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Automatic assessment of EMS-98 intensities

Seismology and Geomagnetism Programme

Internal Report IR/06/048

BRITISH GEOLOGICAL SURVEY

SEISMOLOGY AND GEOMAGNETISM PROGRAMME

INTERNAL REPORT IR/06/048

Automatic assessment of EMS-98 intensities

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Foreword

This report presents a proposal for the basis of an automatic system for assigning EMS-98 intensity values to questionnaire data gathered from a web page. Such systems have been proposed in the past and are in use in some countries. That proposed here operates in a manner designed to mimic human reasoning in assigning intensities.

This report was originally drafted as an informal document in May 2005 and revised in October 2005. The latter version was circulated to some interested parties. This version constitutes its formal release.

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1 Introduction

This report describes a system to be used for a program for automatically assigning intensity values on the EMS-98 scale (Grünthal 1998) to data recorded from an internet macroseismic questionnaire. The procedures are still in development and require refinement. They were initially designed to work with the current web pages maintained by the Seismology and Geomagnetism Programme of the BGS, but it is anticipated that the scheme may also be appropriate for use in other countries also.

This document is chiefly concerned with describing procedures for actually assigning intensity from questionnaire data using an automatic algorithmic process. Such systems already exist in several countries, and it is not my intention in this report to review previous work. The best-known system is that described by Wald et al (1999). The problem with the approach described by Wald et al (1999) is that it rests on a correlation between certain scores and a single set of intensities assigned in a traditional way. Thus, although the system produces some numbers that could be inferred to be intensities, there is no treatment of the data with regard to the actual written scale. Also, Wald et al's (1999) system is designed to work with the Modified Mercalli Scale, which is ill-defined compared to EMS-98. The process proposed here is intended to mimic actual expert human judgement in assigning intensity values; thus the resulting intensity values are more comparable to traditional intensity values. Each value is really arrived at by comparing the data directly to the EMS-98 scale, without any artificial regressions.

It may be helpful first to put the intensity assessment procedure in context of the overall web system being developed in BGS. The various stages are intended to be overseen by a control program that runs continually and calls other programs as needed, and which updates the web pages dynamically.

2 Data gathering process

The outline of the data gathering process is as follows:

1) Each time a questionnaire is completed, a record is saved in the database.
2) At any time, there should be a list of "active events" – those recent earthquakes for which data are being gathered. These are the events for which maps may be viewed. If the date/time in the new record corresponds to an active event (within some small time margin), then the control program, having received and processed the questionnaire, extracts from the database all the records for the active event (including the new one) and calls the intensity assessment program. Normally the user will select the relevant earthquake from a drop-down menu.
3) The intensity assessment program processes the latest version of the file for the earthquake. The data are grouped by 5 km grid squares and an intensity value assessed for each square. The results are written as a file and passed to the mapping program.
4) The mapping program is responsible for serving up the updated map to the website. It would be possible to have a simple custom program that produced a standard map as a jpg that would then be loaded into the web page. Alternatively, given some expertise in using more sophisticated web mapping software, a proper online GIS option could be developed that would allow the user more control over how the map was viewed.

2.1 SPATIAL REFERENCES

The system is dependent on the existence of some way of collecting the location of the respondent to accuracy of about 1 km. In the UK, this is very easy – software exists and can be licensed that will parse a given post code and return latitude/longitude or national grid co-ordinates with a precision of less than 1 km. This has been tested with this system and works well. The situation in other European countries may well vary. Each national institute deploying a system based on this plan may have to implement its own local solution.

It is very much to be desired that data should be referred to co-ordinates, and not plotted by postcode area as in the system operated in the USA, which results in maps that show intensities assigned to areas that vary hugely in size and shape.

2.2 SPURIOUS DATA ENTRIES

Some procedures need to be developed to filter out spurious responses. One simple check is to log the ISP of each response and check that duplicate data are not accepted. Those who are minded to abuse the system are not usually interested in, or capable of, composing credible spurious data, so manual review should be able to weed out false replies. However, the more this can be done by automatic systems, the better.

2.3 UPPER LIMIT OF THE SYSTEM

This system is intended to assess intensity up to 8 EMS. Anything higher than 8 will be returned as 8. It is envisaged that intensities higher then 7 (or even 6) will mostly be assessed from field investigation, but this system will allow indications of higher intensities to appear on the web map immediately after the event has occurred.

2.4 THE QUESTIONNAIRE

The questionnaire used has been modified from the sample questionnaire published in the New Manual of Seismological Observatory Practice, and could be considered a first draft of a common EMS-98 questionnaire. It is implemented as a series of five pages corresponding to the usual sections of a macroseismic questionnaire (see Appendix). The questionnaire gathers some data in a standard way (user selects options from menus, etc) and some in a free-form way. Only the standard data is used for automatic intensity assessment; free-form data is retained for later consultation. Some of the standard data is not actually used in intensity assessment, but is collected in case it might be of some interest later (for instance, the character of the vibration experienced).

The idea of having a standard questionnaire for EMS-98 has been discussed many times before. In the past it has not been a practical goal because of differences between countries in who such a questionnaire is addressed to. A questionnaire designed to be answered by a local burgomaster for a whole village should be composed differently from one designed to be answered by a single member of the public. The advent of internet data gathering has evened out all such differences between European nations, and one common questionnaire is now a realisable goal.

2.5 THE DATABASE

The database, which includes the data for all events, both standard and free-form, is held in Oracle. The “controlling program” is responsible for extracting the standard data for a single earthquake and passing it to the intensity assessment program when needed. It then sends the results to the program that updates the map.

A data file for a single event, as extracted from the database, looks like this:

```
200502141844026103691030011611012111111110100000000000
200502141844027803771010011600022222211122000000000000
200502141844027703631010011511011111111111111111111111
200502141844040102811010000000000000000000000000000000
200502141844026003681010040012022011111100101111111111
200502141844027903811010000000000000000000000000000000
200502141844027903782010011310321111111111100000000000
200502141844027703761030011400022001101102100000000000
200502141844035603211010000000000000000000000000000000
200502141844025303711030013311020000000000000000000000
```

The first twelve digits of each line contain date and time, and the next eight are the grid reference. The remaining values in each line related to questions in the questionnaire, and generally take the form that 0 = no answer or don't know, 1 = no, 2 or higher = yes. The exact meaning of the fields is given in Table 1. In the first line shading has been added to alternate fields to aid reading. The date is 2005/02/14, time 18h 44m; the first observation is at grid reference 0261, 0369.

3 Operation of the intensity assessment program

The intensity assessment program works as follows.

Firstly, the data are divided into 5 km squares, and the records within each square are processed together to assign an intensity value for that square. A minimum threshold value is set, and while the number of records for the square is less than that value, intensity will be given either as 1 (not felt) if there are no positive observations, or F (felt) if there are. The minimum value is currently five, but is adjustable. If all the observations from a square are negative, the intensity is assessed as 1 irrespective of the number of records.

If the minimum requirement is met and the earthquake was felt, the program assesses intensity. The procedure is essentially one of elimination, and is designed to mimic human judgement in this respect. It proceeds from high intensities downwards.

