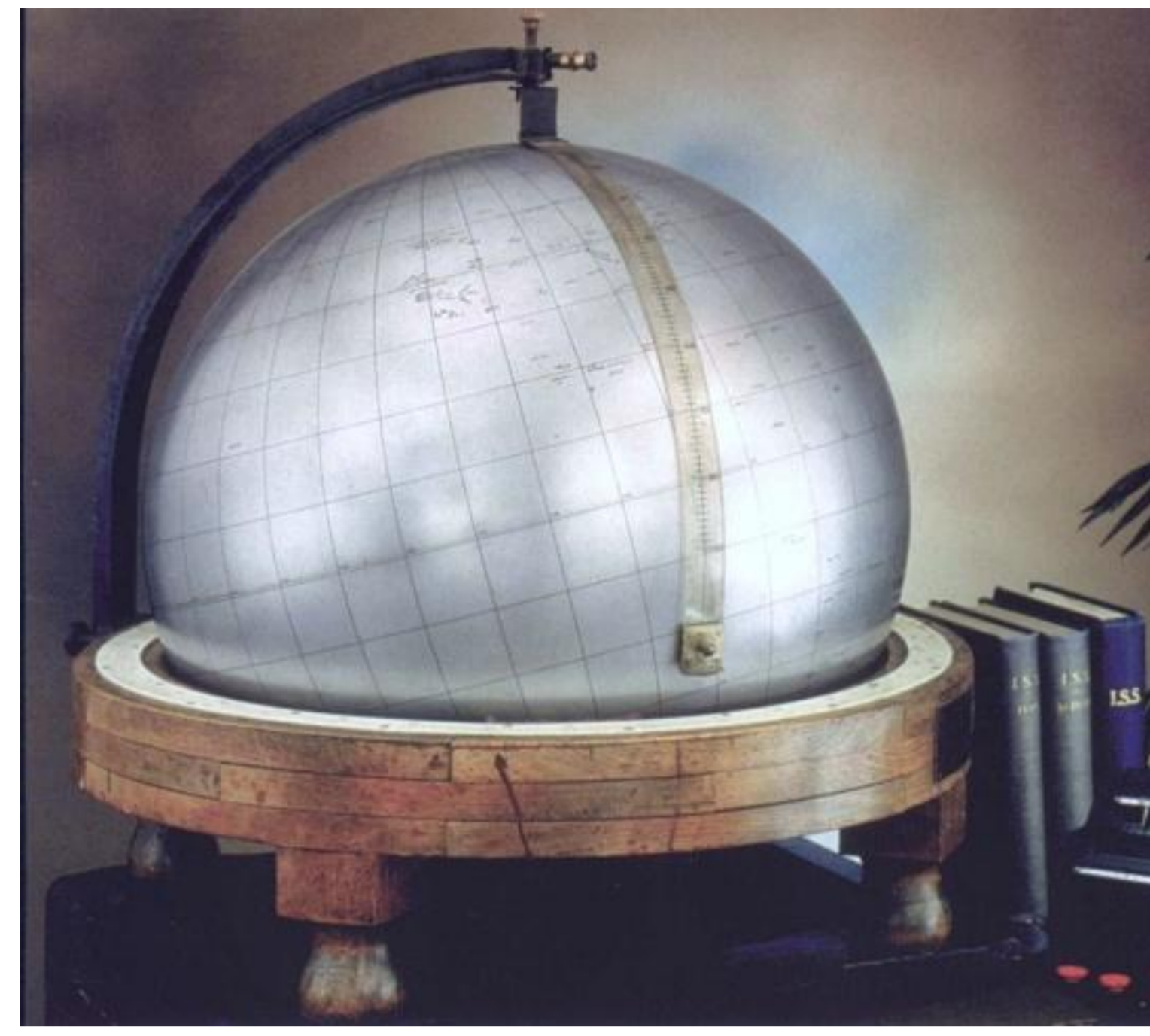


INTERNATIONAL SEISMOLOGICAL CENTRE (ISC): PROVIDING DATA SETS FOR MONITORING RESEARCH

Dmitry Storchak, István Bondár, James Harris, Oriol Gaspà Rebull, Juan Benjuema and Beatriz Vera

www.isc.ac.uk

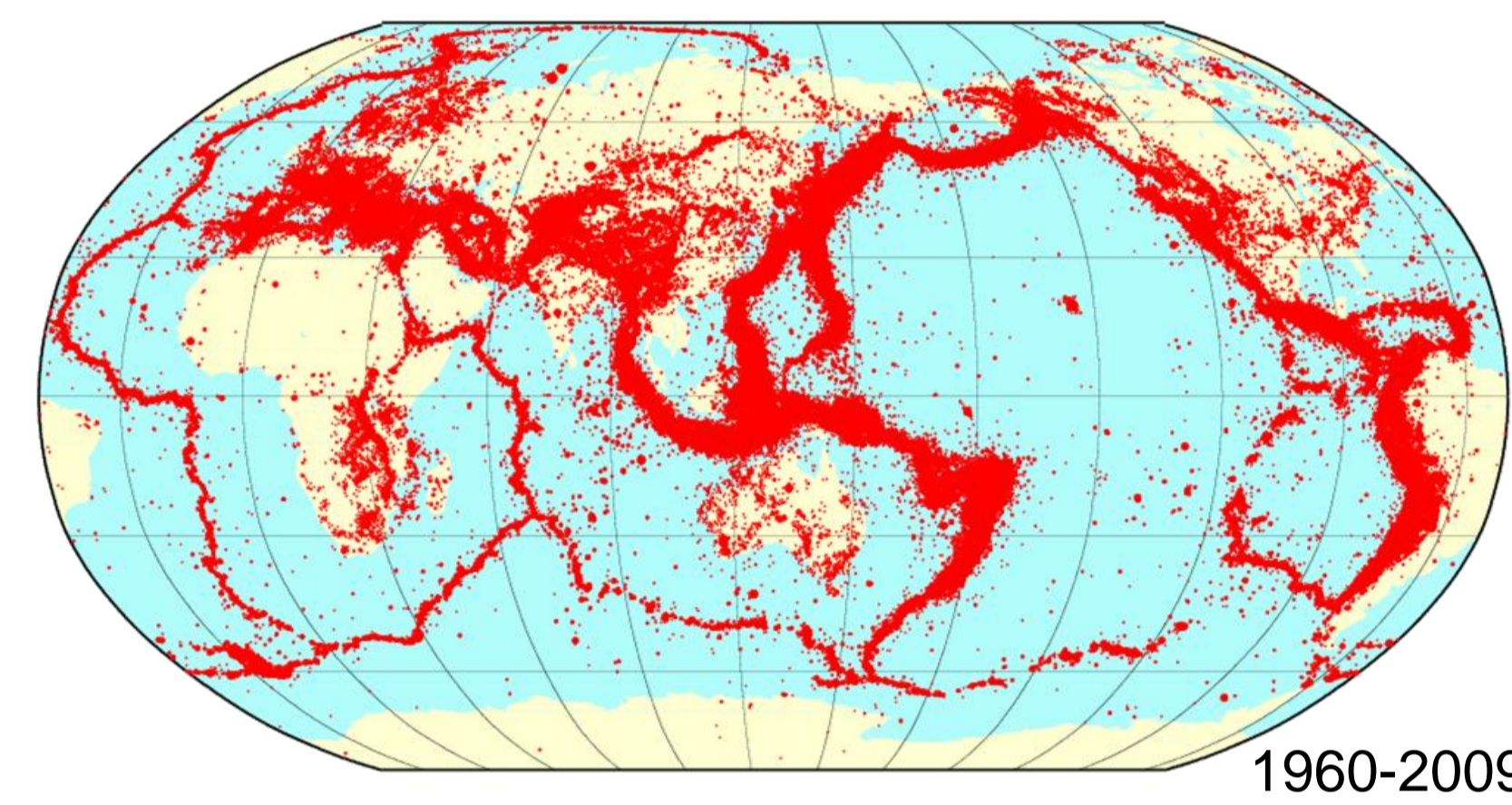
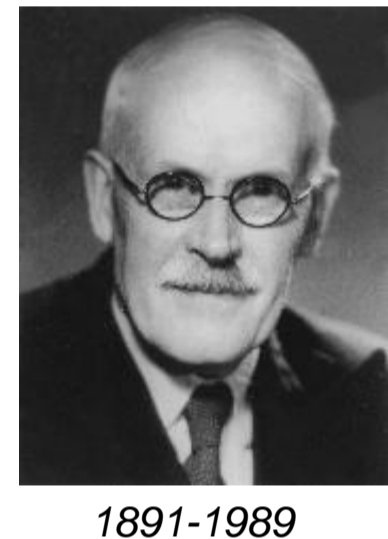


