Collaborative Research: Geodesy curriculum for the 21st century--Innovative science for addressing societally critical issues

Project Period: 07/01/2013-06/30/2018 (original end date 6/30/16 extended to 2018)

Principal Investigators: Meghan Miller (PI), Donna Charlevoix (Co-PI), Beth Pratt-Sitaula (CoPI)

Sponsor: NSF DUE-TUES

Award ID: 1245025

Collaborators: Bruce Douglas (Indiana University), Rebecca Walker (Mt San Antonio College)

Screen shot of fifth published GETSI classroom module called “Surface Process Hazards”. Students use lidar and InSAR data to better understand landscapes and landslides.
Outcomes Statement for General Public

Recent technological innovations in geodesy (the measurement of the size, shape, and mass distribution on Earth and changes over time) have allowed a wide range of advances in our understanding of Earth processes on topics critical to society such as natural hazard mitigation, climate change, and water resource management. GETSI (GEodetic Tools for Societal Issues; [http://serc.carleton.edu/getsi](http://serc.carleton.edu/getsi)) is a curriculum development and dissemination project to increase the representation of geodetic data use by both introductory and majors-level undergraduate students. GETSI collaborating institutions are UNAVCO, Mt. San Antonio College, and Indiana University. Science Education Resource Center (SERC) and National Association of Geoscience Teaching (NAGT) were also critical partners. The curriculum development model was adapted from SERC’s InTeGrate project and used evidence best practices for STEM education and rigorous review process. Additional details were informed by two charrettes and a survey to gather community input. The project produced and disseminated five teaching modules for introductory and majors-level undergraduate courses:

- Ice Mass and Sea Level Changes (Introductory)
- Surface Process Hazards (Introductory)
- Imaging Active Tectonics with InSAR and Lidar Data (Majors Level)
- GPS, Strain, and Earthquakes (Majors Level)
- Measuring Water Resources with GPS, Gravity, and Traditional Methods (Majors Level)

The project also developed animations and an online interactive tool for viewing earthquake data, designed and implemented a variety of in-person and virtual professional development activities for instructors, and published a data-rich geoscience curriculum developer’s manual ([http://serc.carleton.edu/getsi/develop](http://serc.carleton.edu/getsi/develop)).

The positive results from the module testing and evaluation of student work show that the modules have the capacity to support students in achieving the learning goals set for each module. The development and design cycle and careful multi-checkpoint review using the GETSI Materials Design Rubric was shown to be a robust process for achieving high quality teaching resources.

Feedback from the short courses and webinars indicate that participants felt that they were of high quality. For example at the short course held in conjunction with AGU, participants said their satisfaction with the course was 9 out of 10. All participants also indicated plans to use elements of at least two modules and 85% stating intention to use elements of all three that were included in the course.
Accomplishments

What are the major goals of the project?

Recent technological innovations in geodesy (the measurement of the size, shape, and mass distribution on Earth and changes over time) have allowed a wide range of advances in our understanding of Earth processes on topics critical to society such as natural hazard mitigation, climate change, and water resource management. Undergraduate teaching resources have not kept pace. GETSI (GEodetic Tools for Societal Issues) is a curriculum development and dissemination project to increase the representation of geodetic data use by both introductory and majors-level undergraduate students. GETSI is partnered with the SERC (Science Education Resources Center) InTeGrate project (Interdisciplinary Teaching about Earth for a Sustainable Future) for curriculum design, assessment, evaluation, and web hosting. The project will produce five modules that encompass about two weeks of class time each – two at the introductory level and three at the majors’ level.

Overarching Objectives

1. Improve geoscience (particularly geodetic) knowledge base of undergraduate students both for general science literacy (introductory) and future science workforce (majors-level).
2. Improve effectiveness of teaching resources and pedagogy employed by faculty members teaching geodesy, geoscience, and allied sciences.

TUES Type 1 Outputs

1. Development, testing, revision, and dissemination of five curricular modules featuring geodesy data investigations on societally important topics which support Earth science and quantitative literacy at both introductory and majors’ levels in diverse academic settings.
2. Developers’ manual to facilitate future integration of geodesy and other data into teaching materials.
3. Support for faculty in integrating curriculum into courses

TUES Type 1 Outcomes

1. Students:
   a. Are able to apply authentic geodetic data and quantitative reasoning to addressing critical societal issues
   b. Have improved understanding of nature and methods of science
   c. Gain better understanding of relevant geoscience and climate literacies and the ability to apply them to critical resource, hazard, and environmental issues

2. Faculty
   a. Adopt developed geodesy curriculum modules
   b. Include more connections between authentic data and addressing of critical societal issues
   c. Increase use of promising pedagogical practices in STEM education
   d. Use systematic assessment of student learning
What was accomplished under these goals?

Major Activities

1. Conducted two webinar charrettes (n=25) and a survey (n=63) to gather input from geoscience instructors as to what types of geodetic curriculum they saw as beneficial.
2. Developed website with comprehensive information for both faculty users and author team members.
3. Development, testing, revision, and publication of five curricular modules featuring geodetic data and methods applied to critical societal issues. [http://serc.carleton.edu/getsia](http://serc.carleton.edu/getsia)
   a. Ice Mass and Sea Level Changes [intro level]
   b. Imaging Active Tectonics with InSAR and Lidar data [majors level]
   c. GPS, Strain, and Earthquakes [majors level]
   d. Measuring Water Resources with GPS, Gravity, and Traditional Methods [majors level]
   e. Surface Process Hazards [intro level]
4. To support the desired learning outcomes in the modules, UNAVCO and GETSI also joined in collaborations with several other organizations in order to
   a. Develop four animations that are used to support learning in three of the modules ([https://www.youtube.com/playlist?list=PLzmugeDolFOot41MIBBZiLYBCB0M-p1P](https://www.youtube.com/playlist?list=PLzmugeDolFOot41MIBBZiLYBCB0M-p1P))
      i. Measuring Drought: A GPS Network Offers A New Perspective
      ii. Glaciers are retreating: How can we measure the full ice loss?
      iii. What can GPS tell us about future earthquakes?
      iv. GPS and Earthquake Early Warning
   b. Develop an online interactive tool for modeling InSAR earthquake data – Visible Earthquake ([https://earthquakes.aranzgeo.com/](https://earthquakes.aranzgeo.com/))
6. Provided professional development to undergraduate geoscience instructors
   a. In addition to the two instructor PIs, six other module authors gained significant experience with curriculum development and high quality STEM pedagogy. Another four module pilot testers also received substantial professional development on curricular development and testing.
   b. Four modules were featured in three webinars held in collaboration with the InTeGrate Project ([http://serc.carleton.edu/integrate/workshops](http://serc.carleton.edu/integrate/workshops))
      i. Using Data to Teach About Societally Important Questions (47 participants)
      ii. Addressing Water Resources and Sustainability in Upper-level Undergraduate Courses (28 participants)
      iii. Addressing Earthquake Hazards with LiDAR, GPS, and InSAR in Upper-level Undergraduate Courses (49 participants)
   d. Full-day short course held in conjunction with the American Geophysical Union (AGU) annual meeting 2016 “Hooking undergraduates into geophysics data and methods through societally important issues” with 26 participants ([http://www.unavco.org/education/professional-development/short-courses/2016/agu-education/agu-education.html](http://www.unavco.org/education/professional-development/short-courses/2016/agu-education/agu-education.html))
7. Launched feedback surveys to gather responses from faculty users of GETSI curricular modules (http://serc.carleton.edu/getsi/share_experience.html)
8. Various project PIs presented on project activities at annual meetings of AGU, GSA, and Earth Educators Rendezvous.
9. Information about the modules was disseminated at UNAVCO booths at AGU and GSA annual meetings and through listservs, news feeds, and social media of UNAVCO and NAGT.

Specific Objectives

At this point, nearly all elements of the three Outputs have been completed, as well as progress towards the Overarching Objectives, the scope of which extends beyond just this Phase 1 “exploratory” project.

Output #1 was completed. All five modules have been published.

Output #2 was completed with the publication of the “Data-rich Geoscience Curriculum Developer’s Manual” (http://serc.carleton.edu/getsi/develop)

Output #3 was completed above the level originally specified in the proposal. Not only did GETSI do a series of webinars but the project also presented GETSI modules in two short courses (see above).

Overarching Objective #1 relates to student knowledge. The positive results from the module testing and evaluation of student work show that the modules have the capacity to support students in achieving the learning goals set for each module. The development and design cycle and careful multi-checkpoint review using the GETSI Materials Design Rubric (http://serc.carleton.edu/getsi/info_team_members/forms_docs/index.html#assess) was shown to be a robust process for achieving high quality teaching resources.

Overarching Objective #2 relates to the quality of faculty teaching and use of high quality teaching resources. The feedback from the short courses and webinars indicate that participants felt the they were of high quality. For example at the short course held in conjunction with AGU, participants said their satisfaction with the course was 9 out of 10. All participants also indicated plans to use elements of at least two modules and 85% stating intention to use elements of all three that were included in the course.

Opportunities for training and professional development?

GETSI materials authors and pilot testers receive professional development related to pedagogical best practices for geoscience teaching. Participants in webinars and short courses receive professional development related to both pedagogy and geodesy content.

How have results been disseminated to communities of interest?

As described above in Major Activities Output #3, modules have been disseminated via a short courses, webinars, conference booths, conference presentations, listservs, and websites. GETSI is also featured on the UNAVCO website as a major project (http://www.unavco.org/projects/projects.html#Major) giving it prominence beyond just the Educational section, which tends to be limited to a smaller subset of the UNAVCO community.
Products

Conference Papers and Presentations

Title: Innovations in making EarthScope science and data accessible
Conference: American Geophysical Union Annual Meeting 2013
Location: San Francisco, CA
Authors: Beth Pratt-Sitaula, Robert Butler, Jill Whitman, Frank Granshaw, Robert Lillie, Nancee Hunter, Vince Cronin, Phillip Resor, Shelley Olds, Meghan Miller, Rebecca Walker, Bruce Douglas

Title: GETSI Project: GEodesy Tools for Societal Issues – An initiative to create teaching modules for undergraduates based on the application of geodetic data sets
Conference: UNAVCO Science Workshop 2014
Location: Broomfield, CO
Authors: Bruce Douglas, Beth Pratt-Sitaula, Becca Walker, Meghan Miller

Title: GEodesy Tools for Societal Issues (GETSI): Undergraduate curricular modules that feature geodetic data applied to critical social topics
Conference: American Geophysical Union Annual Meeting 2014
Location: San Francisco, CA
Authors: Bruce James Douglas, Beth Pratt-Sitaula, Becca Walker, Meghan Miller and Donna Charlevoix

Title: Using geodetic data to teach about changes in ice mass and sea level in introductory courses
Conference: American Geophysical Union Annual Meeting 2014
Location: San Francisco, CA
Authors: Leigh Stearns, Becca Walker, and Beth Pratt-Sitaula

Title: Use of geodetic data in the introductory geoscience classroom: components of the GETSI project’s Ice Mass and Sea Level Changes module
Conference: Geological Society of America Annual Meeting 2015
Authors: Becca Walker, Leigh Stearns, Beth Pratt-Sitaula

Title: Undergraduate teaching modules featuring geodesy data applied to critical social topics (GETSI: GEodetic Tools for Societal Issues) [invited]
Conference: American Geophysical Union Annual Meeting 2015
Location: Baltimore, MD
Authors: Beth Pratt-Sitaula, Becca Walker, Bruce Douglas, Donna Charlevoix, Meghan Miller

Title: Teaching With Geodesy Methods and Data
Conference: UNAVCO Science Workshop 2016
Location: Broomfield, CO
Authors: Beth Pratt-Sitaula, Bruce Douglas, Becca Walker, Christopher Crosby, Katherine Shervais, Donna Charlevoix

Title: Data-rich societally-relevant undergraduate teaching resources for geoscience classrooms and field courses
Conference: Earth Educators Rendezvous 2016
Location: Madison, WI
Authors: Donna Charlevoix, Beth Pratt-Sitaula, Bruce Douglas, Becca Walker, Christopher Crosby, Katherine Shervais

