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The NORSAR Data Center (FDSN Network Code NO)

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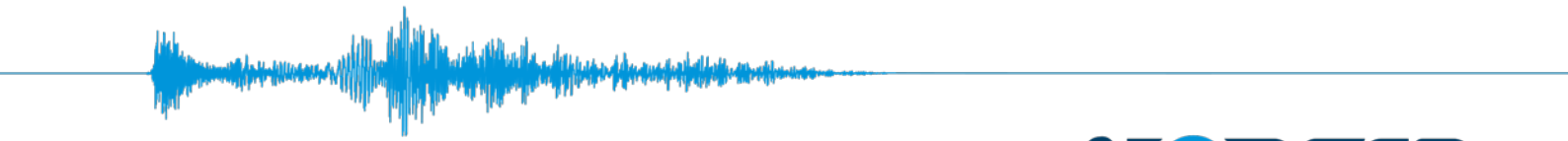

NORSAR

1 Introduction

The NORSAR project was established in 1968 when a Government-to-Government agreement between the United States of America and Norway came into effect. The agreement focused on seismic array research with the main purpose to develop means for the verification of compliance with a future nuclear-test-ban treaty. NORSAR was established to fulfil the objectives of this agreement. From 1970 – 1993, NORSAR was a section of the Royal Norwegian Council for Industrial and Scientific Research, and from 1993 – 1999 a section of the Norwegian Research Council. NORSAR became an independent research foundation on 1 July 1999 and with ratification of the CTBT by the Norwegian Parliament on 15 July 1999, NORSAR has been established as the Norwegian National Data Center (NDC) for treaty verification. NORSAR employs about 45 people.

Figure 1. *Main building of the NORSAR institute in Kjeller, Norway.*

Based on a strong international profile, NORSAR conducts research, development and consulting within various fields of seismology and applied geophysics. From the early days of devoted seismic array research, NORSAR has broadened its research activities to include subjects like earthquake hazard & risk assessment and seismic modelling for the petroleum industry. The infrastructure of the institute consists of a data center and field installations (several seismic array stations) constructed for the recording of seismic signals from earthquakes and underground explosions.

Figure 2. *A map of the Norwegian IMS stations, the NORES array and the two 3C stations AKN and JETT. NORSAR, as the Norwegian NDC, is responsible for the seismic auxiliary stations AS72 (SPITS array) and AS73 (3C stations JMIC), the primary stations PS27 (NOA array) and PS28 (ARCES array), the infrasonic array (I37NO), and the radionuclide station on Spitsbergen (RN49). NOA is the array with the largest aperture of the whole IMS network.*

NORSAR is a large seismological observatory specialized in seismic arrays, and with extensive access to data in real time from its own arrays and 3c stations and from arrays and 3C stations operated by other institutions, and from various data banks. NORSAR's own data are freely available to the seismological community. NORSAR scientists have involved themselves and their institute extensively in international cooperation over the years regarding various aspects like array design, installation and operation. NORSAR has been a main contributor to the technology presently used at the International Data Centre (IDC) of the Provisional Technical Secretariat of the Comprehensive Nuclear-Test-Ban Treaty Organisation (CTBTO) in Vienna. For further general information on NORSAR see web-page (http://www.norsar.no).

