The IASPEI Reference Event (GT) List Maintained by the ISC

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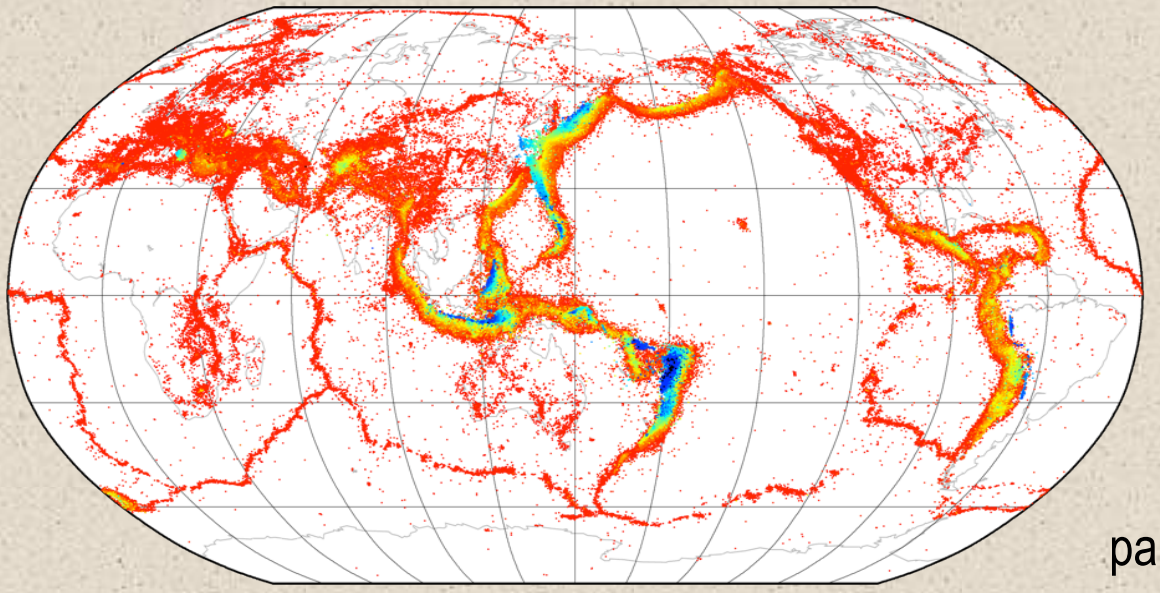
Intro: ISC Core Mission – the ISC Bulletin



~7.4 M events, ~206 M seismic arrivals based on ~17,000 stations during 1904-2019

The ISC mission is to maintain the most

- long-term,
- complete,
- continuous,
- accurate

global summary of seismicity and parameters of instrumental recordings at as many well-distributed seismic stations as possible.

Intro: ISC Core Mission – the ISC Bulletin

The ISC routinely collects earthquake bulletins from ~150 seismic networks in ~100 countries, comprising in total ~8,000 permanent seismic stations worldwide.

Original seismograms are freely available only from a small fraction of these stations, but it is possible to collect parameters of station analysis done by local seismologists.

For technical, monetary or diplomatic reasons, no individual national institution is able to receive data from as many geographically distributed stations as the ISC does.

The Key is the **non-profit**, **non-governmental** and strictly **international status** of the ISC.

IASPEI Reference Event List (GT) maintained by the ISC

The GT-List includes:

events (both earthquakes and explosions):

- *(lat, lon)* is known with high confidence;
- seismic signals recorded at regional and/or teleseismic distances.

GTx event is known within x km to a 95% confidence level.

GT-List is useful for:

- Validation of 3D Earth models
- Testing new location algorithms
- Developing empirical path corrections
- Assessing accuracy of published bulletins

Origins:

- Nuclear explosions adopted from the Nuclear Explosion Database (*Bennett et al, 2010*);
- GT0-5 chemical explosions, rock bursts, mine-induced events and a few earthquakes from *Bondár et al (2004)*;
- GT5 events (typically earthquakes with crustal depths) identified using either the method *of Bondár et al (2008)* (2,275 events) or *Bondár & McLaughlin (2009)*, which are updated regularly, mostly from the ISC Bulletin.

