PART I
Databases of Global Tropical Cyclogenesis

In the Part I we give the description of up-to-date methods of data acquisition, systematization, classification, gathering and storage for global tropical disturbances. Design principals, structure and performance characteristics of up-to-date datasets and catalogues are reported.

It should be noted that particular attention has been given to research and development activities directed primarily at the solution of specific problems for designing and using global tropical cyclogenesis datasets.

1. Scientific and Applied Philosophy of Global Cyclogenesis Dataset Design

Considering the questions of the development of modern global cyclogenesis datasets and of the application of existing tropical cyclones datasets and archives, a number of crucial points should be borne in mind.

The one group of these circumstances is defined by scientific problems and, in particular, problems of studying an effect of tropical disturbances of different degrees of intensity to the thermodynamics and kinematics of the tropical atmosphere. This problem involved closely with the problem of studying possible global changes of our planet, and with practical problems of short-term and long-term global climate forecast (Gray, 1979; Anthes, 1982; Kondratyev, 1992; Kondratyev et al., 1995; Hansen et al., 1997; Henderson-Sellers et al., 1998; Lighthill et al., 1994; Bengtsson et al., 1996; Elsner and Kara, 1999; Gray et al., 1997; Sharkov, 2000). Obviously that the experimental base of these studies can serve as the systematized remote data given on global tropical cyclogenesis. The case in point is the physical process, considered simultaneously on the whole basin of the World Ocean (rather then on separate its basins).Of course, the importance of study of structured features of regional cyclogenesis does not call in question.

The other group of these circumstances is connected with scientific-methodical problems resulting from the classification and the identifications of different tropical structures, the exchange of data information and following detailed systematization and acquisition. Difficulties, appearing when deciding the classification problems, are primarily responsible for multi-scale processes of dynamic and thermodynamic interaction when forming a dynamic structure of tropical cyclone from the helical turbulent chaos. This, in turn, led to the position that developed current classification procedures cannot meet to full measure the requirements for remote monitoring of tropical disturbances. This gives rise to the grave inhomogeneity and dissimilarity as in the initial raw information, so and in databases and archives (Neumann, 1993; Gray, 1997).

The third group of circumstances lies in administrative-economic plane and is connected with broad spreading in mass media and on network Internet, conducted by federal US organizations and commercial companies, textual reporting, separate fragments of satellite information and preliminary forecasts of active phases of tropical cyclones for purposes of warning a population on the impending danger and taking the necessary precautions. Not in the least imploring obvious importance of such statement of the problem, it should be note that the fragmentary archiving of this kind is free from the systematic character. This brings into existence stubborn problems for using these information sources both for the scientific analysis, and for making the scientific databases.

In spite of external fundamental differences, all above enumerated groups of questions, appearing when developing the scientific databases of tropical disturbances, are intimately related. In such a manner, without the detailed analysis of contribution of each group of circumstances in the general problem of archiving of tropical cyclogenesis data it is difficult to understand a modern condition of catalogue procedures for global tropical cyclogenesis data.

The whole collection of studies of large-scale tropical distrurbances is essentially divided into two large directions:

• an individual tropical disturbances study or local approach (structure, track record, energy, thermo- and

mass-exchange, track features of individual cyclones) and

• a global approach, considering formation and evolution of tropical disturbances as bound sequence of events in global and regional scales.

Natural physical reason for specified division (of course, in certain sense conventional) may be cited as degree of non-equilibrium in ocean-atmosphere system: high degree is for local transformations and weak one is for global processes. Detailed review of present state of the art of studying the tropical disturbances is contained in works (Sharkov, 1997; 1998, 2000).