MISSION

- ✓ 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)

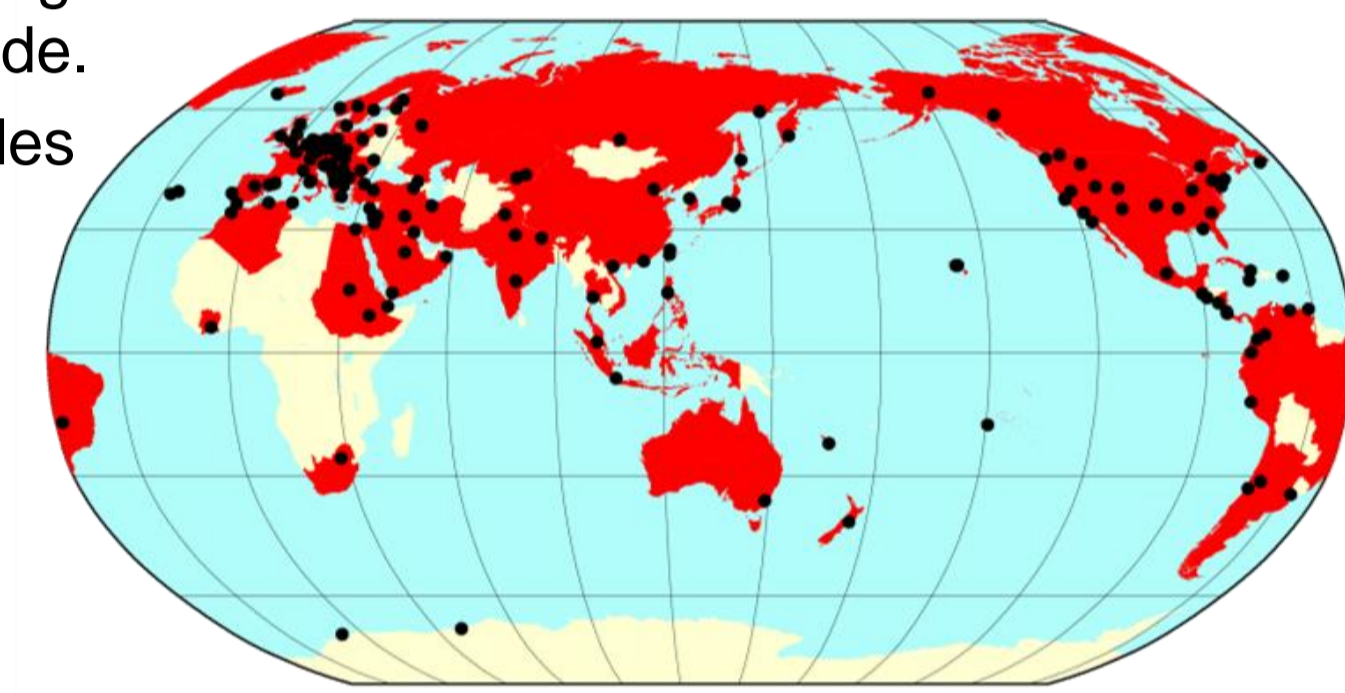


The ISC history goes back to John Milne and Harold Jeffreys



ISC DATA COLLECTION 1900-2009

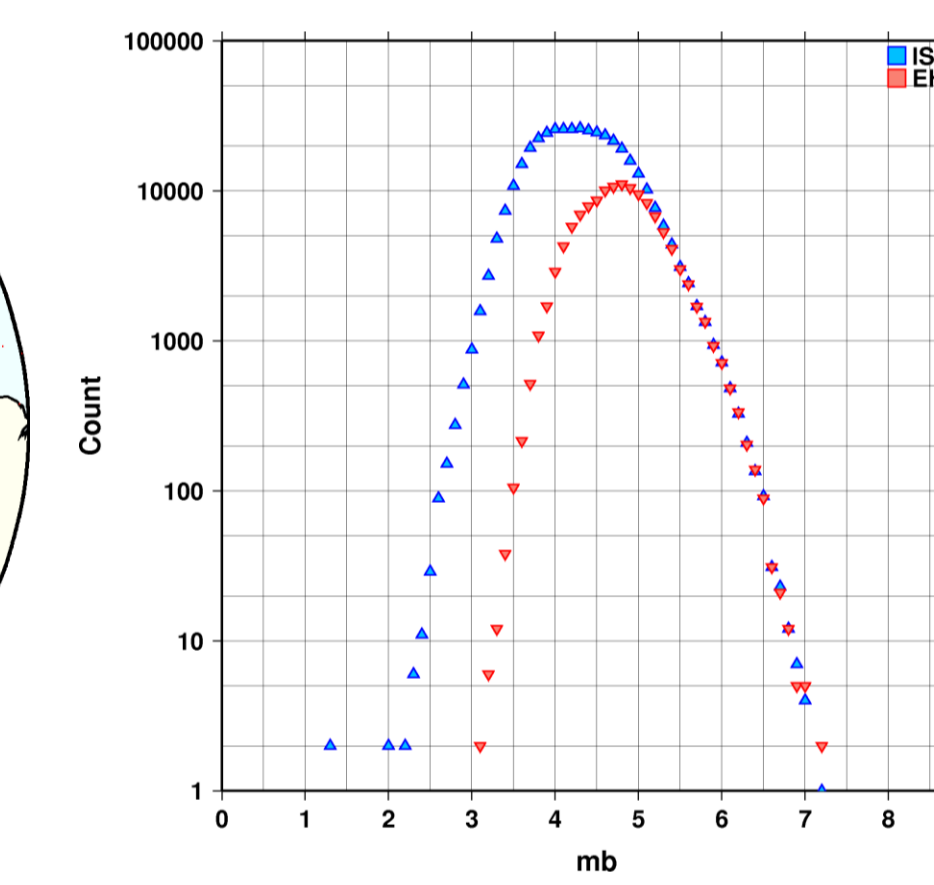
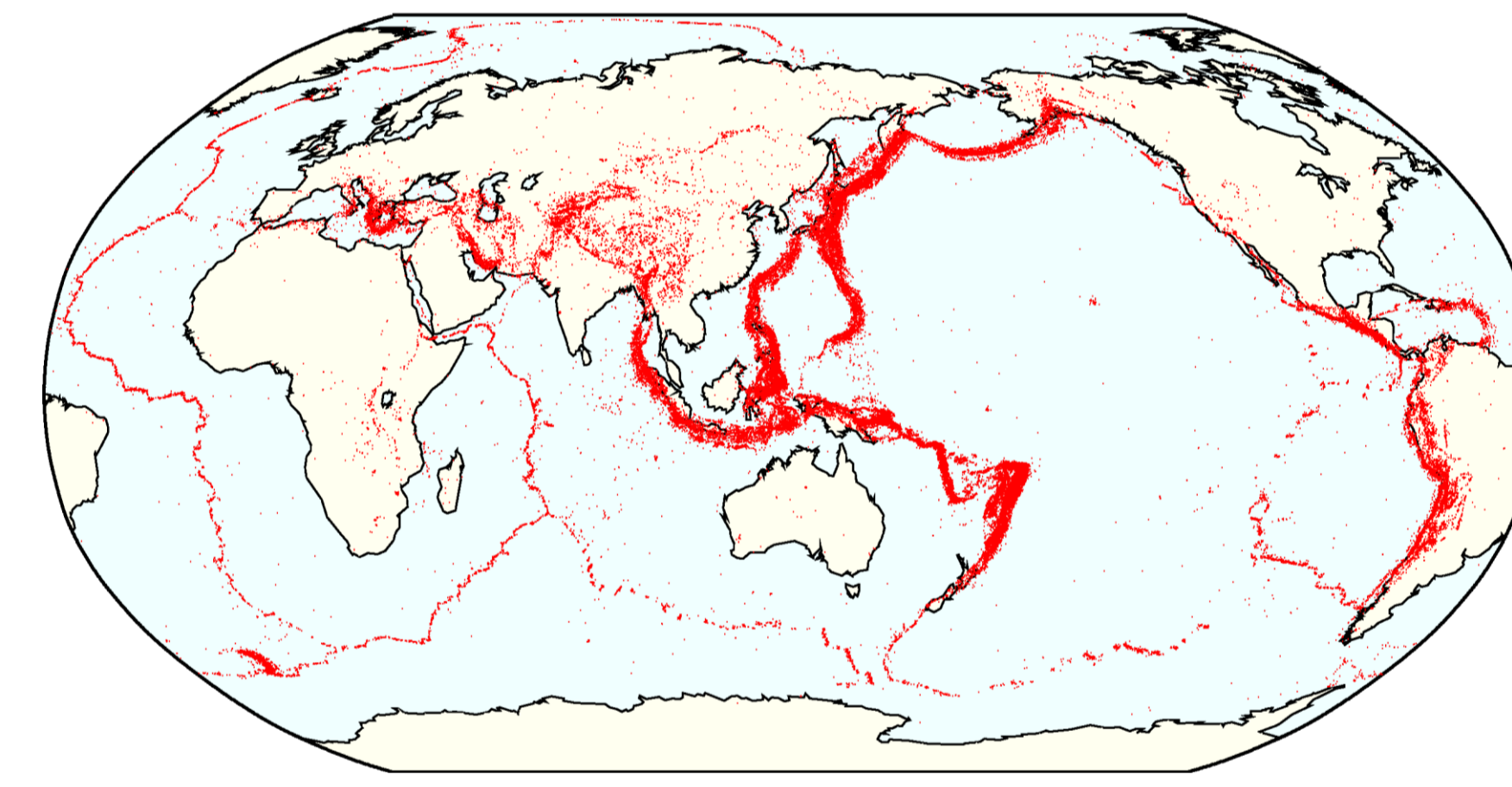
- Thanks to its international & non-governmental status, the ISC is able to collect information from a large number of institutions worldwide.
