TX-ESP and BC-ESP: A Collaborative Educational Seismology Project in Texas and New England

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Abstract

There is growing concern that the quality of science education today is not adequate to provide students with the level of scientific literacy they will need to be effective citizens in the 21st century. To address this concern, Educational Seismology Projects (ESPs), such as the Texas Educational Seismic Project (TX-ESP) and the Boston College (BC) Educational Seismology Project (BC-ESP) promote inquiry-based learning and investigative methods in Earth science classrooms, at public events, and in after-school activities. TX-ESP is a 501c3 Non-Profit Public Charity which focuses on educational seismology outreach and collaborative research with BC-ESP. BC-ESP is operated by BC's Weston Observatory, a research and science education center of its Department of Earth and Environmental Sciences. Our common goal is to enhance science education by offering opportunities for students, teachers, and the public to be directly involved with research scientists. Through our educational partnerships, we make a difference in the lives of citizens and students of all ages and in differing socio-economic circumstances by engaging in hands-on learning opportunities and teaching science as it is actually practiced. The science of seismology forms an excellent foundation for this endeavor because: (1) it is an interdisciplinary science that requires integration of many STEM concepts, and (2) it teaches how the natural environment impacts our everyday lives. A particular advantage of this collaboration is the locations of our ESPs. BC-ESP is located far from plate boundaries, where students don't tend to record as many earthquakes as they do at TX-ESP, which is much closer to plate boundaries and thus records more earthquakes, with stronger signals, than BC-ESP. When BC-ESP students see the TX-ESP recordings (on their own web-interface), they often find more subtle signals of the same earthquakes on their New England seismograms. This provides teachable moments for students at both locations to investigate seismic wave propagation and attenuation, as well as differences in seismicity between intraplate and plate boundary environments. Also, TX-ESP students leverage a high-quality seismology curriculum through BC-ESP's research experience and its successful, long-term ESP presence in New England.

Collaborative Educational Seismology Projects in Texas and New England

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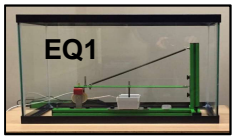
There is a growing concern that the quality of science education today is not adequate to provide students with the level of scientific literacy they will need to be effective citizens in the 21st century. To address this concern, Educational Seismology Projects (ESPs), such as the Texas Educational Seismic Project (TX-ESP) and the Boston College Educational Seismology Project (BC-ESP) promote inquiry-based learning and investigative methods in Earth science classrooms, at public events, and in after-school activities. Our common goal is to enhance science education by offering opportunities for students, teachers, and the public to be directly involved with research scientists.

Educational Seismic Instrumentation

RIGHT: Ward's vertical educational seismograph, uses oil as a damping mechanism.

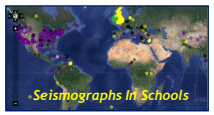
BELOW: Raspberry Shake seismograph available in a number of configurations: 1-C, 3-C, Strong Motion, Infrasound



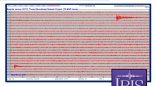
Raspberry Shake seismographs include self-contained Raspberry Pi computing systems

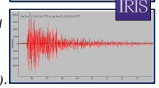
Networks and Partnerships

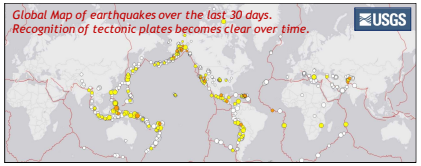
ESP's leverage existing seismic networks and their mapping software to introduce citizen scientists to the world of Seismology.



Students utilize the internet to gather global information about the dynamic Earth. Specific seismic events can be reviewed (RIGHT) and events can also be studied cumulatively over a period of time (BELOW).







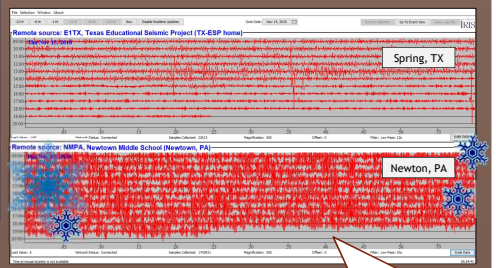
Global Map of earthquakes over the last 30 days. Recognition of tectonic plates becomes clear over time.

