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"NATIONAL SURVEY FOR SEISMIC PROTECTION" AGENCY
 MINISTRY OF EMERGENCY SITUATIONS, REPUBLIC OF ARMENIA



Country Report: REPUBLIC of ARMENIA

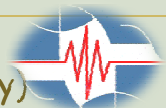
Armine Khangaldyan

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 Department of Observation Network
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ADRC Visiting Researcher 2012

General Information

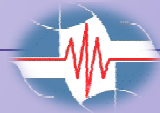
Official name	Republic of Armenia (RA), briefly - Armenia
Name in official language	Hayastani Hanrapetutyun, briefly - Hayastan
National flag	rectangular panel with three equal horizontal stripes of red, blue, orange from top to bottom in the proportion 1:2
Head of the State	President
Legislative power	one-chamber National Assembly
Official language	Armenian (is part of Indo-European family of languages)
Capital	Yerevan
Administrative and territorial unit	Marz (11 Marzes in all including Yerevan city)
National currency	Dram (international currency code - AMD)



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Geographical Information

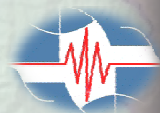
Territory	29.74 thousand square km (is comparable with the territory of Belgium or Albania)
Average elevation above sea level	1800 m
The highest peak	Aragats mountain - 4090 m
The lowest altitude	Debed river canyon - 380 m
The greatest extent	365 km
Region	north latitudes of subtropics
Climate	dry, continental
Average temperature	in January - -6.8°C , in July - $+20.8^{\circ}\text{C}$
Time zone	Greenwich mean time + 4 hours



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Demographic Information

Population	3.2 Million, population of the capital (Yerevan)- 1.1 Million
Ethnic breakdown	Armenians (98%), Russians, Yezidis, Kurds, Assyrians, Greeks, Ukrainians, Jews and representatives of other nationalities
Religion	Christianity (Armenian Apostolic Church), professed by the vast majority of the population

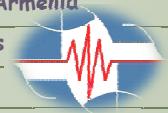


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Historical Information

RUSSIA

IV-III thousand years B.C.	origin of forearmenian tribal unions on the territory of the Armenian Plateau
782 B.C.	establishment of Yerevan city
VI-V centuries B.C.	completion of the Armenian people's ethnic forming on the Armenian Plateau territory and development of the Armenian language
189 B.C.	formation of independent Armenian state
301 A.D.	official acceptance by Armenia of Christianity as a state religion
405 A.D.	creation by Mesrop Mashtots of the Armenian Alphabet - the basis of written language
428 A.D.	partition of Armenia between Rome and Persia
VII century	Armenia is in the power of Arabs
884 A.D.	liberation of the northwestern part of Armenia and recovery of Armenian State system
1080-1375	Armenian State system established in Kilikia (Mediterranean area)
1639	partition of Armenia between Turkey (Western Armenia) and Persia (Eastern Armenia)
1828	Eastern Armenia joins Russia
1915	deportation and genocide of Armenians in Western Armenia
1918	Armenian State system recovery in Eastern Armenia-Declaration of the Republic of Armenia
1920	establishment of the Soviet rule in Armenia
1922-1991	Armenia is a part of the USSR
1991	collapse of the USSR and declaration of Independence of the Republic of Armenia
1991	Armenia is a founding member of the Commonwealth of Independent States
1992	Armenia is a member of the U.N.O.
1999	signing of partnership agreement between Armenia and the European Union
2001	Armenia is a full member of the Council of Europe



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GEORGIA

RUSSIA

Armenia's climate is dry and temperate. The summers are warm and the winters are cold and snowy. Much of the country is mountainous and altitude differences can have a significant effect on local climate.

The population of Armenia (as of 2011) is estimated to be almost 3 million people. There are cities of notable size, such as Gyumri (170,000) and Vanadzor (115,000).

Armenia was a part of the former USSR. It gained its independence on September 21, 1991.