A series of ratios are computed according to

$$R = Np / (N_1 + v (N_2 - N_1))$$

where Np is the number of people who reported that a certain type of diagnostic was observed, N_1 is the number of people who answered the relevant question(s), N_2 is the total number of respondents and v is a user-supplied parameter ranging from 1 to zero. $N_2 - N_1$ is the number that didn't answer the question. Thus if there are 15 observers, and 5 say that X occurred and 5 say X did not occur (and the rest didn't know), then the ratio is 0.5 if v = 0, and 0.33 if v=1, the latter implying that all the non-answers should be treated as no. This bears monitoring to determine its effect; at present the user is allowed to decide (by supplying v) the proportion of non-answers that should be treated as actual "no" answers. A special case is "was the observer frightened" – failure to answer this is always treated as no (the observer must know the answer to this). Experience so far suggests that values of v close to or equal to 1 are most appropriate.

All buildings are considered to be of vulnerability B in EMS terms, hence the ratios for damage are labelled B1-3 rather than D1-3 (as in D for damage).

The ratios that are computed are the following:

B1: Grade 1 damage (as defined by EMS)
B2: Grade 2 damage
B3: Grade 3 damage

S1: Vibration described as strong or noise as loud
S2: Minor strong effects (pictures swing, small objects fall)
S3: Major strong effects (furniture falls over, books fall)

F1: Observer frightened
F2: A few people nearby frightened
F3: Many people nearby frightened

O1: Some positive observation of shaking or noise
O2: Shaking is described as weak or noise as soft
O3: Sleepers woken

R1: Things rattle or shake

Intensity is now assessed according to the following rules. Comments to each rule are added in italics.

Rule 1 – If B2 is at least 0.6 on at least four observations and there is at least one observation of grade 3 damage, the intensity is 8.

Rule 2 – If B3 is at least 0.2 on at least four observations, the intensity is 8.

> *Intensity 8 is principally defined as "most B2 damage, many B3 damage" Rule 1 tracks "most B2" but demands at least one example of B3 damage; Rule 2 tracks "many B3". In both cases some check is made of absolute numbers of damage reports as otherwise single observations from small places could give exaggerated results. "At least four observations" means that if three people report that B3 damage occurred, three people report that it didn't, and six didn't answer the question or didn't know, the criteria are not met.*

If either of these rules applies, the intensity is considered 8 and processing stops. Failing that, the program next considers the possibility of intensity 7.

Rule 3 – If B2 is at least 0.2 on at least four observations, and B1 is at least 0.6, the intensity is 7.

> *Intensity 7 is defined by many cases of B2 damage, and here the ratio is tracked and also the absolute number of observations, again in case the ratio is artificially high in small settlements. It is also expected that a lot of minor damage should be observed; this is an additional check.*

If the intensity is 7, processing stops. If the intensity is not 7, the program now looks at 6 and 5. These intensities are "scored" using two scoring counters, P6 and P5. The next rules decide the scores accumulated by these variables.

Rule 4 – If B2 is greater than zero, or B3 is greater than zero, add 1 to P6; or if B1 is greater than 0.2, add 2 to P6. If neither of these apply, but B1 is greater than zero, add 1 to P5.

> *Intensity 6 is slightly damaging, so if there has been some damage in odd cases, intensity 6 may be indicated, especially if there is significant B1 damage but no B2. If there are just a few cases of B1 damage, this is fairly typical of intensity 5.*

Rule 5 – If B1, B2 and B3 are all zero, subtract 2 from P6.

> *If there is no damage at all, intensity 6 is unlikely.*

Rule 6 – If S1 is greater than 0.4, add 1 to P5; also, if S1 is greater than 0.8, add 1 to P6; if S1 is zero, subtract 1 from P5 and subtract 2 from P6.

> *Cases where most or nearly all observers describe the shaking as strong are typical of higher (in this case >4) intensities. However, if no one thinks the shaking was strong, it probably isn't 5 and is even less likely to be 6.*

Rule 7 – If S2 is greater than 0.2, add 1 to P5; also, if S2 is greater than 0.6, add 2 to P6; if S2 is zero, subtract 1 from P5 and subtract 2 from P6.

This rule tracks effects on objects typical of intensity 5. These should be observed in many cases at intensity 5 and very widely at intensity 6. If they are not reported at all, 5 and 6 are unlikely, especially 6.

Rule 8 – If S3 is greater than zero, add 1 to P5; also, if S3 is greater than 0.2 and the absolute number of S3 observations is more than 1, add 2 to P6; if S3 is zero, subtract 1 from P6.

This corresponding rule tracks strong effects on objects typical of intensity 6. One or two observations of this sort of thing may be found at intensity 5, but if they are common (both ratio and absolute numbers are checked) then 6 is the stronger indication. If these effects are not observed at all it argues to some extent against intensity 6, but not against 5.

Rule 9 - If F1 is greater than 0.2, add 1 to P5; also, if F1 is greater than 0.6, add 2 to P6; if F1 is zero, subtract 1 from P5 and subtract 2 from P6.

This considers whether the observer was frightened. If many were, 5 is suggested; if most were, then 6 is suggested. Note that this is more onerous than in the EMS definition; the difference is due to my perception of what people consider to be "frightening" compared to what is meant in the EMS definition, where it is implied that people are frightened specifically because they fear their houses will collapse. If no one is frightened, then 5 and 6 are counter-indicated.

Rule 10 – If F2 is greater than F3, add 2 to P5; if F3 is greater than F2, add 2 to P6.

Here, F2 describes "a few people nearby were frightened and ran out", and F3 that many people did so. Comparing the two shows whether it was more predominant for few or many people to be frightened. If no one was frightened, both F2 and F3 will be zero and no score is made.

Rule 11 – If F3 is greater than 0.2, add 1 to P6.

If in many cases (> 20%) it is reported that many ran out, then this further supports intensity 6 in addition to Rule 10.

Rule 12 – If F2 is zero, subtract 1 from P5 and subtract 2 from P6; also, if F3 is zero, subtract 1 from P6.

If all reports are that no one was frightened, intensity 5 is counter-indicated and intensity 6 strongly so. If no one reports that many people were frightened, this weakens the case for intensity 6.

The values of P5 and P6 are now themselves interpreted.

Rule 13 – If P6 is greater than P5 and P6 is at least 4, the intensity is 6 and processing stops.

The two counters P5 and P6 now sum up the case for intensity 5 and the case for intensity 6 respectively. The higher value shows which case is stronger. But there may be insufficient evidence for either intensity, so the absolute value of P6 also has to meet a minimum requirement (which is 4).

Rule 14 – If P6 is greater than zero, add 1 to P5. If P5 is now at least 3, the intensity is 5 and processing stops.

If the intensity is not 6, but there is some evidence for 6, that evidence can be construed to be supportive of intensity 5. A requirement of 3 points is needed for an assessment of intensity 5 here.

