Atmospheric aerosol observation system that used unmanned airplane

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We have attempted to develop an unmanned radio control airplane system for in-situ observation of aerosols that it was economical and the time resolution is high in the upper atmosphere. A present object is practical use of the observation of composition, size distribution and the particle concentration of the aerosols up to 3 km a.s.l.. Here, it presents on the introduction of the observation system and the situation of the present stage on development together with animation.

Our observation system on development is composed of the platform (unmanned airplane), the installing instrument and the ground station.

In the platform, an unmanned radio control airplane, called Kite Plane, is used. It is developed for video camera platform and other industrial purposes. In the specification for the aerosol observation model, its payload is 5 kg.

The installing instrument is the OPC (Optical Particle Counter) that measures particle concentration and size distribution, sampler for the particle collection and transmitter that transfers the data to the ground. The OPC developed for the Kite Plane observations has two detection optical systems with different angle for the scattered light collection, called MAC (Multi-Angle optical particle counter). The MAC build into the barometer, the thermometer, and the hygrometer, and its weight is 3 kg. All these data is sent to the ground through the transmitter. Moreover, The MAC is developed to estimate the complex index of refraction in which the size distribution obtained from two detection optical systems is used. This is being researched now. The radiosonde for the meteorological observation is used for the transmitter. The transmission frequency is 404 MHz, and weight is 200 g. A light sampler, 1 kg weight, is also developed for Kite Plane observation. It is two stage impactor with 50% cut off diameter of 2.0 and 0.2 micro meter. 16 sample sheets can be set in each stage. The sampler is controlled from the ground by the radio control system. It is planed that samples are analyzed by microprobe methods, using micro-Raman spectrometer, electron microscope, SEM-EDX e.t.c.. The ground station is composed of transmitter and receiver for the radio wave sending and receiving, and the PC for the data recording.

Test observations were done during 14 days in total to investigate the flight characteristic of Kite Plane, to get the test data of installing instrument and to examine the influence of the measurement data by the vibration. The place where the altitude was different was chosen, and it was done 1-5 times a day and one flight was taken about 30-90 minutes. As a result, it succeeds the observation of the particles concentration, temperature and humidity from the point where the watching control can be done up to 2.6km in the a.s.l.. Some observations of high time resolution of five times a day were able to be done. Some vertical distributions up to the lower free troposphere were obtained. The top in the mixed layer, and the boundary between the boundary layer and the free troposphere was caught from observation. From these results, I think that the aerosol observation with Kite Plane enables the examination of the development process of the mixed layer and of the aerosol exchange process of between the boundary layer and the free troposphere.

At the present stage, the observation up to 3km a.s.l. from the range where the watching control can be done is practical use. For the control of the range where the watching control cannot be done, the autopilot system is being developed in the SKYREMOTE company which produces Kite Plane.