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OPERATIONAL PLAN FOR AN IGOSS SEA LEVEL PILOT PROJECT (ISLPP) IN THE PACIFIC OCEAN

(SC-84/WS-20)

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1. INTRODUCTION

1.1 BACKGROUND

Tide gauge records comprise some of the longest and most reliable oceanic time series in existence. Used in conjunction with wind, atmospheric pressure, sea temperature, salinity, etc., they can yield valuable information on oceanic variability over seasonal and interannual time scales. From the tide gauge data the astronomical tide and shorter period fluctuations can be removed by averaging the data so that the Mean Sea Level (MSL) variation can be determined. Recently much interest has been centred on MSL fluctuations as a future tool to monitor variability in the open oceans and at continental margins.

Installation and long-term operation of tide gauges on open coasts and islands to measure, not only tide, but fluctuations in sea level should be both feasible and useful for all Member States of the IOC. These observations would be of particular importance to developing countries in helping them to understand the ocean variations off their coasts which affect fisheries and marine resources. For example, the occurrences of an El Niño are reflected in changes of Mean Sea Level. This relationship, when understood, could have great importance to the fisheries management of such countries as Chile, Ecuador and Peru.

A major role played by the oceans in infuencing climate is through the transport of heat from one part of the world to another, particularly from low to high latitudes. Sea level patterns contain much information about this process since heat content is reflected in water density and surface current velocity is reflected in the transverse slope induced by geostrophic compensation. A major World Ocean Experiment (WOCE) is being planned for the period 1987-1992 and co-sponsored by the WMO/ICSU Joint Scientific Committee (JSC) and the Joint SCOR/IOC Committee on Climatic Changes and the Ocean (CCCO). It was noted at the Third Session of the CCCO that "... the WOCE, as presently conceived, would not be viable withough high quality altimeter measurements from at least two and possibly three satellites, adequately tracked, and supported by other measurements to permit oorrection for variations of atmospheric moisture, the ionosphere, etc." This was accompanied by a statement of the advantage of combining satellite altimeter data with measurements from tide gauge networks.

Because sea level and its variations are influenced by so many factors pertinent to meteorological and oceanic processes, and also because it is recognized that obtaining sufficient data and achieving a facility in identifying the pertinent signals may take considerable time and practice, it is proposed that an immediate start be made to designing data networks, data distribution systems and analytical methods to assist in the study of sea level and its relationship to long-range and climatic changes. This project should be undertaken in an operational mode for the following reasons:

(i) technology is progressing towards the capability of real-time access to data;

(ii) synoptic data sets are necessary for the production of monthly sea level charts and such data sets are most easily obtainable from operational networks;

(iii) ground truth for satellite altimetry must be carried out in an operational mode to be effective; and,

(iv) finally, correlation of MSL with other environmental parameters, together with a realistic forecasting ability for phenomena in a 1-6 month range, requires an operational system.

1.2 IGOSS SEA LEVEL PILOT PROJECT (ISLPP)

The Joint IOC/WMO Working Committee for the Integrated Global Ocean Services System (IGOSS) is ideally placed to undertake a Pilot Project for the operational exchange of MSL data. IGOSS is a global operational oceanic system consisting of national facilities and services provided largely by the participating Member States themselves, with co-ordination and support from the IOC and WMO and other international and regional organizations. As an intergovernmental body, IGOSS can approach related international organizations interested in MSL for their assistance.

The two essential components are:

(i) establishment of a basic scheme for rapid collection and publication of mean sea level and mean air pressure;

(ii) combined assesment of the capabilities and requirements necessary for the development of an optimum system.

1.3 PURPOSE AND OBJECTIVES

The Pilot Project will undertake to upgrade the present MSL data networks in the Pacific Basin in order to obtain a monthly synoptic data set of mean sea levels from which monthly MSL charts will be produced and disseminated. The data collected will continue to be forwarded to the Permanent Service for Mean Sea Level (PSMSL), Bidston, UK, for archival in the usual way. The Pacific Basin was chosen for the Pilot Project because of the many possible island locations and the existence of a related co-operative system in the Tsunami Warning Network.

