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A numerical study of mantle flow around a junction using a new subduction zone model in three-dimensional sphere

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Sear-wave splitting is one of the useful tools to constrain the direction of mantle flow and by using this, the three dimensionality of mantle flow, especially in subduction zone, has been revealed. Among these studies, one seismological study recently shows that at a junction around northeast Japan and southwestern Kurile, the fast direction of observed shear-wave splitting in the back-arc side is sub-parallel not to the direction of surface Pacific plate motion but to the local-maximum dip direction of the subducting Pacific slab. It may suggest the existence of mantle return flow in that direction.
In this presentation, we focused on mantle flow in a junction and examined it using a newly developed subduction zone model in three-dimensional spherical shell geometry. This new model may require less computational effort to achieve subduction like features. In this model, velocity is imposed on the top surface and in a small three-dimensional region around the shallow plate boundary while below this region, the slab is able to subduct under its own weight. Surface plate velocities are given by Eulers theorem of rigid plate rotation on a sphere. The velocity imposed in the region around the plate boundary is determined so that mass conservation inside the region is satisfied. Trench migration can be easily incorporated in this model.
We performed a preliminary calculation using the similar situation to a junction around northeast Japan and southwestern Kurile. The result shows that in the shallow part there is mantle return flow perpendicular to the plate boundary, which is consistent with observed shear-wave splitting in this area.

Keywords: junction, three-dimensional spherical geometry, shear-wave splitting