



Gravity Fields of the Moon Derived from GRAIL mission Data

Frank G. Lemoine (1), Sander Goossens (2,1), Terence J. Sabaka (1), Joseph B. Nicholas (3,1), Erwan Mazarico (4,1), David D. Rowlands (1), Bryant D. Loomis (5), Douglas S. Chinn (5,1), Gregory A. Neumann (1), David E. Smith (4,1), and Maria T. Zuber (4)

(1) NASA GSFC, Planetary Geodynamics Lab., Greenbelt, MD, United States (frank.g.lemoine@nasa.gov), (2) CRESST/University of Maryland, Baltimore County, Baltimore, MD, U.S.A., (3) Emergent Space Technologies Inc., Greenbelt, MD, U.S.A., (4) Massachusetts Institute of Technology, Cambridge MA, U.S.A., (5) SGT Inc., Greenbelt, MD, U.S.A.

The Gravity Recovery and Interior Laboratory (GRAIL) spacecraft conducted the mapping of the gravity field of the Moon from March 1, 2012 to May 29, 2012, for the primary mission and from August 30, 2012 to December 14, 2012 for the extended mission. During both mission phases, the twin spacecraft acquired highly precise Ka-band range-rate (KBRR) intersatellite ranging data and Deep Space Network (DSN) data from altitudes of 3 to 94 km above the lunar surface. During the extended mission, the spacecraft orbits were maintained at a mean altitude of 23 km, compared to 50 km during the primary mission. In addition, from December 7 to December 14, 2012, data were acquired from a mean altitude of 11.5 km. With these data, we have derived solutions in spherical harmonics to degree 900, as well as local solutions over regions of interest such as Orientale. The new gravity solutions show improved correlations with LOLA-derived topography to very high degree and order and resolve many lunar features in the geopotential with a resolution of less than 15 km. We discuss the methods we used for the processing of the GRAIL data, and evaluate these solutions with respect to the derived power spectra, Bouguer anomalies, and fits with independent data (such as from the low-altitude phase of the Lunar Prospector mission). We also evaluate the prospects for development of solutions to degree 1080 with GRAIL data.