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A Unified Seismic Bulletin of Central Asia on the Base of Historical Data

Anna Berezina, Natalia Mikhailova, Kevin Mackey, Inna Sokolova, Bayan Bekturganova, Shohrukh Murodkulov, Elena Pershina, Kenneth Abrams, and Rengin Gök

T2.5 - 89

POSTER

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ABSTRACT

We have created a unified seismic bulletin of Central Asia to improve event locations and knowledge of seismic hazards. The National Data Centers and seismic networks of Kazakhstan, Kyrgyzstan, and Tajikistan have digitized historic bulletins of earthquakes with mb3.0 and greater from this region of Eurasia for 1949-2017. Soviet era data covering portions of Uzbekistan, Turkmenistan, and Russia have been included for completeness. Data available from the International Seismological Centre (ISC) for all years, and local digital seismic bulletins since 1993 were collected and merged with the digitized bulletins. In total, the unified bulletin contains over 10 million arrivals. To obtain regional magnitude conversion relationships from small events with traditional magnitudes (ML, mb and Ms), we use the coda calibration technique that allowed direct calculation Mw from source spectra that were obtained using the Coda Calibration Tool (CCT), developed at LLNL. After merging all available information and relocations, the Central Asia unified seismic bulletin was created. This is the first comprehensive bulletin developed for this region.

This project fills in a considerable portion of a gap in data for the region, increases the accuracy of event parameters, preserves unique archival data, and supplements ISC bulletins with new data for the region.

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INTRODUCTION

Region Under Study

The region under study includes all of Central Asia plus a border extending out about 300 km.

The data are divided into eras, analog and digital. The analog era includes 1900 through 1992. Digital era covers 1993-2017. Most of the data from the analog era has been manually typed as a part of this project. In most cases, the catalogs and bulletins from the digital era were already in machine-readable format, though still required merging in our «Quakebase» software developed for this project.

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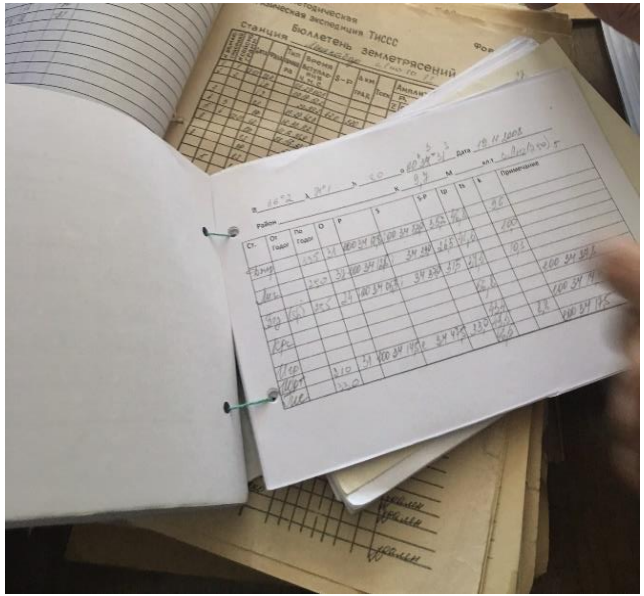
METHODS

Data Sources

Primary analog-era data sources for this project are the seismological archives in Central Asia. Data from the original seismogram analysis were recovered and merged from different networks. Some original seismograms were reanalyzed. Data were supplemented with catalogs and bulletins from the International Seismological Centre and Soviet publications. Digital-era data are from the digital seismic networks of each participating country.



