

**ISC-GEM Catalogue**

# ISC PRODUCTS for LARGE EARTHQUAKES

## in the LATIN AMERICA and CARIBBEAN REGION



**ISC Event Bibliography**

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James Harris

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

# International Seismological Centre, **ISC**



*Prof. John Milne  
(1850-1913)*

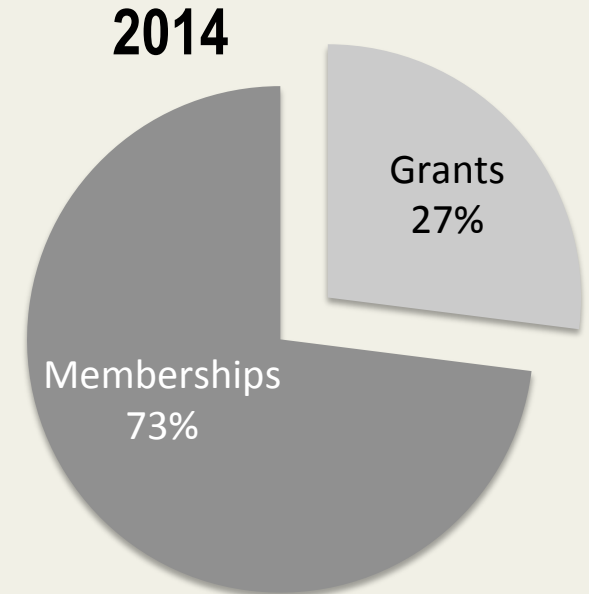
- set up in **1964** to continue the work of the ISS and BAAS (from early **1900s**)
- international, non-profit, non-governmental
- based in **UK**
- 17-19 staff

## Supported by:

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

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

Sponsors: *Reftek*



# ISC data products for large earthquakes: [www.isc.ac.uk](http://www.isc.ac.uk)

## 1. ISC Event Bibliography

## 2. ISC-GEM Catalogue

Seismological  
Centre

International Station Registry

Event Bibliography

Bibliography of Seismology

Seismological Contacts

ISC-GEM Catalogue

### ISC News

2014-01-16

[Sep - Dec 2013 Newsletter](#)

2014-01-16

[May - Aug 2013 Newsletter](#)

2014-01-16

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

2013-04-14

[ISC Event Bibliography released](#)

### News for / from data contributors

2013-11-21

[Census of legacy Quanterra dataloggers](#)

2013-04-26

[100 years of the OSC, Bolivia](#)

2012-11-05

[Temporary development work, SRC, Trinidad](#)

2012-10-06

[Zlata Sinyova, KNDC, Kazakhstan](#)

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Centre Séismologique  
International

Международный  
Сейсмологический Центр

国際地震センター

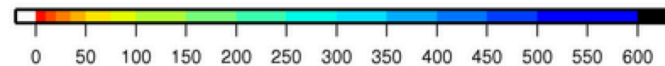
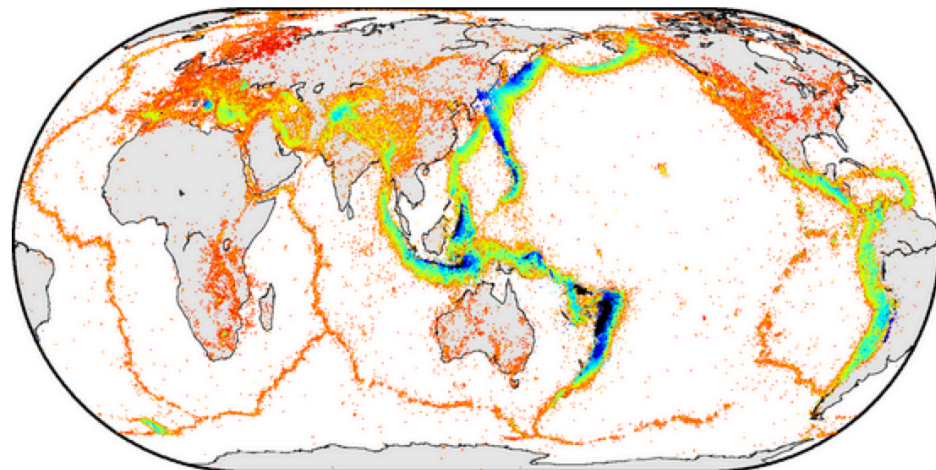
国际地震中心

