NATIONAL SCIENCE FOUNDATION
Directorate for Education and Human Resources (EHR)
Division of Undergraduate Education (DUE)
Advanced Technological Education (ATE)

<u>**Annual Report For:**</u>
<u>**GeoTech—The National Geospatial Technology Center of Excellence**</u>
<u>**May 2010**</u>

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EXECUTIVE SUMMARY

This report details the accomplishments of the NSF DUE ATE (0801893) funded National Geospatial Technology Center of Excellence (GeoTech) during its second year of operation (Sept. 1, 2009—August 31, 2010). The Center will be concluding the second year of operation of its initial four year grant (2008-2012) in August 2010

The major successes of the second year of operation are based on the carefully crafted recommendations of the National Visiting Committee, under the leadership of Deidre Sullivan, PI and Director of the MATE Center. The specific recommendations of the NVC were followed faithfully by the CoPI team. Because of these recommendations, the GeoTech Center was able to avoid mission-creep, and focus on several clearly-delineated goals for the second year that have resulted in several significant accomplishments.

The Center was able to engage the Dept. of Labor (DOL) to complete their *Geospatial Technology Competency Model* (GTCM). After spending nearly $8M and four year, the DOL's GTCM effort had stalled. By careful design and execution, the Center has been able to successfully complete the initial draft of the GTCM. This seminal document will provide the foundation for remainder of the Center efforts—from professional development to curriculum material to articulation best practices. The GTCM has been completed in draft form (May 1, 2010), and is due for publication on the Dept's Competency Model Clearinghouse after June 1, 2010. Along with the GTCM, the Center has also completed its research on the Meta-DACUM Analysis of Common Core Competencies for GIS Technologist. This research supports the GTCM with detailed data to complete the upper tiers of the GTCM. Together, these two documents provide a basis for future success of the Center by providing an industry-recognized foundation for all of our academic work.

On the technology front, the Center has been highly successful in the wide-spread adoption of remote desktop access (RDA) technology to allow learners and teachers in remote schools and colleges to access server-based GIS application software. This revolutionary method of pushing geospatial technology into formerly inaccessible locations allows learners in underserved areas, such as rural or Title 1 schools, to access the latest in GIS. Before the RDA model, the use of GIS application software was limited to those schools and colleges able to afford the technology, and support staff required to install and maintain it. Now, with RDA, the Center is delivering GIS application software to underserved middle schools in Georgia, remote colleges in Kentucky, and Title 1 schools in poor and rural South Texas.

People

- Phillip Davis—Principle Investigator (PI). Professor Computer Science, Del Mar College, Corpus Christi TX.
- Vincent A. DiNoto—CoPI, Dean of College and Systemic Initiatives Professor of Physics and Astronomy. Jefferson Community and Technical College, Louisville KY.
- Mike Rudibaugh—CoPI. Geography/GIS Instructor, Lake Land Community College, Matoon IL.
- Chris Semerjian—CoPI. Assistant Director, Lewis F. Rogers Institute for Environmental & Spatial Analysis, Gainesville State College, Gainesville GA.
- Ken Yanow—CoPI. Ken Yanow Professor of Geographical Sciences, Southwestern College, San Diego CA.
- Ann Johnson—CoPI. Outreach Manager GeoTech Center, Del Mar College, Beatty NV.
- David DiBiase—CoPI. David DiBiase, Director John A. Dutton e-Education Institute College of Earth and Mineral Sciences, The Pennsylvania State University
- Ming-Hsiang Tsou—Senior personnel, Associate Professor Geography Department, San Diego State University, San Diego CA.
- Christine Lewis—Senior personnel.
- Amy Ballard—Senior personnel. CMS Instructor, GIT/Geomatics Applied Technologies Dept. Chair Central New Mexico Community College, Albuquerque NM.
- Amy Work—Senior personnel. GIS Analyst & Education Coordinator Institute for the Application of Geospatial Technology, Cayuga Community College, Auburn NY.
- Rodney Jackson—Senior personnel. Program Chair, Geospatial Technology Geomatics & Sustainability Division, Central Piedmont Community College, Charlotte NC.
- John Johnson—Senior personnel.
- Angie Milakovic—Senior personnel. Assistant Professor of Geographic Information Systems Bismarck State College, Bismarck ND

Organizations

The Penn State University. CoPI David DiBiase of the Dutton e-Learning Institute @ Penn State University is our lead researcher on the effort to establish a Common Core Competency model within the well established GIS&T Body of Knowledge work. David is working with the Department of Labor, Employment Training Administration, Business Relations Group and the GIS Certification Institute (GISCI) to create entire new Standard Occupation Guidelines to precisely define the entry level GIS Technician standard. Through a series of DACUM workshops, meta-analysis of previous geospatial workforce studies, and extensive vetting with professional organizations and societies, like GISCI, the GeoTech Center will establish national standards of GIS Technician Common Core Competencies that will form the basis of national articulation and certification models.

Central New Mexico Community College. Senior personnel Amy Ballard provides summer workshops for geospatial educators in the New Mexico region on behalf of the Center. Amy

works closely with surveyors and other geospatial employers in the Albuquerque area to secure meaningful internships and work experience for your GIS students and graduates. She is an active member of the New Mexico Geographic Alliance and well-known throughout the area as a stellar geo-educator, supporting mapping projects throughout her are. She is also an active member of the ASPRS, Rio Grande Chapter.

Institute for the Application of Geospatial Technology (IAGT). Senior personnel Amy Work provides leadership in the areas of K-12 teacher education and development as well as our international program. She is responsible for the development of international research opportunities for college faculty and undergraduate students.

Environmental Systems Research Institute, Inc. (ESRI) is our major industry partner and provides unlimited access to its software, online training, campus facilities nationwide, and personnel to assist the GeoTech Center in training learners and educators about GIS application software.

Central Piedmont Community College. Senior personnel Rodney Jackson provides year-round training to workforce, K-12 educators, and learners on behalf of the Center. He also provides access to distance learning modules and courses that will become part of our professional development offering through the resource repository.

Lake Land College. CoPI Mike Rudibaugh is responsible for the creation of our national geospatial educator's map which will document the precise location and information of all existing community college geospatial programs. This map will serve as the foundation of our marketing, research, and dissemination efforts for our public-facing website.

Kentucky Community & Technical College System (KCTCS). CoPI Vince DiNoto leads the technology component of the GeoTech Center in our effort to demonstrate the use of desktop virtualization of GIS application software. Under Vince's leadership, the Center will create an online ArcGIS web service whereby we can demonstrate the use of virtualization to allow colleges and secondary schools to participate in GIS application software without the need for complex local installation, maintenance and support. All these services will be provided by the Center in a 'Software as a Service' (SaaS) demonstration mode. Vince also works with CoPI Mike Rudibaugh of Lake Land College to assist Dr. Arlen Gullickson on our effort to provide GIS advising services to the Evalua|t|e Center.

