

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

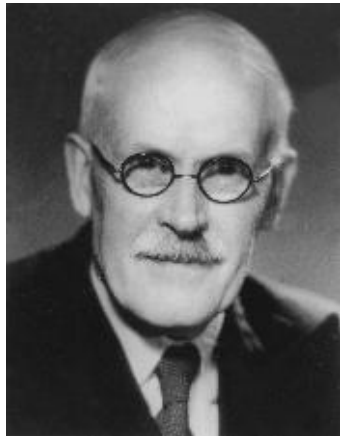
Dmitry Storchak, István Bondár, James Harris
& Oriol Gaspa

www.isc.ac.uk

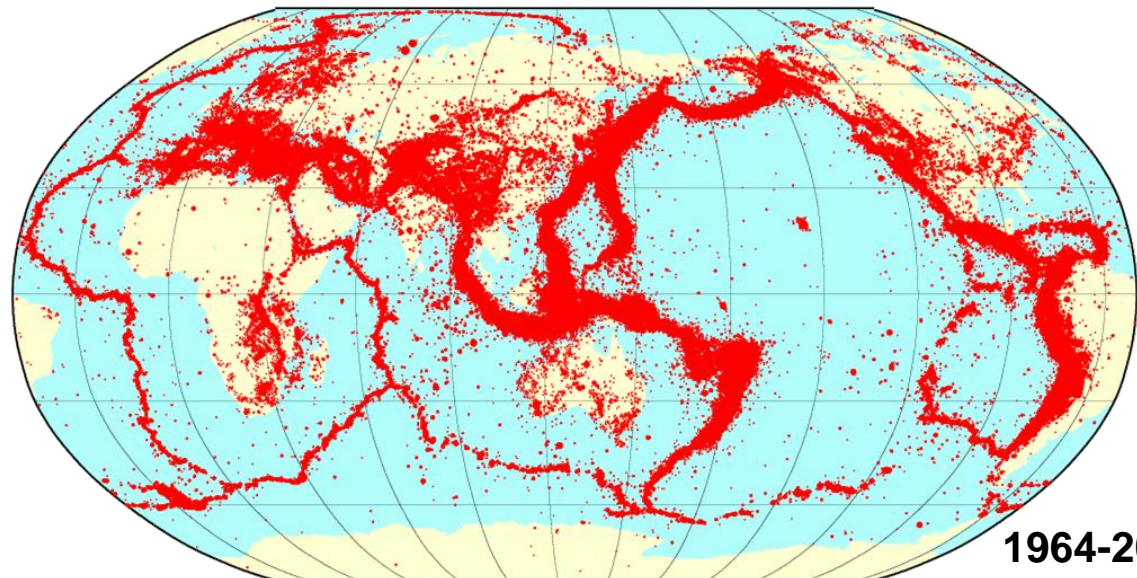
STATUS: ISC MISSION



The ISC history goes back to John Milne and Harold Jeffreys



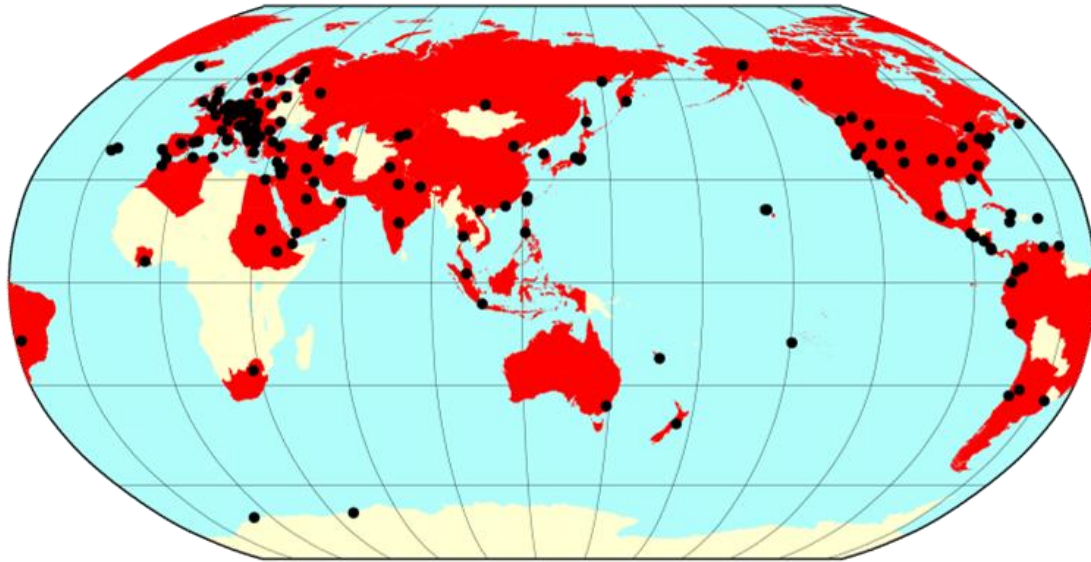
- ✓ Compilation of the definitive summary of the world seismicity, the longest continuous & uniform set of bulletin data
- ✓ Running the International Seismic Station Registry (with WDC for Seismology, Denver, NEIS)
- ✓ Collection of Ground Truth (GT) events (with IASPEI)



