

Promotion of Scientific Research on Climate and Earth System Sciences Using Aircrafts

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The aim of this proposal is to promote climate and earth system research in the area of atmospheric science, oceanography including sea ice, glaciology, volcanology and ecology by a dedicated aircraft observation system.

In its annual guidelines in 2013, the Working Group for Earth Observation Promotion, Subdivision on Research Planning and Evaluation, Council for Science and Technology of MEXT summarized critical scientific issues for understanding of the global change. These include circulation and budget of the greenhouse gases, cloud and precipitation processes, changes in tropospheric species, climate change in polar regions, and changes in water circulation. The necessity of establishing well-organized aircraft observation system for conducting long-term research of the global change is also mentioned. In-situ measurements by state-of-the-art instruments on board aircraft provide accurate data for estimating key parameters with high temporal and spatial resolutions, which lead to improve our understanding of the critical processes.

The expected research area in which a breakthrough is achieved with aircrafts is the mechanism of the changes in climate and earth system. The climate change, especially the global warming, is caused by changes in the earth radiation balance due to greenhouse gases such as carbon dioxide. On the other hand, aerosols are known to work to suppress the global warming but remain the most uncertain factor on the radiation balance. Response of clouds is also known to be the most uncertain factor of the climate system to the global warming. Changes in heavy rainfalls and typhoons under the global warming are also urgent issues. Since Japan has been leading the world by the sophisticated numerical modeling and the satellite observations, synergetic use of the aircraft observations with them will lead great progress of research in this area. Furthermore, Asian region remains an observational gap of aircrafts though it is the "hotspot" of aerosols including PM2.5 and greenhouse gases and most frequently experiences strong tropical cyclones, so that Japan's contribution and leadership of the aircraft observation in this region is highly anticipated. Unfortunately, among the advanced countries in the world, Japan is the only country that does not have a research aircraft dedicated to the earth sciences, which is the motivation for making this proposal.

The aircraft which we think most suitable for our research is the Mitsubishi Regional Jet (MRJ) since it has enough space to simultaneously equip several observational instruments and it can be relatively easily refurbished for equipping the instruments by taking advantage of the domestic production. The cost of the aircraft will be about 6 billion yen and the operational/maintenance cost will be about 1.2 billion yen per year.

Having an aircraft for exclusive use for earth sciences has great advantages for both types of researches which requires long-term monitoring such as greenhouse gases and agile observations of hazardous events such as typhoons, heavy rainfalls and volcanic eruptions.

The Center for Orbital and Suborbital Observations, Institute of Space-Earth Environmental Research, Nagoya University will lead the program in the framework of the "Joint Usage/Research Center (JURC)". A JURC steering committee that consists of specialists of each research area from various organizations will be responsible for the research and operational plan.

A number of international organizations, organizations and universities of foreign countries sent us supporting letters expressing great expectation of our proposal such as Japan's leadership of the aircraft observation in Asian region and international cooperation in climate system studies and

typhoon observations over western Pacific. Moreover, high precision observations of greenhouse gases by aircraft are becoming increasingly important to realize the Paris Agreement of COP21.

Keywords: Climate, Earth system, Aircraft observations, Ecosystem, Oceans, Volcano