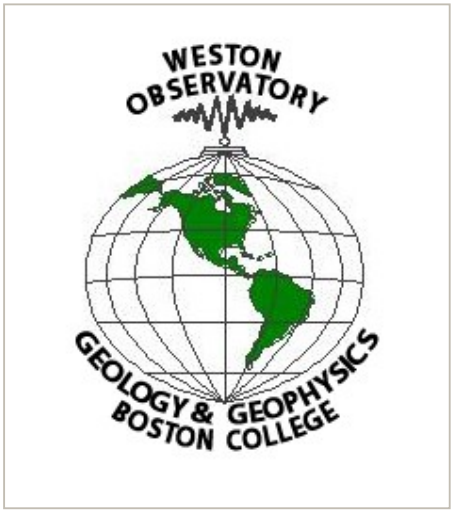
A STUDY OF NEW ENGLAND SEISMICITY

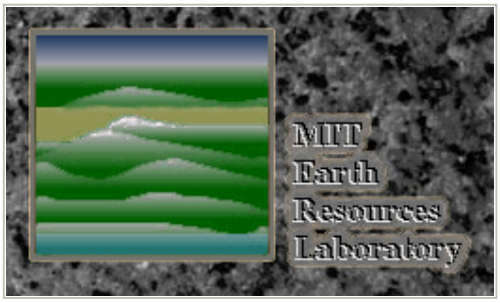
Quarterly Earthquake Report

January - March 1998

New England

Seismic Network





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NEW ENGLAND SEISMIC NETWORK

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for

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Notice

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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 1998. 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 2 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 12 broadband three-component, 4 short-period vertical, and 8 strong-motion stations. The coordinates of the stations are given in Table 2, and a map of the network is shown in Figure 1.

WES operates 11 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. WES is continuing to upgrade its recording stations with 4 more broadband instruments scheduled for installation in 1999. WES also maintains 8 SMA-1 strong-motion instruments in New England.

ERL at MIT currently operates 1 broadband and 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. Station WFM has a CMG-40T sensor and transmits 3-channel, 24-bit data continuously to a central processor (Pentium PC) at ERL where waveform windows of suspected events are analyzed and archived. WES and ERL record some stations in analog format on helicorders to provide additional data for analysis.

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Seismicity

There were 2 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 2 shows the locations of these events. Figure 3 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. 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 header lists the hypocenter and geographic location information adopted from the authoritative network. Travel-time information has been computed for these regional events by fixing the hypocenter obtained from the authoritative network and then running HYPO78.

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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 earthquake activity to 1990. This will be updated as new Northeastern U.S. Seismic Network Bulletins are produced.

Our entire earthquake database can be accessed through the World Wide Web using the address "http://www-erl.mit.edu/NESN/homepage.html". For extraction of waveforms and hypocenter data, use our database search engine. Link to "Seismic Event Server at MIT ERL (SESAME)" and then click on "Interactive query form" under the heading "Custom Materials". Alternatively, the most recent local earthquake data, recorded by the M.I.T. Seismic Network, may be accessed by logging in to our anonymous FTP directory ("ftp erl-dialup.mit.edu"). The waveform files are in SAC format at both sites. Waveforms are downloaded as a Unix-compressed tar volume from our web-site and as individual Unix-compressed files from our FTP site.

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)
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 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: 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
   1 = 0.50 weight
   1 = 0.25 weight
   1 = 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@bcvms.bc.edu
Alan Kafka	Research Seismologist	617-552-8300	kafka@bcvms.bc.edu
Susan O'Connor	Seismic Analyst	617-552-8337	dannolfo@bcvms.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
		617-552-8300	
Weston Observatory		617-552-8388 (FAX)	

