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**GEOLOGICAL SURVEY OF CANADA
OPEN FILE 8532**

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New Brunswick, earthquake**

M. Lamontagne and K.B.S Burke

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Felt reports for the 1855 Magnitude 5.2 Moncton, New Brunswick, earthquake

M. Lamontagne and K.B.S. Burke

Abstract

The February 8th, 1855, magnitude 5.2 (m_N) Moncton earthquake occurred sometime between 06:30am to 07:15am local time. It is one of the largest of southeastern New Brunswick and it caused minor damage. Chimney damage was reported in Moncton, New Brunswick. In Hopewell, near the epicentre, the shock cracked the plastering of walls. The earthquake was felt over most of New Brunswick, Nova Scotia and Prince Edward Island and was also felt in the state of Maine. This Open File Report provides the felt information from 55 localities. For each locality, the felt information is rated on the Modified Mercalli intensity (MMI) scale and tabulated in a Microsoft Excel sheet. When available, the description of the felt report is added. For many of the accounts, the second author copied the text by hand from the screen of the microfilm reader. In addition, when the copier microfilm reader was available, newspapers were scanned or copied from the on-line digital newspapers. The Open File also provides a GoogleEarth kmz file that allows the felt information reports to be viewed in a spatial tool.

Introduction

The February 8th, 1855, magnitude 5.2 (m_N) Moncton earthquake occurred sometime between 06:30am to 07:15am local time. The Universal Time (U.T.) assigned to this event is 11:15 and is different from the 18:00 UT found in some previously published studies. The earthquake is described in much detail in Burke (2009).

This earthquake was felt throughout most of New Brunswick and Nova Scotia and as far to the southwest as Boston, Massachusetts (Leblanc and Burke (1985); Figure 1 and 2). A felt area magnitude of 5.2 (based on the Modified Mercalli Intensity (MMI) IV) was proposed in a re-evaluation of this event by Leblanc and Burke (1985).

The earthquake is the largest to be reported in southeastern New Brunswick and it caused minor damage. Chimney damage was reported in Moncton, New Brunswick. Minor damage was also reported for this earthquake, such as in an account from Hopewell, a village within 20 km south-southwest of the epicentre, which states "At the chemical factory in this place, the shock caused the plastering of walls to crack and rend from top to bottom" (New Brunswick Reporter, February 16, 1855). Due the damage it caused, this earthquake is also part of the significant earthquakes of Canada (Lamontagne et al., 2018).

The damage points to an epicentre in the Moncton area. The February 8th, 1855 earthquake was reported by Dawson (1868) to have occurred at "the bend of the Petitcodiak", the nineteenth name for the Moncton region in southeastern New Brunswick. Smith (1962) assumed that the epicentre was at latitude 46.0°N and 64.5°W, approximately 25 km southeast of Moncton. Based on the felt reports of aftershocks, the epicentre proposed by Smith (1962) was accepted by Leblanc and Burke (1985). This epicentre and a magnitude of M_N 5.2 are now listed in the Canadian National Earthquake Database (NEDB).

The general location of the earthquake is confirmed by the reports of several aftershocks being felt in the Moncton area during the month of February, 1855 (Saint Andrews Standard, March 7th, 1855). The dates and universal times of the aftershocks were (Burke, 2009):

Date	Time (U.T.)*
18550210	1100 (estimated magnitude: 3.5)
18550222	-----
18550222	2210
18550224	0703
18550228	1832

*The corrected local time has then been converted to Universal Times (U.T.) by adding the appropriate time difference (+ 4 hours for AST times).

This Open File Report includes a spreadsheet with the felt information from 55 localities. For each locality, available felt information is provided and rated on the Modified Mercalli intensity (MMI) scale. The scans of the original newspapers are included when available. The Open File also provides a GoogleEarth kmz file that allows the felt information reports to be viewed in this geospatial tool.

The three main objectives of this Open File are:

- 1) To provide a table with the available felt reports and localities.
- 2) To provide the interpreted intensities on the Modified Mercalli scale.
- 3) To include the text and the scans the original newspaper accounts when available.