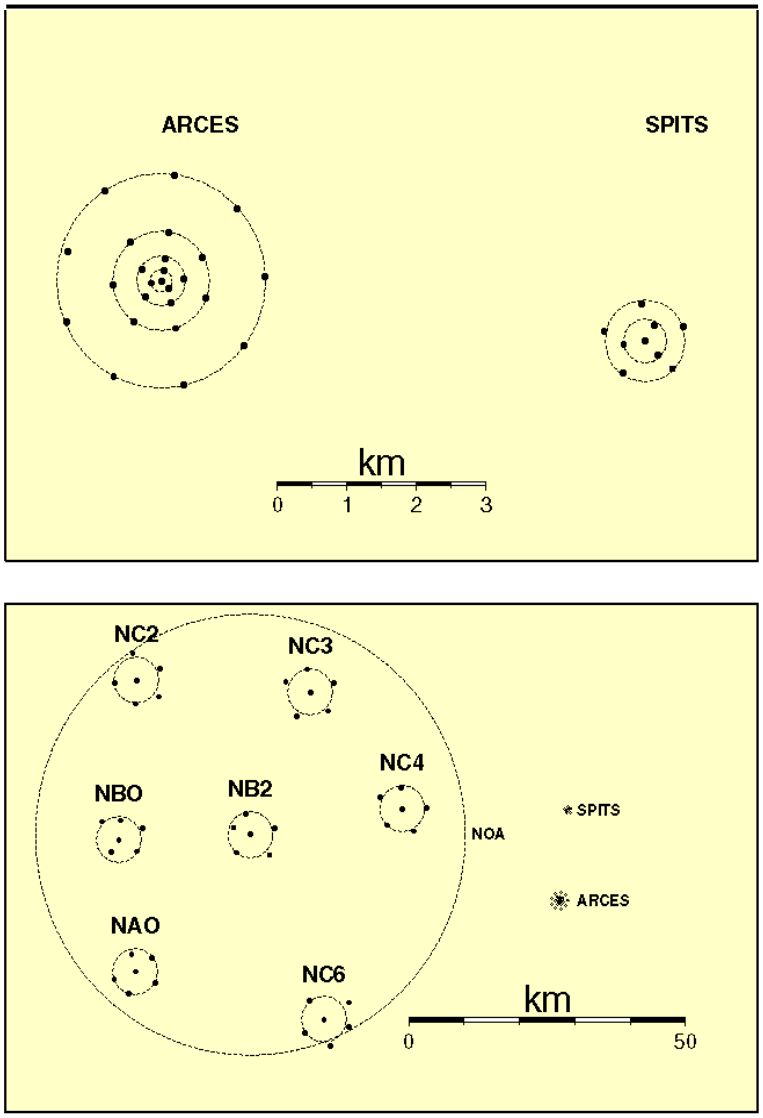

Figure 3. *Geometry and size of the three NORSAR arrays currently in operation NOA, ARCES and SPITS. The NORES array is now operative again with 9 of its 25 sites (A- and B-ring), has a geometry identical to that of ARCES, and is co-located with site NC602 of the NOA array.*

2 The Network

The permanent seismic network currently operated by NORSAR consists of four seismic arrays and four three-component (3C) stations. Fig. 3 shows geometry and size of the different arrays. Three arrays are part of the IMS operated for the CTBT organization in Vienna and are located in Southern Norway (NOA, the initial (large) NORSAR array), PS27), the Norwegian Arctic (ARCES array, PS28) and on Spitsbergen, the main island of the Svalbard Archipelago (SPITS array, AS72). A fourth array (the NORES array) co-located with one of the NOA subarrays had been out of operation for many years due to a fire caused by lightening, which destroyed most of the electronic equipment. Since January 2011, the array is operative again with 3C short period sensors at 9 of its originally 25 sites (A- and B-ring).

All arrays are equipped with short period and/or broadband sensors from different vendors but each array has at least one 3C broadband sensor.

The 3C broadband station located on the Island of Jan Mayen in the North Atlantic between Norway and Greenland is also part of the IMS network (JMIC, AS73). Since October 2009, NORSAR operates a 3C broadband station (AKN) at Åknes (Møre & Romsdal, Western Norway) to monitor an unstable rock slope. In February 2012, NORSAR installed a 3C broadband station (TROLL) at the Norwegian research base Troll in Dronning-Maud Land, Antarctica. In November 2014 a new 3C broadband station (JETT) was installed in Nordnes (Troms, Northern Norway) to monitor the unstable rock slope Jettan.

Since September 2004, the NORSAR network is member of the Federation of Digital Seismographic Networks (FDSN) and the FDSN network code is NO.

In 2012-2014, the Norwegian pool of mobile sensors had been build up with financing from the Research Council of Norway. This new pool is steered by committee consisting of representatives from all major seismologically interested institutions in Norway and is led by and hosted at NORSAR. The pool consists of 30 stations equipped with EDR-210 dataloggers, 24 STS-2.5, and 6 CMG-3ESPC sensors. The tool is currently deployed in northern Norway in the framework of two research projects.