MIT/ERL PERSONNEL

Name	Network Position	voice phone	email address
M. Nafi Toksöz	Principal Investigator	617-253-7852	nafi@erl.mit.edu
Charles Doll	Research Seismologist	617-253-7863	doll@erl.mit.edu
Charles Doll	Seismic Analyst	617-253-6290	doll@erl.mit.edu
Sara Brydges	Administrator	617-253-7797	sara@erl.mit.edu
		617-253-8027	
Earth Resources Lab		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
GLO	42.6403	-70.7272	15.2	Gloucester, MA	MIT
HNH	43.7050	-72.2860	180.0	Hanover, NH	WES
MIM	45.2436	-69.0403	140.0	Milo, ME	WES
NH1	43.5473	-71.5743	402.0	Sanbornton, NH	WES
ONH	43.2792	-71.5056	280.0	Oak Hill, NH	MIT
QUA2	42.2789	-72.3525	168.0	Belchertown, MA	WES
TRY	42.7311	-73.6669	131.0	Troy, NY	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	9.14	New Haven, CT	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 1998

Date	Time	Lat	Long	Depth	Mag	Int	Location
Yr/Mo/Dy	Hr:Mn:Sec			(km)			
1998/01/08	04:34:11.89	42.855	-70.040	25.22	2.7	MA, East of Cape Ann (offshore)	
1998/02/13	17:16:09.27	43.757	-71.336	4.00	2.7	NH, West of Ossippee	

