Five years ago, the NEES (Network for Earthquake Engineering Simulation) program of the NSF re-instrumented the Wildlife Liquefaction Array (WLA), an earthquake detection site located just south of the Salton Sea and East of San Diego. As part of this site update, several new instruments were installed at a location near the existing site. Six downhole accelerometers were installed at different depths at this site. Downhole accelerometers are used to help understand how different layers of the earth respond to earthquakes. This is important when trying to design buildings that are capable of surviving earthquakes.

At the new WLA site, five traditional downhole accelerometers were installed at depths from 3 to 100m below the surface. These sensors are installed by drilling a hole into the ground and then placing a rigid PVC pipe into that hole (Top Left). The casing is necessary to allow maintenance and repairs to be made to the sensors that are lowered into the holes. In addition to the five traditional (rigid) casings, one flexible casing was also installed (Top Right). This flexible casing was installed at the same location and depth (5.5m) as one of the rigid casings so that a study could be conducted on the differences between the data recorded by each tube.

This is the first time that the influence of rigid PVC casings on strong ground motion recordings has been investigated. I began working on this study in February as a research project for a writing class using a small data set from February 2008. In May, I learned that I had been awarded the SCEC Internship at UCSB, my home institution, and would be able to continue looking into the differences in the data that has been collected by the sensors in these two different casings. In June, we obtained an excellent data set that we are analyzing. We are now looking at a large data set (40 events above magnitude 3.0) of aftershocks from the M5.7 Ocotillo earthquake of 6/15/2010. The figure below shows the vertical accelerations from the Ocotillo mainshock that were recorded in the two 5.5m holes at WLA.
It is very difficult to see if those two records are different. Because of this, we must perform some simple analysis techniques. By using these techniques we are able to produce the image below. This image is a ratio of the two acceleration plots above in the frequency domain, instead of the time domain. If the data coming from the two different types of casings were identical the image below would be a straight line of value one. It is clear that the data coming from the casings is not identical. At this point in the study, we are doing more to characterize how the rigid casing influences the accelerometer recordings. Once this is determined, it is possible that our current understanding of how the ground moves during an earthquake could be further improved and changes could be made so that our buildings are even more earthquake resistant.

References: