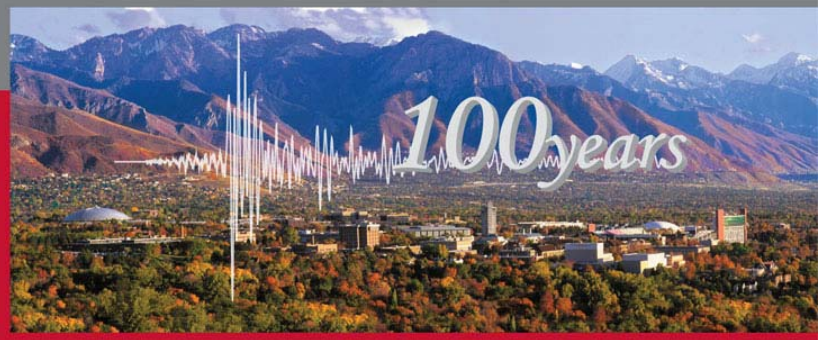
Seismographic Centennial

June 29, 1907 – June 29, 2007



Commemorating the centennial of the installation of the first seismographs in Utah by Dr. James E. Talmage and Celebrating 100 years of earthquake recording at the University of Utah

University Of Utah
Seismograph Stations
THE UNIVERSITY OF UTAH

FOREWORD

In celebrating the centennial of earthquake recording at the University of Utah, we honor the legacy of James E. Talmage, a truly remarkable man, as well as the contributions of many dedicated individuals during the past 100 years.

This brochure gives snapshots of the past and present—and an introduction to the second hundred years. As I compiled the bits and pieces, I was reminded that seismologists are sometimes accused of being "historians" in the sense of reporting information *after* an earthquake has occurred. The evidence of our being not *just* historians lies in modern seismological practice—in probabilistic earthquake forecasting and predictive ground-motion modeling, in our providing post-earthquake information in near real-time, and in pursuing capabilities for earthquake early warning (once an earthquake is in progress). Earthquake prediction, alas, remains elusive.

In this season, we'll happily accept the label of historian because of the opportunity to learn from the past, particularly from the life of James E. Talmage. Any reader of John Russell Talmage's 1972 biography of his father, *The Talmage Story*, will certainly come to appreciate the elder Talmage's inspirational character and extraordinary achievements. And any scientist reading his words that were published in newspaper articles on June 29–30, 1907, will come to understand that his intentions in installing the first seismographs in Utah went much beyond simply acquiring the latest "scientific apparatus."

At stake was a quest to test objectively the earthquake behavior of the Wasatch fault. Were future destructive earthquakes a certainty as the eminent geologist Grove Karl Gilbert had earlier warned? Or could strain energy be routinely released more benignly? Modern science favors Gilbert. Ever the gentleman, Talmage offered, "Should a destructive earthquake here occur I trust the men who have prophesied of its coming will not be present at the time; I wish them safe protection and the satisfaction of saying, 'I told you so.' " (*Deseret Evening News, June 29, 1907)*

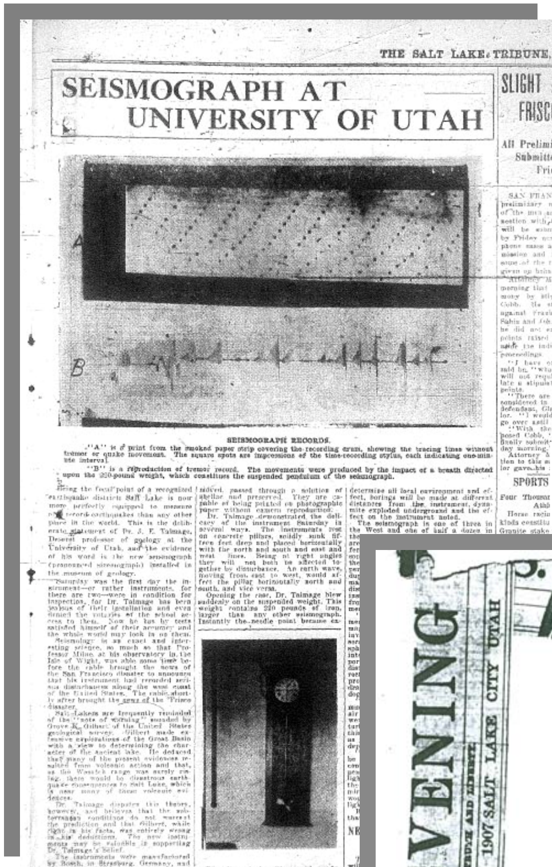
Preparing for June 29, 2007, has brought many rewards—and it promises the prospect of sharing the celebration with special friends. Count yourself among them if you're reading this. "Welcome."

