# Modelling the Effect of Plate Subduction and Superplum on Seismic Wave Propagation in 2-D Cylindrical Whole Earth Model

# Yanbin Wang [1], Hiroshi Takenaka [2], Takashi Furumura [3]

[1] Dept. Earth and Planetary Sci., Kyushu Univ., [2] Dept. Earth & Planet. Sci., Kyushu Univ., [3] Hokkaido Univ. Edu.

We investigated the effect of descending slab and upwelling superplum on wavefield by modelling seismic wave propagation in 2-D cylindrical whole earth model.

The pseudospectral method is used to solve the elastodynamic equations in 2-D cylindrical coordinate. The singularity arises at the center of the earth is avoided by extension of field variables in radial direction. A multidomain scheme (Takenaka & Wang, 1999) is used to increase the time interval to make the calculation for the whole earth model to be implemented on a general computation resource.

The algorithm is applied to the PREM model including descending slab and upwelling superplum. Variation of wavefield caused by the slab and plum is studied by the amplitudes and arrival times of several phases on the synthetic seismograms.

In last two decades, the global scale tomography study has revealed the details of the seismic velocity structure of the earth's interior, which helps us to understand more about the earth's dynamics. Forward modelling of seismic wave propagation in global scale is important tool to constrain the models obtained by tomography. We simulated the seismic wave propagation in 2-D cylindrical whole earth model including descending slabs and upwelling superplum, and tried to investigate the effects of these global scale structures on the seismic wavefield.

We adopted the pseudospectral method (PSM) to solve the elastodynamic equations in 2-D cylindrical coordinate. The model and wavefield are defined in the angular

and radial directions, and the derivatives of wavefield are approximated by using the fast Fourier transform in both of the directions. When we solve the 2-D cylindrical elastodynamic equations for whole earth, singularity arises at the center (r=0) of the earth. To avoid this singularity, we develop a new scheme that uses extension of field variables in the radial direction. Wavefield at the center and the wave propagation through the center can be calculated by this scheme.

The time interval used in the calculation must be chosen according to the smallest grid spacing in the grid. In cylindrical coordinate system, the smallest grid spacing is located around the center in the angular direction that is much smaller than the grid spacing in the radial direction. Generally, the smallest angular grid spacing around center is so small that the calculation is too time consuming to be carried out. To overcome this problem, we adopt a multidomain scheme (Takenaka & Wang, 1999) to increase the smallest angular spacing and increase the time interval that is large enough to enable us to perform the calculation for the whole earth model on a general computation resource.

The algorithm is firstly applied to the PREM model in a 2-D slice of the whole earth, and then we include the descending slab and the upwelling superplum structures into the model. The variation of the wavefield caused by the slab and plum is studied by investigating the amplitudes and arrival times of several phases on the synthetic seismograms on all the surface of the 2-D cylindrical earth.