The fundamental base of the global approach is a study of structured features to evolutions of tropical disturbances, considered in the terms of the model of the stochastic flow of homogeneous events in regional and global scales. The investigation of these problems is one of the important aspects of study of ocean-atmosphere system when studying a contribution of intensive vortex disturbances in the thermodynamics and kinematics of tropical atmosphere on different temporary scales. This problem is closely allied to the task of studying an influence of possible climate change of planets on global cyclogenesis (Henderson-Sellers et al., 1998; Lighthill et al., 1994; Bengtsson et al., 1995, 1996; Landsea et al., 1999), to problems of clearing up the nonequilibrium in global system of the ocean-atmosphere (Hansen et al., 1997), as well as to the action of large-scale atmospheric circulations and ENSO phenomenon on the cyclogenesis features (Revell and Gonltner, 1986; Gray, 1993; Gray et al., 1997; Elsner and Kara, 1999; Pielke and Landsea, 1999).

The pioneering purposeful studies of global tropical cyclogenesis as a stochastic flow of events have showed its combined hierarchical structure in ranges from scales of a time life of single structure to climatic scales (Astafyeva et al., 1994, 1995; Sharkov, 2000) and have allowed to be formed a preliminary statistic-quantitative models (Pokrovskaya and Sharkov, 1993, 1994a, b; 1996a, b; 1999b, c; Sharkov, 2000). The experimental statistical models of this type play key role in forming and developing prospective satellite projects to study large-scale disasters (Anfimov et al., 1995; Balebanov et al., 1997).

As to the cyclogenesis, considered with respect to primary stages of TC (tropical disturbances, and tropical depressions), the problem on the finding of correlation between primary and mature stages of TC was formulated in works (Khromov, 1948; 1966) and then (Minina, 1970; 1982; 1987). For a variety of organizing and methodical reasons this problem has not been properly resolved for any length of time.

The attentive analysis of geoinformation banks and databases (and their modifications) available in practice on large-scale tropical disturbances points to the fact that making the databases on ÒC goes primarily on the regional level for performing purely administrative-economic problems of given region, as well as problems of purely commercial plan (refer to, for instance, catalogue of climatic databases (NCDC, 1991; WMO, 1992), bulletins of World Meteorological Organization (WMO) and Meteorological Satellite Centre (MSC, 1986), as well as broadly quoted reviews (Neumann et al., 1993; Neumann, 1993) and Web-catalogues (Landsea, 1998)). In accordance with international agreements, state observing services, participating in monitoring TC, are consistent with the principle of the local responsibility for its observing areas in the World Ocean (Pielke and Pielke, 1997).

From standpoints of performing problems of this kind in limited areas this circumstance is wholly satisfactory since purposes and tasks of regional centers are directed on problems of forecasting of intensity, tracks of moving the tropical disturbances, warning of corresponding state services on disasters. Under such stating a primary task initial stages of TC in existing systems of observing are not fixed (though fragmentary observed) and, accordingly, have not been acquired in databases and thus, raw data information is completely lost for researchers, studying different stages of TC. Also the certain ‘loss’ of raw information (and sometimes very valuable) under 'transition' of observed object from one area of responsibility in another takes place (Neumann, 1993).

Thereby, currently in the experimental study of temporal evolution of tropical cyclogenesis the condition occurred, when statistics of early stages of TC subsequently, as well as not in the stage of mature cyclones, are highly fragmentary and do not allow to present, more or less, the completed pattern for the cyclogenesis of primary and mature stages (McBride, 1995; Zehr, 1992; Pokrovskaya and Sharkov, 2000). Similar situations occurred at the study of end-point (on the scale of time evolution) forms of tropical cyclones (so named extratropical cyclones or post-typhoon forms), as the purposeful remote observations and more over the monitoring of such conditions of the tropical forms were not conducted (with the exclusion of separate events). And accordingly information was not systematized and acquired.

Scientific studies on possible variations of global climate, on evolutions of large-scale atmospheric catastrophes require absolutely other approach, as follows — strict systematizations in finding the moments of formation, in fixing and tracking objects of tropical cyclogenesis at all stages of their evolutions (and particularly at their initial stage and stage of dissipation or of transformation). In this case observation must be conducted simultaneously on the all basins of World Ocean as a united physical process. Results of such methodological approach will be demonstrated below (see Ch. II).