- The ISC data collection includes important data sets such as
 - ISS (1900-1964)
 - EHB (1960-2006)
 - IASPEI GT (GT0-5 events)
 - US Array phase data
 - IDC REB
- The ISC is the only source of IDC REB for academic institutions.
- The ISC data are free and open to everyone.



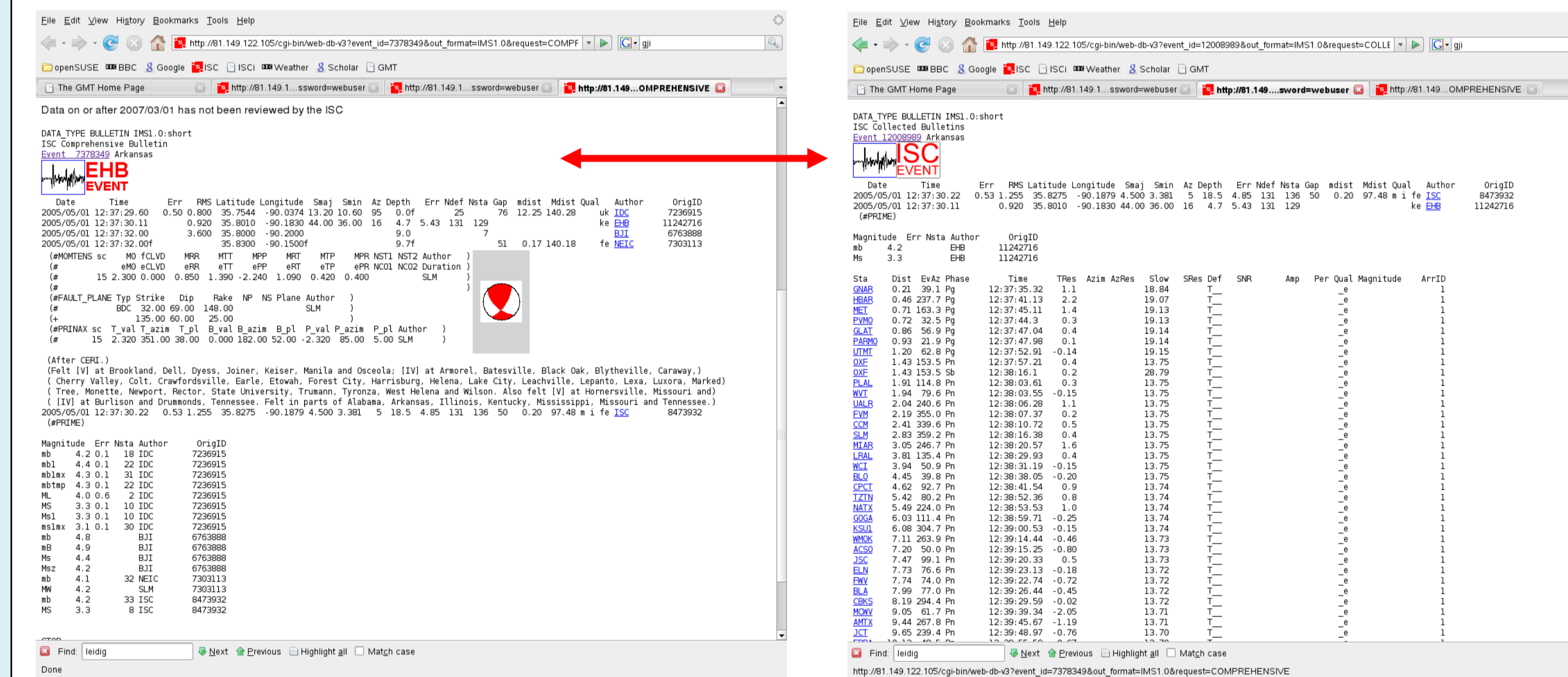
~120 agencies contribute bulletin data to the ISC

