

# INTERNATIONAL SEISMOLOGICAL CENTRE (ISC): CURRENT STATUS & PLANS



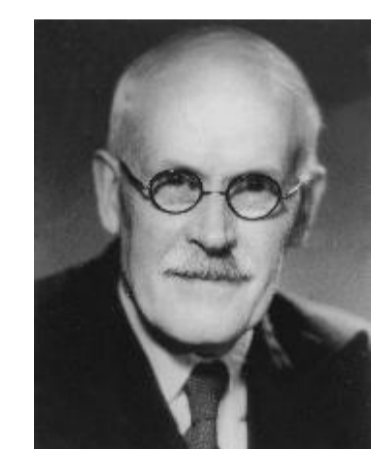
Dmitry Storchak, István Bondár, James Harris & Oriol Gaspà

[www.isc.ac.uk](http://www.isc.ac.uk)

## STATUS: MISSION

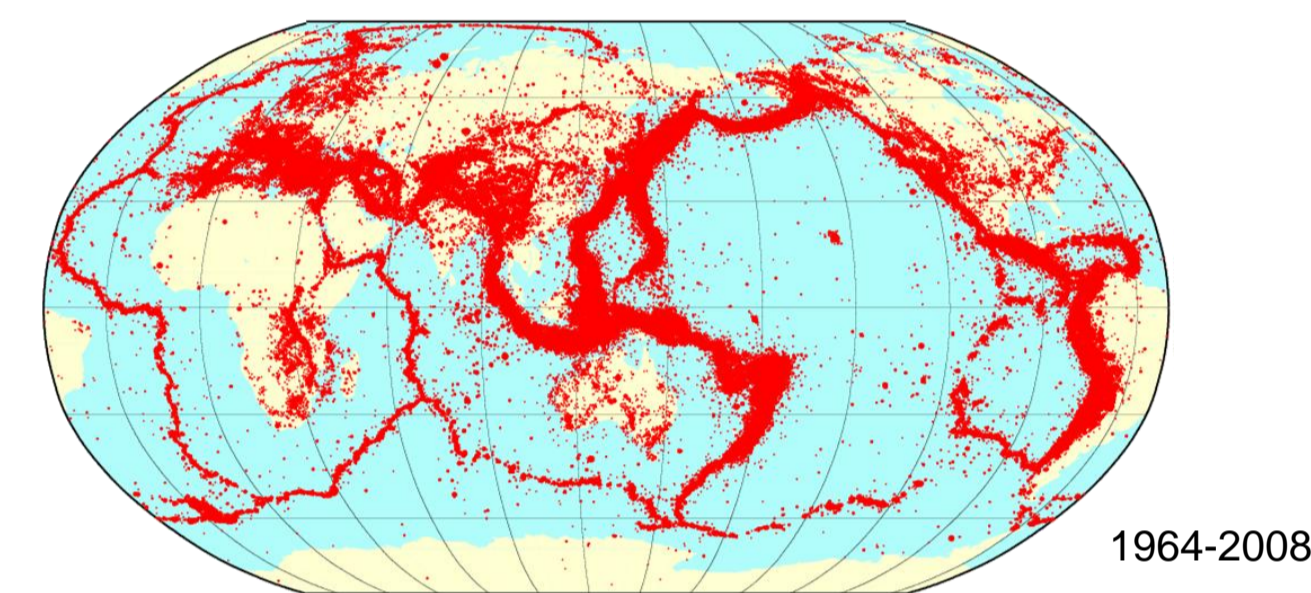


The ISC history goes back to John Milne and Harold Jeffreys



1891-1989

- ✓ Compilation of the **definitive summary of the world seismicity**, the longest continuous & uniform set of bulletin data
- ✓ Running the International Seismic **Station Registry** (with WDC for Seismology, Denver, NEIS)
- ✓ Collection of **Ground Truth (GT) events** (with IASPEI)



1850-2008

## STATUS: ISC DATA COLLECTION



~120 agencies contribute bulletin data to the ISC;  
~55 of them support the ISC financially

- ✓ Thanks to its international & non-governmental status, the ISC is able to collect information from a large number of institutions worldwide.
- ✓ The ISC data collection includes important data sets like ISS, EHB, IASPEI GT, US Array.
- ✓ The ISC is the only source of IDC REB for academic institutions.
- ✓ The ISC data are free and open to everyone.

