EarthScope USArray Introductory and Advanced Short Courses
2009-2017

The seismological and magnetotelluric data collection component of the National Science Foundation's EarthScope program, called the USArray (usarray.org), aimed to produce a dataset that could be used to investigate the geologic structure and dynamics of the North American continent. The USArray consisted of four components: the Transportable Array, Flexible Array, Reference Network, and Magnetotelluric Array. In addition to the data collected by these arrays, many other types of geophysical data were collected over more than fifteen years across the contiguous (lower-48) United States and Alaska. The volume of data flowing into the IRIS facility pushed the geophysics community to find new ways to utilize data effectively and challenged the ability of different research groups to cope with the quantity and complexity of USArray data.

To address this need, the Transportable Array Working Group, with leadership from Gary Pavlis (Indiana Univ.) and Suzan van der Lee (Northwestern Univ.), proposed to bring together current experts to share existing techniques with graduate students and early career researchers (ECRs), and in turn, encourage these ECRs to lead the development of the next generation of processing and analysis techniques. The EarthScope USArray short course idea was born, with the goals to: 1) provide a forum for the education of early career researchers in current data processing best practices, 2) bring subject matter experts together to share research software and teach each other and ECRs the concepts behind their approach to data analysis, and 3) bring array-based seismic exploration methods from industry into USArray data processing practice.

Starting in 2009, the EarthScope USArray Introductory and Advanced Short Courses were intense, week-long courses focused on graduate students, post-docs, and other ECR seismologists (see table below). The PIs (Van der Lee and Pavlis) chose a diverse set of instructors for the short course (see table below) to expose students to a wide range of ways to solve data processing problems with the aim to inspire the participants to become future leaders in the development of more effective ways to handle large seismic arrays, such as USArray. Participants were selected by each program's steering committee, based on the information provided in their applications.

Program Structure

The initial short course was hosted and led by Suzan van der Lee at Northwestern University in 2009. Organizing faculty and IRIS staff, assisted by guest instructors from the IRIS community and facilities, taught 1-3 hour lectures and exercises focused on the philosophies and strategies to handle big data. Topics of these courses ranged from basic questions, like 'what is data?' to higher-level concepts, such as database processing and data discovery. The week ended with groups of students making presentations on ideas for the next data products or community tools.

With the success of the 2009 workshop, thanks in large part to very positive reviews and continued demand, the course was repeated in 2010 and 2011 for subsequent groups of budding seismologists. The first three years of the USArray short course were a mix of graduate students and ECRs, and in 2013, to address a larger spectrum of demand, the short course was split into a

4-day introductory short course (for graduate students in their first 1-2 years) and a 5-day advanced short course for late-stage graduate students and ECRs.

From 2014, IRIS offered a 5-day introductory course at Northwestern during even years and an advanced course at the University of Indiana during odd years. In 2017, the processing and analysis focus moved to the Oklahoma Wavefields project, instead of focusing on USArray data. Financial support for travel and associated costs for participants was provided by the National Science Foundation (NSF) through workshop awards, the EarthScope USArray Program, and the Seismological Facilities for the Advancement of Geoscience (SAGE) facility operated by IRIS for NSF.

Participants and Instructors

The short courses were held annually from 2009-2017, with the exception of 2012, and two separate short courses for the introductory and advanced levels were held in 2013, resulting in a total of nine short courses. Three short courses included a mix of introductory level (graduate students in years 0-2) and advanced level (graduate students 3+ years, postdocs, and early career faculty) participants. Over the years, we were able to reach a total of 226 participants, 140 male and 80 female participants (6 of unknown gender). The participants came to the short course from 91 unique institutions from the United States and abroad. (Please note that the National Science Foundation provided financial resources to support participants in the United States. International participants provided their own financial support.)

The breakdown per year of the level, host institution, number of participants, gender, and number of institutions that participated is provided in the table below.

