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7.1 Status Report: Norway's participation in GSETT-3

Introduction

A fairly detailed account of Norway's participation in GSETT-3 during January 1995 - June 1996 was given in Mykkeltveit & Baadshaug (1996). The present contribution is essentially an update of that report, but offers in addition some material on use of the AutoDRM protocol in conjunction with the change of status on 1 October 1996 of the Spitsbergen array from a primary to an auxiliary station in GSETT-3.

Norwegian GSETT-3 stations and communications arrangements

From the second half of 1993, Norway has provided continuous data from three GSETT-3 primary array stations: ARCESS, NORESS and Spitsbergen. The location and configurations of these three stations are shown in Fig. 7.1.1. ARCESS and NORESS are 25-element arrays with identical geometries and an aperture of 3 km, whereas the Spitsbergen array has 9 elements within a 1-km aperture. All three stations have a broadband three-component seismometer at the array center.

Data from these three stations are transmitted continuously and in real time to NOR_NDC. The NORESS data transmission uses a dedicated 64 Kbits/s land line, whereas data from the other two arrays are transmitted via satellite links of capacity 64 Kbits/s and 19.2 Kbits/s for the ARCESS and Spitsbergen arrays , respectively.

The NORESS array has been used in GSETT-3 as a temporary substitute for the NORSAR teleseismic array (also shown in Fig. 7.1.1; station code NOA), awaiting a complete technical refurbishment of the latter. This effort has now been completed, and starting 30 August 1996, data from the NORSAR array have been transmitted continuously to the IDC. The NORESS array will, however, be retained as a GSETT-3 primary station at least until such time that the NORSAR array data are fully used in the IDC operational processing cycle. We are cooperating with the IDC on the task of preparing for the processing of NORSAR data at the IDC, and the status of this effort is given in Section 7.2 of this report.

On 1 October 1996 numerous changes were made worldwide to the GSETT-3 network. The purpose of these coordinated changes was to bring the GSETT-3 network in line with the seismic component of the International Monitoring System (IMS) to the extent possible. As the Spitsbergen array is an auxiliary station in IMS, this station changed its status from primary to auxiliary in GSETT-3 on that date. This involved terminating the continuous forwarding of SPITS data to the IDC and making data from this station available to the IDC on a request basis via the AutoDRM protocol (Kradolfer, 1993; Kradolfer, 1996). Initial experience on the use of AutoDRM for SPITS is reported below.

Uptimes and data availability

Figs. 7.1.2 - 7.1.4 show the monthly uptimes for the three Norwegian GSETT-3 primary stations ARCESS, NORESS and Spitsbergen, respectively, for the period January -

September 1996, given as the hatched (taller) bars in these figures. These barplots reflect the percentage of the waveform data that are available in the NOR_NDC tape archives for each of these three stations. The downtimes inferred from these figures thus represent the cumulative effect of field equipment outages, station site to NOR_NDC communication outages and NOR_NDC data acquisition outages. Some of the larger downtimes are due to specific reasons, as follows:

- The NORESS hub facility was hit by lightning on 12 July, resulting in serious damage to a number of electronic components. Repairs were completed on 27 July.
- The Spitsbergen array was down almost continuously between 10 March and late June, due to damage to the battery bank at the array site, caused by overcharging by the windmill system.

Figs. 7.1.2-7.1.4 also give the data availability for these three stations as reported by the IDC in the IDC Station Status reports. The main reason for the discrepancies between the NOR_NDC and IDC data availabilities as observed from these figures is the difference in the ways the two data centers report data availability for arrays: Whereas NOR_NDC reports an array station to be up and available if at least one channel produces useful data, the IDC uses weights where the reported availability (capability) is based on the number of actually operating channels.