2. Existing Archiving Procedures and Current Databases

The variety of problems and tasks facing the federal agencies, the scientific community and the commercial organizations in the design of tropical cyclones' archiving gives rise to the multiplicity of lines in the development of archives and datasets carried data and information on tropical cyclogenesis. Such compound hierarchy of archiving procedures is primarily determined by significant variety in spatial-temporal detailing for the representation of data products. Here, in this section, we try to examine existing archiving procedures and current global tropical cyclogenesis archives.

2.1. Areas and Centres of Responsibility

The primary sources of initial data for global tropical cyclogenesis are the state centres of areas of responsibility and the respective warning agencies in the first place (Neumann, 1993; Piekle and Piekle, 1997): Joint Typhoon Warning Centre (USA), National Hurricane Centre (USA), Bureau of Meteorology (Australia), Japanese Meteorological Agency (Japan), Fiji Meteorological Service (Fiji), Philippine Atmospheric, Geophysical and Astronomical Services Administrations (Philippine), Meteorological Service (Reunion), India Meteorological Department (India).

In accordance with international agreements and WMO operational plans areas and centres of responsibility in the World Ocean are distributed in the following manner (Pielke and Pielke, 1997):

• regional association I (WMO, 1983), high seas tropical cyclone warning responsibility areas for the southwest Indian Ocean incorporating area for Madagascar (Antananarivo) and Mauritius (Vacoas); area for Reunion (Sainte Clotilde); area for Mozambique (Maputo) and for Kenya (Nairobi);

• regional association IV (WMO, 1988), United States National Hurricane Center (NHC), Miami, Florida area of high tropical cyclone warning responsibility. This includes (1) the North Atlantic, Caribbean Sea and the Gulf of Mexico and (2) the Eastern North Pacific east of longitude 140°W. The area of responsibility for the United States Central Pacific Hurricane Center (CPHC) located at Honolulu, Hawaii includes the Eastern North Pacific west of longitude 140°W to 180°W;

• United States Joint Typhoon Warning Center (JTWC), Guam/Pearl Harbor, areas of high seas warning responsibility west of longitude 180° to the east coast of Africa;

• regional association V (WMO, 1989) areas of high seas warning responsibility for the South Pacific and the southeast Indian Ocean region includes (1) areas for Australia (Perth, Darwin and Brisbane), Papua New Guinea (Port Moresby) and Indonesia (Jakarta), (2) areas for Fiji (Nadi) and New Zealand (Wellington);

• WMO/ESCAP Panel on Tropical Cyclones (WMO, 1986), high seas tropical cyclone warning areas for the Bay of Bengal, the Arabian Sea and vicinity include (1) areas of responsibility for India (Calcutta, Bay of Bengal) and Bombay (Arabian Sea), (2) areas of responsibility for Pakistan (Karachi), Bangladesh (Dhaka), Burma (Rangoon) and Sri Lanka (Columbo);

• ESCAP/Typhoon Committee (WMO, 1987), high seas tropical cyclone warning areas for western North Pacific include (1) areas of responsibility for People's Republic of China (Dalian, Shanghai and Guangzhau), for Republic of Korea (Seoul), Vietnam (Hanoi) and Japan (Tokyo). This involves South China Sea and Yellow Sea. (2) Areas of responsibility for Philippine Islands (Manila, PAGASA) and Hong Kong (Royal Observatory) include the North Pacific west of longitude 135°E to 115°E and north of latitude 5°N to 25°N.

For a variety of socio-economical and natural reasons, the contribution of each individual centre in the development of the global tropical cyclogenesis archiving is abrupt unequivalent. JTWC and NHC play a key part in the data acquisition processes and in the worldwide transmission of data products. Below we refer to the development and the structure of data products of a number of centres in its area of responsibility.

2.2. Services and Products of Centres of Responsibility

The Joint Typhoon Warning Centre provides a variety of routine products and services to the organizations within its area of responsibility (AOR) as prescribed by special instructions. JTWC issues the following products.

• Significant tropical weather advisory: Issued daily, or more frequently as needed, to describe all tropical disturbances and their potential for further development during the advisory period.

• Tropical cyclone formation alert: Defines a specific area when synoptic, satellite, or other germane data indicate development of a significant tropical cyclone (TC) is likely within 24 hours.

