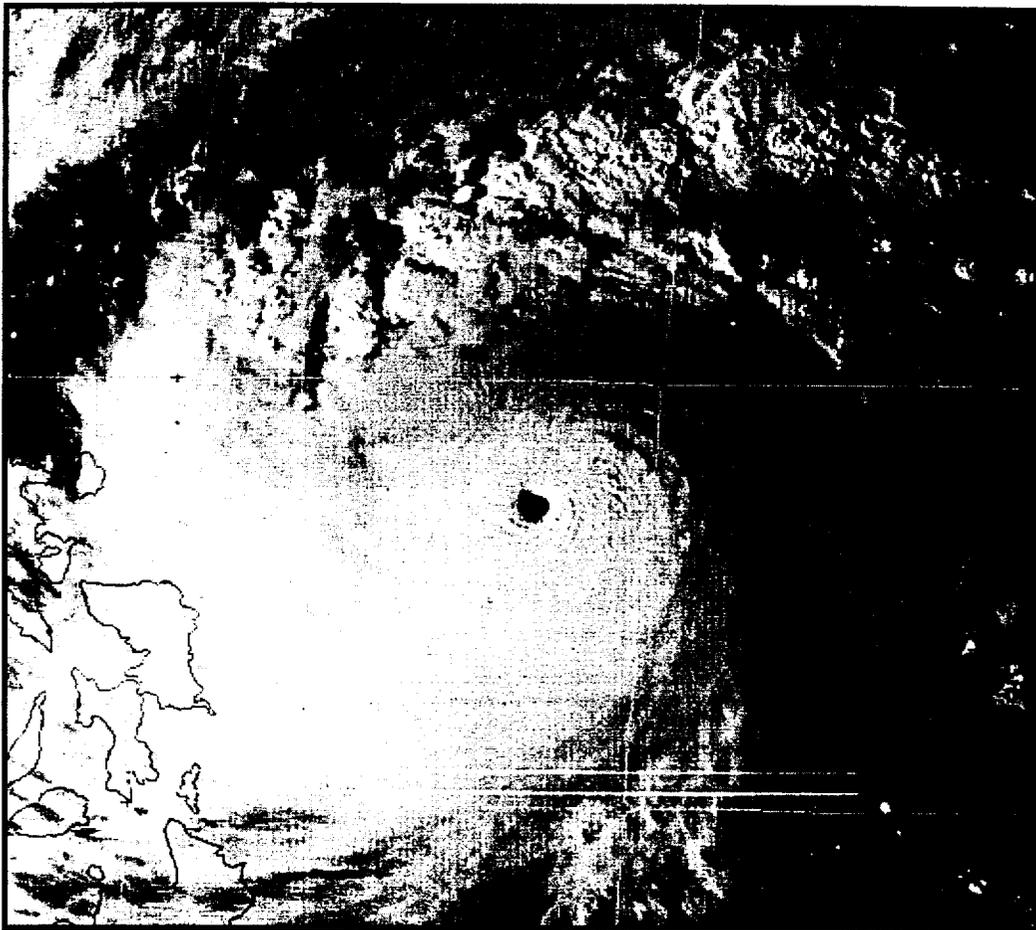


# 1995 ANNUAL TROPICAL CYCLONE REPORT



JOINT TYPHOON WARNING CENTER  
GUAM, MARIANA ISLANDS

**FRONT COVER:** The most intense western North Pacific tropical cyclone of 1995, Super Typhoon Angela (29W), approaches the northern Philippine Islands. At the time of this image, Angela has a peak intensity of 155 knots (80 m/sec), an estimated minimum sea-level pressure of 879 millibars, and an 18 nautical mile diameter eye (010731Z November visible GMS imagery).

**U. S. NAVAL PACIFIC METEOROLOGY AND OCEANOGRAPHY CENTER WEST  
JOINT TYPHOON WARNING CENTER  
PSC 489, BOX 12  
FPO AP 96536-0051**

## **JAMES F. ETRO**

**CAPTAIN, UNITED STATES NAVY  
COMMANDING OFFICER**

## **JOSEPH P. BASSI**

**LIEUTENANT COLONEL, UNITED STATES AIR FORCE  
DIRECTOR, JOINT TYPHOON WARNING CENTER**



*Work on this report was supported in part by funds provided by  
the Office of Naval Research Grant N00014-91-J1721*