## STATUS: INTERNATIONAL SEISMOGRAPHIC STATION REGISTRY (IR)

In conjunction with World Data Center for Seismology (Denver, NEIS), the ISC is responsible for running the International Seismographic Station Registry (IR).

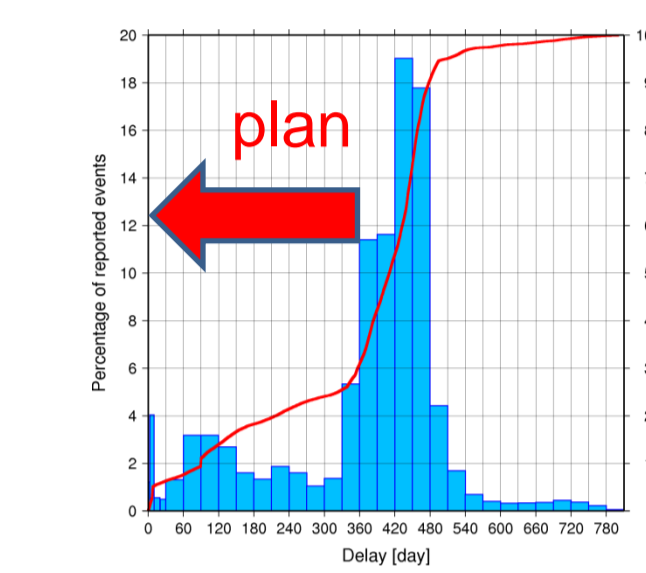


16,583 stations, open or closed, are currently registered in the IR. Recently ~4500 of those report seismic arrival data to the ISC each year. The most recent development is the registration of ~1600 US Array stations.

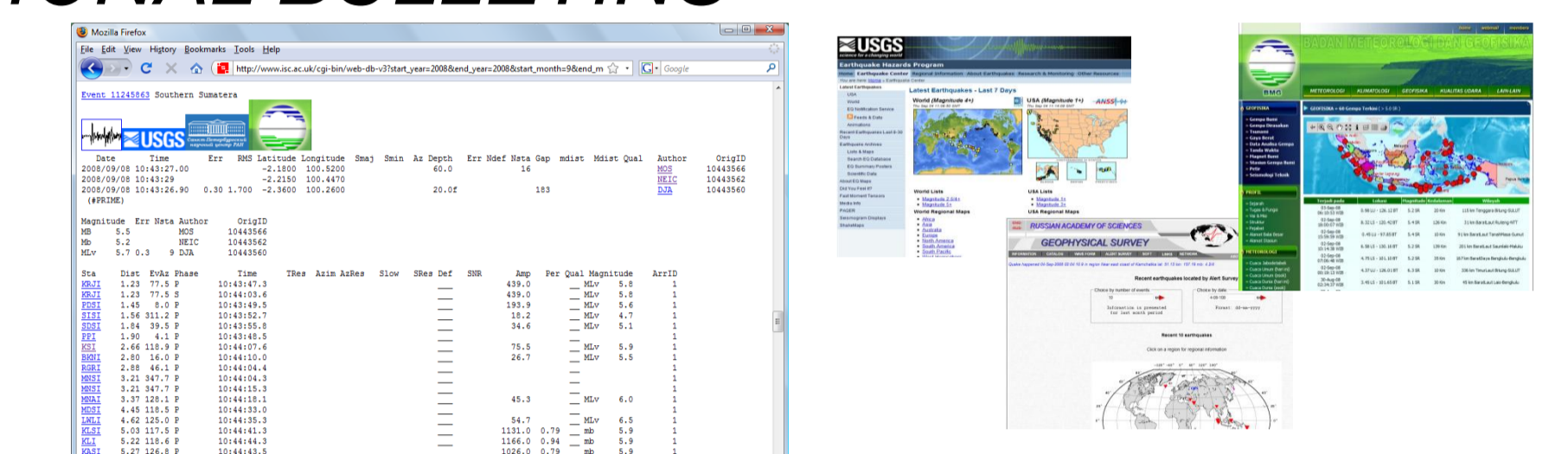


Using the ISC web-site one can submit information to register a new station as well as search and obtain information about already registered stations.

