FINAL TECHNICAL REPORT

AWARD NO: 04HQAG0024

Recipient Name:	University of South Carolina, Office of Sponsored Programs and Research, Columbia SC 29208
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Title of Recipient's	Cooperative Central and Southeast US Integrated Seismic Network
Application:	- USC

Program Element: SEISMIC

ABSTRACT

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COOPERATIVE CENTRAL AND SOUTHEAST US INTEGRATED SEISMIC NETWORK - USC

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Routine seismic monitoring for the central and southeast US is carried out through the "Cooperative Central and Southeast US Integrated Seismic Network". As part of the program, the South Carolina Seismic Network (SCSN) headquartered at the University of South Carolina (USC) routinely monitors seismicity in South Carolina. This report provides a technical summary of seismic monitoring in South Carolina during 2004 – 2007. In South Carolina SCSN monitors tectonic earthquakes as well as reservoir-induced earthquakes. The tectonic earthquakes are mostly concentrated in Middleton Place Summerville Seismic Zone (MPSSZ) near Charleston, the focus of interest under this grant. The reservoir induced earthquakes, supported by another source, are located around Lakes Jocassee, and Keowee, and Bad Creek reservoir in northwestern SC, and Monticello reservoir in central SC. Any earthquakes that occur in other parts of the state are also recorded and located. The data from all parts of SC except the Coastal Plain are continually recorded digitally through the "Earthworm" system at USC. Continuous digital recording through the same system of the data from the Coastal Plain was done at Charleston Southern University (CSU) in Summerville up to 2005, and accessed via the Internet from USC. These data are archived at USC and also transferred to USGS, Golden via CERI, Memphis. The phase data and locations were sent to Virginia Tech for compilation in the annual Southeast US Seismic Network (SEUSSN) bulletins. The node at Charleston Southern University was abandoned in 2005 and efforts made, overall unsuccessfully, to establish a new node at the facilities of Dorchester County Emergency Services Department at Summerville. This led to a significant decrease in the ability to locate small magnitude events. Reconfiguration of SCSN into digital recording began in 2007.

INTRODUCTION

The "Cooperative Central and Southeast US Integrated Seismic Network" conducts routine seismic monitoring for the central and southeast US. The South Carolina Seismic Network (SCSN) headquartered at the University of South Carolina (USC) routinely

monitors seismicity in South Carolina as part of this program. In South Carolina SCSN monitors tectonic earthquakes as well as reservoir-induced earthquakes. Support for monitoring earthquakes near reservoirs and other parts of the state is obtained from other sources and not from the USGS. The tectonic earthquakes are mostly concentrated in Middleton Place Summerville Seismic Zone (MPSSZ) near Charleston, the focus of the USGS support. The reservoir induced earthquakes are located around Monticello reservoir in central SC. Earthquakes that occur in other parts of the state are also recorded and located. The data from all parts of SC are continually recorded digitally and sent to USGS Golden and also archived at USC. Additionally, the SCSN publishes reports on felt events which can be obtained from its website at http://scsn.seis.sc.edu/bulletin/bulletin.html. This report provides a technical summary of seismic monitoring in South Carolina during 2004 – 2007.

SOUTH CAROLINA SEISMIC NETWORK OPERATION

Station Locations

During 2004, the South Carolina Seismic Network consists of 11 short period stations, (Figure 1) and four strong motion stations that were established near Charleston. Of the eleven stations, 6 are short period, vertical component and data were transmitted by analog-telemetry, and 5 stations were short period three component sites and their data too were transmitted by analog telemetry. The emphasis was on monitoring the seismicity in the Middleton Place Summerville Seismic Zone (MPSSZ) – the location of the "Charleston" earthquakes. In cooperation with the operators of the Savannah River Site seismic network, SCSN provides a coverage of the regional seismicity.

Additional mini networks (Figures 3, 4), supported by DOE monitor reservoir induced seismicity near Monticello Reservoir in central SC and Lake Jocassee in northwest SC.

Seismic data were recorded at the Charleston Southern University, CSU in Figure 2 – the Charleston node [CHAS, Charleston SC operated by USC] and the University of South Carolina in Columbia [COSC Columbia, SC operated by USC].

Eight short period stations were telemetered by a combination of VHF radio and telephone circuits to CSU [CHAS in ANSS listing] (Figure 2). The data are digitized with 16 bit resolution at 100 sps. The data are recorded continuously to disk and event triggered by Earthworm. It includes a revolving continuous buffer of about 5 days and triggered events with M>1.0. This facility also uses an additional PC-based system (Willy Lee) in event triggered mode as a backup recording device. Data from the "Willy Lee" system can be retrieved from Columbia via a modem. One channel is also recorded on helicorders for local display, education and outreach. Nineteen channels of data were exported to USC for data recording and analysis, (Figure 2).

Three short period stations were telemetered by a combination of VHF radio and telephone circuits to the recording center at the University of South Carolina in Columbia (COSC in ANSS listing). These data are digitized with 16 bit resolution at 100 sps. The data are saved to disc continuously and event triggered by Earthworm. At USC the continuos buffer is for about 3 days and M>= 1.5 are triggered and recorded.These data are also continuously recorded with 16 bit resolution at 50 sps by a PC-based (Willy Lee) system and saved on disks and tapes, and displayed on three helicorders displaying data from JSC, COW and lower coastal plain for quick reference of seismicity in the state. The tape drive can store approximately 2 gigabytes of data on a single tape. Accumulating data at a rate of 288 Mb

per day, the data are mass dumped each morning from hard disk to tape. A backlog of 60 days data is maintained for further use. At USC, (COSC), 19 channels are imported from CHAS, and 7 channels are exported to NEIC (and on to CERI). Earthworm channels are continuously displayed on the SCSN website at http://scsn.seis.sc.edu.

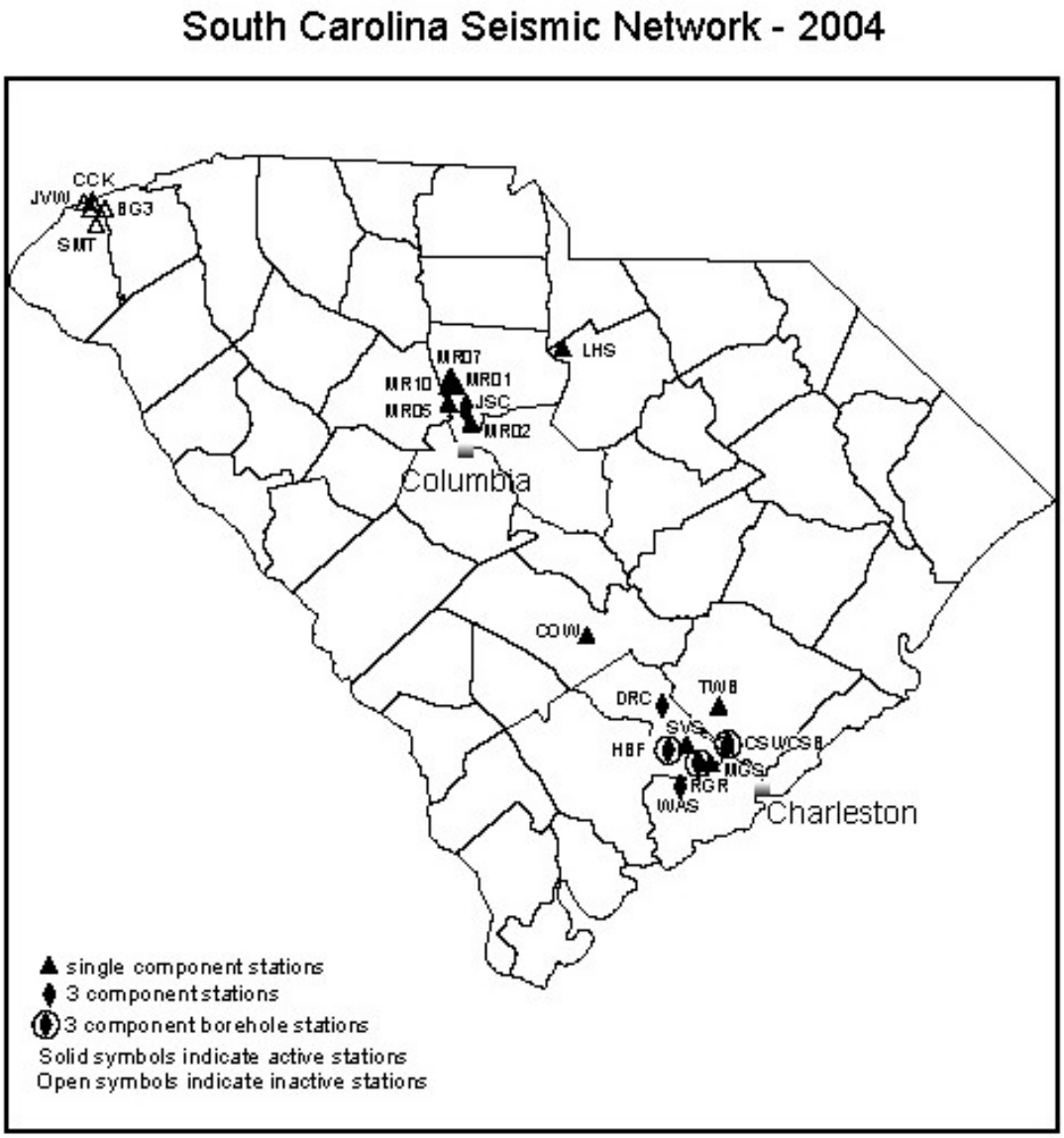

Figure 1: Distribution of stations/subnets of the South Carolina Seismic Network during 2004. Triangles (▲) represent single component stations while diamonds (♦) represent three component stations.

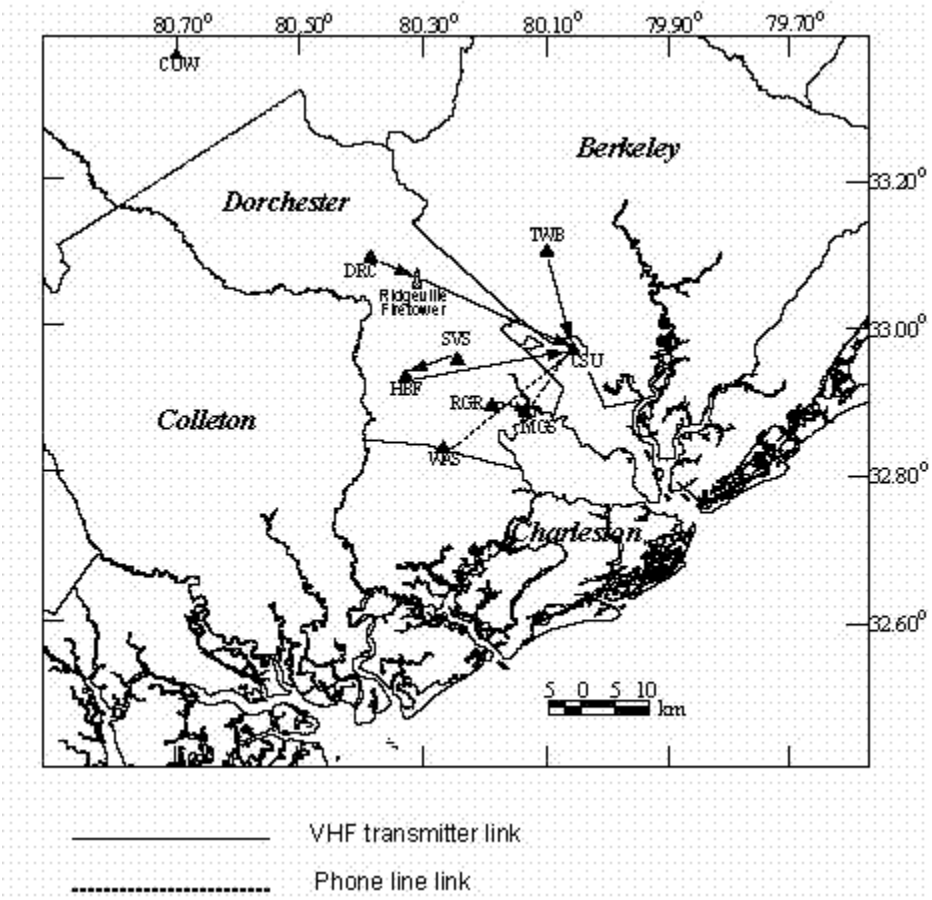

Figure 2: Stations of the Coastal Plain Seismic Network and their telemetry routes.

