The Research Council of Norway (NFR)

NORSAR

NORSAR Scientific Report No. 2-96/97

Semiannual Technical Summary

1 October 1996 – 31 March 1997

Kjeller, May 1997

APPROVED FOR PUBLIC RELEASE, DISTRIBUTION UNLIMITED

7.3 NORSAR Large Array Processing at the IDC Testbed

Introduction

Beginning 1 September 1996, the large array NORSAR (NOA) data have been continuously transmitted to the IDC. Already in April 1996, a new function, *"compute-beamform-fk"* (Fyen 1996), to be used for large array slowness vector estimation, was implemented into the DFX in cooperation with SAIC staff.

IDC testbed operation of this version for NOA data was initiated on 9 October 1996.

DFX processing at the testbed

During the period 11 January 1997 through 19 February 1997, we analyzed carefully the results from IDC REB, the NOA detection processing done at NDPC, and the NOA testbed DFX processing done at the IDC.

Using an automated process, we calculated for each REB event the predicted arrival time and back-azimuth for NORES and NOA. If a detection was found with onset time within the expected IASPEI arrival time +/- 5.0 seconds, then the detection was declared as belonging to the event. If the detection in addition had an azimuth within +/- 15.0 degrees, then the detection was associated to the event. For simplicity, only P, PKiKP, PKPdf and PKPbc (depending on distance) were used to predict arrival time. Only events in the teleseismic range, i.e., more than 20.0 degrees from NOA were analyzed.

Table 7.3.1 summarizes our findings.

In the table, the term "detection" is used to describe the number of REB events for which at least one detection had an onset time within the predicted arrival time +/- 5.0 seconds. The term "association" is used to describe the number of REB events for which at least one detection had both onset time within the predicted arrival time window and azimuth within the predicted back-azimuth +/- 15.0 degrees.

The term "NORSAR" is used to define the number of events for which either NDPC processing or DFX testbed processing detected with NOA array data. "DFX testbed NOA" means detections obtained by DFX processing. "NDPC" means detections obtained with the old detection processing (DP/EP) done at NDPC. NORES detection or association is based on REB origin, assoc and arrival tables from the IDC operations database.

The interpretation of the results is that DFX has fewer detections that can be associated with events as compared to the original NDPC processing. We have from earlier studies found that the individual processing of 10-minute segments may cause some boundary problems, and this could explain some of the difference. Moreover, the time delays across the NORSAR array are up to 9 seconds, and reduction from triggers to detections is more complicated than for smaller arrays. Several case studies have been performed to select parameters for this process, but more work needs to be done.

Table 7.3.1. Detection statistics 11 January - 19 February 1997. See text for explanation.

	Number of events
Number of teleseismic events in REB	1911
No NORES or NORSAR detection	1296
Either NORES or NORSAR detection	615
Either NORES association or NORSAR association	453
NORES association, but no NORSAR association	117
NORSAR association, but no NORES association	129
NORSAR and NORES association	207
NORES detection	476
NORES associated	324
DFX testbed NOA detection	288
DFX testbed NOA associated	227
NDPC detection	409
NDPC associated	302
NDPC reviewed and associated	259

For the associated detections, we have looked at azimuth residuals. The results in Fig. 7.3.1 demonstrate the improvement of the beamform F/K process using new time delay corrections (upper right figure) as compared to the old beampacking technique (lower left). The automatic DFX process has azimuth residuals comparable to those of the analyst review detections at NDPC. It should be noted that further improvements may be achieved when the analyst at IDC can revise slowness estimates for any array. The NORES residuals are obtained from the REB NORES azimuths.

During the period analyzed, the NDPC analyst reported 9 additional events that were not in the REB. Four of these events were defined as origins on the testbed with NOA association.

It seems to be fair to draw the conclusion that DFX processing of NOA data is close to satisfactory. The most important improvement to concentrate on is to reduce the number of missed detections. The time delay corrections used seem to satisfy the expectation of smaller azimuth residuals for a larger array.

Before making any definite statement about missed detections, it is necessary to gain further experience with analyst review. This would involve looking at optimum beams for NOA and verifying whether or not a detection should have been triggered.

For any event defined at the IDC, an array beam will be presented for the analyst. The process used to create this beam — Beamer — has not yet been modified to adopt time delay corrections. It is necessary for the analyst review to have this ability to make NOA beams. In the near future, the IDC plans to replace Beamer with DFX, and NORSAR staff will assist in this process. When this has been completed, NORSAR processing can be implemented as part of regular IDC operation.