If the intensity is still not assigned, it must be between 2 to 4. The program now considers three more counters, P2, P3 and P4 to score these possibilities. First to be considered is variable 15,

which, as shown in Table 1, can have a value up to 8. The meaning of the responses is as follows:

Value	*Meaning*
0	Don't know whether others felt it or not
1	No-one felt it
2	One or two felt it
3	Some but not many
4	Many felt it
5	Most felt it
6	Everyone felt it
7	Only people indoors felt it
8	Only people upstairs felt it

Rule 15 – For each record in which variable 15 is 1 or 2, add 1 to P2; for each record in which variable 15 is 3 or 8, add 1 to P3; for each record in which variable 15 is 4-7, add one to P4.

> *These are temporary values, which will be overwritten by the next rule. The idea is to give an overall score at this stage based on the predominant response on how much the earthquake was felt (essentially the modal value). If the values were not reset in this way, the scale of the numbers held in P2, P3 and P4 would be affected by the total number of responses.*

Rule 16 – If P2 is greater than P3 and greater than P4, then P2 is now equal to 2 and P3 and P4 are now equal to zero. Otherwise, if P2 is greater than P3 and equal to P4, or equal to P3 and greater than P4, then P2 is now equal to 1, P3 is equal to 2, and P4 is equal to zero. Otherwise, if P3 is greater than P4, P3 is now equal to 2 and P2 and P4 are now equal to zero. Otherwise, P4 is now equal to 4 and P2 and P3 are now equal to zero.

> *The scores of P2, P3 and P4 now reflect the predominant opinion about how much the earthquake was felt. If there are very few positive observations, the balance favours intensity 2; if most reports are that many (or most) people felt the earthquake, 4 is strongly indicated.*

The next rules continue to modify the scoring counters.

Rule 17 – If P5 is greater than zero, add P5 to P4.

> *If there were some indications of intensity 5, but not quite enough for an assignment under Rule 14, this supports the case for intensity 4.*

Rule 18 – If O1 is less than or equal to 0.1, add 1 to P2; otherwise, if O1 is greater than 0.1 and less than or equal to 0.4, add 1 to P3 and subtract 1 from P2; otherwise, if O1 is greater than 0.4, add 1 to P4, and subtract 1 from P3, and subtract 2 from P2.

> *What is recorded by O1 is whether the observer felt or heard the earthquake in some shape or form himself/herself. Using this as a sample, one can gain further insight as to whether the earthquake was felt by very few, few or many people and adjust the scores accordingly.*

Rule 19 – If O2 is greater than 0.8, then subtract 1 from P4 and also, if P2 is more than P3, add 1 to P2, but if P3 is greater than or equal to P2, add 1 to P3.

> *Here O2 reflects the number of people who actually described the shaking as weak or the sound as soft. If this is the overwhelming case, it suggests the intensity is not 4. It is taken that the weakness of the shaking further enhances the case for either intensity 2 or 3, whichever seems more probable at this stage.*

Rule 20 – If O3 is greater than 0.2, add 1 to P4.

> *This means that if many sleepers were woken, it is evidence for intensity 4.*

Rule 21 – If R1 is greater than or equal to 0.2, add 1 to P4; in addition, if R1 is greater than 0.4, add 1 to P4 and subtract 1 from P2.

> *The first part of this rule boosts the case for intensity 4 if many objects, windows, etc rattle. If this is reported in more than 40% of cases the argument for intensity 4 is even stronger and the intensity is very unlikely to be 2.*

Rule 22 – If R1 is zero, subtract 1 from P4.

> *If nothing rattles, this argues against intensity 4.*

Rule 23 – If all the felt observations are exclusively from people at rest on upper floors (there is enough information in variables 9, 10, 13 and 14 to work this out), add 2 to P2.

> *It is classically the case that intensity 2 observations come only from people at rest on upper floors. The program looks for observations either from people not at rest or not on upper floors, and if it finds none, it strengthens the case for intensity 2.*

Rule 24 – If P2 is greater than P3 and P2 is greater than P4, the intensity is 2; if P4 is greater than P2 and P4 is greater than P3, the intensity is 4.

Rule 25 – If the intensity has not been decided by any previous rule, the intensity is 3.

> *These two rules between them weigh up the cases for intensity 2, 3 and 4. If one case is stronger than the others, the highest value in P2, P3 and P4 decides the matter. In case of ties, the default assumption is that the intensity is 3.*

The above set of rules in effect constitute a new intensity scale, since the values and procedures are not exactly the same as those in EMS-98. However, the intention is that these rules will give values that will be close to those that would be determined by a human expert, especially in cases where there are many observations. They are intended to mimic human reasoning as much as possible, and in ways that are transparent.

However, they need careful testing and observation of problem cases. Issues include to what extent “don’t know” responses should be considered as “no” responses in calculating ratios, and some of the actual scoring values, especially the minimum requirements for deciding intensity 5 and 6. It would be possible to add consideration of things other than damage for deciding intensity 7 and 8, or taking into account how many people felt the earthquake in deciding intensity 5 and 6, if it turned out that this would improve the reliability of the results. But it is expected that intensities of 7 and above will chiefly be assigned from field surveys.

The software to implement this system, taking data files as shown on page 3 as input, has been written (in FORTRAN), and appears to work, but has been little tested very little owing to absence of test data. (There has been a distinct lull in British seismicity since 2002). It was applied to two events in 2005, one of which was actually a very large explosion, felt and heard over much of southern England (Musson 2006), and the other was a small (3 ML) event near Fort William, in Scotland. The data set for the former was large, with just over 3000 responses to process. The other was more modest, as might be expected for a small earthquake in a remote location, with 234 responses. The macroseismic maps are shown as Figures 1 and 2. Both show agreeably regular patterns and are very much in line with expected results.

References

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MUSSON, R M W. 2006. Blast intensity. *SECED Newsletter*, Vol. 19, 9-10.

WALD, D J, QUITORIANO, V, DENGLER, L A, and DEWEY, J W. 1999. Utilization of the Internet for rapid community intensity maps. *Seismological Research Letters*, Vol. 70, 680-697.

Tables

Field #	*Data*	*Notes*
1	Year	
2	Month	
3	Day	
4	Hour	
5	Minute	
6	Easting	To nearest km
7	Northing	To nearest km
8	Location type	1 = Ground floor; 2 = Upper floor; 3 = Outdoors; 4 = Stationary vehicle; 5 = Moving vehicle; 6 = Other
9	Floor	1 = 1st; 2 = 2nd; 3 = 3rd; 4 = 4th to 8th; 5 = 9th or higher
10	Observer position	1 = Sitting/kneeling; 2 = Lying down; 3 = Standing; 4 = Walking; 5 = Other
11	Asleep	1 = No; 2 = Yes
12	Woken	1 = No; 2 = Yes
13	Shaking felt	1 = Nothing; 2 = Weak; 3 = Moderate; 4 = Strong
14	Sound heard	1 = Nothing; 2 = Soft; 3 = Moderate; 4 = Loud
15	Felt by others	Values 1 to 8 (0 for don't know)
16	Fright	1 = No; 2 = Yes
17	Alarm	1 = None; 2 = Few; 3 = Many; 4 = Most (run outdoors)
18	Animals frightened	1 = No; 2 = Yes
19	Windows rattle	1 = No; 2 = Yes
20	Crockery rattle	1 = No; 2 = Yes
21	Hanging objects swing	1 = No; 2 = Yes
22	Pictures swing	1 = No; 2 = Yes
23	Objects move	1 = No; 2 = Yes
24	Books fall	1 = No; 2 = Yes
25	Furniture shakes	1 = No; 2 = Yes
26	Furniture moves	1 = No; 2 = Yes
27	Furniture falls	1 = No; 2 = Yes
28	Clocks stop	1 = No; 2 = Yes
29	Plants sway	1 = No; 2 = Yes
30	Liquids splash	1 = No; 2 = Yes
31	Plaster crack small	1 = No; 2 = Yes
32	Plaster crack large	1 = No; 2 = Yes
33	Plaster fall small	1 = No; 2 = Yes
34	Plaster fall large	1 = No; 2 = Yes
35	Stones fall	1 = No; 2 = Yes
36	Brick crack small	1 = No; 2 = Yes
37	Brick crack large	1 = No; 2 = Yes
38	Walls fall	1 = No; 2 = Yes
39	Chimneys fall	1 = No; 2 = Yes
40	Collapse	1 = No; 2 = Yes

