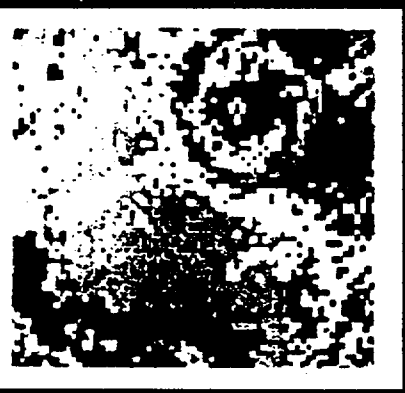
1987 ANNUAL TROPICAL CYCLONE REPORT



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FRONT COVER: The digitized image (center of lower square) of surface wind speed shows Typhoon Kelly (19W) (circular pattern at the top right) and the Philippine Islands (black shapes at bottom left). The technique to develop these surface wind speed fields is currently under development. The surface wind speed field algorithm uses the polarized 19 (horizontal), 22 (vertical) and 37 (vertical and horizontal) gigahertz (GHz) channels of the Defense Meteorological Satellite Program's new special sensor, the microwave imager (SSM/I), which is a four-channel passive microwave radiometer.

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19 January 1988

From: Commanding Officer, U.S. Naval Oceanography Command Center/Joint Typhoon Warning Center, Guam
To: Distribution

Subj: PROMULGATION OF 1987 ANNUAL TROPICAL CYCLONE REPORT

Ref: (a) USCINCPACINST 3140.1S (NOTAL)

1. The Annual Tropical Cyclone Report for 1987 is promulgated in accordance with the provisions of reference (a).

2. The 1987 tropical cyclone season marked the beginning of a new era in tropical cyclone forecasting. Despite an unusually active season, forecasters made a mid-season transition from an aircraft based reconnaissance system to one based mostly on satellites, while recording the lowest track errors in the center's history.

3. The initial release of the Joint Typhoon Warning Center Automation Program hardware and software package also arrived on Guam in 1987. This program has already proved very successful and promises to be one of the most significant advances in the operational forecasting of tropical cyclones.

4. Despite the tremendous added pressures of the 1987 season, the staff has pulled together and done an outstanding job in publishing this document six months ahead of last year. I hope you find this report a valuable contribution to your library.

C. W. HOFFMAN

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FOREWORD

The Annual Tropical Cyclone Report is prepared by the staff of the Joint Typhoon Warning Center (JTWC), a combined USAF/USN organization operating under the command of the Commanding Officer, U.S. Naval Oceanography Command Center/Joint Typhoon Warning Center, Guam. JTWC was established in April 1959 when USCINCPAC directed USCINCPACFLT to provide a single tropical cyclone warning center for the western North Pacific region. The operations of JTWC are guided by CINCPACINST 3140.1 (series).

The mission of the Joint Typhoon Warning Center is multi-faceted and includes:

1. Continuous monitoring of all tropical weather activity in the northern and southern hemispheres, from 180 degrees longitude westward to the east coast of Africa, and the prompt issuance of appropriate advisories and alerts when tropical cyclone development is anticipated.

2. Issuing warnings on all significant tropical cyclones in the above area of responsibility.

3. Determination of reconnaissance requirements for tropical cyclone surveillance and assignment of appropriate priorities.

4. Post-storm analysis of all significant tropical cyclones occurring within the western North Pacific and North Indian Oceans, which includes an in-depth analysis of tropical cyclones of note and all typhoons.

5. Cooperation with the Naval Environmental Prediction Research Facility (NEPRF), Monterey, California, on the operational evaluation of tropical cyclone models and forecast aids, and the development of new techniques to support operational forecast scenarios.