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YEREVAN

Capital

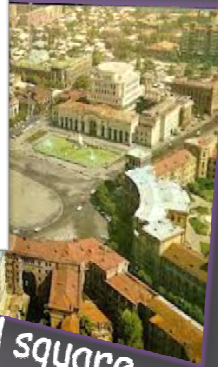
Year of Yerevan is considered the base year of Urartian Erebuni - 782 g to n. Oe. located on the southern outskirts of modern Yerevan



*Ruins of the Erebuni
fortress*



*Central square
of modern Yerevan*



Lake Sevan-"Armenian Sea"



*The only guaranteed source of a large fresh water in Armenia and the largest in the whole Caucasus.
The ancient name of Lake Sevank - which means "black monastery".
Its name from the lake was located in the northwestern part of his monastery.*



Ancient Tatev Monastery



The village Tatev is remarkable for its ancient monastery, which was founded in the 9th century. And in the courtyard of the monastery, survived a stunning monument to the engineering art of the ancients, -Gavazan. This octagonal pillar, built of stones of pure Tesco, height of 8 m. But most interesting is the fact that because of hinge joint with stylobate and very accurate calculation, in earthquakes, and he rocked back in his position!

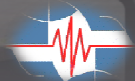


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Armenian Genocide (1915)

(Monument "Tsiternakaberd")

Tsitsernakaberd is a memorial dedicated to the victims of the Armenian Genocide. Every year on April 24, hundreds of thousands of Armenians gather here to remember the victims of the 1915 Armenian Genocide.



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Holy Mount Ararat

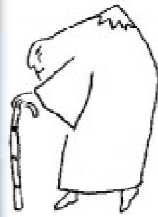
It consists of two fused bases of the cones of extinct volcanoes.

Above the height of 4,100 m, the mountain mostly consists of igneous rocks covered by an ice cap.

The Bible says that it first emerged from the Ararat descending waters of the Flood, landed here the inhabitants of Noah's ark.



Fuji



Ararat

Although Armenia and Japan are very far from each other, they have much in common. Both nations have their own characteristic old "business cards" - 2 amazing mountain that keeps on cheering for centuries.

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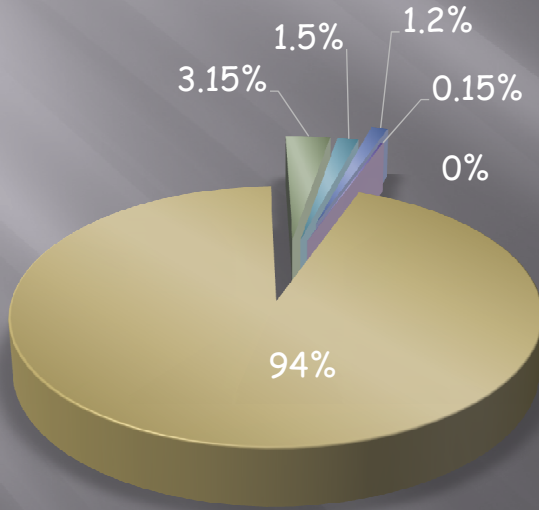
WELCOME TO ARMENIA !



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The disasters in Armenia

Armenia is one of the most disaster prone countries in the world (except the sea disasters), but In Armenia the earthquake disaster is the most harmful for people and property.

