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An improved lunar gravity field model using same-beam VLBI data of SELENE (Kaguya)

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The SELENE has completed its mission on June 2009. During the mission period, we have successfully collected tracking data of three satellites of SELENE; main orbiter (Kaguya), relay sub-satellite (Rstar) and VLBI sub-satellite (Vstar). The tracking data include 2-way range, 2-way Doppler, 4-way Doppler, and differential VLBI. The 4-way Doppler data have provided us new information on the gravity field of the lunar farside, which resulted in a new global lunar gravity field model SGM100h (Matsumoto et al., JGR Planets, in press). The gravity field model will further be improved by incorporating differential VLBI data between Rstar and Vstar.

Since the range and Doppler data densities are rather sparse for Rstar and Vstar, additional VLBI data improve the orbit consistencies of the two sub-satellites. As a result, the farside gravity field can be further improved because the orbit of Rstar serves as a reference for tracking Kaguya via 4-way Doppler. The low-degree gravity coefficients will also improve by taking longer (> 1 week) arc length for Rstar and Vstar which have relatively high mean orbital altitudes.

Results using 13 months of same-beam VLBI data with 1-week arc are presented. Initial results show better orbit consistencies and higher correlations between gravity and topography in the farside. J2 and C22 can be checked through computation of moments of inertia. There are four constraints (J2, C22, beta, gamma) on three parameters (A, B, C) and we have four different solutions for the three principal moments of inertia. Their self-consistency can be an index of accuracy of gravity coefficients. We will discuss whether the current strategy with VLBI data can improve the self-consistency of the moments of inertia.

Keywords: Moon, SELENE(Kaguya), artificial satellite tracking, gravity field, same-beam, VLBI