

# **CHAPTER I — OPERATIONAL PROCEDURES**

## **1. GENERAL**

Services provided by the Joint Typhoon Warning Center (JTWC) include forecasts of tropical cyclone formation, location, intensity, direction and speed of movement, and horizontal extent of critical wind speeds. This information was disseminated in 1973 by: (1) Tropical Cyclone Formation Alerts issued when formation of a tropical cyclone was anticipated; (2) Tropical Cyclone Warnings issued four times daily whenever a significant tropical cyclone was observed in the JTWC primary area; and (3) Tropical Cyclone Warnings issued twice daily whenever a significant tropical cyclone was observed in the JTWC secondary area.

FLEWEACEN Guam provides manual and computerized meteorological/oceanographic products for the JTWC. Communications support is furnished by the Nimitz Hill Message Center of the Naval Communications Station, Guam.

## **2. ANALYSES AND DATA SOURCES**

### **a. FLEWEACEN GUAM ANALYSES:**

(1) Surface mercator analysis, Northern and Southern Hemispheres, western Pacific and Indian Ocean areas; 0000Z, 0600Z, 1200Z, and 1800Z.

(2) Gradient streamline analysis of Asia and the western Pacific; 0000Z and 1200Z.

(3) Surface meso-analysis of the South China Sea region; 0000Z and 1200Z.

(4) Composite surface analysis of the Indian Ocean area; twice daily.

(5) Sea surface temperature charts; daily.

### **b. JTWC ANALYSES:**

(1) Gradient level (3,000 feet) streamline analysis (south of 20°N) and isobaric analysis (north of 20°N); 0000Z and 1200Z.

(2) 700-mb and 500-mb, contour and streamline analysis; 0000Z and 1200Z.

(3) A composite upper tropospheric streamline analysis utilizing rawinsonde data from 250-mb to 150-mb and AIREPS at or above 29,000 feet; 0000Z and 1200Z.

(4) Reconnaissance data. Observations from weather reconnaissance aircraft are plotted on large-scale sectional charts.

(5) Time cross sections of selected tropical stations.

(6) Additional and more frequent sectional analyses similar to those above during periods of tropical cyclone activity.

### **c. SATELLITE DATA:**

Satellite data, especially DMSP (formerly DAPP) satellite imagery, played a major role in the early detection of tropical cyclones in 1973. This aspect, as well as applications of satellite data to tropical cyclone tracking, is discussed in Chapter II.

### **d. RADAR:**

Land radar reports, when available, were used for tracking tropical cyclones during the 1973 season. Once a storm moved within range of a land radar site, reports were usually received hourly. Use of radar during 1973 is treated in Chapter II.

### **e. COMPUTER PRODUCTS:**

Use of the varian plotter by the FLEWEACEN Guam computer center during 1973 eliminated a significant portion of the JTWC hand plotting effort. Varian charts are produced routinely at synoptic times for the surface, 850-mb, 700-mb, and 500-mb levels. Additionally, a chart of the upper tropospheric circulation is produced. This chart uses 200-mb rawinsonde data and AIREPS above 33,000 feet and within six hours of the 0000Z and 1200Z synoptic times. Data not in the proper format for the computer are hand plotted on the charts. These include pibal gradient level winds, low cloud movement, and missing or late synoptic reports necessary for a detailed analysis.

In addition, the standard array of synoptic-scale computer analyses and prognostic charts from the Fleet Numerical Weather Central at Monterey, California are available.

JTWC utilized extensively the FLEWEACEN Guam computer center for objective typhoon forecasts and for statistical post analysis.

## **3. FORECAST AIDS**

### **a. CLIMATOLOGY:**

Various climatological publications listed in the Annual Typhoon Report, 1972 (FWC/JTWC) were utilized in addition to those received recently which include:

(1) Tropical Cyclone Climatology for the China Seas and Western Pacific from 1884 to 1970 (Royal Observatory, Hong Kong, 1972).

(2) North Pacific Tropical Cyclone Vector Mean Charts (Crutcher, H. L., 1973).

(3) North Indian Tropical Cyclone Vector Mean Charts (Crutcher, H. L. and Nicodemus, M. L., 1973).

(4) A Climatology of Typhoon and Tropical Storm Tracks Arranged by Month and Point of Origin (Ocean Data Systems, Incorporated, 1973).