## STAFF

### JOINT TYPHOON WARNING CENTER

LCDR	MICHAEL D. ANGOVE	USN	TDO, DEPUTY DIRECTOR
* LCDR	ERNEST P. PETZRICK	USN	TDO, DEPUTY DIRECTOR
LCDR	ALEX J. DECARIA	USN	TDO
** LCDR	STACY R. STEWART	USNR	TDO
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LT	MICHAEL S. KALAFSKY	USN	TDO
CAPT	RICHARD A. ANSTETT	USAF	TDO
* CAPT	DAN B. MUNDELL	USAF	TDO
CAPT	WILLIAM J. CARLE	USAF	TDO
CAPT	GARY B. KUBAT	USAF	TDO
* AG1	SHISHMON D. BAILEY	USN	LPO, SAT FORECASTER
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AG3	ROBERT M. GIGUERE	USN	STATISTICS, TDA
SRA	DAVID J. CORREA, JR.	USAF	TDA
* SRA	JORDAN S. KELLY	USAF	TDA
* SRA	VINCENT L. PETRASEK	USAF	TDA
SRA	JEFFREY L. WILKERSON	USAF	TDA
SRA	TIMOTHY C. WILLIAMS	USAF	TDA
SRA	CLARK D. WILSON	USAF	TDA
* A1C	SHAWN L. PETERSON	USAF	TDA

### 36 OSS/OSJ

MAJ	ROGER T. EDSON	USAF	TECHNIQUE DEVELOPMENT
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CAPT	JOHN A. RUPP	USAF	TDO, OIC USPACOM SAT NETWORK
MSGT	TIMOTHY R. CRUME	USAF	SAT FORECASTER, NCOIC
* TSGT	VINCENT T. AGUON	USAF	CHIEF INFORMATION MANAGEMENT
TSGT	SHIRLEY A. BROWN	USAF	CHIEF INFORMATION MANAGEMENT
* TSGT	SCOTT C. COPELAND	USAF	SAT FORECASTER
TSGT	ZEFANIAS E. EBARLE	USAF	SAT FORECASTER
* TSGT	HAROLD D. EIFERT	USAF	SAT FORECASTER
* TSGT	MICHAEL S. GREHAN	USAF	SAT FORECASTER
TSGT	DENNIS W. MILLER	USAF	SAT FORECASTER
SSGT	MERRYRUTH I. DEOCARIZA	USAF	SAT FORECASTER
* SSGT	RICHARD D. JACOBSEN	USAF	SAT FORECASTER
SSGT	LINDA R. HAM	USAF	SAT FORECASTER
* SSGT	JEWEL K. TAPPY	USAF	SAT FORECASTER
SSGT	BRUCE W. WOFFORD	USAF	SAT FORECASTER
SRA	SEAN M. MCDUNN	USAF	DATA DEVELOPMENT

### ATCR STAFF

LT	ERIC J. TREHUBENKO	USN	TDO, EDITOR, BEST TRACK OFFICER
CAPT	PAUL H. LEWIS	USAF	TDO, STATISTICS OFFICER
MR	FRANK H. WELLS	USN	TECHNICAL EDITOR
AG2	DARIN L. WARD	USN	LPO, TDA, GRAPHICS
AG3	CHRISTOPHER CROSS	USN	GRAPHICS, TDA
AG3	ANDRES G. GRANT	USN	GRAPHICS, TDA

### UNIVERSITY OF GUAM / JTWC RESEARCH LIAISON

DR	MARK A. LANDER	TROPICAL CYCLONE RESEARCH, TECHNICAL WRITING
MR	CHARLES P. GUARD	TROPICAL CYCLONE RESEARCH, TECHNICAL WRITING

\* TRANSFERRED DURING 1995

\*\* ACTIVE DUTY TRAINING

## FOREWORD

The Annual Tropical Cyclone Report is prepared by the staff of the Joint Typhoon Warning Center (JTWC), a combined Air Force/Navy organization operating under the command of the Commanding Officer, U.S. Naval Pacific Meteorology and Oceanography Center West (NAVPACMETOCCEN WEST)/Joint Typhoon Warning Center, Guam. The JTWC was founded 1 May 1959 when the U.S. Commander-in-Chief Pacific (USCINCPAC) forces directed that a single tropical cyclone warning center be established for the western North Pacific region. The operations of JTWC are guided by USCINCPAC Instruction 3140.1W.

The mission of JTWC is multifaceted and includes:

1. Continuous monitoring of all tropical weather activity in the Northern and Southern Hemispheres, from 180° east longitude westward to the east coast of Africa, and the prompt issuance of appropriate advisories and alerts when tropical cyclone development is anticipated.

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

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

4. Post-storm analysis of significant tropical cyclones occurring within the western North Pacific and North Indian Oceans.

5. Cooperation with the Naval Research Laboratory, Monterey, California on evaluation of tropical cyclone models and forecast aids, and the development of new techniques to support forecast requirements.

