

5. Education, Outreach, and Human Resource Development

The GeoPRISMS community, with support from the GeoPRISMS Office, is actively engaged in Education and Outreach (E&O), with the goal of developing a better-informed public and well-trained student population. The Decadal Review Committee (DRC) made a number of recommendations to continue, enhance, and expand MARGINS E&O activities. These included further development of the MARGINS mini-lessons, continuation of the Postdoctoral Fellowship Program, and expansion of the Distinguished Lectureship Program (DLP) to include visits abroad, video-taping of lectures, and inclusion of early/mid-career scientists as speakers. We have largely followed these recommendations as described below. The DRC also recommended expanding E&O efforts towards K-12 institutions, a recommendation that has not been pursued due to lack of Office resources (see section 4.2). Effective K-12 outreach requires significant effort and evaluation, necessitating a full-time dedicated E&O staff person within the GeoPRISMS Office. The GeoPRISMS Education Advisory Committee (GEAC) also strongly endorsed maintaining the focus on undergraduate education and early-career investigators, due to its greater potential for near-term impact.

Even without a dedicated E&O staff person, GeoPRISMS has been able to maintain a vibrant E&O program that is geared towards the general public and towards undergraduates, graduate students, and postdocs. GeoPRISMS E&O activities include the following:

- GeoPRISMS Distinguished Lectureship Program
- GeoPRISMS Best Student Presentation Prize competition at Fall AGU Meetings
- GeoPRISMS Townhall and Student Forum at Fall AGU Meetings
- Student Symposia and field trips prior to all GeoPRISMS Planning Workshops
- Other student, postdoc, and early-career investigator training:
 - Broad calls for participation (e.g., “Apply to Sail”) to students and postdocs for marine and terrestrial field campaigns (Cascadia Initiative, ENAM seismic experiment, iMUSH)
 - Data processing and interpretation workshops as part of community experiments
 - GeoMapApp tutorials (offered by Andrew Goodwillie, GEAC member) at GeoPRISMS Workshops
 - Joint GeoPRISMS-EarthScope Early-Career Investigator Luncheon at the Fall AGU Meeting 2013
 - GeoPRISMS Best Presentation Prize winners invited to judge presentations
- Ongoing mini-lesson development
 - New NSF DUE TUES grant (joint between GEAC and SERC)

- Contributions from individual GeoPRISMS PIs as broader impacts
- Introduction of student-oriented “Field Blogs” in the bi-annual GeoPRISMS Newsletters
- Presentations in Education sessions at Fall AGU meetings
- Participation in EarthScope E&O Summits
- Efforts to initiate a GeoPRISMS REU Program (proposal unsuccessful)
- Outreach to the scientific community, educators & funding agencies
 - GeoPRISMS sponsored sessions at AGU
 - Bi-annual GeoPRISMS Newsletter (with new and modern layout)
 - GeoPRISMS Listserv Announcements
 - Social Media (Facebook, and Twitter)
- Outreach to the public and policy makers:
 - AGU Exploration Station - AGU Fall Meeting 2011
 - NSF-organized Geohazards Forum on Capitol Hill, September 2011 (Figure 5.1)

Several of these E&O components are developed in more detail below. Chapter 4 provides also some more details on the Newsletter and AGU activities.

Figure 5.1. GeoPRISMS representatives at the Hart Senate Building for the Geohazards Forum (September 2011). From left to right: Donna Shillington, Maya Tolstoy (both at LDEO), Harold Tobin (University of Wisconsin at Madison) and Alison Henning (GeoPRISMS Office).



5.1 Distinguished Lectureship Program (DLP)

The Distinguished Lectureship Program enables scientists working on GeoPRISMS-related projects to visit schools and institutions around the US to communicate the excitement of GeoPRISMS research. The program aims to bring the speakers to a diverse set of audiences, ranging from traditional PhD-granting institutions to four-year colleges, museums, and other venues for public lectures. Since 2010 we have had ~300 applications for DLP speaker visits. There have been a total of 39 speakers who gave 139 presentations. These presentations range from standard academic lectures to special lectures in Earth Science courses and evening lectures in museums.

Attendance at individual lectures ranges from tens to a few hundred. The largest attendance thus far (242 people) was at a talk given by Liz Cottrell (Smithsonian Institution) at the IMAX theater in Tallahassee, FL (Figure 5.2). Host schools and institutions are encouraged to videotape the presentations, which are then posted to the GeoPRISMS website for external viewing.

Speakers are invited by the GeoPRISMS Office Director following recommendations and ranking by the GSOC. We choose speakers from across the GeoPRISMS spectrum of disciplines, with attention to gender balance and distribution between early/mid-career and more established scientists. The current DLP speakers are listed in Figure 5.3 and the locations of the lectures since 2010 are shown in Figure 5.4. A full list of MARGINS and GeoPRISMS distinguished lecturers is in appendix A9.

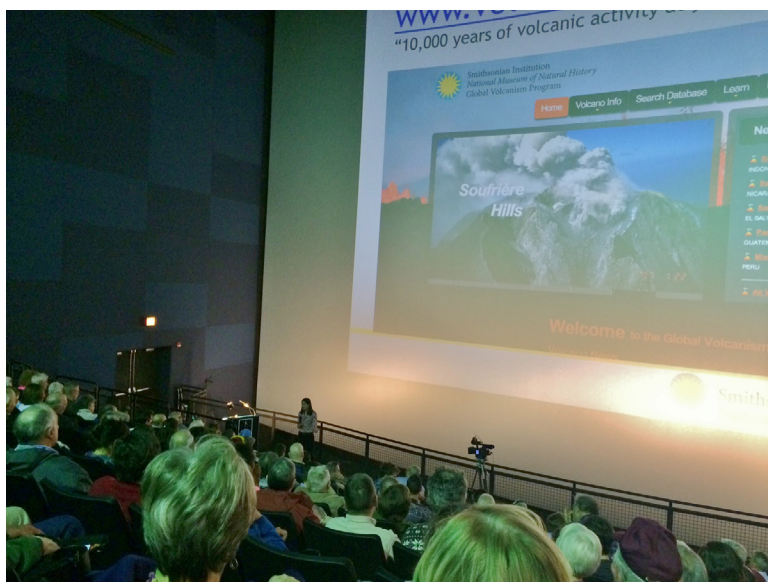


Figure 5.2. DLP Speaker Liz Cottrell at a public lecture in front of 242 participants at the local IMAX Theater during her visit at University of South Florida in February 2015. Photo credit: Shuying Yang.

The impact of the DLP is high. Based on the feedback from speakers and schools (90% complete), we estimate that more than 7000 people have attended lectures discussing GeoPRISMS research. This high impact comes at a modest cost. The average cost to GeoPRISMS per lecture is about \$800 (including honorarium) resulting in an average cost per attendee of only \$16. Nevertheless, in recent years we had to scale down the program from eight to six lecturers due to increases in travel costs (particularly airfares) within a fixed budget. Budget limitations also forced us to limit visits to institutions abroad (as recommended by the DRC) and thus far we have held only one such lecture.

5.2 MARGINS (and GeoPRISMS) Mini-lessons

The MARGINS Mini-Lesson Project, initiated by MARGINS Director Geoff Abers, was reinvigorated during GeoPRISMS by means of a successful NSF DUE grant issued to Julia Morgan at the Rice GeoPRISMS Office. Mini-lessons are modular learning materials that use data resources, visualizations and other information resources to examine and understand fundamental earth processes. This latest project is designed to develop the next generation of data based mini-lessons and to integrate a decade of successful MARGINS research into the upper level undergraduate geoscience curriculum. The project brings together members of the GeoPRISMS Education Advisory Committee (GEAC), prominent scientists from the MARGINS and GeoPRISMS community, as well as curriculum



Figure 5.3. DLP brochure announcing the 2015-2016 lecture program

the [Science Education Resource Center](#) (SERC - directed by Cathy Manduca) at Carleton College. SERC also houses the [MARGINS mini-lessons](#) in their online portal, ensuring ready access and support for a broad range of potential instructors.

The project launched in Spring 2013 and was led by Julia Morgan (Rice), Ellen Iverson, Cathy Manduca (both at Carleton College), Andrew Goodliffe (Alabama), Jeff Marshall (California State Polytechnic Pomona) and Jennifer Beck (EvalArts Consulting). A broader description of the initiative is provided in a [recent GeoPRISMS newsletter](#) provided by Julia Morgan and members of the GEAC. The curriculum development teams draw from a wide spectrum of educators and researchers, listed in Table 5.1.

The mini-lesson authors participated in a series of webinars and virtual workshops, as well as

experts from [On the Cutting Edge](#), a community of geoscience faculty dedicated to improving teaching and student learning. This integration of leading scientists and curriculum experts produces high quality science curricula informed by current educational research and practices.

The original set of mini-lessons was developed under an NSF Course, Curriculum and Laboratory Improvement (CCLI) grant “Using MARGINS data in the Classroom” and resulted in a mix of mini-lessons spanning MARGINS science. An NSF DUE Transforming Undergraduate Education in Science Technology, Engineering and Mathematics (TUES) grant “Bringing NSF MARGINS/GeoPRISMS Continental Margins Research into the Undergraduate Curriculum” was initiated in 2012 and provided the opportunity to synthesize key results of the full decade of MARGINS research, while integrating the existing mini-lesson collection, in order to define a more coherent suite of lessons across the initiatives. Both efforts have been strongly supported by



Figure 5.4. Locations of institutions visited by DLP speakers from 2010-2015.

two face-to-face workshops, during which the structure, content, and pedagogical framework of the mini-lessons was laid out (Figure 5.5). Outside educators were invited to try out the mini-lessons during their development. Their feedback and subsequent peer reviews were crucial for the final refinement of the mini-lessons. The development approach, time-line and availability of the new mini-lessons suite has been presented in several AGU Educational sessions and in presentations at the GeoPRISMS Townhall, in addition to SERC exhibits and Newsletter and listserv announcements. This latest MARGINS mini-lessons project wraps up this summer 2015, when the mini-lessons will finally be released to the public by way of the SERC portal. The MARGINS Mini-Lesson Program has paved the way for the future development of GeoPRISMS Mini-Lessons, defining a model and framework that can be employed by GeoPRISMS PIs as part of their broader impacts. This

SubFac: *Chemical cycling in subduction zones* (Robert Stern, UT Dallas; Ben Edwards, Dickinson College; Sarah Penniston-Dorland, University of Maryland; Chris Kincaid, University of Rhode Island).

SEIZE: *Seismogenic processes at subduction zones* (Casey Moore, UC Santa Cruz; Jeff Marshall, Cal Poly Pomona; Eliza Richardson, Penn State; David Pearson, Idaho State; Sue Cashman, Humboldt State).

RCL: *Rifting processes and feedbacks* (Scott Bennett, USGS Golden CO; Rebecca Dorsey, University of Oregon; Andrew Goodliffe, University of Alabama; Jack Loveless, Smith College; Lisa Lamb, University of St Thomas).

S2S: *Sediment erosion, transfer, and deposition* (Steve Kuehl, Virginia Institute of Marine Science; Lonnie Leithold, North Carolina State; Kathleen Surpress, Trinity University; Adam Hoffman, University of Dubuque).

Table 5.1. Curriculum development teams for the current MARGINS mini-lessons project

will ensure that the latest and best continental margins science can be rapidly incorporated into the undergraduate curriculum.

5.3 Student and Postdoc Opportunities



Figure 5.5. Class demonstration quantifying heat flux during a Carleton workshop on the MARGINS mini-lessons project. Photo credit: Anaïs Férot, GeoPRISMS.

Student Symposia

A significant addition to the new GeoPRISMS Program is enhanced training and engagement of early-career investigators, with particular emphasis on students and postdocs, who will become the next generation of GeoPRISMS scientists. In keeping with this goal, a series of student-centered activities was introduced in association with the primary site implementation workshops. The main component was a one-day Student Symposium scheduled immediately prior to the workshop. Students typically arrive one day early to the meeting, attend a half day of introductory talks on the geology of the primary site, given by experts, discuss their own research through poster presentations (which were then displayed throughout the workshop), and then attend a half-day geologic field trip in the local area (Figure 5.6). The primary goals of these symposia included (a) providing all students with a common background knowledge in preparation for subsequent discussions during the workshop, (b) facilitating interactions between students and senior scientists in a friendly setting, (c) providing an informal forum in which to present their research and hear from their student colleagues, and (d) developing a student cohort that would carry through the workshop and beyond. Students and postdocs also were invited to participate in several other workshop activities, including a best poster competition, a student career dinner, and scribing or leading break-out discussions. Overall, student feedback was extremely positive and the program resulted in a high level of student participation in workshop activities (Table 5.2).

Primary site	Total attendance	Student symposium attendees
Cascadia	173	37 (21%)
Alaska-Aleutians	148	22 (15%)
EARS	108	28 (26%)
ENAM	92	16 (17%; includes postdocs)
New Zealand	145	23 (16%)

Table 5.2. Student participation in the primary site planning workshops



Figure 5.6. Student field trips ahead of the EARS (right) and New Zealand (bottom) site planning symposia. Photo credit: Anaïs Férot, GeoPRISMS.

Student opportunities in GeoPRISMS-funded research projects

The field work and marine cruises associated with GeoPRISMS-funded projects provide unique opportunities for graduate student training, as well as introducing undergraduates to science in the field, and allowing postdocs to hone new skills and supervise field activities. The field work and cruises bring students together with more senior PIs, technical support staff and crew, and provide unique experiences learning how to conduct high quality and interdisciplinary science in the field. For example, many students, typically from the PIs’ home institutions, have participated in PI-driven research projects. However, several community experiments and projects with long or involved deployments have enabled broad calls to students and postdocs across the community to participate in field work or cruises. This model was particularly successful for the Cascadia Initiative (with the [Apply to Sail](#) program hosted by GeoPRISMS), the ENAM community experiment, and the iMUSH project to geophysically image Mount St. Helens.

For the Cascadia Initiative, “Apply to Sail” invitations led to approximately 50 applications per year to fill a limited number of positions. Over five years of operations, a total of 41 graduate students, 25 undergraduates and 3 postdocs participated in the instrument deployment and recovery cruises (Figure 5.7).



Figure 5.7. Left: Samantha Bruce (Adjunct Instructor, College of Charleston) with starfish in front of ROV Jason during a Cascadia Initiative cruise. Bottom: A student checks the status of short period seismometer (photo by Gary Linkevich).



Cruise reports and blogs are available through the [Cascadia Initiative Expedition Team](#) website and a summary of student experiences was published in the [GeoPRISMS Fall 2013 newsletter](#).

The ENAM Community Seismic Experiment (CSE) provided 79 students and young scientists the opportunity to participate in seagoing and/or land-based field

work during several field campaigns (see Nugget by Shillington et al.). These included four different cruises (to deploy and recover OBS instruments and carry out the active source seismic experiment; Figure 5.7) and two campaigns on land. Their experiences were captured well by the [student report](#) published in the Fall 2014 Newsletter and on the [ENAM CSE field blog](#) with many of the blog posts written by participating students. The PIs of the ENAM CSE organized two data processing workshops with a multi-channel seismic workshop at the University of Texas (20 participants) and a seismic reflection workshop at Lamont-Doherty (14 participants). The interest for the workshops and field opportunities was high. The UT workshop alone drew nearly 80 applications, while there were 17 applications for 5 spots on the broadband OBS recovery cruise in March 2015.

There was also strong student participation in the iMUSH field deployments, as [featured in the Spring 2015 newsletter](#). There were more than 250 applications to participate in the active seismic component. From these applications 48 graduate students, 10 undergraduates and 2 postdocs were selected. These students and postdocs came from 29 US institutions and 7 European universities (Copenhagen, Hamburg, Bristol, Lausanne, Free University Berlin, Technical University Berlin and ETH). The passive broadband seismic deployment and retrieval involved 8 graduate students, 6 undergraduates and 1 postdoc. The nodal seismic deployment further involved 8 graduate students and 1 postdoc. The MT component involved a further 8 graduate students, one of whom was chosen from an open application that had 12 interested students.

The GeoPRISMS/EarthScope-sponsored MAGIC project has taken a different approach to student participation in field work. Instead of hosting an open call for applications, the PIs on the

MAGIC project are developing relationships with colleges and universities located near seismic stations (see Nugget by Long and Benoit). The PIs have engaged with faculty and students from 10 institutions, most of which primarily serve undergraduates, who helped install and service stations or host stations on their campuses. In addition to this outreach effort, the MAGIC project is making a particular effort to involve undergraduates in their field campaigns; approximately a dozen undergraduates from Yale and the College of New Jersey have participated in MAGIC field work, benefiting from working closely in the field with PIs, graduate students, and postdocs.

In summary, projects that are sponsored or closely related to GeoPRISMS provide significant opportunities for field experience and hands-on training to a large number of graduate students, undergraduates and postdocs. The calls for applications to sail or to participate in field work are popular and competitive. This provides the essential human resource development necessary to maintain a scientifically well-educated workforce and for the entrainment of new talent in interdisciplinary research on the oceans and on land.

Best Student Presentation Prize Competition at the Fall AGU meeting

The GeoPRISMS Office organizes an annual competition for the best student presentations at the Fall meeting of the American Geophysical Union in San Francisco. This is a continuation of the competition begun during MARGINS and is designed to communicate the breadth of GeoPRISMS science, but also to extend the reach of the program to early-career researchers. Students are invited through newsletter, listserv, website, and Facebook announcements to apply to compete in the program. They submit their abstracts, CVs and short statements of motivation and relevance to GeoPRISMS science, prior to the meeting. Students are not required to work on GeoPRISMS- (or MARGINS-) funded research but their work should fall within the general scope of the GeoPRISMS science objectives. All applicants are also invited to present their research in poster format at the annual Townhall and Student Forum (typically held on Monday evening during AGU week), which offers a friendly and informal opportunity to interact with colleagues and senior scientists (Figure 5.8).

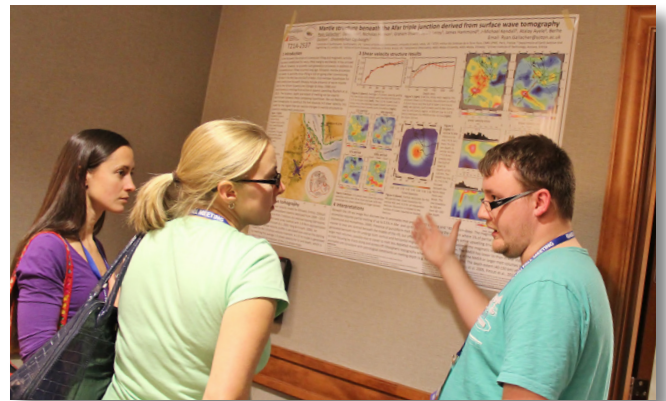


Figure 5.8. Applicants for the Best Student Presentation competition can present their work in poster format at the Townhall and Student Forum at the annual Fall AGU meeting. Photo credit: Anaïs Férot, GeoPRISMS.

Presentation judges are selected from a large pool of former MSC / GSOC and MEAC / GEAC members, former or current postdoctoral fellows, and previous award winners. The recommendations of the judges are evaluated by the GEAC, which decides on the best presentation (one each for oral and poster presentations) and up to two runners-up in each category. The winners receive a cash prize of \$500 and are profiled, along with the runners-up, [in an article on the website](#) and in the newsletter.

The number of applications grew steadily through 2013 (Figure 5.9) before a sudden decline in 2014. Typically there are slightly more female than male applicants and more posters than talks are submitted. In the early years of GeoPRISMS, MARGINS-funded research dominated the submissions but the two GeoPRISMS initiatives have gradually started to dominate the submissions, with more submissions from SCD than RIE. The decline in applications in 2014 appears to be anomalous, and may relate to website or listserv issues leading up to the application deadline. We anticipate an uptick in applications this coming year, particularly with the increase in GeoPRISMS science being carried out.

The list of student presentation award winners since 2010 is provided in Table 5.3. Sixty percent of the winners are female. A full list of winners and runners up is provided in appendix A6.

	<i>Poster</i>	<i>Talk</i>
2014	Andrew Parsons (Leeds)	Kristina Walowski (Oregon)
2013	James Muirhead (Idaho)	Megan Newcombe (Caltech)
2012	Samer Naif (UC San Diego)	Maryjo Brounce (Rhode Island)
2011	Manahloh Belachew (Rochester)	Christie Regalla (Penn State)
2010	Kristin Morell (Penn State)	Linda Chernak (Brown)

Table 5.3. GeoPRISMS Student Presentation Award winners

5.4 Postdoctoral opportunities

The NSF program solicitation for GeoPRISMS encourages applications for GeoPRISMS Postdoctoral Fellowships, which are aimed at providing opportunities for early-career scientists to solidify research skills, build a track record, establish peer relationships, and acquire professional self-confidence. The GeoPRISMS Postdoctoral Fellowship Program issues grants to PIs to support postdoctoral researchers at institutions in the US for up to two years, typically within five years after receipt of their Ph.D. The table below provides the names of the funded postdoctoral researchers or fellows during GeoPRISMS so far. Seven out of the nine postdocs (78%) are female. All who completed their postdoc appointments have since moved into faculty or research positions, and thus are now in the position of training new GeoPRISMS investigators.