Fields of the Table

Using the Microsoft Excel spreadsheet, a table was created that includes some 55 entries (rows). The columns are the same as published in Lamontagne and Burke (2018). The rows have different colours for each province and some cells have different colours when a special note is added.

The columns of the Excel sheet are:

1. CEEF: A date and time that could eventually refer to entries in the Canadian Earthquake Epicentre File (CEEF)
2. Date.time (UTC): date and time of the earthquake in Universal Time.
3. Year_event: Year of the event (YYYY) (Universal Time)
4. Month_event Month of the event (MM) (Universal Time)
5. Day_Event: Day of the event (DD) (Universal Time)
6. Hour-Event: Hour of the event (HH) (Universal Time)
7. Minute-Event: Minute of the event (mm) (Universal Time)
8. Second-Event: Second of the event (ss.s) (Universal Time)
9. MMI Location: Community where earthquake was felt
10. Address: Address where the earthquake was felt (if known)
11. Prov/State: Province or State of the community where the earthquake was felt; NB: New Brunswick; NS: Nova Scotia; PE: Prince Edward Island; QC: Quebec; ME: Maine (USA); MA, Massachusetts (USA) and NH: New Hampshire (USA).
12. Country: Canada or the USA
13. Postal/Zip: Postal Code or Zip Code of the community where the earthquake was felt (if

known). In this Open File, no attempt was made to populate this field.

14. Latitude (°N): Latitude of the community where the earthquake was felt; taken from the original felt reports or more rarely obtained from GoogleEarth.
15. Longitude (°W): Longitude of the community where the earthquake was felt; taken from the original felt reports or, more rarely, obtained from GoogleEarth.
16. Epicentral Distance (km): Epicentral distance in km between the earthquake source and the community where the earthquake was felt. The cell calculates the distance using the formula:

$$\text{Epicentral Distance (km)} = \text{ACOS}(\text{COS}(\text{RADIANS}(90 - (\text{lat. site}))) * \text{COS}(\text{RADIANS}(90 - (\text{lat. of epicentre}))) + \text{SIN}(\text{RADIANS}(90 - (\text{lat. of site}))) * \text{SIN}(\text{RADIANS}(90 - (\text{lat. of epicentre}))) * \text{COS}(\text{RADIANS}(\text{Lon of site} - (\text{Lon of epicentre})))) * 6371$$

The currently-accepted epicentre for the 1855 earthquake is Latitude 46.0°N and Longitude 64.5°W as listed in the second sheet of the Excel file.

17. Final Numeric MMI: Based on the felt report, interpreted Intensity on the Modified Mercalli Scale of 1931. Although MMI is defined using Roman numerals, we decided to convert them to arabic numerals for ease of use.
18. Basis for MMI (English): Aspects of the felt report in English (if available) that were used to rate the MMI (in Arabic numerals).
19. Basis for MMI (French): Aspects of the felt report in French (if available) that were used to rate the MMI (in Arabic numerals).
20. Source of felt report: Source of felt report.
21. Precision of location (km): In some cases, it is possible to estimate the radius of uncertainty of the location. We did not use this field in this report.
22. Minimum MMI: The minimum value of MMI for a felt report that is interpreted to lie within a range of intensities (ex: MMI 3-4; in Arabic numerals).
23. Maximum MMI: The maximum value of MMI for a felt report that is interpreted within a range of intensities (ex: MMI 3-4; in Arabic numerals).
24. Interpreter: Author that made the interpretation.
25. Additional notes: Comments of interest on the felt report or its publication.
26. Original text: Text from a newspaper when available.

Additional information

The original newspaper clippings and various written accounts were photocopied or copied by hand by K.B.S. Burke from microfilm in the UNB library. As of January 2019, the following newspapers were found on-line.

The Head Quarters - 18550214

<https://news.google.com/newspapers?nid=cFHS6HbyZ2cC&dat=18550207&printsec=frontpage&hl=en>

British Colonist Halifax 18550210

<https://news.google.com/newspapers?nid=HDshCWvjkbEC&dat=18550210&printsec=frontpage&hl=en>

Acadian Recorder 18550210

<https://news.google.com/newspapers?nid=3htObqc8RwsC&dat=18550210&printsec=frontpage&hl=en>

The file folder “newspapers” contains the scanned pages from the online documents.