Southwestern Community College. CoPI Kenneth Yanow leads our female recruitment and retention initiative for the GeoTech Center. Kenneth is creating a white paper series on best practices for the retention and recruitment of minorities and females into geospatial programs. Ken works closely with researcher Ming-Hsiang Tsou of San Diego State University on college-to-university seamless articulation through the innovation of geospatial general education courses. One of the single largest barriers to expanding the geospatial programs of two year colleges is the lack of sufficient numbers of students in our introductory geospatial courses. Kenneth and Ming have perfected the method of offering GIS as a General Education course to: 1) increase the number of students in introductory geospatial courses and 2) improve the seamless transfer

of courses from college to universities. Kenneth is performing national research on other methods of implementing GIS as a Gen-Ed course.

Gainesville State College. CoPI Chris Semerjian leads our efforts at recruitment and retention among the HBCU populations of the Southeastern US. He also provides critical support in our DACUM efforts by organizing regional DACUM workshops. He works with researcher Rodney Jackson of Central Piedmont Community College (NC) to develop DoL and NSF grants with HBCU institutions in their area. Chris is active in promoting professional development activities in the Southeastern US, including Metro Atlanta, through the URISA, Georgia Chapter.

San Diego State University. Senior personnel Ming-Hsiang Tsou leads our effort to promote two year college to university articulation methods and research. Ming works directly with CoPI Kenneth Yanow of Southwestern Community College across town in San Diego to articulate Southwestern College into the SDSU program. Ming is also our lead researcher on the use of Web 2.0 technology in recruitment activities. He is a leader in the use of iPhone, YouTube, and other technologies to engage the millennium generation.

Geospatial Infrastructure Technology Association (GITA). GITA is the professional association and leading advocate for anyone using geospatial technology to help operate, maintain, and protect the infrastructure, which includes organizations such as utilities, telecommunication companies, and the public sector. Through industry leading conferences—along with research initiatives, chapters, membership, and other programs—GITA provides education and professional best practices. GITA provides their executive director, Bob Samborski, to serve on the Center's National Advisory Board. They also provide venues, such as the GITA power panel, at their national conferences to disseminate Center deliverables.

Evalua|t|e Center. The Center is working Dr. Arlen Gullickson, to promote the integration of GIS mapping into ATE evaluation and reporting functions. CoPI Mike Rudibaugh is creating a national GIS map of all ATE Centers and Projects that will be published electronically by CoPI Vince DiNoto in the summer of 2009. GeoTech is creating a series of map layers which will display geospatial information specific to ATE researchers, such as the location of project and centers be geographical location, along with a number of research-specific criteria, such as the amount of funding, target audience, participant demographic, evaluation methodologies, etc. The Center is currently working with Dr. Gullickson to disseminate awareness of the collaboration to other Center and Project PIs through a series of webinars, hosted by GeoTech and led by Evalua|t|e, to demonstrate the technology as a tool for research.

Lake Land College. CoPI Mike Rudibaugh of has been working extensively with the Illinois GIS Association presenting workshops to their members to develop professional development opportunities to under-served GIS professionals in the rural areas of Illinois. The Illinois Statewide GIS Initiative will provide the vision for GIS leadership, coordination and services to public and private entities that serve the citizens of Illinois.

New Mexico Geographic Information Council. Senior personnel Amy Ballard has made several presentations to increase the professional development opportunities for professionals in the New Mexico state area. She also seeks internship opportunities for her students and jobs for her graduates among the members of the Council. The New Mexico Geographic Information Council, Inc. (NMGIC), a non-profit dedicated to things geospatial: education, information sharing, technology advancement, and collaboration in the state of New Mexico.

Georgia Institute of Technology (Georgia Tech). CoPI Chris Semerjian works in collaboration with the Georgia Tech in Atlanta to provide physical facilities for the GeoTech Center use. We conducted a two day DACUM workshop for Atlanta area technicians at the Georgia-Tech Conference and Hotel Center in January 2009. Along with this collaboration, Gainesville College and Georgia-Tech are working together to develop the Georgia chapter of URISA to provide professional development opportunities for both college faculty and working geospatial professions in the state of Georgia.

Urban and Regional Information Systems Association (URISA). URISA provides professional development opportunities for geospatial educators and practicing professionals. URISA is a non-profit professional and educational association that promotes the effective and ethical use of spatial information and information technologies for the understanding and management of urban and regional systems. It is a multidisciplinary association where professionals from all parts of the spatial data community can come together and share concerns and ideas.

Middle Georgia College. CoPI Chris Semerjian of Gainesville State College is meeting with Middle Georgia College to discuss articulation between MGC's surveying program and GSC's GIS program. Middle Georgia College will submit an Academic Partner Agreement to GeoTech. Two instructors from MGC will attend summer training at Gainesville State College in the summer of 2009. This partnership can provide a model of programs throughout the Southeastern US between high schools and colleges.

Corpus Christi Independent School District (CCISD). GeoTech Center GIS specialist, John J. Nelson, is working weekly with the Collegiate High School of campus of CCISD to infuse GIS and GPS throughout their high school curriculum. He has provided a series of presentations to their 4H club, demonstrating the use of GIS and GPS for community service project, such as mapping city parks and recreational areas.

American Society for Photogrammetry and Remote Sensing (ASPRS). CoPI Ann Johnson is working as the Center's national business and nonprofit liaison to establish a professional relationship with the ASPRS in order to create professional development opportunities for geospatial educators and practicing professionals. Ann is working with the Education Committee of ASPRS to recognized GeoTech Center as the voice for two year college educators and provides an outlet for our participation in the Societies conferences and workshops.

American Association of Geographers (AAG). CoPI Ann Johnson, along with senior researchers Amy Ballard, Amy Work, and Christine Lewis are working with the AAG to promote collaboration

with the AAG and GeoTech to encourage and promote professional development opportunities for geospatial educators and professionals. The AAG is one of the largest professional organizations in American for geospatial technology and can provide events nationwide relevant to the education and professional needs of two year college educators.

Business Relations Group of the Dept. of Labor's Employment Training Administration (BRG/DoL/ETA). PI Phillip Davis and CoPIs David DiBiase and Ann Johnson are working with the BRG to develop a set of job competencies for the geospatial workforce. Currently the BRG has developed only 4 of the 9 levels required for their industry profile model, and we have agreed to assist them in completing the top 5 remaining levels of their model through the work of David DiBiase and researcher John Johnson. Through our extensive DACUM workshop meetings and findings, and the wider researcher of workforce and education alignment efforts by David DiBiase of Penn State University, the GeoTech Center will develop a set of nationally recognized job descriptions for GIS Technician, GIS Manager, GIS Analyst and Remote Sensing Technician and Remote Sensing Analyst.