Table 1 Explanation of data file format

Figures

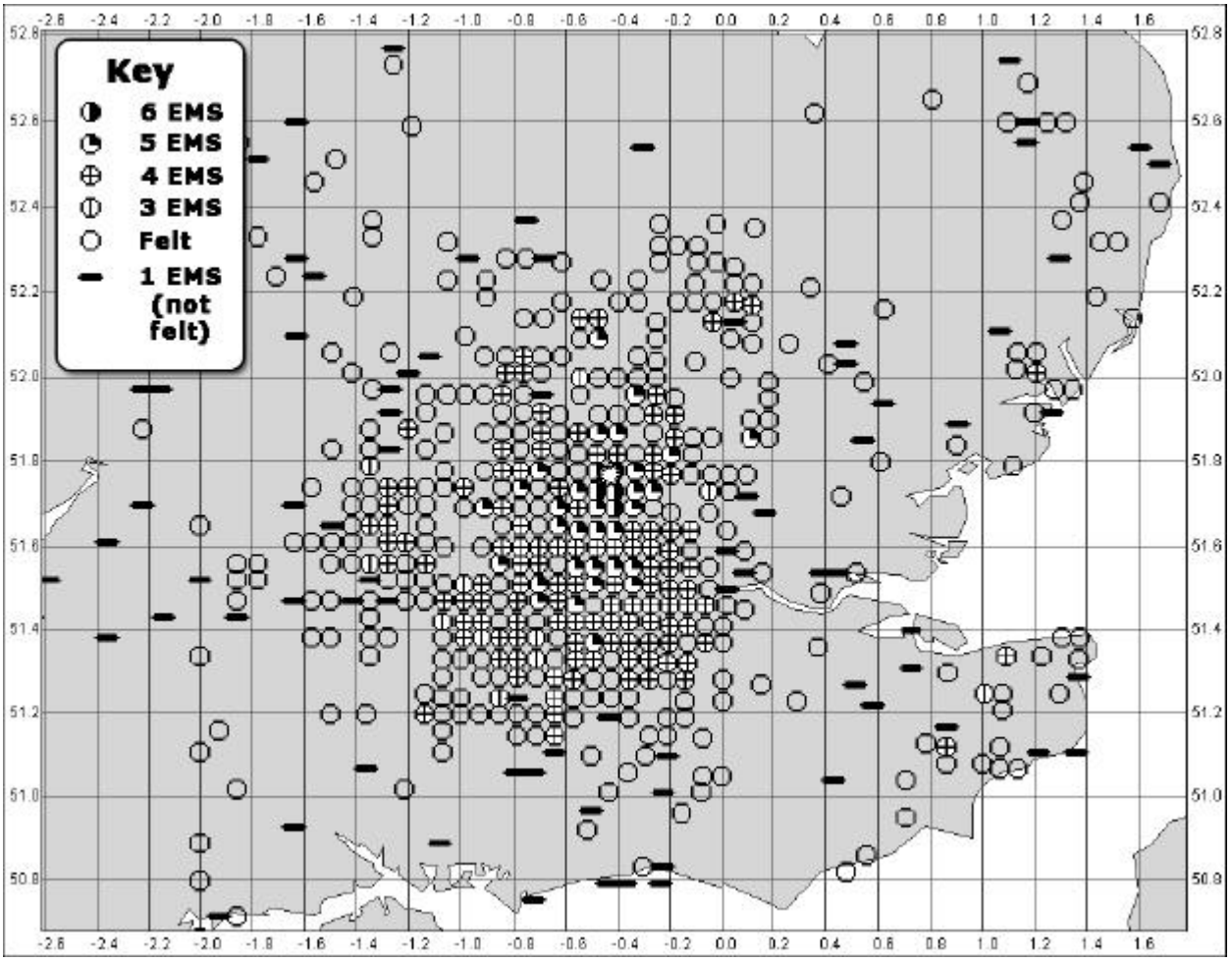


Figure 1 Felt effects of the 11 December 2005 Buncefield blast; splash symbol indicates the location of the explosion

