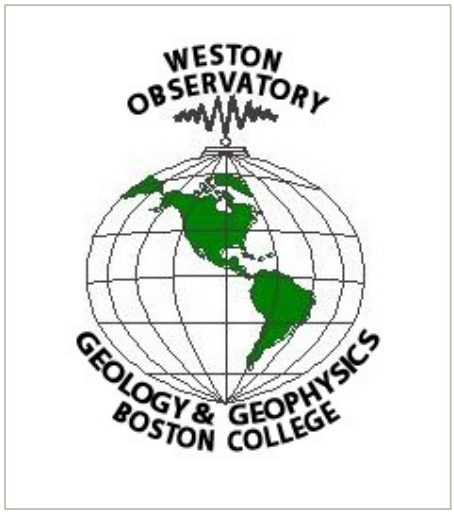
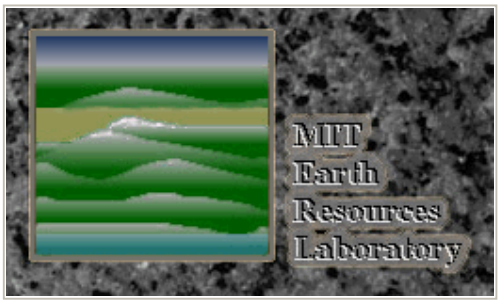
A STUDY OF NEW ENGLAND SEISMICITY

Quarterly Earthquake Report

January - March, 2001

NEW ENGLAND
SEISMIC NETWORK





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NEW ENGLAND SEISMIC NETWORK

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Notice

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January - March, 2001

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Introduction

The New England Seismic Network (NESN) is operated collaboratively by the Weston Observatory (WES) of Boston College and the Earth Resources Lab (ERL) of the Massachusetts Institute of Technology. The mission of the NESN is to operate and maintain a regional seismic network with digital recording of seismic ground motions for the following purposes: 1) to determine the location and magnitude of earthquakes in and adjacent to New England and report felt events to public safety agencies, 2) to define the crust and upper mantle structure of the northeastern United States, 3) to derive the source parameters of New England earthquakes, and 4) to estimate the seismic hazard in the area.

This report summarizes the work of the NESN for the period January - March, 2001. It includes a brief summary of the network's equipment and operation, and a short discussion of data management procedures. A list of participating personnel is given in Table 1. There were 6 earthquakes that occurred within or near the network during this reporting period. Phase information for these earthquakes is included in this report.

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Current Network Operation and Status

The New England Seismic Network currently consists of 14 broadband three-component, 4 short-period vertical, and 8 strong-motion stations. The coordinates of the stations are given in Table 2, and maps of the weak- and strong-motion networks are shown in Figures 1 and 2, respectively.

WES now operates 13 stations with broadband instruments consisting of Guralp CMG-40T three-component sensors. Ground motions recorded by these sensors are digitized at 100 sps with 16-bit resolution. Additional gain-ranging provides 126 dB dynamic range. These stations are operated in dialup mode with waveform segments of suspected events transmitted in digital mode to Weston Observatory for analysis and archiving. During the year 2001, two new seismic stations were added to the WES network. Station UMM was placed in northeastern Maine and station FFD was placed in central New Hampshire. Station MIM, in central Maine was dismantled. WES also maintains 8 SMA-1 strong-motion instruments in New England.

ERL at MIT currently operates 4 short-period stations, all located within 100 km of Boston. The short- period instruments have 1.0 Hz L4C vertical seismometers. Data recorded by these seismometers is transmitted continuously in analog mode to ERL and digitized (12-bit) into a PC at 50 sps. A data acquisition program on the PC triggers on events detected in the short-period data streams and saves them to a disk for manual analysis. Station WFM also has a new three-component, high dynamic range instrument. The instrument has a CMG-40T sensor and transmits 3-channel, 24-bit data at 100 sps continuously to a central processor (Pentium PC) at ERL. Waveform windows of suspected events are extracted from the data stream, analyzed and archived with the short-period data. WES and ERL record some stations in analog format on helicorders to provide additional data for analysis.

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Seismicity

There were 6 earthquakes that occurred in or adjacent to the NESN during this reporting period. A summary of the location data is given in Table 3. Figure 3 shows the locations of these events. Figure 4 shows the locations of all events since the beginning of network operation in October, 1975.

Table 4 gives the station phase data and detailed hypocenter data for each event listed in Table 3. In addition to NESN data, arrival time and magnitude data sometimes are contributed for seismic stations operated by the Geological Survey of Canada (GSC), the Lamont-Doherty Cooperative Seismographic Network., and the US National Seismic Network. Final locations for this section were computed using the program HYPO78. For regional events (those too far from the NESN to obtain accurate locations and magnitudes) phase data are given for NESN stations, but the entry in Table 3 lists the hypocenter and geographic location information adopted from the authoritative network. Accordingly, the epicenter is plotted on the maps using the entry from Table 3.