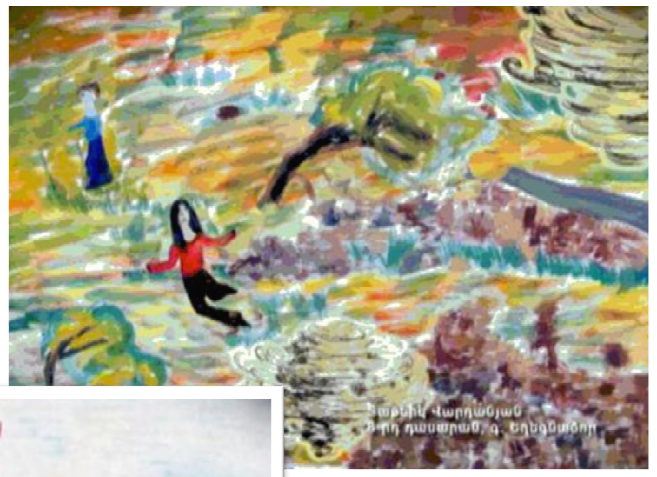


- Earthquakes
- Mudslides
- Landslides and rockfalls
- Floods
- Irradiation



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Disaster by Armenian children eyes



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Spitak 1988, M=7.0 Destructive Earthquake

The recent major earthquake completely destroyed the Spitak, in part-of Leninakan and Kirovakan.

- 25.000 people losses
- 250.000 injured
- 500.000 homeless

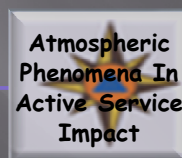
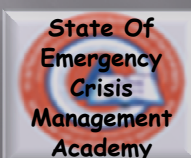
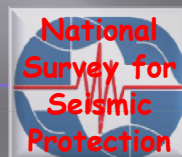


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Ministry of Emergency Situations of the Republic of Armenia



