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Final Report for the Visiting Researcher Program in 2015

SYSTEM DEVELOPMENT OVER THE MONITORING FOR EARLY WARNING OF POPULATION FROM THE THREAT OF LANDSLIDES AND MUDFLOWS

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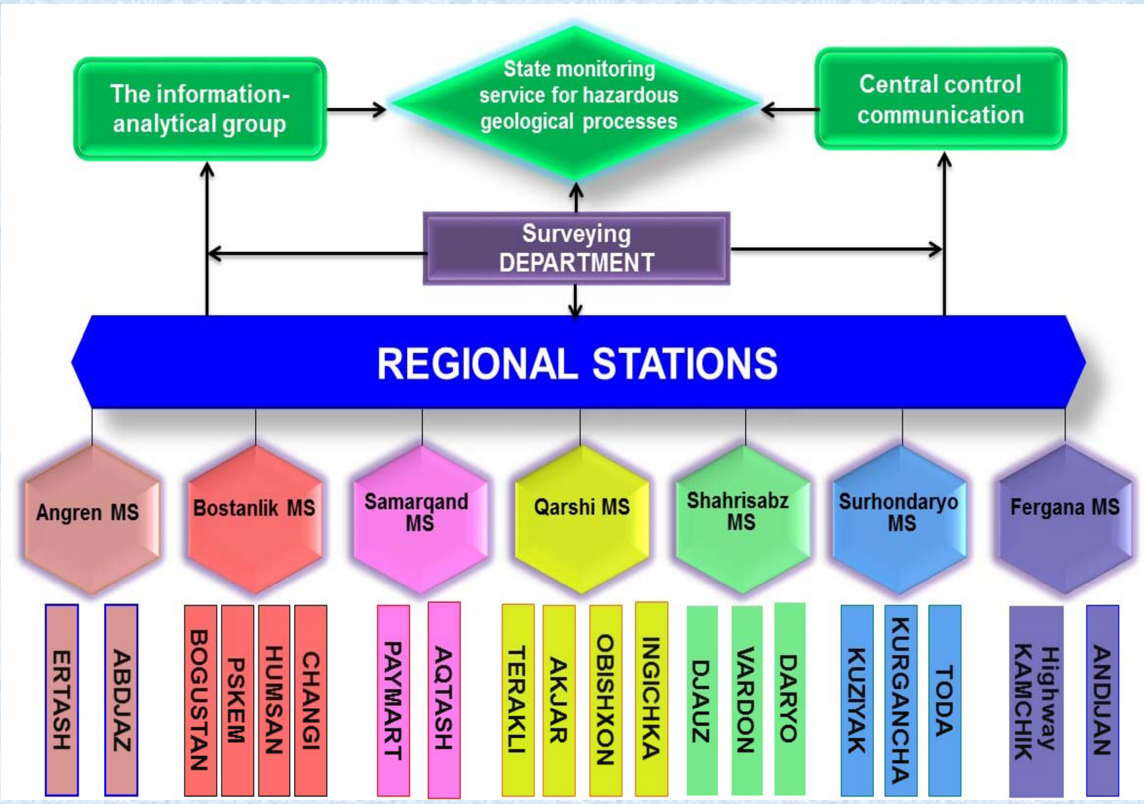
Monitoring Landslides in Uzbekistan

