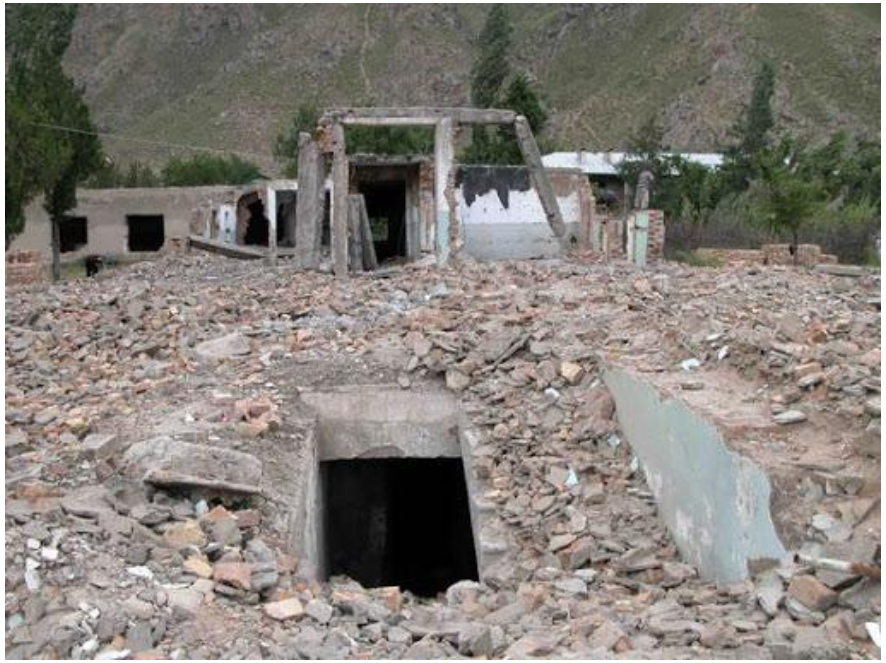
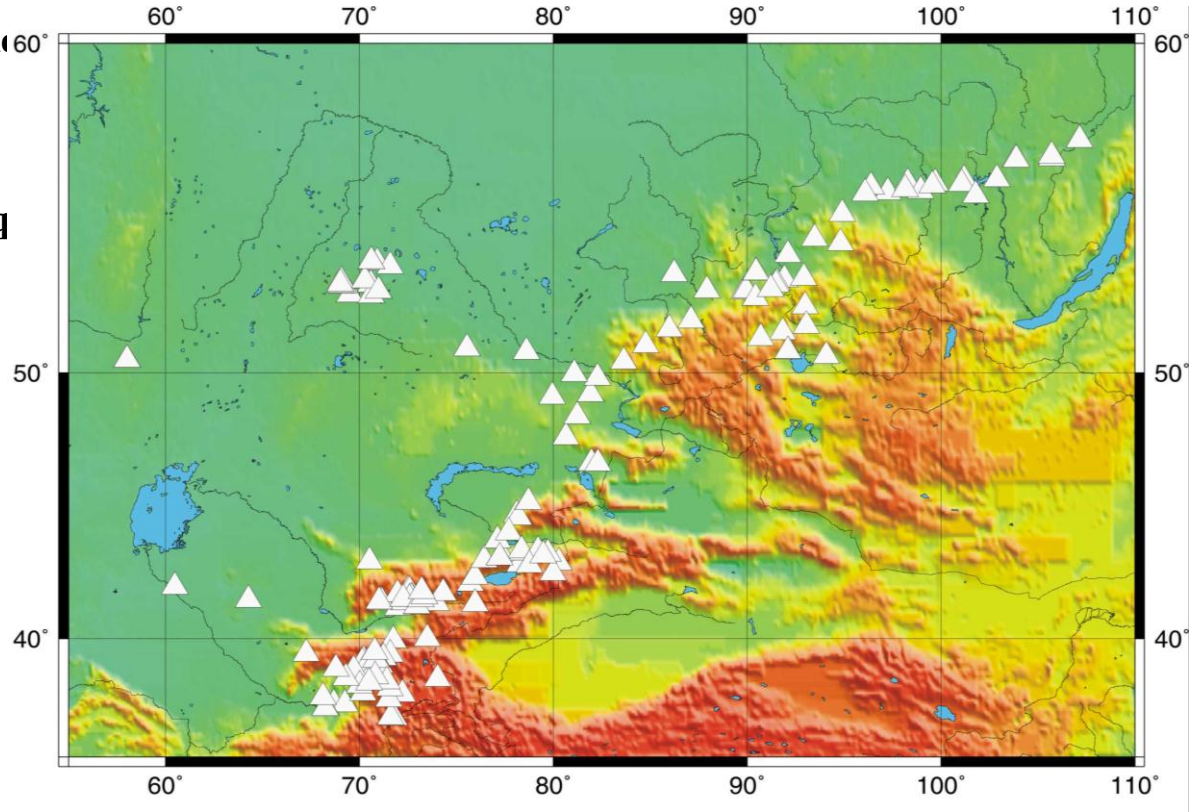
Lessons from historic nuclear test explosions and value of recorded signals for monitoring science