• Tropical cyclone/tropical depression warning: Issued periodically throughout each day to provide forecasts of position, intensity, and wind distribution for TCs in JTWC's AOR.

• Prognostic reasoning message: Issued in conjunction with warnings for tropical cyclones that have potential to reach tropical storm or typhoon strength in the western North Pacific.

Detailed description of JTWC Products and Annual Tropic Cyclone Reports 1959–1998 (in Adobe Acrobat Format) can be available at Web site: http://www.npmoc.navy.mil/jtwc.html. JTWC Annual Tropic

Cyclone Reports contain comprehensive information on each storm, including highlights, track and intensity, discussion, damages, and post-analysis best track and verification (Tabl. I.1).

The National Hurricane Centre (NHC) provides a variety of operational products and services to the organizations and to US mass-media within its area of responsibility. NHC issues the following main products:

- Tropical Cyclone Public Advisory;
- Tropical Cyclone Forecast/Advisory;
- Tropical Cyclone Discussion;
- Tropical Cyclone Strike Probabilities;
- Tropical Cyclone Position Estimates;
- Tropical Weather Outlook;
- Monthly Tropical Weather Summary;
- Reconnaissance and Dropsonde Observations;
- Vortex Data Messages.

Detailed description of NHC Products can be available at Web site: http://www.nhc.noaa.gov (Tabe I.1). This server maintains a current database of meteorological data, historical data, and written information generated by the NWS or received from other official sources. In addition, this server accesses in real-time a selection of current official weather observations, forecasts, and warnings from U.S. government sources for use by the national and international community. It is important to note that in an effort to enhance the science, experimental products may be accessible on this server and care must be taken when using such products as they are intended for research use.

NHC publishes three annual summaries of tropical cyclone activity in its area of responsibility. These include:

- The Atlantic Hurricane Season,
- The Eastern North Pacific Hurricane Season, and
- Atlantic Tropical Systems.

The annual summaries can be found in the following periodicals:

- 'Mariner's Weather Log'.
- 'Monthly Weather Review'.
- 'Weatherwise' (Clark, 1983; DeAngelis, 1984; Gunther and Cross, 1985; Mayfield and Rappaport, 1992, Mayfield and Avila, 1994; Williams, 1992; Lawrence, 1999; Pasch and Avila, 1999; Lander et al., 1999).

The annual summaries for the Australian region can be found in the journal 'Australian Meteorological Magazine' (Hanstrum et al., 1999; Shaik and Bate, 1999).

In this case, however, it should be noted that there are many inhomogeneities in these summaries. This is especially true in regard to early publications (before 1983–1984).

In conclusion of the section it should be noted, that the accession of intensive operational data in Internet system is unique to JTWC and NHC areas of responsibilities. As to the other centres of responsibilities, so the primary information accessed from these centres is fragmentary and very scattered. This is particularly true of the north basin of the Indian Ocean. The forgoing features have a detrimental effect on the quality in forming scientific databases of regional cyclogenesises.

2.3. Global Tropical Cyclogenesis Archives

The main steps in preparing the global tropical cyclogenesis climatology were to develop a global data set in a common format and to establish realiable and consistent global data communication exchange.

The purposeful study of a complete global climatology has only been possible since the satellite era began in the mid-1960s. Before then documentation of tropical cyclones in remote areas of the globe was very fragmented and mostly depended on chance encounters with ships or populated land areas (WMO, 1992; Neumann, 1993; Elsberry, 1987; Elsner and Kara, 1999). Nevertheless approaches to the unification of fragmented and rather spared data obtained from the various sources for developing the global pattern are of great value.

Even with satellite data problems including a standardised method for interpretation, establishing suitable documentation procedures and formats, and dissension of the data were coming to be solved. The matter is that the data sets obtained from the various sources used widely different computerised or hard copy formats. These format dissimilarities could be circumvented, but it was more difficult to resolve in homogeneities, such as: widely different periods of record, missing data, different documentation of the same tropical cyclone in adjacent basins, a synoptic observation times, different wind thresholds for stages of tropical cyclones, different practices for naming tropical cyclones and different wind averaging times in the various basins (Neumann, 1993).

