SnT 2021
CTBT: SCIENCE AND TECHNOLOGY CONFERENCE

CTBTO
PREPARATORY COMMISSION

Joint Seismic Monitoring Activities In Central Asia

Natalya Mikhailova[1], Anna Berezina[2], Johannes Schweitzer[3], Irina Aristova[1], Kanatbek Abdrakhmatov[2], Svein Mykkeltveit[3], Inna Sokolova[1], Elena Pershina[2], Helene Ruud[3]

P5.3-157

POSTER

IGR

[1]Institute of Geophysical Researches NNC RK, Kazakhstan
[2]Institute of Seismology NAS KR, Bishkek, Kyrgyzstan
[3]NORSAR, Norway

ИС НАН КР
IS NAS KR

NORSAR
Exploring the Earth

SnT 2021
CTBT: SCIENCE AND TECHNOLOGY CONFERENCE
Poster No.: P5.3-157

Joint Seismic Monitoring Activities In Central Asia

Natalya Mikhailova (mikhailova@kndc.kz), Anna Berezina (annaberezina8@gmail.com), Johannes Schweitzer (johannes@norsar.no), Irina Aristova (i.aristova@kndc.kz), Kanatbek Abdrakhmatov (kanab53@yandex.ru), Svein Mykkeltveit (svein@norsar.no), Inna Sokolova (sokolova@kndc.kz), Elena Pershina (pev_71@mail.ru), Helene Ruud (Helene@norsar.no)

CTBTO PREPARATORY COMMISSION

Abstract

Central Asia is tectonically complicated with high seismic activity. Over the past 150 years four great earthquakes occurred with magnitudes exceeding 8. Seismic monitoring is one of the most important problems of the region, having both scientific and social significance. Since many years, NORSAR (Norway), the Institute of Geophysical Research (Kazakhstan), and the Institute of Seismology (Kyrgyzstan) are cooperating to solve this problem. A joint scientific program is focusing on capacity building in Central Asia, in relation to technical verification of compliance with the CTBT, as well as research on improved seismic monitoring. Under this cooperation, seismic stations and the National Data Centres (NDC) in Kyrgyzstan and Kazakhstan were upgraded and Central Asian seismologists were trained at the Training Centre, established at Kazakhstan's NDC. In 2018, joint work started on compiling a new seismic bulletin for Central Asia, based on data from 51 stations and 5 arrays. Observed magnitude and energy class discrepancies were studied with respect to systematic station and network effects. Aftershock sequences of 80 earthquakes with different magnitudes were analysed. The induced, anthropogenic and natural seismicity from different regions with mining activities in Kyrgyzstan and Kazakhstan as well as icequakes in the Tien Shan glaciers were analysed.

Joint Seismic Monitoring Activities In Central Asia

Natalya Mikhailova (mikhailova@kndc.kz), Anna Berezina (annaberezina8@gmail.com), Johannes Schweitzer (johannes@norsar.no), Irina Aristova (i.aristova@kndc.kz), Kanatbek Abdrakhmatov (kanab53@yandex.ru), Svein Mykkeltveit (svein@norsar.no), Inna Sokolova (sokolova@kndc.kz), Elena Pershina (pev_71@mail.ru), Helene Ruud (Helene@norsar.no)

Main Project Tasks

- 1. Technical support of Kyrgyzstan (KRNET) and Kazakhstan (KazNET) seismic network stations; support and upgrade of Kyrgyzstan and Kazakhstan National Data Centres.
- 2. Compilation of a regional bulletin for Central Asia; investigation of discrepancies in calculating magnitudes and energy classes.
- 3. Support for the operation of the Training Centre on processing and interpretation of seismic data for members of the National Data Centres of Central Asia.
- 4. Joint scientific research on seismicity of natural and induced earthquakes and their monitoring.

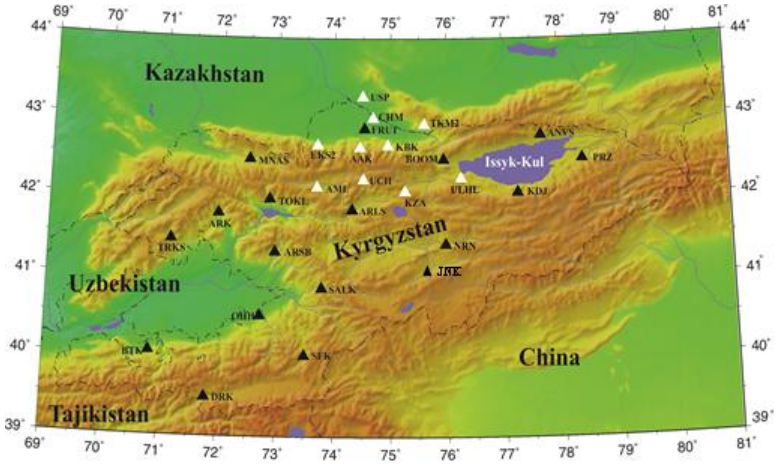
SnT 2021
CTBT: SCIENCE AND TECHNOLOGY CONFERENCE
Poster No.: P5.3-157