1964-2008

IASPEI, Cape Town, 15-01-2009

STATUS: ISC DATA COLLECTION

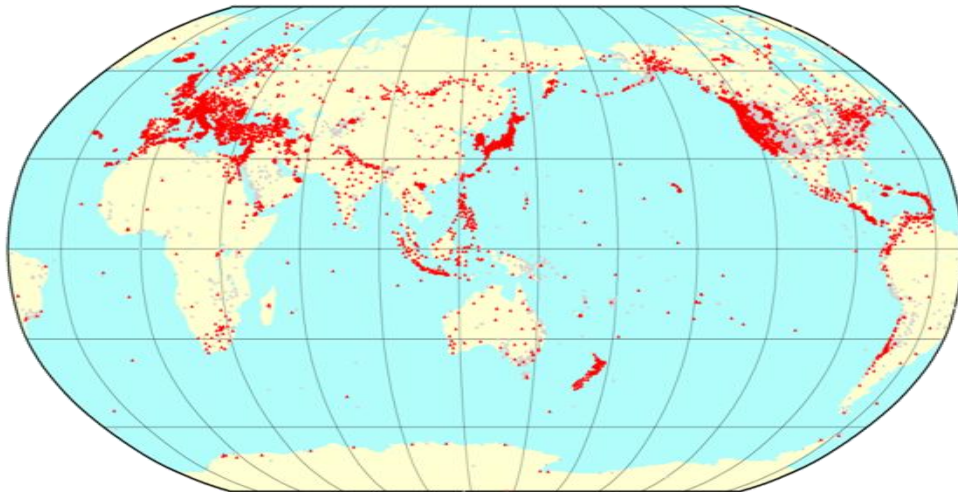


*~120 agencies contribute bulletin data to the ISC;
~55 of them support the ISC financially*

- ✓ 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: INTL SEISMOGRAPHIC STATION REGISTRY(IR)

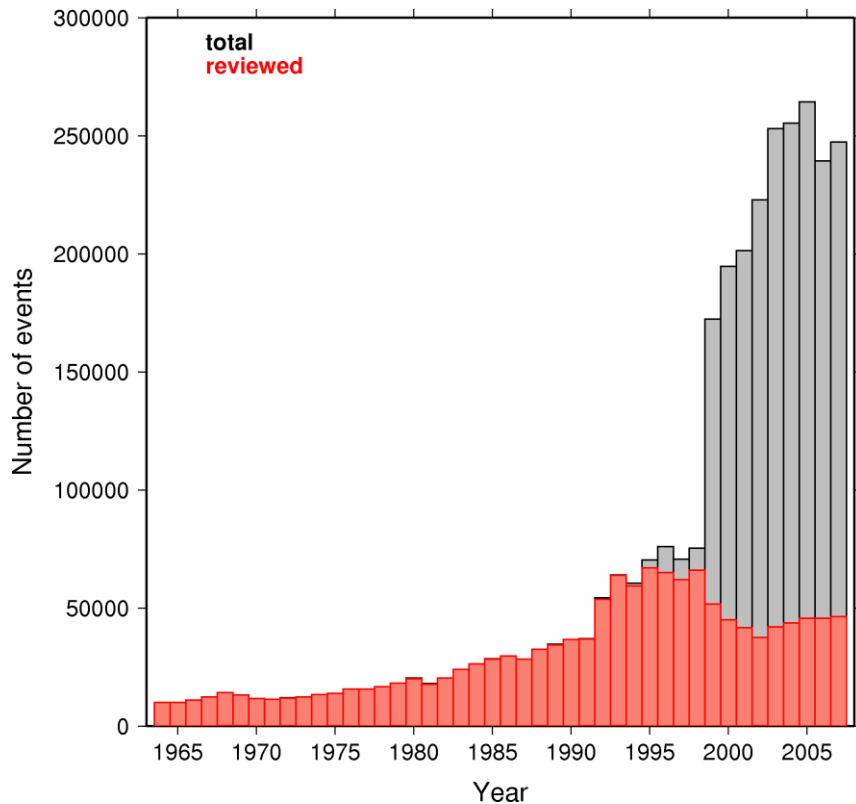
In conjunction with World Data Center for Seismology (Denver, US), the ISC is responsible for running the International Seismographic Station Registry (IR).