— Walter J. Arabasz

James Edward Talmage, Ph.D., D.Sc., LL.D.
1862–1933

President of the University of Utah (1894–1897), first Deseret Professor of Geology at the University of Utah (1894–1907), Fellow of the Royal Society of Edinburgh, Fellow of the Geological Society (London), Fellow of the Geological Society of America, Fellow of the American Association for the Advancement of Science, Fellow of the Royal Microscopical Society (Edinburgh), Associate of the Philosophical Society of Great Britain, and member of the Council of the Twelve, The Church of Jesus Christ of Latter-day Saints (1911–1933)

THE SALT LAKE TRIBUNE
SUNDAY MORNING, JUNE 30, 1907


THE SALT LAKE TRIBUNE,

SEISMOGRAPH AT UNIVERSITY OF UTAH

SEISMOGRAPH RECORDS.

"A" is a print from the smoked paper strip covering the recording drum, showing the tracing lines without tremor or quake movement. The square spots are impressions of the time-recording stylus, each indicating one-minute interval.

"B" is a reproduction of tremor record. The movements were produced by the impact of a breath directed upon the 220-pound weight, which constitues the suspended pendulum of the seismograph.

Being the focal point of a recognized earthquake district Salt Lake is now more perfectly equipped to measure and record earthquakes than any other place in the world. This is the deliberate statement of Dr. J. E. Talmage, Deseret professor of geology at the University of Utah, and the evidence of his word is the new seismograph (pronounced sizesmograph) installed in the museum of geology.

Saturday was the first day the instrument—or rather instruments, for there are two—were in condition for inspection, for Dr. Talmage has been jealous of their installation and even denied the votaries of the school access to them. Now he has by tests satisfied himself of their accuracy and the whole world may look in on them.

Seismology is an exact and interesting science, so much so that Professor Milne, at his observatory in the Isle of Wight, was able some time before the cable brought the news of the San Francisco disaster to announce that his instrument had recorded serious disturbances along the west coast of the United States. The cable shortly after brought the news of the 'Frisco disaster.

Salt Lakers are frequently reminded of the "note of warning" sounded by Grove K. Gilbert of the United States geological survey. Gilbert made extensive explorations of the Great Basin with a view to determining the character of the ancient lake. He deduced that many of the present evidences resulted from volcanic action and that, as the Wasatch range was surely rising, there would be disastrous earthquake consequences to Salt Lake, which is near many of these volcanic evidences.

Dr. Talmage disputes this theory, however, and believes that the subterranean conditions do not warrant the prediction and that Gilbert, while right in his facts, was entirely wrong in his deductions. The new instruments may be valuable in supporting Dr. Talmage's belief.

The instruments were manufactured by Bosch, in Strasburg, Germany, and represent a modified type of the Omori ...

... sidered, passed through a solution of shellac and preserved. They are capable of being printed on photographic paper without camera reproduction.

Dr. Talmage demonstrated the delicacy of the instrument Saturday in several ways. The instruments rest on concrete pillars, solidly sunk fifteen feet deep and placed horizontally with the north and south and east and west lines. Being at right angles they will not both be affected together by disturbance. An earth wave, moving from east to west, would affect the pillar horizontally north and south, and vice versa.

