

# Establishment of Unmanned aerial vehicle systems for Earth system sciences in the polar region

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## 1. Preface

Innovation of automated vehicle systems, including unmanned aerial vehicle, is very active, now. Governments also have been establishing new social systems to accept UAV innovations in our life. Polar science is one of the most suitable field to apply UAVs. Recent UAV experiments by Japanese Antarctic Research Expedition (JARE) are shown and we will also show the advantage and possibility of UAV system for polar sciences.

## 2. Advantages of UAV for Earth System Science and requirement of organization

Unmanned aerial vehicle, so called Drone, include Multi rotors, solid wing plane, para foil plane, rogallo plane, and so on. They are kinds of airplanes, even though no one ride on them. If one UAV loses its lift, it will descend and cannot keep control. Risk of UAV is larger than that for unmanned ground vehicles and water vehicles. Many scientist hope to use UAV, however most of them hesitate to use it because of fears.

Experiment with safe and successful observation and establishment of UAV operation organization will provide peace of mind to many scientists and extend application range of UAV for research of earth system sciences.

## 3. Type of plane for UAV system

There are many kind of plane employed for UAV system as shown in Figure 1s. Each planes have advantage and disadvantage. For example, a solid plane can cruise fast and resist strong wind but require long flat runway, Multi rotor UAV can hold its position in 3-D coordinate but difficult to fly long period, and so on.



Figure 1 UAVs operated by JARE around Syowa station  
a solid wing plane (left), a Rogallo wing plane (center), and a multi rotor plane (right)

## 4. Developments of unique UAV system by JARE

Scientific program of JARE have been developing pioneering UAV systems. Some of them are shown as Figure 2, balloon borne gliding platform (left) for observations in upper troposphere and stratosphere, canard plane (center) for long range (1,000km) observation, and tethered kite for fixed point observations without power.



Figure 2 Unique UAV systems developed and applied by JARE  
balloon borne Kite Plane (left), long range canard plane (center), tethered kite (right)

## 5. Summary

We hope for new UAV sciences to be activated by many scientist and engineer, under arrangement of National Institute of Polar Research (NIPR).