2007 SCEC Annual Report:
SCEC Portable Broadband Instrument Center
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Summary:

The SCEC portable broadband instrument center (PBIC) program at UCSB provides a resource for focused seismic experiments in southern California. These experiments promote student involvement and can be conducted with greater flexibility and shorter lead times than is possible through the IRIS PASSCAL program. In addition, the ability to respond immediately to a major California earthquake with the deployment of portable stations is a primary objective of the PBIC program.

The PBIC equipment has contributed to a number of important results over the years, including analyses of fault-zone guided waves, aftershock seismicity studies, site response analysis studies, building response studies, and detailed images of crustal velocity structure derived from the LARSE refraction profiles. Through support of local experiments in southern California the PBIC continues to support research and provide students and researchers with experience using seismic equipment to collect their data. The 2007 PBIC research activities included supporting a deployment along the Superstition Hills Fault Zone and the continued deployment of some of the PBIC CMG-40T broad band sensors within the southern California Network.

In addition, undergraduate students also participated in PBIC activities throughout the past year. These students participated in the field deployment of equipment and have become invaluable in keeping up with the regular routine maintenance of equipment at the UCSB lab facility.

2007 Superstition Hills Fault Project Support

This experiment has been the testing ground for the two new PBIC stations that have real-time capabilities. The deployment of these real-time stations in this rather remote location is a great success for the PBIC. In 2007, two of the older style stations were replaced with the two new “network” ready stations. Data from these stations is transmitted in real-time to the Caltech/USGS regional network monitoring, and is used help improve the location of earthquakes in this seismically active region. The use of 6-channel real-time stations also provides the three-component strong-motion channels for use in shake map production in the event a significant earthquake strikes the region and the weak-motion channels go off scale.

The data from this deployment is then available via the usual tools from the SCEC data center, providing the project PI with instant access to the experimental data with no post processing! The data is also thus also available to the whole research community for immediate use. Phase picks provided by the network analysts are available via the SCEC data center as well as the waveforms through the data centers STP interface. The significance of this test was that in the event of a major southern California earthquake, a similar deployment of “network ready” portable stations would provide data back in real-time, improving the aftershock locations and potential shake maps made from the larger aftershocks, as well as providing the research community with instant access to the aftershock deployment data. With the older generation instruments, it normally take months to get to the point where the aftershock deployment data released via the PBIC web site, since the data must be retrieved from the sites, and post processing must be completed once the data is recovered.

Integration of PBIC real-time stations to CISN

As mentioned above, the data from the PBIC stations deployed along the superstition hills fault zone are integrated directly into the network processing at Caltech/USGS in Pasadena. As an example of this we show a M1.6 event from October 27, 2007 located in the region as seen by CISN display software in Figure 2. The corresponding waveforms used by the analysts to locate this event can be seen by clicking the waveform products page on CISN display. Figure 3 shows the waveforms, of these two real-time PBIC stations along with the other network stations in the region. Note that these are being treated just as if they were permanent network stations.

The routine processing of wavefoms that are integrated into the data center, such as the "ZY" stations shown in Figure 3 (ZY is the network code assigned to portable deployments in southern California) include the phase picks made by analysts as they improve on the automatic locations of the real-time systems. These phase picks for the PBIC portable stations end up archived along with the waveforms in the data center for use by any interested researcher. The impact of not having to post process data from stand-alone stations, combined with the immediate availability of data to project PI's and the research community in general will hopefully provide the justification and incentive to upgrade the older generation PBIC equipment in the future. In addition, the state-of-health information from the real-time stations also saves significant cost in the maintenance of the stations as you know when a stations is working and when it's not, and the status of power and temperature and other environmental variables related to the operations of the site.

