Building of Platform for Development of Integrated Model to Assess Climate Change Impacts and Vulnerability

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Abstract. Climate change, by its nature, will affect various realms such as society, economy and the environment. In this sense, it is necessary to develop technologies to assess climate change impacts that can pre-emptively consider individual fields including health, water management, forest, agriculture and ecosystems as well as accidents and disasters, and the interaction among the fields in order to analyse climate change impacts. To provide a platform for the integrated assessment models to develop the climate change integrated impacts and vulnerability assessment models and address political issues, MOTIVE (Model of InTegrated Impacts and Vulnerability Evaluation of climate change) has been conducted as a part of a national R&D project since 2014. Under the project, the study built the common DB with 101 integrated items and 1,355 layers that can be commonly used by each field and the DB utilization system, and also developed a tool that displays the results of the climate change impacts and vulnerability assessment models by field. The tool maximized convenience by providing various analysis functions such as visualization, spatial distribution, bias and schematization of the vulnerability assessment results by field. Using the platform of the DB utilization system and the resulting display tool of MOTIVE, it is possible to compare and analyse the results of the climate change impacts and vulnerability assessment models by field, which is likely to be used as an effective means of decision making in the future. This platform will serve as a foundation for building the basis upon which integrated models can be utilized to assess climate change impacts and vulnerability in the future.

1. Introduction

The fifth IPCC report forecasted that the average temperature of the earth in the late 21st century will rise by 3.7°C and the sea level will increase by 63cm if greenhouse gas emissions remain unchecked [1]. This demonstrates clearly that climate change is one of the most threatening environmental problems facing mankind and the planet and must be addressed immediately [2]. South Korea is not exempt from this phenomenon. Under the Korea Meteorological Administration’s RCP 8.5 scenario, the temperature of South Korea will go up by approximately 5.7°C compared to the present by the late 21st century and most of the nation is expected to have a subtropical climate. Climate change, which is expected to become severe, will influence and wreak serious damage on the whole of human society including areas such as personal health and industrial profit making. Therefore, it is required to develop national policies to adapt to such changes and reduce emissions by assessing in advance what kinds of harm and impacts climate change will unleash and analyse vulnerable points so that the technical means can be created to support these policies [3],[4]. The concept of vulnerability to climate change has been defined by the IPCC [3], and this definition is most commonly used [5]. Although many researchers around the world have been studying climate change impacts and vulnerability assessment models, most of the studies are about assessment technologies regarding climate change impacts in a single field [6]-[8]. Since climate change, by its nature, will impact on
various fields such as society, the economy and the environment, it is necessary to develop technologies in order to assess climate change impacts in a pre-emptive manner so that individual fields and the interaction among such fields can be analysed to accurately evaluate such impacts [9]. For this reason, research on integrated methodology to assess cross-sectoral climate change impacts, vulnerability and adaptation has been carried out globally, and some integrated assessment platforms have been developed. For example, the CLIMSAVE (Climate Change Integrated Assessment Methodology for Cross-Sectoral Adaptation and Vulnerability in Europe) project was implemented during 2010 to 2013 and developed such an integrated assessment platform for Europe [10]. The platform combines ten sectoral models, such as agriculture and forests, biodiversity, water resources, coasts, and urban development [11]-[13] and has been applied widely in climate change impacts, adaption and vulnerability assessment [14]-[15]. In the past, however, there had not been any research or technology development related to the climate integrated assessment platform in Korea. For this reason, a long-term and large-scale project named “MOTIVE (Model of InTegrated Impacts and Vulnerability Evaluation of climate change)” was launched in 2014 and is currently on going. The ultimate goal of this project is to build the Korean integrated assessment platform that can provide reliable scientific information to comprehensively assess vulnerable areas and risks that climate change will produce according to each field. To that end, the study built the impacts and vulnerability assessment models for each field such as health, water management, forest, agriculture and the ecosystem, and these models include accidents and disaster prevention. Currently, the study is seeking to build an integrated assessment platform based on the connection/integration of assessment results of each model. With regard to the first phase of this project, we focused on establishing a DB system to devise an integrated assessment model and model result display tool for project participants (Figure 1).