Satellite imagery used throughout this report represents data obtained by the tropical cyclone satellite surveillance network. The personnel of Detachment 1, 1WW, collocated with JTWC at Nimitz Hill, Guam, coordinate the satellite acquisitions and tropical cyclone surveillance with the following units:

Det 4, 20WS, Hickam AFB, Hawaii

Det 5, 20WS, Clark AB, RP

Det 8, 20WS, Kadena AB, Japan

Det 15, 30WS, Osan AB, Korea

Air Force Global Weather Central,
Offutt AFB, Nebraska

In addition, the Naval Oceanography Command Detachment, Diego Garcia, and Defense Meteorological Satellite Program (DMSP) equipped U.S. Navy aircraft carriers have been instrumental in providing vital satellite position fixes of tropical cyclones in the Indian Ocean.

Should JTWC become incapacitated, the Alternate Joint Typhoon Warning Center (AJTWC) located at the U.S. Naval Western Oceanography Center, Pearl Harbor, Hawaii, assumes warning responsibilities. Assistance in determining satellite reconnaissance requirements, and in obtaining the resultant data, is provided by Det 4, 20WS Hickam AFB, Hawaii.

Changes to this year's publication include: statistical verification for individual warnings for the North Indian Ocean and the southern hemisphere are provided. Again, as last year, raw fix data files previously printed in Annex A, plus the raw warning, forecast and best track data, will be available, upon request (the requested data will be copied onto 5.25 inch "floppy" diskettes provided by the requestor); and, with reference to best track philosophy, a conscious effort has been made to extend the post-warning best tracks to provide better verification for the 48- and 72-hour forecasts.

A special thanks is extended to the men and women of: 27th Information Systems Squadron, Operating Location C and the Operations section of the Naval Oceanography Command Center, Guam for their continuing support by providing high quality real-time satellite imagery; Marine Corps Air Station, Futenma, Japan for their satellite fix support; the Pacific Fleet Audio-Visual Center, Guam for their assistance in the reproduction of satellite data for this report; to the Navy Publications and Printing Service Branch Office, Guam; the Royal Observatory Hong Kong for supporting synoptic data on Super Typhoon Lynn (20W); the Central Weather Bureau, Taiwan for radar scope photographs of Typhoons Vernon (06W), Alex (08W) and Gerald (14W); Dr. Bob Abbey of the Office of Naval Research for his technical support to this publication; Mr. Michael Fiorino at NEPRF for his software conversion for the statistical programs; Mr. S.D. Rice, manager of Mobil Oil Micronesia, Inc. for his damage photos of Ulithi Atoll after Typhoon Orchid (01W); Dr. Greg Holland for sharing the ship's log account of Typhoon Lynn (20W); and Captain K. W. Reese (USAF) for the reconnaissance photograph of Typhoon Wynne (07W)

Note: Appendix IV contains information on how to obtain past issues of the Annual Tropical Cyclone Report (titled Annual Typhoon Report prior to 1980).

