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Impact of the Additional Observation Data on the Weather Analysis

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1. Introduction

One of the primary causes of errors in numerical weather forecasts is errors in the analysis used as the initial conditions in the forecast model. More observations can provide more information about the true atmospheric state, and thus can help reduce such errors. At first glance, it seems obvious that more data should improve atmospheric analyses, as long as the data is reasonably accurate (Morss and Emanuel, 2002).

Recently, there has been interest in adding observations in potentially important locations, called targeting or adaptive observations, to improve specific significant forecasts. The concept of"targeting"observation is based on the idea that the short-range forecast of a significant weather feature, such as an extratropical or tropical cyclone, can be improved by the deployment of a limited number of special observations in an upstream area where the forecast of that feature is most sensitive to errors in forecast model initial conditions (Langland 1999). Targeting observations has been tested for midlatitude-winter forecasts in the Fronts and Atlantic Storm-Track Experiment, the North Pacific Experiment, and the Winter Storm Reconnaissance Program, and for tropical-cyclone forecasts in the Typhoon Hunter-2001, Japan.

The Korea Enhanced Observing Period (KEOP), which took place during the period of 23 September to 6 October, 2001, provides an opportunity to assess the impact of targeted observations on the analysis of extratropical or tropical cyclone using the unmanned aircraft, Aerosonde. It has been pointed out that Aerosonde is one of the appropriate observing systems for extratropical or tropical cyclone observation. In this study, we explore the impact of the additional observation data produced by targeted Aerosonde observations on the weather analysis using the Korea Local Analysis and Prediction System (KLAPS). In addition, the limitations of routine or operational use of Aerosonde are discussed in the section of summary and discussion.

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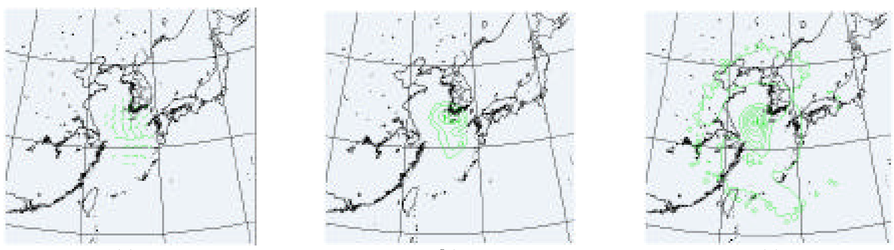
2. WHAT IS THE KLAPS?

The LAPS (Local Analysis and Prediction System) developed in FSL(Forecast System Laboratory), USA is characterized by the ability of the use of Satellite, Radar data applied as only image data before and QuikSCAT, ACARS data produced by new observing system, the easy-application of the assimilated data to various numerical models such as MM5, ARPS, RAMS, and WRF. Some parts of LAPS have been adjusted to an optimal Korean meteorological environment by performing a series of sensitivity experiments to additional observation data.

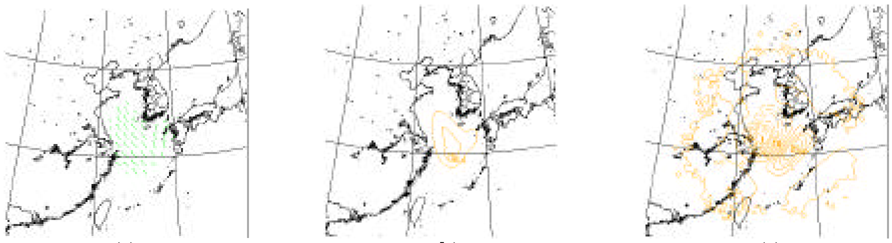
3. RESULTS

Figs. 2 and 3 presents the difference (with minus without Aerosonde data) fields of wind direction, wind speed, and geopotential height at 850 hPa in case of typhoon and cold front, respectively. The inclusion of Aerosonde data in case of typhoon environment is characterized by the dominant southerlies north off Jeju Isalnd and easterlies to south where the targeted Aerosonde flight area is present. Its speed is strong over areas extending southward from the Heuksan Island to the south ocean off Jeju Island(Fig. 2 (a) and 2(b)). In the geopotential height difference, the pronounced positive value revealed over the northern part of the East China Sea, having progressed to the southwestward compared to wind field(Fig. 2(c)). It means that this difference fields provide a favorable condition for delayed northward movement of Typhoon LEKIMA. In case of cold front, strong northwesterlies appeared over the central and southern part of Yellow Sea and the East China Sea including the Aerosonde flight area. Its speed is stronger along 30 N. The geopotential height difference field shows negative values over the eastern part of the East China Sea and to southwest of them positive values.



(a) (b) (c)

Fig. 2. The difference (with minus without Aerosonde data) fields of 850 hPa wind direction(a), wind speed(b), and geopotential height(c) at 00Z 28 September, 2001 analyzed by KLAPS.



(a) (b) (c)

Fig. 3. The difference (with minus without Aerosonde data) fields of wind direction(a), wind speed(b) and geopotential height(c) at 12Z 3 October, 2001 analyzed by KLAPS.

This indicates the development of the cold front with its well-organized pattern and delayed southeastward propagation(Fig. 3). It is found that the Aerosonde data exert a large influence on the improvement in the analysis of typhoon and cold front environment.

3. SUMMARY AND DISCUSSION

The sensitivity analysis with and without ingested Aerosonde data using the KLAPS (Korea Local Analysis and Prediction System) shows that the inclusion of Aerosonde data may provide improved analysis of typhoon environment. However, there are many limitations in observing the inner structure of typhoon and strong cyclone using Aerosonde for the purpose of examine the atmospheric vertical structure of severe weather. high operational costs, inability to fly into severe weather systems such as typhoon, heavy rainfall, incapability of operational observing network due to approval of Aerosonde flight area and frequency. In addition, a strong surface cross-wind at Aerosonde launch/ recovery site is one of the Aerosnde-broken causes and it is impossible to launch Aerosonde under the weather condition of strong wind and irregular wind direction. It would be mentioned that the KEOP-2001 provide strong experimental evidence that Aerosonde may be one of the useful observing systems for better understanding the atmosphere vertical structure of typhoon environment. It is left for further study to test the robustness of the impact of Aerosonde data on increased model accuracy and reliability of severe weather.

Acknowledgements

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