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Global seismic waveform modeling in the whole Moon

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We calculate global seismic wave propagation on cross sections of the realistic whole Moon models.

The U.S. Apollo missions installed five seismometers on the lunar surface. Seismograms obtained during 1969 to 1977 have widely been used for investigation of the lunar interior. For example, many researchers have been working on construction of the 1-D structure models (e.g., Nakamura, 1983, *JGR*; Garcia et al., 2011, *PEPI*). Zhao et al. (2008, *Chinese Sci. Bull.*) further estimated the 3-D velocity structure of the Moon by applying seismic tomography to the moonquake traveltime data.

Now the Japanese next lunar mission "SELENE-II" is planning installation of broad-band seismometers, which are expected to greatly increase resolution of the lunar interior images. Looking back on investigation history of the Earth's interior, our knowledge has been enhanced by mutual progress of observation and numerical methods. Increased enthusiasm for the Moon exploration in recent years strongly requires developing a method for numerical modeling of global seismic wave propagation based on our current knowledge of the lunar interior.

We have been constructing numerical schemes using the finite-difference method (FDM) for accurate and efficient modeling of global seismic wave propagation through realistic Earth models with lateral heterogeneity (e.g., Toyokuni et al., 2005, *GRL*; Toyokuni & Takenaka, 2006, *EPS*). Our scheme calculates the 3-D equations of seismic waves in spherical coordinates only on a 2-D cross section of the whole Earth including a seismic source and receivers ("spherical 2.5-D FDM"), which enables global waveform modeling with a similar computation time and memory as for 2-D modeling with consideration of full 3-D geometrical spreading. This time we apply it to model global seismic wave propagation in the whole Moon. In the presentation, we will show some numerical examples using models by Nakamura (1983, *JGR*) and Garcia et al. (2011, *PEPI*).

Keywords: Moon, seismology, seismic wave propagation, synthetic seismogram, global modeling, finite-difference method (FDM)