

NATURAL RISKS and DANGERS



Contents

1. Basic Definitions
2. Classification of Dangerous Natural Phenomenon
3. Causes of Dangerous Natural Phenomenon.
Geodynamic Processes in the Earth Interior as Risk Factor
4. Basic Mechanisms in Dangerous Natural Phenomenon Occurrence
5. Natural dangerous processes activated by human activity
6. Natural Risk Analysis
7. Regional Aspects of Ecological Risk

Major Natural Disasters listed by the Number of Victims:

- Flooding in China in 1959 (2 million victims)
- Drought in India in 1965-1967 (1,5 million victims)
- Hurricane in Bangladesh in 1970 (300 thousand victims)
- Earthquake in China in 1976 (240 thousand victims)
- Earthquake in Peru in 1970 (70 thousand victims)
- Volcanic eruption on Martinique in 1902 (26 thousand victims)

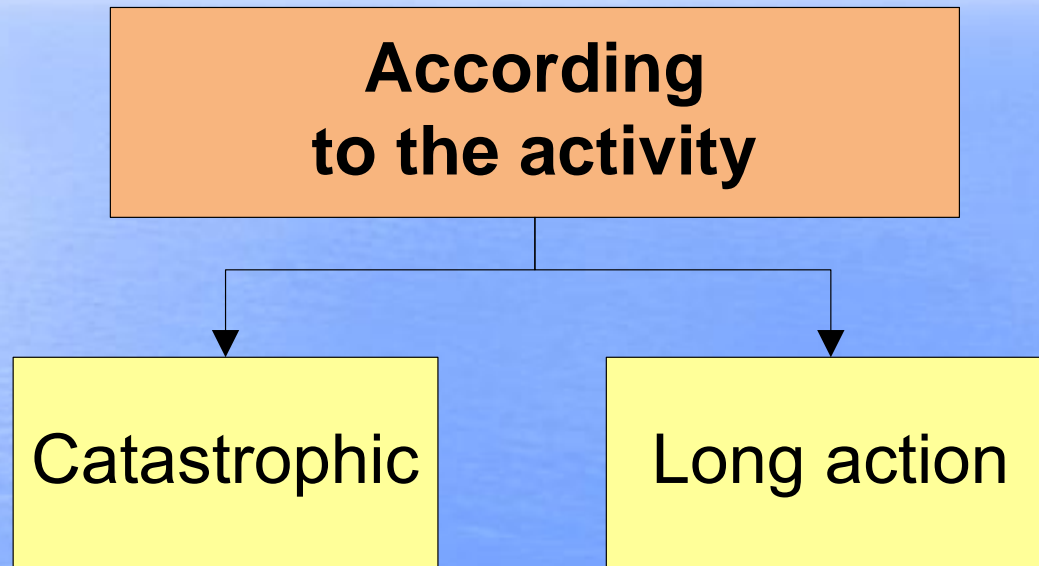
Basic Definitions

- **NATURAL DANGER** – process, quality or state of some parts of lithosphere, hydrosphere, atmosphere or space, harmful to people
- **DANGEROUS RISKS** (dangerous natural phenomenon) – risks connected with destructive natural forces
- **NATURAL RISK** – natural danger probability measure (the total number of dangers), determined for specific object as possible losses at definite time

Basic Definitions

- **DANGEROUS NATURAL PHENOMENON**— event of natural origin which can lead to harmful effect for people, economic facilities and environment due to its intensity, expansion scale and duration.
- **VULNERABILITY** – material object property of losing ability to perform natural or prescribed functions under possible dangerous effects.

Natural risks classification



Natural risks of catastrophic character

- The geophysical dangerous phenomena (earthquakes, eruptions of volcanoes)
- The dangerous geological phenomena (landslips, mud flow, collapses, taluses, avalanches)
- The meteorological dangerous phenomena (storms, hurricanes, squalls, tornadoes)
- The sea dangerous hydrological phenomena (cyclones, tsunami)
- The hydro-geological and hydro-geological dangerous phenomena (flooding)
- Natural fires

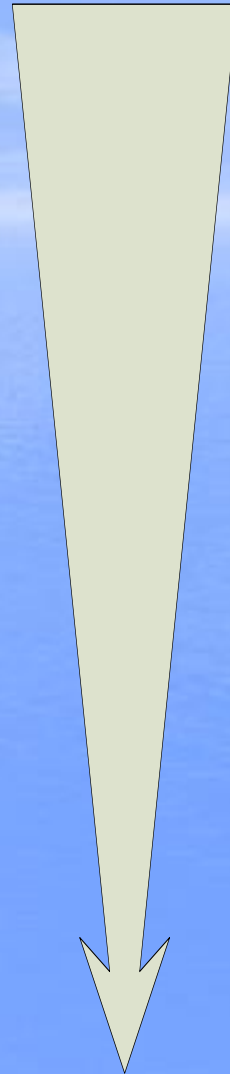
Natural risks of long action

- Desertification
- New growth and frozen ground degradation
- Deflation
- Change of level of reservoirs

- Bogging
- thermokarst erosion
- Karstic processes
- Abrasion
- suffosion
- icing mound

Catastrophic processes are mostly dangerous for human life because of their unexpectedness, power, and uncertainty.


In the order of the victims number decrease :