It is of interest to compare NOR_NDC and IDC data availabilities, based on identical definitions of this term. This has been done in Fig. 7.1.5 for data from the ARCESS array. To produce this figure, we retained the above NOR_NDC definition of data availability, and then queried the IDC database for the existence therein of *any* (one or more channels) ARCES data from the period January - September 1996. The result, as shown in Fig. 7.1.5, is that (with the exception of a discrepancy in June) the loss of data between the NOR_NDC diskloops and the IDC database is very modest indeed. This shows that the data reformatting and forwarding routines running at NOR_NDC (the AlphaRead/-Send suite of programs) with associated hardware, the link between NOR_NDC and the IDC, and the data acquisition software and hardware at the IDC are all reasonably stable and well-operating elements of a complicated data acquisition arrangement.

Initial experience with the AutoDRM protocol

NOR_NDC's AutoDRM has been operational since November 1995 (Mykkeltveit & Baadshaug, 1996).

Between November 1995 and the network changes on 1 October 1996, only 207 requests from external users were processed.

After SPITS changed station status from primary to auxiliary, the request load increased sharply, and for the month of October 1996, the NOR_NDC AutoDRM responded to 12338 requests for SPITS waveforms from two different accounts at the IDC: 9555 response messages were sent to the "pipeline" account and 2783 to "testbed".

The number of requests sent from the IDC were compared to responses returned from NOR_NDC. The NOR_NDC AutoDRM only logs requests after they have been pro-

cessed. Should a request for some reason get lost before processing has finished, it will not appear in any NOR_NDC AutoDRM log-files. The incoming request mail will, however, be present in the log files of the NOR_NDC central mailhost.

At the IDC, 9662 requests for SPITS data are logged as sent from the "pipeline" account.

For each of these, a corresponding response is logged at NOR_NDC, except for 107 requests. They were all sent on 30 October 1996, between 01:35:43 and 15:47:51. No incoming mail from "pipeline" was logged at the NOR_NDC mailhost during this interval.

Mail from other accounts at the IDC did get logged at the NOR_NDC mailhost, so we have reason to believe that the 107 missing requests were lost before they ever reached NOR_NDC.

In conclusion, it seems that all request messages which have reached the AutoDRM from the "pipeline" account at the IDC have been answered. No error messages have been found in the AutoDRM log-files. Apparently, all requests have been properly formatted and the requested data intervals have been inside the NOR_NDC diskloops.

The total volumes of the response messages for October 1996, are:

- 157 MB in 9555 messages to "pipeline",
- 40 MB in 2783 messages to "testbed".

NDC automatic processing and data analysis

These tasks have proceeded in accordance with the descriptions given in Mykkeltveit and Baadshaug (1996). For the period July - September 1996, NOR_NDC derived information on 1832 supplementary events in northern Europe and submitted this information to the Finnish IDC as the NOR_NDC contribution to the joint Nordic Supplementary (Gamma) Bulletin, which in turn is forwarded to the IDC. These events are plotted in Fig. 7.1.6. As can be seen in this figure, the seismic activity in and around Spitsbergen was particularly high during this period.

Data forwarding for GSETT-3 stations in other countries

NOR_NDC continues to forward data to the IDC from GSETT-3 primary stations in several countries. These currently include FINESS (Finland), GERESS (Germany) and Sonseca (Spain). In addition, communications for the GSETT-3 auxiliary station at Nilore, Pakistan, are provided through a VSAT satellite link between NOR_NDC and Pakistan's NDC in Nilore. Data from the Hagfors array (HFS) in Sweden were provided continuously through NOR_NDC until 1 October 1996, on which date this station changed its status in GSETT-3 from primary to auxiliary, in accordance with the status of HFS in IMS. From 1 October 1996, the IDC obtains HFS data through requests to the AutoDRM server at NOR_NDC (in the same way requests for Spitsbergen array data are now handled, see above).

Future plans

NOR_NDC will continue the efforts towards improvements and hardening of all critical data acquisition and data forwarding hardware and software components, so that future requirements related to operation of IMS stations can be met to the maximum extent possible.

NOR_NDC will continue to contribute data to the IDC in the context of the GSETT-3 experiment for as long as that experiment will last. It is now foreseen that the CTBT PrepCom with its Provisional Technical Secretariat will be established in Vienna in 1997, and that this new organization will take over the responsibility for activities like the GSETT-3 experiment once it becomes technically capable of doing so. We then envisage continuing the provision of data from Norwegian IMS stations without interruption to the appropriate structure that will be established for this in Vienna.

