STUDENT LED SITING OF THE EARTHSCOPE TRANSPORTABLE ARRAY: A MID-ATLANTIC PERSPECTIVE

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Abstract

Summer 2012 was the final round of student-led siting efforts for the NSF-funded EarthScope Transportable Array in the continental United States. Beginning in 2005, EarthScope and IRIS began installing and then "leap-frogging" an array of broadband seismometers from west to east across the US. Each summer, student teams from local colleges and universities were hired to scout out locations for next deployment of seismometers. This past summer eight teams from colleges up and down the East Coast worked to find approximately 200 sites for seismometers in advance of their installation beginning in Fall 2012. Each team was responsible for locating 24 to 26 sites in their region. The VA-1 team consisted of three students from James Madison University and the College of William & Mary and had 25 seismometer sites to locate in West Virginia and Virginia. Sites were spaced 70 km apart with a 10 km radius of tolerance around the proposed location for each seismometer. ArcGIS was used to map out the potential site locations based on criteria to limit seismic noise, such as being 3 km from railroads, 1.5 km from highways, 2 km from natural gas pumping stations, and twice the height of any nearby trees. Field work incorporated driving to the general site locations and scouting potential sites using GPS and Google Earth. After locating a possible site the team talked to the landowner and worked with them to find the best place on their land for the seismometer. Reports were written up detailing the precise location, the construction process, and any issues with seismic noise in the area or landowner requests regarding the site. Once the report was filed, the students' job was over unless a site had to be relocated.

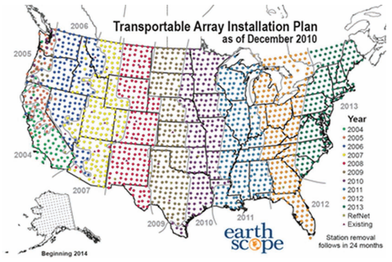
This project was an eye-opening experience for our team. Our experiences ranged from wonderful southern hospitality from the locals to an incident involving a bush and a Suburban. We were exposed to new social situations and learned to adapt our approach depending on whom we were talking too. Overall, the college students' role within the EarthScope Transportable Array project was an important educational outreach effort to the public. By talking to many different landowners, information about EarthScope and IRIS reached new audiences that would likely have never heard about it otherwise.

EarthScope, IRIS & the US Array

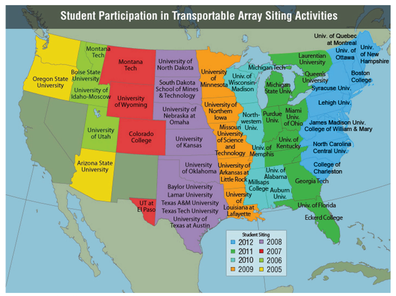
EarthScope is a collaborative project funded by the National Science Foundation (NSF), which focuses on understanding the geology, structure and evolution of the North American Continent. The three main observatories that collectively comprise the EarthScope facility are the US Array - including the Transportable Array (TA) and the Flexible Array (FA), the Plate Boundary Observatory (PBO), and the San Andreas Fault Observatory at Depth (SAFOD). The EarthScope project is multi-disciplinary, incorporating geology, seismology, geodesy, petrology, geochemistry, etc . The topics that are being researched include understanding processes that occur at convergent margins, the interaction and structure between the mantle and crust, and fault and earthquake mechanics, among many others. Collectively, the EarthScope community is collecting data and creating many resources for scientists, teachers, and the general public.

