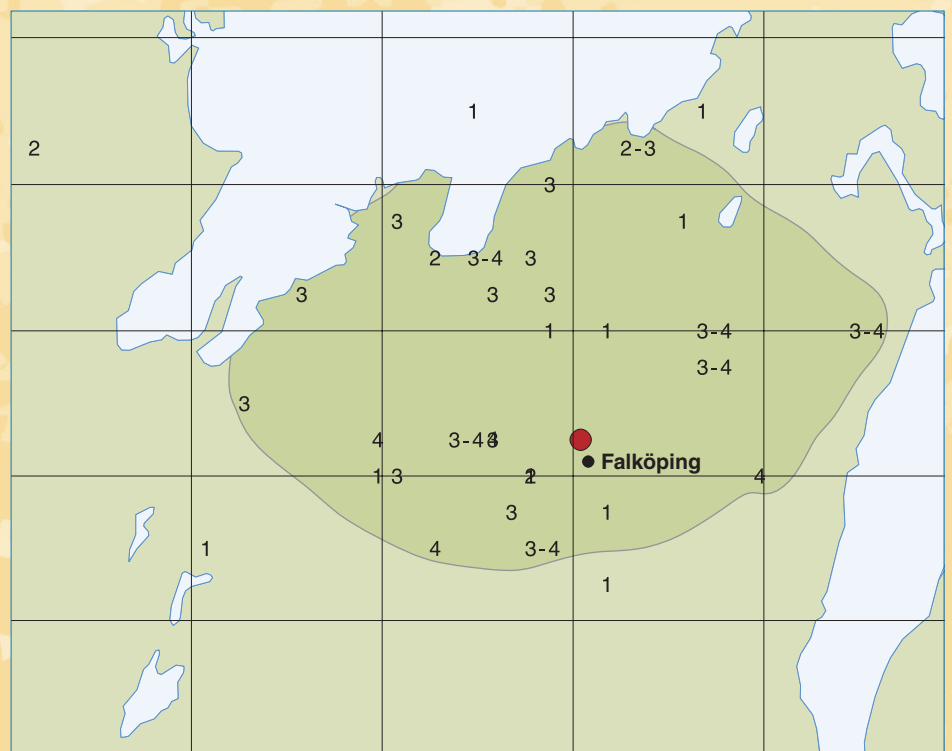


Macroseismic observations in Sweden 1996–2000

Conny Holmqvist, Ota Kulhanek
& Leif Persson



Research Paper C 835

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Cover: Intensity distribution and the area of perceptibility (shaded) for the earthquake near Falköping in Västergötland on September 9, 1999. See page 13 for further information.

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ABSTRACT

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Macroseismic data from 21 earthquakes felt in Sweden during the period 1996–2000 were collected and analyzed. Maximum intensity and, where data so permit (9 events), radius of perceptibility, focal depth and macroseismic magnitude are presented, and 11 isoseismal maps are shown. During the period under review, the largest earthquake with magnitude $M_L=3.7$ took place near Strömstad, south-western Sweden, on November 29, 2000. The maximum reported intensity was V which corresponds to a ground acceleration of the order of 20–40 cm/s² (Trifunac and Brady, 1975).

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INTRODUCTION

The main objective of the present report is to summarize, evaluate and interpret macroseismic observations collected by the Geophysical Department, Uppsala University, during the period 1996–2000. Due to the lack of strong motion records, macroseismic analysis is useful since it provides a possibility to assess the size of an event, to estimate local ground motion parameters (serviceable in engineering applications and insurance policies) and it yields an independent estimate of the focal depth for local or regional earthquakes. A dense geographic coverage by adequate instruments, before an event occurs, is unrealistic. Hence, macroseismic observations collected from large affected areas continue to be the only effective measure to denote the severity of ground motions generated by near earthquakes. On the other hand, seismic intensity cannot completely substitute instrumental records because it does not provide information on the time variation of ground motion. In spite of the semi-empirical character of each intensity report, earthquake intensity when evaluated uniformly and at a sufficiently large number of localities often exhibits regular regional patterns which may provide reliable estimates of the above source parameters.

As soon as an earthquake in Sweden is instrumentally located and a first report that it was felt is known, we mail questionnaires to postmasters, headmasters and volunteers who have agreed to complete the questionnaire. Only exceptionally, we make field visits to epicentral areas. At the same time, we urge local newspapers to publish appeals for information to be sent to the Geophysical Institute, Uppsala University. The latter approach complements the standard routine and often provides additional information details which otherwise would pass unnoticed. The covered area depends on the magnitude and usually has a mean radius between 10 and 100 km. Institute personnel evaluates information supplied by received questionnaires and assigns discrete intensity values in accordance with the Modified Mercalli 1956 scale, hereafter MM scale (Willmore 1979). We are fully aware of more recent scales (MSK, EMS) and their various modifications. However, for Swedish events, which only in very few cases reach intensity VI (i.e. no or only slight structural damage occurs) and macroseismic observations are generally scarce, application of the MM scale is efficient and adequately accurate.

Questionnaires are evaluated as they are received. MM intensities are assigned to the geographic location of each report and an intensity file is created. If data volume and quality permit, the file is used to construct isoseismal maps that show the geographic extent and severity of the shaking. Negative reports (not felt) were also taken into consideration, whereas no use was made of the local geology. Sometimes, felt effects covering several intensity degrees are reported from the same locality, usually from population centres. If this is the case, then we take the largest intensity felt. To ensure the homogeneity of interpretation, present intensity evaluations have been cross-checked with those made during the period 1977–1995 (Kulhanek & Wahlström 1981, 1985, 1992, 1996).

During the 5-year period under review, i.e. between 1996 and 2000, 21 instrumentally located and quantified earthquakes were reported felt in Sweden. This number is close to the average annual number (4.7 events per year) of felt Swedish quakes during the period 1977–1995. In this respect, the frequency of events felt in Sweden between 1996 and 2000 is normal. Table 1 summarizes the instrumental source parameters of the 21 considered events. Events in the table are listed in a chronological order. Source data, i.e. date, epicentral coordinates, origin time and local magnitude, M_L , were taken from “Earthquakes in northern Europe” published annually by the Institute of Seismology, University of Helsinki (Reports R-115, R-128, R-141, R-154, R-167). Note that event No. 18 in Table 1 is not mentioned in the Finish reports and hence for this shock we used source information presented by the Bergen observatory, Norway. Epicentral locations of the events under review are shown in Figure 1.

From the maximum felt intensity, I_o (MM) and the radius of perceptibility, r_p (km), focal depth, h (km), is determined by using the Blake-Shebalin formula (Karnik 1962). Introducing the coefficient of attenuation for events in the Baltic shield, suggested by Ahjos and Korhonen (1984), the formula reads

$$I_o - 2 = 4 \log [(r_p^2 + h^2)/h^2]^{1/2} \quad (1)$$

The radius of perceptibility, r_p , is measured from macroseismic maps. It is evaluated as the radius of a circle with an area equal to the macroseismic area. Maximum intensity, I_o , and radius of perceptibility, r_p , are also used to determine the macroseismic magnitude, M_M (UPP), by applying the formula of Wahlström and Ahjos (1982)

$$M_M(\text{UPP}) = 0.38 + 1.14 \log r_p + 0.23 I_o \quad (2)$$

Derived macroseismic parameters, i.e. macroseismic epicentre, maximum felt intensity, I_o , radius of perceptibility, r_p , focal depth, h , and macroseismic magnitude, M_M , are listed in Table 2. The focal depth is rounded off to the nearest kilometre. For the sake of comparison, Table 2 lists also the instrumental magnitude. In the text, we also mention the areas of perceptibility which we rounded off to the nearest hundred square kilometres.