## PLANS: COLLECTING FAST REVIEWED EVENT INFORMATION & PROVISIONAL BULLETINS



At present the network operators report final reviewed data within 18 months after real time when ready. Therefore the ISC data collection remains incomplete within this period of time.



We plan to actively encourage submission of provisional bulletins and fast reviewed event information before the final reviewed data become available for production of the reviewed ISC Bulletin.

## PLANS: MODERNIZING ISC LOCATION PROCEDURES

Currently ISC uses the 1D ak135 model assuming Gaussian, independent errors. To improve ISC location procedures we consider:

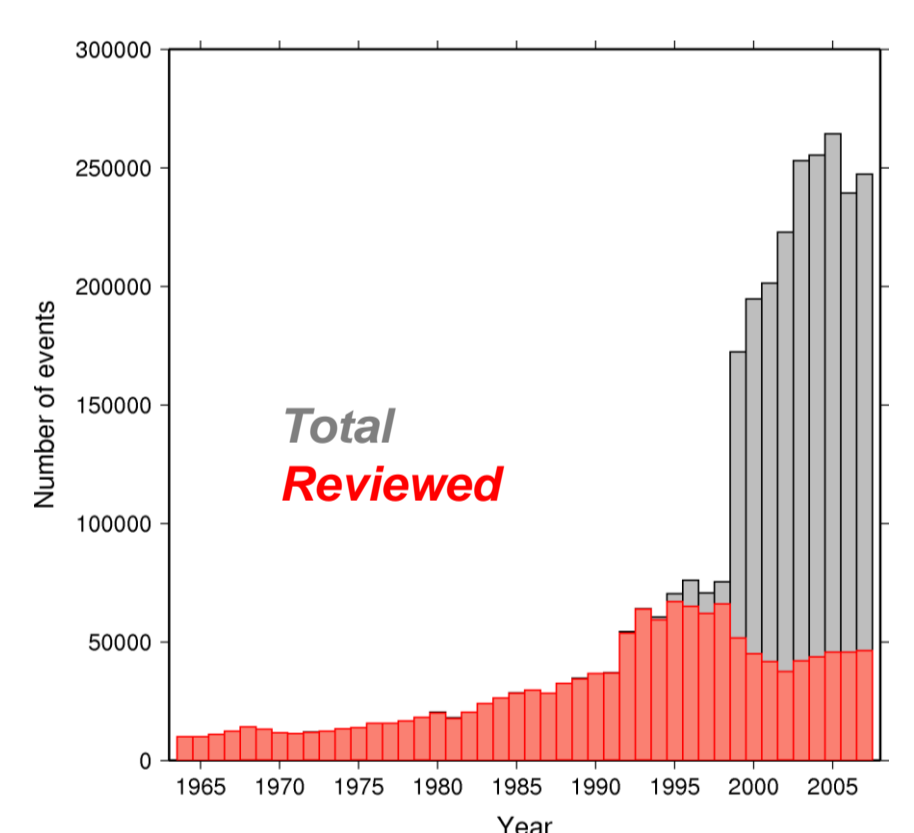
- ✓ Accounting for correlated model error structure;
- ✓ Describing reading errors by non-Gaussian, skewed and heavy-tailed probability distributions;
- ✓ Using core phases and further depth-sensitive phases (core and surface reflections);
- ✓ Probabilistic phase identification methods;
- ✓ Minimizing Lp norm with iterative reweighted least squares or non-linear optimization algorithms;
- ✓ Using back azimuth and slowness measurements.