Structure

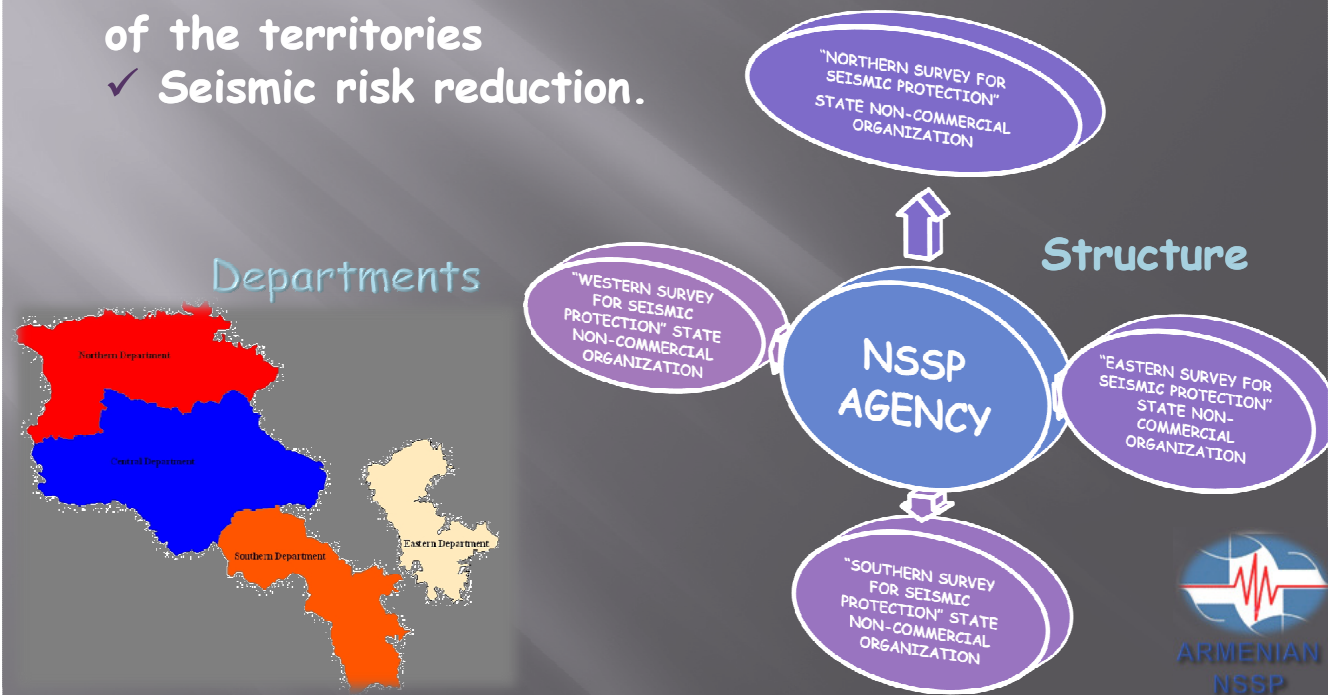


MES of RA is a republican body of executive authority, which in line with such competences as are vested in it by laws and other legal acts, develops, implements and coordinates RA government's policy in the area of civil defense and protection of the population in emergency situations.

Armenian NSSP

General activities:

- ✓ Provision of seismic hazard monitoring in the territory of RA
- ✓ Assessment of the seismic hazard and seismic risk of the territories
- ✓ Seismic risk reduction.



The basic goal of NSSP is Seismic Risk Reduction in Armenia

SRR Strategy includes:


- ✓ Seismic Hazard and Risk Assessment;
- ✓ Vulnerability reduction in urban areas, including reinforcement and upgrading of existing buildings, design of new codes and standards;
- ✓ Public awareness, people education and training;
- ✓ Early warning and notification;
- ✓ Partnership establishment, involving public and private organizations;
- ✓ Risk management, including Emergency Response and Rescue Operations;
- ✓ Disaster relief and people rehabilitation;
- ✓ Insurance;
- ✓ State disaster Law and regulations.



Laws and regulations

Seismic Protection activities are regulated by a number of laws and legislative acts and national programs of the Republic of Armenia:

Law of RA	The Law of the Republic of Armenia on Seismic Protection (2002)
Resolutions of Government	The Complex Program of Seismic Risk Reduction in the RA Territory (1999)
	The Complex Program of Seismic Risk Reduction in Yerevan city (1999)
	The Resolution of the Government of RA on establishment of the list of critical important and general facilities in the field of seismic protection (2003)
Regulation	"National Survey for Seismic Protection" Agency (2008)



Armenian NSSP Main Tasks:

- **seismic monitoring**
- **current seismic hazard assessment and earthquake prediction**
- **seismic and secondary hazard assessment**
- **seismic risk evaluation and reduction, early warning**

including

- ✓ earthquake engineering
- ✓ population education and training
- ✓ preparedness of government officials and local authorities
- ✓ development of early warning system
- ✓ compiling of hazard and maps

➤ seismic monitoring

Seismic monitoring is very important to earthquake registration in Republics of Armenia and Nagorno-Karabakh and seismic regime analysis, also to prediction the strong or not strong but notable earthquakes.

Armenian NSSP is in charge of the seismic protection and seismic monitoring system.

National observation network

Armenian NSSP has the following international and local monitoring systems:

- USGS-IRIS Project
- CTBT International Monitoring System (Comprehensive nuclear Test-Ban Treaty)
- The Real Time Seismic Intensity Display System (Joint Armenian-Japanese (JICA) project)
- READINESS geochemical stations (Armenian-German project)
- Vayk Seismic array network (Armenian-French project)
- Observation Network
- Local Seismic Network

IRIS (Global Seismographic Network Station)

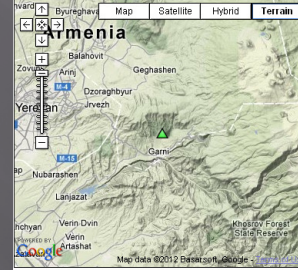
In Garni, at the Geophysical observatory, installed seismic recording station. This station included in the IRIS Global Seismographic Network (GSN) and providing seismographic data to research earthquake hazard mitigation and the verification of a Comprehensive Test Ban Treaty (CTBT).