This lack of a standard for archiving tropical cyclone information was considered by a Technical Co-ordination Meeting (Tokyo, December 1992), which prepared a global tropical cyclone data set — report format, approved by the WMO Executive Council in 1993. The standard format is given in the work (Neumann, 1993). Nevertheless, a number of problems including standardized methods for the interpretation and the assimilation of a communicated raw data remained to be solved in particular global data communication exchange.

Beyond all question the fundamental step in developing the global tropical cyclogenesis datasets was widespread integration of global communication network Internet into communication procedures.

At present the Web site of Hawaii Solar Astronomy (HSA) (Metcalf, 1996) plays a key part in the global

acquisition processes of raw data and in the worldwide transmission of data products including JTWC and NHC data products (Table I.2).

HSA issues the following products:

• Current Tropical Advisories: a list of all current records, watches and warnings on each tropical cyclone, its pre-hurricane stages and post-hurricane stages;

• Storm Track Maps (in GIF and PostScript formats);

• Listings: a list of quantitatively current records on each tropical cyclone in worldwide scale including Year, day and month of observation, Time observation, Name of storm, Geographical Co-ordinates, Speed and Course of storm, Estimated central pressure, Maximum sustained wind, Type of storm, Type of observation.

The historical unit of the server contains Listing for 1994-1999 and Storm Track Archives (in *.gif format) for 1996-1999.

The monthly-averaged global cyclone archive may be available via the printed booklets and WWW pages performed by UK Meteorological Office (Tabl. I.2) (UK Met. office, 1999).

The UK Meteorological Office pages on the World Wide Web contain mainly information on tropical cyclone forecasting at the Meteorological Office. Past issues of this document are held together with observed and forecast track information of recent storms, track prediction error statistics, lists of names, images, moves and photographs and details of tropical cyclone track prediction development at the Meteorological Office.

There is, however, no information about initial stages and post-mature stages of current TC under study. The document includes the only mature (the most active) stages of TC in consideration.

The Web sites of 'Tropical Cyclones' (University of Wisconsin — Madison, USA) and of SUPER Typhoon have provided the best collection of satellite imagery, tropical cyclone advisories, and related products including World Wide Web Links on the Internet (Table I.2). The document and Web pages mentioned above do not include the archiving units in their bodies.

The base component for the development of advanced global tropical cyclogenesis dataset can serve as historical archive produced as CD-ROM 'Global Tropical and Extratropical Cyclone Climatic Atlas 2.0' by NCDC/ NOAA (GTECCA, 1996).

It should be noted that the present historical atlas is essentially a case history resource for primary information. The extent to which the data is realible can be very low (especially for larly data-till 1970). Using this atlas in the formation of scientific data bases demands the serious preprocessing for information contained in this atlas.

The briefly review on the problems in archiving global tropical cyclogenesis data has showed that current archives and servers are not operating as scientific data bases of the global cyclogenesis.

By this means, the development of scientific data bases of global tropical cyclogenesis is now being confronted with a serious problems, in particular, the lack of unified design and engineering phylosophy and methodology in data gathering archiving; the long-term decentralization of the effort on the aqusition and storage for experimental data; the lack of the well-defined structures for output data of various versions for regional data gathering systems. In other words, it takes a development of principals and structures for forming scientific data bases with the introduction of stages for recovering (reconstraction stages) observational data and for bringing obtained data into modern computer standarts.

3. Global Tropical Cyclogenesis Database 'Global-TC'

As the state of above-mentioned archives of raw data gives no way of using these datasets as scientific data-based of the global cyclogenesis, it is the aim of the present section to develop a systematic database 'Global-TC' (electronic version) for chronological, kinematics, geophysical and climatological characteristics of large-scale tropical disturbances in the entire World ocean during a eighteen-year period (1983–2000) (Pokrovskaya et al., 1993; 1994; Pokrovskaya and Sharkov, 1994c; 1997; 1999a, d). It is on the basis of the electronic dataset that the printed version of geoinformation system was formed (see below Part II).