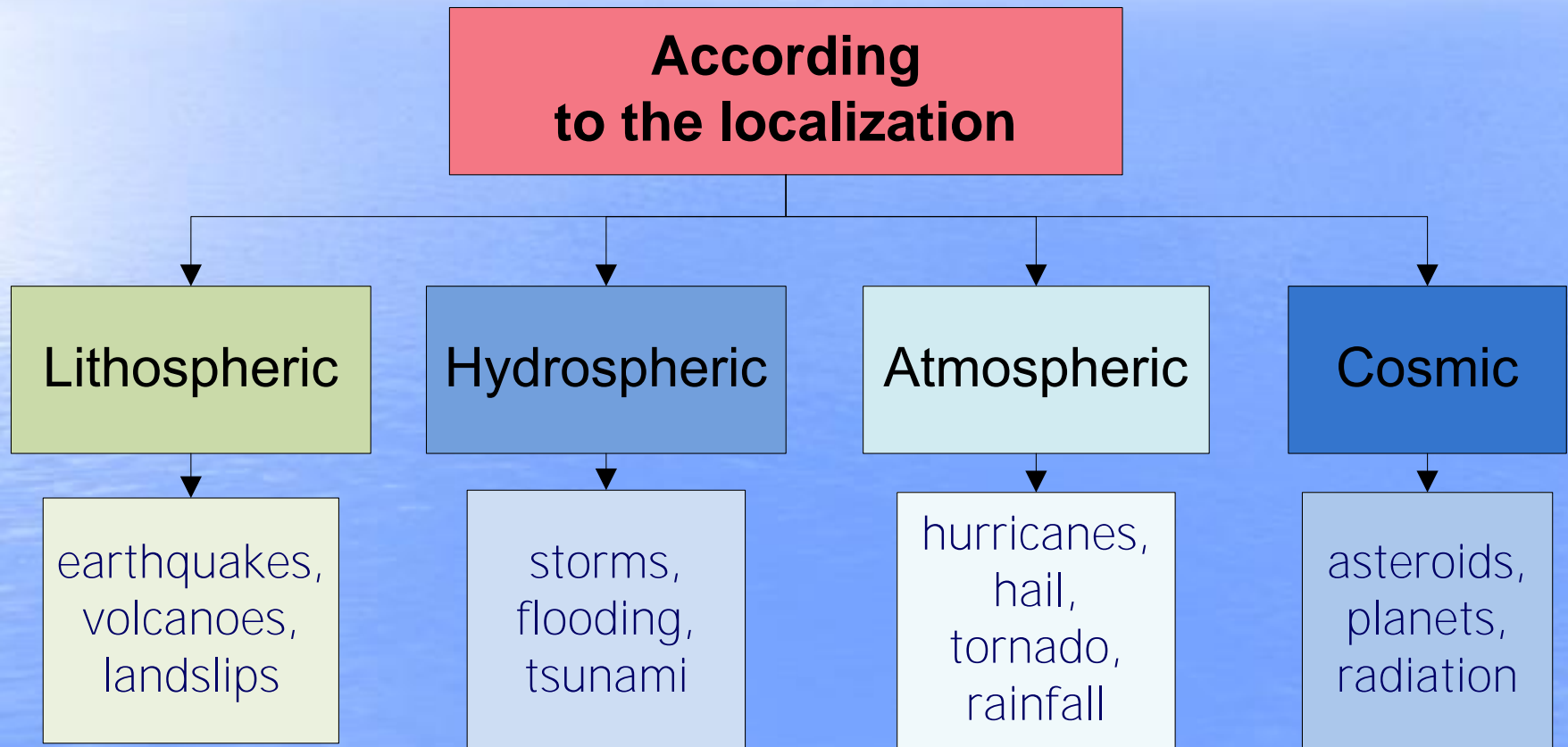
- drought,
- vortexes (hurricanes),
 - floods,
 - earthquakes,
- eruptions of volcanoes,
 - snowfalls,
 - tsunami,
 - landslip,
 - mud flow,
 - snow-slip,
 - rockslide

Specific features of low intensity processes are as follows: long-term preparation period and prolonged ecological consequences.

In the order of area size decrease where they can impair living conditions and make discomfort :

- 
- desertification,
 - fluctuations of level world ocean,
 - a new growth and frozen ground degradation,
 - a deflation,
 - change of level of reservoirs,
 - bogging,
 - thermokarst,
 - linear erosion,
 - karstic processes,
 - abrasion,
 - suffosion,
 - icing mound

Classification of the dangerous natural phenomena



Causes of natural hazards

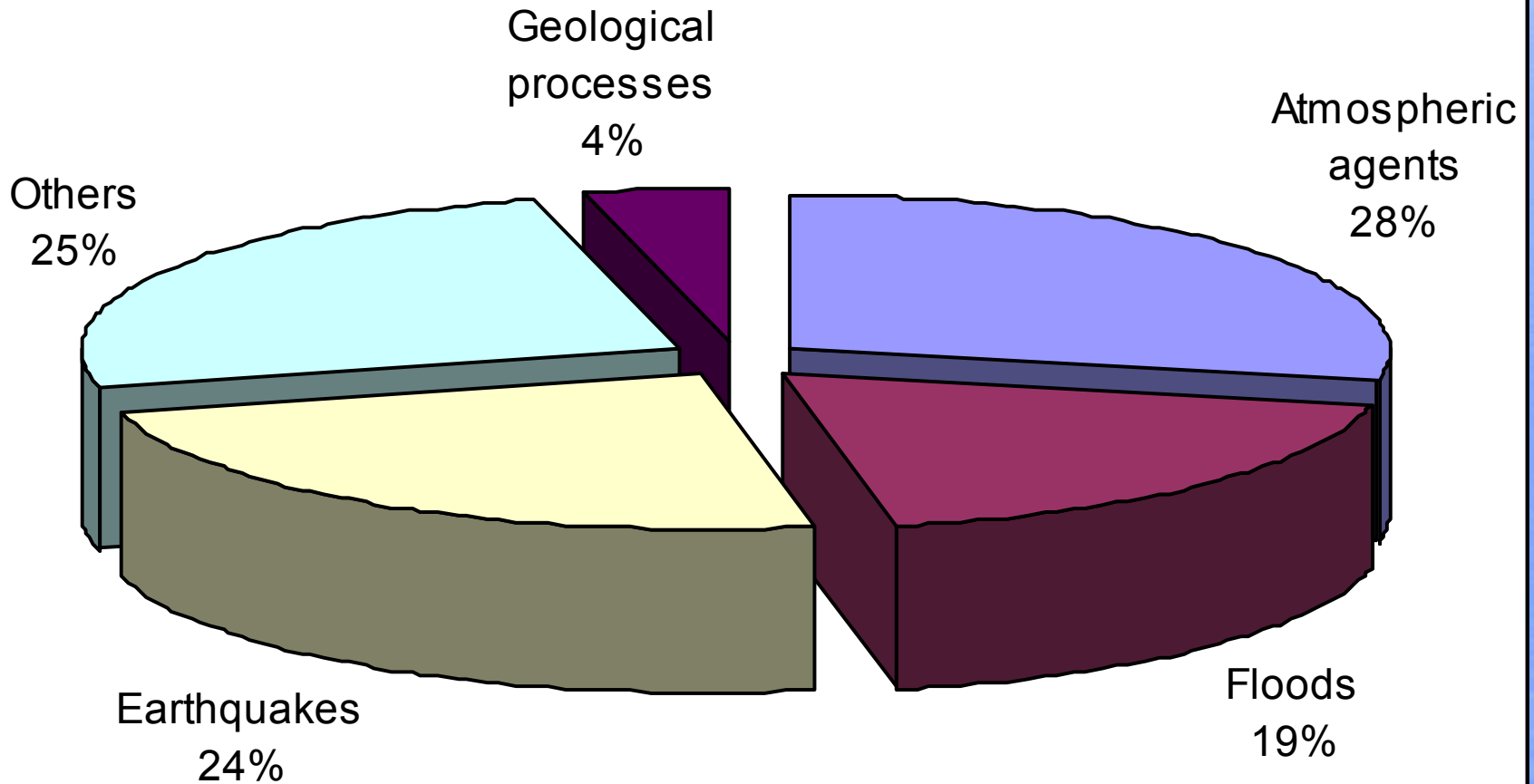
- «The Earth's surface is not only an area of matter, it is also an area **of energy**» (V.I. Vernadsky).
- In fact, the development of numerous complex physical, physical-chemical, and biochemical processes **take place on the Earth's** surface and in its adjacent layers. This process is accompanied by exchange and transformations of various energy forms.



