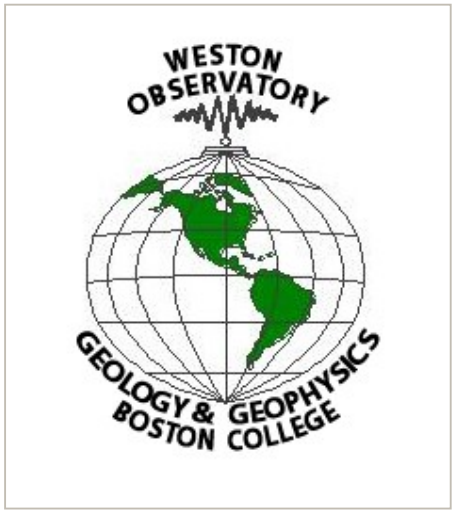
A STUDY OF NEW ENGLAND SEISMICITY

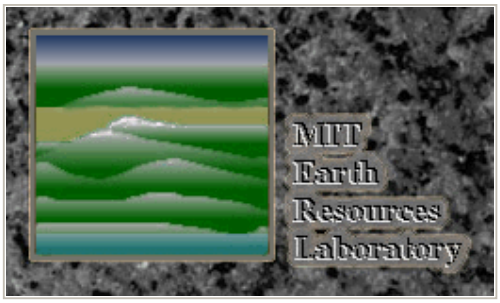
Quarterly Earthquake Report

October - December 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 October - December 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 3 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 11 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 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 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. Personnel at ERL are in the process of installing a new three-component, high dynamic range instrument at Station WFM. 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. WES and ERL record some stations in analog format on helicorders to provide additional data for analysis.

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Seismicity

There were 3 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 earthquake activity to 1991. This will be updated as new Northeastern U.S. Seismic Network Bulletins are produced.

The entire MIT/ERL 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 (recorded by the MIT stations of the NESN through March 1995) 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 more recent local earthquake data, recorded by the MIT stations, may be accessed by logging in to our anonymous FTP directory ("ftp sunda.mit.edu"). To be added to the list of users permitted to access this FTP directory, contact Charles Doll. 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, station 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)

   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@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
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

October- December 1998

Date	Time	Lat	Long	Depth	Mag	Int	Location
Yr/Mo/Dy	Hr:Mn:Sec			(km)			
1998/11/04	12:37:26.73	42.4981	-70.3948	7.98	1.6	MA, 29 km SE of GLOUCESTER (offsh ore)	
1998/11/24	15:07:41.01	42.5828	-73.9976	13.04	2.5	NY, 18 km SSW of ALBANY	
1998/12/25	13:30:25.04	43.7785	-77.8268	2.28	3.3	ON, Lake Ontario	