Q6. We do not know what we do not know. To guide the search for still untapped data treasures, what kind of historic data would be most urgently needed to improve performance of a monitoring organization?

In Soviet time, the Institute of the Physics of Earth had 2 Complex seismologi expeditions (CSE) – in Garm (Tajikistan) and in Talgar (Kazakhstan).
The archives of these expeditions had seismograms from several hundreds sensitive seismic stations installed on the USSR territory starting from 1940. addition to seismic records, there were records of microbarograph, uniq experiments, digital data on magnetic tapes.
The CSE archive in Garm was lost during the Civil war in Tajikistan.





The map of CSE IPE AS USSR seismic stations location

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In Kazakhstan, starting from 1991, after the USSR collapse, the property of Russian organizations located on the territory of the former Union countries was transferred to the national organizations.

In 1994, the property of Talgar CSE including the archive of analogue seismograms and seismic stations were transferred to KazSeleZashita. But the Institute of Physics of Earth had the right to use and manage the property. In 2002, CSE IPE RAS was closed and the archive of historical seismograms became the property of "Prognoz" Corporation of Kazselezashita. In 2002 the CSE IPE RAS was closed and the archive of historical seismograms became a property of "Prognoz" Corporation of Kazselezashita.

"Prognoz" Corporation was closed in 2013. The archive was put into the abandoned, unguarded building; it was subjected to vandalism, there was fire in the building that could destroy the invaluable seismograms.

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In 2015-2016 the archive of CSE IPE RAS was moved to KNDC in Almaty. In 2018 we started the works on arrangement and inventory of the CSE archive. Currently, the works on archive saving are conducted, and the data are used for different research.

Q4. What data exists and are important to the scientific community and the CTBTO but are not available yet? Are these still classified, sitting in institutional archives or not yet digitized? What is the recent progress on the recovery of data? How are they publicly available?

In Central Asia, the Institutes specialized in seismology are aimed at studying of tectonic earthquakes. There are organizations possess the archives of seismograms, stations located at regional distances from the Test Sites. These organizations do not know the value of nuclear explosions seismograms, do not use and do not share the data.

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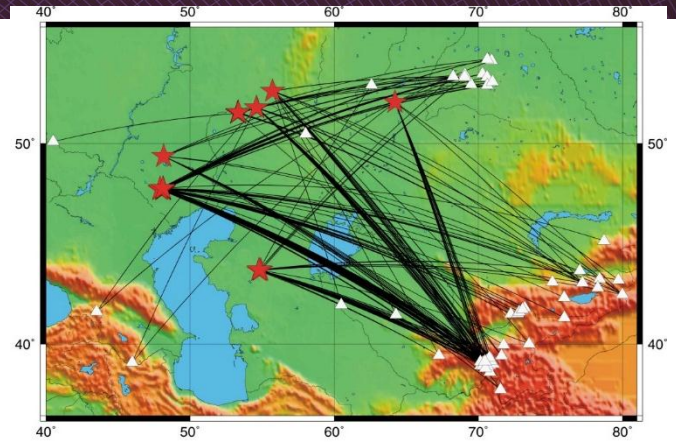
Q8. What has already been learned from historic tests?

In Kazakhstan, during the Soviet Era, the data of peaceful nuclear explosions (Region and Meridian series) were used for deep seismic zoning of the Earth.