Internationales  
Seismologisches Zentrum

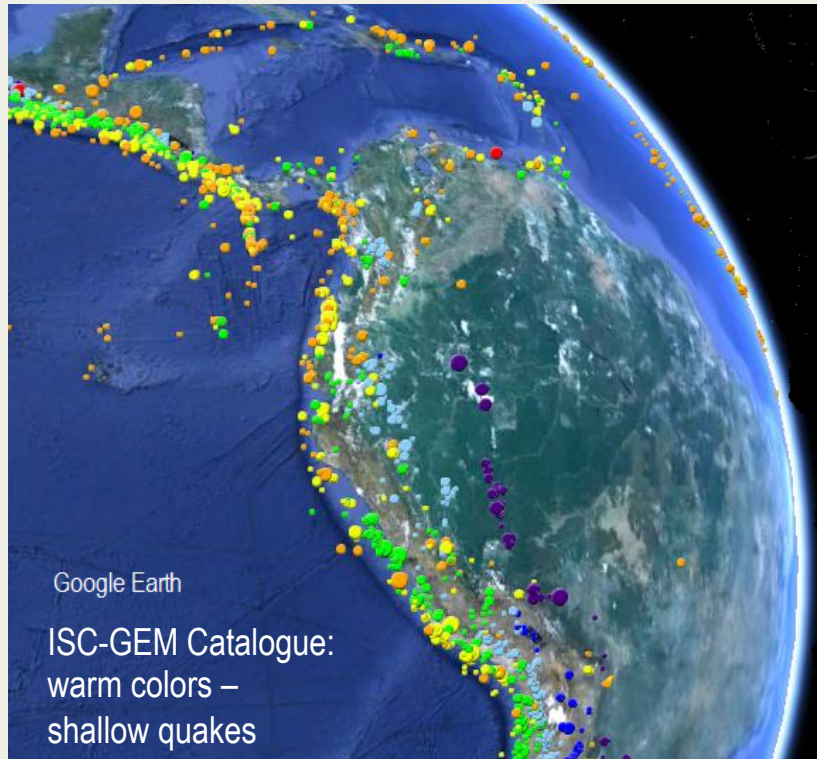
المركز الدولي لبحوث الزلازل

Centro Internacional  
de Sismologia

ISC locations: 1960 to present



# ISC-GEM Global Instrumental Earthquake Catalogue (1900-2009)

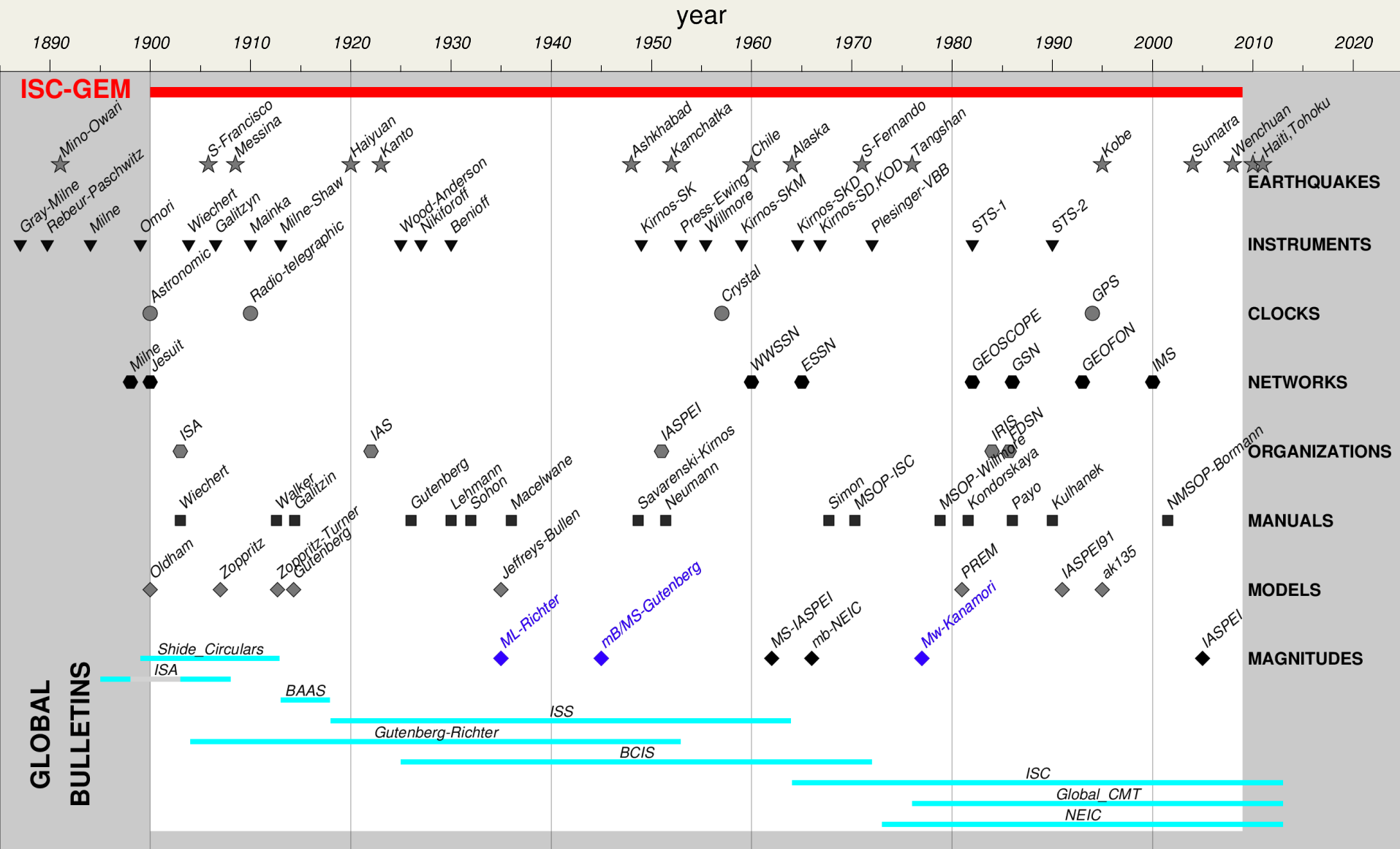


The ISC-GEM Global Instrumental Earthquake Catalogue is built for the purpose of seismic hazard assessment:

- ~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:**  $M_S \geq 5.5$

# ISC-GEM: improvement in length of period



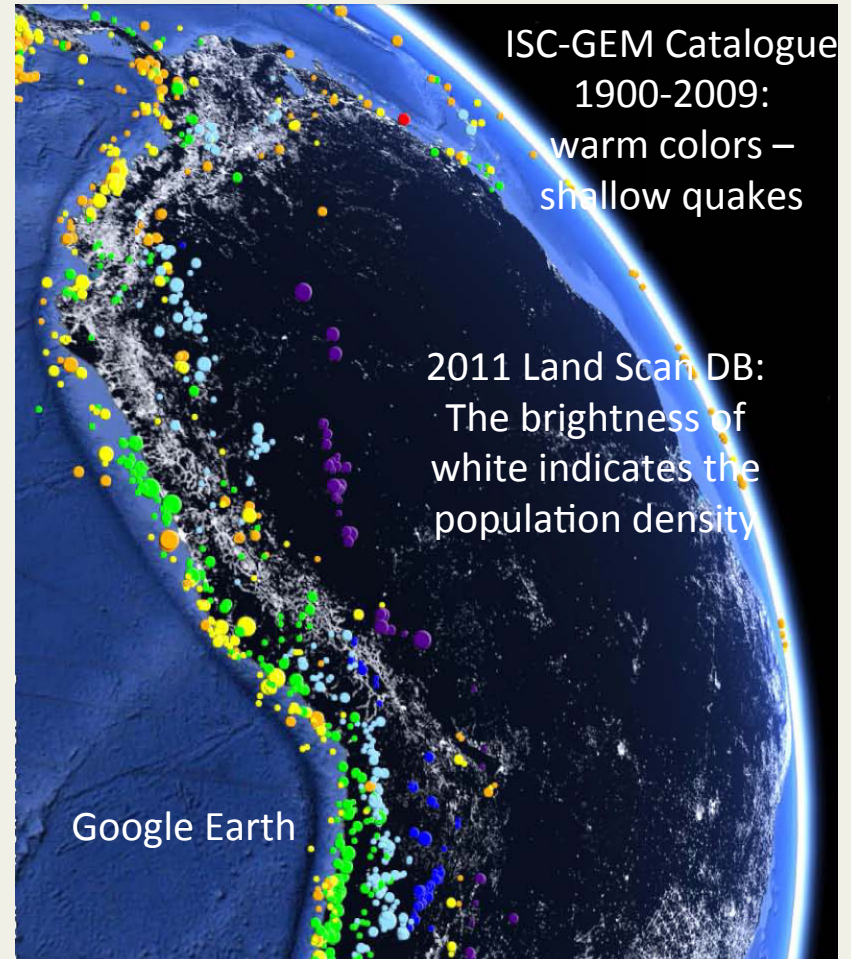
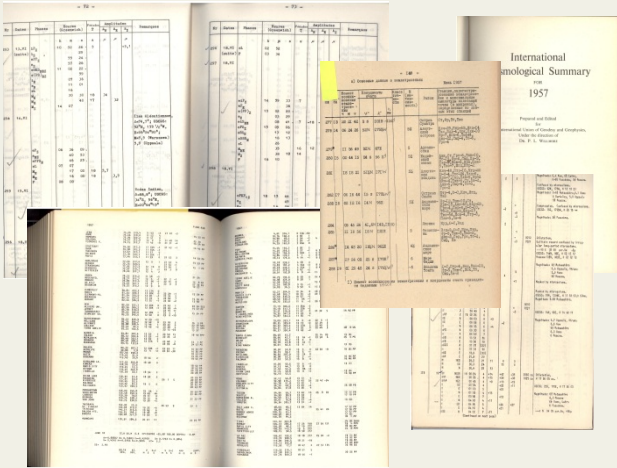
# ISC-GEM: improvement in data availability

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

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

*(Storchak et al., 2014)*

# ISC-GEM: improvement in data availability



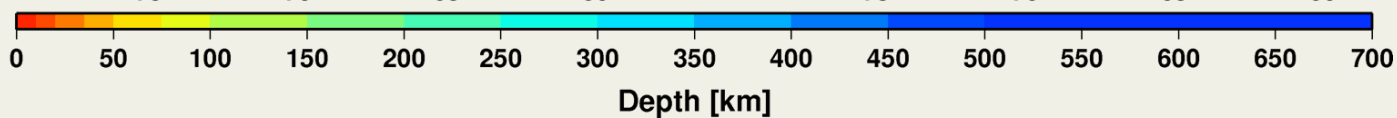
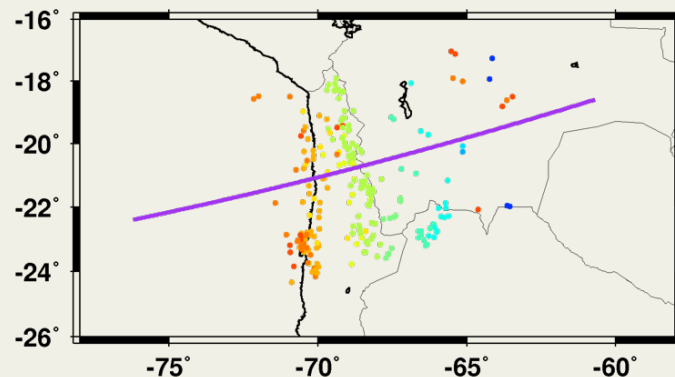
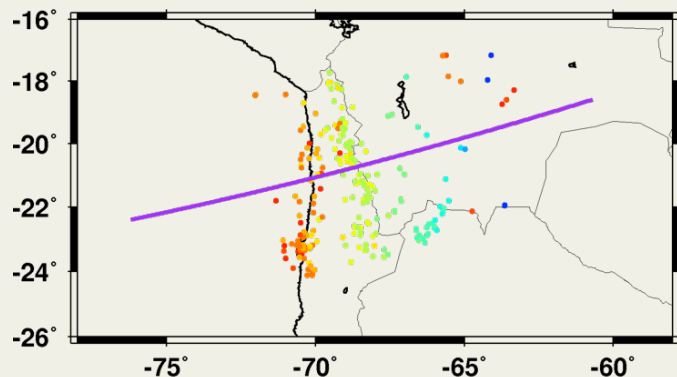
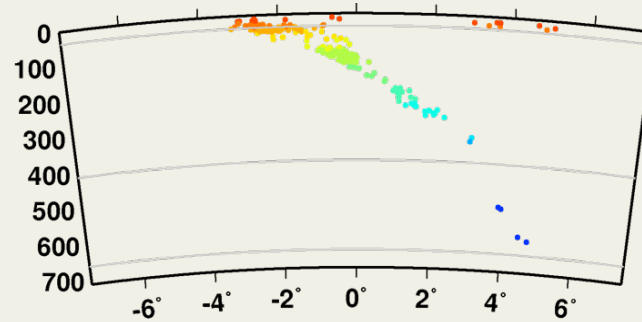
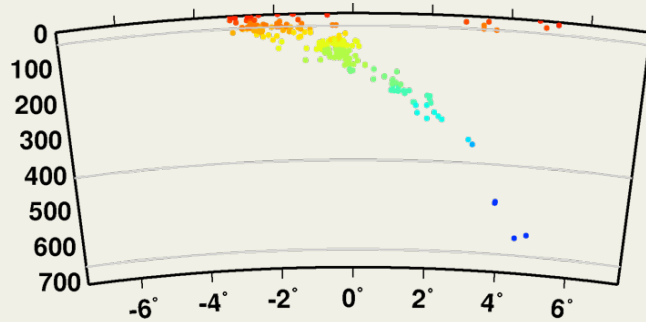
courtesy of Ross Stein, USGS