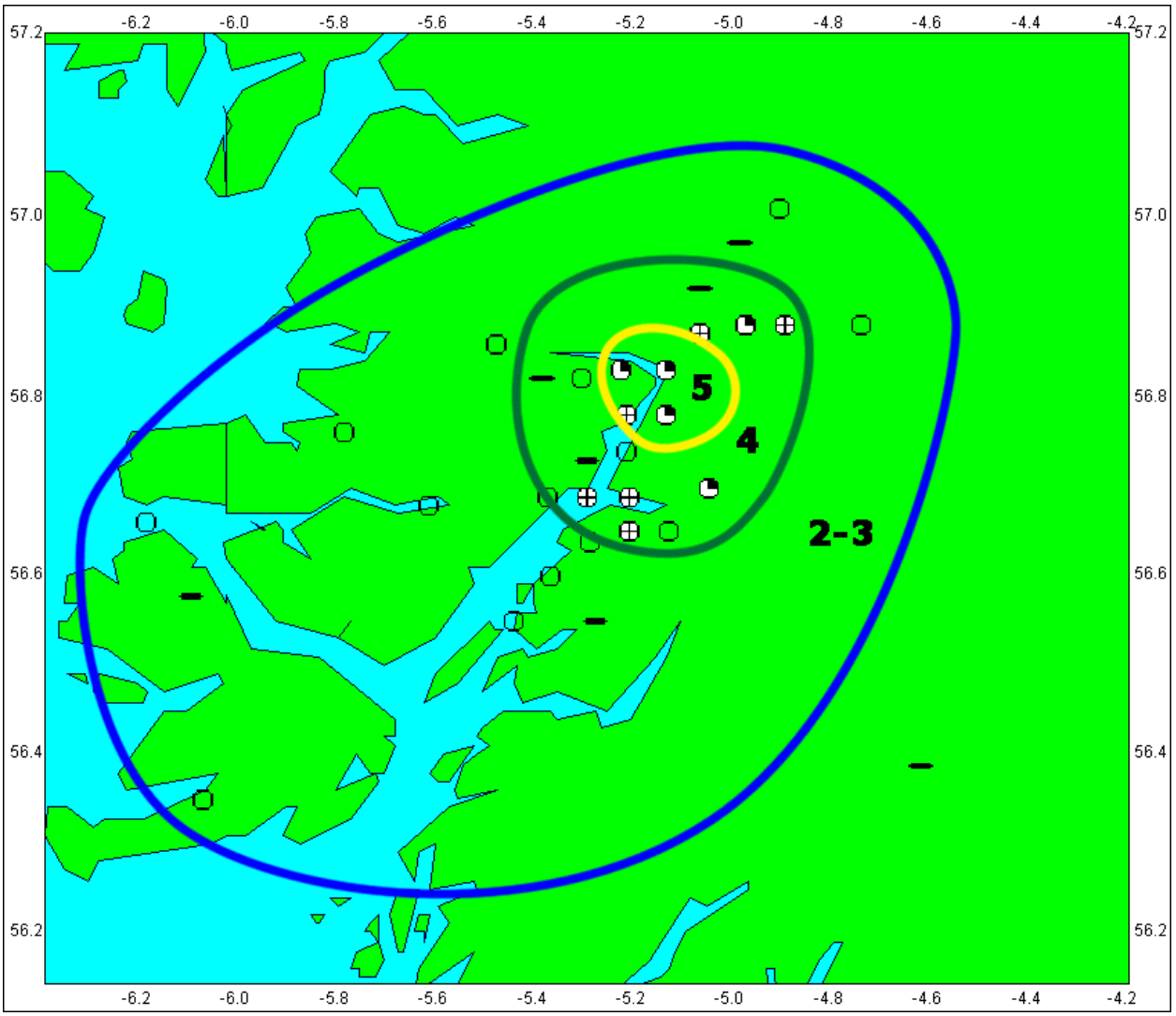
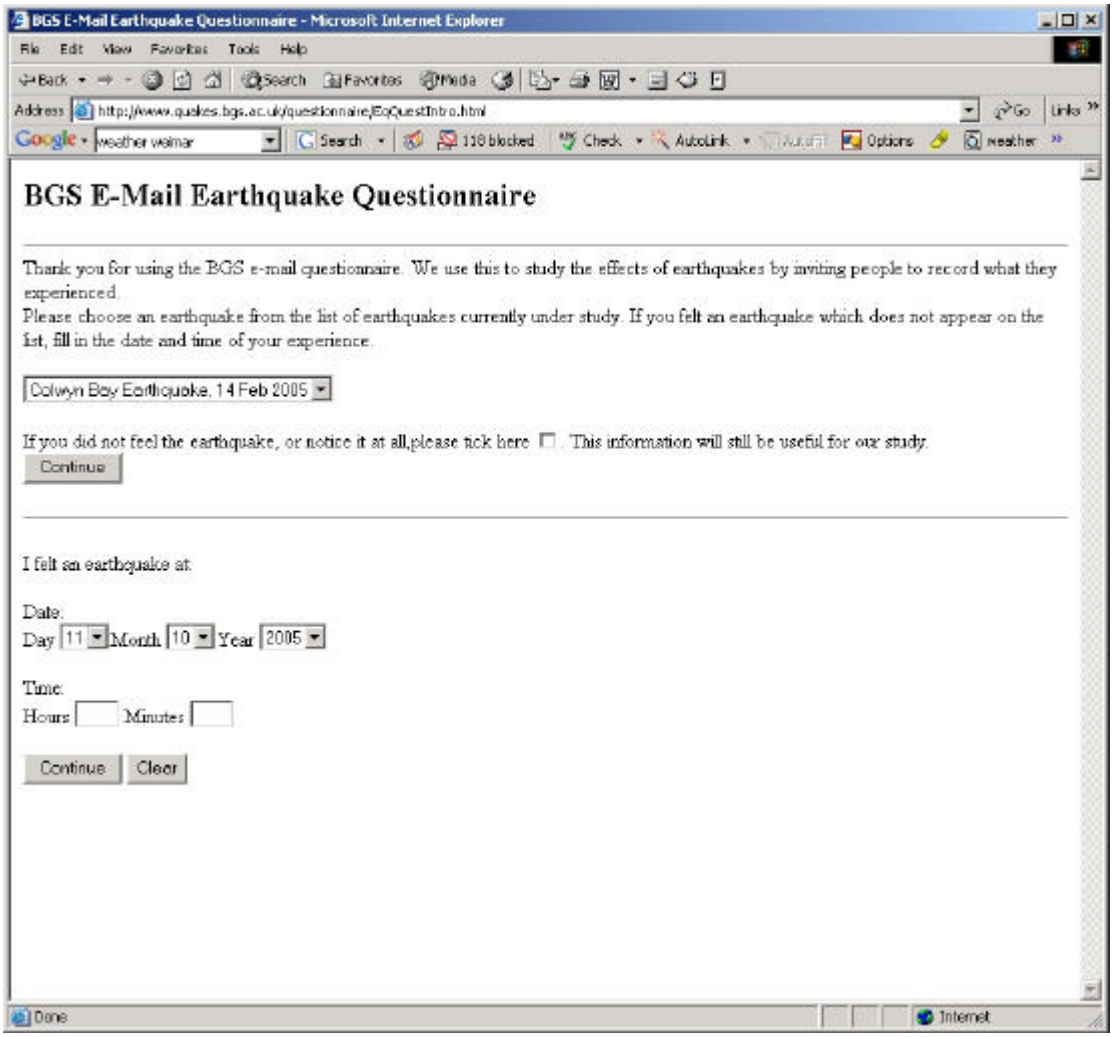
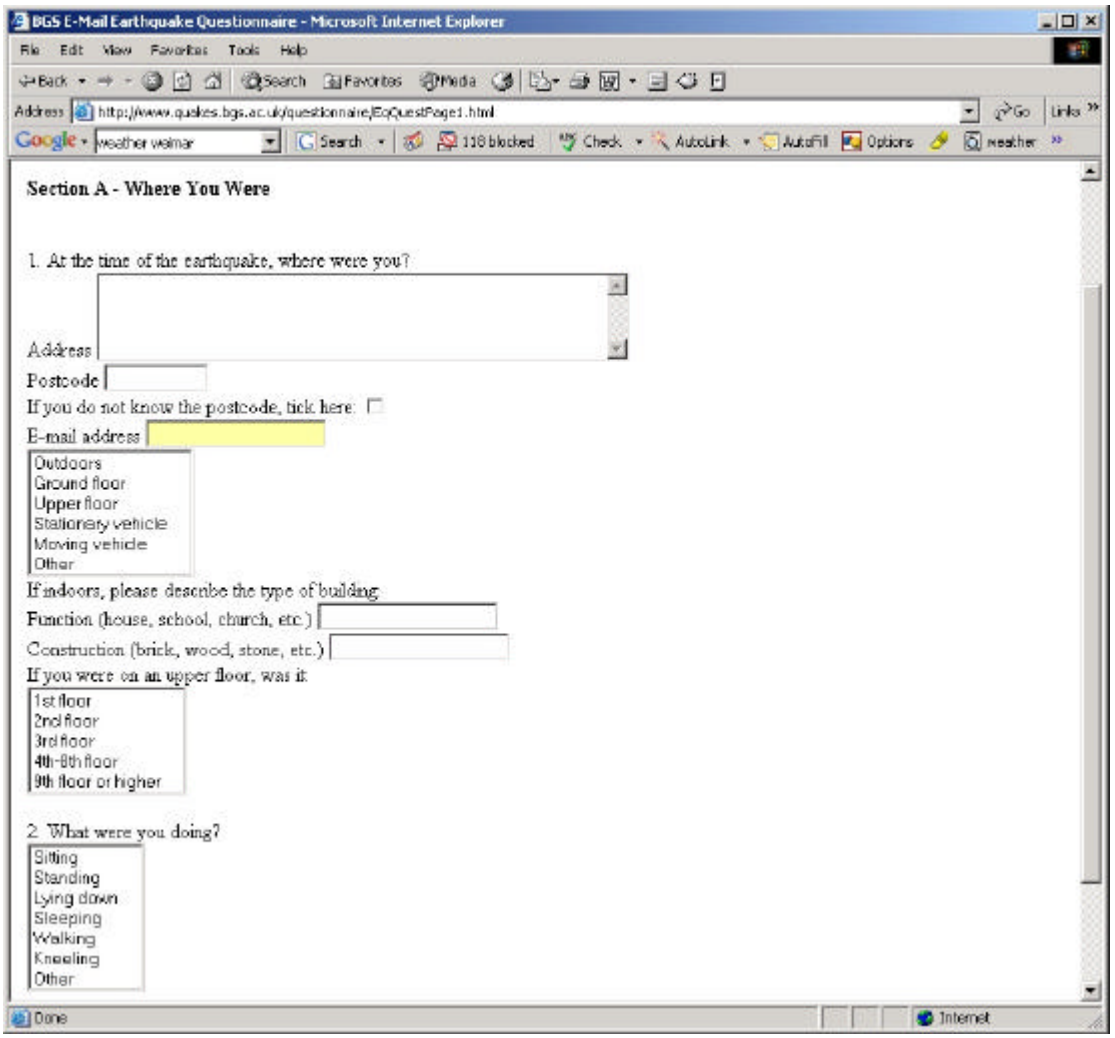


