木星積乱雲の発生頻度と分布の地上観測
Ground-based observations of distribution and intermittency for Jupiter's cumulonimbus.

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From Galileo spacecraft observation, it is suggested that the zonal jet is created by coupling small-scale eddies made by the vertical convection that involved cumulonimbus [Gierasch et al., 2000].
The Jupiter's zonal wind that creates the Belt and Zone is studied by simulations to explain zonal jet's formation mechanism including this hypothesis.
However, these simulation models are not enough to reveal them.
We don't know the actual value of intermittency and distribution of cumulonimbus.
It is necessary to compare the cumulonimbus's intermittency and distribution with wind velocity to verify this hypothesis.
The final goal of our study is to reveal the formation mechanism of the zonal jet.
In our study, we observe the Jupiter by using methane absorption band filters installed 1.6 m Pirka telescope to reveal the cumulonimbus's intermittency, distribution and lifetime.

In this presentation, we introduce the observational result by ground-based telescope from Jan to June in 2017.
We observed the 619nm, 727nm, 756nm, and 889nm filters installed at Multi-Spectral Imager (MSI) (pixel scale = 0.39 arcsec/pix) of the 1.6 m Pirka telescope.
In our observation, we estimate the existence of cumulonimbus by using the relationship that high cloud top appears as a bright point because the sunlight reflected at cloud top before it is completely absorbed by Jupiter's atmosphere.
We operated the Principal Component Analysis (PCA) to identify the position of cloud whose cloud top altitude is high like a cumulonimbus.
PCA is used as image processing way to extract the patterns from images that obtained by some wavelengths.
For our observation data, the high cloud top altitude point is extracted in the resolution of one pixel.
From the simulation, the intermittency of cumulonimbus would be about 5-100days [Sugiyama et al.,2014].
So, we tried to operate the observation once in a few days and, we achieved to operate the observation total 61 times.
The interval of observation ranged from successive days to over one week.
The average seeing is about 3.0 arcsec.
From these observation result,
we find the high cloud top altitude point as a possible candidate of cumulonimbus at about latitude -11° and system III longitude 120° on April 20th, 2017.
These observation conditions were 2.16 arcsec, equal to about 5000km spatial resolution on Jupiter, and observation covered region was from system III 90° to 180°.

Compared with the amateur images that obtained the same day, it is confirmed that the white and bright pattern appeared at that same coordinate position.
We observed Jupiter once in every three days from April 20th to the next couple of weeks.
However, we couldn’t detect the bright point from data when observed June 17th, 2017.
Compared with the amateur images, we couldn’t confirm the bright and white point around that position.
From these results, the lifetime of a possible candidate of cumulonimbus at about latitude -11° and system III longitude 120° is shorter than two months.
From the Galileo spacecraft observation, cumulonimbus is found in latitude near 50° in both hemispheres [Little et al.,1999].
However, from our observation result, the number of the possible candidate of cumulonimbus’s point is low at latitude from 45° to 55°.
We couldn’t distinguish the signal of a bright point that size is smaller than spatial resolution, about ~5000km on Jupiter, from noise because the peak value of brightness was defeated by the atmospheric turbulence and then the brightness various was not reached the detectable value.
For the future work, we will observe using the ground-based telescope with aperture diaphragm mask to improve the average seeing equal to 1.5 arcsec.
And then, we will analyze them to find the cumulonimbus’s position and existence more accuracy.

Acknowledgment:
The author deeply appreciates to Mr. Yasuhiko Murakmi and other staffs of Nayoro observatory for their kind help for observation.

キーワード：木星、積乱雲、対流、地上観測、雷雲
Keywords: Jupiter, cumulonimbus, convection, ground-based observation, thunderstorm