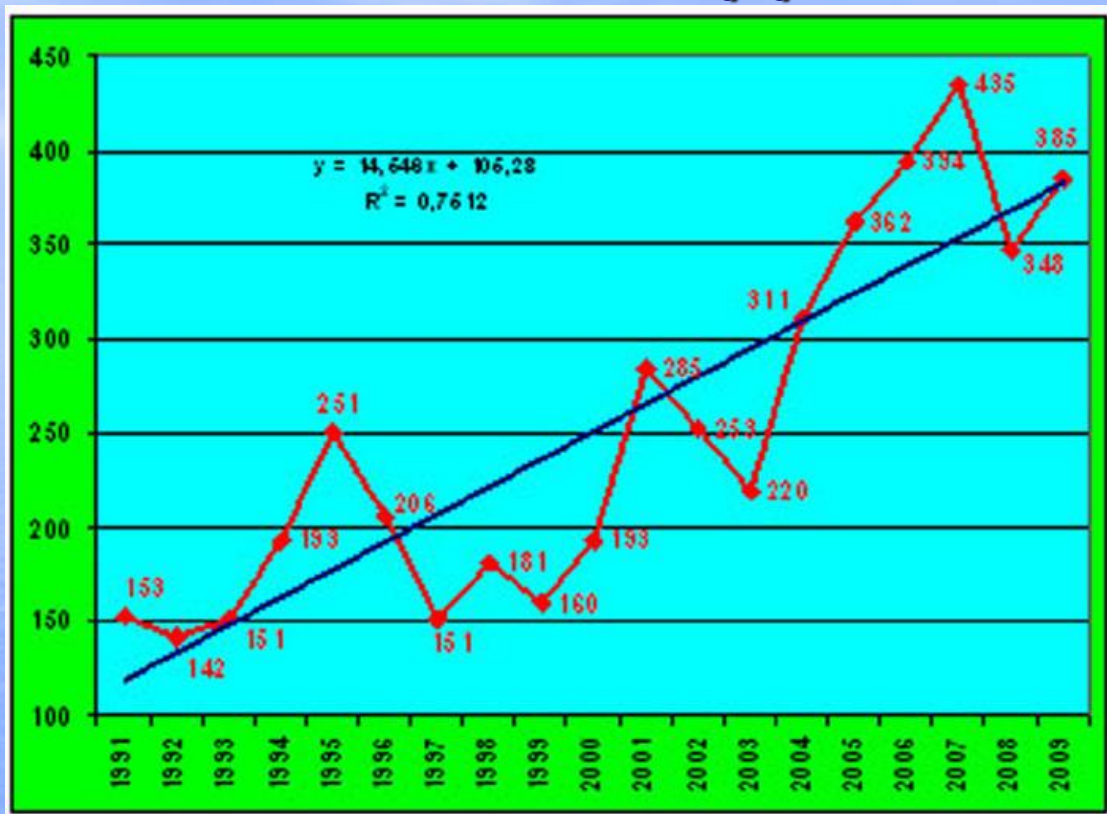
Geodynamic processes within Earth

- The energy source is the processes of matter rearrangement occurring in the interior of the Earth, physical and chemical interactions of its outer shells and physical fields as well as heliophysical effects. Those processes form the **basis for the Earth's** evolution and its natural environment, being the source of continuous transformations of the planet appearance – its geodynamics.
- A man is not capable of stopping or changing the process of evolutionary transformations, he can only forecast their development and in some cases influence their dynamics. Within the last few decades dangerous natural processes are activated by the growing anthropogenic pressure on the environment.

