Progress Report No. 2013-1

for

Norwegian National Seismic Network

January 1 to October 31, 2013

Supported by

Norwegian Oil and Gas Association

and

University of Bergen, Department of Earth Science

Prepared by

Department of Earth Science
University of Bergen
Allegaten 41, N-5007 Bergen

November 2013

CONTENTS

1 Introduction

This annual report describes the operation of the Norwegian National Seismic Network (NNSN) for the first part of 2013. The network is financially supported by the oil industry through the Norwegian Oil and Gas Association and the University of Bergen (UiB). UiB has the main responsibility to run the NNSN. This report covers operational aspects for all seismic stations operated by the Department of Earth Science at the UiB and includes the financial report.

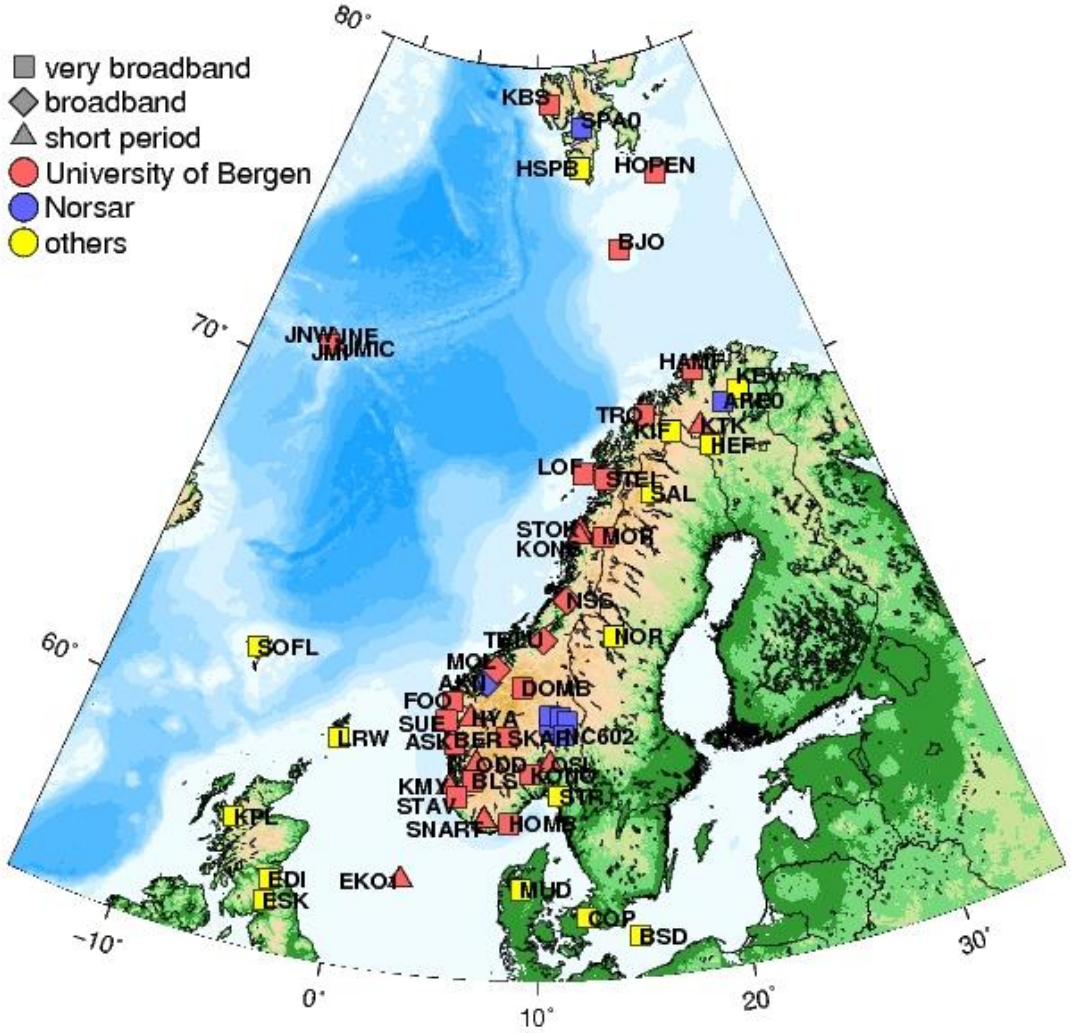

Figure 1. Stations delivering data to the NNSN database.