S. Mykkeltveit
U. Baadshaug

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Mykkeltveit, S. & U. Baadshaug (1996): Norway's NDC: Experience from the first eighteen months of the full-scale phase of GSETT-3. *Semiann. Tech. Summ., 1 October 1995 - 31 March 1996*, NORSAR Sci. Rep. No. 2-95/96, Kjeller, Norway.

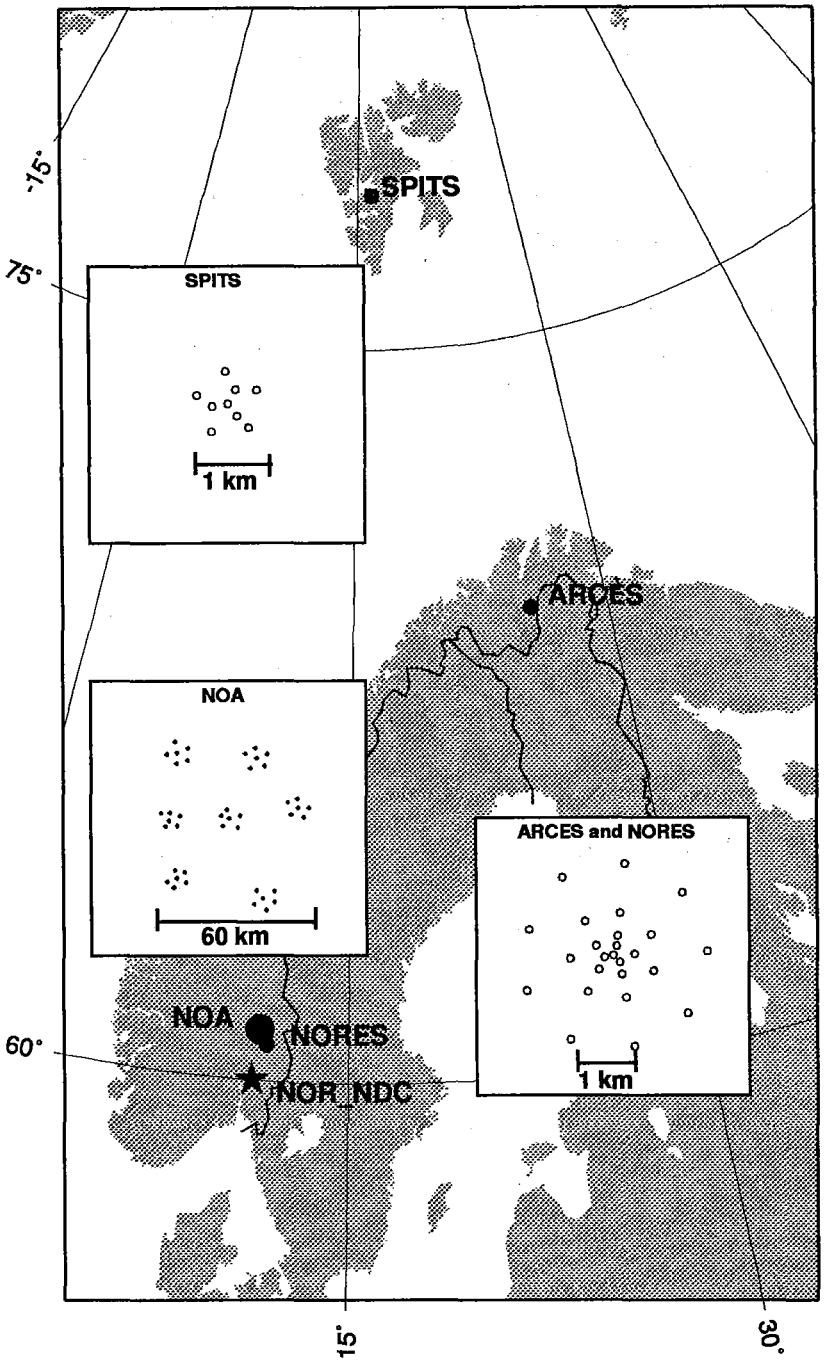

Fig. 7.1.1. The figure shows the locations and configurations of the three Norwegian GSETT-3 primary array stations with station codes NORES, ARCES and SPITS. The data from these stations are transmitted continuously and in real time to the Norwegian NDC (NOR_NDC) and then on to the GSETT-3 IDC. The figure also shows the location of the teleseismic NORSAR array (with station code NOA), which is soon to be fully used in GSETT-3 as a primary station.

