

Monitoring Seismic Events and Content of Isotopes on Atmospheric Aerosol of Tajikistan

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Seismicity on the territory of Tajikistan

Geophysical Survey of the Academy of Sciences of the Republic of Tajikistan has modern seismic stations for seismic control and also for control of nuclear explosions. The database available in: <http://service.iris.edu> <http://service.iris.edu/fdsnws/station/docs/1/builder/>. The seismic stations of Tajikistan registered the sixth nuclear test of North Korea on September 3, 2007 at 03:38:09 (S.H.Negmatullaev, F.Yu. Devonashoev, T.P.Ulubaeva. Modern system of seismic monitoring // Dushanbe, 2018, 21p). Recent years have been actively studying the phenomena occurring in the atmosphere in advance of the upcoming earthquake: failure of the function of air temperature and atmospheric pressure, anomalous change of atmospheric transparency (optical thickness), water vapor content, Angstrom parameter, aerosol optical thickness of the fine and coarse fraction, ozone and nitrogen dioxide content in the vertical column of the atmosphere (https://aeronet.gsfc.nasa.gov/cgi-bin/data_display_aod_v3?site=Dushanbe&nacha=1&level=3&place_code=10)

Control of nuclear explosions

In connection with the signing in 2009 of the Treaty on the Creation of a New Nuclear-Free Zone on the Territory of Central Asia (including Tajikistan), the Geophysical Service of the Academy of Sciences of the Republic of Tajikistan participates in nuclear testing at the regional level. Such work is carried out in close cooperation with the Institute of Geophysical Research of the National Nuclear Center of the Republic of Kazakhstan and its Data Center, as well as with relevant organizations of other Central Asian republics.

On September 3, 2017, North Korea conducted a sixth nuclear test. The first to report this was the Korean Meteorological Administration. The Japanese Foreign Ministry also concluded that North Korea had conducted a nuclear test. The US Geological Survey reported an earthquake of 6.3 points, not far from the North Korean nuclear test site Punggye-ri. This nuclear test took place at 03:30 UTC with coordinates 41° 17' 53" north latitude 129° 04' 27" east longitude

Time of entry of a nuclear explosion wave on September 3, 2017 at the seismic stations of the Academy of Sciences of the Republic of Tajikistan

Station	Type	Date	Time (UTC)	Percentage
TJ MANEM.BHZ	P	2017-09-03	03:38:09.5513 UTC	100%
TJ GARM.BHZ	P	2017-09-03	03:38:12.0859 UTC	100%
TJ CHGR.BHZ	P	2017-09-03	03:38:19.6304 UTC	100%
TJ JGRN.BHZ	P	2017-09-03	03:38:20.0293 UTC	100%
TJ GEZN.BHZ	P	2017-09-03	03:38:26.0623 UTC	100%
TJ SHAA.BHZ	P	2017-09-03	03:38:29.6506 UTC	100%



Fig. 1. Regional network of seismic stations

Seismicity of the territory of Tajikistan for the of 2015

- In January-December 2015 at the territory of Tajikistan there were made continuous seismologic observations by digital broadband seismic stations: Chuyan-Garon, Garm, Igron, Gezan, Manem and Shaartuz to register the earthquakes in a wide range of energetic classes at the territory of Tajikistan and bordering countries. Total these broadband seismic stations have recorded **26654** earthquakes.
- For this period there were registered 20 felt earthquakes with $K=8.9$ and 17.0 ($M=2.7$ and 7.2) with shocks' intensity on the surface from 3 to 7 points.
- We made catalogues of Tajikistan earthquakes with $K \geq 8$. Total 13766 earthquakes with $K \geq 4$ were located. The number of earthquakes with $K \geq 9$ was 9071 including 6427 – deep-focus Pamir-Hindu-Kush earthquakes and 2644 – shallow-focus earthquakes.



