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

Broad Section K

Title of Project： Assessment on climate impacts of short-lived climate forcers by composition and region with hierarchical numerical models

TAKEMURA, Toshihiko
(Kyushu University, Research Institute for Applied Mechanics, Professor)

Research Project Number：19H05669　Researcher Number：90343326
Keyword：short-lived climate forcer, climate model, climate change, air pollution, aerosol

【Purpose and Background of the Research】

Particulates (aerosols) such as PM2.5 and trace gases such as ozone in the atmosphere are both air pollutants and Short-Lived Climate Forcers (SLCFs). Although the United Nations Intergovernmental Panel on Climate Change (IPCC) has made quantitative assessments of imbalance of energy budget, i.e. radiative forcing, for each of the SLCFs, it has not assessed specific climatic changes such as temperature and precipitation.

In this project we quantitatively evaluate the climate change due to SLCFs by composition and region using the climate models developed by the research team. We also aim for a quantitative understanding of the impact of SLCFs on disasters such as extreme temperature and precipitation that have become apparent in recent years.

【Research Methods】

The following are climate and meteorological models of various spatiotemporal scales used in the project that can calculate transport processes and climate effects of SLCFs (Figure 1).

> MIROC-SPRINTARS/CHASER: A climate model which simulates the basic global climatic conditions with a horizontal resolution of several tens of km combining SPRINTARS, which calculates processes related to aerosol, and CHASER, which calculates detailed chemical reaction processes. MIROC-SPRINTARS is also used in the PM2.5 forecast, which is widely available to the general public daily.

> NICAM-Chem: A climate/meteorological model which calculates global atmospheric conditions expressing cloud processes explicitly with a horizontal resolution of 3.5/7/14km combining SPRINTARS/CHASER for calculating the climate effects of SLCFs.

> SCALE-LES: A meteorological model with a horizontal resolution of tens to hundreds of meters that can directly handle cloud processes, which is used for obtaining he knowledge to improve the expression of clouds in climate models.

In the calculations using these climate models, the emission amount related to each SLCF is perturbed, and the changes in the meteorological field such as temperature and precipitation are analyzed. At that time, the calculations are carried out while refining the cloud and precipitation process through improvement of the expression of aerosol-cloud interaction and introduction of a method to prognose raindrops and snowfall.

【Expected Research Achievements and Scientific Significance】

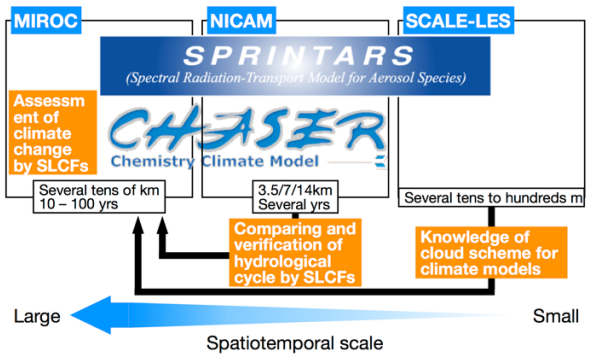

Figure 1　Hierarchical numerical models in this project.

It will create the new research area on an unresolved problem of quantitative impact assessment of climate change by SLCFs through this project in which the atmospheric physics on clouds and precipitation is combined with the atmospheric chemistry. It is an advantage that research can be promoted with understanding the mechanism of the climate impact of SLCFs obtained at the development stage of the numerical models developed by members of this research team themselves. It is expected to make concrete recommendations on mitigation of both climate change and air pollution, which are major international environmental issues.

【Publications Relevant to the Project】

Takemura, T. and K. Suzuki: Weak global warming mitigation by reducing black carbon emissions. Sci. Rep., 9, 4419, doi:10.1038/s41598-019-41181-6 (2019).

Suzuki, K. and T. Takemura: Perturbations to global energy budget due to absorbing and scattering aerosols. J. Geophys. Res., 124, 2194-2209, doi:10.1029/2018JD029808 (2019).

【Term of Project】 FY2019-2023

【Budget Allocation】 153,900 Thousand Yen

【Homepage Address and Other Contact Information】

https://www.riam.kyushu-u.ac.jp/climate/indexe.html