

INTERNATIONAL SEISMOLOGICAL CENTRE

ISC

MISSION and PRODUCTS

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International Seismological Centre, **ISC**



Prof. John Milne

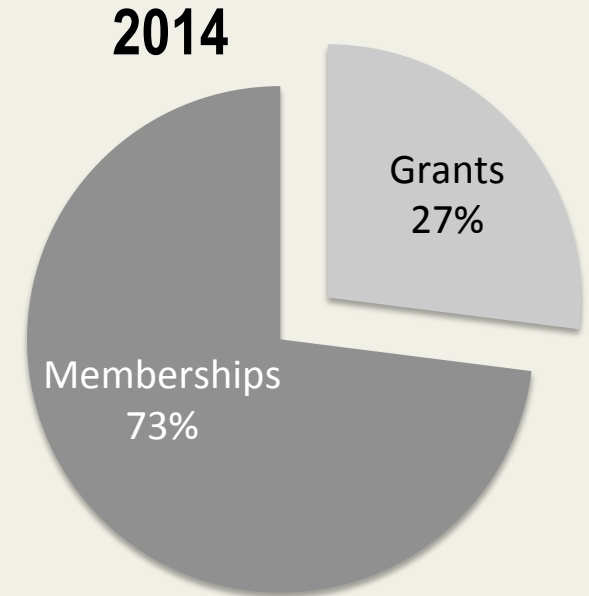
- set up in **1964** to continue the work of the ISS and BAAS (from early **1900s**)
- international, non-profit, non-governmental
- based in **UK**
- 17-19 staff

Supported by:

62 Member-Institutions worldwide, including Argentina, Chile, Jamaica, Mexico, Puerto Rico and Trinidad in LACSC region

Grants: *CTBTO, FM Global, GEM Foundation, Lighthill network, NSF, OYO, USGS*

Sponsors: *Reftek*



ISC data products: www.isc.ac.uk



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ISC News

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[The new version 2.2.4 of the ISC locator code released](#)

2013-04-14

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News for / from data contributors

2013-11-21

[Census of legacy Quanterra dataloggers](#)

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[Zlata Sinyova, KNDC, Kazakhstan](#)

International
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Centre Séismologique
International

Международный
Сейсмологический Центр

国際地震センター

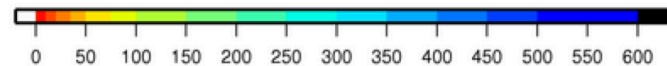
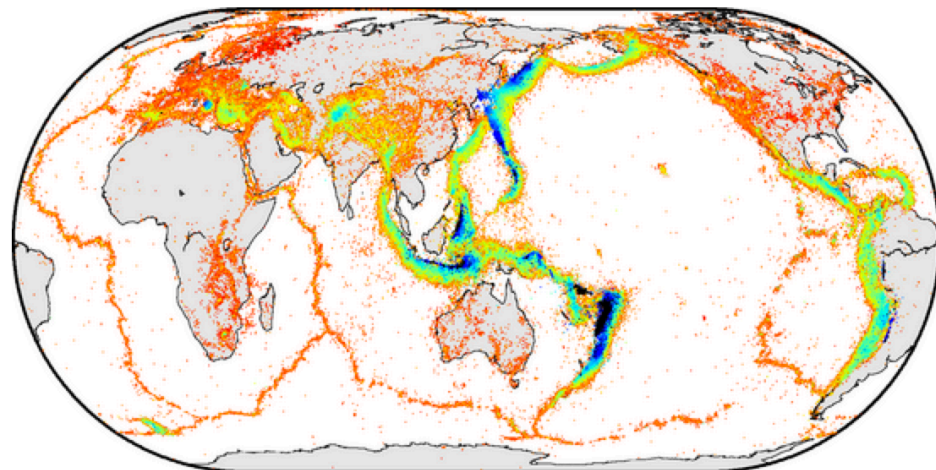
国际地震中心

Internationales
Seismologisches Zentrum

المركز الدولي لبحوث الزلازل

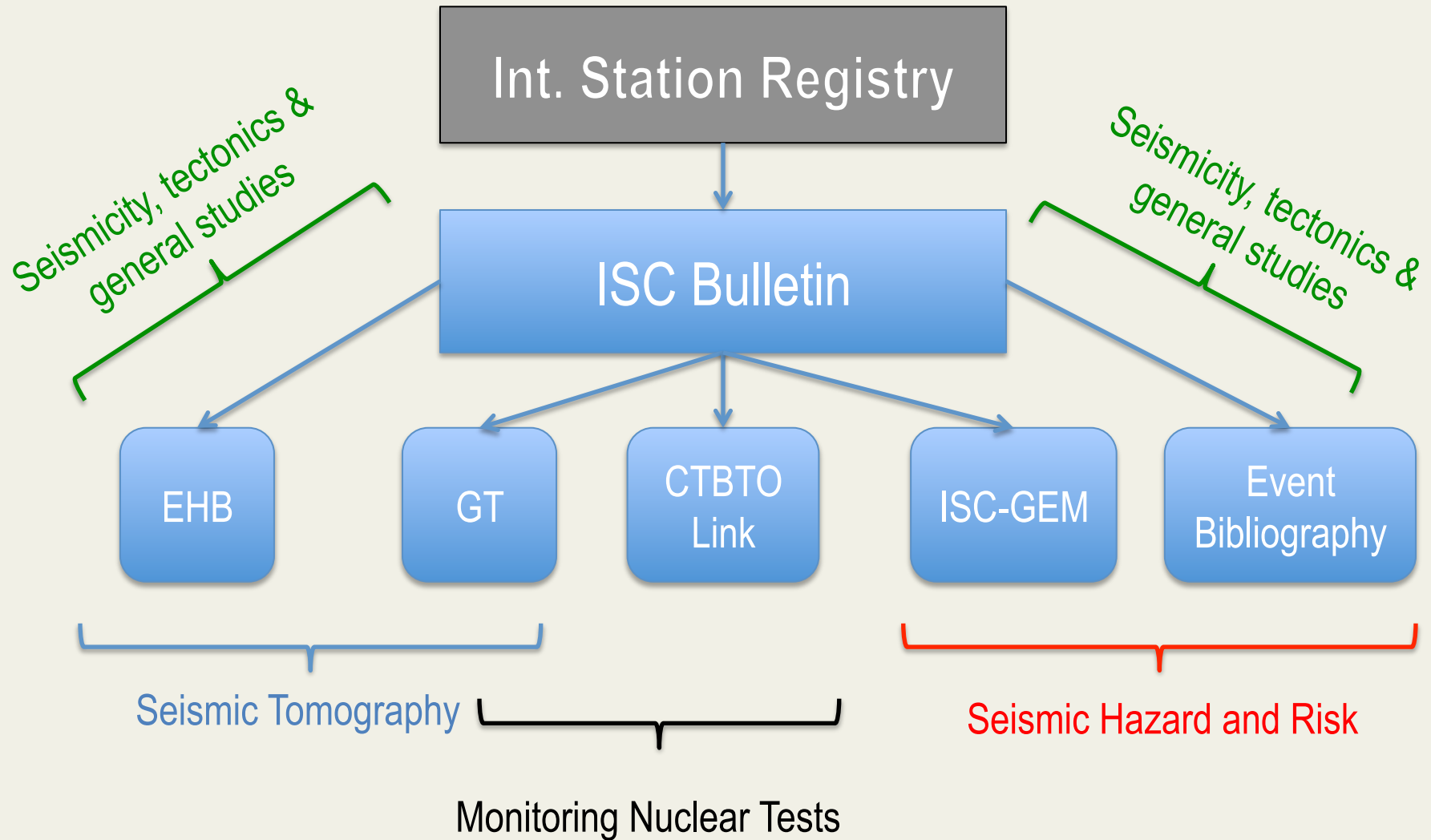
Centro Internacional
de Sismologia

ISC locations: 1960 to present



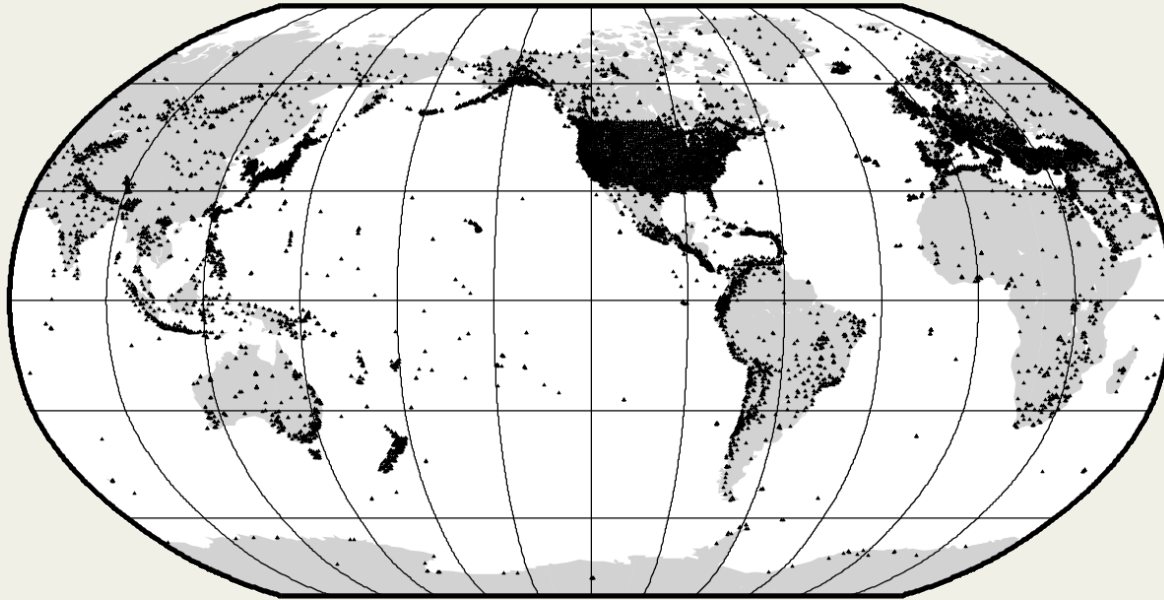
Depth (km)

