Assimilation experiment on Zoshigaya local heavy rainfall event

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1. Introduction

The Meteorological Research Institute of the Japan Meteorological Agency (JMA) has been developing a nonhydrostatic cloud-resolving 4DVAR assimilation system (NHM-4DVAR) based on the JMA operational mesoscale model (NHM). The aim of this development is to investigate mechanisms of strong convection.

In this presentation, an assimilation experiment on a local heavy rainfall event occurred on 5 August 2008 in Zoshigaya, Tokyo, will be presented. Especially, comparisons between assimilation methods of GPS precipitable water vapor (PWV), GPS zenith total delay (ZTD), and GPS slant total delay (STD) data will be discussed.

2. GPS Slant Delay Observation

GPS-PWV has only zenith information of water vapor on the observation site, and also GPS-ZTD has only zenith information but has information of several elements of atmosphere (i.e., pressure, temperature, and water vapor). While, GPS-STD has vertical and horizontal information of several elements of the atmosphere. These characteristics are advantageous to reproduction of small scale cumulonimbus, especially, for a high resolution assimilation system.

3. Impact Tests

A local heavy rainfall event with a horizontal scale of about 10 km occurred on 5 August 2008 at Zoshigaya, Tokyo. This event was caused by cumulonimbi which generated around Tokyo bay and four drainage workers at a construction site were killed by an abrupt freshet.

A cloud-resolving nonhydrostatic 4-dimensional variational assimilation system (NHM-4DVAR; Kawabata et al. 2008) was applied to this heavy rainfall event. First, an impact test for the assimilation of GPS-PWV, GPS-ZTD, and GPS-STD was conducted, in order to evaluate the performance of each data assimilation methods. In this experiment, only GPS data was assimilated with 10-munite window.

4. Results

Figure 1 shows precipitable water vapor field of the first guess, the result of GPS-PWV, GPS-ZTD, and GPS-STD, respectively. Small amount of water vapor in the first guess is modified by all assimilations and the distributions by each data assimilation methods are similar.

But, much coherent distribution of precipitable water vapor is observed around the observation points in the result of GPS-STD assimilation. In order to modify this situation, we carried out additional an impact test, which another observation (surface pressure, temperature, and relative humidity) is additionally used. These observations may provide incoherent water vapor structure in low level of the atmosphere. Through the additional result (Fig. 2), the assimilation of surface temperature and humidity modify the coherent distribution, but that of pressure does not.

It is considerable that the coherent structure is made by the observational correlation between radio waves from GPS satellites. In order to confirm this hypothesis, further investigations are required.

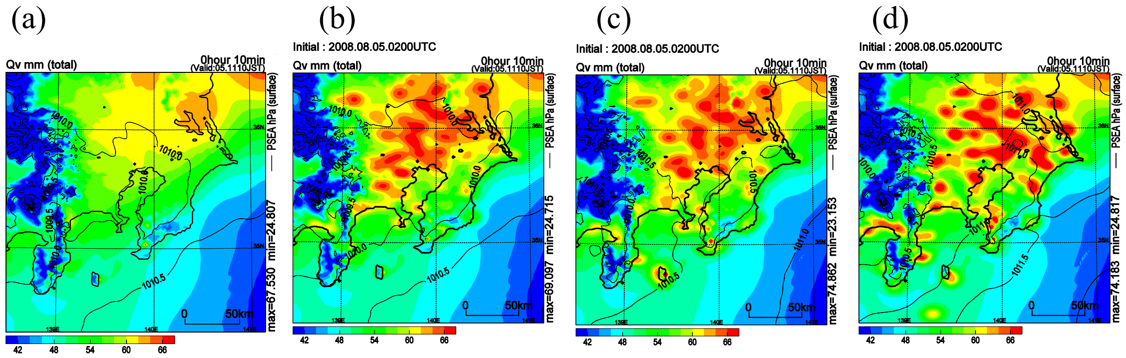

Figure 1. Horizontal distribution of precipitable water vapor from (a) Bck, the assimilation of (b) PWV, (c) ZTD, and (d) STD.

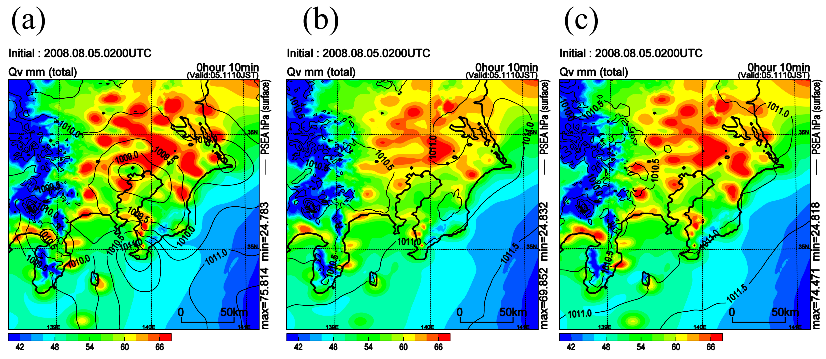

Figure 2. Horizontal distribution of precipitable water vapor from the additional assimilation of (a) surface pressure, (b) temperature, (c) humidity.

Reference

Kawabata, T., H. Seko, K. Saito, T. Kuroda, K. Tamiya, T. Tsuyuki, Y. Honda, and Y. Wakazuki, 2007: An assimilation and forecasting experiment of the Nerima heavy rainfall with a cloud-resolving nonhydrostatic 4-dimensional variational data assimilation system. *J. Meteor. Soc.* Japan, **85**, 255–276.