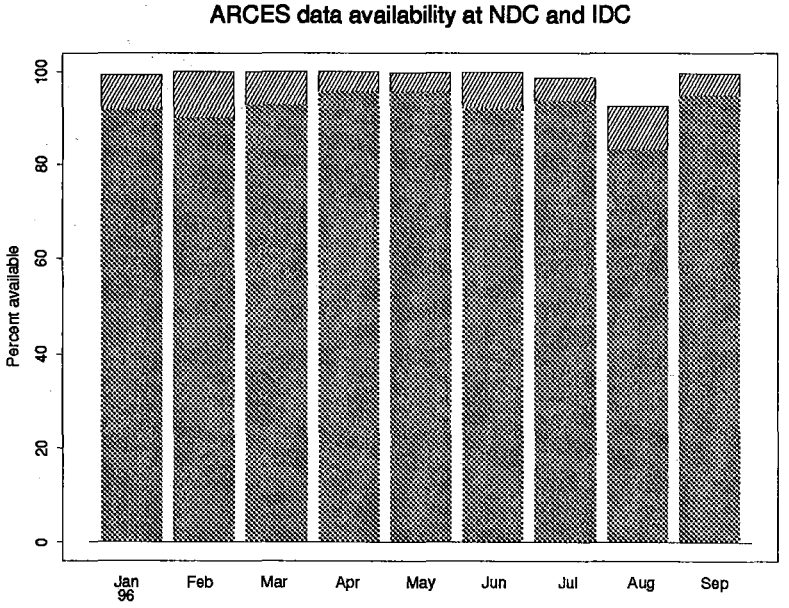

Fig. 7.1.2. The figure shows the monthly availability of ARCESS array data for the period January - September 1996 at NOR_NDC and the IDC. See the text for explanation of differences in definition of the term "data availability" between the two centers. The higher values (hatched bars) represent the NOR_NDC data availability.

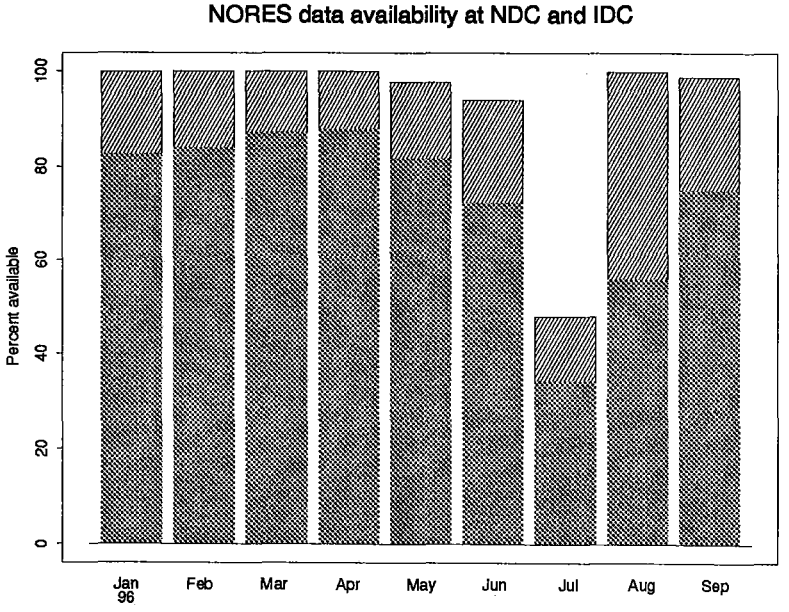

Fig. 7.1.3. The figure shows the monthly availability of NORESS array data for the period January - September 1996 at NOR_NDC and the IDC. See the text for explanation of differences in definition of the term "data availability" between the two centers. The higher values (hatched bars) represent the NOR_NDC data availability.