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TABLE 4

EARTHQUAKE PHASE DATA LIST
NEW ENGLAND AND ADJACENT REGIONS
October- December 1998

```
SOUTH & COASTAL NEW ENGLAND, CHIBURIS, 1979
98NOV04 MA, 29 KM SE OF GLOUCESTER (OFFSHORE)
 DATE      ORIGIN     LAT N     LONG W    DEPTH    MN  MC   ML GAP    RMS   ERH   ERZ Q
981104 1237 26.73 42-29.89   70-23.69    7.98       1.6      238   0.34   2.5   2.4 C
 STN   DIST AZM   RMK HRMN    SEC    TOBS    TCAL    RES    WT AMX PRX XMAG FMP FMAG
 GLO   31.5 300  IP 0 1237  32.08    5.35    5.42 -0.07  1.82                 49   1.7
                 S 0 1237  36.32    9.59    9.64 -0.05  1.82
 DXB   54.7 207  EP 0 1237  35.84    9.11    9.18 -0.07  1.74                 34   1.5
                 S 3 1237  41.26   14.53   16.34 -1.81  0.03
 WES   77.4 261  EP 2 1237  40.34   13.61   12.90  0.70  0.77
                ES 2 1237  50.08   23.35   22.97  0.37  0.82
 DNH   80.5 329  EP 3 1237  41.46   14.73   13.42  1.31  0.18                 32   1.6
                 S 3 1237  49.92   23.19   23.89 -0.70  0.39
 WFM   90.8 278  EP 1 1237  41.62   14.89   15.00 -0.12  1.21
                 S 1 1237  53.22   26.49   26.70 -0.22  1.21
SOUTH & COASTAL NEW ENGLAND, CHIBURIS, 1979
98NOV24 NY, 18 KM SSW OF ALBANY
 DATE      ORIGIN     LAT N     LONG W    DEPTH    MN  MC   ML GAP    RMS   ERH   ERZ Q
981124 15 7 41.01 42-34.97   73-59.86   13.04   2.5 2.7      298   0.37   5.1   3.6 D
 STN   DIST AZM   RMK HRMN    SEC    TOBS    TCAL    RES    WT AMX PRX XMAG FMP FMAG
QUA2 139.6 104  IP 1 15 8   2.81   21.80   22.08 -0.31  1.38 138 .22   2.6 126   2.7
                 S 0 15 8  20.44   39.43   39.30  0.08  1.86
 HNH 187.0  48 IPD0 15 8   9.88   28.87   28.35  0.48  1.63  62 .16   2.5 112   2.7
                 S 3 15 8  31.15   50.14   50.47 -0.38  0.40
 WFM 205.8  89   P 0 15 8  11.80   30.79   30.67  0.11  1.56
                 S 1 15 8  35.50   54.49   54.59 -0.12  1.17
 BRY 215.8 110   S 1 15 8  38.18   57.17   56.79  0.38  1.13
 WES 221.0  96 IPD2 15 8  12.84   31.83   32.55 -0.73  0.67  28 .20   2.2  85   2.5
                 S 1 15 8  38.83   57.82   57.94 -0.14  1.12
 NH1 224.5  61 IPD3 15 8  15.54   34.53   32.98  1.55  0.11  80 .18   2.7 138   2.9
                 S 3 15 8  41.55   60.54   58.70  1.83  0.02
 GLO 268.5  89   P 4 15 8  23.70   42.69   38.41  4.28  0.00
```

```
                S 1 15 8 49.00  67.99  68.37 -0.38 0.94
NORTHWEST MAINE CRUSTAL STRUCTURE
98DEC25 ON, LAKE ONTARIO
 DATE      ORIGIN     LAT N     LONG W   DEPTH   MN  MC  ML GAP   RMS  ERH  ERZ Q
981225 1330 25.04 43-46.71  77-49.61   2.28  3.3          257  0.14  3.3  3.4 C
 STN   DIST AZM  RMK HRMN    SEC    TOBS    TCAL    RES   WT AMX PRX XMAG FMP FMAG
 WBO 244.5  56  P 0 1331   2.12   37.08   36.95   0.13 1.62
 OTT 245.6  43  P 0 1331   2.24   37.20   37.09   0.11 1.62
 EEO 332.9 343  P 1 1331 12.88   47.84   47.86 -0.02 1.00
                S 1 1331 50.27   85.23   85.19   0.04 1.00
 MIV 346.8  85  P 2 1331 14.54   49.50   49.58 -0.08 0.65
 GRQ 350.2  26  P 1 1331 14.78   49.74   50.01 -0.27 0.93
 PNY 360.5  71  P 1 1331 16.51   51.47   51.28   0.16 0.94
 MDV 374.1  86  P 2 1331 17.94   52.90   52.95 -0.07 0.60
 TRQ 374.6  44  P 0 1331 18.10   53.06   53.01   0.05 1.20
 MNT 384.9  60  P 1 1331 19.12   54.08   54.28 -0.20 0.87
 VT1 410.9  81  P 4 1331 26.16   61.12   57.49   3.61 0.00
                S 4 1331 82.48  117.44  102.33  15.07 0.00
 MOQ 474.9  69  P 3 1331 32.42   67.38   65.39   1.85 0.00
 NH1 504.7  93  P 4 1331 61.19   96.15   69.08  27.08 0.00  88 .28  3.3
 DPQ 511.3  51  P 1 1331 34.71   69.67   69.89 -0.22 0.56
 WES 551.8 106  S 4 1332 53.94  148.90  133.29  15.59 0.00
 WVL 657.6  83  S 4 1332 90.79  185.75  156.56  29.17 0.00
```