**~4,000** downloads  
from **~1,000** unique IP-addresses  
in **15** months

# ISC-GEM: improvement in earthquake location

before

ISC-GEM

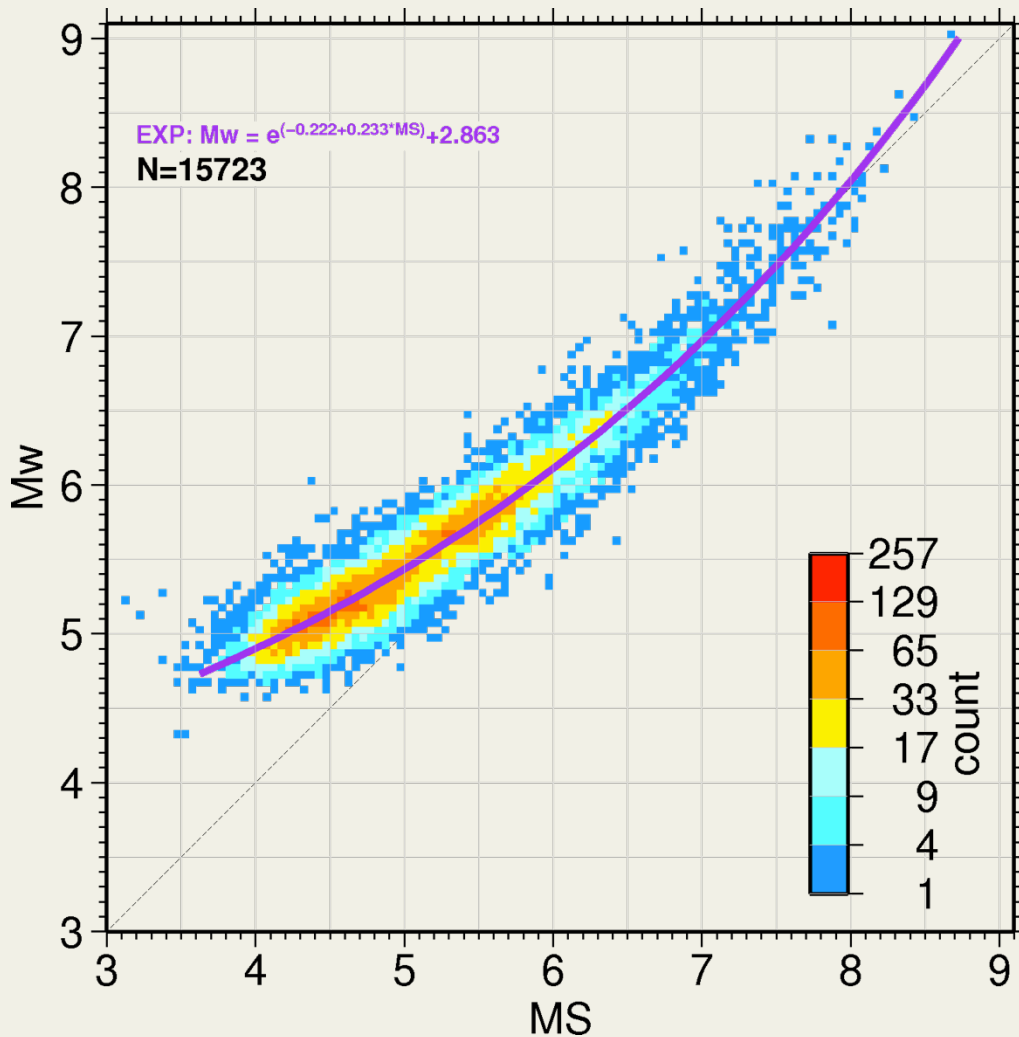


As a result of consistent relocation of hypocentres with the same technique (**EHB+ISC**) and velocity model (*ak135*) we observe tighter clustering of earthquake hypocentres, better focusing, many regional tectonic features are illuminated

Location maps and cross-sections in the Arica region (*Bondár et al., 2014*)