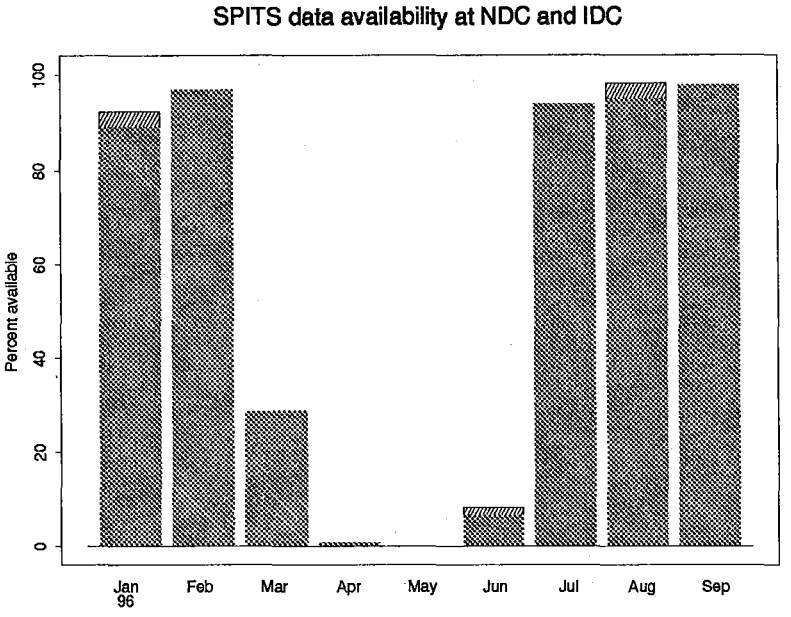

Fig. 7.1.4. The figure shows the monthly availability of Spitsbergen array data for the period January - September 1996 at NOR_NDC and the IDC. See the text for explanation of differences in definition of the term "data availability" between the two centers. The higher values (hatched bars) represent the NOR_NDC data availability.

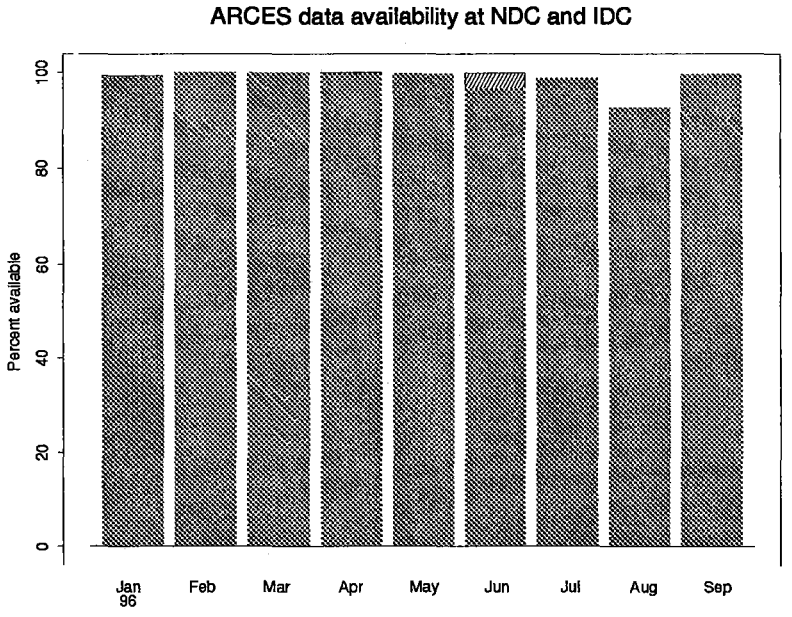

Fig. 7.1.5. The same as Fig. 7.1.2, except that the definition of the term "data availability" at the IDC has been changed to be identical to that used by NOR_NDC. The higher values (hatched bars; difference only observable here for June) represent the NOR_NDC data availabity.