The Pilot Project is conceived as a test of the feasibility and usefulness of an operational MSL network. Although the ultimate objective would be an on-line data network with a variety of products, the pilot project will concentrate on assembling basic data from existing sources within a 30-day time frame following the close of each observational period (initially one month) and publishing tabulations and charts within the subsequent 30-day period. Therefore, the January chart would be available in March, the February chart in April, and so on. Turn-around time will be trimmed to a minimum over the course of the Pilot Project Charts produced initially will show spot values of MSL from participating gauges. However, as the quantity of data and confidence build, contoured charts of MSL seasonal anomalies will be possible.

The Pilot Project will have the following goals:

(i) The identification and recruitment of tide gauges into an operational MSL network.

(ii) The improvement of the data communication network for tidal and sea level data.

(iii) The evaluation of the usefulness and feasibility of synoptic MSL charts for the prediction of climatic trends, long-range weather, ocean processes and fisheries information.

(iv) The improvement of the timeliness, quantity and quality of data flowing into the PSMSL archive.

The objective of a successful Pilot Project is the implementation of an operational MSL programme on a global scale.

2. BASIC COMPONENTS

The basic components of the pilot scheme will be the existing permanent gauging stations of Member States of the Pacific Basin. It is recognized that the accuracy and capability of these stations will vary but an assessment of the potential network, its weaknesses, strengths and gaps will be an important part of the Pilot Project.

2.1 PARAMETERS TO BE MONITORED

(i) The basic parameter to be communicated is the monthly mean sea level. It is recognized that there exist many levels of sophistication for determining this information and initially Member States will be requested merely to indicate which of the following methods has been used to determine the data set from each gauging station:

(a) Low pass numerical filtering of hourly values.

(b) Arithmetic Mean of hourly tidal heights.

(c) Arithmetic Mean of paired high and low tidal levels (Mean Tide Level).

Initially the periods should be of common calendar months, but consideration will be given to alternatives and shorter periods as the Project develops.

(ii) It would be most desirable if daily means of sea level were also submitted to the SOC for reasons of quality control.

(iii) Because ocean dynamics are directly related to sub-surface pressure (sea level pressure plus atmospheric pressure), monthly mean air pressures measured at or near the tide gauge site should also be transmitted wherever and whenever possible.

2.2 GAUGE INFORMATION

(i) Initially all records will be considered. During the Pilot Project an assessment of the usefulness of individual locations will be made and a gauge may be given lower priority for one or more of the reasons given in Appendix 1.

The Pilot Project will also identify locations that will assist in the overall effectiveness of the network and liaise with national and international agencies to encourage the installation of new gauges. Oceanic island stations, where available, are an asset to the network because of the weaker effects of local weather on the MSL signal at such locations. Other locations may be sought in areas of data gaps or because of the need to verify particular conditions. The Pilot Project must maintain its flexibility and adjust the network over the first few years to reach optimum effectiveness.

(ii) Information of the tide gauge itself will be required for evaluation purposes on a once-only basis. This information will include:

(a) age and make of gauge

(b) location, maps, special site features

(c) datum - tide gauge Bench Mark and auxiliary Bench Mark locations and control

(d) historical review of data to present

(e) data output (chart, digital, etc.)

(f) frequency of operator access, procedures for datum control

(g) air pressure measurement procedures and barometer location.

2.3 OPTIONAL ENVIRONMENTAL INFORMATION

To correlate the readings with variations in the local environment it would be beneficial to have a complementary data set of associated environmental information.

2.4 ASSESSMENT

The performance and relevance of all stations will be subject to continuing assessment, but certain stations will be selected for more detailed study and evaluation. These stations will provide information to be used in the development of standards, quality control and analysis procedures, and oceanographic significance, during the course of the Pilot Scheme. These studies may include comparisons with historical or contemporary data on the ocean's temperature and salinity structure in the region.