Seismic Network Operations

IU GNI

Garni, Armenia

IU GNI commences operations on: 1991_191

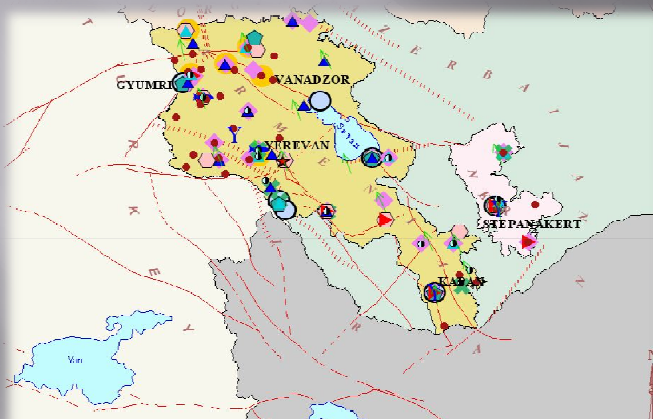


Host:	National Survey for Seismic Protection
Latitude:	40.149
Longitude:	44.741
Elevation:	1609
Datalogger:	Q330
Broadband:	STS-1VBB_w/E30
Accelerometer:	FBA_ES-T_EpiSensor_Accelerometer
Telemetry Status at the NEIC:	● Last Data: Minutes



National observation network

The Armenian NSSP has a unique **multi-parameter observation network** consisting of 150 stations (40 parameters) for real-time monitoring of geosphere.



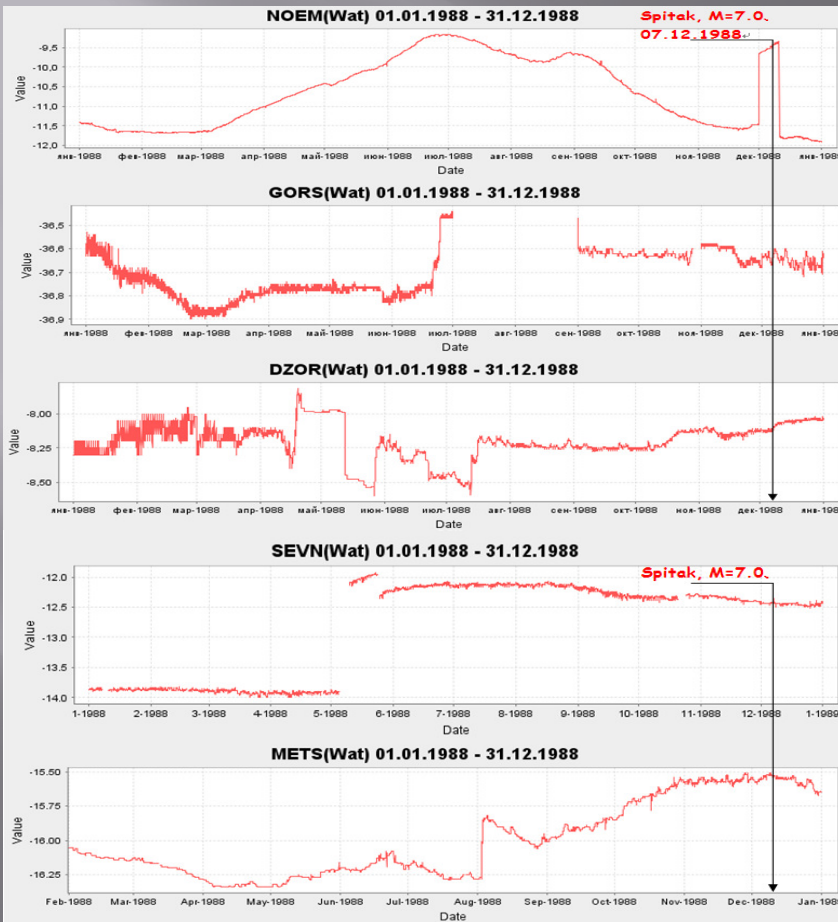
Legend

- GPS stations
- Ionospheric stations
- Regional seismic stations
- Hydrogeodynamical stations
- Electromagnetic stations
- Biology stations
- Radiometry stations
- Geomagnetic stations
- Geochemical stations
- READINESS geochemical stations
- Atmospheric pressure stations
- GSN IRIS
- Telemetry seismic stations
- SMART accelerometers
- SMART accelerographs
- Active faults