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Data Management

Recent event locations are available via FTP at: SEISMOEAGLE.BC.EDU. Waveform data are saved in Nanometrics, ASCII, and SEED formats and are available via SEISMOEAGLE.BC.EDU or through personal contact. Earthquake lists can be fingered at QUAKE@SEISMOEAGLE.BC.EDU. Weston Observatory maintains two web pages with information about local earthquakes: "http://www.bc.edu:80/bc_org/avp/cas/wesobs/" and "http://seismoeagle.bc.edu/". The latter page is still under contruction. Currently available on the seismoeagle web page is the full catalog of northeastern U.S. earthquake activity to 1992. This will be updated as new Northeastern U.S. Seismic Network Bulletins are produced.

MIT/ERL provides two internet utilities, the MIT/ERL web-site ("www-erl.mit.edu/NESN/homepage.html") and an anonymous FTP directory, to distribute seismic data. SESAME (Seismic Event Server at MIT/ERL) is the web data server that distributes catalogs, reports, earthquake bulletins, and epicenter and station maps (including an archive of recent seismic events). The FTP site, named "sunda.mit.edu", is the current facility available to download waveform data recorded by the MIT NESN. The client machine IP number must be forwarded to us for the client to gain access to the anonymous FTP directory. After logging on, the user changes directories to "pub/seismic". Waveforms of individual events for the period April 1995 through the present are accessed as Unix-compressed SAC files, through the anonymous FTP directory. A "readme" file offers further explanation about the data. Older waveform data in SAC format (1981 - March 1995) will be made available on the FTP site upon request.

For more information on matters discussed in this report or general earthquake information (reports, maps, catalogs, etc.) consult our web-sites www-erl.mit.edu/NESN and www.bc.edu:80/bc_org/avp/cas/wesobs/ or contact:

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Explanation of Tables

Table 1: List of personnel operating the NESN

Table 2: List of Seismic and Strong Motion Stations

1. Code = station name
2. Lat = station latitude, degrees north
3. Long = station longitude, degrees west
4. Elev = station elevation in meters
5. Location = geographic location
6. Operator = network operator

Table 3: Earthquake Hypocenter List

1. Date = date event occurred, Yr (year)/Mo (month)/Dy (day)
2. Time = origin time of event, Hr (hour):Mn (minute):Sec (second)
   in UCT (Universal Coordinated Time, same as Greenwich Mean Time)
3. Lat = event location, latitude north in degrees
4. Long = event location, longitude west in degrees
5. Depth = event depth in kilometers
6. Mag = event magnitude
7. Int = event epicentral intensity
8. Location = event geographic location

Table 4: Earthquake detailed hypocenter and phase data list

Table Header: detailed hypocenter data

1. Geographic location
2. DATE = date event occurred, yr/mo/dy (year/month/day)
3. ORIGIN = event origin time (UCT) in hours, minutes, and seconds
4. LAT N = latitude north in degrees and minutes
5. LONG W = longitude west in degrees and minutes
6. DEPTH = event depth in kilometers
7. MN = Nuttli Lg phase magnitude with amplitude divided by period
8. MC = signal duration (coda) magnitude

   WES: 2.23 Log(FMP) + 0.12Log(Dist) - 2.36 (Rosario, 1979)
   MIT: 2.21 Log(FMP) - 1.7 (Chaplin *et al.*, 1980)

9. ML = local magnitude

   WES: calculated from Wood-Anderson seismograms (Ebel, 1982)
   GSC (Geological Survey of Canada): Richter Lg magnitude

10. GAP = largest azimuthal separation, in degrees, between stations
11. RMS = root mean square error of travel time residual in seconds
12. ERH = standard error of epicenter in kilometers
13. ERZ = standard error of event depth in kilometers
14. Q = solution quality of hypocenter

    A = excellent
    B = good
    C = fair
    D = poor

Table Body: earthquake phase data

1. STN = station name
2. DIST = epicentral distance in kilometers
3. AZM = azimuthal angle in degrees measured clockwise between true north and vector pointing from epicenter to station
4. Description of onset of phase arrival

   I = impulsive
   E = emergent

5. R = phase

P = first P arrival
S = first S arrival

6. M = first motion direction of phase arrival

   U = up or compression
   D = down or dilatation

7. K = weight of arrival

   0 = full weight (1.0)
   1 = 0.75 weight
   2 = 0.50 weight
   3 = 0.25 weight
   4 = no weight (0.0)

8. HRMN = hour and minute of phase arrival
9. SEC = second of phase arrival
10. TCAL = calculated travel time of phase in seconds
11. RES = travel time residual (error) of phase arrival
12. WT = weight of phase used in hypocentral solution
13. AMX = peak-to-peak ground motion, in millimicrons, of the maximum envelope amplitude of vertical-component signal, corrected for system response
14. PRX = period in seconds of the signal from which amplitude was measured
15. XMAG = Nuttli magnitude recorded at station
16. FMP = signal duration (coda), in seconds, measured from first P arrival
17. FMAG = coda magnitude recorded at station