Basic Natural Danger Development Tendencies in the World

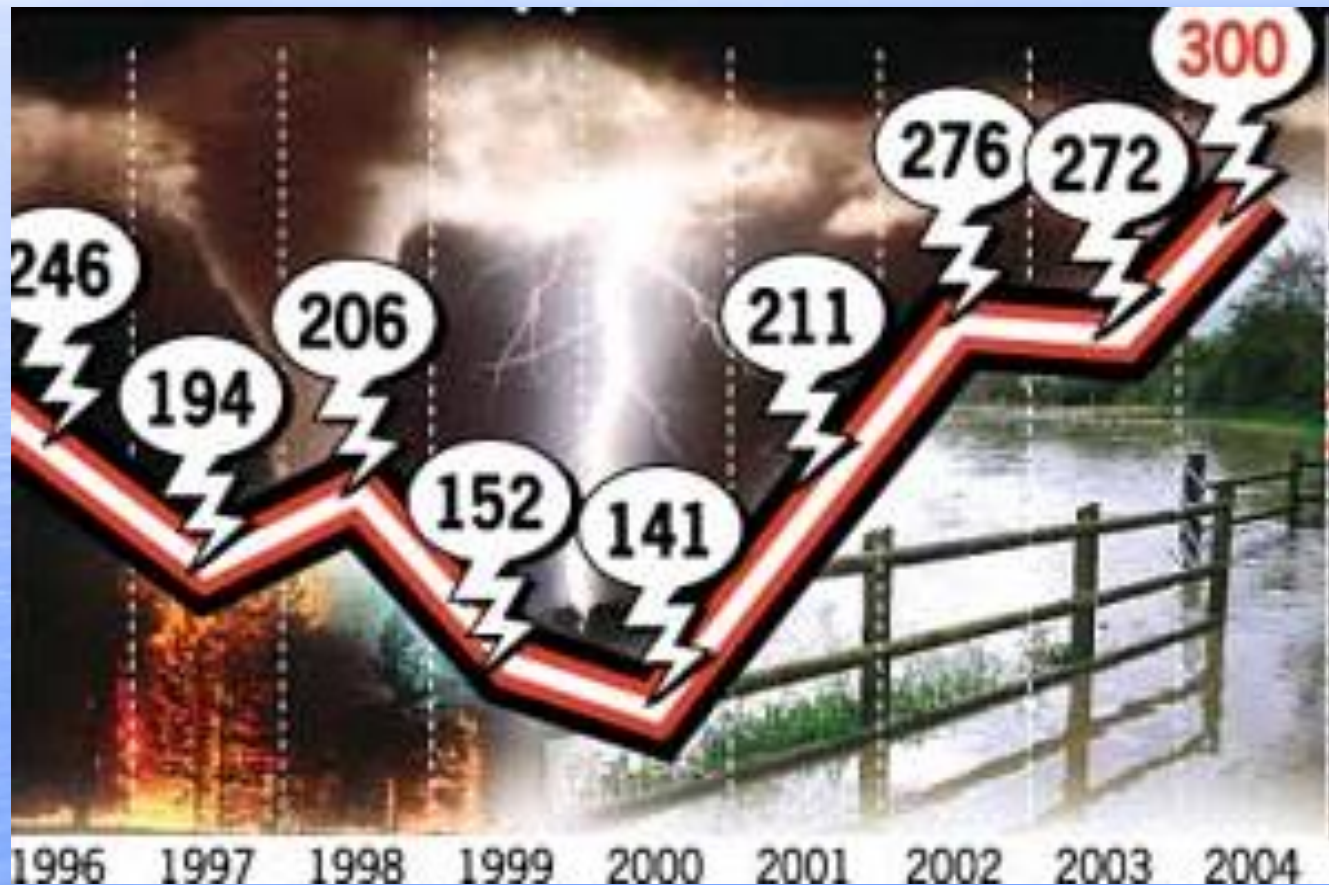


The quantity of the dangerous natural phenomena in the world increases every year.

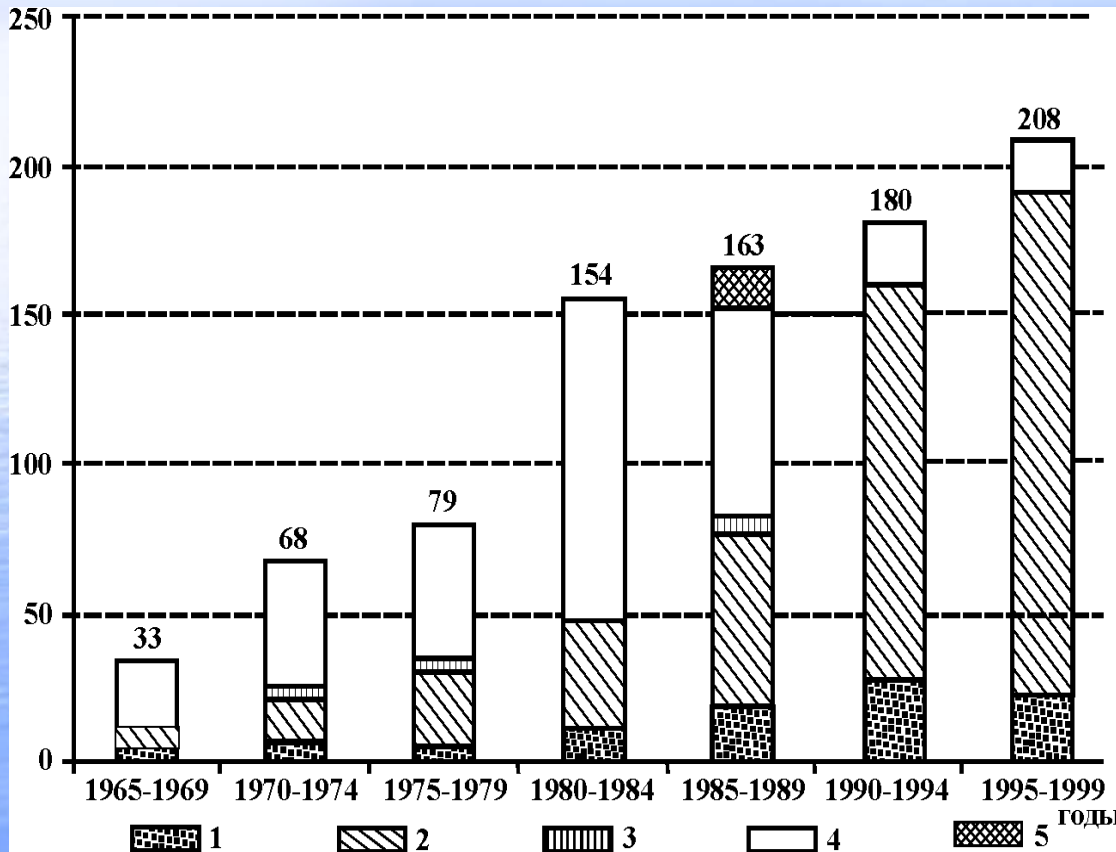


Distribution of total number of cases of the dangerous hydro meteorological phenomena and complexes of the adverse meteorological phenomena on years for the 1991-2009 which have put social and economic losses.