Stations	Number
Radiometric	25
Geomagnetic monitoring	10
Electromagnetic monitoring	7
Atmospheric pressure measuring	7
Seism-biologic	2
Hydro-geodynamic	13
Hydro-geochemical Regional	7
Hydro-geochemical READINESS	5
Seismic	10
IRIS (international global network station, unique in the region, long period)	1
Ground strong motion	20
Telemetric seismic	28
Real Time Seismic Intensity Display	5



➤ Current Seismic Hazard Assessment and Earthquake Prediction



"Noyemberian" station situated 75 km north-east of the Spitak earthquake source zone. It became evident that anomalous changes in ground water level took place from December 1 till December 10, 1988, i.e. during the Spitak earthquake preparation and realization.



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The "HUYS" (HOPE) new automatic system

The "HUYS" (HOPE) new automatic system for current seismic hazard assessment based on time series data of various parameters, obtained the National observation network, is developed and implemented at the Armenian NSSP. The system is on the stage of testing and experimentation.

The screenshot shows the 'HUYS' (HOPE) software interface. The main window is titled 'Options' and includes a map of Armenia with a red dot indicating the station location. The station information is: Station "DZOR", longitude: 44.63, latitude: 40.2. The 'Anomalies Management' section shows a list of parameters (Atmosphere Pressure, BJO, Conductance, Debit, GenMag, Genkh, Ion) and a table of anomalies. The 'Anomalies Found' section shows a graph of the anomaly for DZOR (Wat) from 10-Aug to 11-Aug. The console at the bottom displays the following text:

```

max of an_dynamics = 0.4399999999999999
average of max_dynamics = 0.014649
dynamics=0.014649
    
```



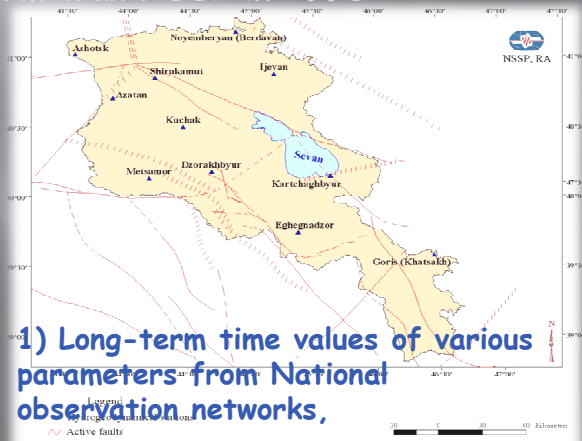
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Short description of system "HUYS" (HOPE) (scale 1:500.000), compiled at Armenia NSSP in 1998

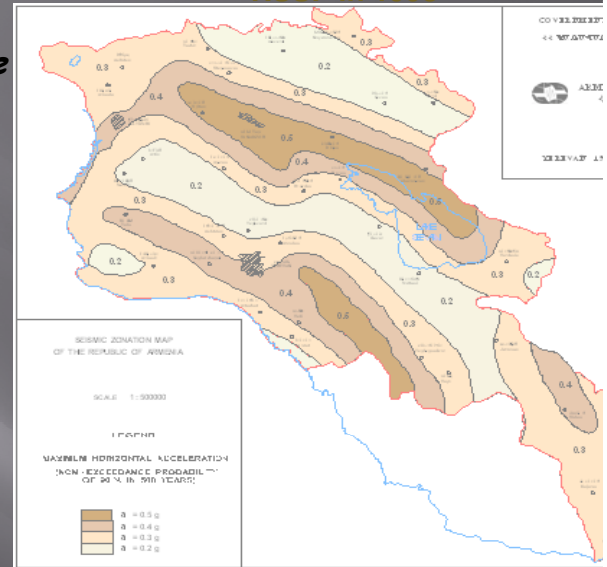
For seismic risk reduction the great value has reliability of an estimation of current seismic hazard.