Table 5: Microearthquakes and other non-locatable events

1. Date = date event occurred, Yr (year)/Mo (month)/Dy (day)
2. Sta = nearest station recording event
3. Arrival Time = phase arrival time, Hr (hour):Mn (minute):Sec (second)

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TABLE 1

WESTON OBSERVATORY PERSONNEL

Name	Network Position	voice phone	email address
John E. Ebel	Principal Investigator	617-552-8319	ebel@bc.edu
Alan Kafka	Research Seismologist	617-552-8300	kafka@bcvms.bc.edu
Susan O'Connor	Seismic Analyst	617-552-8337	dannolfo@bc.edu
Edward Johnson	Project Engineer	617-552-8332	johnson@bcvms.bc.edu
Patricia Tassia	Administrative Secretary	617-552-8311	tassia@bcvms.bc.edu
W. Richard Ott, S.J.	Assistant to the Director	617-552-8335	ottwi@mail1.bc.edu
Weston Observatory		617-552-8300 617-552-8388 (FAX)	

MIT/ERL PERSONNEL

Name	Network Position	voice phone	email address
M. Nafi Toksöz	Principal Investigator	617-253-7852	toksoz@mit.edu
Robert Cicerone	Research Seismologist	617-253-7863	cicerone@erl.mit.edu
Heather Hooper	Seismic Analyst	617-253-6290	
Sara Brydges	Administrator	617-253-7797	sara@erl.mit.edu
Earth Resources Lab		617-253-8027 617-253-6385 (FAX)	

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TABLE 2

SEISMIC STATIONS OF THE NEW ENGLAND SEISMIC NETWORK

Code	Lat	Long	Elev (m)	Location	Operator
BCX	42.3350	-71.1705	61.0	Chestnut Hill, MA	WES

BRY	41.9178	-71.5388	380.0	Smithfield, RI	WES
DNH	43.1225	-70.8948	24.0	Durham, NH	MIT
DXB	42.0610	-70.6992	8.0	Duxbury, MA	MIT
FFD	43.4702	-71.6533	131.0	Franklin Falls Dam, NH	WES
GLO	42.6403	-70.7272	15.2	Gloucester, MA	MIT
HNH	43.7050	-72.2860	180.0	Hanover, NH	WES
NH1	43.5473	-71.5743	402.0	Sanbornton, NH	WES
QUA2	42.2789	-72.3525	168.0	Belchertown, MA	WES
TRY	42.7311	-73.6669	131.0	Troy, NY	WES
UMM	44.7100	-67.4583	35.0	Machias, ME	WES
VT1	44.3317	-72.7536	410.0	Waterbury, VT	WES
WES	42.3850	-71.3220	60.0	Weston, MA	WES
WFM	42.6106	-71.4906	87.5	Westford, MA	MIT
WVL	44.5648	-69.6575	85.0	Waterville, ME	WES
YLE	41.3100	-72.9269	914.0	New Haven, CT	WES
PQI	46.6710	-68.0168	175.0	Presque Isle, ME	WES

STRONG MOTION STATIONS OF THE NEW ENGLAND SEISMIC NETWORK

Code	Lat	Long	Location	Operator
SM1	44.90	-67.25	Dennysville, ME	WES
SM2	44.49	-73.10	Essex Junction, VT	WES
SM3	41.45	-71.33	Newport, RI	WES
SM4	42.38	-71.32	Weston, MA	WES
SM5	42.66	-71.30	Lowell, MA	WES
SM6	42.30	-71.34	Natick, MA	WES
SM7	42.39	-71.54	Hudson, MA	WES
SM8	44.48	-69.61	North Vassalboro, ME	WES

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TABLE 3

EARTHQUAKE HYPOCENTER LIST
NEW ENGLAND AND ADJACENT REGIONS
January - March, 2001

Date Yr/Mo/Dy	Time Hr:Mn:Sec	Lat	Long	Depth (km)	Mag	Int	Location
2001/01/03	23:05:29.51	43.6543	-71.4503	20.71	1.6		NH, 4 KM E OF MEREDITH
2001/01/07	19:59:44.28	43.5238	-71.6558	7.41	2.7*		NH, 8 KM N OF FRANKLIN
2001/01/17	12:34:20.16	40.5872	-73.9632	9.97	2.5		NY, 9 KM S OF NEW YORK CTY
2001/01/20	20:38:18.32	44.8417	-67.9500	5.00	2.1		ME, 42 KM W OF MACHIAS
2001/02/03	17:50:43.28	41.4067	-72.7010	2.00	1.8		CT, NE OF WALLINGFORD
2001/03/24	11:57:18.59	50.0160	-63.6138	5.00	3.6		PQ, LOWER ST LAWRENCE

* indicates Mc rather than Mn.