FY15	Shuoshuo Han	University of Texas
	Aurore Sybrandt	University of Idaho
FY13	Taryn Lopez	University of Alaska Fairbanks
	Sabine den Hartog	Penn State University
FY12	Abijit Ghosh	University of California at Santa Cruz (now at UC Riverside)
	Haiying Gao	University of Rhode Island (now at the U of Massachusetts).
FY11	Ellen Syracuse	University of Wisconsin Madison (now at Los Alamos National Laboratory)
	John Naliboff	University of California at Davis (now at the Geological Survey of Norway)
	Hiroko Kitajima	Penn State University (now at Texas A&M University)

Table 5.4. Postdoctoral scholars supported by GeoPRISMS including (where appropriate) their current affiliations.

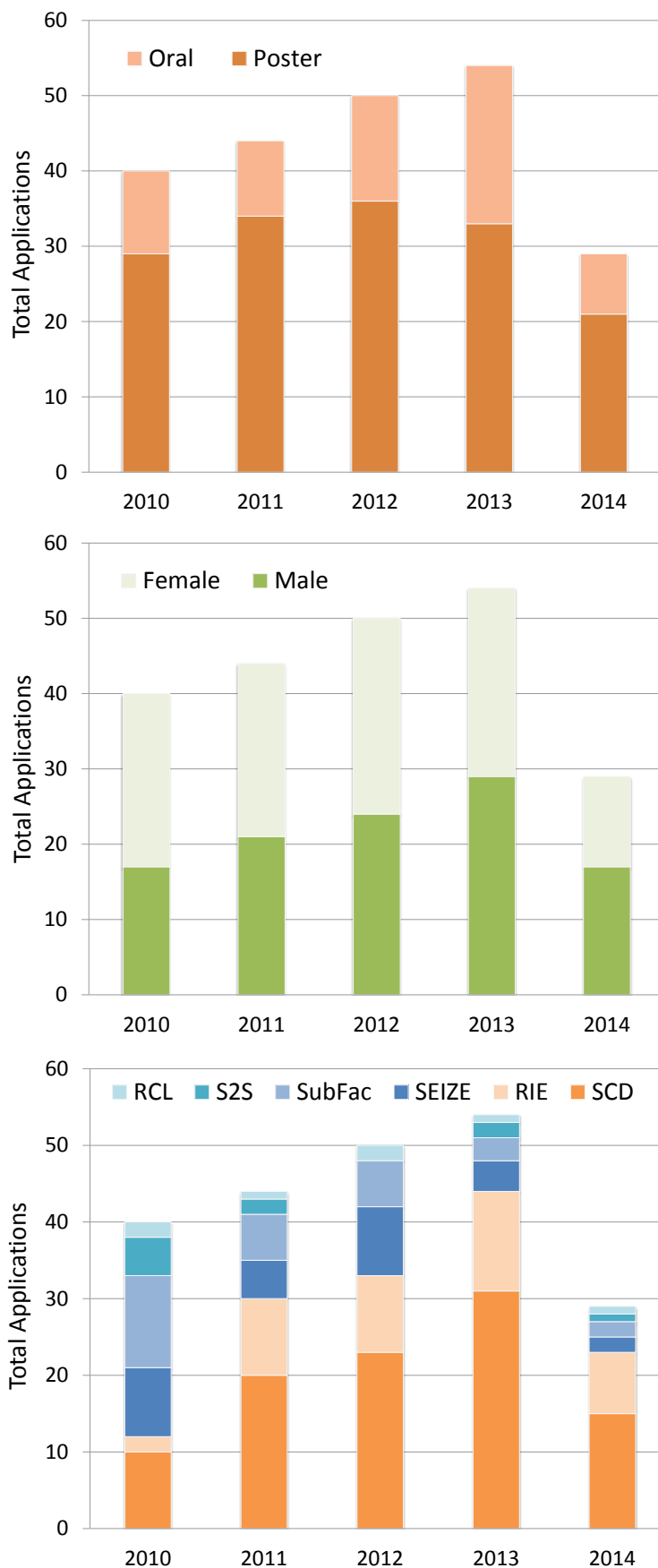


Figure 5.9. GeoPRISMS Best Student Presentation statistics (2010-2014)