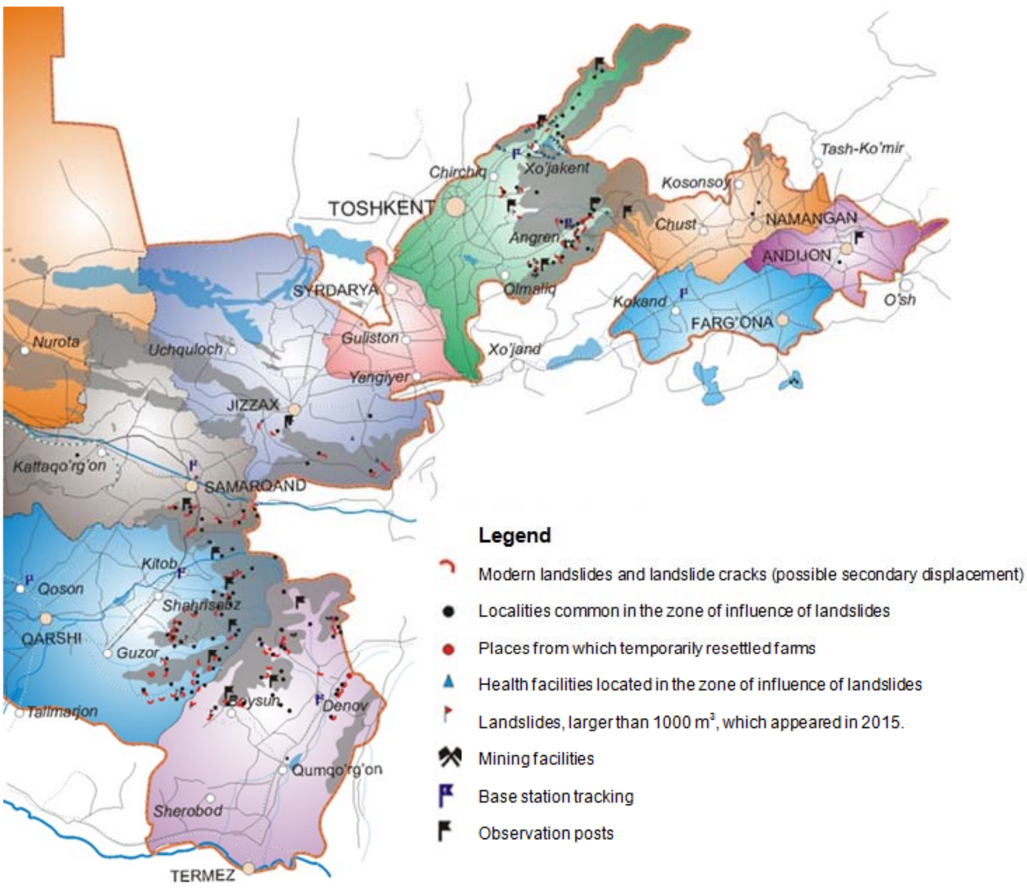
The Structure of Monitoring



Main Tasks of State Service on Monitoring:

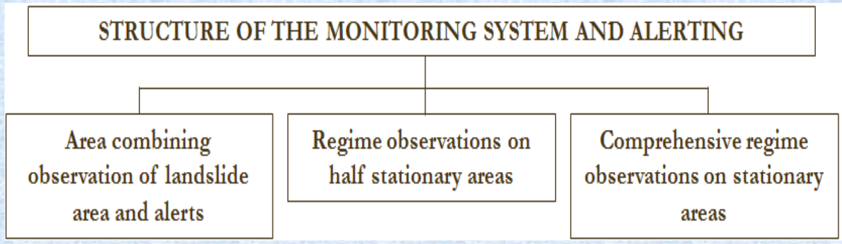
- Identification of areas of dangerous geological processes and the evaluation of their activation;
- Organization of monitoring;
- State control of dangerous geological processes;
- Preparation and issuance of recommendations;
- Warning the local public authorities, relevant ministries, state committees and agencies of the possible activation of hazardous processes shall issue recommendations on the organization of observations of dangerous geological processes;
- Gives engineering and geological information about the development of dangerous geological processes, findings and prescriptions for taking action to prevent or mitigate their negative impacts;
- Agree upon to local government authorities, ministries, state committees and departments to current and perspective plans use of territories, including projects for industrial and civil construction, in the areas of dangerous geological processes and issues conclusions about the possibility of their development and other.

Map displays dangerous geological processes in mountain and foothill areas of the Republic of Uzbekistan



The Structure of the Monitoring System and Warning

Structure monitoring dangerous geological processes - more attention is not paid to the forecast, and the hazard assessment and the Prevention of process. On this basis, a system of monitoring of dangerous geological processes consists of four blocks:



Features of Monitoring Landslide

- Daily transmission of information results observation from monitoring stations to Central Control communication of SMS, where it generalizes forwarded to the Council of SMS;
- Council of SMS reviewed daily results of observations of atmospheric precipitation forecasts, fluctuations in flow rate water springs various trends of landslides and makes the following recommendations;
- At the most hazardous events immediately sent to information of the Ministry of Emergency Situations and other interested agencies;
- Practically conducted daily control of the results of observations.

Factors formation of landslides

The mountain territory of the Republic of Uzbekistan are most susceptible to dangerous geological processes (landslides, avalanches, subsidence, suffusion, karsts). Among them are the highest risk of landslides.

Landslide – slipping and detachment masses of rocks down the slope under the influence of gravity, with the participation of surface and underground water, seismic impact and human activities.

Signs landslides on the slopes:

- Cracks on the surface of Earth;

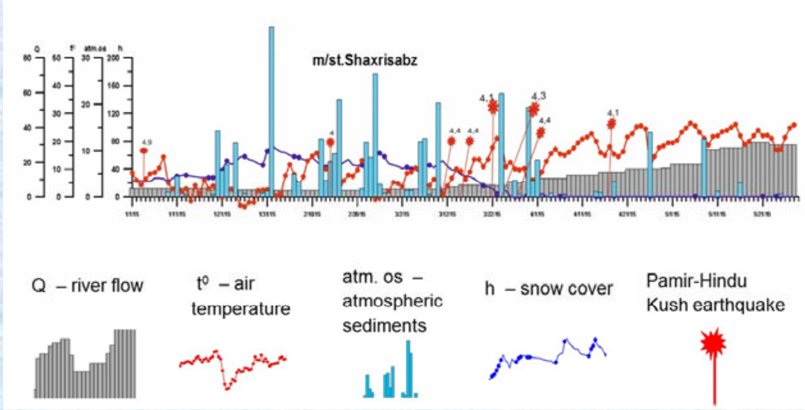
- At the foot of slopes formed by extrusion shaft;

- Between the rollers and bumps under certain conditions, accumulate surface water and groundwater. This causes waterlogging slopes;

- "Drunken trees" and broken tree trunks, as well as the loss of a vertical column of telephone and power lines, fences, walls, etc.