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TABLE 4

EARTHQUAKE PHASE DATA LIST
NEW ENGLAND AND ADJACENT REGIONS
January - March, 2001

```
HUGHES AND LUETGERT NH
01JAN03 NH, 4 KM E OF MEREDITH
 DATE     ORIGIN     LAT N     LONG W    DEPTH    MN  MC   ML GAP    RMS   ERH   ERZ Q
010103 23 5 29.51 43-39.26   71-27.02   20.71   1.6 1.8      141   0.27   2.1   3.1 B
 STN   DIST AZM   RMK HRMN    SEC    TOBS    TCAL    RES    WT AMX PRX XMAG FMP FMAG
```

```
 HNH  67.6 275 EP 1 23 5 41.24  11.73  11.40  0.30 1.17  23 .13  1.5  47  1.8
               ES 1 23 5 49.58  20.07  20.29 -0.28 1.17
 WFM 116.0 182 EP 1 23 5 48.65  19.14  18.78  0.35 1.06
               ES 3 23 5 61.93  32.42  33.43 -1.03 0.20
 WES 141.4 176 EP 4 23 5 47.36  17.85  22.49 -4.65 0.00  13 .13  1.7
               ES 1 23 5 69.36  39.85  40.04 -0.21 0.99
QUA2 169.6 206 EP 3 23 5 57.43  27.92  26.09  1.80 0.00  10 .13  1.7
               ES 1 23 5 76.15  46.64  46.44  0.14 0.93
 WVL 172.8  56 EP 0 23 5 56.00  26.49  26.49 -0.01 1.24   8 .15  1.6
               ES 0 23 5 76.60  47.09  47.15 -0.08 1.24
  HUGHES AND LUETGERT NH
01JAN07 NH, 8 KM N OF FRANKLIN
 DATE     ORIGIN    LAT N    LONG W   DEPTH   MN  MC  ML GAP   RMS  ERH  ERZ Q
010107 1959 44.28 43-31.43  71-39.35   7.41  1.6 2.7     113  0.49  2.7  4.8 C
 STN  DIST AZM  RMK HRMN   SEC   TOBS   TCAL   RES   WT AMX PRX XMAG FMP FMAG
 HNH  54.7 292 IPD1 1959 54.13   9.84   9.22  0.59 1.34  26 .07  1.5
               ES 1 1959 60.51  16.23  16.42 -0.24 1.40
LBNH  82.5 345 EP 1 1959 58.21  13.93  13.74  0.12 1.32              124  2.6