Number of the dangerous natural phenomena in Russia (on years)

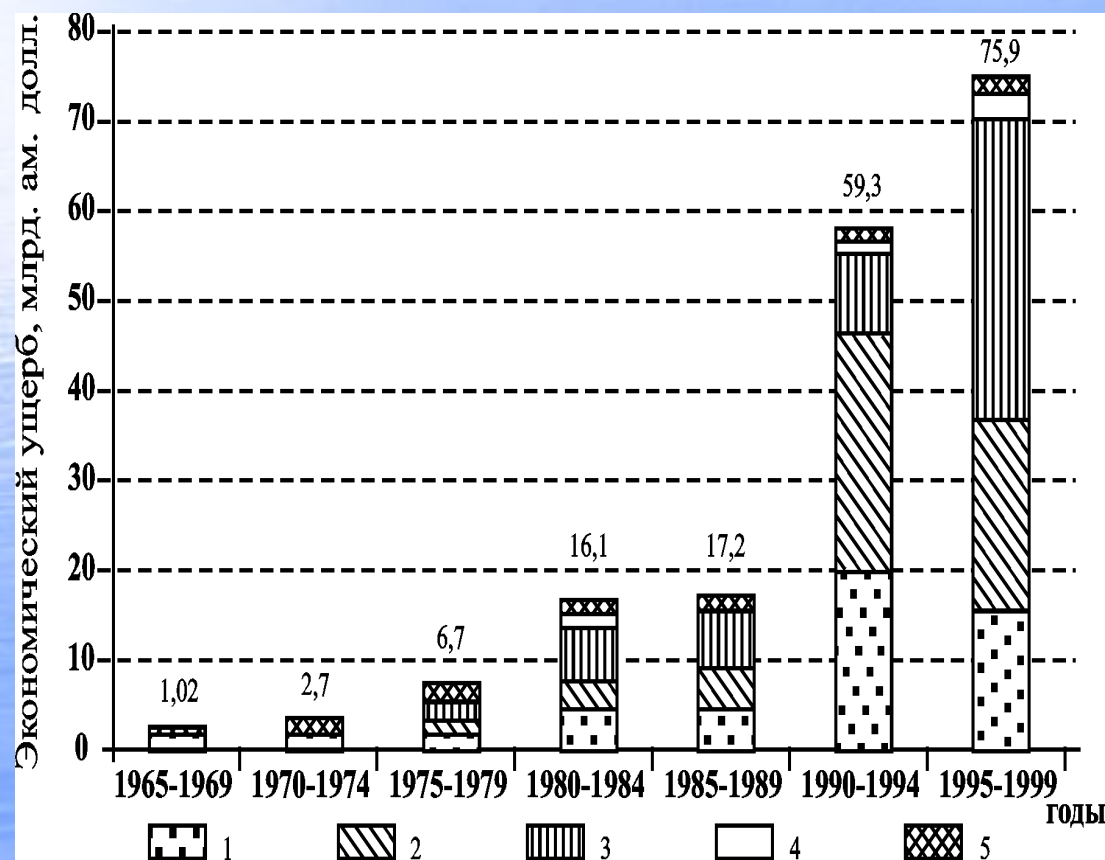


Every year the number of natural hazards, the number of victims as well as economic losses are growing in the world.



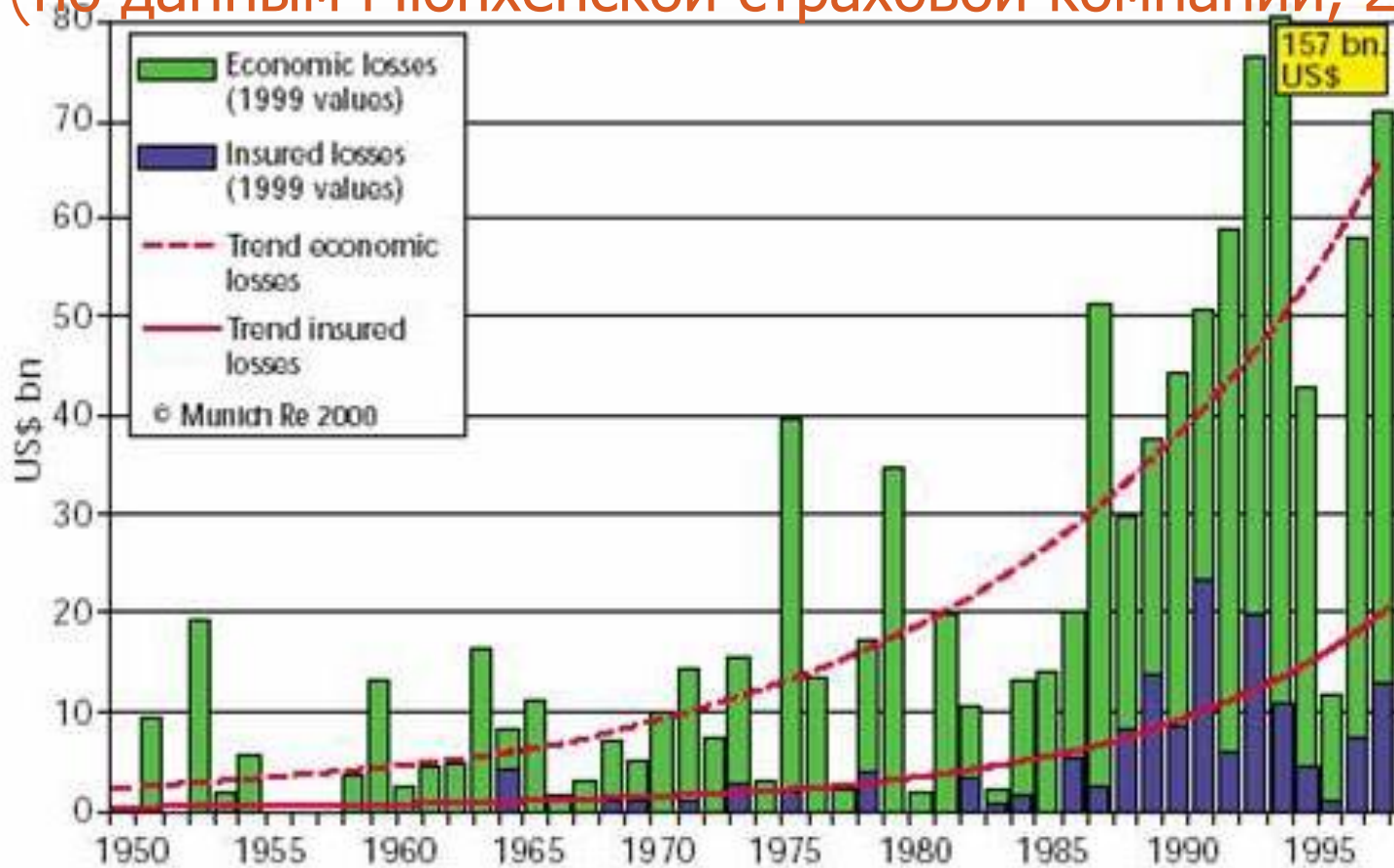
- 1 – typhoons и storms;
- 2 – flooding;
- 3 – earthquake;
- 4 – dryness;
- 5 – other

