INTERNATIONAL SEISMOLOGICAL CENTRE (ISC)

2014

Annual Director's Report

The year 2014 was another successful year for the ISC thanks to the extended support of the ISC Members and Project Sponsors. 17 ISC and one Oxford OeRC staff members have been involved in operations and several major development projects. Bulletin data for earthquakes and explosions during recent (2011-2014) and historical (1950-1959) periods were added to the live ISC database that grew by 10% in one year. New agencies in European-Mediterranean area started reporting directly to the ISC following closure of bulletin production at EMSC. The Station Registry, GT-List, ISC-GEM catalogue and the ISC Event Bibliography were further updated and extended. A link between CTBTO and the ISC database was popular with the monitoring community. Mirrors of the ISC database and website have been operated at the IRIS DMC, ERI and LLNL. A large number of scientific articles published in 2014 indicate an extensive worldwide use of the ISC data. The GEM 2014 Outstanding Contribution Award was given to the ISC for services to seismic hazard and risk community.

EXECUTIVE SUMMARY

- The ISC finances remained stable thanks to the continued support from 63 Member-Institutions in 46 countries, additional project grants (23% of the total income) from CTBTO, GEM Foundation, USGS, US NSF, FM Global, Lighthill Risk Network, OYO, UK KTP as well as sponsorship from Reftek.
- The GEM 2014 Outstanding Contribution Award was given to the ISC for services to seismic hazard and risk community.
- 17 staff members plus a member of the OeRC of Oxford University worked at the ISC during the year.
- Parameters of 1728 stations were registered or modified in the **International Seismograph Station Registry** (IR).
- Within hours, days and weeks after event occurrence, the ISC collected and grouped preliminary data from 28 networks and distributed the **Preliminary ISC Bulletin**.
- The main collection of revised bulletins from 137 institutions stood at 12 months behind real time but several agencies were not able to adhere to this deadline.
- Following closure of the Euro-Med bulletin production at **EMSC**, several new direct contributions from agencies in the area have been set up at the ISC.
- 11 data months were added to the Reviewed **ISC Bulletin** with ~64,000 seismic events and ~5.7 million arrivals with two further data months in review.
- The size of ISC database increased by ~10% during the year and reached 157Gb.
- The overall ISC Bulletin (reviewed and unreviewed parts) is substantially more complete than the bulletins of either the NEIC/USGS or the IDC/CTBTO.
- The **ISC-GEM Global Instrumental Earthquake Catalogue** (1900-2009) has been extended to include all known earthquakes with M_W 5.5 and above during 1950-1959 and 2010-2011.
- The **ISC Event Bibliography** was further updated.
- We continued operating and improving the **CTBTO Link to the ISC database** with a healthy stream of recorded queries from the NDCs and IDC.
- We released two further volumes of the printed **Summary of the Bulletin of the ISC** providing current information on the ISC/IASPEI procedures and standards, contents of the ISC Bulletin and bringing four invited articles on notable earthquakes or seismic network status from JMA, GNS and Tohoku University.
- The ISC database and the website mirrors at IRIS DMC in Seattle, ERI in Tokyo and LLNL in Livermore guaranteed improved speed of access to ISC data.
- We continued maintaining and distributing the IASPEI Reference (**GT**) Event List, the **EHB** Bulletin and the List of **International Contacts in Seismology**.
- The **FDSN-compliant web-service** has been put in action.
- The ISC staff submitted several scientific articles and participated in several conferences providing publicity for the ISC throughout the year.
- The large number of published scientific articles using ISC data indicates a wide-range use of ISC products by many researchers worldwide.

STAFF

As many as 17 members of staff worked at the ISC during 2014, thanks to the regular Member's and sponsor's support and a number of additional projects such as the ISC-GEM Catalogue, CTBTO Link and the Bulletin Rebuild.

Formally an employee of Oxford University e-Science Research Centre, Dr Hui Fang, continues to be based at the ISC working on the Visual Bulletin Analysis System (VBAS) as part of a joint three-year project part-funded by UK Government KTP Programme.

One more member of the ISC staff received a Doctorate degree. Now there are 6 Ph.D., 7 M.Sc. or equivalent and 3 B.Sc. or equivalent degrees among the staff.

Several members of staff took part in professional meetings, travelled to international conferences and participated in professional training programmes.

The ISC staff often organise sessions during major scientific conferences. Several ISC staff are members and often contribute to running professional organizations such as IASPEI, CoSOI, SECED, EGU and SSA.

During the year we saw the departure of István Bondár who returned to his home country Hungary and Wayne Richardson who returned to New Zealand having finished his 4-year term. The Trainee Analyst Ivana Jukic and Data Entry officer Natalia Safronova also left.

MANAGEMENT and ADMINISTRATION

Dmitry Storchak, Ph.D.
Director/Seismologist
Russia/UK

Maureen Aspinwall
Administration Officer
UK

DATA and SYSTEMS MANAGEMENT

James Harris
Senior Systems & Database Administrator
UK

John Eve, B.Sc.
Data Collection Officer
UK

Przemek Ozgo
Systems Administrator
Poland

DEVELOPMENT

István Bondár, Ph.D.
Senior Seismologist
Hungary (left in April)

Wayne Richardson, Ph.D.
Senior Seismologist
New Zealand (left in August)

Kostas Lentas, Ph.D.,
Seismologist/Developer
Greece

BULLETIN ANALYSIS TEAM

Emily Delahaye, M.Sc.
Seismologist / Lead Analyst
Canada

Blessing Shumba, M.Sc.
Seismologist / Analyst
Zimbabwe

Rosemary Wylie,
M.Phys.Geog., Analyst
UK

Rebecca Verney, B.Sc.,
Analyst,
UK

Ivana Jukić, M.Sc.
Seismologist / Trainee Analyst
Croatia (left in May)

VBAS PROJECT

Hui Fang,
Ph.D., Computer Science
China
Based at the ISC, formally an employee of Oxford University e-Research Centre (OeRC)

ISC-GEM and EVENT BIBLIOGRAPHY OFFICE

Domenico Di Giacomo,
Ph.D.
Seismologist
Italy

Natalia Safronova,
M.Eng.
Data Entry Officer
Russia (left in December)

Elizabeth Ball,
B.Sc.Geog.,
Data Entry Officer
UK

Daniela Catanescu,
M.Sc.Admin.,
Data Entry Officer
Romania

OPERATIONS

INTERNATIONAL SEISMOGRAPH STATION REGISTRY (IR)

Traditionally, the ISC maintains the International Seismograph Station Registry (IR) together with NEIC/USGS. The IR allocates globally unique codes to seismic stations worldwide.

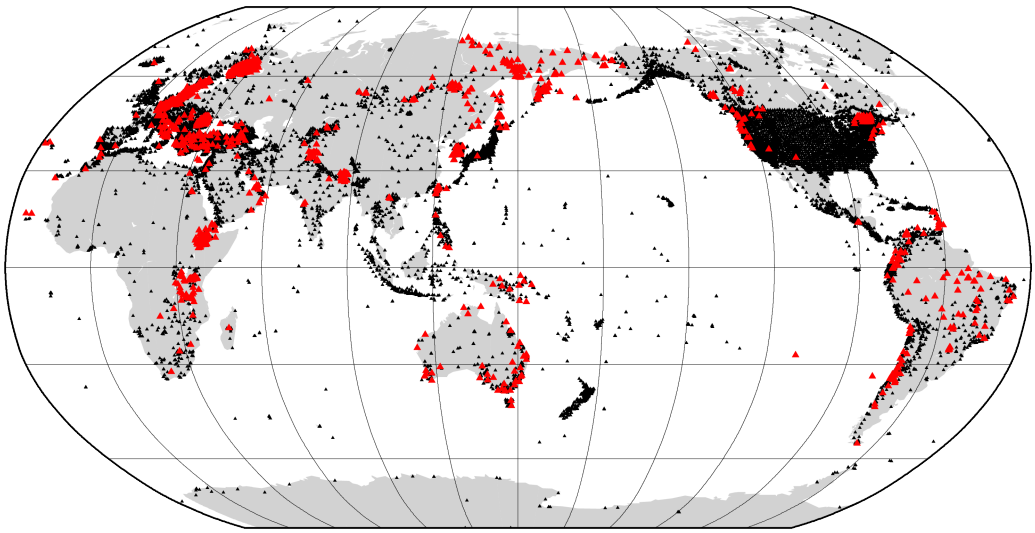


Figure 1. *21,343 stations, open or closed, were fully registered in the International Seismographic Station Registry at the end of 2014; parameters of 1,728 of those (in red) were either registered or modified during 2014.*

At the end of 2014, the IR contained information on 21,343 stations with 1,728 of them registered or updated during the year (Fig.1). In 2014, the IR has been particularly improved and extended in Europe, Russia, Africa, Australia and South America as part of the work on:

- including datasets for ISC Bulletin Rebuild project;
- taking over former EMSC data collection in Europe;
- improving the IASPEI Reference Event (GT) List and participation in the CTBTO initiative of building the Regional Seismic Travel Times (RSTT).

Joint work with the NEIC is underway to update the IR with the new Agency.Deployment.Station.Location (ADSL) convention in accordance with the IASPEI recommendation. The new registry will feature station codes that are unique within each network deployment as opposed to being globally unique. The new registry will help to give credit to all institutions that perform different parts of the monitoring job: operating seismic stations, performing waveform analysis or reporting parametric data.

The ISC runs a popular web-page giving an account of already registered stations as well as inviting the submission of parameters required to register a new station. Figure 2 demonstrates per country use of the IR related web-searches. US numbers are dominated by the NEIC running regular queries to synchronise their database with the IR.

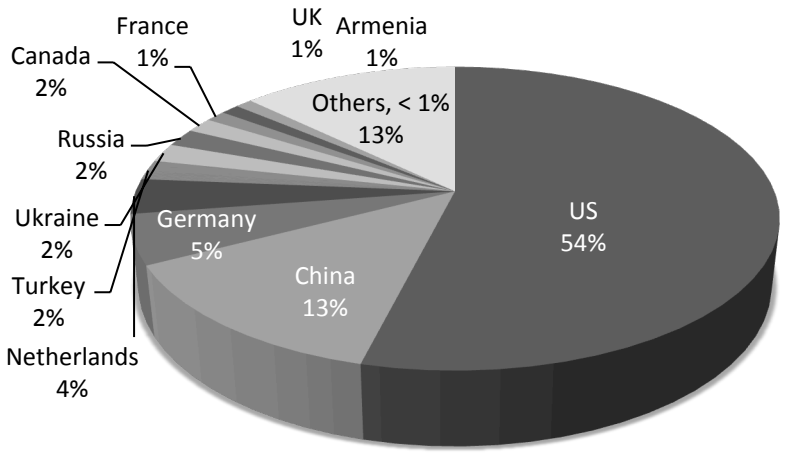


Figure 2. *Per country statistics of the web-searches related to the IR; US numbers are dominated by the NEIC running regular queries to synchronise their database with the IR.*

The unique IR codes are used by the international waveform data centres such as the IRIS DMC and ORFEUS for an appropriate waveform archival and distribution.

COLLECTING PRELIMINARY NETWORK BULLETINS

The ISC continues to collect preliminary bulletin data from a large number of networks and data centres. These data are expected to undergo at least a minimal review by local analysts. Typically the incoming data include a preliminary hypocentre location, magnitude estimates, moment tensor solution and station arrival data, though variations are large from agency to agency. 28 agencies reported preliminary data to the ISC during year 2014 (Table 1).

In 2014, NSC (Syria) and NIEP (Romania) began or restarted contributing its preliminary bulletins in addition to the final bulletins that had been reported for several years.

Unfortunately, contributions of preliminary solutions from the NNC (Kazakhstan) were temporarily interrupted. Council of Geosciences (South Africa) still hasn't resumed previously interrupted preliminary earthquake reports.

Table 1*. 28 agencies reported preliminary hypocentre determinations and corresponding arrival time data to the ISC in 2014.*

Country	**Reporting Agency**
Armenia	National Survey of Seismic Protection
Australia	Geoscience Australia
Canada	National Earthquake Hazards Program
China	China Earthquake Administration
Cyprus	Cyprus Geological Survey Department
Czech Republic	Geophysical Institute, Academy of Sciences of the Czech Republic
Denmark	Geological Survey of Denmark and Greenland
Egypt	National Research Institute of Astronomy and Geophysics
France	European Mediterranean Seismological Centre
France	Institut de Physique du Globe de Paris

Georgia	Seismic Monitoring Centre of Georgia
Germany	Helmholtz Centre Potsdam GFZ German Research Centre Geosciences
Germany	Landeserdbebendienst Baden-Wuerttemberg
Indonesia	Badan Meteorologi dan Geofisika
Iran	International Institute of Earthquake Engineering and Seismology
Israel	Geophysical Institute
Italy	Istituto Nazionale di Geofisica e Vulcanologia
Japan	Japan Meteorological Agency
Kyrgyzstan	Institute of Seismology, Academy of Sciences of Kyrgyz Republic
Norway	NORSAR
Romania	National Institute for Earth Physics
Russia	Geophysical Survey (GS), Russian Academy of Sciences (RAS)
Russia	Baykal Centre, GS, Siberian Branch, RAS
Russia	Kamchatka Regional Seismic Centre, GS, RAS
Spain	Instituto Geografico Nacional
Syria	National Syrian Seismological Center
UK	British Geological Survey
USA	National Earthquake Information Center, USGS

In addition, there are 16 agencies that switched into a speedy mode of data processing, where bulletins are produced soon after event occurrence and the staff never return for event re-analysis unless there is a special need (Table 2). Theses agencies can be considered as reporting both preliminary and final bulletins at the same time.

Table 2. *Agencies performing final analysis within a month of event occurrence.*

Country	**Reporting Agency**
Albania	Institute of Seismology, Academy of Sciences of Albania
Algeria	Centre de Recherche en Astronomie, Astrophysique et Géophysique
Chinese Taipei	Institute of Earth Sciences, Academia Sinica
France	Laboratoire de Détection et de Géophysique/CEA
French Polynesia	Laboratoire de Géophysique/CEA
Germany	Alfred Wegener Institute for Polar and Marine Research
Germany	Seismological Obs. Berggießhübel, TU Bergakademie Freiberg
Ivory Coast	Station Géophysique de Lamto
Moldova	Institute of Geophysics and Geology
Namibia	Geological Survey
Norway	NORSAR
Portugal	Instituto Geofisico do Infante Dom Luiz
Romania	National Institute for Earth Physics
Switzerland	Swiss Seismological Sevice
Tunisia	Institut National de la Météorologie
Puerto Rico, USA	National Seismic Network, University of Puerto Rico

BUILDING PRELIMINARY ISC BULLETIN

Preliminary hypocentre solutions and station arrivals are grouped in the ISC database with corresponding solutions from other agencies and made available through the standard ISC Bulletin search procedure within a few hours of receipt. For each event an output includes several hypocentre solutions reported by various agencies, all reported source mechanisms and magnitude estimates as well as corresponding station arrival data. Earthquake headers include logo images of each reporting agency. By clicking on the logo, Preliminary ISC Bulletin users can get further information from each agency directly.

Almost all events with magnitude 5 and above and many of smaller magnitudes are reported within the first week. Further reports beyond one week add information to already reported large and moderate events and also inform about smaller events.

This process is there to fill the gap between the event occurrence and the time when the final Reviewed ISC Bulletin becomes available. It presents an attempt to consolidate the effort of many data centres and networks to make their data available internationally in good time. At this stage ISC does not compute or publish its own event solutions. This service is not intended for use by the media or civil protection agencies. It is designed to be used by seismologists to receive as much information as possible in one single format from one single place and then to get access to details using provided links to the original data reporters.

No later than one year after each seismic event occurrence, the preliminary data from agencies are substituted with their final, revised versions; this is well before the ISC analysts make their final review of the ISC Bulletin. The ISC hypocentre solutions are still based only on the revised set of bulletin parametric data given by each reporting institution.

COLLECTING REVISED NETWORK BULLETINS

The standard ISC data collection is the collection of revised bulletin data from many agencies (network data centres and single observatories) around the world up to 12 months behind real time. With a few exceptions, this delay gives the data contributors enough time for reviewing and finalising their bulletin data before submission to the ISC. Figure 3 shows 137 agencies that reported final reviewed bulletin data directly to the ISC in 2014. In addition, a few tens of agencies reported to the ISC via regional data concentrating centres such as the National Earthquake Information Center (NEIC), the European Mediterranean Seismological Centre (EMSC, until Autumn 2014). Moderate to large events with magnitude 4.5-5.0 and above in large parts of Africa and on mid-oceanic ridges are reported by the NEIC, International Data Centre of CTBTO, Geophysical Survey of Russian Academy of Sciences (GS RAS) and China Earthquake Networks Center (CENC). The increase in the total number from 2013 (115 to 137) was partly due to a considerable effort by the ISC Data Entry Officer and the Director to reinstate delayed and lost contributions where possible:

- ✓ University of Addis Ababa, Ethiopia,
- ✓ Observatoire Géophysique d'Arta, Djibouti,
- ✓ Earthquake Research Center, Ataturk University, Turkey

- ✓ Instituto Nacional de Prevención Sísmica, San Juan, *Argentina*
- ✓ Republic Center of Seismic Survey, Baku, *Azerbajan*
- ✓ West Bohemia Seismic Network, *Czech Republic*
- ✓ Institut de Physique du Globe, Strasbourg, *France*
- ✓ Tehran University, *Iran*
- ✓ Dipartimento per lo Studio del Territorio e delle sue Risorse, Genova, *Italy*
- ✓ National Research Institute for Earth Science and Disaster Prevention, *Japan*
- ✓ National Council for Scientific Research, *Lebanon*
- ✓ Seismological Observatory Skopje, FYR *Macedonia*
- ✓ Sultan Qaboos University, *Oman*
- ✓ Micro Seismic Studies Programme, *Pakistan*
- ✓ East African Network, *responsible country alternates annually*
- ✓ University of Uppsala, *Sweden*
- ✓ Swiss Seismological Sevice, *Switzerland*
- ✓ National Syrian Seismological Center, *Syria*
- ✓ Thai Meteorological Department, *Thailand*
- ✓ Institut National de la Météorologie, *Tunisia*
- ✓ Subbotin Institute of Geophysics, *Ukraine*
- ✓ Dubai Seismic Network, *UAE*
- ✓ National Seismological Center, *Yemen*

Especially notable are the effects of the EMSC's decision to stop collection of the revised bulletin data from agencies in the region and discontinue production of the Euro-Mediterranean Bulletin. This decision was taken by the EMSC General Assembly on the understanding that the ISC will be able to continue its bulletin services in the region and, where necessary, will accept direct contributions of bulletin data from a few agencies in the region that were coming only via EMSC in the past. Thus, we instigated a considerable communication effort to invite agencies otherwise missing from ISC data collection lists to start direct reporting to the ISC, using acceptable protocols.

In addition, two regional networks in Russia started reporting data from two low-seismicity areas in Urals and far North. The network in Naples started contributing as a result of one of the ISC seismologists taking part in a project work in Italy.

Thus, new reporters in 2014 were:

- ✓ Institute of Physics of the Earth, *Brno*, *Czech Republic*
- ✓ University of Patras, Department of Geology, *Patras*, *Greece*
- ✓ Osservatorio Sismologico Universita di *Bari*, *Italy*
- ✓ Research Laboratory of Experimental and Computational Seismology, *Naples*, *Italy*
- ✓ Institute of Environmental Problems of the North, RAS, *Arkhangelsk*, *Russia*
- ✓ Mining Institute, Ural Branch, RAS, *Perm*, *Russia*
- ✓ Institut Cartogràfic de Catalunya, *Barcelona*, *Spain*

Delayed or lost contributions include those from:

- (*Delayed*) Instituto Astronomico e Geofísico, *Brazil*
- (*Permanent*) Central American Seismic Center (CASC), *Costa Rica*
- (*Until further notice*) Observatorio Vulcanológico y Sismológico, *Costa Rica*
- (*Delayed*) Observatoire Volcanologique de Goma, *DR Congo*
- (*Until further notice*) Dublin Institute for Advanced Studies (DIAS), *Ireland*
- (*Delayed*) Kyrgyz Seismic Network, *Kyrgyzstan*
- (*Delayed*) Geological Survey Department Malawi, *Malawi*
- (*Delayed*) Research Centre of Astronomy and Geophysics, *Mongolia*
- (*Delayed*) Seismological Institute of Montenegro, *Montenegro*
- (*Delayed*) Altai-Sayan Seismological Centre, GS SB RAS, *Russia*

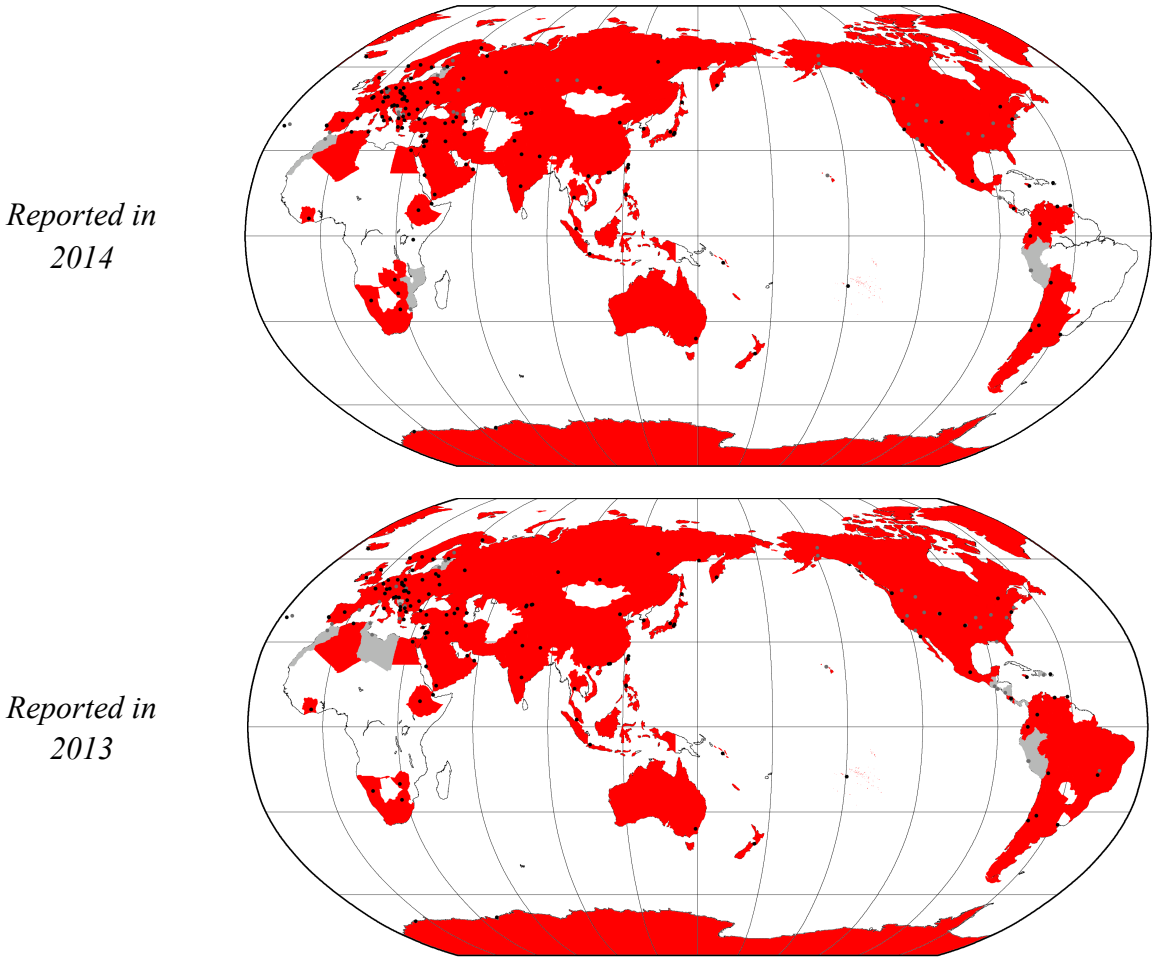


Figure 3. *137 agencies in 2014 (as compared to 115 in 2013) reported bulletin data directly to the ISC (black dots); dry land territories covered by these reports are in red. Grey areas indicate those territories and agencies that are covered indirectly via reports from NEIC, EMSC and CASC. No colour indicates areas that are not covered by local network operator reports. Comparison of 2014 and 2013 indicate a delay in current contributions from Brazil and a loss of contributions from Ireland and Libya. Also on the map are numerous new and recovered contributions as listed in the text above.*

During 2014, the IRIS DMC continued its contribution of station arrival times that were picked and reviewed by the USArray Array Network Facility in the Institute of Geophysics and Planetary Physics (IGPP) of the Scripps Institution of Oceanography, UCSD. The data set represents a considerable increase in station arrival numbers associated to already known events in the US and moderate to large events worldwide (Fig. 4). Whilst being a major source of highly useful data for tomographic research, this data set presented a major challenge to the ISC in the past because the large concentration of stations generally biased the ISC solutions. This is no longer the case since data year 2009 when the new ISC Locator has taken correlated travel-time error structure into account. Nevertheless, the increased numbers of stations, reporting the same event, continue to create a major workload for the ISC Analysts.