## PLANS: TAKING OWN AUTOMATIC MEASUREMENTS OFF THE WAVEFORMS

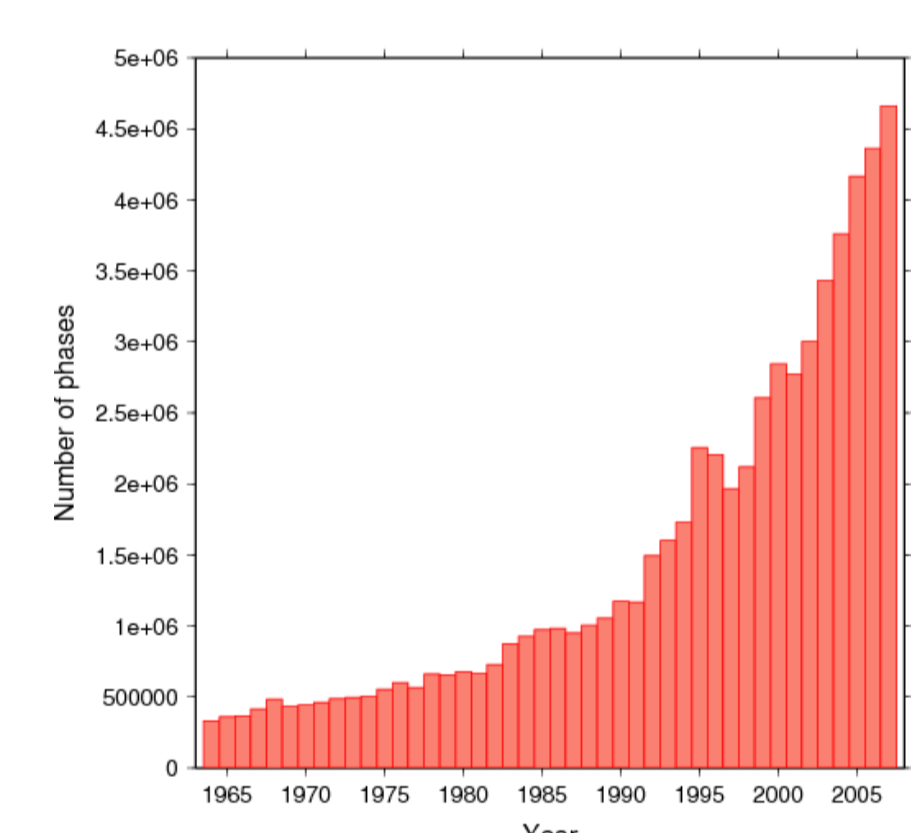
Traditionally the ISC has used only parametric data building upon the measurements taken from seismograms by local operators. With the abundance of waveform data available on-line it becomes possible to set up automatic procedures at the ISC for a selected set of stations with the purpose of:

- ✓ Taking **consistent amplitude measurements** to compute an additional set of more reliable ISC magnitudes;
- ✓ Picking **pP, sP, pwP and PcP** arrivals to constrain the ISC depth estimates where no other means are available;
- ✓ Measuring **back azimuth and slowness** from 3 component stations to assist with event location;
- ✓ Creating a **detection list of later phases** for general use in seismic research.

