Annual Project Summary: 2001
Cooperative Central And Southeast U.S. Seismic Network--CERI

USGS Award No.: 01HQAG0010

M. M. Withers
CERI
Campus Box 526590
The University of Memphis
Memphis, TN 38152-6590
Ph: 901-678-4940
Fax: 901-678-4734

Program Element: Seismic Networks

Key Words: Seismology, Mitigation, Real-time earthquake information, Database

October 31, 2001

SUMMARY

This is the annual project summary for USGS Award 01HQAG0010: " *Cooperative Central And Southeast U.S. Seismic Network--CERI*" This agreement covers the CERI component of the CUSSN to perform network operations, and routine data processing, archiving, and dissemination for the purpose of seismic hazards evaluation and scientific studies in the Mid-America region. Collaborating CUSSN institutions include the University of Memphis, St Louis University, Virginia Tech, and the University of South Carolina at Columbia.

Routine Operations

CERI continued with routine operations, maintenance, analysis and participation in the CUSSN. The CERI component of the CUSSN operated 120 permanent seismic stations in FY 2001 (All but 2 are at least 3 component, 12 are broadband, 10 are ANSS urban strongmotion). Telemetry concerns require operation of six data concentrators (or node) linked to a central processing facility at CERI. Each node contains about 5 days of continuous revolving buffer and local creation and storage of triggered datasets. Three nodes are linked to CERI in continuous near-real-time and the other 3 are ISDN dialup. Efforts to link all nodes in continuous near-real-time are ongoing. Routine operations information and data availability are online.

For nodes with real-time telemetry to CERI, subnetwork triggers are analyzed daily. Both paper and digital *helicorder* records are monitored for state of health purposes and missed events. From one to several hours of data are archived for teleseismic events of interest (35 events during

reporting period). Routine and automated event locations are shared with other networks via *QDDS*. Reviewed parameters are similarly shared and are emailed to the quake_cussn listserv (contains 136 recipients). By far the most popular tool has been the *recenteqs* webpage accounting for more than three quarters of the 3.5 million hits over the past twelve months.

A weekly summary of regional and worldwide earthquakes is faxed to approximately 100 recipients in the government and the private sector. While long-distance telephone charges for these faxes was not contained within the budget, the popularity of these reports has precluded other, less costly communications (e.g. internet). Data are also available via a finger utility, and reviewed and automated earthquake summaries are also available for events within the past six months. Various catalog searches are also supported. Psuedo-helicorder images provide a quick review of station operation and events for the previous week.

Accomplishments

- Installed node at Morristown Community College in northeast TN.
- Installed 3 stations telemetered to Morristown node.
- Installed 12 ANSS urban strong motion stations.
- Assisted installation of USNSN station LRAL.
- Installed 170 foot communications tower at Shelby Forest, TN.
- Established 2Mbps spreadspectrum microwave link to node at Marked Tree, AR.
- Established near-real-time links with Delaware Geological Survey.
- Established near-real-time links with University of TN, Knoxville.
- Reorganized data analysis staff to improve productivity.
- Completed analysis of all data collected through December 2000.
- Deployed temporary portable arrays at Bhuj, India and Enola, AR.
- Assumed responsibility for 18 station LDEO strong motion network in New Madrid (10 stations operational as of February, 01).
- Established anss-ma.org domain and website.
- Significant progress has been made in developing management and implementation plans for ANSS-MA.

Data Acquisition Processing

Six remote acquisition systems and one local system in Memphis are maintained and provide several levels of redundancy. The remote systems are PC-based *earthworm* using National Instruments 12 bit digitizers. Standard short-to-long-term ratios are employed to store triggered data streams. Additionally, a revolving continuous buffer of about 5 days provides opportunities for post-event archiving. All remote nodes include about 3 days of battery backup. The node at CERI consists of 5 computers housed in an earthquake resistant rack within a halon protected, environmentally controlled room with battery and diesel generator backup and 100baseT infrastructure. The Memphis systems are as follows:

- PC dedicated to digitizing.
- Sun Ultra 5 for local use with local stations only
    - redundant triggered data

    - redundant revolving continuous buffer
    - automated locations
    - automated alerts via page, email, recenteqs, QDDS, and experimental CUBE
- Sun Ultra 10 for external use with local and external stations
    - triggered data
    - revolving continuous buffer
    - automated locations
    - automated alerts to external *earthworm systems* and experimental near-real-time database
    - near-real-time data exchange with other networks
- PC dedicated to experimental near-real-time *Oracle* database
- Sun Ultra 5 dedicated to www services.