Table 1. *All seismometer sites of NORSAR's network and their actual instrumentation.*

ISC Code	Latitude [°]	Longitude [°]	Elevation [km]	Instrument	Component(s)
NOA (PS27), March 1971 – present					
Subarray NA0 (Brumunddal)					
NAO00	60.8237	10.8324	0.3790	CMG-1V-Hybrid	BBZ
NAO01	60.8442	10.8865	0.4260	CMG-3T-Hybrid	VBB-3C
NAO02	60.8057	10.8971	0.3620	CMG-1V-Hybrid	BBZ
NAO03	60.7881	10.8084	0.2230	CMG-1V-Hybrid	BBZ
NAO04	60.8105	10.7625	0.2970	CMG-1V-Hybrid	BBZ
NAO05	60.8507	10.8193	0.2900	CMG-1V-Hybrid	BBZ
Subarray NB2 (Vangsåsen)					
NB200	61.0397	11.2148	0.7170	CMG-1V-Hybrid	BBZ
NB201	61.0495	11.2939	0.6130	CMG-3T-Hybrid	VBB-3C
NB202	61.0069	11.2778	0.6470	CMG-1V-Hybrid	BBZ
NB203	61.0107	11.1677	0.7300	CMG-1V-Hybrid	BBZ
NB204	61.0498	11.1581	0.6700	CMG-1V-Hybrid	BBZ
NB205	61.0710	11.1977	0.6370	CMG-1V-Hybrid	BBZ
Subarray NBO (Moelv)					
NBO00	61.0307	10.7774	0.5290	CMG-3T-Hybrid	VBB-3C
NBO01	61.0616	10.7834	0.5960	CMG-1V-Hybrid	BBZ
NBO02	61.0492	10.8569	0.5210	CMG-1V-Hybrid	BBZ
NBO03	61.0129	10.8371	0.4290	CMG-1V-Hybrid	BBZ
NBO04	61.0119	10.7524	0.3980	CMG-1V-Hybrid	BBZ
NBO05	61.0597	10.7219	0.5530	CMG-1V-Hybrid	BBZ
Subarray NC2 (Lillehammer)					
NC200	61.2807	10.8354	0.8470	CMG-1V-Hybrid	BBZ
NC201	61.2988	10.9138	1.0330	CMG-1V-Hybrid	BBZ
NC202	61.2545	10.9110	1.0540	CMG-1V-Hybrid	BBZ
NC203	61.2438	10.8318	0.7140	CMG-1V-Hybrid	BBZ