## STATUS: TIMELINES

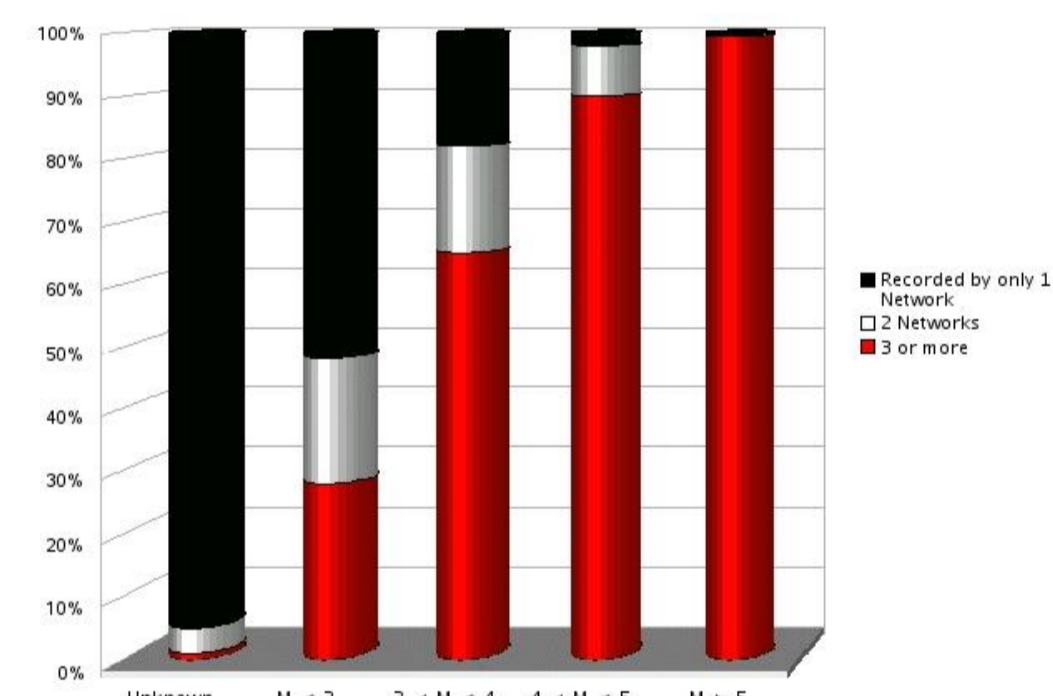


As the number of seismic networks has grown over the years, the ISC is collecting progressively larger number of seismic events each year. Only those with magnitude larger than ~3.5 are reviewed by the ISC seismologists.



Progressively larger number of seismic arrivals is collected and included into the ISC Bulletin.

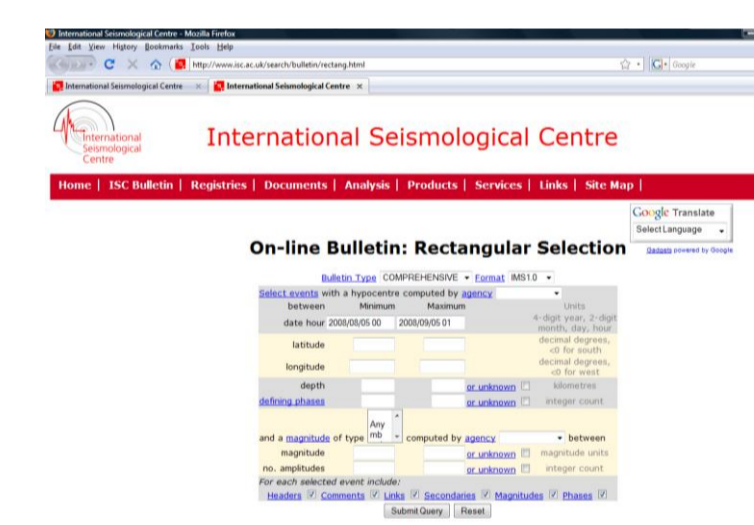
## STATUS: MERGING NETWORK BULLETINS



The ISC is charged with publishing the most accurate locations of seismic events.

Since the ISC uses 1D velocity model globally, the ISC event locations are only likely to be superior to those of local networks, when data of several networks for the same seismic event are reported to the ISC.