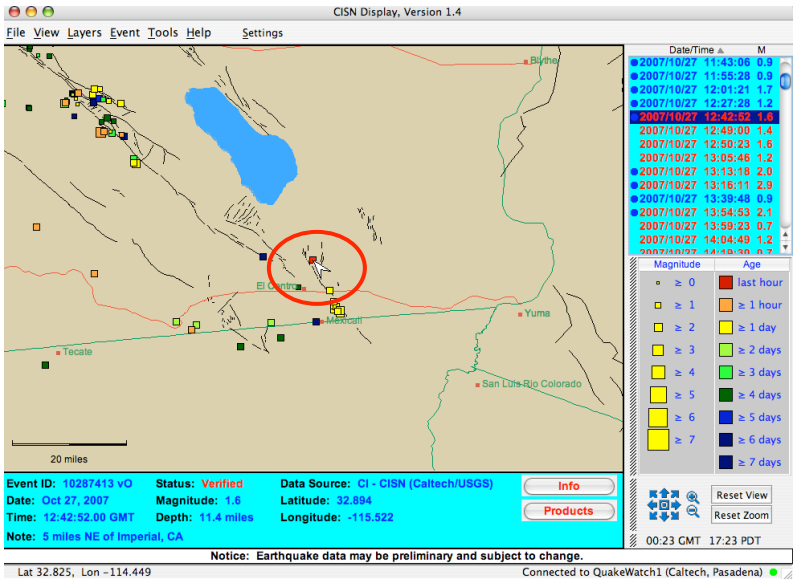

Figure 2. M1.6 event ~17km SE of the SCEC PBIC portable stations deployed along the Superstition Hills Fault as seen through the CISN Display software.