NC204	61.2759	10.7629	0.8510	CMG-3T-Hybrid	VBB-3C
NC205	61.3231	10.8227	0.9580	CMG-1V-Hybrid	BBZ
Subarray NC3 (Rena)					
NC300	61.2617	11.4141	0.3660	CMG-1V-Hybrid	BBZ
NC301	61.2762	11.4905	0.2900	CMG-1V-Hybrid	BBZ
NC302	61.2328	11.4726	0.3000	CMG-1V-Hybrid	BBZ
NC303	61.2251	11.3690	0.4010	CMG-3T-Hybrid	VBB-3C
NC304	61.2784	11.3320	0.3930	CMG-1V-Hybrid	BBZ
NC305	61.2979	11.4035	0.3120	CMG-1V-Hybrid	BBZ
Subarray NC4 (Elverum)					
NC400	61.0791	11.7189	0.5220	CMG-1V-Hybrid	BBZ
NC401	61.0804	11.7994	0.5830	CMG-1V-Hybrid	BBZ
NC402	61.0446	11.7573	0.4500	CMG-1V-Hybrid	BBZ
NC403	61.0537	11.6683	0.3040	CMG-1V-Hybrid	BBZ
NC404	61.0982	11.6456	0.3320	CMG-1V-Hybrid	BBZ
NC405	61.1128	11.7153	0.4960	CMG-3T-Hybrid	VBB-3C
Subarray NC6 (Løten)					
NC600	60.7473	11.4584	0.3210	CMG-1V-Hybrid	BBZ
NC601	60.7746	11.5416	0.2480	CMG-1V-Hybrid	BBZ
NC602	60.7353	11.5414	0.3050	CMG-3T-Hybrid	VBB-3C
NC603	60.7050	11.4807	0.3400	CMG-1V-Hybrid	BBZ
NC604	60.7263	11.3956	0.3780	CMG-1V-Hybrid	BBZ
NC605	60.7770	11.4103	0.2420	CMG-1V-Hybrid	BBZ
ARCES Array (PS28), since October 1987 – present					
ARA0	69.5349	25.5058	0.4030	CMG-3T-Hybrid	VBB-3C
ARA1	69.5363	25.5071	0.4110	CMG-3T-Hybrid	BB-3C
ARA2	69.5338	25.5078	0.3920	CMG-3T-Hybrid	BB-3C
ARA3	69.5346	25.5019	0.4020	CMG-3T-Hybrid	BB-3C
ARB1	69.5379	25.5079	0.4140	CMG-3T-Hybrid	BB-3C
ARB2	69.5357	25.5134	0.3970	CMG-3T-Hybrid	BB-3C
ARB3	69.5324	25.5106	0.3760	CMG-3T-Hybrid	BB-3C
ARB4	69.5328	25.4998	0.3780	CMG-3T-Hybrid	BB-3C
ARB5	69.5363	25.4985	0.4050	CMG-3T-Hybrid	BB-3C
ARC1	69.5411	25.5079	0.3810	CMG-3T-Hybrid	BB-3C
ARC2	69.5383	25.5229	0.3950	CMG-3T-Hybrid	BB-3C
ARC3	69.5329	25.5231	0.3760	CMG-3T-Hybrid	BB-3C
ARC4	69.5293	25.5117	0.3770	CMG-3T-Hybrid	BB-3C
ARC5	69.5300	25.4981	0.3740	CMG-3T-Hybrid	BB-3C
ARC6	69.5341	25.4882	0.3950	CMG-3T-Hybrid	BB-3C
ARC7	69.5396	25.4937	0.3620	CMG-3T-Hybrid	BB-3C
ARD1	69.5483	25.5093	0.3950	CMG-3T-Hybrid	BB-3C
ARD2	69.5452	25.5308	0.3660	CMG-3T-Hybrid	BB-3C
ARD3	69.5366	25.5483	0.3310	CMG-3T-Hybrid	BB-3C
ARD4	69.5271	25.5362	0.3710	CMG-3T-Hybrid	BB-3C
ARD5	69.5214	25.5118	0.3510	CMG-3T-Hybrid	BB-3C
ARD6	69.5227	25.4900	0.4130	CMG-3T-Hybrid	BB-3C
ARD7	69.5294	25.4707	0.4130	CMG-3T-Hybrid	BB-3C
ARD8	69.5384	25.4686	0.3680	CMG-3T-Hybrid	BB-3C
ARD9	69.5454	25.4857	0.3590	CMG-3T-Hybrid	BB-3C
ARE0	69.5349	25.5058	0.4030	Closed since 2014	
NORES Array since October 1985 – present (in bold); out of operation 11/06/2002 – 29/12/2010					
NRA0	60.7353	11.5414	0.3020	GS13	SP3C
NRA1	60.7366	11.5423	0.2910	GS13	SP3C
NRA2	60.7343	11.5433	0.3110	GS13	SP3C
NRA3	60.7350	11.5387	0.2960	GS13	SP3C
NRB1	60.7381	11.5426	0.2990	GS13	SP3C
NRB2	60.7355	11.5475	0.3150	GS13	SP3C