Factors formation of landslides are:

1. **Meteorological conditions;**
2. **Seismic factors (earthquake);**
3. **Technogenic impact.**



Meteorological conditions

#	Types of research	Threshold levels
1	Determination of water content which is expected next spring season	Change of low water on wet years
2	Estimation of rainfall the previous winter period (November or December to February months)	> 500-600 mm
3	Estimation of monthly total precipitation spring (March, April, May)	II-160-200 mm III -170-400 mm IV-140-250 mm V-150 -200 mm
4	Monitoring and evaluation of the daily loss atm. rain for 2-3 days, 5 and 10 days, with a view to timely identification of critical periods and improved the situation	2-3 days >90-110 mm 10 days – 150 -170 mm 15 days –> 220 mm
5	Control of the intensity and duration of heavy rain	1 day – 35-50 mm intensity 8-12 mm/hour

Seismic factors of landslides on impact of earthquake

1. It is a devastating historical earthquake, which are associated with about 65 ancient landslide zones. In these areas there is a relationship inherit places Education today landslides in the circus of ancient seismogravitational residual deformation;

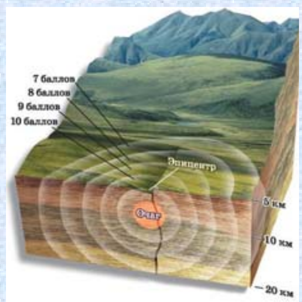
2. Influence of local earthquakes that emerged over the past 50 years is very limited, because they are not deep, and often took place in the autumn;

3. The formation of landslides during and after the strong influence of M - 5,5-7,4, distant (400-500 km), deep (170-230 km), the Pamir-Hindu Kush earthquake zone. These earthquakes in the mountain areas of Uzbekistan in the spring cause long-term low frequency (2 min) fluctuations in saturated soils that form liquefaction, cracked, mud flows;

4. Landslides after earthquake in spring in 3-10 days under influence of precipitation and groundwater.

Time of onset of the Pamir-Hindu Kush earthquakes and formation landslide processes in 2015

The time and intensity of earthquakes				Date and place of landslide		
#	**Day and month**	**M**	**H (km)**	**Day and month**	**Name of site**	**Volume m³**
1	11.03	4.4	88.97	11.03	Djauz	700 th.
2	15.03	4,4	173,8	15.03	BUT M-39 high/way 1316,8-1316,9 km	10 th.
3	21.03	4,9	100	21.03	Pustinlik 2004	2,7 th.
4	24.03	4,3	140,16	24.03	Nondek	5 mln.
5	5.04	4,2	128,14	6.04	Handiza	1,5 mln.
6	11.04	4,3	217,3	11.04	Etimtav	2,6 th.
7	11.04	5,2	217,3	11.04	Zarangbulak	10,8 th.
8	15.04	4,2	94,5	15.04	100,6 km railway T-B-K	11,5 th.
9	17.04	4,1	200,2	17.04	Gushsay	11, 7 th.



Anthropogenic impact on natural environment

All kinds of engineering-economic impact on geological environment lead to activation of dangerous geological processes.

Areal.
Development of land, industrial zones, etc.

Linear.
Construction of roads and railroads, canals, etc.

Local.
Some local construction in the mountainous area.

Monitoring system landslides

Monitoring system in Uzbekistan subdivided into three groups:

First – areal monitoring landslide-prone areas to identify new dangerous areas for settlements, recreation, mining and hydraulic structures, roads, canals, water pipelines, transmission towers and other facilities.

Second – Stationary where monitoring of the development of landslide fissures held on extensometer, Mark.

Third – stationary sites, home of the full range of observations of the mechanism of the landslide. Areal monitoring station conducts observations at 750-800 sites.

Aerovisual observation.

Together with representatives of the Uzbek Hydrometeorological Service (Uzhydromet), the Ministry of Emergency Situations and others. Ministries and departments conducted a survey aerovisual mountain and foothill areas of the Republic of Uzbekistan in order to identify new areas and landslide-prone areas, as well as the scale of the landslide threat.

Methods for monitoring landslides

GPS method 500 (Switzerland)

Geodetic Satellite Navigation System Leica GPS System 500 (with software SKI-Pro) – the automatic mode, you can get an increment of geodetic coordinates and elevations of points with no direct line your visibility between them in a more operational mode.

GPS receiver to measure Landslide displacement

Electronic tachymeter for shooting landslide

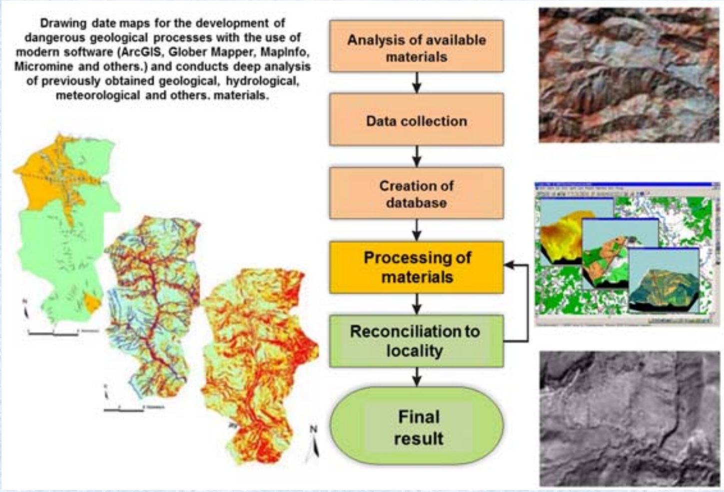
Electronic extensometer (Japan)