Joint Seismic Monitoring Activities In Central Asia

Natalya Mikhailova (mikhailova@kndc.kz), Anna Berezina (annaberezina8@gmail.com), Johannes Schweitzer (johannes@norsar.no), Irina Aristova (i.aristova@kndc.kz), Kanatbek Abdrakhmatov (kanab53@yandex.ru), Svein Mykkeltveit (svein@norsar.no), Inna Sokolova (sokolova@kndc.kz), Elena Pershina (pev_71@mail.ru), Helene Ruud (Helene@norsar.no)

CTBTO PREPARATORY COMMISSION

Technical Support: KRNET Seismic Stations Upgrade



Map of the Kyrgyz monitoring network location. White triangles – KNET stations (RS RAS); Black triangles – KRNET stations (IS NAS KR).

- Hardware upgrade of KRNET stations with monitors, more stable power supply, UPS, HDD, External HDD, etc.
- Another very important feature of an effective operation of a seismic network is a stable data transmission in near-real-time mode. Practically all KRNET seismic stations are now equipped with GPRS-routers (cellular internet) and the near-real-time data of KRNET stations are openly accessible at the IRIS/DMC website (http://www.iris.edu). The number of its requests is increasing with time.

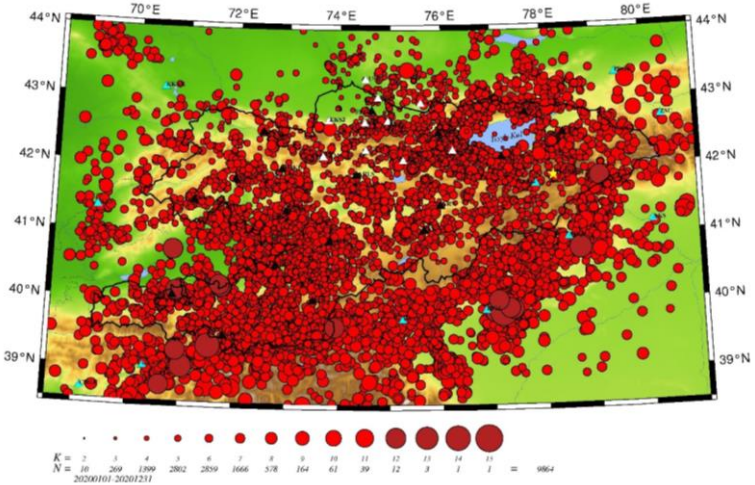
SnT 2021
CTBT: SCIENCE AND TECHNOLOGY CONFERENCE
Poster No.: P5.3-157

Joint Seismic Monitoring Activities In Central Asia

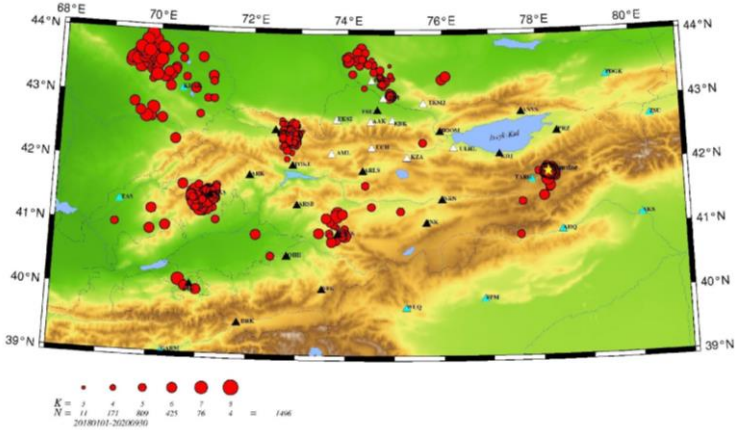
Natalya Mikhailova (mikhailova@kndc.kz), Anna Berezina (annaberezina8@gmail.com), Johannes Schweitzer (johannes@norsar.no), Irina Aristova (i.aristova@kndc.kz), Kanatbek Abdrakhmatov (kanab53@yandex.ru), Svein Mykkeltveit (svein@norsar.no), Inna Sokolova (sokolova@kndc.kz), Elena Pershina (pev_71@mail.ru), Helene Ruud (Helene@norsar.no)

CTBTO PREPARATORY COMMISSION

Monitoring of Earthquakes and Explosions on the Territory of Kyrgyzstan



Seismicity map of Kyrgyz territory for 2020 (M ≥ 0.5, N=9864).



