Achievements of the EarthScope USArray in North America

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EarthScope's USArray observatory provides observations of geophysical targets across a large portion of the North American continent through the systematic deployment of seismic, magnetotelluric, and atmospheric instruments. The seismic and atmospheric components of USArray consist of a Transportable Array (TA), Flexible Array (FA), and Reference Network (RefNet). In the fifteen years of USArray these geophysical instruments were deployed across roughly 6% of the Earth's land surface. From 2004-2015 the TA used a rolling deployment to occupy approximately 1,679 sites spanning the contiguous 48 states at 70 km inter-station spacing (**Figure 1**), and at present the TA spans Alaska and parts of western Canada at 85 km spacing (**Figure 2**). These stations have provided broadband seismic, barometric pressure, and atmospheric infrasound observations. The pool of instruments that comprise the FA have been deployed by numerous individual investigators in dense arrays to investigate local and regional features (**Figure 3**) over time periods ranging from days to years. The RefNet provides a permanent, stationary foundation for the TA and FA, with approximately 100 broadband stations deployed across the contiguous US at roughly 300 km spacing and operated for the full duration of USArray. The magnetotelluric (MT) component of USArray has provided both fixed and campaign-style long-period magnetotelluric observations at over a thousand locations across the US (**Figure 4**).

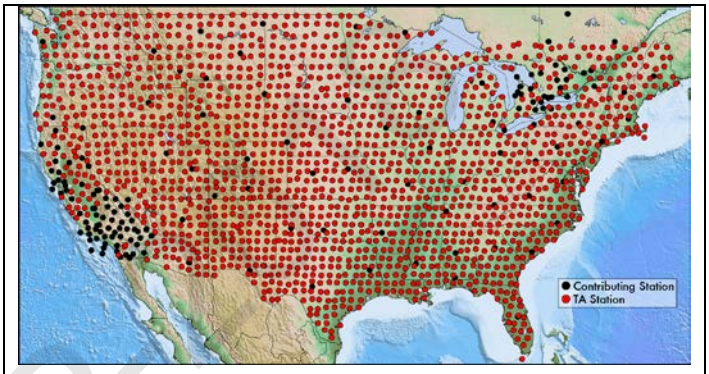

Figure 1. Map of TA in the contiguous United States. TA stations are shown in red, while pre-existing stations that contributed to the TA coverage are shown in black.

USArray includes a comprehensive data management capability that receives, archives, and distributes data, metadata, and data products. The TA and RefNet data are acquired and distributed in real time. All data collected by USArray are openly available. Many of the observations have also been incorporated into a variety of data products that have been developed to facilitate use of USArray by many different audiences. The scientific community has used USArray data to achieve a wide range of results—those that were anticipated when the facility was proposed and those that were completely unanticipated. Data products such as direct visualizations of seismic wave propagation recorded by the TA have been viewed hundreds of thousands of times on the web by the general public.

Many of the field activities of USArray engaged both students and the public in important ways and this has been a significant component of USArray outreach. The TA alone has engaged well over one hundred students in site reconnaissance activities and placed seismic stations on the property of roughly one thousand different landowners who received reports on their own station's contributions to science.

The USArray project has developed a number of best practices that can inform other large-scale science initiatives that the Earth science community is contemplating. Key strategies employed by USArray included: using a survey, rather than hypothesis-driven, mode of observation to generate comprehensive, high quality data on a large scale for exploration and discovery; making data freely and openly available to any investigator from the very onset of the project; and using proven, commercial, off-the-shelf systems to ensure a fast start and avoid delays due to over-reliance on unproven technology or concepts.

The scope of the project was set ambitiously, but managed carefully throughout the execution to avoid overextending. The network and station configuration was controlled to ensure efficient operations while providing consistent, uniform observations.

We will provide a brief overview of the deployments and accomplishments of USArray from the past fifteen years, and an overview of the significant and diverse scientific results that have been achieved. We will touch on some of the technologies and organizational and operational strategies that have enabled the success of USArray. We will conclude with a look to the future and a brief discussion of USArray plans.

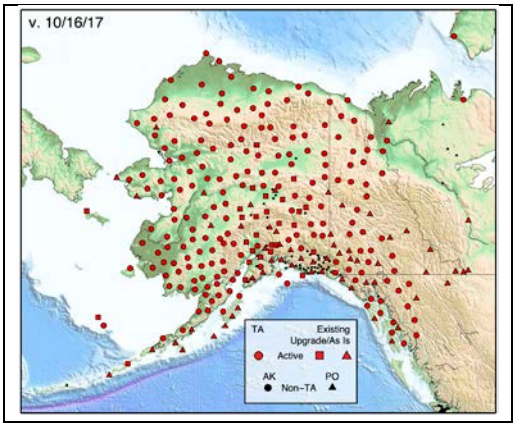

Figure 2. Map of TA in Alaska and parts of western Canada. TA stations are shown by red circles, and pre-existing stations that contribute to the TA coverage are shown in red squares and triangles. Other stations in Alaska are shown in black.

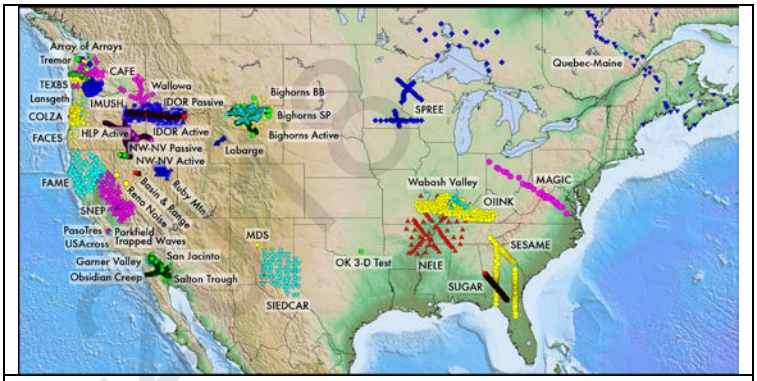

Figure 3. Flexible Array deployments in the contiguous United States during the first twelve years of USArray.

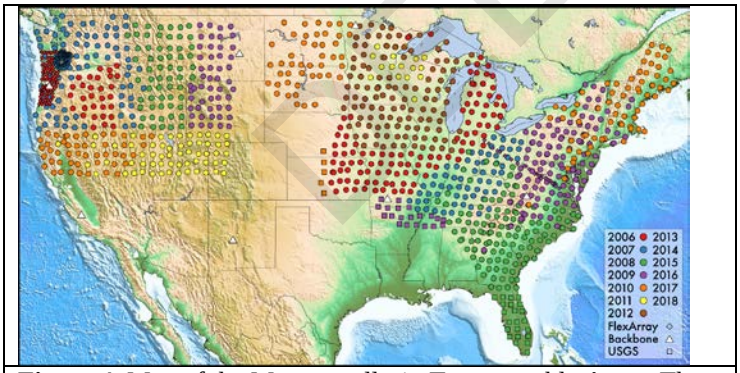

Figure 4. Map of the Magnetotelluric-Transportable Array. The current field season will fill the gap between the western and eastern coverage regions.

This material is based upon work supported by the National Science Foundation's Seismological Facilities for the Advancement of Geoscience and EarthScope (SAGE) which is a major facility fully funded by the National Science Foundation. Additional figures and more information can be found at www.usarray.org and www.iris.edu.