               ES 1 1959 67.99  23.71  24.47 -0.87 1.18
 WFM 102.4 172 IPU1 1959 61.52  17.24  16.96  0.26 1.25              116  2.6
               ES 3 1959 73.13  28.84  30.19 -1.37 0.21
 WES 129.4 168 EP 1 1959 65.68  21.40  21.17  0.21 1.19  13 .08  1.7
               ES 1 1959 81.67  37.39  37.69 -0.32 1.19
 QUA 132.2 206 EP 4 1959 69.46  25.18  21.59  3.55 0.00
               ES 4 1959 85.71  41.43  38.44  2.93 0.00
 WVL 194.8  55 EP 4 1959 79.98  35.70  30.53  5.16 0.00
               ES 2 1959 99.07  54.79  54.34  0.43 0.65
 NCB 212.9 283 EP 3 1959 77.86  33.58  32.76  0.74 0.29              108  2.7
LSCT 242.1 212 EP 4 1959 84.28  40.00  36.36  3.58 0.00               91  2.6
SE OF NEW YORK, HUGHES & LUETGERT
01JAN17 NY, 9 KM S OF NEW YORK CITY
 DATE     ORIGIN    LAT N    LONG W   DEPTH   MN  MC  ML GAP   RMS  ERH  ERZ Q
010117 1234 20.16 40-35.23  73-57.79   9.97  2.5 2.7     271  0.49 11.1  4.9 D
 STN  DIST AZM  RMK HRMN   SEC   TOBS   TCAL   RES   WT AMX PRX XMAG FMP FMAG
 PAL  46.5   6   P 1 1234 26.73   6.57   7.30 -0.73 1.21
 GPD  63.6 319   P 1 1234 30.83  10.67   9.87  0.80 1.14
 TBR  65.3 340   P 0 1234 30.20  10.04  10.13 -0.13 1.69
CRNY  87.7  23   P 0 1234 33.62  13.46  13.52 -0.06 1.62
 YLE 118.6  47 IP 2 1234 38.17  18.01  18.22 -0.21 0.75 147 .19  2.5
               ES 2 1234 52.99  32.83  32.43  0.40 0.75
LSCT 136.1  27   P 1 1234 41.64  21.48  20.89  0.54 1.05
QUA2 231.2  36 EP 3 1234 53.58  33.42  34.31 -0.92 0.23  53 .21  2.5
               ES 2 1234 80.92  60.76  61.07 -0.36 0.55
 BRY 251.1  54 EP 4 1234 61.84  41.68  36.77  4.90 0.00  44 .17  2.6  94  2.7