3. DATA FLOW NETWORK

3.1 DATA COLLECTION

The ultimate objective of an operational sea level data collection scheme is to provide real-time automatically collected data at a central point for rapid processing. Such systems will be available in the future and even now some automated gauges are in use. For the Pilot Project, however, the collection will be accomplished by a variety of methods. In general, raw data (usually in some hard copy format) will be transmitted to a National Oceanographic Centre (NOC) where the records will be quality

controlled and a monthly mean sea level extracted. This mean value, as well as other requested data, will then be forwarded to the IGOSS Specialized Oceanographic Centre (SOC) for MSL in the Pacific Ocean where the data from all National Centres will be compiled into a suite of products. In some cases it may be more convenient for data to be sent directly to the SOC. For example, if the national system is unable to respond within the operational time frame, or in fact if a national processing centre does not exist. (See Figure 1).

A variety of formats may be required to cover the data flow of raw and processed data. Formats will depend on the exact nature of the gauge, national capabilities and mode of data transmission. Appendix 2 lists some of the communication systems which may be used. The most convenient for the low information rates implied will become apparent during Project development.

4. DATA PROCESSING

4.1 AT THE GAUGE SITE

The local maintenance technician would be asked to perform regular checks and perhaps straightforward calculations on site, for example, computing mean tide level from high and low tidal heights or from extracted hourly readings. A more normal alternative would be for the technician to scale off and send the raw data along with comments to the National Centre or, exceptionally, the SOC.

4.2 AT THE NATIONAL OCEANOGRAPHIC CENTRE

The National Centre will normally be responsible for collection and quality control of data and forwarding of the calculated MSL and air pressure values to the SOC. The National Centres should ensure that the gauge data is quality controlled and that the monthly mean sea level is calculated in the most accurate way available, as indicated in 2.1.

4.3 AT THE SPECIALIZED OCEANOGRAPHIC CENTRE

The SOC will have information on each network gauge in order to judge the relative quality of data from that gauge. Using the monthly MSL and air pressure from each gauge site and the monthly quality control information associated with each gauge, the SOC will produce such data products as are deemed important. Initially basic listings will be published. As the Scheme develops, the products may include but are not limited to:

(i) Listing of gauges and the respective monthly MSL and mean air pressure values to a locally defined datum;

(ii) Charts of Pacific monthly MSL and total pressure relative to the long-term mean at each site;

(iii) Updated maps or lists based upon data received after the 30-day operational production;

(iv) Contour maps of seasonal MSL and total pressure anomalies relative to the long-term mean for that month;

(v) Updated charts of anomalies as in (iii);

(vi) Complementary environmental information.

5. EVALUATION AND DEVELOPMENT OF THE PILOT PROJECT

5.1 DEVELOPMENT

The Pilot Project will run for five years commencing in 1984. At the end of that period, if successful and useful, the Project will become operational. The problems associated with accessing data, arriving at an effective network, communications, product formulation and dissemination are expected to be faced and overcome during the lifetime of the Project. It is expected that these problems will be identified by participating Member States, by the processing centre and by the clients using the data. The solutions will be addressed as appropriate by the Member States themselves, by regional bodies, by action from the processing centre, by action by the IOC and WMO Secretariats for IGOSS, by the JWC for IGOSS, or by the governing bodies themselves.

The responsibility of IGOSS in this Project is in the operational exchange of the data, in the operational analysis and preparation of the data product and in the dissemination of that product. The requirements for action outside these responsibilities that is necessary in the continuing development of the Project will be addressed to the national, regional or intergovernmental body as appropriate.

5.2 SCIENTIFIC EVALUATION

The evaluation of the usefulness of the final product, on which lies the ultimate decision on whether the Pilot Project will continue as an operational system, will be carried out by a workshop comprised of the clients of the data. Workshops will be convened two/three years after the commencement of ISLPP and again at the end. The composition of the workshop will include not only ocean climate representatives but also scientists interested in the MSL data from the point of view of weather forecasting, fisheries and ground truthing for satellites. A report of the workshops, together with recommendations, will be reviewed and action taken by the Joint IOC/WMO Working Committee for IGOSS.

