THORPEX - Pacific Asian Regional Campaign (T-PARC)

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Abstract

The THORPEX Pacific Asian Regional Campaign (T-PARC) was conducted in 2008 under an international partnership to understand the life cycle of tropical cyclones over the western North Pacific from genesis through intensification to recurvature and extra-tropical transition.

THORPEX is a ten-year international global atmospheric research project (see http://www.wmo.int/pages/prog/arep/thorpex/index_en.html) being implemented under the World Weather Research Programme (WWRP) of the World Meteorological Organization (WMO). Its aim is to accelerate improvements in the accuracy of one-day to two-week high-impact weather forecasts and society's utilization of weather products. The program was established by the WMO Congress at its 14th session (Geneva, May 2003).

During the T-PARC special observations period between 1 August and 5 October 2008, the Japan Meteorological Agency (JMA) deployed the following enhanced observations targeting Nuri (0812), Sinlaku (0813) and Jangmi (0815) with the aim of improving numerical weather prediction (NWP) performance for TCs: (i) enhanced upper soundings by two research vessels and four automatic upper-sounding stations, and (ii) MTSAT rapid-scan operations, in addition to collaborative dropsonde operations by the DLR Falcon. JMA also provided products related to typhoon ensemble forecasting and sensitive-area information useful for typhoon-targeting observations.

To support T-PARC's operations, JMA also created a web page at http://tparc.mri-jma.go.jp to give an overview of the campaign. The page includes the special-observations schedule, provides information on current atmospheric conditions and forecasts, and gives guidance on special observations and data/information for THORPEX researchers. Plans are also under way to provide special observation datasets for researchers via the page.

JMA has also conducted several studies regarding the impact of T-PARC observation data on numerical predictions of tropical cyclone tracks and intensities. One study indicated a case where special observation data had a large positive impact on tropical cyclone track forecasts for Sinlaku, but less impact on those for Jangmi.

1. Introduction

In the 2008 typhoon season, an international field experiment involving special typhoon observations was carried out as part of the World Meteorological Organization (WMO) research programme.

THORPEX is a ten-year international global atmospheric research project (see http://www.wmo.int/pages/prog/arep/thorpex/index_en.html) being implemented under the WMO's World Weather Research Programme (WWRP).   Its aim is to accelerate improvements in the accuracy of one-day to two-week high-impact weather forecasts and society's utilization of weather products.   The project was established in May 2003 by the 14th WMO Congress.

As a regional THORPEX project, a summer field experiment called the THORPEX Pacific Asian Regional Campaign (T-PARC) was conducted.   T-PARC is a project based on the societal needs of typhoon-prone countries in Asia, and aims to improve prediction in the following two areas: (i) the life cycle of tropical cyclones in the western North Pacific from genesis to extratropical transition/decay, and (ii) high-impact weather events over North America, the Arctic and elsewhere whose dynamical roots and/or forecast errors are driven by typhoons and other intense cyclogenesis events over east Asia and the western Pacific.

This summer field experiment had three specific major areas of focus: (i) tropical cyclogenesis, (ii) recurvature, and (iii) extra-tropical transition.   The objectives of T-PARC include both the improvement of regional prediction in Asia and North America and the study of these events' impacts on the downstream flow of global atmospheric circulation.

During the T-PARC special observation period from 1 August to 5 October 2008, eleven tropical circulation systems, including four named tropical cyclones (Nuri, Sinlaku, Hagiput and Jangmi), were observed using a variety of observation tools including sondes, manned aircraft (the DLR Falcon and planes from the US Air Force in addition to aircraft from a related science project) and the MTSAT satellite.   The observation data gathered provide a deeper understanding of typhoons and other high-impact weather events and help to improve related forecasting.

During the campaign, the Japan Meteorological Agency (JMA) deployed the following enhanced observations targeting Nuri (0812), Sinlaku (0813) and Jangmi (0815): (i) enhanced upper soundings by two research vessels and four land stations, and (ii) MTSAT rapid-scan operations, in addition to collaborative dropsonde operations by the DLR Falcon.   The Agency also provided products related to typhoon ensemble forecasting and sensitive-area information useful for typhoon-targeting observation.

To support T-PARC's operations, JMA also created a web page at http://tparc.mri-jma.go.jp to give an overview of the campaign.   The page includes the special-observation schedule, provides information on current atmospheric conditions and forecasts, and gives guidance on special observations and data/information for THORPEX researchers.   Plans are also under way to provide special observation datasets for researchers via the page.