The ISC data products



1: International Seismograph **Station Registry**

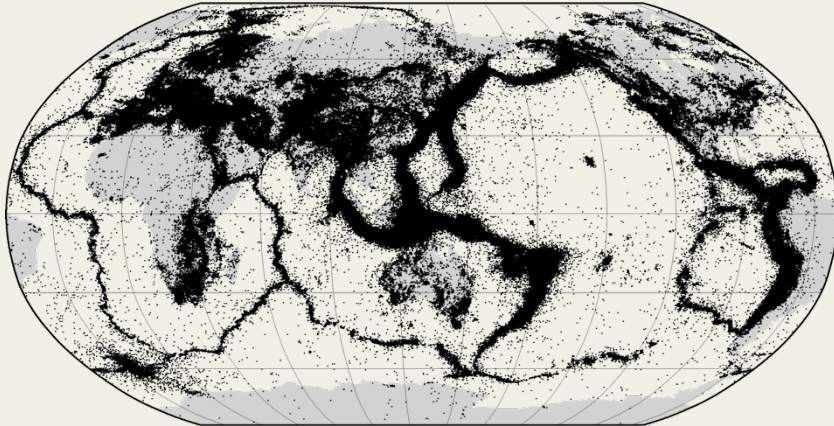
Since 1970s, we maintain the Registry jointly with NEIC / USGS



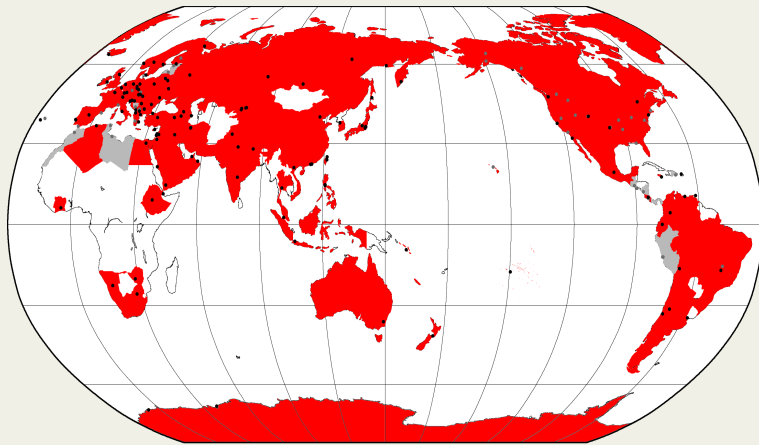
*~19,000 stations,
open or closed,
were registered in the IR
at the end of 2013*

The IR station codes are used in various types of seismological research as well as for waveform storage and distribution by IRIS DMC, EIDA and other data centres

2: ISC Bulletin (1964-2014)



5 million events, 1960-2014

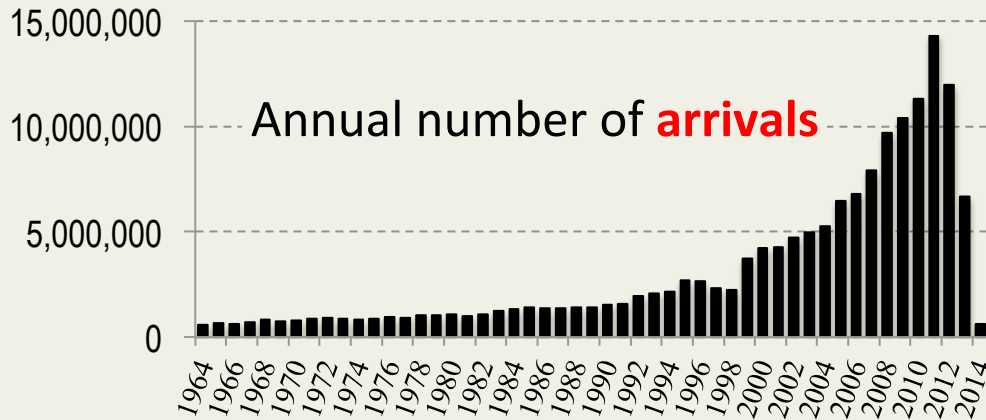
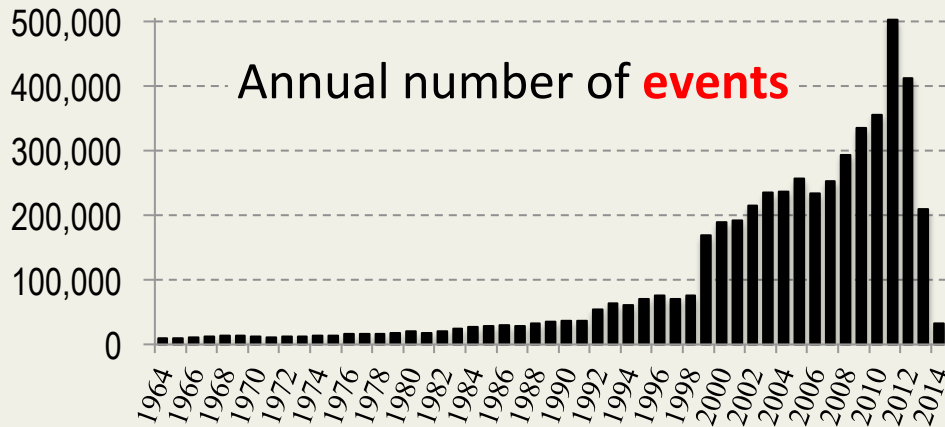


130 agency-contributors

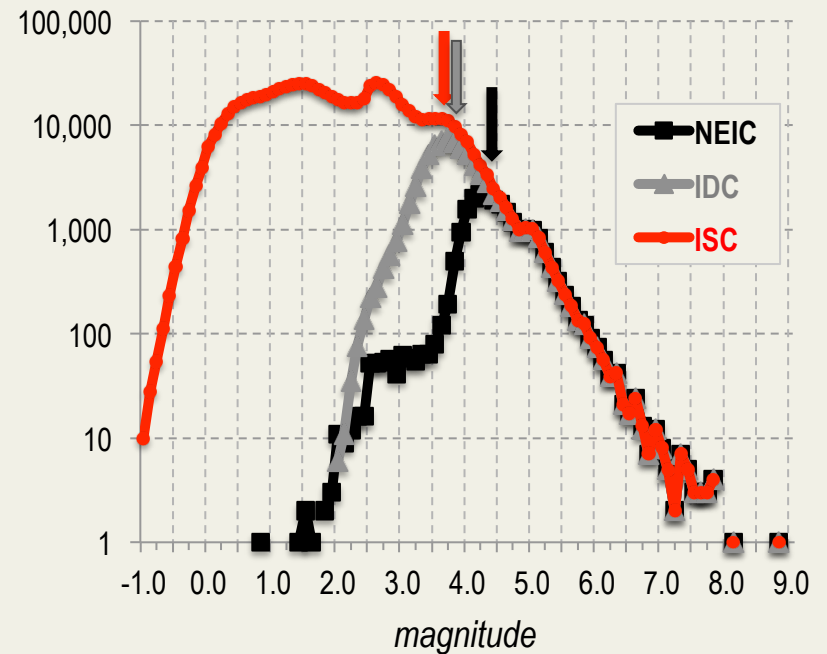
- The definitive and the most complete long-term record of global earthquake information
- Contains major source parameters of over 5 million seismic events: natural and anthropogenic
- ~130 agencies around the world report bulletin data to be included into the ISC Bulletin.
- Dry land territories covered by these reports are in **red**. Grey areas covered via reports from NEIC, EMSC and CASC.
- Individual agency bulletins in different formats are parsed, checked, merged per natural event, event parameters re-calculated, reviewed and made available to users in a standard format.