EHB – Groomed ISC Bulletin

- The 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. The EHB algorithm has been used to significantly improve routine hypocenter determinations made by the ISS, ISC and PDE. The EHB algorithm uses
 - The ak135 1D global travel-time model with ellipticity and elevation corrections
 - Iterative relocation with dynamic phase identification
 - 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 ($\Delta > 28^\circ$) observations with a teleseismic secondary azimuthal gap $< 180^\circ$
- The EHB bulletin is regularly updated by Bob Engdahl
- The EHB is hosted on the ISC website and currently contains 130,000 events between 1960 and 2006 accompanied with ~20,000,000 arrival data

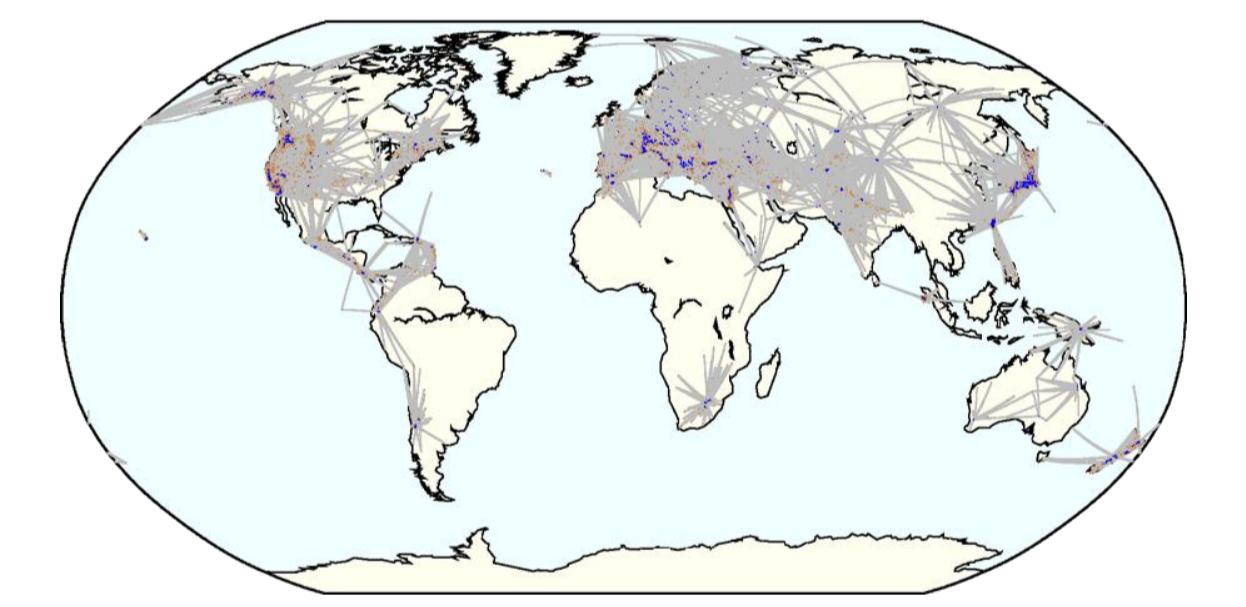
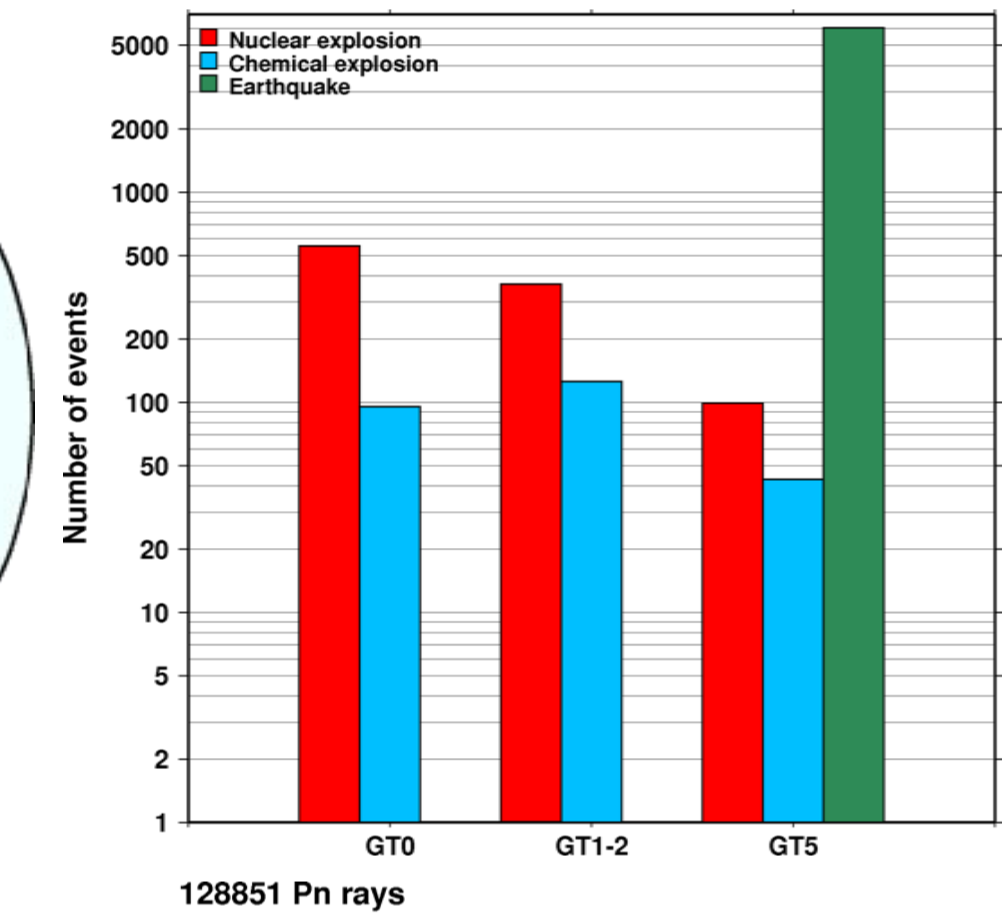
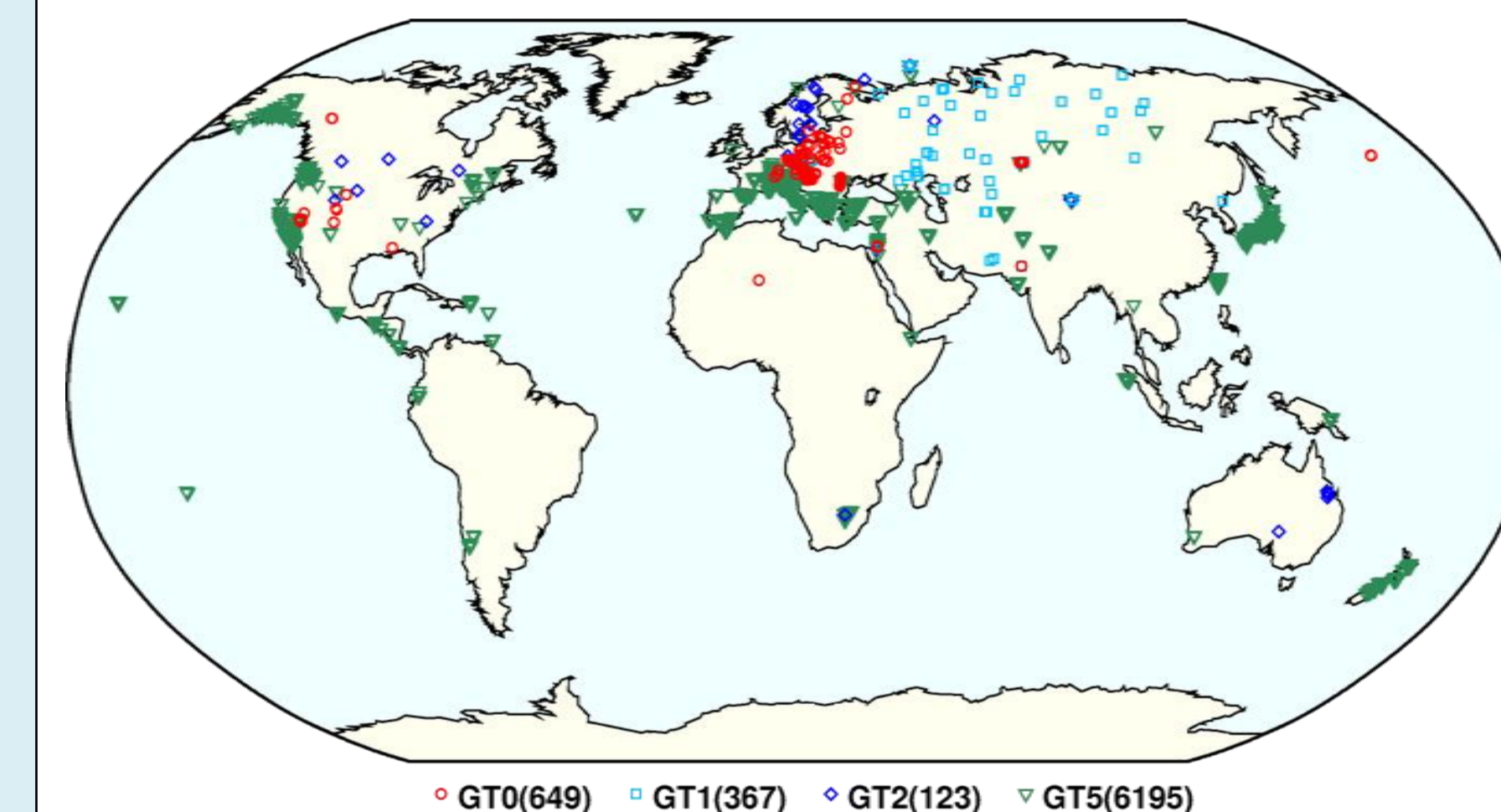