A Microsoft Excel spreadsheet contains the basic information on the felt reports is part of this Open File. The MMI ratings of Burke (2009) are given. When a range of MMIs exist, we chose the highest integer value.

GoogleEarth file

To ease the consulting of the data and put them in a geographic context, a kml file is added and can be viewed using the GoogleEarth software that can be downloaded at:

<https://www.google.com/earth/download/ge/>

A static image of the Google Earth display is shown as Figure 3.

Conclusions and recommendations

A new digital repository of felt reports for the 1855 Magnitude (M_N) 5.2 Moncton earthquake was created. We are confident that this Open File includes all available information on how this earthquake was felt in the Maritimes and Maine, but will be amended if new information is

uncovered. We hope that it will be useful for research on this earthquake as well as on other intraplate earthquakes.

Acknowledgments

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Wood, H.O. and Neumann F. 1931. Modified Mercalli Intensity of 1931. Bulletin of the Seismological Society of America, 21: 277-283.

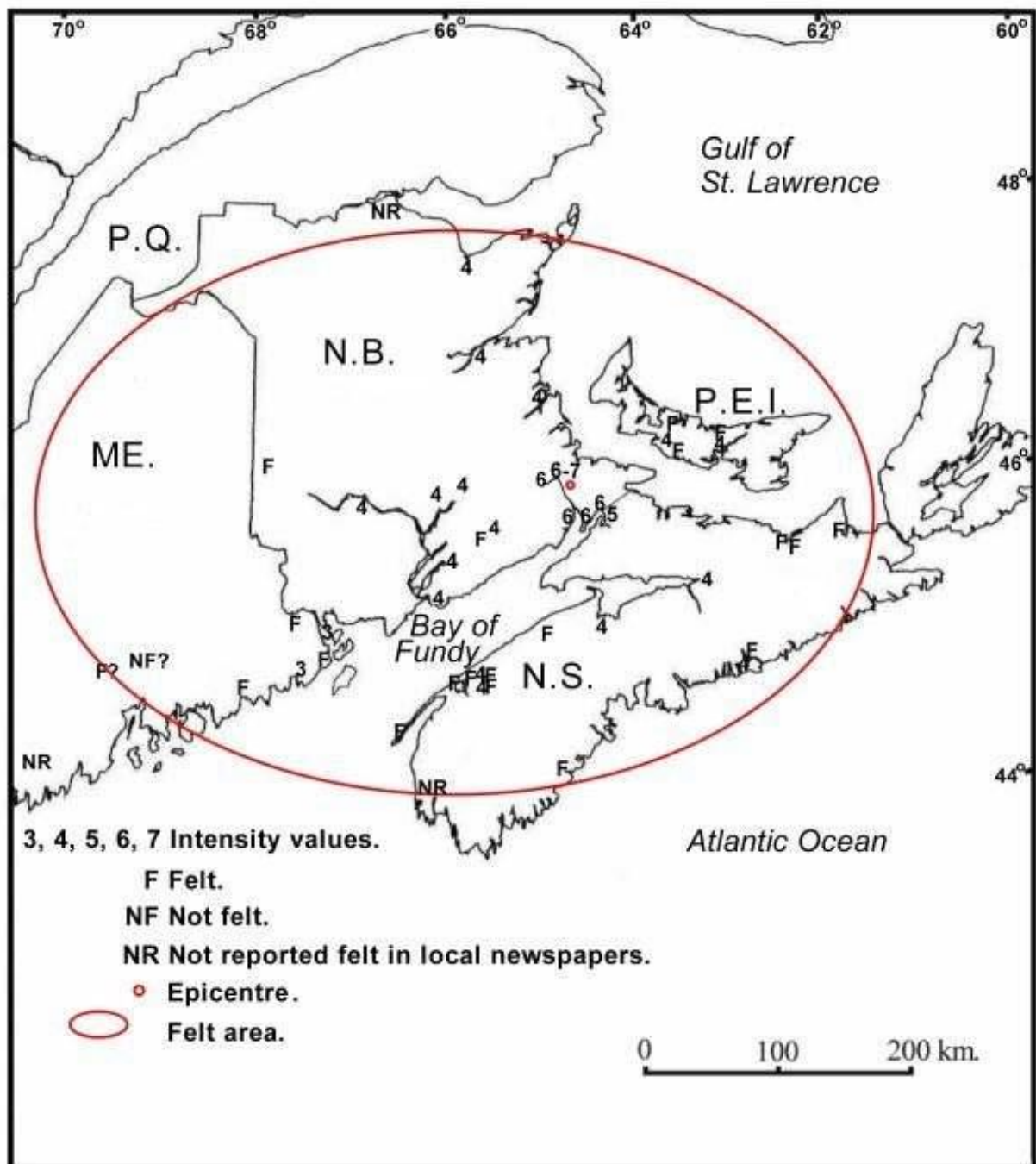


Figure 1. Map of the revised Modified Mercalli intensities for the 1855 Magnitude 5.2 Moncton earthquake (Burke, 2009).