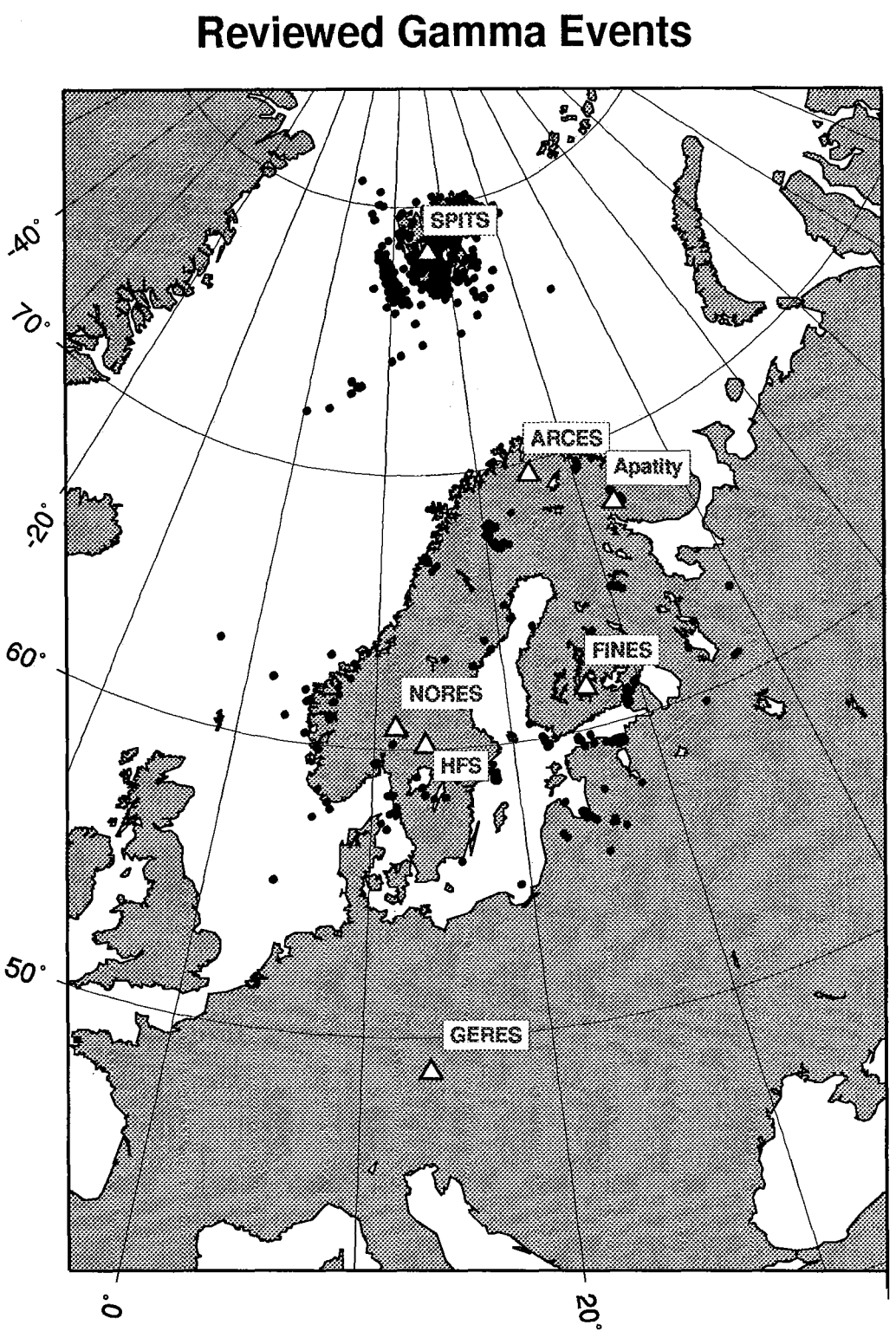

Fig. 7.1.6. The map shows the 1832 events in and around Norway contributed by NOR_NDC during July-September 1996 as Supplementary (Gamma) data to the IDC, as part of the Nordic Supplementary data compiled by the Finnish NDC. The map also shows the seismic stations used in the data analysis to define these events.