After the special observations, JMA conducted a preliminary study on the impact of T-PARC observation data on numerical prediction.   The study indicated a case where special observations had a large positive impact on track forecasts for Sinlaku, but less impact on those for Jangmi.

2. Overview of the THORPEX Pacific Asian Regional Campaign

2.1 Objectives

The main objectives of T-PARC are to understand (i) tropical cyclogenesis, (ii) recurvature of tropical cyclones, and (iii) extra-tropical transition of tropical cyclones. Each of these includes regional prediction goals for Asia and North America and studies on the impacts of these events in relation to downstream flow.   To accomplish the above objectives, the following aircrafts were used:

- DLR Falcon 20
- WC-130J (from USAF under the TCS-08 program)
- P-3 (from NRL under TCS-08)
- ASTRA (from DOTSTAR)

In addition, driftsonde operation was conducted by the US, special upper-sounding operations were performed by the Korea Meteorological Administration (KMA) and JMA, and MTSAT-2 rapid-scan operations were performed by JMA.

During the campaign (1 August to 5 October 2008), eleven tropical circulation systems were observed in total. These consisted of four named tropical cyclones (Nuri, Sinlaku, Hagiput and Jangmi), one tropical depression, one ex-tropical storm and five others.   Here, we give an overview of the campaign conducted by JMA.

2.2 THORPEX and T-PARC

THORPEX is a 10-year international global atmospheric research program run under the World Meteorological Organization (WMO)/World Weather Research Program (WWRP) to accelerate improvements in the accuracy of one-day to two-week high-impact weather forecasts and society's utilization of weather products.

T-PARC is based on societal needs to improve prediction of (i) the life cycle of tropical cyclones in the western Pacific from genesis to extratropical transition/decay, and (ii) high-impact weather events over North America, the Arctic and elsewhere whose dynamical roots and/or forecast errors are driven by upstream typhoons and other intense cyclogenesis events over east Asia and the western Pacific.

Scientists mainly from the Republic of Korea and Japan participated in T-PARC to understand the mechanism behind tropical cyclone recurvature and examine the feasibility of targeted observations for such cyclones.   Dropsonde observation using the DLR Falcon is covered by Bessho et al. in this volume in more detail.

The targeting expert team was organized to guide aircraft flight missions involving the provision of sensitivity information near tropical cyclones using different types of sensitivity analysis, such as the singular vector method or the ensemble Kalman filter technique.   A more detailed description of JMA's sensitivity analysis is given in a separate paper by Komori et al. in this volume.

2.3 Observation System Experiment (OSE) for Sinlaku and Jangmi

The major concern for Japan is the impact of targeted observation on tropical cyclone track forecasting.   Several Observing System Experiments (OSEs) were performed to evaluate the related impacts for Sinlaku and Jangmi, with the results indicating an overall improvement in the accuracy of track forecasting.   For Sinlaku, the track forecast was improved by 20 – 30 percent for the period 0 – 12 hours before recurvature and by 10 percent in 60 – 84 hours after recurvature.   However, for Jangmi, the tracks both with and without special sonde observations were identical, suggesting that the impact is small when the forecast is good.   Intercomparison of track forecasts by several centers (JMA, KMA, ECMWF and NCEP) is now under way to identify common features and differences among them.   More detailed information is available in a separate paper by Yamashita et al. in this volume.

2.4 T-PARC webpage

Huge amounts of observation and forecast data are available from the special experiments performed under T-PARC in 2008.   For researcher convenience, a number of related products from JMA and other organizations are provided on the T-PARC website at http://tparc.mri-jma.go.jp/.   The details of the information on the webpage are described in a separate paper by Hoshino and Nakazawa in this volume.

3.   Conclusion

During the T-PARC special observation period from 1 August to 5 October 2008, JMA deployed the following enhanced observations targeting Nuri, Sinlaku and Jangmi to improve numerical weather prediction (NWP) performance for TCs: (i) enhanced upper soundings by two research vessels and four automatic upper-sounding stations, and (ii) MTSAT rapid-scan operations, in addition to collaborative dropsonde operations by the DLR Falcon.   The Agency also provided products related to typhoon ensemble forecasting and sensitive-area information useful for typhoon-targeting observation.

JMA has also conducted several studies regarding the impact of using the T-PARC special targeted observation data on numerical predictions of tropical cyclone tracks and intensities.   One study indicated a case where special observation data had a large positive impact on tropical cyclone track forecasts for Sinlaku, but less impact on those for Jangmi.