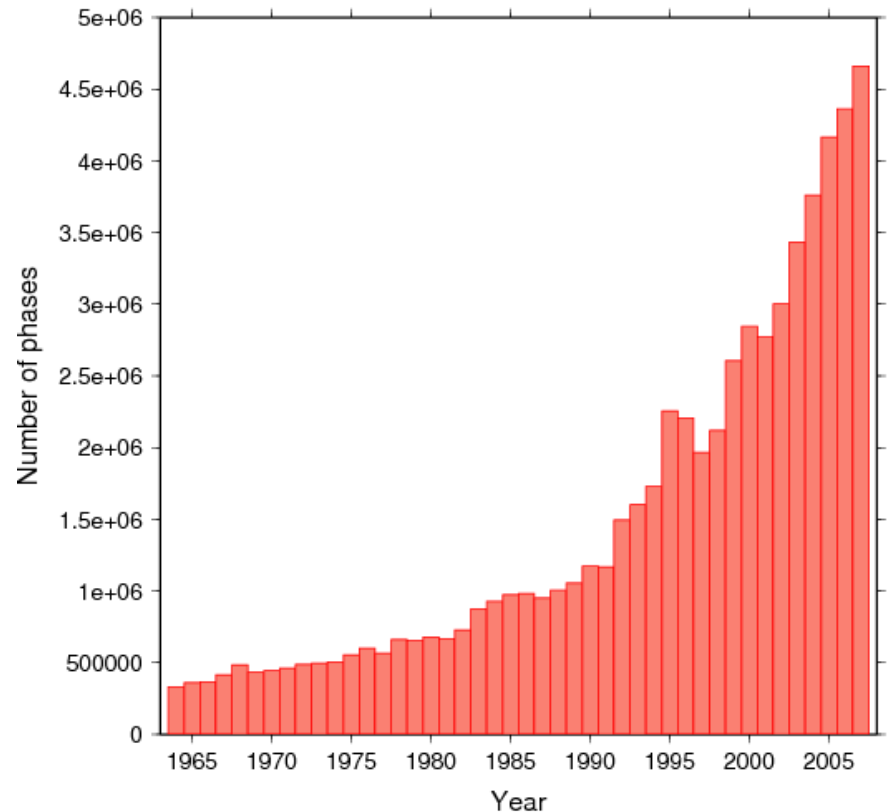
Using the ISC web-site one can submit information to register a new station as well as search and obtain information about already registered stations.

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.

