Temporal variation of cloud structure by spectral imaging of Saturn in visible and near infrared spectral ranges using LCTF

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It has been considered that patterns appearing in Saturn's surface are caused by ammonia clouds in the troposphere, although we can't directly look into the interior structures of atmosphere because Saturn is covered with thick clouds like as Jupiter. The patterns on Saturn's surface should be produced by differences of cloud top altitudes and physical properties of cloud particles. It has been suggested by ground-based observations that altitudes of clouds and physical properties of cloud particles show temporal and spatial variations. However, there are some limitations of observations: for example, only specific wavelength ranges for imaging and some time to scan planetary disk for spectroscopy. In order to acquire information on whole disk of Saturn at more wavelengths, we have observed reflectivity of solar light on Saturn's surface at 71 wavelengths with 5nm step in visible and near infrared spectral ranges (650-1000nm) in a short period (about 15min) using the 60 cm reflector optical telescope at Iitate observatory, Fukushima, Japan, operated by Tohoku University, and liquid crystal tunable filter (LCTF) in 2005-2007.

We investigated temporal variations of cloud altitudes and physical properties of cloud particles, comparing our results with similar previous observations reported by West et al. (1982) and Ortiz et al. (1993). In order to obtain information on cloud top altitudes, we calculated ratios of methane absorption band to continuum to remove scattering effects. It is considered that methane is about the same altitude distribution everywhere in Saturn's atmosphere. No difference of ratios (890nm/935nm) at upper cloud altitudes was seen between our results and past results, while ratios (725nm/750nm) of our results were higher than that of past results at lower cloud altitudes. It seems that lower cloud altitudes have moved upwards on decadal scale. This would imply seasonal variation of Saturn's atmosphere. In order to obtain information on physical properties of cloud particles, we examined trends of ratios of continuum (680,750,830nm) to continuum (935nm) as a function of latitude. Trends of our results were not similar to that of past results at all and this trend has changed in short period (2005-2007). These mean scattering properties of aerosols have changed not only in decadal scale but also in short time.

We have to consider many contributing factors which are not only acquired parameters by observation but also density and composition of atmosphere and radius of aerosol etc to quantify cloud top altitudes and scattering properties. There are some doubts whether solutions obtained by results of imaging at limited wavelengths and many assumptions of parameters are uniqueness or not. Hence, we will make use of advantages that we can acquire images at multi-wavelengths to develop new scheme of constrained radiation transfer. We will estimate dynamics of Saturn's atmosphere by obtaining detailed space structure of cloud top altitudes.