GIS Certification Institute (GISCI). PI Phillip Davis and CoPIs David DiBiase and Ann Johnson are collaborating with the GISCI to develop and vet nationwide, a set of common core competencies for the GIS Technician level job description. The GIS Certification Institute (GISCI) is a 501(c) nonprofit organization established to provide professional standards for GIS professionals on a national level. GISCI provides the world's most recognized professional certification, the GISP, exam. GISCI has developed a working group, hosted by the GeoTech Center, to work collaboratively with education and professional groups in the creation of industry-driven job descriptions for the GISCI and Dept. of Labor.

South Central Arc Users Group (SCAUG) is working with the GeoTech Center staff (John Nelson & Phillip Davis) to establish regional subchapters of the organization to provide professional development activities for geospatial workers in more remote and rural areas of the South Central US. SCAUG is the South Central Arc User Group, an organization dedicated to the benefit of users of ESRI's Geographic Information software in the states of Texas, Oklahoma, Louisiana, and Mississippi. The GeoTech Center will model the SCAUG process of creating new subchapter organizations and will document the experience to determine feasibility as a national model.

University Consortium of Geographic Information Science Programs (UCGIS). CoPI David DiBiase from Penn State is leading our effort to work with UCGIS to create career pathways through the UCGIS sponsored GIS&T Body of Knowledge. This research effort will provide well-defined pathways for occupation-specific sets of knowledge, skills and abilities (KSA) that can be used by both industry and academic organizations to evaluate performance and articulation. CoPI Ann Johnson is also working with the UCGIS Education Committee to get two year colleges recognized as legitimate partners with UCGIS.

Kentucky Geographical Alliance (KGA). CoPI Vince DiNoto is working with the KGA to provide professional development opportunities for its members in geospatial technology. The Louisville campus of the KCTCS hosted GIS and remote sensing workshops during the spring and summer terms of 2009. The National Geospatial Technology Center, Jefferson Community and Technical College, and the Kentucky Information Technology Center (KITCenter) in Partnership with Kentucky Division of Geographic Information, Kentucky Geographic Alliance and the University of Kentucky Tracy Farmer Center announces a regional one day conference held on Wednesday, June 17, 2009 with pre-conference workshops on Monday, June 15 and Tuesday, June 16 on the Southwest campus of Jefferson Community and Technical College in Louisville, Kentucky. This first conference of its kind provides a regional and Kentucky perspective of geospatial education in the P-16 segment. Presentations by leaders and practitioners in the field will provide participants with an up-to-date view. Plenary sessions and professional development tracks include the following topics: -Educational initiatives in GIS, remote sensing and other geospatial fields.

Other Collaborators

Center for Economic Development of Del Mar College has contracted with the GeoTech Center to provide GIS maps for our College Board of Regents and President in preparation to expand the college's service area into high-growth regions of our 5 county service area. John Nelson, GeoTech Center GIS Technician, is leading the effort by creating a geographic database and maps, based upon college-provided data as well as commercially available demographic data from several providers. This collaborative effort includes the Office of the President, Dean of Economic Development, and the office of Institutional Research on Effectiveness.

ACTIVITIES AND FINDINGS

Activities/Findings

In year two, the Center engaged in several noteworthy research initiatives which have gone very well and should provide a solid foundation for further work going into year three of operation beginning September 1, 2010. These research initiatives are directly attached to specific recommendations for last year's NVC annual report and indicate the genius behind those recommendations and the years of prior experience of the NVC chairperson and other members. These major initiatives include:

1. Dept. of Labor's Geospatial Technology Competency Model (GTCM)
2. Meta-DACUM Analysis of the GIS Technologist Core Competencies (Meta-DACUM)
3. Remote Desktop Access to Virtual GIS Applications (RDA)
4. GIS as a General Education Elective (GISGenEd)
5. Web Map of Community College Geospatial Academic Programs through Adobe FLEX (FLEXaMap)

Each of these five major initiatives is briefly described below.

GTCM—the Department of Labor's Geospatial Technology Competency Model (GTCM)initiative started in March 2009 with an initial meeting between GeoTech Center CoPIs (Davis/DiBiase/Johnson). From this a series of meeting with the DOL was held through July 2009. A protocol to complete the GTCM was proposed by David DiBiase. This methodology was approved by the DOL and concluded in an unprecedented two day national forum of geospatial industry experts in February 2010. This meeting resulted in a proposed set of critical GTCM industry sector definitions which were widely disseminated for vetting among the broadest possible range of geospatial industry experts and public comment. The final proposed GTCM is due for publication by the Dept. of Labor in early June 2010, about the time this report is filed with the program officer. The GTCM is paramount to the Center. With this document, we can begin completing the upper tiers (6-9) of the GTCM in order to precisely define the industry sectors, such as GIS Technologist, Remote Sensing Technologist, Survey Technicians, etc. From these highly detailed occupation descriptions, the Center can create a matching baseline curriculum guide for colleges that can assist in curriculum development, college to college and college to university articulation, etc. The GTCM may also lead to advances in professionalizing the geospatial industry through certification. Currently the only nationally-recognized certification, the GISP, is a lengthy portfolio-based document that is only appropriate for 10+ year experienced professionals with Bachelors + degrees. It completely lacks a competency-based examination, or entry-level provisional certification for two year college graduates. Our work with the GIS Certification Institute, the GISP provider, may result in such examination and provisional certification.
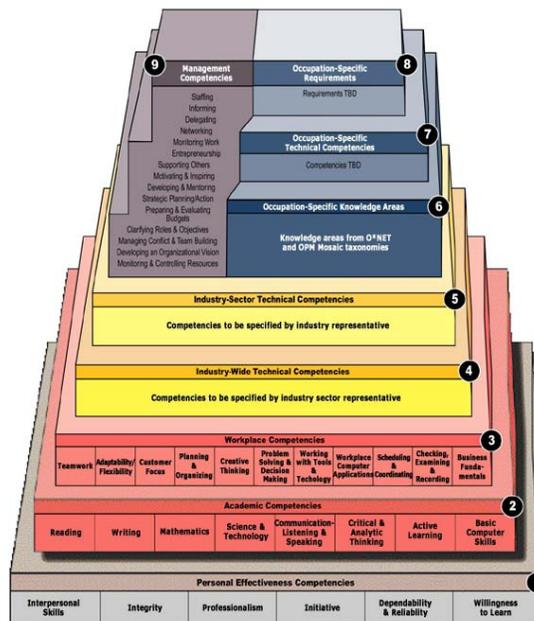
Dept. of Labor Competency Model Template