Location of 1496 industrial explosions (2018 – 2020) in well known quarries (Kumtor, Terek-Say mine, Bozymchak, Ishtamberdy, and the border zone to Kazakhstan)
White triangles - the KNET stations (GS RAS)
Black triangles - the KRNET stations (IS NAS KR).

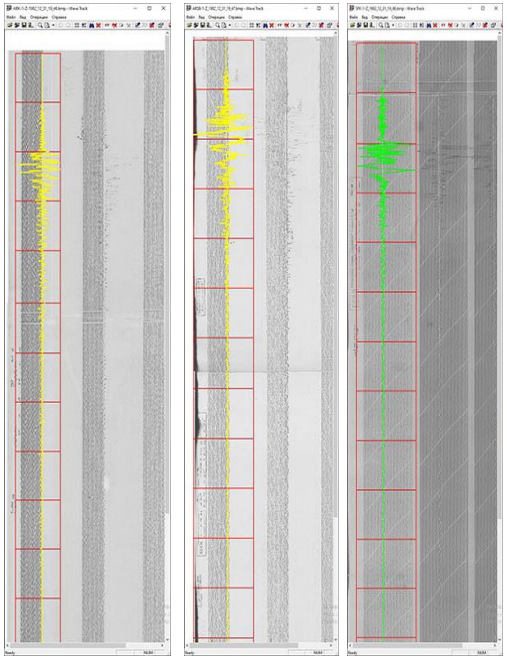
SnT 2021
CTBT: SCIENCE AND TECHNOLOGY CONFERENCE
Poster No.: P5.3-157

Joint Seismic Monitoring Activities In Central Asia

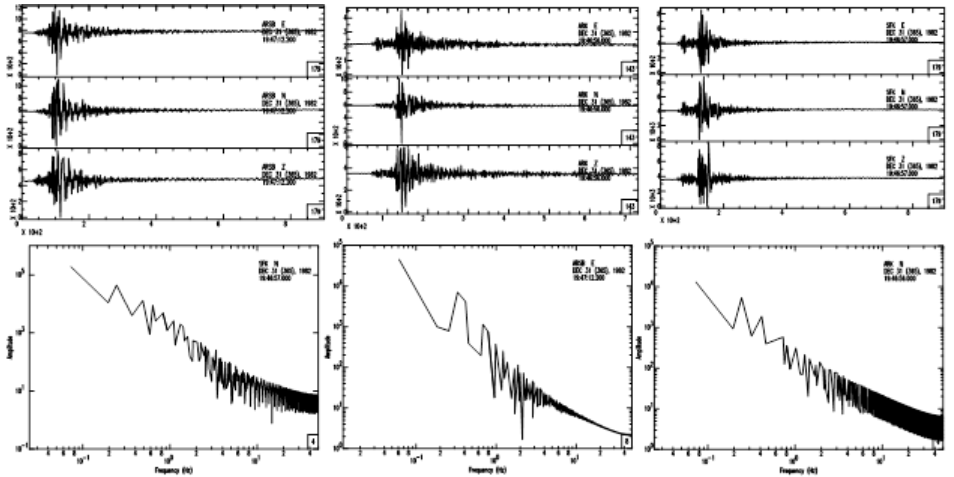
Natalya Mikhailova (mikhailova@kndc.kz), Anna Berezina (annaberezina8@gmail.com), Johannes Schweitzer (johannes@norsar.no), Irina Aristova (i.aristova@kndc.kz), Kanatbek Abdrakhmatov (kanab53@yandex.ru), Svein Mykkeltveit (svein@norsar.no), Inna Sokolova (sokolova@kndc.kz), Elena Pershina (pev_71@mail.ru), Helene Ruud (Helene@norsar.no)

CTBTO PREPARATORY COMMISSION

Capacity Building at the Kyrgyz National Data Centre (NDC-KG)



Scanning and digitizing of analogue seismograms



Example of the digitized earthquake of 31.12.1982 (Mw=4.9, ARSB («Arslanbob»), SFK («Sufi-Kurgan») and ARK («Arkit») stations).