Table 1. Instrumental source parameters of felt Swedish earthquakes during the period 1996–2000.

Event No	Date			Epicentral Coord.		Origin time GMT	M_L	Province	Location
				°N	°E				
1	Mar	17	1996	64.2	20.3	10 13 02	3.0	Västerbotten	Vindeln
2	Mar	19	1996	63.7	18.7	11 39 11	3.2	Ångermanland	Trehörningsjö
3	Mar	28	1996	57.4	16.4	20 56 07	2.2	Småland	Fårbo
4	Sep	24	1996	63.3	15.3	19 42 08	3.3	Jämtland	Lit
5	Dec	17	1996	55.6	12.9	18 15 14	2.6	Skåne	Malmö
6	Feb	15	1997	63.9	18.6	19 32 18	3.1	Ångermanland	Nyliden
7	Feb	18	1997	64.3	20.8	00 35 26	2.5	Västerbotten	Skalberget
8	Aug	28	1997	59.6	13.2	06 02 38	3.1	Värmland	Ö. Ämtervik
9	Oct	19	1997	65.4	22.4	19 50 58	3.2	Norrbottnen	Junkön
10	Dec	4	1997	64.8	19.7	03 10 46	2.9	Västerbotten	Bastuträsk
11	Oct	12	1998	63.1	18.6	04 57 29	2.6	Ångermanland	Ulvön
12	Nov	16	1998	60.8	17.3	01 49 03	3.0	Gästrikland	Gävle
13	Apr	8	1999	66.6	23.4	03 19 33	2.8	Norrbottnen	Övertorneå
14	Sep	9	1999	58.3	13.6	18 16 40	2.7	Västergötland	Falköping
15	Oct	10	1999	58.1	12.8	16 27 31	2.8	Västergötland	Vårgårda
16	May	1	2000	65.4	18.7	21 38 51	3.0	Lappland	Adak
17	May	23	2000	57.1	15.5	16 41 57	2.4	Småland	Åseda
18	May	23	2000	63.7	20.3	18 58 59	2.0	Västerbotten	Obbola
19	Sep	10	2000	61.7	16.4	08 15 03	2.7	Hälsingland	Järvsö
20	Nov	29	2000	59.0	11.2	22 07 54	3.7	Bohuslän	Strömstad
21	Dec	20	2000	57.3	13.3	14 16 01	2.8	Småland	Smålandsstenar

Note that the earthquake of December 4, 1997 near Bastuträsk (No. 10, Table 1) was reported felt, however no questionnaires were received at the Geophysical Institute. The event of November 29, 2000 (No. 20, Table 1) took place near the Norwegian border, but we had access only to reports from the Swedish side of the border. This was the strongest event, $M_L=3.7$, during the period under review. The maximum felt intensity was V (MM), corresponding to a peak horizontal ground acceleration of about 3% of g (Trifunac & Brady 1975). Ground accelerations predicted by Willmore (1979) or by Båth (1980) are slightly lower.

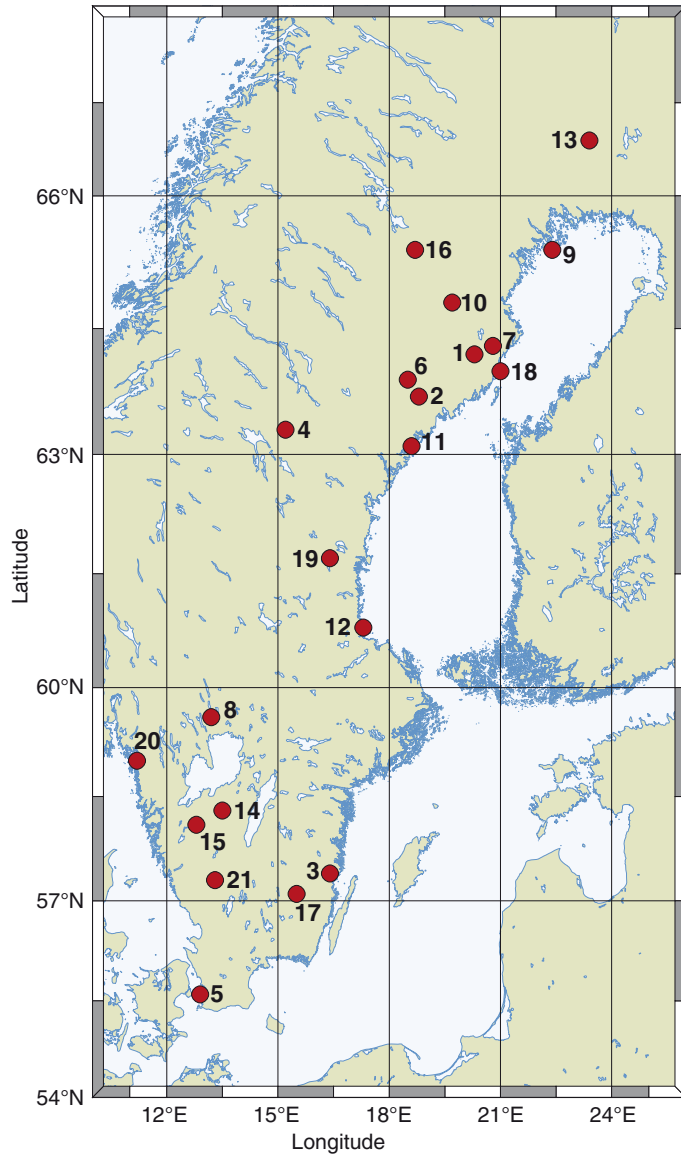


Fig. 1. Map of Sweden showing distribution of earthquakes (red dots) listed in Table 1. Event numbers are those used in the table.

Table 2. Macroseismic parameters deduced in the present study. M_L is taken from the Helsinki report.

Event No	Date	Location	I_0 (MM)	r_p (km)	Focal depth (km)	M_L	M_M (UPP)
2	Mar 19 1996	Trehörning	V	36	7	3.2	3.3
3	Mar 28 1996	Fårbo	IV			2.2	
4	Sep 24 1996	Lit	IV	37	12	3.3	3.1
6	Feb 15 1997	Nyliden	IV	73	24	3.1	3.4
8	Aug 28 1997	Ö. Ämtervik	IV	53	18	3.1	3.3
9	Oct 19 1997	Junkön	V			3.2	
11	Oct 12 1998	Ulvön	III–IV			2.6	
12	Nov 16 1998	Gävle	IV			3.0	
13	Apr 8 1999	Övertorneå	IV–V	13	3	2.8	2.7
14	Sep 9 1999	Falköping	IV	41	14	2.7	3.1
15	Oct 10 1999	Vårgårda	IV	21	7	2.8	2.8
16	May 1 2000	Adak	V	43	8	3.0	3.4
19	Sep 10 2000	Järvsö	IV–V	14	3	2.7	2.7
20	Nov 29 2000	Strömstad	V			3.7	

FELT EARTHQUAKES

In the following paragraphs, we provide a short, mostly qualitative, description of collected macroseismic data for events listed in Table 1. For each individual event we present an estimate of the maximum felt intensity and a list of localities which reported the highest intensities. Geographical names of each event (also used in Table 1), have been selected arbitrarily from population centers near the epicentre which need not be one of the localities providing macroseismic data. For a fast orientation, we also add the corresponding province. When available data permit, an isoseismal map is plotted. In the text, we apply the following rough event quantification: weak ($M_L < 2.5$), moderate ($2.5 \leq M_L < 3$) and strong ($M_L \geq 3$).

March 17, 1996, Vindeln, Västerbotten

A moderate earthquake was felt in a limited area of coastal Västerbotten, about 30 km east of Vindeln, on the morning of March 17, 1996. 41 questionnaires were collected together with several articles from local newspapers. Felt intensities were the following: Brännfors (III), Flarken (II), Liden (III), Ormsjö (II), Rundvik (II–III), Sävar (III), Umeå (II), Vindeln (III) and Ånäset (IV). The scarcity of reports does not allow the construction of an isoseismal map.

March 19, 1996, Trehörningsjö, Ångermanland

At noon on March 19, 1996 a moderate earthquake took place near Trehörningsjö in the coastal area of Ångermanland. We collected 55 reports from the epicentral area. The event was also covered by 4 local newspapers. 22 reports left positive descriptions of felt effects, the remainder were “not felt” answers. Intensity V was felt, most likely due to local soil conditions, at Klöse, 38 km SSE of the instrumental epicentre. Intensity IV (or III–IV) was felt in Hörnsjö, Ottonträsk, Ström, Svedje, Trehörningsjö and Östra Strömåker. 14 localities reported observations corresponding to intensity III.

The quake, with maximum intensity $I_o = V$, was felt in an area extending approximately 90 km in the NE–SW direction, i.e. roughly parallel with the coast line (Fig. 2). The area of perceptibility is about 4 100 km² which provides estimates of the focal depth of 7 km and of the macroseismic magnitude $M_M(\text{UPP}) = 3.3$.

March 28, 1996, Fårbo, Småland

A weak earthquake was felt in a limited coastal area of the Småland province on the evening of March 28, 1996. The location of the event was to some extent a surprise since shocks of this size have been unknown in south-eastern Sweden. The proximity (less than 20 km) of the epicentre to the nuclear power plant in Oskarshamn generated some debate even though the production of the plant was not interrupted. We collected 39 reports from inhabitants in the area. The maximum intensity IV was felt in Fårbo and Simpevarp, 5 km SE and 15 km NE of the instrumental epicentre, respectively. Some sleeping people awoke. Windows and dishes rattled, floors and walls creaked, furniture began to shake, hanging objects swung slightly, liquids in open vessels were slightly disturbed. The shock was felt in a standing car. Intensity III (or II–III) was reported from Figeholm, Fliseryd, Kristdala, Oskarshamn, Påskallavik and Värlebo. 9 reports were received from the city of Oskarshamn alone, most of them (8) reported intensity of III or “not felt”. The macroseismic map was not plotted.

September 24, 1996, Lit, Jämtland

On the evening of September 24, 1996, a strong earthquake shook the area of central Jämtland. The epicentre was located near Lit, about 35 km north-east of Östersund. We received 58 replies to our questionnaires. The quake was felt with the highest intensity of IV (or III–IV) in Lagmanslandet, Lill-

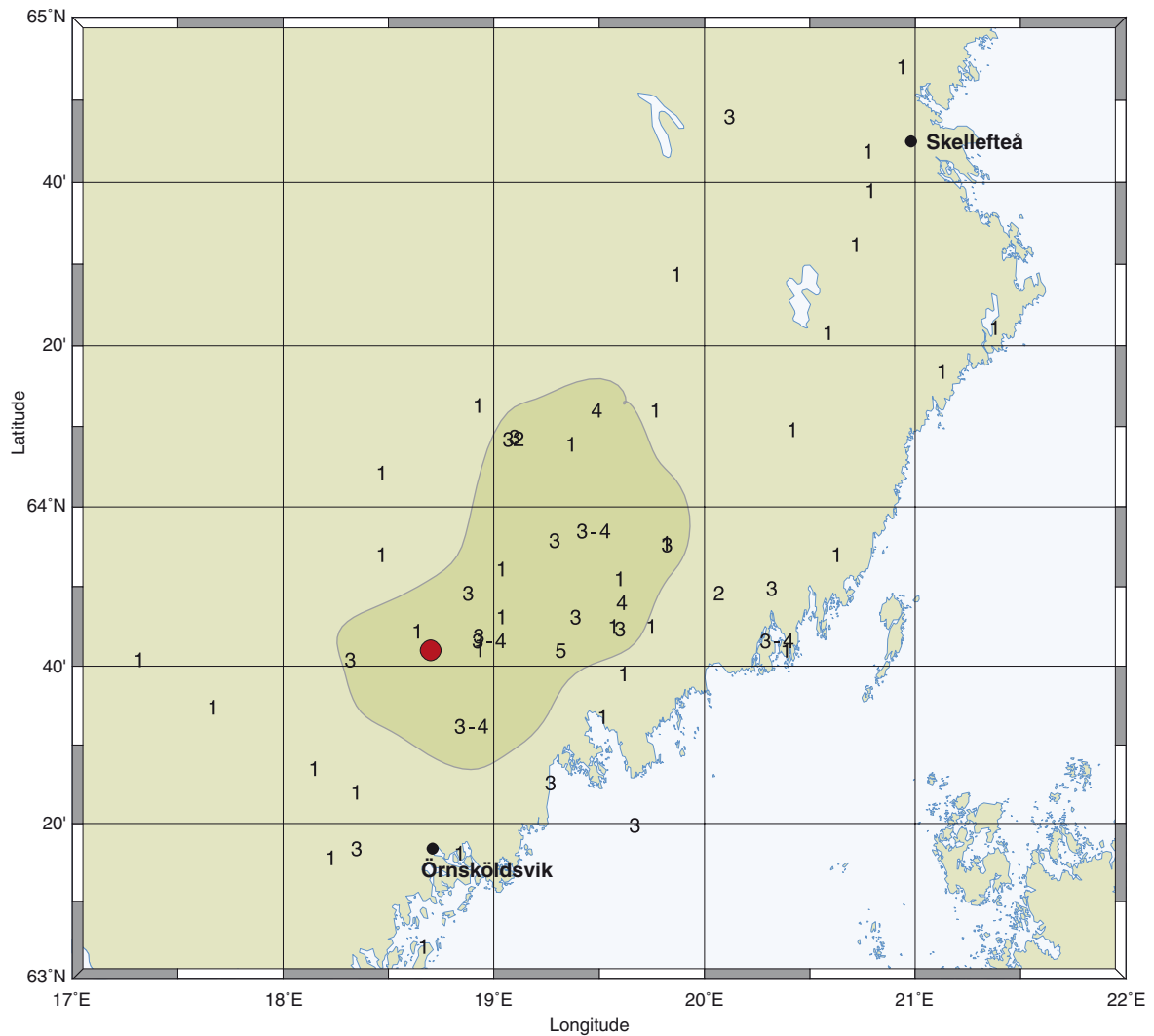


Fig. 2. Intensity distribution (Arabic figures) of the earthquake of March 19, 1996. Intensity is assessed in the MM scale, Figure 1 shows localities where the event was not felt. The large solid circle is the location of the instrumental epicentre. For fast orientation, small solid circles denote larger population centres and the shaded area is the area of perceptibility.

sjöhögen, Näverede, Ottersgård, Selet and Stugun. Intensity III was reported from another 18 localities. The sensation of vibrations was often compared to vibrations due to a passing of a heavily loaded truck. Buildings trembled, windows and dishes rattled, furniture began to shake. Some inhabitants in the epicentral area feared that their furnaces had exploded. In Lagmanslandet and Näverede, pets (dog, cat) became uneasy.

The collected macroseismic information is displayed in Figure 3. The quake was felt within a semi-circular area of about 4300 km², which together with the maximum felt intensity, $I_o=IV$, provides a focal depth of 12 km and a macroseismic magnitude of 3.1.

