Plenary 5: EarthScope innovations and looking into the future (Lin, Newman, Webb)

We concluded the meeting with a morning session devoted to transformative ideas both with current EarthScope data and infrastructure, and looking into the future, beyond the NSF-funding of EarthScope science and facilities. We highlighted particularly innovative projects looking at very deep-earth structure using EarthScope data, and reaching out to the far-reaches of the Alaskan frontier to communicate EarthScope science to remote inhabitants.

Michael Thorne from the University of Utah illuminated the lower mantle-core transitions using the transportable array to interrogate differential paths of diffracted shear waves around the outer core. Not only is he better imaging massive mountains with 200+ km of relief atop the core-mantle boundary, but he's now finding other strong features, termed Chi-reflectors, occurring about 800 km above these features.

With the Transportable Array moving to Alaska, Carl Tape, from the University of Alaska Fairbanks, highlighted opportunities for scientific discoveries as well as education and outreach in this tectonically active region, and distinct challenges related to infrastructure. For example, because Alaska's western region is a massive, California-sized environment without any roads, it poses logistical challenges for deployments and makes it also impractical to reach most its inhabitants. For educational outreach, Tape explains that it is necessary use both in-person opportunities and virtual tools to connect with students and residents. Technology, including tools like IRIS's Active Earth Monitor, can be installed in places where students and/or communities will congregate, and deliver content to those outside of Alaska. When connecting with local populations, he's found it beneficial to communicate through stories, capitalizing on personal connections with elders in the communities, and in exploring and relaying information in old newspaper stories surrounding the 1964 Alaskan earthquake, or Redoubt eruption.

While looking forward, and beyond EarthScope, we looked at what was originally proposed to be the fourth-leg of EarthScope -- a dedicated InSAR mission capable of dense near-global coverage. Matt Pritchard, from Cornell University, discussed some of the surprising and sometimes serendipitous observations the community has been able to make using a range of satellites from European and Japanese space agencies across the EarthScope environment, including groundwater movement, coal and salt mining activity, and even a very small (magnitude 3) earthquake in the suburbs of Chicago. Pritchard discussed current NASA plans to launch a new SAR satellite joint with the India Space Agency for global coverage with L-band imagery. Because the new satellite will have only a 6-day repeat, it will be well suited for evaluating rapidly evolving deformation, such as inflating volcanoes, or active landsliding from monsoons. This mission, with a planned launch in 2020, will have open data access to what looks to be about a petabyte of data annually!

Starting with the infrastructure developed in the Pacific Northwest and Alaska through the Cascadia Initiative and EarthScope, Jeff Freymueller, from the University of Alaska Fairbanks, discussed a community-led idea to develop a first-of-its-kind Subduction Zone Observatory (SZO) spanning the eastern Pacific down through southern Chile. The project, which will necessarily be a massive international collaboration, aims to understand the range of processes that control and are the consequences of tectonic collision, including mountain building, volcanism, and seismic activity. Focussing primarily on outstanding challenges in earthquake behavior, Freymueller discussed our lack of information about the controls on styles of megathrust fault behavior along-strike, down-dip, and through the seismic cycle. Why do portions of the fault slip freely while others lock-up? Why does accumulated stress fail in either frequent slow lurches (slow-slip events), or in major earthquakes, occasionally with devastating strong-shaking and tsunamis? Such a project will draw on advances made in NSF Margins and GeoPRISMS programs, and will necessarily integrate basic science advances, with modern improvements in hazards assessments, and community education.

Closing our session, Maya Tolstoy, from the Lamont Doherty Earth Observatory, discussed opportunities for basic earth science on the seventy percent of the earth that most of us ignore, the seafloor. Home to approximately 90% of plate boundaries, the seafloor is a particularly difficult environment in which equipment must be resistant to corrosion, extreme pressures, biofouling, and trawling. Deployment and recovery generally requires large ships, and a level of uncertainty not familiar to landlubbing scientists. Recent improvements in seafloor platform designs and network infrastructure are encouraging. Large trawl-resistant encasements for ocean-bottom seismometers are making data in the first thousand meters more secure, and quieter! Development of research and hazards-focussed seafloor cabled instrumentation offshore Cascadia as a part of the Oceans Observatory Initiative (OOI) and central Japan in the Dense Ocean floor Network System for Earthquakes and Tsunamis (DONET-I and -II), are creating new data and opportunities to understand the geophysical behavior in two particularly dangerous subduction zone environments. Mostly supported by industry applications, recent developments with precision tiltmeters, resistivity, and magnetotelluric observations of the earth below the ocean, are also very encouraging.