A simple data assimilation to remove discontinuity between global and regional models

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1. Introduction

Integration of a regional numerical model requires time varying forcing fields for the lateral boundaries. The lateral boundary conditions have a significant influence on the downscaling at climate time-scale, since they continuously influence the interior of the regional domain. Therefore, many downscaling projects require forcing output in very high pressure level resolution and convenient forcing method. (K. Yoshimura and M. Kanamitsu, 2009)

Incremental interpolation is a method to recover such a fine vertical scale structure and examine how procedure can improve the regional simulation (e.g., Bloom et al., 1996, Joergensen and Moehrlen, 2003). This method uses short range forecast with a global coarse resolution model as a guess and vertically interpolates the difference between the external forcing field and the guess at the standard pressure levels to model levels. The inconsistency between the external forcing and downscaling model always exists and cannot be eliminated but the use the incremental interpolation is a way to reduce this inconsistency (K. Yoshimura and M. Kanamitsu, 2009).

The purpose of this study is to investigate the accuracy of a regional model simulation by the use of coarse vertical resolution forcing fields and to examine the impacts of the vertical resolution of the forcing field using the Incremental interpolation scheme using the Weather Research and Forecasting (WRF; Skamorock et al., 2005) model.

2. The Incremental Interpolation

The Forcing field F_g^* of the Incremental Interpolation method obtained following :

$$F_{INC} = F_g + \Im_{p\to s}(\Im_{s\to p}(F_a) - \Im_{p\to s}(\Im^*_{s\to p}(F_g))$$

Where F_g and F_a are the initial guess field and analysis fields in full sigma-level coordinate, and $\Im_{p\to s}$ and $\Im_{s\to p}$ are interpolation operators from pressure-to-sigma and sigma-to -pressure coordinates, respectively.

The National Centers for Environmental Prediction (NCEP) Final Analysis (FNL), which has a resolution of 1°×1°, is used as the analysis field. The output from the WRF model is considered as an initial guess field.

The field F_g^* is obtained by adding the increment to the guess field at all sigma level, which is used

as initial and boundary condition for the next time step.

3. Numerical Experimental Setup

The WRF model version 3.0 is used to examine the effect of the Incremental vertical interpolation, which is the fully compressible non-hydrostatic model with Arakawa-C grid system. The physics packages include the WRF single-Moment 3-Class (WSM3) microphysics scheme (Hong et al., 2004), the new Kain-Fritsch (Kain and Fritsch, 1993) cumulus parameterization scheme, the Noah land-surface mode (Chen and Dudhia, 2001), the Yonsei University planetary boundary layer (YSUPBL) (Hong et al., 2006), a simple cloud-interactive radiation scheme (Dudhia, 1989), and Rapid Radiative Transfer Model (RRTM) longwave radiation (Mlawer et al., 1997) schemes.

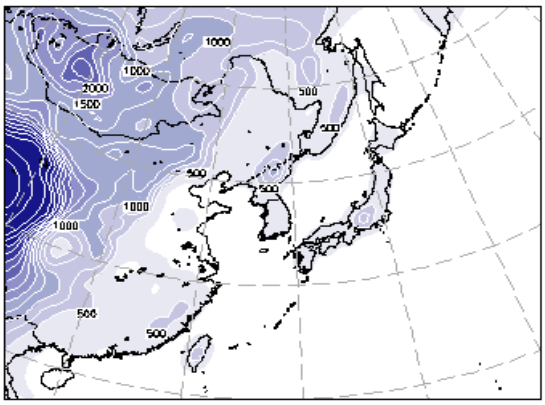

Fig. 1 the domain of the WRF Model

The model domain covers the East Asian region with emphasis on Korea peninsula. The number of grid points is 109 (west-east) by 86 (north-south), and 48km resolution is chosen (Fig. 1). The experiments were started every 0000 UTC of each day during 1month from 1, July to 1, Aug 2006. Each experiment was integrated during 24 hour and started every 00UTC of 31 days. Two experiments were designed to investigate the effect of the incremenal interpolation. Table 1. sumarrizes the conductde experiments under varying initial and boundary conditions in this study.

Table 1. Summary of experiments

Experiment	Initial Condition	Boundary Condition
CTL	FNL_WPS	FNL_WPS
EXP1	FNL_INC	FNL_INC

The CTL experiment was performed without the field inclusion of the incremental interpolation at all of the sigma levels.

4. Preliminary Results

From the comparison with radio-sonde data, CTL experiment shows generally the cold bias in the vertical profile for the temperature field and reveals a distinct cold bias accompanying an intensified through to the west of the Korean peninsula over the surface. EXP1 experiment, which uses the incremental interpolation method shows a better agreement with the observation, compared with the CTL experiment. Cold bias over the surface with the CTL experiment also slightly reduces in the EXP1 experiment (not shown). More results and analysis will be presented in the conference.

References

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