2: ISC Bulletin

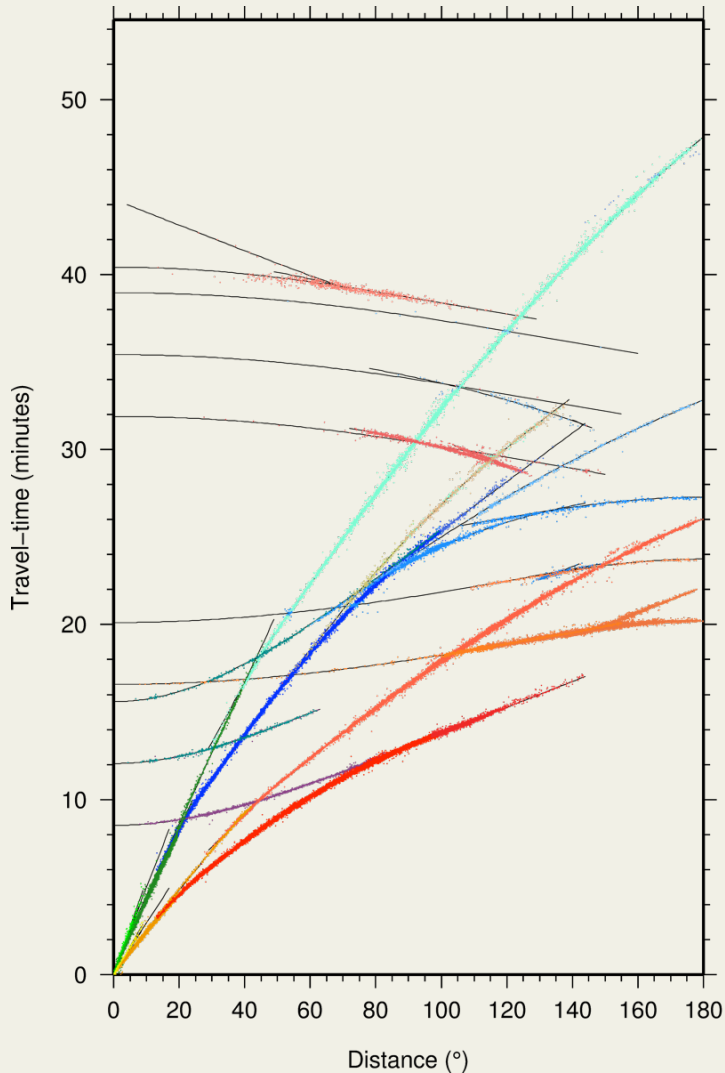
Growth of event & phase data volume continues



Worldwide, the ISC Bulletin is more complete than either of NEIC or IDC



2: ISC Bulletin

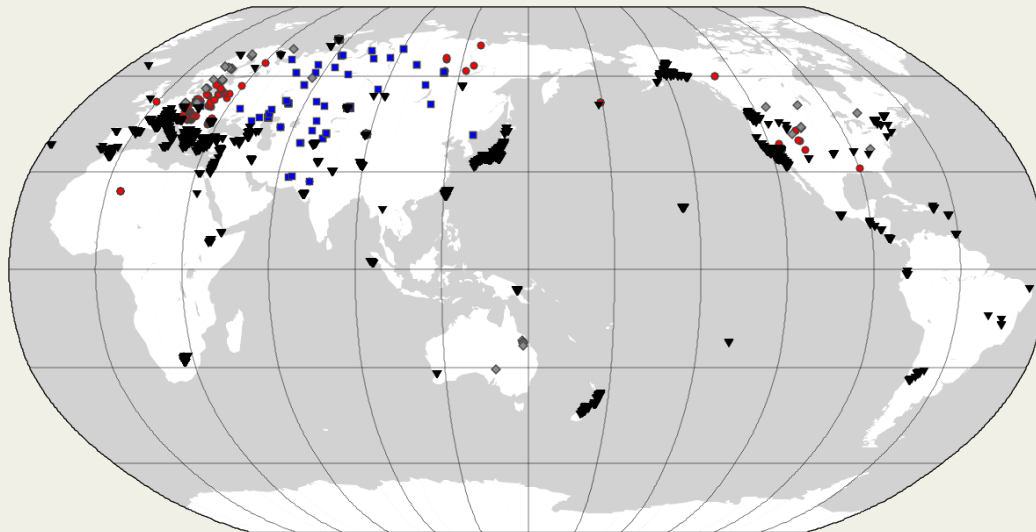


ISC Bulletin (M > 5.5, Depth <= 20): **330** events
68 ak135 phases, **470898** residuals
2009/01/01 to 2011/09/30

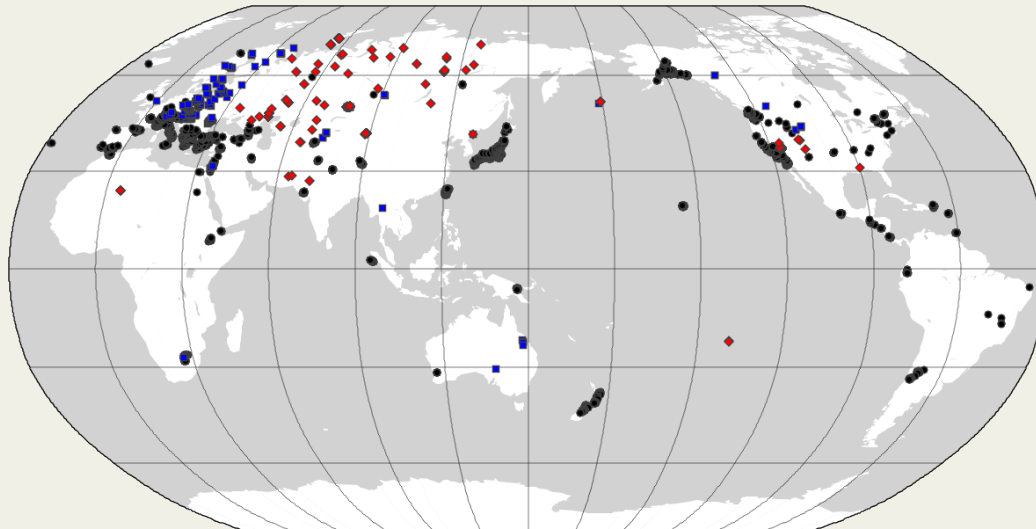
- Pg (751)
- Pb (657), PbPb (1)
- Pn (28955), PnPn (554)
- PnS (393)
- Sg (634)
- Sb (622), SbSb (1)
- Sn (5311), SnSn (524)
- SPn (37)
- pPn (1)
- P (295700)
- PP (11776)
- PS (670)
- S (16555)
- SS (6737), SP (418)
- pwP (2), pP (3116), pS (8), pPdif (6)
- sP (2473), sS (931), sPdif (4), sSdif (3)
- PcP (3313), PcS (183)
- Pdif (11141)
- ScP (753), ScS (662)
- Sdif (261)
- PKPab (7830), PKPbc (10024), PKPpdf (45002)
- PKSab (3), PKSbc (24), PKSdf (439)
- PKiKP (6172)
- PPab (24), PPbc (18), PPdf (786)
- PKKPab (558), PKKPbc (1976), PKKPdf (440)
- SKPab (71), SKPbc (245), SKPpdf (26)
- SKSac (2019), SKSdf (489), SKiKP (274)
- SSac (22)
- SKKPab (2), SKKPbc (123), SKKPdf (2)
- SKKSac (584), SKKSdf (23)
- pPKPab (47), pPKPbc (12), pPKPpdf (425), pPKiKP (31)
- sPKPab (8), sPKPbc (3), sPKPpdf (25), sPKiKP (12)

The ISC Bulletin contains arrival times of many different types of seismic waves, including those predicted by the ak135 velocity model

3: IASPEI Reference Event List, **GT** (1959-2012)



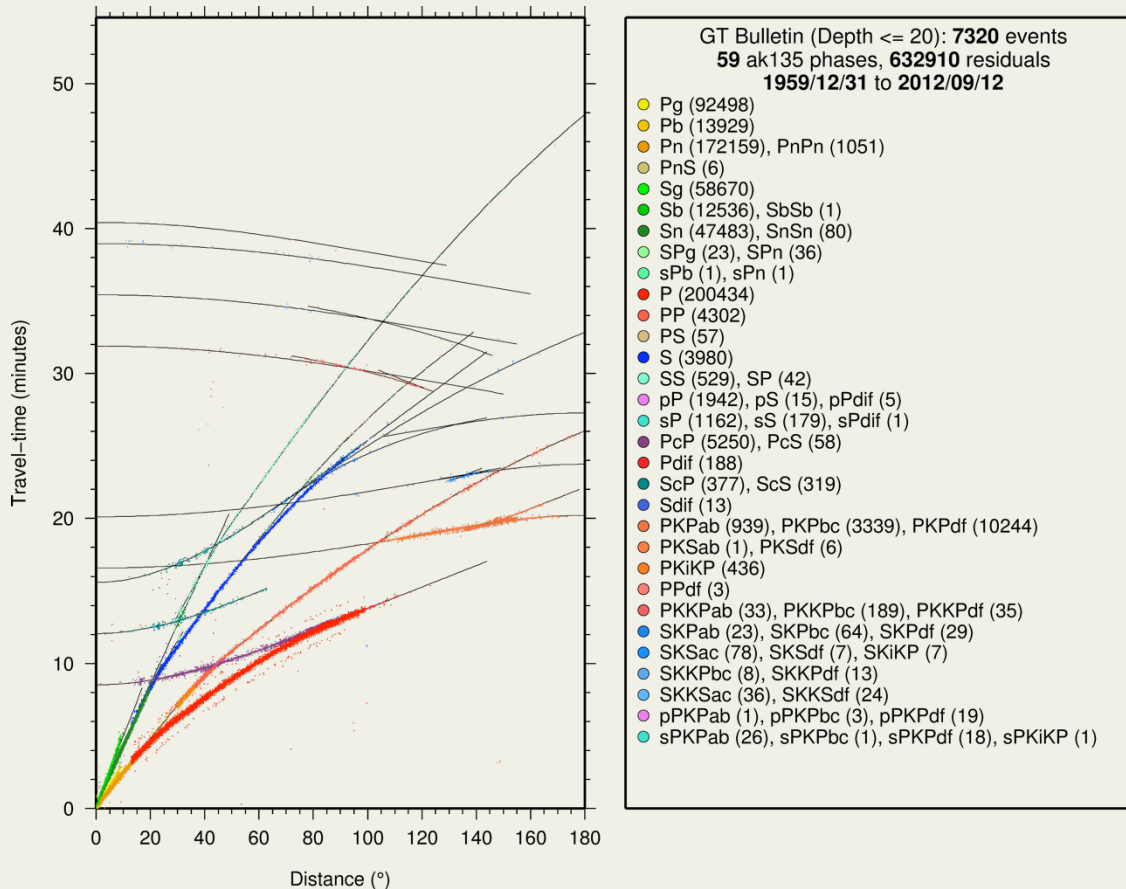
• **GT0(664)** • **GT1(371)** • **GT2(123)** • **GT5(6713)**