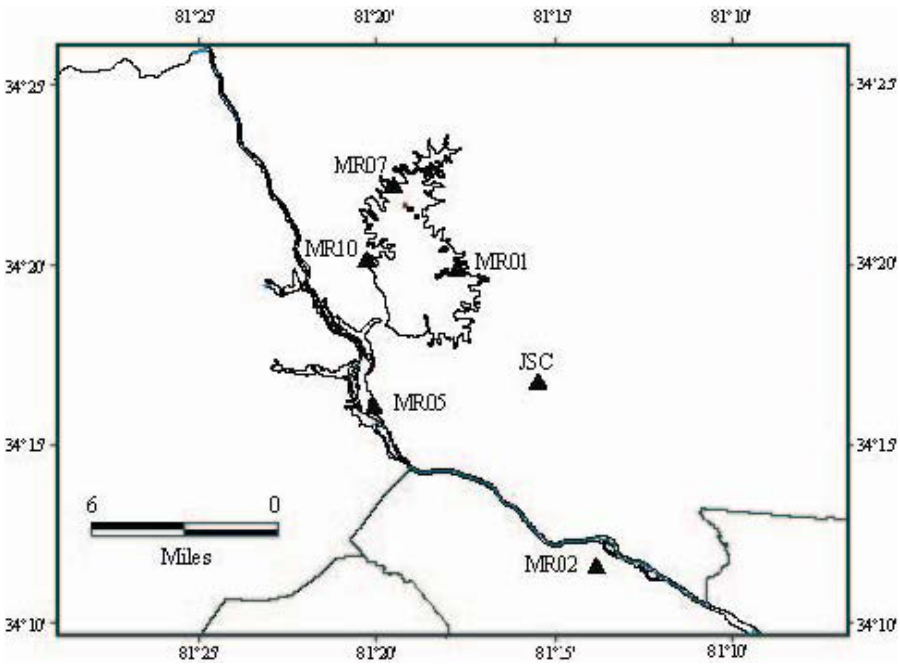

Figure 3: Stations of the Monticello Reservoir sub-network.

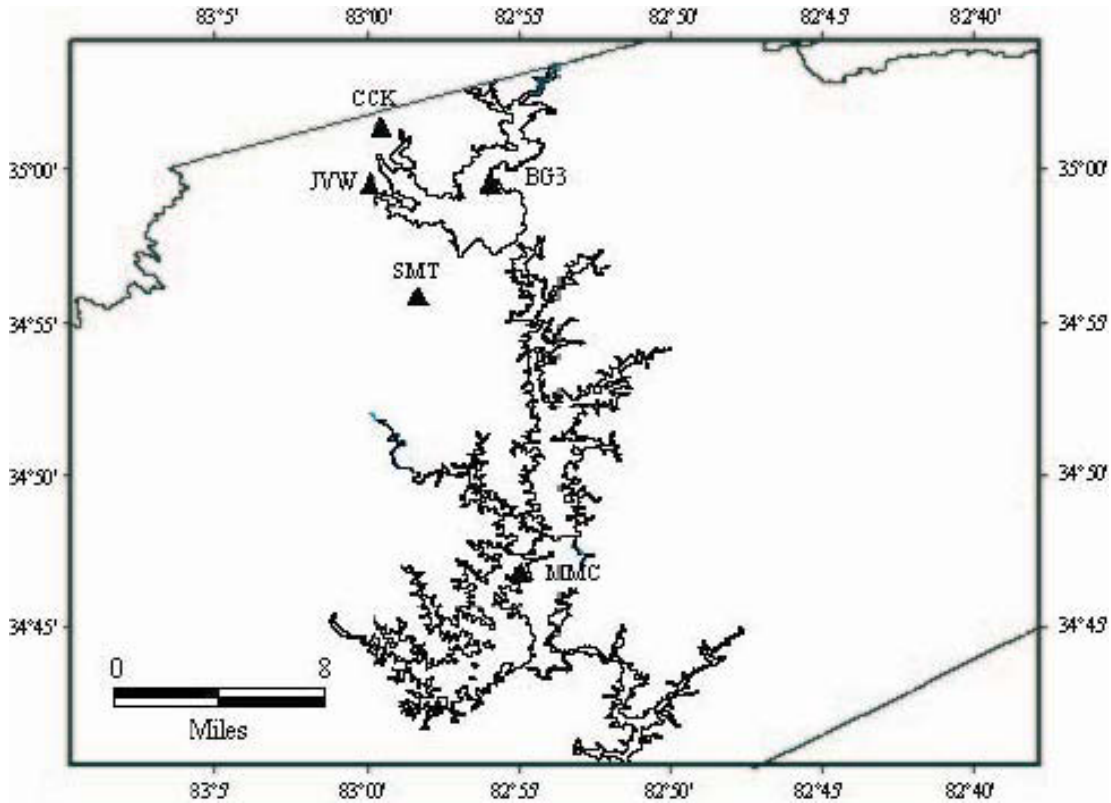

Figure 4: Stations of the Jocassee sub-network.

In 2005 we had to abandon the Charleston Southern University (CSU) node. This came about because of three reasons. The first was the retirement of Dr. Bagwell of CSU. She had been an ardent supporter of SCSN and ensured the efficient and continuous maintenance of the CSU hub. Her replacement and the CSU's commitment suffered a significant lapse after Dr Bagwell's retirement. The second reason was the refurbishing of Ashley Hall, the building where the SCSN node was located. All antennas were decommissioned (affecting half of the data coming into CSU) due to re-roofing. We were then required to move the antennas to another location away from this building. Finally when the interior of the building was being refurbished the workmen would often unplug our computers, and forget to re-plug them. This required a trip from Columbia, to rectify the situation. Third, due to urban growth around Charleston, to the south and west, Westvaco a

timber company that owned large tracts of forested land, and where our stations were located, sold their holdings to developers. This meant that many of our stations which were located on seismically quiet forested lands are now adjacent to new deforesting activities and future housing developments. As anticipated, our stations at SVS, TWB and WAS had to be decommissioned. The urban sprawl has also resulted in increased noise levels.

So we decided to move to a more permanent location. We negotiated with Dorchester County management, and planed to relocate the node at the Dorchester County Emergency Management (DCEM) facility, located about 12 miles northwest of CSU. We anticipated using their high antenna towers for transmission of data. The anticipated telemetry links to DCEM node are shown in Figure 5. Data will continue to be sent via the internet to USC in Columbia.

We planned to upgrade the facilities at DCEM in having a longer continuous rolling buffer for 20 days. We also planned to install the autolocation program there and train the DCEM personel, so that they can quickly respond to local enquiries, before contacting us in Columbia.

Other planned changes include the installation of Panda II automatic Gain ranging seismic amplifiers at RGR and JSC, our best stations. Currently any local earthquake of M>/+ 3.0, in the MPSSZ (for RGR) and in the Piedmont (for JSC), and M>/= 4.0 regionally, saturates the seismograms.

However, because of various personnel changes in DCEM and inordinate delays in acquiring space, the proposed shift got further delayed. In the interim new antennas were installed on the radio tower at DCEM and a new telephone and radiometry links were installed at DCEM. However, due to lack of satisfactory installation of radio links to USC, useful data were not transmitted to USC until 2007. In the mean time, TBW, HBF and SVS

were abandoned due to urban sprawl. Also, in 2007 representatives of USGS indicated that they would no longer support short period recording. Consequently, the ensuing efforts were directed towards installation and acquisition of digital data. This led to a drastic reduction in our ability to record small magnitude events in the Middleton Place Summerville Seismic Zone.

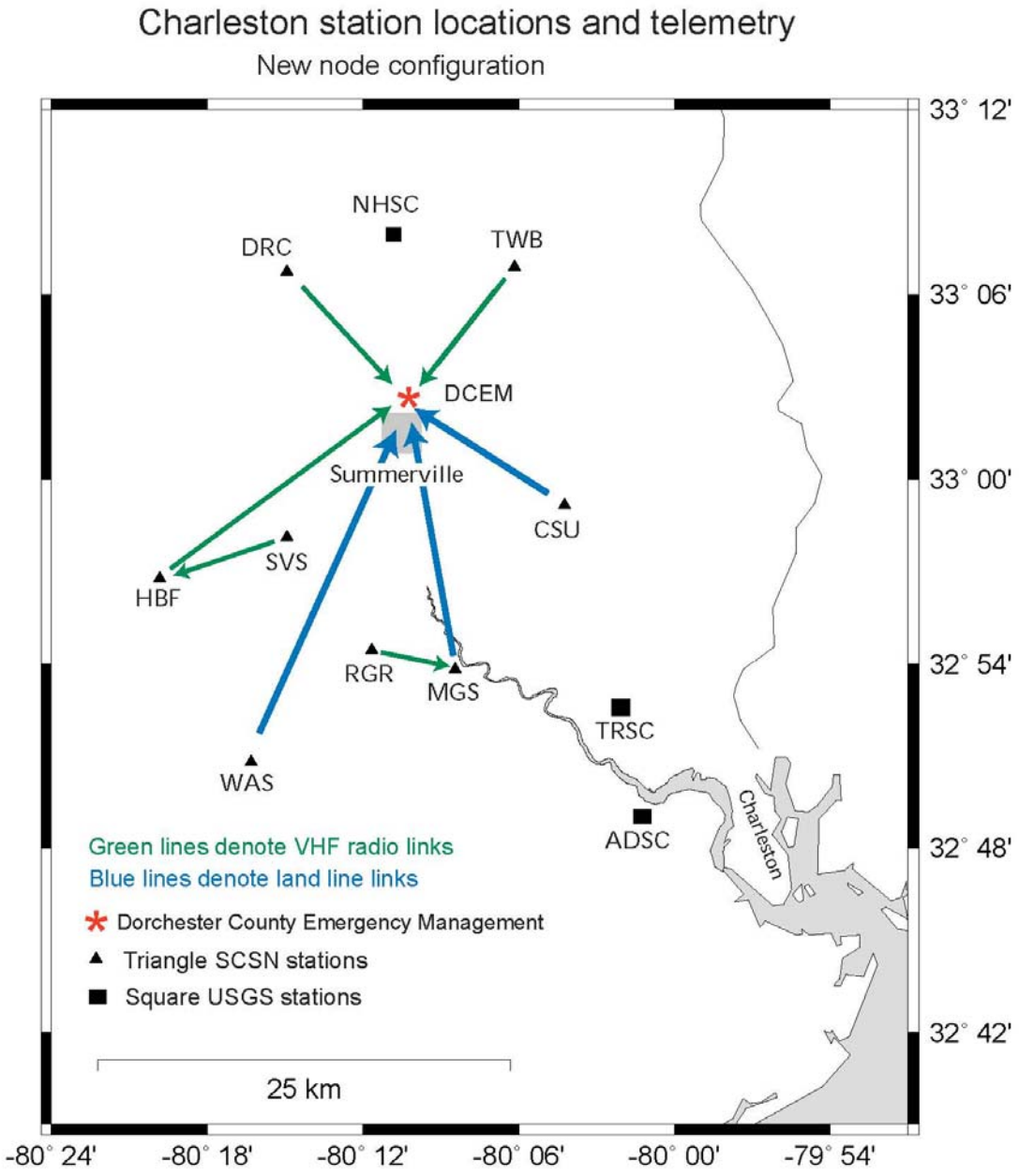

Figure 5: Proposed telemetry set up at DCEM node.

SOUTH CAROLINA SEISMICITY: 2004 – 2007

In South Carolina SCSN monitors tectonic earthquakes as well as reservoir-induced earthquakes. The tectonic earthquakes are mostly concentrated in Middleton Place Summerville Seismic Zone (MPSSZ) near Charleston. The reservoir induced earthquakes are located around Lakes Jocassee, and Keowee, and Bad Creek reservoir in northwestern SC, and Monticello reservoir in central SC. Any earthquakes that occur in other parts of the state are also recorded and located.

South Carolina Seismicity - 2004

A map with all the earthquakes located in South Carolina during 2004 is shown in Figure 6.

Ten felt earthquakes occurred in South Carolina during 2001. The largest, M_L 3.2 event occurred in MPSSZ on July 20, 2004. Aside from these, low level activity continued in the Monticello Reservoir (8 located events) with a M 2.5 event on April 4, 2004. Seismicity in the different regions is discussed below.