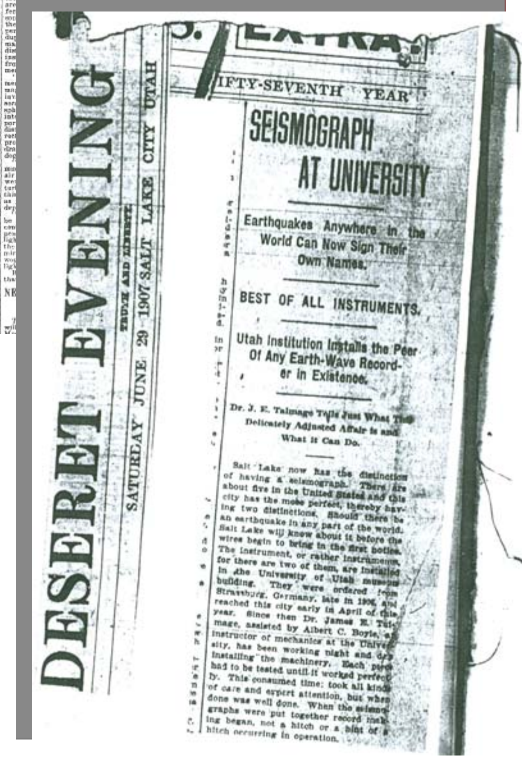
Opening the case, Dr. Talmage blew suddenly on the suspended weight. This weight contains 220 pounds of iron, larger than any other seismograph. Instantly the needle point became ex...

Recording clock with second pendu-

... determine all local environment and effect, borings will be made at different distances from the instrument, dynamite exploded underground and the effect on the instrument noted.

The seismograph is one of three in the West and one of half a dozen in ...

DESERET EVENING NEWS
Saturday, June 29, 1907


DESERET EVENING NEWS

SATURDAY JUNE 29 1907 SALT LAKE CITY UTAH

EXTRA

FIFTY-SEVENTH YEAR

SEISMOGRAPH AT UNIVERSITY

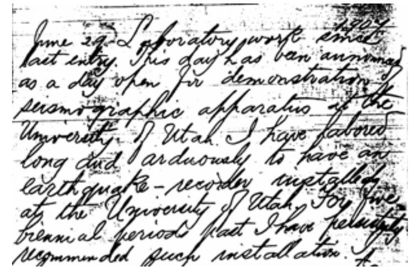
Earthquakes Anywhere in the World Can Now Sign Their Own Names.

BEST OF ALL INSTRUMENTS.

Utah Institution Installs the Peer Of Any Earth-Wave Recorder in Existence.

Dr. J. E. Talmage Tells Just What The Delicately Adjusted Affair Is and What It Can Do.

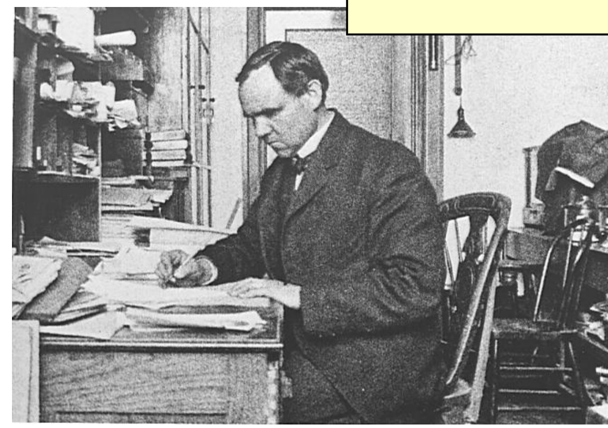
Salt Lake now has the distinction of having a seismograph. There are about five in the United States and this city has the most perfect, thereby having two distinctions. Should there be an earthquake in any part of the world, Salt Lake will know about it before the wires begin to bring in the first notice. The instrument, or rather instruments, for there are two of them, are installed in the University of Utah museum building. They were ordered from Strassburg, Germany, late in 1906, and reached this city early in April of this year. Since then Dr. James E. Talmage, assisted by Albert C. Boyle, an instructor of mechanics at the University, has been working night and day installing the machinery. Each piece had to be tested until it worked perfectly. This consumed time; took all kinds of care and expert attention, but when done was well done. When the seismographs were put together record making began, not a hitch or a hint of a hitch occurring in operation.



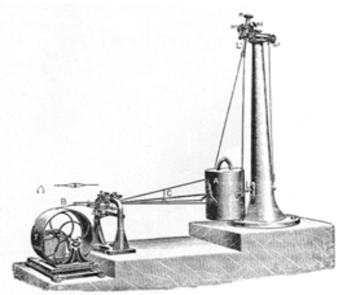
1907

June 29. Laboratory work since last entry. This day has been announced as a day open for demonstration of seismographic apparatus at the University of Utah. I have labored long and arduously to have an earthquake-recorder installed at the University of Utah. For five biennial periods past I have persistently recommended such installation . . .