Economic damage in the world:



Ущерб от опасных природных явлений

(по данным Мюнхенской страховой компании, 2002).



The decrease in people and industrial object protection from natural hazards

the number of victims has increased annually on average within the period from 1962 to 1992 by 4,3%, injured – by 8,6%, and the value of economic losses – by 6%. The number of died people from seven types of disasters on the Earth within 35 years amounts 3,8 mln.

The consequences of natural hazards are closely connected with social-economic factors

- Continuous growth of poverty in developing countries is one of causes of increase in human society vulnerability for natural hazards.



- The rise in the number of natural disasters in the world is conditioned by some global processes in social, natural, and technogenic spheres, that determine the intensification of natural hazard development and decrease in people protection. Accelerated growth of critical conditions is connected with not only uncontrolled increase in human population but also the growth of technogenic impact on the environment. .

As a result of climate changes explained by increase in temperature on the Earth the intensification of natural dangerous processes is observed. Even regular forecast for Ocean level rise could result in floods of some countries and inundating of low coastal areas, increase in flooding frequency and area of flooded zone, intense development of coastal erosion, destruction of dams, strengthening of waves etc.

General regularities in natural hazard development

- Definite spatial coincidence
- The higher intensity, the rarer occurrence
- Some specific phenomena are followed by definite type of hazard
- Possible prediction at all unexpectedness
- Possibility of predicting and planning active and passive measures
- Human activity results in intensity of natural hazards
- Among natural hazards there is interconnection. One event could be a reason, a starting point for the other one. The peculiarity of natural hazards consists in the fact that each of them causes a chain of quickly or slowly developing processes, some of which could be momentary and catastrophic, the other – with remote environmental effect.

Natural dangerous processes activated by human activity

- Technogenic human impact on the lithosphere leads to global changes in the environment and activates development a wide range of dangerous processes in it, becomes the reason of appearance of new technonative processes and phenomena, among which the most dangerous are
 - induced seismicity,
 - lowering of surface
 - flooding
 - karstovo-suffozionnye failures
 - technogenic physical fields

The induced seismicity

- Technogenic factors may accelerate the accumulation of stress in the crust, increasing the frequency of earthquakes, or help to reduce the stress occurring as a "trigger" for the seismic event prepared by the nature. The induced seismicity is frequently caused by creation of large reservoirs and pumping of fluids in the deeper horizons of the crust. It is established that the induced seismicity is caused only by 0.63% of dams with heights up to 10m , 10% up to 90m and 21% - up to 140 m or more.



Local earthquakes in the eastern part of Tatarstan (including Romashkinskoye field)

Years	Territory	Number of events per year
1986	The eastern part of Tatarstan	17
1987	-----"	50
1988	-----"	52
1989	The eastern part of Tatarstan (including Romashkinskoye deposit)	29 (27)
1990	-----"	63 (52)
1991	-----"	77 (72)
1992	-----"	86 (79)
1993	-----"	82 (81)
1994	-----"	140 (140)
1995	-----"	77 (77)
1996	-----"	31 (31)
Total:	-----"	704 (675)

Lowering of the earth's surface

- **Subsidence is the sinking or gradual lowering of the earth's surface. It is found worldwide in a variety of environments on land and the seafloor. Subsidence can result from either natural geologic and/or man-made causes. Natural geologic causes are basin-downwarp, fault movement, sediment compaction, and relaxation of deep earth stresses. Man-made causes include groundwater pumping, mining, oil and gas production, river channelization, and surface loading. A subsided area can vary in size from a few acres to thousands of square miles.**