2 Operation

In Norway, UiB operates 32 of the seismic stations that form the Norwegian National Seismic Network (NNSN). NORSAR operates 3 seismic arrays, which also include broadband instruments, and two single seismometer stations (JMIC and AKN) (Figure 1). In total,

NORSAR provides data from 12 broadband stations to the NNSN. The station HSPB is operated jointly between NORSAR and the Geophysical Institute, Polish Academy of Sciences, Warsaw, Poland. The seismicity detected by the network is processed at UiB, but also NORSAR integrates their results in the joint database at UiB. A seismicity map for the reporting period is shown in Figure 2.

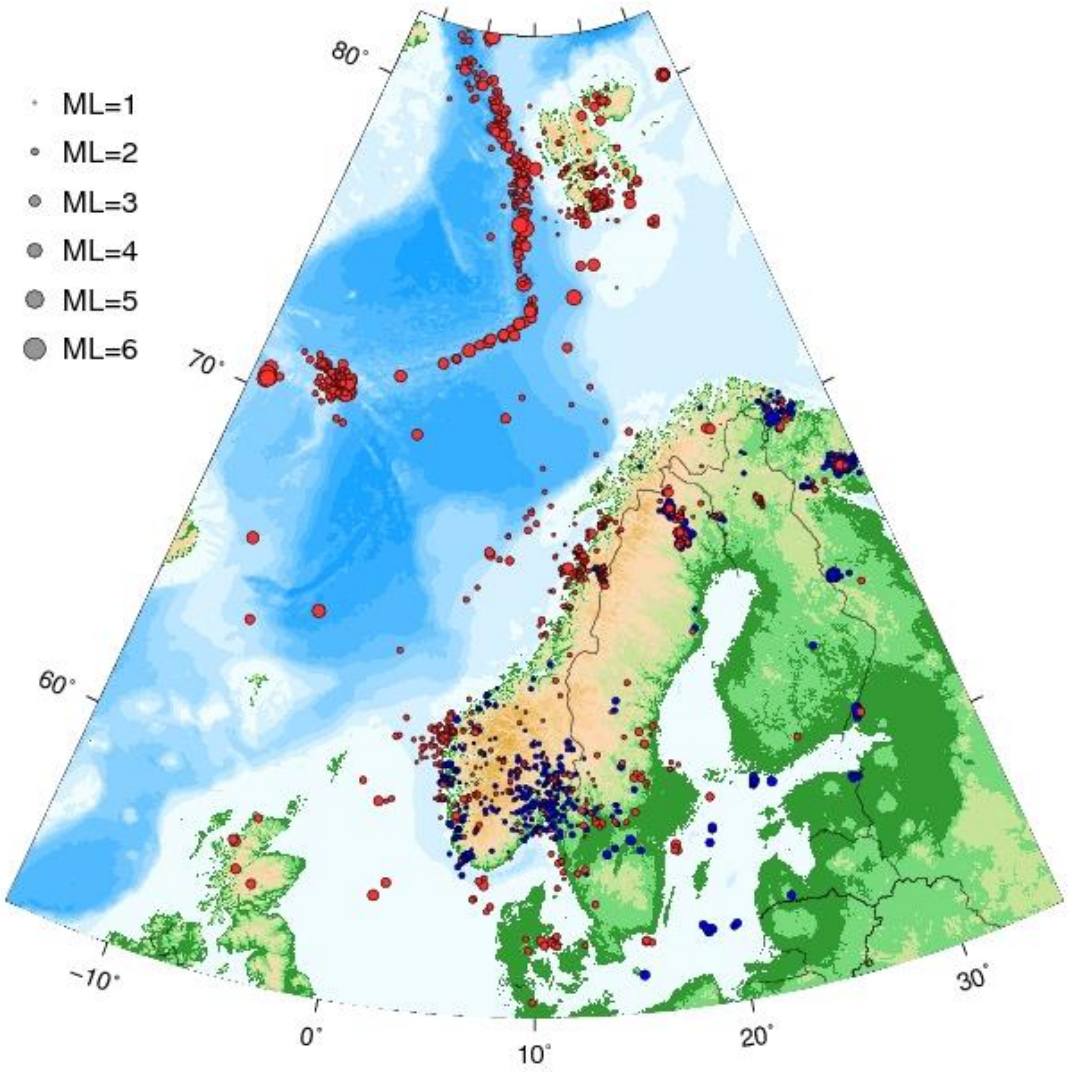

Figure 2. Seismity map showing earthquakes (red) and explosions (blue) for the period January to October, 2013.