2. Development

2.1. Building DB system for MOTIVE

To develop a DB system for MOTIVE, a total of 620 literatures were investigated and 20 government organizations were interviewed. Based on the demand survey results, the integrated DB has been
constructed on 101 integrated items and 1,302 layers related to eight fields including health, agriculture, water management, forest and the ecosystem (Table 1). Also, we were continuing to push forward with standardization for collected DB details and material to make them easier to automate. Developing this system was performed in a web-based manner in order to share climate information from the common DB anywhere, anytime. The system was opened in April, 2016, and is expected to be constantly updated.

**Table 1. Building quantity of non-climatic spatio-temporal DB.**

| Classification       | Number of integrated items | Number of layers | Example                                                                                           |
|----------------------|-----------------------------|------------------|---------------------------------------------------------------------------------------------------|
| Health               | 38                          | 689              | Number of emergency medical institutions, people diagnosed with water-borne epidemics, etc.       |
| Agriculture          | 18                          | 96               | Apple production, rice production, soil map, etc.                                                 |
| Water management     | 3                           | 42               | Red tide occurrence data, aquatic ecology measurement data, etc.                                  |
| Forest               | 27                          | 132              | Forest type map, statistics of forest products                                                    |
| Eco-system           | 2                           | 3                | Ecological zoning map, distribution status of endangered species, etc.                             |
| Combination data     | 7                           | 33               | Land cover map, DEM, etc.                                                                         |
| Political map        | 1                           | 30               | Political map                                                                                     |
| Social economy       | 5                           | 330              | GRDP (Gross Regional Domestic Product), Energy demand, etc.                                        |
| **Total**            | **101**                     | **1,355**        | -                                                                                                 |

2.2. **Building Result Display Tool for MOTIVE**

The study developed a tool to display the results of the climate change impacts and vulnerability assessment models by field. The tool was designed to provide the DB and assessment results of the climate change impacts and vulnerability in the form of spatial information on the web. The process of the result display consisted of four stages of 1) data creation, 2) materials upload, 3) service registration and 4) view map (Figure 2). The display tool has three major functions of viewing the display data, uploading the display data and viewing map for each stage. Viewing the display data features the functions of searching data, viewing the list, and viewing and requesting the meta information. Uploading the display data features the functions of registering the meta information, selecting the coordinates, registering the legend information and registering the display data by year. The viewing map features functions including the basic functions of WEB GIS (Zoom In, Out and Pan, etc.) and split viewing the map to compare the vulnerability assessment results.
3. Results and Discussion
The study built the common DB search and download system based on the common DB, which is currently in operation. The common DB search and download system can be used by logging on to the website of MOTIVE (http://motive.kei.re.kr) and going through the following process: 1) search data, 2) request data, 3) approve data request (administrator) and 4) inquire and download the request result (Figure 3).

As shown in Figure 4, it is possible to view and compare the vulnerability assessment results by field using the functions of viewing the map and split viewing the map to find out the results of the climate change impacts and vulnerability assessment models by field, which were registered by the process of the result display tool. In particular, it is possible to compare the results of the same data by year, different data of the same year and the same points through location-based linkage based on the
compared vulnerability assessment results, and additionally view the statistical information. Therefore, it is considered that various decisions can be made using the results.

![Image](image_url)

Figure 4. An Example of Comparison of the Impacts and Vulnerability Assessment Results by Field Using the Display Tool

4. Conclusions and Future Work

We have described the platform for the integrated assessment models to develop the climate change integrated impacts and vulnerability assessment models in the MOTIVE project. In order to effectively integrate models for each field, a common DB system with 101 integrated items and 1,355 layers was constructed, and a display tool was developed that can display different results effectively for each field. The expected outcomes and effects of the developed platform are as follows. The expected effects on the policy are development of foundation for efficient national climate change adaptation policy and minimizing mal-adaptation by prioritizing based on scientific analysis. On the industry and economy, this platform supports international support to developing countries via ODA and increasing employment of professional manpower and excavation of new industries for climate change adaptation. Moreover, it can provide scientific grounds for integrated management technology of climate change adaptation and national risk management system for climate change. In the future, more meaningful functions will be developed to establish an integrated assessment platform by connecting and integrating the assessment results of each model.

5. Reference

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