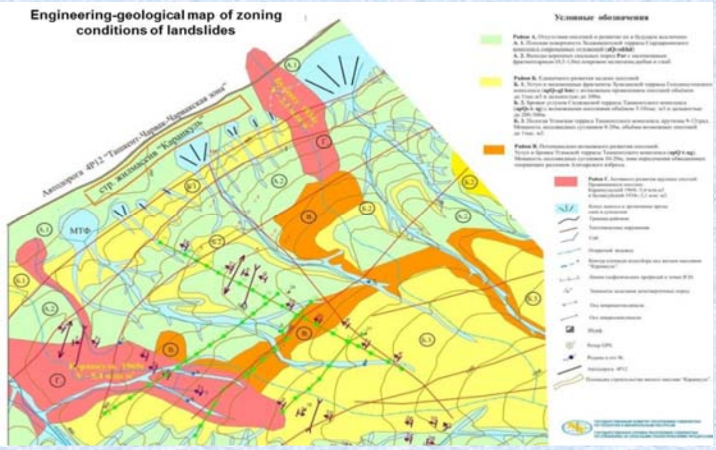
Electronic extensometer detects the movement of the landslide mass and measures the deformation of cracks as result of activation of the landslide. The device also used to refine the direction of the landslide mass and deformation monitoring, whether due to a large cut slope, bulk works.

Landslide displacement measurement with an automatic electronic extensometer

Measurement disclosure landslide cracks using extensometer (SLD)

Electronic rain gauge (Japan)





Every year prepared warning information on possible forms of dangerous geological processes for eight regions and one summary of the Republic of Uzbekistan

Anti-landslide measures

Anti-landslide measures by their nature divided into two groups:
Passive and ***active***.

Passive security-related restrictive event:

- ✓ Prohibition of cutting landslide slopes and devices to them all sorts of seizures;
- ✓ Preventing various kinds bedding as slopes and above them within threatening strip;
- ✓ Prohibition of construction on slopes and in these band structures, ponds, reservoirs, objects with large water consumption without performing constructive activities completely eliminates leakage of water into the soil;
- ✓ Prohibition of explosions and mining operations near the landslides;
- ✓ Protection of trees and shrubs and herbaceous vegetation;
- ✓ Prohibition of uncontrolled irrigation of land, and sometimes their plowing;
- ✓ Prohibition of devices and constant column of water aqueduct device without sanitation;
- ✓ Preventing dumping torrential landslide slopes, thawed, sewage and other waters;
- ✓ Moving in landslide areas.

For active, relate landslide events holding which requires a device engineering structures:

- ✓ Retaining structures – to prevent landslides;
- ✓ Retaining walls – relatively small landslides on the slopes in violation of their resistance because of cutting and give a lick and a promise;
- ✓ Pile rows – to strengthen the landslide slopes in the period of temporary stabilization of landslides, with a relatively small (up to four meters) bias power of the body (concrete, reinforced concrete and steel piles are staggered in not biased rock to a depth of 2 m;
- ✓ Solid pile or sheet series (thin walls) (established less other holding facilities because of their high cost).

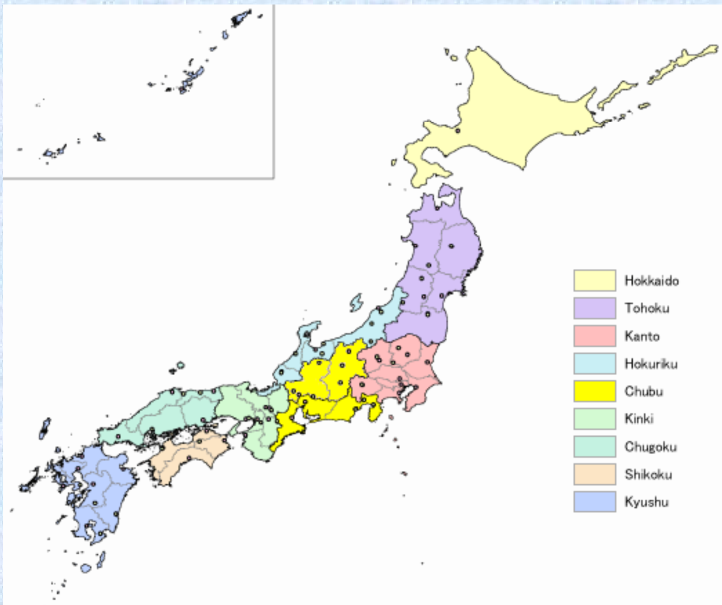
Monitoring Landslides in Japan

About the Japan Landslide Society

The Japan Landslide Society was established in 1963 in the background of such natural conditions. Later, in August, 1999, this society was approved to be a corporation by Science and Technology Agency. This is only one scientific society dealing with landslides not only in Japan, but also in the world.

Recently, the Japan Landslide Society consists of 1,600 individual and group members of scientists and engineers from universities, institutes and geologic consultant companies.

This society includes Department of General Affairs, Department of Editing and Publication, Department of Event Planning, Department of Research and Study, Department of International Affairs. Besides, in Kyushu, Kansai, Chubu, Niigata, Tohoku, Hokkaido and Kanto, local branches are doing firm-rooted activities.