Title: Data-rich societally-relevant undergraduate teaching resources for geoscience classrooms and field courses
Conference: Geological Society of America Annual Meeting 2016
Location: Denver, CO
Authors: Beth Pratt-Sitaula, Bruce Douglas, Becca Walker, Benjamin Crosby, Donna Charlevoix, Christopher Crosby, Katherine Shervais

Title: Societal challenges-oriented data-rich undergraduate teaching resources for geoscience classrooms and field courses
Conference: American Geophysical Union Annual Meeting 2016
Authors: Beth Pratt-Sitaula, Becca Walker, Bruce Douglas, Benjamin Crosby, Donna Charlevoix, Christopher Crosby, Katherine Shervais

Title: Activities, Animations, and Online Tools to Enable Undergraduate Student Learning of Geohazards, Climate Change, and Water Resources
Conference: American Geophysical Union Annual Meeting 2017
Location: New Orleans, LA
Authors: Beth Pratt-Sitaula, Becca Walker, Bruce Douglas, Vince Cronin, Gareth Funning, Leigh Stearns, Donna Charlevoix, Meghan Miller

Websites
GETSI - GEodesy Tools for Societal Issues
http://serc.carleton.edu/getsit/index.html
This is the GETSI project website. It gives background information on the project and is the primary publication site of the teaching modules when they are complete. Development workspaces allow for internal project notes and draft module text. It also provides an archive of webinars and workshops as well as background information on geodesy.

Participants

Individuels
Meghan Miller UNAVCO PI 0 Months
As the UNAVCO President Miller is responsible for coordination with the science community and the successful accomplishment of the work. She is paid entirely out of indirect as her work is for the proportional benefit of all awards; thus she does not draw salary on this grant.

Donna Charlevoix UNAVCO Co-PI 0 Months
As the Director of UNAVCO’s Education and Community Engagement, Charlevoix is also responsible for coordination with the science community and the successful accomplishment of the work. Her salary is covered through the NSF GAGE Facility Cooperative Agreement.
Beth Pratt-Sitaula    UNAVCO    Co-PI    6 Months
A UNAVCO Educational Specialist, Pratt-Sitaula served as the GETSI facilitator in charge of project logistics and communication. She coordinated between UNAVCO, the authors, technical experts, beta-testers, SERC, NAGT, and related organizations. She led dissemination (meeting presentations, journal papers, articles, website content, webinars). Pratt-Sitaula’s funding to work on GETSI was from this NSF TUES grant.

Austin Madson    UNAVCO    Student    4 Months
Madson was a UNAVCO Summer Internship Program (USIP) intern in summers 2014 and 2015. He worked on data processing and map generation in support of the modules. He was paid primarily through the USIP program, which is funded by NSF GAGE Facility, with some additional funds from this NSF TUES grant for follow-up work.

Gareth Funning    UC Riverside    Faculty    1 Month
Funning served as module co-author with collaborator Bruce Douglas (Indiana University) on the majors-level module "Imaging Active Tectonics". He also helped present two short courses and a webinar. His full time job is as a faculty member at UC Riverside. This NSF TUES grant paid him a total of $8100 stipend over the period of work on module development, revision, and dissemination.

Leigh Stearns    Univ. of Kansas    Faculty    1 Month
Stearns served as module co-author with collaborator Becca Walker (Mt San Antonio College) on the introductory level module "Ice and Sea Level Changes". Her full time job is as a faculty member at University of Kansas. This NSF TUES grant paid her a total of $7500 stipend over the period of work on module development and revision.

Phil Resor    Wesleyan Univ    Faculty    1 Month
Resor served as module co-author on the majors-level module "GPS, Strain and Earthquakes". He also helped present a webinar. His full time job is as a faculty member at Wesleyan University. This NSF TUES grant paid him a $1500 stipend.

Vince Cronin    Baylor Univ    Faculty    1 Month
Cronin served as module co-author on the majors-level module "GPS, Strain and Earthquakes". He also helped teach a short course. His full time job is as a faculty member at Baylor University. This NSF TUES grant paid him a $2100 stipend.

Eric Small    Univ. of Colorado    Faculty    1 Month
Small served as module co-author with collaborator Bruce Douglas (Indiana University) on the majors-level module “Measuring Water Resources”. His full time job is as a faculty member at University of Colorado. This NSF TUES grant paid him a total of $7500 stipend over the period of work on module development and revision.