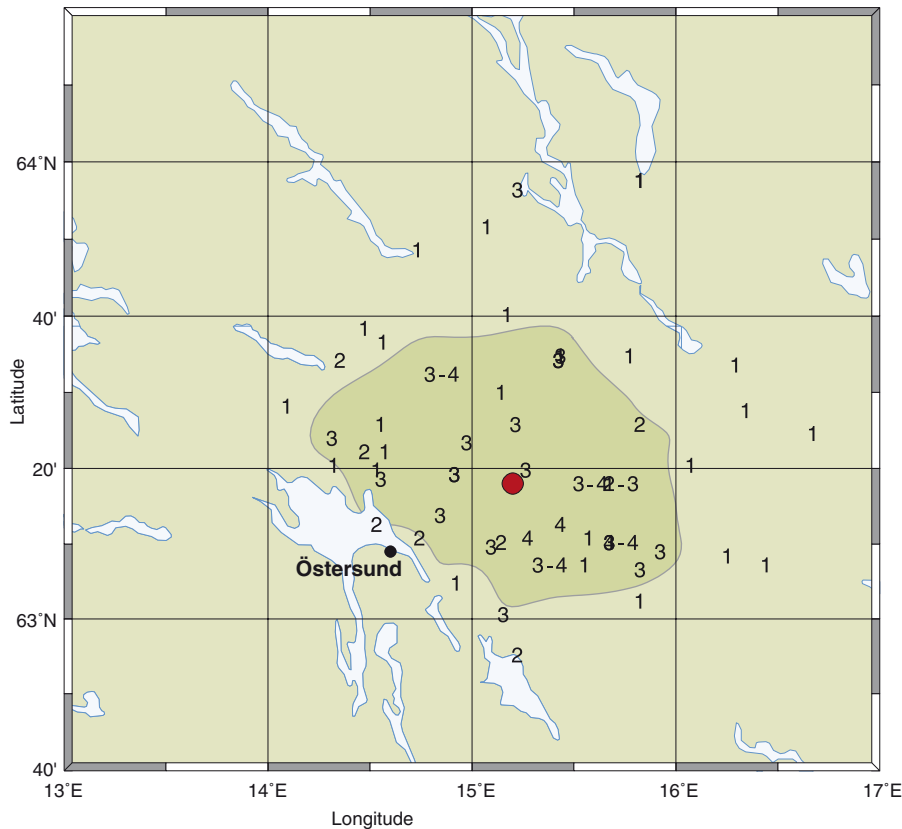


Fig. 3. Intensity distribution and the area of perceptibility (shaded) for the earthquake of September 24, 1996. Conventions as for Fig. 2.

December 17, 1996, Malmö, Skåne

On the evening of December 17, 1996, a moderate quake was felt south of Malmö, in the coastal area of Skåne. The epicentre was located off the south coast of Sweden which together with the low magnitude ($M_L=2.6$) explains that out of 14 questionnaires only two localities south of Malmö, namely Höllviken and Skanör, left positive observations of intensity III. The scarcity of felt intensities does not allow the construction of an isoseismal map.

February 15, 1997, Nyliden, Ångermanland

A strong earthquake occurred on the evening of February 15, 1997, about 20 km north of Nyliden, in the north-eastern part of the Ångermanland province. We received 68 questionnaires, 27 of them with positive descriptions of felt effects. The quake was felt with a highest intensity of IV in Björna, Nyliden and Trehörningsjö, in an area 20–40 km south of the instrumental epicentre. Intensity III–IV was reported from Gulsele and Örnsköldsvik, while intensity III was felt in 21 additional localities.

The area over which the event was generally perceptible and, to some extent, also the area of intensity IV are well defined by the evaluated reports and shown in Figure 4. The event was felt in a relatively large area of more than 16 700 km². Introducing the corresponding radius of perceptibility $r_p=73$ km and the maximum felt intensity $I_o=IV$ into (1), we obtain a focal depth of 24 km. Equation (2) yields a macroseismic magnitude of 3.4.

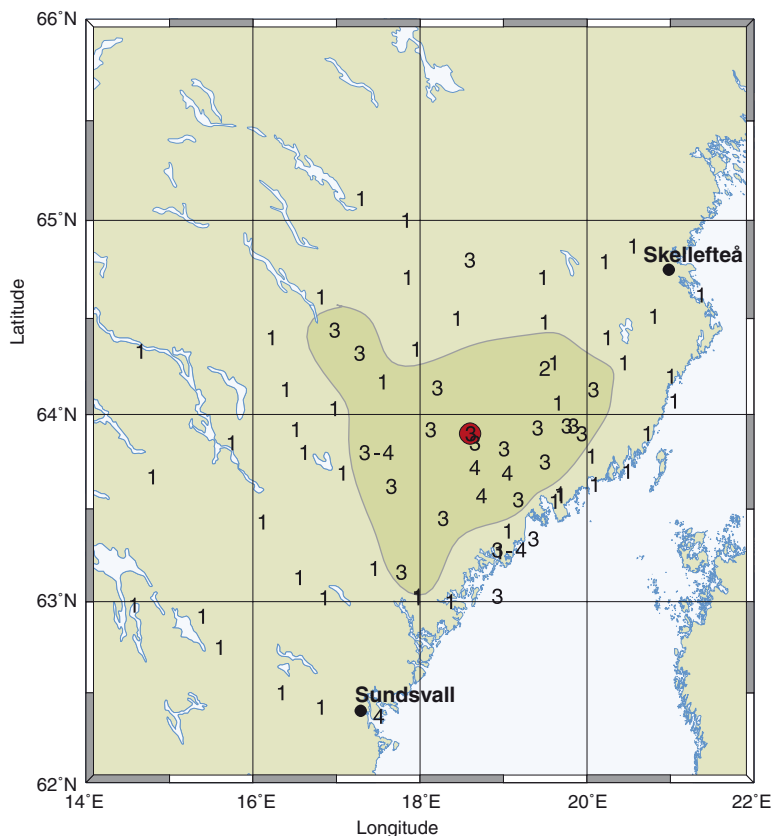


Fig. 4. Intensity distribution and the area of perceptibility (shaded) for the event of February 15, 1997. Conventions as for Fig. 2.

February 18, 1997, Skalberget, Västerbotten

A moderate earthquake took place shortly after midnight on February 18, 1997, close to Skalberget near the coast of Västerbotten, 10–15 km NNW of Robertsfors. We collected 11 questionnaires from the epicentral area, all with answers “not felt”. According to a local newspaper the quake was felt (intensity not specified) by several persons in Robertsfors.

August 28, 1997, Östra Ämtervik, Värmland

On the morning hours of August 28, 1997, a strong quake occurred 5–10 km south-east of Östra Ämtervik, Värmland. The earthquake was felt over a vast area ($\approx 9\,000\text{ km}^2$) of central Värmland without any clear concentration towards the instrumental epicentre. 39 questionnaires were collected. Buildings trembled, windows and dishes rattled, and furniture began to shake. The highest intensity of IV was felt west and south-west of the epicentre in Edane, Slottsbron, Stömme and Torsby. Intensity III–IV was reported from Deje, Forshaga, Karlstad, Ledsjöhed, Rämnen, Hammarö and Östra Ämtervik.

Intensity estimates together with the approximate area of perceptibility are shown in Figure 5. By making use of the radius of perceptibility, $r_p=53\text{ km}$, and the maximum felt intensity, $I_o=IV$, we obtain a focal depth of 18 km and a macroseismic magnitude of 3.3.