Meta-DACUM—the work of researcher John Johnson has led to our completed Meta-DACUM analysis of the Core Competencies for the GIS Technologist occupation. To reach this Meta-

DACUM report, the Center conducted three two-day DACUM workshops in 2008 and 2009 at locations across the country. These workshops extracted the common core competencies of GIS Technologists in both rural and urban settings in several fields, such as Agriculture, Government, and Engineering to provide the broadest possible representation of the field. In addition to these three funded studies, the analysis included a review of historical DACUM results conducted across the country over the past ten years. These results were then normalized through a statistical algorithm developed exclusively by John Johnson for the GeoTech Center. This methodology has never been applied to such a comprehensive and exhaustive set of data on the field. To further validate the findings, the results were vetted and validated by a group of 900 GIS experts across the country in a detailed online survey instrument. The final results were then validated in a series of interviews with current GISP-certified experts from the GISCI working group. This Meta-DACUM document will provide the basis for completing the first GTCM Tier 6-9 occupation: GIS Technologist and provide a model for further work (hence the supplemental funding requested by the PI for researcher John Johnson, March 2010 via Fastlane).

DACUM Chart of GIS Technician Tasks

RDA—the leading edge technology research into using Remote Desktop Access (RDA) to virtual GIS application software has bridged one of the last technical barriers to expanding GIS technology into America's K-12 and higher education labs and classrooms. GIS software, such as ESRI's ArcGIS, has traditionally required extensive technical expertise and financial resources to properly install and maintain. The high level of technical expertise in both IT, networking, and GIS, along with the prohibitive licensing costs, have long prevented the wider adoption of the technology in America's rural and poorer schools and colleges. Using RDA technology, GeoTech partners Gainesville State College (GA), Jefferson College (KY), and Central Piedmont Community College (NC) have successfully deployed GIS to middle schools, high schools and college partners in their respective areas. We are able to provide technical support to teachers in these schools, requiring a zero-footprint installation on school computers. Schools can now provide real GIS

application software to their students requiring little more than a computer and Internet connection. The beta-testing now extends to a rollout to three other GeoTech Center partners: Del Mar College (TX), Southwestern College (CA), and Lake Land College (IL). We anticipate this technology to be widely adopted throughout the remainder of 2010 and 2011 in a number of two year college programs as we continue to provide technical sessions, webinars, and conference presentations on the solution.

GISGenEd

One major struggle for two year geospatial technology programs is to attract and retain sufficient numbers of students to justify their faculty and infrastructure resources. In some areas of the country, two year colleges struggle to meet the minimum number of students in their GIS and related courses. There are only a limited number of students on many campuses that are sufficiently aware and motivated to fill-up a geospatial technology program. What is needed is a mechanism for extending the reach of GIS and related technology into more programs and students. To this end the GeoTech Center has made significant gains in promoting GIS as a general education option to new programs across the nation.

The Center has successfully utilized the existing models at Southwestern College, San Diego State University, and Gainesville State College. CoPIs Ken Yanow, Ming Tsou, and Chris Semerjian have provided numerous white papers, webinars, and conference presentations on their successful models. The impact is just now beginning to gain traction around the country, aided in some part by the current political and budget-crisis climate in many states where legislators are demanding more accountability and productivity of their community colleges. For example, through extensive collaboration with the Center PI, a geospatial educator's working group for the California Community Colleges GIS Collaborative (www.cccgis.org), through its chairperson, Allison Meezan. The Center has provide Ms. Meezan with the results of our Meta-DACUM and GTCM results, along with the white papers by Tsou and Yanow, to assist this group in formulating a state-wide recommendation to incorporate geospatial technology as one component of California's mandatory general education requirement. This California model, if successful at their 100+ colleges, would be a powerful demonstration model for the rest of the country through the GeoTech Center dissemination.

Along with this work, the PI has been working with new university faculty, including Rich Shultz of Elmhurst College (IL) and John Ritter of the Oregon Institute of Technology (OIT, Klamath Falls, OR) who are pioneers in the use of geospatial technology in general education. These university professors have participated in several of the Center's webinars on the topic and are working with two year college faculty in developing their own GIS as a general education elective.

FLEXaMap

One of the most difficult aspects in technology education is the constant change in the underlying technology that occurs at an ever-increasing rate. In the geospatial technology field,

the industry's leading vendor, ESRI, for example, has made a major revision to its flagship product ArcGIS every two to three years, with incremental versions annually. This rapid change leaves most two year college educators behind their commercial peers in industry. One of the major responsibilities of the Center is to provide technical updates for college educators in the most relevant changes in technology. Certainly one of the largest shifts in GIS technology is from the desktop to the Internet or "Cloud Computing". GIS software is rapidly becoming an Internet-based technology, allowing users to reach GIS technology through a simply browser and Internet connection. ESRI has moved in this direction in a major way with the new Adobe FLEX and Microsoft Silverlight API (application program interface) standards. In order to demonstrate the use of the latest Adobe and Microsoft API technologies, the Center undertook a crash training and development program for two of its partners (Del Mar and Jefferson College) following the July 2009 ESRI User's Conference, where the technology was first demonstrated. Throughout the fall of 2009, the Center trained two technicians at Del Mar College and Jefferson, and developed a mapping research group comprised of several CoPIs (Rudibaugh @ Lake Land College and DiNoto @ Jefferson and Davis @ Del Mar College). By February 2010, the Center had published its first FLEX API enabled web-based map. The map (http://216.69.2.35/flexviewer/index.html) displays an interactive database of Community College Geospatial Program in the US. The map is a useful tool for anyone researching the location and course offerings for two year colleges in the US. For the Center, the map is the first of a number of planned implementations of the Adobe FLEX API including an NSF ATE Impacts map of past and present ATE-funded projects and Centers, an interactive map for the EvaluA|T|E Center, and other geo-databases. Through extensive use of the Adobe FLEX technology, the Center will demonstrate the use of this important technology for geospatial educators.
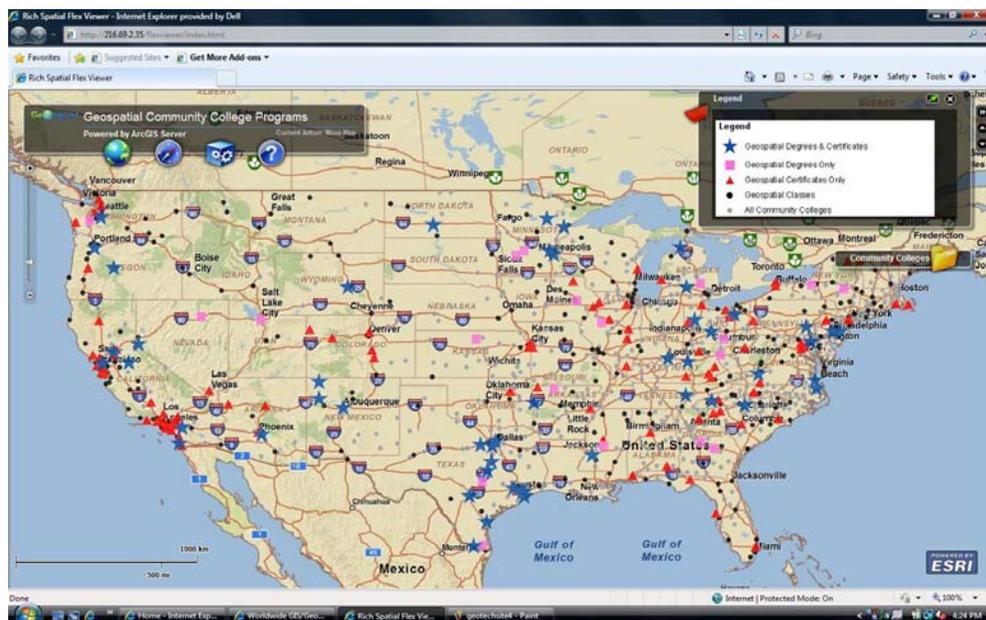
Two Year College Academic Geospatial Programs