Sarah Hall    Coll. of the Atlantic    Faculty    1 Month
Hall served as module co-author with collaborator Becca Walker (Mt San Antonio College) on the introductory level module “Surface Process Hazards”. Her full time job is as a faculty member at College of the Atlantic. This NSF TUES grant paid her a total of $7500 stipend over the period of work on module development and revision.

Jenda Johnson    Volcano Video Productions    0 month
Johnson produced the animations about GPS-ice mass and GPS-groundwater, in
collaboration with Pratt-Sitaula and authors. She was paid through a combination of NSF GAGE and this NSF TUES grant.

Rowan Cockett 3Point Science 1 month
Cockett was the lead programmer for the Visible Earthquake InSAR Tool. He was paid by this NSF TUES grant.

Ellen Iverson SERC 2 month
Iverson was the lead assessment consultant and external evaluator for the GETSI project. She was paid by SERC (Science Education Resources Center) via a subaward from this NSF TUES grant.

Stuart Birnbaum SERC 2 month
Birnbaum was the assessment consultant for the majors-level modules. He was paid by SERC (Science Education Resources Center) via a subaward from this NSF TUES grant.

Monica Bruckner SERC 1 month
Bruckner was the webmaster for the GETSI project later in the project. She supported any team needs related to the SERC-hosted GETSI website and all issues related to submission of student data for assessment review. She was paid by SERC (Science Education Resources Center) via a subaward from this NSF TUES grant.

Kristin O'Connell SERC 1 month
O'Connell was the webmaster for the GETSI project earlier in the project. She supported any team needs related to the SERC-hosted GETSI website and all issues related to submission of student data for assessment review. She was paid by SERC (Science Education Resources Center) via a subaward from this NSF TUES grant.

Organizations

Type: Academic Institution
Name: SERC (Science Education Resource Center)
Location: Northfield, MN
Contribution: Assessment and evaluation; dissemination
Details: SERC provided assessment design, external evaluation, and project dissemination through a subaward. GETSI module design and assessment followed the model of SERC’s InTeGrate project. Expert assessment consultants reviewed modules. Student data was collected using the InTeGrate online collection system. SERC is also hosting the GETSI website and providing content management assistance for the site and webinars. As needed, GETSI announcements go out through SERC channels to the wider geoscience community. Ellen Iverson, SERC Director of Evaluation, provided external evaluation of the GETSI project (see Appendix for SERC Final Evaluation Report).

Type: Other Nonprofits
Name: National Association of Geoscience Teachers (NAGT)
Location: Northfield, MN
Contribution: Collaborative Research
Details: NAGT is collaborating with GETSI on dissemination. For example, as part of publicizing GETSI webinars, announcements went out on NAGT listservs.
Name: American Geophysical Union  
Contribution: Collaborative Research  
Details: AGU collaborated on the hosting and recruiting for the short course held immediately before AGU annual meeting 2016.

Type: Academic Institution  
Name: University of Houston  
Contribution: Collaborative Research, Financial Support  
Details: The UH project “Integrating GPS and LIDAR Into Geoscience Education” co-sponsored with GETSI, the short course immediately before AGU annual meeting 2016

Impacts

What is the impact on the principal discipline?

Geodesy encompasses an increasingly important set of geoscience methods for better understanding earth processes. Its scope has greatly increased from early applications of surveying and tectonic plate motions to include critical insights into natural hazards (e.g., earthquake, volcanoes, landslides), climate change (e.g., ice mass and sea level change), and water resources (e.g., groundwater storage and change). However, the field remains fairly technical and access to many data sets is limited or has substantial technical barriers. Therefore undergraduate students are seldom given the chance to analyze geodesy data. This is a critical omission for a toolbox of techniques needed for the next generation of science literate citizens and geoscience workforce members. GETSI is working to address part of this gap through the development and dissemination of high quality teaching modules for both introductory and majors-level courses that feature geodesy data analysis.

What is the impact on society beyond science and technology?