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TABLE 4

EARTHQUAKE PHASE DATA LIST
NEW ENGLAND AND ADJACENT REGIONS
January - March 1998

```
98JAN08 MA, EAST OF CAPE ANN (OFFSHORE)
 DATE     ORIGIN    LAT N     LONG W   DEPTH    MN  MC  ML GAP   RMS  ERH  ERZ Q
980108  434 11.89 42-51.29  70- 2.39  25.22  2.9 2.7     178  0.41  2.2  1.6 C
 STN  DIST AZM  RMK HRMN    SEC    TOBS    TCAL    RES   WT AMX PRX XMAG FMP FMAG
 BCX 109.3 238 IPD0  434 29.74   17.85   17.62   0.23 2.57 223 .06  2.9
               ES 2  434 42.57   30.68   31.36  -0.68 1.24
 WES 117.5 244 IPD1  434 30.95   19.06   18.69   0.36 1.88              130  2.7
               ES 0  434 45.33   33.44   33.27   0.15 2.54
 BRY 161.4 230 EP 2  434 36.52   24.63   24.12   0.51 1.15
               ES 1  434 54.27   42.38   42.93  -0.55 1.77
 MOQ 325.6 327  S 1  435 30.80   78.91   79.00  -0.34 1.36
 DPQ 477.1 333  P 1  435 15.47   63.58   63.09   0.48 0.94
 A11 487.8 359  S 2  435 67.02  115.13  114.64   0.47 0.61
 A54 512.3 357  P 2  435 19.94   68.05   67.43   0.55 0.57
               S 0  435 71.72  119.83  120.03  -0.31 1.17
 A16 512.7   0  S 3  435 69.99  118.10  120.12  -2.02 0.02
 LMQ 522.1 358  P 0  435 20.60   68.71   68.64  -0.01 1.14
               S 0  435 74.30  122.41  122.19   0.10 1.14
 LMN 533.6  51  P 0  435 21.35   69.46   70.07  -0.61 1.07
               S 3  435 73.90  122.01  124.72  -2.72 0.00
 A61 537.8 360  P 3  435 23.19   71.30   70.58   0.71 0.26
               S 1  435 77.84  125.95  125.63   0.30 0.80
 A21 539.6   3  P 3  435 20.50   68.61   70.80  -2.19 0.01
               S 0  435 77.48  125.59  126.03  -0.44 1.06
 A64 552.7   1  P 4  435 80.23  128.34   72.42 55.90 0.00
 GSQ 710.8  19  P 3  435 44.38   92.49   91.95   0.53 0.12
 CNQ 732.6  12  P 1  435 46.62   94.73   94.63   0.07 0.31
 ICQ 771.2  16  P 0  435 51.10   99.21   99.40  -0.20 0.27
98FEB13 NH, W OF OSSIPPEE
 DATE     ORIGIN    LAT N     LONG W   DEPTH    MN  MC  ML GAP   RMS  ERH  ERZ Q
980213 1716  9.27 43-45.41  71-20.17   4.00  2.4 2.7     143  0.54  1.4  1.4 D
 STN  DIST AZM  RMK HRMN    SEC    TOBS    TCAL    RES   WT AMX PRX XMAG FMP FMAG
 NH1  30.2 220 IPD0 1716 14.29    5.02    5.09  -0.06 2.22              127  2.5
               S 1  1716 18.04    8.77    9.06  -0.28 1.67
LBNH  71.6 319 IPD3 1716 20.04   10.77   11.90  -1.19 0.43
               S 4  1716 27.67   18.40   21.19  -2.89 0.00
 DNH  79.0 153 EP 0 1716 22.60   13.33   13.13   0.20 2.01              116  2.6
               S 0  1716 32.40   23.13   23.38  -0.24 2.01
 WFM 128.0 186 EP 1 1716 30.76   21.49   20.90   0.59 1.34              128  2.7
               S 0  1716 46.34   37.07   37.20  -0.14 1.80
 GLO 133.5 158 EP 2 1716 31.62   22.35   21.74   0.61 0.88              147  2.9
               S 1  1716 47.58   38.31   38.70  -0.39 1.32
 MDV 150.7 280 IPU3 1716 34.79   25.52   24.34   1.16 0.39
```

```
                 S 2 1716 51.75  42.48  43.33 -0.88 0.79
  WES 152.4 180 EPU0 1716 33.79  24.52  24.61 -0.10 1.70  42 .08  2.4 124  2.7
                 S 3 1716 52.17  42.90  43.81 -0.92 0.39
 HBVT 153.9 296  P 3 1716 35.13  25.86  24.84  0.97 0.40
                 S 1 1716 52.97  43.70  44.21 -0.61 1.23
  BCX 158.5 175 EPU3 1716 35.79  26.52  25.54  0.99 0.40
                 S 1 1716 54.49  45.22  45.45 -0.23 1.26
 FLET 167.9 310  P 3 1716 37.45  28.18  26.96  1.22 0.37
                 S 3 1716 56.09  46.82  47.99 -1.17 0.34
  MIV 179.8 281  P 3 1716 38.90  29.63  28.45  1.19 0.35
                 S 0 1716 59.95  50.68  50.63  0.05 1.58
 QUA2 183.9 207 EP 4 1716 35.59  26.32  28.96 -2.67 0.00
                 S 2 1716 61.81  52.54  51.55  0.94 0.75
  MOQ 187.6 337  P 0 1716 38.78  29.51  29.42 -0.04 1.55
  DXB 195.4 165 EP 3 1716 40.60  31.33  30.38  0.95 0.36              118  2.8
                 S 0 1716 63.24  53.97  54.08 -0.11 1.52
  BRY 205.0 185 EP 0 1716 41.20  31.93  31.56  0.38 1.48              125  2.8
                 S 4 1716 63.50  54.23  56.17 -1.94 0.00
  TRY 221.1 239 EP 2 1716 43.58  34.31  33.55  0.77 0.68
                 S 0 1716 68.83  59.56  59.71 -0.15 1.41
  MNT 265.7 317  P 1 1716 48.71  39.44  39.06  0.39 0.91
                 S 2 1716 77.74  68.47  69.52 -1.05 0.54
 LSCT 278.0 214  P 0 1716 49.40  40.13  40.57 -0.48 1.15
                 S 0 1716 83.91  74.64  72.21  2.34 0.13
  PTN 305.3 287  P 0 1716 53.36  44.09  43.94  0.11 1.05
                 S 0 1716 89.49  80.22  78.22  1.94 0.37
 MSNY 312.9 296  P 0 1716 54.03  44.76  44.89 -0.13 1.01
                 S 0 1716 88.93  79.66  79.90 -0.25 1.01
  WBO 342.9 294  P 0 1716 57.64  48.37  48.58 -0.21 0.89
  DPQ 344.1 341  P 0 1716 57.89  48.62  48.73 -0.11 0.88
  A54 417.5  10  P 1 1716 66.41  57.14  57.80 -0.72 0.41
```