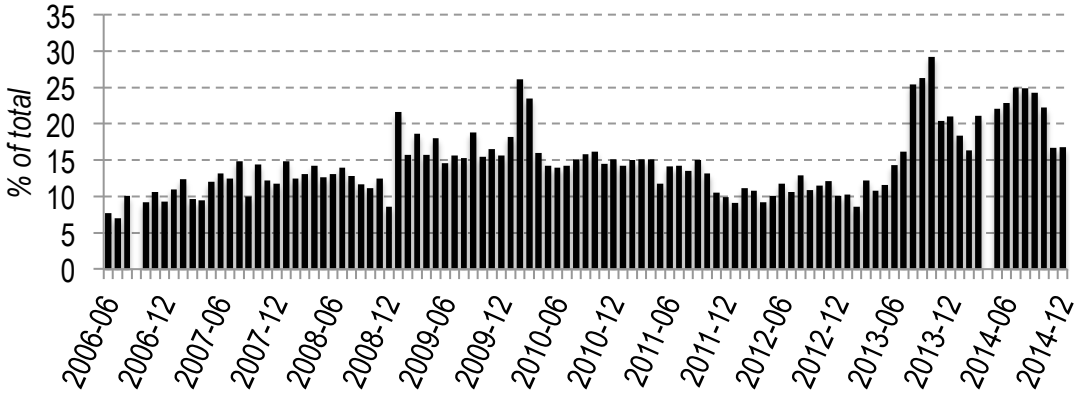


Figure 4. *Fraction of arrival time picks reported by USArray network facility as compared to the total number of arrivals associated to ISC Bulletin events of magnitude over 4.5.*

ISC BULLETIN REVIEW

The ISC Bulletin is progressively updated with each network report coming in. Preliminary network contributions are substituted with final reviews. New events are built, merged or split with every new report coming to the ISC by e-mail and processed either automatically or manually by the ISC Data Entry Officer, who is working remotely from his home office in Scotland.

The ISC seismologists/analysts review approximately one fifth of all events formed in the ISC database by the automatic procedures. This review makes the ISC Bulletin accurate and trustworthy. The accuracy of *ak135*-based ISC solutions and magnitude estimates, proper grouping of reported information between the events in the Bulletin is under constant scrutiny. The ISC analysts also review the correctness of automatic association of reported station arrivals to events, reported arrival's phase identification and travel-time residuals.

When the time comes, one month's worth of data is pulled into a separate database table space and a set of automatic procedures are run to produce the first automatic ISC event locations and magnitude determinations for those events that are large enough to be reviewed by the ISC seismologists. It would be impossible for the ISC to sustain a review of every

reported event, so from data year 1999 the data collection thresholds were removed and review thresholds introduced. Following various recent improvements this system continues to serve its purpose by limiting the number of seismic events to be reviewed by ISC analysts. The threshold criteria are complex yet almost all events of magnitude approximately 3.5 and larger are reviewed.

The team of five analysts (including a trainee) fully completed the review of 11 months of the ISC Bulletin (Aug 2011-June 2012) during the calendar year 2014. In addition, a fair amount of work was done for the months of July and August 2012.

Throughout 2014, the Analyst Team included four to five members:

- Mrs Emily Delahaye (Canada), the Lead Analyst, returned from maternity leave in March 2014;
- Mr Blessing Shumba (Zimbabwe), Analyst;
- Ms Rosemary Wylie (UK), Analyst;
- Ms Rebecca Verney (UK), Analyst;
- Ms Ivana Jukić (Croatia), Trainee Analyst, left ISC in May.

During the Lead Analyst's absence her duties were shared by Rosemary Wylie and Blessing Shumba. Scientific assistance was also given by Dr. Wayne Richardson, Senior Seismologist, whose long experience of editing the ISC Bulletin was also useful during training as well as in solving difficult cases.

During the final steps in the analysis procedure, the team also included the ISC Director, who ran and reviewed the results of the procedure identifying previously unreported events based on the un-associated station arrivals available in the ISC database.

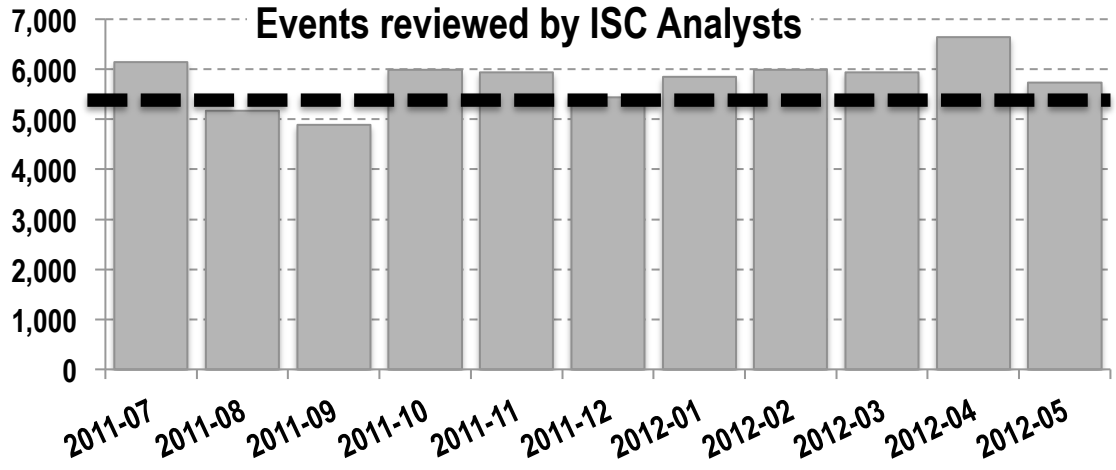


***Figure 5**. Monthly number of seismic events in the Reviewed ISC Bulletin processed during 2014; the dashed line shows the average monthly event number during 12 months preceding the Great Tohoku Earthquake and the earthquake sequence that followed.*

In 2014, the Analysis team was working with a still increasing number of seismic events that were considered worthy of ISC re-analysis. Monthly event numbers (Fig. 5) mostly exceeded those common during the 12 months preceding the Great Tohoku earthquake of March 2011 and following earthquake sequence that broke all reporting records.

The result of the ISC work can be seen when comparing Figures 6 and 7, showing hypocentre locations reported by all data contributing networks and primary hypocentres in the ISC Bulletin. A fuzzy picture of the worldwide seismicity sharpens up, especially in case of the reviewed ISC Bulletin.

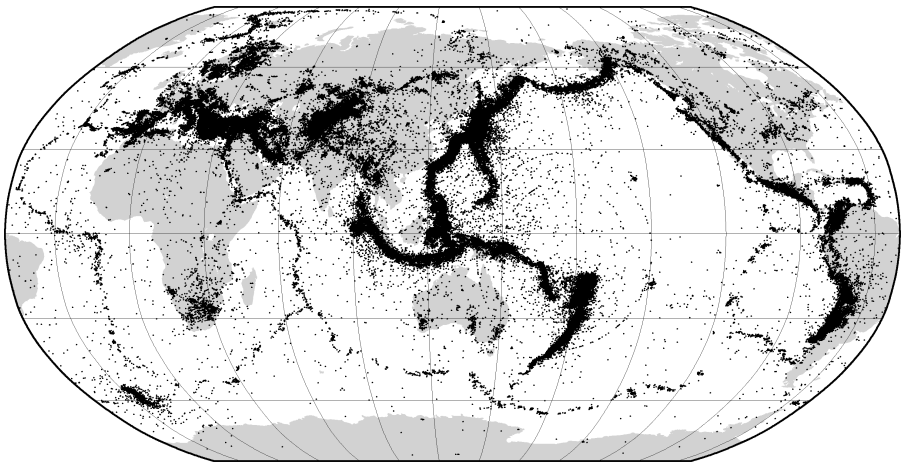


***Figure 6**. All hypocentres reported by individual networks (July 2011 – May 2012).*

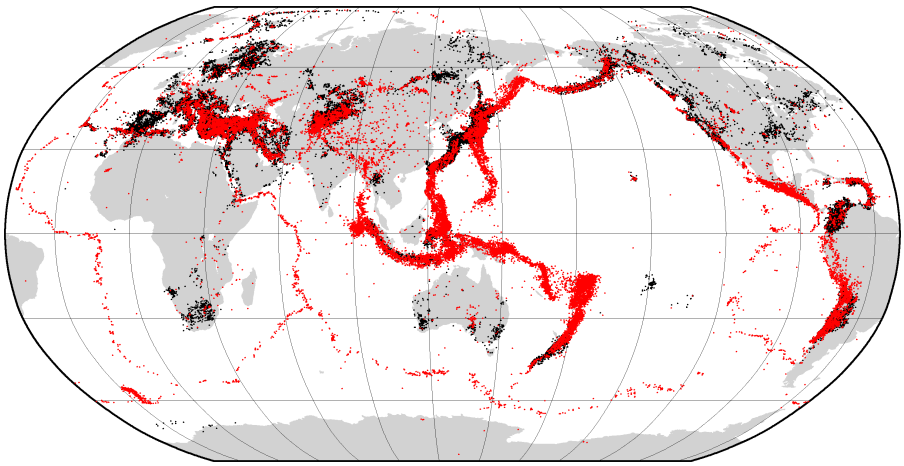


***Figure 7**. Primary hypocentres in the ISC Bulletin (black) in the period (July 2011 – May 2012); red colour highlights the events reviewed by the ISC analysts.*

Overall, during the calendar year 2014, ~64,000 reviewed events with ~5.7 million of associated phases were added to the reviewed part of the Bulletin by the ISC analysts. Figure 8 demonstrates the diversity of seismic phases generated by shallow earthquakes and identified in the ISC Bulletin.

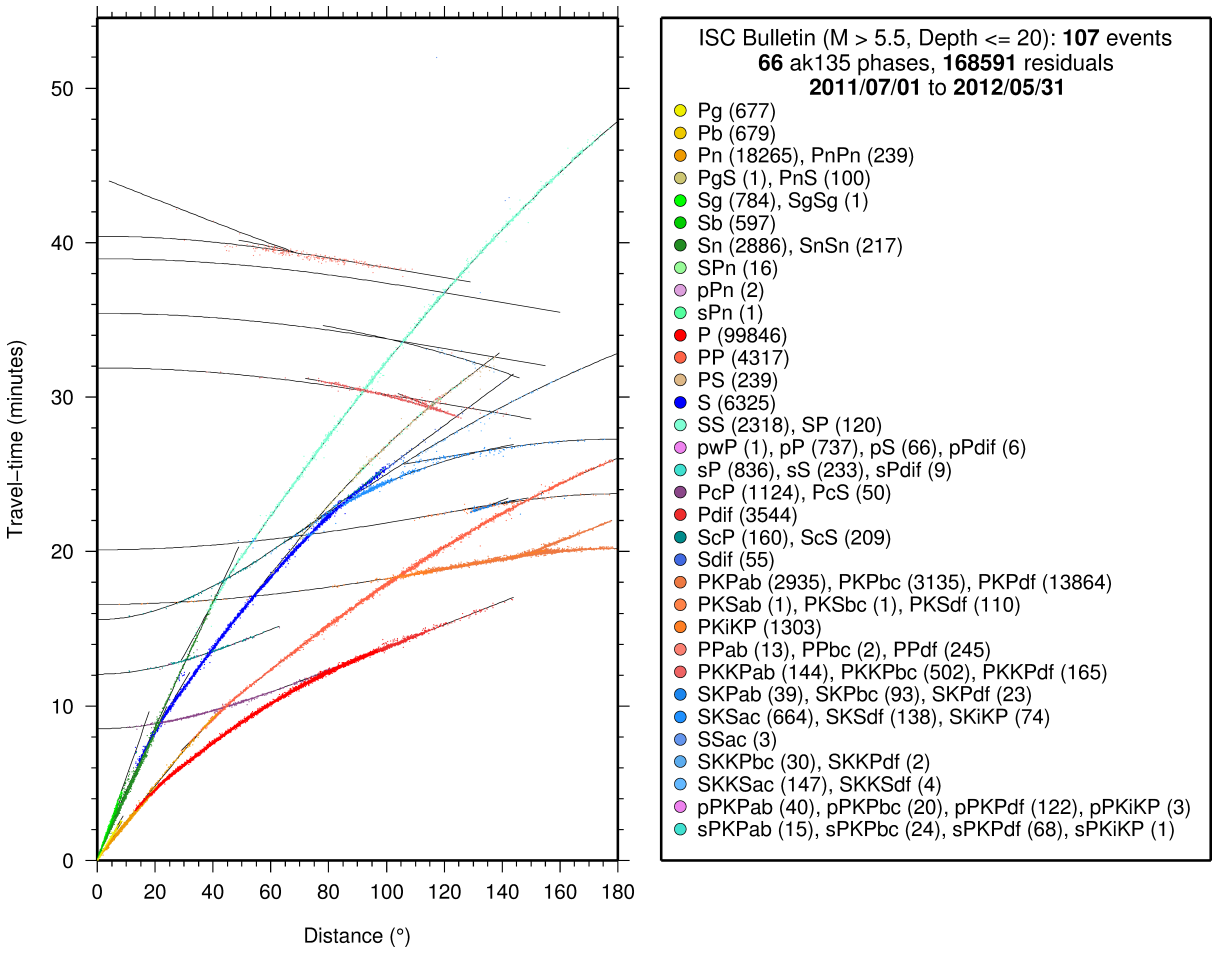


***Figure 8**. Seismic phases from shallow events reviewed by the ISC analysts during 2014.*

DESIGNING A VISUAL BULLETIN ANALYSIS SYSTEM (VBAS)

The issue of the constantly increasing amount of station arrival information available for each event in the Bulletin is still pressing. With partial support (66.6%) from the UK Government Knowledge Transfer Programme (KTP) and jointly with the Oxford University e-Research Centre (OeRC) we are working on the development of the Visual Bulletin Analysis System (VBAS) to replace the existing paper-scanner-screen based batch-type analysis. The new system would allow the ISC analysts to concentrate on the review of graphical information summaries with highlighted outliers instead of reviewing all data in text format.

Dr Hui Fang is formally employed by Oxford University to work as a KTP Associate on this project. He shares his permanent office with the ISC Analysts that take keen interest in this development. In his work Hui Fang is supported by Prof. Min Chen and Dr. Simon Walton who specialize in computer visualization at OeRC in Oxford. During the past year, we designed ways of efficient and concise presentation of seismological bulletin information in graphical as opposed to textual way. A brainstorming meeting was organized among the ISC and OeRC staff to suggest the elements of the front screen to be used by the ISC analysts on

the routine basis. Quarterly LMC meetings bring together those in the ISC and OeRC responsible for the project running along with Dr Gillian Rysiecki, the KTP Coordinator.

GENERAL STATISTICS of the ISC BULLETIN

The ISC Bulletin and the ISC database grow by the day in both seismic event (earthquake or explosion) numbers and reported seismic wave arrival times and amplitudes at stations registered in IR (Fig. 9 a,b).

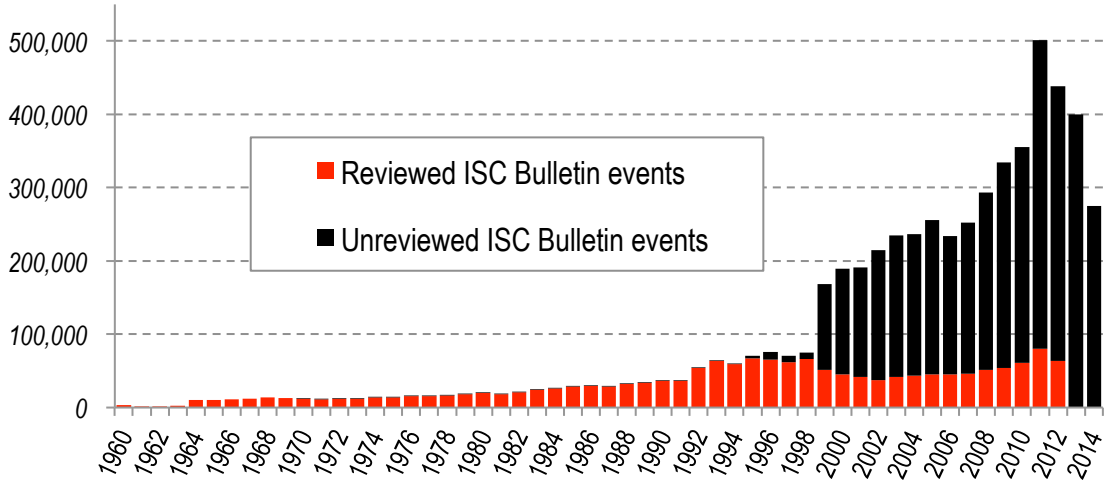


***Figure 9a**. Timeline of the annual number of reviewed and unreviewed (small) events in the ISC Bulletin. The total height of each column represents the annual number of all seismic events in the ISC Bulletin.*

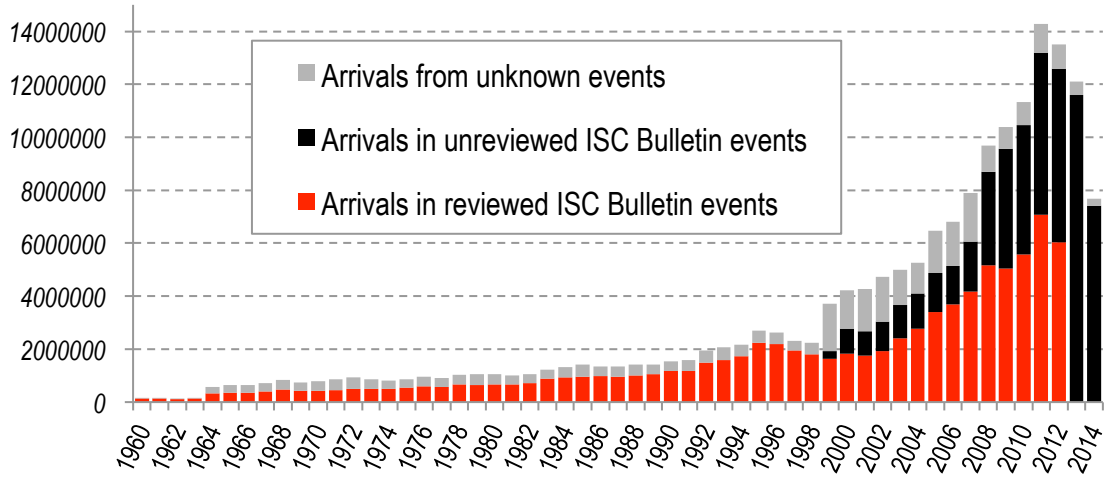


***Figure 9b**. Timeline of the annual number of seismic arrivals associated with both reviewed (red) and unreviewed (black) events in the ISC Bulletin, as well as those arrivals in the ISC database that are not associated to any known events (grey). The total height of each column represents the annual number of all seismic arrivals in the ISC database.*

Figure 10 demonstrates the comparative magnitude completeness of the ISC Bulletin and bulletins of the NEIC/USGS and IDC/CTBTO. The ISC and IDC Bulletins appear to be more complete globally than NEIC by at least half a unit of magnitude. The NEIC has adopted its new global magnitude cut-off threshold of 4.5 which means that the ISC Bulletin will always be more complete by definition. The IDC is unlikely to use many more seismic sites/arrays than they use at present due to exact IMS network station positions written in the Comprehensive Test Ban Treaty. Hence, it is likely that there will be even more seismic events in the future that will be unique to the ISC Bulletin. The ISC Bulletin, of course, has a vast number of small events not listed in either IDC or NEIC bulletins.

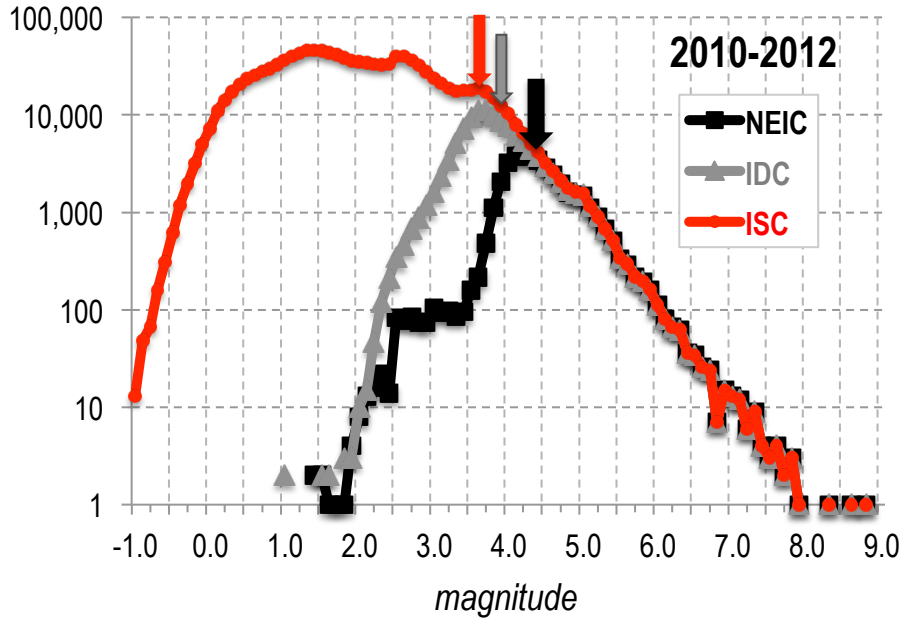


***Figure 10**. Number of seismic events in the ISC, NEIC/USGS and IDC/CTBTO (REB) bulletins during the 2010-2012 period; vertical arrows indicate an approximate magnitude of completeness.*

The ISC Bulletin is used by many researchers worldwide. Figure 11 shows that use of the ISC Bulletin from the ISC website has, yet again, increased as compared to previous years.

