Poster No. T4.1-P2 SnT

Disclaimer

The views expressed on this poster are those of the authors and do not necessarily reflect the view of the CTBTO

Assessment of the Quality of the Interactive Analysis and Reviewed Event Bulletin during the September 2016 Experiment. Josep Vila (Josep.Vila@ctbto.org), Fekadu Kebede (Fekadu.Kebede@ctbto.org), Gerhard Graham (Gerhard.Graham@ctbto.org) and Edwin Dindi Ndubi (Edwin.Dindi Dindi Dindi Ndubi (Edwin.Dindi Dindi Ndubi (Edwin.Dindi Dindi Ndubi (Edwin.Dindi Dindi Ndubi (Edwin.Dindi Dindi Dindi Ndubi (Edwin.Dindi Dindi Dindi Ndubi (Edwin.Dindi Dindi Dindi Ndubi (Edwin.Dindi Dindi Dindi Dindi Ndubi (Edwin.Dindi Dindi Dindi Dindi Ndubi (Edwin.Dindi Dindi Di

INTRODUCTION

The experiment ran from 1-14 September 2016 with technical focus on the normal day-to-day activities of collecting and processing IMS data and production of IDC products under benign conditions. A baseline bulletin REB (named BAS) was created by an independent team of waveform analysts produced with effectively no time constraints, for three reference days. In this work we assess the quality of the regular REB by comparing it with the independent analysis for the three reference days.

For evaluation purposes, and further to the estimation of the detection threshold parameters of the IMS network during the dates of the experiment, the comparison is done setting the following target requirements:

- The REB contains at least <u>98%</u> of the events identified in the baseline bulletin that pass the event definition criteria.
- 2. No more than <u>4%</u> of the events in the REB are "false" relative to the events in the baseline bulletin.
- For <u>96%</u> of the matching events, the REB location error ellipses overlap the independent event error ellipses.

DATA

Data selected for bulletin comparison and used for comparison corresponds to days 6, 8 and 14 September. The table and graph below summarize the total and number of events on each day respectively





METHODOLOGY

The assessment of the quality is done using two different software packages.

BULCMP (Matlab application - Comparison of IDC with respect to other)

Commissioned by the French NDC in 1996 as a contribution to the evaluation of GSETT-3 and eventually donated to Evaluation Section of the PTS.

Events in the two bulletins are pair wise associated using a probabilistic technique referred to as Dynamic Event Matching. The technique considers origin times and location together with given uncertainties.

BullComp (IDC built-in application [SQL scripting] – Built-in system for self-comparison)

The comparison task is performed by utilizing a comprehensive approach that includes the use of BullComp software and other scripts developed for comparison purposes and visual inspection for matching of bulletin data available in text format.

This methodology considers, in addition to the origin times and locations, phase information.



Example screenshot of the dynamic event matching process used by BULCMP

.Ndubil@ctbto.org) (Preparatory Commission for the Comprehensive Nuclear-Test Ban Treaty Organization, Vienna International Center, P.O. Box 1200, 1400-Vienna, Austria)

Geographical distribution of the epicentres of all events used as input for comparison



Graphical representation of the percentage of matching events per magnitude intervals (left) and by setting different lower threshold (right). Note the significant changes in the percentages



Comparison of the number of events in the BAS bulletin and the number of matching events per magnitude intervals (left) and by setting a lower threshold (right). Note the influence of the statistical sample

Requirement #2: No more than 4% of the events in the REB are "false" relative to the events in the baseline bulletin



Graphical representation of the percentage of false events per magnitude intervals (left) and by setting different lower threshold (right). Note the significant changes in the percentages



Comparison of the number of events in the BAS bulletin and the number of false events per magnitude intervals (left) and by setting a lower threshold (right). Note the influence of the statistical sample

Requirement #3: For 96% of the matching events, the REB location error ellipses overlap the baseline bulletin location error ellipses



DATA ANALYSIS





For a proper comparison of bulletins the detection capability of the network and the magnitude of completeness (Mc) of the bulletins need to be considered.

A first indication of the values of Mc can be assessed through the frequency-magnitude distributions. The left and mid plots below display the frequency-magnitude distribution of the IMS network using the number of events in the REB for the full years 2000, 2005 and 2010 where the patterns denote a decrease of Mc over time.

The right plot presents the same distribution considering the three days used for comparison during the September 2016 experiment and for both the REB and the baseline bulletin. The positive trend indicates that many events have magnitudes below Mc.



PTS assessment of the Network Threshold

The PTS monitors the detectability of the IMS network by means of a continuous threshold monitoring technique determining earthquake detection probabilities directly from seismic station recordings and by using noise spectra^(*). The graphs below display the time evolution of the worldwide averaged median mb able to be detected by the IMS network at 90% confidence level over one day. The value obtained during the September 2016 Experiment is **3.66**.



RESULTS

Based on 357 events in the reference bulleting

Considering the worldwide coverage of the IMS network, thus meaning a relatively small number of observations, and the sequence of aftershocks after the event occurred on 1 September 2016, additional investigation including zonation is needed to ascertain the reasons of the discrepancies between the REB and the reference bulletin.

umber of events in BAS umber of events in REB latching events sing events (extra in BAS) alse events (extra in REB) Matching events with overlapping ellipses

Summary of the results of the bulletin comparison (table) and map of the epicentres of the events above the estimated level of detectability. Red and green dots correspond to the missing and extra events respectively.

DETECTABILITY AND DATA COMPLETENESS

If Mc > "Real Mc" then "reliable data can be discarded"

If Mc < "Real Mc" then "biased analysis due to incompleteness of the bulletins"</p>

Kværna, T. et al., (2002). PAGEOPH 159, 969–987; 989–1004.

• 188 are above the estimated level of detectability of the IMS network (mag \geq 3.6).

92.6% (176/188) of the events match in both REB and baseline bulletins and the percentage of matching events whose ellipses overlap is <u>92.9%;</u> both values close but not meeting the target requirements.

• Only 1.1% (2 events with magnitude \geq 3.6) are false events in REB (not present in the baseline bulletin) thus exceeding the target requirement by a significant margin.