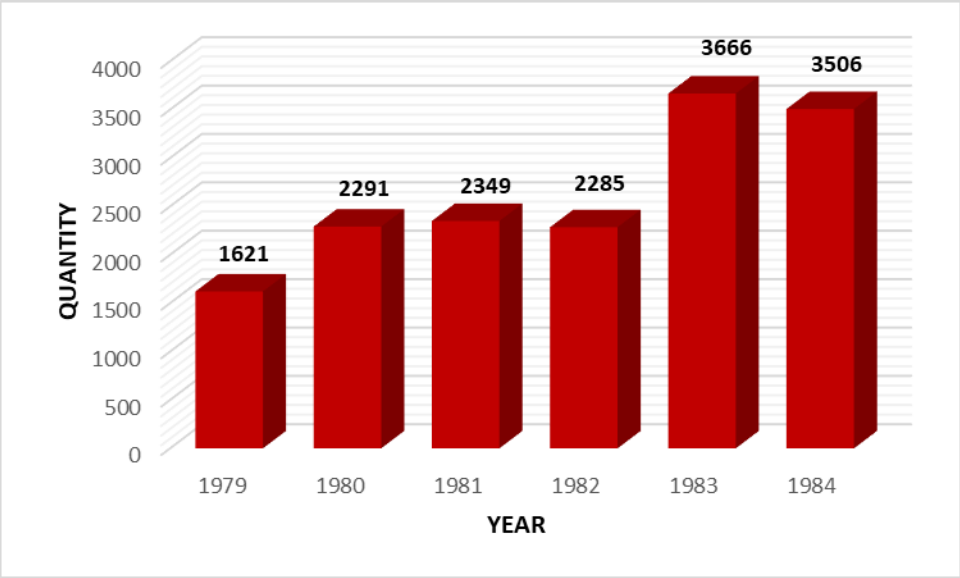
SnT 2021
CTBT: SCIENCE AND TECHNOLOGY CONFERENCE
Poster No.: P5.3-157

Joint Seismic Monitoring Activities In Central Asia

Natalya Mikhailova (mikhailova@kndc.kz), Anna Berezina (annaberezina8@gmail.com), Johannes Schweitzer (johannes@norsar.no), Irina Aristova (i.aristova@kndc.kz), Kanatbek Abdrakhmatov (kanab53@yandex.ru), Svein Mykkeltveit (svein@norsar.no), Inna Sokolova (sokolova@kndc.kz), Elena Pershina (pev_71@mail.ru), Helene Ruud (Helene@norsar.no)

CTBTO PREPARATORY COMMISSION

Capacity Building at the Kyrgyz National Data Centre (NDC-KG)



Number of seismograms per year scanned in 2020

	Data	Time	Lat	Long	H	Mw
KIS	03.03.1981	05:53:00.4	39,317	72,600	15	5.6
ISC	03.03.1981	05:52:39.3	39.14	72.50	10	5.4
KIS	31.12.1982	19:46:46.6	42,867	77,367	15	5.3
ISC	31.12.1982	19:46:49.7	42.75	77.01	20	5.3
KIS	26.03.1987	11:56:54.4	41.49	69.57	5	4.9
ISC	26.03.1987	11:56:52.7	41.93	69.81	10	5.2
KIS	17.06.1988	13:30:43.6	42,933	77,4	20	5.3
ISC	17.06.1988	13:30:47.1	43.01	77.51		5.6
KIS	29.03.1990	16:19:12.2	39,43	73,25	21	5.3
ISC	29.03.1990	16:19:18.09	39.35	73.23	29	5.3
KIS	01.12.1990	18:09:27.70	40,883	73,65	5	5.1
ISC	01.12.1990	18:09:30.59	40.89	73.55	27	5.2
KIS	31.10.1991	02:29:03.70	40.17	72.87	15	4.7
ISC	31.10.1991	02:29:05.0	40.15	72.79	30	4.9
KIS	17.03.1993	10:15:05.00	41.80	72.70	25	4.3
ISC	17.03.1993	10:15:05.97	41.02	72.07	24	4.8
KIS	18.01.1996	09:33:49.80	41.90	77.45	5	4.8
ISC	18.01.1996	09:33:50.6	41.87	77.45	15.5	5.2
KNET	16.01.2004	09:06:18.25	42.55	75.29	18	4.8
KIS	16.01.2004	09:06:18.25	42.55	75.29	18	4.4
ISC	16.01.2004	09:06:17.61	42.58	75.30	20	4.8
KIS	20.06.2005	14:25:02.25	42.77	74.37	22	3.5
KNET	20.06.2005	14:25:02.25	42.77	74.37	22	3.9
ISC	20.06.2005	14:25:58.50	42.79	74.05	10	3.6

Comparison of earthquake parameters: ISC and after digitizing and reanalysing at KIS