Bulletin example from Tajikistan

Kazakhstan bulletin archive

Kyrgyzstan seismogram storage

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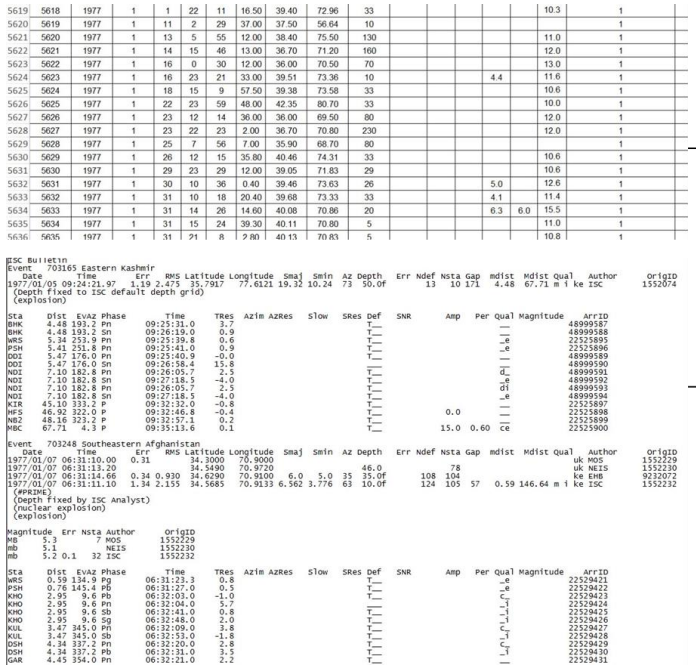
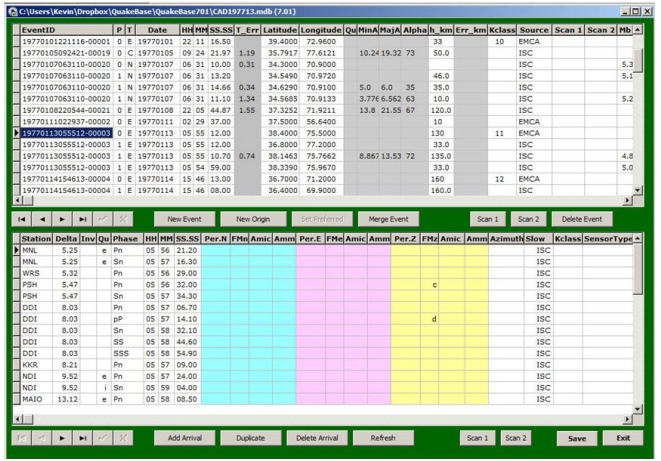
METHODS

Database Software

We developed a custom database entry software called «Quakebase», that allows the merging of multiple data formats and allows direct manual entry of catalogs and bulletins. For phase and bulletin data, scans of the original source material are dynamically linked in the software for preservation of legacy data.





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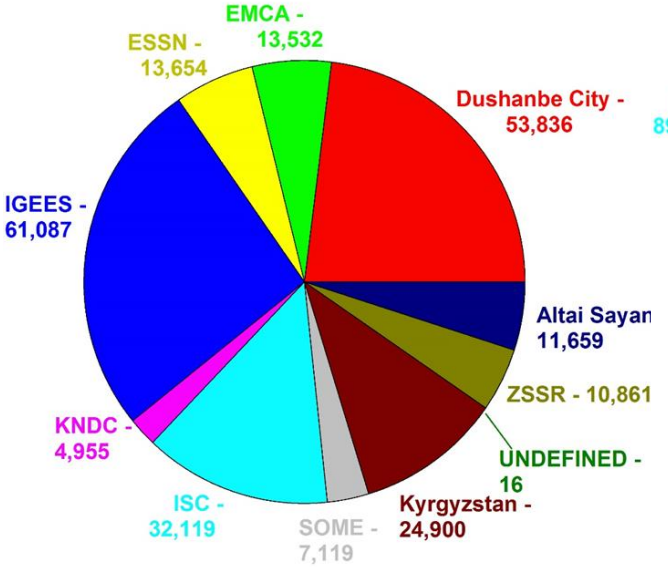
Analog Era (1900-1992) Catalog and Bulletin Assembly