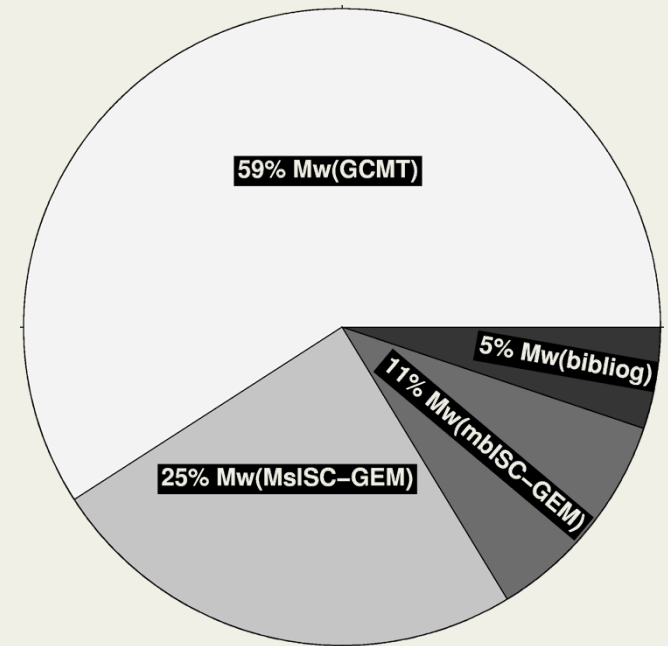
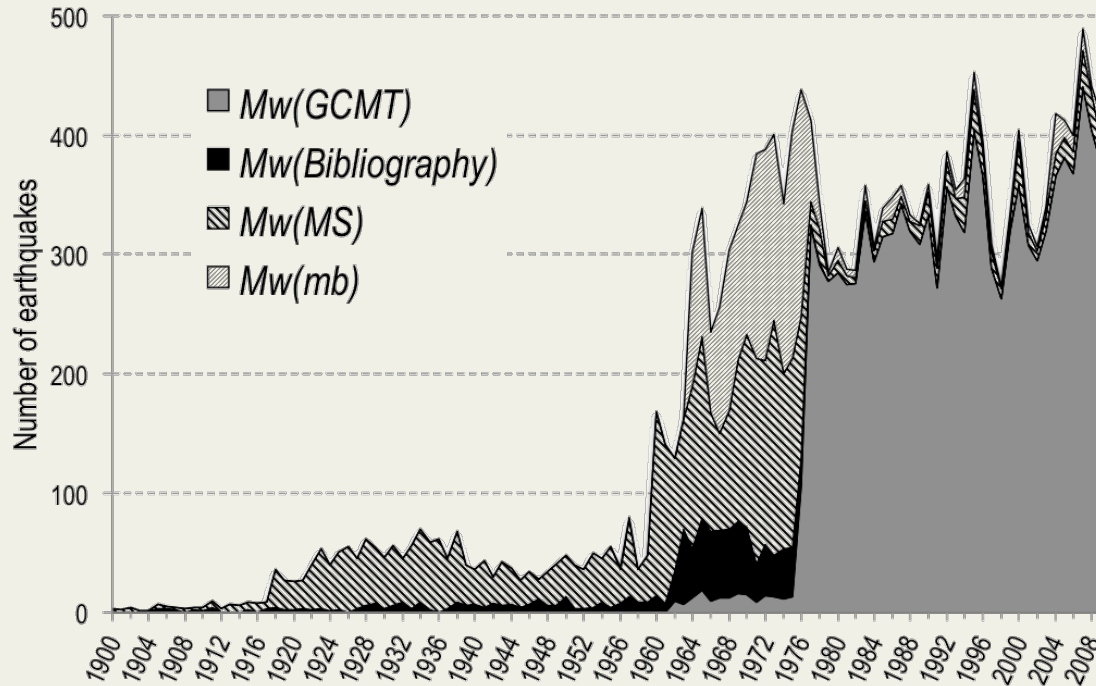
# ISC-GEM: improvement in magnitude homogeneity



(Di Giacomo et al., 2014)

We used **GCMT  $M_w$**  and re-computed **ISC  $M_S$**  determinations of the modern period to build regression curves that were later applied to obtain  $M_w$  proxies in the early period before GCMT.

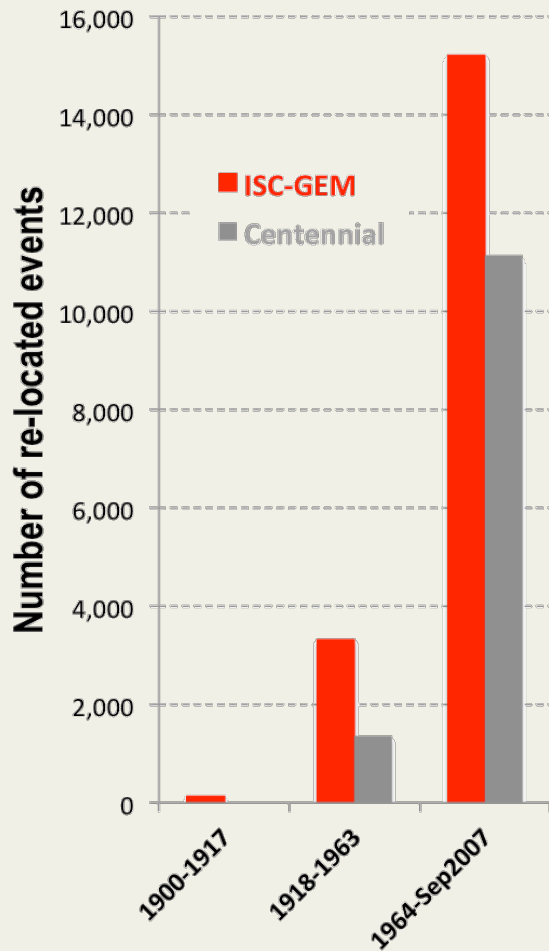
# ISC-GEM: improvement in magnitude homogeneity



(Storchak et al., 2014)

We assigned an  $M_W$  magnitude value (direct or proxy) with an estimate of uncertainty to each earthquake in 1900-2009.

# ISC-GEM: comparison to Centennial catalog (\*)



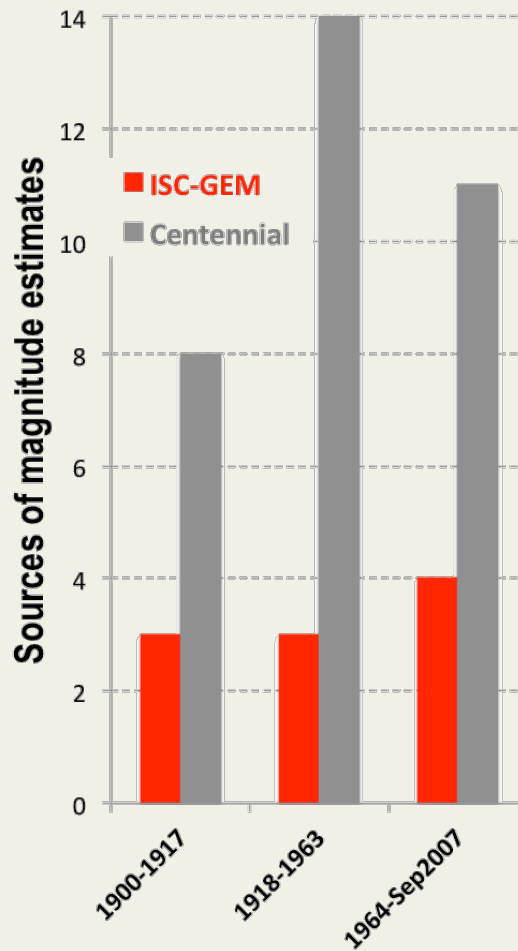
## ISC-GEM:

all hypocentres in 1904-2009 have been re-computed using the same:

- location technique
- velocity model

## Centennial:

a lot fewer earthquakes were re-located



## ISC-GEM:

Magnitude type: all  $M_W$  from just 4 comparable sources:

- direct GCMT,
- direct Bibliog,
- $M_S$ ,
- $mb$

## Centennial:

5 different types of magnitude from 14 sources

(\*) **Centennial Catalog:** 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.