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TABLE 5

MICROEARTHQUAKES AND OTHER NON-LOCATABLE EVENTS

Date	Sta	Arrival Time
Yr/Mo/Dy		Hr:Mn:Sec

None recorded this quarter

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NESN Station Map

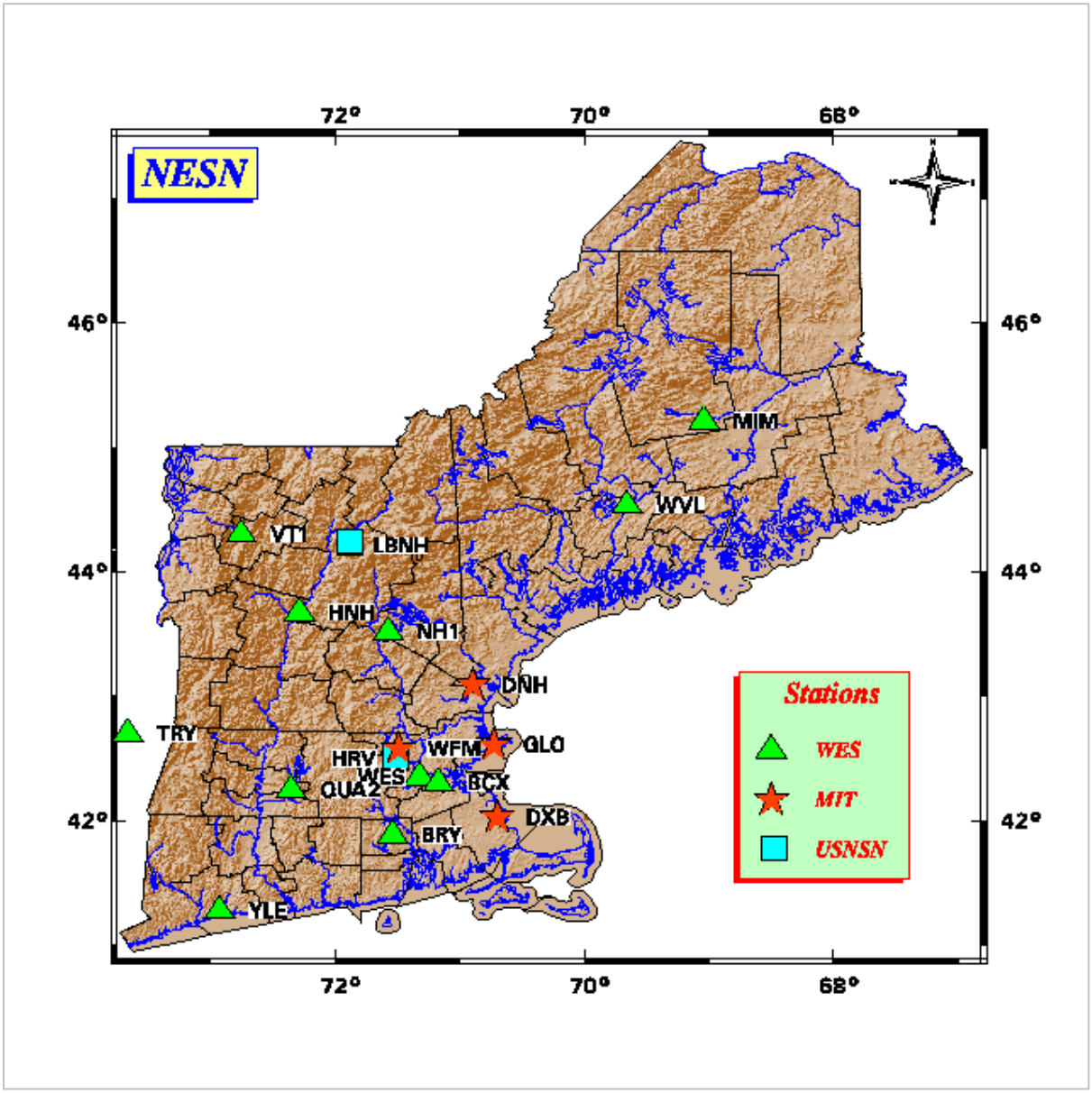

Figure 1: Map of stations of the New England Seismic Network (NESN) in operation during period January - March, 1998. Also included are the US National Seismic Network stations operating in New England during this period.