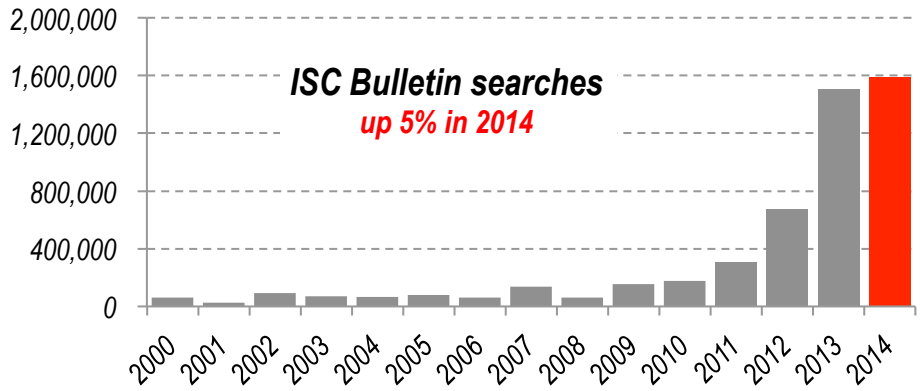


***Figure 11**. Annual number of the ISC Bulletin searches made by website users during 2014 was up 5% as compared to 2013.*

Figure 12 shows the multinational character of the ISC Bulletin search users.

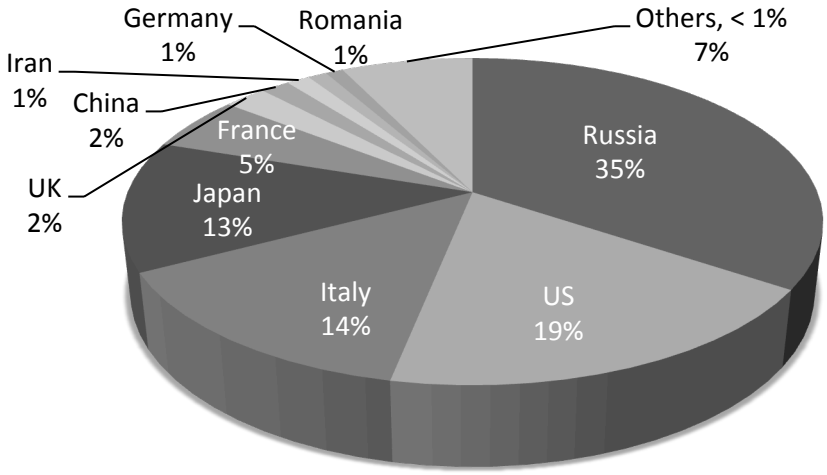
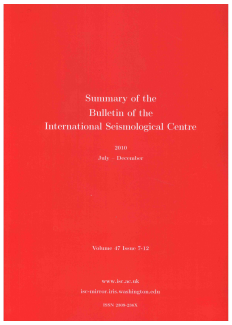


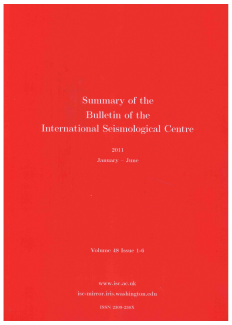
***Figure 12**. Per country distribution of the ISC Bulletin searches made by ISC website users during 2014.*

The above statistics include the use of the ISC mirror website at IRIS DMC, yet it does not include bulletin searches made from mirror-sites at ERI in Tokyo and LLNL in Livermore. Where reliably known, we removed the numbers related to web crawlers.

PRINTED SUMMARY of the BULLETIN of the ISC

The ISC has ceased publication of the printed ISC Bulletin with the last data of year 2009. From data year 2010 it was decided to replace this publication with the printed *Summary of the Bulletin of the ISC* which covers six months of the Bulletin data enclosed on a DVD. The old Bulletin was a listing of individual event hypocentres and magnitudes. The issues of the Summary that were produced in 2014 included the following topics:





- The ISC (Mandate, History, Evolution of the Bulletin, Member Institutions, Sponsors, Data Contributors, Staff)
- Operational Procedures (data collection, grouping, association, thresholds, location, magnitude determination, review, history of operational changes)
- Availability of the ISC Bulletin
- Citing the ISC
- IASPEI Standards
- Summary of Seismicity (6 months)
- Invited articles on:
  - Notable Events (from New Zealand and Japan)
  - Individual network history, status and procedures (from Japan)
- Statistics of Collected Data
- Overview of the ISC Bulletin
- Leading Data Contributors
- Glossary

With the departure of an ISC Senior Seismologist, Wayne Richardson to his home country, the role of the Chief Editor has been retained by him on a consultancy basis until an appropriate substitute is found.

The invited articles from the Summary are also used on the ISC website. Articles on notable events contribute to the ISC Event Bibliography. Network description articles become associated with general information available for each agency contributing to the ISC Bulletin.

As a book publisher, the ISC receives a refund of the Value Added Tax on all goods and services that it buys from other suppliers.

IASPEI GT LIST

The International Seismological Centre maintains the IASPEI database of Reference Events (earthquakes and explosions, including nuclear) for which epicentre information is known with high confidence (to 5km or better, GT5) with seismic signals recorded at regional and/or teleseismic distances (Fig.13a,b). It should be noted that the depth of these events is not known to the same level of accuracy as the epicentre.

The global effort of collecting and validating GT events is coordinated by the CoSOI/IASPEI working group on Reference Events for Improved Location that includes Bob Engdahl, Eric Bergman, István Bondár and Kostas Lentas.

The GT database of 8,573 reference events (1962-2012) and approximately 870,000 station arrivals facilitates better visualization of the Earth structure, better modelling of velocities of seismic waves, more accurate travel time determinations and increased accuracy of event locations.

The ISC users are able to search this database at the ISC website and receive GT locations and corresponding ISC locations along with station arrival data available for each event. A cross-link to the ISC Bulletin is provided for users to go between ISC and GT databases.

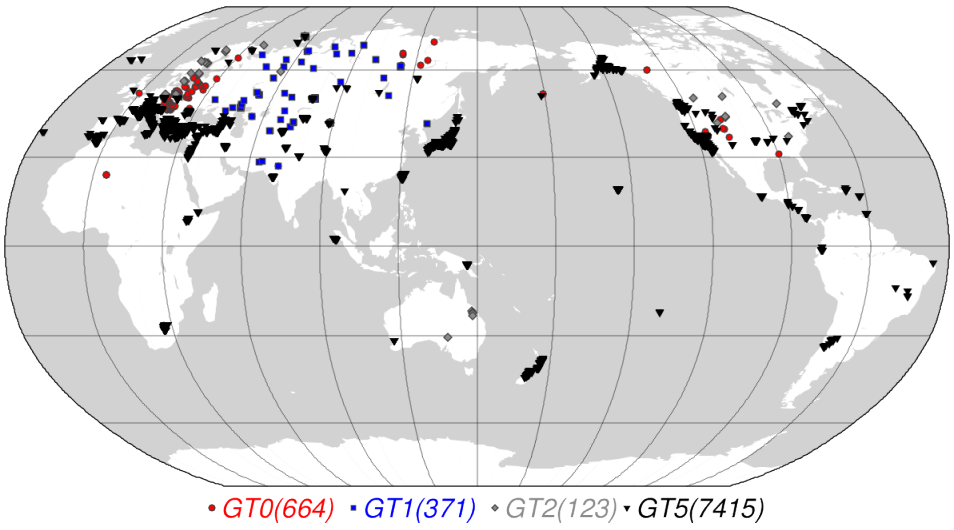


Figure 13a. *The IASPEI List contains seismic events during 1959-2012 for which epicentre information is known with high confidence (to 5km or better (GT5))*

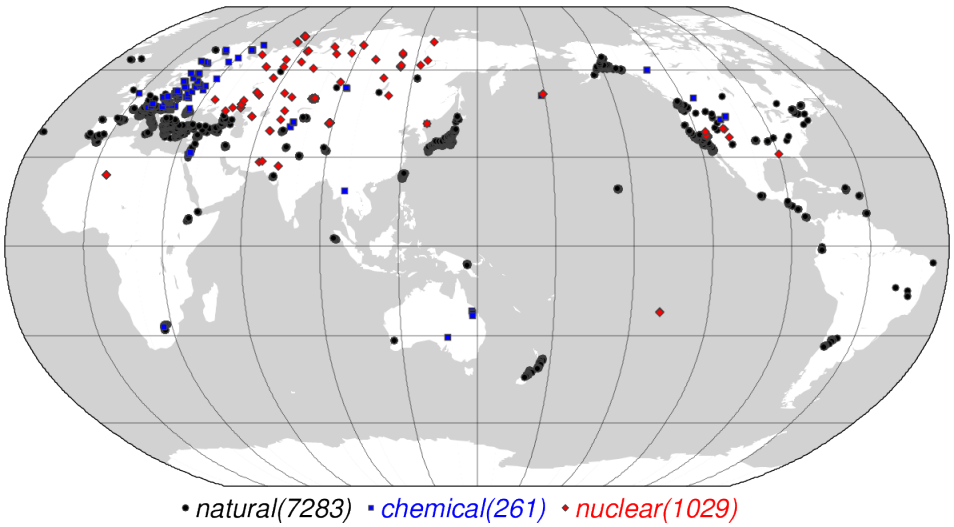


Figure 13b. *The IASPEI List contains natural earthquakes as well as chemical and nuclear explosions.*

At the end of analysis of each ISC Bulletin data year, we add new events to the Reference Event List. During 2014, 596 events have been added or updated (Fig. 14).

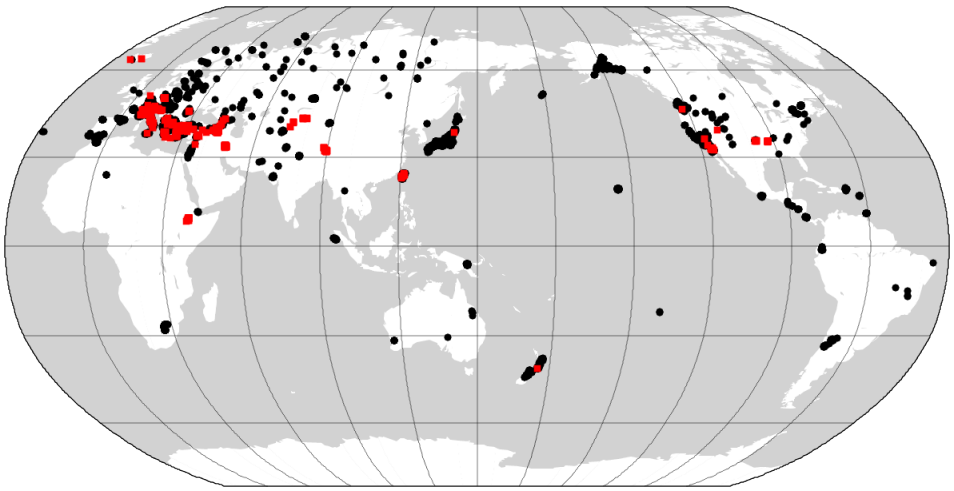


Figure 14. *During 2014, 596 events (red) have been either updated or added to the IASPEI list of Reference earthquakes and explosions*

EHB BULLETIN

The EHB (Groomed ISC Bulletin) (Engdahl *et al*., 1998) contains a set of most accurate seismic event locations regularly used in academic research, especially in seismic tomography. The EHB algorithm has been used to significantly improve routine hypocentre determinations of well-recorded events made by the ISS, ISC and NEIC/PDE.

The EHB algorithm uses:

- the *ak135* 1D global travel-time model with ellipticity and elevation corrections;
- iterative relocation with dynamic phase identification (Kennett *et al*., 1995);
- first arriving P, S and PKP phases and teleseismic depth phases pP, pwP and sP;
- empirical teleseismic patch corrections (for 5x5 degree patches);
- weighting by distance-dependent phase variance;

- selection criteria for EHB events having 10 or more teleseismic ($\Delta > 28^{o}$) observations with a teleseismic secondary azimuthal gap < 180º.

Following the agreement with Bob Engdahl, the EHB is hosted on the ISC website and currently contains 141,478 events between 1960 and 2008 accompanied by ~25 million arrival data. The EHB can be browsed, searched or downloaded from the ISC web-site. Corresponding events of the ISC and EHB Bulletins are cross-referenced for the convenience of the ISC users.

With the new ISC Location algorithm (Bondar and Storchak, 2011) in the ISC routine operations and planned relocation and enrichment of the entire ISC Bulletin with the new and missing bulletin data already taking place, it is understood that further production of the EHB bulletin in its current form, that made such a great contribution towards the global tomographic studies, is discontinued.

With the end of the ISC Bulletin Rebuild project, we are planning to upgrade and extend this service to include newly available data for past earthquakes as well as data years beyond 2008.

ISC EVENT BIBLIOGRAPHY

The ISC Event Bibliography (first release in April 2013) facilitates an interactive web search for references to scientific publications linked to both natural and anthropogenic events that have occurred in the geographical region of their interest based on earthquake (location, time, magnitude, etc.) and/or publication parameters (author name, journal, year of publication, etc.). The output is presented in a format accepted by major scientific journals. For most recent publications the results include the DOI that allows direct access to scientific articles from corresponding journal websites.

References are collected and linked to events in the ISC database based on the titles and abstracts of scientific publications that could be found in the ISC Bibliography of Seismology, electronic indexes provided by scientific journals as well as references collected during the work on the ISC-GEM Catalogue.

References to publications are not limited to Seismology. They cover a broad range of disciplines including, but not limited to earthquake engineering, tectonics, structural geology, geodesy, remote sensing, nuclear test monitoring, tsunami, landslides, environmental studies, coastal science, natural disasters, hydrology, geochemistry, atmospheric sciences and geomagnetism. This feature makes the Event Bibliography an attractive tool for multidisciplinary studies and useful for researchers and students from different fields.

The Event Bibliography currently includes ~17,000 articles, ~14,000 seismic events and ~500 journal titles (Di Giacomo et al., 2014). Seismic events cover the period from 1904 till present; publications cover the period from 1950 till present (Fig. 15).

Most prominent authors and journals are listed in Tables 3 and 4.

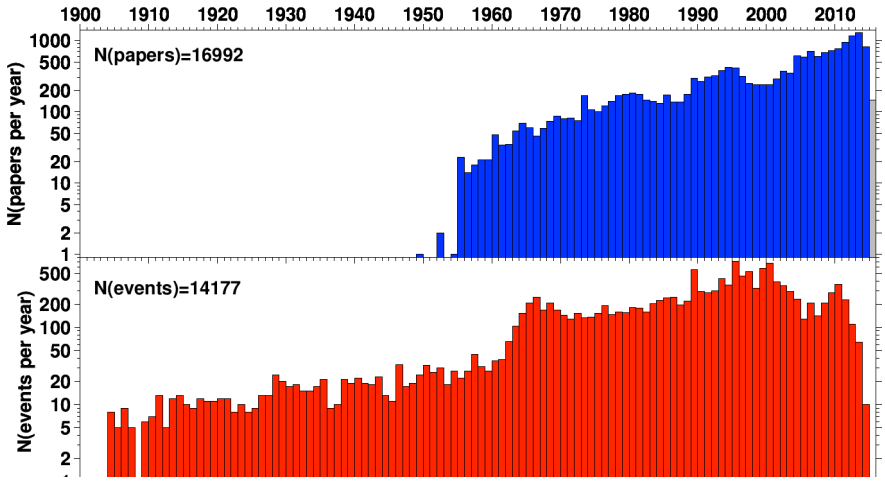


***Figure 15**. Annual numbers of seismic events and related scientific articles in the ISC Event Bibliography*

Author	N(papers)
Kanamori,H.	294
Lay,T.	120
Satake,K.	108
Wyss,M.	90
Helmberger,D.	90
Ambraseys,N.N.	89
Okal,E.A.	85
Bürgmann,R.	82
Hasegawa,A.	78
Sato,T.	75
Singh,S.K.	75
Aki,K.	70
Jackson,J.A.	70
Liu,J.	66
Hayakawa,M.	64
Mori,J.	63
Dreger,D.	61
Li,Y.	60
Irikura,K.	59
Hauksson,E.	57

***Table 3.** List of the first twenty authors with the largest number of specific event-oriented articles included in the ISC Event Bibliography.*

Journal	N(papers)
Bull. seism. Soc. Am.	2095
J. geophys. Res.	1159
Geophys. Res. Lett.	1030
Geophys. J. Int.	669
Tectonophysics	637
Pure appl. Geophys.	472
Earthq. Spectra	440
Earth Planets Space	417
Seismol. Res. Lett.	405
Acta seism. sin.	289
Bull. Earthq. Res. Inst. Tokyo Univ.	258
Natural Hazards	241
EOS. Trans. Am. geophys. Un.	237
Annls Geophys.	233
Nature	228
Phys. Earth Planet. Interiors	221
Zisin	210
Chinese J. Geophys.	205
J. Seismol.	192
Nat. Hazards Earth Syst. Sci.	192

***Table 4.** List of the first twenty journals with the largest number of articles in the ISC Event Bibliography.*

SEISMOLOGICAL CONTACTS

The objective of this project is to update and maintain up-to-date information on the network of scientific institutions, seismologists and geophysicists in each country willing to serve as scientific points of contact to:

- Seismologists and Geophysicists in other countries;
- Governments;
- Charitable, Response and Relief organizations;
- Media.

Particular care is given to establishing and maintaining contacts in developing countries.

The service benefitted from support in terms of staff time from the Institute of Geophysics and the China Earthquake Networks Center of China Earthquake Administration.

The registry in its current form is readily available for scientific & research institutions, governmental bodies, charitable and relief organizations and media at:

www.isc.ac.uk/projects/seismocontacts (Fig.16).

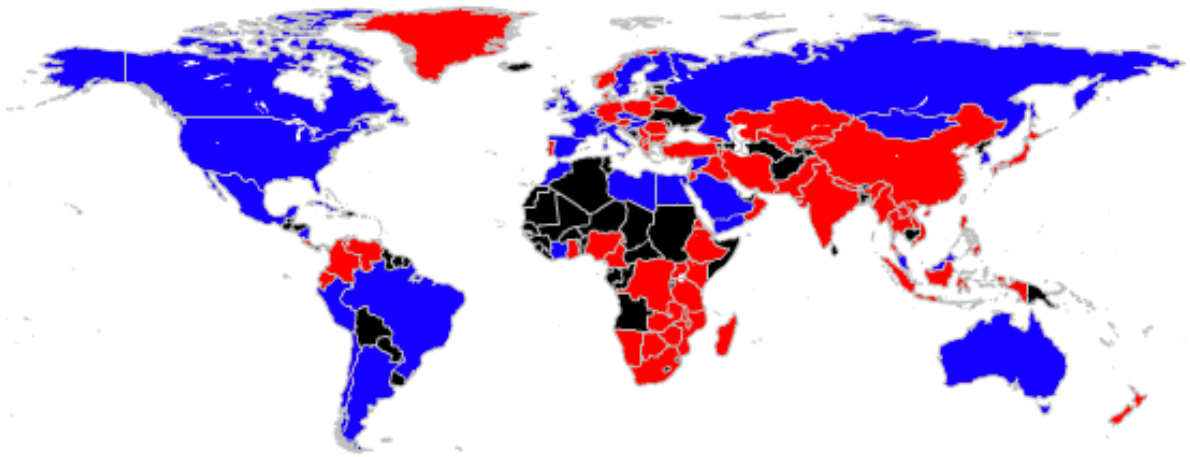


***Figure 16**. Seismological Contacts webpage; in **red** are countries in which institutes and individual staff members are willing to share information and serve as a local point of contact; in **blue** are countries for which we have information about operating geophysical organisation(s); in **black** are countries for which we do not hold any information.*

ISC DATABASE

The ISC holds its entire collection of data in the relational Postgre database on a Linux server with a RAID Array. In 2014, this database grew by ~10% and reached 157Gb, thanks to a steady increase in the number of seismic arrival picks associated to the ever growing number of reported seismic events.

ISC WEB and FTP SITES

The ISC web-site as a whole and the ISC Bulletin search in particular continued to grow in popularity during 2014 (Fig.17). The number of hits (excluding web crawlers) reached ~10 million, having increased by almost 30% compared with 2013. The website hits include access to various pages, including the products, standards, procedures, documents and history notes.

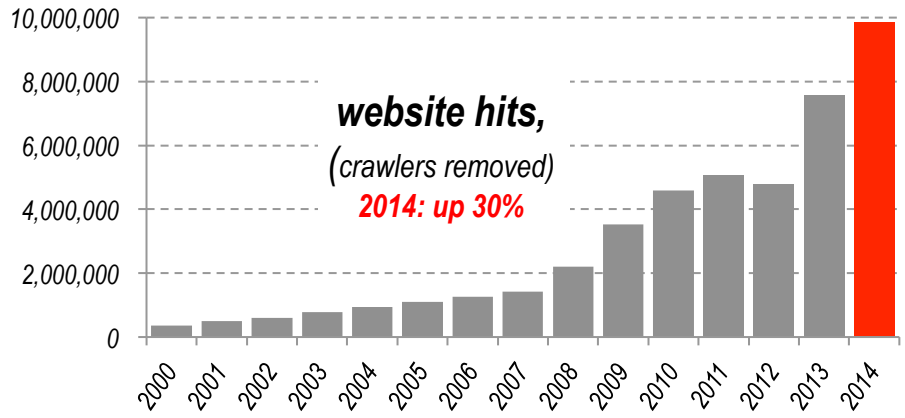


Figure 17. *Annual numbers of the ISC website hits.*

The ISC ftp site is used for downloading the pdf copies of the printed ISC Bulletins and Regional Catalogues, the ISC Bulletin in FFB and ISF formats, the EHB bulletins and the text version of the IR station list.

Per country usage of the ISC web and ftp services (Fig. 18ab) demonstrates worldwide interest to the ISC data.

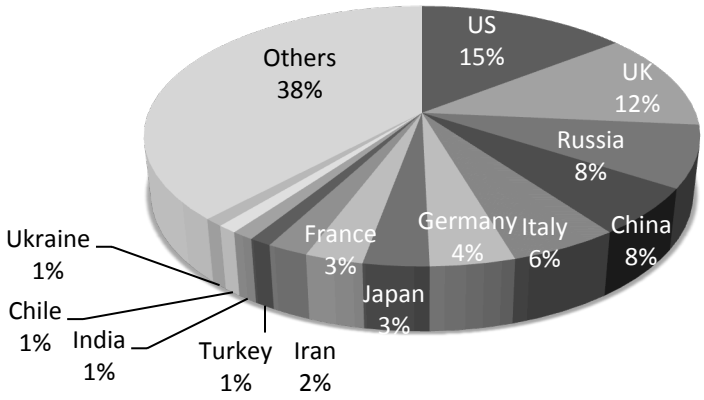


Figure 18 (a). *Per country statistics of the* ***ISC website hits***

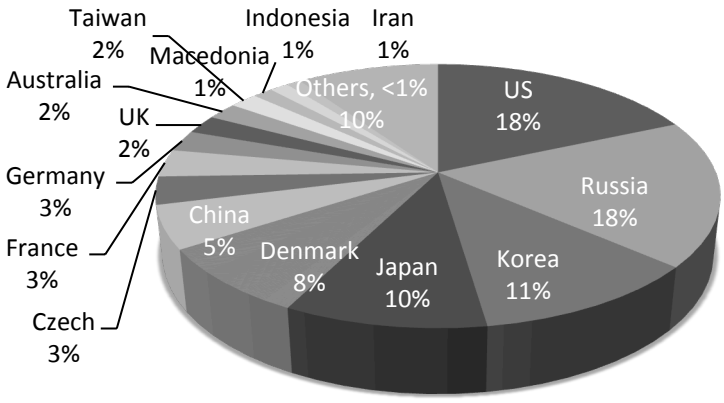


Figure 18 (b)**. Per country statistics of **downloads from the ISC ftp-site

ISC DATABASE and WEBSITE BACKUP and MIRRORS

The ISC continued maintaining one of it's servers at the IRIS DMC in Seattle in order to hold a mirror of the ISC database and the ISC website. This was done with the kind assistance from the DMC in order to achieve a general ISC data back-up, fall over facility in case of a breakdown of services at the ISC itself as well as to spread the load on the ISC Internet line and give ISC users faster access to data.

In addition, the IRIS DMC is able to use the database on a daily basis to serve the DMC archive users with event based selection of waveform data.