## STATUS: PUBLICATIONS



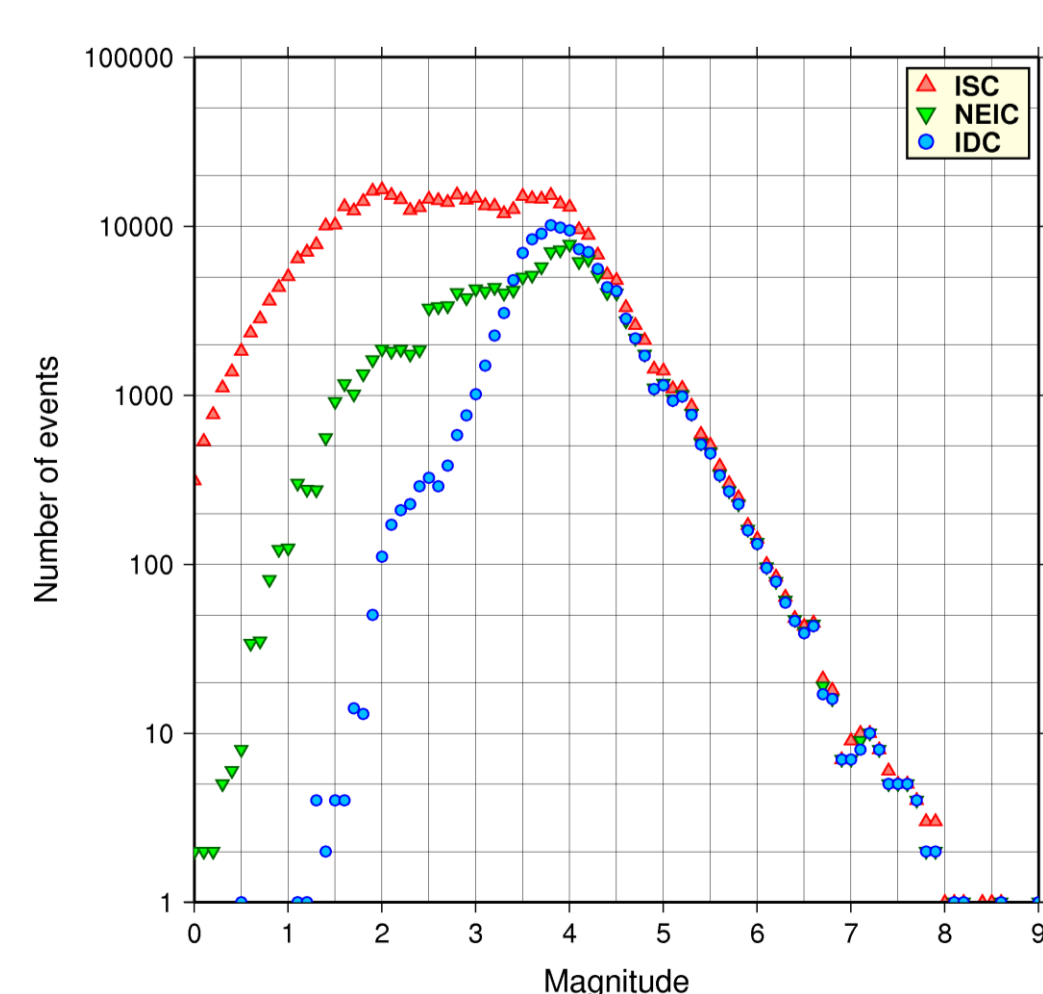
ISC Bulletin data are available from the ISC web and ftp sites. We plan to diversify the output of the web searches to satisfy various groups of users working in different fields.



Annual CD-ROMs and printed Bulletins remain among the ISC products. There are plans to transform the printed bulletin into a summary of the ISC data that will also include a description of the ISC operations and procedures. CD-ROMs might eventually give way to other commonly used digital data-carriers with considerably higher capacity.