5.3 MANAGEMENT EVALUATION

The management and monitoring of the Project as an operation will be continuous. Problems may be identified at all levels of data collection, transmittal, analysis and product dissemination. The Project will be designed so that appropriate action can be undertaken to remedy problems in a timely fashion. It will be necessary to establish an Advisory Group to assist in this matter.

6. ADMINISTRATIVE ARRANGEMENTS

6.1 INTERNATIONAL ARRANGEMENTS

The Project will be conducted under the auspices of the Joint IOC/WMO Working Committee for IGOSS and will report therefore to the respective governing bodies of IOC and WMO. These organizations will be asked to co-ordinate any necessary co-operation with other international

bodies as appropriate, and to keep such bodies informed on the status of the ISLPP. The Joint Working Committee will also request the respective regional and other relevant subsidiary or advisory bodies of the IOC and WMO to assist in the operation of the Pilot Project.

6.2 PILOT PROJECT MANAGEMENT

The management elements are defined as follows:

(i) National

Participating Member States will be urged to nominate a National Contact for ISLPP. In cases where the National Contact is different from the National Representative for IGOSS, they would be expected to maintain close liaison. The National Contact for ISLPP shall:

(a) arrange with the appropriate national authorities for the designation of tide gauge stations;

(b) be responsible for all matters concerning the transmission of national MSL data to the SOC*;

(c) receive, and further distribute within the Member State as appropriate, the monthly MSL products from the SOC;

(d) participate in the work of the Advisory Group for ISLPP (see below).

(ii) Specialized Oceanographic Centre

The Specialized Oceanographic Centre will receive the data and produce monthly sea level charts and other related products, and disseminate these on a monthly basis.

(iii) Advisory Group

The Advisory Group monitoring the operation of ISLPP will consist of the Director of the SOC and any National Contacts willing to assist. The Director of PSMSL and the Chairman of the Task Team of Governmental Experts on the Further Development of the IGOSS Observing System will be ex officio members. They will carry out their work without the necessity of meeting.

(iv) IGOSS IOC/WMO Secretariat

The IOC and WMO Secretariats will assist in the development, implementation and operation of the Pilot Project in such activities as the preparation and dissemination of operational guidelines, letters, communication with nations, communications with other intergovernmental organizations, etc.

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* The National Contact, as soon as designated, should communicate direct y with the Head of the SOC in order to make suitable arrangements for the transmission of data.

