Assesment of KAGUYA (SELENE) Lunar Gravity Field Models

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On September 14, 2007, the KAGUYA (SELENE) spacecraft were launched from Tanegashima Space Center in Japan. KAGUYA consists of three satellites: a main orbiter in a 100 km by 100 km circular, polar orbit, and two small subsatellites in 100 km by 2400 km (Rstar) and 100 km by 800 km (Vstar) el-liptical, polar orbits. Until now, tracking of lunar satellites consisted of 2-way (or 3-way, where the up- and downlink stations are different) tracking data, leaving a gap in the tracking coverage over the far side of the Moon as the satellite cannot be tracked there from Earth. This severely hampers the determination of the global lunar gravity field, and, consequently, this also puts limits on the precision of orbits of lunar satellites.By employing 4-way Doppler tracking between the main orbiter and Rstar, the first direct track-ing data of a satellite over the far side have been obtained, resulting in a newly determined global lunar gravity field. The existing 2-way tracking data set is furthermore complemented by precise differential VLBI tracking between Rstar and Vstar, providing a sensitivity perpendicular to the line-of-sight from station to satellite.

This work focuses on analysing the tracking data from the Kaguya satellites for the main purpose of lunar gravity field estimation and precise orbit determination. Gravity models from Kaguya data are evaluated in terms of data fit and performance in orbit determination. Results for including altimetry crossovers in the orbit determination of the Main satellite are also presented. The performance of the differential VLBI data in the orbit determination of the small subsatellites is also discussed, as well as their contribution to the gravity solutions. Finally, concerning the gravity field itself, updated results for the polar moment of inertia C/MR2 from the degree 2 coefficients, and for the lunar k2 Love number are also included.