Middleton Place Summerville Seismic Zone

The MPSSZ continued to be the most active (non RIS) seismic source zone in the Coastal Plain in 2004 (Figure 7). There were 12 events in MPSSZ in the year 2004 of which 10 were felt (Table 1, Figure 7).

Monticello Reservoir

There were 8 events in Monticello Reservoir in the year 2004 of which one was felt (Table 2, Figure 8).

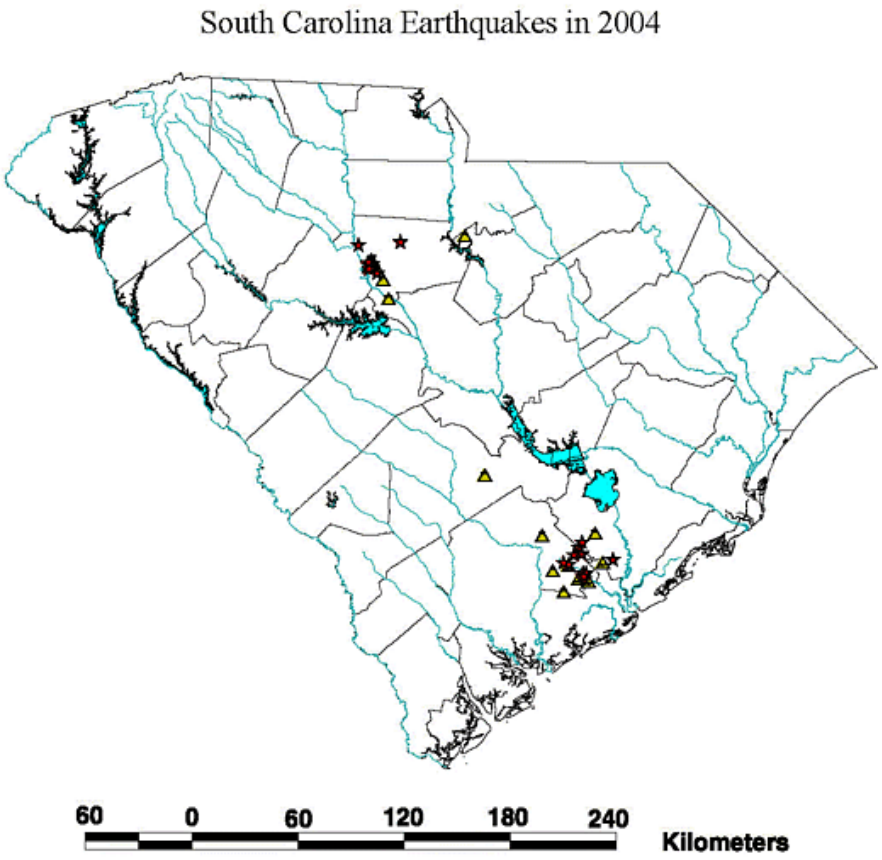

Figure 6: Earthquakes located in 2004 in South Carolina.

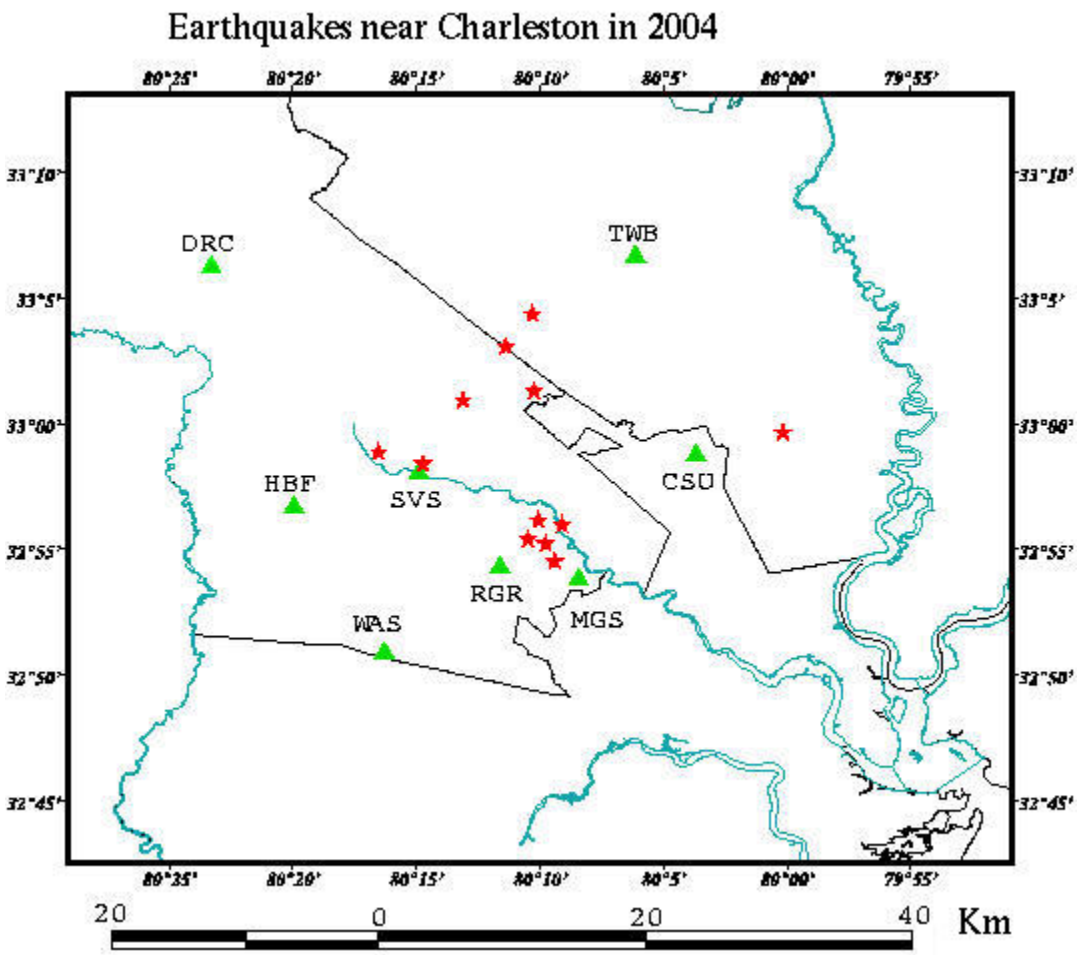

Figure 7: Earthquakes located in 2004 in the Charleston area.

Table 1: Earthquakes near Charleston in 2004

Date(UTC)	Hr	Min	Sec	Lat(N)	Lon(W)	Depth(km)	Mag	Q
040113	18	19	26.87	33-01.03	80-13.15	7.47	2.21	A
040212	11	03	35.20	32-54.47	80-09.39	9.09	2.02	A
040229	12	40	05.26	32-56.13	80-10.08	7.69	2.01	A
040501	04	16	28.27	32-59.71	80-00.16	10.66	2.71	A
040508	11	25	21.68	32-55.37	80-10.52	5.75	1.94	A
040720	09	13	14.45	32-58.42	80-14.78	9.90	3.12	A

040813	04	11	05.09	32-58.94	80-16.57	7.04	2.20	A
040818	03	43	42.36	33-01.35	80-10.28	7.71	2.53	A
040820	01	56	21.34	32-56.00	80-09.11	6.92	1.87	A
041125	22	58	45.89	33-03.20	80-11.39	12.88	2.70	A
041207	22	23	50.80	32-55.22	80-09.77	6.95	2.24	A
041210	07	13	00.87	33-04.50	80-10.31	10.32	2.36	B

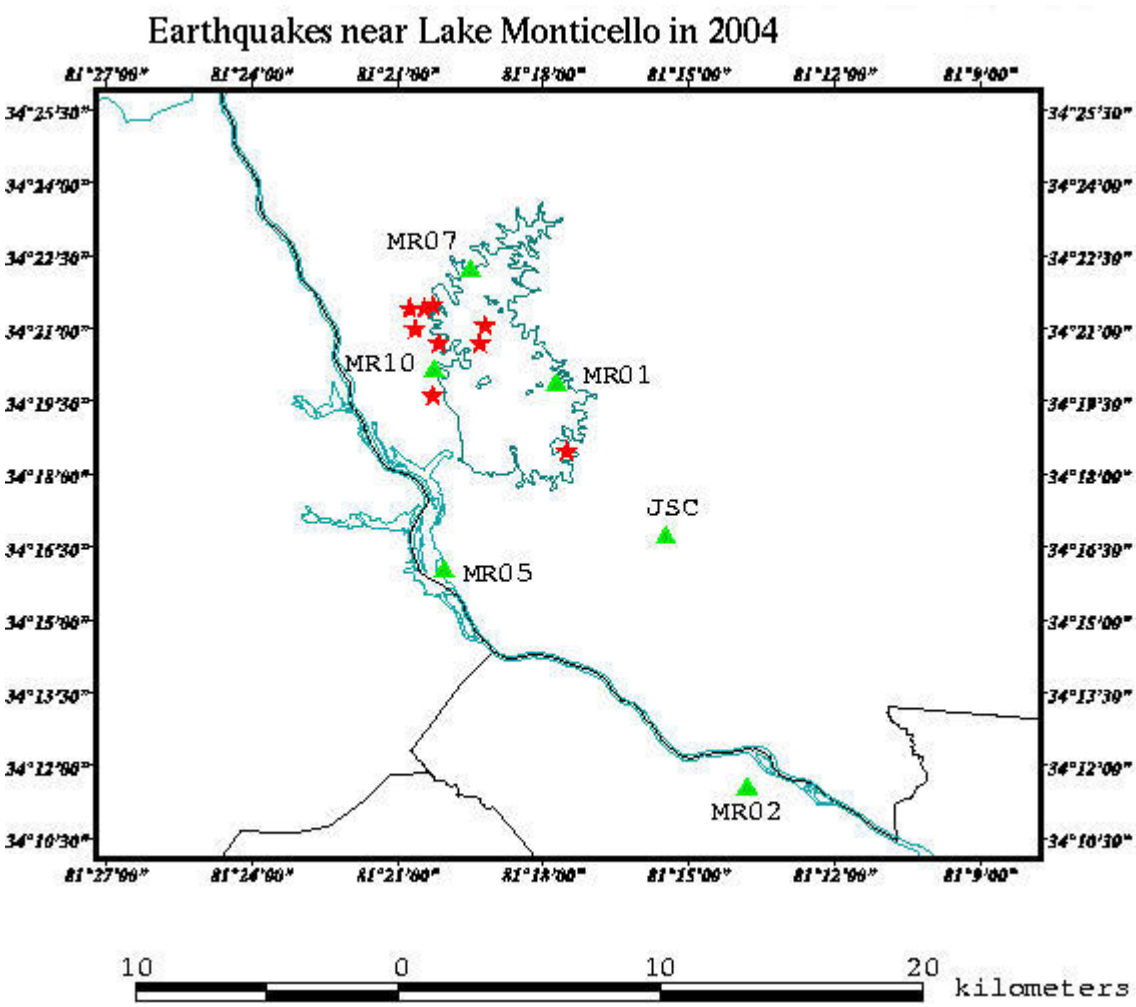

Figure 8: Earthquakes located in 2004 near Lake Monticello.

Table 2: Earthquakes near Monticello Reservoir in 2004

Date(UTC)	Hr	Min	Sec	Lat(N)	Lon(W)	Depth(km)	Mag	Q
040120	05	45	27.64	34-21.07	81-19.21	1.11	.979	A
040120	16	57	51.31	34-20.72	81-19.33	1.47	.947	A
040130	17	42	30.85	34-21.47	81-20.27	0.26	.504	B
040202	15	45	52.18	34-20.99	81-20.62	1.72	1.72	A
040202	15	46	40.78	34-21.10	81-20.53	2.01	0.04	a
040311	08	45	47.33	34-21.43	81-20.76	0.92	1.02	A
040329	10	09	16.46	34-20.71	81-20.13	1.71	.682	A
040404	09	18	55.52	34-19.62	81-20.29	8.78	2.50	A

Other Tectonic Activity

Three small events were located outside the MPSSZ and Monticello Reservoir. These events occurred in Fairfield and Lexington Counties in Central South Carolina (Figure 9, Table 3).