NRB3	60.7326	11.5440	0.3140	GS13	SP3C
NRB4	60.7333	11.5372	0.2990	GS13	SP3C
NRB5	60.7367	11.5363	0.2890	GS13	SP3C
NRC1	60.7414	11.5434	0.2990	GS13	SPZ
NRC2	60.7383	11.5525	0.3390	GS13	SP3C
NRC3	60.7331	11.5533	0.3520	GS13	SPZ
NRC4	60.7293	11.5452	0.3110	GS13	SP3C
NRC5	60.7301	11.5341	0.2990	GS13	SPZ
NRC6	60.7348	11.5287	0.3030	GS13	SPZ
NRC7	60.7402	11.5331	0.2750	GS13	SP3C
NRD1	60.7486	11.5449	0.3050	GS13	SPZ
NRD2	60.7444	11.5616	0.3720	GS13	SPZ
NRD3	60.7359	11.5689	0.4530	GS13	SPZ
NRD4	60.7271	11.5633	0.3790	GS13	SPZ
NRD5	60.7222	11.5475	0.3480	GS13	SPZ
NRD6	60.7233	11.5288	0.3520	GS13	SPZ
NRD7	60.7302	11.5162	0.3370	GS13	SPZ
NRD8	60.7390	11.5167	0.3010	GS13	SPZ
NRD9	60.7466	11.5266	0.2780	GS13	SPZ
NRE0	60.7352	11.5414	0.3070	Closed since 2002	
SPITS Array (AS72), since November 1992 – present					
SPA0	78.1777	16.3700	0.3230	CMG-3TB	BB3C
SPA1	78.1797	16.3755	0.3200	CMG-3TB	BBZ
SPA2	78.1759	16.3766	0.2500	CMG-3TB	BBZ
SPA3	78.1773	16.3588	0.3390	CMG-3TB	BBZ
SPB1	78.1796	16.3906	0.3010	CMG-3TB	BB3C
SPB2	78.1742	16.3846	0.2000	CMG-3TB	BB3C
SPB3	78.1737	16.3584	0.2340	CMG-3TB	BB3C
SPB4	78.1789	16.3482	0.3400	CMG-3TB	BB3C
SPB5	78.1823	16.3683	0.2950	CMG-3TB	BB3C
JMIC (AS73), since October 2003 – present					
JMIC	70.9866	-8.5057	0.160	STS-2	BB3C
AKN, since October 2008 – present					
AKN	62.1783	6.9974	0.508	Guralp ESPC	BB3C
TROLL, since February 2012 – present					
TROLL	-72.0082	2.5300	01.399	STS-2.5	BB3C
JETT, since November 2014 – present					
JETT	69.55572	20.40950	0.631	Guralp ESPC	BB3C
Norwegian broadband pool					
24 Stations				STS-2.5	VBB3C
6 Stations				CMG-ESPC	BB3C

Starting 10 November 2000, NORSAR keeping all new data from its stations including all broadband channels on-line on disk (RAID system with a capacity of about 50 TByte). In addition all data are copied onto NORSAR's robot-tape archiving system with a capacity of about 50 TByte. All old data were and still are copied from the old tape archive (ExaBytes, MAG tapes) into the RAID and robot-tape archiving systems.

In October 2003, a new broadband station was installed on Jan Mayen, an island in the middle of the North Atlantic. NORSAR is responsible for this new 3C BB station (JMIC), which is an auxiliary station of the IMS network of the CTBTO in Vienna.

In August 2004, the long planned refurbishment of the SPITS array could be realized: new data loggers were installed and all seismometers were exchanged to 1C or 3C broadband borehole sensors.

In October 2009, a new 3C broadband station was built to monitor the Åknes site, an unstable rock slope in Western Norway.

In summer 2011 a larger refurbishment of the NORSAR array NOA has started. This work was finished in summer 2012. As result of this work, all 42 NOA sites are now equipped with new hybrid broadband seismometers (either 3C or vertical) and digitizers. A detailed description of the new hybrid sensors can be found in Roth et al. (2011b).

In February 2012, a new 3C broadband station was built in the framework of a cooperative project between NORSAR and the Norwegian Polar Institute at the Norwegian Antarctic Research Station Troll to monitor regional and global seismicity and dynamics of the Antarctic ice shield (Schweitzer et al., 2012).

In September 2014, the whole ARCES array was equipped with the 3C sensors of the hybrid broadband type as developed for NOA. All 25 sites of the ARCES array are now 3C and broadband.

In November 2014 NORSAR installed the 3C broadband station JETT in Nordnes, Norway. The main purpose of this permanent station is to monitor the unstable rock slope Jettan.

Further details on NORSAR as Norwegian NDC and technical details of the data exchange between the data center at Kjeller and the seismic installations can be found in Fyen & Iranpour (2003, ORFEUS Newsletter (vol5no2)).

3 (Fast) Exchange of Earthquake Related Parameters

NORSAR has a long tradition in real time location of seismic events. Since its start in the early 1970s, teleseismic events were located by measuring ray parameter and backazimuth of detected P-type onsets with the large NOA array. Since more than one decade, such automatic solutions for larger teleseismic events are automatically distributed via e-mail to EMSC and other interested institutions. The analyst reviewed teleseismic locations are published on NORSAR's web-page (http://www.norsardata.no/NDC/bulletins/norsar/).