The mirror has been operational since September 2011. The database in Seattle is updated with 1 hour time lag. The ISC continues to promote the mirror on the website, in regular newsletters and email notifications. The mirror at IRIS currently serves 10% of the bulletin searches.

Other mirrors of the ISC database are maintained by the Earthquake Research Institution (ERI) of University of Tokyo to serve the research community in Japanese universities and by the Lawrence Livermore National Laboratory (LLNL) to serve users from monitoring laboratories in the US.

DEVELOPMENT PROJECTS

EXTENSION of the ISC-GEM CATALOGUE

The ISC-GEM Global Instrumental Catalogue is one of the most outstanding global components that was originally funded by the GEM Foundation and now widely used for modelling seismic hazard on a regional and global scale. The catalogue is now also used as both an authoritative reference and a starting point in GEM's regional initiatives in South America, Africa and Asia. The Catalogue also has a multidisciplinary use in a wide range of other areas such as studies of global seismicity, inner structure of the Earth, tectonics, nuclear monitoring research, rapid determination of hazard etc.

The catalogue is very popular with 5,368 downloads from 2,263 unique IP-addresses recorded since it became available at the ISC website. The catalogue is obviously a well known resource and a great credit to both the ISC and the GEM Foundation.

The magnitude cut-off thresholds in the original ISC-GEM catalogue are as follows:

- 1900-1917: $M_S \geq 7.5$ worldwide + smaller shallow events in stable continental areas
- 1918-1959: $M_S \geq 6.25$
- 1960-2009: $M_S \geq 5.5$

We are currently working on extending the ISC-GEM catalogue by decreasing the magnitude cut-off thresholds in the early instrumental period before 1960 as well as adding recent years beyond 2009 (Figure 19). The work began on November 1, 2013, initially with funding from the GEM Foundation and FM Global. At the same time, a massive fundraising campaign was instigated that has, so far, brought four additional funding commitments from both the private and the commercial sector: Lighthill Risk Network in London (Aon Benfield, Catlin, Guy Carpenter and Lloyd's), United States Geological Survey (USGS), United States National Science Foundation (NSF) and the OYO Corporation in Japan. Our fundraising efforts continue.

The team working on the project includes members of the ISC staff and leading experts from University of Colorado and MTA Research Centre in Hungary. Several institutions internationally have also helped by providing copies of vital historical data.

Six scientific publications explaining details of the project have now been published by the team in a special volume of the Physics of the Earth and Planetary Interior and Seismological Research Letters. References to the ISC-GEM catalogue are becoming progressively more common.

Year 1 of the project ended in October 2014 with data years 1950-1959 and 2010-2011 added to the catalogue. Provided our fundraising campaign is successful, we shall complete the work in the next 3 years (Figure 20).

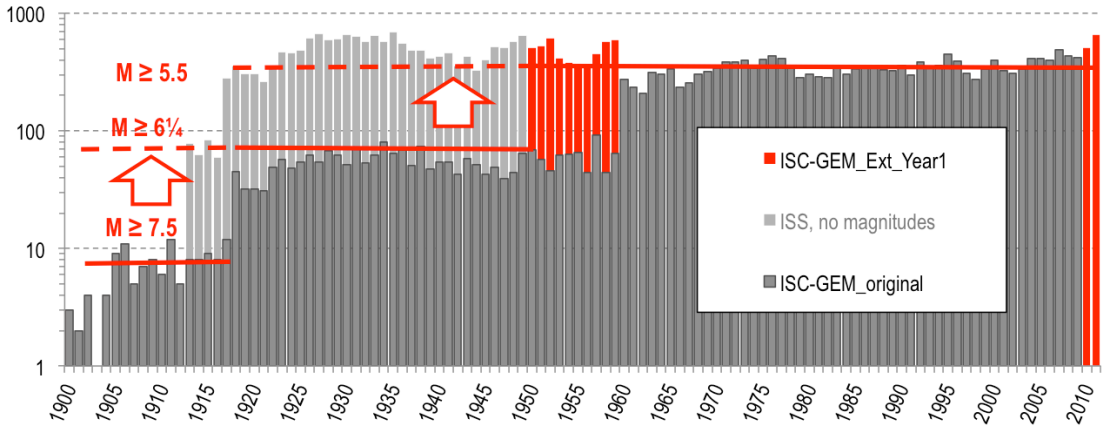


Figure 19. *Annual earthquake numbers in the original ISC-GEM catalogue are in dark grey; earthquakes added during the 1st Year of the Extension Project are in red and the number of events available in the ISS (the main original source of data prior to 1964) are in light grey. The ISS does not contain magnitudes. Red horizontal lines represent the numbers of earthquakes with magnitude ≥ 5.5, 6¼ and 7.5, expected to be added during Project Years 2-4, based on the rates of seismicity recorded by modern seismic networks today.*

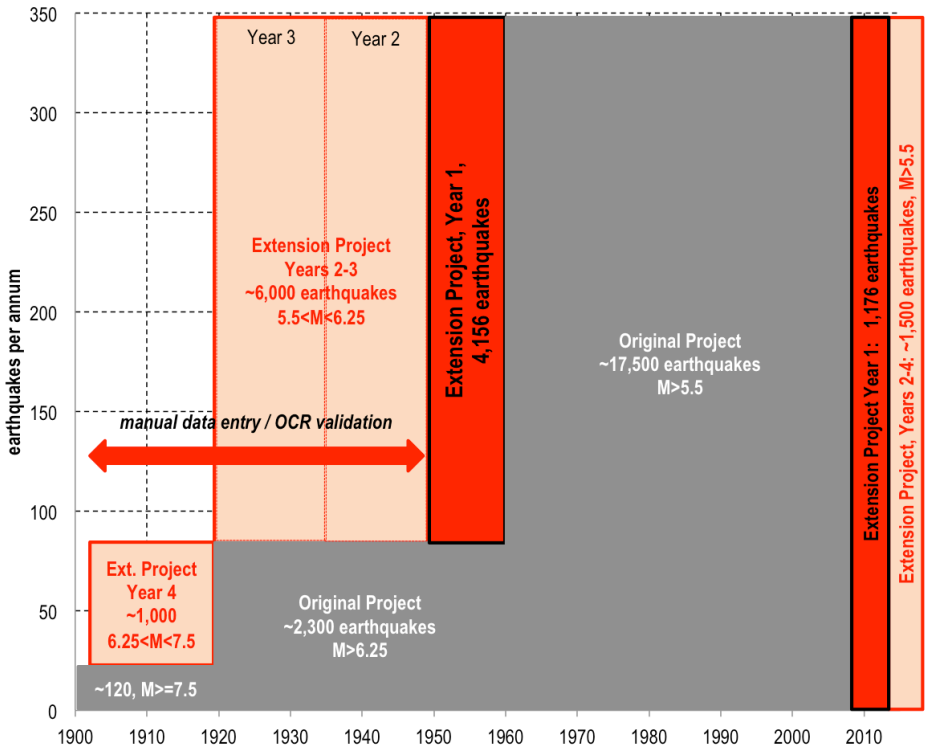


Figure 20. *Approximate number of earthquakes for each period of time and magnitude interval in the original and extended (Year 1) ISC-GEM catalogue (dark grey and red) and the number of earthquakes expected to be added to the catalogue (pink cream) during the Years 2-4 of the Extension Project; large effort in the manual data entry and validation of OCR processing of historical paper bulletins is required for years 1904 till 1949.*

SCANS of HISTORICAL STATION BULLETINS

As part of the ISC-GEM catalogue works, many historical station bulletins collected over the years at the ISC and used in the project have been scanned by the SISMOS at INGV in Italy. In the past, these scans were only available by visiting the ISC and searching through numerous boxes in the ISC warehouse. Now, many of the most interesting long-term network and observatory bulletins are available at http://storing.ingv.it/bulletins/ISC-GEM/ .

CTBTO LINK to the ISC DATABASE

Back in 2008, the UK Foreign and Commonwealth Office (FCO) awarded the ISC with a three year grant to set up a dedicated and secure link to the ISC database for the CTBTO PTS and National Data Centres. The UK FCO provided 90% of the total funding with GEUS (Denmark), NORSAR (Norway), FOI (Sweden) and University of Helsinki (Finland) complementing it with 2.5% each. From April 2011, the funding of the project was taken over by the CTBTO with an intention to continue for three years until March 2015.

During 2014 we maintained a dedicated server at the ISC that holds a mirror version of the ISC database. The dedicated web-based software package designed and maintained by the ISC for this service allowed users from PTS and National Data Centres for CTBTO to query the ISC database in ways specific to the explosion monitoring community. The software package includes four types of bulletin searches: an area based, an REB event based, GT event based and an IMS station based search through the wealth of the parametric information in the ISC database.

The objective of the project is to provide the capacity for NDCs to perform various types of analysis such as:

- assessing the historical seismicity in a specific region;
- putting an event of interest into context with the seismicity of the surrounding region;
- examination of observations reported by non-IMS stations;
- comparison of hypocentre solutions provided by various agencies;
- relocating an REB event based on the user selected arrival times available for this event in the ISC database;
- investigation of station histories and residual patterns of IMS or IMS surrogate stations.

We also developed an interface for selecting waveforms of non-IMS stations for REB events from the IRIS DMC archive. For each recent REB and GT event, this interface:

- allows selection of stations by distance / azimuth to the REB epicentre;
- shows the number of stations, for which waveforms are available at IRIS DMC;
- exhibits pre-prepared images of selected waveforms, filtered and un-filtered with theoretical first arrivals indicated on top of the waveform images;
- offers a form to request part of waveform, based on absolute or relative theoretical arrival times of required seismic phases or on group velocity of surface waves;

- triggers a request to IRIS DMC; as a result, users receive required waveforms by e-mail in the SEED format.

Figure 21 shows user activity on the Link by both PTS/CTBTO and NDCs.

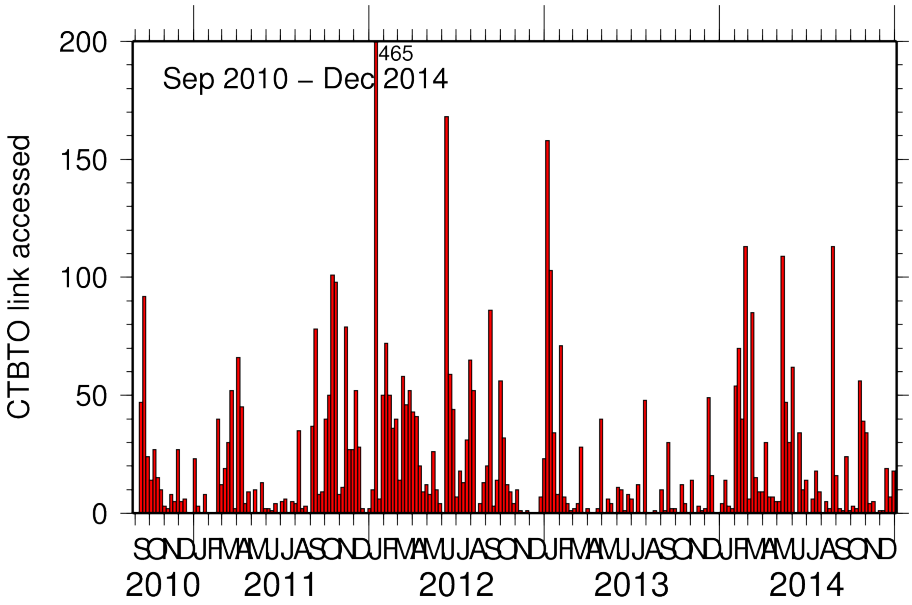


***Figure 21**. The Link to the ISC database mirror is provided to the NDCs through the IDC secure website. The figure shows the healthy stream of user activity.*

It may first appear that this project benefits only CTBTO. This isn't true as the ISC, its Member-Institutions and the ISC product users gain a great deal from the developments on this project:

- The ISC development staff acquired important skills and experience during this project. The advances made under this project are gradually implemented to improve the traditional open ISC web services.
- In particular, experience of downloading, checking quality and processing waveforms on the industrial scale will help the ISC's mid-term plans of making its own automatic waveform measurements to further improve the quality of the ISC Bulletin.
- The ISC and its Bulletin users gained much speedier access to the REB Bulletin which is now available within 20-50 days after event occurrence as opposed to half a year to a year in the past (Fig. 22).
- Many National Data Centres for CTBTO are run by institutions that are either Members of the ISC or reporters of data to the ISC.
- Several NDC's either became ISC Members or increased their financial contributions, based on the added value of the ISC service.

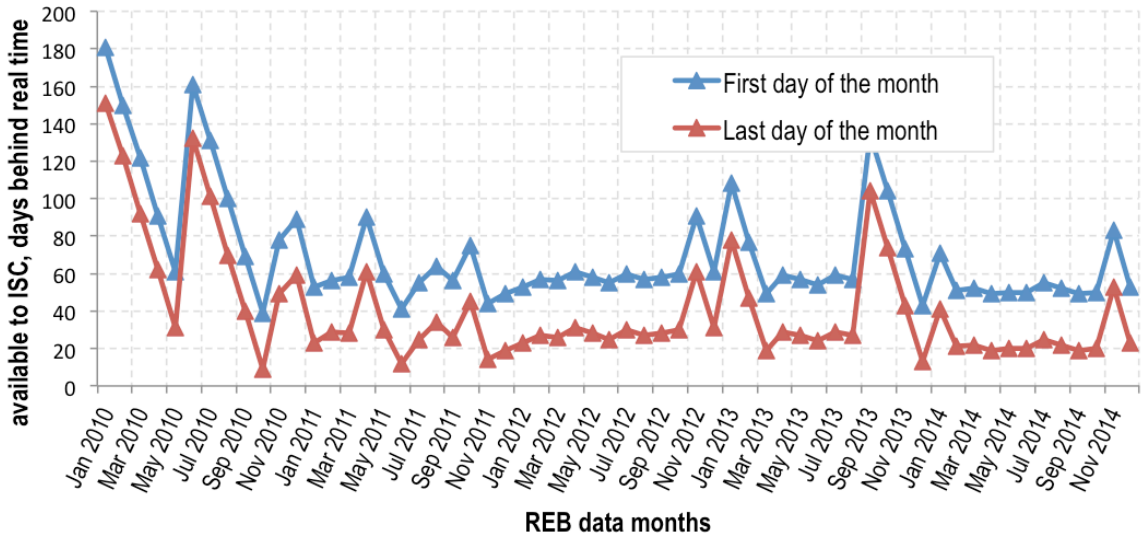


***Figure 22**. The availability of the IDC REB data to general ISC Bulletin users (days behind real time) has considerably improved with the routine operation of the CTBTO Link. End-of-year glitches are going to be addressed by CTBTO by setting more automated procedures of providing bulletins to the ISC with certain delay.*

It also has to be noted that although the software created under this project is open only to the monitoring community, the actual data used by them are exactly the same as used by all ISC users: the ISC Bulletin, GT List, EHB and International Seismograph Station Registry.

ISC BULLETIN REBUILD

The value of the ISC Bulletin is dependent upon following uniform procedures over a long period of time. Nevertheless, essential changes in the ISC procedures have occurred:

- The *ak135* velocity model has been used since 2006 whilst *JB* travel times were used in the past.
- A new event Locator based on different approach was introduced from data year 2009.
- Throughout the ISC history different sets of seismic phases were used for location: P & (from 2001) S with other *ak135* phases from 2009.
- Latitude & longitude error estimates were computed before Oct 2002, followed by full error ellipses later on.
- Procedures that determine what reported events require relocation by the ISC were also changed in 1999, 2005 and 2006.

Thus, the ISC Bulletin will benefit from being rebuilt using uniform procedures to guarantee homogeneity through its entire period: 1960-2009. The US NSF provided substantial funding for this project to complement the funds already made available by Japan, India and China for further general development at the ISC.

As part of this project we are:

- Re-computing all ISC hypocentres with uncertainties;
- Re-computing all ISC event magnitudes with uncertainties;
- Soliciting, obtaining and integrating essential additional datasets that have not been available at the time of original ISC Bulletin production (Fig.23);
- Performing essential integrity and consistency checks, quality control and correction.

During 2014 we continued with a thorough review and clean-up of the contents of the ISC Bulletin in the areas of seismic arrival phase identifications, channel information, first motion information and suspiciously large magnitude estimates.

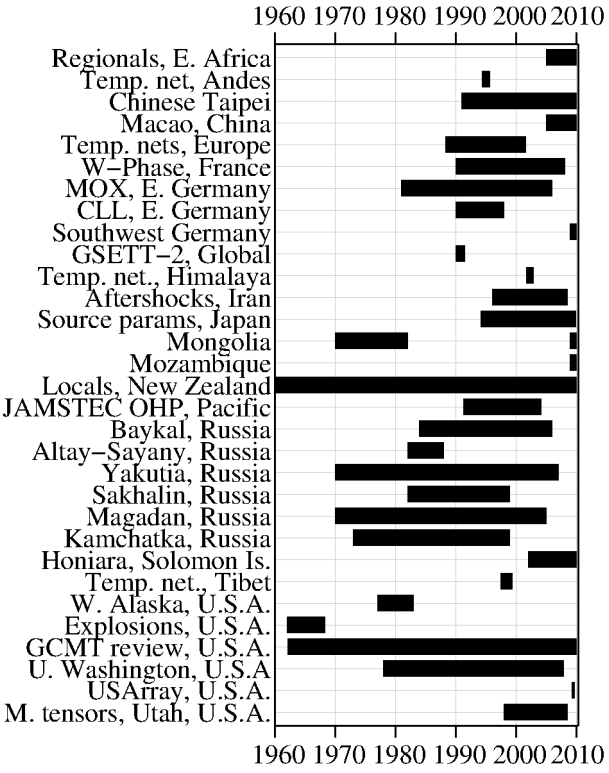


***Figure 23**. Previously unavailable data to become part of the Re-built ISC Bulletin.*

FDSN-COMPLIANT WEB-SERVICE

Based on the funding provided by IRIS, the ISC has designed its first web-service compliant with FDSN rules (service.iris.edu/fdsnws). This service provides the ISC Bulletin in the QuakeML format to all users. Currently this service operates only from the mirror ISC website based at IRIS DMC (http://isc-mirror.iris.washington.edu/fdsnws/event/1/).

One of the main users of this service is IRIS DMC itself. The ISC Bulletin in QuakeML helps the DMC to serve event-based request for waveform downloads.

We are planning to expand this service for users of the standard ISC website.

FINANCE

The detailed financial statements of the ISC for 2014 were audited by Griffins, Chartered Accountants (Newbury, UK) and approved by Prof. John Woodhouse of ISC Executive Committee. These statements present the state of ISC's financial affairs as at 31 December 2014.

INCOME

In 2014, ISC had a total income of £788,488 from national contributions and grants for special projects. The grants are listed as Other Income and amount to almost 23% of the total income. The providers of these funds are of itemised on page 7 of the accounts. Interest on ISC bank accounts plus the income from selling ISC publications is also included. The NSF funds and also other grants, where work has yet to start, have been split between 2014 and 2015.

The exchange rate between the UK £ and USA $ veered between the opening rate of £1=$1.65 at the start of the year, down to £1=$1.71 and then finishing the year at £1=$1.56 at the end of December.

At the year-end £21,384 had yet to be paid by members but at the time of writing this report some £5,850 has been received. The total of bad debts written off was £11,420 following our policy to write off funds where nothing has been received for three years. Since the year end one unit of subscription from Iraq has arrived.

EXPENDITURE

About 77% of ISC expenditure in 2014 was committed to personnel costs, £40,360 more than the amount spent in 2013. During the year we saw the departure of several members of staff. The staff costs include salaries, pension contributions, and recruitment and repatriation of new and departing staff. The ISC salaries follow the newly adopted ISC salaries scales approved by the Executive Committee and based on the CPI (inflation index) in UK.

Building expenses were above the previous years' costs because they include the cost of installing a lift for disabled, thereby making the ISC building fully accessible for all. Computing costs were just £60 less in 2013. The total travel costs for the staff and the Executive Committee was less than the previous year as the Executive Committee meeting was held in Thatcham. Staff travelled to several countries to attend meetings to increase the profile of the ISC and also to seek new data and future funding.

RESERVES

The gain in income over expenditure for 2014 was £22,968. ISC total reserves, comprising the cash in the bank, value of building and land, money owed to ISC (debtors) minus the money ISC owes (creditors) increased during 2014 to £762,517, this includes money earmarked for on-going projects. The Contingency Fund stands at £30,000 in accordance

with the wishes of the ISC Governing Council. The ISC General Reserve of £732,517 is equivalent to around 12 months future operation of the ISC. This is within British guidelines for charitable organizations.

CASH FLOW

The cash flow in Fig. 24 shows receipts and outlays using dates when transactions were recorded at the bank and the bank balances where US Dollars and Euros are converted to Sterling using the exchange rate as of the end of each month.

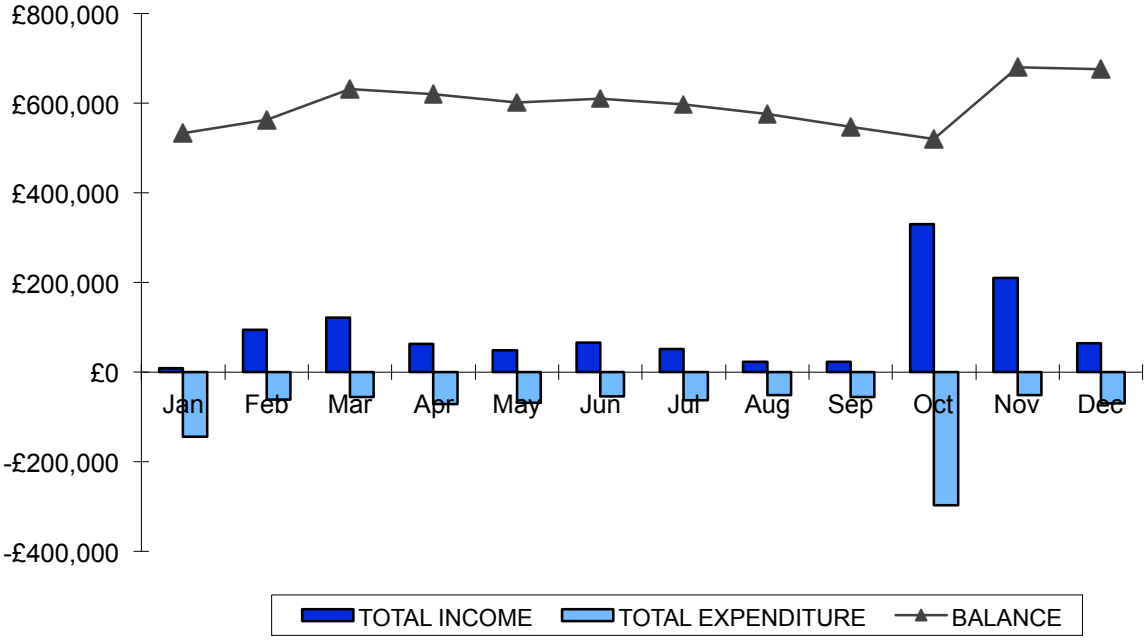


Figure 24. *Income/Expenditure cash flow and cash balance 2014*

SCIENTIFIC LIAISONS

VISITORS to the ISC

The following geophysicists visited ISC premises in Thatcham during the year:

- Bob Engdahl, University of Colorado, Boulder, *United States*
- Huang Yuan, Department of Earthquake Monitoring and Prediction, CEA, *China*
- Gao Jingchun, Hebei Earthquake Administration, CEA, *China*
- Kang Ying, Guangdong Earthquake Administration, CEA, *China*
- Huang Wenhui, Guangdong Earthquake Administration, CEA, *China*
- Dai Guanghui, CENC, CEA, *China*
- Liu Ruifeng, CENC, CEA, *China*
- John Adams, Geological Survey, *Canada*
- John Woodhouse, Oxford University, *UK*
- Guy Masters, IGPP, University of California San Diego, *USA*
- Bertrand Delouis, GeoAzur / CNRS, *France*
- Kenji Satake, ERI, University of Tokyo, *Japan*
- Johannes Schweitzer, NORSAR, *Norway*
- Min Chen, OeRC, Oxford University, *UK*
- Simon Walton, OeRC, Oxford University, *UK*
- Joan Latchman, Seismic Research Centre, UWI, *Trinidad and Tobago*
- Willy Aspinall, Bristol University, *UK*

CONFERENCES, MEETINGS, WORKSHOPS

Members of the ISC staff presented at the following conferences, meetings and workshops:

- International Seismology School, GS RAS, Aghveran, *Armenia*
- EGU meeting, Vienna, *Austria*
- CTBTO WG-B, Vienna *Austria*
- LACSC Assembly, Bogota, *Colombia*
- NEIC-ISC-EMSC Coordination meeting, Bruyères-le-Châtel, *France*
- GEM annual, Pavia, *Italy*
- ASC Assembly, Makati City, *Philippines*
- Unconventional Oil & EOR, Adam Smith Conference, Moscow, *Russia*
- ESC Assembly, Istanbul, *Turkey*
- Nicholas Ambraseys Memorial Symposium, London, *UK*
- Anglo-Japanese Foundation meeting, London, *UK*
- Earthquakes: from Mechanics to Mitigation, Geological Society, London, *UK*
- Insurance Modelling and Data Expose (IMDE 2014), London, *UK*
- 30 Years of Global Seismic Tomography, Oxford, *UK*
- SSA meeting, Anchorage, *US*

ISC STAFF VISITING OTHER INSTITUTIONS

Often with the help of the hosting institution, the members of the ISC staff visited and, where appropriate, gave a presentation to members of staff of:

- IDC CTBTO, Vienna, *Austria*
- IAEA, Vienna, *Austria*
- Geological Survey of Colombia (SGC), Bogota, *Colombia*
- GEM Secretariat, Pavia, *Italy*
- PHIVOLCS, Quezon City, *Philippines*
- Manila Observatory, Manila, *Philippines*
- Kandilli Observatory and Earthquake Research Institute, Istanbul, *Turkey*
- Anglo-Japanese Foundation, London, *UK*
- SECED, London, *UK*
- Oxford University, Earth Science Department, *UK*
- Oxford e-Research Centre, *UK*
- Michigan State University, East Lansing, *US*
- USGS, Reston, *US*
- IRIS, Washington DC, *US*

GEM OUTSTANDING CONTRIBUTION AWARD

On behalf of the ISC-GEM catalogue team, the ISC Director received the 2014 GEM Outstanding Contribution Award. The trophy is engraved with the words "the legacy of the ISC-GEM Seismic Catalogue that Dmitry and his team brought to life is a longer, richer, more accurate, and more uniform record of instrumentally recorded global earthquakes that ever before achieved".