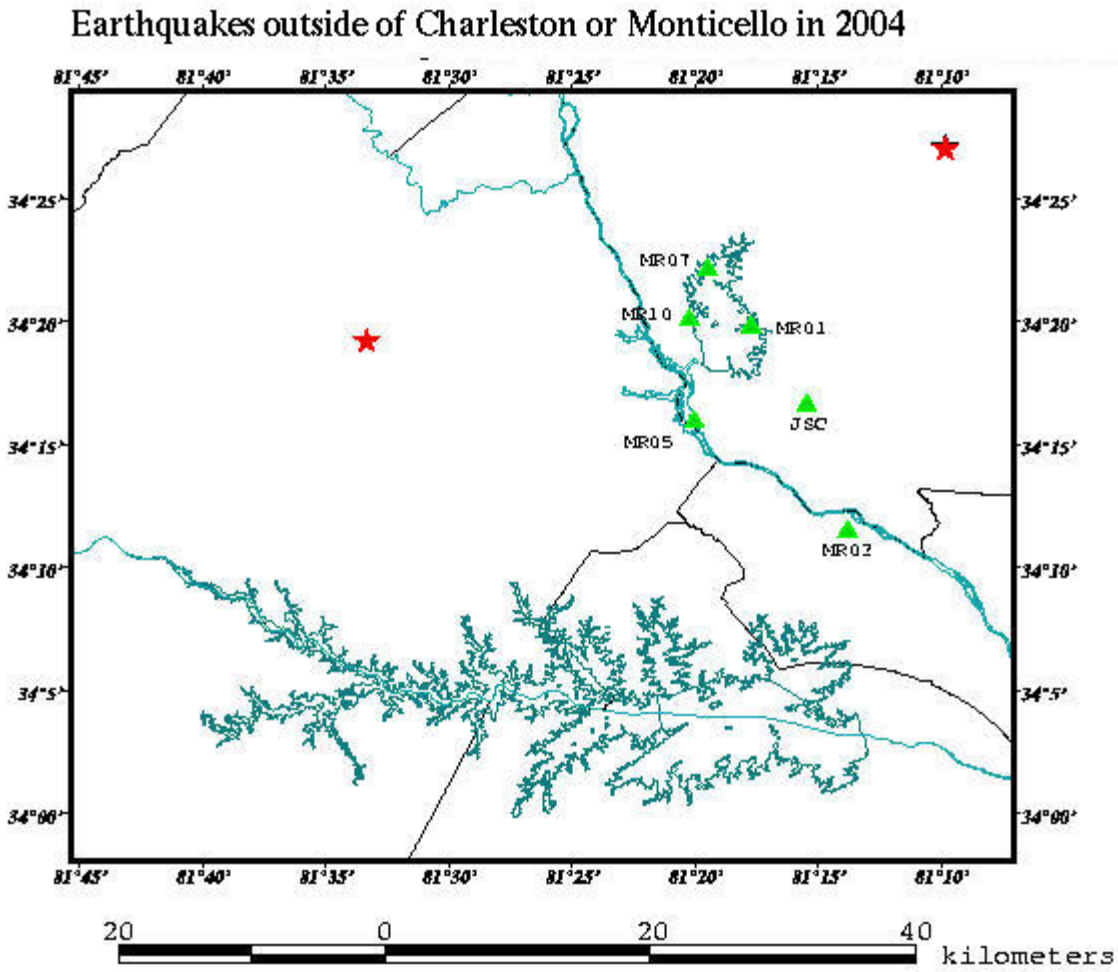

Figure 9: Earthquakes in Fairfield and Lexington Counties, South Carolina.

Table 3: Earthquakes in areas outside Charleston and Monticello

Date(UTC)	Hr	Min	Sec	Lat(N)	Lon(W)	Depth(km)	Mag	Q
20040112	01	55	16.90	34-27.13	81-09.82	2.52	1.40	C
20040325	03	03	11.44	34-19.24	81-33.33	3.24	1.21	C
20040329	23	15	40.66	34-27.34	81-09.83	1.95	1.95	C

<u>South Carolina Seismicity – 2005-2007</u>

Routine analysis and location of micro-earthquakes in South Carolina suffered

greatly due to the closure of the Charleston Southern University node. However, we continued to monitor and analyze data for significant felt events in these years. They are described below.

Earthquakes near Charleston in 2005

Two earthquakes with M> 2.0 were felt in the Summerville area (Table 4, Figure 10).

Table 4: Earthquake near Charleston in 2005

Date(UTC)	Hr	Min	Sec	Lat(N)	Lon(W)	Depth(km)	Mag	Q
20050222	23	18	50.21	32n57.30	80w09.77	2.99	2.15	C
20051119	20	3	16.14	33n00.55	80w06.99	10.20	2.6	C

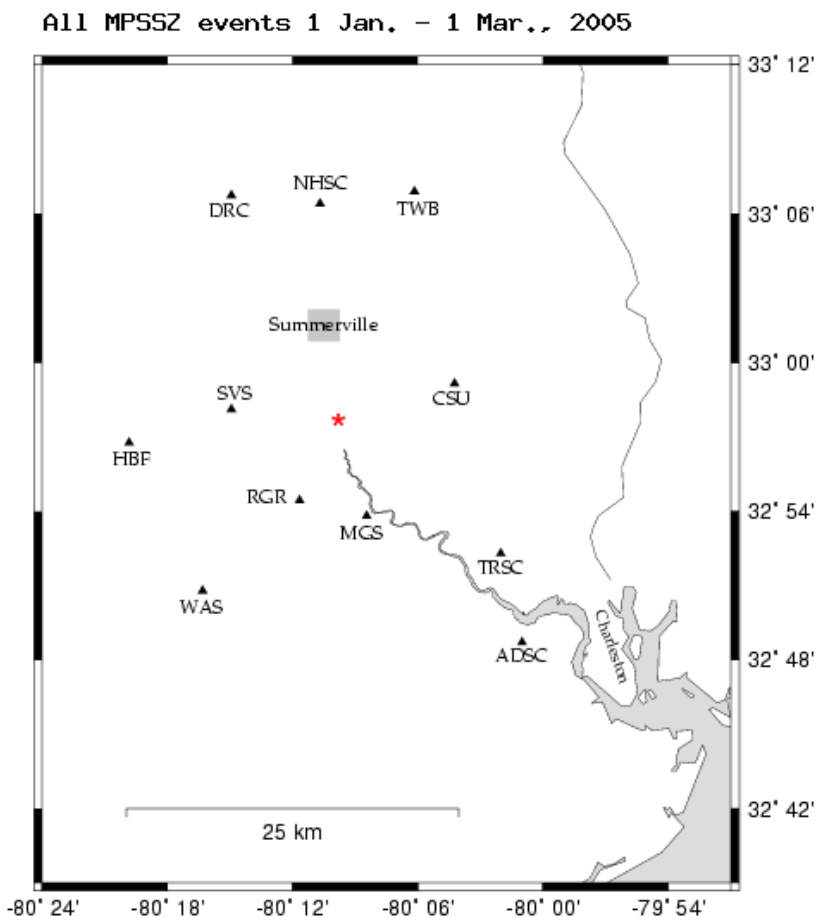

Figure 10: Earthquakes in the Charleston area in 2005 (only one event is shown).

Earthquakes in areas outside Charleston and Monticello in 2005

A felt earthquake which was also accompanied by a load noise occurred near Columbia, SC, and appeared to be centered near the offices of the South Carolina Geological Survey. Subsequent monitoring for aftershocks revealed two or three possible micro-earthquakes at the same location, which is given in Table 5 (Figure 11). We provided data and other information to the South Carolina Geological Survey who put out a report on this event. This report is reproduced below.

Table 5: Earthquake near Columbia, SC

Date(UTC)	Hr	Min	Sec	Lat(N)	Lon(W)	Depth(km)	Mag	Q	(Comment)
050218	14	21	56.42	34-08.00	81-08.71	0.00	2.65	C	very shallow, sez .7km

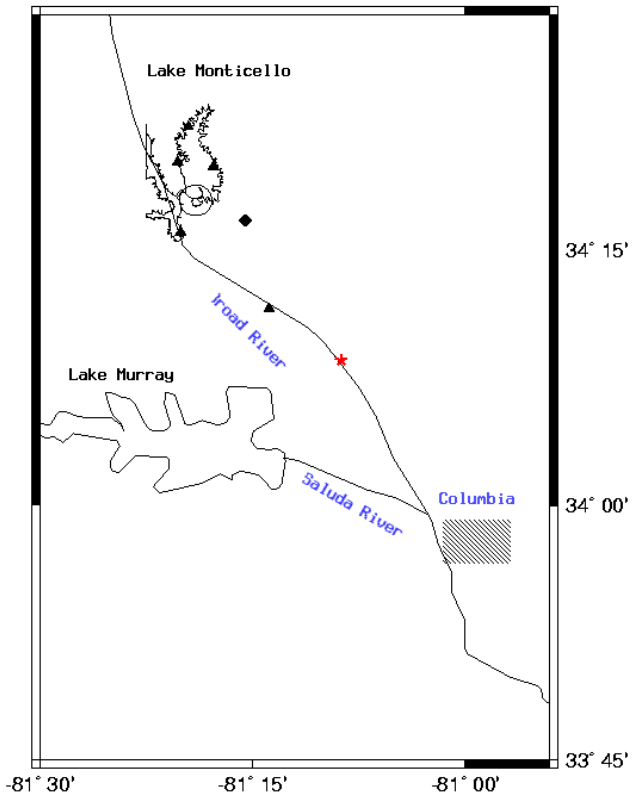

Figure 11: Earthquake near Columbia, SC.

Magnitude 2.9 – South Carolina 2005 February 18 14:21:55 UTC

Jennifer Krauser South Carolina Geological Survey

On February 18, 2005, a magnitude 2.9 earthquake occurred near Columbia, S.C. At approximately 9:21 am several people in the South Carolina Geological Survey, located at 5 Geology Road, Columbia, SC 29212, felt this event. Most of the people here felt shaking lasting two to three seconds with some computer monitors noticeably shaking along with a loud boom. Originally thought to be a blast from a local quarry or the Lake Murray dam, after a few minutes, seismographs of the event were found via the web, and the event was identified as an earthquake and not a blast (see Figure 1).

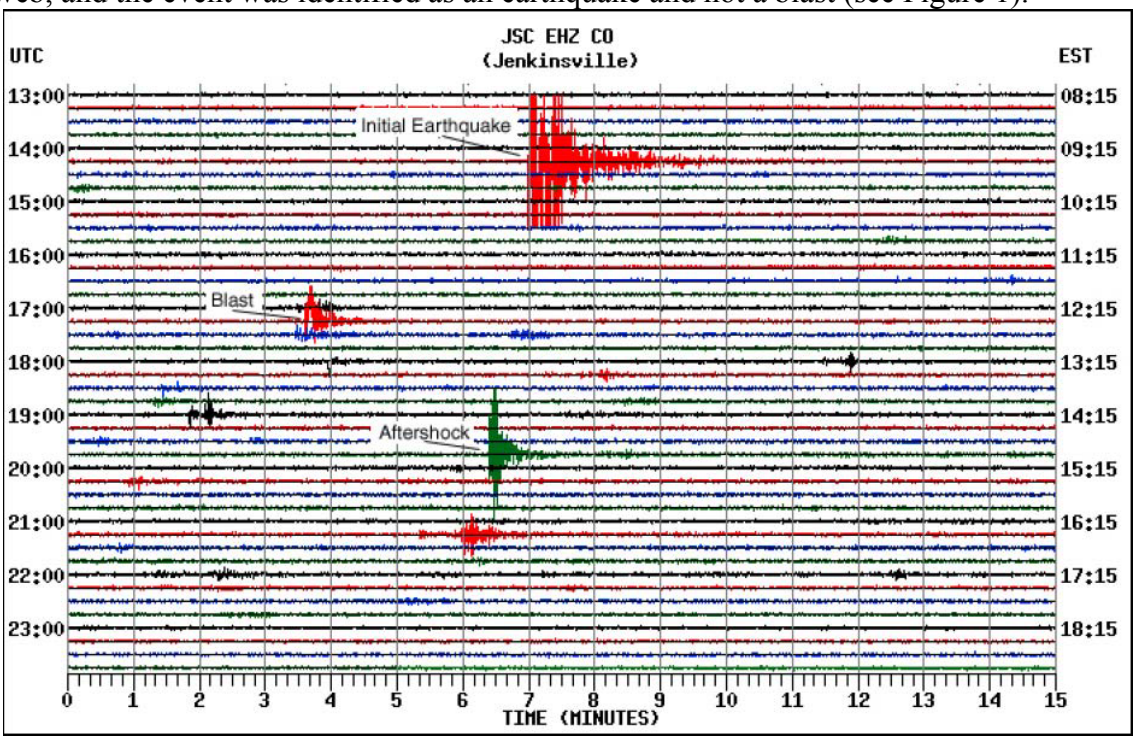

Figure 1. Jenkinsville seismograph for February 18, 2005. Main event at 9:22 am, as well as an aftershock felt by some at 2:51 pm. These displays digitally simulate actual seismograms that are routinely recorded at University of S.C. Time is indicated at the left end of the lines in Universal Time Coordinate (UTC or Greenwich) time and at the right end of the lines in local Eastern time.