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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

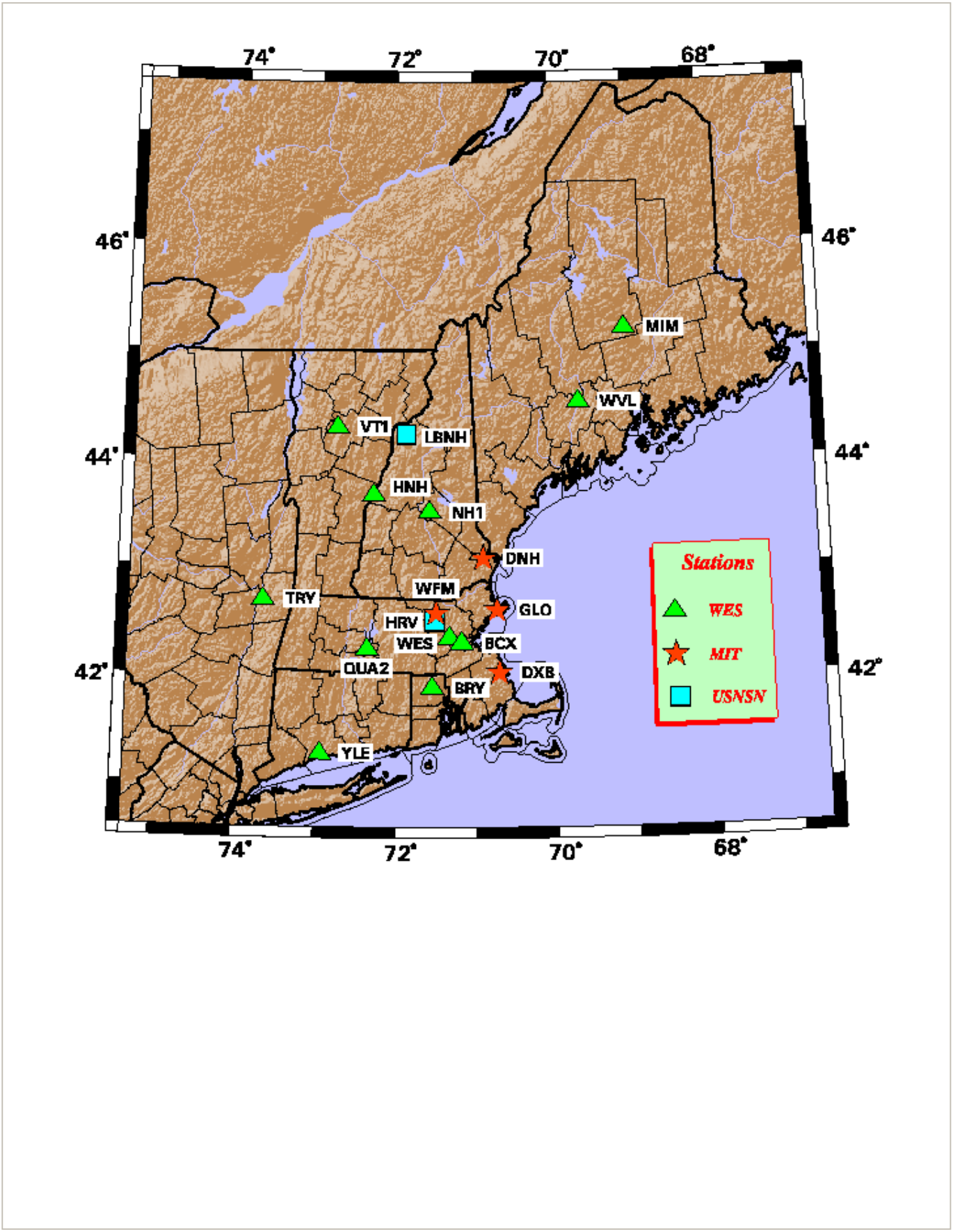

Figure 1: Map of stations of the New England Seismic Network (NESN) in operation during period October - December, 1998. Also included are the US National Seismic Network stations operating in New England during this period.