• **natural(6581)** • **chemical(261)** • **nuclear(1029)**

- The IASPEI Reference Event List, commonly known as the GT-ground truth bulletin, is a database of earthquakes and explosions, for which:
 - ✓ hypocentral information (lat, lon, depth) is known with high confidence (to 10 km or better (GT10)) and
 - ✓ seismic signals recorded at regional and/or teleseismic distances.
- The list is maintained by the ISC under the supervision of IASPEI

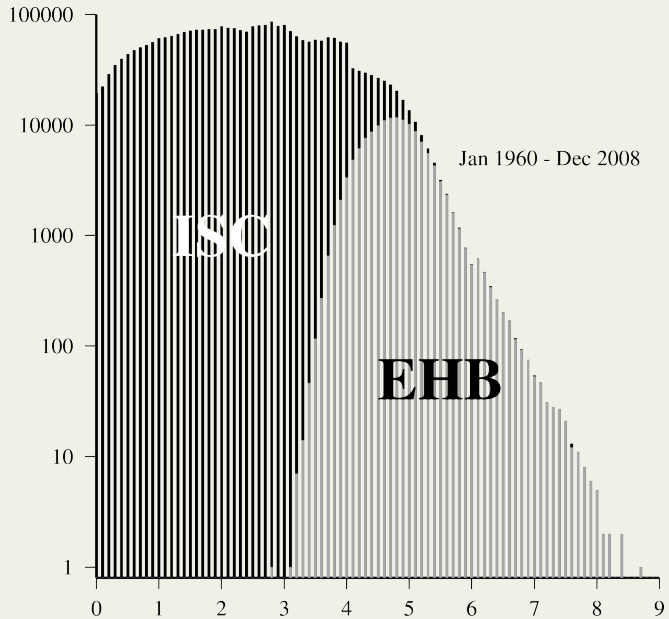
3: IASPEI Reference Event List, GT



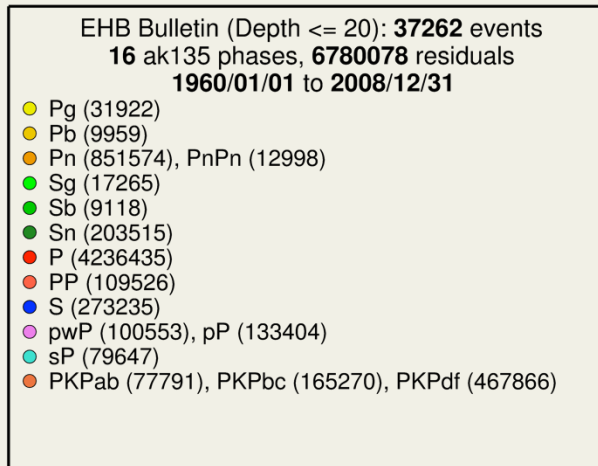
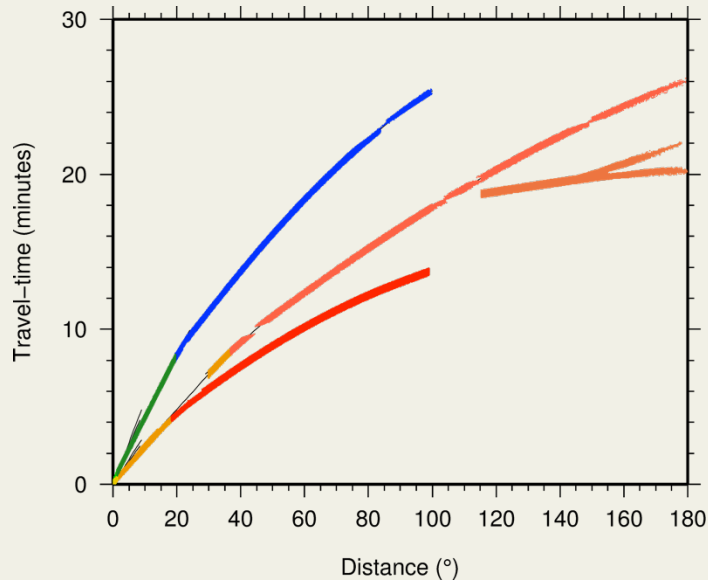
~8,000 events

~650,000 seismic arrivals

4: EHB (1960-2008)

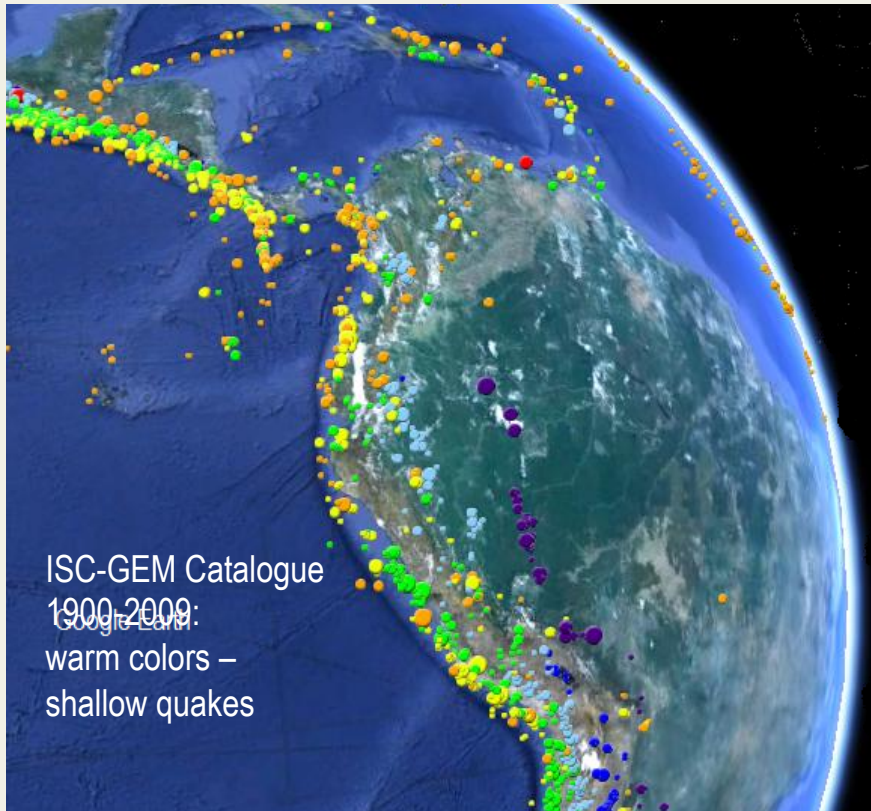


The EHB dataset is a groomed subset of the ISC Bulletin with well recorded seismic events relocated using (*Engdahl et al, 1998*) technique



The EHB contains arrival times of the most prominent and well reported types of seismic waves

5: ISC-GEM Catalogue (1900-2009)



The ISC-GEM Global Instrumental Earthquake Catalogue is built for the purpose of seismic hazard assessment:

- ~19,000 homogeneous hypocentre locations and M_W estimates
- with the estimates of uncertainty
- covering 110 years period
- prepared using uniform location and magnitude determination techniques,
- using original arrival time measurements

- **1900-1917: $M_S \geq 7.5$** worldwide + smaller shallow events in stable continental areas
- **1918-1959: $M_S \geq 6\frac{1}{4}$**
- **1960-2009: $M_S \geq 5.5$**

