6C.1 DROPSONDE OBSERVATIONS FOR TYPHOON SURVEILLANCE NEAR THE TAIWAN REGION (DOTSTAR): AN OVERVIEW

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1. INTRODUCTION

Since many typhoons have caused great devastation over the years, typhoon research has always been of utmost importance to Taiwan and its people. In August 2002, the National Science Council (NSC) of Taiwan made funding of approximately NT$100 million available for typhoon research over three years, and this fund is supporting the "Priority Typhoon Research" project directed by the first author. This project is an interdepartmental, international effort involving Taiwan and the U.S., and one crucial mission is to observe typhoons with GPS dropsondes in a project entitled "Dropsonde Observations for Typhoon Surveillance near the TAiwan Region" (DOTSTAR). It is expected that DOTSTAR will shed light on typhoon dynamics, enhance typhoon track forecasting accuracy, place Taiwan at the forefront of international typhoon research, and make a significant contribution to the study of typhoons in the northwestern Pacific and East Asia region.

2. OVERVIEW of DOTSTAR

DOTSTAR is a collaborative effort between researchers from the National Taiwan University (NTU) and the Central Weather Bureau (CWB), in partnership with scientists at the Hurricane Research Division (HRD) and the National Centers for Environmental Prediction (NCEP) of the National Oceanic and Atmospheric Administration (NOAA). The DOTSTAR project builds upon work (Burpee et al. 1996; Aberson 2003) pioneered at NOAA's HRD to improve track forecasts of tropical cyclones. The key to the project is the use of airborne sensors, “dropwindsondes”, released from jet aircraft flying above 42,000 feet in the environment of a tropical cyclone approaching the area near Taiwan (see the targeted area in Fig. 1). These sensors gather temperature, humidity, pressure, and wind velocity information as they fall to the surface. Information from the surveillance flights is transmitted by a satellite phone aboard the aircraft in real time to the CWB (see the operational flow chart in Fig. 2). To make the maximum and optimal use of the data, the dropsonde data are assimilated into the numerical models of CWB, NCEP, the U.S. Navy’s Fleet Numerical Meteorology and Oceanography Center (FNMOC) and Japan Meteorological Agency (JMA) in real time. The data are adopted immediately in the analysis and the 72-hour typhoon forecast of CWB. The data are expected to improve the accuracy of typhoon track and development forecasts.

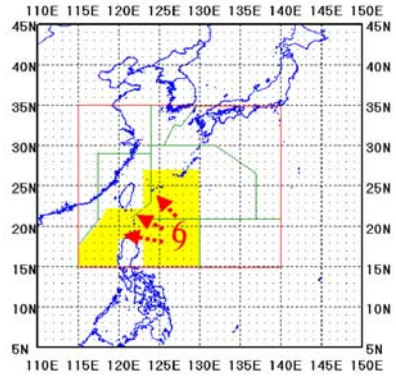

Fig. 1. The targeted area (shaded) for typhoon surveillance in DOTSTAR.

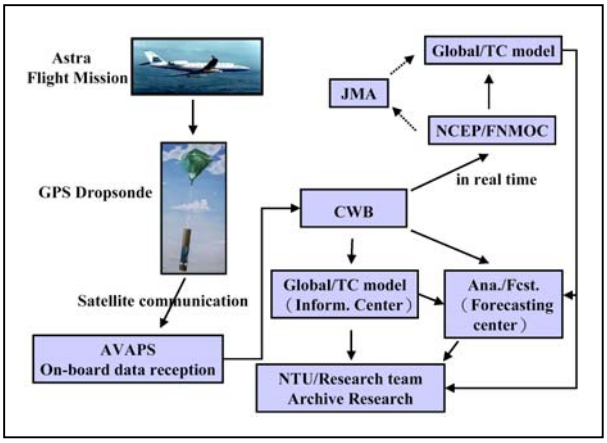

Fig. 2. Flow chart of DOTSTAR.