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NESN Strong-Motion Station Map

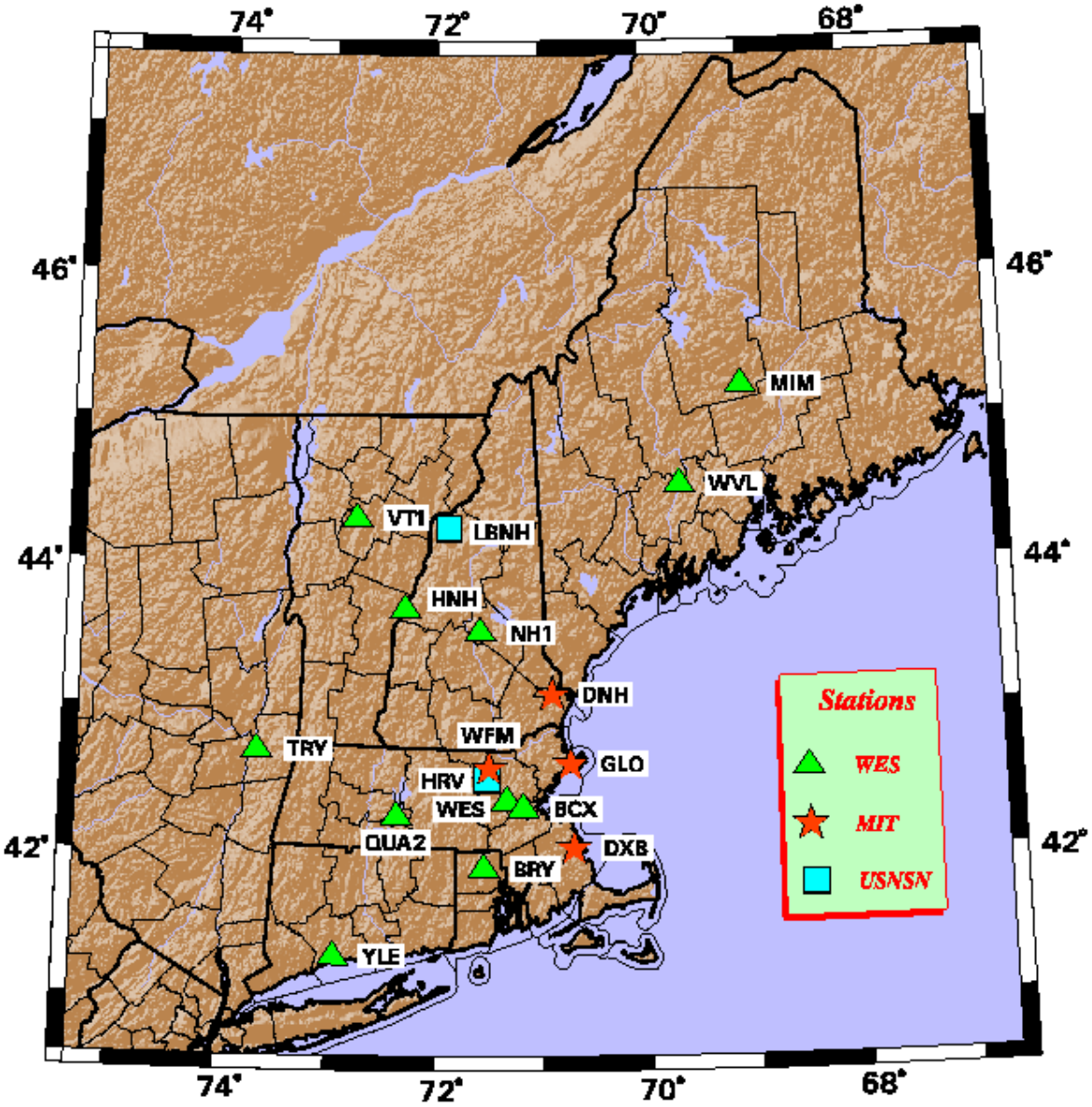

Figure 2: Map of strong-motion stations of the New England Seismic Network (NESN) in operation during period October - December, 1998.