SnT 2021
CTBT: SCIENCE AND TECHNOLOGY CONFERENCE
Poster No.: P5.3-157

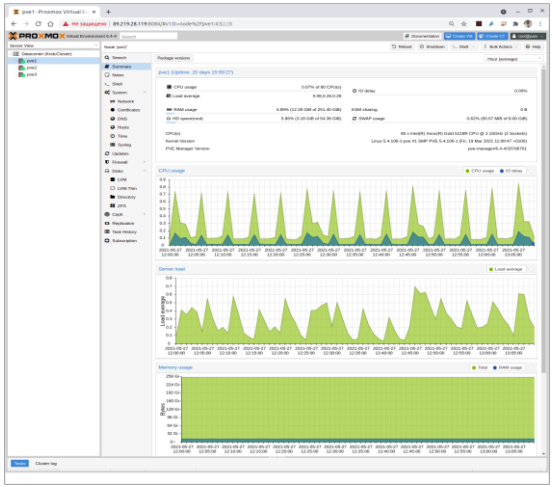
Joint Seismic Monitoring Activities In Central Asia

Natalya Mikhailova (mikhailova@kndc.kz), Anna Berezina (annaberezina8@gmail.com), Johannes Schweitzer (johannes@norsar.no), Irina Aristova (i.aristova@kndc.kz), Kanatbek Abdrakhmatov (kanab53@yandex.ru), Svein Mykkeltveit (svein@norsar.no), Inna Sokolova (sokolova@kndc.kz), Elena Pershina (pev_71@mail.ru), Helene Ruud (Helene@norsar.no)

CTBTO PREPARATORY COMMISSION

KNDC Upgrade

Installation of a fail-safe system for data acquisition, processing and storage and the operation of a virtualization management platform in a new computer cluster at the KNDC.



A cluster of three high-performance servers is running a Proxmox Virtual Environment platform. For a fail-safe operation of the system, the cluster uses the distributed file system CEPH, and the data storage system build on RAID technology.

SnT 2021
CTBT: SCIENCE AND TECHNOLOGY CONFERENCE
Poster No.: P5.3-157

Joint Seismic Monitoring Activities In Central Asia

Natalya Mikhailova (mikhailova@kndc.kz), Anna Berezina (annaberezina8@gmail.com), Johannes Schweitzer (johannes@norsar.no), Irina Aristova (i.aristova@kndc.kz), Kanatbek Abdrakhmatov (kanab53@yandex.ru), Svein Mykkeltveit (svein@norsar.no), Inna Sokolova (sokolova@kndc.kz), Elena Pershina (pev_71@mail.ru), Helene Ruud (Helene@norsar.no)

CTBTO PREPARATORY COMMISSION

Training Courses in Support of the CTBTO Conducted by KNDC

In 2018, KNDC relaunched the courses on interpreting and processing of digital seismograms in support of the CTBTO. These courses have been conducted since 2010 for members of the National Data Centres in the Central Asia countries of the former Soviet Union.

In 2018–2020, the 4 one-month courses were organised with 27 participants from 4 countries: Kazakhstan, Uzbekistan, Tajikistan, and Kyrgyzstan. From Uzbekistan the courses were attended by 2 teams from different Organizations: the Centre of Seismic Prediction Monitoring of MES of the Republic of Uzbekistan, and from the Institute of Seismology AS RU.

SnT 2021
CTBT: SCIENCE AND TECHNOLOGY CONFERENCE
Poster No.: P5.3-157

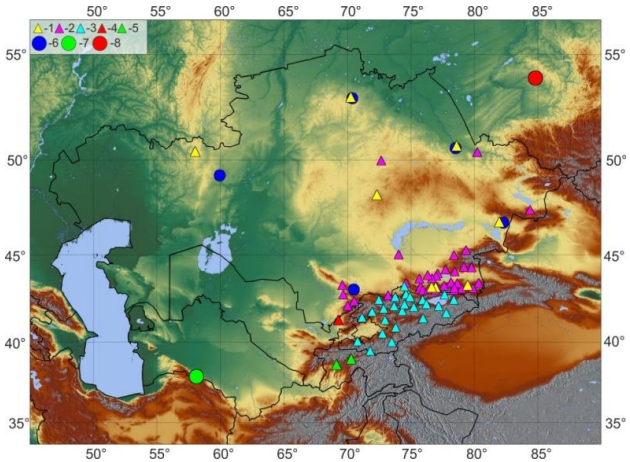
Joint Seismic Monitoring Activities In Central Asia

Natalya Mikhailova (mikhailova@kndc.kz), Anna Berezina (annaberezina8@gmail.com), Johannes Schweitzer (johannes@norsar.no), Irina Aristova (i.aristova@kndc.kz), Kanatbek Abdrakhmatov (kanab53@yandex.ru), Svein Mykkeltveit (svein@norsar.no), Inna Sokolova (sokolova@kndc.kz), Elena Pershina (pev_71@mail.ru), Helene Ruud (Helene@norsar.no)