# ISC Event Bibliography: Motivation

Seismologists often need to identify scientific articles related to specific earthquakes at particular date or in specific regions.

Bibliographical searches such as Google Scholar would require them to type a text string containing a name for the earthquake or the region and date it occurred.

This search may need to be repeated several times to account for all possible transliterations of a place name in English, several different ways of specifying a date and a variety of names of the area where the earthquake has occurred.

The results then have to be merged and the unavoidable duplicates removed.

The procedure is daunting and often leads to unstable results.



# ISC Event Bibliography: What does it do?

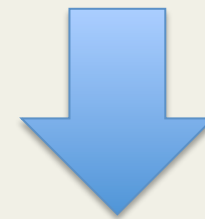
## Searches for:

- references to scientific publications
- linked to both natural and anthropogenic events
- within the selected area and time period
- interactive
- based on earthquake (location, time, magnitude, etc.) and/or
- publication parameters (author name, journal, year of publication, etc.).



Image: Los Angeles Times, Sep 20, 2010

## Mexico City Earthquake, 1985



all together  
**209**  
references

ISC Event Agency	Origin time	Lat	Lon	Depth	Magnitude	Articles_total	Event code
516251	ISC 1985-09-21 01:37:15	17.81	-101.69	42.1	mb(ISC) = 6.2	40	MEXICOCITY1985B

Ruff, L.J. and Miller, A.D., 1994. Rupture process of large earthquakes in the northern Mexico subduction zone, *Pure appl. Geophys.*, 142, 1, 101-171, DOI: 10.1007/BF00875970

Lermo, J. and Chavez-Garcia, F.J., 1993. Site effect evaluation using spectral ratios with only one station, *Bull. seism. Soc. Am.* 83, 5, 1574-1594.

Ramírez-Gaytán, A., Aguirre, J., Jaimes, M.A., and Huérfano, V., 2014. Scaling Relationships of Source Parameters of Mw 6.9–8.1 Earthquakes in the Cocos–Rivera–North American Subduction Zone, *Bull. seism. Soc. Am.*, 104, 2, 840-854, DOI: 10.1785/0120130041

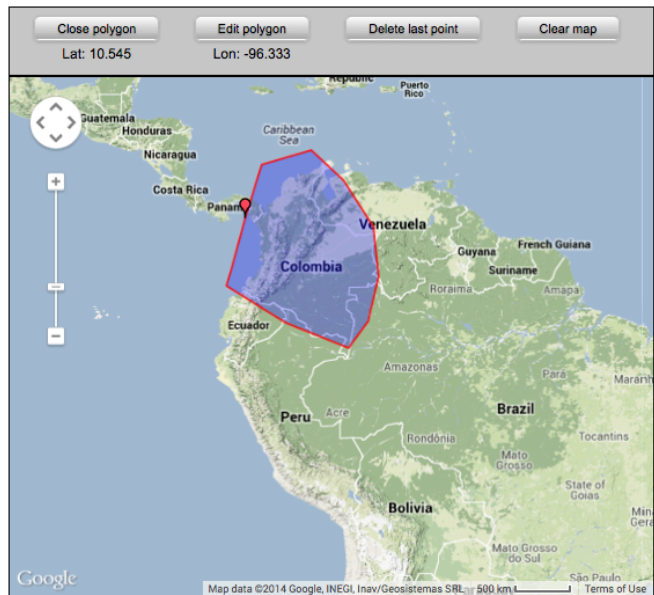
Talandier, J., Reymond, D., and Okal, E.A., 1987. Mm: Use of a variable-period mantle magnitude for the rapid one-station estimation of teleseismic moments, *Geophys. Res. Lett.*, 14, 8, 840-843, DOI: 10.1029/GL014i008p00840

Goguitchaichvili, A., Ramírez-Herrera, M.T., Calvo-Rathert, M., Aguilar Reyes, B., Carrancho, Á., Caballero, C., Bautista, F., and Contreras, J.M., 2013. Magnetic fingerprint of tsunami-induced deposits in the Ixtapa–Zihuatanejo Area, Western Mexico, *Int. Geol. Rev.*, 55, 12, 1462-1470, DOI: 10.1080/00206814.2013.779781

Ordaz, M. and Singh, S.K., 1992. Source spectra and spectral attenuation of seismic waves from Mexican earthquakes, and evidence of amplification in the hill zone of Mexico City, *Bull. seism. Soc. Am.* 82, 1, 24-43. Michoacan, Mexico earthquake at periods of 1 to 30 seconds, *Geophys. Res. Lett.*, 13, 6, 597-600, DOI: 10.1029/GL013i006p00597

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# ISC Event Bibliography: What does it do?



**Event origin time:**

Start date: 2010 01 01 Time (HH:MM:SS): 00  
 End date: 2011 01 01 Time (HH:MM:SS): 00