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NESN Quarterly Seismicity Map

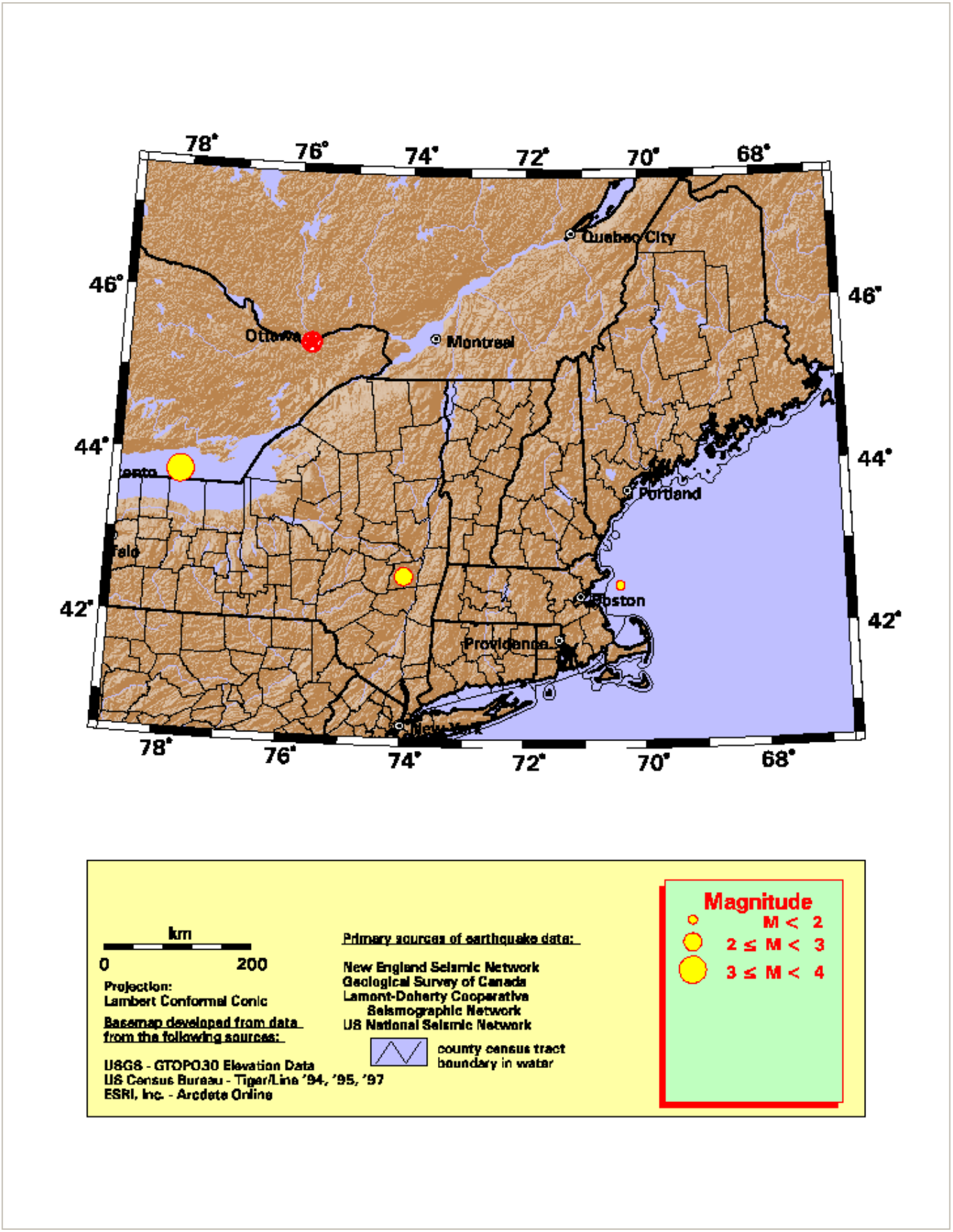

Figure 3: Earthquake epicenters located by the NESN during period October - December, 1998.