5: ISC-GEM Catalogue, large data entry effort

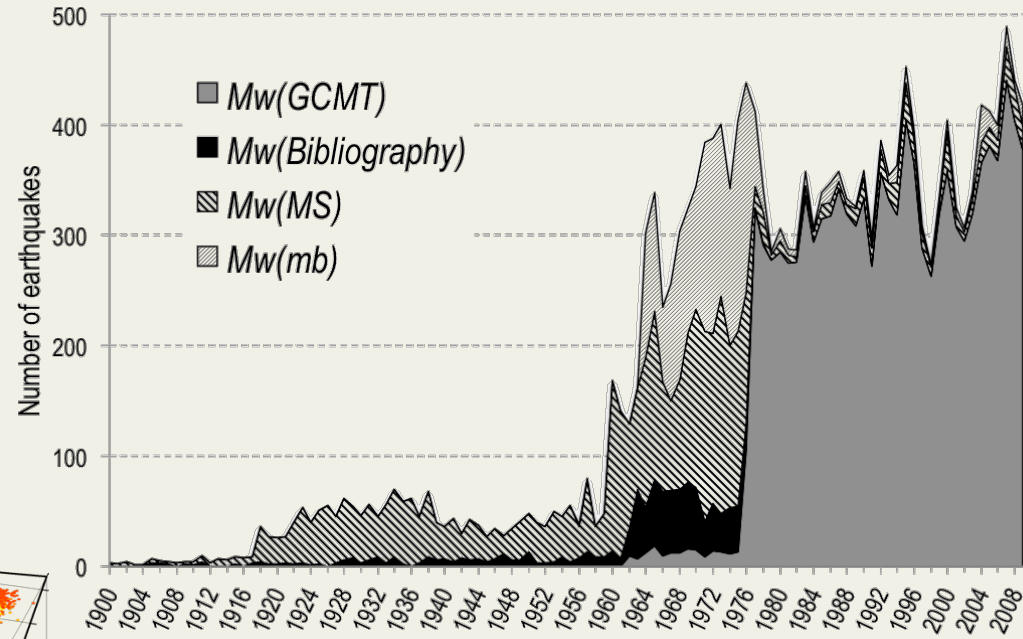
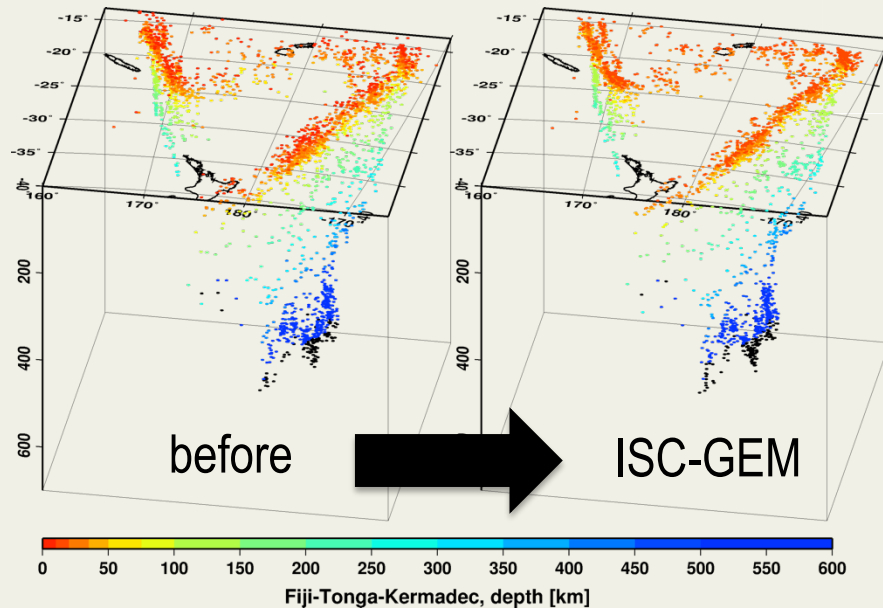
The work on the ISC-GEM Catalogue required digitising of a large volume of data that has not been available electronically in the past.

Global Parametric Data	1900–1959	1960–1970	1971–1977	1978–2009
Body wave arrival times amplitudes & periods	<i>Became electronically</i>	<i>Already available</i>		
Surface wave amplitudes & periods	<i>available thanks to the</i>	<i>as part of the</i>		
Mo & Mw	<i>ISC–GEM catalogue</i>	<i>ISC & GCMT</i>		

(Storchak et al., 2014)

5: ISC-GEM Catalogue, homogeneity

All magnitudes are expressed in M_W scale with uncertainties

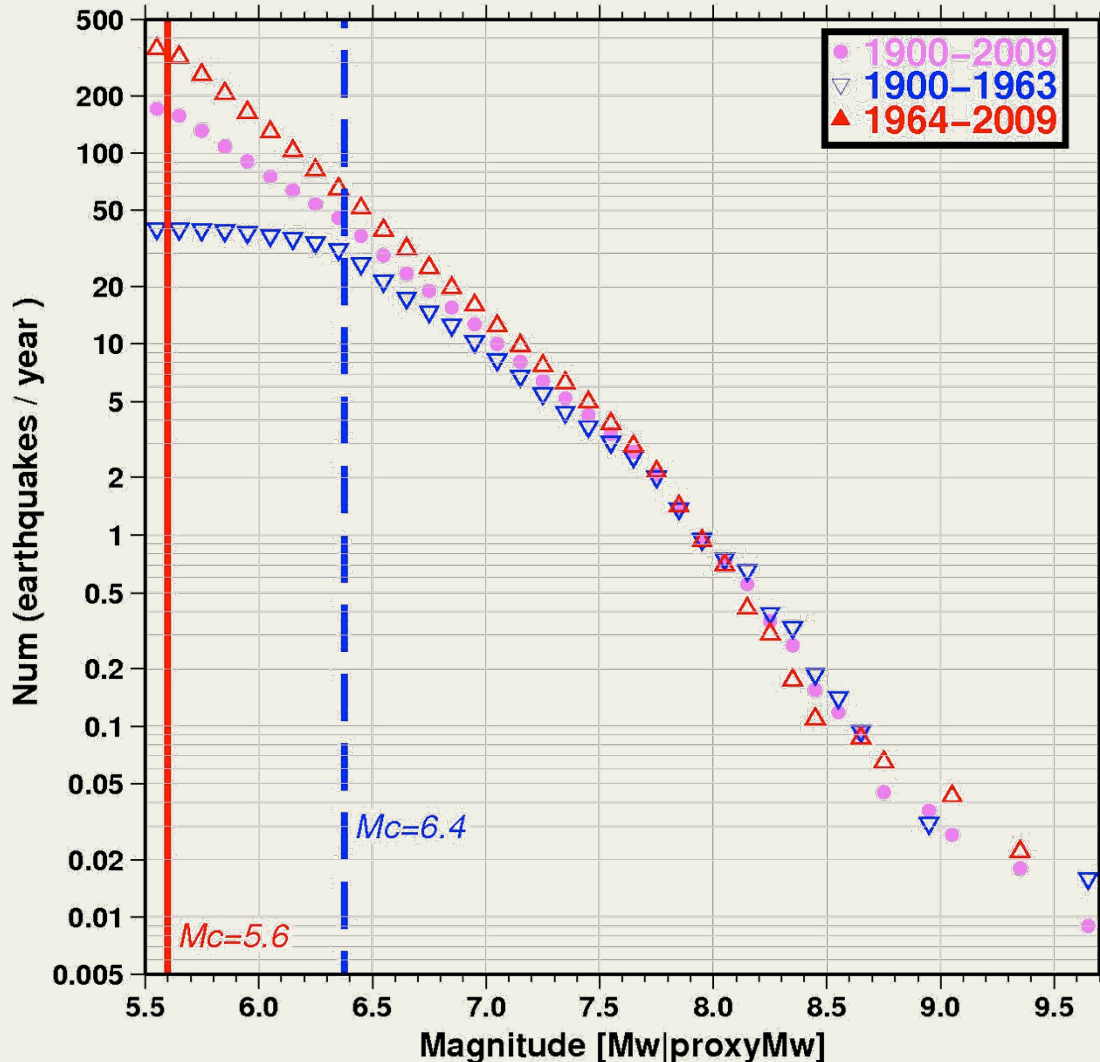


(Storchak et al., 2014)

All hypocentres recomputed using a combination of **EHB** and **ISC** location techniques

5: ISC-GEM, magnitude-frequency distribution

ISC-GEM catalogue



Seismicity rates for large ($M > 7.5$) earthquakes better assessed considering the entire time period (pink)

For moderate earthquakes the modern period (red) is a better basis for magnitude-frequency studies, whereas for strong to major shallow earthquakes the entire ISC-GEM catalogue should be used

6: ISC Event Bibliography (1904-2014)

- An interactive web-search for references to scientific articles related to seismic events in a particular region and period of occurrence/publication;
- **~16,000** articles, **~14,000** seismic events and **~500** journal titles (Di Giacomo *et al.*, 2014);
- seismic events cover: 1904-present;
- publications cover: 1950–present;
- includes articles in many fields of Geosciences;

Close polygon Edit polygon Delete last point Clear map
Lat: 10.545 Lon: -96.333

ISC Event	Agency	Origin time	Lat	Lon	Depth	Magnitude	Articles_total
14267830	ISC	2010-01-24 16:40:17	7.5	-72.95	162.8	mb(ISC) = 4.5	1
1443400	ISC	1999-01-25 18:19:18	4.47	-75.68	24.3	Mw(BRVD) = 6.2	8

Prieto, G.A., Florez, M., Barrett, S.A., Beroza, G.C., Pedraza, P., Blanco, J.F. and Poveda, E., 2013. Seismic evidence for their intermediate-depth earthquake rupture, *Geophys. Res. Lett.*, 40, 23, 6064-6068, DOI: [10.1002/2013GL058109](#)

Sanchez-Silva, M., Yamin, L.E., and Caicedo, B., 2000. Lessons of the 25 January 1999 Earthquake in Central Colombia, *Earth* [10.1193/1.1586123](#)

Rios, D.A. and Hermelin, M., 2004. Prediction of landslide occurrence in urban areas located on volcanic ash soils in Pereira, *Colombian Environ.*, 63, 1, 77-81, DOI: [10.1007/s10064-003-0210-9](#)

Wang, Y., 1999. Report on Colombia earthquake damage to lifelines, *Oregon Geology* 61, 1, 20-21.