3.1. Principles of Database Design

Earlier the authors (Pokrovskaya and Sharkov, 1993) put forward the idea of studying and developing probability characteristics of tropical cyclogenesis intensity as complex structure signals using the theory of random time series. The idea formed the basis of the database under consideration.

Principles of the database are the following:

1. The initial information for 'Global-TC' should contain a chronological (generalized) catalogue of global tropic cyclogenesis in the form of a time series of events (flux of events) from 1983 to 1999.

2. For regional cyclogenesis, analogous catalogues should be formed for six regions of the World Ocean, which are the most active generators of tropical disturbances in the global cyclogenesis.

3. A structure of geophysical data on each tropical disturbance should be in the second (independent) information unit of the database.

4. Methods for establishing the database computational architecture should provide an independent selec-

tion and storage of all types of information, rather a quick search and presentation of information, sufficiently concise form of storage in standard PC.

The central problem with such an information system is a thorough systematization of the initial material obtained from different regions and observation centers in different information codes and with highly different details.

In accordance with the database principles under consideration, 'Global-TC' dataset consists of three units: a generalized chronological catalogue, a evolutionary data unit and a geophysical data unit. A detailed description of units, computational architecture is given below.

3.2. Data Preparation Technique

The primary information on the tropical cyclones originated at the World ocean basin for 1983–1992 was obtained from archive of Hydrometcenter of Russian Federation, where it was transmitted from regional centres as telex messages and was stored in the primary archive. By virtue of a lot of objective reasons the information had a number of disadvantages and dissension in the obtained data that cannot be corrected as time passed. As to the particular event so in all of the messages the data on the evolution 'history' of the disturbance was very sparse and, as a rule, there is no information on an initial stage of the evolution of a disturbance. The 'first' information (fixed) point of TC evolution was the stage as the tropical depression, though it is known that TC can exist within several days in stage of a primary tropical disturbance. An example of such situation is found in the temporary evolution of TC 'Eugene' (NEP, No. 9904), where the primary stage (L) was seen during five days (see Part II). In a number of cases there were no data in basic synoptic terms. Almost always the termination of TC evolution was fixed at the moment of destruction up to stage of tropical depression, though also it is well-known that TC can prolong the life as an area of low pressure or in the form of a subtropical frontal disturbance rather long. As we already noted, such post-typhoon meteorological structures are tracked by modern satellite remote sensing methods down to a subpolar belt.

The initial information for 1993–1996 was obtained from the data files of worldwide network Internet. Unfortunately, the format of initial data has also the disadvantages as we marked above for the telex transmission. Before all this information was placed at the 'Global-TC' database it was put to the careful critical analysis and was supplemented as complete as one can.

In all of the unit of the data for 1983–1996 there is no information on primary tropical disturbances (TD), which in further do not transfer in mature TS, except for periods in 1988 (July, August, September), 1989 (May, June, July), 1992 (September, October, November) for Northwest Pacific, when Space Research Institute has conducted the ship-borne experimental works and the specialized activity on archiving the detailed data the primary stages of TC was carried out.

The database for 1997–2000 was generated on the basis of the daily information obtained via Internet at Web site of Hawaii Solar Astronomy (URL http://www.solar.ifa.hawaii.edu) that plays a main role in the global acquisition process of the raw data and in the worldwide transmission of data products from Joint Typhoon Warning Centre (in Guam / Pearl Harbor), and also information from regional meteorological offices (Tokyo, Miami, New Delhi, Calcutta, Darwin, Fiji, etc.).

This information block has the much greater entirety of events occurring in the tropical zone of the World ocean than information for 1983–1996. However it is necessary to note that the going primary information generalized also has a lot of essential defects: the strong dissimilarity and dissension of the data obtained from various sources of information; the lack of the agreed definitions on one and same meteorological events; the absence of the rigidly fixed schemes of the representation of the information; temporary disconnections of the information in the worldwide transmission of data products; the grave distortion of the information by the transmission; the subjective estimations of the observers ; using various languages (except for English) at the description of the meteorological processes; introducing in the telegrams foreign (in relation to tropical meteorology) information etc. All of above creates serious difficulties when making a unified package of a consequent number of information files and requires a careful inspection and selection in pre-processing the raw data.

