Engaging High School Science Teachers in Field-Based Seismology Research: Opportunities and Challenges

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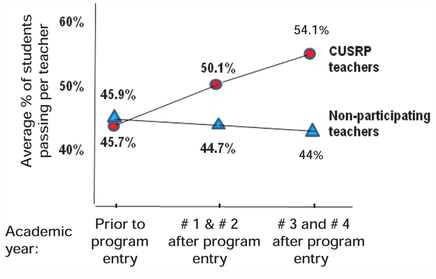
Abstract

Research experiences for secondary school teachers have been shown to improve their students' test scores, and there is a substantial body of literature about the effectiveness of RET (Research Experiences for Teachers) or SWEPT (Scientific Work Experience Programs for Teachers) programs. RET programs enjoy substantial support, and several opportunities for science teachers to engage in research currently exist. However, there are barriers to teacher participation in research projects; for example, laboratory-based projects can be time consuming and require extensive training before a participant can meaningfully engage in scientific inquiry. Field-based projects can be an effective avenue for involving teachers in research; at its best, earth science field work is a fun, highly immersive experience that meaningfully contributes to scientific research projects, and can provide a payoff that is out of proportion to a relatively small time cmmitment. In particular, broadband seismology deployments provide an excellent opportunity to provide teachers with field-based research experience. Such deployments are labor-intensive and require large teams, with a variety of field tasks. A recently established pilot program, known as FEST (Field Experience for Science Teachers) is experimenting with providing one week of summer field experience for high school earth science teachers in Connecticut. Here I report on results and challenges from the first year of the program, which is being funded by an NSF CAREER grant and is being run in conjunction with a temporary deployment of 15 seismometers in Connecticut, known as SEISConn.

Motivation and Teacher Recruitment



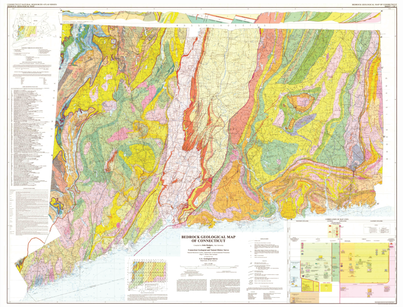
Teacher participation in RET programs can boost the test scores of the teachers' students and encourage teachers to emphasize scientific inquiry, rather than just content, in their teaching (e.g., Dresner and Worley, 2006; Silverstein et al., 2009). This is demonstrated in the example at left, from the Columbia University Summer Research Program (CURSP).

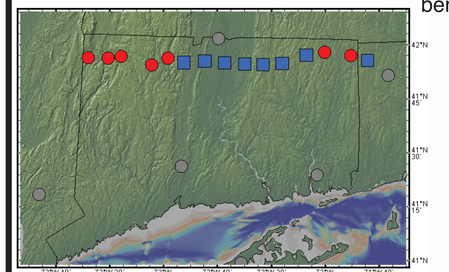
Silverstein et al. (2009)

Goal: Provide a summer research/field experience that provides a payoff out of proportion to a minimal time commitment. We recruited (through word of mouth and via the Institute for Science Instruction and Study at Southern Connecticut State U.) two Connecticut high school earth science teachers to participate in one week of field work in August 2015.

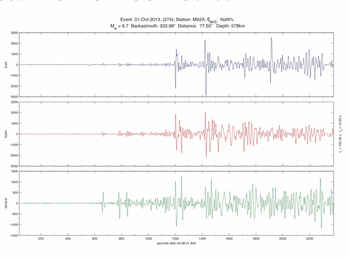
Left: Troy Schinkel (transitioning from Southington High School to community college teaching). Right: Meg Weingart (Cheshire High School).

The SEISConn Experiment



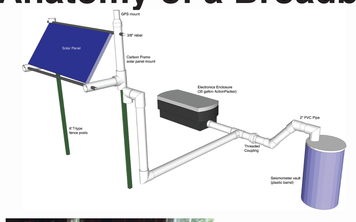


The Seismic Experiment for Imaging Structure beneath Connecticut (SEISConn) is a project to deploy 15 seismometers across northern CT for a period of 2-3 years, beginning in summer 2015. Connecticut exhibits complex surface geology (left) that reflects over 1 Ga of Earth history, including Appalachian orogenesis and the rifting that broke apart the Pangea supercontinent. The scientific goal of SEISConn is to understand the structure of the crust and mantle lithosphere beneath northern Connecticut.



Left: Map of SEISConn deployment, including stations that were installed in 2015 and currently operating (red circles) and stations planned for 2016 (blue squares). Stations of the EarthScope USArray Transportable Array, which operated from 2013-2015, are shown with gray circles. Stations will record continuously for 2-3 years and will record earthquakes from all over the world; these recordings will be used to image the crust and mantle lithosphere. Right: Example of a three-component seismogram from TA station M62A (Hamden, CT) showing ground motion due to a deep earthquake in the western Pacific on October 1, 2013.

Anatomy of a Broadband Seismic Installation



Installation of a broadband seismometer is labor intensive and requires ~4-6 hours of work for a team of ~4 people. Top left: schematic diagram of a station (courtesy of John West). Top right: Photograph of a completed SEISConn station at Fort Hill Farm in Thompson, CT. Left: Equipment being tested by Troy and Meg before deployment in the field, including the datalogger/digitizer, battery, solar panels, and the sensor.

FEST Year 1: Postcards from the Field

The SEISConn field team after a successful install (top left) and taking a well-earned break (top center). Meg shows off her digging skills (top right) and installs a sensor (bottom right). Maureen configures the datalogger (bottom left), while Meg gets up close and personal with the vault and Meg and Troy contemplate their digging strategy (bottom center).

Lessons Learned, Followup, and Future Plans

- First year of FEST was a success! Working on a local project provided both logistical advantages and opportunities for scientific engagement - "science in our backyard."
- Seismology deployment is well suited for field-based RET - team building, opportunities for public outreach with landowners. Can RET opportunities be easily incorporated into ongoing seismology deployments by other PIs?
- PI visit to Cheshire High School earth science classes to talk about the project in spring 2015 were successful - followup visits planned for 2016 and beyond.
- Challenges:
  - How to maintain teacher partnerships beyond the week-long field experience?
  - Teacher recruitment: how to effectively recruit teacher participants going forward, particularly from urban school districts?
  - Assessment: so far assessment has been relatively informal - what improvements can be made?
  - Is FEST scaleable? Small-scale, PI-driven RET programs require effort on the PI's part, and support is necessary.
- Looking forward: FEST will run for 2-3 more summers, with 3-4 teacher participants per summer. Stay tuned!

References and Acknowledgements

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Silverstein, S. C., J. Dubner, J. Miller, S. Glied, and J. D. Loike (2009), Teachers' participation in research programs improves their students' achievement in science, Science, 326, 440-442.