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NESN Strong-Motion Station Map

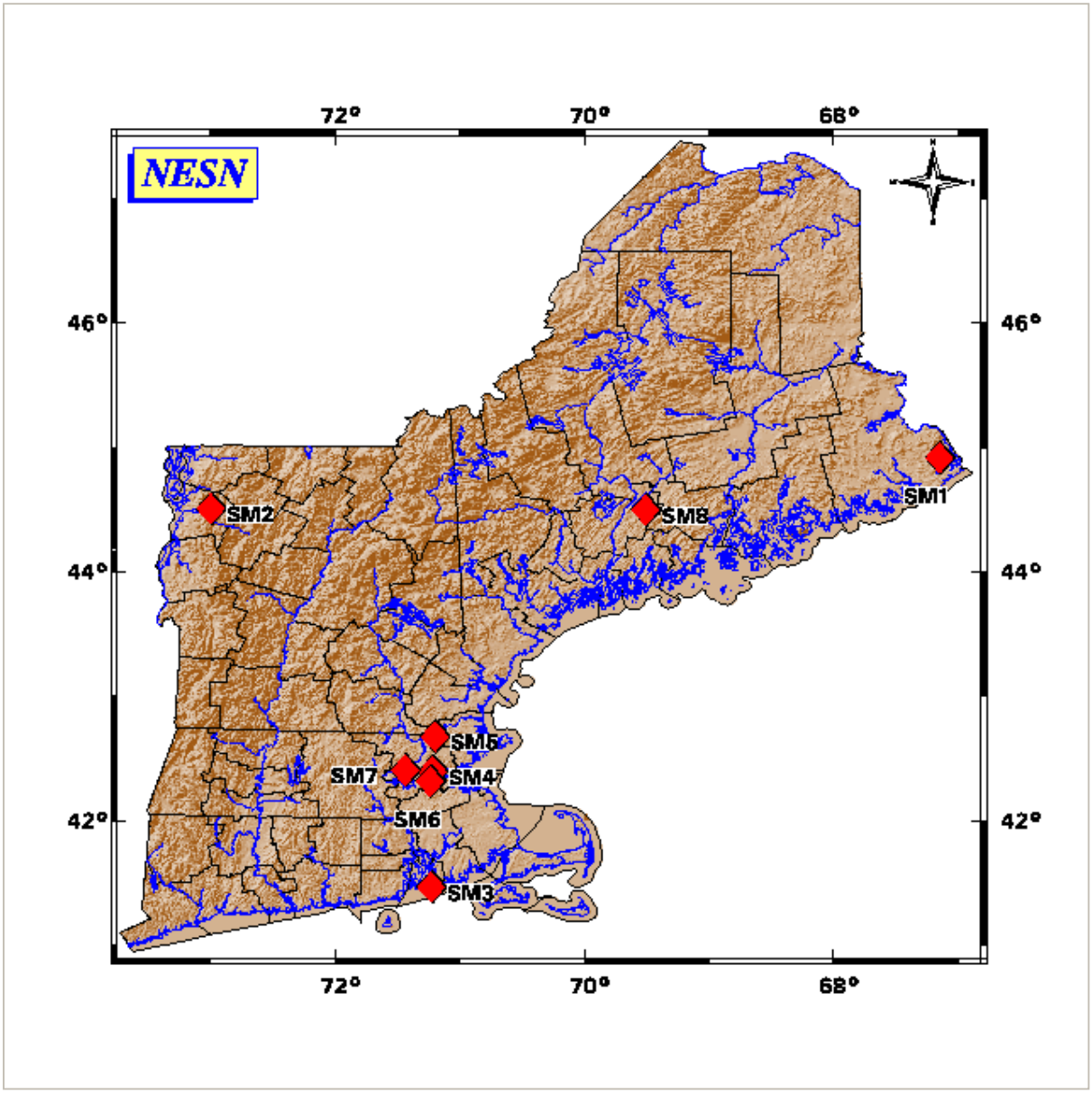

Figure 2: Map of strong-motion stations of the New England Seismic Network (NESN) in operation during period January - March, 1998.