Seismicity of the territory of Tajikistan for the of 2016

- In January-December 2016 at the territory of Tajikistan there were made continuous seismologic observations by digital broadband seismic stations: Chuyan-Garon, Garm, Igron, Gezan, Manem and Shaartuz to register the earthquakes in a wide range of energetic classes at the territory of Tajikistan and bordering countries. Total these broadband seismic stations have recorded **25 435** earthquakes.
- For this period there were registered 35 felt earthquakes with $K=8.6$ and 15.9 ($M=2.6$ and 6.6) with shocks' intensity on the surface from 2 to 7 points.
- Total 14 210 earthquakes with $K \geq 5$ were located. The number of earthquakes with $K \geq 9$ was 8706 including 5778 – deep-focus Pamir-Hindu-Kush earthquakes and 2928 – shallow-focus earthquakes.
- According to the catalogue data monthly maps have been constructed.

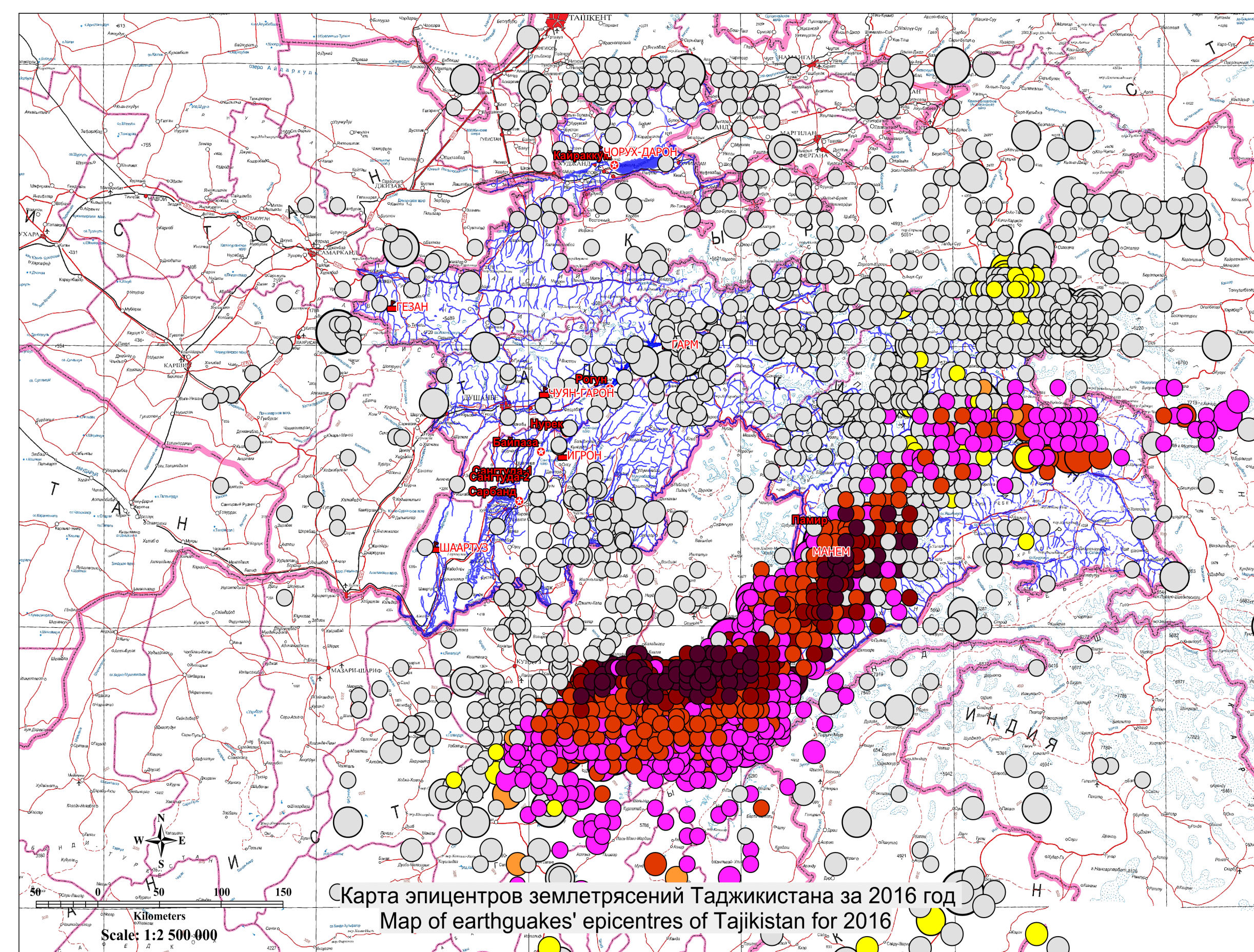
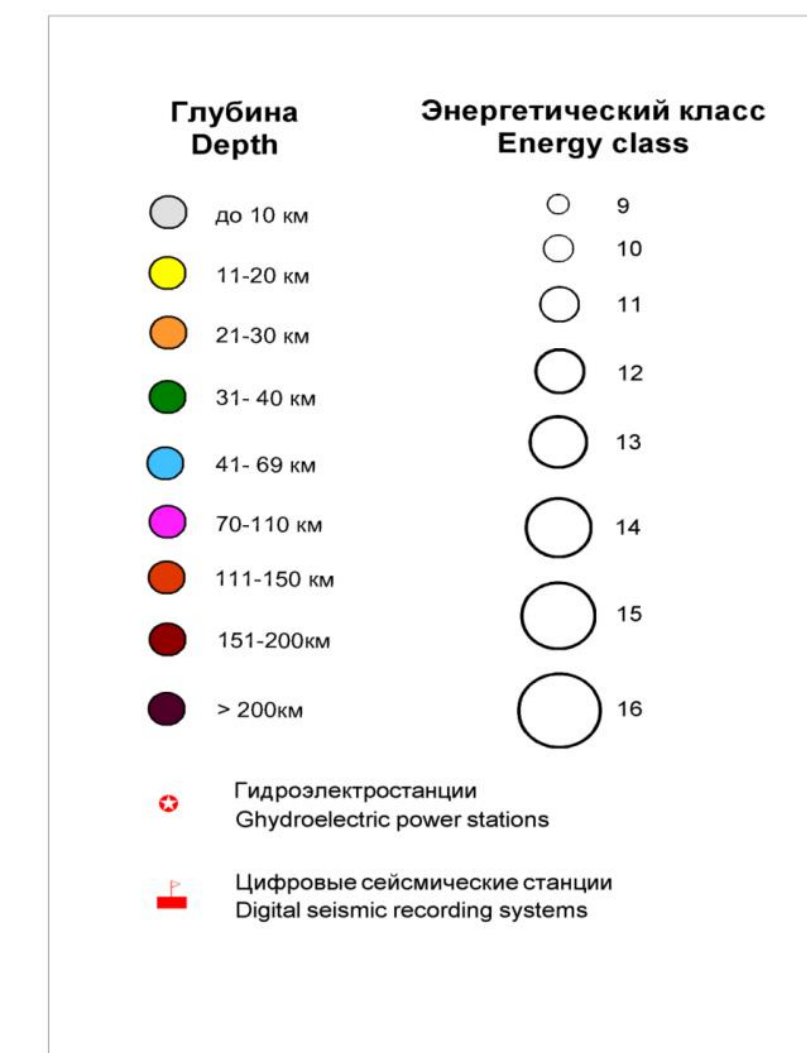


