CHAPTER III —— RESEARCH SUMMARY

1. GENERAL

One of the three major tasks of the Joint Typhoon Warning Center is to conduct tropical cyclone analysis and forecasting research. In most cases the research projects are directly concerned with either movement or intensity forecast improvement. Meteorologists from outside agencies such as the Environmental Prediction Research Facility, the Naval Postgraduate School, the 54th Weather Reconnaissance Squadron and Detachment 1, 1st Weather Wing often collaborate with JTWC on research projects. The following briefs summarize significant research completed during the past year. Research underway but not yet completed is not reported in this section.

2. COST EFFECTIVENESS EVALUATION OF DROPSONDE DERIVED SEA LEVEL PRESSURES IN TROPICAL CYCLONES OF THE WESTERN NORTH PACIFIC

(Reference: McPeek, R. E. and O. R. Scrivener, FLEWEACEN/JTWC Technical Note 74-6).

From the earliest days of aircraft reconnaissance of tropical cyclones, dropsonde data taken in the cyclone centers showed a very high correlation between dropsonde measured surface pressure and aircraft measured 700-mb height. Jordan (1957) studied this correlation and derived a regression equation that has been used operationally for many years as an initial estimate of surface pressure by Joint Typhoon Warning Center (JTWC), Guam. Sea level pressure measurement is an important tool in deriving maximum surface wind speeds in tropical cyclones. In the light of present day forecasting techniques and ever tightening budgetary constraints, this study was undertaken to determine the feasibility of relying solely on a regression equation to derive sea level pressure from aircraft measured 700-mb heights.

Results showed that Jordan's regression equation can be used operationally for determining tropical cyclone intensity. By using the equation for minimum sea level pressure estimates, instead of dropsonde measured sea level pressure, a dollar savings of approximately $100,000 would be realized in the Western North Pacific each year.

3. DERIVATION OF A REVISED MAXIMUM WIND/MINIMUM SEA LEVEL PRESSURE RELATIONSHIP FOR TROPICAL CYCLONES

(Reference: Atkinson, G. D. and C. R. Holliday, FLEWEACEN/JTWC Technical Note 75-1)

A revised minimum sea level pressure/maximum sustained surface wind relationship for tropical cyclones for the Western North Pacific is derived. The data sample used was 26 years of peak wind gust observations from island and coastal meteorological stations which experienced tropical cyclone hits. Minimum sea level pressures were determined from station pressure data and aircraft reconnaissance observations. The recorded peak gust values were adjusted for differences in station and anemometer elevation and reduced to sustained (one-minute average) surface winds using standard gust factor relationships. The resulting equation is:

$$V_{max} = 6.7\,(1010 - P_c)^{0.644}$$

Where Vmax is the maximum sustained surface wind and Pc is the minimum sea level pressure. The standard error of the regression equation on the dependent data is 8.8 knots and 75% of the cases fell within ± 10 knots of the regression line. Due to the availability of better ground truth observations of maximum surface winds, this relationship is considered more accurate than previous minimum pressure/maximum wind relationships which were derived primarily from maximum surface winds estimated from aircraft reconnaissance sea state observations. The new relationship has been adopted for operational use by JTWC and is used in conjunction with maximum flight level (700 mb) winds and satellite intensity estimates to determine the maximum sustained wind speeds in tropical cyclones. The maximum wind values derived from this equation can be adjusted subjectively for synoptic situations in which the environmental pressures on the cyclone's periphery are abnormally high or low. Table 3-1 gives the pressure/wind relationships derived from the equation.

TABLE 3-1. MAXIMUM SUSTAINED (ONE-MINUTE AVERAGE) SURFACE WIND SPEEDS (MWS) (KNOTS) FOR SPECIFIED VALUES OF MINIMUM SEA LEVEL PRESSURE (MSLP) (mb).

MSLP	MWS	MSLP	MWS	MSLP	MWS
1000	30	960	83	920	122
995	38	955	89	915	126
990	46	950	94	910	130
985	53	945	99	905	134
980	60	940	103	900	138
975	66	935	108	895	142
970	72	930	113	890	146
965	78	925	117	885	150

4. FORECAST VERIFICATION AS A FUNCTION OF RECONNAISSANCE PLATFORM

(Reference: Harrison, E. J., Jr., and A. L. Bryant, FLEWEACEN/JTWC Technical Note 75-2)

There has been much discussion in recent years as to the effect of reconnaissance platforms on forecast position accuracy, e.g., will a 24-hour forecast based on an aircraft fix be more accurate than one based on satellite? This study compares the mean warning position and forecast accuracies for JTWC warnings based on aircraft, satellite, radar and other fixes for the 1973 and 1974 seasons. The single most important result of the study is that warnings based on aircraft fixes are, in the mean, more accurate. The main reason for this is the ability of the aircraft to locate the storm center, regardless of the stage of cyclone development. When storms are well developed, there is essentially no difference in forecast accuracy between warnings based on aircraft and satellite; however, in the poorly developed storms aircraft-based warnings are considerably (approximately 22%) more accurate. The study indicates that continued use of the Selective Reconnaissance Program will provide the most accurate position forecasts possible, while optimizing utility of dwindling aircraft assets.