

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

Integrated Disciplines (Environmental Science)



Title of Project : Understanding the interaction between ice sheets, ocean and atmosphere under large scale climate changes of the past

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Research Project Number : 17H06104 Researcher Number : 30272537

Research Area : Environmental science, Environmental dynamic analysis

Keyword : environmental change, paleoclimate modeling

【Purpose and Background of the Research】

During the past 1 million years, there were glacial-interglacial climate cycles with periodicities of around 100,000 years. We have, for the first time, used a full scale numerical model to simulate the glacial cycles of the past 400,000 (Abe-Ouchi et al, 2013). We now extend our experiments to cover the past 1.5 million years to elucidate the processes leading to ice sheet collapse, the interaction with the global climate and the cause of the transition of the periodicity from 40,000 to 100,000-years. Using an atmosphere-ocean coupled climate model, we challenge to propose the mechanism of the millennial scale climate change, such as Dansgaard-Oeschger oscillation, B/A and Younger Dryas events. Another important issue that needs to be addressed is whether abrupt climate changes are the cause or effect of deglaciation.

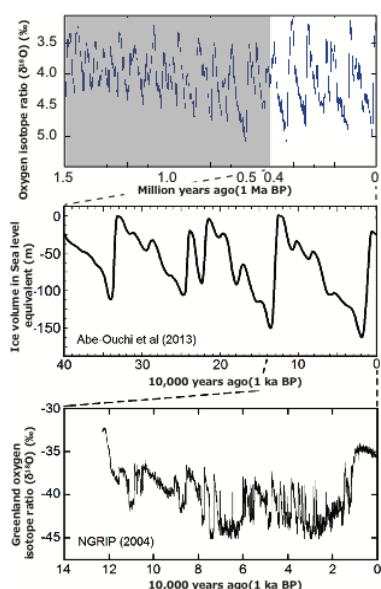


Figure 1 Glacial cycles of the past 1.5 Million years

【Research Methods】

We will carry out various numerical experiments to simulate the climate and ice sheets by using coupled atmosphere-ocean, ice sheet and vegetation models, with orbital parameters and greenhouse gas levels as model input. We will use ocean

biogeochemical and isotope-incorporated models to compare with paleoclimate data and validate climate model results. Changes in the periodicity of the glacial cycle, changes in the climate, ice sheets and ocean during the Last Glacial Termination, reproduction of the millennial scale abrupt climate changes and prerequisites for these changes to occur will be investigated.

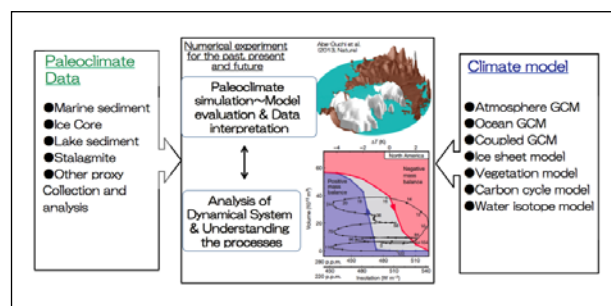


Figure 2 Outline of research

【Expected Research Achievements and Scientific Significance】

Various sensitivity experiments with climate models should yield temporal and spatial reconstructions of air temperature, precipitation, ocean circulation, ice sheet and vegetation distribution, ocean biogeochemical state, and a better understanding of the mechanisms involved. Clarifying the mechanisms behind glacial climate change by carrying out long-term simulation, while also establishing a research base to systematically tie model and data through international cooperation together presents an opportunity to contribute to the science of past-to-future climate.

【Publications Relevant to the Project】

- Abe-Ouchi, A. et al. (2013), *Nature*, 500, 190-193, doi:10.1038/nature12374.
- Kawamura et al (2017), *Science Advances*, 3, e1600446, doi:10.1126/sciadv.1600446.

【Term of Project】 FY2017-2021

【Budget Allocation】 157,600 Thousand Yen

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