Fig. 2. Map of earthquakes epicenters of Tajikistan for 2016

Y	N	M=2-6	Energy Class, (Magnitude)
2007	11306	32	$K=8.6 - 14.3$ ($M=2.6-5.7$)
2008	13 129	37	$K=7.4 - 15.0$ ($M=1.9-6.1$)
2009	10022	32	$K=8.4 - 15.0$ ($M=2.4-6.1$)
2010	9835	39	$K=8.6 - 14.8$ ($M=2.5-6.0$)
2011	6509	30	$K=8.6 - 15.0$ ($M=2.6-6.1$)
2012	12818	36	$K=8.5 - 14.6$ ($M=2.5-5.9$)
2013	12234	31	$K=7.9 - 15.0$ ($M=2.2-6.1$)
2014	16444	22	$K=8.0 - 14.5$ ($M=2.2-5.8$)
2015	26 654	20	$K=8.9 - 17.0$ ($M=2.7-7.2$)
2016	25 435	35	$K=8.6 - 15.9$ ($M=2.6-6.6$)

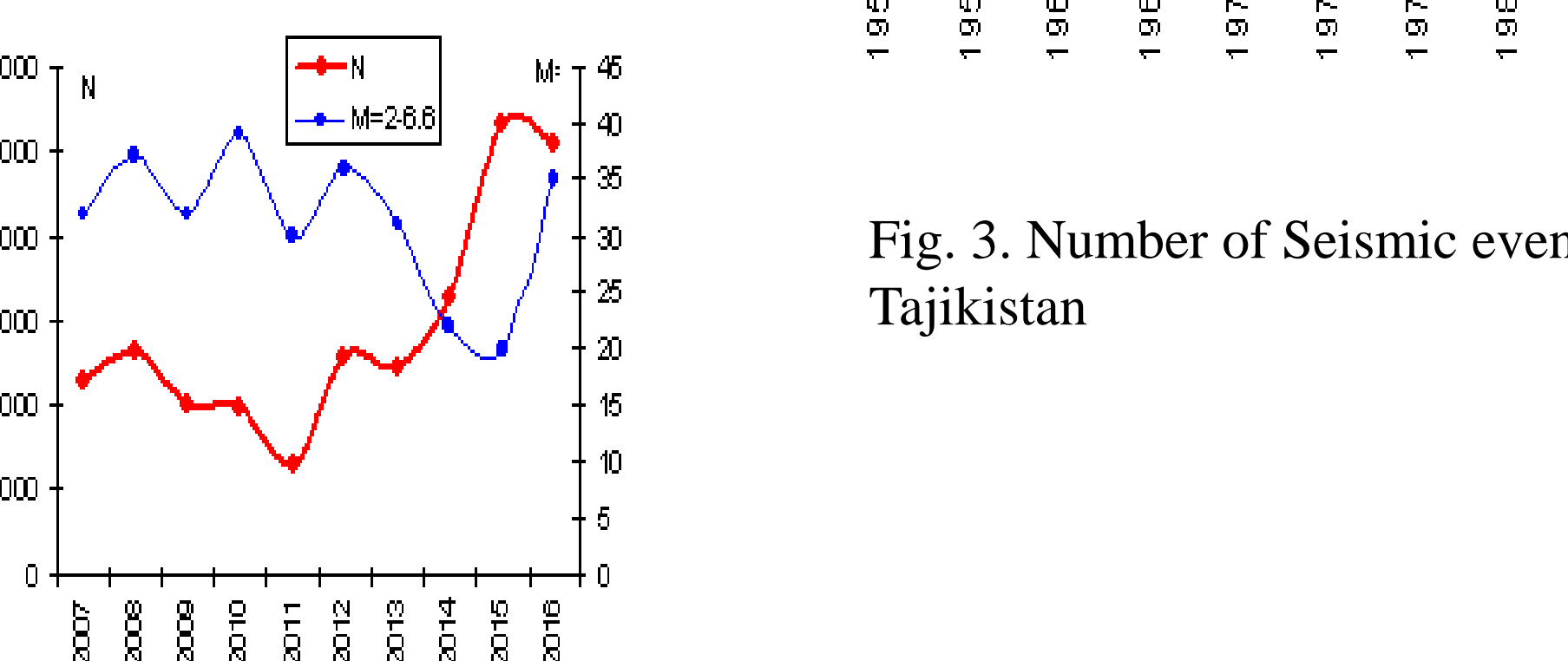
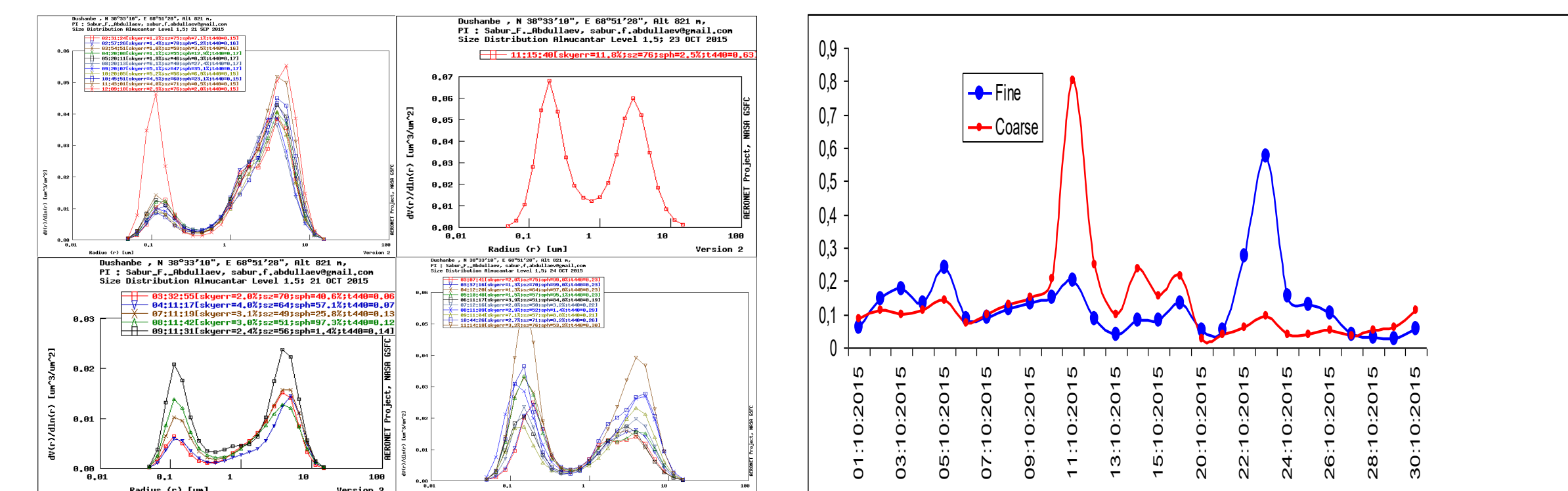
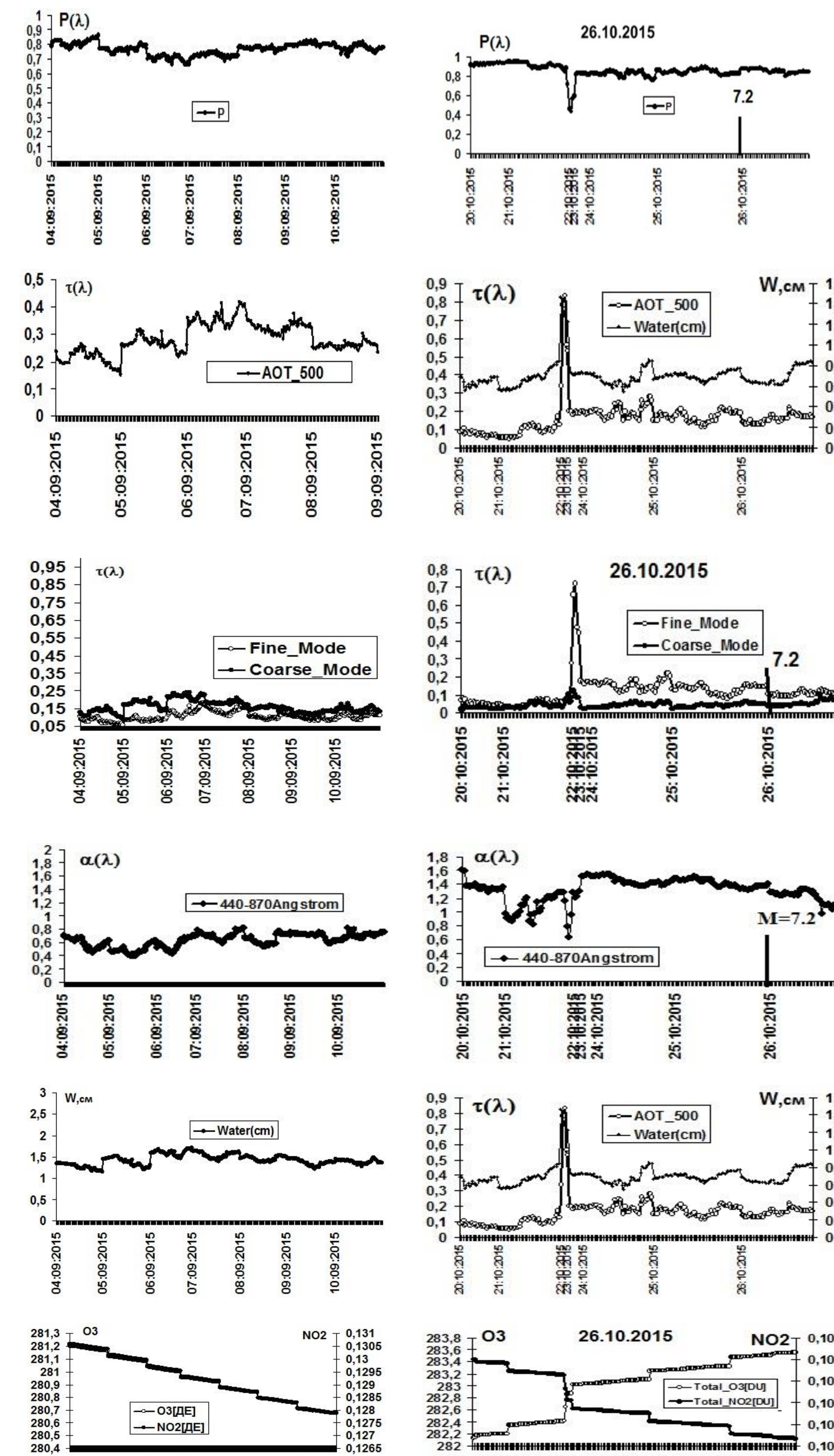


