かぐやで観測された5MHz帯での月表面アルベドの全球分布

熊本 篤志 [1]; 中川 広務 [2]; 小野 高幸 [3]; 小林 敬生 [4]; 春山 純一 [5]
[1] 東北大・理・地球物理; [2] 東北大・理・地球物理; [3] 東北大・理・地球物理; [4] KIGAM; [5] JAXA

Global mapping of the lunar surface albedo at 5 MHz observed by Kaguya

Atsushi Kumamoto[1]; Hiromu Nakagawa[2]; Takayuki Ono[3]; Takao Kobayashi[4]; Junichi Haruyama[5]
[1] Dept. Geophys, Tohoku Univ.; [2] Geophysics, Tohoku Univ.; [3] Dept. Geophys., Grad. Sch. Sci., Tohoku Univ.; [4] KIGAM; [5] JAXA

Global mapping of the lunar surface albedo in at 5 MHz has been investigated based on the data obtained by Lunar Radar Sounder (LRS) onboard the Kaguya (SELENE) spacecraft. Usually radar sounder detects not only the subsurface echoes but also the surface echoes. In order to identify the subsurface echoes, it is needed to understand the characteristics of the surface echo components, which are to be excluded correctly. Understanding of the off-nadir echo is especially important because they are usually observed in the same range bins with those of subsurface echoes. It is well known that the surface echo power depends mainly on the surface roughness, and secondarily on the permittivity of the surface. So it is also expected that we can discuss the global distribution of the roughness and the permittivity on the lunar surface based on the global map of the surface echo power. Therefore, we have investigated the global distribution of the nadir and off-nadir surface echo power based on the Kaguya Lunar Radar Sounder (LRS) data.

The global distributions of the nadir and off-nadir echoes in a frequency range of 4-6 MHz were derived from the Kaguya/LRS dataset. The Kaguya spacecraft moved along the polar orbit with an altitude of about 100 km. In order to achieve enough range resolution, Kaguya/LRS transmitted chirp pulse with a chirp rate of 2MHz/200usec. The transmission power of Kaguya/LRS was 800 W. The echo power and range to the reflector can be obtained by Fourier analysis of the echo waveform after mixing with local chirp signal [Ono et al., 2010]. In most cases, it is easy to identify the nadir surface echoes: They are earliest and most intense in the radargram. It is however considered that the echoes observed after the arrival of the nadir surface echo consists of various components such as off-nadir surface echoes, volume scatters, and echoes from the subsurface reflectors. In the present analysis, we assumed that the main part of those echoes was off-nadir surface echoes.

In addition, we have also derived the global distribution of the surface roughness parameters, such as Hurst exponent, from the digital terrain model (DTM), which is built based on the Kaguya Terrain Camera (TC) data. The surface roughness can be characterized by RMS slope, or Allan deviation of the surface height. If we assume the self-affine fractal surface model, the RMS height is given by parameters such as Hurst exponent. The surface echo power can be calculated by the radar equation. Assuming Kirchhoff Approximation (KA), the backscattering coefficient, which is needed for calculations of the radar equation, can be obtained from the roughness parameters [cf. Franceschetti et al., 1999; Shepard and Campbell, 1999; Bruzzone et al., 2011].

Based on the comparison between observed and estimated surface echo powers, we could identify the enhanced permittivity regions in western part of Mare Imbrium, and the eastern part of Oceanus Procellarum, which are considered to be associated with ilmenite abundance on the lunar surface. In presentation, we will also report the analysis results in the polar region, and estimation of total reflectance of the Moon for Earth-Moon-Earth (EME) communication experiment.