(5) Tropical Cyclones of the North Indian Ocean (Sadler and Gidley, 1973) ENVPREDRSCHFAC Tech Paper No. 2-73.

(6) The Typhoon Analog Computer Program (TYFOON) described in the 1972 Typhoon Analog Program (TYFOON-72).

b. EXTRAPOLATION:

Extrapolation of storm movement using 12-hour mean speed and direction was the most reliable objective method for both 24- and 48-hour forecasts. Forecasts are determined by simple linear extrapolation using the 12-hour old best track position and the current warning position.

c. OBJECTIVE TECHNIQUES:

During 1973, the following objective forecasting methods were employed:

(1) ARAKAWA - Regression forecasts derived from surface pressure grid values.

(2) MOHATT (Modified HATRACK) - Steering by geostrophic winds derived from smoothed height fields at 850-mb and 700-mb levels modified by 12-hour history inputs.

(3) TYMOD - Program selects best steering level using global band upper air fields (GBUA) from PLENUMWEACEN Monterey modified by 12- or 24-hour history inputs.

(4) TYFOON - Analog weighted mean track.

#### 4. FORECASTING PROCEDURES

a. TRACK FORECASTING:

An initial track based on persistence blended subjectively with climatology is developed for a 3-day period. This initial track is subjectively modified by the following:

(1) Recent steering is evaluated by considering the latest upper air analyses as representative of the average upper air flow over the past 24 hours. (The latest upper air analyses are about 12 hours old, thus roughly representing the mid-point of the last 24-hour time interval). By this technique, actual past 24-hour movement serves to indicate the best steering level as well as the effectiveness of steering.

(2) Objective techniques are considered, with the techniques being ranked according to their past performance on similar storms.

(3) Twenty-four hour height change analyses are evaluated for forecast track/speed changes (Hoover, Devices for Forecasting Movement of Hurricanes, Manuscript of U.S. Weather Bureau, 1957).

(4) The prospects of recurvature are evaluated for all westward moving storms. The basic requisites for this evaluation are accurate continuity on mid-latitude troughs and numerical progs to indicate changes in amplitude or movement. Relative position and strength of the subtropical ridge and northward tendency due

to internal forces are also important considerations.

(5) Finally, a check is made against climatology to ascertain the likelihood of the forecast. If the forecast track is climatologically unusual, a reappraisal of the forecast rationale is conducted and adjustment made if warranted.

b. INTENSITY FORECASTING:

For intensity forecasting, heavy reliance is placed on short term trends, climatology, and the satellite interpretation model developed by Mr. Vernon Dvorak of the National Environmental Satellite Service. After these initial inputs, further factors considered are upper tropospheric evaporation and possible terrain influence.

#### 5. WARNINGS

Tropical cyclone warnings are numbered sequentially. If warnings are discontinued and the storm reintensifies, as Typhoons Dot, Ellen, and Patsy did this year, warnings are numbered consecutively from the last warning issued. Amended or corrected warnings are given the same number as the warnings they modify plus a sequential alphabetical designator to indicate it is an amended warning. Forecast positions are issued at 0000Z, 0600Z, 1200Z, and 1800Z. The forecast periods are 12-hr and 24-hr for tropical depressions and 12-hr, 24-hr, 48-hr, and 72-hr for typhoons and tropical storms.

Forecast periods are stated with respect to warning time. Thus, a 24-hour forecast verified 26 1/2 hour after the aircraft fix data, 30 hours after the latest surface synoptic chart, and 30 or 36 hours after the latest upper air charts.

Warning forecast positions are verified against the corresponding post analysis "best track" positions. A summary of results from 1973 is presented in Chapter V.

#### 6. PROGNOSTIC REASONING MESSAGE

Whenever warnings on typhoons and tropical storms are being issued, a prognostic reasoning message is released at 0000Z and 1200Z. This message is intended to provide the field meteorologist with the reasoning behind the latest JTWC forecasts.

#### 7. TROPICAL WEATHER SUMMARY

This message is issued daily from 1 May through 31 December and otherwise when tropical cyclone formation is forecast or observed. It is issued at 0600Z and describes the location, intensity, and likelihood of development of all tropical low pressure areas including upper tropospheric lows and significant cloud masses detected by satellite.

#### 8. TROPICAL CYCLONE FORMATION ALERT

Alerts are issued when the formation of a tropical cyclone is anticipated. These messages are issued as required and are valid for up to 24 hours unless cancelled, superseded, or extended.