Project Training Development

The Center provided a number of educational workshops and institutes around the country in second year. The Center divided its efforts into two categories: national and regional efforts. National efforts included those aimed at the broadest possible reach and leverage partnerships with other Centers and private industry to offset the expense of travel. The regional efforts leverage the widely dispersed geography of the Center's ten college and university partners coast to coast. A brief summary of our activities is provided:

National Training Development Activities

>High Impact Technology Exchange Conference—Scottsdale AZ, July 2009.   The HiTec conference was a joint ATE Centers & Projects conference meant to provide a synergy of ATE Centers in a single event. The conference provided two days of workshops plus two days of conference presentations, and impacted 500 participants. The GeoTech Center was a top-level executive producer, expending some $30,000 in participant support towards this first-ever conference. The Center sponsored 25 participants in a full day workshop on geospatial education, along with several presentations and exhibit. The Center is repeating this in July 2010 at a reduced level for the second HiTec Conference in Orlando FL. The Center has further committed to participate in the 2011 HiTec Conference scheduled for San Francisco.

>ESRI—GeoTech Joint Teachers Teaching Teachers GIS Institute (T3G)—Redlands CA, June 2009. The Center partnered with leading GIS software vendor ESRI, Inc. to provide an intensive week long institute for secondary and college geospatial educators. Unique to the T3G Institute is its training-the-trainer emphasis on improving experienced geospatial educator's **use** of geospatial technology. Applicants are required to be highly proficient with the technology prior to joining the institute in order to focus on pedagogical issues and techniques. This highly selective institute enrolled only 40 of the more than 100 applicants who submitted a competitive application. The institute enjoys the team-teaching of the most recognized group of geospatial educators, including a number of ESRI's K-12 and Higher Education Team, and commercial educators, Roger & Anita Palmer. To further broaden the impact of the institute, the Center engaged the graduates in a year-long series of workshop and presentations they provided to students and fellow educators in their area, covering the entire US. The 40 educators choose their own activities through a GeoTech grant application that paid them to perform dissemination of their T3G experience through presentations or projects. The Center is partnering with ESRI again in June 2010 to repeat the T3G Institute another year.

Regional Training Activities

>GeoEd 2009 Conference and Workshops—Louisville KY, June 2009. CoPI Vince DiNoto led the GeoEd conference at his home campus of Jefferson College in a three day

conference and workshop event that provided workshops in GIS and GPS technology to teachers and technicians to approximately 160 participants. The preconference workshops enrolled some 100 participants in four two day workshops, followed by a daylong conference addressing geospatial education research in the Kentucky and Indiana region. The Center is scheduled to repeat and expand this event in June 2010 with the GeoED 2010 event featuring the research of David DiBiase and John Johnson.

Gainesville State College Geospatial Workshop—Gainesville GA, July 20-24, 2009. The workshop was attended by 23 educators and education administrators from various universities, the Technical College System of Georgia and local school districts. These education professionals were exposed to geospatial technology including Geographic Information Systems (GIS), the Global Positioning System (GPS) and remote sensing. All attendees were then asked to submit an action plan on how they would utilize or demonstrate geospatial technology in their schools or classrooms.

GIS Academy @ Del Mar College—Corpus Christi TX, June 2009. This weeklong workshop for students and educators focused on the secondary school level with the use of GPS and GIS technologies. Participants learned to utilize GPS units for outdoor data collection and then created maps from their data using ESRI ArcGIS desktop software. They produced maps and projects for use in the classrooms in the 2009-2010 academic year.   Participants included teachers from numerous school districts in South Texas. The Center will sponsor another GIS Academy in June 2010.

GIS Teachers Summer Workshop—San Diego CA, June 2009. CoPIs Ken Yanow and Ming Tsou from Southwestern College and SDSU combined their efforts to provide a 3 day intense workshop to 30 K-12, college, and university-level geospatial educators, using the professional services of Roger & Anita Palmer to provide best-practices in geospatial education pedagogy. With the success of the first workshop, the Center will be inviting 24 of the original 30 participants back in June 2010 to continue up on the pedagogy.

Outreach Activities

The Center provided numerous outreach activities in all areas of the country where campuses are located. The activities range from simple classroom presentations by a single faculty member to full-day GIS Day Events, involving dozens of presenters and hundreds of participants, usually secondary school students. Events in year two included:

National "Bizarre" Map Challenge (BMC)—nationwide contest running January 11—April 27, 2010. This first-ever event was hosted by San Diego State University under the direction of senior researcher, Dr. Ming-Hsiang Tsou. The event, hosted completely online, drew 80 entries nationwide and engaged nearly 3000 online votes from the public (primarily geospatial educators and students). The event provided significant exposure for the GeoTech Center among the country's major universities, colleges, and

professional societies. It was featured by the National Geographic Explorer and other prominent geography networks. You can [read the story](#) and visit the event's dedicated [website](#).