Major Landslides in recent years and their impact

Hiroshima (August 20, 2014)

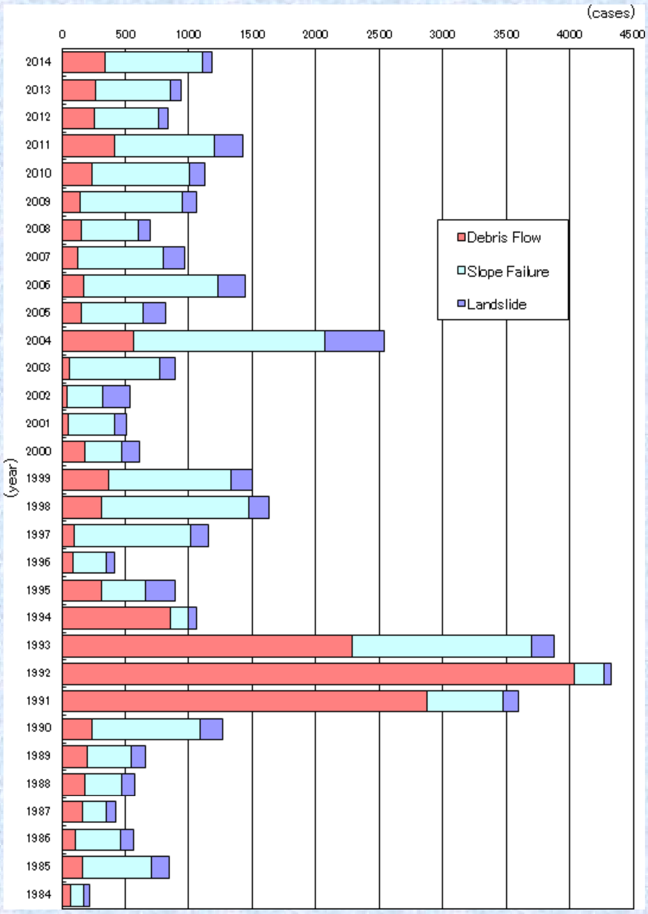
Tohoku-Taiheiyo Earthquake, Shirakawa, Fukushima (March 2011)

Nakagusuku, Okinawa (Jun 2006)

Imari, Saga (Sep 2006)

The Number of Disaster Occurrence

Year	Debris Flow	Slope Failure	Landslide	Total
1982	293	1567	147	2007
1983	352	1093	119	1564
1984	67	103	51	221
1985	165	538	145	848
1986	104	356	102	562
1987	165	186	70	421
1988	181	291	102	574
1989	200	345	111	656
1990	238	852	180	1270
1991	2879*	599	122	3600
1992	4035*	232	55	4322
1993	2288*	1413	171	3872
1994	853	142	68	1063
1995	309	347	237	893
1996	91	258	64	413
1997	101	917	136	1154
1998	317	1160	152	1629
1999	373	960	168	1501
2000	180	291	137	608
2001	48	365	96	509
2002	46	275	218	539
2003	57	712	128	897
2004	565	1511	461	2537
2005	158	483	173	814
2006	169	1057	215	1441
2007	129	675	162	966
2008	154	452	89	695
2009	149	803	106	1058
2010	234	767	127	1128
2011	419	781	222	1422
2012	256	505	76	837
2013	262	590	89	941
2014	338	769	77	1,184



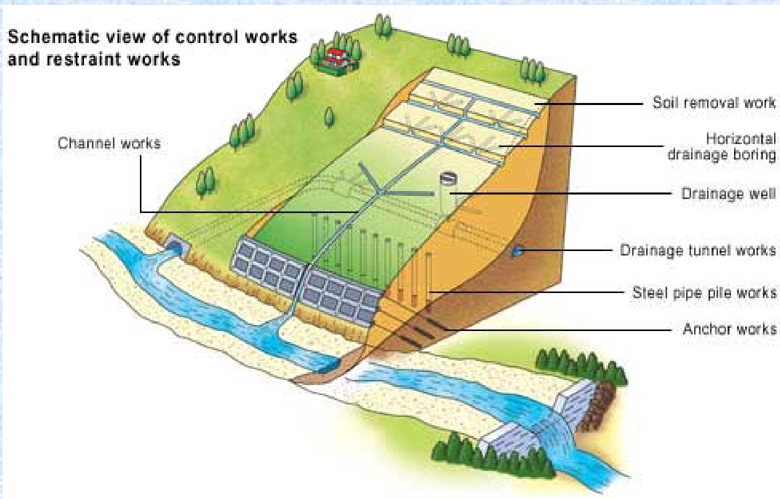
New methods of monitoring landslides and maintaining them in a stable state

Two third of the Japanese Archipelago is dominated by mountains; 100 million people are forced to live and work in slopes or around slopes. Landslides often cause disasters and cause extensive damage.

In this regard, research organizations and universities to carry out research work on the study and prevention of landslides. Also conduct monitoring of landslides and develop new designs to maintain a steady state of landslides.

Preventive measures against landslide

A landslide is caused by a combination of various factors (topography, geology, geological structure, ground water, etc.). Accordingly, measures to be taken for landslide prevention come in a variety of types. Broadly the landslide preventive measures are classified into two types of works: control works and restraint works.