STATUS: TIMELINES

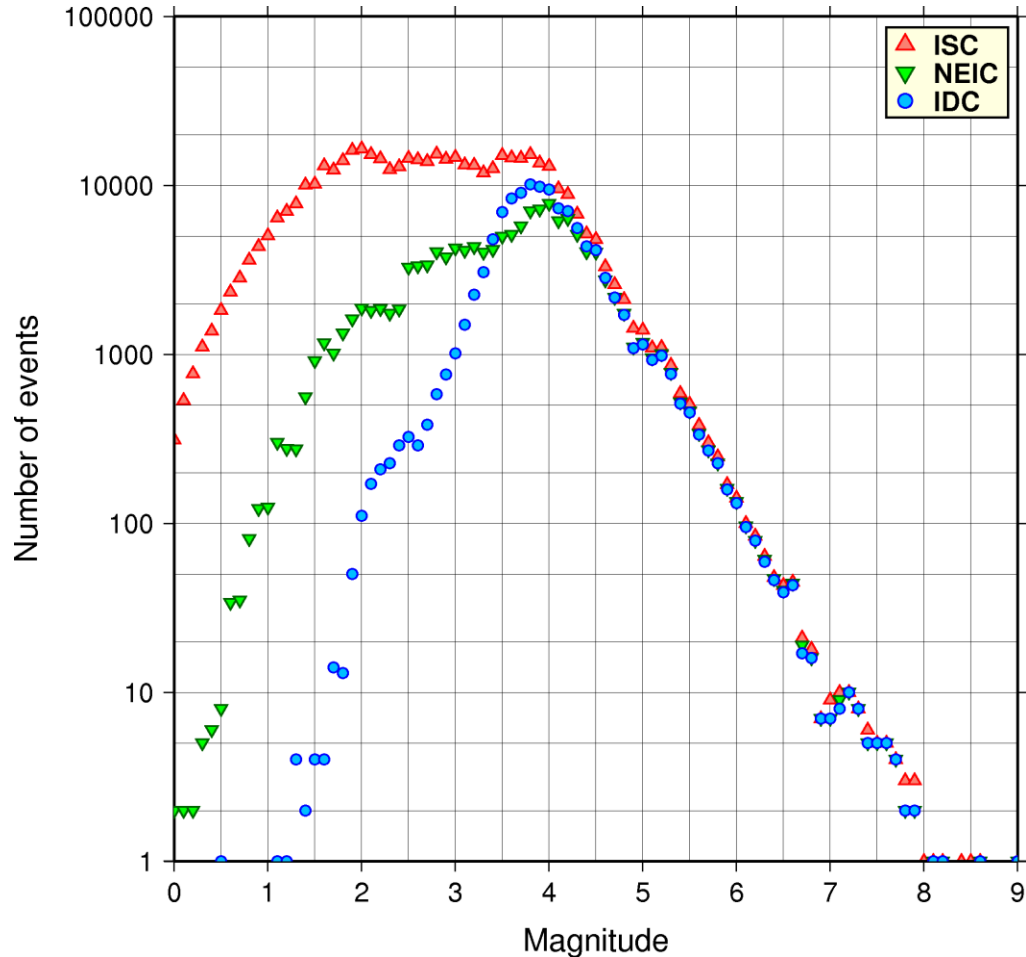


As the number of seismic networks was growing over the years, the ISC was collecting progressively larger number of seismic events each year. Only those larger than $M>3.5$ are reviewed by the ISC seismologists.