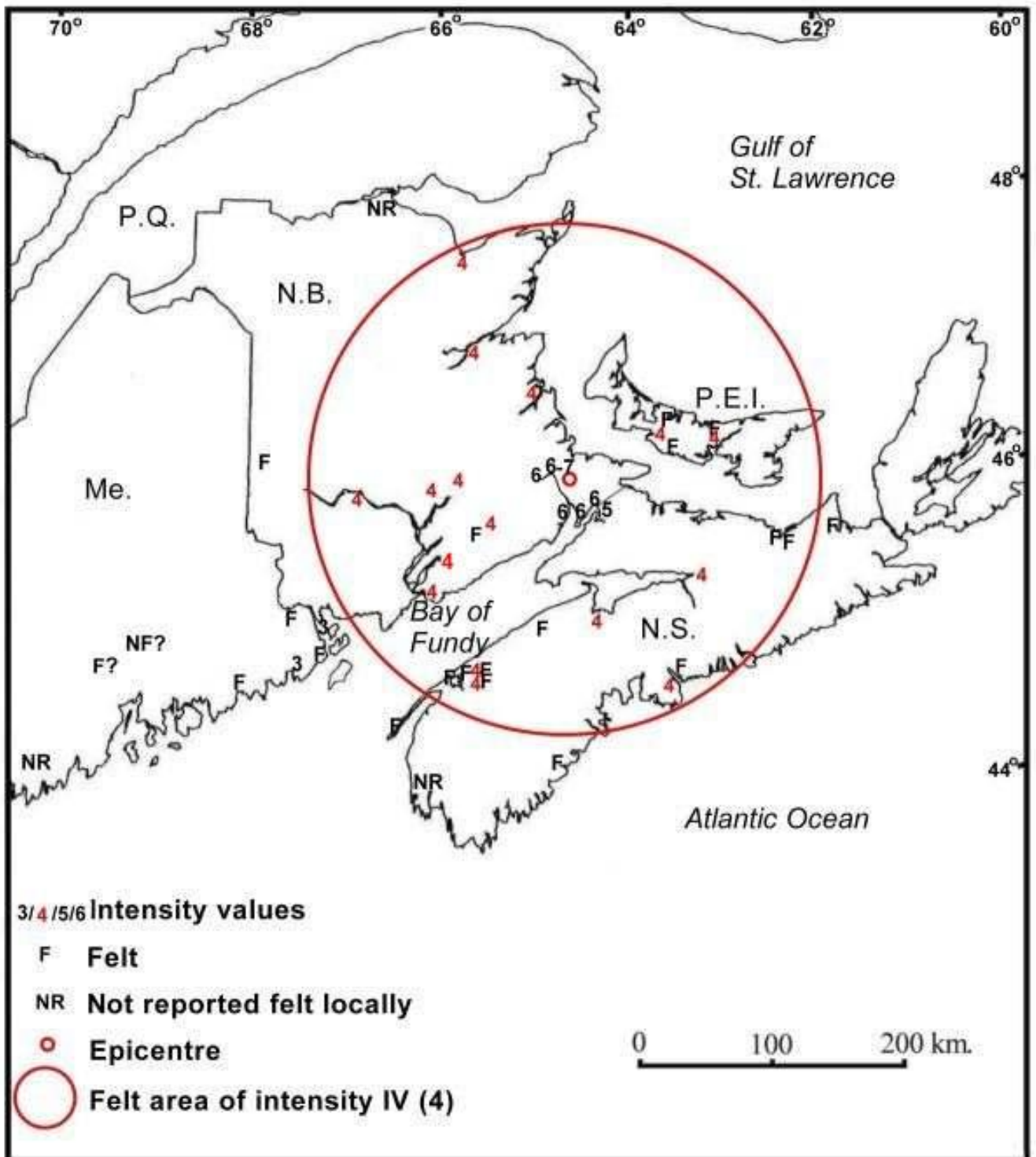


Figure 2. Map that shows the extent of the area for the Modified Mercalli intensity IV for the 1855 Magnitude 5.2 Moncton earthquake (Burke, 2009). The MMI IV felt area was used to determine the magnitude by Burke (2009).