               ES 4 1234 89.21  69.05  65.46  3.59 0.00
 WES 297.5  48 EP 4 1235  8.55  48.39  42.49  5.89 0.00  35 .21  2.5
               ES 4 1235 35.05  74.89  75.64 -0.77 0.00
SOUTHEAST MAINE CRUSTAL MODEL
01JAN20 ME, 42 KM W OF MACHIAS
 DATE     ORIGIN    LAT N    LONG W   DEPTH   MN  MC  ML GAP   RMS  ERH  ERZ Q
010120 2038 18.32 44-50.50  67-57.00   5.00  2.1         193  0.35  5.5 **** D
 STN  DIST AZM  RMK HRMN   SEC   TOBS   TCAL   RES   WT AMX PRX XMAG FMP FMAG
 UMM  41.6 111                                        69 .14  1.7
 PQI 203.4 359 EP 4 2038 35.42  17.10  30.87-13.81 0.00  40 .10  2.5
               S 4 2038 44.94  26.62  54.96-28.39 0.00
 LMN 271.0  66 EP 4 2038 60.43  42.11  39.22  2.89 0.00
               S 1 2038 88.15  69.83  69.80  0.02 1.51
 A11 318.6 327 ES 2 2039 37.85  79.53  80.28 -0.77 0.64
LBNH 323.2 258 EP 4 2039  9.56  51.24  45.67  5.51 0.00
               S 3 2039 39.74  81.42  81.29  0.02 0.41
 A21 345.2 337 ES 1 2039 44.92  86.60  86.12  0.48 1.05
 LMQ 352.4 329 EP 4 2039  9.28  50.96  49.27  1.62 0.00
               S 4 2039 60.50 102.18  87.69 14.36 0.00
 A61 357.4 333  S 0 2039 47.09  88.77  88.79 -0.04 1.39
SOUTH & COASTAL NEW ENGLAND, CHIBURIS, 1979
01FEB03 CT, NE OF WALLINGFORD
 DATE     ORIGIN    LAT N    LONG W   DEPTH   MN  MC  ML GAP   RMS  ERH  ERZ Q
010203 1750 43.28 41-24.40  72-42.06   2.00  1.8         181  0.44  3.6  4.9 C
 STN  DIST AZM  RMK HRMN   SEC   TOBS   TCAL   RES   WT AMX PRX XMAG FMP FMAG
 YLE  21.7 240 IPD0 1750 47.05   3.77   3.67  0.10 1.23  99 .12  1.6
               S 0 1750 49.46   6.18   6.53 -0.36 1.21