The quarry and mining activities in South Carolina, North Carolina, and Eastern Tennessee are regularly seen on these stations, as well as sonic booms, trains, and man-made blasts.

After confirming the findings when the United States Geological Survey (USGS) posted the preliminary results a few minutes later, a group of people from the South Carolina Geological Survey set out to investigate the findings, as the hypocenter (surface location of the epicenter, where the epicenter is the location of the earthquake below the surface) was located only a few miles from the Geological Survey building. Upon interviewing several people near the Broad River Road and St. Andrews Road Intersection in Columbia, S.C., where the hypocenter was originally located, we found that many people did not feel the earthquake. As we headed back towards the

Geological Survey building, we did, however, find people who felt the earthquake.

As more data were analyzed, a new epicenter was located a few miles farther northeast in the Columbia North quadrangle (See Figure 2). Also, the fault associated with this earthquake is assumed to be a strike-slip fault, which correlated well with the interviews we gathered while investigating. Most of the people along this strike felt the earthquake, while the farther we got from the strike the fewer people we found who felt it. The South Carolina seismic network final location for the February 18, 2005 earthquake placed the epicenter farther northwest in the Richtex quadrangle with a magnitude of 2.65.

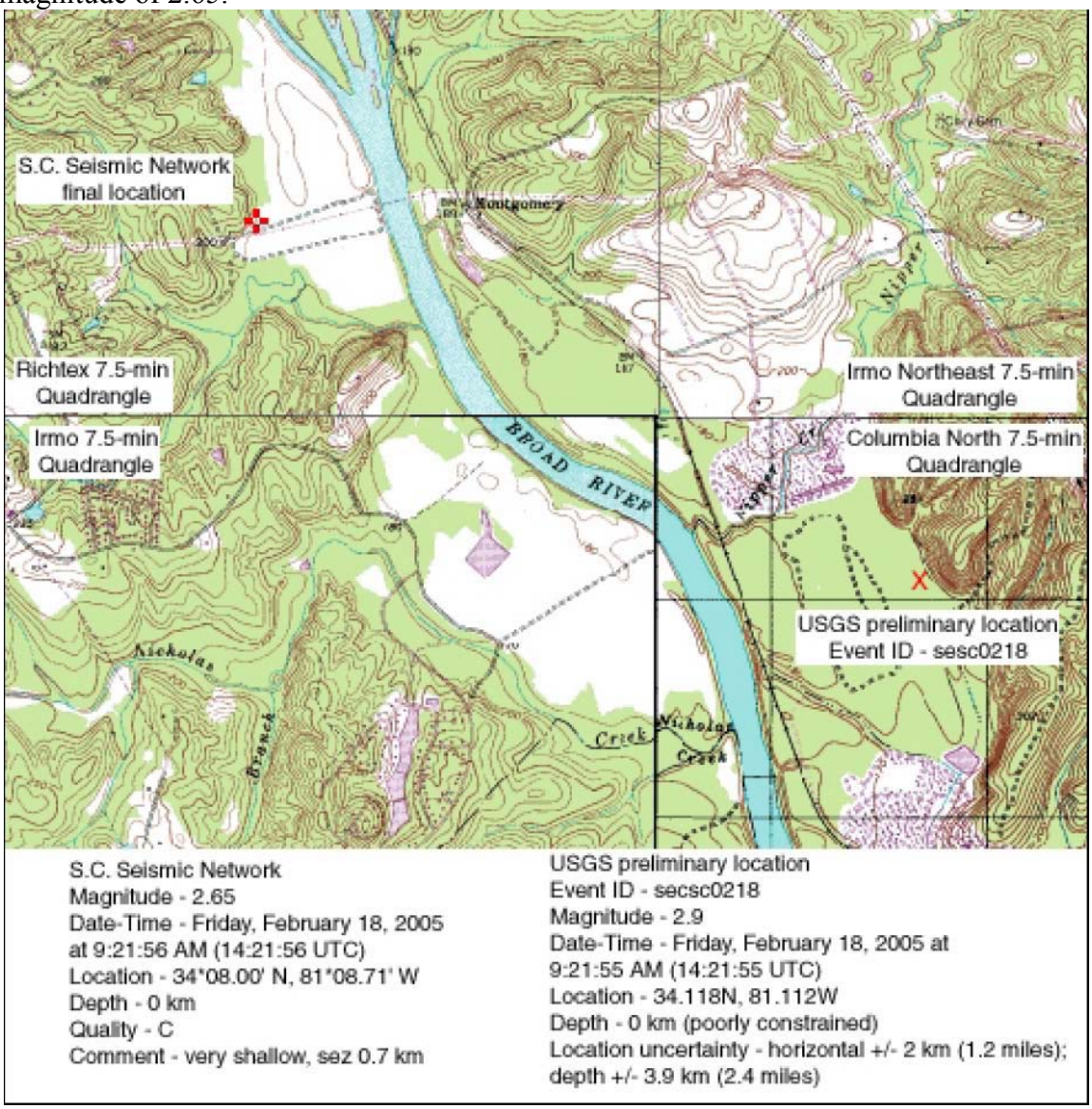

Figure 2. Preliminary earthquake report, southeast U.S. seismic network and the S.C. seismic network final report for the South Carolina earthquake on February 18, 2005. (http://earthquake.usgs.gov/recenteqsUS/Quakes/sesc0218.htm and http://scsn.seis.sc.edu/html/otherlat.html) Topographic map from www.topozone.com.

When the earthquake was announced by the local news stations, more surveys

were completed via the web to gather data about the intensity of this event (http://pasadena.wr.usgs.gov/shake/). Intensity is a qualitative measure of the strength of ground shaking at a particular site, using earthquake effects such as, Did you feel the event?, Did any item move (i.e. furniture, pictures)?, and Your reaction to the event. The U.S. currently uses the Modified Mercalli Intensity Scale. Each earthquake large enough to be felt will have a range of intensities. Usually (but not always) the highest intensities are measured near the earthquake epicenter and lower intensities are measured farther away. Roman numerals are used to describe intensities to distinguish them from magnitudes (See Table 1).

INTENSITY	**I**	**II-III**	**IV**	**V**	**VI**	**VII**	**VIII**	**IX**	**X+**
SHAKING	Not felt	Weak	Light	Moderate	Strong	Very Strong	Severe	Violent	Extreme
DAMAGE	none	none	none	Very light	Light	Moderate	Moderate /Heavy	Heavy	Very Heavy

Table 1. Modified Mercalli Intensity Scale

A total of 123 responses in 16 zip codes were gathered on the USGS website over the weekend after the event with an average maximum intensity of III (See Figures 3 and Table 2). The South Carolina Geological Surveys' own investigation gathered data from local individuals to help narrow the hypocenter of the earthquake and to see if any physical damage had occurred (See Table 3). Within the 29201 zip code, near Burlington Coat Factory on Broad River Road, people heard the boom associated with the earthquake but did not feel any shaking. In and around Irmo (29063), three people who were interviewed did feel the earthquake and gave the earthquake an intensity ranging from II to IV. The closer we came to Lake Murray Dam, the fewer people were found who felt the earthquake. Even though most people at the original calculated epicenter did not feel the earthquake, we found a few who did, and they reported the shaking to be mild to moderate, giving an average intensity of III. There were also a few who reported that they felt the earthquake downtown and also at the Columbia International University off Monticello Road. Also, at about 2:51:30 PM, February 18, 2005, three people felt an aftershock within the Geological Survey building. Pradeep Talwani, director of the South Carolina Seismic Network and Don Stevenson, SRS, deployed two portable seismographs (measuring vertical and horizontal ground motions) in the South Carolina Core Repository. Preliminary results indicate several minor aftershocks of the 2.9 earthquake on February 18, 2005. Monitoring will continue until the end of the month.

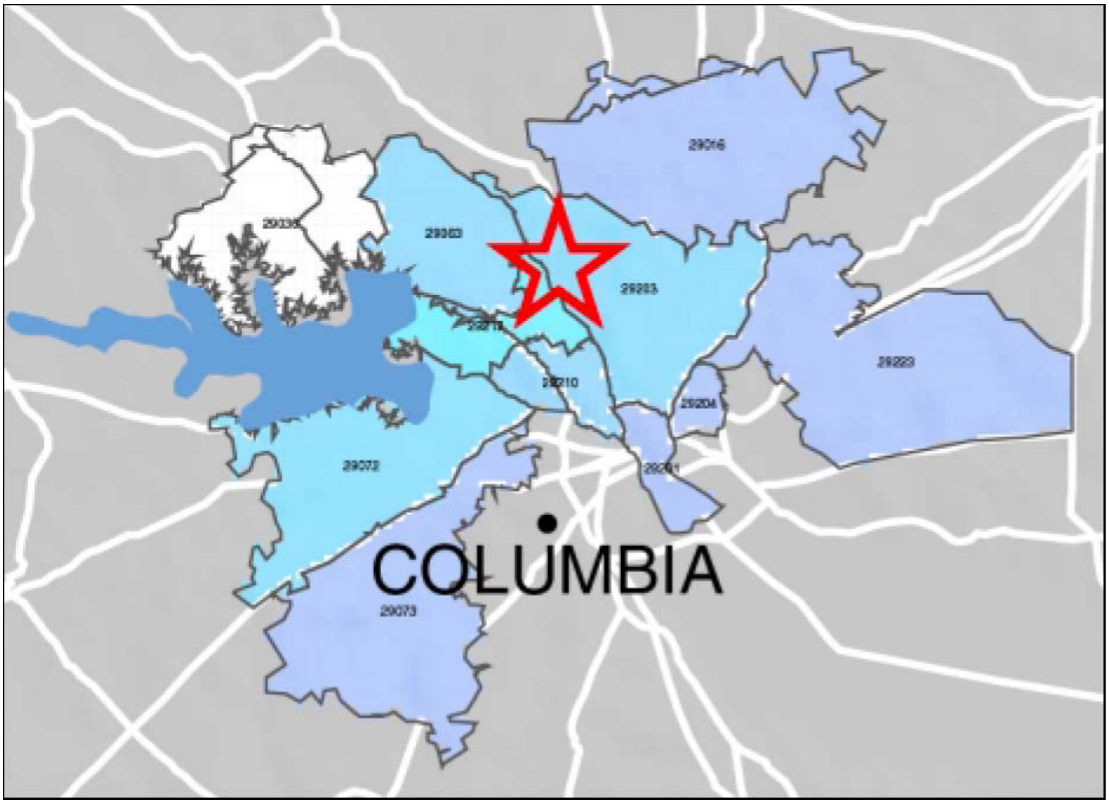

Figure 3. USGS community internet intensity map (5 miles ENE of Irmo, S.C.) ID: sc0218, 09:21:55 EST, FEB 18, 2005, Magnitude 2.9, Latitude N34.12, Longitude W81.11.