In connection with the indicated features of the primary information there was a urgent necessity of realization of a special pre-processing stage of the data (that sometimes is named in the Western literature as 'preprocessing' and in Russian as the critical analysis).

The technique, designed by the authors, of a preliminary stage of data pre-processing included a number of essential elements.

First of all the obtained information was classified on separate basins, in each of that are related to temporary and spatial coordinates. The correctness and entirety of the message, bound with reference climatic features of each basin, were tested. The basic performances expressed in digital parameters for several separate meteorological elements (or their combinations) are double checked for the complementarity as their quantitative values play key role at the solution of any practical problem. The special difficulty at the analysis was represented by the process of the identification and classification

of disturbances and of their geographical location, since the texts of the messages contained the unagreed definitions for the same meteorological elements and the dissimilar definitions of a place of occurrence of events. The problem of the remote sensing detection for the initial forms of tropical disturbances is rather intricate and, in general way, ambiguous as these physical systems on its own occure as the less well-structured forms in comparison with the mature TC forms.

By a primary form of a tropical disturbance is meant an separeted tropical meteorological system with well-organized convection and with from 100 till 300 n mi in diameter. The system has non-frontal variable characteristics and has maintained its during 12–24 hours. In the Atlantic Ocean and in other basins where typically tropical (Easterly) waves occur, by a primary form is meant an trough or a cyclonic flow curvatures with the well-defined convection. An example of such situation is found in the temporary evolution of TC 'Bret' (ATL, No. 9902), where the tropical wave that initiated the TC onset was observed during 11 days (see Part II).

For definition of the character of TC dissipation and the classification of stage of its dissipation it was necessary to establish the accompanying atmospheric processes and quantitative values of the separate meteorological elements (Harr and Elsberry, 2000; Harr et al., 2000; Klein et al. 2000). These items of information are missed in the obtained messages.

After the realization of the critical analysis and reduction of the information to the unified kind it was archived.

For archiving in Space Research Institute (Russian Academy of Sciences) the special database was created, in which the minimum necessary list of parameters was performed in the best way describing the processes occurring in tropical atmosphere. On the basis of the developed database the thematic processing in interests of the various approaches to the problems of generation and forecasting of tropical disturbances can be used most efficiently.

Each of the TC or tropical disturbance again generated and in further not transformed in the mature form has the separate information file in the database with sequentially mapping the cycle of its life. Except for the generally accepted denotations of stages (TD, TS, STS, T) (Pielke and Pielke, 1997; Liu et al., 1994), the alphabetic designation of a tropical wave (W) and of the initial tropical disturbance (L) were entered by virtue of the fact that the form of storage of the information in the 'GLOBAL-TC' database was based in strictly specified registration of stage of a disturbance and of the coordinates of its centre. For mapping the point describing its mean location of coordinates W for each synoptic term of the observation was selected.

3.3. Chronological Data Unit

The aim of this unit of 'Global-TC' is to give a chronological picture of successive events of global cyclogenesis during 1983–2000 (without details of each TC state and evolution). The entire World ocean area was divided into six regions characterized by peculiar circulation of tropical cyclogenesis. Tables of the catalogue contain annual data on each TC life-period (dates of the origin and the dissipation) and it's maximum stage and number according to the international classification. These data are systematized for each region individually.

3.4. Evolutionary Data Unit

The unit files contain information on the tropical disturbance structure and evolution, energy, thermal, and kinetic characteristics of each disturbance from its origin to dissipation.

In the each file there is a TC name according to the international catalogue, followed by its international number in brackets, which gives the information on the region of TC origin, year, and ordinal number in the given year. There is an ordinal number of the given file in a consecutive raw of the entire information on the given TC.