ESPs Grow New Citizen Scientists

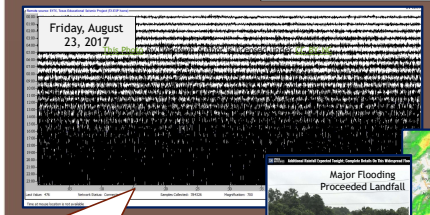
Through our educational partnerships, we make a difference in the lives of citizens and students of all ages and in differing socio-economic circumstances by engaging in hands-on learning opportunities and teaching science as it is actually practiced.

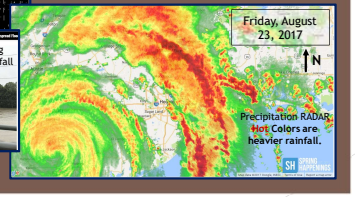
The science of seismology forms an excellent foundation for this endeavor because: (1) it is an interdisciplinary science that requires integration of many STEM concepts, and (2) it teaches how the natural environment impacts our everyday lives (see BELOW).

Monitoring the Weather....



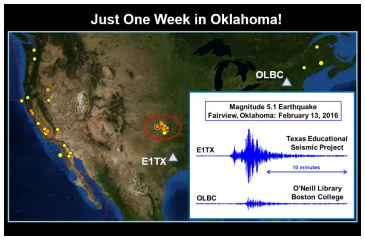
ABOVE: Comparison of Stations **E1TX** and **NMPA**. What weather differences might you observe?





ABOVE and RIGHT: Monitoring the arrival of Hurricane Harvey in Houston, TX 2018. Recorded by Station E1TX

Testing Technology and Seismology Concepts

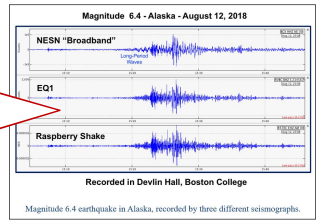


COLLABORATION ACROSS THE NATION

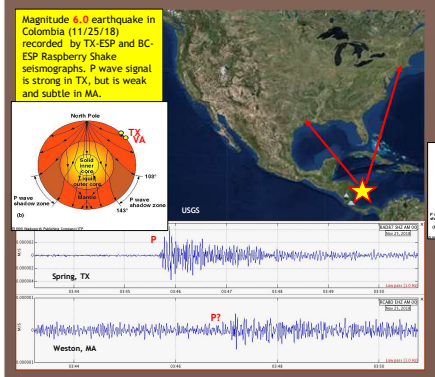
An advantage of this collaboration is the locations of our ESPs. BC-ESP is located farther from regions of very active seismicity, so BC-ESP students don't tend to record as many earthquakes as TX-ESP students. Our TX-ESP seismographs record more earthquakes, with stronger signals, than BC-ESP. When BC-ESP students see the TX-ESP recordings (on their own web-interface), they often find more subtle signals of the same earthquakes on their New England seismograms. Ongoing recording of high-quality seismograms provides opportunities to generate State-specific, NGSS inspired, and original curriculum.

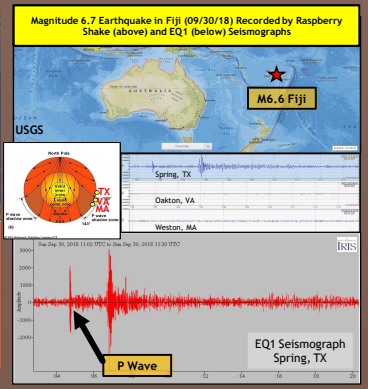
Comparing Technology

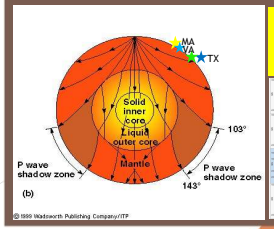
After significant earthquakes, Weston Observatory compares seismograms recorded by expensive, research-quality seismographs with seismograms of the same earthquakes recorded by low-cost educational instruments. The EQ1, AS1, and Raspberry Shake seismographs offer reasonable quality seismograms for conducting citizen science research (See BELOW). This enables open-ended, inquiry-based discussions about the effectiveness of different seismic technologies.

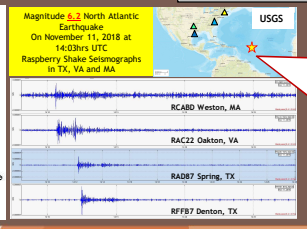


ESP Examples of Wave Propagation and Attenuation









Comparing seismograms at multiple locations provides teachable moments for TX-ESP and BC-ESP students to investigate seismic wave propagation and attenuation.

Contributions from Dave Curry and Daniel Rohmer