GIS Day Event @ Del Mar College—Corpus Christi TX, November 17, 2009. Del Mar College and Texas A&M University—Corpus Christi combined forces, along with Texas A&M—Kingsville, the City of Corpus Christi, and several private engineering and surveying firms, provided demonstrations and presentation of geospatial technology to more than 600 secondary and middle school students from more than one dozen school districts from a four county area.
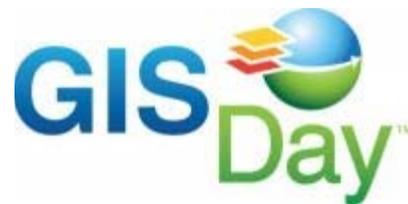
Piedmont Community College - Charlotte NC. Senior researcher Rodney Jackson and his staff presented the following events throughout year two:

Independence High School Career Day 04/02/09: Matt Miller attended a career fair at Independence High School. A booth representing geospatial technology was present and visited by hundreds of high school students during their lunch break. A presentation was also given to three technology classes before and after the high schools lunch break.

NC State Geographic User Committee 04/16/09: Matt Miller gave a presentation at the North Carolina State Geographic User Committee in Raleigh, NC on April 16th, 2009 addressing GIS education in the Community College System. Topics included curriculum education, continuing education, and partnerships that would mutually benefit state GIS users and CPCC.

2009 NC Arc Users Group Western Meeting 05/05/09: Matt Miller gave another presentation to the Western Group of the North Carolina Arc Users Association in Hickory, NC entitled "GIS in Community Colleges". The presentation covered the various resources offered from CPCC's Geospatial Technology Center to professional working in the Federal, State, and Local Government capacities. Resources included Continuing Education and Occupational Extension courses, curriculum education opportunities for working professionals, and student outreach.

SERUG 04/27/09: Matt Miller gave a presentation at the ESRI Southeastern Regional Users Group in Jacksonville, FL April 27-29, 2009. The presentation titled "How do we face the future? Integrating Geospatial Technology and Sustainability" was in the Environmental Awareness with GIS track and drew a crowd between 75 and 100 people. The presentation was intended to illustrate GIS as a burgeoning tool within many environmental disciplines but more importantly in Sustainability, and how CPCC was preparing students to be equipped with a "geospatial toolset" to accompany their degree.

San Diego State University

October 2, 2009 graduate assistant Justin Sheppard created 29 new student accounts were created for Madison High School GIS & Global Technologies course on the GIS Career and Education Awareness learning module website. The GIS Career and Education Awareness poster was presented at the Association of Pacific Coast Geographers conference in San Diego, CA.

October 14, 2009 arranged a meeting with Ken Yanow and the GIS manager from the City of Chula Vista to create an undergraduate internship opportunity for students on.

November 13, 2009 give a presentation at the Community College DAY at SDSU. SDSU Geography department devoted an afternoon to our community college colleagues and their students. About 50 community college students and teachers were in attendance for tours of the department and presentations by students (Leah Bremer, Sean Crotty, Sam Cortez and Emily Power Neder) and faculty (Diana Richardson, Stuart Aitken, Ed Aguado, Pascale Joassart, Trent Biggs and Ming Tsou). The afternoon ended with a reception on our balcony, and some considerable excitement about the possible of an SDSU transfer for many of the community college students.

November 18, 2009 participate on the GIS Day activity at SDSU. The major event is the Careers in GIS/Geography Panel Presentation. This panel brings together various professionals to speak about their GIS job experiences, career opportunities, job searching tips and much more.

November 28, 2009 visited Samuel Morse High School and introduces Geospatial Technology to 30 high school students and with the teacher, Steven Fox. This is a part of outreach activities for GeoTech Center.

November 2009 graduate student Justin Shepard mentored 16 students from Patrick Henry High School completed the GIS Career and Education Awareness learning modules. Certificate awards were created for the students and sent to their instructor. The web server hosting the GIS Career and Education Awareness website was moved to the SDSU Geography Department server room to ensure stable temperature conditions and administrator access.

December 2009 a total of 8 students completed the GIS Career and Education Awareness learning modules. Seven of the students were from the Alamo Navajo Community School in Magdalena, New Mexico and one student was from Patrick Henry High School in San Diego, California. Certificate awards were created for the students and sent to their instructor. Web server administration of the GIS Career and Education Awareness website continued as normal with no incidents following the move in November.

December 7, 2009 visited Dr. Fred Goldberg on to discuss how to improve the student learning module design and teachers' professional development workshops. Dr. Goldberg is the Project Director of NSF-funded "Constructing Physics Understanding in a Computer-Supported Learning Environment (CPU Project)" and a professor in Physics Department at San Diego State University and a senior researcher at the Center for Research in Mathematics & Science Education (CRMSE).

January 2010 graduate assistant, Justin Shepard, completed the first revision of the Project website has completed in January. Since the site is actively used by students and school faculty it was important to keep the look and feel of the site the same. To ensure consistency across the site and reduce time spent on updates the new pages utilize a dwt template. There are a few remaining issues that we would like to continue refining, however the new site is up and running. Some of the issues include the menu displaying differently in Internet Explorer and Mozilla and we would like to add captions to the videos in order to make the pages more accessible to all users. As web accessibility concerns continue to grow and more users weigh in it may be necessary to refine the website.

Central New Mexico Community College

Friday, June 26 2009 Advanced Placement Summer Institute in Human Geography Integrating Geospatial Technologies into your AP Classroom Presenters: Amy Ballard, Central New Mexico Community College; Denise Bleakley, Sandia National Labs This session will feature strategies for using geospatial technologies such as GIS software and Google Earth to bring Human Geography to life for students. Emphasis will be on aligning exercises with existing AP curriculum.

Ongoing Year Two Activities: Environmental Protection Technology 173 course, Water Quality Working with instructor to integrate GIS and GPS into her existing course. This will include field activities and classroom-based mapping. The goal is to evolve this effort into a regular course in the curriculum, as well as to use it as an example of successful integration of GIS into another program at the College.

Conference and other events

July 2009 ESRI Users Conference in San Diego CA: a team of 6 CoPIs attend the annual event and present a series of papers on the Center's initiatives. The Center sponsors an all day expo at the Educator's sub-conference and a half-day booth at the Academic Fair. A total of more than 300 college and university geospatial educators are directly impacted over a period of 4 days.

July 2009 HiTec ATE NSF Conference in Scottsdale AZ: a team of 7 CoPIs attends this first-ever annual event as executive producers. We provide a full day workshop to 25 educators and workforce professionals, conduct three presentations, and exhibit at the two day expo over a period of four days. More than 500 attendees are impacted.

September 2009 USRIA Annual Conference in Anaheim CA: CoPI David DiBiase and senior researcher John Johnson provide two presentations on the GTCM And Meta-DACUM results to 40 participants from the geospatial industry.