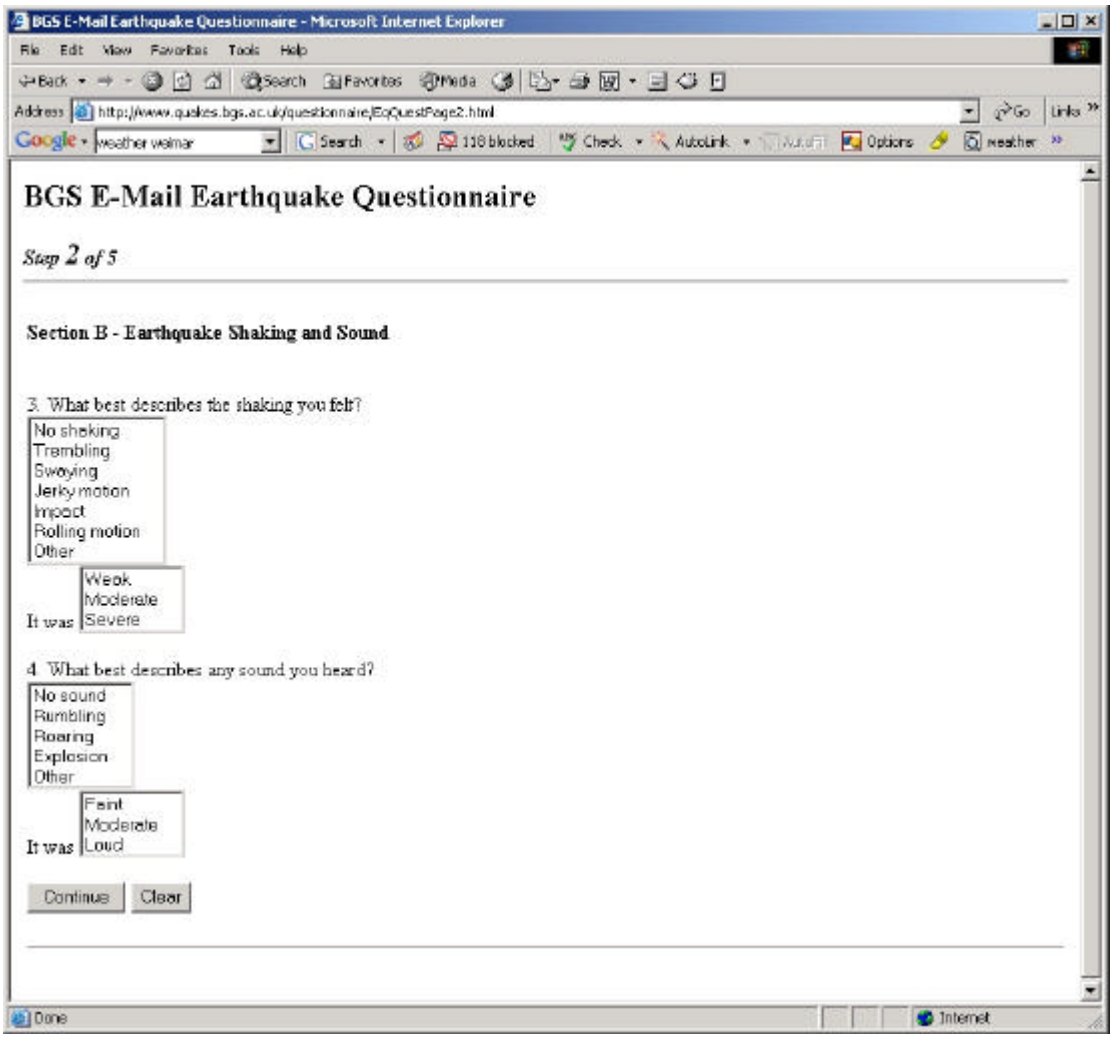
Figure 2 Felt effects of the 10 December 2005 Fort William earthquake (3.0 ML)

Appendix

The questionnaire currently used with this system on the BGS web site is shown in the following scans.