ISC PRIZE for OXFORD UNIVERSITY STUDENTS

A few years ago the ISC established a small annual Prize in Mathematics and Geophysics (£200 and the annual ISC DVD-ROM) for a best first year student at the Earth Science Department of its home institution – the University of Oxford. In 2014, the prize was given to Mr Andrew Heard, the student with the best exam results in geophysics and mathematics. By awarding this prize the ISC hopes to attract Oxford University students to take note of the ISC services right from their first year, support the ISC in the future and perhaps even help the ISC in fulfilling its mission.

STATION BULLETINS from BRITISH GEOLOGICAL SURVEY

Two major steps have been made to improve the ISC's historical paper-based station bulletin collection, both through the initiative of the former BGS Seismologist, Dr Roger Musson. We received two lorry-size loads from Eskdalemuir and Edinburgh in Scotland. The latter is especially valuable as it contains many bulletins that are filling gaps in the ISC collection. These bulletins have been collected and used by Dr Musson during many tens of years of his

career at BGS. As BGS is moving its operations from Murchison House to a smaller building on the outskirts of Edinburgh, it was decided that the bulletins will be better used at the ISC.

SCIENTIFIC PAPERS PUBLISHED by the ISC STAFF

The following article was published in SRL to describe the new product – the ISC Event Bibliography:

Di Giacomo, D., Storchak, D.A., Safronova, N., Ożgo, P., Harris, J., Verney, R. and Bondár, I. (2014). A New ISC Service: The Bibliography of Seismic Events, Seismol. Res. Lett., 85, 2, 354-360, doi: 10.1785/0220130143

During 2014, as many as six scientific articles describing the work on the ISC-GEM Catalogue have been through the review process at Physics of the Earth and Planetary Interior (PEPI). They are expected to be in print early 2015.

OTHER REFERENCES USED IN THIS REPORT

BAAS, 1900-1912. British Association for the Advancement of Science, Ciculars 1-27 issued by the Seismological Committee of the British Association for the Advancement of Science (*Shide Circulars*).

BAAS, 1913-1917. British Association for the Advancement of Science, Seismological Committee, monthly bulletins.

Bondár, I., and D. Storchak, Improved location procedures at the International Seismological Centre, 2011. *Geophys. J. Int*., 186, 1220-1244.

Dziewonski, A.M., Chou, T.A. and Woodhouse, J.H., 1981. Determination of earthquake source parameters from waveform data for studies of global and regional seismicity, *J. Geophys. Res.*, 86, B4, 2825-2852.

Ekström, G., Nettles, M., and Dziewonski, A.M., 2012. The global CMT project 2004–2010: Centroid-moment tensors for 13,017 earthquakes, *Phys. Earth Planet. Int*., 200-201, 1-9.

Engdahl, E.R., van der Hilst, R. and Buland, R., 1998. Global teleseismic earthquake relocation with improved travel times and procedures for depth determination, *Bull. Seism. Soc. Am.*, 88, 722-743.

Engdahl, E.R., and A. Villaseñor, 2002. Global seismicity: 1900-1999. In *International Handbook of Earthquake and Engineering Seismology*. Part A, edited by W.H.K. Lee, H. Kanamori, P.C. Jennings and C. Kisslinger. Academic Press, 665-690.

ISS, 1918-1963. International Seismological Summary, annual volumes.

Kennett, B. L. N., Engdahl, E. R., and Buland, R., 1995. Constraints on seismic velocities in the Earth from traveltimes, *Geophys. J. Int*., 122, 108-124.

SCIENTIFIC PAPERS PUBLISHED in 2014 that USED the ISC DATA

This list is a result of a special effort to put together a collection of scientific papers that used ISC or EHB data and published in 2014. The list is by no means complete. The ISC has become such a familiar name that many researchers unfortunately fail to reference the ISC when using the ISC data.

We have searched Google Scholar for scientific papers that refer to the ISC data. We used the exact phrases "International Seismological Centre", and "International Seismological Center" and "EHB"+ "seismic" for papers appearing in 2014. No doubt many more references can be found by using different search phrases.

Rupture complexity of the 1994 Bolivia and 2013 Sea of Okhotsk deep earthquakes Z Zhan, H Kanamori, VC Tsai, DV Helmberger… - Earth and Planetary …, 2014 – Elsevier **...** Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) are also roughly in a horizontal plane with a similar depth (scattered between 590 and 640 km, with a mean of 620 km based on IDC/CTBTO) as the Okhotsk mainshock I**nternational Seismological Centre**, 2011). **...**

Rupture process of the 2010 Mw 7.8 Mentawai tsunami earthquake from joint inversion of near-field hr-GPS and teleseismic body wave recordings constrained by ... H Yue, T Lay, L Rivera, Y Bai… - Journal of …, 2014 - Wiley Online Library **...** Estimates of short-period body wave magnitude (m b = 6.1–6.5) and surface wave magnitude (M S = 7.1–7.6) from various organizations are tabulated by the **International Seismological Centre**

A New ISC Service: The Bibliography of Seismic Events D Di Giacomo, DA Storchak… - Seismological …, 2014 - geoscienceworld.org**...** The **International Seismological Cent re** (ISC) is a not-for-profit organization with the primary mission of producing the definitive summary of the seismicity of the Earth (ISC Bulletin; ISC, 1964–2013

...Sources of Error and the Statistical Formulation of MS: mb Seismic Event Screening Analysis DN Anderson, HJ Patton, SR Taylor, JL Bonner… - Pure and Applied …, 2014 – Springer We thank Dr. Dmitry Storchak, Director of the **International Seismological Centre**, for his support in the acquisition of the data used in this article.

The profound reach of the 11 April 2012 M 8.6 Indian Ocean earthquake: Short-term global triggering followed by a longer-term global shadow FF Pollitz, R Bürgmann, RS Stein… - Bulletin of the …, 2014 - bssaonline.org **...** To address how often an extended globally quiet period has occurred, we make use of the **International Seismological Centre**-Global Earthquake Model (ISC-GEM) catalog, which begins in 1900 and is intended to supplant the Centennial catalog (Engdahl and Villaseñor, 2002 **...**

The 2013 Okhotsk deep-focus earthquake: Rupture beyond the metastable olivine wedge and thermally controlled rise time near the edge of a slab
L Meng, JP Ampuero… - Geophysical Research …, 2014 - Wiley Online Library **...** The purple band represents a ~15 km wide metastable olivine wedge centered on the hypocenter. The gray dots are the aftershocks in the **International Seismological Centre** catalog with horizontal location uncertainty smaller than 30 km. **...**

Deterministic seismic hazard analysis for greater Mumbai, India S Desai, D Choudhury - Proceedings of the 2014 geo-congress, …, 2014 - ascelibrary.org **...** various national and international agencies like Indian Meteorological Department (IMD), Gauribidanur Array of Bhabha Atomic Research Center (BARC), Geological Survey of India (GSI), United States GeologicalSurvey, **International Seismological Centre** (ISC) UK **...**

Seismic phase names: IASPEI StandardDA Storchak, J Schweitzer, P Bormann - Encyclopedia of Solid Earth …, 2014 **...** Springer Science+Business Media BV 2011. Seismic Phase Names: IASPEI Standard. Dmitry A. Storchak 1 , Johannes Schweitzer 2 and Peter Bormann 3 1 **International Seismological Centre** (ISC), Pipers Lane, Thatcham, RG19 4NS, Berkshire, UK. **...**

Breaking the oceanic lithosphere of a subducting slab: The 2013 Khash, Iran earthquake WD Barnhart, GP Hayes, SV Samsonov… - Geophysical …, 2014 - Wiley Online Library**...** This subduction zone in southern Iran and Pakistan currently accommodates the northward convergence between the Arabian oceanic plate and Eurasia (Figure 1). Available earthquake locations (**International Seismological Centre**, 2011; USGS PDE Catalog, http://www **...**

Uppermost mantle velocity from Pn tomography in the Gulf of AdenJ Corbeau, F Rolandone, S Leroy, A Al-Lazki… - 2014 - geosphere.gsapubs.org We combine our data with data from the International Seismological Centre (ISC) global catalogue (ISC-2011) in order to improve the data set and tomography model resolution (comparisons of the resolution between the ISC data only and the combined data set with hand-picked…

Structure of the subduction transition region from seismic array data in southern Peru K Phillips, RW Clayton - Geophysical Journal International, 2014 - gji.oxfordjournals.org **...** The flat slab and the transition from normal to flat slab subduction can be roughly delineated by the seismicity of the Wadati–Benioff

zone as is shown in Fig. 2. Event locations are from the **International Seismological Centre** (ISC) reviewed ...

Pn-velocity structure beneath Arabia–Eurasia Zagros collision and Makran subduction zones Al Al-Lazki, KS Al-Damegh… - Geological Society, …, 2014 - sp.lyellcollection.org **...** We use catalogue events recorded by Oman, UAE, Saudi Arabia and Iran networks, the **International Seismological Centre** and the National Earthquake Information Center. Events of 1.8–16 degree distances were used for this Pn-tomography. **...**

An improved earthquake catalogue (M≥ 4.0) for Turkey and Near Surrounding (1900-2012)FT KADİRİOĞLU, RF KARTAL, T KILIÇ… - Second European …, 2014 - researchgate.net **...** (1975), Ayhan et al. (1981), Ambraseys and Finkel (1987), Ambraseys and Jackson (1998), Kalafat et al. (2011), National Earthquake Information Centre (NEIC) Catalogue, Bulletins of International Seismological Summary (ISS), **International Seismological Centre**

How Complete is the ISC‐GEM Global Earthquake Catalog? AJ Michael - Bulletin of the Seismological Society of America, 2014 - bssaonline.org **..** Section. Abstract. The **International Seismological Centre**, in collaboration with the Global Earthquake Model effort, has released a new global earthquake catalog, covering the time period from 1900 through the end of 2009. **...**

Crustal structure of Hubei Province of China from teleseismic receiver functions: Evidence for lower crust delamination R Huang, L Zhu, Y Xu - Tectonophysics, 2014 – Elsevier **...** the Dongting Lake plain. Red lines are sutures and faults. Small circles are earthquakes between 1981 and 2014 the **International Seismological Centre** catalog, color-coded by their focal depths. The numbers are crustal **...**

TROLL: A New, Very Broadband Seismic Station in Antarctica J Schweitzer, M Pirli, M Roth…- Seismological …, 2014 - srl.geoscienceworld.org **...** Several South Sandwich events have been detected at TROLL, which are only reported by other stations in Antarctica (eg, the Neumayer III stations), according to the **International Seismological Centre** (ISC) Online Bulletin (ISC, 2010). **... Centre** (2010). On‐line bulletin..

Determining the geometry of the North Anatolian Fault East of the Marmara Sea through integrated stress modeling and remote sensing techniques B Karimi, N McQuarrie, JS Lin, W Harbert - Tectonophysics, 2014 – Elsevier **...** Seismic data from the Mudurnu valley show a normal sense of motion, indicating that the link may be an extensional fault between two major echelon fault segments (Mudurnu and Izmit faults) (Heidbach et al., 2008, **International Seismological Centre**, 2011 and Neugebauer et **...**

The Coulomb Stress Changes and Seismicity Rate due to the 1990 Mw 7.3 Rudbar Earthquake K Sarkarinejad, S Ansari - Bulletin of the Seismological Society of …, 2014 - bssaonline.org **...** The total number of events for pre‐ and post‐1990 are 53 and 152, respectively. These events are obtained from the Engdahl (1900–2007; ER Engdahl, personal comm., 2008) and **International Seismological Centre** (2007–2012; see Data and Resources) catalogs. **...**

Model Update January 2013: Upper Mantle Heterogeneity beneath North America from Travel‐Time Tomography with Global and USArray Transportable Array Data S Burdick, RD Van der Hilst… - Seismological …, 2014 - srl.geoscienceworld.org**...** The data included in the inversion consist of ~10 million P‐wave residuals from the **International Seismological Centre** and the National Earthquake Information Center, which are processed using the algorithms developed by Engdahl et

Seismicity, structure and tectonics in the Arctic region M Kanao, VD Suvorov, S Toda, S Tsuboi - Geoscience Frontiers, 2014 – Elsevier **...** Distribution of tectonic provinces, seismicity and volcanoes in Eurasian continent andsurrounding regions (after database of Cornell University; the world geology map,seismicity is after the I**nternational Seismological Centre** (ISC), 2011). **...**

Seismic hazard assessment of Iran by Ising cellular automation modeling A Asadi - Iranian Journal of Science and Technology (Sciences), 2014 - ijsts.shirazu.ac.ir **...** By this procedure and calculations based on the magnitude intensity and energy of earthquakes in Iran using ISC and USGS from 1960 to 2009 (**International Seismological Centre**, 2011; US Geological Survey, 2012), new results of hazard assessment were obtained based on **...**

K-means cluster analysis and seismicity partitioning for Pakistan K Rehman, PW Burton, GA Weatherill - Journal of seismology, 2014 – Springer **...** NESPAK. BGS and NESPAK make use of the International Seismological Summary (ISS) / **International Seismological Centre** (ISC), ENGD (Engdahl et al. 1998), Global Seismic Hazard Assessment Programme (GSHAP; Zhang et al

Comment on "A Unified Seismic Catalog for the Iranian Plateau (1900–2011)" by Mohammad P. Shahvar, Mehdi Zare, and Silvia Castellaro N Mirzaei, E Shabani… - Seismological Research …, 2014 - srl.geoscienceworld.org **...** According to Engdahl et al. (2006), depths for many events in **International Seismological Centre** (ISC) and US Geological Survey (USGS) National Earthquake Information Center (NEIC) global catalogs, until only recently based entirely on first‐arrival times of P waves, are often **...**

The Euro-Med Seismological portal and its webservices for interactive and automatic data access L Frobert, R Bossu, P Kaestli, J Küng… - EGU General …, 2014 - adsabs.harvard.edu **...** Earthquake Research Community for Europe), transformative initiatives of EPOS (European Plate Observing System) and GEM (Global Earthquake Model) as well as key actor such as the USGS (US Geological Survey), the ISC **International Seismological Centre**) or IRIS **...**

The Global Earthquake Model-Past, Present, Future A Smolka, J Schneider, R Stein - EGU General Assembly …, 2014 - adsabs.harvard.edu **...** projects SHARE and EMME. Notably, the **International Seismological Centre** (ISC) led the development of a new ISC-GEM global instrumental earthquake catalogue which was made publicly available in early 2013.

A High-Resolution View of Global Seismicity F Waldhauser, DP Schaff - AGU Fall Meeting Abstracts, 2014 - adsabs.harvard.edu **...** We present high-precision earthquake relocation results from our global-scale re-analysis of the combined seismic archives of parametric data for the years 1964 to present from the **International Seismological Centre** (ISC), the USGS's Earthquake Data Report (EDR), and **...**

Angola Seismicity MAP FAP Neto, G Franca - AGU Fall Meeting Abstracts, 2014 - adsabs.harvard.edu **...** We also analyzed technical reports on the seismicity of the middle Kwanza produced by Hidroproekt (GAMEK) region as well as international seismic bulletins of the **International Seismological Centre** (ISC), United States Geological Survey (USGS), and these data served **...**

A Catalog of Nepal Himalaya Earthquakes from 1255 to 2012 GK Bhattarai, S Ojha, S Rajaure - International Journal of Landslide and …, 2014 - hils.org.np **...** In this catalog, magnitude is estimated from different reported intensities using appropriate empirical relations. Instrumental catalog used in this work consists of earthquakes reported by **International Seismological Centre** (ISC). **...**

A new catalogue of instrumental seismicity for metropolitan france: methodology (si-hex project) S MERRER, Y CANSI, M CARA, A SCHLUPP - eaee.org **...** project was to produce a backbone catalogue for the whole SI-Hex zone by merging the arrival times from the French networks and those from the foreign stations provided by EMSC, the Euro-Mediterranean Seismological Centre and ISC, the **International Seismological Centre ...**

Seismicity in the Antarctic Continent and Surrounding Ocean M Kanao - Open Journal of Earthquake Research, 2014 - file.scirp.org Seismicity in the Antarctic and surrounding ocean is evaluated based on compiling data by the **International Seismological Centre** (ISC). **...**

Large recorded earthquakes in sub-Saharan Africa V Midzi, B Manzunzu - Extreme Natural Hazards, Disaster Risks …, 2014 - books.google.com **...** 4 people killed. a Surface-wave magnitude Ms as published by the **International Seismological Centre** (ISC, 2011). **...** ISC (1991). Regional Catalogue ofEarthquakes, 26 (July-December 1989)

The hellenic seismological network of crete (hsnc): recent results of its operation in the front of the hellenic arc. PAPADOPOULOS, G CHATZOPOULOS… - eaee.org **...** com). All stations are registered to **International Seismological Centre** (ISC) and the network is listed by International Federation of Digital Seismograph Networks (FDSN) with the assigned permanent network code HC. HSNC **...**

Low-frequency microseismic field behavior in seismoactive regions of the earth and its relation to geodynamic processes MY Stepanova, AV Gorbatikov - gr.ifz.ru **...** models, Geochem. Geophys. Geosyst., 2012, vol. 13, Q01021, 2011GC003875. **International Seismological Centre**, On-line Bulletin, http://www.isc.ac.uk, Int. Seis. Cent., Thatcham, United Kingdom, 2010.

Reply to "Comment on 'A Unified Seismic Catalog for the Iranian Plateau (1900–2011)'by Mohammad P. Shahvar, Mehdi Zaré, and Silvia Castellaro" by Noorbakhsh … MP Shahvar, M Zaré… - Seismological Research …, 2014 - srl.geoscienceworld.org **...** McKenzie, 1984). The event number 7056 (8 November 2011) and the event number 6789 (9 February 2011), are reported under the ID 17525142 and 16852124 in the **International Seismological Centre** (ISC) ...

Bearing of topography and converging plate geometry on earthquake incidences in the Central Himalaya PK Khan, MA Ansari, VM Tiwari, S Mohanty, J Banerjee - nceg.upesh.edu.pk**...** sectors of the Himalayan arcuate belt. The earthquake data were taken from the catalogues of Indian Society Earthquake Technology, **International Seismological Centre** and US Geological Survey. A total of 13 focal mechanisms **...**

mb: Ms Screening Revisited for Large Events SR Ford, WR Walter - Bulletin of the Seismological Society of …, 2014 - bssaonline.org **...** Data and Resources. International Data Centre Reviewed Event Bulletin magnitudes can be retrieved from the **International Seismological Centre** (last accessed June 2013). Computer Programs in Seismology **...**

Reply to comment by Günter Leydecker on "The European–Mediterranean Earthquake Catalogue (EMEC) for the last millennium" G Grünthal, R Wahlström - Journal of seismology, 2014 – Springer **...** BGR since 1995. Leydecker (2011) has expanded this database by adding, often uncritically, interpretations of events from other seismological networks, eg data from the **International Seismological Centre** (ISC)

An Evaluation of the 11 th September, 2009 Earthquake and Its Implication for Understanding the Seismotectonics of South Western Nigeria OU Akpan, MA Isogun, TA Yakubu, Open Journal of …, 2014**.** The **International Seismological Centre** (ISC), United Kingdom located the same event at 6.290˚N and 5.070˚E, determined the body wave (M B) and surface wave (M S) magnitudes of 4.4 and 3.9 respectively as well as focal depth of 10 km. **...**

Reprint of: Two-year survey of earthquakes and injection/production wells in the Eagle Ford Shale, Texas, prior to the MW4. 8 20 October 2011 earthquake C Frohlich, M Brunt - Earth and Planetary Science Letters, 2014 – Elsevier **...** Fashing area: probable earthquakes and injection/production wells. We located 35 probable earthquakes in the Fashing area (Fig. 3 and Fig. 4, and Table S3). Since 1982 the **International Seismological Centre** (ISC) has reported 15 earthquakes within the area mapped in Fig. **...**

Standards and Methodologies of Seismological Data Generation, Processing and Archival & Guidelines for Data Sharing and Supply RS DATTATRAYAM, G SURESH, PR BAIDYA… - Proc Indian Natn Sci …, 2014 - insa.nic.in **...** IMD is a permanent member of the **International Seismological Centre** (ISC), UK since its inception and data from Indian stations is incorporated in all the seismological bulletins of ISC, which are one of the world's most widely referred publications on global earthquakes. **...**

Earthquakes, tsunamis, and the related vulnerability in South America and the Caribbean–an overview OJ Pérez, C Rodríguez, JL Alonso - Extreme Natural Hazards, 2014 – books .google.com **...** All locations are taken from the **International Seismological Centre** (ISC, 2011) world seismicity catalogue. These figures also show the tectonic features of both regions. **...** On-line bulletin,http://www. isc. ac.