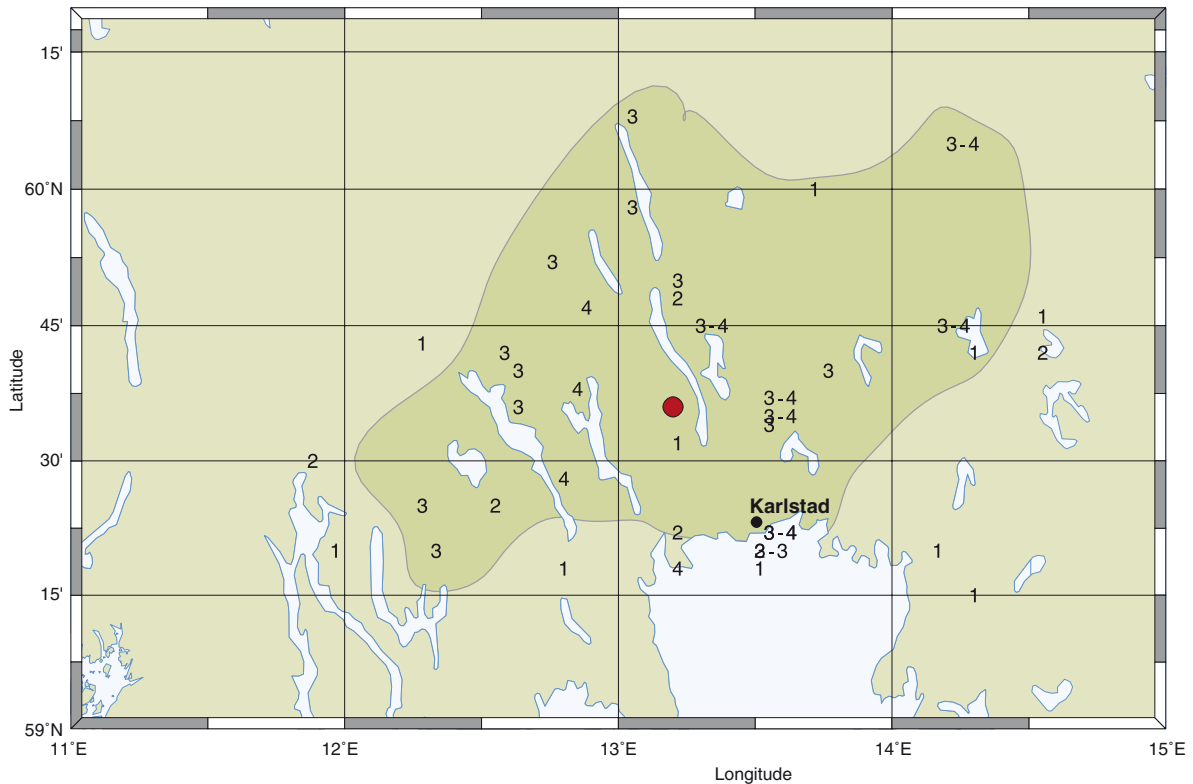


Fig. 5. Intensity distribution and the area of perceptibility (shaded) for the shock of August 28, 1997. Conventions as for Fig. 2.

October 19, 1997, Junkön, Norrbotten

On the evening of October 19, 1997, a strong earthquake shook the southern coastal area of Norrbotten. Due to the offshore location of the quake (approximately 25 km south-east of Luleå) it was felt only in a narrow coastal strip. Intensity reports were received from 24 localities. The maximum intensity V was reported from Sunderbyn where buildings trembled, some people ran outside and the sensation of vibrations was like that due to a heavy object falling inside the building. Intensity IV was felt in Luleå, Rosvik and Örnäset (Luleå). In addition, 9 localities felt shakings with intensity III including Vitå where dogs became uneasy. The collected on-land macroseismic information is shown in Figure 6. Due to the offshore location of the event, we could not derive the focal depth and the macroseismic magnitude.

October 12, 1998, Ulvön, Ångermanland

On the morning of October 12, 1998, a moderate offshore quake was felt in two separate areas of coastal Ångermanland. The epicentral location was 10–15 km east of the island of Ulvön. 18 questionnaires were returned to the department. Intensity III–IV was felt in Docksta, Husum, Skede, Ullånger and Örnköldsvik. Reported vibrations were like those due to the passing of a heavy truck, buildings trembled, dishes and windows rattled, a door moved and some inhabitants were afraid that their furnaces had crashed. Collected data were not sufficient to estimate the macroseismic magnitude and focal depth.

November 16, 1998, Gävle, Gästrikland

A strong earthquake occurred on the early morning of November 16, 1998, about 15 km south-west of Gävle, in the central coastal area of Gästrikland. Only 14 questionnaires were returned to the department with the highest intensity of IV reported from Eggegrund, Gävle, Hille, Ockelbo and Storvik.

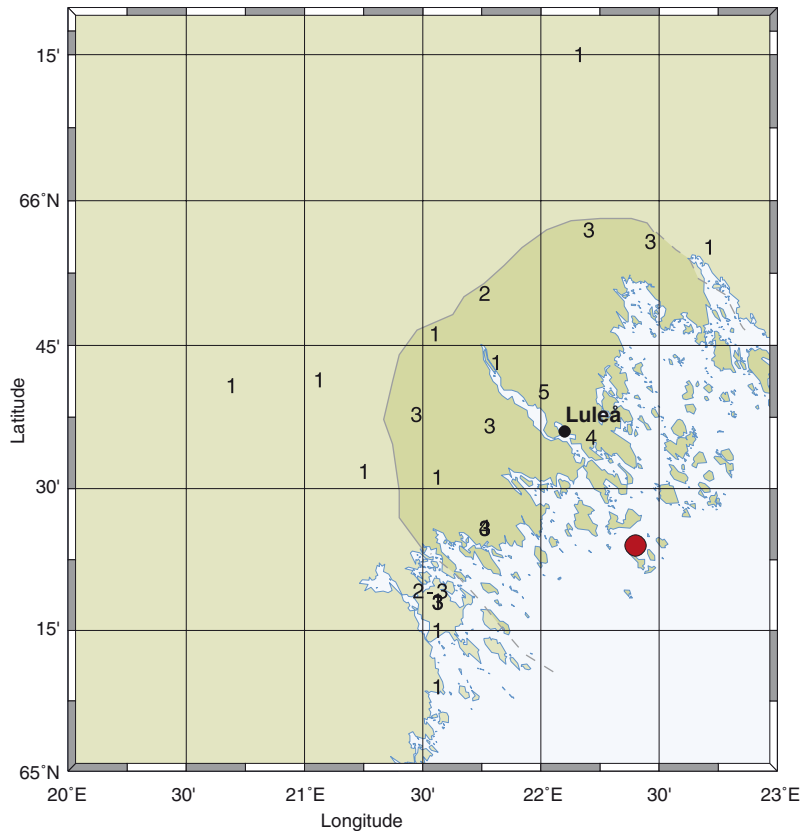


Fig. 6. Intensity distribution and the on-land portion of the area of perceptibility (shaded) for the earthquake of October 19, 1997. Conventions as for Fig. 2.

Another 7 reports indicated intensities of III and III–IV. A local newspaper covered the event extensively. A number of sleeping people awoke, furniture began to shake, and windows rattled. Many ran out and checked their furnaces. The scarcity of observations, with respect to the magnitude of 3.3, and the low felt maximum intensity, can to some extent, be explained by the epicentral location near to the shore. No isoseismal map was drawn.