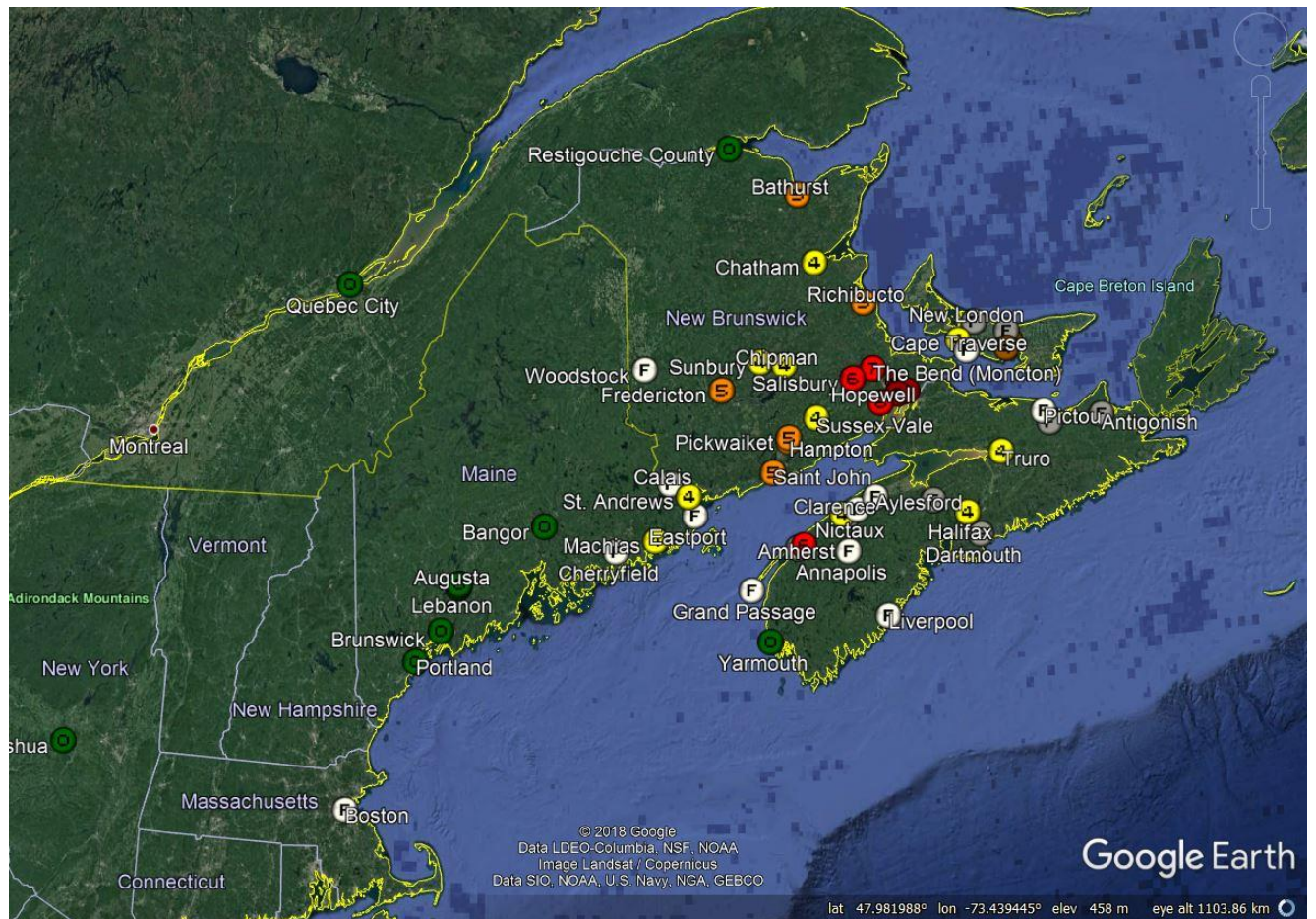


Figure 3. Static image of Google Earth view showing distribution of felt reports included in this Open File and generated from the kml file. For some locality, the MMI value may differ from those of figures 1 and 2 because this map is based on the maximum value of MMI where the maps of Burke (2009) used on the minimum value of the range.

Appendix 1: Modified Mercalli Intensity Scale (Wood and Neumann, 1931)

I. Not felt -- or, except under especially favorable circumstances.

Under certain conditions, at and outside the boundary of the area in which a great shock is felt:

- sometimes birds, animals, reported uneasy and disturbed;
- sometimes dizziness or nausea experienced;
- sometimes trees, structures, liquids, bodies of water, may sway; doors may swing, very slowly.

II. Felt indoors by few, especially on upper floors, or by sensitive or nervous persons.

Also, as in grade I, but often more noticeably:

- sometimes hanging objects may swing, especially when delicately suspended;
- sometimes trees, structures, liquids, bodies of water, may sway, doors may swing, very slowly;
- sometimes birds, animals, reported uneasy and disturbed;
- sometimes dizziness or nausea experienced.

III. Felt indoors by several, motion usually rapid vibration.

- Sometimes not recognized to be an earthquake at first.
- Duration estimated in some cases.
- Vibration like that due to the passing of light or lightly loaded trucks or heavy trucks some distance away.
- Hanging objects may swing slightly.
- Movements may be appreciable on upper levels of tall structures.
- Rocked standing motor cars slightly.

IV. Felt indoors by many, outdoors by few.

- Awakened few, especially light sleepers.
- Frightened no one, unless apprehensive from previous experience.