UiB is in the process of upgrading the NNSN by changing short period (SP) to broadband (BB) seismometers. A further effort is made to install additional high quality digitizers. The current status of this upgrade is shown in Figure 3. As of today the numbers of SP, BB stations and stations with real time transmission are listed in Table 1.

Table 1. Overview of UiB seismic stations

	Short Period	Broadband	Real time
Number of stations	11	21 (18 with natural period greater than 100 sec)	29 (not real time are 2 short period and 1 broadband stations on Jan Mayen)

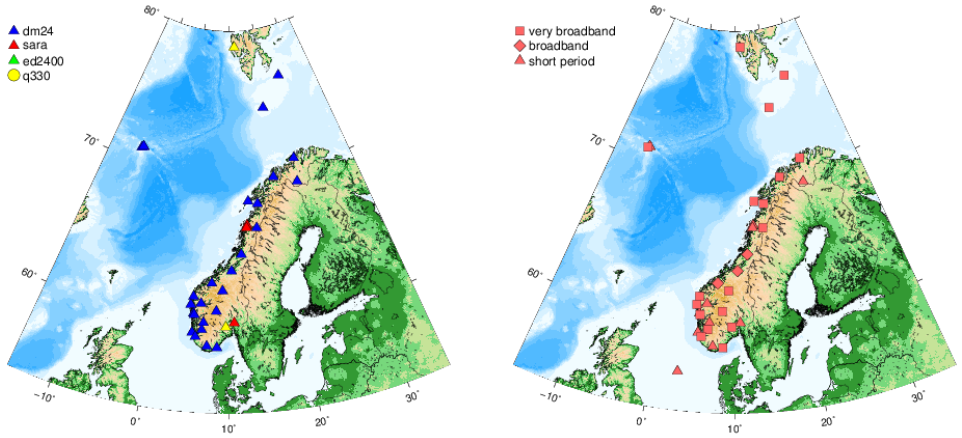

Figure 3. Status of the NNSN stations operated by UiB as of 31 October 2013. Left: Overview of digitizers, still to be upgraded are types Sara and EarthData (ED). Right: Overview of seismometers.

The operational stability for each station is shown in Table 2. The downtime is computed from the amount of data that are missing from the continuous recordings at UiB. The statistics will, therefore, also show when a single component is not working. This is done as the goal is to obtain as complete continuous data from all stations as possible. Also, communication or computing problems at the centre will contribute to the overall downtime. In the case of communication problems, a station may not participate in the earthquake detection process, but the data can be used when it has been transferred. Thus, the statistics given allow us to evaluate the data availability when rerunning the earthquake detection not in real-time.

The downtime for the majority of stations is below 5%. Larger down time were observed for the following stations: ASK, FOO, SNART, SUE and TBLU (see technical service overview for details). The completeness for KBS and KONO is below 95%, however, this results from data exchange problems, and more complete data are available from the IRIS data center.

Table 2. Data completeness in % for January to October 2013 for all stations of the NNSN operated by UiB.

Station	Data completeness in %
Askøy (ASK)	**93.6**
Bergen (BER)	99.6
Bjørnøya (BJO)	98.5
Blåsjø (BLS)	98.3
Dombås (DOMB)	99.4
Florø (FOO)	**62.1**
Hammerfest (HAMF)	99.6
Homborsund (HOMB)	97.9
Hopen (HOPEN)	97.4
Høyanger (HYA)	98.9
Jan Mayen (JMI)	100.
Jan Mayen (JNE)	100.
Jan Mayen (JNW)	100.
Karmøy (KMY)	96.9
Kautokeino (KTK)	98.1

Station	Data completeness in %
Kings Bay (KBS)	***92.8***
Kongsberg (KONO)	***93.5***
Konsvik (KONS)	99.5
Lofoten (LOF)	96.3
Mo i Rana (MOR8)	96.4
Molde (MOL)	97.7
Namsos (NSS)	97.6
Odda (OOD1)	98.8
Oslo (OSL)	98.0
Skarslia (SKAR)	95.0
Snartemo (SNART)	**88.6**
Stavanger (STAV)	99.6
Steigen (STEI)	97.4
Stokkvågen (STOK)	97.8
Sulen (SUE)	**83.7**
Blussvoll (TBLU)	**92.1**
Tromsø (TRO)	98.0

3 Field stations and technical service

The technical changes for each seismic station are listed below. It is noted if these changes are carried out by the respective local contact and not by the technical staff of UiB. When a station stops working, tests are made to locate the problem. Sometimes the reason cannot be found and the cause of the problem will be marked as unknown.