Flooding

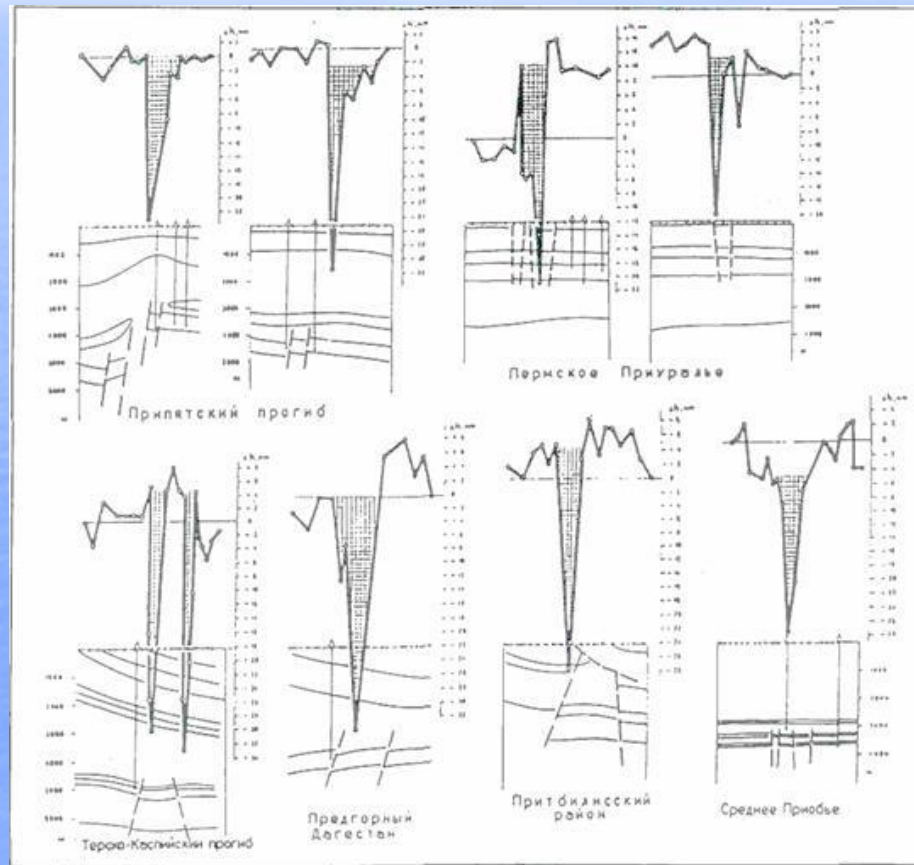


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- One of the most widespread dangerous natural- technogenic processes is the flooding of territories, which consists in raising the upper aquifer to the surface of the Earth. In Russia, the waterlogged condition of the around is in about 800 hectares of urban areas. The flooding of the cities is noted in 960 (88%) of the 1092 cities, including Moscow, St. Petersburg, Novosibirsk, Omsk, Rostov-on-Don, Tomsk, Khabarovsk, and Novgorod, Yaroslavl, Kazan. Damage from flooding one hectare of urban area (depending on the degree of its development capital facilities, the availability of historical and architectural monuments, branched underground infrastructure laziness) is from 15 to 200 thousand dollars.

Karstovo-suffozionnyye failures

- The intensive pumping of groundwater and changes in the steady hydrodynamic conditions in areas affected by the ancient karst may intensify karst-suffusion processes leading to the formation of technogenic and natural funnels genesis. In some areas these processes are so active that they are dangerous not only for buildings and structures, but also for people.

Technogenic physical fields



**Natural accident because of
technogenic factors**

**Rupture of pipeline on the
land**



- In May, 2008 a crack appeared on the pipeline Krasnoyarsk – Irkutsk.

Length of the crack was about 380 millimeters.

The crack appeared because of



In result:

- There was emission of oil on the surface of the Earth, so it`s the pollution of environment

Fortunately, there were not any nearby lakes or rivers.

So it`s only pollution of the nearby land (but rather big pollution)



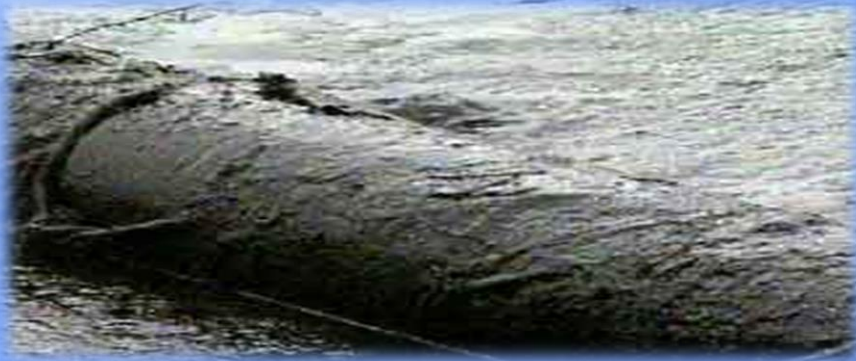


- Emission of oil was about 25 cubic meters. And about 20 cubic meters were removed
- The crack was liquidated by specialists and the pipe line continued to work in its normal manner

In general:

Accidents connected with pipelines have terrible damaging effects, for example:

- Pollution of fertile layer of soil
- Disturbance of usual life of different animals and fish
- Influence on all parts of the environment (including hydrosphere, atmosphere, lithosphere and others)



natural risk analysis

- The process of natural risk analysis is ultimately aimed at decrease in social, economic, and ecological damages from dangerous natural impacts. An ideal procedure of such an analysis is a permanent cyclic process including:

identification and prediction of natural hazard development in time and space

vulnerability assessment of damaged objects for all stated genetic types and kinds of natural hazards

natural risk management

assessment of partial and integral risk and losses from hazards

identification and prediction of natural hazards

- 1. What natural hazards, where and in what circumstances could damage the territory involved?
- 2. What is their intensity, frequency and impact duration?
- 3. Mapping of natural hazard forecast

Vulnerability assessment of industrial objects and population

- **1. How is or will the territory used (be used)?**
- **2. What object are there on the territory or are supposed to be built?**
- **3. What is the number, composition, distribution in objects and motion of the population?**
- **4. What is vulnerability of some objects and population under the impact of hazards of definite type and intensity?**

Natural risk assessment

- 1. What scenarios of development and consequences of natural hazards are possible?
- 2. What is the probability of these scenarios development?
- 3. What would be the losses in case of separate hazards?
- 4. What would be the summary losses?

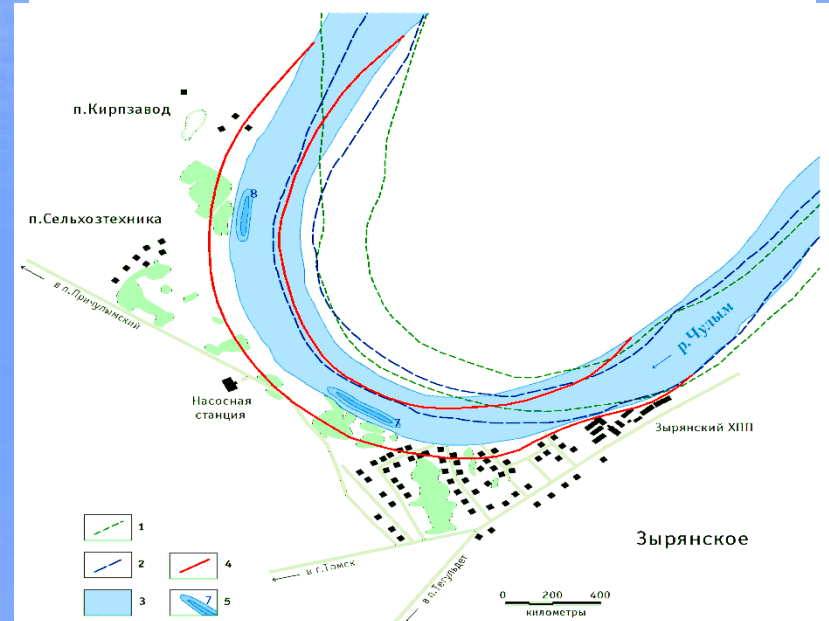
Natural risk management

- 1. What measures are supposed to be taken to decrease the risks?
- 2. What levels of risk are taken as acceptable ones?
- 3. How will the information exchange and natural hazard, risk and conditions management be performed?
- 4. What is the attitude of population to the stated hazards, risks, precaution measures and control?
- 5. What additional measures are necessary to be taken to decrease and control the risks?