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NESN Quarterly Seismicity Map

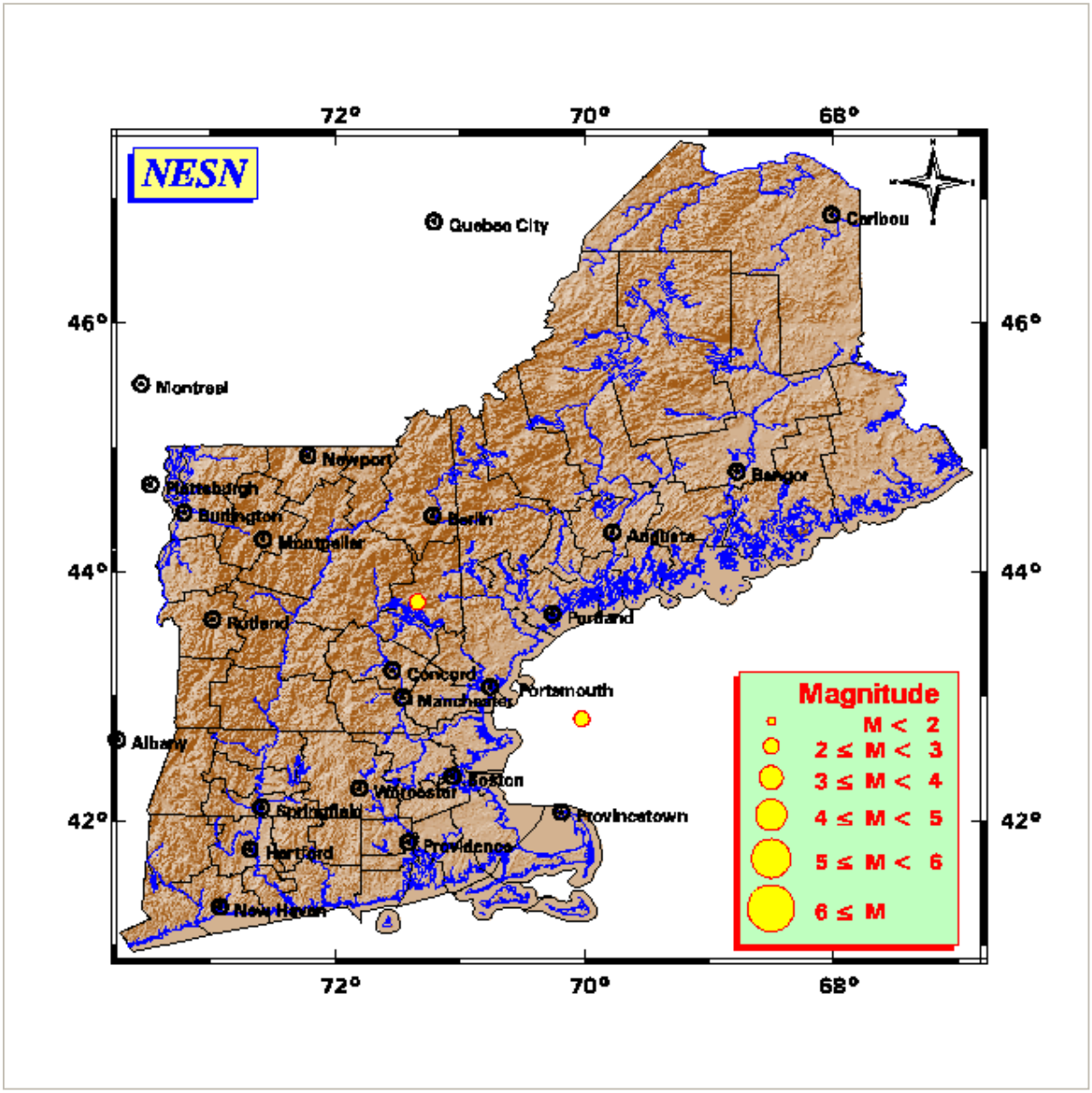

Figure 3: Earthquake epicenters located by the NESN during period January - March, 1998.