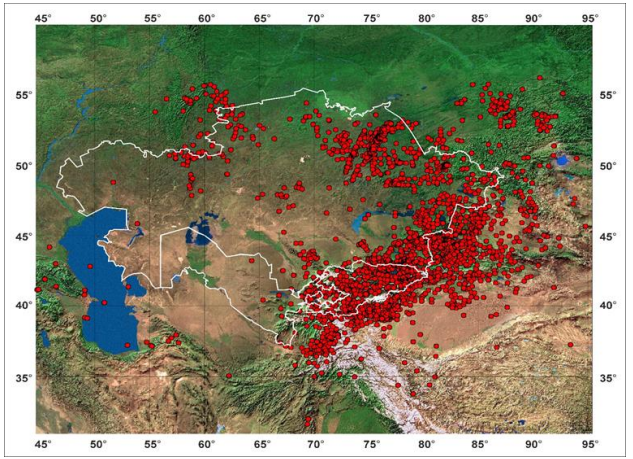
CTBTO PREPARATORY COMMISSION

Joint Scientific Research Conducted by KNDC and IS KR

Compilation of a regional seismic bulletin for the territory of Central Asia



The used 51 three-component stations and 5 seismic arrays



Example for a map of epicenters based on the new regional bulletin of Central Asia for a period of 3 months (3692 events)

Joint Seismic Monitoring Activities In Central Asia

Natalya Mikhailova (mikhailova@kndc.kz), Anna Berezina (annaberezina8@gmail.com), Johannes Schweitzer (johannes@norsar.no), Irina Aristova (i.aristova@kndc.kz), Kanatbek Abdrakhmatov (kanab53@yandex.ru), Svein Mykkeltveit (svein@norsar.no), Inna Sokolova (sokolova@kndc.kz), Elena Pershina (pev_71@mail.ru), Helene Ruud (Helene@norsar.no)

Joint Scientific Research Conducted by KNDC and IS KR

Observed magnitude and energy class K discrepancies were studied with respect to systematic station and network effects

The results of the analysis of allowed revealing the main factors causing the discrepancies in mpv and K values estimated at different Data Centres:

- Incorrect description of instrument parameters in the databases of the organization.
- Different approaches to measure the parameters for magnitude and K calculation.
- Including the station observations into the calculations with a priori different underground characteristics of the stations.

For the KNDC and IS KR stations all station parameters have now been corrected and harmonised in the database, which improves the results. In a next step, the same work is planned for the SEME stations.

SnT 2021
CTBT: SCIENCE AND TECHNOLOGY CONFERENCE
Poster No.: P5.3-157

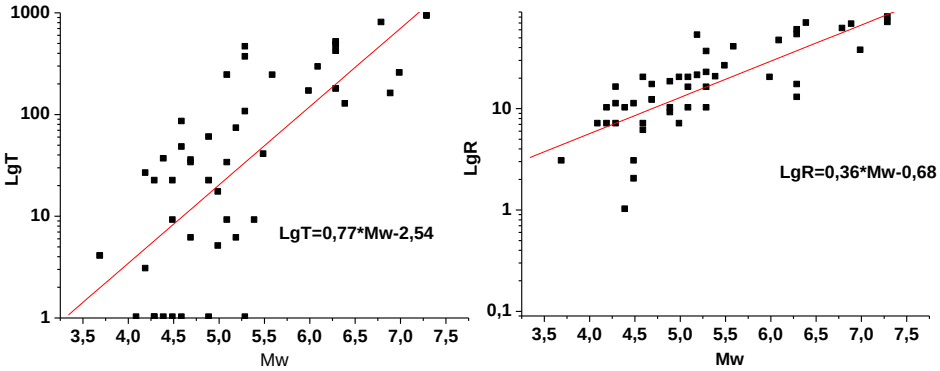
Joint Seismic Monitoring Activities In Central Asia