1. Database comprise:

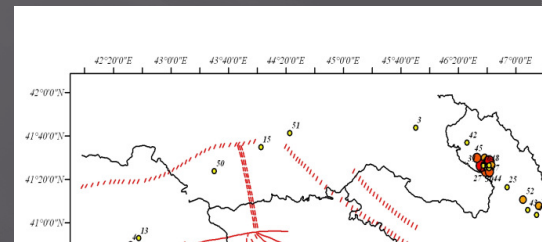
- 1) Long-term time values of various parameters from National observation networks,
- 2) National seismic catalogue,
- 3) Seismic hazard map of RA territory (scale 1:500.000), compiled at Armenian NSSP in 1998



- 1) Long-term time values of various parameters from National observation networks,



National Seismic Catalogue



Short description of system "HUYS" (HOPE)

2. Knowledge base comprise:

- 1) Results of testing 11 strong regional ($M \geq 6.0$) and 7 local notable ($3.5 \leq M \leq 5.0$) earthquakes: forms of display of anomalies-precursors of the tested earthquakes for all used parameters, and also sizes of probability of seismic realization of anomalies-precursors.
- 2) results of testing of "HUYS" (HOPE) on separate parameters of earthquakes with magnitude $M \geq 3.5$, events in RA territory and next regions,

3) other materials.



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Results of test and testing "HUYS" (HOPE)

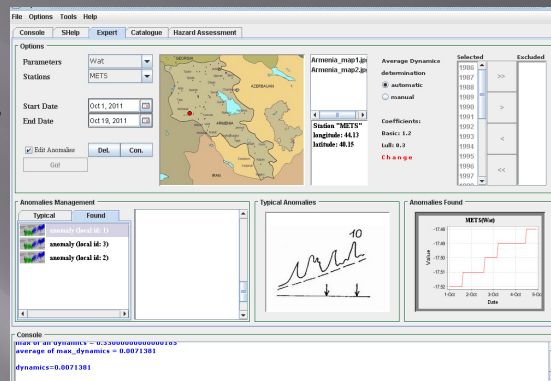
As a result of "HUYS" application on separate parameters and on their wide complex size Z_{cur} . will be defined In conditional points and zone S of current seismic hazard in territory RA.

If the size of current hazard is more than size of critical hazard in the given zone an earthquake in territory RA could be occurred. The program counts also time interval of hazard Δt .

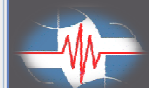
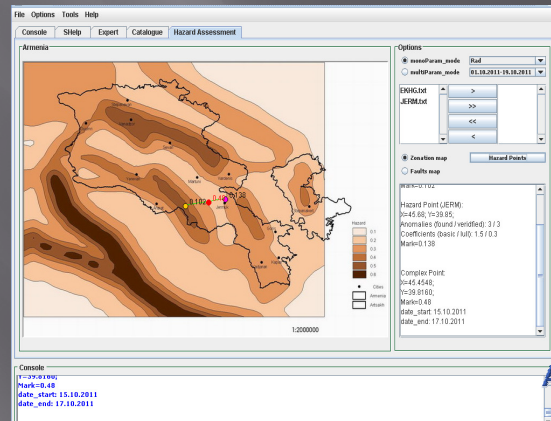
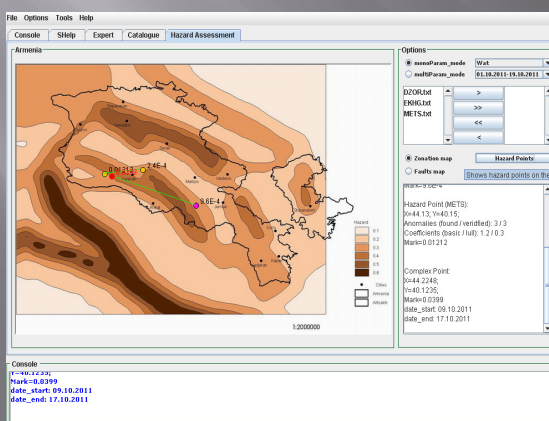
For the purpose of solving various tasks concerning an estimation of current seismic hazard, now the testing of 20 notable earthquakes with $M \geq 3.5$, events in territory RA for 1988-2007 is held and Hope results in hopeful results.