- EHB events can be browsed and downloaded
- ISC and EHB events are cross-referenced

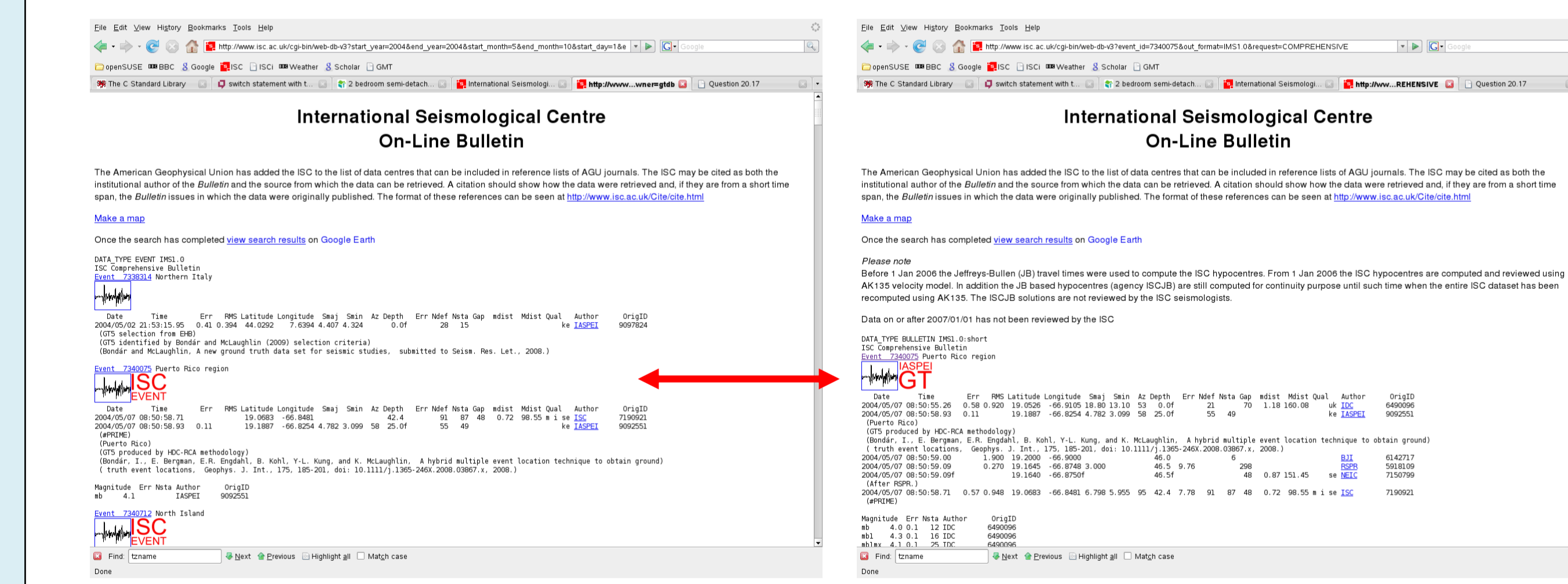


IASPEI Reference Event List of GT0-5 events

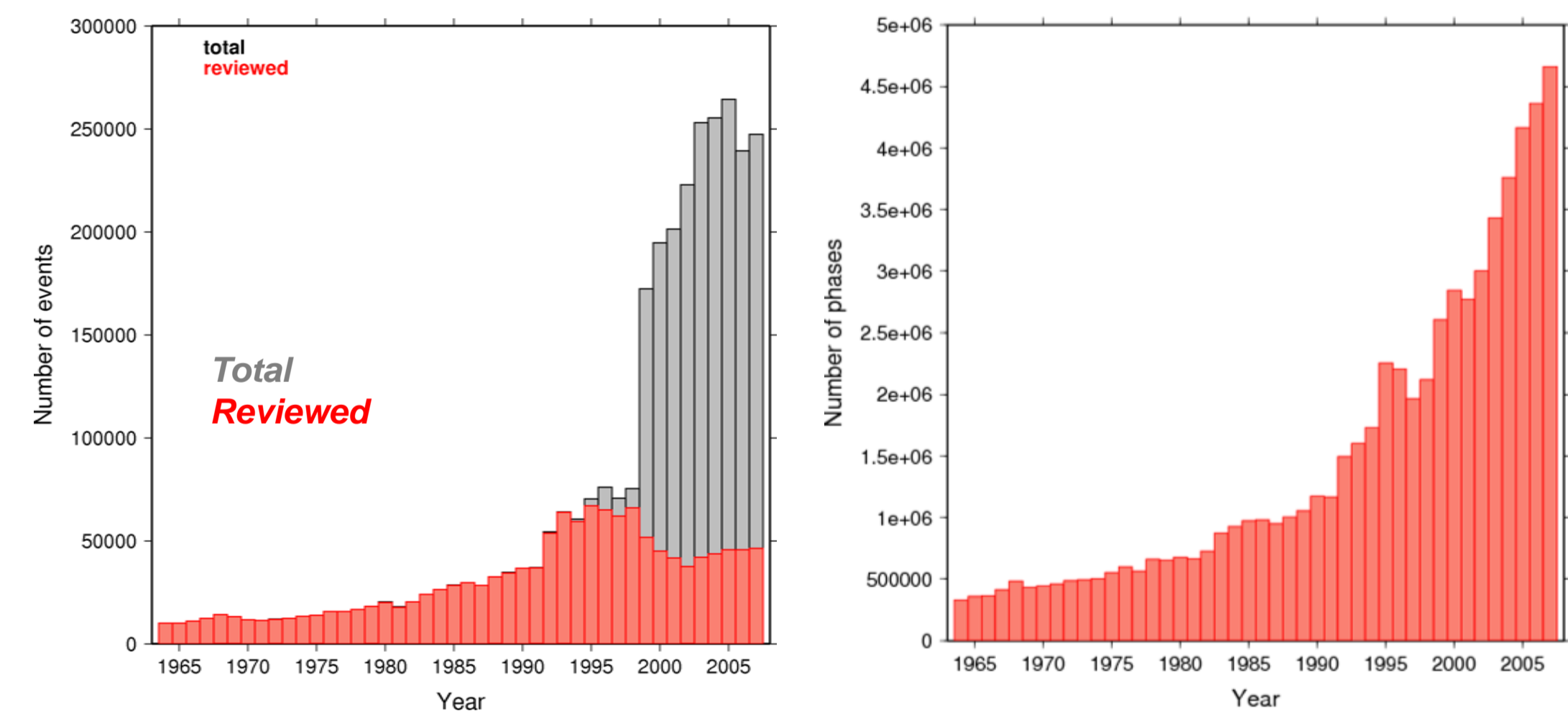
- GT (ground truth): locations known at high, 95% confidence level
- GT0-5 locations are necessary to
 - Validate 3D Earth models against observed travel-times
 - Test new location algorithms
 - Develop empirical path corrections
 - Assess the accuracy of published bulletins
- The effort was coordinated by the CoSOI/IASPEI Working Group on Reference Events for Improved Locations co-chaired by Bob Engdahl and Paul Richards
- The data set is hosted on the ISC website and currently contains 7,334 GT0-5 events accompanied with ~500,000 arrival data



- Reference events can be
 - browsed
 - downloaded
 - submitted at the ISC website
- ISC and GT events are cross-referenced
- Event submissions are welcome!