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

STATUS: IDC, NEIC & ISC Bulletins

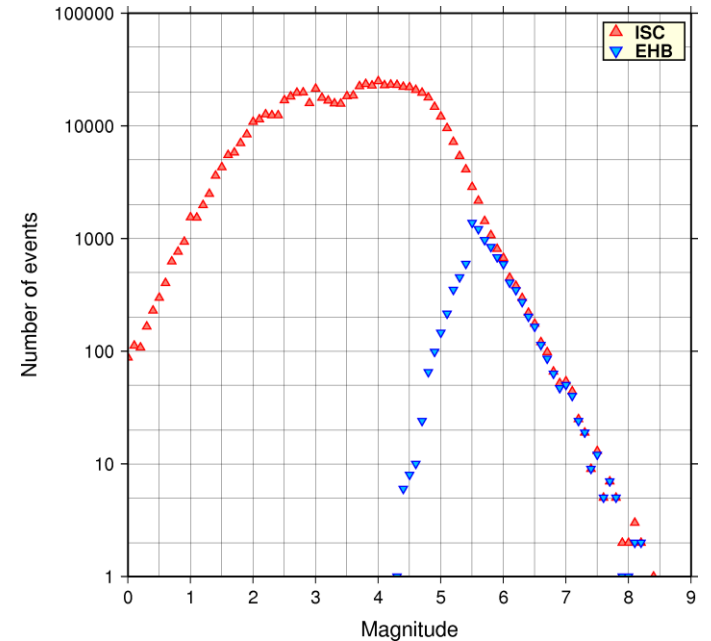
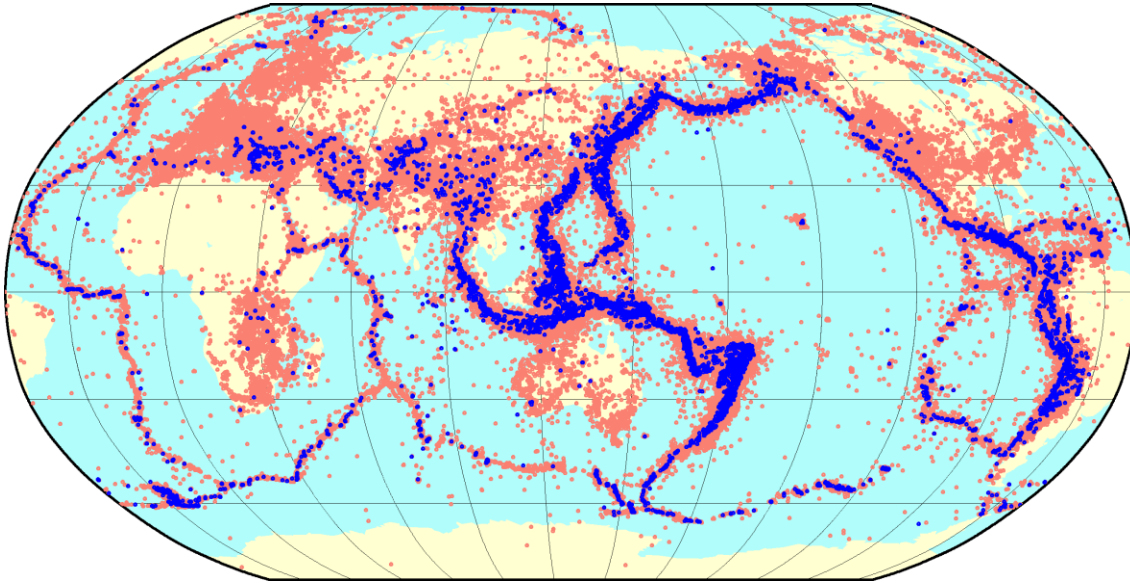


The ISC Bulletin appears to be the most complete among other comparable global seismic event bulletins produced by the NEIC (USGS) and IDC (CTBTO). This is owing to the fact that ISC awaits until all available reviewed bulletin data have been submitted by local operators.

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 rather limited set of certified IMS seismic stations and arrays. This manifests itself in comparatively lower accuracy of locations as a payout for the speed of production and completeness.

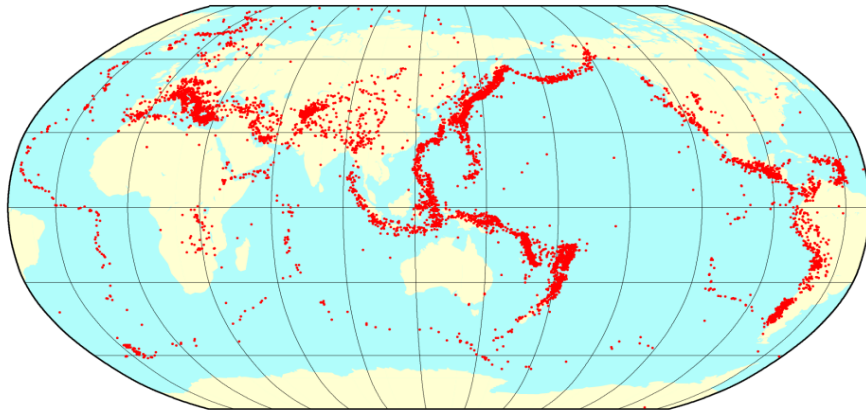
STATUS: EHB



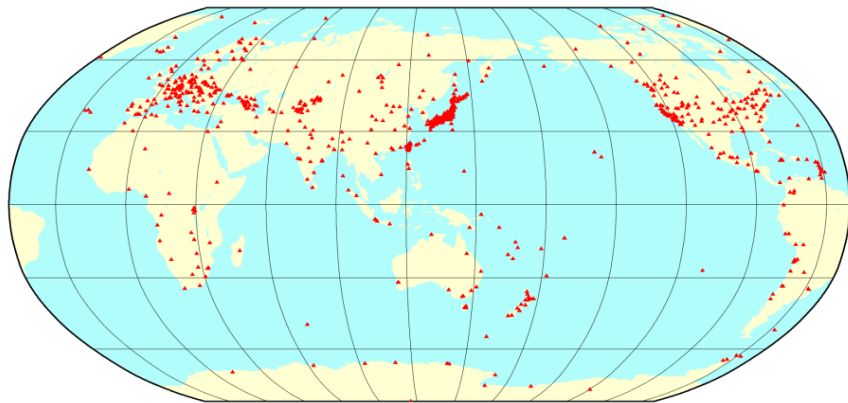
EHB (E.R. Engdahl, R.D. van der Hilst, R. Buland ,1998) catalogue contains a set of most accurate seismic event locations often used in academic research. This catalogue originates from the ISC data collection and represents just 10% of all ISC events where a recording network satisfies specific criteria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