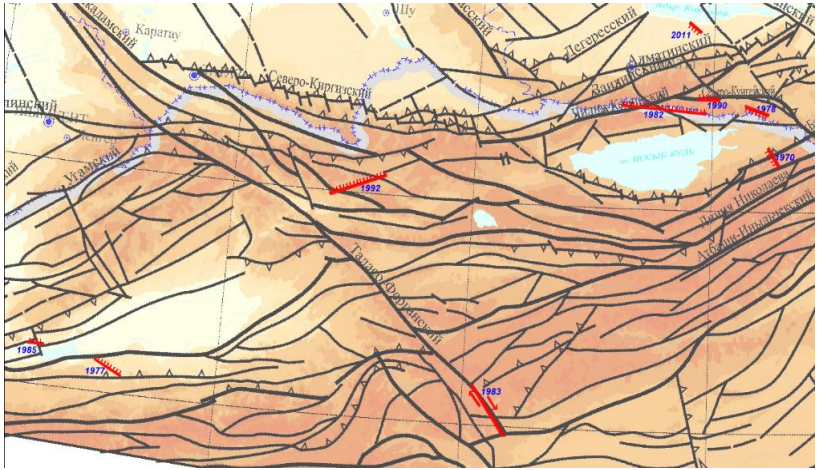
Natalya Mikhailova (mikhailova@kndc.kz), Anna Berezina (annaberezina8@gmail.com), Johannes Schweitzer (johannes@norsar.no), Irina Aristova (i.aristova@kndc.kz), Kanatbek Abdrakhmatov (kanab53@yandex.ru), Svein Mykkeltveit (svein@norsar.no), Inna Sokolova (sokolova@kndc.kz), Elena Pershina (pev_71@mail.ru), Helene Ruud (Helene@norsar.no)

CTBTO PREPARATORY COMMISSION

Study of temporal and spatial characteristics of aftershock series from large crustal earthquakes in Central Asia

Aftershock sequencies of 80 large and quite large crustal earthquakes (3.7 ≤ Mw ≤ 7.3) for the period 1955 – 2016 in the area 39.0° – 0.5° N and 52.5° – 85° E were investigated.





For 16 earthquakes of Tien Shan the probable slip plane regarding the two nodal planes could be determined by analysis of the spatial distribution of the aftershocks.

SnT 2021
CTBT: SCIENCE AND TECHNOLOGY CONFERENCE
Poster No.: P5.3-157

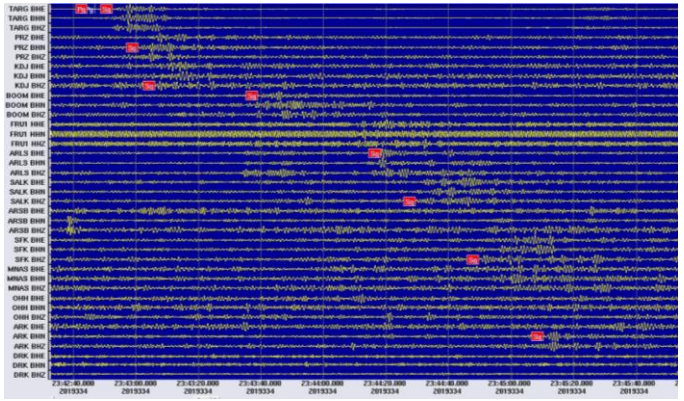
Joint Seismic Monitoring Activities In Central Asia

Natalya Mikhailova (mikhailova@kndc.kz), Anna Berezina (annaberezina8@gmail.com), Johannes Schweitzer (johannes@norsar.no), Irina Aristova (i.aristova@kndc.kz), Kanatbek Abdrakhmatov (kanab53@yandex.ru), Svein Mykkeltveit (svein@norsar.no), Inna Sokolova (sokolova@kndc.kz), Elena Pershina (pev_71@mail.ru), Helene Ruud (Helene@norsar.no)

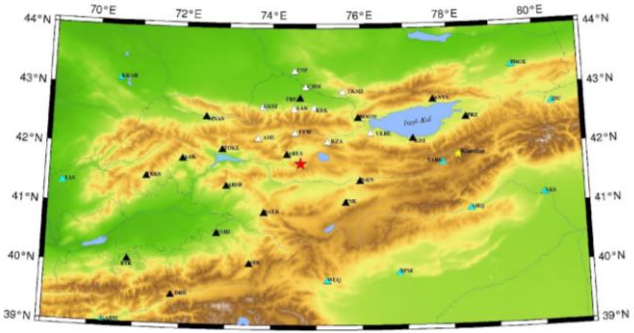
CTBTO PREPARATORY COMMISSION

Recording of Landslides in Kyrgyzstan

Photos of the mountain before and after the landslide of September 14, 2020 (akipress.kg).



Seismic records of the landslide close to the Kumtor mine on December 1, 2019.



Map of the landslide locations and recording seismic stations.