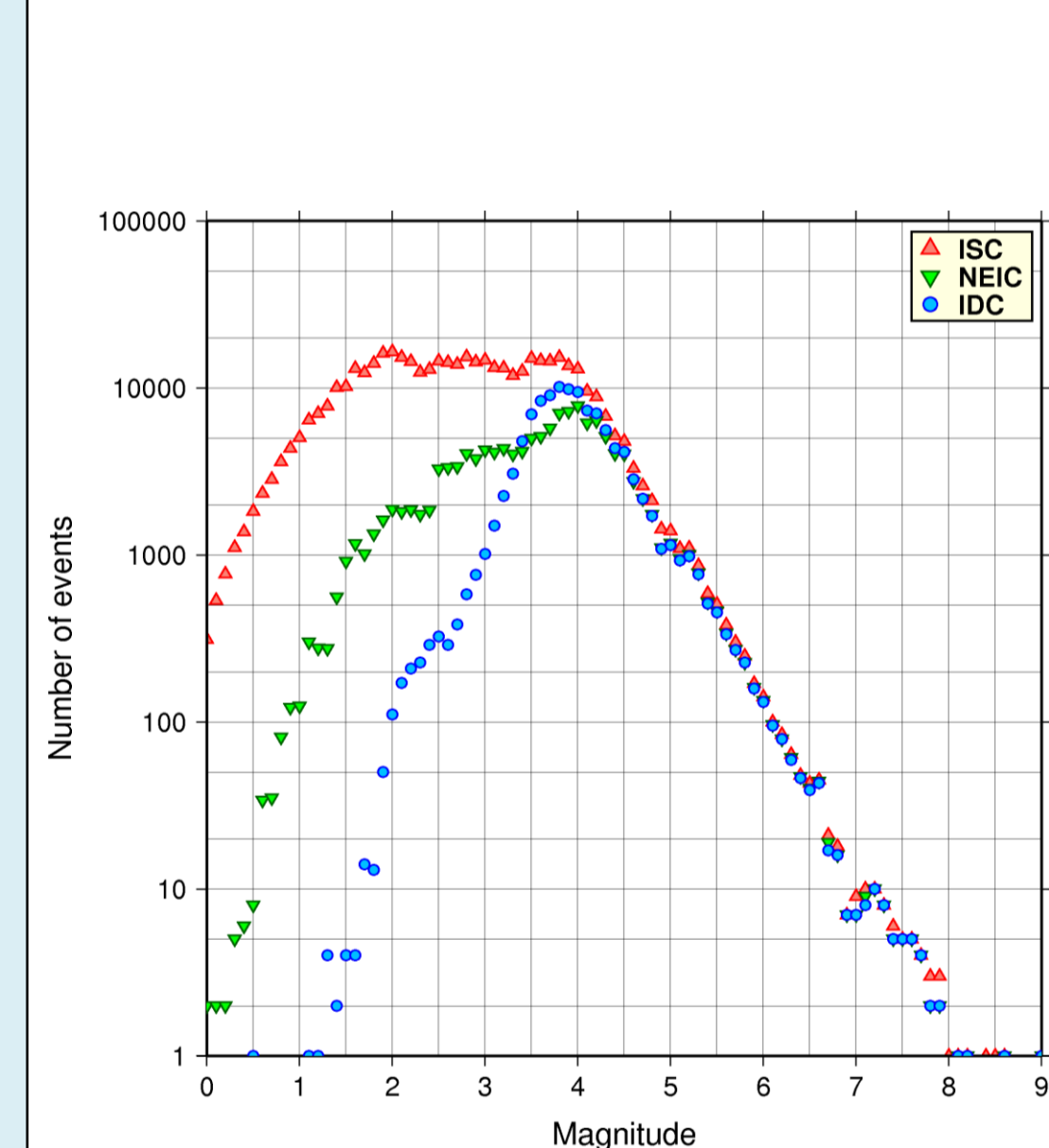
ISC BULLETIN



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.

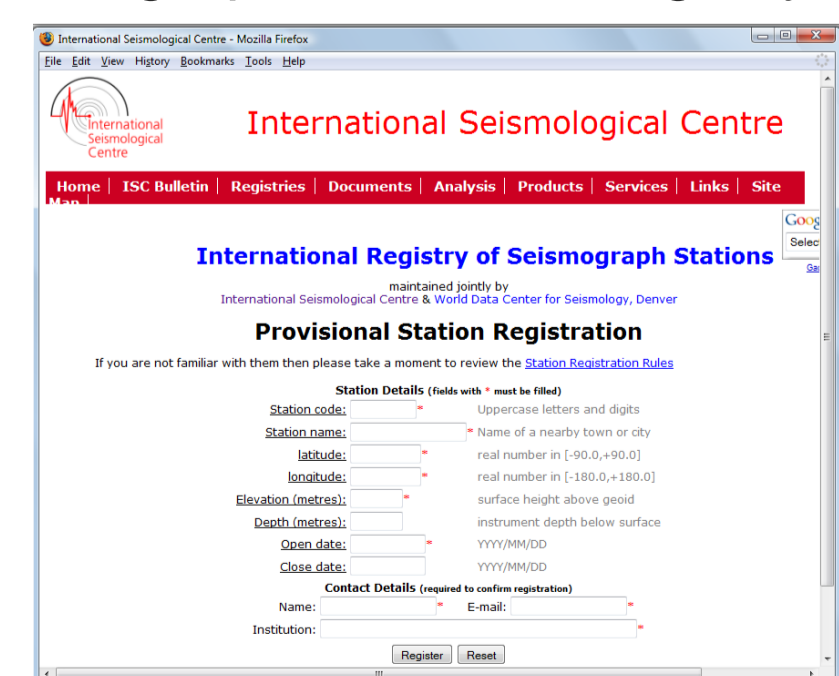
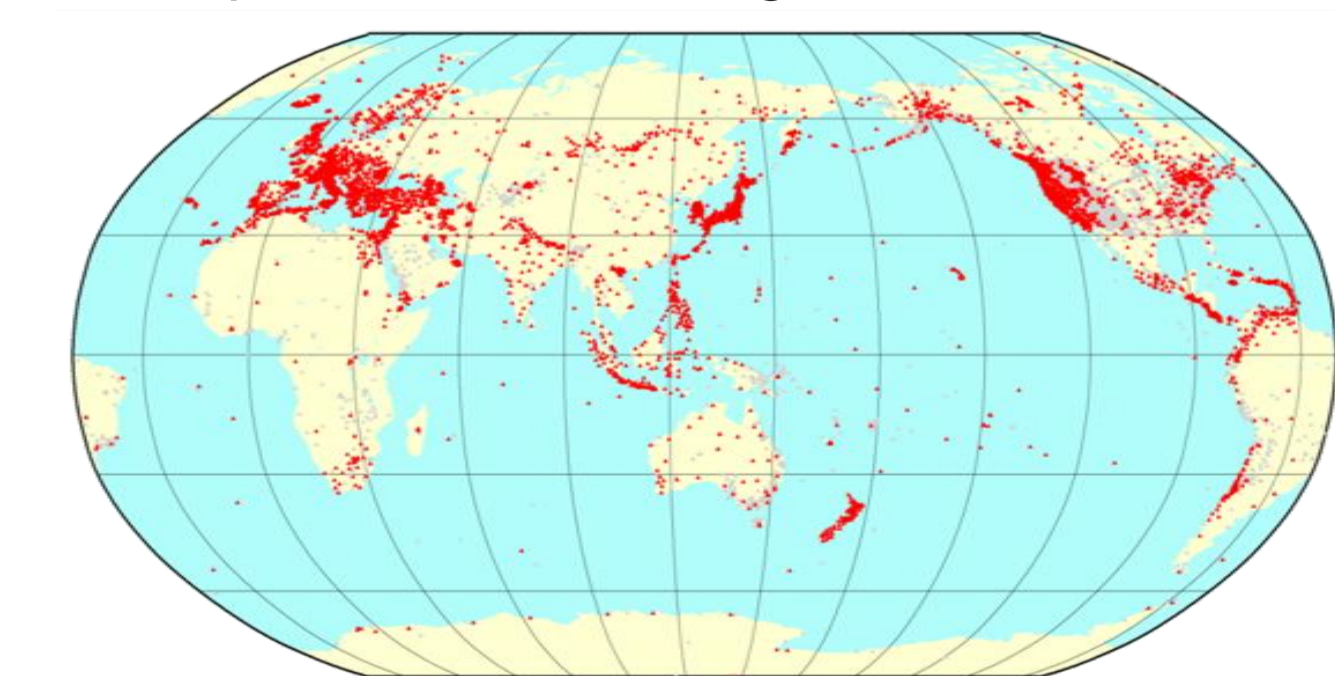
IDC, NEIC vs ISC DATA COLLECTION



- The ISC Bulletin is the most complete among other comparable global seismic event bulletins produced by the NEIC (USGS) 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.