RESULTS

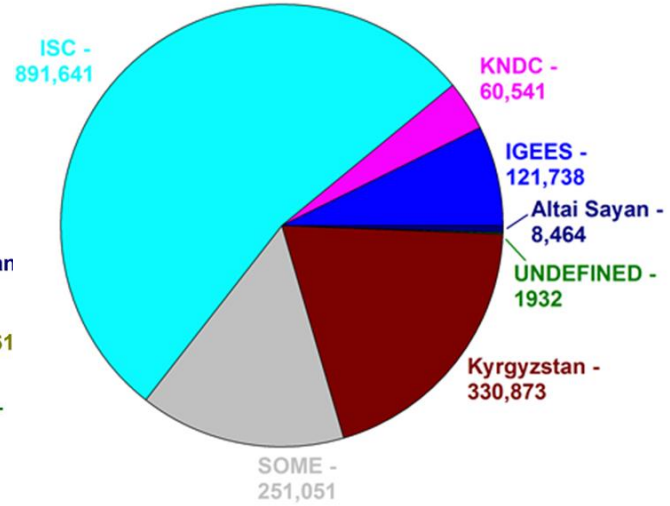
The analog era data, from 1900-1992, for Central Asia contains over 230,000 event entries and over 1.6 million arrivals from 10 primary and secondary sources

CATALOG



Total: 233,738 Origins

BULLETIN



Total: 1,666,240 Arrivals

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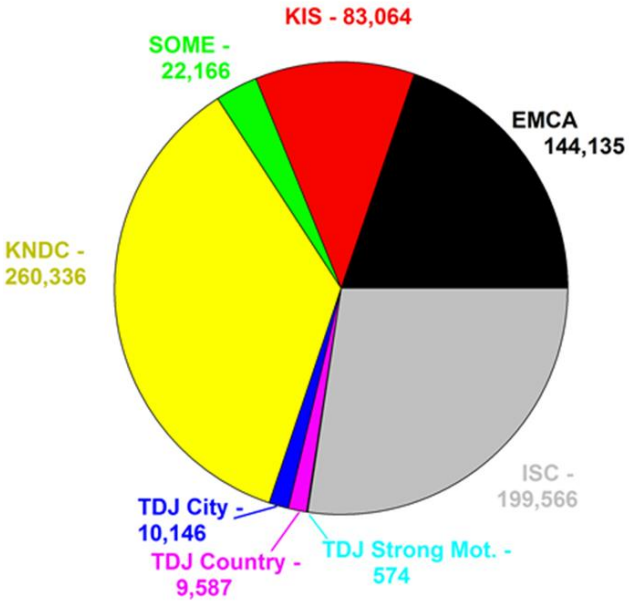
RESULTS

Digital Era (1993-2017) Catalog and Bulletin Assembly

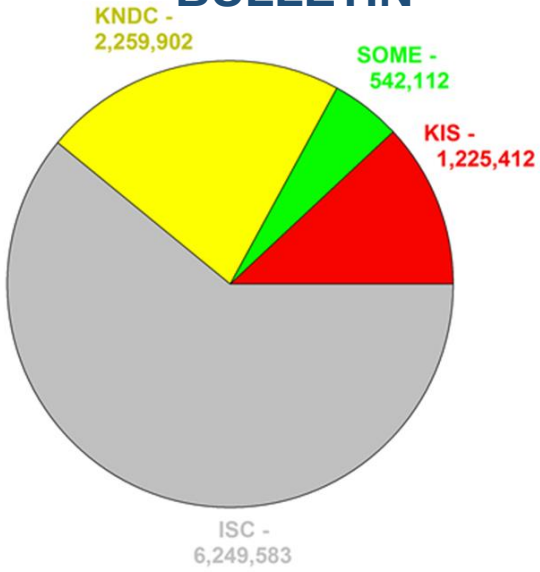
The digital era data, from 1993-2017, for Central Asia contains over 725,000 event entries and over 10 million arrivals from 8 primary and secondary sources