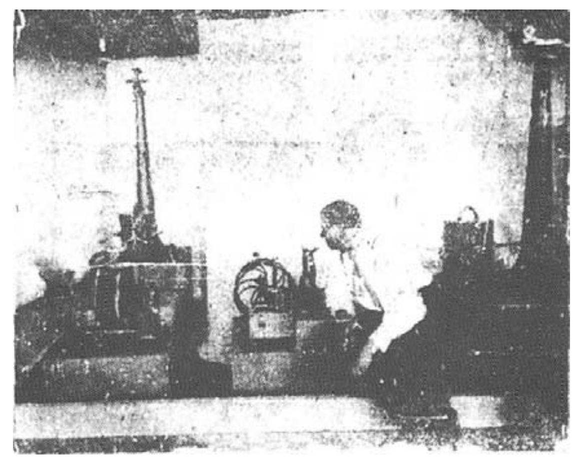
—Excerpt from James E. Talmage's journal



James E. Talmage, Deseret Professor of Geology, in his office on the University of Utah campus, ca. 1904
— *Photo used by permission, Utah State Historical Society,*



Bosch-Omori pendulum seismograph (early 1900s)



"Dr. Talmage Reading the Record"
—*Salt Lake Tribune*, June 30, 1907

Marriott Library, University

Dr. Frederick J. Pack looking at smoked-paper recording drum of Bosch-Omori seismograph on University of Utah campus, ca. 1930.

1930–1974

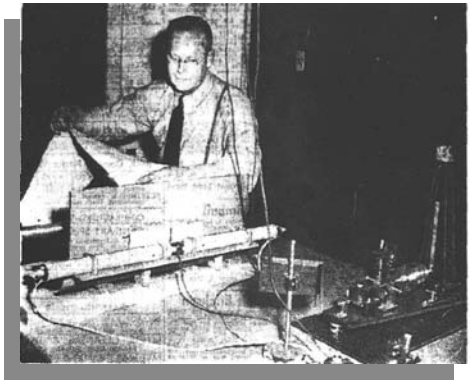
Salt Lake Telegram: June 10,1942

Dr. Hyrum Schneider holding photographic recording from McComb-Romberg horizontal-component seismograph at station SLC on University of Utah campus.

Daily Utah Chronicle: January 21, 1974

Drs. Kenneth L. Cook (left) and Robert B. Smith (right) examining calibration signals on helicorder in UUSS central recording lab.

Salt Lake Telegram: June 10,1942



Mr. Andrew M. Anderson changing photographic seismograms at station SLC on University of Utah campus.

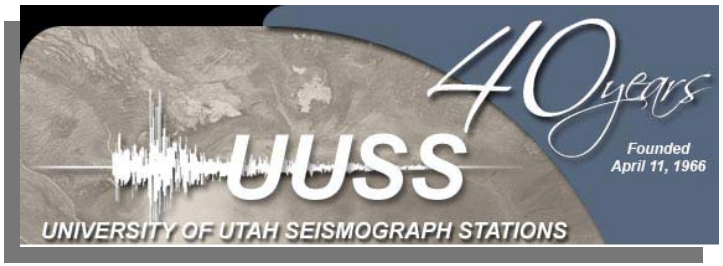
Evolution of Earthquake Recording in Utah

1907	First seismographs on University of Utah campus
1939 to 1950s	Seismographs at University of Utah and Utah State University
1960s	Skeletal statewide network of five onsite-recording stations (the original “University of Utah Seismograph Stations”); records mailed to U campus for interpretation
1974	Beginning of regional telemetered seismic network (radio, microwave, telephone telemetry); approximately 50 remote seismic stations in 1978
1981	Beginning of digital recording
2002	Real-time earthquake information system, including urban strong-motion network
2007	223-station regional/urban seismic network (163 stations in Utah)

Changing Motivation for Seismic Recording

1907	Observational science and public curiosity about earthquakes
1930s	Beginning of systematic earthquake monitoring nationwide following damaging earthquakes in California
1960s	Nuclear test monitoring
1970s	Earthquake research and interest in earthquake prediction
1980s	Added need to serve emergency management and earthquake engineering
Now	Multipurpose seismic monitoring as part of an Advanced National Seismic System; interest in developing capabilities for early warning once a large earthquake is in progress