QUA2 101.1  17 IP 0 1750 60.83  17.55  16.77  0.75 0.91
               IS 0 1750 72.78  29.50  29.84 -0.40 1.02
 BRY 112.2  60 IP 0 1750 62.17  18.89  18.59  0.29 1.01  60 .17  2.1
               IS 0 1750 75.87  32.59  33.09 -0.51 0.99
 WES 157.8  46 EP 0 1750 69.22  25.94  25.55  0.37 0.90
               S 0 1750 88.23  44.95  45.48 -0.56 0.86
 BCX 163.6  51  S 0 1750 90.78  47.50  47.05  0.44 0.87
NORTHWEST MAINE CRUSTAL STRUCTURE
01MAR24 PQ, LOWER ST LAWRENCE
 DATE     ORIGIN    LAT N    LONG W   DEPTH   MN  MC  ML GAP   RMS  ERH  ERZ Q
010324 1157 18.59 50- 0.96  63-36.83   5.00  3.6 3.8     272  0.44 11.8 13.0 D
 STN  DIST AZM  RMK HRMN   SEC   TOBS   TCAL   RES   WT AMX PRX XMAG FMP FMAG
 SMQ 222.2 276   P 0 1157 52.71  34.12  33.89  0.16 2.09
 ICQ 269.0 258   P 1 1157 58.64  40.05  39.68  0.36 1.46
 GSQ 281.4 244   P 2 1158  0.68  42.09  41.20  0.88 0.85
               S 0 1158 32.02  73.43  73.34  0.07 1.94
 CNQ 331.5 256   P 1 1158  6.39  47.80  47.38  0.38 1.34
               S 1 1158 43.42  84.83  84.34  0.43 1.32
 MNQ 371.8 279   P 1 1158 10.55  51.96  52.36 -0.41 1.26
               S 1 1158 51.16  92.57  93.21 -0.64 1.23
 LMN 471.5 191   P 3 1158 21.75  63.16  64.67 -1.52 0.13
               S 4 1158 68.35 109.76 115.12 -5.36 0.00
 PQI 495.0 221 IPU1 1158 25.97  67.38  67.58 -0.23 1.02 156 .24  3.6 309  3.7
               S 4 1158 75.13 116.54 120.29 -3.80 0.00
 A21 514.4 240   P 0 1158 28.54  69.95  69.97 -0.02 1.31
               S 3 1158 81.65 123.06 124.54 -1.49 0.12
 A64 520.7 242   P 1 1158 28.90  70.31  70.74 -0.46 0.96
