Impacts of the low-level convergence data on the local heavy rainfall

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1. Introduction

One of the aims of the 'Social System Reformation Program for Adoption to Climate Change' project is to observe thunderstorms that cause local heavy rainfalls in urban areas (such as the Tokyo Metropolitan area) and to clarify the mechanisms of their generation, development and decay by using the observation data and outputs of numerical models. In the Nerima local heavy rainfall that occurred in 1998, the thunderstorms were generated by the convergence that was produced by a thermodynamic low. Because convergence started before the generation of the thunderstorms, it is expected that the thunderstorms can be reproduced before their generation when the large-scale convergence data was provided. In this study, the observation data of the airplane and of the low-level profilers in the urban area, which have the information of the horizontal convergence of the low-level wind, were assimilated and their impacts were investigated by checking that the generation and development of the thunderstorms were reproduced by the assimilation of these data.

2. Outline of the observation system simulation experiments

In the observation system simulation experiments of his study, three kinds of observation data were produced from the truth data (outputs of numerical model in which thunderstorm was well reproduced), and were assimilated into the first-guess (initial conditions in which the thunderstorm was not reproduced). The impact of observation data, namely how the thunderstorm is improved by the assimilation of the observation data was investigated.

In this study, the thunderstorm which was similar to the observed one was reproduced with the nested LETKF system by the assimilations of GPS precipitable water vapor data and of horizontal wind of Doppler radar. This data that was most similar to the observed one was used as the truth data. The following three observation data which surrounded the thunderstorm were produced from the truth data of 15 JST, 2 hour before the development of the thunderstorm. The first is the airplane data, which is water vapor, temperature, heading wind speed or horizontal wind at the height of 400 m at the circle points in Fig. 2a. Second one is the wind profiler data which is the horizontal winds below the height of 200 m at the same points of airplane data. And the last one is the thermo profiler data which is the temperature profiles below the height of 600 m at the same points of airplane data. These data was assimilated into the initial condition of 15 JST which were obtained by assimilation of the conventional data only.

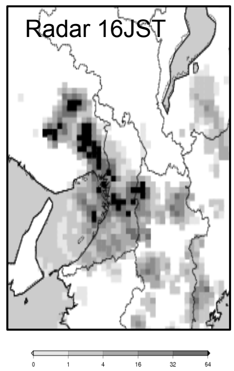

Fig. 1 Rainfall region of the thunderstorm at 16 JST 5th Sep. 2008 to which OSSE applied.

3. Impacts of low-level data which surrounded the generation point of the thunderstorm

When the airplane data or profiler data were assimilated, the thunderstorm was reproduced where it was observed. These results show that observation data surrounding the thunderstorm can improve their rainfall forecast even if the direct observation data of the thunderstorm was not used.

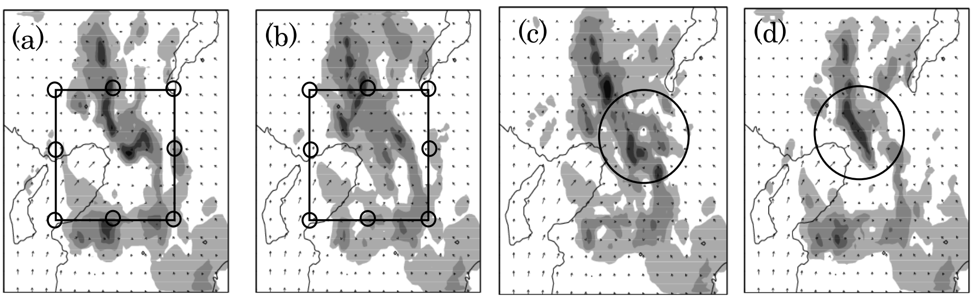

Fig 2: Results of OSSE. (a) Truth data obtained by the assimilation of the conventional data and GPS and Doppler radar data. (b) First guess data obtained by the assimilation of the conventional data. (c) and (d) Result of assimilations of truth-derived airplane data and truth-derived profiler data

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Reference

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