WHO WE ARE TODAY

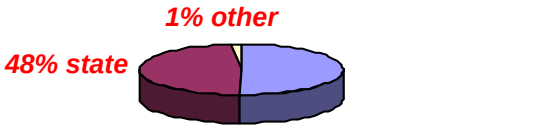


Research Education Public Service

"University of Utah Seismograph Stations" (UUSS)

- Originally a small group of seismographic installations, with onsite recording, in the early 1960s
- UUSS formally recognized as an organizational entity by the (then) University of Utah Board of Regents on April 11, 1966
- We are a distinct entity—and part of a larger seismology group—within the University's Department of Geology and Geophysics (see opposite page)
- We operate a 223-station regional/urban seismic network (543 data channels), including 163 stations in the Utah region
- Real-time earthquake information system operating since 2002 as part of an Advanced National Seismic System
- $1.8 million current annual budget for 2007–08, including $770,500 from a state line-item appropriation and excluding a one-time state appropriation of $720,000
  - — $1.6 million <u>for the Utah region only</u> (excluding seismic monitoring in the Yellowstone region) for seismic network operations, associated earthquake-related research (including coal-mining-induced seismicity and infrasound), and earthquake education and outreach

Breakdown of $1.6 million:



Earthquake Seismology at the University of Utah
June 29, 2007

Department of Geology and Geophysics

I. University of Utah Seismograph Stations (UUSS)

Faculty
Dr. Walter J. Arabasz, Director and Research Professor

Dr. Kristine L. Pankow, Assistant Director and Research Assistant Professor
Dr. James C. Pechmann, Research Associate Professor

Permanent Staff
Relu Burlacu, Seismic Network Manager
Dr. David L. Drobeck, Seismograph Technician
John M. Hale, Earthquake Information Specialist
Martha S. Knowlton, Administrative Assistant
Ali Moeinvaziri, Computer Professional
Paul M. Roberson, Earthquake Information Specialist
Jon Rusho, Strong-motion Engineer
James K. Whipp, Seismograph Technician

Part-time Staff and Students
Kathryn A. Albee
Judith I. Holtshouser
Kevin J. Jensen
Gordon B. Johansen
Joseph Morgan
Peter O'Neill
Sheryl J. Peterson

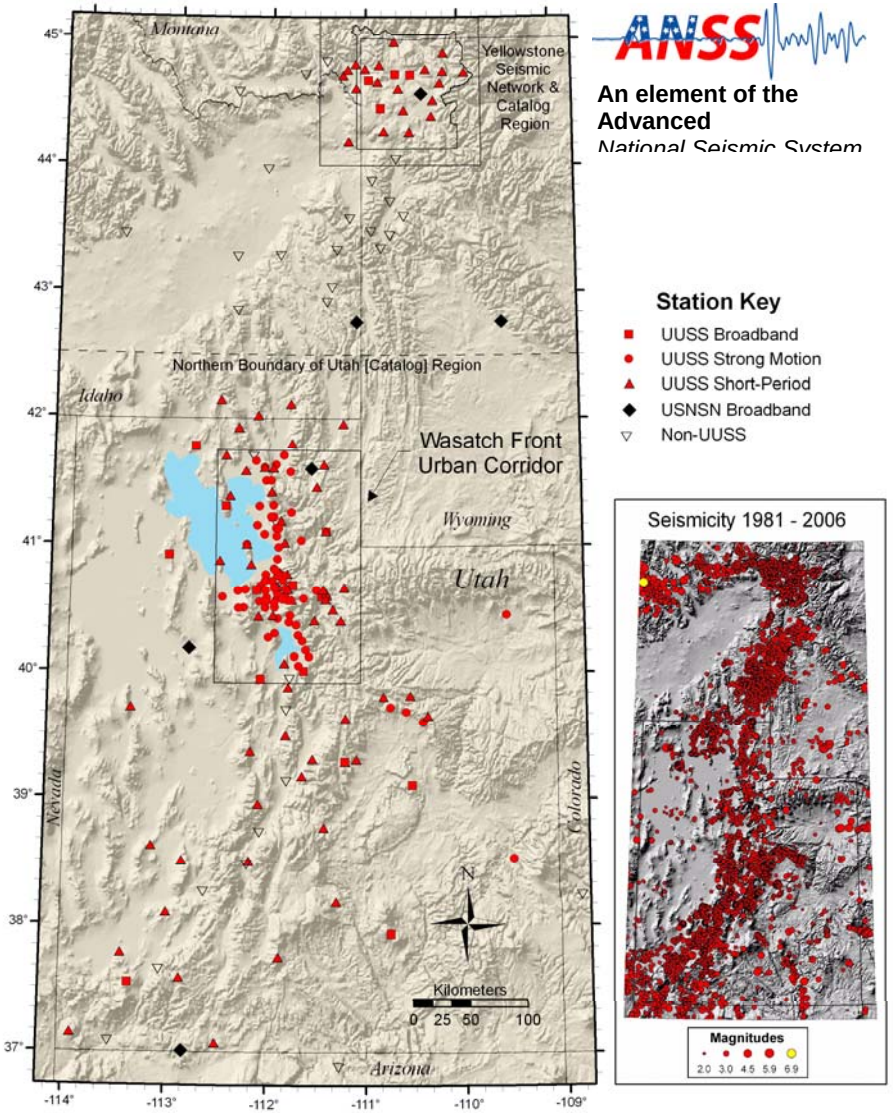
II. Academic Program in Earthquake Seismology