- Vibration like that due to the passing of heavy or heavily loaded trucks.
- Sensation like heavy body striking building or falling of heavy objects inside.
- Rattling of dishes, windows, doors; glassware and crockery clink and clash.
- Creaking of walls, frame, especially in the upper range of this grade.
- Hanging objects swung, in numerous instances.

- Slightly disturbed liquids in open vessels. Rocked standing motor cars noticeably.

V. Felt indoors by practically all, outdoors by many or most: outdoors direction estimated.

- Awakened many, or most.
- Frightened few -- slight excitement, a few ran outdoors.
- Buildings trembled throughout.
- Broke dishes, glassware, to some extent.
- Cracked windows -- in some cases, but not generally.
- Overturned vases, small or unstable objects, in many instances, with occasional fall.
- Hanging objects, doors, swing generally or considerably.
- Knocked pictures against walls, or swung them out of place.
- Opened, or closed, doors, shutters, abruptly. Pendulum clocks stopped, started, or ran fast, or slow.
- Moved small objects, furnishings, the latter to slight extent.
- Spilled liquids in small amounts from well-filled open containers.
- Trees, bushes, shaken slightly.

VI. Felt by all, indoors and outdoors.

- Frightened many, excitement general, some alarm, many ran outdoors.
- Awakened all.
- Persons made to move unsteadily.
- Trees, bushes, shaken slightly to moderately.
- Liquid set in strong motion.
- Small bells rang -- church, chapel, school, etc.
- Damage slight in poorly built buildings.
- Fall of plaster in small amount.
- Cracked plaster somewhat, especially fine cracks; chimneys in some instances.
- Broke dishes.
- Fall of knick-knacks, books, pictures.
- Overturned furniture in many instances.
- Moved furnishings of moderately heavy kind.