Fig. 3. Number of Seismic events on the territory of Tajikistan



Content of isotopes on atmospheric aerosol of Tajikistan

Tajikistan lies in the global dust belt in close proximity of some major dust sources like the Taklamakan desert, the Aralkum desert of the desiccating Aral Sea, the Kyzylkum and Karakum deserts east of the Caspian Sea, the Iranian Dasht-e-Kavir and Dasht-e-Lut deserts and the deserts in Afghanistan. Therefore Tajikistan is frequently affected by severe dust events every year (from April until November) and it is a net accumulator of dust. Tajikistan is a country with a dry climate and benefits from its water resources in the mountainous Pamir region, which are stored in a large part in glaciers. Furthermore, Central Asia and especially Tajikistan are highly affected by climate change. For example, dramatic glacier shrinking took place in the last decades, which has also an effect on the water resources of Tajikistan and the whole Central Asian area. Since the trans-regionally important rivers as Amu Darya and Syr Darya are fed by glacier melt water, which were originally feeding the Aral Sea which now became itself a strong dust source. On the other hand, deposited dust itself can accelerate glacier melt by altering the glacier's surface albedo. The results of the investigation of the isotopes distributions TI-208, Pb-212, Ac-228, Pb-214, Bi-214, Th-234, Ra-226, Pb-210, Cs-137, Be-7 and K-40 in the samples of atmospheric aerosol of the southern, central and northern parts of Tajikistan are represented. Significant correlations were found between the concentrations of Cs-137 and Th-234 isotopes (0.95), Cs-137 and Ra-226 (0.95), Ra-226 and Bi-214 (0.84), Ac-228 and Ra-226 (0.75), Pb-210 and Pb-214 (0.69), Ac-228 and Pb-214 (0.64), K-40 and Pb-212 (0.71), Cs-137 and Bi-214 (0.78), Th-234 and Pb-212 (0.67). Correlations between the concentrations of the remaining isotopes are insignificant or negative. The statistical data for dust intrusion shows that the concentration of isotopes K-40, Cs-137 and Bi-214 exceeds the background pollution level is tens of times, and the remaining isotopes - dozens of times.

