Development and Evaluation of High Resolution Climate System Models

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Preface

Climate system model (CSM) is an attempt to encapsulate everything we know about the Earth System, which involves the atmosphere, hydrosphere, geosphere, cryosphere, and biosphere, along with all of the interactions and feedbacks involved. The CSM has been an irreplaceable tool that gives us a way of understanding the overall climate system—the past, present, and future climate change, and the performance of the CSM has been an important objective criteria to evaluate the nation's response capability for climate change. Therefore, developing the CSM to improve capability of climate simulation and climate projection is one of the most significant research areas in global change studies over the world.

However, the climate system is a complex system and hence the CSM is also highly complicated. Uncertainties of the CSM are everywhere. The more complex a model, the more factors it takes into account, and the more uncertainties it includes. Currently, three critical scientific tasks to enhance capabilities of the CSM are increasing the complexity of CSMs to encapsulate everything we know about the Earth System, increasing resolutions to produce global climate predictions at weather-resolving scales with lead times of several decades, and decreasing uncertainty to provide more accurate simulations of present climate and more credible and reliable predictions and projections of future climates.

The development of CSMs in China has a solid foundation and long-term accumulations. However, there are still significant gaps compared with developed countries. In recent years, high resolution models have been developed in many countries. With the ability to distinguish events and processes with finer spatial and temporal scales, high resolution climate models have exhibited great potential for large improvement in model performance. Taking into account that the climate of China is significantly modulated by the complicated topography, there are urgent needs to develop our own high resolution CSM with focus on the complex climate conditions in eastern Asia and the Western Pacific.

With the support of major national scientific research projects on Global Changes, the project "Development and validation of high resolution climate system model" was carried out in 2010, which aimed to shorten the gap between China

and developed countries in climate modeling science through organizing a group of distinguished scientists and engineers to build a high resolution CSM of China. After nearly 5 years of hard work and perseverance, we have made encouraging progress: a high resolution CSM has been established which has exhibited some advantages in climate simulating, especially over East Asia; an evaluation and validation system for high resolution climate modeling has been set up which contains a series of innovative criteria focusing on specific features of East Asian climate; an interactive ensemble coupled platform has been built to enable the flexible application of model components and a thorough analysis of their interactions. The major achievements of the project will be introduced in the following parts of this book.

As the Chief Scientist of this project, I greatly acknowledge the support from the Ministry of Science and Technology of China. I also express my great appreciation to all the members of this project for their hard work, dedication, and commitment in these years.

Rucong Yu

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