YEAR	LEVEL	HOST INSTITUTION	# OF PARTICIPANTS	Male/Female (Unknown)	# of Institutions
2009	Introductory/Advanced	Northwestern	20	12/8 (0)	17
2010	Introductory/Advanced	Northwestern	22	18/3 (1)	18
2011	Introductory/Advanced	Northwestern	26	10/13 (3)	22
2013	Introductory	Northwestern	27	14/13 (0)	24
2013	Advanced	Northwestern	24	18/4 (2)	18
2014	Introductory	Northwestern	24	16/8 (0)	24
2015	Advanced	Indiana Univ.	28	19/9 (0)	26
2016	Introductory	Northwestern	27	14/13 (0)	21
2017	OK Wavefields (Introductory/Advanced)	Indiana Univ.	28	19/9 (0)	25

We also want to thank all of the 43 instructors who helped organize, facilitate, and teach/lecture during each of the short courses. Special thanks to Suzan van der Lee (Northwestern Univ.) and Gary Pavlis (Indiana Univ.) who wrote the original workshop proposal and hosted the short

courses held at their institutions. The mentorship and guidance that each instructor provided for this week-long short course is fully appreciated. Below we provide information on the instructors, affiliation, and the years that they participated in the short course. The number of returning instructors shows that the short course was a fruitful experience and worth returning for.

Name	Affiliation	Years Participated
Chuck Ammon	Penn State Univ.	2015, 2016
Katyliz Anderson	IRIS/PASSCAL	2013
Eliana Arias-Dotson	IRIS/PASSCAL	2009, 2010, 2011
Luciana Astiz	University of California – San Diego, now at National Science Foundation	2009, 2010
Mitchell Barklage	NodalSeismic, now at Northwestern	2015
Tammy Bravo	IRIS	2010
Mike Brudzinski	Miami Univ. of Ohio	2013, 2014, 2015
Philip Crotwell	University of South Carolina	2009
Heather DeShon	Southern Methodist Univ.	2016, 2017
Andy Frassetto	IRIS	2013, 2014, 2015
Ed Garnero	Arizona State Univ.	2009
David Hale	Colorado School of Mines	2009
Robert Henschel	Indiana Univ.	2015
Alex Hutko	IRIS DMC, now at the PNSN	2015
Marianne Karplus	Univ. of Texas – El Paso	2016, 2017
Chuck Langston	Univ. of Memphis	2017
Wenjie Lei	Princeton Univ.	2015
Lee Liberty	Boise State Univ.	2014
Fan-Chi Lin	Univ. of Utah	2017
Lay Kuan Loh	Northwestern	2014
Beatrice Magnani	Southern Methodist Univ.	2013
Tobias Megies	Munich Univ.	2015
Robert Mellors	Lawrence Livermore Nat'l Lab	2017
Meghan Miller	University of Southern California, now at Australian National Univ.	2010, 2011, 2013, 2014, 2016,
Igor Morozov	University of Saskatchewan	2009
Gary Pavlis	Indiana University	2009, 2010, 2011, 2014, 2015, 2017
Zhigang Peng	Georgia Tech	2013
George Slad	IRIS/PASSCAL	2014

Celso Reyes	IRIS DMC	2013
Rob Porritt	University of Southern California, now at Sandia National Labs	2010, 2013, 2014, 2016,
Ray Sheppard	Indiana Univ.	2015
Stefany Sit	Univ. of Illinois – Chicago	2016
Brian Stump	Southern Methodist Univ.	2017
Danielle Sumy	IRIS	2014, 2015, 2016, 2017
Justin Sweet	IRIS	2016, 2017
John Taber	IRIS	2009, 2013
Scott Teige	Indiana University	2009
Chad Trabant	IRIS DMC	2009, 2010, 2011, 2014
Suzan van der Lee	Northwestern Univ.	2009, 2010, 2011, 2013, 2014, 2016
John D. West	Arizona State Univ.	2011
Erin Wirth	Univ. of Washington	2016
Emily Wolin	Northwestern, now at USGS ASL	2014, 2015
Bob Woodward	IRIS	2009, 2010, 2011