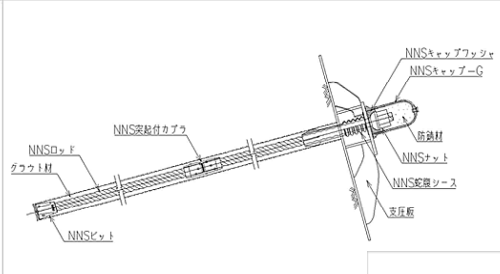
New nailing network system

Therefore, so far has been developed various disaster prevention method

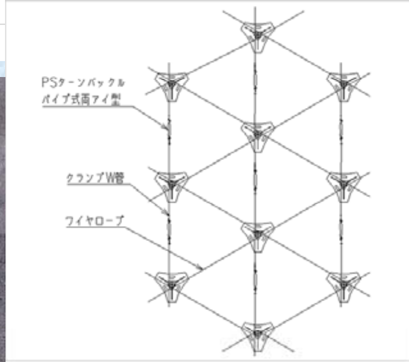
In recent years, with increasing awareness of the environment and landscape, also for slope stabilization measures, there is a growing interest in the construction method of conservation taking advantage of the green on the slopes.

"Non-frame construction method" is, as a new slope stabilization method that meet the demands of this era. Non-frame construction method reinforcing material (rock bolts), Bearing plate. Head consolidated material consists of (wire rope).

施工イメージ図(CG)



構造断面図（自穿孔方式の場合）



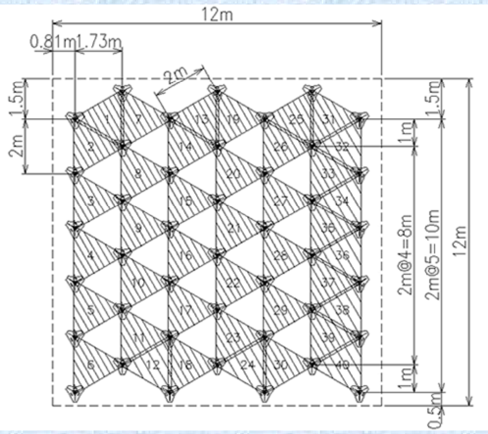
構造平面図

Used material

1. NNS rod
2. NNS cap – G
3. NNS nut
4. NNS Cap washer
5. NNS with projection coupler
6. NNS bellows sheath
7. NNS bit
8. Bearing plate
9. Wire rope
10. PS turnbuckle Pipe type
11. Clamp W tube

Wire rope Masu mounting three lock bolt in one so that the triangle. Digits and the hatching in the figure shows the mounting position of the wire rope. Construction interval of the lock bolt, it may also be shortened by soil conditions.

Standard layout



【安全防護柵設置例】

Mudflows in Uzbekistan

In Republic of Uzbekistan monitoring of mudflows are Centre of Hydrometeorological Service at Cabinet of Ministers of the Republic of Uzbekistan (Uzhydromet).

Uzhydromet conducts hydrometeorological and agrometeorological observations on the whole territory of the Republic of Uzbekistan. In the zone of responsibility of Uzhydromet, the stations that have long terms of observation are located. The network united under Uzhydromet includes more than 400 stations.

A **mudflow** or mud flow is a form of mass wasting involving "very rapid to extremely rapid surging flow" of debris that has become partially or fully liquefied by the addition of significant amounts of water to the source material.

Mudflows contain a significant proportion of clay, which makes them more fluid than debris flows; thus, they are able to travel farther and across lower slope angles. Both types are generally mixtures of various kinds of materials of different sizes.

Monitoring Mudflows

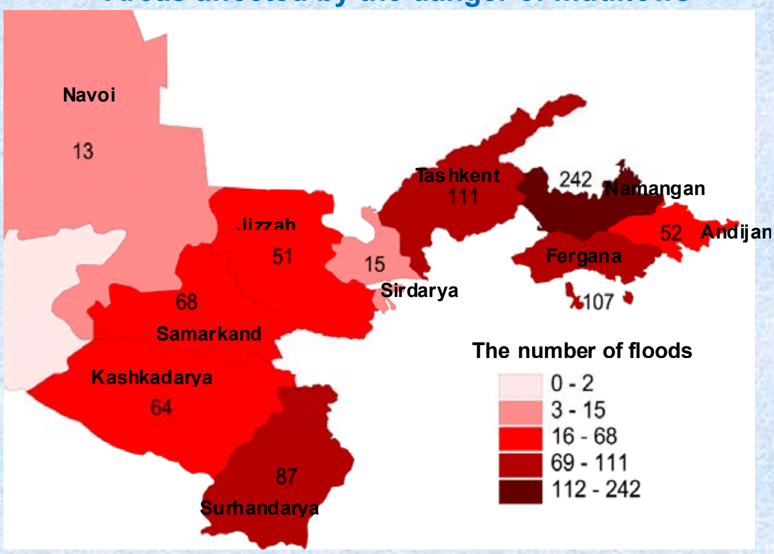
The main sources of surface runoff in the Central Asian region are Transboundary Rivers Amudarya and Syrdarya, the average annual flow of which is - 78.5 and 37.1 cubic km / year respectively, and to the basins of the rivers, most of which belong to the region. The main flow of the river Amu Darya - 83% formed on the territory of Tajikistan, the Syrdarya river flow by 80% formed on the territory of Kyrgyzstan. Much of the territory occupied by mountains of the Central Asian Republics and this determines the specific form of floods. In Kyrgyzstan Mountains, cover 95% of the total, 93% in Tajikistan, Uzbekistan about 30%, Turkmenistan - 28%.

