

Topic	Reports and bulletins
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1 General information

The results of seismogram analyses are published in reports, event lists, bulletins and data catalogues (called "products"), which are the basis of data exchange between seismological institutions, data centers and for informing the public. The parameter data, primarily source and/or phase parameter values, should be stored in a digital database and presented in a clear and uniform manner.

The predefinition of an appropriate format depends on the requirements for the major usage of the product, for example whether a product is intended for further applications on a computer or for human readability. However, earthquake catalogues are published in numerous different formats. Therefore, a description of the individual used format should be given as a reference or directly attached to the product. Some formats have been developed to a comprehensive level, which is widely accepted in the seismological community. The IASPEI Seismic Format (ISF) was adopted as a standard format for exchanging seismic parameter data by the IASPEI Commission on Seismic Observation and Interpretation. The ISC as well as the NEIC and an increasing number of national data centers publish their catalogues in the ISF format, which also complies with the IMS1.0 format that was developed for the verification of the Comprehensive Nuclear Test Ban Treaty (CTBT). The ISF format description is available on the ISC-WEB site (<http://www.isc.ac.uk/standards/isf>).

A relatively new development is the format QuakeML. It was developed with special emphasis on real-time parameter exchange and in view of the need to frequently extend the format by data fields not contained in the standard itself. This is achieved by using XML as basis for QuakeML. More information on QuakeML can be found on the website <http://www.quakeml.org>

The products contain source and/or phase parameters. Products which include source parameters represent the seismicity within a given time period for a pre-defined area and above a reliable magnitude threshold. These limitations have to be taken into account, in order to provide a high quality product which claims to be of a high degree of completeness and accuracy.

Comprehensive products based on networks of stations distributed world-wide are published by the World Data Center (WDC) for Seismology (operated by NEIC, Denver, Colorado, USA) (<http://neic.usgs.gov>), the International Seismological Centre (ISC) (Newbury, England) (<http://www.isc.ac.uk>), and the International Data Centre of the Comprehensive Nuclear-Test-Ban Treaty Organisation (Vienna, Austria) (<http://www.ctbto.org>). The precision of these products with respect to epicenter location is $\Delta D < 1^\circ$.

In general, the products of national data centers and observatories provide data for events within an area that is well covered by the station network used for the data analysis. How complete these products are depends on the spacing between the stations, which also has a

major influence on the magnitude threshold. An example of such products is given by the German local bulletin of the Federal Institute for Geosciences and Natural Resources (BGR) at the following internet address: <http://www.bgr.bund.de/erdbebenkatalog-deutschland>. The precision of this product is $\Delta D < 0.1^\circ$.

Publication of teleseismic epicenter data from a regional network is useful only if the precision of the data is known or reliable calibration values for the correction of systematic location errors are available. Such a calibration for the GRF array/GRSN (see Section 8.7.5 and Fig. 8.17 in Chapter 8) is used by the BGR for determinations of epicenters world-wide in its teleseismic bulletin. The precision in the distance range $D = 13^\circ\text{--}100^\circ$ is $\Delta D < 3^\circ$ (see http://www.bgr.bund.de/DE/Themen/Erdbeben-Gefahrungsanalysen/Seismologie/Seismologie/Erdbebenauswertung/Erdbebenkataloge/Teleseism_Bulletins/teles_bulletins_node.html).

However, if only phase parameters are available, it is also important for these to be reported to the international data centers, because these values are indispensable to improve the accuracy and comprehensiveness of their products. The ISC, for example, compiles a data catalogue based on reported phase parameter values received from a number of observatories and data centers world-wide (<http://www.isc.ac.uk/doc/analysis/2007p01/datacol.html>).

The information provided by a product also depends on how long after the event the product is to be published. For example:

2 Fast determination of epicenters of strong earthquakes

Information is provided for a single event immediately after it is detected and recognized as a strong earthquake or an earthquake which could cause substantial damage. The parameter values are obtained by automatic processing or manual analysis. They are published within minutes or hours after the event and are distributed mainly by e-mail or made available on the WWW. The NEIC publishes a near-real-time earthquake bulletin with about 20 recent earthquakes, which is updated every 5 minutes (<ftp://hazards.cr.usgs.gov/cnss/quake>). More detailed information is provided for the latest earthquakes in the world on the website http://earthquake.usgs.gov/earthquakes/recenteqsww/Quakes/quakes_all.php. This website contains information for earthquakes of the last 7 days. A global, near-real-time earthquake bulletin is also produced by the GFZ Potsdam via the website <http://geofon.gfz-potsdam.de/eqinfo> where automatically produced earthquake information is published within minutes for significant events.

For local and/or regional purposes in Central Europe, fast epicenter determinations are also provided by the European Mediterranean Seismological Centre (EMSC) (<http://www.emsc-csem.org/Earthquake/index.php>). Epicenter determinations, which are received from national data centers, are automatically associated to the corresponding earthquake and published on the website for latest data contributions (<http://www.emsc-csem.org/Earthquake/seismologist.php>).

3 Preliminary products

Information is provided for all routinely analyzed events at regular time intervals, typically daily, weekly or monthly. This information may be subject to modification if phase readings from additional stations or arrival times of later phases are identified at a later stage of the

analysis or new data is received from contributing observatories. NEIC publishes, for example, their preliminary products on a weekly and monthly basis (<ftp://hazards.cr.usgs.gov/weekly> and <ftp://hazards.cr.usgs.gov/edr> , respectively). The BGR produces a preliminary event list of local, regional and world-wide seismic events with a time delay of 1 to 3 days. It is published on the BGR-website (http://www.bgr.bund.de/DE/Themen/Erdbeben-Gefahrungsanalysen/Seismologie/Seismologie/Erdbebenauswertung/Detaillierte_Auswertung/Daten_GRS_GRF/grf_grsn_node.html). Revised German products are the monthly distributed German local bulletin and the regional and teleseismic bulletin as described in section 1. All German products are based on the GERESS and GRF arrays, GRSN, and GEOFON networks. Additionally, seismic stations of neighboring countries, which provide online data access, are used for a precise determination of earthquakes in the border areas of the German station network. The results of local seismological services and observatories with their dense local station networks are also considered, in order to provide the German local bulletin with the best possible earthquake localizations.

4 Final products

The most complete and precise data on seismic events is published when all of the available data has been analysed. These products may be published up to several months after the events. ISC, for example, distributes their final products (<http://www.isc.ac.uk/doc/products/index.html>) about two years after the earthquakes occurred. The final ISC bulletin can be downloaded from the ISC website (<ftp://ftp.isc.ac.uk/pub/isf>) or can be requested at the ISC on compact disc. This bulletin comprises the most comprehensive information on global earthquakes including the final results of various national data centers and forms the base for scientific studies at universities and research facilities.

National as well as international data centers make their earthquake catalogues and bulletins available to the public on their WEB sites. In most cases it is also possible to search online for earthquake information in the data bases of the data centers. Requests can be individually configured for selected spatio-temporal criteria. This service is, for example, provided at the ISC website <http://www.isc.ac.uk/search/index.html>.

Additional references

ORFEUS software library, <http://orfeus.knmi.nl>
IRIS, <http://www.iris.washington.edu>
RENASS, <http://renass.u-strasbg.fr/>
SED, <http://www.seismo.ethz.ch/index>
GEOFON: <http://geofon.gfz-potsdam.de>

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