**Publication options:**

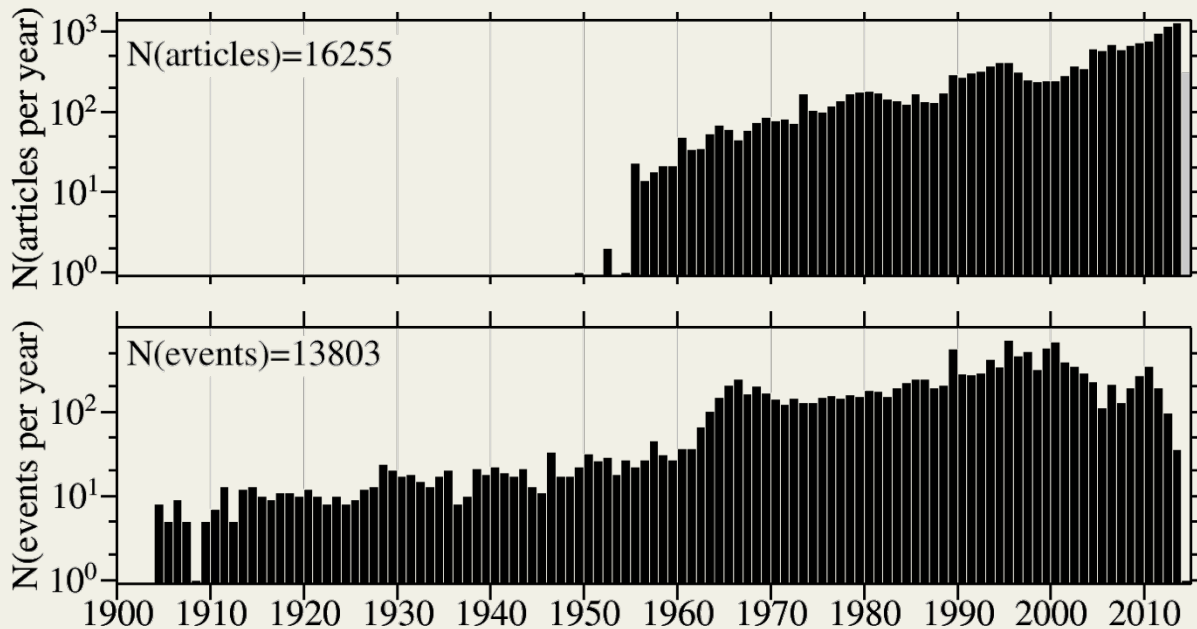
**Publication date:** Min Year  Max Year

**Sort by:** Event origin time  Year of publication  Journal

Journal:   
 Author:   
 Surname: (Names divid)

ISC Event Agency	Origin time	Lat	Lon	Depth	Magnitude	Articles_total	Event code
<a href="#">14267830</a>	ISC 2010-01-24 16:40:56	6.75	-72.95	162.8	mb(ISC) = 4.5	1	
Prieto, G.A., Florez, M., Barrett, S.A., Beroza, G.C., Pedraza, P., Blanco, J.F., and Poveda, E., 2013. Seismic evidence for thermal runaway during intermediate-depth earthquake rupture, <i>Geophys. Res. Lett.</i> , 40, 23, 6064-6068, DOI: <a href="#">10.1002/2013GL058109</a>							
<a href="#">1443400</a>	ISC 1999-01-25 18:19:18	4.47	-75.68	24.3	Mw(ERVD) = 6.2	8	COLOMBIA1999
Sanchez-Silva, M., Yamin, L.E., and Caicedo, B., 2000. Lessons of the 25 January 1999 Earthquake in Central Colombia, <i>Earthq. Spectra</i> , 16, 2, 493-510, DOI: <a href="#">10.1193/1.1586123</a>							
Rios, D.A. and Hermelin, M., 2004. Prediction of landslide occurrence in urban areas located on volcanic ash soils in Pereira, Colombia, <i>Bull. Eng. Geol. Environ.</i> , 63, 1, 77-81, DOI: <a href="#">10.1007/s10064-003-0216-9</a>							
Wang, Y., 1999. Report on Colombia earthquake damage to lifelines, <i>Oregon Geology</i> 61, 1, 20-21.							
Dimaté, C., Rivera, L., and Cisternas, A., 2005. Re-visiting large historical earthquakes in the Colombian Eastern Cordillera, <i>J. Seismol.</i> , 9, 1, 1-22, DOI: <a href="#">10.1007/s10950-005-1413-2</a>							
Trenkamp, R., Mora, P.H., Salcedo, H.E., and Kellogg, J.N., 2004. Possible Rapid Strain Accumulation Rates Near Cali, Colombia Determined From Gps Measurements (1996-2003), <i>Earth Sci. Res. J.</i> 8, 1, 25-33.							
Gonzalez De Schroeder, S., Flarez, J., and Colonia Guitarrez, J.E., 2002. Morbilidad en Asentamientos Post-Terremoto en Armenia, Colombia, <i>Revista de Salud Publica</i> 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) earthquake of 25 January 1999, <i>J. geophys. Res.</i> , 107, B6, 2107, DOI: <a href="#">10.1029/2001JB000197</a>							
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 (Colombia), in the frame of the Neotectonics of arc-continent collision concepts, <i>Earth Sci. Res. J.</i> 15, 1, 47 - 74.							
<a href="#">112441</a>	ISC 1995-03-04 23:23:41	1.31	-77.30	5.0	mb(ISC) = 4.3	1	
Jiménez, M.J., García-Fernández, M., and Romero, J., 2009. 1989-1995 Earthquake sequences in the Galeras volcano region, SW Colombia, and possible volcano-earthquake interactions, <i>Tectonophysics</i> , 463, 1-4, 47-59, DOI: <a href="#">10.1016/j.tecto.2008.09.004</a>							
<a href="#">125610</a>	ISC 1995-01-19 15:05:06	5.09	-72.94	36.6	mb(ISC) = 6.2	3	TAURAMENA1995
Dimate, C., Rivera, L., Taboada, A., Delouis, B., Osorio, A., Jimenez, E., Fuenzalida, A., Cisternas, A., and Gomez, I., 2003. The 19 January 1995 Tauramena (Colombia) earthquake: Geometry and stress regime, <i>Tectonophysics</i> , 363, 3-4, 159-180, DOI: <a href="#">10.1016/S0040-1951(02)00670-4</a>							
Anvidsson, R. and Ekström, G., 1998. Global CMT analysis of moderate earthquakes, Mw ≥ 4.5, using intermediate-period surface waves, <i>Bull. seism. Soc. Am.</i> 88, 4, 1003-1013.							
Dimaté, C., Rivera, L., and Cisternas, A., 2005. Re-visiting large historical earthquakes in the Colombian Eastern Cordillera, <i>J. Seismol.</i> , 9, 1, 1-22, DOI: <a href="#">10.1007/s10950-005-1413-2</a>							
<a href="#">167996</a>	ISC 1994-06-06 20:47:43	2.99	-76.03	32.6	mb(ISC) = 6.3	2	COLOMBIA1994
1994. Earthquake and tsunami report, December 1993 through June 1994. Three local tsunamis generated, <i>Tsunami News!</i> 26, 1, 3.							
Dimaté, C., Rivera, L., and Cisternas, A., 2005. Re-visiting large historical earthquakes in the Colombian Eastern Cordillera, <i>J. Seismol.</i> , 9, 1, 1-22, DOI: <a href="#">10.1007/s10950-005-1413-2</a>							
<a href="#">268313</a>	ISC 1992-10-18 15:11:59	7.15	-76.84	10.0	mb(ISC) = 6.4	5	COLOMBIA1992B
Ammon, C.J., Lav, T., Velasco, A.A., and Vidale, J.E., 1994. Routine estimation of earthquake source complexity: the 18 October 1992 Colombian earthquake.							