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NESN Cumulative Seismicity Map

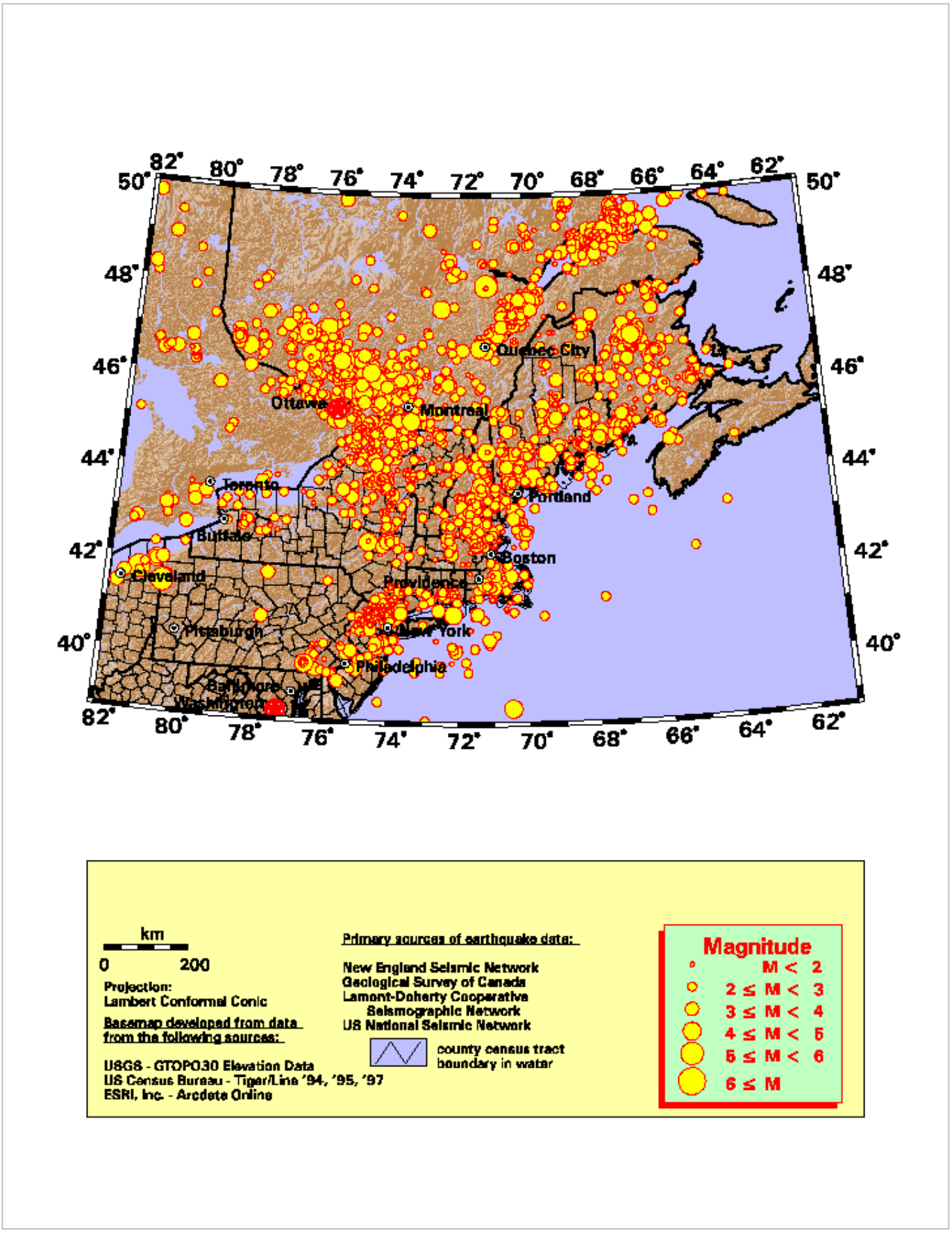

Figure 4: Seismicity for period October, 1975 - December, 1998.

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Acknowledgments

We would like to thank the Undergraduate Research Opportunities Program (UROP) of MIT for its support to the network. Our map database has been developed in-house using ARCINFO and in part basemap data provided by ESRI, Inc. (Arcdata Online), USGS GTOPO30 Elevation Data, and TIGER/Line '94, '95, and '97 (US Census Bureau) spatial data.

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