 LMQ 564.4 241   P 1 1158 34.40  75.81  76.14 -0.40 0.87
               S 3 1158 92.60 134.01 135.53 -1.65 0.06
 UMM 657.4 206 EP 4 1158 48.99  90.40  87.62  2.76 0.00  45 .23  3.5   0  3.9
 HNH 963.8 223 EP 1 1159 23.76 125.17 125.45 -0.31 0.07
               S 4 1159 94.92 196.33 223.29-27.02 0.00
 WES1036.1 215 EP 3 1158 91.78 133.19 134.37 -1.20 0.00
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TABLE 5

MICROEARTHQUAKES AND OTHER NON-LOCATABLE EVENTS

Date Yr/Mo/Dy	Sta	Arrival Time Hr:Mn:Sec
None recorded this period.		

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NESN Station Map

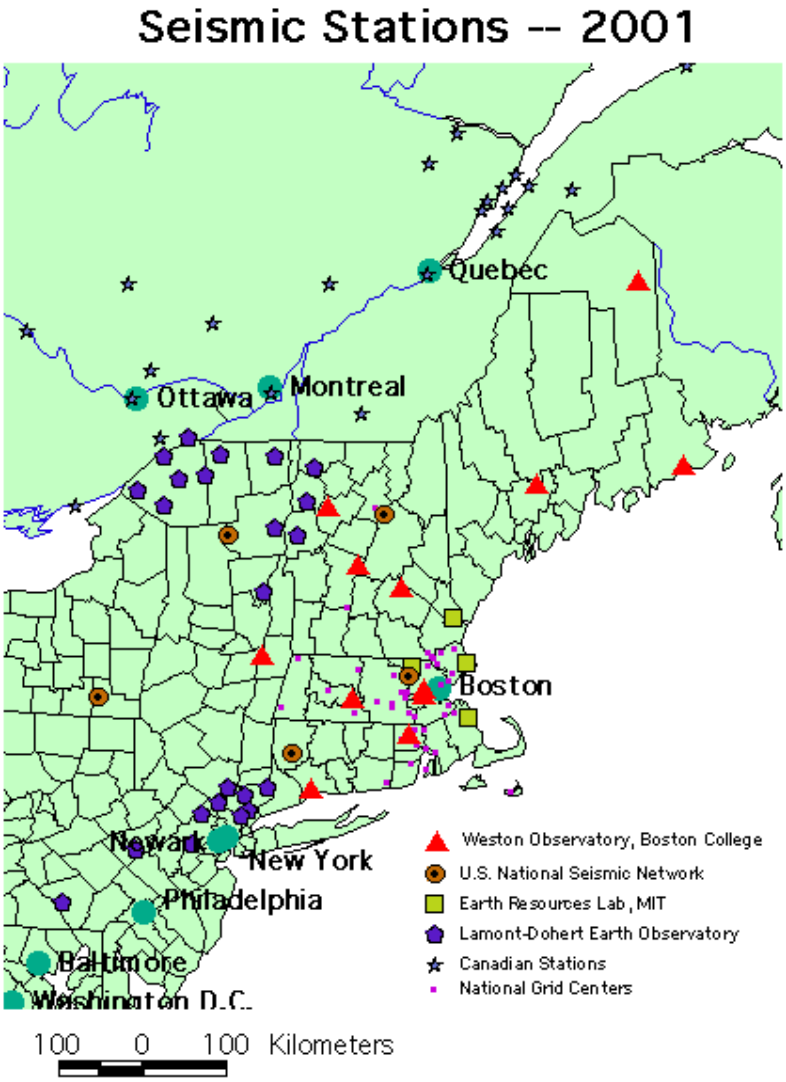

Figure 1: Map of stations of the New England Seismic Network (NESN) in operation during period January - March, 2001. Also included are the US National Seismic Network stations operating in New England during this period.

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NESN Strong-Motion Station Map

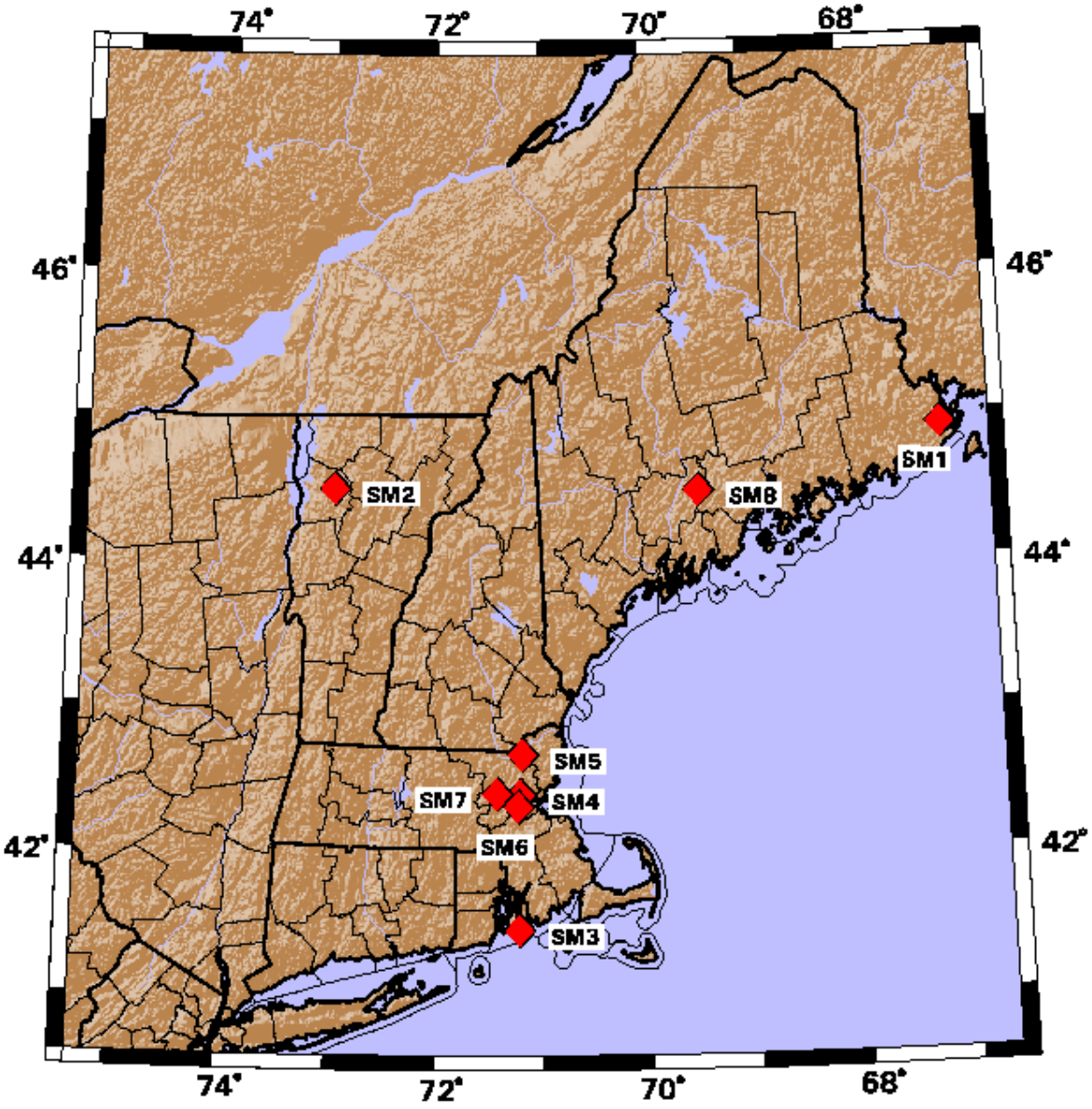

Figure 2: Map of strong-motion stations of the New England Seismic Network (NESN) in operation during period January - March, 2001.

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NESN Quarterly Seismicity Map

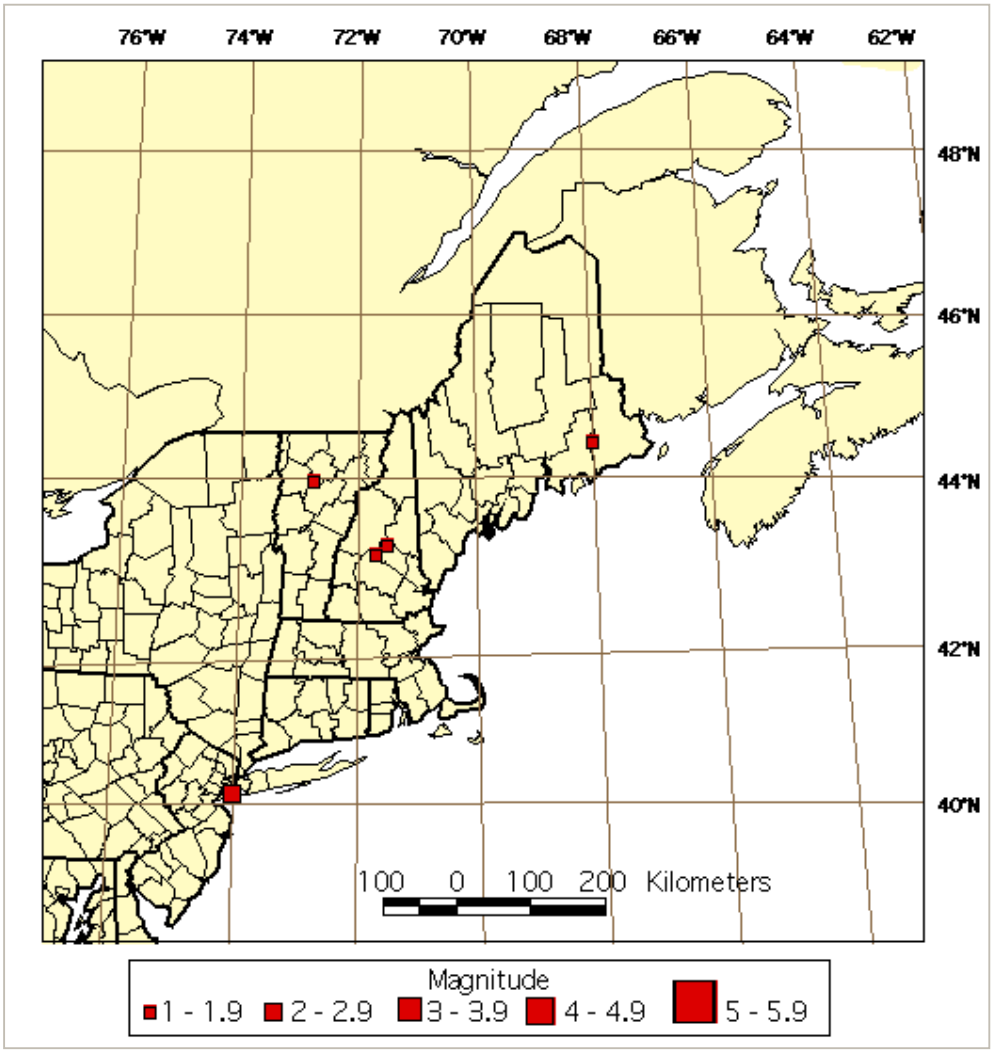

Figure 3: Earthquake epicenters located by the NESN during period January - March, 2001.

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NESN Cumulative Seismicity Map

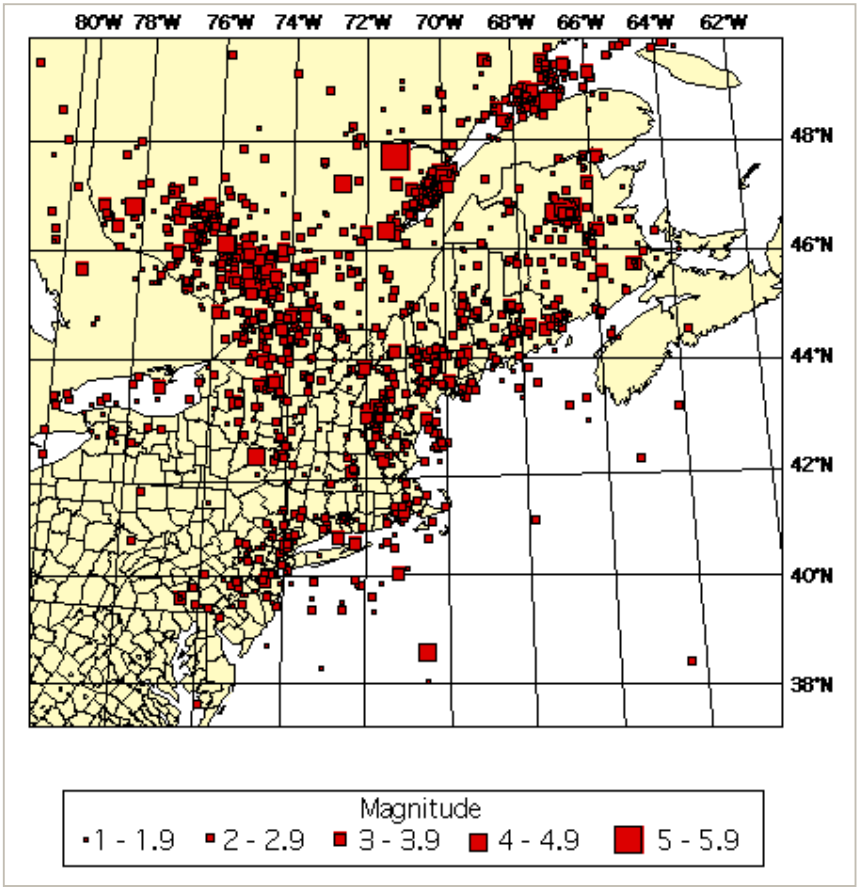

Figure 4: Seismicity for period October, 1975 - March, 2001.

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