Dimaté, C., Rivera, L., and Cisternas, A., 2005. Re-visiting large historical earthquakes in the Colombian Eastern Cordillera, *J. Geophys. Res.*, [10.1007/s10950-005-1413-2](#)

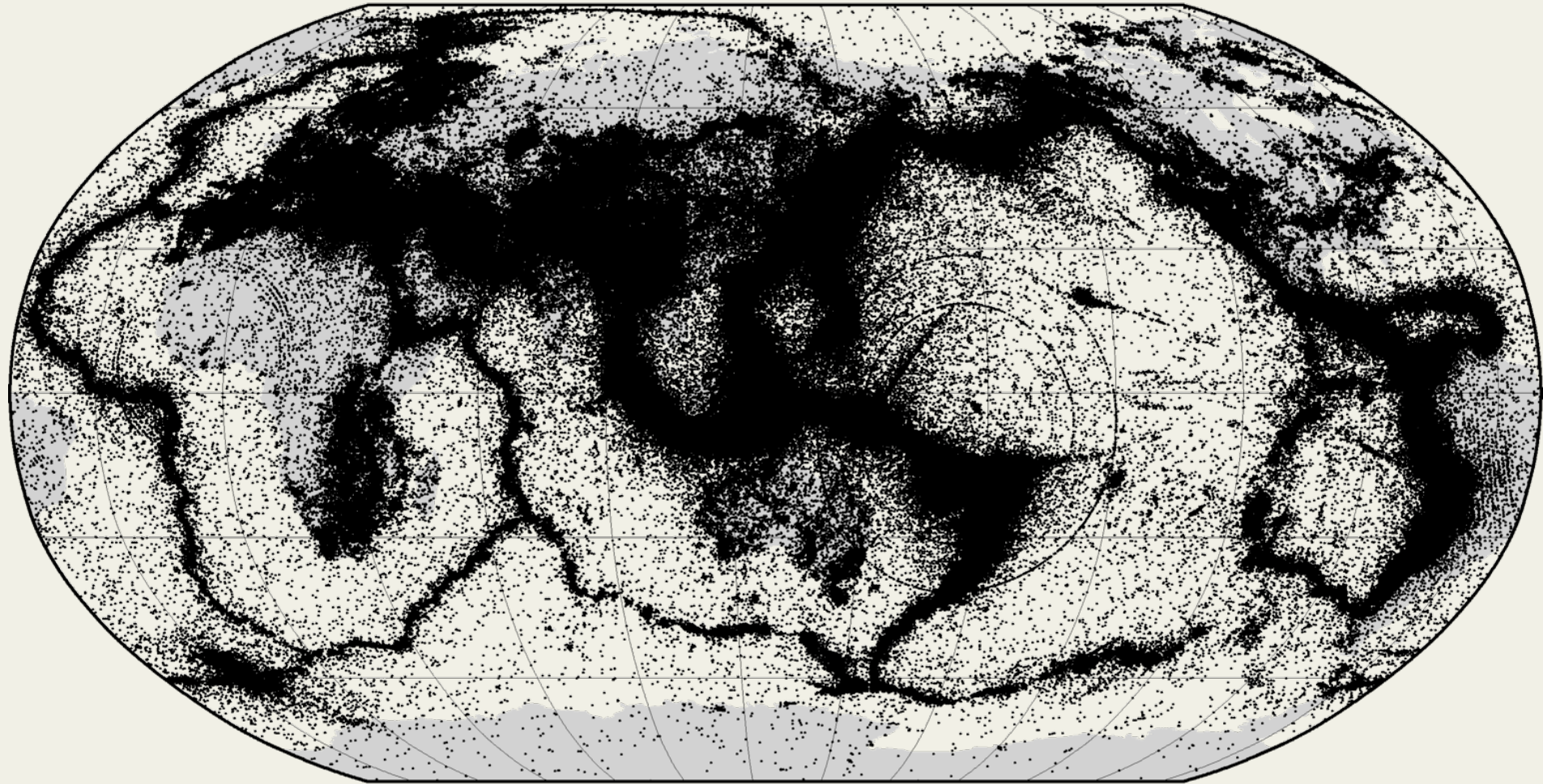
Trenkamp, R., Mora, P.H., Salcedo, H.E., and Kellogg, J.N., 2004. Possible Rapid Strain Accumulation Rates Near Cali, Colombia: Measurements (1996-2003), *Earth Sci. Res. J.*, 8, 1, 25-33.

Gonzalez De Schroeder, S., Flarez, J., and Colonia Guitierrez, J.E., 2002. Morbilidad en Asentamientos Post-Terremoto en Armenia, *Revista Colombiana de Geología* 4, 3, 270 - 277.

Ugalde, A., Vargas, C.A., Pujades, L.G., and Canas, J.A., 2002. Seismic coda attenuation after the Mw = 6.2 Armenia (Colombia) 1999, *J. geophys. Res.*, 107, B6, 2107, DOI: [10.1029/2001JB000197](#)

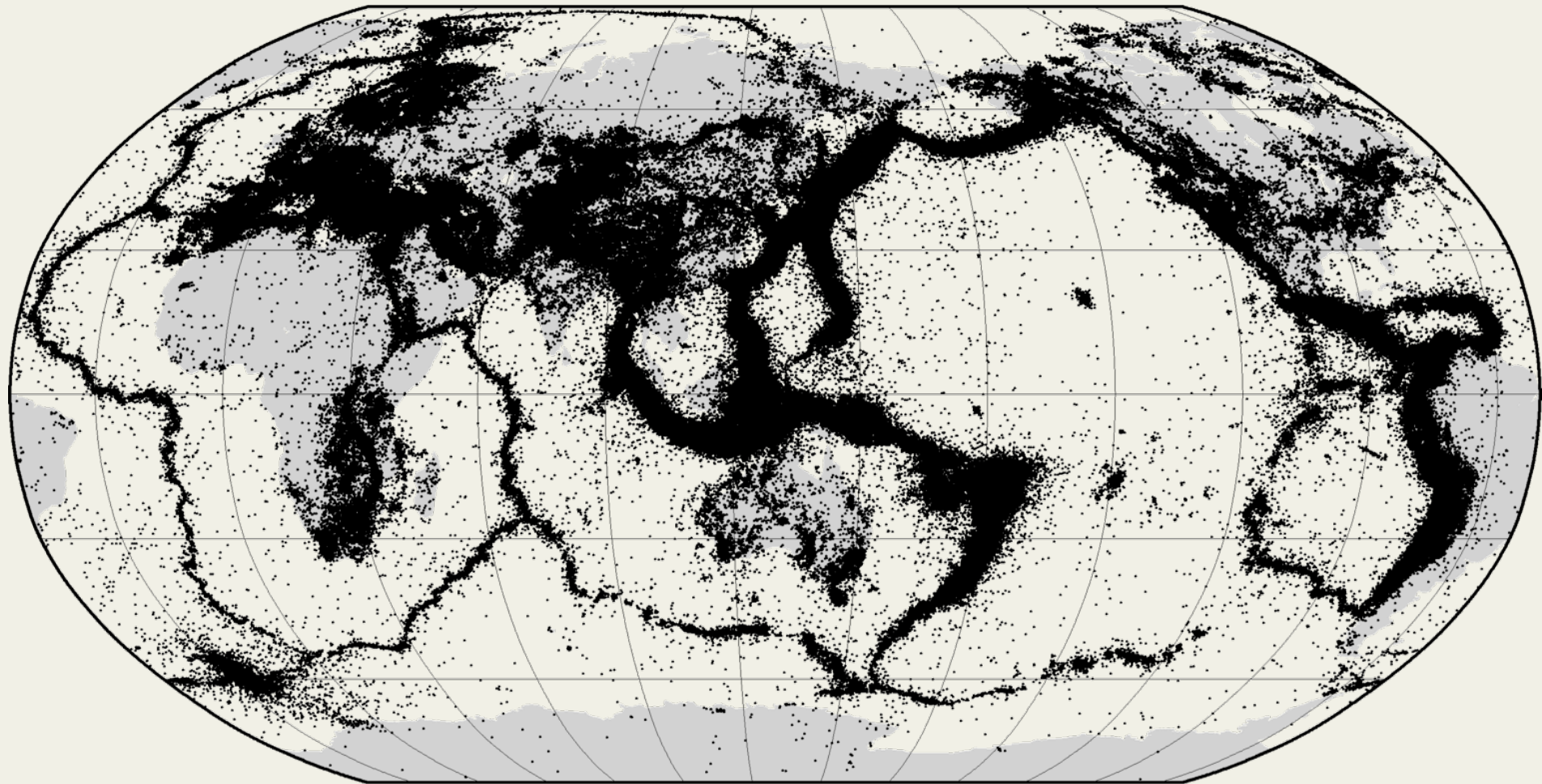
Vargas, C.A., Mann, P., and Borrero, C., 2011. Field guides for excursions to the Nevado del Ruiz Volcano and to the Romeral fault system: The Neotectonics of arc-continent collision concepts, *Earth Sci. Res. J.* 15, 1, 47 - 74.