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CONTRACTIONS

ABIO	Significant Tropical Weather Advisory for the Indian Ocean
ABPW	Significant Tropical Weather Advisory for the Western Pacific Ocean
ABS MAG	Absolute Magnitude
ACCRY	Accuracy
ACFT	Aircraft
ADP	Automated Data Processing
AFGWC	Air Force Global Weather Central
AIREP	Aircraft Weather Report(s) (Commercial and Military)
AOR	Area of Responsibility
APT	Automatic Picture Transmission
ARWO	Aerial Reconnaissance Weather Officer
AVG	Average
AWN	Automated Weather Network
BPAC	Blended Persistence and Climatology
BT LAT	Best Track Latitude
BT LON	Best Track Longitude
BT WN	Best Track Wind
CDO	Central Dense Overcast
CI (or)	Cirriform Cloud or Cirrus Current Intensity (Dvorak)
CINCPAC	Commander-in-Chief Pacific AF - Air Force, FLT - Navy
CLD	Cloud
CLIM	Climatology
CM	Centimeter
COSMOS	Cyclops Objective Steering Model Output Statistics
CPA	Closest Point of Approach
CSC	Cloud System Center
CSUM	Colorado State University (CSU84) Model
CYCLOPS	Tropical Cyclone Steering Program (HATTRACK and MOHATT)
DEG	Degree
DIR	Direction
DMSP	Defense Meteorological Satellite Program
DTG	Date Time Group
FI	Forecast Intensity (Dvorak)
FLT	Flight
FNOC	Fleet Numerical Oceanography Center
FT	Feet
GMT	Greenwich Mean Time
GOES	Geostationary Operational Environmental Satellite
HATTRACK	Hurricane and Typhoon Tracking and Steering Program
HGT	Height
HPAC	Mean of XTRP and CLIM Techniques (Half Persistence and Climatology)
HR(S)	Hour(s)
ICAO	International Civil Aviation Organization
INIT	Initial
INJAH	North Indian Ocean Component of TYAN
INST	Instruction
IR	Infrared
JTWC	Joint Typhoon Warning Center
KM	Kilometer(s)
KT	Knot(s)
LLCC	Low-Level Circulation Center
LVL	Level
M	Meter(s)
M/SEC	Meter(s) per Second
MAX	Maximum
MB	Millibar(s)
MET	Meteorological
MIN	Minimum
MOHATT	Modified HATTRACK
MOVG	Moving
MSLP	Minimum Sea-level Pressure
MSN	Mission
NEDN	Naval Environmental Data Network
NEDS	Naval Environmental Display Station
NEPRF	Naval Environmental Prediction Research Facility
NESDIS	National Environmental Satellite, Data, and Information Service

NET	Near-Equatorial Trough
NM	Nautical Mile(s)
NOAA	National Oceanic and Atmospheric Administration
NOCC	Naval Oceanography Command Center
NOGAPS	Navy Operational Global Atmospheric Prediction System
NORAPS	Navy Operational Regional Atmospheric Prediction System
NTCM	Nested Tropical Cyclone Model
NWOC	Naval Western Oceanography Center
NR	Number
NRL	Naval Research Laboratory
OBS	Observations
OTCM	One Way (Interactive) Tropical Cyclone Model
PACOM	Pacific Command
PCN	Position Code Number
POS ER	(Initial) Position Error
RADOB	Radar Observation
RECON	Reconnaissance
RT	Right
SAT	Satellite
SFC	Surface
SLP	Sea-Level Pressure
SRP	Selective Reconnaissance Program
STNRY	Stationary
SST	Sea Surface Temperature
ST	Subtropical
STR	Subtropical Ridge
STY	Super Typhoon
TAPT	Typhoon Acceleration Prediction Technique
TC	Tropical Cyclone
TCARC	Tropical Cyclone Aircraft Reconnaissance Coordinator
TCFA	Tropical Cyclone Formation Alert
TCM	Tropical Cyclone Model
TD	Tropical Depression
TDO	Typhoon Duty Officer
TIROS	Television Infrared Observational Satellite
TPAC	Extrapolation and Climatology Blend
TS	Tropical Storm
TY	Typhoon
TYAN	Typhoon Analog Program
TYFN	Western North Pacific Component (Revised) of TYAN
TUTT	Tropical Upper-Tropospheric Trough
ULAC	Upper-Level Anticyclone
ULCC	Upper-Level Circulation Center
VEL	Velocity
VIS	Visual
WESTPAC	Western (North) Pacific
WMO	World Meteorology Organization
WND	Wind
WRNG(S)	Warning(s)
WRS	Weather Reconnaissance Squadron
WW ER	Wind Warning Error
W#	Warning Number
XTRP	Extrapolation
Z	Zulu Time (Greenwich Mean Time)
24 ER	24-Hour (Position) Error
48 ER	48-Hour (Position) Error
72 ER	72-Hour (Position) Error
24 WE	24-Hour Wind (Warning) Error
48 WE	48-Hour Wind (Warning) Error
72 WE	72-Hour Wind (Warning) Error