The results of testing for the earthquake 15km NE Garni (14.10.2011, $M=3.8$).

In the course of work seismogene anomalies at first are separated.



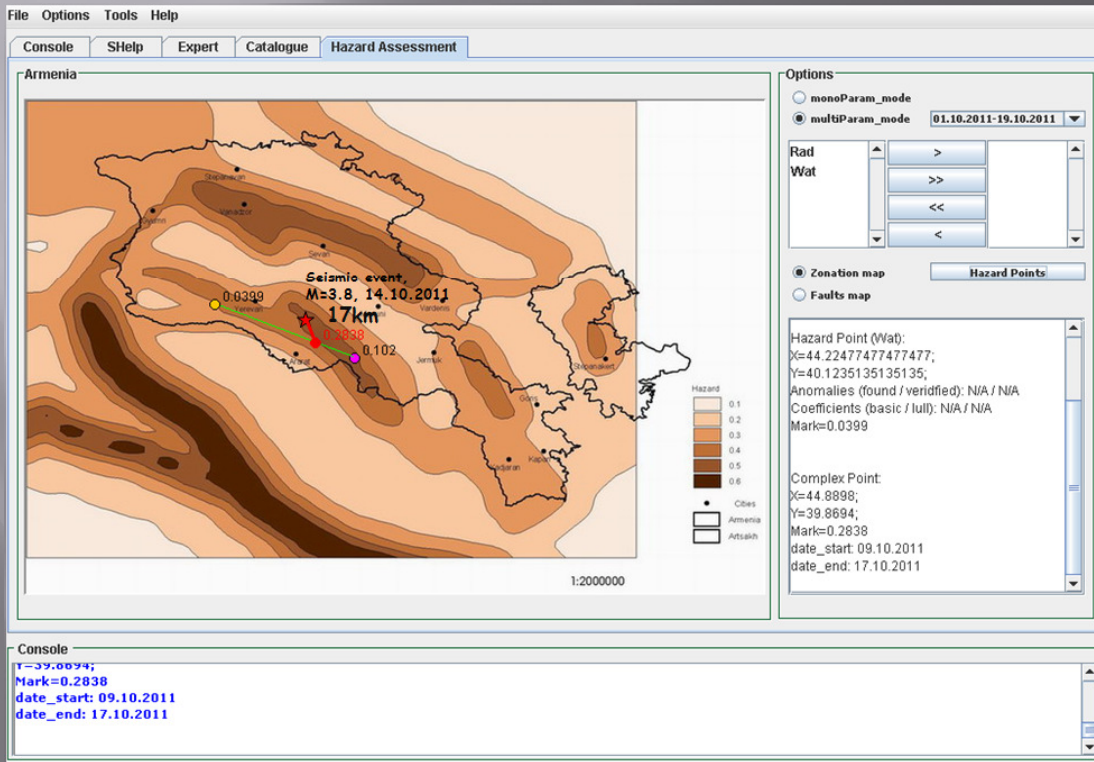
Then the zone and size of current seismic hazard are calculated.



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The results of testing for the earthquake 15km NE Garni (14.10.2011, M=3.8).

Finally, the zone of current seismic hazard is very close (17km) to the epicenter of the occurred earthquake.



Thank you
for attention!

