure SST	Easter, Darwin Rapa Stations Peru Coastal Stations	Yes or No to the occurrence of an El Nino Event	1 Dec of each year using data through October
Barnett	Surface Winds SST, Sea Level	20°N - 20°S Whole Pacific and Indian Ocean	SST Anomaly at Talara, Christmas Island and other tropical locations	Not being currently prepared but could be issued with lead times of 10-12 months and 3-4 months (later needs S.L. and wind data)
Newell	Ship winds SST (ship or buoy) Sea Level Pressure	Whole N & S Pacific 40°N - 40°S Whole Pacific Peru Coastal Stations Easter, Darwin, Rapa	Temperature Anomaly for Jan. at Peruvian Coastal Stations	1 Nov. of each year using data through August
O'Brien	Ship winds	20°N - 20°S Whole Pacific	Yes or No for occurrence of a moderate or strong El Nino Event	1 Jan. using data through November (Uses a simulation model - not routinely deployed)
Miller	SST (ship, coastal station)	Eastern Tropical Pacific 30°N - 30°S, East of 180°W Coastal Stations of Ecuador and Peru	Prepares monthly means and anomaly charts of SST. Includes comments on likelihood of El Nino	Monthly charts available 15 days after end of each month

* All variables are monthly means and are required within 15 days of end of month.