

TESTING THE AK135 MODEL FOR LOCATING SEISMIC EVENTS IN THE WIDER FENNOSCANDIA-EUROPEAN ARCTIC REGION

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Abstract

During the last General Assembly, IASPEI recommended that the International Seismological Centre (ISC) and other international data centers should replace the Jeffreys-Bullen tables (JB) with the more accurate travel-time AK135 tables for locating seismic events. On the average, AK135 has shown to be superior to the Jeffreys-Bullen tables, in particular if P- and S-type onsets are jointly included and if PKP phases and later onsets were associated.

However, it is still unknown if a change of the travel-time tables will lead to undesired regional location anomalies. To evaluate the effect of using AK135 instead of the Jeffreys-Bullen tables, the ISC produced for a 10 months time period (January - October 2004) parallel bulletins using both travel-time tables.

In this contribution we are comparing the results in these bulletins for all 63 events in the region 55° to 90° N and -15° to 90° E with the regional bulletins of NORSAR and other local or regional bulletins in the region. Since local velocity models will always produce slightly different event locations, the focus in this study is on the question if the use of AK135 reduces or increases the discrepancies between the ISC and the local/regional bulletins

Methodology

To evaluate the application of the AK135 travel-time tables at ISC for seismic events in the wider Fennoscandian and European Arctic area three different bulletins could be used as reference.

NORSAR publishes an analyst reviewed bulletin (www.norsar.no/NDC/bulletins) locating events in the area of interest. 14 of the 63 ISC located events are also listed in the NORSAR bulletins (Fig. 3).

The Seismological Institute of the University in Helsinki is collecting all reported seismic onset observations at stations in Fennoscandia and compiles the so-called Helsinki Bulletin (www.seismo.helsinki.fi/bul/index.html). 11 of the 63 ISC located events are also listed in the Helsinki bulletins (Fig. 4).

The IDC in Vienna (pws.cibto.org) publishes the Reviewed Event Bulletins (REBs) based on onset readings at stations contributing to the International Monitoring System (IMS) for monitoring the Nuclear-Test-Ban Treaty. 59 of the 63 ISC located events are also listed in the REBs (Fig. 5).

Most of the events in the region located by the ISC (see Figs. 1 & 2) occurred offshore, far away from any seismic station. Therefore, none of the locations can be assumed as very precise. However, due to the usage of regional velocity models the locations published by NORSAR and Helsinki can be assumed to be more accurate and can be used to compare the JB and AK135 based ISC locations. Because of different focus at NORSAR and in Helsinki, the two bulletins do not overlap significantly (compare Figs. 3 & 4).

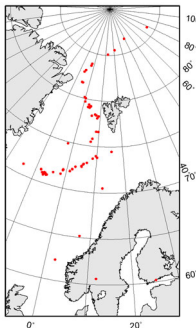


Figure 1: ISC Locations for the 63 test events applying the Jeffreys-Bullen travel-time tables.

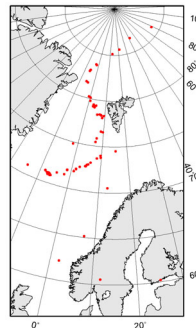


Figure 2: ISC Locations for the 63 test events applying the AK135 travel-time tables.

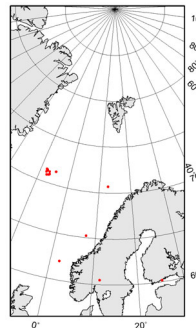


Figure 3: NORSAR locations for 14 of the 63 test events.

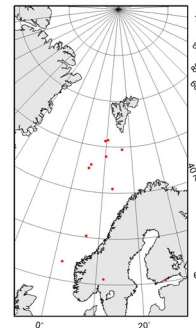


Figure 4: Locations in the Helsinki bulletin for 11 of the 63 test events.

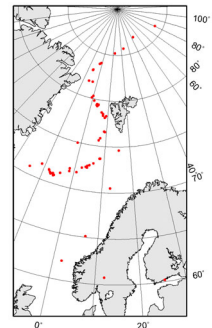


Figure 5: REB Locations for 59 of the 63 test events.

Conclusions

- Although only a small number of epicenter solutions could be compared, in all cases the discrepancy between regional models and the ISC solutions becomes smaller in the case of applying the AK135 travel-time tables.
- Also the REB solutions based on regional velocity models are closer to the AK135 than to the JB travel-time tables.
- All bulletins used as reference have very little resolution in event depths as shown by the huge amount of 'fixed depth' solutions.
- There is no evidence that a change of the travel-time tables at ISC from JB to AK135 introduces any bias in seismic event locations for the investigated region.

Table 1: Results of the Bulletin Comparisons

Source Bulletin	Comparison	Number of Events	Mean Epicentral Distances [km]	Median of Epicentral Distances [km]	Mean Improvement JB -> AK135 [%]	Median Improvement JB -> AK135 [%]
ISC	AK135-JB	63	8.0	8.1	-	-
NORSAR	ISC-JB	14	26.9	22.8	17.5	13.6
NORSAR	ISC-AK135	14	22.2	19.7		
Helsinki	ISC-JB	11	32.0	24.6	30.6	22.8
Helsinki	ISC-AK135	11	22.2	21.7		
IDC	ISC-JB	59	21.1	16.8	19.0	21.4
IDC	ISC-AK135	59	17.1	13.2		