September 2009 Association of Pacific Coast Geographers in San Diego CA: senior researcher Ming Tsou attend the APCG Conference and presented a paper on using Web 2.0 tools, such as the iPhone, to engage young students in middle and secondary school in geospatial technology.

October 2009 League for Innovation CIT Conference in Detroit MI: CoPIs Phillip Davis and Vince DiNoto presented two workshops on using the new Remote Desktop Access software to provide virtual access to GIS.

October—November 2009 GIS Basics for Educators Coventry High School, Coventry, RI: T3G participant Peter Stetson taught the GIS Basics for Educators course to faculty members at Coventry High School where teachers developed a walking tour of the high school campus using GPS track logs and digital cameras to create a map of the high school campus. Teachers learned to transfer data from GPS units onto computers; photographs from cameras to computers and hotlink them together using the DNR Garmin and Poto2GPS programs. The ultimate goal was to enable teachers to be comfortable enough with their own skills to bring the idea back to their classrooms and have their students create their own maps. The teacher's maps were printed in the high school graphics department so that they can display their maps in their classrooms.

October 2009 Northwest ESRI Users Group Annual Conference in Sun River OR: CoPI Ann Johnson conducted a workshop presentation on using the GeoTech Center resources, such as the Clearinghouse, to a group of 25 geospatial educators from the OR, WA, and ID state region.

October 2009 Geological Society of America in Portland OR: CoPI Ann Johnson exhibited at the GSA in front of more than 800 attendees for nationwide.

October 2009 National Science Foundation Annual ATE PIs Conference in Washington DC: The Center, represented by a team of six CoPIs, hosted a Birds of a Feather session for Geospatial Technology which was attended by 40 participants, mostly two year college GIS faculty. The Center demonstrated the new RDA technology, the GTCM research, along with the Meta-DACUM results at the time.

November 2009 ASPRS Annual Conference and Workshops in San Antonio TX: CoPI Ann Johnson presented a half day workshop on GIS software to approximately 20 secondary school educators from the San Antonio area.

November 2009 Association of Career and Technical Educators Annual Conference in Nashville TN: CoPI Vince DiNoto manned the Joint Centers ATE booth during this three—day long conference.

December 2009 American Geophysical Union Annual Meeting in San Francisco CA: CoPI Ann Johnson presented a paper on the GeoTech Center to approximately 25 attendees.

December 2009 National Academy of Sciences Geosciences Advisory Board Meeting in Washington DC: CoPI David DiBiase presented the forthcoming GTCM initiative to the members of the board in order to disseminate the research to the highest levels of the professional and solicit feedback.

January 2010 Elmhurst College Dare to Dream STEM Workshop in Elmhurst IL: T3G participant, Dr. Rich Shultz, provided a one-day STEM workshop, illustrating how GIS can be combined with other STEM sciences and designed to give the 80 Latina high school aged girls an opportunity to explore the excitement of geographical information systems (GIS) through demonstrations, classroom presentations, and hands-on activities.

January 2010 Future of Geosciences Cyber-Education Workshop in Washington DC: CoPIs Ann Johnson and Phillip Davis presented a paper on the GeoTech Center initiatives to a group of some 100 university and college geosciences faculty on the importance of partnering with America's two year community and technical college to promote a more seamless educational pathway to the four year degree.

January 2010 ATE Synergy Project Workshop in Albuquerque NM: CoPIs Ann Johnson, Phillip Davis and Ken Yanow, along with senior personnel Amy Ballard, attended the first of three Synergy workshops scheduled for 2010 and presented the Center's plan to the group.

January 2010 Metropolitan Area (ESRI) Users Group in Denton TX: Senior staff member John Nelson attended the first annual MAUG Conference and Workshops and exhibit for the GeoTech Center to the nearly 150 D/FW area GIS professionals in attendance.

February 2010 University Consortium of Geographic Information Science Annual Winter Meeting in Washington DC: CoPI David DiBiase presented the GeoTech Center work on the GTCM before the UCGIS Board of Directors as evidence of our research agenda and

worthiness to be considered for associate membership in this prestigious university research consortium.

March 2010 Synergy Project Thought Leaders and Innovation Coaches Workshop in Baltimore MD: CoPIs Phillip Davis and Ann Johnson attended the second in the series of three Synergy Project workshops and presented an update on the Center's project to ramp-up our Remote Desktop Access technology project nationwide in the second half of 2010.

March 2010 League of Innovations Conference in Baltimore MD: Senior staff member John Nelson exhibited with the Joint ATE Centers exhibit at this three day event.

March 2010 Association for Supervision and Curriculum Development (ASCD) Annual Conference in San Antonio TX: Barbaree Duke, Curriculum Integration and GIS in Education Consulting, presented "Transforming Curriculum Using Geospatial Technologies" for teachers, administrators and curriculum support personnel.

April 2010 American Associate of Geographers Annual Conference in Washington DC: CoPI Ann Johnson attended the AAG meeting and presented on two workshops related to GeoTech Center research and activities.

April 2010 American Association of Community Colleges Annual Conference in Seattle WA: PI Phillip Davis attended the annual conference meeting and exhibited in the Joint ATE Center's booth for three days.

April 2010 ASPRS Workshops and Conference in San Diego CA: CoPI Ann Johnson and senior researcher Ming Tsou attended the ASPRS workshops and presented on their research with the GeoTech Center.

April 2010 Geospatial Infrastructure Technology Association Annual Conference in Phoenix AZ: PI Phillip Davis and senior staffer John Johnson exhibited during this four day conference to more than 800 geospatial educators and industry professionals.

April 17 2010 at Salem Middle School, in Virginia Beach, Virginia: *Exploring Your World with GIS,* a six –hour, hands-on workshop was held Saturday by Georgeanne C. Hribar, "Graduate "2009 T3 Summer Institute at ESRI. The 22 workshop participants included: 1 museum professional, 1 high school teacher, 1 middle school administrator, 2 pre-service teachers, and 17 middle school teachers. Three school divisions were represented: 5 participants from Suffolk, 1 teacher from Chesapeake, and 13 social studies and science teachers from Virginia Beach City Public Schools. In addition, there was a museum educator from Nauticus and the 2 pre-service teachers from Christopher Newport University.

PRODUCTS

Journal

Kawabata, Mizuki, Thapa, Rajesh, Oguchi, Takashi, and Tsou, Ming-Hsiang (Accepted, In Press, 2010) "Multidisciplinary Cooperation in GIS Education: A Case Study of US Colleges and Universities", The Journal of Geography in Higher Education.