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NESN Cumulative Seismicity Map

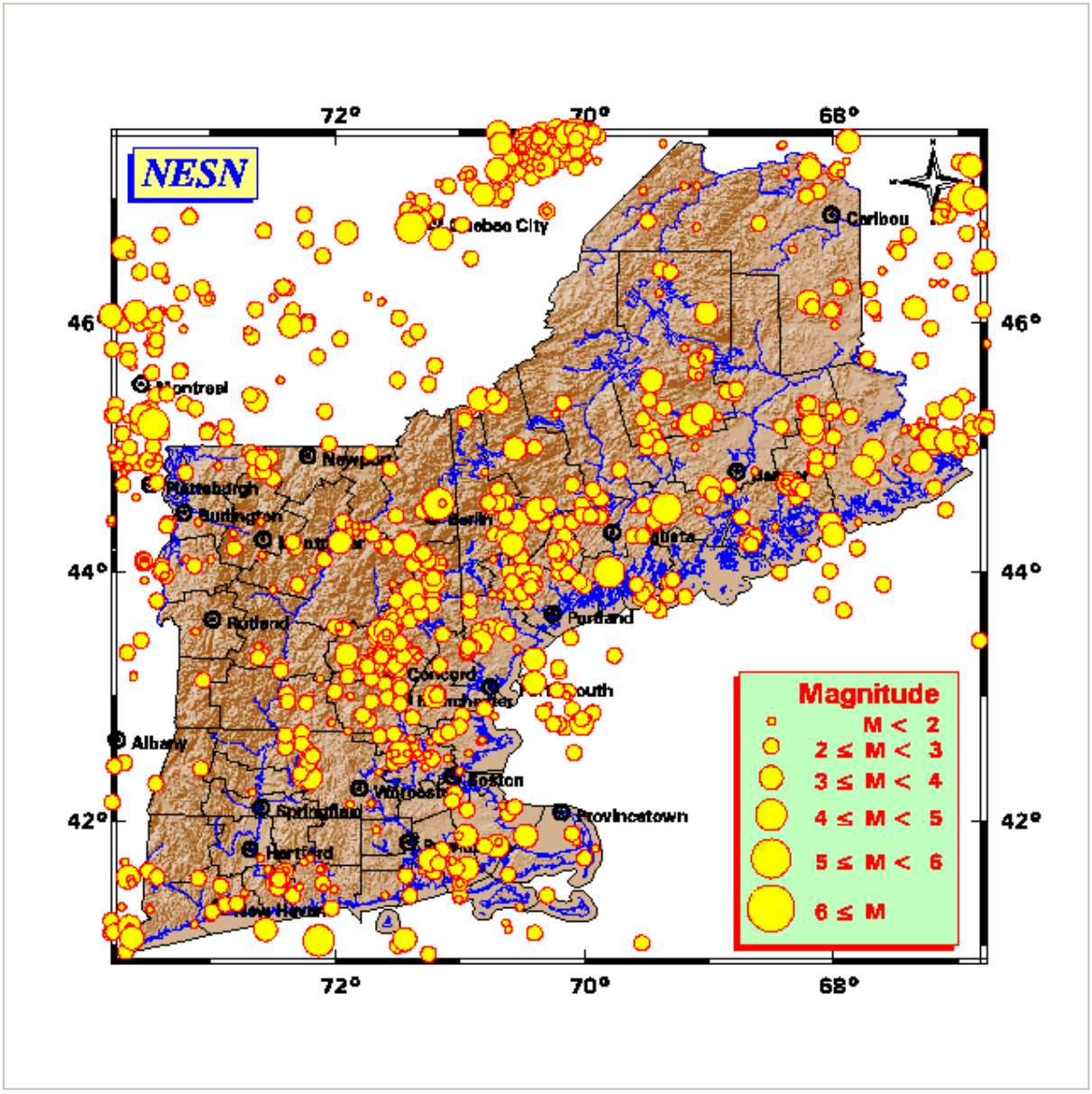

Figure 4: Seismicity located by the NESN for period October, 1975 - March, 1998.

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