Statistics for event sc0218

Total reports:	121
Number of zip codes:	16
Maximum intensity:	III

5 miles ENE of Irmo, South Carolina Mag: **2.9**

Community name	Zip code	Ave. dist. (km)	Ave. intensity	Reports
FLETCHER (NC)	28732	192.98	III	1
BLYTHEWOOD (SC)	29016	14.10	II	1
CHAPIN (SC)	29036	20.62	I	1
IRMO (SC)	29063	8.74	III	24
LEXINGTON (SC)	29072	20.38	III	1
LEXINGTON (SC)	29073	27.60	II	2
SUMTER (SC)	29154	68.29	III	1
COLUMBIA (SC)	29201	16.55	II	6
COLUMBIA (SC)	29203	6.15	III	18
COLUMBIA (SC)	29204	14.30	II	2
COLUMBIA (SC)	29210	8.37	III	31
COLUMBIA (SC)	29212	6.78	III	24
COLUMBIA (SC)	29223	25.63	II	6
CHARLESTON (SC)	29406	166.44	II	1
CLEVELAND (SC)	29635	175.75	II	1
TAYLORS (SC)	29687	146.75	I	1

Table 2. Statistics for the February 18, 2005 South Carolina earthquake at 9:21:55 AM generated by the USGS earthquake hazards program. Table 3. Geological Survey field investigation results of the February 18, 2005, earthquake.

Location of interviewee	**Did they feel the earthquake**	**Other information**
Bi-Lo, 3315 Broad River Road, Columbia, SC, 29210	No	
Rent-A-Center, 7200 Broad River Road, Irmo, SC, 29063	No	
Lawmen's Safety Supply, 3315 Broad River Road, Columbia, SC, 29210	No	
City Financial, 1629 Broad River Road, Columbia, SC, 29210	Yes, 2 people	Saw windows shaking
Public Library on Broad River Road, Columbia, S.C., 29210	No, 4 people	
Eckerd, 3100 Broad River Road, Columbia, SC, 29210	No	
Jackson Hewitt Tax Service, 3315 Broad River Road, Columbia, SC, 29210	Yes, 4 people	Saw windows and other objects shaking
Richland Memorial Hospital area, Columbia, S.C., 29203	Yes	
Embassy Suites Hotel, 200 Stoneridge Drive, Columbia, SC, 29210	Yes, 1 person	No other person felt it
Jim Hudson Mitsubishi, 310 Greystone Blvd., Columbia, SC, 29210	No, 2 people	
Dodgeland of Columbia, 190 Greystone Blvd., Columbia, SC, 29210	No, 5-6 people	
Resident in Hopkins, S.C., 29063	No	
Honda Cars of Columbia, 178 Greystone Blvd., Columbia, SC, 29210	No	
DHEC building on Bull Street, Columbia, S.C., 29203	No	
Burlington Coat Factory at Dutch Square	No	Heard a loud noise

Mall, 800 Bush River Road, Columbia, SC, 29210		
Dentist office on St. Andrews Road, Irmo, S.C., 29063	No, 3 people	
Law officer on Lake Murray Blvd., Irmo, S.C., 29063	No, 2 people	
Anderson, S.C.	No	
Spartanburg, S.C.	No	
Gas station at the 215/I-20 interchange	No	
Geological Survey Building, 5 Geology Road, Columbia, SC, 29212	Yes, 5+ people, 1 person did not feel it	Computer monitors shaking, heard a loud boom, 3 people also felt the aftershock around 2:51 pm.
141 Monticello Trial, Columbia, SC, 29203	Yes, 2 people	Heard a loud noise
Near the YMCA, 1501 Kennerly Road, Irmo, SC, 29063	Yes	Heard a loud noise
Netherland Drive, Irmo, S.C., 29063	Yes, 2 people	Ran outside to see what happened
Brook Pines Apartments, 169 Brook Pines Drive, Columbia, SC, 29210	Yes, 1 person	Noticed pictures move on wall
Columbia International University building, 7435 Monticello Road, Columbia, SC, 29203	Yes, 1 person	Ran outside, was on second story
Shareditch Road, Columbia, S.C., 29210	Yes, 2 people	Heard a loud noise and also ran outside

Earthquakes in areas outside Charleston and Monticello in 2006

A sequence of foreshock, main shock and aftershock occurred near Jonesville in Union County, SC, in January 24, 25 and 30 respectively (Figure 12, Table 6). The earthquakes were associated with a baldrock granitic pluton (Figure 13).

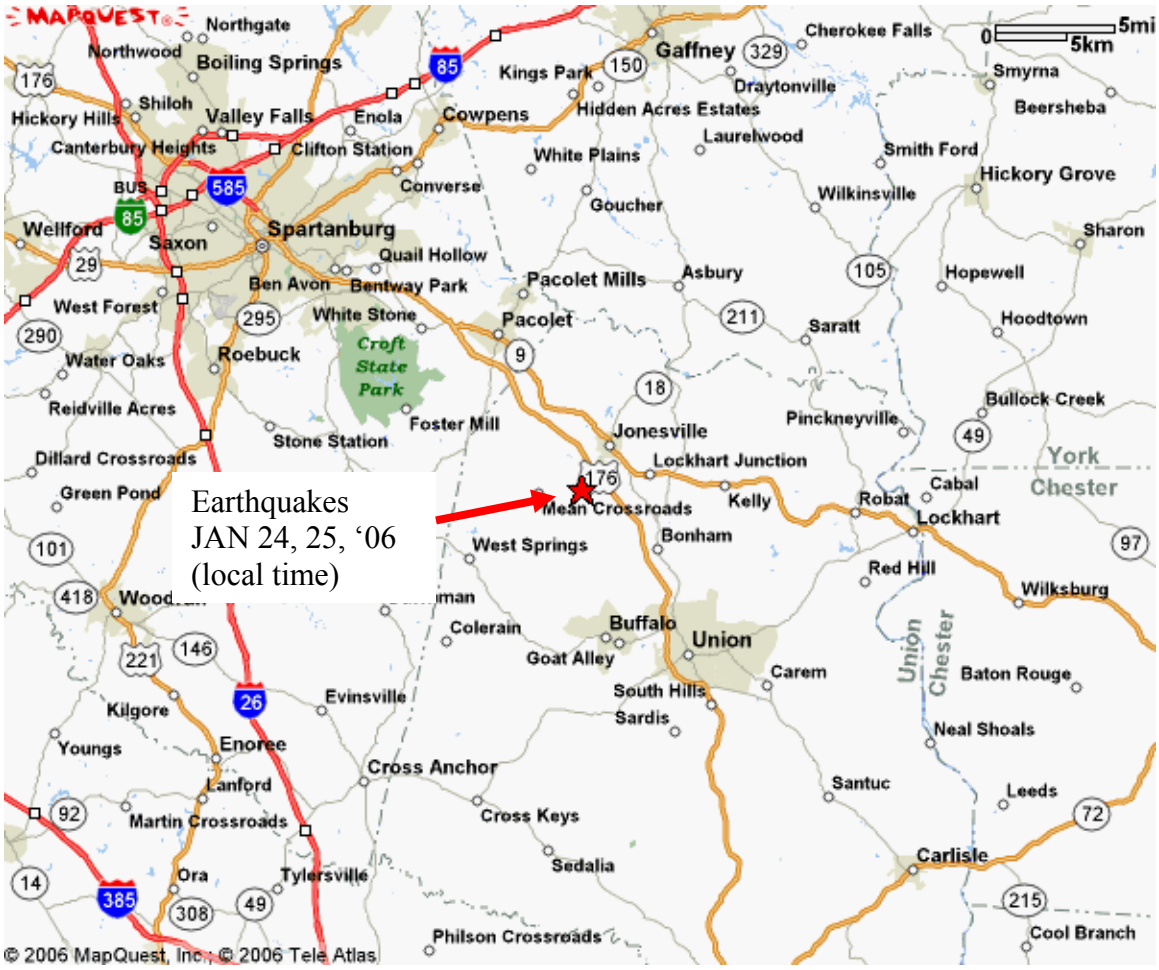

Figure 12: Earthquakes near Jonesville, Union County.

Table 6

Jan 24, 2006 at 10:27 pm (03:27 UTC)	M 2.5		
Jan 25, 2006 at 03:17 am (08:17 UTC)	M 1.5	Lat 34° 48' 31.5''	Long 81° 42' 03''
Jan 30, 2006 at 01:49 pm (18:49 UTC)			

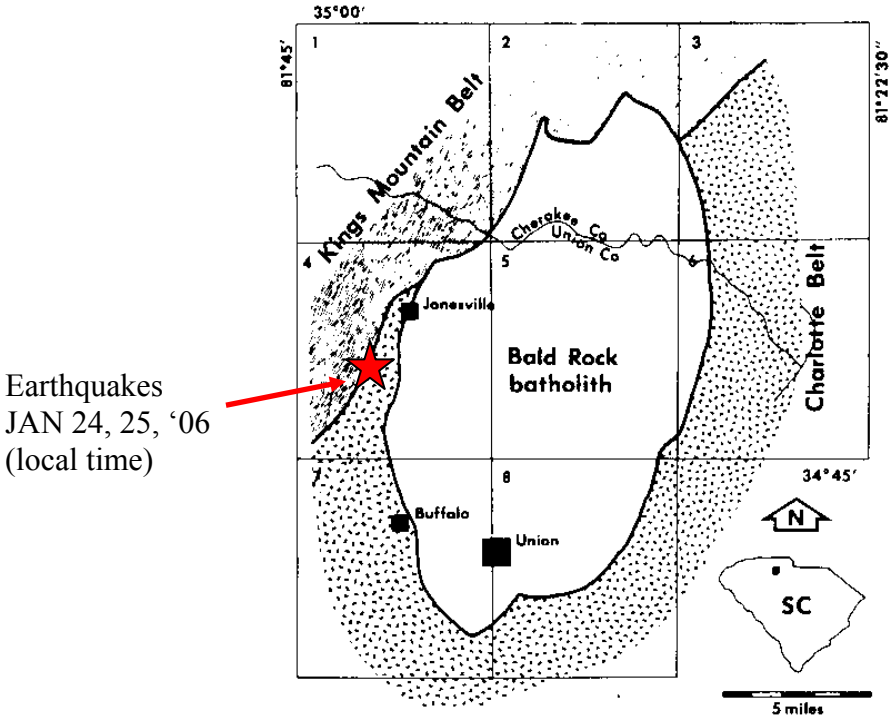

Figure 13: The earthquakes near Jonesville were associated with a baldrock granitic pluton (Figure from van Gelder and McSween, 1981)

Two earthquakes were felt in the Peedee area on Friday September 22, 2006 at 11.22 UTC, (07.22AM EDT) and Monday September 25, 2006 at 05.44 UTC (05.44 AM EDT) (Figure 14). These earthquakes were assigned magnitudes of 3.5 and 3.7 respectively by the US Geological Survey. The USGS location parameters are given in Table 7. These earthquakes were well recorded on JSC and COW, two stations of the South Carolina Seismic network (SCSN). Several smaller aftershocks were also recorded. The phase data for these events are given in Table 8. In the accompanying map (Figure 15) we have plotted the locations of these events on an enlargement of Figure 1 from Hatcher et al., (1977), showing the Eastern Piedmont Fault System (EPFS) in the region between Columbia and the SC/NC border. Both the earthquakes lie in the vicinity of the EPFS. The isoseismal data (Figure 16) compiled by the USGS for the September 25 earthquake seems to have a preferred NE-SW

orientation, with the largest intensity values along the EFPS. High intensity values were also obtained near the Coastal Plain overlap (Fall Line). Such amplification of seismic energy along the Fall Line is routinely observed for earthquakes in the Middleton Place Summerville Seismic Zone (MPSSZ), the source zone of the "Charleston" earthquakes. The high intensities observed near Gaffney and Blacksburg in Central South Carolina near the boundary with North Carolina, seem to be associated with the Kings Mountain Belt. Historically, the EPFS has been the source of several earthquakes (M < 4.5). The last felt earthquake along EPFS occurred on April 13, 1998 and was assigned a magnitude 3.9. It was located in the Camden – McBee area.

Table 7

2006. 09.22. 07. 22.01 (EDT) Mag.3.5 Lat.34.70 N, Long.79.75 W and 2006. 09. 25. 01.44 (EDT) Mag.3.7 Lat.34.60 N and Long. 79.83 W.

