



12th International Conference on Hydroinformatics, HIC 2016

Development of future precipitation forecasting program using probability forecast and climate change scenario

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Abstract

Recently, it is estimated that Korea and other countries will face water shortage, and the water related industries and technologies will be increasingly important. So the cutting-edge IT technology and existing water management infrastructure have been combined to develop the concept of smart water grid, which is widely applied in Korea and overseas. To apply the smart water grid, it is important to calculate the available volume of water resources. It requires the future precipitation forecasting data analysis, and the precipitation forecast of Korea Meteorological Administration and climate change scenario data can be essential elements in calculating short-term and long-term available quantity of water resources. Korea Meteorological Administration is providing the precipitation data for the next 10 days through community and mid-term forecast while providing the precipitation for the next 3 months through the long-term forecast using past normal-year data. It is difficult to estimate the precipitation after 3 months so this research used the climate change scenario data. RCP8.5 scenario was used to provide the precipitation data of 1km*1km resolution, and especially it used the Kriging technique to interpolate and thus provide the missing grid, which was not provided by conventional RCP scenario, considering the latest administrative district.

It used C language based visual studio2013 and the data including the climate change scenario was saved in an Oracle DB so that it can be used through a server of Incheon National University. The Oracle DB contains future RCP scenarios from 2015 to 2050, and a Windows based application was developed so that a user can extract the precipitation data by setting the time frame and location. The extracted result is saved as a text file format in order to facilitate the use.

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Peer-review under responsibility of the organizing committee of HIC 2016

Keywords: Climate change scenarios; Future precipitation prediction

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1. Introduction

According to the National Institute of Meteorological Research (2009), the annual precipitation amount of the Korean Peninsula is expected to increase by 17% in the 21st century compared to 20th century. The increase of precipitation amount in August and September is expected to be large, and the spatial/temporal variability of precipitation amount is expected to be even larger, increasing the possibility of contradictory precipitation phenomena such as drought and heavy rain in certain regions [1]. The process of producing the detailed prediction of climate change in the Korean Peninsula is as follows. The Meteorological Administration and National Institute of Meteorological Research (2011) prepared the 5th evaluation report for IPCC, and to produce the detailed prediction of climate change in the Korean Peninsula, they calculated in 2012 the multi-stage prediction data of climate change in the Korean Peninsula by combining the global climate prediction model, regional climate prediction model and statistical spatial elaboration model [2].

Yeongjongdo Island and Daecheongdo Island, which are the demonstration plants of Smart Water Grid Research Group, were used as subjects for developing the program which provides the future precipitation data. The study allowed comparison by using the average year's data based on the precipitation data for the past 30 years. By comparing the data of future precipitation prediction with the average year's data of the past, the study allowed users easily judge whether the predicted precipitation amount is large or small. The classification of future precipitation data provided is shown in Table 1.

Table 1. Classification of future period and data used

Term	Precipitation data	Period
Short	Meteorological Administration's community prediction (~three days) and mid-term (10 days) prediction	Future 10 days
Medium	Meteorological Administration's long-term prediction	10 days ~ three months
Long	RCP 8.5 scenario supplementing missing data	More than three months

In this study, the precipitation data by RCP 8.5 where the concentrated emission of greenhouse has is maximized are used as the predicted amount of future precipitation. The program used in this study was Visual Studio based on C language.

2. Classification of precipitation prediction data

As precipitation data for providing short/mid/long-term prediction on future precipitation, the average year's observation data of the past, the probability prediction by Meteorological Administration, and the climate change scenarios supplemented with missing grids were used.

As data of daily unit, RCP 8.5 scenario with a grid of 1km×1km was applied with the recent administrative district map. Regarding the research on missing grids in climate change scenarios of coastal areas conducted by Park (2014), the missing grids of island areas were created. Then, the result of studying the optimal spatial interpolation method to supplement data of the missing areas was applied to supplement and use the precipitation data of missing grids [3, 4].

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