April 8, 1999, Övertorneå, Norrbotten

In the early morning of April 8, 1999, a moderate quake took place near Siekasjärvi, about 20 km north-west of Övertorneå in the province of Norrbotten. The event was felt in a limited area ($\approx 500 \text{ km}^2$) close to the Sweden–Finland border with a rather sparse population. 16 reports were collected at the department. We did not have access to information from the Finnish part of the macroseismic area. Intensity IV–V was felt in Siekasjärvi, about 5 km south of the instrumental epicentre, where many sleeping people awoke, a few ran out, buildings trembled and animals became uneasy. Intensities III or III–IV were reported from Kuusijärvi, Penttäjä, Rantajärvi and Ruokojärvi. The limit of perceptibility, on the Swedish side of the border, is shown in Figure 7. Collected macroseismic data yield a focal depth of 3 km and a macroseismic magnitude of 2.7.

September 9, 1999, Falköping, Västergötland

On the evening of September 9, 1999, a moderate earthquake shook a wide area of south-central Sweden. The instrumental epicentre was located about 10 km north of Falköping in the province of Västergötland. We evaluated 34 questionnaires. The highest intensity IV was reported from Fåglavik, Norra Vånga, Tidaholm and Vara where buildings trembled, and windows and dishes rattled. Vibrations were like those caused by the passing of a heavily loaded truck. For another 15 localities the estimated intensities were III or III–IV. Felt intensities do not exhibit any clear increase towards the instrumental epicentre (Fig. 8).

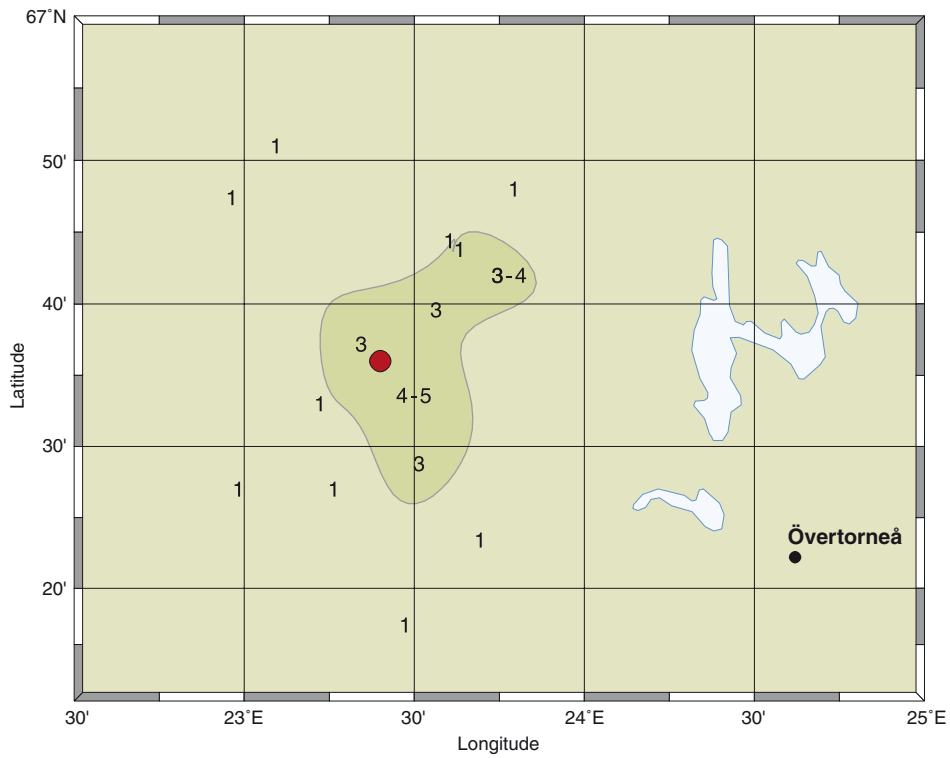


Fig. 7. Intensity distribution and the area of perceptibility (shaded) for the event of April 8, 1999. Conventions as for Fig. 2.

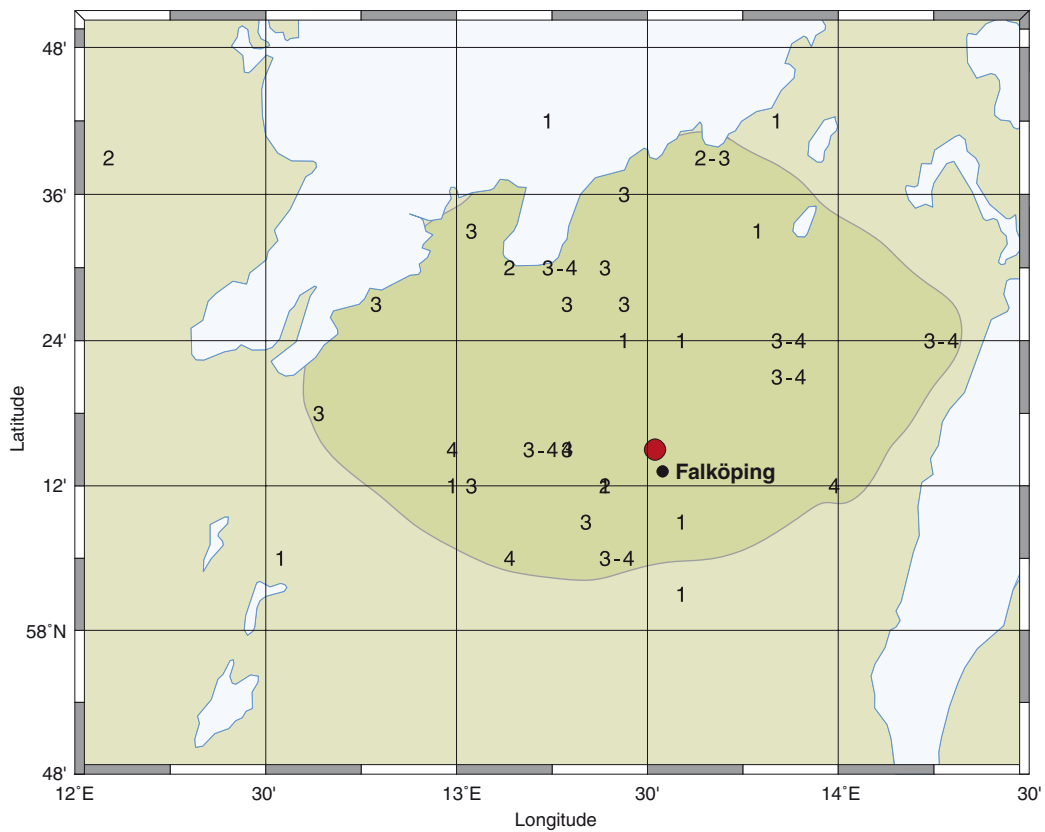


Fig. 8. Intensity distribution and the area of perceptibility (shaded) for the event of September 9, 1999. Conventions as for Fig. 2.

The event was felt in a large semi-circular area of about 5 300 km². Observed macroseismic intensities provide $h=14$ km and $M_M= 3.1$.

October 10, 1999, Vårgårda, Västergötland

A moderate earthquake was felt in a small area of $\approx 1\,400$ km² near Vårgårda in the province of Västergötland on the early evening of October 10, 1999. The instrumental epicentre was located about 15 km north of Vårgårda. We collected 31 answers to our questionnaires. The highest intensity of IV was reported from Södra Lundby, while intensity III–IV was felt in Magra and Vara. Roofs creaked, windows rattled, furniture began to shake. Felt intensities were similar to those generated by a passing of a heavily loaded truck. Intensity III was felt in Herrljunga, Stenstorp, Vedum and Vårgårda. Determined intensities together with the estimated area of perceptibility are displayed in Figure 9. Observed macroseismic parameters introduced into (1) and (2) give $h=7$ km and $M_M= 2.8$, respectively.

