

Proposal to the master plan 2020: Promotion of Scientific Research on Climate and Earth System Sciences Using Aircrafts

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This research plan is the proposal to the Master Plan 2020 of the Science Council of Japan by the Meteorological Society of Japan jointly with the Japan Society of Atmospheric Chemistry, and the Japan Society for Aeronautics and Space Sciences as a fusion study between engineering and atmospheric science with the use of unmanned aerial vehicles for earth observation. This proposal is supported by 10 societies such as the Japan Geoscience Union (Atmospheric and Hydrospheric Sciences Section). This proposal is selected as one of priority areas (16 new themes).

The purpose of this research is to promote climate and earth system science research across all earth science fields, including the atmosphere, ocean, vegetation, snow and ice, and the solid earth, by introducing Japan's first aircraft dedicated to earth observation.

Changes in the global environment, including global warming, are progressing rapidly, and are exerting a great influence on human economic and social activities and the basics of life such as water and food supply. However, in order to understand the behavior as a system of climate and environment (fluctuation of macroscopic amount), it is indispensable to understand the microscopic amount and elementary processes such as the concentration of greenhouse gases, the particle size and chemical composition of clouds and aerosols. It can be said that various fields of earth science face this scale gap problem in common. Only aircraft observations can measure micro quantities of less than 100m, including wide areas and altitude distributions, which cannot be captured by satellites or ground-based observations. In other words, aircraft observation is a means of obtaining an entirely new insight of observation, instead of increasing the accuracy of conventional observation. This research aims to a paradigm shift in the earth sciences field to realize the understanding of climate and earth system behavior based on the understanding of microscopic quantities and elementary processes by aircraft observation. With an emphasis on aircraft observations, we aim to establish an integrated earth science framework that crosses the fields of the atmosphere, ocean, land vegetation, snow and ice, and the solid earth. In particular, we will conduct observational research focusing on Asia and the Arctic region, which are gaps in aircraft observations, even as rapid environmental changes become apparent.

Until now, there has been no aircraft dedicated to earth observation in Japan. No systematic aircraft observations were carried out in Asian region even Japan has been leading observation technology. In order to take advantage of Japan's strengths, this study will introduce Japan's first aircraft dedicated to earth observation, based on a joint use system that enables researchers in a wide range of fields to use aircraft from a long-term perspective and establish a researcher-centered operation system. Through long-term operation (10 years), systematic observations and research on important themes in earth science will be achieved with innovative results, as well as strategic equipment development and human resource development. For observation, we will rent Gulfstream-IV class jets aircraft owned by private companies for exclusive use. Furthermore, the use of unmanned aerial vehicles, which have undergone rapid technological progress in recent years, will be strongly promoted.

As for the implementation organization, the Center for Orbital and Suborbital Observations, Institute of

Space-Earth Environmental Research, Nagoya University, will be the operating base of the joint use. The ownership and operation of the aircraft is outsourced to a private company. In addition, JAXA will provide support for the flight technology. In this research, the Aircraft Observation Promotion Committee, consisting of researchers from all over the research fields of atmosphere, ocean, terrestrial ecosystem, snow and ice, earthquake and volcano, will be established to support observational research. In the planning of this plan, 22 academic societies contributed for establish a 224-page research plan.

This research also aims to contribute to the society of disaster prevention and mitigation by improving the accuracy of typhoon forecast and torrential rainfall and understanding the mechanism of disasters such as floods. Through such research, we aim to contribute to the United Nations' SDGs and Future Earth.

Keywords: Climate change, Aircraft observation