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

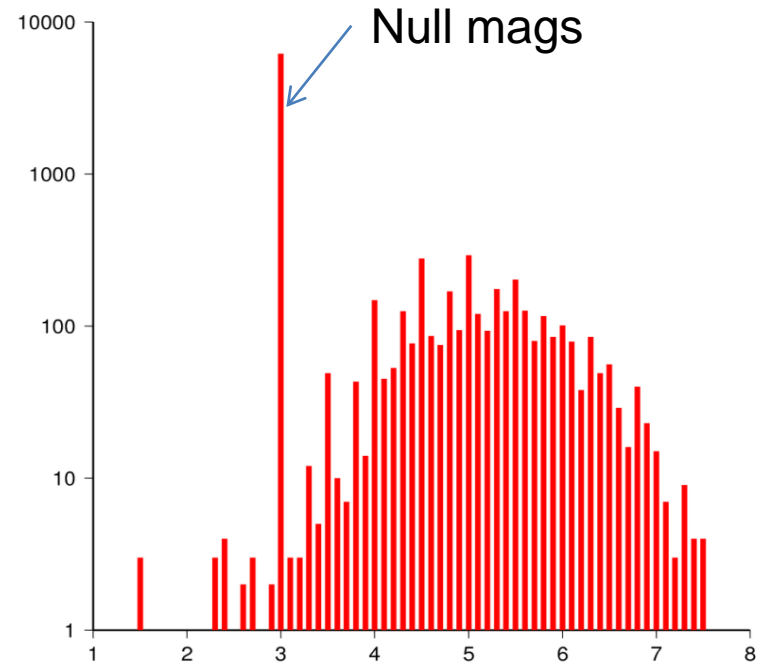
STATUS: ISS data (1960-1963)



Map of events

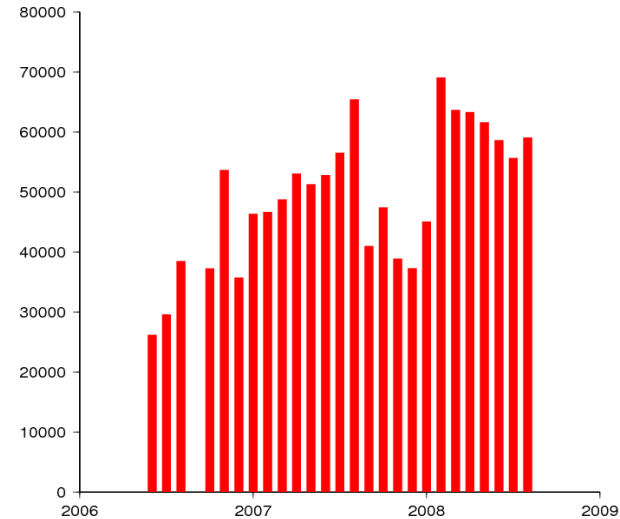
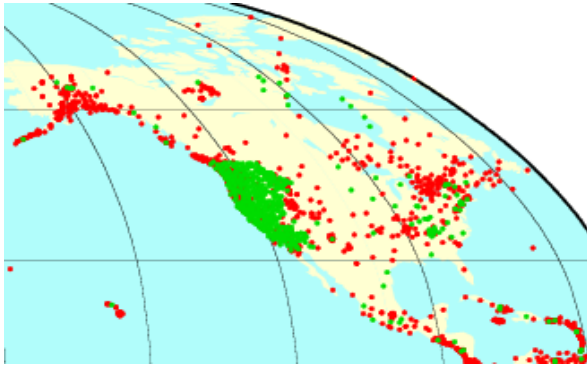


