【Grant-in-Aid for Scientific Research (S)】

Broad Section K

Title of Project： Pan-Arctic Water-Carbon Cycles

HIYAMA, Tetsuya
(Nagoya University, Institute for Space-Earth Environmental Research, Professor)

Research Project Number：19H05668　Researcher Number：30283451
Keyword：global warming, Arctic sea ice retreat, atmospheric-terrestrial water cycle, permafrost degradation, greenhouse gases

【Purpose and Background of the Research】

Recent global warming accelerates Arctic sea ice retreat, which derives significant changes in atmospheric-terrestrial water cycle in the Arctic and pan-Arctic regions. Because spatiotemporal variations in emission (or absorption) of greenhouse gases are largely dependent on surface water and vegetation conditions over the terrestrial land surfaces, for better understanding and for better future projection of water-carbon cycles in the pan-Arctic region, it is necessary to conduct an integrated study on atmospheric-terrestrial water-carbon cycles in the region.

The purpose of this research is to integrate atmospheric-terrestrial water and carbon cycles in the pan-Arctic region. We firstly integrate atmospheric- and terrestrial-water cycle models which can calculate spatiotemporal variations in the atmospheric moisture transport, moisture flux convergence, precipitation, vegetation condition, permafrost degradation, and river discharge over the Arctic and pan-Arctic regions, with important boundary conditions of the Arctic sea ice extent. We finally produce spatiotemporal maps of water-covered area, vegetation condition, and fluxes of greenhouse gases. We mainly focus on Northern Eurasia because there are very limited data on the fluxes of greenhouse gases in the region.

【Research Methods】

To achieve above-mentioned goals, we firstly develop a water traceable integrated model (WTIM), based on a water vapor tracer model and a coupled hydrological and biogeochemical model. Then we produce spatiotemporal maps of water-covered area and vegetation condition in Northern Eurasia, using satellite remote sensing data and WTIM products with the help of spatiotemporal data fusion technics. Finally, we estimate spatiotemporal maps on the fluxes of greenhouse gases over Northern Eurasia using a biogeochemical model (Figure 1). To validate the maps, we will continuously measure fluxes of greenhouse gases at eastern Siberia and northern Mongolia.

This study consists of four groups: terrestrial observation group, terrestrial modeling group, atmospheric research group, and integration group. The four groups strongly collaborate each other. We will also organize international scientific symposiums (or workshops) in the research period, and will co-produce our scientific outcomes with Siberian and Mongolian researchers.

【Expected Research Achievements and

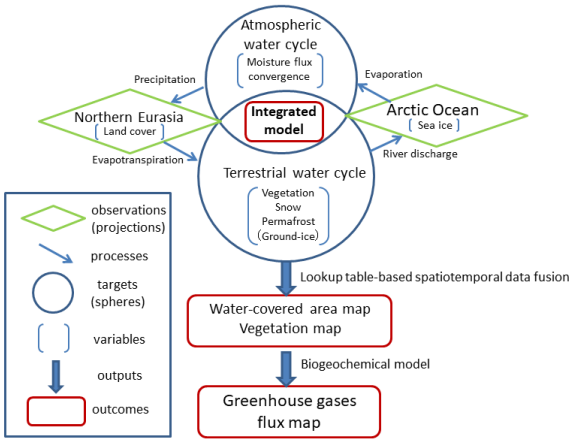

Figure 1 Flowchart of this research

Scientific Significance】

This study can reduce uncertainty of the biogeochemical model, and contribute to better understand water-carbon cycles in the pan-Arctic regions. We also contribute to better understand polar amplification in the Arctic and pan-Arctic regions.

【Publications Relevant to the Project】

Hiyama, T. and Takakura, H. (eds.): Global Warming and Human-Nature Dimension in Northern Eurasia. Global Environmental Studies Series, Springer, 224pp, 2018, https://doi.org/10.1007/978-981-10-4648-3

Ohta, T., Hiyama, T. et al. (eds.): Water-Carbon Dynamics in Eastern Siberia. Ecological Studies, 236, Springer, 309pp, 2019, https://doi.org/10.1007/978-981-13-6317-7

【Term of Project】

FY2019-2023

【Budget Allocation】

154,700 Thousand Yen

【Homepage Address and Other Contact Information】

http://www.isee.nagoya-u.ac.jp/en/index.html
hiyama@nagoya-u.jp