May 1, 2000, Adak, Lappland

Shortly before midnight on May 1, 2000, a strong earthquake struck a large area of northern Lappland. The instrumental epicentre was located about 5 km north-east of Adak. 35 questionnaires were received at the department. The event was felt with the maximum intensity of V or IV–V in Björkland, Buresjön and Gunnarn. Windows, doors and dishes rattled, floors and walls creaked, furniture began to shake, buildings trembled, many sleeping people awoke and a few ran outdoors frightened. Pets (dogs) became uneasy. 12 localities reported intensity IV. The collected macroseismic data together with a deduced area of perceptibility are displayed in Figure 10.

This event was felt within an area of about 5 800 km². By using the collected macroseismic data we derived a focal depth of 8 km and a macroseismic magnitude of 3.4.

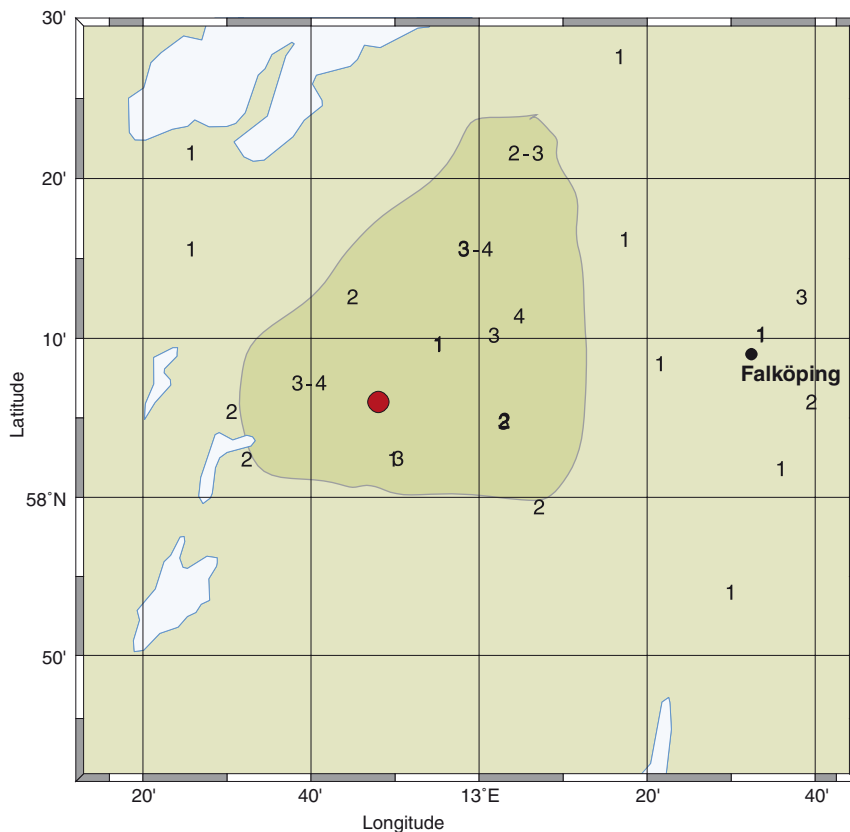


Fig. 9. Intensity distribution and the area of perceptibility (shaded) for the shock of October 10, 1999. Conventions as for Fig. 2.

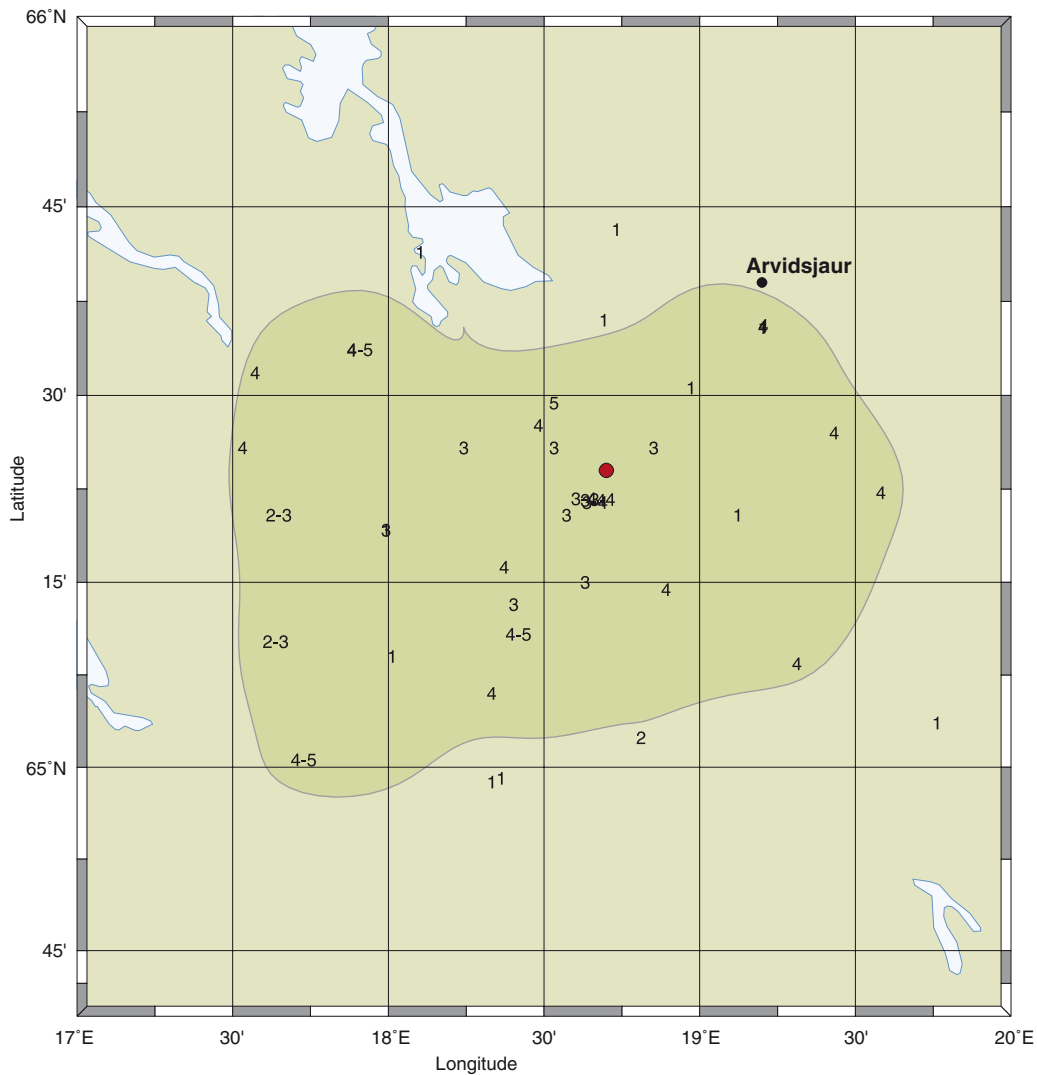


Fig. 10. Intensity distribution and the area of perceptibility (shaded) for the shock of May 1, 2000. Conventions as for Fig. 2.

May 23, 2000, Åseda, Småland

A weak earthquake took place on the afternoon of May 23, 2000, in central Småland province. The instrumental epicentre was located about 10 km south-east of Åseda. The event was felt only in Svenshult with intensity II–III.

May 23, 2000, Obbola, Västerbotten

Another weak earthquake occurred on the evening of May 23, 2000, in the coastal area of Västerbotten. The instrumental epicentre was about 10 km south of Umeå. The only report came from Obbola where the felt intensity was III.

