

**Center for Earthquake Research and Information
(CERI)**

<http://www.memphis.edu/ceri/>

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Leadership

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Mission

CERI, established in 1977 as the Tennessee Earthquake Information Center, is a Tennessee Board of Regents Center of Excellence at the University of Memphis devoted to understanding the causes and consequences of earthquakes and the structure and evolution of the continental lithosphere. CERI addresses these needs through cutting-edge research, comprehensive graduate student education, operation of state-of-the-art seismic and GPS networks, and dissemination of technical and practical information to the private and public sectors.

BUDGET INFORMATION

Please see attached spreadsheet.

PERFORMANCE NARRATIVE

Primary Goals and Purpose of CERI and Support Systems Offered to Member Faculty

CERI is a Tennessee Center of Excellence created to perform state-of-art scientific research into the nature of earthquakes in continental interiors, monitor earthquakes within the central and southeastern United States, and to serve the public and educational institutions of the State of Tennessee in providing accurate information on earthquake effects and hazards. CERI faculty members administer the Geophysics Concentration for the MS and PhD Earth Science graduate program at the University of Memphis and the interdisciplinary program in Engineering Seismology with the Civil Engineering Department.

CERI is an entity of the State of Tennessee that is reauthorized every 4 to 8 years by the legislature and governor. This occurred in the 2015-2016 legislative session when CERI was reauthorized under State Sunset Laws to June 30, 2022 (SB 1510 and HB 1608). Preparation for the next reauthorization will occur in early 2021.

CERI has additional direct ties to the State through the West Tennessee Seismic Safety Commission (WTSSC). The WTSSC has been tasked to initiate, with the assistance of state, federal, and local government agencies, a comprehensive program to prepare the state for responding to a major earthquake. The WTSSC is a twelve (12) member board appointed as follows: two (2) members chosen by the Speaker of the House of Representatives, two (2) members chosen by the Speaker of the Senate and eight (8) members appointed by the governor. The WTSSC represent the following professional areas: architecture, fire protection, public utilities, engineering, geology or seismology, local government, insurance, business, emergency health services, nonprofit emergency assistance, local education and emergency management. The WTSSC was created through the Tennessee Code Annotated, Title 58, Section 4. CERI (created by Tennessee Code Annotated, Section 49-8-602) is authorized and directed to provide any information or services requested by the commission to achieve its goals. Gary Patterson, Director for Education and Outreach at CERI, is the Executive Director for the WTSSC.

Thus, through State of Tennessee mandates, CERI addresses a wide range of scientific and public outreach activities in addition to University academic matters.

A primary function of CERI is maintaining a large seismic network in the central and southeastern United States to monitor earthquakes. CERI technical staff operate and maintain over 144 seismic stations in 10 states in the region from Arkansas to Virginia. This seismic network is part of the Advanced National Seismic System (ANSS) through our partner, the U.S. Geological Survey. CERI personnel analyze earthquakes that occur within CERI's area of influence to determine and distribute earthquake locations and magnitudes. The raw waveform data and data products are then sent to national data centers in Seattle (Incorporated Research Institutions in Seismology – IRIS) and to the U.S. Geological Survey in Golden, Colorado, and become available to the public through USGS, IRIS, and CERI websites. Much research at CERI concerns earthquake hazards within the central and southeastern U.S. region and is helped by data collected by the seismic network. ***Goals of the network include continual upgrade of hardware***

and software facilities to more efficiently and accurately determine the parameters of earthquakes within the region.

CERI's research mission into the causes and effects of earthquakes is greatly enhanced by participation in graduate programs in Earth Sciences and Civil Engineering. In Fall 2015 the CERI faculty was given full responsibility for administering the Geophysics Concentration for the MS and PhD in Earth Sciences. At the same time, CERI and the Civil Engineering Department started an interdisciplinary program in Engineering Seismology that has resulted in cross listing many CERI and Civil graduate courses. ***Goals for the Earth Sciences Geophysics***

Concentration include:

- ***High quality graduate student training resulting in refereed student publications and exceeding yearly graduation quotas for PhD (3) degrees;***
- ***Focus on PhD program and reduce emphasis on MS program to address the University strategic goal of attaining Carnegie R1 status;***
- ***Replacing two tenure-track faculty members who left CERI in 2018 (Taborda and Daub);***
- ***Maintain current state of the Engineering Seismology interdisciplinary program with Civil Engineering.***

CERI offers the faculty the full spectrum of support systems needed for success in research and education. Faculty and research staff members are provided office and lab space for their research, support staff for IT systems, liberal start-up funds for computers and other equipment, and administrative support for submitting grants and contracts to external sponsors as well as for day-to-day contract administration. Governance of all academic matters is done democratically and faculty and research staff input is required for decisions concerning graduate student admissions. An annual, all-hands, meeting is held in the third week of September each year to review accomplishments and plans for the upcoming year; all faculty, staff, and students attend. In addition, the Graduate Coordinator and Director for Administration and Finance facilitate all needed activities for proper functioning of the graduate programs. ***A major goal of CERI is to provide a high-quality learning environment for the graduate students including good office space and laboratory facilities.***

Activity Targets, Outcome Objectives, and Metrics Associated with Achieving Progress

Activity Targets:

- Maintain seismic, GPS, and IT networks
- Maintain Field Deployment Laboratory
- Administer the Geophysics Concentration for MS and PhD degrees in Earth Sciences
- Maintain the interdisciplinary Engineering Seismology program with Civil Engineering
- Perform search for two tenure-track positions (Spring 2019)
- Participate in formal review of Earth Sciences graduate programs (Spring 2019)
- Maintain a high level of externally funded research and scholarship
- Maintain vigorous Education and Outreach Program

Objectives:

- Upgrade Seismic Networks
- Upgrade field research equipment
- Attain/exceed graduation rate of 3/year for PhD degree using CERI graduates
- Attain at least 2 refereed publications per year for faculty members. Increase student refereed publications.

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- Increase external support of graduate students
- Hire two tenure-track faculty
- Obtain a positive endorsement from the graduate program review

Membership/Affiliate Criteria

CERI operates as an autonomous educational and research unit within the University of Memphis. The criterion for membership is primarily based on source of support for CERI faculty, staff, and graduate students (i.e., whether personnel are on CERI budgets). There are no formal criteria for defining a CERI affiliate. However, a small number of faculty members from other departments routinely sit on student graduate committees and CERI standing committees. These “friends of the Center” are de facto CERI affiliates.

Evidence of Progress Made during 2018-2019 Towards Goals/Objectives/Targets

Activity Targets:

- *Maintain seismic, GPS, and IT networks:* This is a principal task for network personnel and has been ongoing. A staff of 7 is organized and routinely given tasks by the Director for IT and Seismic Networks. A large number of technical improvements have been made to the seismic and GPS networks. Congressional increases given to the U.S. Geological Survey in FY19 have resulted in significant supplementary funds being awarded to CERI faculty members (Withers and Smalley) for upgrading equipment in both networks.
- *Upgrade Field Research Equipment:* With significant help from the College of Arts and Sciences equipment fund, CERI has purchased a complement of 60 three-component autonomous seismometers with associated data servers and equipment racks. This system is a significant upgrade to the seismic field capabilities of CERI faculty and will enable collection of seismic data from diverse experiments. Access to this equipment by the faculty and graduate students will create opportunities for collecting important data sets that can be used in ongoing funded research and for proposing new research.
- *Attain/exceed graduation rate of 3/year for the PhD in Earth Sciences:* Four PhD students graduated between September 2018 and August 2019 (Ogweno, Azizzadeh-Roodpish, Khoshnevis, Aslam). Another 2 PhD students will be defending after thesis deadlines in July/August and will graduate in the Fall. This is a direct contribution to the University goal of attaining Carnegie I research university status in 5 years. In response to budget pressures since 2014, CERI has had to cut back on admission of graduate students to the Geophysics concentration. This, and the Universities strategic goal of attaining Carnegie R1 status has led the faculty to focus on recruiting PhD students at the expense of the Masters program. The incoming class for Fall 2019 will consist of 5 new PhD students, 2 of which who will be supported by University R1 Fellowships, and 1 supported by the Center’s Palisades Geophysical Fellowship. Nevertheless, 3 Masters students (Jambo, Hee, Aslam) graduated this year, one (Aslam) using the MS-on-the-way-to-PhD option in the program.
- *Maintain the interdisciplinary Engineering Seismology program with Civil Engineering:* Primary evidence for program success is the cross listing of 9 CERI graduate courses in