The lines that follow denote:

1. A development stage (L is tropical low area, where the sustained wind in the centre is <15 m/s; TD is tropical depression, 15–18 m/s; TS is a tropical storm, 18–23 m/s; STS is a strong tropical storm, 26–31 m/s; T is a typhoon (a hurricane, and a tropical cyclone) the maximum stage of system development, >33 m/s) (most observational centres use a 10-minute average to define sustained winds).
2. Observation data, day and month.
3. Observation time, hours by Greenwich time.
4. System's centre coordinates, degrees.
5. Pressure in the centre of the system (hurricane eye), millibars.
6. Wind intensity in the centre (eye's wall), m/sec.
7. Trajectory of the system, in rhombs of the horizon and movement rate in knots (a knot, i.e. a nautical mile per hour, equals about 1.15 miles per hour or 0.51 m $\cdot s^{-1}$).
8. An area with predominating wind rates of 26 m/s (50 knots) and 15 m/s (30 knots), radius in miles, trajectory in rhombs; within the hemisphere with predominating winds of the rates mentioned, the integers following this information denote a radius of the given wind in the rest space.
9. Wind forecast 12 and 24 h ahead, m/s.

Saffir / Simpson Hurricane Scale is used for the classification of TC within T stage (Pielke and Pielke, 1997).

3.5. Geophysical Data Unit

This unit consists of the following onformation during some periods of 1986, 1988 and 1989.

1. Geophysical data (vertical profiles of temperature and water vapour) retrieved from NOAA satellite within the tropical region of North-West Pacific (5–30°N, 100–180°W) during periods: September–December 1986; July–September 1988; May–August 1989.

2. Meteorological data collected from the radiosonde sensing from the coastal (island) stations in the Pacific basin.

3. Meteorological data acquired during special detailed radiosonde and rawinsonde ascents from a reseaech vessels, Taken part in the field experiments in the tropical of Pacific during given periods.

3.6. Computational Architecture of Database

For convenience, rapid search for an information fragment, and concise form of storage, the following structure of the database was chosen:

1. All types of information are independently arranged in the chronological form according to the time scale.

2. All types of data are written down as binary files with information units of a fixed length and repeating units also of a fixed length, whose numbers are shown in the information unit.

3. A concrete way of subdivision into files is chosen from the expected volume of each type information.

4. Total files for each type are stored in a hierarchic structure of subdirectories in order that directories of each level contain from several dozens to several hundreds files.

From the above said, for information about typhoons, files have got names D:\METEO\gg\15ggNN.dat with a characteristic file number of 0.5–4 kb, NN is an international ordinal number of a typhoon for a current years.

The above describes scheme of database allows an easy search of different data corresponding to a space-time interval of interest and a rapid use of data for correcting the methods of experiments in situ.

The database language is Turbo Pascal (v. 6.0) and library Object Professional.

The data on global cyclogenesis from ‘Global-TC’ dataset may be used in studies of global climate, solar-terrestrial interrelations, and crisis situations including forecasting of ecologically dangerous atmospheric events.

Table I.1

Regional Tropical Cyclone Archives

Area of t et t ot t t t t t t t t t	t rot t t t t	t eart	t ort at	t et t t t e
a c	Tracks			c aa
	Tracks			
	r s	T		
	as			a aa r
	Tracks			s s c rr ca
as r ac c	Tracks			c aa
	r s	T		
	Tracks			s s c rr ca
s r ac c	r s	T		c a
	s racks			
	Tracks			s s c r ca
ac c	r s s racks		T	c a
a c a	r s s racks		T	c a
r a c a	r s	T		c a
	s racks			

Table I.2

Global Tropical Cyclogenesis Archives and Current Raw Data Sets

Title	t	e	t	e ite
ro i or s or d ide	Advisories r s is i s	rre	e i	so r i ii exdo i
	is i s		e	
	or r Ar ives		i	
o ro i d r ro i o e i i A s A	or r s ve is i s	A	os	d o ov
	rr ives			
ro i o es	Advisories oo s i d es	e i e d	e i	i s sse is exdo i
	i ds es			
oo or d ide ro i o e e o iss e	Advisories es	e i e d	e i	s er oo o
o ro i e i	o r o ore s s	o	e oo e or	e o i eov