BGS E-Mail Earthquake Questionnaire - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://www.quakes.bgs.ac.uk/questionnaire/EqQuestPage1.html
Go Links
Google weather weimar
Search 118 blocked Check AutoLink AutoFill Options weather
Section A - Where You Were
1. At the time of the earthquake, where were you?
Address
Postcode
If you do not know the postcode, tick here:
E-mail address
Outdoors
Ground floor
Upper floor
Stationary vehicle
Moving vehicle
Other
If indoors, please describe the type of building
Function (house, school, church, etc.)
Construction (brick, wood, stone, etc.)
If you were on an upper floor, was it:
1st floor
2nd floor
3rd floor
4th-8th floor
9th floor or higher
2. What were you doing?
Sitting
Standing
Lying down
Sleeping
Walking
Kneeling
Other
Done
Internet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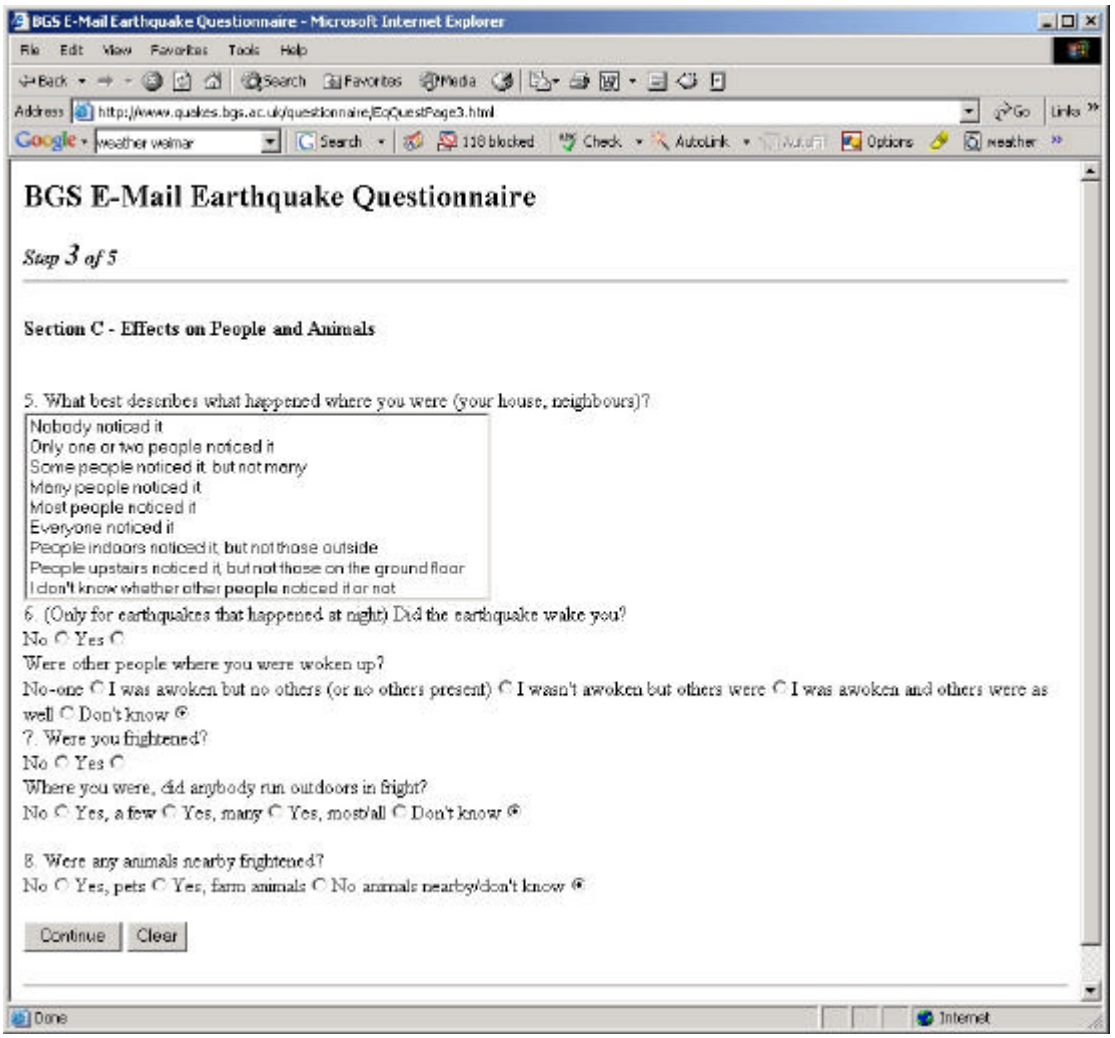
Step 2 of 5
Section B - Earthquake Shaking and Sound
3. What best describes the shaking you felt?
No shaking
Trembling
Swaying
Jerky motion
Impact
Rolling motion
Other
It was
Weak
Moderate
Severe
4. What best describes any sound you heard?
No sound
Rumbling
Roaring
Explosion
Other
It was
Faint
Moderate
Loud
Continue
Clear
Done
Internet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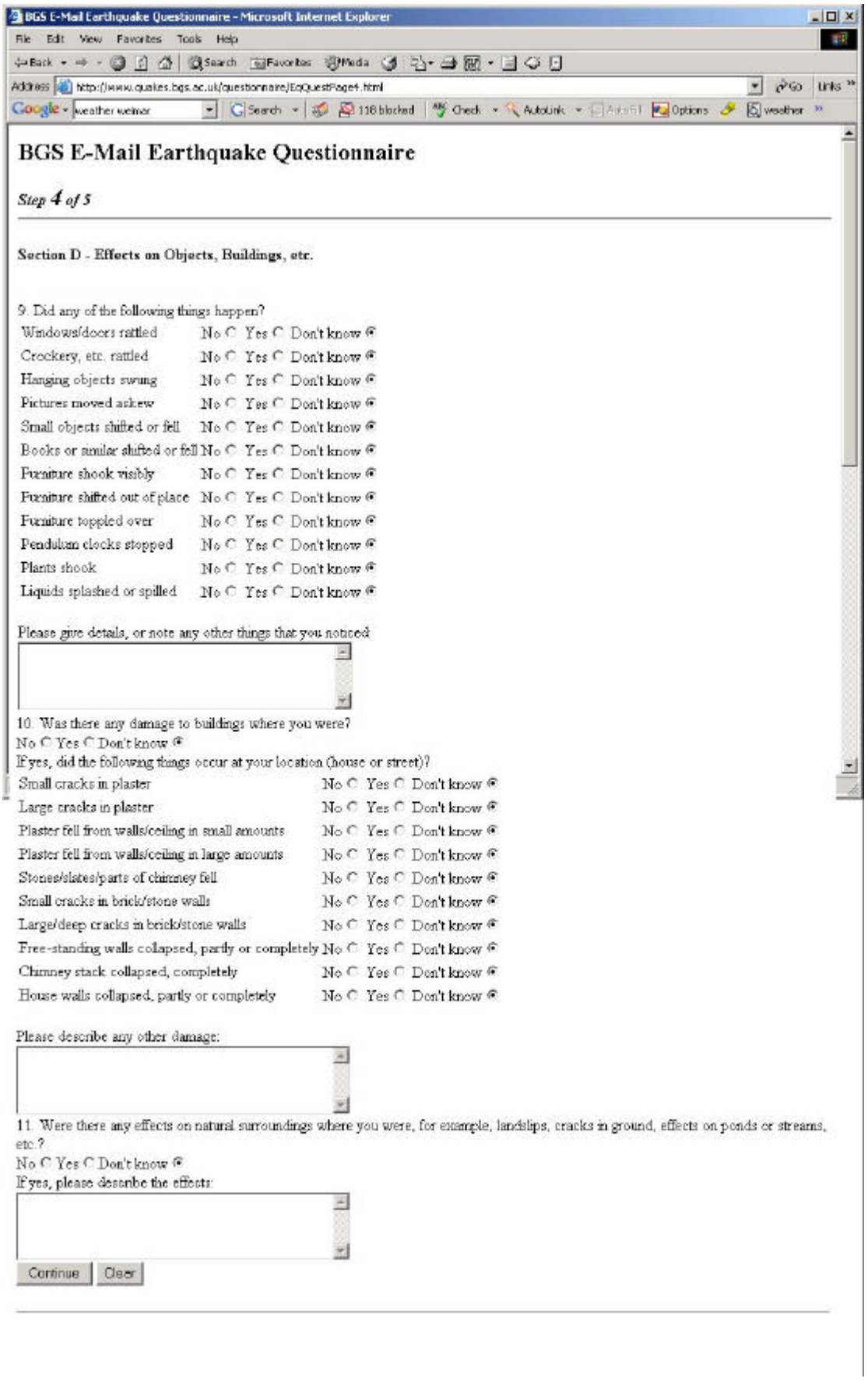
Step 3 of 5
Section C - Effects on People and Animals
5. What best describes what happened where you were (your house, neighbours)?
Nobody noticed it
Only one or two people noticed it
Some people noticed it, but not many
Many people noticed it
Most people noticed it
Everyone noticed it
People indoors noticed it, but not those outside
People upstairs noticed it, but not those on the ground floor
I don't know whether other people noticed it or not
6. (Only for earthquakes that happened at night) Did the earthquake wake you?
No Yes
Were other people where you were woken up?
No-one I was awoken but no others (or no others present) I wasn't awoken but others were I was awoken and others were as well Don't know
7. Were you frightened?
No Yes
Where you were, did anybody run outdoors in fright?