During the 1980s, NORSAR was heavily involved in developing the concept of single-array locations based on local and regional P- and S-type observations with small aperture arrays. The results of many years of on-line, fully automatic data analysis of small-aperture array data are available on NORSAR's web-page (http://www.norsardata.no/NDC/bulletins/dpep/).

At the beginning of the 1990s, NORSAR developed the Generalized Beam Forming (GBF) method which jointly interprets detections from several arrays. The combination of observations from several arrays and location with a grid search algorithm results in a more robust automatic event list at local and regional distances. All GBF results are available on NORSAR's web-page (http://www.norsardata.no/NDC/bulletins/gbf/).

Based on the GBF results, analyst reviewed data interpretations and event locations are performed and distributed to the community for all events with a GBF-magnitude equal or larger than 2.0. In addition to the small aperture array results, these analyst reviewed locations may also contain onset readings from non-NORSAR 3C-stations. As shown in Fig. 4, NORSAR receives data from other data centers in line with various bilateral co-operative agreements. The analyst reviewed results for local and regional events are distributed by e-mail to international data centers like ISC or EMSC but also to the University of Bergen and other interested institutions. The results are copied on NORSAR's web-page (http://www.norsardata.no/NDC/bulletins/regional/).

To inform the public in Norway in the case of felt seismic events, NORSAR developed during the year 2001 an (internal) alert system, which automatically locates seismic events at local, regional and teleseismic distances within about 5 to 10 minutes, after a first onset with a high signal-to-noise ratio (SNR) has been observed at one of its stations. By July 2002, this system was stable enough that its results could be distributed externally. Based on observations at the arrays ARCES, FINES, HFS, (NORES), NOA, and SPITS, locations of large(r) seismic events are automatically sent to ORFEUS and the European-Mediterranean Seismological Centre (EMSC). In addition to triggering activities at the data centers, these alert messages with their included onset parameters are used in particular at the EMSC to calculate very quickly together with other observations more precise event locations. Not all located events are reported to ORFEUS and EMSC: NORSAR reports only those events, which have been located by P onsets from at least 3 arrays. However, all most recent NEWS locations are available from NORSAR's web-page (http://www.norsardata.no/NDC/bulletins/ael.html).

4 Waveform Data Exchange

As part of its CTBT related activities, NORSAR distributes data from several installations to different data centers. As a supporter of an open-data policy, the NORSAR data center has since several years an email-based AUTODRM system running. In October 2003, after NORSAR received from ORFEUS in context of the EC financed MEREDIAN project supporting software, NORSAR could extend this service and install on NORSAR's website a web-page for direct and thereby faster access to the AUTODRM service (http://www.norsardata.no/NDC/data/autodrm.html).

