inSights
the EarthScope newsletter
Spring 2013

EarthScope News

New EarthScope Website Unveiled

The EarthScope website has been redesigned to better showcase EarthScope science, resources, and discoveries and share them with the scientific community and broader public.

The extensive redesign was a collaborative effort between UNAVCO and ESNO. The new website features a user-friendly front page that includes social media links, blog entries, a photo-of-the-week, and recent geo events. In addition we have added a resources page for students, teachers, and researchers. The new website was launched April 1, 2013.

To see these features and many more, visit http://earthscope .org.

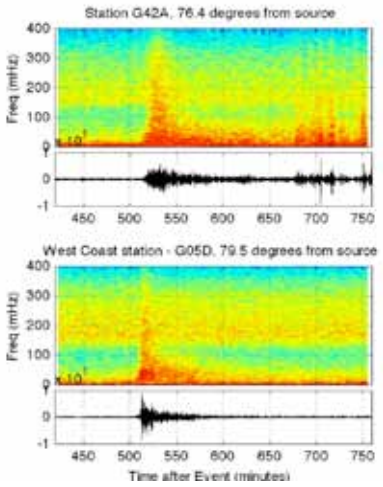
Call for Speakers!

The EarthScope National Office is now accepting nominations for its 2013-2014 Speaker Series. Each of the five selected Speakers will present his/her talk to five colleges and universities over the next academic year. The nomination deadline is April 24. For more information on qualifications and how to submit a nomination, go to www.earthscope.org/speakers. Information on how schools can apply for a Speaker will be in our summer edition.

Chelyabinsk Meteor lit up the Transportable Array

Catherine D. de Groot-Hedlin and Michael Hedlin, Laboratory for Atmospheric Acoustics, Institute of Geophysics and Planetary Physics, University of Calfornia, San Diego

The large meteorite that entered Earth's atmosphere above Chelyabinsk, Russia last month drew attention to the USArray Transportable Array (TA). Significant overpressure from the shock wave damaged structures in Chelyabinsk, blew in thousands of windows and injured over 1,000 people - mainly due to flying glass. A preliminary study of seismic data shows this event generated not only very low amplitude body waves at high frequencies, but also high amplitude, long-period surface waves. This perhaps is not surprising due to the large footprint of the meteorite's shock wave. A large release of energy is believed to have come from an explosion of the disintegrating bolide that occurred at an altitude of ~30 km near the end of the ballistic entry path. The shock wave from this explosion, or from the combined explosive and ballistic source, excited large Rayleigh waves that have been seen at GSN stations to 40°. The waves might have been detected at more distant stations if it were not for interference from surface waves excited by a Mw 5.8 earthquake in the Tonga Trench that occurred 18 minutes before the arrival of the meteorite. Preliminary work indicates that the TA did not record the event seismically as it was located at epicentral distances of over 70°. However, air pressure and infrasound sensors recently added to the TA recorded the passage of a long wave train of infrasound signals. Although the entry and final burst of the meteorite occurred over a 16 second time span, the wave train seen crossing the TA lasted for over 50 minutes. The TA shows that the speed of sound crossing the polar region to the western United States was approximately 290 meters per second while the main part of the TA, in the eastern United States, recorded slower signals at about 270 meters per second. Although the recordings made of this event by the TA are unprecedented, due to the high density of the network and its spatial extent, infrasound signals were also recorded at even greater distances by infrasound arrays in the International Monitoring System. The IMS stations have shown that the sound waves circled the entire globe (returning to Chelyabinsk in over 35 hours).



Timeseries and spectrograms from two stations in the TA

This extraordinary event will require improvements to algorithms used to synthesize the propagation of infrasound. In the time it takes for infrasound to circle the globe, the atmosphere through which the sound propagates changes significantly. The atmospheric models that are used in the computation of rays or full-wave synthetics now have to accommodate this 4th dimension of time variability.

The TA was able to record this event due to two major upgrades. Small barometers (MEMS sensors) were installed at all sites starting in late 2008 in an effort led by Bob Busby, Transportable Array Manager. Following this, Frank Vernon and Michael Hedlin (UCSD) received funding from NSF to add a second, broader band, barometer (Setra 278) and an infrasound microphone, manufactured by the National Center for Physical Acoustics at the University of Mississippi, to each site. The TA now continuously records air pressure in the entire band from D.C. to the Nyquist at 20 Hz. Due to these upgrades the TA not only will continue to record a broad suite of atmospheric events such as the Chelyabinsk meteorite and provide a wealth of pressure data for meteorological studies, but will also give unprecedented data for the study of the interaction of the atmosphere and solid Earth.

For full version with additional figures please visit www.earthscope.org

USArray Status

By Perle Dorr, IRIS

With operating stations blanketing the southeastern states, the Transportable Array is on target to complete its journey across the contiguous US and southeastern Canada by September 30, 2013. To date, almost 1,600 stations have been commissioned and nearly 1,100 stations have been removed following each station's two year service period; there are currently about 430 TA stations in operation. Data quality and reliability of TA stations remain high as sites are installed in different geologic regions; data availability consistently exceeds 95%. The final session of the TA Student Siting Program was held during summer 2012. Throughout the years, this program engaged approximately 135 students from more than 50 universities. Significant progress has been made in coordination with the scientific community, numerous Federal and state agencies, and Native corporations to develop plans for the proposed deployment of the TA in Alaska and western Canada.