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Civil Engineering. CERI supported a tenure-track faculty member who had a joint appointment between CERI and Civil Engineering (Taborda). Unfortunately, Taborda left the University and CERI no longer has direct ties with Civil Engineering. By definition, this will reduce interaction between Civil Engineering and CERI and which will be a challenge for program growth.

- *Perform search for two tenure-track positions:* Spring 2019 was extremely busy with the search for 2 tenure-track positions to replace Taborda and Daub. 70 candidates responded to the job advertisement and nearly all were very high-quality, credible scientists. With great difficulty, the Search Committee narrowed the field to 6 excellent candidates who were then scheduled to visit in February and March. We were fortunate to recruit our 2 top candidates to come to CERI; Thomas Göbel from UC Santa Cruz and Christos Kyriakopoulos from UC Riverside. Both will arrive in Fall semester 2019. Göbel is a seismologist and experimentalist working on the forefront of Earthquake Physics and Induced Seismicity. Kyriakopoulos works on Earthquake Physics, source simulation, Tectonics, and Education and Outreach. Both are excellent fits for the mission and scope of the Center and will be starting externally funded research programs.
- *Participate in formal review of Earth Sciences graduate programs:* CERI was pleased to participate in the THEC-mandated review of the Earth Sciences academic programs. An external committee of four members visited the University February 10 through 12 to evaluate undergraduate and graduate programs in Earth Sciences. Two members of the committee visited the Department of Earth Sciences (DES) and two CERI. DES and CERI received uniformly excellent marks from the peer review. Our excellent review is a validation of CERI's policies and approach to graduate education. Comments concerning the review of the Concentration in Geophysics included:
 - “(The CERI graduate handbook) is an excellent document and could serve as a model for geoscience departments at other universities.”
 - “We commend CERI faculty for maintaining a healthy graduate program through the recent financial difficulties.”
 - “CERI graduate students were extremely positive about their academic experience at the University of Memphis.”
 - “We note that graduate students author or coauthor approximately 50% of center's peer-reviewed publications.”
 - “We commend CERI on generating such a diverse group of graduate students, which is unusual in geoscience.”
- Maintain a high level of externally funded research and scholarship.
- Increase external support including graduate student support: 26 proposals for external grants and contracts were submitted by Center faculty and staff between September 2016 and August 2017. 24 projects were on-going or newly awarded during the same time interval. Student GRA support on external grants and contracts was (6, 6, 9) for (Fall'16, Spring'17, Summer'17), respectively, compared to (9, 5, 6) for (Fall'15, Spring'16, Summer'16), respectively. Having the HUD grant raised Center research income to FY'14/FY'13 levels and was a welcome increase over FY'15 that was a 7 year low. However, the Center Faculty and Research Staff were not able to raise the number of student GRA stipends in FY'16 compared to earlier years. Even so, GRAs from external research programs comprised a larger percentage of graduate support since we reduced our student population by allowing fewer annual admissions.

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- *Maintain vigorous Education and Outreach Program:* CERI's Education and Outreach (E&O) Program continued its mission in 2018-2019 to transfer technical and non-technical earthquake information to public and private sector groups in the Central and Eastern US, especially in the Greater Memphis Area. Over its 42-year history, CERI has grown to become an annual destination for dozens of area schools, non-governmental organizations, and professional groups seeking earthquake information. Non-technical information transfer at CERI includes activities for K-12 teachers and students, public service announcements, public meetings for earthquake safety, and museum display development. CERI E&O's frequent technical interaction with state and local governments has naturally led to development of multidisciplinary applied research projects that address gaps in community preparedness, such as school structural safety evaluations. Gary Patterson is Director for Education and Outreach and Kent Moran is a research associate handling outreach events and CERI webmaster.