Major changes during this reporting period of 2013 were:

Ask (ASK) 08.01.13: Data lost from 31.12.12 due to faulty power supply and monitor.

24.05.13: Station down from 18.05 due to PC problems. New PC was installed 24.05 and the station was in operation from midnight.

Bergen (BER) No visit or technical changes.

Bjørnøya (BJO1) No visit or technical changes.

Blåsjø (BLS) No visit or technical changes.

Blussvoll (TBLU) 21.05.13: Station down from 28.04.13 due to PC problems. Local contact was able to fix the problem.

Dombås (DOMB)	22.10.13: Visit. The aluminum box was too small to use the standard insultaion shield for the sensor. The box was insulated on the outside.
Florø (FOO)	09.01.13: Visit. The Trillium 120PA sensor was replaced by a Trillium 120P due to signal problems**.** 04.04.13: Station down since 17.03.13 due to PC problem. PC replaced by local operator. 19.09.13: Visit. Since 14.06 the power supplied to the sensor has been unstable due to bad connection in the junction box. Data lost.
Hammerfest (HAMF)	No visit or technical changes.
Homborsund (HOMB)	13.05.13: Visit. Sensor centred as it had not been stable. 11.10.13: Visit. A new concrete base was made in the aluminium box as the previous one had deteriorated. Trillium 120P changed and thermo shield was installed. New PC installed**.**
Hopen (HOPEN)	10.01-26.02.13: Problems with GPS antenna. New GPS antenna was send from Bergen and installed by local staff.
Høyanger (HYA)	14.02-19.02.13: GPS signal unstable.
Jan Mayen (JMI)	04.01.13: New Patton modem installed by base personnel, to avoid telemetry gaps. 28.01.13: New Nanometrics accelerometer model "Titan" installed. 31.01.13: The PC was replaced with a PC with larger harddrive. 30.04.13: UPS installed.
JNE	No visit or technical changes.
JNW	No visit or technical changes.
Karmøy (KMY)	29.04.13: Visit. The vertical sensor (SS-1) was relocated from the temporarily location in the house to a permanent site outside and a new cable installed. New GPS antenna and Guralp digitizer installed. 28.08.13: Station down between 20-28.08 due to bad connection. Problem solved by local operator.
Kautokeino (KTK)	23.09.13: Digitizer gain remotely changed from 1x to 8x. The station had several problems with digitizers which have been replaced two times by the local operator.
Kings Bay (KBS)	No visit or technical changes.

Kongsberg (KONO)	No visit or technical changes.
Konsvik (KONS)	No visit or technical changes.
Lofoten (LOF)	02.07.13: Communication/PC problem. Local contact restarted the station 05.07. Data lost between 02.07 at 11:00 to 08.07 at 00:00. 09.07.13: PC problem. New PC sent from Bergen and installed 12.07.13 by local contact. Data lost between 09.07 at 02:00 to 12.07 at 16:00.
Mo i Rana (MOR8)	01-17.01.13: Communication down. No data lost. During May 2013 it was observed water in the aluminium-box. The local contact removed the water and tried to seal the box. The data was noisy and all connection and the sensor must be checked. At the time with water in the vault, the data had spikes. 05-07.06.13: Visit. A new concrete base in the box was made and waterproof primer was applied. The sensor was insulated inside the box and insulation was also used outside the aluminium-box. Work was done to drain water from the site.
Molde (MOL)	21.10.13: Visit. The sensor (Guralp CMG-6TD) was replaced by one of the same type.
Namsos (NSS)	No visit or technical changes.
Odda (ODD1)	29-30.04.13: Visit: A new GPS antenna, power suply and a digitizer (Guralp CGM-EAM) were installed.
Oslo (OSL)	No visit or technical changes.
Skarslia (SKAR)	21.03.13: Station installation completed and in operation for the first time. 05.04.13: Visit by local electrician. 28.05.13: Visit by local contractor. 15.07.13: Visit for inspection. 03-12.08.13: Station down due to thunderstorm which resulted in a power failure. Power reconnected by local inspector of the ’renseanlegg’ 05.09.13: A new digitizer for the GPS was installed. GPS now ok. 27.09.13: Visit for inspection and documentation.
Snartemo (SNART)	08.03.13: Router for communication installed by local operator. 24.06.13: Visit. Digitizer (GuralpEAM DM24) installed. GPS antenna replaced. 28.06.13: New PC installed. Data lost between 07-28.06.13.

