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New phase remote sensing stimulated by the use of airborne observation

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Center for Environmental Remote Sensing (CEReS), Chiba University, is processing, archiving, and disseminating satellite data and related ground observation data to wide communities in remote sensing and environment-related areas. In the field of atmospheric remote sensing, we have established a radiometer network (SKYNET), which contributes to satellite data validation through characterization of atmospheric aerosols and clouds in East Asia. Also, the radiometer data are valuable for studying air pollutants due to anthropogenic activities when coupled with data from lidar and high spectral resolution spectroradiometer observations. Quantitative analysis of global biomass can be implemented by means of vegetation remote sensing. Methodology for obtaining highly accurate vegetation reflectance has been sought using satellite- and ground-based observations, as well as directional observation using unmanned helicopters. This approach has been exploited for developing an algorithm to be used for GCOM-C1, JAXA's next-generation satellite. In the field of microwave remote sensing, sensors based on circularly polarized synthetic aperture radar (CP-SAR) technique have been developed for both small satellites and unmanned aircraft applications.

Currently a new cooperative study plan is being discussed among university research institutes/centers based on chartering a manned airplane for scientific observation purposes. Through this initiative, it is expected that atmospheric science and climate system studies (University of Tokyo), cloud and precipitation system studies (Nagoya University), as well as high-level scientific application of remote sensing data (Chiba University) will be promoted. The primary goal of CEReS activity will be to achieve highly accurate remote sensing of vegetation, snow and ice fields, and coastal areas through the realization of high-precision atmospheric correction of satellite data, which would have been impossible without resorting to aircraft observation.

As more and more high resolution satellite data are becoming available, needs are growing for high-precision retrieval of physical quantities such as land or ocean surface reflectance. The largest obstacle for this improvement is the spectral changes due to atmospheric scattering and absorption. The influence of air molecules (Rayleigh scattering) can be corrected relatively easily. In contrast, correcting the effects of clouds and aerosols (Mie scattering) tends to be much more difficult, due to their temporal and spatial variability. Conventionally, network observation using a number of sunphotometers and skyradiometers has been implemented for measuring the optical properties of atmospheric aerosols and clouds. Also helicopter and unmanned air vehicle (UAV) measurements have been undertaken covering altitude ranges lower than 150 m above ground. Still, it is difficult to carry out the validation of satellite remote sensing imagery over an extended region.

The aircraft project currently under discussion will enable the measurements of radiation quantities and surface reflectance from high altitudes. The radiometer and hyperspectral camera measurements from both unmanned (low altitude) and manned (high altitude) platforms will allow us to improve radiative transfer algorithms indispensable for high-precision atmospheric correction. This, in turn, will contribute to dramatically improving the accuracy of algorithm for estimating biomass amount based on reflectance measurements. In addition, all-weather and both day- and nighttime surface observation can be demonstrated by equipping the CP-SAR instrumentation.

Keywords: remote sensing, airborne observation, vegetation, atmosphere, microwave sensor