Zhang, T. and Tsou, M.-H. (2009). Developing a grid-enabled spatial Web portal for Internet GIServices and geospatial cyberinfrastructure, International Journal of Geographical Information Science. 23(5), pp.605-630.

Books

Tsou, Ming-Hsiang (2009). Chapter 48: The Integration of Internet GIS and Wireless Mobile GIS. In Manual of Geographic Information Systems, edited by Marguerite Madden, published by the American Society for Photogrammetry and Remote Sensing (ASPRS), pp. 923-933.

Johnson, Ann (2009). Chapter 4.7: Geospatial Education at U.S. Two-Year Institutions. Submitted for publication in Unwin, Foote, Tate and DiBiase (in preparation) *Teaching Geographic Information Science and Technology in Higher Education.* © 2009 John Wiley & Sons.

Internet Dissemination

The Center has produced the following live webinars in recorded format:

GIS Integration Across the Curriculum. Amy Work, Institute for the Application of Geospatial Technology, recorded May 7, 2010.

Getting Started on SkillsUSA National Geospatial Competition. Amy Ballard, Central New Mexico Community College, recorded November 20, 2009.

Results of the national Meta-DACUM Analysis of GIS Technician Core Competencies. John Johnson, GISWS, Inc., recorded January 26, 2010.

Using Web 2.0 Social Media in Geospatial Technology Courses. Dr. Ming-Hsiang Tsou, San Diego State University, recorded February 17, 2010.

Perfect Grant Proposal and Better Project Management using Logic Models. Ann Johnson, Bare Mountain Consulting, recorded April 22, 2010.

GIS as a General Education Course. Ken Yanow, Southwestern Community College, recorded February 19, 2010.

Other specific products

The Center made several significant contributions to the geospatial field in year two including:

Geospatial Technology Competency Model—the GTCM is the foundational document used by the Dept. of Labor's Employment & Training Administration to define the scope and occupations that comprise the geospatial technology industry. This comprehensive document was develop through collaboration with industry and professional societies representing the broadest possible range of groups within the geospatial industry. Once this document is complete in early June 2010, it will provide the nation with a definitive description of the industry and serve as the basis for future work to define each emerging occupation, such as GIS Technologist, within the industry. Schools and colleges may use the GTCM to guide their curriculum development, articulation agreements, and other educational activities. Professional accrediting agencies, such as the GIS Certification Institute or American Society of Photogrammetrists and Remote Sensing (ASPRS), may use the GTCM to perfect existing credentials, such as the GISP, or create new ones.

Meta-DACUM of Common Core Competencies for GIS Technologists—this document is the result of research conducted in year two that produced three DACUM workshops combined with an exhaustive review of previous DACUM dating back 10 years. The unique feature of this document is that is identifies every possible task performed by a GIS Technologists in every segment of the industry and in every region of the country. From this comprehensive list, a rank-order list of tasks, based on frequency and rank by experts, identified a common core set of competencies that should be considered essential for any GIS technologists to possess. With this document, we can now for the first time, provide a list of items that are essential knowledge in this occupation, which may become the basis for future certification, testing, and curriculum guidelines for community college geospatial educators.

Community College Geospatial Academic Program Mapping Portal—the Center has created an ArcGIS spatial database of all known GIS and geospatial academic programs at America's 1134 community colleges. This database is presently linked with an ArcGIS Webserver that provides online access to the database through a browser and Internet connection. The server utilizes the latest in Adobe FLEX API technology to provide the end-user with an easy to navigate interface. The direct purpose of the database is to provide students, parents, educators, and the public with knowledge about America's two college geospatial programs. Its secondary purpose is to demonstrate the latest in server-based technology to encourage two year college educators to adopt the technology into their academic programs. This site is accessible by clicking on the map on the Center's website: http://geotechcenter.org.

CONTRIBUTIONS

Within Discipline—the Center has made the following contributions:

Year One (2008)

Year Two (2009)

1. Geospatial Technology Competency Model (GTCM) for the Dept. of Labor.
2. Meta-DACUM Analysis of Common Core Competency for GIS Technologists.
3. Technology Plan for Remote Desktop Access for Virtual Access to GIS Application Software.

Human Resources Development

The Center sponsored several of its own staff for training at various partner colleges in order to better prepare them to support the advanced technology we are engaging in to better serve our role as leading edge in geospatial technology. In year two this included:

Del Mar College—GIS Analyst John J. Nelson was provided week-long workshop at ESRI in Redlands, CA. to learn the new Adobe FLEX API technology to build and maintain Del Mar College's ArcGIS Web server.

Jefferson College—GIS Analyst Ross Allen was provided a week-long ESRI workshop on the Adobe FLEX API technology to build and maintain the public-facing Two Year Community College Academic Geospatial Programs map (http://216.69.2.35/flexviewer/index.html).

Del Mar College—GeoTech Center Coordinator Minerva Borger has completed an Introduction to ArcGIS 9.3 online course to acquaint her with the technology foundation of the Center.

Lake Land College—GIS Technician Brooke Ferguson completed an ESRI online course on ArcGIS 9.3 to assist her in creating the Community College Academic Geospatial Programs geo-database.

Research and Education

The Center conducted fundamental educational research into the best practices for building and sustaining two year college academic geospatial technology programs including:

CoPI David DiBiase—conducted several workshops and forums on the development of the Dept. of Labor's Geospatial Technology Competency Model (GTCM). This research will result in updating the GTCM with the latest definition of the geospatial industry as a

whole as well as define the various industry sectors, such as GIS, Surveying, etc, as well as the occupation definitions at the upper tiers of the GTCM model.

Senior researcher John Johnson—conducted three DACUM workshops on the GIS Technician occupation and performed a statistical meta-analysis of the results producing the first-ever Meta-DACUM Analysis of Common Core Competencies for GIS Technician. This work will be incorporated into the GTCM as one of several tier 6 occupation definitions. It is also being reviewed by the GIS Certification Institute as the basis for an exam-based certification to improve their existing GISP (GIS Professional) certification and potentially develop a provision certification, such as a GISA (for "associate", versus "professional").

CoPI Kenneth Yanow—produced a white paper on best practices for recruitment and retention of minorities and women into geospatial technology fields. This white paper provides the basis for his webinars on the topic.

CoPI Vince DiNoto—produced a white paper on Remote Desktop Access to Virtual GIS Application software that provides a technology roadmap for educators wishing to adopt this solution to providing access to GIS technology to students in remote locations.

CoPI Ann Johnson—produced a chapter on the development and history of geospatial higher education in the US. The chapter describes the historical and technology drivers in the development of two year community college academic geospatial programs in America's 1150 two year colleges.