Faculty
Dr. Robert B. Smith, Professor and Associate Director of UUSS

Post-doctoral Fellows
Dr. Wu-Lung Chang
Dr. Taka'aki Taira

Graduate Students
Aaron C. DeNosaquo
Jamie M. Farrell
Jeremy B. Koons
Christine M. Puskas
Katrina R. Settles
Ivan G. Wong

University of Utah Regional/Urban Seismic Network
June 2007



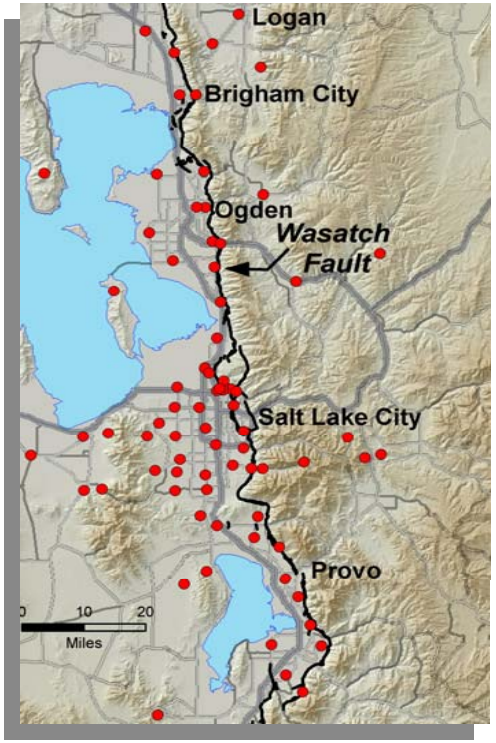
ANSS

An element of the Advanced *National Seismic System*

Station Key

- UUSS Broadband
- UUSS Strong Motion
- UUSS Short-Period
- USNSN Broadband
- Non-UUSS

Wasatch Front Urban Strong-motion Network

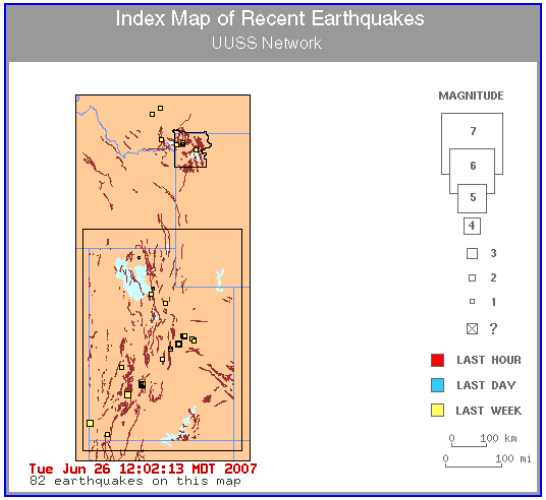


Examples of **urban strong-motion stations** (above). Designed to record strong earthquake ground shaking in the built environment onscale and with high fidelity—chiefly for earthquake engineering and emergency-response applications.

