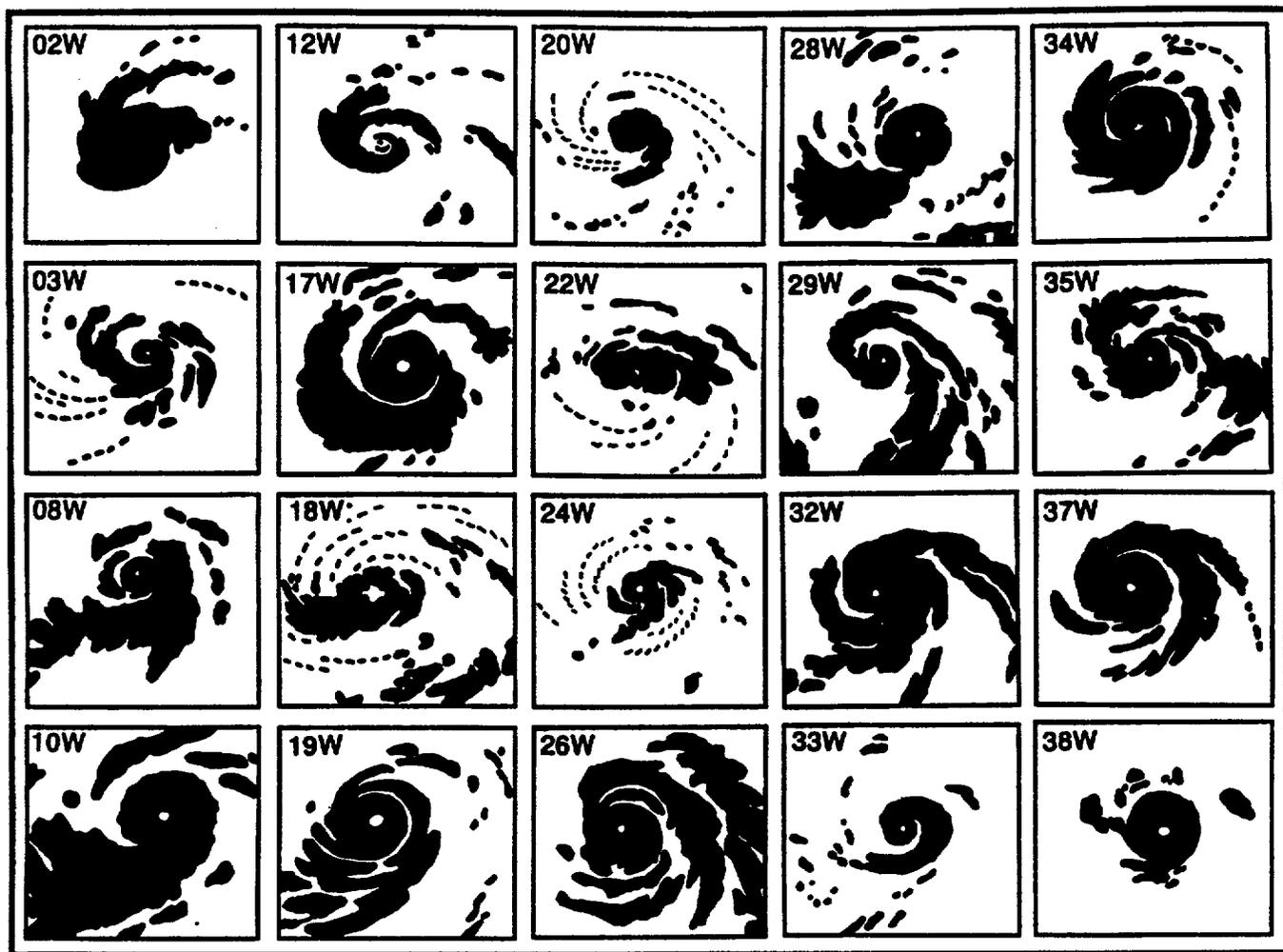


1994 ANNUAL TROPICAL CYCLONE REPORT



JOINT TYPHOON WARNING CENTER
GUAM, MARIANA ISLANDS

FRONT COVER: All twenty of the typhoons that formed in the western North Pacific Ocean in 1994 appear in this mosaic of cloud silhouettes to show the variability of cloud pattern size and shape of these typhoons at, or near, their peak intensity. All the boxes within the mosaic are of the same scale (10° of latitude by 10° of longitude) and, for reference, each typhoon's alphanumeric designator appears in the upper left corner of its respective box. (Cloud silhouettes courtesy of Dr. M. A. Lander.)

