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Generation and Verification on the Synthetic Precipitation/Temperature Data

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Abstract

Recently, because of the weather forecasts through the low-resolution data has been limited, the demand of the high-resolution data is sharply increasing. Therefore, in this study, we restore the ultra-high resolution synthetic precipitation and temperature data for 2000-2014 due to small-scale topographic effect using the QPM (Quantitative Precipitation Model)/QTM (Quantitative Temperature Model).

First, we reproduce the detailed precipitation and temperature data with 1km resolution using the distribution of Automatic Weather System (AWS) data and Automatic Synoptic Observation System (ASOS) data, which is about 10km resolution with irregular grid over South Korea. Also, we recover the precipitation and temperature data with 1km resolution using the MERRA reanalysis data over North Korea, because there are insufficient observation data. The precipitation and temperature from restored current climate reflect more detailed topographic effect than irregular AWS/ASOS data and MERRA reanalysis data over the Korean peninsula. Based on this analysis, more detailed prospect of regional climate is investigated.

Key words : High resolution, Topographic effect, QPM, QTM

I. Introduction

Lately, in each region of Korean peninsula, the extreme weather events such as heavy rain and severe drought has occurred. However, It is difficult to provide adequate information about these weather events. Because of the weather forecasts through the low-resolution data has been limited, the demand of the high-resolution data is sharply increasing. Especially in complex terrain of Korean peninsula, high-resolution data considering topographic effects is required. Generally, extreme weather events tend to occur locally high strength in a short period of time, the local and regional detailed data is necessary. Because the observational

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data provided by KMA is distributed about irregular 10 km resolution, difficult to considering topographic effects and forecasting detailed extreme weather phenomena. The weather forecasting and climate prediction targeting the whole Korean peninsula has limitations due to lack of available observation data in the cases of North Korea. Therefore, in this study, we restore the ultra-high resolution synthetic precipitation and temperature data for 2000-2014 due to small-scale topographic effect using the QPM (Quantitative Precipitation Model)/QTM (Quantitative Temperature Model).

II. Data and Method

In this study, we used high-resolution terrain data (DEM: Digital Elevation Model) to account for the effect of small-scale topography over Korean peninsula. Also, we recover the precipitation and temperature data with 1km resolution using the reanalysis data over North Korea, because there are insufficient observation data. Through the correlation analysis of some cases, we selected appropriate MERRA reanalysis data provided by NASA (Table 1). These datasets were converted to regular grid through the barnes method. Finally, we restored the synthetic precipitation and temperature data of 1km resolution considered complex topographic effect.

Table 1. Available Datasets

data	institute	time interval	horizontal resolution	vertical resolution	period
ERA-Interim	ECMWF	vertical : 6hr horizontal : 12hr	0.75˚×0.75˚	60 Levels	1979-present
ERA-40	ECMWF	6hr	1.125˚×1.125˚	60 Levels	1958-2001
CFSR	NCEP	6hr	0.5˚×0.5˚	64 Levels	1979-2010
GFS	NCEP	6hr	0.5˚×0.5˚	64 Levels	2004-present
MERRA	NASA	vertical : 3hr horizontal : 1hr	1.25˚×1.25˚ 0.667˚×0.5˚	72 Levels	1979-present
NCEP/DOE Reanalysis 2	NCEP/DOE	6hr	2.5˚×2.5˚	17 Levels	1981-2010 1979-present
TRMM	NASA	6hr	0.25˚×0.25˚	-	1998-present
GLDAS	NASA	1hr	0.125˚×0.125˚	-	1996-2007

III. Verification

In order to verify the synthetic precipitation and temperature data, we used the ground observation data over South Korea and GTS data over North Korea provided by KMA. We selected the verification points that the distance between the reproduced synthetic data and observation data was less than 200m. Also, we verify the simulated performance of QPM about these verification points (Fig. 1).

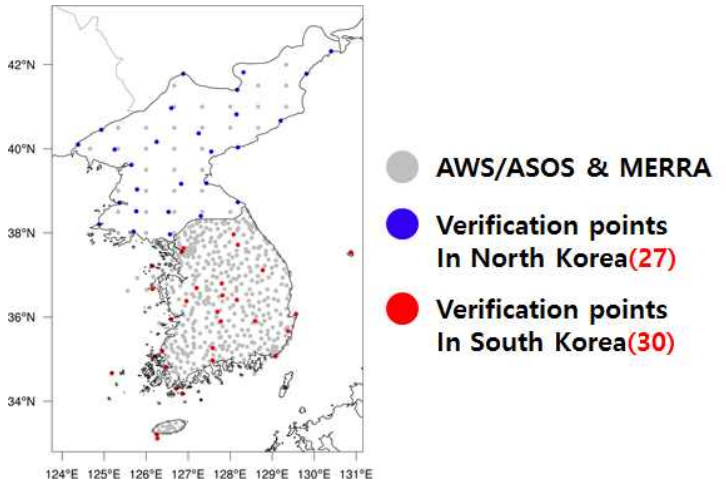

Fig. 1. Verification points over Korean peninsula.

3.1. Precipitation

The results of verification of synthetic precipitation over South Korea represent the mean precipitation error in many cases were about 0.1-0.15 mm and the correlation coefficients were higher than 0.7 (Table 2). For South Korea restoration results showed a relatively high accuracy.

However, there was a tendency to underestimate the precipitation in most cases of North Korea. Also, represented generally low correlation with these impacts.

Table 2. Precipitation verification results of cases in South and North Korea

	South Korea (1hr)			North Korea (12hr)		
	CASE 1	**CASE 2**	**CASE 3**	**CASE 1**	**CASE 2**	**CASE 3**
AVE (OBS/QPM)	5.49/5.33	6.18/6.02	3.48/3.51	34.44/21.90	32.95/20.59	23.70/18.98
STD (OBS/QPM)	6.35/5.92	9.20/6.97	4.04/3.40	22.97/15.08	21.91/9.57	17.35/10.61
RMSE	2.05	6.03	0.54	28.47	24.10	18.13
CORR	0.95	0.75	0.78	0.14	0.34	0.29

3.2. Temperature

The results of verification of synthetic temperature over South Korea represent the correlation coefficients were higher than 0.7 (Table 3). And when grided temperature lapse rate was applied, the error tend to decrease and the correlation coefficient tend to increase (Table 3).

Table 3. Temperature verification results of cases in South and North Korea

Lapse Rate	Unapplied			Applied		
	AVE	**RMSE**	**CORR**	**AVE**	**RMSE**	**CORR**
CASE 1	27.0	2.30	0.81	26.7	2.31	0.83
CASE 2	-10.1	4.79	0.76	-12.3	4.64	0.79
CASE 3	17.2	4.24	0.69	16.3	3.96	0.77

Unapplied: Grided temperature lapse rate unapplied; Applied: Grided temperature lapse rate applied.

IV. Conclusion

In this study, we used an irregular observation data over South Korea and MERRA reanalysis datasets over North Korea in order to restore the precipitation and temperature data of 1km grid spacing for the current climate (2000-2014). QPM/QTM were performed through the consideration of complex topographic effects and physics. Thus, the restored synthetic data can be a useful data to analyze the regional climate characteristics of Korean peninsula.

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