Research Interests

One of my research interests involves studying rupture properties of large earthquakes by using data from seismic arrays. I study large magnitude earthquakes (more specifically mega-thrust earthquakes) to investigate how the rupture initiates and progresses along a fault plane during an earthquake. I use back-projection technique to search for rupture properties (rupture velocity, duration, short period seismic radiation, etc.) and their relationship with the stress drop, slip distribution across the fault zones (Sufri et. al, 2012; Koper et. al, 2012; Lay et. al, 2010; Xu et. al, 2009). One main advantage of this technique is that there is no need for prior information (such as rupture velocity, and fault dimensions) in terms of processing the data. Another advantage is the initial back-projection results could help to compute more precise finite fault models and because of the speed of the technique, it could help emergency management agencies for responding to disaster areas in a short period of time.

My current research interest involves processing large seismic array data to study ambient seismic noise generated by the ocean waves. Ambient seismic noise is becoming one of the most interesting topics in Seismology. There are two contributing factors to this trend. First, the seismic noise is used in tomography studies for imaging the shallow earth structure. Researchers in tomography use seismic noise sources to fill in the gaps in the earthquake tomography results. The theory in these studies assumes diffusive noise field and if anisotropy in the noise field is present the computed Green's functions could be biased. One way to reduce this biasing problem is determining more precise locations of noise sources. The second reason of studying seismic noise is to understand the atmosphere-ocean-solid earth interaction. It was shown in previous studies that past ocean wave activity and the ocean- climate could be derived from the historic seismic records. Locating and tracking the seismic noise sources could enhance the studies related to effects of climate change on oceans. In a recent study, we have tracked and determined the locations of microseismic sources generated during the passage of Sandy by extracting the polarization attributes from the seismic data (Sufri et. al, 2013). We also compared our results to computed daily averages of the power spectral density of the equivalent pressure generated by the ocean surface gravity waves using the WAVEWATCH-III ocean wave model. One other important observation we made was a possible presence of Love wave particle motion during the passage of Sandy. I have also analyzed and cataloged ambient noise sources recorded by the Earthscope Transportable Array during 2009. I have determined duration, power, and the dominant periods of these recorded microseisms and compared with the 3-hour averages of the power spectral density of the ocean gravity waves using WAVEWATCH-III ocean wave model (in progress). Future studies will involve back-projecting the azimuths obtained from polarization analyses in order to produce precise location of the noise sources. Currently, there is a debate if the double frequency microseismic (3-8 sec) sources are generated close to coastlines or in deep oceans (Atlantic and Pacific). Although the comparison of power spectral densities of the ocean surface gravity waves from ocean wave models to the seismic signals contributes to noise source location, the back-projection will help to enhance the precision of microseism locations. I also plan to generate synthetics from ocean wave spectra to estimate displacement along the paths between stations and noise sources and finally invert for Q values in order to see how lithology is affecting the wave propagation of ambient noise. The modeling will also help in understanding how and where the Love waves are generated. Since Love waves are constructive interference of SH waves, a better understanding of source mechanism may shed light on generation of SH waves from the ocean waves.