VII. Frightened all -- general alarm, all ran outdoors.

- Some, or many, found it difficult to stand.
- Noticed by persons driving motor cars.
- Trees and bushes shaken moderately to strongly.
- Waves on ponds, lakes, and running water.
- Water turbid from mud stirred up.
- Incaving to some extent of sand or gravel stream banks.
- Rang large church bells, etc.
- Suspended objects made to quiver.
- Damage negligible in buildings of good design and construction, slight to moderate in well-built ordinary buildings, considerable in poorly built or badly designed buildings, adobe houses, old walls (especially where laid up without mortar), spires, etc.
- Cracked chimneys to considerable extent, walls to some extent.
- Fall of plaster in considerable to large amount, also some stucco.
- Broke numerous windows, furniture to some extent.
- Shook down loosened brickwork and tiles.
- Broke weak chimneys at the roof-line (sometimes damaging roofs).
- Fall of cornices from towers and high buildings.
- Dislodged bricks and stones.
- Overturned heavy furniture, with damage from breaking.
- Damage considerable to concrete irrigation ditches.

VIII. Fright general -- alarm approaches panic.

- Disturbed persons driving motor cars.
- Trees shaken strongly -- branches, trunks, broken off, especially palm trees.
- Ejected sand and mud in small amounts.
- Changes: temporary, permanent; in flow of springs and wells; dry wells renewed flow; in temperature of spring and well waters.
- Damage slight in structures (brick) built especially to withstand earthquakes.
- Considerable in ordinary substantial buildings, partial collapse: racked, tumbled down, wooden houses in some cases; threw out panel walls in frame structures, broke off decayed piling.
- Fall of walls.

- Cracked, broke, solid stone walls seriously.
- Wet ground to some extent, also ground on steep slopes.
- Twisting, fall, of chimneys, columns, monuments, also factory stacks, towers.
- Moved conspicuously, overturned, very heavy furniture.

IX. Panic general.

- Cracked ground conspicuously.
- Damage considerable in (masonry) structures built especially to withstand earthquakes:
- threw out of plumb some wood-frame houses built especially to withstand earthquakes;
- great in substantial (masonry) buildings, some collapse in large part; or wholly shifted frame buildings off foundations, racked frames;
- serious to reservoirs; underground pipes sometimes broken.

X. Cracked ground, especially when loose and wet, up to widths of several inches; fissures up to a yard in width ran parallel to canal and stream banks.

- Landslides considerable from river banks and steep coasts.
- Shifted sand and mud horizontally on beaches and flat land.
- Changed level of water in wells.
- Threw water on banks of canals, lakes, rivers, etc.
- Damage serious to dams, dikes, embankments.
- Severe to well-built wooden structures and bridges, some destroyed.
- Developed dangerous cracks in excellent brick walls.
- Destroyed most masonry and frame structures, also their foundations.
- Bent railroad rails slightly.
- Tore apart, or crushed endwise, pipe lines buried in earth.
- Open cracks and broad wavy folds in cement pavements and asphalt road surfaces.

XI. Disturbances in ground many and widespread, varying with ground material.

- Broad fissures, earth slumps, and land slips in soft, wet ground.
- Ejected water in large amount charged with sand and mud.
- Caused sea-waves ("tidal" waves) of significant magnitude.
- Damage severe to wood-frame structures, especially near shock centers.

- Great to dams, dikes, embankments, often for long distances.
- Few, if any (masonry), structures remained standing.
- Destroyed large well-built bridges by the wrecking of supporting piers, or pillars.
- Affected yielding wooden bridges less.
- Bent railroad rails greatly, and thrust them endwise.
- Put pipe lines buried in earth completely out of service.

XII. Damage total -- practically all works of construction damaged greatly or destroyed.

- Disturbances in ground great and varied, numerous shearing cracks.
- Landslides, falls of rock of significant character, slumping of river banks, etc., numerous and extensive.
- Wrenched loose, tore off, large rock masses.
- Fault slips in firm rock, with notable horizontal and vertical offset displacements.
- Water channels, surface and underground, disturbed and modified greatly.
- Dammed lakes, produced waterfalls, deflected rivers, etc.
- Waves seen on ground surfaces (actually seen, probably, in some cases).
- Distorted lines of sight and level.
- Threw objects upward into the air.