Special thanks to: the men and women of the Alternate Joint Typhoon Warning Center for standing in for JTWC as needed; Fleet Numerical Meteorology and Oceanography Center (FLENUMETOCCEN) for their opera-

tional support; the Naval Research Laboratory for its dedicated research; the Air Force Global Weather Central (AFGWC) and National Oceanic and Atmospheric Administration (NOAA) National Environmental Satellite, Data, and Information Service (NESDIS) for satellite support; the 36th Communications Squadron's Defense Meteorological Satellite Program (DMSP) Site 18 at Nimitz Hill, Guam; and the Operations and Equipment Support departments of NAVPACMETOCCEN WEST, Guam for their high quality support; all the men and women of the ships and facilities ashore throughout the JTWC area of responsibility (AOR), and especially on Guam, who took the observations that became the basis for our analyses, forecasts and postanalyses; CDR. Lester E. Carr III and Dr. Russell L. Elsberry for their efforts at the Naval Postgraduate School and publication of the Systematic and Integrated Approach to Tropical Cyclone Track Forecasting Part II ; the personnel at the Navy Publications and Printing Service Branch Office, Pearl Harbor; Dr. Robert F. Abbey Jr. and the Office of Naval Research for their support to the University of Guam (UOG) for the JTWC Research Liaisons to JTWC; the UOG Research Liaisons for their contributions to this publication; Dr. Mark Lander for his training efforts, suggestions and valuable insights, and Mr. Charles P. Guard for his support and data collection efforts; Dr. Jeff Hawkins, Chris Veldon, Samuel Chang and Roger Weldon for their tireless efforts to get the most possible out of remote sensing technologies; Capt Carl Davis for his assistance in obtaining the satellite imagery for the northern Indian Ocean tropical cyclones; Mr. John "Jack" Beven for his efforts to include ground truth in his Weekly Tropical Cyclone Summaries; and, AG2 Darin Ward, AG3 Andres Grant, and AG3 Chris Cross for their excellent desktop publishing and graphics assistance.

## EXECUTIVE SUMMARY

Although 1995 was an average year with respect to the number of significant tropical cyclones (TCs) in the western North Pacific, it challenged the Joint Typhoon Warning Center (JTWC) with a variety of types. Highlights include the very small, or "midget", Typhoon Mark, forming at an uncharacteristically high latitude; Tropical Storm Colleen, which transitioned from a subtropical "Kona" storm to a tropical storm; and Super Typhoon Angela, which hammered the island of Luzon in the Philippines with their strongest winds in three decades.

Less than half of the western North Pacific significant TCs reached typhoon intensity or greater during 1995. A total of 599 warnings were issued on these — the lowest number of warnings in seven years. The larger number of poorly defined, or "low end" systems contributed to some large initial position errors and larger than normal mean 24-hour forecast errors when compared with the 10-year average. In contrast, the forecast errors at 48 and 72 hours were normal with respect to the 10-year averages.

JTWC continued to outperform the majority of the objective forecast guidance available to support its warnings in 1995. This appears to be due, in part, to the aggressive application of CDR Lester E. Carr III and Dr. Russell L. Elsberry's Techniques detailed in Systematic and Integrated Approach to Tropical Cyclone Track Forecasting (NPS-MR-94-002 December 1994).

Fifty-four warnings were issued on the four significant tropical cyclones which occurred in the North Indian Ocean during 1995, and only 245 warnings were issued on the 22 significant tropical cyclones in the Southern Hemisphere. JTWC forecast errors in the Northern Indian Ocean were comparable to the 19-year average

and the lowest ever for the 15 years in the Southern Hemisphere.

Several exciting tools were made available to the JTWC during 1995, contributing to improved gradient- and upper-level analyses. These tools ranged from improved data availability and display, to improved satellite reconnaissance capabilities within JTWC's Area of Responsibility. Summarized below, they are discussed in greater detail within the report.

Improvements to scatterometer data display and availability by both Naval Oceanographic Office and NOAA have aided in positioning of TCs, as well as defining wind-field structure.

The addition of water vapor imagery and water vapor-derived wind vectors have made significant impact on the TDO's upper-level wind analysis — helping to define upper-level structure and aiding in intensity forecasts.

The addition of Naval Pacific Meteorology and Oceanography Detachment Diego Garcia, to the DMSP Tropical Cyclone Reporting Network has resulted in a significant increase in the number of fixes taken for TCs in the Indian Ocean — increasing TDO confidence in TC location and movement in this data-sparse region.

The JTWC is now receiving METEOSAT 5 imagery from Naval European Meteorology and Oceanography Center (NEMOC), Rota, Spain. These images are remapped from a normal polar to a mercator projection at NEMOC and then automatically forwarded via File Transfer Protocol (FTP) to the JTWC, where they are animated. This new capability, coupled with the additional fix support from Diego Garcia, allows the JTWC to truly MET Watch the Western Indian Ocean for the first time in history.

We at JTWC are looking forward to making use of these tools in 1996 and the development of even more exciting techniques.

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