Ground-based multispectral observation of Saturn in visible and near infrared light

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Storms occur regularly on Saturn's surface. Large storms called as Great White Spots (GWSs), which develop about ten times larger than regular storms (300 - 3000 km in diameter) and GWSs exist during a few months. Previous occurrences of GWSs are identified six times, and GWSs occur about once per Saturnian year (29.5 Earth years). GWSs occur in early summer of northern hemisphere, therefor, a relationship between Saturnian season and GWSs is suggested [Sancehz-Lavega and Battaner, 1987]. On the other hand, latitude of GWSs are different at each timen namely, varying from 5 N to 58 $^\circ$N. GWS's cloud top altitude is estimated by comparison between observed reflectivity of Saturn's surface in three methane absorption bands (619, 727, 890 nm) and results of radiative transfer calculation of cloud structure model. GWSs' reflectivity represent vertical cloud structure and haze and cloud particle informations. Therefore, observations of GWSs' reflectivity in several wavelengths is important for study about GWSs' development and depression. The last storm was detected on 5 December 2010, earlier than expected timing inferred from previous storm period by about ten years. The storm happened as a visible bright spot on northern latitude of 37.7 degrees, and two weeks later, it's west-east size expanded 15,000 km. About two months after, it encircled the planet. Cassini spacecraft observed the storm with high spatial resolution [Sanchez-Lavega, et al., 2011] and a ground based telescope observed [Snaz-Requena, et al., 2012] in two months development period. Cassini's observation proposed that cloud top altitude was ˜0.15 bar. However, there are no report of the GWS's observation in depression period after February 2011.

In this study, we observed the last large storm appeared in 2010 by spectral imaging in visible and near infrared (400 - 1000 nm) range in the depression period, May and June 2011, and observed Saturn in no storm period, February 2012. These observations used Multi-Spectral Imager (MSI) and a ground-based 1.6 m PIRKA telescope operated by Hokkdaido University. MSI, which uses two Liquid Crystal Tunable Filters (LCTF) and an EM-CCD, was developed in Hokkaido University. MSI enables us to capture spectral images at many wavelengths in a short time period. We get spectral image data of the storm, in the wavelength range of 400 - 1100 nm with FWHM of 5 - 10 nm, at 180 colors on 5 May 2011. Additionally, on 6 June 2011, we observe Saturn in three methane bands at 88 colors, and on 18 February 2012 we observed in same wavelength region at 9 colors. We derived latitudinal variation of Saturn's spectrum in visible and near-infrared. Methane absorption bands were confirmed and the rough shape of the spectrum is consistent with past observations [ex. Karkoschka, 1994]. And center-limb profile of spectrum at same latitude may provide characteristic of scattering, because of less longitudinal variation of spectrum. In addition, we investigated the latitudinal variation of Saturn's absolute reflectivity in three methane absorption bands observed on 5 May and 6 June. In these datas, a relative reflectivity in 727 nm slightly changed In about a month. This period is fading phase of this GWS. Therefore detection of an absolute reflectivity variation at the latitude of the GWS leads to a fading speed information of the GWS. Comparison between image data of storm existing period (May and June 2011) and those of no storm period (February 2012) suggested the change of haze particle characteristic.