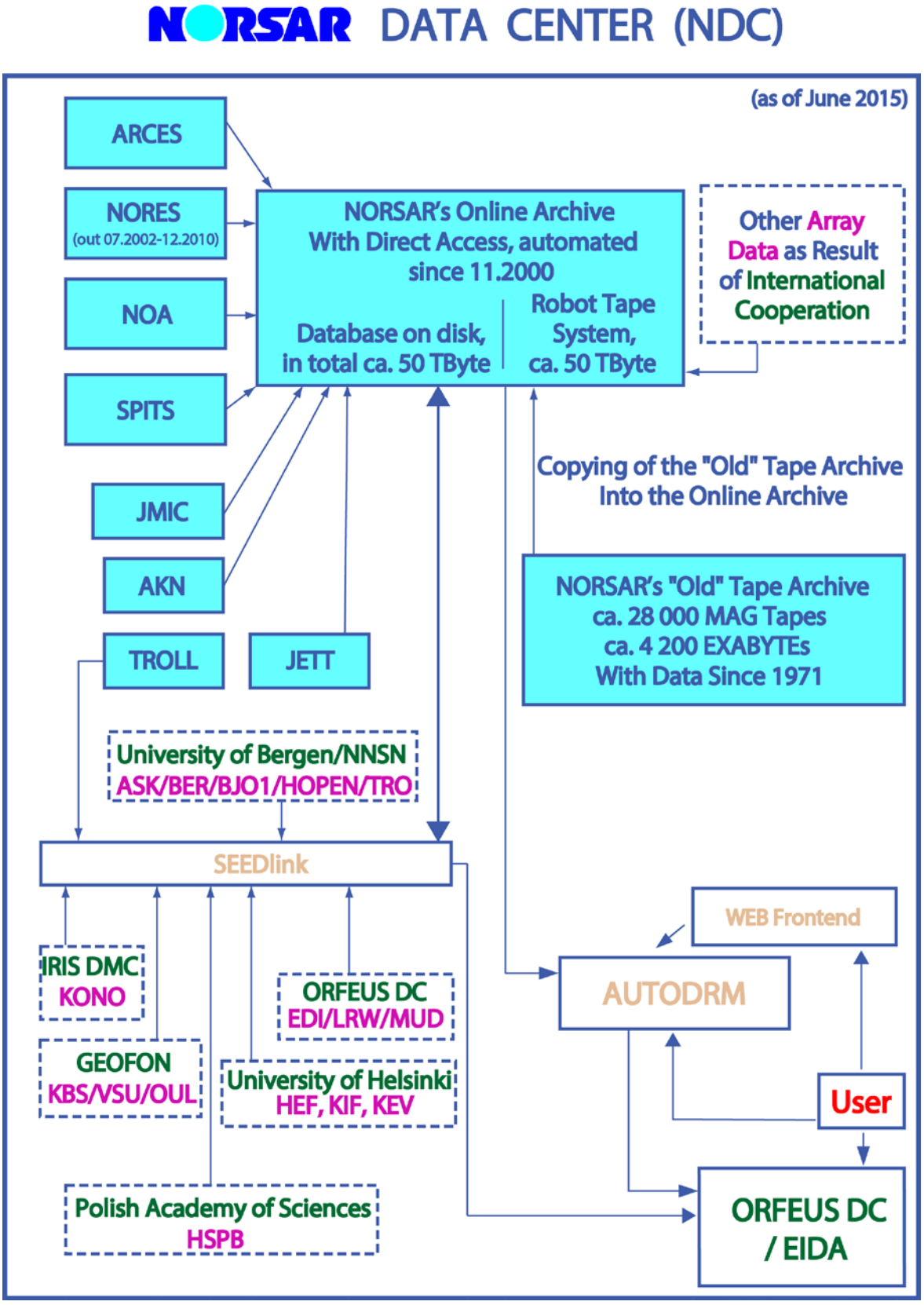

Figure 4. Structure of NORSAR's data archive and flow of data from and to NORSAR. The data received by NORSAR from other data centers in line with various bilateral co-operative agreements are plotted as broken lines.

Since the end of October 2002, NORSAR sends the continuous broadband data stream of the broadband sensor installed at the ARCES array site E0 (ARE0, see Tab. 1, since September 2014 site ARA0) to ORFEUS Data Center (ODC). The number of broadband data provided by NORSAR to ORFEUS (VEBSN) had been extended over the following years (3C broadband site NAO01 of the NOA array (May 2003); broadband SPA0 site of the SPITS array and the 3C station JMIC on Jan Mayen (June 2007); all broadband sites of NOA (March 2008); all nine sites of the broadband SPITS array (six 3C and three Z); the site at Åknes (November 2009); the site at Troll (February 2012), and the site at Jettan (November 2014). All broadband data can be retrieved in real-time from the ODC by other data centers or institutions.

Within the frame of an International Polar Year project and close co-operation with Polish colleagues, a new broadband sensor (STS-2) had been installed in September 2007 at the Polish Polar station Hornsund on Spitsbergen. This station became permanent and its data are distributed since autumn 2009 by the Polish Academy of Sciences (Geophysical Institute) as part of the Polish network. During the same project a former short-period seismic station of the Norwegian National Seismic Network (NNSN) on the Arctic Island of Hopen had been upgraded with a broadband sensor (STS-2). Also these data are today freely accessible in real time via the ODC (VEBSN).