	The station was visited several times during the summer. Several attempts were made to improve the signal.
Stavanger (STAV)	29.01.13: The GPS was changed by the local operator. 24.06.13: The sensor was moved from the reception area and reinstalled in the basement of the building.
Steigen (STEI)	30.03-04.04.13: Station down due to power failure. Data lost for this period of time.
Stokkvågen (STOK)	No visit or technical changes.
Sulen (SUE)	26.03.13: Visit. Station location and the sensor were found broken due to tree cutting. The station had to be reinstalled. No data until April 24. 23-24.04.13: Visit: A new site was made and the station was reinstalled. Sensor: Trillium 120PA. 17.10.13: Heavy lightning during morning hours caused power failure. Station down until end of October. The communication to the station was down for a longer time period than the power loss.
Tromsø (TRO)	No visit or technical changes.

4 NNSN plans

The overall purpose of the NNSN is to provide data both for scientific studies, but equally important for the routine observation of earthquakes. This in principle means that broadband seismometers are desired at all sites. However, in areas where additional stations are deployed for local monitoring, short-period seismometers are sufficient. The number of broadband seismometers in the network will be increased to replace existing short period instruments. A general goal for the future development has to be to achieve better standardization in particular with the seismometers and digitizers. The total number of stations for now should remain stable, but it is important to improve the overall network performance.

We now report achievements for 2013, and then give the plans for 2013/14.

4.1 Achievements in 2013

- Upgrade: Stations KMY, ODD1 and SNART were upgraded with Guralp digitizers.
- The new station at Skarslia, Ål municipality, was installed 21 March 2013.. The station has been performing well and has very low noise levels.
- Preparations for a new station near Fauske, northeast of Bodø, have started and the installation is scheduled for end of November 2013.

- Data from the new NEONOR2 project with temporary deployments in Nordland will be available to the NSNN. At the end of October, 17 of 25 planned stations are operational with communication to 10 of them. All stations are equipped with high quality broadband stations. There is no cost to the NNSN project from this deployment.
- Research and development:
    - UiB: A PhD candidate (Andrea Demuth) has started at UiB in September. The PhD project will have a duration of three years. The proposed topics are evaluation of the network, magnitude scales, attenuation tomography and earthquake source parameters. Additional research work has been carried out on the large Jan Mayen fracture zone earthquakes and the Storfjorden earthquakes. Both of these studies are nearly completed.
    - NORSAR: Work has been carried out on the use of the mb(Lg) scale which is based on coda waves.
- An accelerometer has been installed in parallel to the seismometer at the JMI site.
- NNSN website: Progress has been made on the selection of helicorder plots.
- The Nordic Seminar on Detection Seismology was arranged in Bergen September 16-18, with 40 participants from all Nordic countries and the Baltic states.

4.2 Plans for 2013/2014

- Upgrade: Stations OSL and STOK will be considered for installation of a broadband seismometer.
- Planning for upgrade of the two Jan Mayen stations JNE and JNW will begin depending on agreement with FKD and continuation of operations on Jan Mayen.
- Hopen: The station is to be improved by re-siting and new construction of the vault. The existing STS2 seismometer has to be checked and will temporarily be replaced with a Nanometrics sensor. Timing of this will also depend on the costs involved.
- Research and development: This activity will continue in close collaboration between UiB and NORSAR.
- Strengthen the collaboration with NORSAR on data processing through technical visits.
- Collaborate with other Scandinavian countries to improve identification of explosions, particulary in Northern Scandinavia.
- Revising the questionnaires for felt earthquakes.

5 Economy

The Norwegian National Seismic Network is supported economically by the Norwegian Oil and Gas Association and the Department of Earth Sciences, University of Bergen.

The contributions from the two sources in kNOK for 2013 are:

Norwegian Oil and Gas Association	**5830**
University of Bergen, Department of Earth Sciences	**1264**
Total	**7094**

Table 3. Accounting for 2013 for the Norwegian National Seismic Network (in 1000 NOK)

	Budget for 2013	**Spent by Oct. 31**	**Rest**
Carried forward from 2012			0
Salary UiB	3975	-3212	763
International memberships	105	-5	100
Project travels inc. overtime	260	-182	78
Project equipments	520	-639	-119
Rent/Electricity/local salary	312	-198	114
Communication	312	-122	190
NORSAR operational tasks	415	-311	104
NORSAR salary	1145	-858	287
Other	50	-13	37
TOTAL	**7094**	**-5540**	**1554**