The use of the CERI web page in conjunction with Facebook and Twitter to provide notices and information on local seismic events has helped to address our goal of educating the public about earthquake hazards. CERI social media resources are routinely used and promoted by local media. There are approximately 52,000 hits on the CERI webpages per month and 1200 hits per month on the CERI facebook page.

Outreach staff are always quite busy with school groups attending presentations at CERI or going to schools and other organizations to give presentations. Events occur every few days and outreach staff may interact with 100 to 400 people per month at these events.

- Attain at least 2 refereed publications per faculty member. Increase student refereed publications: Appendix 1 contains a list of refereed publications published by CERI faculty, staff, and students, and Appendix 2 presentations giving at national conferences for 2016-2017. Appendix 1 shows that 10 faculty and staff were authors or co-authors on 19 publications. Only 2 faculty members had one or less publication. More importantly for building a nationally ranked graduate program, 12 out of 19 publications (63%) had graduate students as first authors. Last year this number was 11 out of 28 (39%) publications showing a relative increase. The 58 presentations given at national scientific meetings show that 17 of the presentations were authored or co-authored by students. Generally, refereed publications have been averaging about 20 publications per year before 2015. Our scientific output has remained constant in response to internal budget cuts.

Identification of Special Achievements and/or Challenges During the Prior Year

Achievements:

- *Monitoring Earthquakes in the Central United States:* CERI, partnered with the US Geological Survey, is the regional center for the central United States in the Advanced National Seismic System. CERI faculty and staff actively monitor the New Madrid and Eastern Tennessee Seismic Zones and maintain a large seismic recording network of ~140 seismic stations in 10 states. CERI responds to significant regional earthquake events by fielding aftershock studies using temporary seismic stations and provides the public, media, and other scientific organizations data and earthquake information. During 2018-2019 we deployed a small seismic network in southern Alabama/Florida pan handle around an area of suspected induce seismicity and worked with State Geologist of both

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Alabama and Florida. CERI processed and posted 521 earthquakes so far during the 2018-2019 academic year (9/1/18-6/27/19) to the National Catalog (<https://earthquake.usgs.gov/data/comcat/>) and to our local catalog (<http://www.memphis.edu/ceri/seismic/catalog.php>). The numbers of earthquakes have been going up in the New Madrid seismic zone over the past several years and appear on the USGS annual hazard map as an elevated area of risk.

- *CERI Education and Outreach Program:* CERI E&O programs directly reach over 2000 K-12 students from Shelby County each year through site visits and in-school presentations. Many more students are influenced through CERI workshops for teachers who use provided materials in their classrooms. In addition, several public service announcements for earthquake awareness have been co-produced with the Tennessee Emergency Management Agency each year since 2006 and shown throughout the central U.S. CERI E&O staff have also continued to maintain museum displays at the Pink Palace museum in Memphis, the New Madrid museum in New Madrid, MO, and the Reelfoot Lake visitor's center in Tiptonville, TN. The West Tennessee Seismic Safety Commission continues to serve as an effective conduit of communication from the government of the State of Tennessee and the Tennessee Emergency Management Agency to local Emergency Responders and agencies in west Tennessee.
- *Jesuit Seismological Association (JSA) Award Winner*
Center faculty member Chris Cramer was awarded the JSA award by the Eastern Section of the Seismological Society of America in 2018 for his work concerning the earthquake hazards of intraplate seismic zones of North America. There have been 4 CERI winners of this award over time (Johnston – 1999, Langston – 2011, Powell – 2016, Cramer – 2018).
- *Center Budget*
The Center's budget is now in the black after University budget cuts at the end of FY14. This was accomplished after instituting severe restrictions on travel and other activities, cutting staff, staff and faculty attrition through retirements. As mentioned above we have also cut back on graduate student admissions each year to approximately 5 students.

Challenges:

The number of Center faculty is at an all-time low with Tabora and Daub leaving, standing at 3 tenure-track and 3 research-track faculty members.