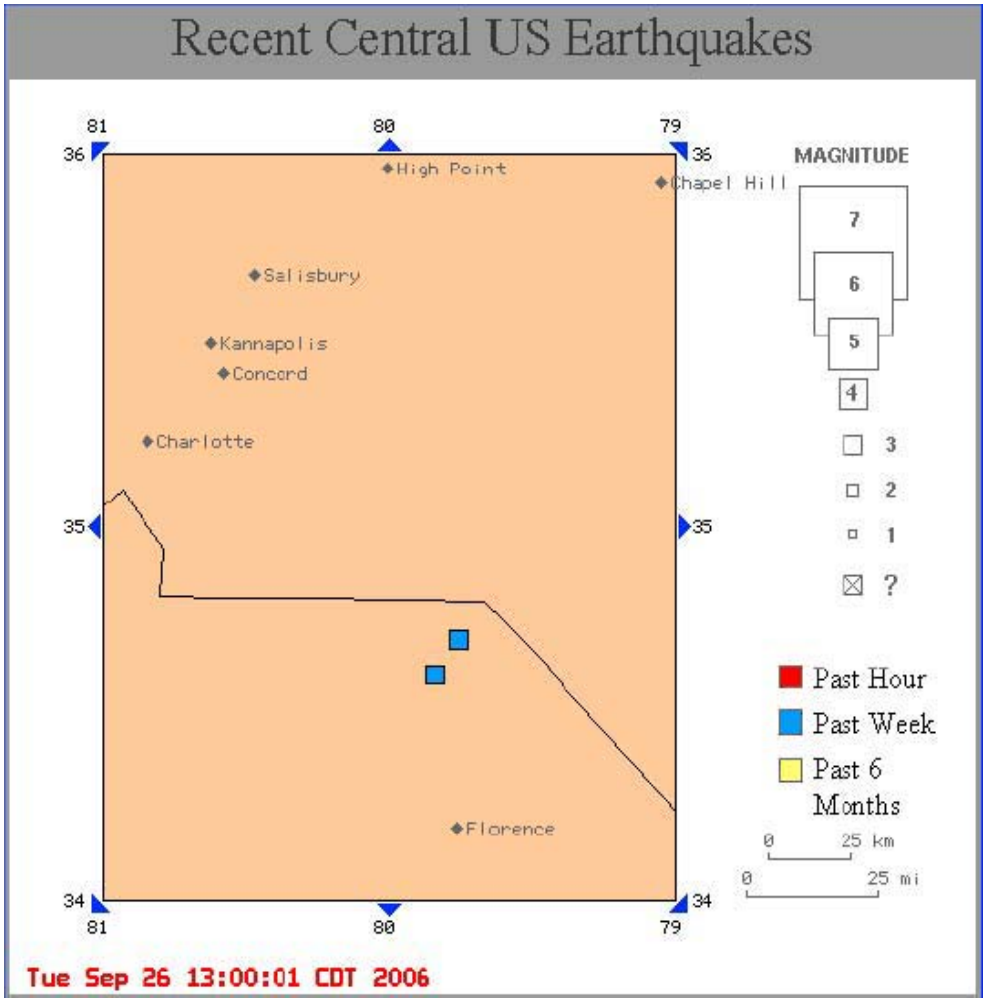

Figure 14: Earthquakes in the Peedee area

Table 8: Phase data obtained from JSC and COW stations.

1. JSC 2006.09.22.	11.22	.27.13 (e) D	42.82 (4)	
COW		27.13 (e) U	42.67 (3)	
2. JSC and COW	13.53			
3. JSC and COW	13.59			
4. JSC 2006.09.23.	17.08	55.90 D	09 12.56	
COW		55.91 U	12.50	
5. JSC 2006.09.25	05.44	48.02 D		

COW			48.02 U	
6. JSC	(NOISY)	06.21	08.93 U	25.04 (3)
COW (NOISY)			08.93 D	25.48 (3)

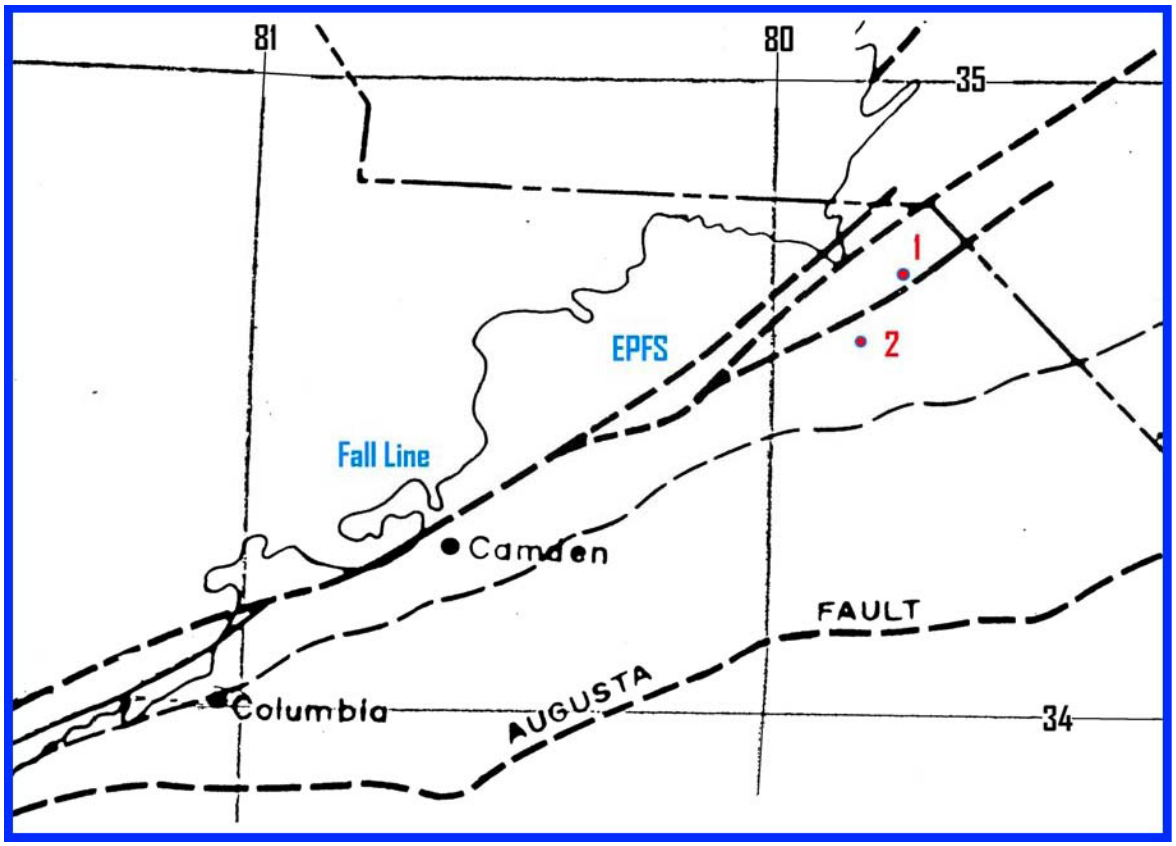

Figure 15: Location of Eastern Piedmont Fault System (EPFS) and the two Peedee earthquakes.

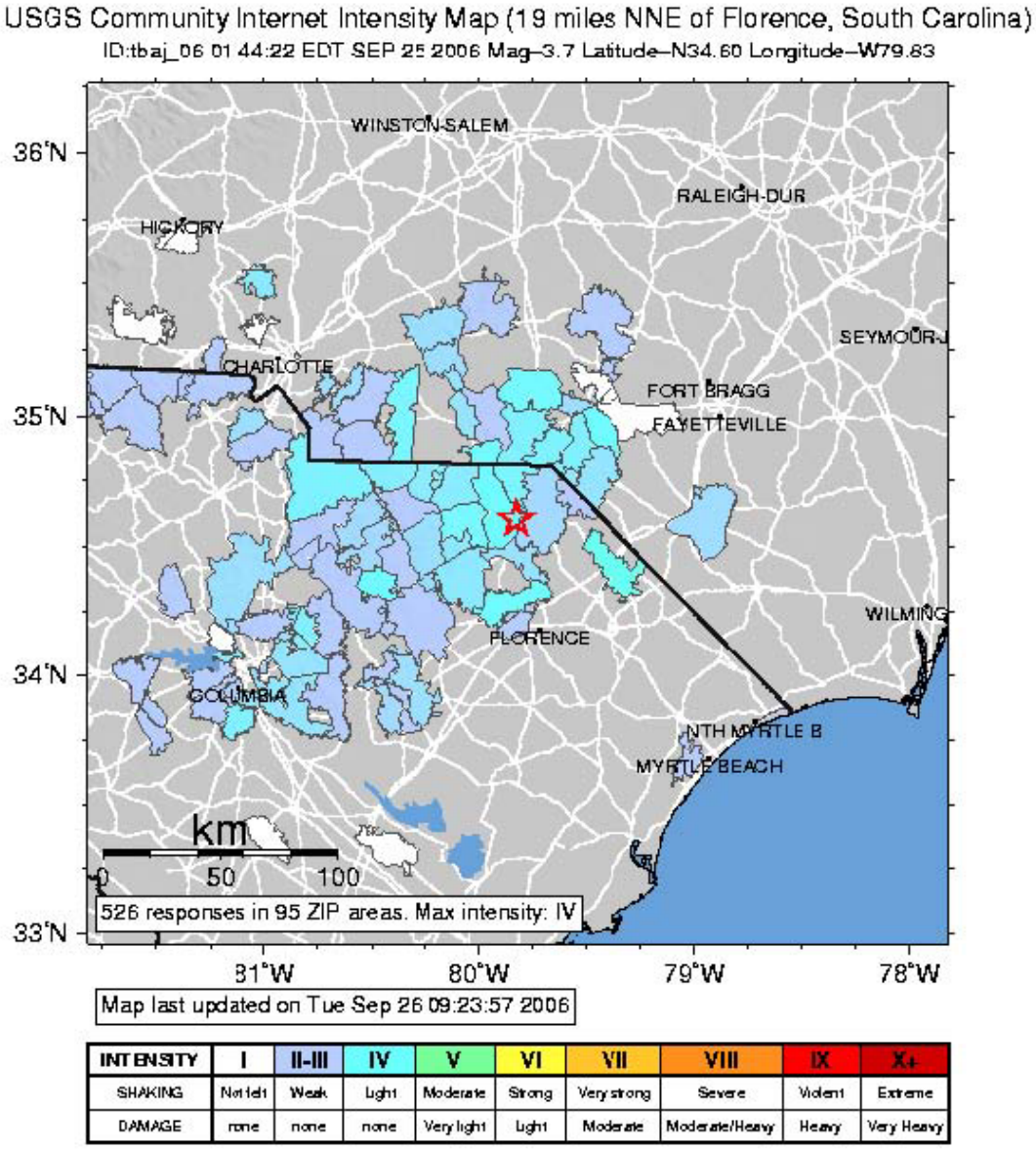

Figure 16: Intensity data for the earthquake on September 25, 2006 from USGS.

2007 EARTHQUAKES

Two felt earthquakes occurred south of Lake Marion in the central Coastal Plain of South Carolina. These events wee located in the vicinity of an area where there are many limestone quarries. They were felt on the property of the Berkeley quarry (Figure 17) and may have been related to ongoing operations there.

Felt earthquakes also occurred in the Aiken area near the South Carolina –Georgia border in March, 2007 and in the Middleton Place Summerville Seismic zone in October, 2007 (Figures 18 and 19). The location parameters of these earthquakes are given in Table 9 below and their locations are shown in Figures 18 to 19.