CATALOG



Total: 729,574 Origins

BULLETIN



Total: 10,259,007 Arrivals

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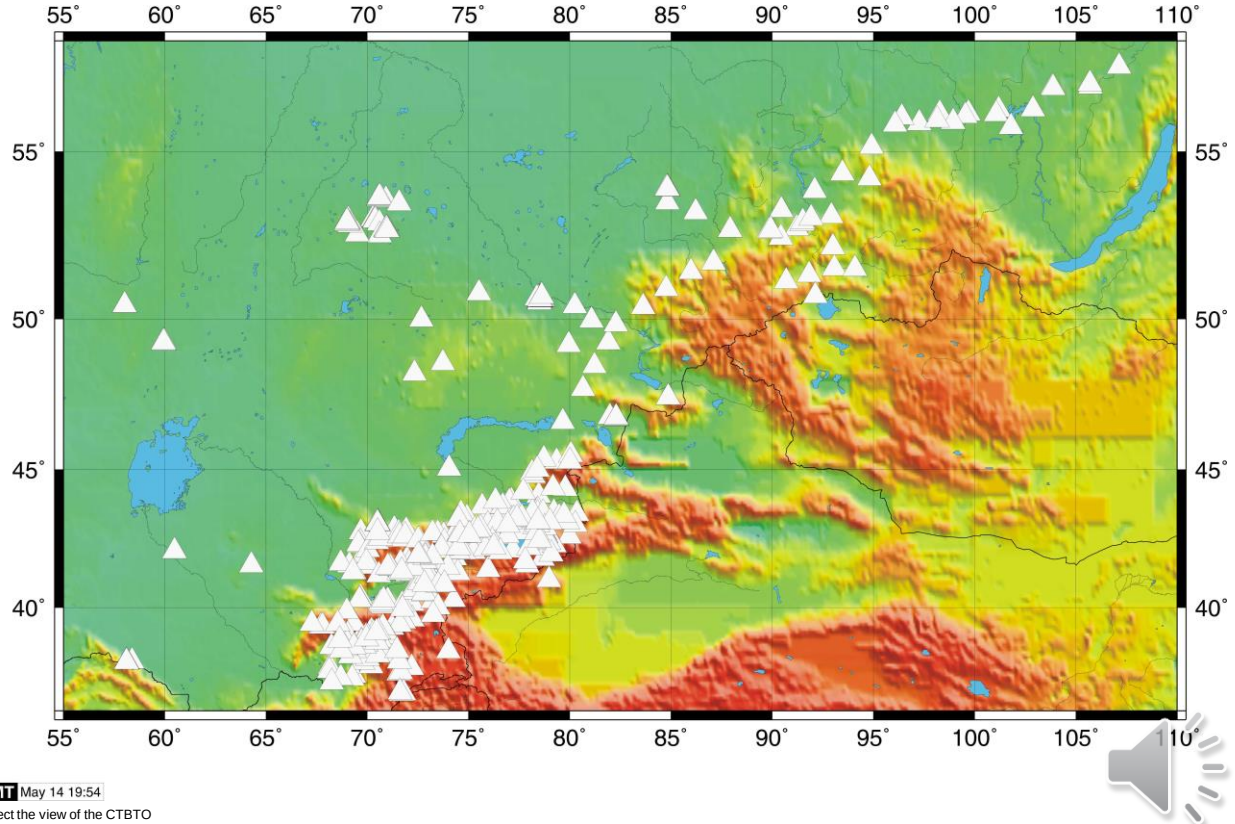
METHODS

Seismic Stations

Data from over 400 local and regional stations, both permanent and temporary, were compiled for this project. Additional data from stations reporting to the ISC are included. The adjacent map shows the Central Asia stations used.



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METHODS

Station Metadata

The Quakebase software links to a 'Passport' for each station that contains comprehensive histories, metadata, and calibrations. This recovery of calibration and other information is critical. Seismogram digitizations of legacy data rely on system response files to conduct quantitative research.

Strong Motion Station: ARZ

Station Code: ARZ

Open Date: 2000

Close Date : open

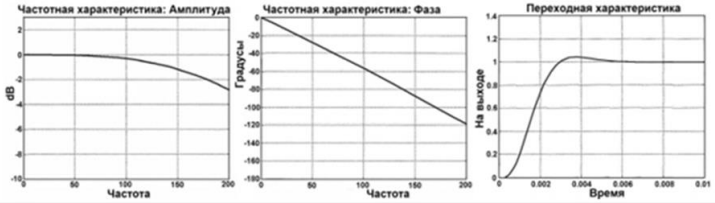
Location: 43.349 E, 76.008949 N 650m GPS Coordinates

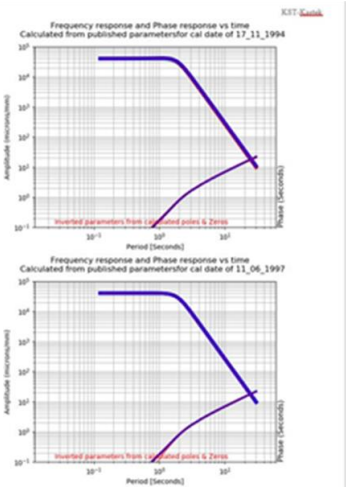
Address: Almaty, Ahmetova st. 13.