Since September 2010, a new broadband station (BRBA) is in operation in Barentsburg, the Russian settlement on the island of Spitsbergen, Svalbard Archipelago (Roth et al., 2011a). The station was installed within the frame of a common research project between the Kola Regional seismological Center (KRSC) of the Kola Branch of Geophysical Survey of RAS (Apatity, Russia) and NORSAR financed by the Norwegian Research Council. In autumn 2012, this station was supplemented by a second seismometer site (BRBB).

Table 2. *List of stations, for which NORSAR has agreements on data access and exchange to achieve an improved regional location capability.*

Station	Type	Station Operator(s)
Apatity	Array	Kola Regional Seismological Center
ASK	BB 3C	University of Bergen (NNSN)
BER	BB 3C	University of Bergen (NNSN)
BJO1	BB 3C	University of Bergen (NNSN)
BRBA /BRBB	BB 3C	Kola Regional Seismological Center
EDI	BB 3C	British Geological Survey
EKA	Array	Güralp Systems Ltd., AWE Blacknest
FINES	Array	University of Helsinki
Hagfors	Array	Swedish Defence Research Agency (FOI)
HEF	BB 3C	University of Helsinki
HOPEN	BB 3C	University of Bergen (NNSN)
HSPB	BB 3C	Institute of Geophysics, Polish Academy of Sciences
KBS	BB 3C	GEOFON / IRIS DMC / USGS / AWI / University of Bergen (NNSN)
KIF	BB 3C	University of Helsinki
KEV	BB 3C	University of Helsinki
KONO	BB 3C	IRIS DMC / USGS / University of Bergen (NNSN)

LRW	BB 3C	British Geological Survey
MUD	BB 3C	Geologiske Undersøgelser for Danmark og Grønland
OUL	BB 3C	GEOFON / SGO, University of Ouly, Finland
TRO	BB 3C	University of Bergen (NNSN)
VSU	BB 3C	GEOFON / Geological Survey of Estonia

To supplement NORSAR's location capabilities, NORSAR exchanges through bilateral cooperation data with other seismological institutions (see Fig. 4 and Table 2). Depending on size and location of an event the reviewed regional bulletins (see above) may contain additional readings from arrays and 3-component broadband stations operated by these institutions. Data from BB 3C stations are retrieved from the international data centers GEOFON in Potsdam, IRIS DMC in Seattle, ORFEUS in DeBilt, the University of Bergen, the Seismological Institute of the University in Helsinki, and the Geophysical Institute of the Polish Academy of Sciences.

5 Data Archiving and Data Retrieval

As seen on Fig. 4, since autumn 2001, NORSAR stores all continuous data directly on a RAID system for direct access. However, all data are additionally saved on tapes, which are accessible by an automatic tape-robot system. This tape archive is today the data back-up system for NORSAR.

Table 3. *Periods of operation for the different NORSAR stations and direct accessibility to their data (outages due to upgrading or repair activities are not tabled).*

Station	Time Period	Direct Accessibility
Old NORSAR	04.1971 – 09.1976 event triggered	Yes
NOA	09.1976 – 09.1982 event triggered	Yes
NOA	09.1982 – today continuous	Yes
ARCES	10.1987 – today continuous	Yes
NORES	10.1984 – today continuous (not 06.2002 – 12.2010)	Yes
SPITS	11.1992 – today continuous	Yes
JMIC	10.2003 – today continuous	Yes
TROLL	02.2012 – today continuous	Yes
JETT	11.2014 – today continuous	Yes

Some comments on the table above: NORSAR has digital data back to 1971. The major part of these data was originally archived in the (old) tape archive containing about 28.000 ½ inch magnetic tapes and about 4.200 8 mm data cartridges (EXABYTEs). These original tapes are only accessible by operator support.

During the last years, NORSAR has worked hard on copying these old data on disk and into the tape robot archive. Up to now, all short-period data of the large NOA array were retrieved from the old storage media for the years 1971 – 2000. In addition, all data of the small aperture arrays NORES and ARCES were copied from their earliest data in 1984 (NORES) and 1987 (ARCES) until the end of 1989. Then, NORSAR started copying data from the

autumn of 2000 backwards for the small aperture arrays ARCES, NORES and SPITS to get all data directly accessible.

6 Other aspects

The very important retrieval of all digital data collected by NORSAR from old tape media will be continued.

7 Literature

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