Table 9: Earthquakes in 2007

DATE (UTC)	LAT (N)	LONG (W)	DEPTH (km)
2007 01 29 0847	33° 20.32’	80° 12.59’	6.18
2007 02 02 0604	33° 16.58’	80° 16.26’	0.07
2007 03 08 0415	35° 0.31’	80° 3.03’	0.04
2007 03 14 0320	33° 36.67’	82° 9.98’	14.18

<u>Location parameters</u>

```
date    origin     lat     long    depth    mag no d1 gap d  rms    avwt   se
 20070129  847 12.05 33n20.32  80w12.59   6.18        22 26 197 1  .1178  1.00   .10

   seh  sez q sqd  adj in nr   avr  aar nm avxm mdxm sdxm nf avfm mdfm sdfm   vpvs
    .8  1.3 c b d  .08 10 22 .0000 .067  0            .0  0            .0   .000

 date    origin     lat     long    depth    mag no d1 gap d  rms    avwt   se
 20070202  6 4  7.09 33n16.58  80w16.26    .07        25 21 175 1  .0793  1.00   .10

   seh  sez q sqd  adj in nr   avr  aar nm avxm mdxm sdxm nf avfm mdfm sdfm   vpvs
   2.5   .2 c c c  .10 10 26 .0000 .039  0            .0  0            .0   .000

    date    origin     lat     long    depth    mag no d1 gap d  rms    avwt   se
 20070308  415 33.20 35n  .31  80w 3.03    .04        18 91 207 1  .3578  1.00   .10

   seh  sez q sqd  adj in nr   avr  aar nm avxm mdxm sdxm nf avfm mdfm sdfm   vpvs
   6.4   .5 d d d  .06 10 22 .0000 .246  0            .0  0            .0   .000

 date    origin     lat     long    depth    mag no d1 gap d  rms    avwt   se
 20070314  320 19.04 33n36.67  82w 9.98  14.18        15 50 333 1  .0992  1.00   .10

   seh  sez q sqd  adj in nr   avr  aar nm avxm mdxm sdxm nf avfm mdfm sdfm   vpvs
   1.0  3.9 d c d  .31 10 15 .0000 .080  0            .0  0            .0   .000
```

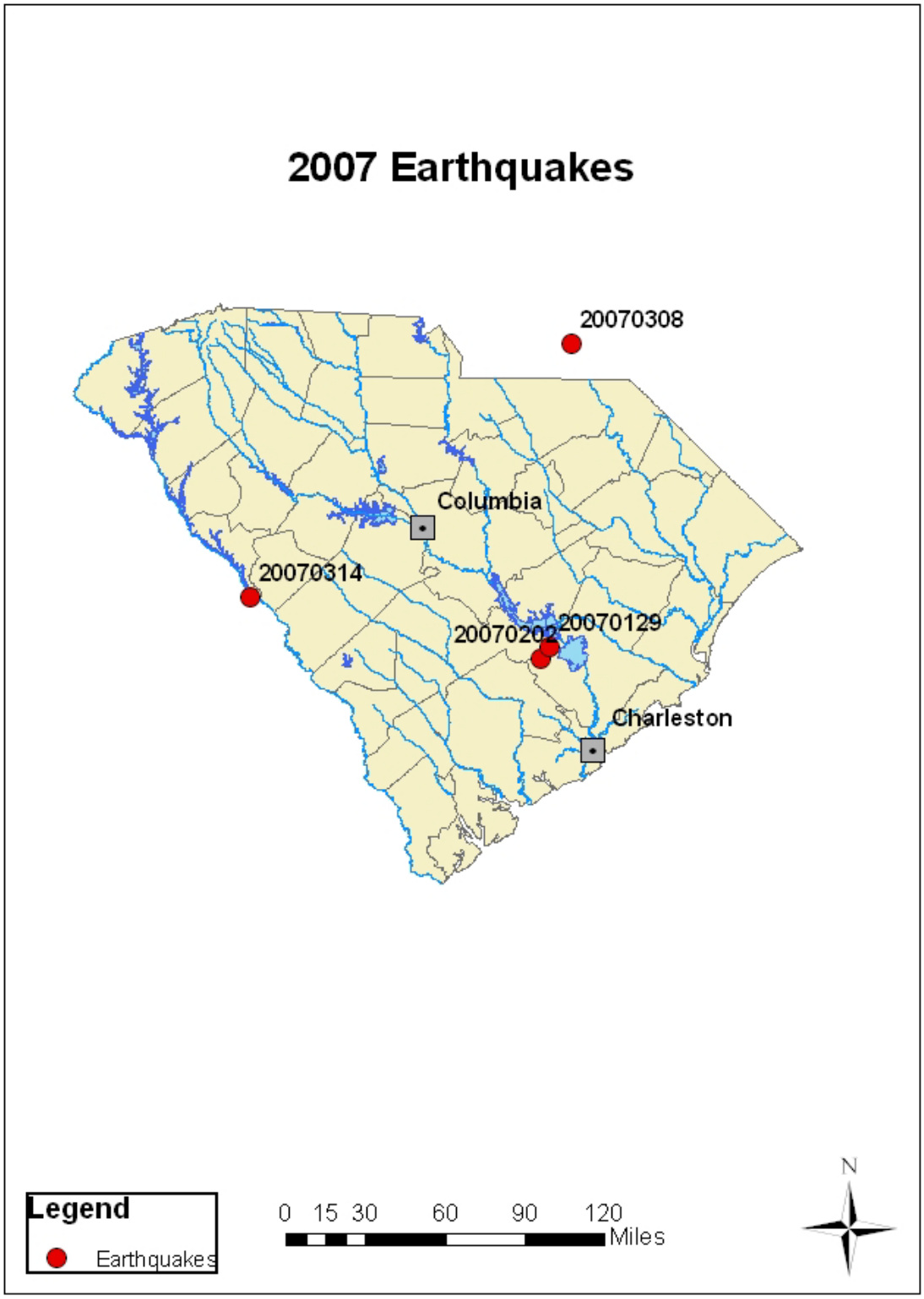

Figure 17: Earthquakes in 2007

LOCATION OF 2007/01/29 AND 2007/02/02 EARTHQUAKES

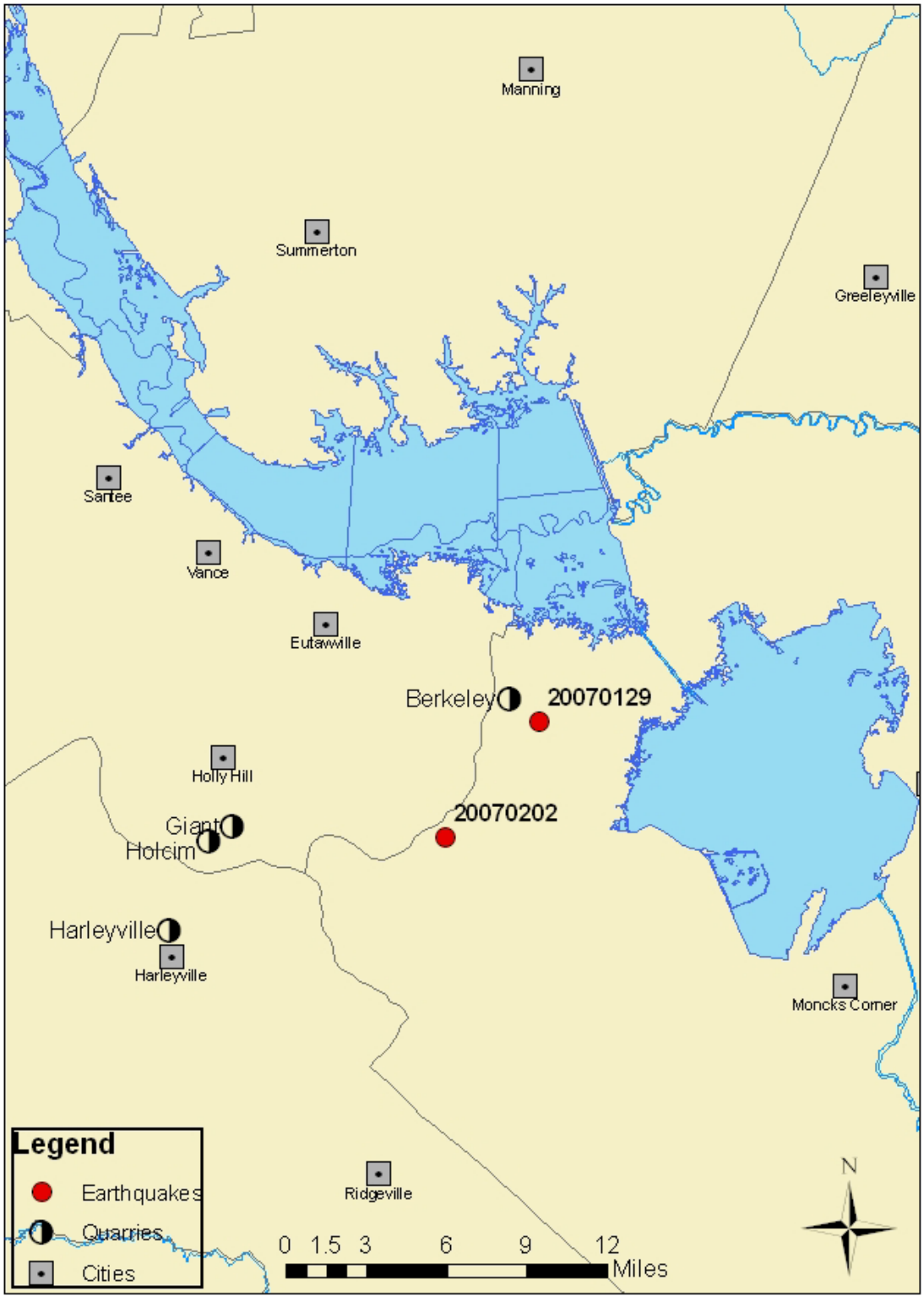

Figure 18: Location of earthquakes south of Lake Marion, SC.

October 13, 2007, 7:06 UTC
Latitude: 32.927º N Longitude: 80.020º W Depth: 3.04 km Magnitude: 2.5

Location Map

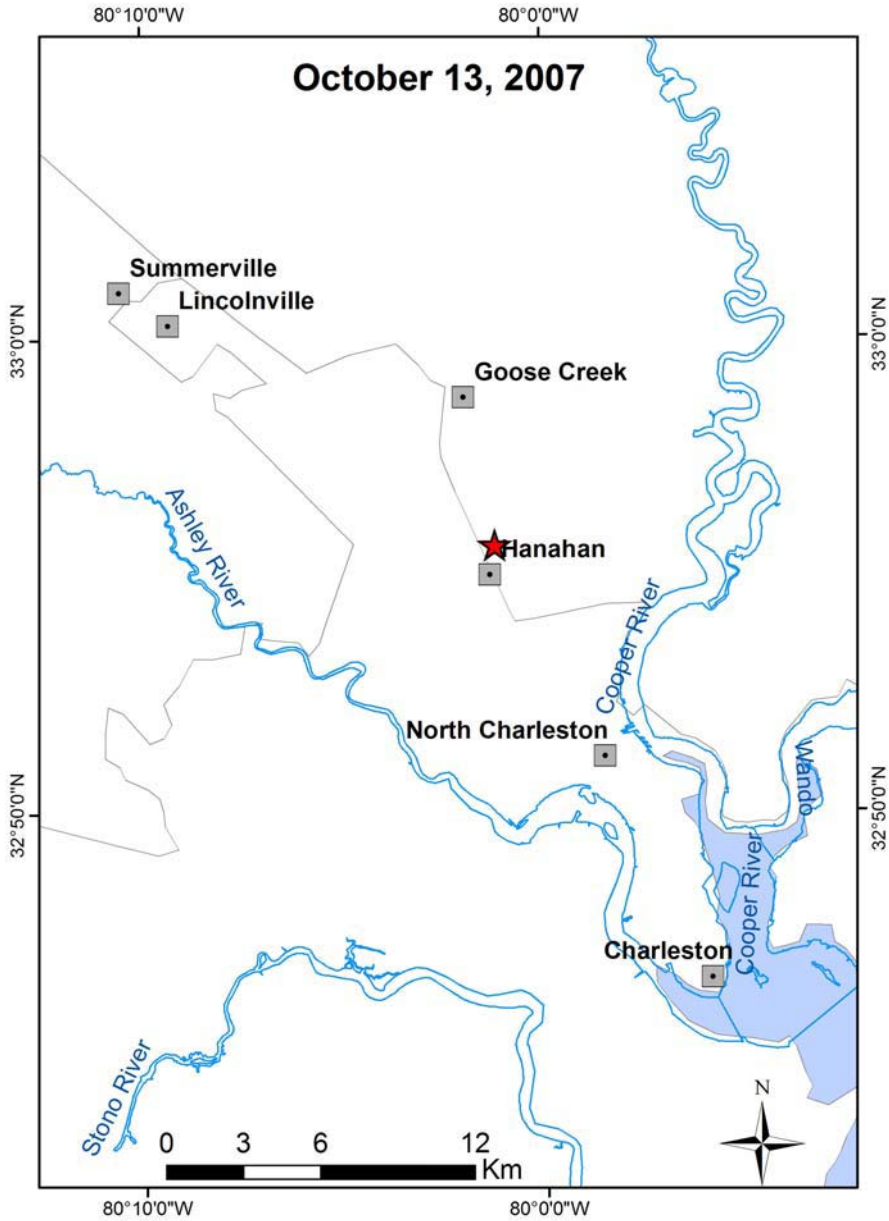

Figure 19: Location of felt earthquake in the Summerville area.