Mechanisms of Earthquakes in Iceland P Einarsson - Encyclopedia of Earthquake Engineering, 2014 – Springer **...** 1. Epicenters in Iceland and along the Mid-Atlantic Ridge system 1964–2004. Data are from the catalogs of the **International Seismological Centre**. Bathymetry is from General Bathymetric Chart of the Oceans (Modified from Sólnes et al. **...**

Multidimensional scaling visualization of earthquake phenomena AM Lopes, JAT Machado, CMA Pinto… - Journal of …, 2014 – Springer **...** to be interpreted. 3.1 Brief description of the dataset In this study, the Bulletin of the **International Seismological Centre** (ISC), available online at http://www.isc.ac.uk/, is used (International Seismological ...

Updated seismic hazard assessment of Tunisia A Ksentini, NB Romdhane - Bulletin of earthquake engineering, 2014 – Springer **...** FMD Frequency magnitude distribution GEM Global Earthquake Model GMPE Ground motion predictive equation GR Gutenberg Richter GSHAP Global seismic hazard assessment program INM National Institute of Meteorology ISC **International Seismological Centre**

`Earthquake-origin expansion of the Earth inferred from a spherical-Earth elastic dislocation theory
C Xu, W Sun - Geophysical Journal International, 2014 - gji.oxfordjournals.org
... expansion. Data required for each earthquake are the focal mechanism based on the CMT solutions, which are available from the **International Seismological Centre** event catalogue

A Method for First–Order Earthquake Depth Estimation Using Superarrays IM Tibuleac - Seismological Research Letters, 2014 - geoscienceworld.org **...** The earthquake was located by the National Earthquake Information Center (NEIC) at a depth of 63 km, by **International Seismological Centre** (ISC) at 65.3 km and by the Mexico Network at a depth of 67 km, with the closest station at 88 km (Javier Pacheco, personal comm **...**

Analysis of precursory seismicity patterns in Zagros (Iran) by CN algorithm M Maybodian, M Zare, H Hamzehloo… - Turkish Journal of …, 2014 - journals.tubitak.gov.tr **...** Starting in March 2012, CN prediction results have been routinely updated based on the eventswith M ≥ Mc = 4.0 as they are reported in the **International Seismological Centre** catalog. Key words: CN algorithm, Zagros, Iran, earthquake prediction, seismicity patterns **...**

Estimation of Ground Motion in Kuala Lumpur Due to Sumatra Subduction Earthquake TC Van, TL Lau - InCIEC 2013, 2014 – Springer **...** 1. To fill in missing data and avoid inaccurate details, catalogues from other seismological centers such as United States Geological Survey (USGS) database, **International Seismological Centre** (ISC) database and National Earthquake Information Center (NEIC) database **...**

Tracking seismic source evolution: 2004 Mw 8.1 Macquarie Island event BLN Kennett, A Gorbatov, S Spiliopoulos - wwwrses.anu.edu.au **...** shift to the records. We work on a grid of points in 3-D surrounding the hypocentral location reported by the **International Seismological Centre** (ISC), and seek to locate the position for which the Page 2. 2 Figure S1: Seismograms **...**

Skewed orientation groups in scatter plots of earthquake fault plane solutions: Implications for extensional geometry at oceanic spreading centers GS Lister, H Tkalčić, S McClusky… - Journal of Geophysical …, 2014 - Wiley Online Library **...** Centroid Moment Tensor (GCMT) project. In some cases, as will be explicitly mentioned later in the text, data from the **International Seismological Centre** have been sourced...

Azores seismogenic zones J Fontiela, M Bezzeghoud, P Rosset, JF Borges… - 2014 - dspace.uevora.pt**...** Springer. Gutenberg, E., Richter, CF, 1944, Frequency of earthquakes in California. Bulletin of the Seismological Society of America, **International Seismological Centre** – 2011. http://www.isc.ac.uk, Internatl. Seis. Cent., Thatcham, United Kingdom. **...**

Seismometer Arrays J Schweitzer - 2014 - Springer
... The code name with which it is registered in the international registry of seismic stations at **International Seismological Centre** (http://www.isc.ac.uk/registries/) is provided for each array. All array maps are plotted in the same scale (Courtesy of SJ Gibbons, NORSAR) **...**

A deep-focus earthquake with M w= 8.3 felt at a distance of 6500 km RE Tatevossian, GL Kosarev, VV Bykova… - Izvestiya, Physics of the …, 2014 – Springer **...** REFERENCES Anderson, JG, Savage, MK, and Quaas, R., "Strong" ground motions in North America from the Bolivia earth quake of June 9, 1994 (Mw = 8.3), Geophys. Rev. Lett., 1995, vol.22, pp. 2293–2296. Bulletin of the i**nternational Seismological Centre**. **...**

Seismic Hazard Analysis for Urban Territories: A Case Study of Ahmedabad Region in the State of Gujarat, India TP Thaker, KS Rao - Advances in Soil Dynamics and Foundation …, 2014 - ascelibrary.org **...** the available information from different resources for the time period from 1668-2010.The earthquake data were collected from different sources, ie, Geological Survey of India (GSI), Indian Meteorological Department (IMD) **International Seismological Centre** (ISC)

A Seismic Microzonation Study with Geotechnical Aspects on the New Construction Sites in Ardabil, Iran AA Noshahr, G Nouri, R Negahdar, R Sadeghi - 2014 - ojceu.ir
... The results of investigations by Ambraseys and Melville (1982) and Berberian (1994) which are about historical earthquakes (before 1900) and IIEES (International Institute of Earthquake Engineering and Seismology of Iran), ISC **(International Seismological Centre**) which are **...**

Earthquake forecasting and its verification in northeast India
WK Mohanty, AK Mohapatra, AK Verma… - … , Natural Hazards and …, 2014 - Taylor & Francis **...** Available from: http://neic.usgs.gov/neis/epic/epic_rect.html View all references (http://neic.usgs.gov/neis/epic/), **International Seismological Centre** (ISC)22. **International Seismological Centre** (ISC), On-line Bulletin, Bull Int Seismol Centre, Thatcham, (UK). **...**

Early instrumental seismicity recorded in the eastern Alps
D Sandron, G Renner, A Rebez… - Bollettino di Geofisica …, 2014 - researchgate.net **...** It was, therefore, necessary to have recourse to phase readings reported in bulletins of international agencies [mainly the **International Seismological Centre** (ISC), former International Seismological Summary (ISS)] to fill in the missing

A reappraisal of surface wave group velocity tomography in the Subantarctic Scotia Sea and surrounding ridges A Vuan, M Sugan, MPP Linares - Global and Planetary Change, 2014 – Elsevier **...** Zone. Seismic stations and earthquakes used in this study are represented by red triangles and yellow stars, respectively. Small dots are earthquakes included in the EHB bullettin **International Seismological Centre**, 2013)

Observed and predicted North American teleseismic delay times X Lou, S van der Lee - Earth and Planetary Science Letters, 2014 – Elsevier **...** 1c. Earthquake origin times and hypocenter locations are from official catalogs in the preference order of EHB (Engdahl et al., 1998), ISC**, International Seismological Centre** 2010), and USGS/NEIC PDE (http://earthquake.usgs.gov/research/data/pde.php). 2.2. **...**

MOZART: A Seismological Investigation of the East African Rift in Central Mozambique J Fonseca, J Chamussa… - Seismological …, 2014 - srl.geoscienceworld.org **...** Figure 5. (a) Seismicity of Mozambique and surrounding regions, 1912–2006. Machaze 2006 earthquake (star) included; aftershocks excluded for clarity.Source: **International Seismological Centre**. (b) Zoom in of the study region **...**

Geodynamic modeling of the South Pacific superswell C Adam, M Yoshida, D Suetsugu, Y Fukao… - Physics of the Earth and …, 2014 – Elsevier **...** from a global inversion of P-wave differential travel time residuals among broadband seismic waveform data recovered by the BBOBS and PLUME arrays, and other permanent seismic stations in addition to P-wave arrival time data from **International Seismological Centre** (ISC). **...**

Teleseismic moderate earthquake depth estimations and source analysis of deep intraplate earthquakes to image the spatial variations of the Guerrero … J Letort, F Cotton, J Gilbert, I Bondár - 2014 - real.mtak.hu **...** (3) Punctual Interface depth estimation by inversion of interface depth and focal mechanism. REFERENCES I., Bondar & D., Storchak, (2011). Improved location procedures at the **International Seismological Centre**. GJI 186, 1220-1244. J., Bonner, et al. (2002). **...**

Probabilistic seismic hazard assessment of Himachal Pradesh and adjoining regions NS Patil, J Das, A Kumar, MM Rout, R Das - Journal of Earth System …, 2014 - Springer
... Acknowledgements. Earthquake data from India Meteorological Department, India, US Geological Survey, USA and **International Seismological Centre**, On-line Bulletin, United Kingdom catalogs have been used in this study and the authors remain grateful for this support. **...**

Stress Transfer by the 2008 Mw 6.4 Achaia Earthquake to the Western Corinth Gulf and Its Relation with the 2010 Efpalio Sequence, Central Greece M Segou, WL Ellsworth, T Parsons - Bulletin of the Seismological …, 2014 - bssaonline.org **...** Figure 1. (a) Instrumental seismicity (circles) for the January 1964–June 2008 time period for the western Greece region, taken from the **International Seismological Centre** (ISC) bulletin. Events with small, gray, large gray ...

2.5-Dimensional tomography of uppermost mantle beneath Sichuan–Yunnan and surrounding regions Y Lü, Z Zhang, S Pei, E Sandvol, T Xu, X Liang - Tectonophysics, 2014 – Elsevier **...** study. These travel time data are from three sources, the **International Seismological Centre** (1960–2007), the China Earthquake Data Center (1990–2009), and the Annual Bulletin of Chinese Earthquakes (1985–2011)...

Global Earthquake and Volcanic Eruption Risk Management Activities, Volcanic Hazard Assessment Support System and Asia-Pacific Region Hazard Mapping … S Takarada, JC Bandibas, Y Ishikawa, Y Kuwahara… - Episodes, 2014 - episodes.co.in **...** actions. 3. Develop a website hub for the consortium in English and major Asian languages, which would link to websites of allied global efforts, such as VHub, GEM Nexus, and the **International Seismological Centre** (ISC)

SEISMIC DESIGN CONSIDERATIONS FOR EAST AFRICA Z LUBKOWSKI, M VILLANI, K COATES… - eaee.org **...** EHB 1960-2008 Mw ≥4 Update of ISC catalogue based on the hypocentrelocation algorithm by Engdahl et al. Reviewed **International Seismological Centre** (ISC) catalogue 2009-2011 Mw ≥4 Hypocentre location algorithm by Bondar & Storchak (2011). **...**

Source properties of the 29 January 2011 ML 4.5 Oroszlány (Hungary) mainshock and its aftershocks Z Wéber, B Süle - Bulletin of the Seismological Society of America, 2014 - bssaonline.or**...** Our solution is situated within a few kilometers from the solutions given by the US Geological Survey (USGS) National Earthquake Information Center (NEIC), the European–Mediterranean Seismological Centre (EMSC), the **International Seismological Centre** (ISC), as well as **...**

Empirical conversion between teleseismic magnitudes (mb and Ms) and moment magnitude (Mw) at the Global, Euro-Mediterranean and Italian scale B Lolli, P Gasperini, G Vannucci - Geophysical Journal …, 2014 - gji.oxfordjournals.org **...** We analysed the conversion problem between teleseismic magnitudes (M s and m b) provided by the Seismological Bulletin of the **International Seismological Centre** and moment magnitudes (M w) provided by online moment tensor (MT) catalogues using the chi-square **...**

Analysis of largest earthquakes in Turkey and its vicinity by application of the Gumbel III distribution
T Tsapanos, Y Bayrak, H Cinar, G Koravos… - Acta …, 2014 - degruyter.com **...** (2009). This catalogue, covering the period between 1900 and 2005, is taken from the Bogaziçi University, Kandilli Observatory, Earthquake Research Institute (KOERI) and the **International Seismological Centre** (ISC

Estimation of maximum magnitude (M max): Impending large earthquakes in northeast region, India AK Mohapatra, WK Mohanty, AK Verma - … of the Geological Society of India, 2014 – Springer **...** Accordingly, a homogenous and complete earthquake catalogue for a period from 1897 to 2009 has been prepared from different sources like United States Geological Survey (USGS), **International Seismological Centre** (ISC), Global Centroid-Moment-Tensor (GCMT), ...

The Review of Seismicity of Central Mid-Atlantic Fracture Zones MA Isogun, AA Adepelumi - ijser.org
... Abstract - The seismic activities between 1990 and 2009 in the Mid-Atlantic Fracture Zones (between Latin America and West Africa) have been analysed using 688 sets of seismic parametric data obtained from the **International Seismological Centre** bulletin**.**

Intraplate seismicity across the Cape Verde swell: A contribution from a temporary seismic network
D Vales, NA Dias, I Rio, L Matias, G Silveira, J Madeira… - Tectonophysics, 2014 – Elsevier **...** Seismicity available in the ISC catalogue 1938–2014 is resumed to 24 events (**International Seismological Centre**, 2011) and registered earthquakes felt in the islands during the 20th century. Top right: location of Cape Verde in the Atlantic. **...**

Hydrogeochemical and seismological exploration for geothermal resources in South Sinai, Egypt utilizing GIS and

remote sensing AE EL-Rayes, MO Arnous, HA Aboulela - Arabian Journal of Geosciences, 2014 – Springer **...** A catalogue of micro to moderate earthquake that affects the study area has been compiled for the mentioned period as revealed from the National Earthquake Information Centre, the **International Seismological Centre** (ISC), the Egyptian National Seismic Network **...**

Unbiased estimation of moment magnitude from body–and surface–wave magnitudes R Das, HR Wason, ML Sharma - Bulletin of the Seismological …, 2014 - bssaonline.org **...** For m b –to–M w conversion, 19,466 globally distributed data pairs of body–wave magnitudesfrom the **International Seismological Centre** (ISC) and moment magnitudes from the Global Centroid Moment Tensor are considered for the period 1976–2007. **...**

Comprehensive seismic hazard assessment of Tripura and Mizoram states TG Sitharam, A Sil - Journal of Earth System Science, 2014 – Springer .(.Oldham 1883), Kangra [M w 8.6, 1905, IMD (India Meteorological Department)], Bihar-Nepal earthquake (M w 8.4, 1934, USGS and IMD), Assam–Tibet (M w 8.7, 1950, USGS), Indo-Burma earthquake [M w 7.2, 1988, USGS, ISC (**International Seismological Centre**)],

Finite–difference p wave travel time seismic tomography of the crust and uppermost mantle in the Italian region L Gualtieri, P Serretti, A Morelli - Geochemistry, Geophysics, …, 2014 - Wiley Online Library **...** to the shallowest 50 km. In our study we use travel times of P waves from earthquakes located inside the model region, retrieved from the EHB seismic catalog [**International Seismological Centre** (ISC), 2009)

The 2007–8 volcanic eruption on Jebel at Tair island (Red Sea) observed by satellite radar and optical images W Xu, S Jónsson - Bulletin of Volcanology, 2014 – Springer **...** earthquake activity. Earthquakes located by regional networks provide limited information, although they show increased seismicity near the island as early as 21 September 2007 (**International Seismological Centre**, ISC).

Interseismic locking on the Hikurangi subduction zone: Uncertainties from slow–slip events
R McCaffrey - Journal of Geophysical Research: Solid Earth, 2014 - Wiley Online Library **...** All mechanisms except GeoNet are [**International Seismological Centre**, 2011]. Purple curves outline the extent of cumulative slow slip for 2000–2014 (the 100 mm contour).**...**

Evidence for active faults in Küçükçekmece Lagoon (Marmara Sea, Turkey), inferred from high-resolution seismic data H Alp - Geo-Marine Letters, 2014 – Springer **...** Earth Planet Sci Lett 186:143–158 ISC (2011) Online Bulletin, **International Seismological Centre**, Thatcham, UK. http://www.isc.ac.uk Ketin İ (1968) Relations between general tectonic features and the main earthquake regions in Turkey. **...**

Multiscale seismic tomography and earthquake relocation incorporating differential time data: application to the Maule subduction zone, Chile JD Pesicek, H Zhang, CH Thurber - Bulletin of the Seismological …, 2014 - bssaonline.org
... These data consist of reprocessed teleseismic data for 2605 cataloged earthquakes in the Maule region reported by the **International Seismological Centre** and National Earthquake Information Center (NEIC) for the 11 February 1960–9 September 2010 time period using the **...**

The 2001–present induced earthquake sequence in the Raton Basin of northern New Mexico and southern Colorado JL Rubinstein, WL Ellsworth, A McGarr… - Bulletin of the …, 2014 - bssaonline.org **...** ComCat replaces the ANSS composite catalog. This catalog is supplemented by catalogs from the **International Seismological Centre** (ISC) Bulletin, the Los Alamos Scientific Laboratory seismic array (1973–1984), a catalog produced by Meremonte et al

Integrated geophysical–petrological modeling of lithosphere–asthenosphere boundary in central Tibet using electromagnetic and seismic data J Vozar, AG Jones, J Fullea, MR Agius… - Geochemistry, …, 2014 - Wiley Online Library **...** Earthquake data from the **International Seismological Centre** were taken between longitudes E88° and E90° and projected onto the profile plane. The earthquake hypocenter positions are plotted as open circles within the profile **...**

Active tectonics of Iran deduced from earthquakes, active faulting and GPS evidences naruto-u.ac.jp**...** al. 2006). Open circles represent 4501 earthquakes (magnitude between 2.4 and 7.4) recorded from 1964 to 2002 (after the **International Seismological Centre**, online bulletin, Guest et al., 2006). Page 4. № 2 8 13 continuous **...**

Temporal variations of seismicity parameters in the Central Alborz, Iran M Agh-Atabai, M Mirabedini - Acta Geophysica, 2014 - degruyter.com **...** M. AGH-ATABAI and MS MIRABEDINI 502 ISC), **International Seismological Centre**, Thatcham, United Kingdom, on-line bulletin, http://www.isc.ac.uk. Jackson, J., K. Priestley, M. Allen, and M. Berberian (2002), Active tectonics of the South Caspian Basin, Geophys. J. Int. **...**

Symmetry and tendency judgment of Ms≥ 8.0 strong earthquakes in Chile J Junfang, Y Shuyan, Y Junping - Geodesy and Geodynamics, 2014 - Elsevier
... 2.1. Data source. The data in this paper were mainly collected from the **International Seismological Centre**, and the scientific data about earthquakes, including primarily information of the Ms ≥ 8. 0 earthquakes in Chile since 1800 (Tab. 1), were obtained from the sharing center. **...**

Tracking high–frequency seismic source evolution: 2004 Mw 8.1 Macquarie event BLN Kennett, A Gorbatov… - Geophysical Research …, 2014 - Wiley Online Library **...** Bondar, I., and D. Storchak (2011), Improved location procedures at the **International Seismological Centre**, Geophys. J. Int., 186, 1220–1244. **...**

The 29 September 1969, Ceres, South Africa, earthquake: Full waveform moment tensor inversion for point source and kinematic source parameters F Krüger, F Scherbaum - Bulletin of the Seismological Society of …, 2014 - bssaonline.org
... Seismicity (1963–2012) in southern Africa from the **International Seismological Centre**
catalog. Mechanisms are taken from the CMT catalog and regional studies. The white star marks the epicenter of the 29 September 1969 Ceres earthquake. **...**

The southeastern Caribbean subduction to strikeslip transition zone: a study of the effects on lithospheric structures and overlying clastic basin evolution and fill
TG Alvarez - 2014 - repositories.lib.utexas.edu

... data; including focal mechanism solutions for the analysis of seismicity patterns in the region were derived from the databases of the **International Seismological Centre** (ISC) and the United States Geological Survey (USGS). ...

Estimation of Seismic Ground Motion Induced by the 23 January, 2005 Earthquake in Palu Region, Central Sulawesi, Indonesia PS Thein, S Pramumijoyo… - Journal of …, 2014 - davidpublisher.com ... and cross cuts Sulawesi along 300 km, from Palu Bay southward turn to the southeast connecting to the Matano and Lawanopo Faults [1]. Based on ISC (**International Seismological Centre**), USGS (United States Geological Survey) catalog [2], Indonesian Institute of ...

Ancient terrane boundaries as probable seismic hazards: A case study from the northern boundary of the Eastern Ghats Belt, India S Gupta, WK Mohanty, A Mandal, S Misra - Geoscience Frontiers, 2014 – Elsevier ... 1996, 9, 25, 22.00, 84.00, mb: 4.2, ISC. 1998, 5, 22, 22.13, 84.91, mb: 4.8, ISC. 2001, 6, 12, 22.24, 83.92, mb: 4.7, ISC. 2003, 7, 30, 21.80, 84.30, M L : 3.4, ISC. (USGS: United States Geological Survey; ISC: **International Seismological Centre**; GSI: Geological Survey India). ...

Earth's inner core: Innermost inner core or hemispherical variations? KH Lythgoe, A Deuss, JF Rudge, JA Neufeld - Earth and Planetary Science …, 2014 – Elsevier ... Past studies of absolute PKIKP travel times have used data from the **International Seismological Centre** (Ishii and Dziewonski, 2002 and Su and Dziewonski, 1995), which despite being a large data set is noisy and may miss anomalous arrivals. ...

Azores seismogenic zones Z sismogénicas dos Açores - 2014 - researchgate.net ... Springer. Gutenberg, E., Richter, CF, 1944, Frequency of earthquakes in California. Bull. Seism. Soc. Am., 34, 185–188. **International Seismological Centre** - ISC, 2011. http://www.isc.ac.uk, Internatl. Seis. Cent., Thatcham, United Kingdom. Mogi, K.

Variable Star Symbols for Seismicity Plots DC Agnew - Seismological Research Letters, 2014 - srl.geoscienceworld.org ... The data for 1900–2009 inclusive is from the **International Seismological Centre**–Global Earthquake Model (ISC–GEM)– Global Instrumental Earthquake Catalogue (Storchak et al., 2013), with the years 2010–2012 taken from the National Earthquake Information Center

Bayesian inversion of free oscillations for Earth's radial (an) elastic structure RWL de Wit, PJ Käufl, AP Valentine… - Physics of the Earth and …, 2014 – Elsevier ... The models iasp91 (Kennett and Engdahl, 1991) and ak135 (Kennett et al., 1995) were constructed to explain the extensive catalogue of travel times documented by the **International Seismological Centre** (ISC). More recently, Cammarano et al

Spatial variation of probabilistic seismic hazard for Mumbai and surrounding region SS Desai, D Choudhury - Natural hazards, 2014 – Springer ... various national and international agencies like Indian Meteo- rological Department (IMD), Gauribidanur Array of Bhabha Atomic Research Center (BARC), Geological Survey of India (GSI), United States Geological Survey (USGS), **International Seismological Centre** (ISC) UK ...

Semi-Periodic Sequences and Extraneous Events in Earthquake Forecasting. II: Application, Forecasts for Japan and VenezuelaCBQ Cartaya, FAN Pichardo, E Glowacka… - Pure and Applied …, 2014 - Springer... from the Cajigal Observatory, which monitored seismicity since the late XIX century (Grases 2005), plus information from other international centers, such as the South American Regional Seismological Center (CERESIS), **International Seismological Centre** (ISC

DP Shukla, CS Dubey, AS Ningreichon, RP Singh BK Mishra - Nat Hazards, 2014 - researchgate.net ... The earthquake data from **International Seismological Centre** (ISC) reveal that highest number of earthquakes have occurred in high (109) and very high (80) zones 1440 Nat Hazards (2014) 71:1433–1452 123 Author's personal copy Page 11. Table 2 Linear parameters ...

Source study of the Jan Mayen transform fault strike-slip earthquakes Q Rodríguez-Pérez, L Ottemöller - Tectonophysics, 2014 – Elsevier ... c Hypocenter reported by the Harvard global CMT catalog. d Hypocenter reported by the **International Seismological Centre** (ISC). Magnitudes: ... f Magnitude (M) reported by the **International Seismological Centre** (ISC). g M w , m b , and M s (Harvard global CMT catalog). ...