Dynamics of monthly changes in the content of isotopes in the Tajikistan

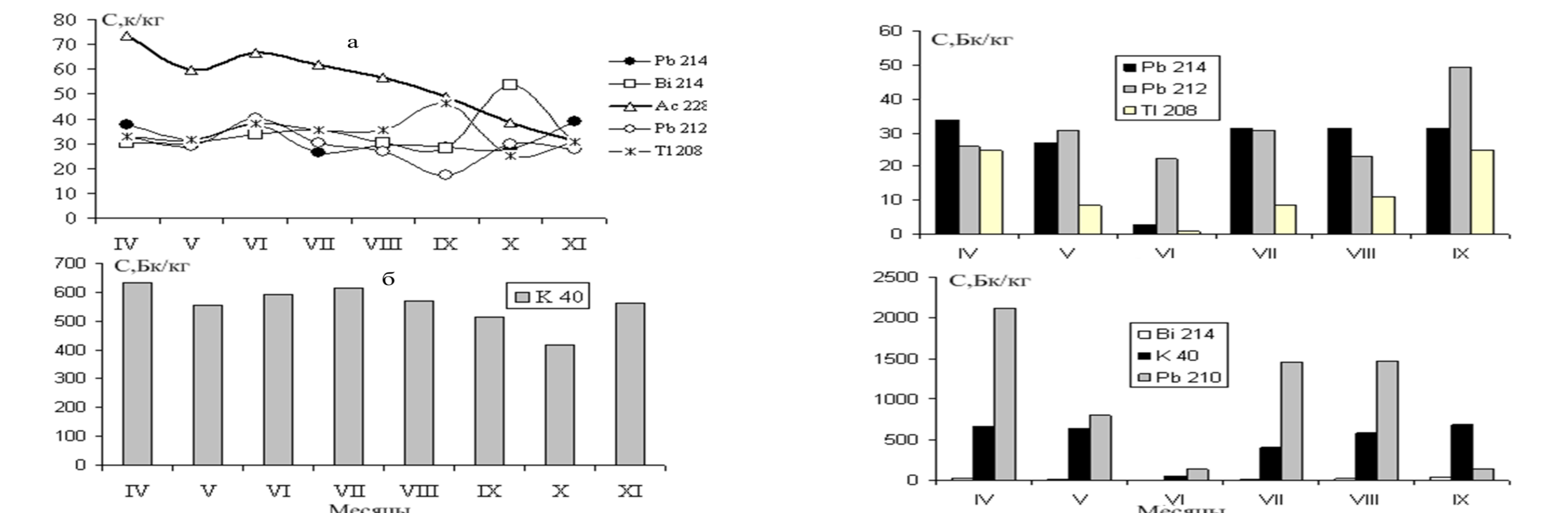


Fig. 3. Dynamics of monthly changes in the content of isotopes in aerosol samples in the south (Ayvadh settlement, Shaartuz district). (2011) (Bq / kg)