Spring and summer - the main phase in the hydrological regime of the rivers of Central Asia, during which takes place from 70 to 80% of annual runoff. On most rivers at this time of the year, there is the greatest water flow.

It should be noted that in terms of the damage, the most attention in the Central Asian region deserve mudflows and floods, formed as a result of high altitude lake.

Mudflows are widespread throughout the mountain and foothill part of Uzbekistan and are often cross-border nature, since the majority of mudflows formed on the territory of neighbouring states – Kyrgyzstan and Tajikistan.

Areas affected by the danger of mudflows



The scheme of distribution of glacial lakes

Mountain glacial lakes

One of the powerful village-forming factors are of high altitude lake. Lakes Breakthroughs do not happen often, but are extremely destructive.

Total number of glacial lakes that threaten the territory of Uzbekistan located on the territory of Uzbekistan and neighbouring territories is – 315.

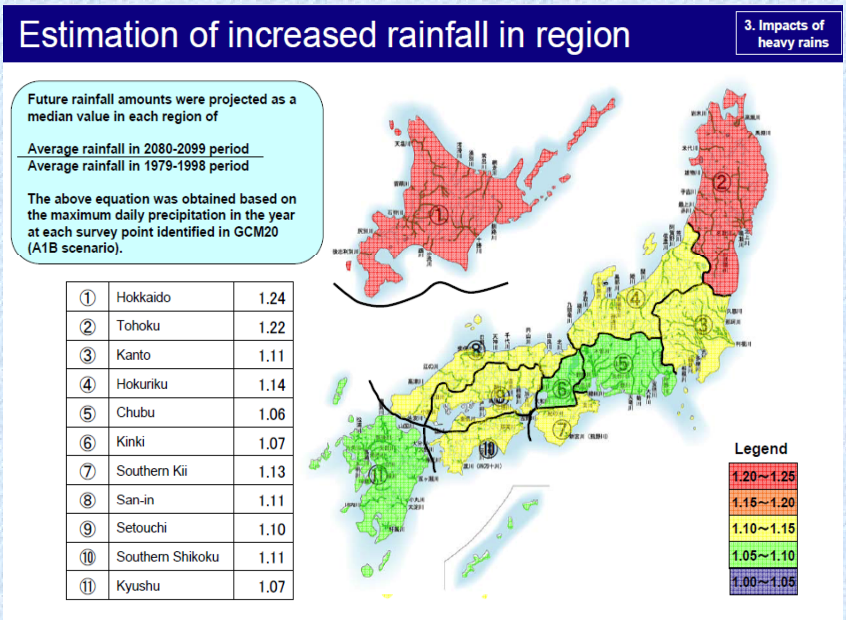
Preventing floods risk

- Much attention paid in Uzbekistan to the development and improvement of methods of prevention mudflows danger. Warning threat of flood, various origins include:
- Compiling short-term background of warnings about the possibility of the mudflows and floods on the basis of an assessment form factors (rainfall, their intensity, the state of the snow cover, air temperature);
- Alert stakeholders about the passing of the risk of floods and mudslides on the approved scheme warning;
- alert the public about the passing of the risk of mudslides and floods;
- Risk Assessment threat mudflows and floods on specific objects based on specialized research. Design and construction of protective structures.
- Issuing regulations on carrying out the necessary steps to protect the public, staff and facilities from mudflows threats and monitoring their implementation.

Mudflows in Japan

Japan has a summer rainy season in June and July called the Baiu season, and an autumn rainy period in September and early October characterized by tropical low-pressure systems (typhoons). These rains supply the water needed for growing rice and other crops, but sometimes their intensity causes damaging debris flows and landslides.

SABO is a Japanese term that means erosion and sediment control works. The Japanese style of SABO erosion control works is more intensive than Western erosion control works. The term SABO is known internationally, and is used both in and outside Japan.



①	Hokkaido	1.24
②	Tohoku	1.22
③	Kanto	1.11
④	Hokuriku	1.14
⑤	Chubu	1.06
⑥	Kinki	1.07
⑦	Southern Kii	1.13
⑧	San-in	1.11
⑨	Setouchi	1.10
⑩	Southern Shikoku	1.11
⑪	Kyushu	1.07

Administrative organizations engaged in erosion and sediment control

Erosion and sediment control works are administered and conducted under the authority of two governmental organizations:

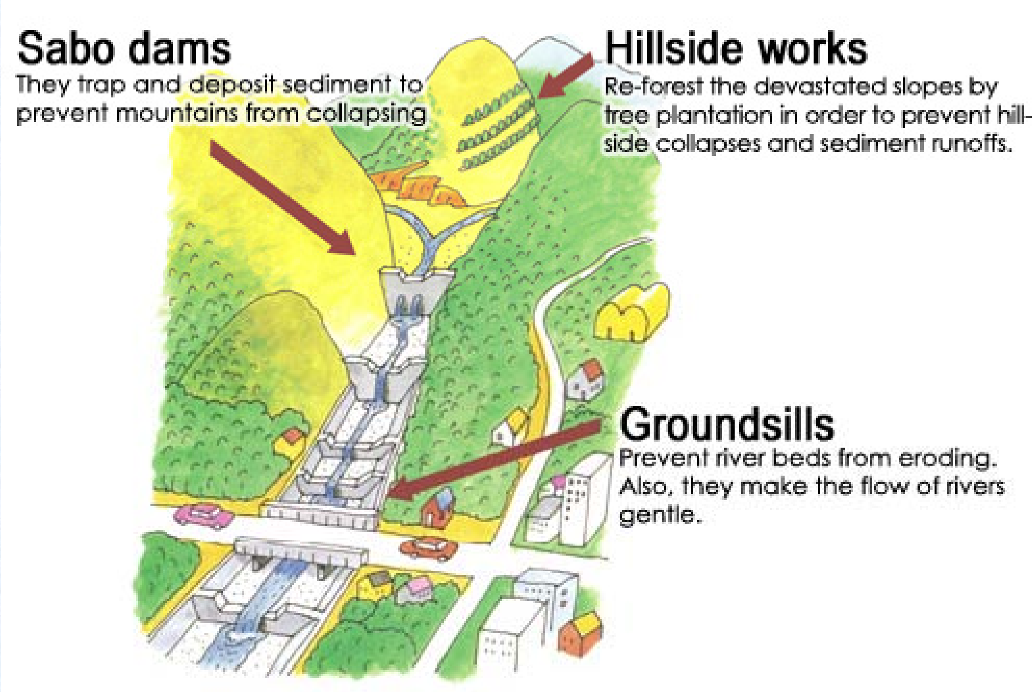
(1) the erosion department of the Ministry of Land, Infrastructure and Transport, formerly the Ministry of Construction;

(2) the Forestry Agency of The Ministry of Agriculture, Forestry and Fisheries.

There are 47 prefectures in Japan; in each prefecture, the Agriculture and Forest Department and the Sabo Section of the Public Works Department are responsible for erosion control works.

Debris Flow Measures

Building Sabo dams upstream traps the sediment there and prevents it from eroding and flowing downstream. Sabo dams also serve to stop debris flow.



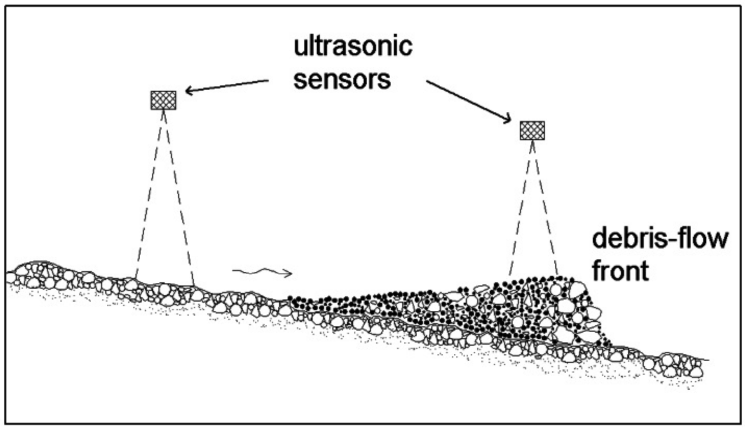
Open steel pipe in a Sabo dam

Concrete-slit Sabo dam before sediment discharge

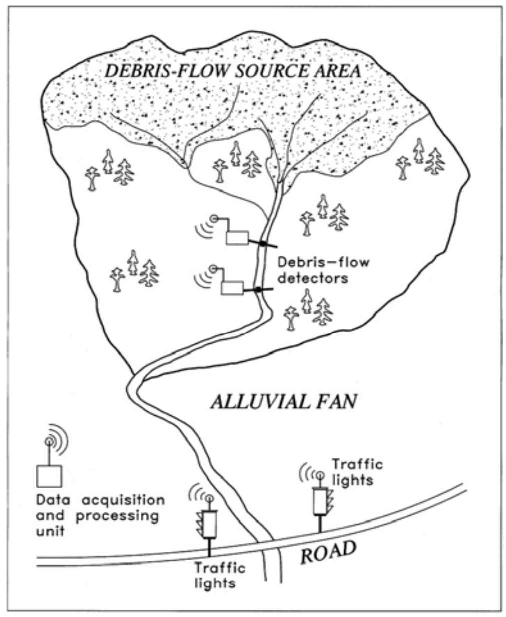
Debris flow barrier successfully catching the debris flow snout at Mount Tateyama, Japan.

Grid Sabo dam with trapped debris flow

Debris Flow Sensors



1) Wire sensors.
2) Vibration sensors.
3) Light sensors.
4) Acoustic sensors.



Sketch of the components of a debris-flow warning system

Different type of sensors

CONCLUSIONS

Japan has a wealth of experience and knowledge to mitigate and prevent natural disasters, in which the whole world takes the example, including Uzbekistan. For achievement that the people of Japan have experienced a lot, the result has demanded full commitment and full involvement of all relevant subjects, including Governments, regional and international organizations, civil society including volunteers, the private sector and academia.

Currently Goscomgeology collaborates and interested in further cooperation with ADRC mitigation of natural disasters, with the common goal of substantial reduction of the victims, the early warning of the dangers and to reduce the social, economic and environmental assets of communities.

In Japan, I spent a wonderful time. I learned about a new system of disaster management, early warning and disaster prevention.

I would especially like to stay at the developed method to prevent landslides “New nailing network system” which is very effective for the reinforcement of landslides preserving the natural surface structure of the environment.

After returning to the country, I plan to show presentation about Disaster management system and recommend this “New nailing network system” the chairman. I also plan to prepare a lecture for primary school students about natural disasters and the action in the event of disaster, with intended installation examples.