Introduction

For many teleseismic questions it is far more important to be able to model realistic frequencies (e.g., 0.001 Hz for body waves) than variations of the seismic parameters and the wave field in full 3D. Some points of interest are: diffraction at the CMG, teleseismic effects from subduction zones and scattering within the mantle caused by small scale heterogeneities.

To solve the elastic wave equation on a teleseismic scale, an axi-symmetric finite difference (FD) scheme was applied. To be able to model additional regional 3D structure without the restriction to axi-symmetry, a combination of the axi-symmetric scheme (3Dms) and a scheme for 3D spherical sections (3D) was performed.

One advantage of the FD method compared to other methods is that it can be used without modifications to model the Earth's crust. The use of an appropriate grid is crucial for the stability of the scheme. In order to fill the earth model with grid points a discretization in polar coordinates is used. To avoid instabilities of the algorithm due to the decreasing grid spacing towards the center,

The Grids:

- **SH-Case**
- **PSV-Case**

**Axi-Symmetry:**

**Verification:**

Figure 7 shows the wave field of an SH source located at the symmetry axes for a homogeneous medium. The source depth was set to 1000 km. The depth is not realistic for real earthquakes, but avoids high-amplitude surface waves which would suppress the body waves in the snapshots. The dotted region at the source, where the body waves penetrate the spherical section where full 3D modeling is performed. The arrows denote the direction of wave propagation. For this special case, the wave field is constant along the direction of the snapshot. Note that the orientation of the axes is different from Figure 6.

**Regional 3D structure:**

As a final 3D structure a cylindrical low-velocity body was centered in the spherical section. The size of the 3D section is 1000 km, the cylinder's length is 770 km and the diameter is 200 km. The 3D model size is 701 points. The dominant period is 50 s. The velocity contrast was set to 50% in order to produce prominent reflection and conversion effects in the snapshots. The figures above and on the right show different velocity components in different cross sections through the center of the 3D section. The amplitudes of all snapshots are drawn to scale. Above, the u component, which is equivalent to the SH motion in the axi-symmetric case, is shown. The strong velocity contrast leads to diffraction and smaller wave lengths inside the cylinder. On the right, the a component and 4-component, which are the non SH components, shown. For a pure axi-symmetric model or an additional homogeneous 3D section these components would be zero.