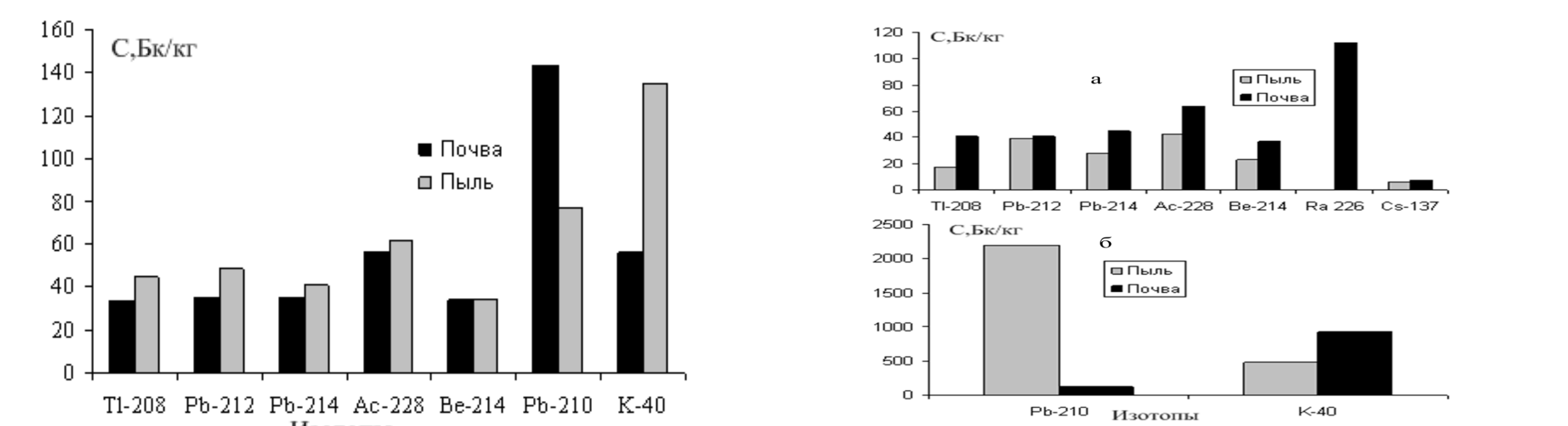


Fig. 4. Dynamics of monthly changes in the content of isotopes in the AA of northern Tajikistan

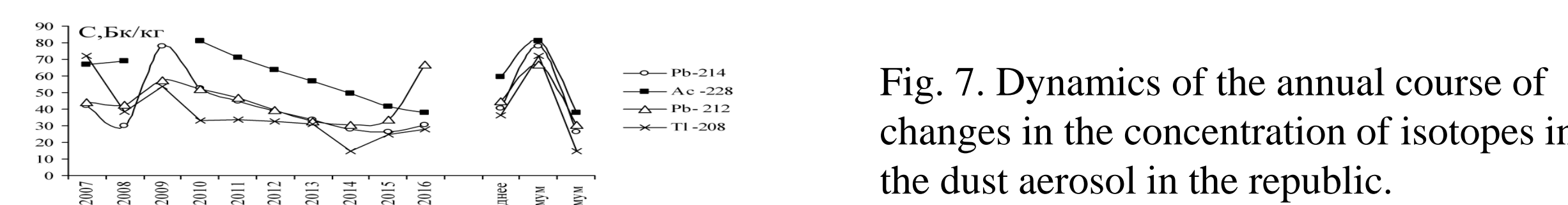


Fig. 5. The concentration of isotopes in Samples of aerosol and soil in the southern part of Tajikistan

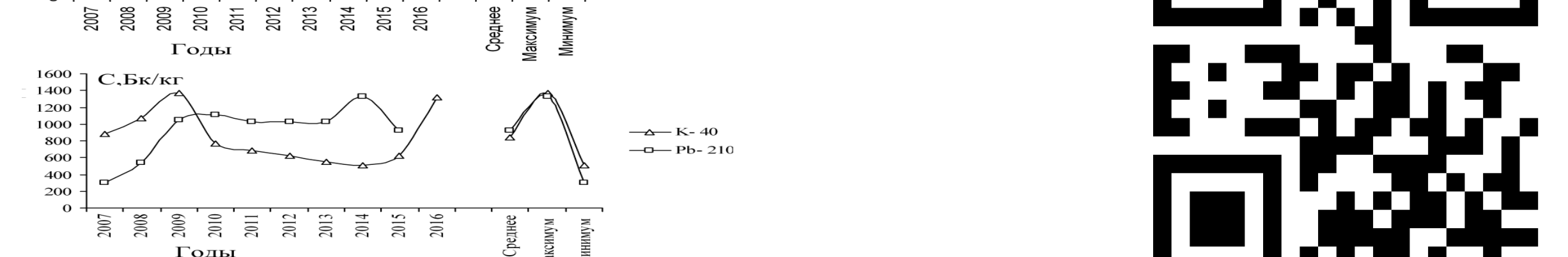


Fig. 6. Concentration of isotopes in the aerosol and soil samples in the northern part of Tajikistan

Fig. 7. Dynamics of the annual course of changes in the concentration of isotopes in the dust aerosol in the republic.