Map of stations contributing picks



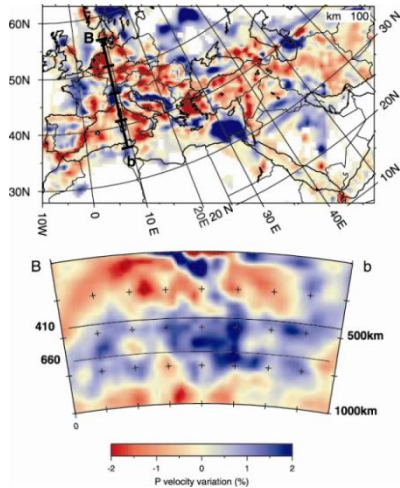
Thanks to the continuing work of Antonio Villaseñor and Bob Engdahl, the ISC was able to introduce in its database station arrival picks for ISS events in 1960-1963.

STATUS: USArray picks

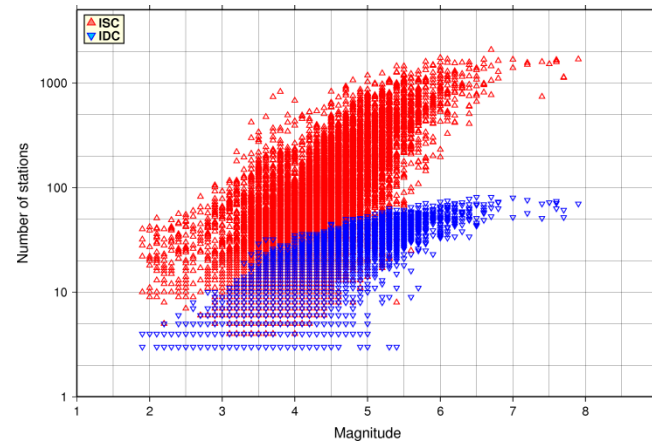


Starting with data month of July 2006 IRIS DMC has begun contributing to the ISC the USArray station arrivals picked and reviewed by USArray Array Network Facility. Approximately 1650 stations have been registered in the IR (upper left). The data set represents a considerable increase in station arrival numbers associated to events in US and moderate to large events worldwide.

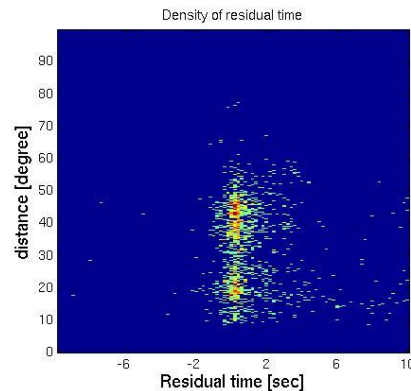
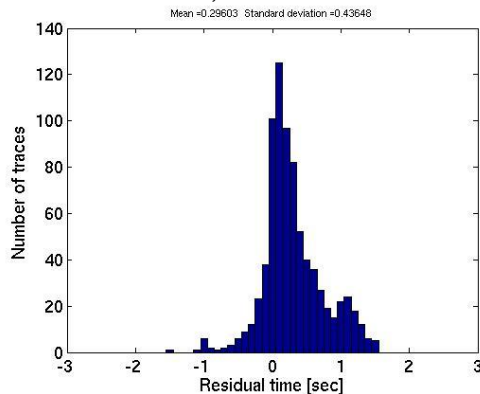
STATUS: SCIENTIFIC VALUE OF THE ISC



Arrival times from the ISC Bulletin are being used to study deep earth structure by means of body-wave travel time tomography. An example: *Piromallo 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 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: *J. Lee, L.Küperkoch, T.Meier, W. Friederich, ESC General Assembly, 2008.*

- The ISC Bulletin data are used in:**
- ✓ Compilation and testing global velocity models
 - ✓ Seismic tomography
 - ✓ Seismic hazard assessment
 - ✓ Earthquake prediction
 - ✓ Earthquake source studies
 - ✓ Seismotectonic studies
 - ✓ Nuclear test monitoring
 - ✓ Testing performance of automatic seismic onset picking techniques
 - ✓ General studies as a tool for initial assessment