Recording History:

ARZ Strong Motion Station was opened at 2000. The station is located in the bomb shelter of the Aviation Repair Plant, in a monolithic concrete basement. Soil conditions at the station – interstratification of loams, sandy loams and sands.

Ground motion registration is performed by the Altus-ETNA accelerometer (Kinemetrix, USA). The type of sensor is "EpiSensor" - an orthogonally oriented three-axis compensation accelerometer with a full signal amplitude of 2g, natural frequency of 50 Hz, attenuation of 70% of the critical and dynamic range of more than 135 dB (0.01-50 Hz). The device is working in the trigger mode. The trigger threshold is set to 0.05% of the total signal amplitude. The amplitude, phase, and transient characteristics of the sensor are shown below.





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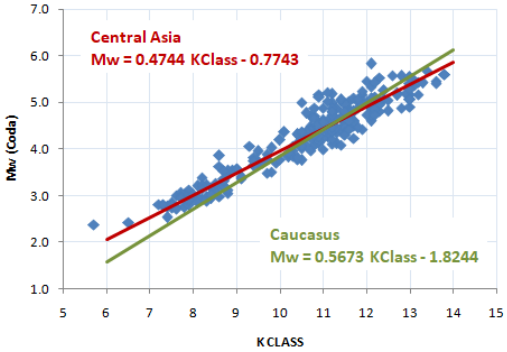
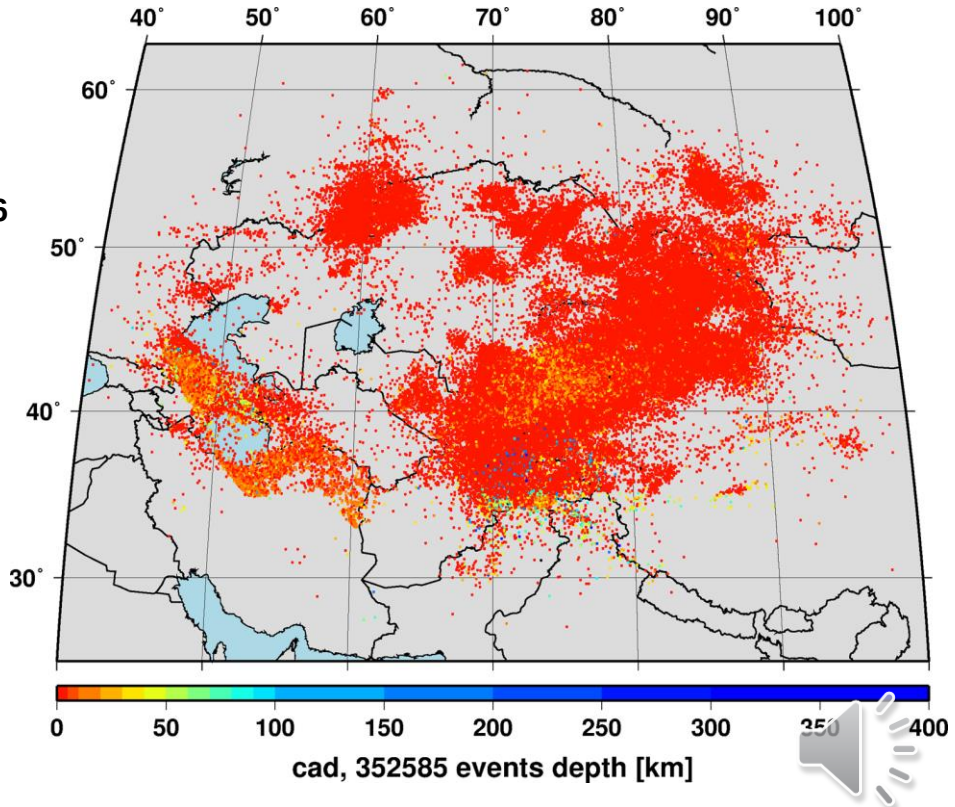
RESULTS

Seismicity Map

A map of the original epicenters shows the seismic activity of Central Asia. Using the compiled catalog, events are being relocated. Please see poster T2.5-86 by István Bondár for these procedures and results.