All hypocentres reported to the ISC



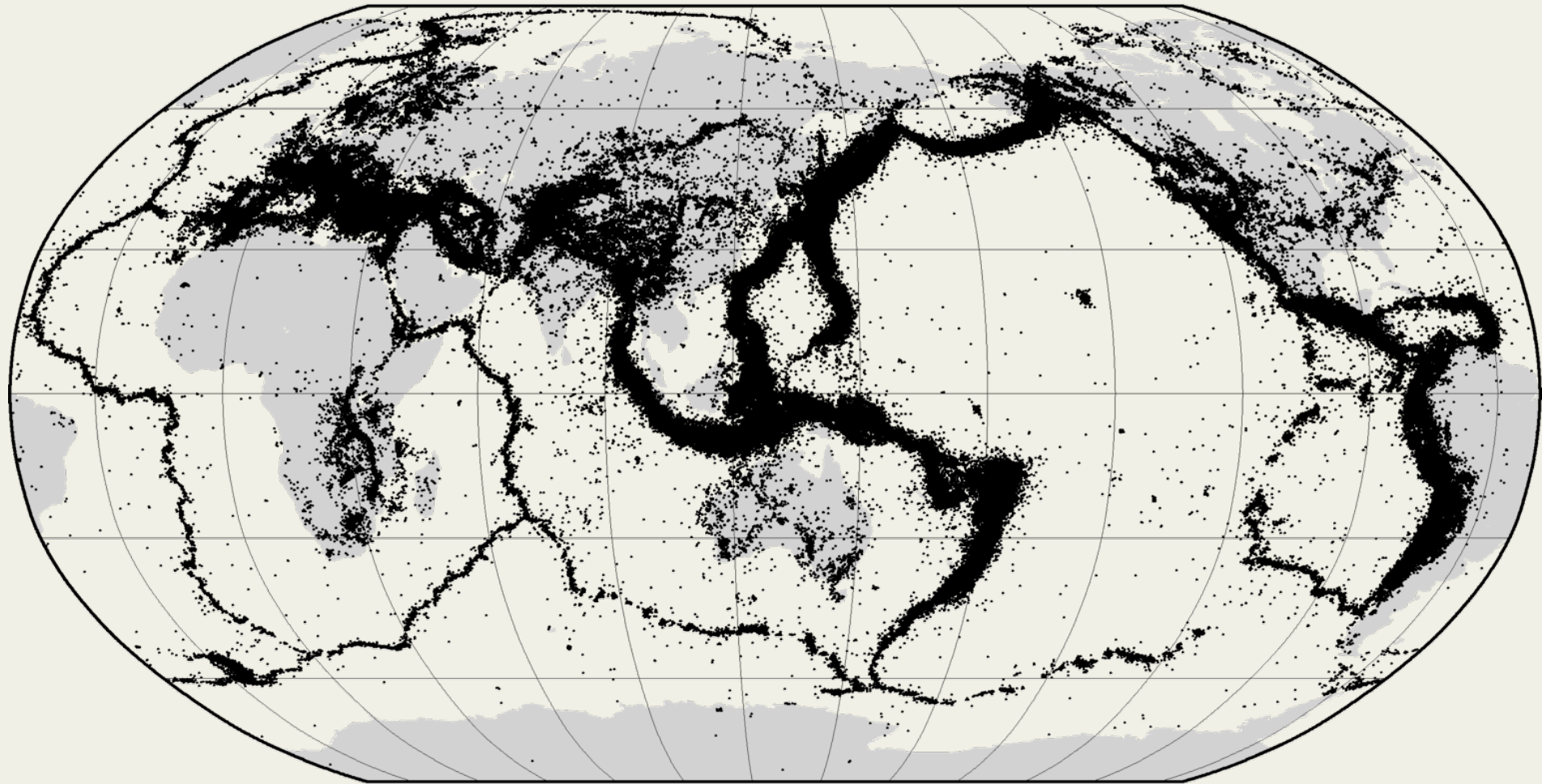
10 M hypocentre solutions

Events in ISC Bulletin, grouped (1964-2014)



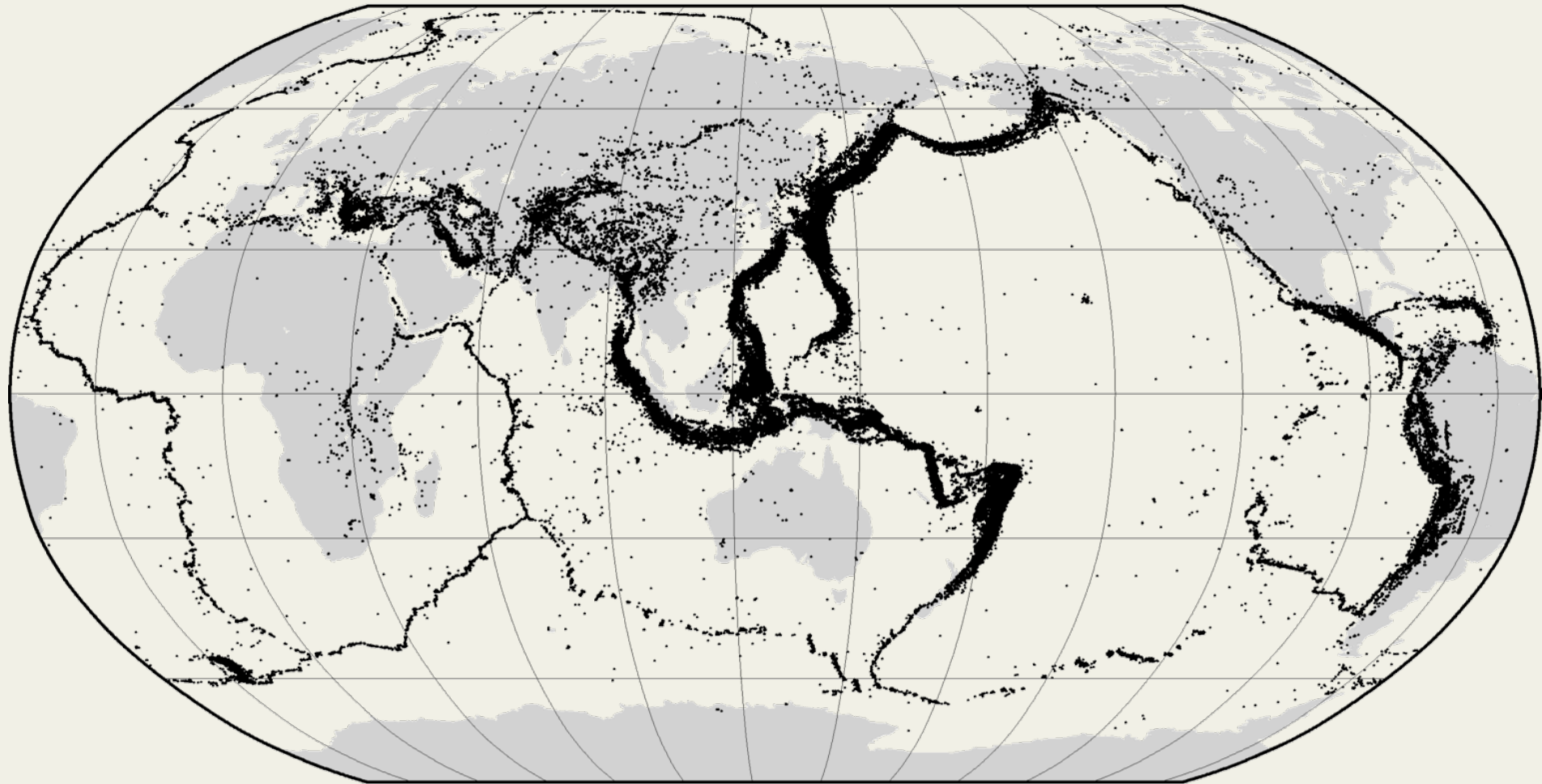
5.1 M events

Events **relocated by ISC** (1964-2011)



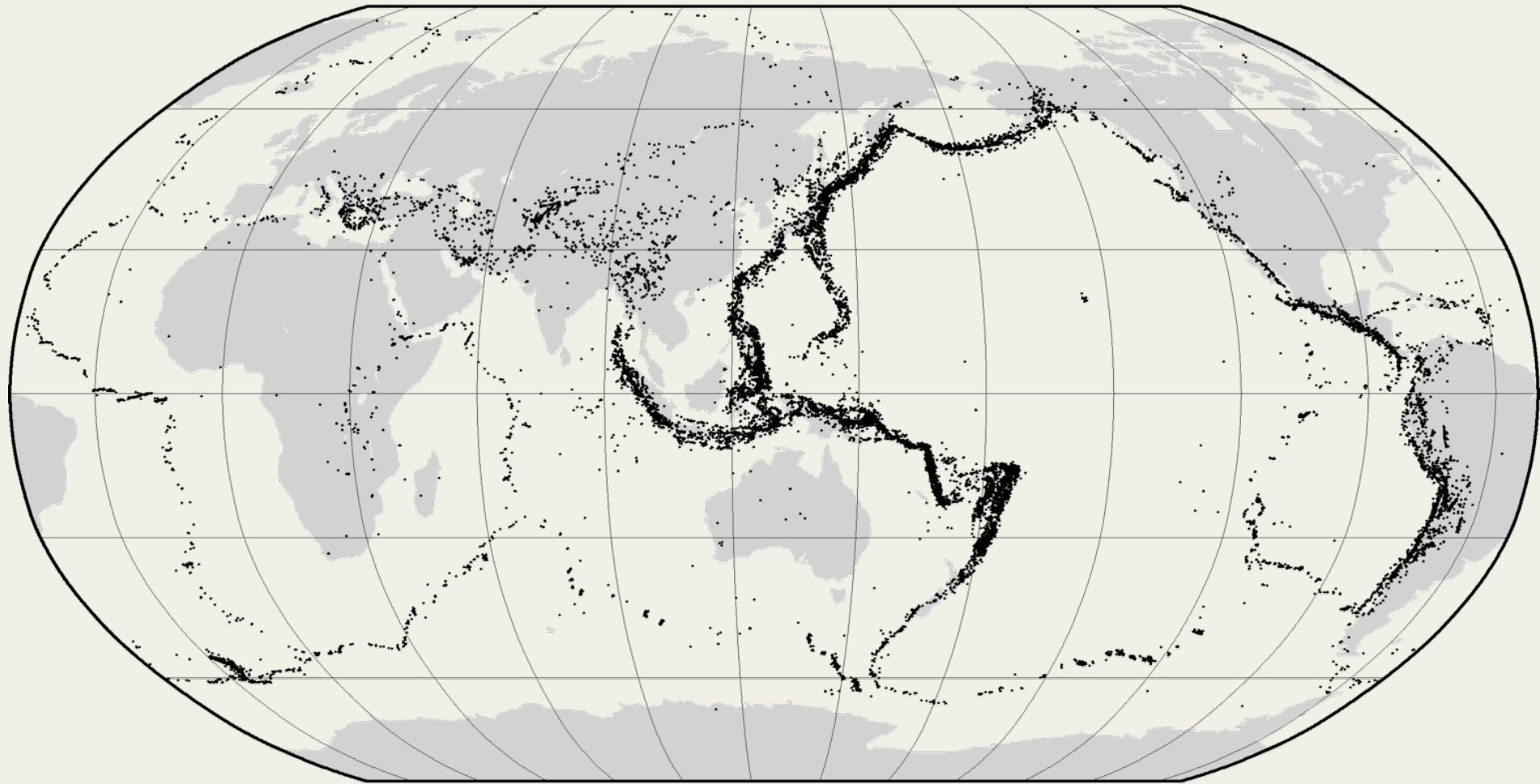
1.1 M events

EHB (1960-2008) (Engdahl *et al.*, 1998)