Vrancea Earthquakes Impact on Republic of Moldova (South Area): A Deterministic Parametric Study I SANDU, C LA MURA - Int Conference:„5 th National Conference …, 2014 - researchgate.net ... Наук), Кишинев 2006, 24-50 (in Russian) 4. Mostrioukov A., Petrov V., (1994), Catalogue of focal mechanisms of earthquakes 1964-1990. Materials of the World Data Center, Moscow 5. ISC (1964-2002), Bulletins of the **International Seismological Centre**

Pn anisotropy beneath the South Island of New Zealand and implications for distributed deformation in continental lithosphere JA Collins, P Molnar - Journal of Geophysical Research: Solid …, 2014 - Wiley Online Library ... first step of analysis, we simply fit a straight line through all travel times versus epicentral distance using the locations and origin times given in either the NZNSN GeoNet (http://www.geonet.org.nz/earthquake/) catalog or the ISC catalog **International Seismological Centre** 2013 ...

GIS-based morpho-tectonic studies of Alaknanda river basin: a precursor for hazard zonation
DP Shukla, CS Dubey, AS Ningreichon, RP Singh… - Natural hazards, 2014 - Springer
... The earthquake data from **International Seismological Centre** (ISC) reveal that highest number of earthquakes have occurred in high (109) and very high (80) zones 1440 Nat Hazards (2014) 71:1433–1452 123 Page 9. Table 2 Linear parameters for sub-basins of Alakn and...

Earthquake hazard of dams along the Mekong mainstream
S Pailoplee - Natural Hazards, 2014 - Springer
... The comprehensive earthquake catalogs maintained in the **International Seismological Centre** (ISC), the National Earthquake Information Center (NEIC), and the Global CMT Project Moment Tensor Solution (CMT) were used in this study

PROBABILISTIC SEISMIC HAZARD ASSESSMENT OF THE EUROPEAN EXTREMELY LARGE TELESCOPE (" E-ELT") PROJECT (CHILE) M Corigliano, CG Lai, L Scandella, E Spacone… - 2014 - nees.org

... most accredited databases: the National Seismological Service of the University of Chile (SSN), the National Earthquake Information Center (NEIC), which includes different database (ie PDE,NOAA, SISRA, Centennial), the **International Seismological Centre** (ISC

Probabilistic seismic hazard analysis at a strategic site in the Bay of Bengal SCT Trianni, CG Lai, E Pasqualini - Natural Hazards, 2014 – Springer **...** Eight international databases have been consulted: **International Seismological Centre** (ISC), National Earthquake Information Centre [USGS-NEIC (PDE)], Global CMT Catalogue Search,USGS Moment Tensor and Broadband Source Parameter Search, Global Significant **...**

The persistence of memory JAT Machado, AM Lopes - Nonlinear Dynamics, 2014 – Springer **...**TheBulletinof the **International Seismological Centre** (ISC), available online at (http://www.isc.ac.uk/), is used in this study. The data catalog covers the period of years 1904–2013. Each record **...**

Semi-automatisation de l'extraction des anomalies de drainage. Application au centre de l'Atlas méridional de la Tunisie
M Ben Hassen, B Deffontaines, MM Turki - Géomorphologie, 2014 - cairn.info **...** Photogrammetric Engineering and Remote Sensing 11, 1523-1527. Institut National de la Météorologie (1995) – Bulletins de sismologie de la Tunisie. Tunis. ISC (2012) – **International Seismological Centre**. On-line bulletin (http://www.isc.ac.uk/iscbulletin/). **...**

STUDI AWAL CODA Q-FACTOR WILAYAH SESAR OPAK
I Gunawan - Jurnal Meteorologi dan Geofisika, 2014 - 202.90.199.54 **...** First geodetic measurement of convergence across the java trench. Geophysical Research Letters, 21, 2135-2138. **International Seismological Centre** (2014). On-line Bulletin. Thatcham, United Kingdom. Int. Seis. Cent. http://www.isc.ac.uk. **...**

Zastosowanie metodologii geodezji naturalnej w predykcji trzęsień ziemi (na przykładzie trzęsienia Virginia 23.08. 2011)
Z Adamczewski - Przegląd Geodezyjny, 2014 - yadda.icm.edu.pl **...** Moon System. Obs.Royal de Belgique. Com. Serie B No 160. 1999; [8] **International Seismological Centre**. On-Line Bulletin. www.isc.ac.uk; [9] Reports on Geodesy. Warsaw University of Technology No.3(70)2004.

Time dependent seismicity in the continental fracture system
BC PAPAzAChOS, GF KArAKAISIS… - Bollettino di Geofisica …, 2014 - inogs.it **...** Data sources searched to compile this catalogue are the bulletins of the **International Seismological Centre** (ISC, 2012), the National Earthquake Information Centre of USGS (NEIC, 2012), the online Global Moment Tensor Catalogue (GCMT, 2012) and published ...

The September 2011 Sikkim Himalaya earthquake Mw 6.9: is it a plane of detachment earthquake? S Baruah, S Saikia, S Baruah, PK Bora… - … , Natural Hazards and …, 2014 - Taylor & Francis **...** About 80 earthquakes with M ≥ 4.0 are reported in both **International Seismological Centre** and theEngdahl–Hilst–Buland (EHB) relocated catalogue for Sikkim and surroundings within 25 o –29 o N and 86 o –90 o E (figure 1). Earthquakes in the EHB catalogue were **...**

The 2008 Nura earthquake sequence at the Pamir–Tian Shan collision zone, southern Kyrgyzstan
C Sippl, L Ratschbacher, B Schurr, C Krumbiegel… - …, 2014 - Wiley Online Library **...** A misinterpretation of this second pulse of moment release as a pP depth phase on some teleseismic stations might have led to the substantially deeper hypocentral depth estimated by **International Seismological Centre** (ISC) (28 km; this leads to a pP-P time of 9.3 s if a crustal **...**

Fully probabilistic seismic source inversion–Part 1: Efficient parameterisation SC Stähler, K Sigloch - Solid Earth, 2014 - solid-earth.net **...** If the event is shallow according to the **International Seismological Centre** (ISC) catalogue (< 30km), we draw from depths between 0km and 50km; ie, m1 ∼ U(0,50). For deeper events, we draw from depths be- tween 20km and 100km. **...**

The Varzeghan earthquake doublet reveals complex stress and slip patterns S Amini, Z Zarifi, R Roberts, B Lund - ucl.ac.uk **...** archive. We compare source parameters from over 70 InSAR studies of 57 global earthquakes with those in the Global CMT (GCMT) **International Seismological Centre** (ISC) and Engdahl–Hilst–Buland (EHB) seismic catalogs. **...**

A new seismogenic model for the Kyparissiakos Gulf and western Peloponnese (SW Hellenic Arc)
J MASCLE, G PAPADOPOULOS… - Bollettino di Geofisica …, 2014 - researchgate.net **...** of modern seismographs was established by NOA according to the World Wide Standardized Seismographic Network requirements and the revision of the earthquake parameters by standardized procedures was started by the **International Seismological Centre**

The 2007 eruptions and caldera collapse of the Piton de la Fournaise volcano (La Réunion Island) from tilt analysis at a single very broadband seismic station
FR Fontaine, G Roult, L Michon… -Geophysical …, 2014 - Wiley Online Library **...** The first and main collapse step of the summit caldera initiated on 5 April at 20:48 producing a M S 4.8 seismic event (**International Seismological Centre**, Online Bulletin, http://www.isc.ac.uk, Internatl. Seis. Cent., Thatcham, United Kingdom, 2011). **...**

Explanation of Temporal Clustering of Tsunami Sources Using the Epidemic–Type Aftershock Sequence Model EL Geist - Bulletin of the Seismological Society of America, 2014 - bssaonline.org **...** Results from the other earthquake catalogs using a minimum start year of 1960 are shown in Tables 5 and 6, including the Centennial catalog (2002) and the **International Seismological Centre**–Global Earthquake Model (ISC–GEM) catalog (Storchak et al., 2013). **...**

Heterogeneity and anisotropy of Earth's inner core A Deuss - Annual Review of Earth and Planetary Sciences, 2014 - annualreviews.org **...** The deepest parts of the inner core are studied by using PKIKP on its own. Absolute travel time studies using PKIKP arrival times from **International Seismological Centre** catalog show weaker anisotropy of only 1–3% (Morelli et al. **...**

Central Andean mantle and crustal seismicity beneath the Southern Puna plateau and the northern margin of the Chilean–Pampean flat slab P Mulcahy, C Chen, SM Kay, LD Brown, BL Isacks… - …, 2014 - Wiley Online Library
... Most of the earthquakes analyzed from the Southern Puna array document activity in a region for which very few teleseismic events are listed in the global catalogs of the

Preliminary Determination of Episodes (PDE), ISC [**International Seismological Centre**, 2010], and NEIC **...**

Present‐day kinematics of the East African Rift E Saria, E Calais, DS Stamps… - Journal of …, 2014 - Wiley Online Library**...** the location of a zone of faulting across the deep abyssal plain of the submarine Natal Valley[Reznikov et al., 2005] and the m b 5.9, 7 April 1975 event in the Transkei basin (latitude =−37.6237, longitude = 30.9846; **International Seismological Centre** Online Bulletin, http://www **...**

Deep seismic reflection images of the Wharton Basin oceanic crust and uppermost mantle offshore Northern Sumatra: Relation with active and past deformation
H Carton, SC Singh, ND Hananto… - Journal of …, 2014 - Wiley Online Library **...** [2010] for events until October 2007, otherwise locations from the Engdahl, van der Hilst, Bulland (EHB) catalog, and locations from t **International Seismological Centre** catalog [ISC 2011]

Multifaulting in a tectonic syntaxis revealed by InSAR: The case of the Ziarat earthquake sequence (Pakistan) B Pinel‐Puysségur, R Grandin… - Journal of …, 2014 - Wiley Online Library **...** They were followed by a cluster of 47 aftershocks with magnitudes larger than 3.5. The events are located by global seismological networks within a large area, spreading over a 1500 km 2region source **International Seismological Centre** (ISC), US Geological Survey (USGS)). **...**

A saga of the 1896 South Iceland earthquake sequence: magnitudes, macroseismic effects and damageR Sigbjörnsson, R Rupakhety - Bulletin of earthquake engineering, 2014 – Springer **...** Sigbjörnsson 2000). For later events, MS values of some of the earthquakes have been estimated by different agencies, such as the **International Seismological Centre** (ISC) and the United States Geo- logical Survey (USGS). These **...**

Zonal concentration of some geophysical process intensity caused by tides and variations in the Earth's rotation velocity B Levin, A Domanski, E Sasorova - Advances in Geosciences, 2014 - search.proquest.com **...** 2009b). Such normalizing determines the average number of earthquakes generated per every 100km of plate boundary. The worldwide seis- mic catalog (the **International Seismological Centre** catalog (ISC, UK)) was used.

Source parameters of the 2005–2008 Balâ–Sırapınar (central Turkey) earthquakes: Implications for the internal deformation of the Anatolian plate Y Çubuk, S Yolsal-Çevikbilen, T Taymaz - Tectonophysics, 2014 – Elsevier **...** KOERI, Istanbul). Reported earthquake magnitudes are taken from Harvard Global CMT Catalog, **International Seismological Centre** (ISC), Earthquake Research Center (AFAD-DAD, Ankara) and KOERI, respectively

Estimation of Source Parameters of M w 6.9 Sikkim Earthquake and Modeling of Ground Motions to Determine Causative Fault S Chopra, J Sharma, A Sutar, BK Bansal - Pure and Applied Geophysics, 2014 - Springer
... 6.2), respectively. Some 80 earthquakes Mw [4.0 have been reported in the **International Seismological Centre** (ISC)/Engdahl, Hillst and Buland (EHB) relocated catalog for Sikkim and the surrounding area. A microearthquake **...**

Earthquake scenario in West Bengal with emphasis on seismic hazard microzonation of the city of Kolkata, India SK Nath, MD Adhikari, SK Maiti… - … Hazards and Earth …, 2014 - search.proquest.com **...** We therefore prepared an earthquake catalog of the Bengal Basin and the adjoining region spanning the 1900–2012 period by considering three major earthquake data sources, namely the **International Seismological Centre** (ISC, http: //www.isc.ac.uk), the US Geological **...**

Self‐Consistent Earthquake Fault‐Scaling Relations: Update and Extension to Stable Continental Strike‐Slip Faults M Leonard - Bulletin of the Seismological Society of America, 2014 - bssaonline.org **...** Where available, I have used the M w , using M w =(log(M 0)–9.1)/1.5 (Kanamori and Anderson, 1975; Kanamori, 1978; Purcaru and Berckhemer, 1978), from the **International Seismological Centre**‐Global Earthquake Model (ISC‐GEM; Storchak et al., 2013) Catalogue. **...**

Anomalous Fluoride and Warm Water Wells May Indicate Blind Geothermal Systems in Cenozoic Basins of Northwestern Thailand FS Singharajwarapan, SH Wood, A Fuangswasdi… - researchgate.net **...** Since the year 2000 least 16 earthquakes greater than Mb = 3.5 and up to 4.6 have occurred in the Chiang Mai basin area (**International Seismological Centre**, 2014), and some have occurred near the Mae Tha fault, and also near the arc of fluoride-anomalous groundwater. **...**

A new Moho boundary map for the northern Fennoscandian Shield based on combined controlled-source seismic and receiver function data H Silvennoinen, E Kozlovskaya, E Kissling, G Kosarev… - GeoResJ, 2014 – Elsevier **...** The event information was taken from the earthquake database of the **InternationalSeismological Centre** (http://www.isc.ac.uk/). Of these events, those with clear P-wave arrivals were selected for calculation of PRFs and stacking

The coupling of Indian subduction and Asian continental tectonics A Replumaz, FA Capitanio, S Guillot, AM Negredo… - Gondwana …, 2014 – Elsevier **...** 2). This model has been updated by Villaseñor et al. (2003) by including arrival times of earthquakes from 1995 to 2002 listed in the bulletins of the **International Seismological Centre** and reprocessed using the EHB methodology (Engdahl et al., 1998). **...**

Large earthquake processes in the northern Vanuatu subduction zone KM Cleveland, CJ Ammon, T Lay - Journal of Geophysical …, 2014 - Wiley Online Library
... 1990]. While the **International Seismological Centre** catalog (ISC) lists a depth of 73 km for the first event, Tajima et al. [1990] found that the long-period surface wave observations were most consistent with a depth of ~40 km. **...**

Refined models of gravitational potential energy compared with stress and strain rate patterns in Iberia MC Neves, RM Fernandes, C Adam - Journal of Geodynamics, 2014 - Elsevier
... Epicenters (gray dots) are from the **International Seismological Centre** (www.isc.ac.uk) and fault traces from the QAFI atabase (www.igme.es/infoigme/aplicaciones/qafi); (b) the five considered areas with similar internal stress conditions: western Iberia – WI, Gulf of Cadiz – GC **...**

Regionally heterogeneous uppermost inner core observed with Hi‐net array TG Yee, J Rhie, H Tkalčić - Journal of Geophysical Research: …, 2014 - Wiley Online Library

... Event information was taken from the reviewed Bulletin of the **International Seismological Centre** (ISC), which is manually checked by ISC analysts and relocated. The targeted events have the body wave magnitudes (m b) between 5.0 and 6.7. **...**

Transition from a singly vergent to doubly vergent wedge in a young orogen: The Greater Caucasus AM Forte, E Cowgill, KX Whipple - Tectonics, 2014 - Wiley Online Library **...** Seismicity data from catalog assembled by Mumladze et al. [2014]. Focal mechanism data (1977–2012) are from the **International Seismological Centre** Bulletin and are colored by depth and scaled by magnitude (3.3 < M w < 7.4) [Centre, 2011]. **...**

Faulting within the Pacific plate at the Mariana Trench: Implications for plate interface coupling and subduction of hydrous minerals EL Emry, DA Wiens… - Journal of Geophysical …, 2014 - Wiley Online Library **...** Earthquake arrival time data were collected from **International Seismological Centre** On-line Bulletin [2010] for all Global Centroid Moment Tensor (GCMT) earthquakes occurring between 9–26°N and 138–154°E from 1 January 1976 to 1 October 2010

Imaging the Antarctic mantle using adaptively parameterized P-wave tomography: evidence for heterogeneous structure beneath West Antarctica SE Hansen, JH Graw, LM Kenyon, AA Nyblade… - Earth and Planetary …, 2014 – Elsevier **...** Prior global body wave tomography studies have shown poor resolution in Antarctica because only about 30 seismic stations across the entire continent report arrivals to the **International eismological Centre** (ISC), and most of these stations are located along the coast (Fig. **...**

An active oblique–contractional belt at the transition between the Southern Apennines and Calabrian Arc: The Amendolara Ridge, Ionian Sea, Italy L Ferranti, P Burrato, F Pepe, E Santoro… - …, 2014 - Wiley Online Library **...** study region and surroundings was obtained by merging some seismic catalogues that cover different time spans: the Parametric Catalog of Italian Earthquakes (CPTI11) [Rovida et al., 2011] with earthquakes from 1005 to 1981; the **International Seismological Centre** (ISC)

Imaging topographic growth by long–lived postseismic afterslip at Sefidabeh, east Iran A Copley, K Reynolds - Tectonics, 2014 - Wiley Online Library **...** Three earthquakes of magnitudes 3.6–3.8 are the only to be present in the area in the **International Seismological Centre** (ISC) catalog during the time covered by our postseismic InSAR results, suggesting the deformation is likely to have been mostly aseismic (over 300 such **...**

Regional seismotectonics analysis as a contribution to the study of local seismogenic sources in calima reservoir zone, … J Leandro Pérez, EJ Salcedo-Hurtado… - Boletin de …, 2014 - scielo.org.co **...** Consultado el 24 de julio de 2012. del sitio Web de Ingenieros Consultores ...

Pn anisotropic tomography and dynamics under eastern Tibetan plateau J Lei, Y Li, F Xie, J Teng, G Zhang… - Journal of Geophysical …, 2014 - Wiley Online Library **...** Cui and Pei [2009] combined the data from International Deep Profiling of Tibet and the Himalaya seismic networks and the **International Seismological Centre** bulletins during 1964 and 2006, in addition to the data set used by Huang et al. [2003]. Xu et al. **...**

Buildup of a dynamically supported orogenic plateau: Numerical modeling of the Zagros/Central Iran case study T François, E Burov, P Agard… - Geochemistry, …, 2014 - Wiley Online Library **...** of orogenic plateau. image Figure 1. (a) Location map of the Arabia-Eurasia collision zone. The orange circles represent 1964–2002 seismic event data from the **International Seismological centre** (2001). The black arrows refer **...**

A new record and geography of tsunamis, earthquakes and tropical cyclones in Bangladesh and their relevance to disaster risk reduction
ME Alam - 2014 - researchgate.net **...** IOT Indian Ocean Tsunami IPCC ntergovernmental Panel on Climate Change IRIS Incorporated Research Institutions for Seismology ISC **International Seismological Centre** ITIC International Tsunami Information Centre MoEF Ministry of Environment ...

Seismotectonics of the Pamir B Schurr, L Ratschbacher, C Sippl, R Gloaguen… - …, 2014 - Wiley Online Library
... et al. [2013], and the Global Instrumental Earthquake Catalogue-**InternationalSeismological Centre** global earthquake catalog 4: Storchak et al. [2013]). Five depth profiles are marked on map and plotted on the right side. (b **...**

Mantle dynamics in the Mediterranean C Faccenna, TW Becker, L Auer, A Billi… - Reviews of …, 2014 - Wiley Online Library **...** and normal (ticks on downthrown side). (b) Seismicity color-coded by hypocentral depth (**International Seismological Centre** catalog, magnitude range > 4). Download figure to PowerPoint. The map of instrumental seismicity **...**

Seismic hazard estimates for the area of Pylos and surrounding region (SW Peloponnese) for seismic and tsunami risk assessment D Slejko, M Santulin, J Garcia - Boll. Geof. Teor. Appl, 2014 - ogs.trieste.it **...** Papazachos et al. (2000a), in fact, obtained two scaling laws between number of stations recording the event (NS) and ML for the outer and the inner part of the Hellenic Arc, using the data of **International Seismological Centre ...**

Aggravated Earthquake Risk in South Asia: Engineering versus Human Nature R Bilham - Earthquake Hazard, Risk, and Disasters, 2014 - books.google.com **...** lines in Pa/yr, Bilham et al., 2003) and potential energy stress in the Indian subcontinent (Ghosh et al., 2006), with megaquake rupture zones (green), recent earthquakes (Preliminary Determination of Epicenters (PDE) by the **International Seismological Centre** inferred GPS **...**

Collaborative Research: High-Resolution Seismic Velocity and Attenuation Models of Western China E Sandvol, J Ni, T Hearn, WS Phillips - 2014 - DTIC Document **...** The amplitude tomography method has proven successful and performs well even for lower quality data sets such as the surface-wave amplitudes archived by the **International Seismological Centre**

Slab interactions in the Taiwan region based on the P-and S-velocity distributions in the upper mantle I Koulakov, YM Wu, HH Huang, N Dobretsov… - Journal of Asian Earth …, 2014 – Elsevier **...** zones. Abstract. We present a new model of P- and S-velocity anomalies in the upper mantle beneath the Taiwan region based on the inversion of travel time data from the **International Seismological Center** (ISC) catalog. **...**

An appraisal of aftershocks behavior for large earthquakes in Persia M Nemati - Journal of Asian Earth Sciences, 2014 – Elsevier **...** 43 Earthquakes are investigated, using data from the global **International Seismological Center** (ISC) seismic catalogue and from the regional earthquake catalogue of the Institute of Geophysics, University of Tehran (IGUT) between 1961–2006 and 2006–2012 respectively. **...**

Three‐dimensional P wave azimuthal anisotropy in the lithosphere beneath China Z Huang, P Wang, D Zhao, L Wang… - Journal of Geophysical …, 2014 - Wiley Online Library **...** In this study, we have combined a large amount of arrival-time data from local and regional earthquakes compiled by the China Seismic Network (CSN) data center and the **International Seismological Center** (ISC) to map the P wave azimuthal anisotropy in the lithosphere **...**

Fault-Plane Solution of the Earthquake of 19 March 2005 in Monatele (Cameroon) EN Ndikum, CT Tabod, APK Tokam… - Open Journal of …, 2014 - file.scirp.org **...** this earthquake situated it at a latitude of 4˚10.86', a longitude of 11˚1.38' with a depth of 10 km by the US National Earthquake Information Center (NEIC); and at a latitude of 4˚12.74', a longitude of 11˚6.28' with a depth of 10 km by the **International Seismological Center** (ISC)

A complete and homogeneous magnitude earthquake catalogue of Iraq EAMS Al-Heety - Arabian Journal of Geosciences, 2014 – Springer **...** Events were considered duplicates if they had a time difference of 10 s or less and space origin difference of 0.5° or less. In a given set of duplicate events, an event, which had a magnitude and **International Seismological Center** source, was retained as the record of the event. **...**

Assembleia Luso Espanhola de Geodesia e Geofísica Asamblea Hispano-Portuguesa de Geodesia y Geofísica A Hispano-P - researchgate.net**..** (1994) which cover the period from 1900 to 1992. b. EHB (Engdahl et al., 1998) catalogue updated to 2009 from the website of the **International Seismological Center** (ISC), covering the period from 1964 to 2009.

Seismicity of the northern Barents Sea in area of the Franz Victoria and Orla troughs AN Morozov, NV Vaganova, YV Konechnaya - Geotectonics, 2014 – Springer **...** To obtain information on historical earthquakes in the study area over period from 1908 to 2011, we used the data of the **International Seismological Center** (ISC)

Seismic Risk Assessment of Khyber Pakhtunkhwa Province Pakistan SA Khan, MA Qureshi, PG Scholar - Life Science Journal, 2014 - lifesciencesite.com **...** Instrument earthquake records are taken for **International Seismological Center** (ISC, 2012).100 years instrumental records are use in hazard and ..