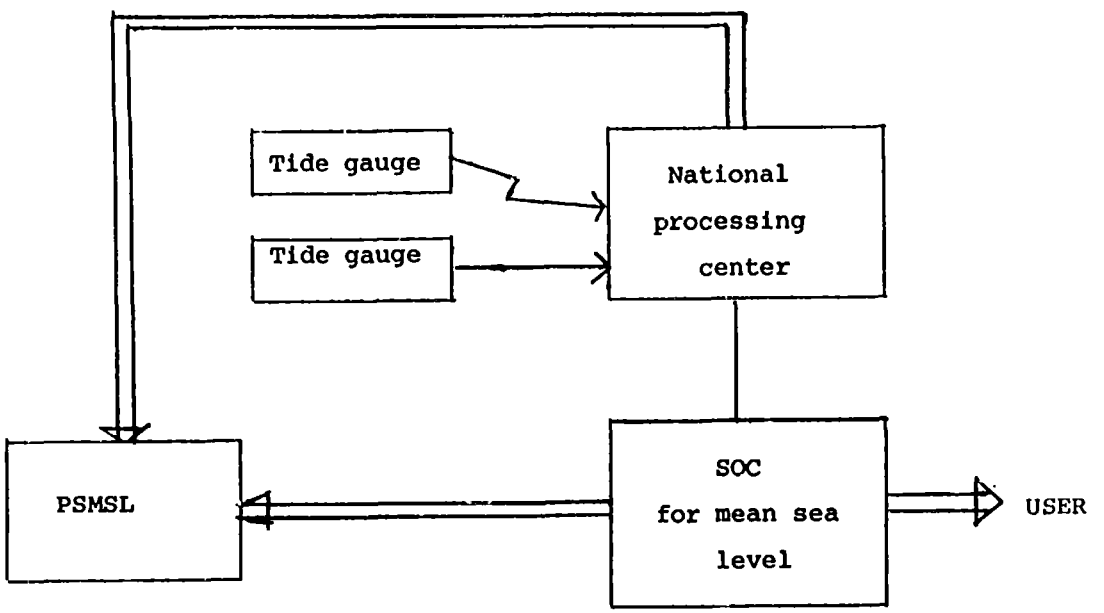
7. TRAINING, EDUCATION AND MUTUAL ASSISTANCE

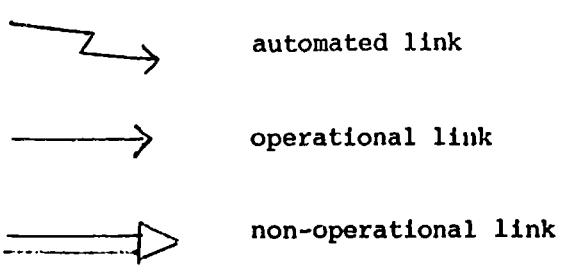
During the initial stages of the Pilot Project it is expected that many requirements for assistance will emerge. These requirements will be co-ordinated and passed on to the governing bodies of IOC and WMO for action as appropriate.

The raising of the standards of national gauging networks to acceptable standards in all participating countries will have important benefits to the global tidal network.

Figure 1

General Data Flow for IGOSS Sea Level Data





APPENDIX 1

Criteria for selection of tide gauges to be utilized in the ISLPP

Initially all tide gauges will be considered, however, during the Pilot Project an assessment of the usefulness of individual locations will be made and a gauge may be given a lower priority for one or more of the following reasons:

i) Location is adjacent to another more accurate gauge;

ii) The accuracy of the gauge is less than acceptable;

iii) Access to the data proves to be unobtainable in an operational mode;

iv) The location is too influenced by local conditions to be useful for indicating ocean variability.

APPENDIX 2

Communication Systems

The following communication systems along with others may be used for the ISLPP. In all cases the operational nature of the Pilot Project must be considered so that the products can be provided in a timely and routine manner.

Telex/Cable	The SOC will have a telex/cable number. The telex should also be available between a gauge and the SOC for direct transmission of reduced data.
Telephone	Data reduced at the gauge could be telephoned directly to the SOC or to the National Centre. This method would also be a good way to transmit the data from the National Centre to the SOC by Voice Communication. However, this may induce errors, especially between centres using different languages. In general, the number of times the values are manually transcribed should be held to a minimum. Thus, telefax, telex or telemail should be considered more favourably.
Mail	Mail could be utilized in transmitting hard-copy records from the gauge to the National Centre although the delay added to processing product preparation time must be taken into consideration in achieving the 30-day time frame. Mail could also be considered as a communication means between the NOC and SOC, however, the small volume of processed data involved would dictate a quicker method, if available.
Radio	Automatic transfer of data from the gauge to the national centre could be accomplished by radio links. Also, radio could be used in lieu of the phone for voice transmission.
Satellite	For remote gauges telemetering in real-time to National Centres is ideal. An automatic satellite telemetry gauge package should be a goal for national systems for hydrography, MSL and Tsunami work.
GTS	This system may be a good means for transmitting the MSL data from National Centre to the SOC and possibly for the distribution of gridded products from the SOC.
Telemail	This method of computer to computer transfer of data could be useful between the SOC and National Centres, especially if more data than the value of MSL is involved.

The optional environmental information may accompany the sea level data using the above means of data communication. These additional data could however be sent on a "soon as available" basis by mail as a separate package.

Except for the original data on the gauge and the optional environmental data, most information will be very compact and easily transmitted.