Plans for the Upcoming Academic Year Including Goals and Expected Achievements

CERI is currently pursuing the writing of a new strategic plan. All Center personnel (faculty, staff, and graduate students) met at the Meeman Biological Research Station for the day on October 27, 2017, to start dialog on the new strategic plan. Our last strategic plan was written in 2005 and applied to 2005-2008. We also underwent an external review in 2011 that was very helpful in resolving a long-standing administrative problem and gave direction to future faculty hires that have been mostly accomplished. University budget reorganization and resulting CERI budget reductions have taken much of our energy since 2015 and have, unfortunately, reduced our forward momentum with respect to growing the graduate program. Our strategic planning exercise should be good in helping to revitalize our existing programs and moving us forward.

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Writing of the strategic plan will be complete in Spring 2018 and will be forwarded to the administration for comment.

Our budget deficit has significantly decreased over time through the help and support of the Dean of the College of Arts and Sciences. However, the deficit is still a major factor affecting programs at the Center. Obtaining more or larger external grants to increase support of our graduate students, allowing for more faculty and staff salary release, and increasing the potential for Indirect Cost Return is an obvious strategy that the faculty and staff are actively pursuing. But in addition, there are a number of issues that should be discussed with the administration concerning the role of interdisciplinary research centers at the University and how they might best contribute to the academic priorities of the University as a whole. It is likely that these discussions will take place in conjunction with our strategic planning during Spring 2018.

CERI Personnel 2016-2017

FACULTY

CHIU, Jer-Ming	Professor
CHOI, Eunseo	Assistant Professor
CRAMER, Chris H.	Research Professor
DAUB, Eric	Assistant Professor
LANGSTON, Charles	Professor, Director
POWELL, Christine	Professor/Graduate Coordinator
SMALLEY, Robert	Research Professor
TABORDA, Ricardo	Assistant Professor (joint with Civil Eng.)
WITHERS, Mitch	Associate Research Professor, Director IT and Seismic Networks

POST-DOCTORAL FACULTY

WU, Chunquan	Post-Doctoral Fellow
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FACULTY EMERITUS

DORMAN, Jim	Director/Professor
JOHNSTON, Arch	Director/Professor

STAFF

BOLLWERK, Jim *	Seismic Network Engineer
BREWER, Steve *	Digital Seismic Systems Supervisor
BROADBENT, Tanya	Draftsman
DAVIS, James *	Local Tech Support Provider I
DEBULA, Robert	Local Technical Support Provider II
HORTON, Steve	Research Scientist
MARSHALL, Deshone	Local Technical Support Provider I
McGOLDRICK, Chris *	Research Equipment Tech II
MORAN, Nathan Research	Associate II – Physical Science
PARKER, John *	Research Assoc. Tech
PATTERSON, Gary	Director Education & Outreach
PAUL, John	Research Scientist
SMITH, Michelle	Assistant Director Adm. & Finance
STEINER, David *	Research Equipment Technician II
WITHERS, Holly *	Research Associate II

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*seismic and gps networks staff

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GRADUATE STUDENTS

AHAMED, Sabber	Graduate Research Assistant
AL NOMAN, Md. Nayeem	Graduate Research Assistant
ASLAM, Khurram	Graduate Research Assistant
AUSBROOKS, Scott	Graduate Research Assistant
AZIZZADEH, Shima	Graduate Research Assistant
BASU, Urbi	Graduate Research Assistant
BOLARINA, Oluwaseyi	Graduate Research Assistant
DHAR, Mahesh	Graduate Research Assistant
FADUGBA, Oluwaseun	Graduate Research Assistant
GENG, Yu	Graduate Research Assistant
GLOVER, Chloe	Graduate Research Assistant
HUDA, Md. Monsurul	Graduate Research Assistant
JAMBO, Eric	Graduate Research Assistant
KHOSHNEVIS, Naeem	Graduate Research Assistant
KUTLIROFF, Jerome	Graduate Research Assistant
LIU, Chunyu	Graduate Research Assistant
MEREDITH, John	Graduate Research Assistant
MATHENY, Peter	Graduate Research Assistant
MOUSAVI, S. Mostafa	Graduate Research Assistant
OGWENO, Luke Philip	Graduate Research Assistant
SAXENA, Arushi	Graduate Research Assistant
YANG, Yang	Graduate Research Assistant
ZHANG, Jia	Graduate Research Assistant
ZHANG, Yixin	Graduate Research Assistant