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* TRANSFERRED DURING 1994

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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 (NAVPACMETOCEN 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 operational evaluation of tropical cyclone models and forecast aids, and the development of new techniques to support operational forecast requirements.

Special thanks to: Lieutenant Colonel Peter A. Morse for his support as the Director, JTWC for the past year and a half; the men and women of the Alternate Joint Typhoon Warning Center

for standing in for JTWC as needed; Fleet Numerical Meteorology and Oceanography Center (FLENUMETOCEN) for their operational support; the Naval Research Laboratory for its dedicated research; the Air Force Global Weather Central for continued 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 NAVPACMETOCEN 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 post analyses; the staff at National Oceanic and Atmospheric Administration (NOAA) National Environmental Satellite, Data, and Information Service (NESDIS) for their tropical cyclone position and intensity estimates; 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 1*; the personnel at the Navy Publications and Printing Service Branch Office, Guam; Dr. Robert F. Abbey Jr. and the Office of Naval Research for their support to the University of Guam for the JTWC Research Liaisons to JTWC; the University of Guam Research Liaisons for their important contributions to this publication; Dr. Mark Lander for his training efforts, suggestions and valuable insights; and, AG3 Andres G. Grant, AG3 Robert M. Giguere and AG3 Jason E. Eccles for their excellent desktop publishing and graphics assistance.

EXECUTIVE SUMMARY

1994 was notable for the Joint Typhoon Warning Center (JTWC) in many respects. We witnessed the two longest-lived tropical cyclones on record; Typhoon John, which lasted for 30 days over the North Pacific Ocean and Tropical Cyclone Rewa (05P) which lasted for 21 days in the southwestern Pacific Ocean. We also, for the first time in history, recorded the binary interaction between Typhoon Pat and Tropical Storm Ruth and through eventual merger.

The Northwest Pacific (NWPAC) was especially active in 1994, with several long lived, slow-moving typhoons that dramatically increased the workload for the men and women of the JTWC. For the first time in our 36-year history, the JTWC issued more than 1000 warnings in NWPAC, on a total of 41 significant tropical cyclones. The DMSP Tropical Cyclone Reconnaissance Network (DMSP Network) logged over 5000 fixes during the year; also a record high. In spite of the very heavy workload, the JTWC continued to improve its forecast accuracy. Track forecast errors at 48- and 72-hours were the lowest ever, and intensity forecast errors were among the lowest in 20 years.

Sixty warnings were issued on the five tropical cyclones which occurred in the North Indian Ocean during 1994, and a record total of 390 warnings on 30 tropical cyclones in the Southern Hemisphere, 27 of which were within JTWC's area of responsibility. JTWC forecast errors were better than the long-term averages for 19 years in the North Indian Ocean, and among the lowest ever for the 14 years in the Southern Hemisphere.

During the past year, the JTWC has refined its forecast methods by applying a "systematic and integrated approach to tropical cyclone forecasting" developed by CDR Lester Carr and Dr. Russell Elsberry at the Naval Postgraduate School. This approach helps the forecaster improve upon dynamical track forecasts generated by the numerical models by fostering a more analytical view of the environmental influences on tropical cyclone motion, size and intensity.

When we consider JTWC forecasting performance over the past 20 years, it is important to note that the seven "best" years in NWPAC have occurred in the 8-year period since the loss of dedicated aircraft reconnaissance in 1987. Our results in 1994 underscore the value of actions taken by the center and supporting agencies to upgrade our computer systems, develop state-of-the-art satellite processing equipment, and better utilize the data from remote sensing platforms. The time savings afforded us by version 2.76 of the Automated Tropical Cyclone Forecast (ATCF) system, improved data retrieval capabilities of the Automated Weather Distribution System (AWDS) and integration of the Mark IVB into the Meteorological Imagery, Data Display, and Analysis System (MIDDAS) contributed to better forecast time management. The task of issuing 1058 high-quality warnings over the course of 168 tropical cyclone days (94 of which had multiple tropical cyclones), would have been very difficult if not impossible in the grease-pencil and acetate world we operated in less than 10 years ago.

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