Example of a **regional seismic station** (left) at a remote rock site with radio telemetry, designed primarily for the continuous, high-fidelity digital recording and accurate location of earthquakes and other seismic events.

UUSS EARTHQUAKE INFORMATION PRODUCTS
www.quake.utah.edu
(see also earthquake.usgs.gov)

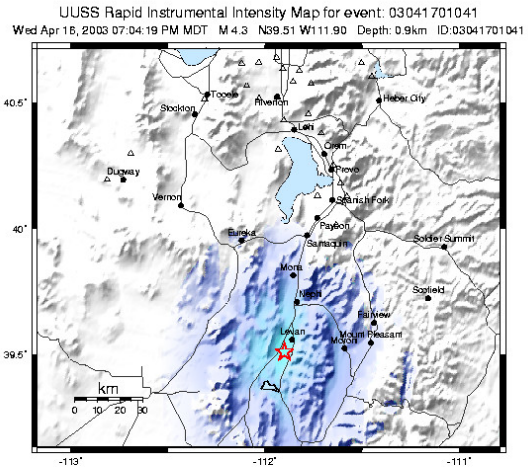
- Recent earthquake activity—earthquake alerts automatically broadcast to emergency managers and posted on the Web within a few minutes of a potentially disruptive earthquake, indicating its size and location



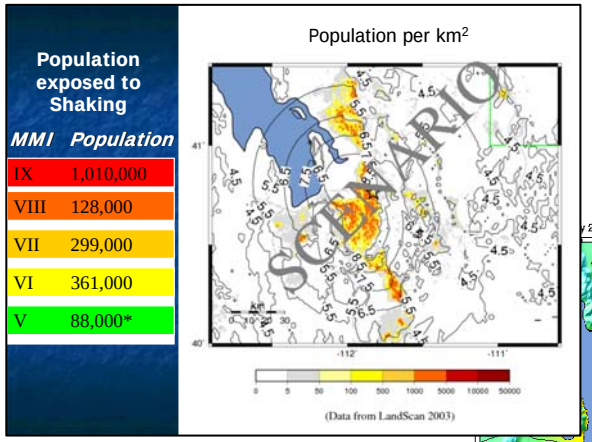
- ShakeMaps—rapid automatic maps of shaking distribution and severity broadcast and posted on the Web within 5 minutes of a sizeable earthquake
- Automated maps of population exposed to shaking, and automated linking of ShakeMap information to FEMA's HAZUS software for rapid loss estimation
- Scenario ShakeMaps for disaster planning
- Did you feel it?
- Live Seismograms

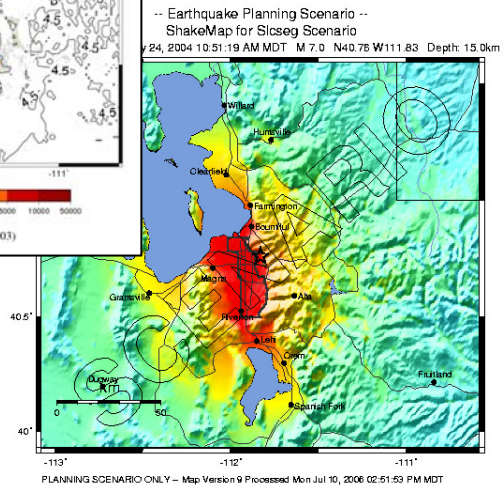
Example UUSS Web map (above) of recent earthquake activity

Example of an automated ShakeMap (right) from the UUSS Web site showing the intensity of ground shaking from a magnitude 4.3 shock near Levan, Utah, in April 2003 (other available companion maps show measured values of peak ground acceleration and peak ground velocity).