PLANS: MODERNIZING ISC LOCATION

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

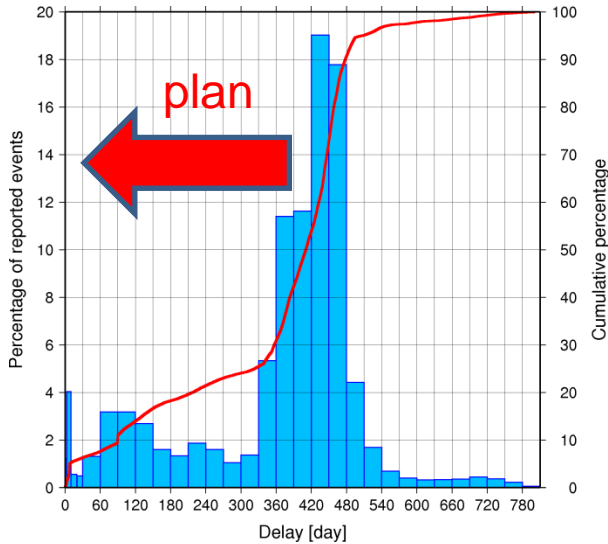
- ✓ Use further phases beyond P&S, available when using ak135 (PKP, PcP, etc)
- ✓ Improve relative weighting scheme between phases
- ✓ Use depth-sensitive phases (core and surface reflections including pwP)
- ✓ Obtain starting location via Nearest Neighbor Algorithm
- ✓ Account for correlated model error structure
- ✓ Characterize reading errors by non-Gaussian, skewed and heavy-tailed probability distributions
- ✓ Introduce probabilistic phase identification methods
- ✓ Use azimuth, slowness & SNR measurements.
- ✓ Improve magnitude determination procedures

PLANS: TAKING OWN MEASUREMENTS OFF THE WAVEFORMS

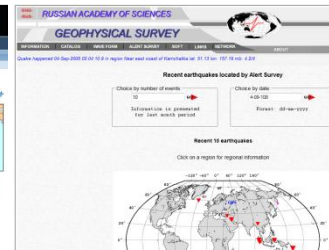
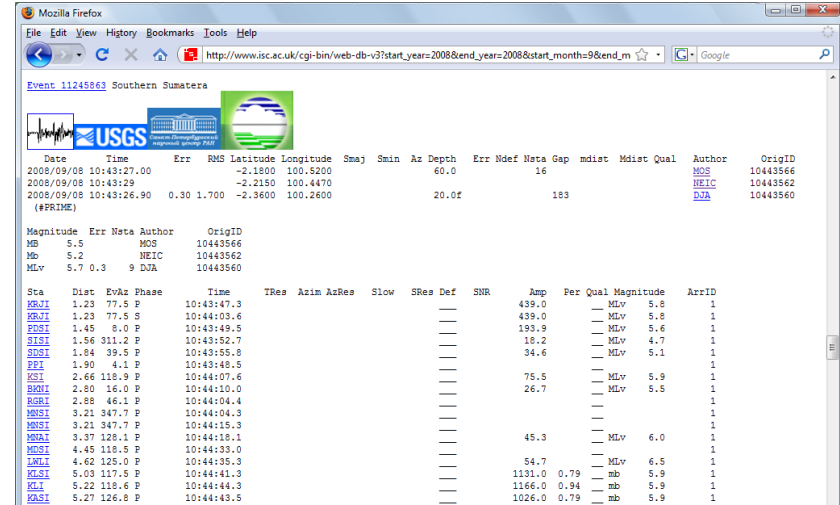
Traditionally the ISC has always been using only parametric data building upon the measurements taken from seismograms by local operators. With the abundance of waveform data available on-line it becomes possible to set up automatic procedures at the ISC for a selected set of stations with the purpose 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, slowness, SNR** from 3 component stations to assist with event location;
- ✓ Creating a **detection list of later phases** for general use in seismic research.

PLANS: COLLECTING REVIEWED PROVISIONAL BULLETINS



At present the network operators report final reviewed data within 14-16 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 fast reviewed event solutions and provisional bulletin information before the final reviewed data become available for production of the reviewed ISC Bulletin.

SUMMARY

- ✓ The ISC remains the preferred source of definitive comprehensive and most complete summary of the 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 source of data for a wide range of geophysical research
- ✓ The ISC continues operating the International Seismographic Station Registry jointly with WDC for Seismology, Denver (USGS)
- ✓ 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 carry out experiments in taking specific automatic measurements off the waveforms available on-line to improve parameters in the ISC Bulletin