No Yes, a few Yes, many Yes, most/all Don't know
8. Were any animals nearby frightened?
No Yes, pets Yes, farm animals No animals nearby/don't know
Continue
Clear
Done
Internet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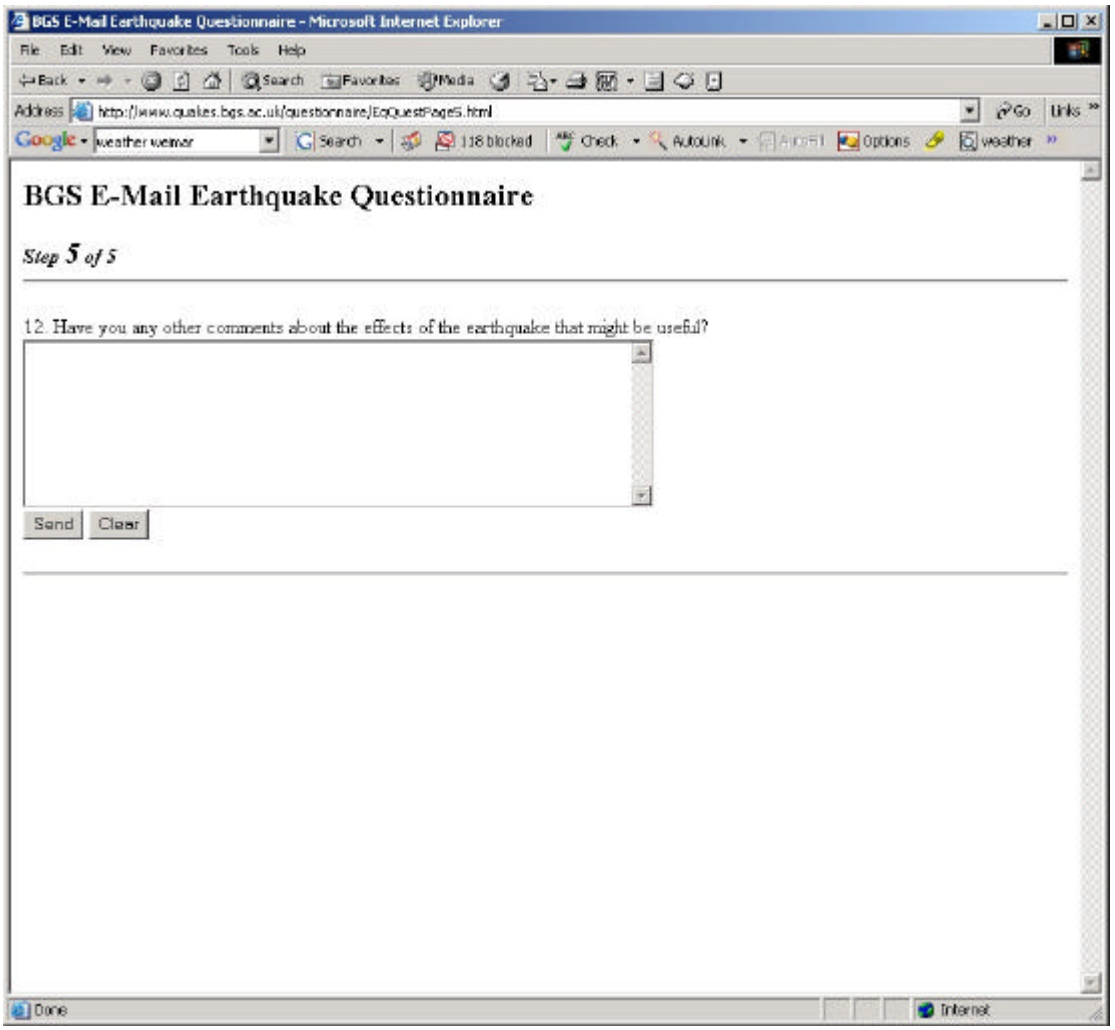
Step 4 of 5
Section D - Effects on Objects, Buildings, etc.
9. Did any of the following things happen?
Windows/doors rattled No Yes Don't know
Crockery, etc. rattled No Yes Don't know
Hanging objects swung No Yes Don't know
Pictures moved askew No Yes Don't know
Small objects shifted or fell No Yes Don't know
Books or similar shifted or fell No Yes Don't know
Furniture shook visibly No Yes Don't know
Furniture shifted out of place No Yes Don't know
Furniture toppled over No Yes Don't know
Pendulum clocks stopped No Yes Don't know
Plants shook No Yes Don't know
Liquids splashed or spilled No Yes Don't know
Please give details, or note any other things that you noticed
10. Was there any damage to buildings where you were?
No Yes Don't know
If yes, did the following things occur at your location (house or street)?
Small cracks in plaster No Yes Don't know
Large cracks in plaster No Yes Don't know
Plaster fell from walls/ceiling in small amounts No Yes Don't know
Plaster fell from walls/ceiling in large amounts No Yes Don't know
Stones/slates/parts of chimney fell No Yes Don't know
Small cracks in brick/stone walls No Yes Don't know
Large/deep cracks in brick/stone walls No Yes Don't know
Free-standing walls collapsed, partly or completely No Yes Don't know
Chimney stack collapsed, completely No Yes Don't know
House walls collapsed, partly or completely No Yes Don't know
Please describe any other damage:
11. Were there any effects on natural surroundings where you were, for example, landslips, cracks in ground, effects on ponds or streams, etc.?
No Yes Don't know
If yes, please describe the effects:
Continue
Clear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Step 5 of 5
12. Have you any other comments about the effects of the earthquake that might be useful?
Send
Clear
Done
Internet