Magnitude conversion is obtained from direct Mw measurements using Coda Calibration Tool (CCT).





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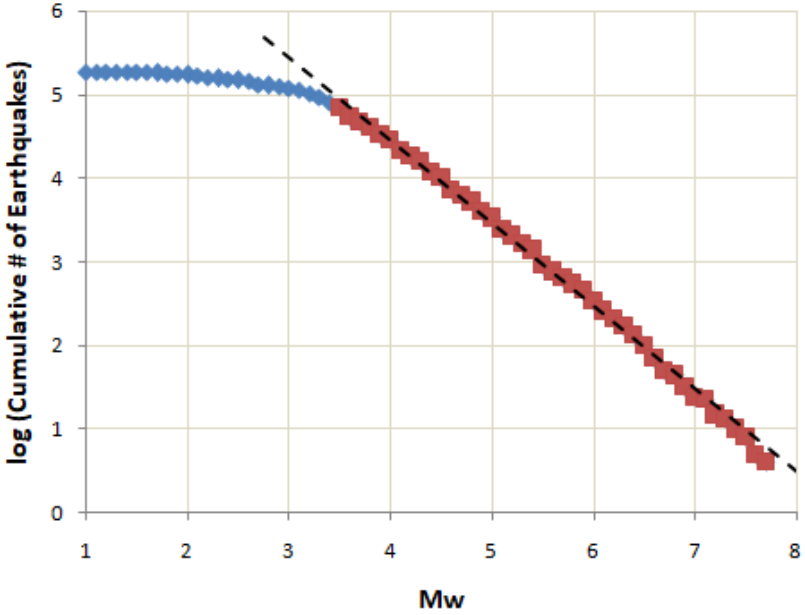
RESULTS

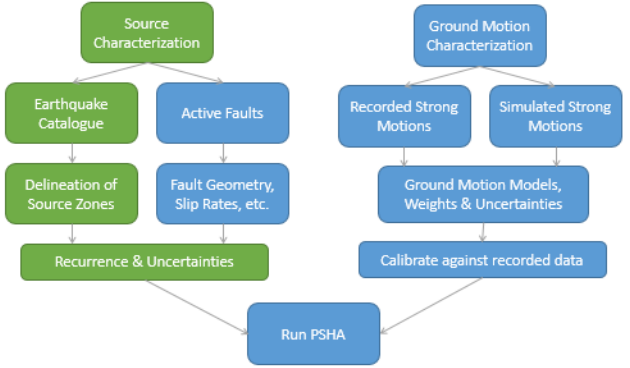
Ongoing Work



The Unified Seismic Bulletin and event relocations will be used for Probabilistic Seismic Hazard Assessment (PSHA) for Central Asia. A part of this process is establishment of a unified Mw magnitude scale for the region and an understanding of magnitude recurrence relationships (Gutenberg-Richter a- and b- values)

Importance of the Earthquake Catalogue Quality for PSHA

PSHA Workflow



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CONCLUSIONS

- **This project developed a unified comprehensive seismological catalog and bulletin for Central Asia by merging regional data from archives in Kazakhstan, Tajikistan, and Kyrgyzstan as well as other regional published and unpublished data.**
- **The project saves remaining historical archives of seismic bulletins and metadata, the loss of which is irreplaceable.**
- **The project fills in a considerable portion of the existing gap in the database for the observational period after 1990, as well as increase the accuracy in the source parameterization of events for earlier period, and assists to preserve the unique seismic information available in corresponding archives.**
- **The bulletin and catalog, in conjunction with regional strong motions records and active fault distribution will be used to determine accurate seismic hazard assessments for modernized building codes of countries in Central Asia using the PSHA methodology.**
- **Catalog and bulletin data, and updated station metadata from this study is planned to be submitted to the ISC for inclusion into their globally accessible data products. The data will be useful to the global monitoring community.**

Please, see poster T2.5-86 by István Bondár for results of event relocations