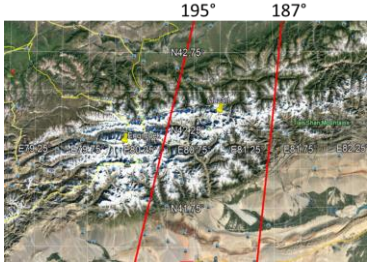
SnT 2021
CTBT: SCIENCE AND TECHNOLOGY CONFERENCE
Poster No.: P5.3-157

Joint Seismic Monitoring Activities In Central Asia

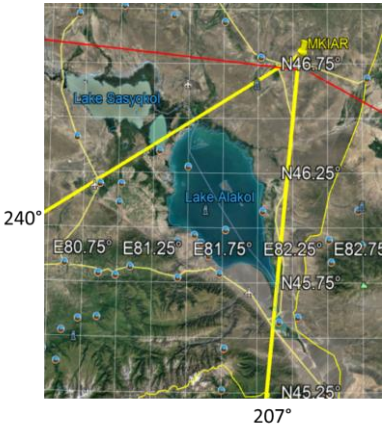
Natalya Mikhailova (mikhailova@kndc.kz), Anna Berezina (annaberezina8@gmail.com), Johannes Schweitzer (johannes@norsar.no), Irina Aristova (i.aristova@kndc.kz), Kanatbek Abdrakhmatov (kanab53@yandex.ru), Svein Mykkeltveit (svein@norsar.no), Inna Sokolova (sokolova@kndc.kz), Elena Pershina (pev_71@mail.ru), Helene Ruud (Helene@norsar.no)

CTBTO PREPARATORY COMMISSION

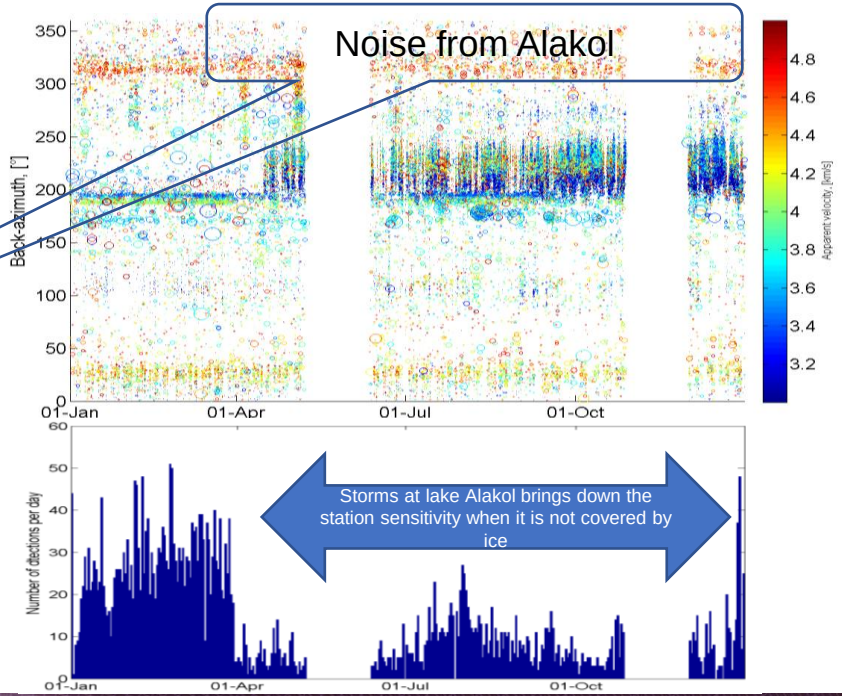
Icequake Signals Detected at the MKAR Seismic Array in 2017



MKAR and lake Alakol



Directions from MKAR to the Tian-Shan glaciers



Joint Seismic Monitoring Activities In Central Asia

Natalya Mikhailova (mikhailova@kndc.kz), Anna Berezina (annaberezina8@gmail.com), Johannes Schweitzer (johannes@norsar.no), Irina Aristova (i.aristova@kndc.kz), Kanatbek Abdrakhmatov (kanab53@yandex.ru), Svein Mykkeltveit (svein@norsar.no), Inna Sokolova (sokolova@kndc.kz), Elena Pershina (pev_71@mail.ru), Helene Ruud (Helene@norsar.no)

Conclusion

1. The Project has allowed improving significantly the communication among seismologists from 4 Central Asian countries regarding monitoring seismic events, and, as a result of the training courses, it has contributed to unify the seismic data processing in the region.

2. Owing to the Project support, CTBTO related capacities were strengthened at two National Data Centres and the operation of stations in two seismic networks was supported.

3. A range of joint studies in the field of seismic event monitoring was conducted. The catalogues and regional seismic bulletins of earthquakes and explosions were created, new types of events – landslides and icequakes were studied with data of the seismic stations.

4. The Project allowed specialists of two countries to attend international conferences and symposia and publish the results of their work in scientific journals.

5. Unfortunately, due to the global pandemic, the training courses planned for 2020 were not conducted, and conferences could not be attended.