GT: Current Workflow

We select and relocate qualifying events from the **ISC Bulletin**

We search through **scientific publications**

We review **external event nominations** submitted through the webpage

We participate in dedicated efforts to **build qualifying events**

CTBTO PREPARATORY COMMISSION

RSTT

The IASPEI "GT Police"

- Bob Engdahl
- István Bondár
- Eric Bergman

vet all candidate events

Accepted GT candidates are included into the GT-List and made freely available from the dedicated webpages

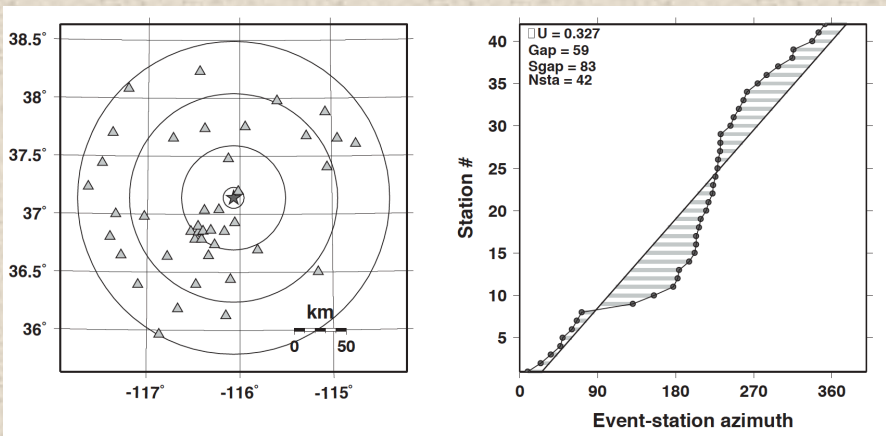
PostgreSQL

www.isc.ac.uk/gtevents

GT: Identifying and giving appraisal to candidate events

1. Candidate events are selected:
   - mb/MS < 6.1 (to satisfy point-source approximation)
   - at least one station within 10 km (to increase confidence and help resolve depth)
   - 10 stations up to 150 km (to avoid Pg/Pn & Pg/Pb cross-over distances)
   - network geometry metric, ΔU ≤ 0.35
   - secondary azimuthal gap < 160˚
   - recorded at teleseismic distances
2. Selected events are relocated using stations within 150 km.
3. The above criteria reassessed once again.

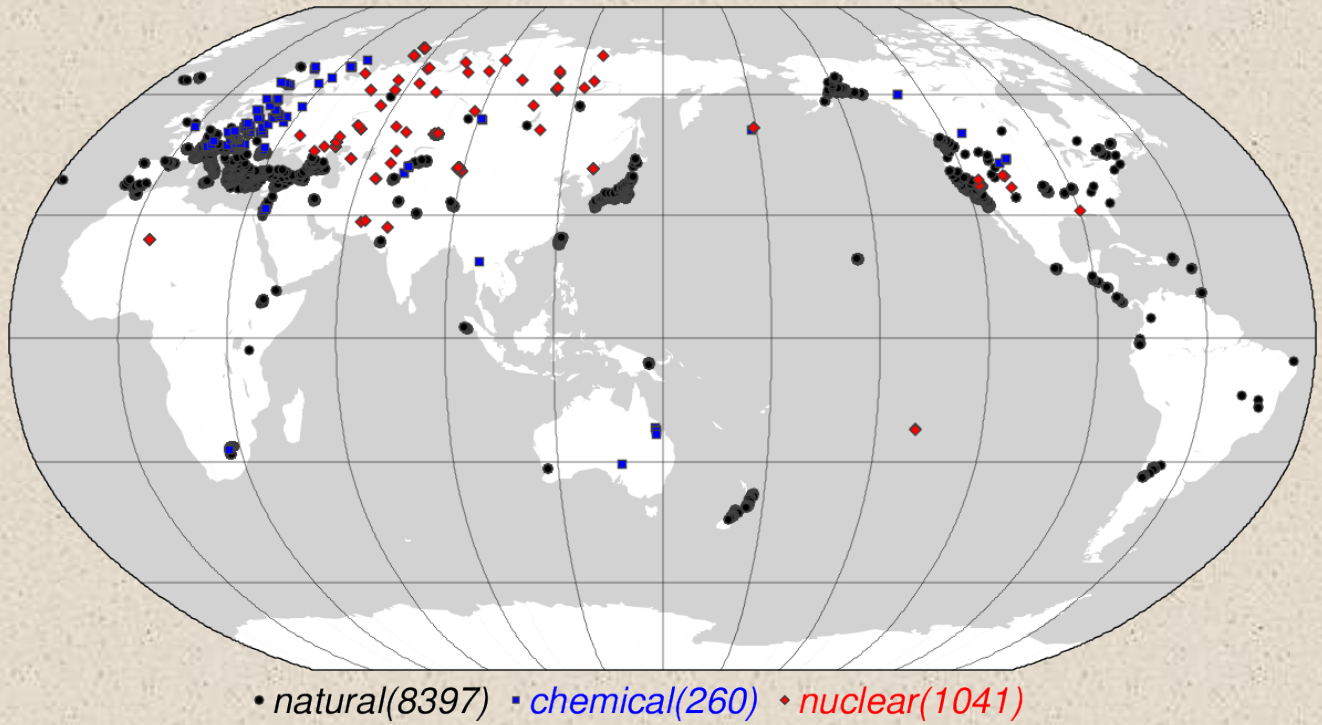
*Network geometry metric, **ΔU**, measures deviation from azimuthally uniform station distribution;*