While links to additional networks are being established, the following CUSSN data were being exchanged as of 30 October, 2001:

- CAPE Cape Girardeau, MO (operated by SLU)
    - export 16 channels to SLU,
    - record local revolving buffer and triggered data streams
- SLU Saint Louis, MO (operated by SLU)
    - import 12 channels from distributed SLU Quanterra sites,
    - export 22 channels to CERI,
    - import 15 channels from CERI,
    - record local revolving buffer and triggered data streams
- BLO, MPH, UALR Quanterra Nodes (operated by SLU)
    - A local Sparc 5 provides an earthworm ring buffer in addition to the currently continuously saved Quanterra mini-SEED buffers. This extra capability provides real time data streams for automatic location in addition to preserving the continuously archived data stream. Currently stations with local Sparcs also provide data streams to NEIC's USNSN through a *VDL* (Virtual Data Logger) module.
- NMAD New Madrid, MO (operated by CERI)
    - WAN access projected for early 2002.
    - will export 128 channels to CERI,
    - record local revolving buffer and triggered data streams
- LNXT Lennox, TN (operated by CERI)
    - WAN access projected for late, 2001.
    - will export 120 channels to CERI,
    - record local revolving buffer and triggered data streams
- MKTA Marked Tree, AR (operated by CERI)
    - export 100 channels to CERI
    - record local revolving buffer and triggered data streams
- CERI Memphis, TN (operated by CERI)
    - export automated locations to NEIC,
    - export automated locations to QDDS,
    - import automated locations from NEIC,
    - import automated locations from LRNC,

    - import 9 channels from distributed broadband installations,
    - import 128 channels from MKTA,
    - will import 120, and 100 channels from NMAD and LNXT respectively,
    - import 22 channels from SLU,
    - export 15 channels to SLU,
    - export 28 channels to NEIC,
    - import 3 channels from Maryland Geological Survey,
    - export 3 channels to Maryland Geological Survey,
    - import 3 channels from Delaware Geological Survey,
- CHAS Charleston, SC (operated by USC)
    - export 19 channels to USC,
    - record local revolving buffer and triggered data streams
- COSC Columbia, SC (operated by USC)
    - import 19 channels from CHAS,
    - export 9 channels to LRNC,
    - export 5 channels to NEIC,
    - import triggered data from LRNC,
    - record local revolving buffer and triggered data streams
- BLA Blacksburg, VA (operated by VPI)
    - export 15 channels to LRNC,
    - export 5 channels to NEIC,
    - import 5 channels from LRNC,
    - import 5 channels from COSC,
    - import 6 channels from NEIC via LRNC
- LRNC Hickory, NC (operated by CERI)
    - import 9 channels from COSC,
    - import 15 channels from NEIC,
    - export 3 channels to NEIC,
    - export automated locations to CERI,
    - record local revolving buffer and triggered data streams, pending MTTN installation, will cease automated location and imports, and will export 28 channels to MTTN
- STAR Star Mountain near Athens, TN (operated by CERI)
    - record local revolving buffer and triggered data streams,
    - Pending internet access will export 32 channels to MTTN,
    - record local revolving buffer and triggered data streams
- MTTN Morristown, TN (operated by CERI)
    - export 12 channels to CERI,
    - record local revolving buffer and triggered data streams
      UT Knoxville, TN (operated by CERI)
    - export 20 channels to CERI,
    - import 20 channels from TVA,
    - import 21 channels from CERI,
    - export 21 channels to TVA,
    - record local revolving buffer
      TVA at Knoxville, TN (operated by TVA)

- export 21 Channels to CERI via UT,
- import 20 Channels from CERI via UT,
- record local revolving buffer and triggered data streams

Communications with some nodes via public internet suffer occasionally from insufficient bandwidth (e.g UT Knoxville and LRNC). We will be reorganizing the communications topology in the coming year to minimize throughput at these nodes. The learning curve for the spreadspectrum microwave backbone has been crested and all planned permission have been obtained. After completing the link to Marked Tree (via repeaters at UofM and Shelby Forest, TN) work began, and continues on the link to Lennox, TN (via repeaters at Luxora, AR and Edith, TN). Following completing of that link, work will begin on the link to New Madrid. Recent renegotiation of the New Madrid property and tower agreements will require an additional, unplanned repeater most likely in the Portageville, MO area. St Louis University will be installing a Frame Relay circuit to New Madrid to provide an additional level of redundancy.

Catalog

A comprehensive review of all waveform data has been completed and all events have been archived. Number of recorded events per year for the New Madrid Seismic Zone are:

- 1995 12
- 1996 99
- 1997 100
- 1998 94
- 1999 107
- 2000 173
- 2001 136

Installation of the current network began in 1995. Several major modifications during installation (i.e. migration from a previous acquisition system to *earthworm*) as well as major setbacks (vandalization of the New Madrid node in 1999) precluded a complete catalog until calendar 2000. Further, previous lack of real-time communications hampered timely review of events resulting in a significant backlog (primarily "weeding" out false triggers). We expect that as communications and station coverage improve, the number of recorded events will increase both for the NMSZ and the entire ANSS-MA region. After completion of the comprehensive review, station corrections were determined and applied to reduce hypocentral and arrival time uncertainties. Procedures developed in processing data from a temporary deployment in Bhuj (i.e. automated focal mechanism, etc) will be applied and we will be determining new magnitude parameters.

Future Directions

In addition to improvements planned and underway that were previously mentioned, we will begin work on:

- increasing real-time data availability in Memphis for the entire ANSS-MA region,

- upgrading the CERI central processing node to ANSS Regional Processing Facility standards,
- developing procedures for routine analysis and archiving for the entire ANSS-MA region,
- continuing with new installations to improve coverage particularly in the Southern Appalachian Seismic Zone,
- and continuing to improve ability of analysis and technical staff throughout the region to operate as a single team.