The US Array component is managed and monitored by IRIS (Incorporated Research Institutions for Seismology), a university consortium supported by the NSF that works with seismological data through collection and distribution of this data, and maintenance of facilities. The TA component of US Array consists of a "big-foot" array of seismometers that are iteratively moving from west to east across the continent US. Deployment of the TA began in 2004, and will conclude with deployment in Alaska in 2014. The Array consists of a north-south oriented swath of seismometers, spaced 70 km apart. Each swath is in place collecting data for a period of two years, after which it moves to the next swath to the east. Current deployment of the TA is in the Mississippi Valley region of the Mid-continent. Siting for east coast deployment was completed in Summer, 2012, with east coast deployment beginning this fall (2012). These seismometers record wave data from any earthquake around the world that is above a 5.5 magnitude. The seismic data is used, among other things, to get high resolution pictures of the interior of the earth as well as to create datasets and useful visualizations for research and education.

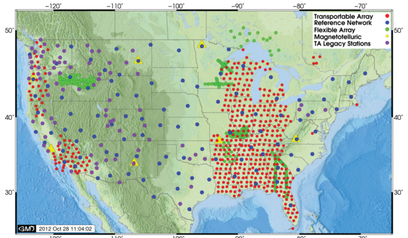
This poster focuses on the TA siting project, which involves undergraduate and graduate earth science in determining the best possible for seismometers in a given region. Since the siting program began in 2005, there have been student teams from 49 colleges and universities involved across the country, each assigned a different area to scout during the summers. The student siting project concluded this past summer (2012), with eight teams from colleges and universities on the East Coast scouting 24 to 26 sites. The next TA deployment is Alaska, and due to it's set of unique logistical complexities, siting efforts will not use students in the same way as in the lower 48 states.



US Transportable Array installation plan, color coded by year
(Map Courtesy of IRIS)



List of colleges that participated in seismometer station siting for the US Transportable Array Project



Current Location of active US Array seismometers
(Map courtesy of IRIS.edu)

Participants in the TA siting workshop for the eastern US, Pittsburgh, PA 2012

Peter and Tim scouting a practice site near Pittsburgh, PA.

Installation of Seismometer (R58B) near Mineral, VA in August 2012

Covering station R58B near Mineral, VA in August 2012

Completed installation of station R58B near Mineral, VA
(Photo Courtesy of IRIS)

Public Outreach and Publicity

The one thing that was common with a lot of the people that we talked too was their interest in the science that we were researching. Many had never heard of the US Array, but most had felt the Louisa County, Virginia earthquake that occurred in August of 2011. We distributed pamphlets and information about websites to people who weren't able to help us with a site and these people would have probably never known the Transportable Array was in their backyard! The amount of people we were able to give information too was incredible. We talked to 20+ houses on a long day and at each one we gave them information. Multiply that by the 2 months we spent traveling around and that's a lot of people!

JMU graduate helps with national seismometer grid project

Finding ideal locations to place seismometers may not be quite as difficult as finding a needle in a haystack, but it isn't easy.

Bethany Meier, a 2011 JMU graduate with a bachelor's degree in geology and environmental science, can attest to that. Meier traveled about 8,000 miles through Virginia and West Virginia this summer in search of suitable spots for the instruments that will help scientists get a better understanding of the earth's movements and its history.

Aside from an intimidating bull or two, a landowner who wasn't particularly happy about her visit and a lot of 12-hour workdays, Meier said she was elated to be part of the EarthScope program, which is funded by the National Science Foundation.

Bethany Meier works with Tim Kropp at a seismometer site.

"It was an awesome experience," she said. "It's such a big part of geology and the earth science field."

Meier was the leader of a three-person team that was responsible for finding suitable locations in most of Virginia and all of West Virginia. Meier's teammates were Tim Kropp, a JMU senior majoring in geology and environmental science; and Peter Steele, a William and Mary student. Steve Whitmeyer, an associate professor of geology and environmental science at JMU, teamed up with a William & Mary faculty member to get a grant for the siting project. Whitmeyer is also chairman of the EarthScope education and outreach subcommittee and a member of the EarthScope steering committee.

Each siting team was provided a map of the areas they were to work in. The maps included a grid with dots marking the ideal locations for the seismometers. The teams could mark suitable locations anywhere within 10 kilometers of the dots. They marked the locations by placing stakes in the ground.