J. Fyen

Reference

Fyen, J. (1996): Improvements and Modifications, Semiannual Technical Summary 1 October 1995 - 31 March 1996, NORSAR Sci.Rep. No. 2-95/96, Kjeller, Norway.

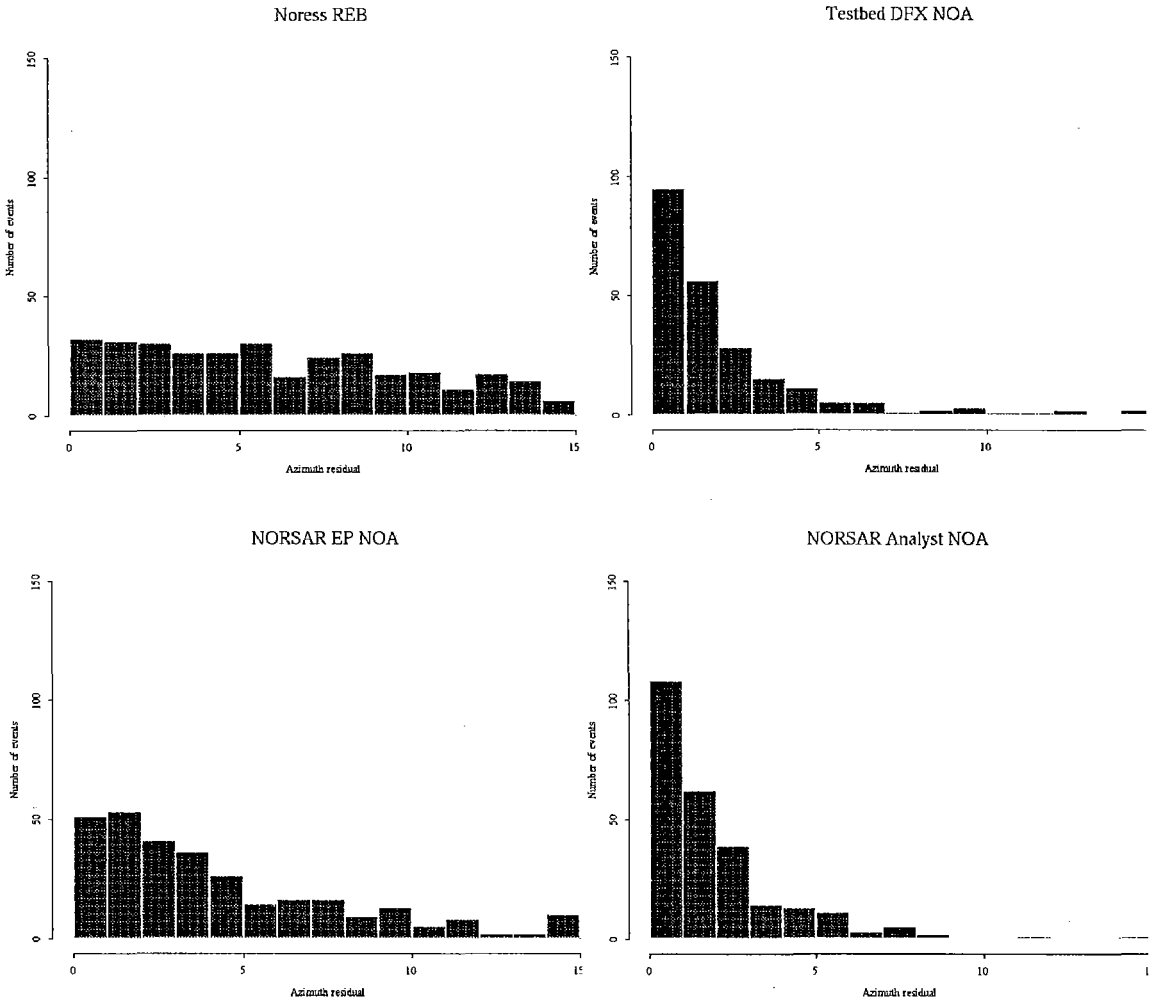

Fig. 7.3.1. Distribution of azimuth residual for associated detections. The residual is the absolute value of the difference between predicted and observed backazimuth for events where the detection was associated according to the criteria in the text. The upper left shows distribution for the NORES associated detections. The upper right shows azimuth residuals for DFX NOA detections. The lower left shows residuals for automatic NORSAR prcoessing using old beampacking and old time delay corrections. The lower right figure shows residuals for NORSAR detections refined by analyst review at NDPC. (Old time delay corrections).