September 10, 2000, Järvsö, Hälsingland

A moderate quake took place in the morning hours of September 10, 2000, in central Hälsingland province, with an instrumental epicentre about 13 km east of Järvsö. We collected 30 questionnaires with reported felt intensities. The highest intensity of IV–V was felt in Svedja, while intensity IV was reported from Nor, Simeå, Skog and Vålsjö. Buildings trembled throughout, windows rattled, paintings

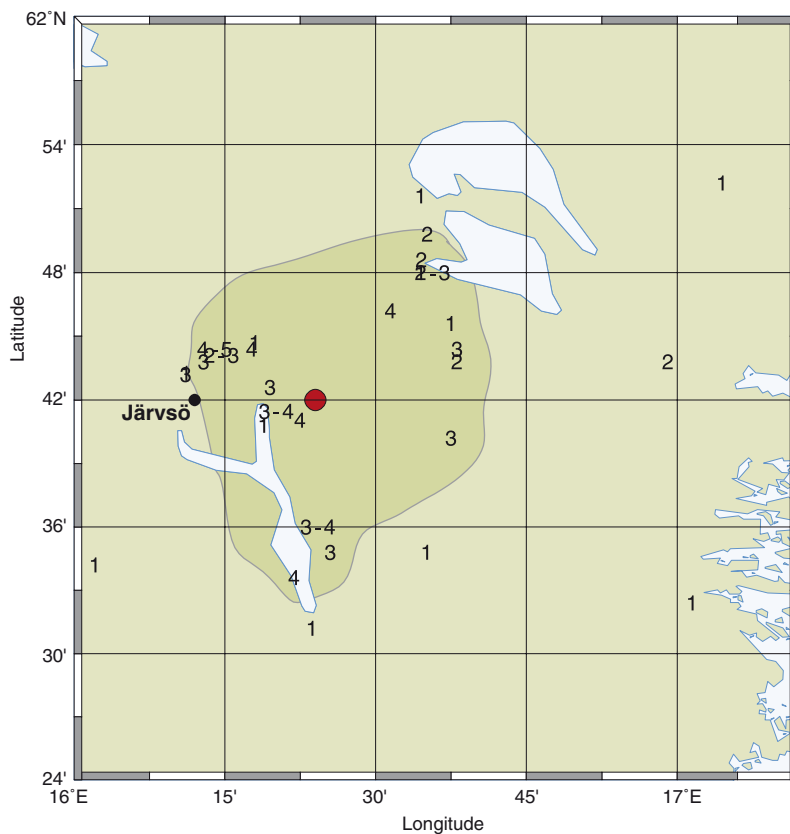


Fig. 11. Intensity distribution and the area of perceptibility (shaded) for the earthquake of September 10, 2000. Conventions as for Fig. 2.

swung out of place, some people ran outside and some thought their furnaces had exploded. The sensation of vibrations was similar to that due to a heavy object falling inside the building. Some people had difficulties to keep their balance. The collected macroseismic information is shown in Figure 11.

The earthquake was felt in a small semi-circular area of about 600 km². The estimated macroseismic intensities yield $h=3$ km and $M_M=2.7$.

November 29, 2000, Strömstad, Bohuslän

In the late evening of November 29, 2000, a strong earthquake shook a vast area of the provinces of Bohuslän and Västergötland. The instrumental epicentre was located less than 10 km north of Strömstad, near to the Norwegian border. 112 questionnaires were collected at the department. However, we did not have access to information from the Norwegian side of the macroseismic area. The largest intensity of V was reported from Strömstad and Tanumshede, while intensity IV was felt in Bengtsfors, Borås, Ed, Grästorp, Karlstad, Kil, Mellerud, Moledet, Nord-Koster and Syd-Koster, Sollebrunn, Säffle and Västra Bleken. In Strömstad and Tanumshede many sleeping people awoke, some were frightened and ran out. Buildings trembled throughout, and furniture began to shake. The sensation of vibrations was like that due to the passing of a train. Felt intensities are shown in Figure 12. This is the largest Swedish event during the period of review. Access to the Swedish part of macroseismic data only, made it impossible to draw a corresponding isoseismal map.

December 20, 2000, Smålandsstenar, Småland

By mid-afternoon of December 20, 2000, a moderate earthquake was felt in a limited area of western Småland. The instrumental epicentre was located about 15 km north-west of Smålandsstenar. 15 reports were collected at the department. A maximum intensity of IV was felt in Bredaryd and in Landeryd where the quake was felt indoors by many people. Floors creaked. Felt vibrations were comparable to those due to the passing of a heavily loaded truck. A small number of reports and a rather inconsistent geographical spread of reported intensities prevent the presentation of a map of the macroseismic field.

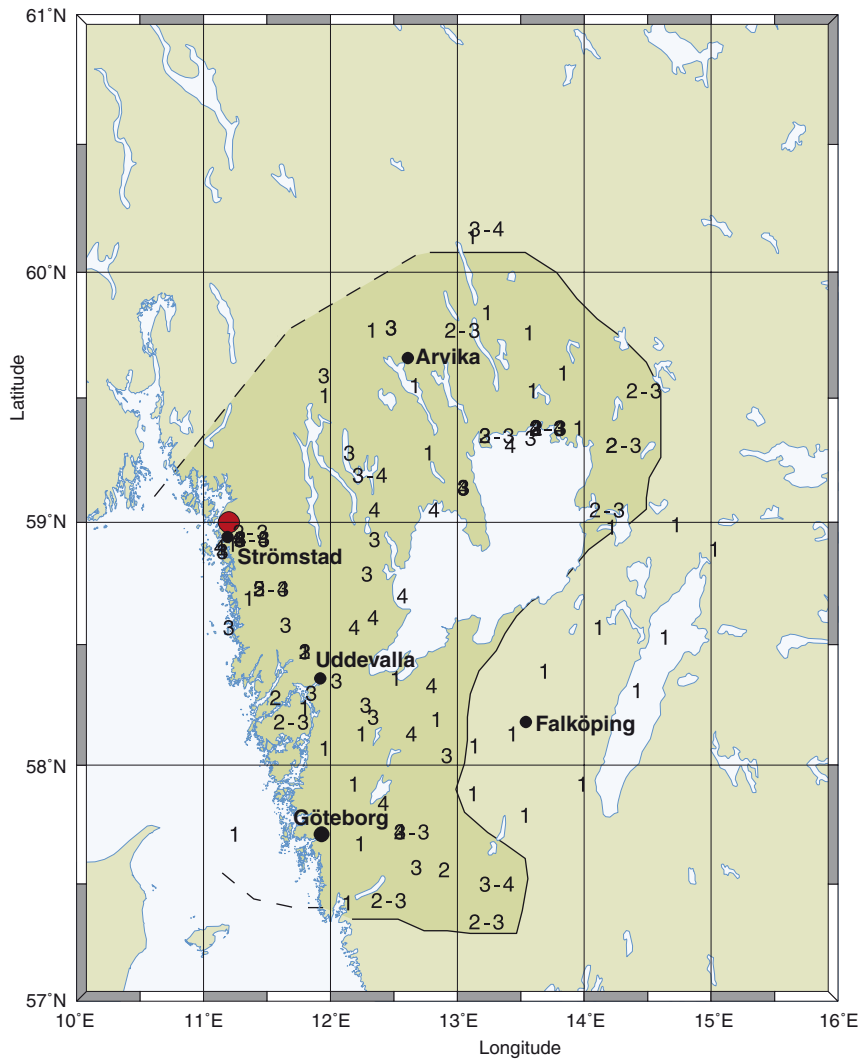


Fig. 12. Swedish part of intensity distribution and area of perceptibility (shaded) for the earthquake of November 29, 2000. Conventions as for Fig. 2.

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