Among the valuable experiences, Meier said, was approaching landowners and requesting their permission to locate the seismometers on their property. "You have to be able to talk to people to do research on their land," she said. "It takes a lot of patience and shows an ability to work in teams. It's such a big project."

Most people were willing to listen, she said, but one did get angry. And a bull didn't seem too pleased by their presence either. The farmer stayed with the team and carried a 10-foot stake just in case, Meier said.

It also took some patience to find just the right spots. The seismometers can't be more than 50 miles apart and the criteria for suitable locations, which lists about 20 or so things to avoid, adds to the difficulty. The instruments are so sensitive that they have to be placed well away from houses — they could detect flushing toilets and shifting foundations — and away from driveways and roads. They also can't go too close to trees because roots vibrate. "And then railroads, forget railroads," Meier said. West Virginia's mountainous terrain and lack of cell service in some places also added to the difficulty, Meier said. The instruments have to have cell service.

The most difficult place to find a location was in the city of Charleston, W.Va., Meier said. The team spent three days there and was fortunate to talk to someone who helped convince a neighbor it would be OK. There was one day, she said, where they found a location in 2-1/2 hours and called it a day.

Different groups will install the seismometers, which will stay in place for about two years before being moved to Alaska. The first EarthScope seismometer in Virginia was installed Wednesday, Aug. 8, in Mineral, nearly a year after the Aug. 23, 2011 earthquake there that rattled central Virginia and was felt all along the mid-Atlantic. The rest of the Virginia seismometers will be installed in the spring. The West Virginia instruments will be installed this fall.

Meier is now headed to West Virginia University to pursue a master's degree in geology. After that, she said she wants to work in the field for a time before returning to school for a doctorate and then teaching at a university.

Looking Back

The experiences my team and I went through ranged from embarrassing and hilarious to educational and everything in between. The worst experience was probably when a dog decided to chew on our suburban's tires and I ended up running over a man's plant. Everything worked out, but that's not how you want to start a day of knocking on peoples' doors.

One of the best parts was meeting all the different animals that people owned. Mostly the pets were dogs, who were actually very friendly. One house had two peacocks in their front yard! The husband and wife told us many stories about the two of them escaping and the trouble they would get in on their adventures to where they finally had to build a large penned in area for them. We had a couple of dogs try to come home with us as well.

Another benefit of our experiences was learning from all the people that we interacted with. There is nothing like experiencing culture through talking to all the people from different geographic locations. We spent two afternoons talking to a man who was a retired forester who worked for years in Florida. The biggest culture difference I noticed was between locations in WV with natural gas lines and the ones that didn't have them yet. The people who had lines on their property highly disliked the situation, but people who lived in areas pipelines hadn't invaded yet wanted them.

The funniest experience was when we were scouting in Virginia close to the end of the summer. We had been traveling around all day with no luck and no food. We made a split second decision to turn into a driveway of a little farm as a last resort before we gave up for the day. When we knocked on the door, a shirtless man in ripped jeans answered the door. He was such a nice man and ended up allowing us to place one on his property. When we left, Peter told me, "You know, at the beginning of the summer that may have taken me by surprise, but I didn't even blink." That's when we knew there was little that could shock us when knocking on doors.

Final Thoughts

This summer was an amazing opportunity and I'm thankful for everyone who made it possible for me to join in on this experience. This includes Dr. Steve Whitmeyer, the EarthScope team, everyone from IRIS, the NSF for funding the project, and of course my partners Tim and Peter. The days were long, but the experience of meeting so many new people, gaining experience working with landowners and spreading word about EarthScope, IRIS and the Transportable Array made it completely worth it. As a future science educator the most rewarding part of the summer was spreading the word about new projects in science and getting the general public involved. It was such a great feeling when people were interested in the project and wanted to know more and we were able to give them information that they never would have gotten if the US Transportable Array hadn't come through their region.