【Grant-in-Aid for Specially Promoted Research】

Science and Engineering (Engineering)

Title of Project： New frontiers in global hydrology

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Research Project Number：16H06291　Researcher Number：50221148
Research Area：Global hydrology
Keyword：Hydrology, Integrated hydrological cycles and water resources model

【Purpose and Background of the Research】

The field of global hydrology today has certainly evolved and established itself nearly three decades after Bras et al. (1987) led the call for greater prominence. Current hydrology has a capability to monitor, understand, and predict global hydrological cycles of social-ecological systems, combining both human and natural systems.

The purpose of this project is to develop fundamentals for Terrestrial Model in the Next Generation (TiMiNG), which enables millenary global 1km simulation and should be a flag ship of global hydrology for coming 20 years.

【Research Methods】

This project will develop a new terrestrial model in the next generation (TiMiNG) based on the hydrodynamic river model CaMa-Flood (Yamazaki et al., 2011), combining water and energy cycles represented in a land surface model MATSIRO (Takata et al., 2003), water isotope processes (Yoshimura et al., 2006), human interventions of H08 (Hanasaki et al., 2010), glacier mass changes (Hirabayashi et al. ,2013), and a global deep ground water (Koirala et al., 2014), with a comprehensive representation of the expansion and shrink of water surface of lakes, river surface including flood inundation for surface water and energy cycles. TiMiNG will have a capability to couple with general circulation models (GCMs) or Earth System models (ESMs) through appropriate couplers, and a flexible structure to incorporate various terrestrial processes, such as redistribution of soil moisture and ground water by sub-grid scale topography, water temperature, glacier, sediment cycles, and long-range transfer.

In parallel with the development of TiMiNG, 4 sets of numerical experiment will be challenged under this proposal in order to solve the current issues in global hydrology and preparing for the forthcoming 1 km global simulation for 1000 years.

1) Real-time 1 km simulation over Japan
2) Hyper-resolution simulation over the Aral Sea Basin in Western Asia for 50 years
3) Hyper-resolution simulation over the globe for one year
4) 250 years simulation from 1850 through 2100 (under the 3rd phase of the Global Soil Wetness Project; GSWP3)

【Expected Research Achievements and Scientific Significance】

With TiMiNG, it is expected that community development of terrestrial modeling would be much easier and smooth, and up-to-date knowledge on terrestrial processes will be reflected promptly. Also, leading and managing the GSWP3 and Land Surface, Snow, Soil-moisture Model Inter-comparison Project (LS3MIP) in the CMIP6 will evaluate the state-of-the-art modeling systems and generate a comprehensive set of quantities for global energy, water and carbon cycles, which is necessary to increase the depth of our understanding of the global hydrology.

【Publications Relevant to the Project】

Oki, T., and S. Kanae, 2006: Global Hydrological Cycles and World Water Resources, *Science*, **313**(5790), 1068-1072.

Hanasaki, N., S. Kanae, T. Oki, K. Masuda, K. Motoya, N. Shirakawa, Y. Shen, and K. Tanaka, 2008: An integrated model for the assessment of global water resources - Part 1: Model description and input meteorological forcing, *Hydrol. Earth Syst. Sci.*, **12**, 1007-1025.

Yamazaki, D., S. Kanae, H. Kim, T. Oki, 2011: A physically based description of floodplain inundation dynamics in a global river routing model, *Water Resour. Res.*, **47**(4), W04501.

【Term of Project】

FY2016-2020

【Budget Allocation】

340,700 Thousand Yen

【Homepage Address and Other Contact Information】

http://hydro.iis.u-tokyo.ac.jp/