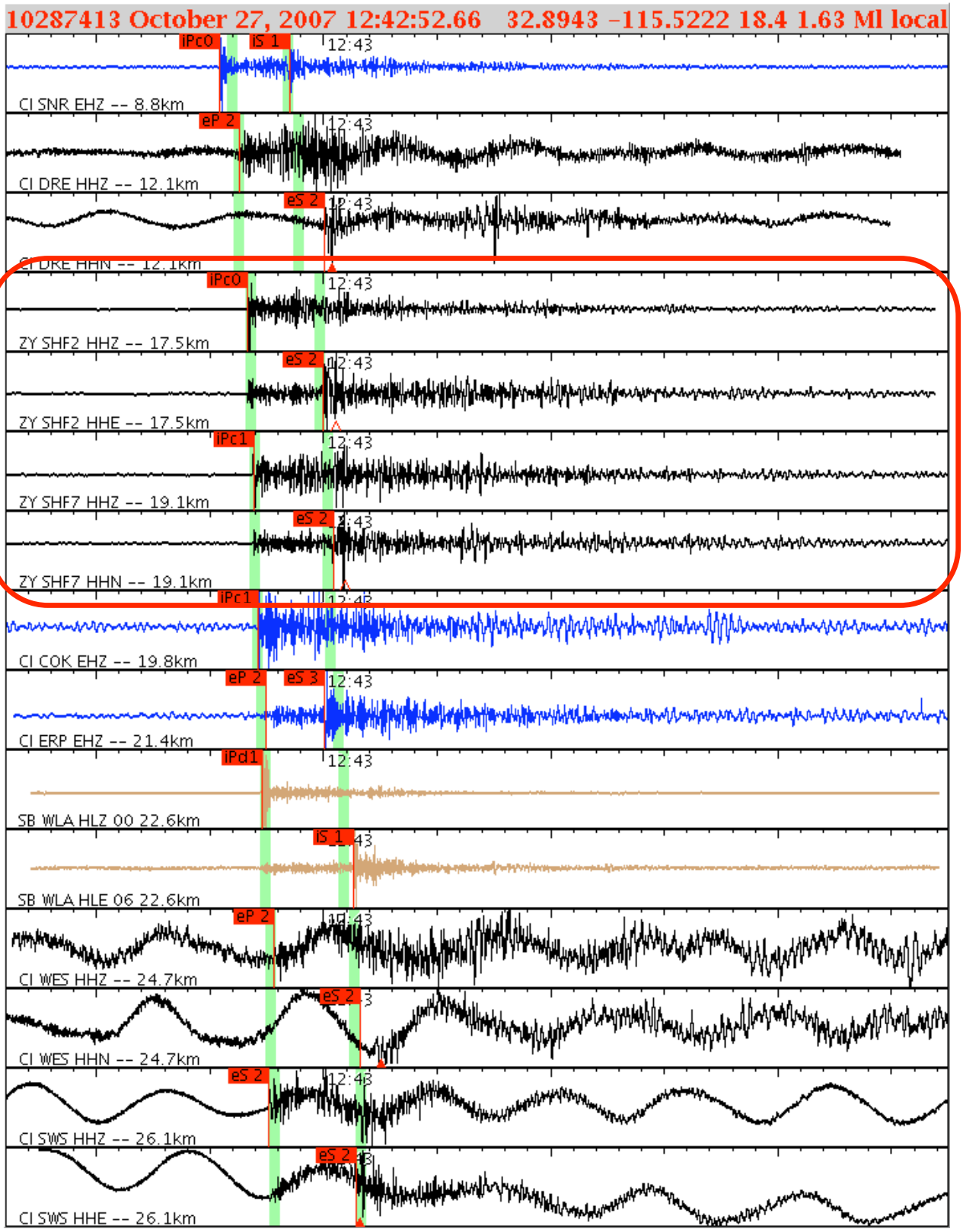

Figure 3. Waveforms products from the SCEDC including data from PBIC stations.

Web page updates

Based on comments from the previous years proposal review we have updated the PBIC website to provide more direct links to the information that appeared to be missing to some of the reviewers, including the current use and availability of PBIC equipment. While this information is actually stored in an online database that is updated whenever equipment comes into or leaves the PBIC facility, it was not linked from the main PBIC page, so users previously had to search for it. We've now put links to this information on the PBIC main page. In the next year we plan to update the web page to also include the past project reports.

Maintenance of PBIC Equipment

The majority of the SCEC PBIC DAS's (along with the semi-permanent loan IRIS PASSCAL instruments) are now ~15 years old and while recent deployments have shown that these instruments can still provide very useful data, they do require regular attention and maintenance in order to ensure that they are ready for deployment in the event of a significant earthquake. The undergraduate students are the main source of labor for taking care of these maintenance tasks. In 2007, we have started to maintain a pool of instruments in constant 24/7 operation in the lab. This has helped with troubleshooting some of the problem stations, which need more "personal" attention. In the past, we have only put the DAS's on power for 24 hours once per month. Now, by keeping at least 10 of the systems always in operations, and swapping these systems in and out each month, we have a pool of dataloggers that is even more prepared for the next significant event.

The PBIC pool of large external batteries must also be put on charge regularly to ensure that they remain topped off and ready to go in the event of a significant earthquake in the region. One of the undergraduate student assistants is assigned the weekly task of swapping the battery chargers across the pool of batteries to maintain a float charge on all batteries. Over the course of a month, each of the batteries is swapped at least once into and out of the charging systems.

Once again all of the GPS units had to be upgraded to new firmware as RefTek had finally corrected its "week jump" problem that was firmware related. This involved opening up each of the timing receivers yet again to replace the firmware chips on the internal boards. Significant effort went into developing post-processing software that would fix the data being collected by the DAS's in the field that had GPS clocks with this firmware bug. This software was then used as an additional step in processing the data once it was returned from each field visit to the stations. In 2007, we also set up a permanent GPS antenna on the roof of the PBIC lab building, with a GPS repeater inside the lab, so that when we operate the stations continuously in the lab for testing and maintenance, we can also confirm that the instruments GPS clocks are locking. We now no longer have to test in a field deployment to ensure that firmware fixes actually work!

Updating the PBIC web accessible equipment database as equipment is serviced, or moves in and out of the lab is also part of the routine operations of the PBIC. This ensures that any researchers interested in using equipment have an idea for what instruments are available and working at any point in time. In the past year there were comments from the reviewers of the PBIC project that there was no way to tell the usage of the PBIC equipment. The web-based inventory contains the numbers of instruments being used on each project. An example of the web inventory can now be found by clicking the "PBIC online database" link directly from the PBIC home page. (http://projects.crustal.ucsb.edu/scec/pbic/)