The data of the Lazurit model explosion conducted to create a dam by destroying a mountain slope in Myurzhyk on December 7, 1974, Y=1.7 kt were used to study the behavior of testing buildings – parts of temporary typical seismic resistant buildings constructed in the near-field of the explosion.

The UNE seismograms were used for seismic discrimination.



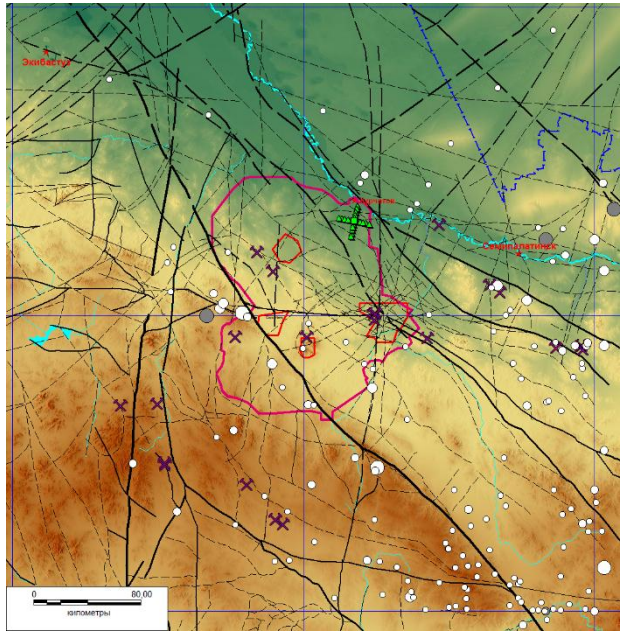
Currently:

The regional travel-time curves were constructed for different regions of Kazakhstan.

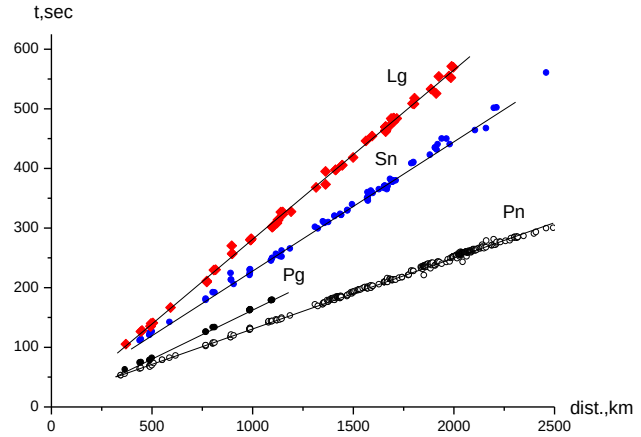
The induced effects on the environment are studied. The geodynamic processes at the regions of large nuclear Test Sites.

The nuclear tests parameters are précised.

The historical seismicity of the Semipalatinsk Test Site was investigated.



Map of STS seismicity



The travel-time curve of regional phases Pn, Sn and Lg, constructed using UNE records.

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Q7. What needs to be done to assure historic data are usable now and by future generations (e.g. digitizing, data format adaption, sensor calibration and meta data retrieval)?

Some Organizations want to start the process of historical seismograms saving, but encounter with a range of problems.

1. **At the present time, the generation that worked with the historical analogue seismograms have quitted their work. The young seismologists work with digital seismograms processing and need to be trained to work with the analog records, so it is necessary to arrange such courses. In Central Asia such courses are conducted by KNDC for the seismologists from CIS countries.**
2. **First, the seismograms should be scanned with good resolution. As this process does not require such amount of time as digitization.**
3. **There is not a lot of digitization software that is accessible and easy to use. A lot of Centers want to start the digitization work, but do not know where to take the suitable software, in which formats to save data, how to start. It is necessary to choose the best software for digitization, make it perfect, adapt to all types of seismograms and include into the NDC-in-a-Box.**
4. **It is necessary to choose and recommend the NDC the most appropriate data format (probably, SEED, as it is quite widespread, there are a lot of conversion software into other data formats. It is necessary to elaborate a list of data necessary to be saved together with a digitized seismogram, so that the metadata are not lost.**
5. **It is possible to digitize only a small part of archive as a lot of seismograms of large explosions are clipped, and there are also seismograms having bad photo-paper quality. Such seismograms can be processed, and a seismic bulletin can be made. It is necessary to give recommendations what parameters should be saved.**