Because Alaska is remote and environmental conditions are challenging, modifications to the station design and installation procedures are necessary. Several test stations have been installed in Alaska and in the Yukon Territory to study drilling technologies and "direct burial" sensor emplacement methodologies as well as the reliability of power systems, communications and other electronics. The Flexible Array (FA) instrument pool continues to be heavily utilized; current deployments include equipment for five researcher-led experiments in the eastern half of the country. The permanent magnetotelluric (MT) observatory continues to telemeter raw data from its seven stations. The transportable MT array continued activities in the Midcontinent Rift region where 115 stations were completed during a highly successful 2012 field season.

Using data from USArray observatories as well as other networks, the IRIS Data Management System generated and disseminated plots and visualizations following several "Special Events," including the derecho in June 2012, Hurricane Sandy in October 2012, and more recently, the North Korean nuclear explosion and the meteor blast over Russia. Other outreach activities and products include content development for the Active Earth Monitor in collaboration with the EarthScope National Office and UNAVCO, and interaction with national and international news media.

Right: A three-man team from the EarthScope Transportable Array installed a prototype seismic station at Eagle Plains, Yukon Territory, Canada, just 30 km south of the Arctic Circle. The image shows the station's seismometer being placed in a 55-inch deep borehole in exposed bedrock. The electronics, power, and communication subsystems for the station are enclosed in an all-weather hut (not shown) to protect them from the weather and large wildlife.

The 2013 EarthScope National Meeting, Raleigh, North Carolina

On May 13-15 EarthScope will host its third National Meeting. An optional half-day field trip kicks off the conference on May 12. Plenary sessions guide the discussion followed by multiple breakout and poster sessions. New this year is an exciting Ignite-style presentation. The National Meeting is the only conference of its kind that fully examines all aspects of the EarthScope program. Join a standout group of experts in sharing results, challenges, and brainstorming The Next Big Thing.

Plenary sessions include:
EarthScope the Dream. A history of how a huge program like EarthScope came together and what we can learn from this example as we move forward toward The Next Big Thing.

EarthScope in Full Swing is a review of the goals and the accomplishments of the program. There is so much to say that this will comprise two half days!

EarthScope ++: Alaska examines the vision, objectives, challenges, and successes of locating the EarthScope program to Alaska.

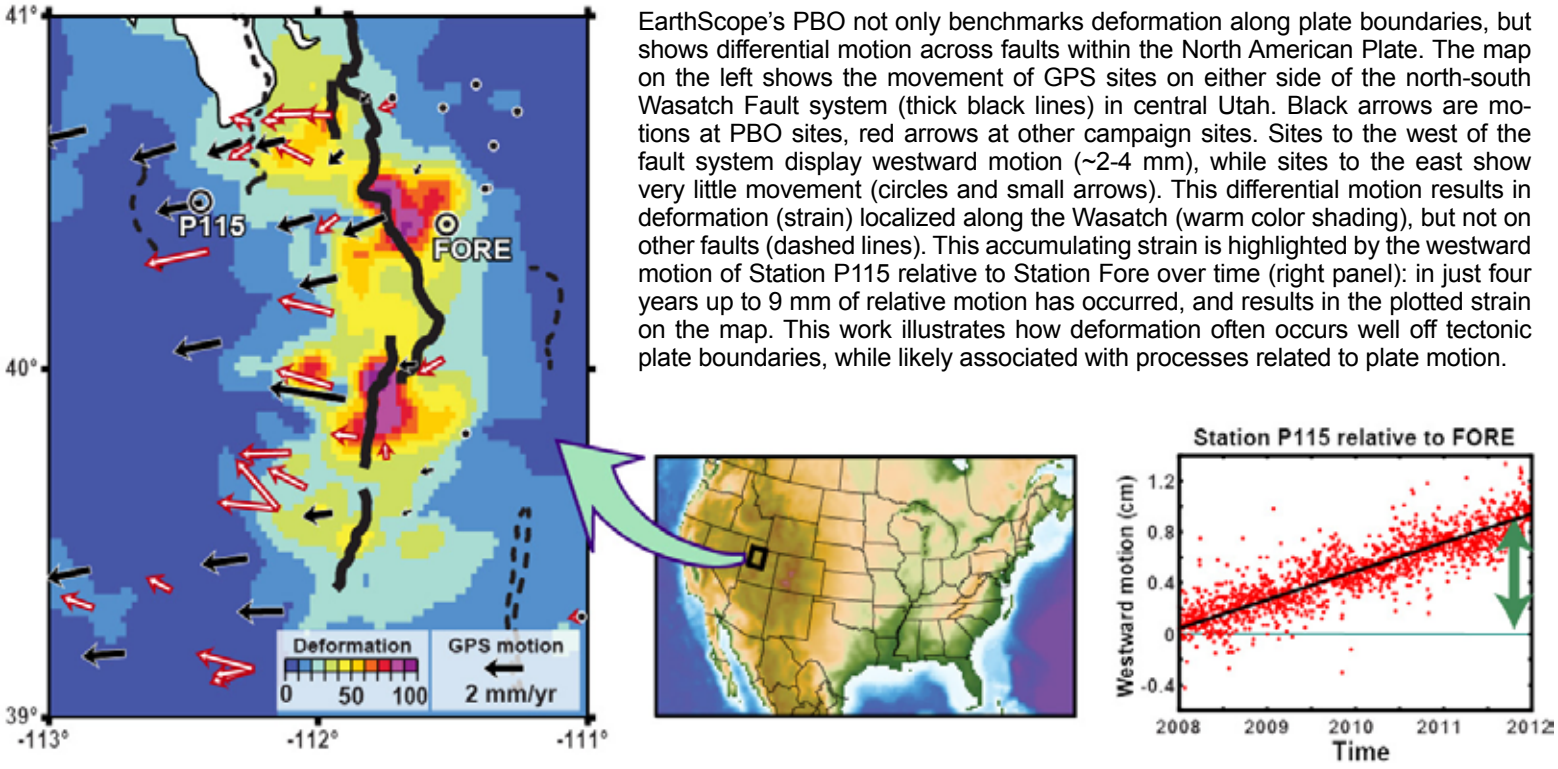
The Next Big Thing. This is the question we're asked often, "What's next?" We will discuss possible proposals, challenges, and opportunities to help guide funding and research towards the Next Big Thing.