ΔU=0 – stations uniformly distributed in azimuth
ΔU=1 - all the stations at the same azimuth

Bondár & McLaughlin, SRL, 2009

GT: Events by type



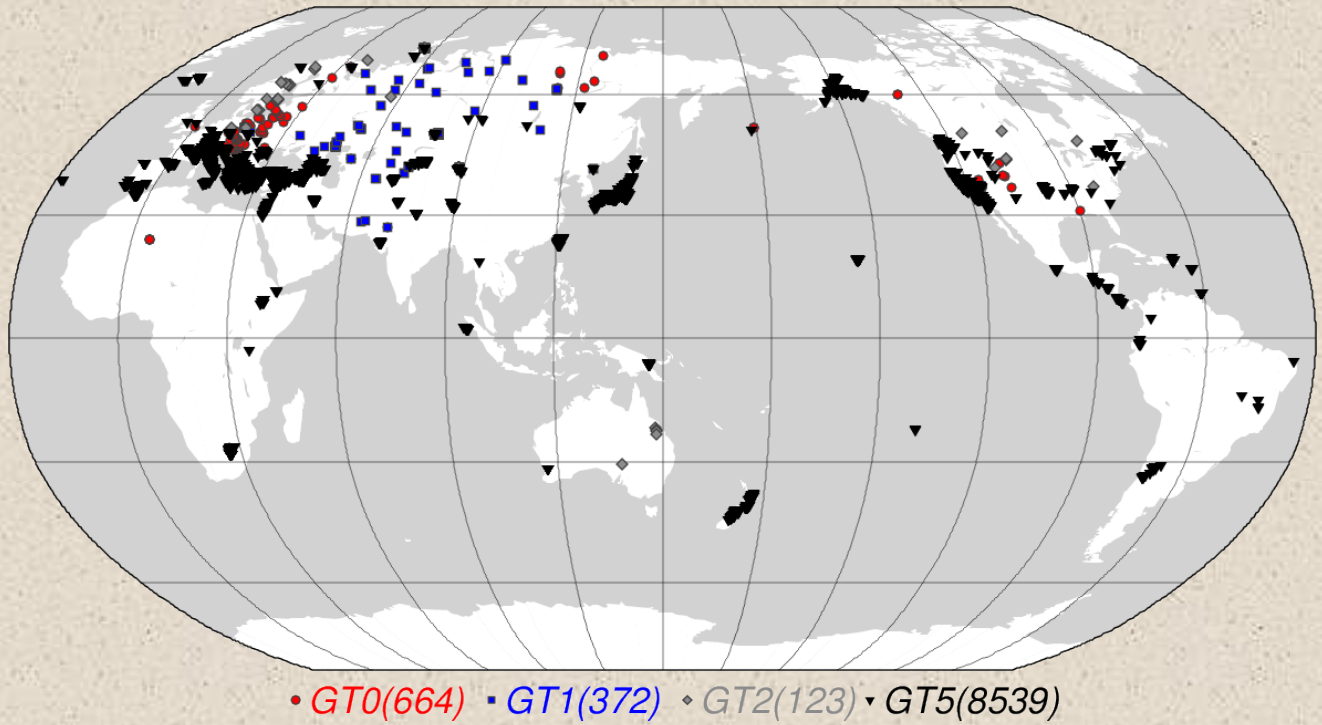
9,698 GT(0-10) events with locations known with 95% confidence level:

✓ natural

✓ anthropogenic

accompanied by **~1,130,000** associated seismic arrivals

GT: Events by location accuracy (GTx)



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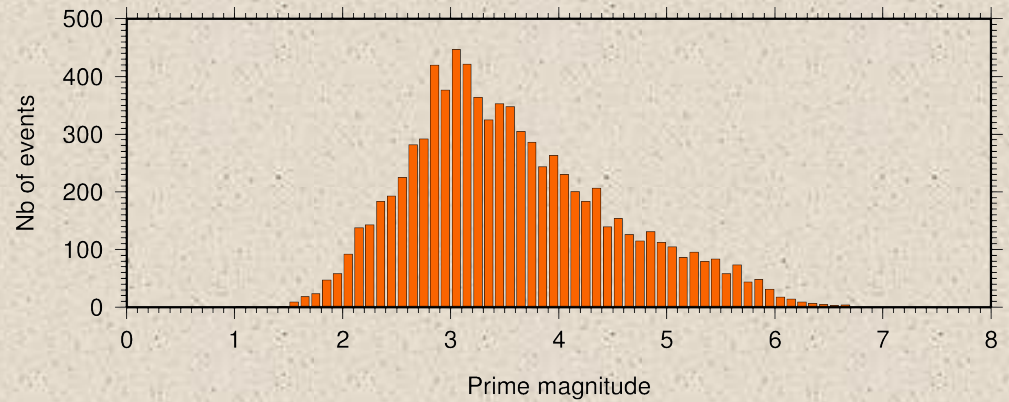
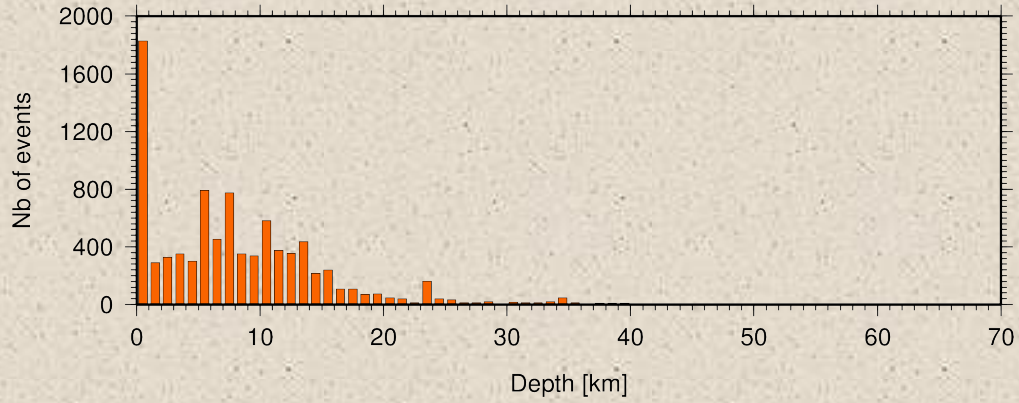
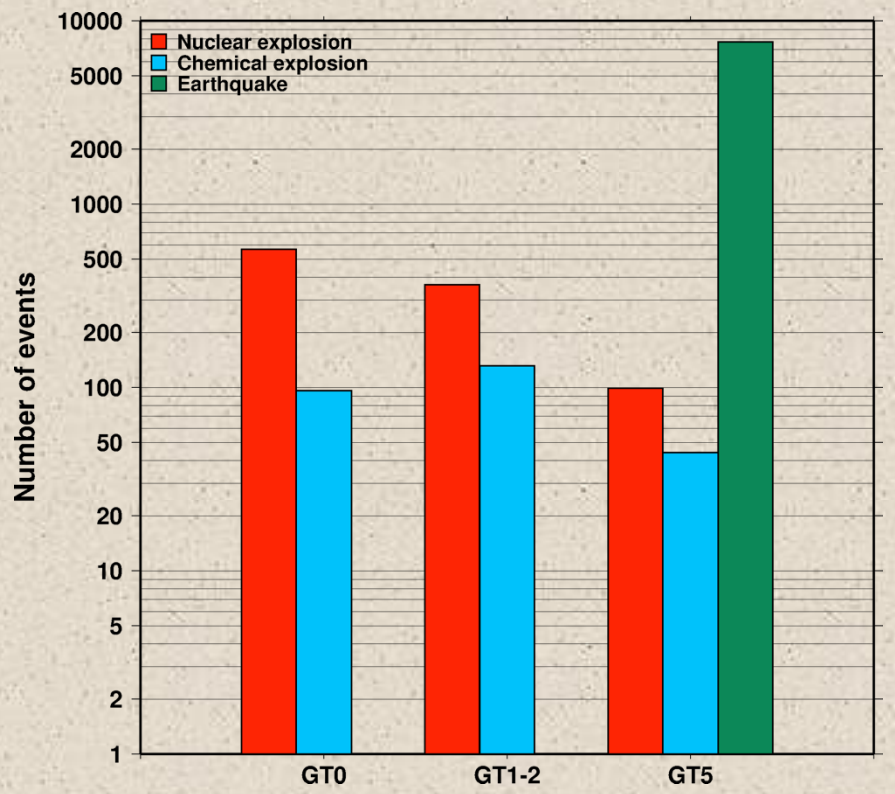
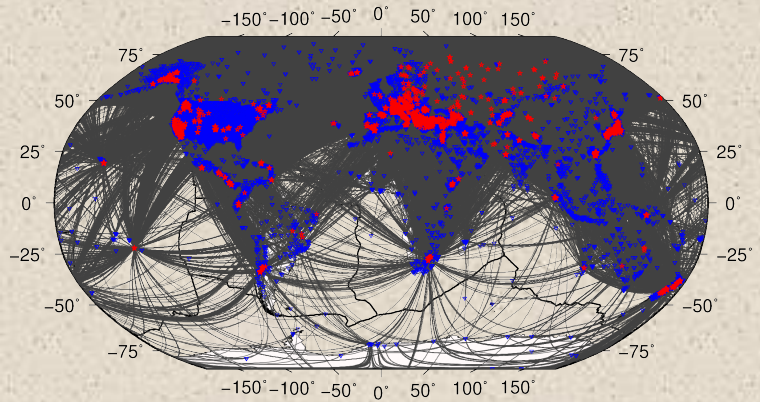
GT: General Statistics