INTERNATIONAL SEISMOGRAPHIC STATION REGISTRY

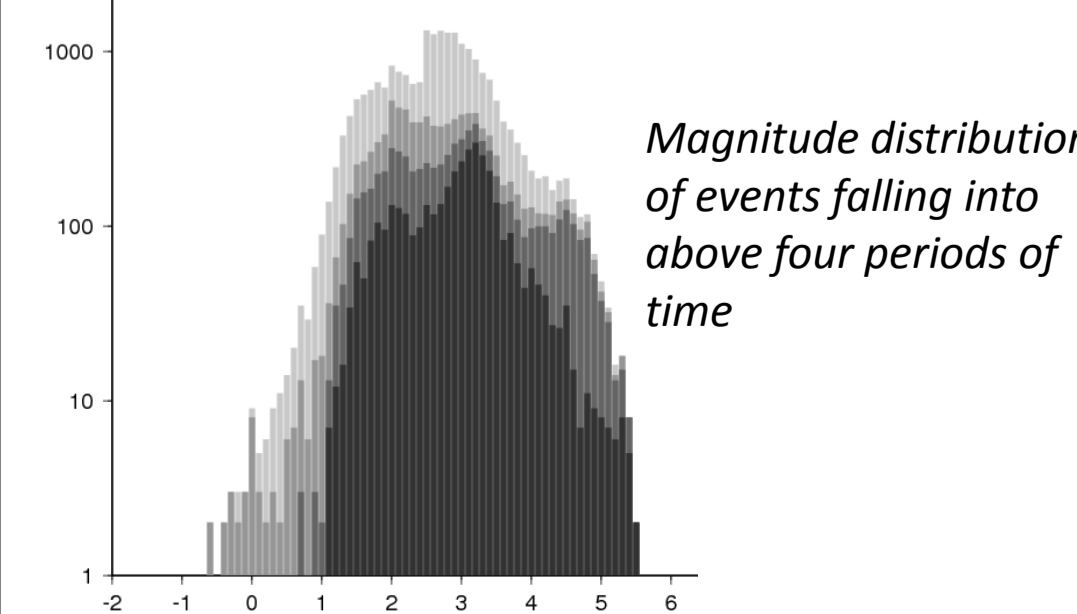
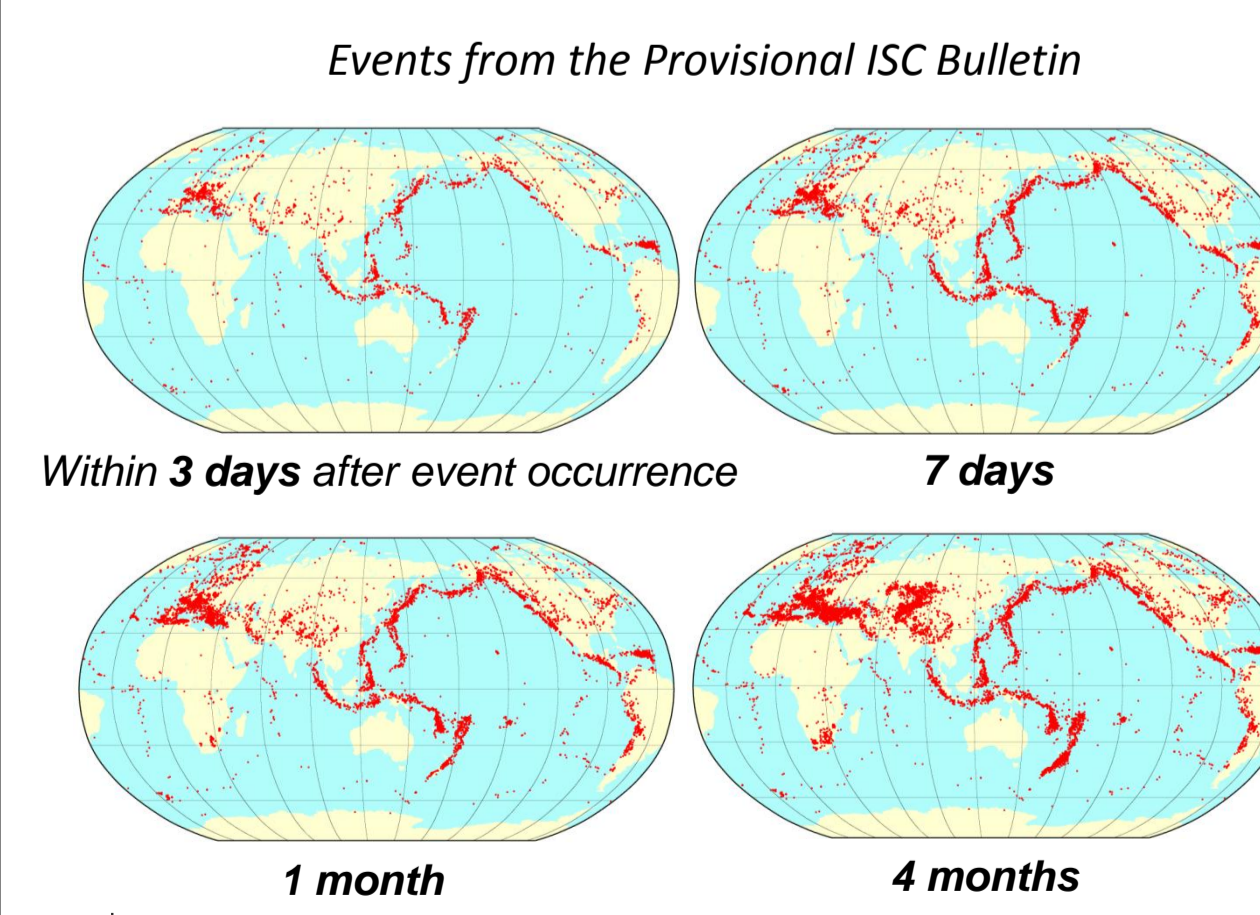
The ISC, in conjunction with the World Data Center for Seismology (NEIS), is responsible for running the International Seismographic Station Registry.



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.

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

TIMELINESS



- The **Reviewed ISC Bulletin** (based on the final data from networks) is available 24 months after real time.
- In the mean time, the **Provisional ISC Bulletin**, based on provisional hypocenter solutions and station arrival data from networks, is available from the ISC website in the order of days/weeks after real time.
- No ISC locations are available in the Provisional Bulletin
- We are currently making efforts to improve the provisional data collection

MODERNIZING ISC LOCATION PROCEDURES

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

- Using all phases with valid ak135 travel-time predictions, especially depth-sensitive phases (core and surface reflections, including pwP and swP)
- Obtaining the initial location for the linearized location algorithm by a nearest neighbor search algorithm
- Accounting for correlated model error structure
- Describing reading errors by non-Gaussian, skewed and heavy-tailed probability distributions
- Waveform processing to pick depth phases, and measure amplitudes

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 provisional bulletins before the final reviewed bulletins become available
- We plan to improve the ISC location procedures