**Sedimentary Basin Amplification in the Seattle and Tacoma Basins: Constraints from Local Earthquakes and 3D Simulations**

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Sedimentary basins have been shown to increase the intensity of ground motions and duration of shaking during earthquakes. To characterize sedimentary basin effects within the Seattle and Tacoma basins in Washington state, we analyze Pacific Northwest Seismic Network and U.S. Geological Survey strong motion recordings of five local earthquakes (**M**3.9-6.8), including the 2001 Nisqually earthquake. We also perform ground motion simulations using a finite-difference method and a 3D velocity model specific to Cascadia, to compare observed and synthetic waveforms up to a frequency of 1 Hz. In the recorded data, amplification of ground shaking is apparent in the Seattle basin for all of the earthquakes analyzed, and for a subset of events in the Tacoma basin. To place quantitative constraints on basin amplification, we compute the spectral ratios of inside-basin sites to outside-basin sites at 1-, 2-, 3-, and 5-seconds period. We observe basin-edge generated surface waves at sites within the Seattle basin for most ray paths that cross the Seattle fault zone. We also note basin-edge surface waves in the Tacoma basin during one of the local earthquakes, which has not been previously documented. The velocity model does not reproduce basin-edge effects in the Tacoma basin. We also note a large late phase following the S-wave in some synthetic waveforms, not observed in recordings, from one event west of the Seattle basin and one event west of the Tacoma basin. The lack of basin-edge effects in the Tacoma basin and the large late phase may suggest that the 3D velocity model along the western boundary of the Puget Lowland needs to be improved. We find that the largest amplification factors, larger than predicted by simulated data (see Figure), in the Seattle basin are produced by the shallow earthquake located to the west. The shallow depth and location of this event relative to the Seattle basin suggest that crustal and megathrust earthquakes may produce greater basin amplification than intraslab events.

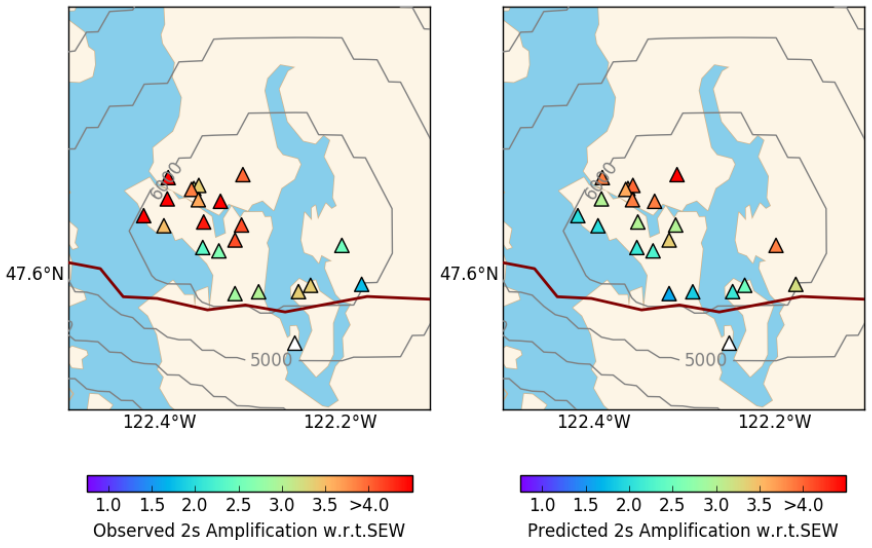


***Figure:*** *Observed (left) and predicted (right) amplification factors at 2 s period in the Seattle basin from a shallow earthquake west of the basin. Triangles are seismic stations, with colors representing amplification relative to a reference site outside of the basin (i.e., SEW, white triangle). Red line is the Seattle fault. Contours represent the depth to 2500 m/s shear-wave velocity in the Cascadia velocity model.*