The typhoon surveillance missions are carried out by an Astra SPX jet from the Aerospace Industrial Development Corporation (AIDC) in Taichung. It is the first time in the last 16 years that aircraft are used in the northwestern Pacific to observe typhoons near Taiwan. Dropsondes are deployed from the jet directly into the periphery of typhoons from an altitude

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of 42,000 feet. Each flight lasts for up to six hours. Data are collected in key selected areas (Aberson 2003) surrounding the typhoon and this information will be extremely useful in forecasting and academic research. The project will enable scientists to formulate future airborne observation strategies, facilitate adaptive observations of typhoons, and improve data assimilation capability. The project is therefore considered a pioneering step forward in basic research and forecasting of typhoons.

The objectives of DOTSTAR are as follows:

1) To conduct a pilot study to enhance observations of the atmosphere around Northwest Pacific typhoons that may affect the Taiwan area.

2) To evaluate how the dropwindsonde data influence model track predictions, and study the optimal observation strategies for improving forecasts.

3) To provide guidance for future observation strategies.

4) To validate remote sensing data around typhoons and help explore typhoon dynamics and theories.

5) To improve adaptive observation strategies and data assimilation, which are at the forefront of typhoon forecasting and research.

3. PROGRESS

During the 2002 hurricane season, four researchers from Taiwan worked with HRD scientists, learning the operational and scientific aspects of aircraft use to sample the hurricane environment. A number of essential tasks were completed before the typhoon season in 2003. First, the whole aircraft platform, Dropsonde equipment and the onboard data receiving, analysis, and transmitting system and programs were successfully set up at AIDC; Second, the system for the real –time analysis and assimilation of dropsonde data at CWB was completed; Third, test flights were successfully performed.

On 1 September 2003, the first DOTSTAR mission was successfully completed around Typhoon Dujuan, with 11 dropsondes released (Fig. 3). NOAA remarked upon the successful collaboration in a press release. On 2 November 2003, the second mission was conducted for Typhoon Melor with 15 dropsondes released (Fig. 4), and the ASTRA flew directly over the centre of Melor. By flying over the eye for the first time, the mission has laid the foundation for future observations of typhoons' central structures.

The preliminary results from the first two missions will be presented in a companion paper by Huang et al. (2004), entitled "The Impact of GPS dropsondes on typhoon track forecasts of DOTSTAR".

Information on DOTSTAR is also available at http://typhoon.as.ntu.edu.tw/DOTSTAR.htm.

We are expecting to undertake at least 8 surveillance missions in 2004 and 2005, respectively. As the DOTSTAR research team continues to harvest important data and gain valuable experience, we believe that future typhoon observations will reach full maturity, enabling significant progress in both academic research and typhoon forecasting.

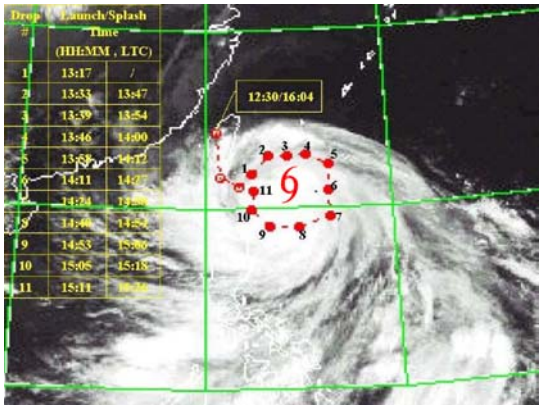

Fig. 3. The GMS-5 IR Imagery and the flight track and the released locations of the dropsondes for Typhoon Dujuan, 0430 – 0800 UTC 1 September 2003.

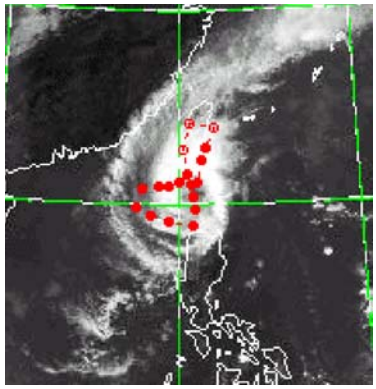

Fig. 4. The GMS-5 IR Imagery and the flight track and the released locations of the dropsondes for Typhoon Melor, 0400 – 0700 UTC 2 November 2003.

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