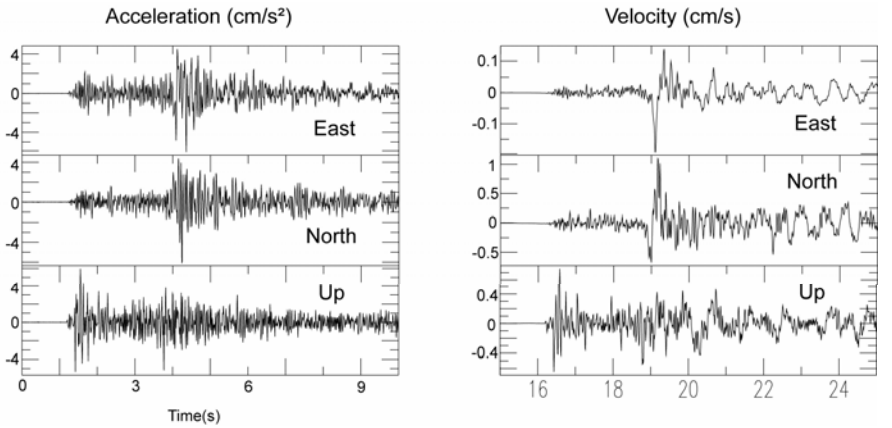
PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<.17	.17-1.4	1.4-3.9	3.9-9.2	9.2-18	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	16-31	31-60	60-116	>116
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+





Scenario ShakeMap (right) for a magnitude 7.0 earthquake in the Salt Lake Valley and a companion map (above) indicating the number of people exposed to different degrees of ground shaking. Maps are made for planning purposes. In the event of a real earthquake, such maps would be automatically generated and broadcast within a few minutes.

PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<.17	.17-1.4	1.4-3.9	3.9-9.2	9.2-18	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	16-31	31-60	60-116	>116
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+



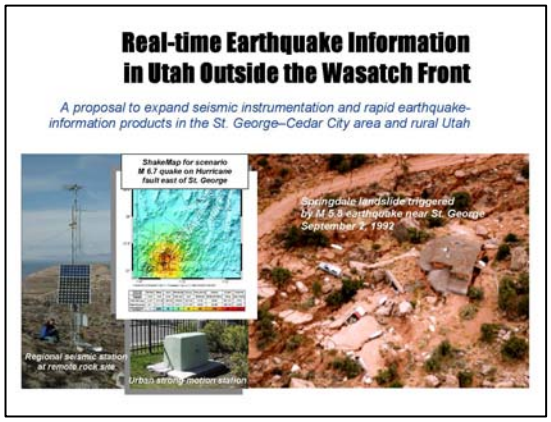
Examples of digital recordings of ground acceleration and velocity made by a UUSS urban strong-motion instrument at Bates Elementary School in North Ogden, Utah. The ground motion is from a magnitude 3.6 earthquake in January 2003 located beneath Pineview Reservoir, eight miles away. Recordings such as these, routinely made by our urban strong-motion network, provide the input to ShakeMaps and are also fundamentally important for earthquake engineering.

BEGINNING THE NEXT 100 YEARS

Two recent developments provide an immediate springboard for beginning the next 100 years of seismic monitoring in Utah:

$1 MILLION APPROPRIATION FROM 2007 STATE LEGISLATURE

In March 2007, after more than two years of effort—and thanks to facilitating by the Utah League of Cities and Towns and the Utah Seismic Safety Commission—UUSS successfully persuaded the Utah Legislature to invest in enhanced capabilities for seismic monitoring in Utah. Funding starts July 1, 2007:



$420,000 one-time for the St. George-Cedar City area and rural Utah outside the Wasatch Front

$300,000 one-time for backup systems and re-engineering of network telemetry to ensure continuity of operations following a large earthquake

$327,000 per year ongoing funds added to the UUSS state line-item appropriation

THE KENNECOTT EARTHQUAKE INFORMATION CENTER

On June 14, 2007, an announcement was made that Kennecott Copper of Utah had committed $600,000 to the University of Utah's College of Mines and Earth Sciences to establish the Kennecott Earthquake Information Center. The center will be housed in the new Frederick A. Sutton Building (left), now being built for the Department of Geology and Geophysics and scheduled for completion in February 2009. Kennecott's generous donation will pay for necessary space costs for UUSS to move its facilities into the seismically designed Sutton Building and for part of the costs to equip and furnish the new earthquake information center.

UUSS — THE DIRECTORS

Dr. Kenneth L. Cook
1966–76

Dr. Stanley H. Ward
1976–80

Dr. Robert B. Smith
1980–85

Dr. Walter J. Arabasz
1985–present

Thank you for sharing our centennial celebration!