As our global population continues to increase, living in ever more marginal lands with ever-increasing temperatures and decreasing water resources, our ability to mitigate effectively for natural hazards, respond to climate changes, and manage our common resources becomes ever more critical. The GETSI project is focusing the study of earth science through the lens of societally important questions. The aim is to increase students’ (future citizens’) ability to analyze and address these challenges.

Changes/Problems

Actual or Anticipated problems or delays and actions or plans to resolve them

The module publication took longer than originally anticipated for several of the modules but everything was finished in the end. Similarly gathering feedback from instructors was delayed, but ultimately completed.
Appendix – Report from External Evaluator

Final Evaluation Report
Prepared for GETSI by
Ellen Iverson, Director of Evaluation
Science Education Resource Center (SERC) at Carleton College

Summary and Logic Model

A. INPUTS
- NSF Funding
- UNAVCO
- TUES partner colleges, universities, and faculty
- SERC
- NAGT Geodesy community
- Earth science teaching community feedback

B. OVERARCHING OBJECTIVES
1. Improve geoscience (particularly geodetic) knowledge base of undergraduate students both for general science literacy (introductory) and future science workforce (majors-level).
2. Improve effectiveness of teaching resources and pedagogy employed by faculty members teaching geodesy, geoscience, and allied sciences.

C. TUES TYPE 1 OUTPUTS
1. Development, testing, revision, and dissemination of four curricular modules featuring geodesy data investigations which support Earth science and quantitative literacy at both introductory and majors’ levels in diverse academic settings
2. Developers’ manual to facilitate future integration of geodesy and other data into teaching materials.
3. Support for faculty in integrating curriculum into courses.

D. TUES TYPE 1 OUTCOMES
1. Students:
   a. Are able to apply authentic geodetic data and quantitative reasoning to addressing critical societal issues
   b. Have improved understanding of nature and methods of science
   c. Gain better understanding of relevant geoscience and climate literacies (Table 1) and the ability to apply them to critical resource, hazard, and environmental issues
2. Faculty:
   a. Adopt developed geodesy curriculum modules
   b. Include more connections between authentic data and addressing of critical societal issues
   c. Increase use of promising pedagogical practices in STEM education (e.g., Froyd, 2008)
   d. Use systematic assessment of student learning

E. LONG TERM OUTPUTS
1. Development, testing, revision, and publication of a larger collection of curricular modules featuring geodesy.
2. Support faculty in integrating curriculum into diverse institutions and course settings across the USA.

Figure 1 GETSI Logic Model

The logic model (figure 1) outlined in the proposal guided work on this project. Overall, the project met or exceeded its goals in outputs, outcomes, and long term outputs through ongoing community engagement. This evaluation report summarizes four years of evaluation progress and findings for the GETSI Geodesy Tools for Societal Issues project. In addition to meeting the outputs and outcomes, two areas of success are worth noting: 1) This project prioritized community engagement early and throughout its timeline. Early indicators from web usage, webinar attendance, and faculty requests for instructor materials demonstrate remarkable success in a short period of time and 2) This project provided a proof of concept of adapting a materials development process and design rubric from another geoscience NSF project (InTeGrate) successfully. It demonstrates how collaboration across NSF funded projects can yield to products that are of high quality and use to impact faculty teaching and student learning.
Engaging the Broader Community

The project met its intended goals of both engaging the community early in the project and connecting back to the community with support for integrating new geodetic materials in their courses.

Early Community Engagement Events

In the first year of the project, Dr. Beth Pratt-Sitaula facilitated two webinars for the 25 faculty who applied to be part of a virtual dialogue about geodesy teaching resources. The end of event survey indicated high satisfaction with the webinar (8.9 out of 10). The participants of the webinars indicated that teaching resources that integrated geodetic data would be valued in introductory and majors courses.

Final and Ongoing Community Engagement

In this final year of the project, Project leadership continued to engage the broader community with the completed materials. Event efforts have included webinars (via the InTeGrate webinar series) and a short-course at AGU (see Table 1). These efforts connected with the community both synchronously and asynchronously via the website.