An Earthquake Risk Assessment Study of Khyber Pakhtunkhwa Province Pakistan MA Quershi, H Ahmad, AU Shah3a, SA Khan3b - cusit.edu.pk**...** Instrument earthquake records are taken for **International Seismological Center** (ISC, 2012).100 years instrumental records are use in hazard and risk calculation **International Seismological center** (ISC) UK, website: ttp://www.isc.ac.uk/, accessed on March 2012 17. **...**

Seismological aspects of the Varzeghan twin Earthquakes on 11 August 2012 (Mw 6.3 and Mw 6.1), in East Azerbaijan province, NW Iran JV Farahani, M Zare - Episodes, 2014 - episodes.co.in ISC Alikhalaj AMB: Ambraseys and Melville (1982), **International Seismological Center**, UK, BAN= BANISADR, FD = Focal Depth Page 7. June 2014 102 **...**

Peak Ground Acceleration on Bedrock and Uniform Seismic Hazard Spectra for Different Regions of Golpayegan, Iran AS Afarani, GG Amiri, SAR Amrei - ijitee.org **...** A list of instrumental earthquakes in Golpayegan from 1900 to the present has been collected, the most important of which is the website **International Seismological Center**

Reprint of: Two-year survey of earthquakes and injection/production wells in the Eagle Ford Shale, Texas, prior to the MW4. 8 20 October 2011 earthquake C Frohlich, M Brunt - Earth and Planetary Science Letters, 2014 – Elsevier **...** The center of the MMI VI area (Table S2) was at 28.79N 98.17W, 12 km southwest of the epicentre determined by the NEIC (28.865N 98.079W), but only about 3 km from the prime epicentre reported by the **International Seismological Center** (28.7616N 98.1572W). 3.2. **...**

Earthquake Catalogue of the Thailand Meteorological Department—A Commentary S Pailoplee - Journal of Earthquake and Tsunami, 2014 - World Scientific **...** tmd.go.th/TRF/earthquake catalog.php, is contributed to by the compilation of six agencies, ie (i) China Digital Seismic Network, Beijing, China (BJI), (ii) TMD, Bangkok, Thailand (BKK), (iii) International Data Center (IDC), (iv) **International Seismological Center** (ISC), (v) Institute **...**

Polish Polar Station in Hornsund, Spitsbergen M Górski - Seismic Events in Glaciers, 2014 – Springer **...** Seismological experiments are occasionally organized directly on the Hans Glacier. The seismological station in Hornsund, labelled HSP according to **InternationalSeismological Center** Code, is a short-period station. Instruments **...**

Seismic Hazard Assessment of Syria RA Ahmad - nec.gov.sy **...** The instrumentally recorded seismo- logical data events were collected from **International Seismological Center** regional catalog (ISC), US Geological Survey catalog (USGS), World Data Center regional catalog (WDC), and Syrian National Earthquake Center (NEC, 2011). **...**

Kamchatka subduction zone, May 2013: the Mw 8.3 deep earthquake, preceding shallow swarm and numerous deep aftershocks A Špičák, J Vaněk - Studia Geophysica et Geodaetica, 2014 – Springer **...** Page 4. Context of the May 2013 Kamchatka deep earthquake Stud. Geophys. Geod., 58 (2014) 79 determinations published by the **International Seismological Center** (ISC http://www.isc.ac.uk/) by the procedure of Engdahl et al.

Moho depth variations in the Taiwan orogen from joint inversion of seismic arrival time and Bouguer gravity data Z Li, S Roecker, K Kim, Y Xu, T Hao - Tectonophysics, 2014 - Elsevier **...** The seismic arrival time data used in this study were recorded by 98 permanent and temporary stations between 1991 and 2010. Most of the arrival time picks are taken from **InternationalSeismological Center** (ISC), with some of them prior to 1998 provided by Prof. **...**

Earthquake magnitude prediction by adaptive neuro-fuzzy inference system (ANFIS) based on fuzzy C-means algorithm

M Mirrashid - Natural Hazards, 2014 – Springer **...** magnitude scales were reported. The **International Seismological Center** (ISC) was reference for mb and Ms. The last reported event that has been recorded in two scales was on February 6, 2010. Therefore, for earthquakes **...**

Accurate location and focal mechanism of small earthquakes near Idukki Reservoir, Kerala: implication for earthquake genesis U Saikia, SS Rai, M Subrahmanyam… - …, 2014 - currentscience.ac.in **...** this region. We compare in Table 4, parameters of four earthquakes determined in this study with those computed by the **International Seismological Center** (ISC) and the India Meteorological Department (IMD).

Seismic Hazard Assessment and Determination of Maximum Design Base Acceleration of Yazd A Asadi, MK Barkhordari - Journal Archive, 2014 - civiljournal.semnan.ac.ir
... More precise seismic data was gathered in Yazd and its vicinity after 1900 due to installation of earthquake-recording devices. This seismic data were collected from the **International Seismological Center** (ISC) and the National Earthquake Information Center (NEIC). **...**

A spatial statistical analysis of the occurrence of earthquakes along the Red Sea floor spreading: clusters of seismicity K Al-Ahmadi, A Al-Amri, L See - Arabian Journal of Geosciences, 2014 – Springer **...** Historical data have been collected from Ambraseys et al. (1995). International data centers have been searched for additional data such as the **International Seismological Center** for the period from 1964 to 1998, and the National Earthquake Information Center

Deterministic seismic hazard assessment close to a gas field in northern Oman I El-Hussain, A Deif, AME Mohamed, K Al-Jabri… - Arabian Journal of …, 2014 – Springer **...** 1994) supports the possibility of having moderate earthquakes along the entire Oman Mountains. On March 3, 1971, the **International Seismological Center** catalogues published an earthquake of magnitude 5.2 at the most east part of Oman. This event, surprisingly, was not felt. **...**

Large-scale seismic signal analysis with Hadoop TG Addair, DA Dodge, WR Walter, SD Ruppert - Computers & Geosciences, 2014 – Elsevier **...** seismicity around the world (eg the United States Geological Survey National Earthquake Information Center, the Comprehensive nuclear-Test-Ban Treaty (CTBT) International Data Center,the US National Data Center, the **International Seismological Center**) and many ...

A new model of slab tear of the subducting Philippine Sea Plate associated with Kyushu–Palau Ridge subduction L Cao, Z Wang, S Wu, X Gao - Tectonophysics, 2014 - Elsevier
... 2). A further subset of arrival times from local earthquakes in the study region during the period from 1960 to 2008 was compiled by the **International Seismological Center** (ISC). Earthquakes were selected from these data sets only if they satisfied the following criteria: (1). **...**

Unbiased estimation of moment magnitude from body–and surface–wave magnitudesR Das, HR Wason, ML Sharma - Bulletin of the Seismological …, 2014 - bssaonline.org**...** Body–and surface–wave magnitudes of earthquake events for the entire globe from the **International Seismological Center** (ISC), (http://www.isc.ac.uk/search/Bulletin; last accessed August 2010), and moment magnitudes from the Global Centroid

Reference database for seismic ground-motion in Europe (RESORCE) S Akkar, MA Sandıkkaya, M Şenyurt, AA Sisi… - Bulletin of earthquake …, 2014 – Springer **...** In the absence of such earthquake-specific studies, the earthquake metadata (eg, epicentral location, focal depth as well as magnitude estimations other than local magnitude, ML) were mostly taken from the Bulletin of the **International Seismological Center** (www. isc.ac.uk). **...**

Seismic hazard analysis of Mersin Province, Turkey using probabilistic and statistical methods RF Kartal, G Beyhan, A Keskinsezer… - Arabian Journal of …, 2014 - Springer
... (1975) catalog for 01 Jan 1916 to 31 Dec 1964, **International Seismological Center** (ISC) catalog for 01 Jan 1965 to 31 Dec 2005, and Republic of Turkey Prime Ministry Disaster and EmergencyManagement Precidency (RTPMDEMP 2009) catalog for 01 Jan 2006 to 31 Dec **...**

The array network facility seismic bulletin: Products and an unbiased view of United States seismicity L Astiz, JA Eakins, VG Martynov… -eismological , 2014 - srl.geoscienceworld.org
... Once the final analyst review of a monthly database is complete, the event bulletin is reformatted using db2ims and ims2dmc and exported using orbxfer2 to the DMC. The final ANF Seismic Bulletin picks are forwarded to the **International Seismological Center** (ISC) by the DMC. **...**

Intensity-distance attenuation laws for the Portugal mainland using intensity data points B Le Goff, JF Borges… - Geophysical Journal …, 2014 - gji.oxfordjournals.org **...** Table 1. Seismic events used to estimate the attenuation law. IPMA, Instituto Português do Mar e da Atmosfera;ISC **International Seismological Center**; IGN, Instituto Geografico Nacional. Due to the small number of observed **...**

Multiple styles and scales of lithospheric foundering beneath the Puna Plateau, central Andes SL Beck, G Zandt, KM Ward… - Geological Society of …, 2014 - memoirs.gsapubs.org **...** 1) pro- vide some of the first seismic images for this region. Bianchi et al. (2013) combined teleseismic traveltime data (**International Seismological Center** data) and regional earthquake data to image the upper mantle in the southern Puna (25°S–28°S). They found overall low **...**

The Role of Microzonation in Estimating Earthquake Risk
IA Parvez, P Rosset - Earthquake Hazard, Risk, and Disasters, 2014 - books.google.com **...** There are many global earthquake catalogs, for example, the United States Geological Survey (USGS)/National Earthquake Information Center catalog **International Seismological Center** catalog, the National Oceanic and Atmo- spheric Administration catalog, and ...

Seismic hazard analysis of Sinop province, Turkey using probabilistic and statistical methods RF Kartal, G Beyhan, A Keskinsezer - Journal of Earth System Science, 2014 – Springer **...** 4 The creation of earthquake catalog. The Republic of Turkey Prime Ministry Disaster and Emergency Management Presidency (RTPMDEMP 2009a)earthquake database and **International Seismological Center** (2009) records were used for earthquake catalogs. **...**

The seismogenic thickness in the Dead Sea area F Aldersons, Z Ben-Avraham - Dead Sea Transform Fault System: Reviews,

2014 – Springer **...** They performed an iterative simultaneous inversion for source parameters, P- and S-velocities, and Moho depth using local traveltimes reported by the **International Seismological Center** between 1964 and 2001 (ISC 2001). **...**

Historical seismicity of the Jordan Dead Sea Transform region and seismotectonic implications H Zuhair, S McKnight, D Eaton - Arabian Journal of Geosciences, 2014 - Springer
... 2005; Utsu 1990; Marzouk 2008; Salamon 2010) and the catalogs of other international organizations including the National Earthquake Information Center of the USGS (NEIC), the **International Seismological Center** (ISC), and the National Geophysical Data Center/World **...**

Probabilistic seismic hazard analysis for the city of Quetta, Pakistan S Rehman, C Lindholm, N Ahmed, Z Rafi - Acta Geophysica, 2014 - degruyter.com **...** The catalogues used in the present study are **International Seismological Center** (ISC), United States Geological Survey (USGSPDE), and Pakistan Meteorological Department (PMD) earthquake data catalogues, whereas the Harvard Cen- troid Moment Tensor (CMT **...**

Variation of regional Gutenberg–Richter law parameter before and after large earthquakes in some earthquake prone zones around the world SK Midya, PK Gole - Indian Journal of Physics, 2014 – Springer **...** tested. Acknowledgments. The authors would like to thank United States Geological Survey (USGS) and **International Seismological Center** (ISC) for making the earthquake data freely available on their websites.

PN anisotropy tomography of the Colorado plateau and adjacent areas S Cheng-2014 scholarsmine.mst.edu
... al.(2007,2008) studied the uppermost mantle Pn wave velocity and anisotropy in China South Sea northeast area and Yellow Sea based on the network of Chinese earthquake stations and ISC (**International Seismological Center**) report from 1980-2004 of the Pn travel time. **...**

Adapting Pipeline Architectures to Track Developing Aftershock Sequences and Recurrent Explosions
T Kværna, DB Harris, SJ Gibbons, D Dodge - 2014 - DTIC Document **...** 4.5.5 Example 2 of setting a template according to the time center and time-variance. .... 84 Approved for public release; distribution is unlimited. x Page 13. APPENDIX – List of Figures Fig. A.1 Events from the bulletins of the **International Seismological Center** (www.isc.ac.uk, **...**

Multiple-frequency tomography of the upper mantle beneath the African/Iberian collision zone
M Bonnin, G Nolet, A Villaseñor… - Geophysical Journal …, 2014 - gji.oxfordjournals.org **...** The boxes show the studied area. To overcome the poor vertical resolution offered byteleseismic waves in the lithospheric part of the model, we add delay times of local P and Pn events from the **International Seismological Center** catalogue. **...**

Seismic Tomography Beneath the Western United States Using a Joint Body Wave-Surface Wave Inversion Algorithm EM Golos, RD van der Hilst, H Yao… - AGU Fall Meeting …, 2014 - adsabs.harvard.edu **...** The eastern and central parts are **seismically** quiet and generally exhibit uniformly fast **seismic** propagation **..**We determine **seismic** velocities in the mantle beneath the western United States using a **...** results presented here use both body wave arrival times (from the **EHB** and ISC **...**

Seismic array analysis and redetermination of depths of earthquakes in Tien-Shan: implications for strength of the crust and lithosphere A Alinaghi, F Krüger - Geophysical Journal International, 2014 - gji.oxfordjournals.org **...** origin times, and our redetermined depths (in km), compared with those of **EHB** catalogue (Engdahl et al **...** unusual high depths, one located in Kazakh Shield, a relatively quiet seismic domain,and **...** is important because of its occurrence in a region otherwise **seismically** quiet, and **...**

Source parameters of the 1 may 2013 mb 5.7 Kishtwar earthquake: implications for **seismic**hazards S Mitra, S Wanchoo, KF Priestley - Bulletin of the Seismological …, 2014 - bssaonline.org **...** Our inference is strengthened by the observed hypocentral distribution of small–to–moderate earthquakes (**EHB** catalog 1962 to 2008), which cluster around this event and conform to the geometry of this fault plane (Fig. 4). Beneath the Kashmir Himalayan **seismic** gap lies the **...**

Kamchatka subduction zone, May 2013: the Mw 8.3 deep earthquake, preceding shallow swarm and numerous deep aftershocks A Špičák, J Vaněk - Studia Geophysica et Geodaetica, 2014 – Springer **...** January 1996 swarm, centered at 53.9°N, 159.4°E and consisting of 50 **EHB** events **...** A dangling slab, amplified arc volcanism, mantle flow and **seismic** anisotropy in the Kamchatka plate **...** Volcanic plumbing system and **seismically** active column in the volcanic arc of the Izu-Bonin **...**

Seasonal variation in the deformation rate in NW Himalayan region DD Khandelwal, V Gahalaut, N Kumar, B Kundu… - Natural Hazards, 2014 – Springer **...** In some cases, these parameters have recorded pre-, co- and post-**seismic** changes related to moderate **...** Purple-filled circles are the earthquakes during 1970–2011 from the **EHB** catalogue. **...** The bold curve is the response of locking of the **seismically** active ...

Detection of the Lehmann discontinuity beneath Tonga with short-period waveform data from Hi-net J Chen, YZ Zhou, HC Wang - Science China Earth Sciences, 2014 - Springer
... The focal depths and locations of the earthquakes prior to 2008 were taken from the high accuracy **EHB** database (http://www.isc.ac.uk/**EHB**/index.html). Considering that the focal depth determined by local **seismic** networks is unreliable, the depth phase pP was utilized to **...**

Quantifying potential earthquake and tsunami hazard in the Lesser Antilles subduction zone of the Caribbean region GP Hayes, DE McNamara… - Geophysical Journal …, 2014 - gji.oxfordjournals.org **...** 2012) catalogue (using **EHB** where available and PDE otherwise to assure catalogue completeness for **...** between these coupling ratios and the percentage of moment released **seismically** over the past 108 yr provides an estimate of how much **seismic** potential energy

Earth's inner core: Innermost inner core or hemispherical variations? KH Lythgoe, A Deuss, JF Rudge, JA Neufeld - Earth and Planetary Science …, 2014 – Elsevier **...** We use events with a moment magnitude (M w M w) greater than 6 for the time period 1990–2008, for which the **EHB** catalogue (Engdahl et al **...** We assume that the outer core is **seismically** homogeneous, since it is vigorously convecting and previous **seismic** studies have **...**

Imaging subducted slab structure beneath the Sea of Okhotsk with teleseismic waveforms Z Zhan, DV Helmberger, D Li - Physics of the Earth and Planetary Interiors, 2014 - Elsevier

... **Seismic** waveforms have better sensitivities to velocity perturbations and sharpness than travel times alone. **...** 2A). In this area, the relocated **EHB** catalog (Engdahl et al., 1998) shows that seismicity continues down to ~600 km depth, and has relatively little variation along strike **...**

Tectonic structures across the East African Rift based on the source parameters of the 20 May 1990 M7. 2 Sudan earthquake JK Mulwa, F Kimata - Natural hazards, 2014 – Springer **...** 2, confirms the existence of a **seismically** active fault zone trending in a NW–SE direction. **...** International Seismo- logical centre, **EHB** Bulletin, www.isc.ac.uk 2009 Houston H (1990) Broadband source spectrum, **seismic** energy and stress drop of the 1989 Maquarie ridge **...**

Final Technical Report Award G11AP20016 Multiple Event Relocation at the National Earthquake Information Center
EA Bergman - 2014 - earthquake.usgs.gov
... It therefore provides a way to extensively leverage a small amount of high-quality **seismic** data, say from a temporary network **...** code has been thoroughly tested against the Engdahl's single event location algorithms that implement the well-known **EHB** processing methodology **...**

Full-Wave Tomographic and Moment Tensor Inversion Based on 3D Multigrid Strain Green's Tensor Databases Y Shen - 2014 - DTIC Document **...** iv Page 7. 11. (a) Broadband **seismic** stations (triangles) used in full-wave ambient noise tomography of the Tibetan plateau. The 3000-m contour outlines the plateau. **...** The cross marks the FDSGT location, the square the **EHB** location, and the diamond the GCMT location. **...**

Recent developments of the Middle East catalog M Zare, H Amini, P Yazdi, K Sesetyan… - Journal of …, 2014 - Springer
... there are high **seismic** activities in this region. For making a good catalog, we used both global sources, such as important international agencies the same as the National Earthquake Information Center (NEIC), **International Seismological Center** (ISC),and **EHB** Bulletin,

Mid-mantle heterogeneities associated with Izanagi plate: Implications for regional mantle viscosity J Li, DA Yuen - Earth and Planetary Science Letters, 2014 - Elsevier
... 1(a)). For earthquakes that occurred before 2008, we used the **EHB** catalog with the source parameters relocated (Engdahl et al., 1998 **...** The **seismic** arrays used in this study include the Pacific Northwest Regional **Seismic** Network (UW), the Caltech Regional **Seismic** Network (CI **...**

Geometry of the subducting Pacific plate since 20 Ma, Hikurangi margin, New Zealand H Seebeck, A Nicol, M Giba… - Journal of the …, 2014 - jgs.lyellcollection.org **...** Global mantle tomography (version MIT-P08) primarily incorporates data from the **EHB** earthquake catalogue and is inverted for 3D variations in P **...** by the age of sedimentary rocks that underlie, onlap and drape volcanic centres imaged on 2D and 3D **seismic**-reflection lines **...**

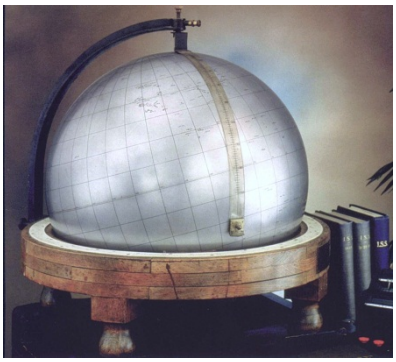
Normal faulting sequence in the Pumqu–Xainza Rift constrained by InSAR and teleseismic body–wave seismology H Wang, JR Elliott, TJ Craig, TJ Wright… - Geochemistry, …, 2014 - Wiley Online Library **...** [2010], based on crustal **seismic** velocities of V P = 6.0 km s −1 , V S = 3.45 km The location (longitude, latitude and depth) refers to the centroid, except in the case of the BW entry, which is the epicenter (longitude, latitude) taken from the **EHB** catalog [Engdahl et al., 1998].

Imaging the Nazca slab and surrounding mantle to 700 km depth beneath the central Andes (18° S to 28° S) A Scire, CB Biryol, G Zandt… - Geological Society of …, 2014 - memoirs.gsapubs.org **...** without it being shifted vertically relative to the predicted location of the slab based on the observed slab seismicity from the **EHB** catalog (Engdahl **...** The data used in this study were collected by 284 short- period and broadband **seismic** stations belonging to 11 separate networks **...**

The SeismogenicThickness in the Dead Sea Area JWP Wilson, GG Roberts, MJ Hoggard… - Geochemistry, …, 2014 - Wiley Online Library **...** Circles and upward/downward triangles = residual topographic estimates and lower/upper bounds obtained by analyzing 21 **seismic** reflection profiles and 3 wide-angle **seismic** refraction surveys [Laughton **...** b) Earthquake seismicity for 1964–1995 from **EHB** catalogue [Engdahl **...**

Historical Earthquakes in Western Australia K McCue - aees.org.au Historical Earthquakes in Western Australia Figure 19 Large earthquakes in Western Australia and region since 1897 (mainly from the **ISC on-line Bulletin**). entre, Canberra ACT. Abstract This paper **...** On 19 August 1977 a great earthquake Mw 8.3 (revised by **EHB)** occurred

SUMMARY OF ACHIEVEMENTS



- We gratefully acknowledge the support from 63 Member-Institutions, development grants from CTBTO, GEM Foundation, USGS, US NSF, FM Global, Lighthill Risk Network, OYO, UK KTP as well as sponsorship from Reftek that allowed ISC finances to stay healthy.
- As many as 17 staff members and one member of Oxford University worked at the ISC improving and extending the ISC products and services.
- Parameters of 1728 stations have been registered and modified in the International Station Registry.
- Preliminary bulletin data are collected from 28 networks and data centres worldwide.
- Revised bulletins are collected from 137 networks worldwide.
- The reviewed ISC Bulletin were produced 30 months behind real time.
- During 2014, ~64,000 events with 5.7 million of associated phases have been added to the Reviewed ISC Bulletin.
- The ISC Bulletin is more complete than the bulletins of either the NEIC/USGS or the IDC/CTBTO.
- The ISC database size has increased by ~10% and reached 157Gb in total.
- The ISC development projects included:
    - The Extension of the ISC-GEM Global Instrumental Earthquake Catalogue;
    - The CTBTO Link to the ISC database;
    - The ISC Bulletin Rebuild (1960-2009);
- The ISC database and the website mirror were operated at IRIS DMC in Seattle, ERI in Tokyo and LLNL in Livermore; this improved the speed of access to the ISC data.
- We continued maintaining the IASPEI Reference (GT) Event List , the EHB Bulletin, the ISC Event Bibliography and the List of International Contacts in Seismology.
- The FDSN-compliant web-service has been put in action.
- The ISC staff participated in a large number of conferences and received good publicity throughout the year.
- Several scientific articles describing new ISC products were submitted for publication during 2014.
- The large number of scientific articles published in 2014 indicates a wide-range use of the ISC Bulletin data by many researchers worldwide.
- The GEM 2014 Outstanding Contribution Award has been given to the ISC for services to seismic hazard and risk community.

Signed, June 15, 2015

Dr. Dmitry A. Storchak
Director