## STATUS: IDC, NEIC & ISC DATA COLLECTIONS

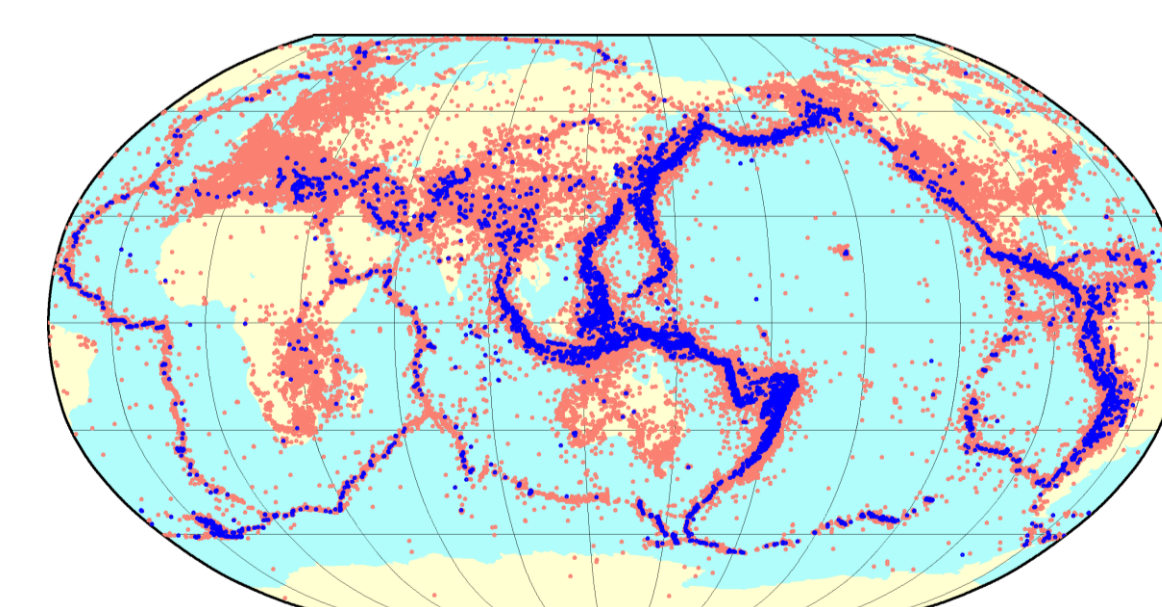


The ISC Bulletin appears to be the most complete among other comparable global seismic event bulletins produced by the NEIC (USCS) and IDC (CTBTO). This is due to the fact that ISC waits until all available reviewed bulletin data have been submitted by local operators.

The NEIC Bulletin is produced reasonably close to real time and therefore a balance between the speed and completeness of its data is observed.

The IDC bulletin data are based on a more limited set of certified IMS seismic stations and arrays. This manifests itself in comparatively lower accuracy of locations as a trade-off for the speed of production and completeness.

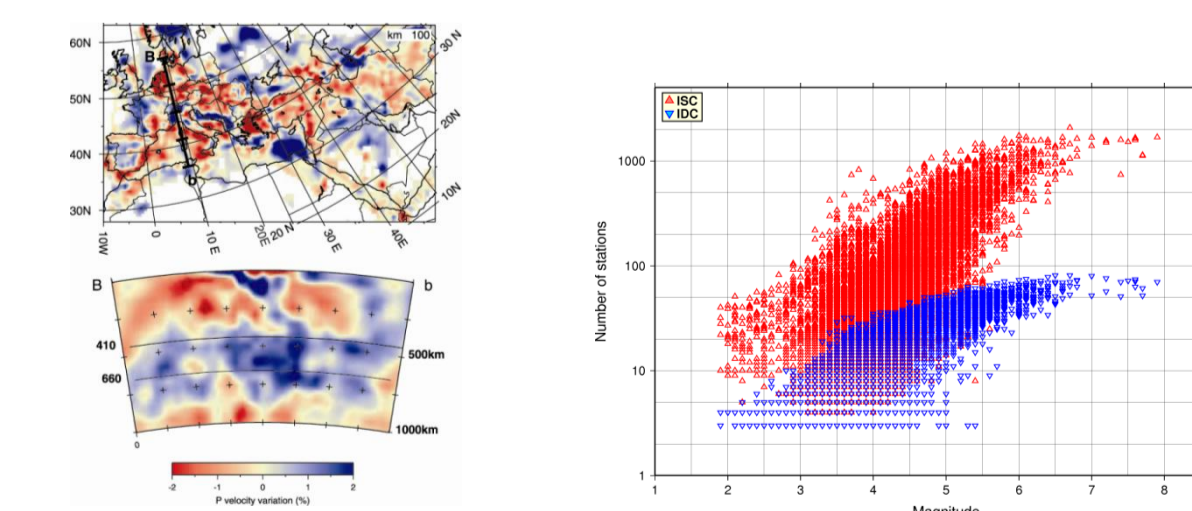
## STATUS: EHB



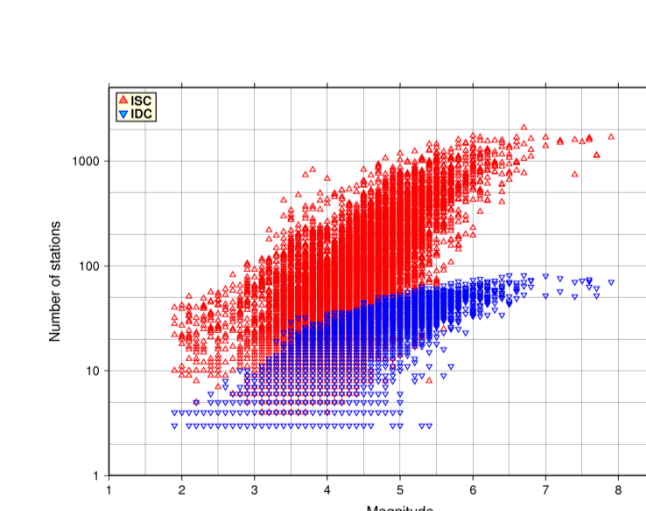
EHB (E.R. Engdahl, R.D. van der Hilst, R. Buland, 1998) catalogue contains a set of most accurate seismic event locations regularly used in academic research. This catalogue originates from the ISC data collection and represents just 10% of all ISC events where a recording network satisfies specific criteria to warrant a more confident location.