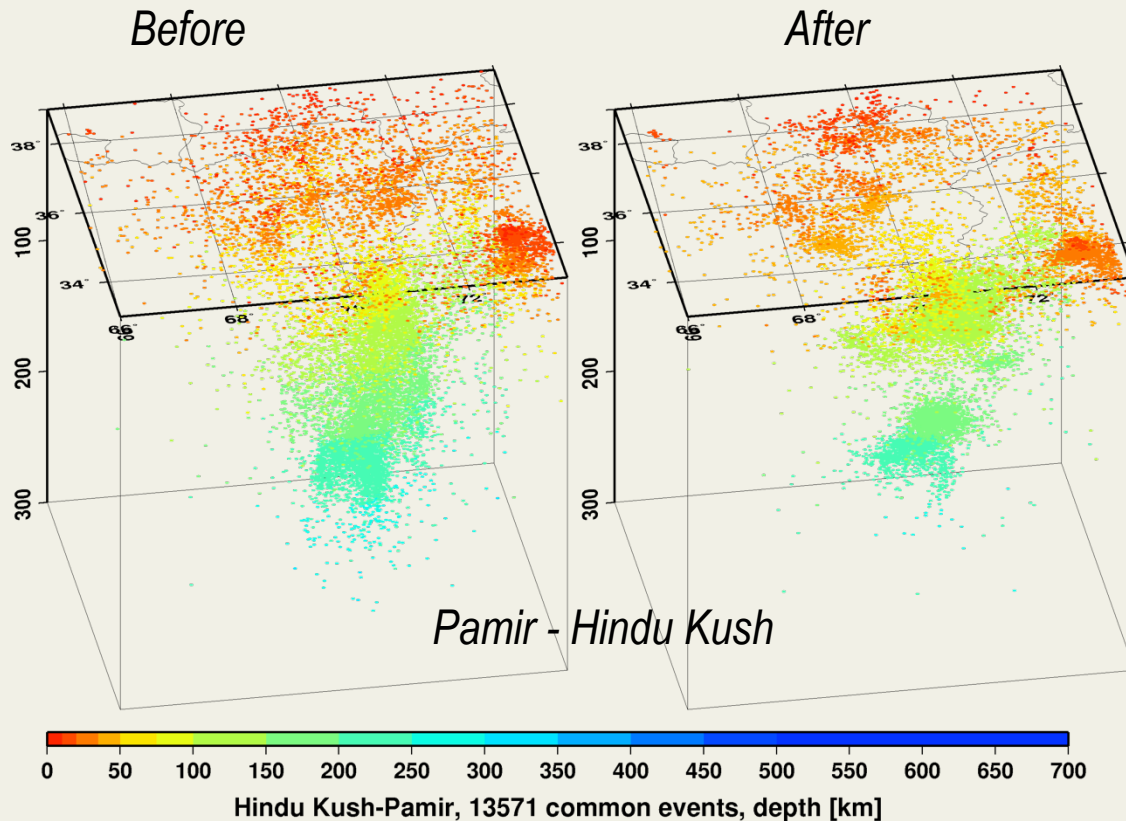
0.14 M events

ISC-GEM events, $M \geq 5.5$ (1900-2009)



20 K events

New ISC seismic event locator



The new ISC Location program was put in operation from data year 2009 (Bondár & Storchak, 2011)

The Bulletin for 1964-2008 so far retained the original hypocentre locations

- ✓ uses all ak135 predicted phases;
- ✓ obtains an initial hypocentre via the Neighbourhood Algorithm;
- ✓ accounts for correlated travel-time prediction error structure;
- ✓ performs iterative linearized inversion using *a priori* estimates of the data covariance matrix;
- ✓ obtains depth-phase depth via depth-phase stacking;
- ✓ provides robust network magnitude estimates with uncertainties;
- ✓ attempts free-depth solution only in the presence of local networks or reported depth-sensitive phases;
- ✓ if there is no depth resolution, the depth is fixed to a region-dependent default depth.

ISC Bulletin Rebuild, ingredients

different location techniques and velocity models used over 100 years

Existing ISS Catalogue

Existing ISC Bulletin

1900

no phase data

1964

old locator

2009

new locator

2013

ISC-GEM bulletin data
(new Locator)

Additional data of permanent and temporary networks

ISC Bulletin data,
(new locator)

all parameters computed with the new ISC locator and ak135

Re-Built ISC Bulletin

1904

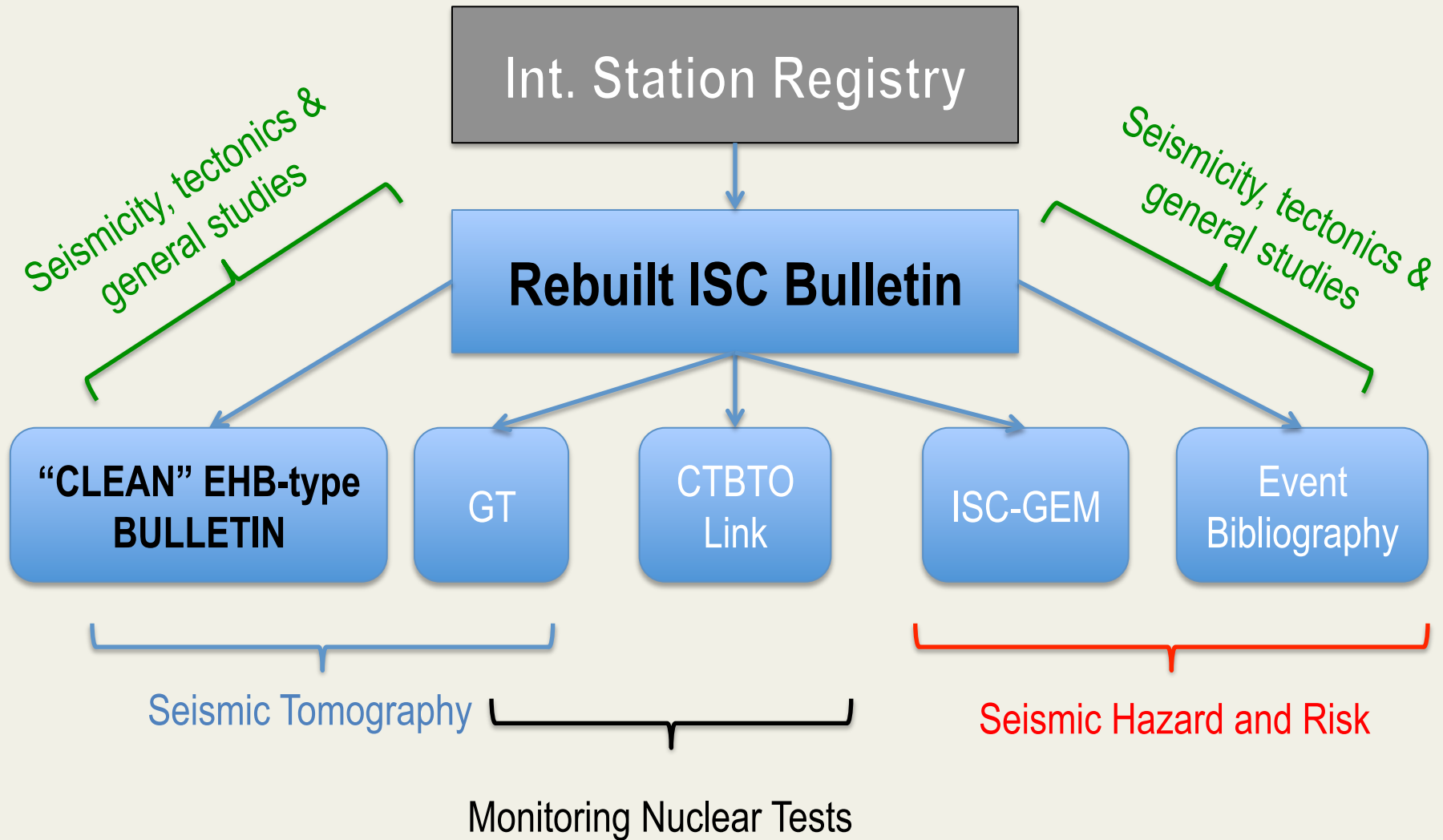
1964

1978

2009

Current

The ISC data products as expected by mid-2015



Summary

- The ISC continues with its unique **long-term international mission** collecting seismic bulletin data from **130** agencies worldwide
- The ISC Products are freely available:
 - **Int. Station Registry** (1964-2014)
 - **ISC Bulletin** (1964-2014)
 - **EHB** (1964-2008)
 - **GT** (1959-2012)
 - **ISC-GEM Catalogue** (1900-2009)
 - **ISC Event Bibliography** (1950-2014)
- The **Rebuilt ISC Bulletin** will be available by **mid-2015**.
- Several geophysical institutions in LAC region are ISC members and many more contribute bulletin data to the ISC
- We encourage other geophysical institutions in the LAC area to join the ISC and provide bulletin data on a regular basis.