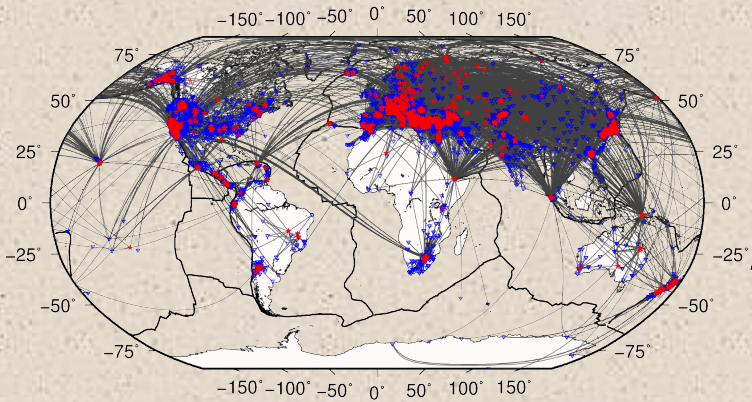


GT: ray paths, seismic phases



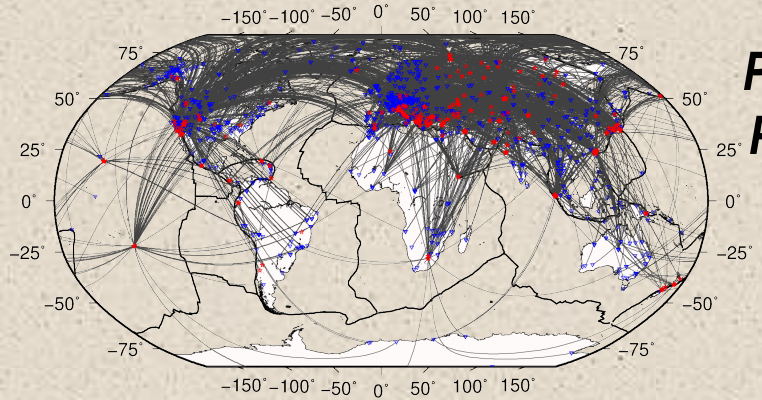
P*, *Pn*, *Pb*, *Pg

667,684 arrivals



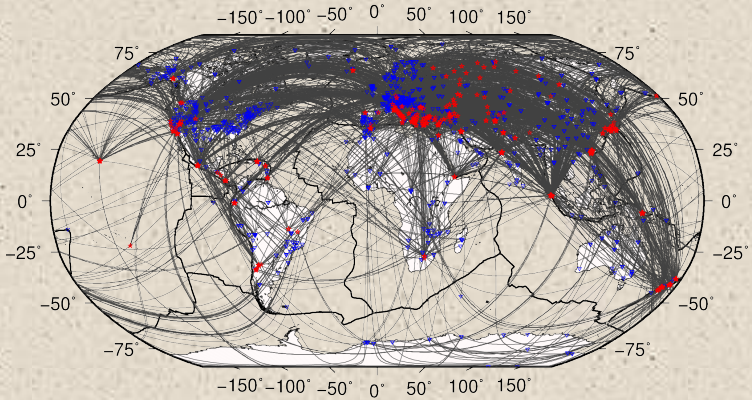
S*, *Sn*, *Sb*, *Sg

195,380 arrivals



PcP*, *ScS*, *PcS*, *ScP

6,804 arrivals



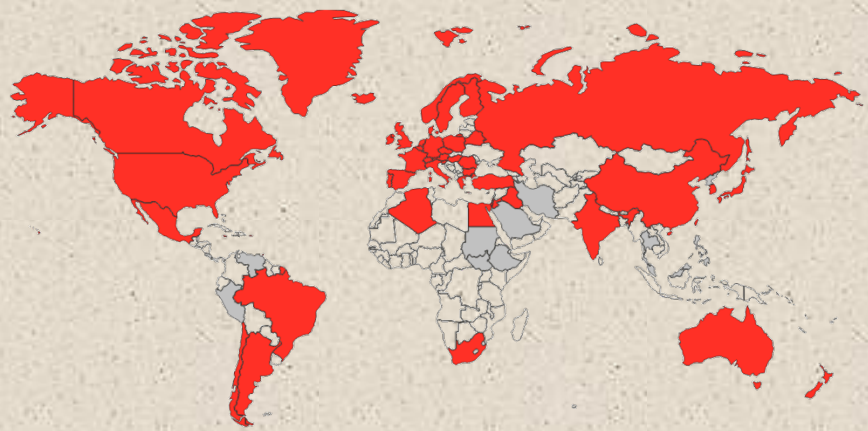
pP*, *pS*, *sP*, *sS*, *sP

5,215 arrivals

Summary

- The ISC continues its unique long-term international mission collecting earthquake bulletins from **~150** agencies worldwide and producing the ISC Bulletin.
- Alongside this work, we continue maintaining and updating the IASPEI Reference Event List (**GT-List**)
- The GT-List contains seismic events with increased accuracy of event locations
- Depth and origin time strongly depend on velocity structure, thus, the GT network criteria focus on the location accuracy.
- The GT–List has poor ray-path coverage in the South hemisphere that is gradually addressed by collecting arrival time data from temporary deployments.
- The GT-List is a useful dataset for:
  - modelling velocities of seismic waves,
  - accurate travel time determination,
  - accurate event location,
  - new location algorithm development.
- The GT-List is freely available at: www.isc.ac.uk/gtevents

ISC Member-Institutions



68 Institutions in **50** countries support the ISC operations, including those **new**:

- TexNet, *USA*
- DIAS, *Ireland*
- NIGGG, *Bulgaria*

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