The EHB catalogue is part of the ISC data collection and is planned to be updated regularly.

## STATUS: SCIENTIFIC VALUE OF THE ISC



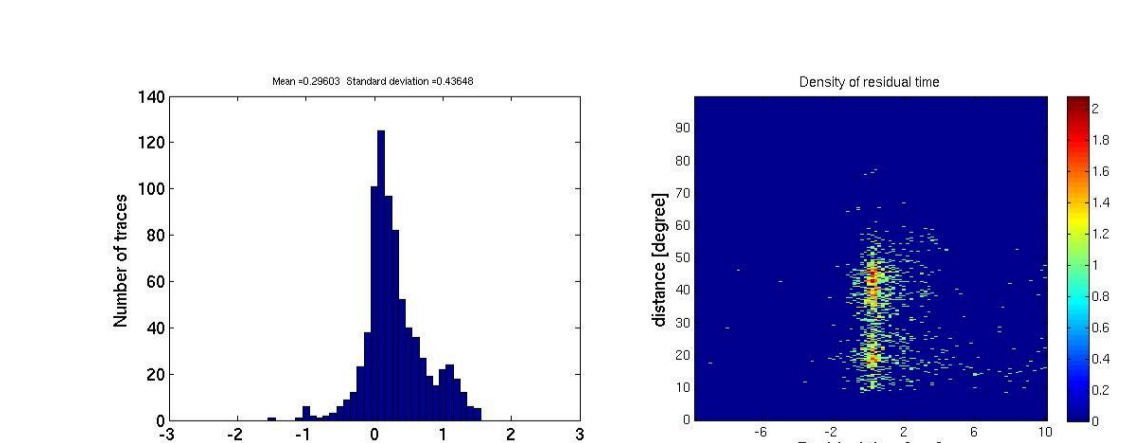
Arrival times from the ISC Bulletin are being used to study deep earth structure by means of body-wave travel time tomography. An example: Pironato and Morelli, J. Geophys. Res., 2003.



The IDC event locations are based on considerably smaller number of seismic stations compared to the ISC. This warrants the common use of the ISC Bulletin as a benchmark for independent assessment of the IDC Bulletin quality and completeness.

The ISC Bulletin data are used in:

- ✓ Compilation and testing global velocity models
- ✓ Seismic tomography
- ✓ Seismic hazard assessment
- ✓ Seismotectonic studies
- ✓ Earthquake prediction studies
- ✓ Earthquake rupture process studies
- ✓ Nuclear test monitoring
- ✓ Testing performance of automatic seismic onset picking techniques
- ✓ General studies as a tool for initial assessment



The ISC collection of manually reviewed arrival picks is often used for testing performance of newly developed techniques of automatic picking of seismic arrivals. An example is: Lee, L., Koperko, T., Meier, W., Friederich, ISC General Assembly, 2008.

## SUMMARY

- ✓ The ISC remains the source of the definitive comprehensive and most complete summary of world seismicity
- ✓ A number of highly important data sets like ISS, EHB, IASPEI GT, US Array are available from the ISC
- ✓ The ISC is the only source of IDC REB for academic researchers
- ✓ The ISC remains a critical source of data for a wide range of geophysical research
- ✓ The ISC continues operating the International Seismographic Station Registry in conjunction with WDC for Seismology
- ✓ We plan to drastically improve the timeliness of the ISC data collection by accepting fast reviewed event solutions and provisional bulletins before the final reviewed bulletins become available
- ✓ We plan to improve the ISC location procedures
- ✓ We plan to start taking specific automatic measurements off the waveforms available on-line to improve parameters in the ISC Bulletin