We will also have poster sessions, breakouts for focused discussions on various topics, and evening programs (fun and rapid fire talks on The Next Big Thing).

To see a full schedule and to register, go to http://www.iris.edu/hq/earthscope_meeting. There is an attendance limit and space is filling quickly.

Plate Boundary Observatory Data: Deformation of the Wasatch Fault System

Corne Kreemer, UNR



EarthScope's PBO not only benchmarks deformation along plate boundaries, but shows differential motion across faults within the North American Plate. The map on the left shows the movement of GPS sites on either side of the north-south Wasatch Fault system (thick black lines) in central Utah. Black arrows are motions at PBO sites, red arrows at other campaign sites. Sites to the west of the fault system display westward motion (~2-4 mm), while sites to the east show very little movement (circles and small arrows). This differential motion results in deformation (strain) localized along the Wasatch (warm color shading), but not on other faults (dashed lines). This accumulating strain is highlighted by the westward motion of Station P115 relative to Station Fore over time (right panel): in just four years up to 9 mm of relative motion has occurred, and results in the plotted strain on the map. This work illustrates how deformation often occurs well off tectonic plate boundaries, while likely associated with processes related to plate motion.

Hot New Science

In each inSights, we will highlight a few recent publications of EarthScope results. Please submit your latest publications to earthscope@asu.edu

Babaie, H., Cindi, M., Hadizadeh, J., Kumar, A. (2013). SAFOD brittle microstructure and Mechanics Knowledge Base, Computers and Geosciences. 10.1016/j.cageo.2013.03.004

Darold, A., Humphreys, E. (2013). Upper mantle seismic structure beneath the Pacific Northwest: A plume-triggered delamination origin for the Columbia River flood basalt eruptions, Earth and Planetary Science Letters, v. 365, p. 232-242.

Gold, R., DePolo, C., Briggs, R., Crone, A., & Gosse, J. (2013). Late Quaternary Slip-Rate Variations along the Warm Springs Valley Fault System, Northern Walker Lane, California-Nevada Border. Bulletin of the Seismological Society of America, 103(1), 542–558.

Rost, Sebastian (2013). Deep Earth: Core mantle boundary landscapes, Nature Geoscience, v. 6, p. 89-90.

Thorne, M. S., Garnero, E. J., Jahnke, G., Igel, H., & Mcnamara, A. K. (2013). Mega ultra low velocity zone and mantle flow. Earth and Planetary Science Letters, (364), 59–67.

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USArray - Alaska Deployment Planning

Terry Pavlis, UTEP

On February 19 and 20 approximately 50 geoscientists met at the Pacific Geoscience Center in Sydney, British Columbia, to discuss objectives for the planned Alaskan phase of EarthScope. Because this was an international collaboration, the workshop primarily focused on science and logistical issues that cross the US-Canadian border. The conference reviewed the status of EarthScope in the lower-48 as well as recent science results in Alaska and northwestern Canada. The science focus was naturally northern Cordilleran-centric with presentations ranging from the active tectonics of the modern margin to the Paleozoic and Mesozoic tectonics of the region. The breakout groups discussed issues ranging from major science questions, to Education and Outreach opportunities, to logistical challenges of this environment. The breakout groups reported summaries of their discussions to the entire group for a broader discussion.

There was general excitement in the group about the potential for major advancements in northern Cordilleran science through EarthScope activities and hope for close collaboration among groups in both countries. A white paper will be released soon.