Table 1 Community Engagement Event Measures

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<th>Engagement product</th>
<th>Engagement Measures</th>
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| Using Data to Teach about Societally Important Questions, offered on March 23, 2016 which featured GETSI Ice Mass and Sea Level Changes module along with InTeGrate Earth Modeling module. | • 82 registered participants  
• 39 participated in scheduled discussion  
• 12 completed end of event survey reporting high satisfaction (9.2 out of 10)  
• 560 users (to date) viewed the webinar page |
| Webinar: Addressing Water Resources and Sustainability in Upper-level Undergraduate Courses, offered October 6, 2016. Webinar highlighted teaching strategies and examples that help students consider water resources and sustainability using real data | • 83 registered participants  
• 28 participated in scheduled discussion hour  
• 18 completed end of event survey reporting high satisfaction (9.1 out of 10)  
• 252 users (to date) viewed the webinar page |
| Webinar: Addressing Earthquake Hazards with LiDAR, GPS, and InSAR in Upper-level Undergraduate courses, offered April 13, 2017. Webinar featured two modules intended for upper-level geoscience courses that feature learning about active tectonics through these geodetic methods and motivated by improved societal preparedness for earthquakes | • 122 registered participants  
• 50 participated in scheduled discussion hour  
• 11 completed end of event survey reporting high satisfaction (8.5 out of 10)  
• 489 users (to date) viewed the webinar page |
| AGU Short Course on December 11, 2016                                             | • 33 participants                                                               |
gave instructors hands-on experience with curricular modules that feature LiDAR, InSAR, GPS, and structure from motion (SfM) photogrammetry data and methods for both classroom and field courses

The website usage has continued to grow (see Table 2) with overall 4,753 unique users. In addition, 46 faculty have requested access to the password protected instructor materials, a particularly powerful measure of planned use in specific courses.

Table 2 Website Usage

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<thead>
<tr>
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<th>Pageviews</th>
<th>Unique pageviews</th>
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<tbody>
<tr>
<td>January – December 2015</td>
<td>5114</td>
<td>3823</td>
</tr>
<tr>
<td>January – December 2016</td>
<td>11906</td>
<td>8980</td>
</tr>
<tr>
<td>January 2015 to May 2017</td>
<td>24036</td>
<td>18237</td>
</tr>
</tbody>
</table>

Outputs and Outcomes

Materials Developed

As proposed the project produced a Developers Manual webpage and Curriculum Modules. The original proposal had identified two introductory and two majors’ modules. The project actually produced five modules with an additional majors’ module.

Developers manual. A webpage that describes key elements, design steps, and lessons learned in the GETSI materials development. The page has had modest use (64 unique pageviews). While the original manual was envisioned to include case stories, the instructor stories are now included as part of the teaching materials which has received more significant web usage.

Module development. As proposed the materials successfully adapted the InTeGrate Step Center process and design rubric. Face-to-face kick off workshops were instrumental in the development of 4 of the 5 modules. The workshops provided a venue to establish working relationships, define timelines and communication plans, review processes, and begin module development. Pratt-Sitaula and either Iverson or the assessment consultant, Dr. Stuart Birnbaum, reviewed the materials against the design rubric prior to pilot testing. The rubric was critical in providing feedback to the module authors on areas of concern. This led to high quality materials prior to field testing.

Student outcomes. The Year 1 modules were piloted in 6 courses, involving over 113 enrolled students. The Year 2 modules were piloted in 8 courses, involving over 140 enrolled students. Summative assessments of student work was sampled across the three field sites for each module. These assessments were scored by Pratt-Sitaula and either Iverson or Birnbaum, using a rubric that identified to what extent the student work met the goals of the module and exhibited the guiding principles of the GETSI project. Pratt-Sitaula used the results of the
scoring of student work to inform the revision plans for the module authors. This ensured that the finished materials included assessments where students would be able to demonstrate successful learning aligned to the learning goals of the module.

**Faculty reflections.** A faculty reflection survey was received by five of the faculty who had authored materials. Faculty reported challenges in managing development schedules with team members at different institutions who had different competing demands. Faculty also reported how excited they were about the completed materials. Three faculty (non-authors) also completed a reflection about their use of the materials in their course. They reported on how the materials was used, what aspects of worked well and which were challenging in their course. The specific comments related to the module were useful in revision of the materials. One overarching theme across these field testers rested in the challenges students had in communicating about the data.