# ISC Event Bibliography: Contents

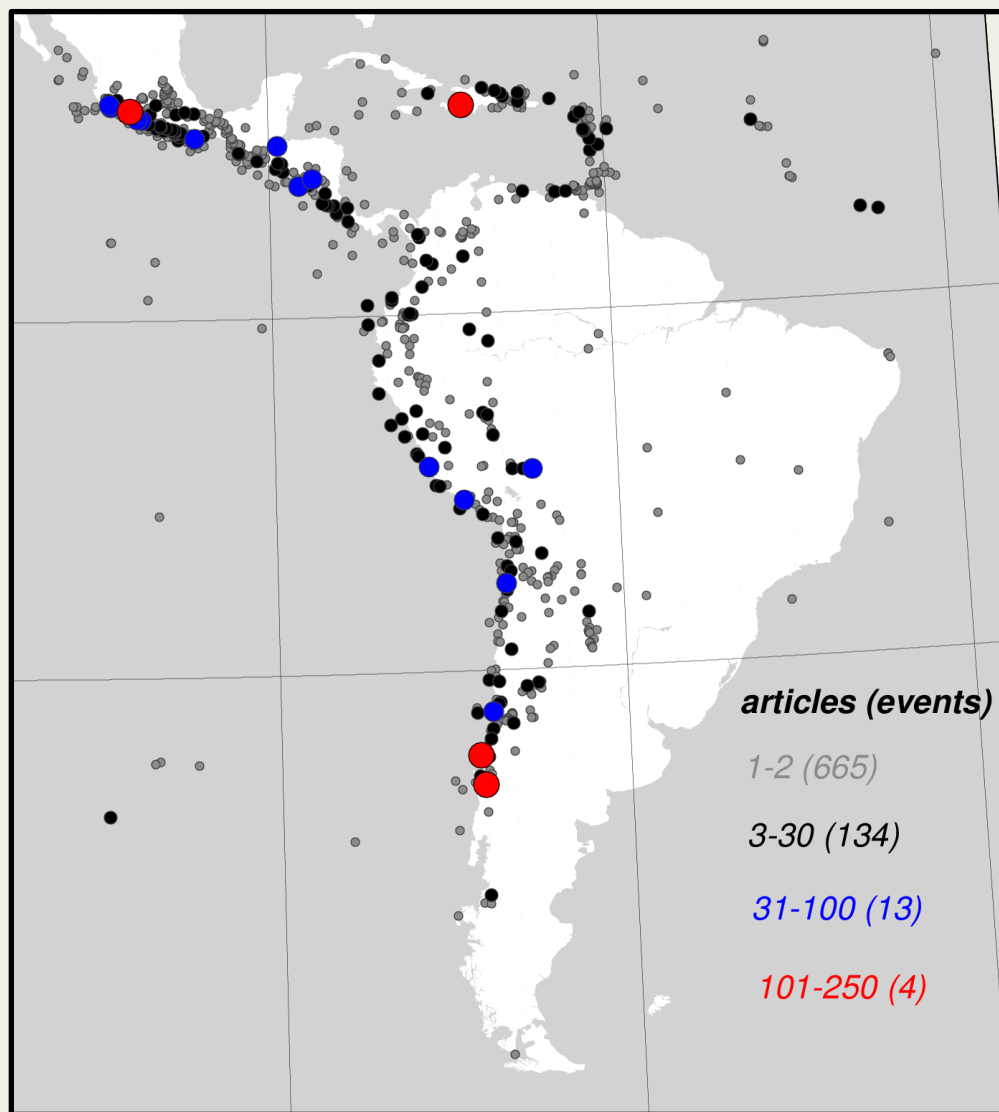


*(Di Giacomo et al., 2014)*

As of May 2013, the ISC Event Bibliography includes:

- scientific articles published in the last **50** years and
- related to seismic events occurred in the last **110** years.
- A few events in the first half of the 20th century
- **16,255** scientific articles related to **13,803** earthquakes and anthropogenic events

# Event Bibliography: most referenced events in LAC



Majority of seismic events attracted just 1 or 2 articles. Some events attracted many tens or even hundreds of articles

Earthquake	year	articles
Maule	2010	235
Mexico City	1985	209
Chile	1960	166
Haiti	2010	101
Managua	1972	72
Bolivia	1994	66
San Antonio	1985	55
Peru	2001	52
Chile	1995	43
Nicaragua	1992	42



# ISC Event Bibliography: Geoscience Fields

References to publications cover:

- Seismology
- Earthquake engineering
- Tectonics
- Structural geology
- Geodesy
- Remote sensing
- Nuclear test monitoring
- Tsunami
- Landslides
- Environmental studies
- Coastal science
- Natural disasters
- Hydrology
- Geochemistry
- Atmospheric sciences
- Geomagnetism

# Summary

- Thanks to the support of its Members, grant providers and sponsors, the ISC is able to continue with its unique **long-term international mission**
- The ISC Products for large earthquakes are free and open:
  - **ISC-GEM Catalogue** (1900-2009)
  - **ISC Event Bibliography** (1950-2014)
- We invite and take into account comments and suggestions from scientists working in LAC area.
  - unexpected locations and magnitudes of earthquakes in the ISC-GEM ??
  - missing references to articles in the ISC Event Bibliography ??
- We maintain the log of changes and publically acknowledge all help received from our colleagues.