Regional Aspects of Natural Risk



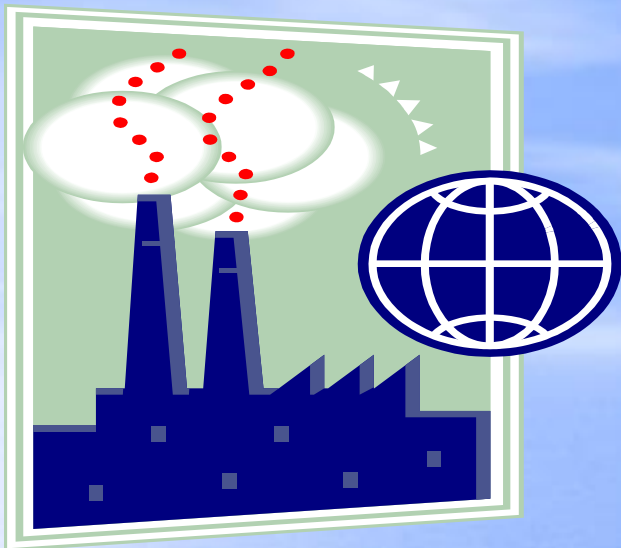
- современное положение береговой бровки
- предполагаемый уровень затопления территории города (уровень воды в р.Томе, 1% обеспеченности)



Tomsk is one of the largest industrial centers of Siberia



- Industry makes up about half of the regional GDP, while agriculture contributes 19% and construction 13%. Chemical and oil industries are the most developed in the region, followed by machine construction. The region's major export items are: oil (62.1%), methanol (30.2%), and machines and equipment (4.8%). Oil extraction and lumbering are the major business of the region's joint ventures.



- **Ecological situation** spread widely not only **in** our country, but **in** all civilized countries of the world. But we realized the danger much later because of the vastness of the country, rich **in** mineral resources. But everything comes to an end. An **ecological** crisis is typical for the **Tomsk** region, too.

EXTREME SITUATIONS OF NATURAL CHARACTER IN TOMSK REGION: FOREST FIRES AND FLOODING

- FOREST FIRE:

- Affected area, thousand.km² - 3,5

- Population in affected area, thousands people-40

- FLOODING :

- Affected area, thousand.km² - 0,9

- Population in affected area, thousands people-70



NATURAL HAZARDS AND DISASTERS IN TOMSK REGION

- Wildfires are an uncontrolled fire burning in wildland areas. Common causes include lightning and drought but wildfires may also be started by human negligence or arson. They can be a threat to those in rural areas and also wildlife.



The scheme of possible flooding of the city territory in case of extreme high debacle



-  - современное положение береговой бровки
-  - предполагаемый уровень затопления территории города (уровень воды в р.Томи, 1% обеспеченности)

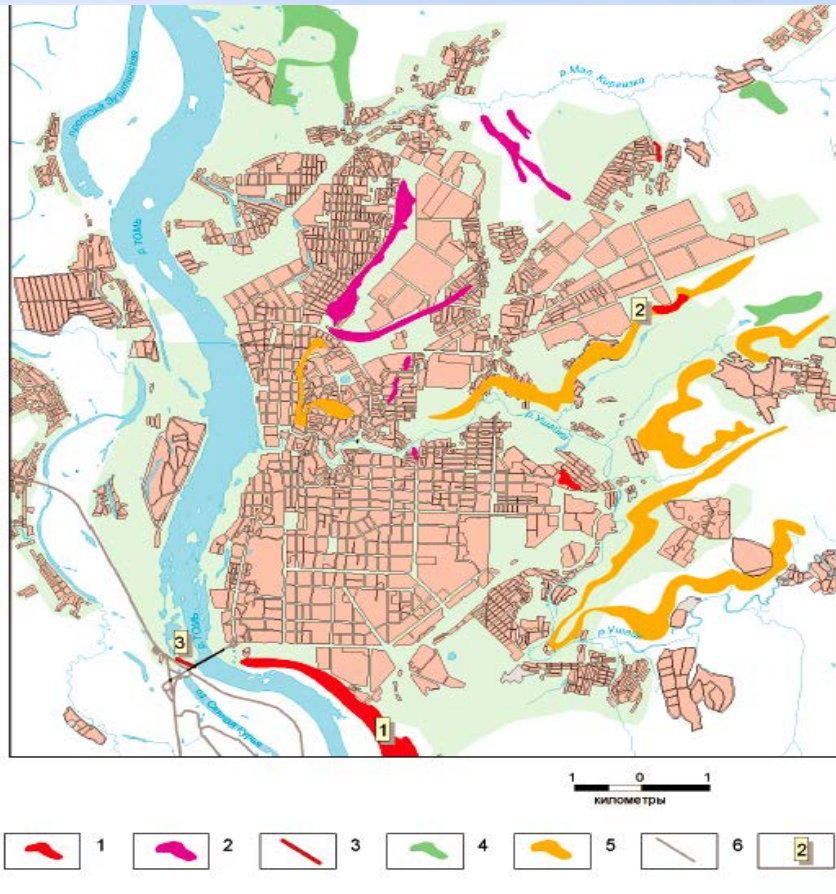
HAIL in the surroundings of Tomsk in august-2008 – unusual natural phenomena in Siberia



The hurricane in the surroundings of Tomsk in july-2005 – unusual natural phenomena in Siberia

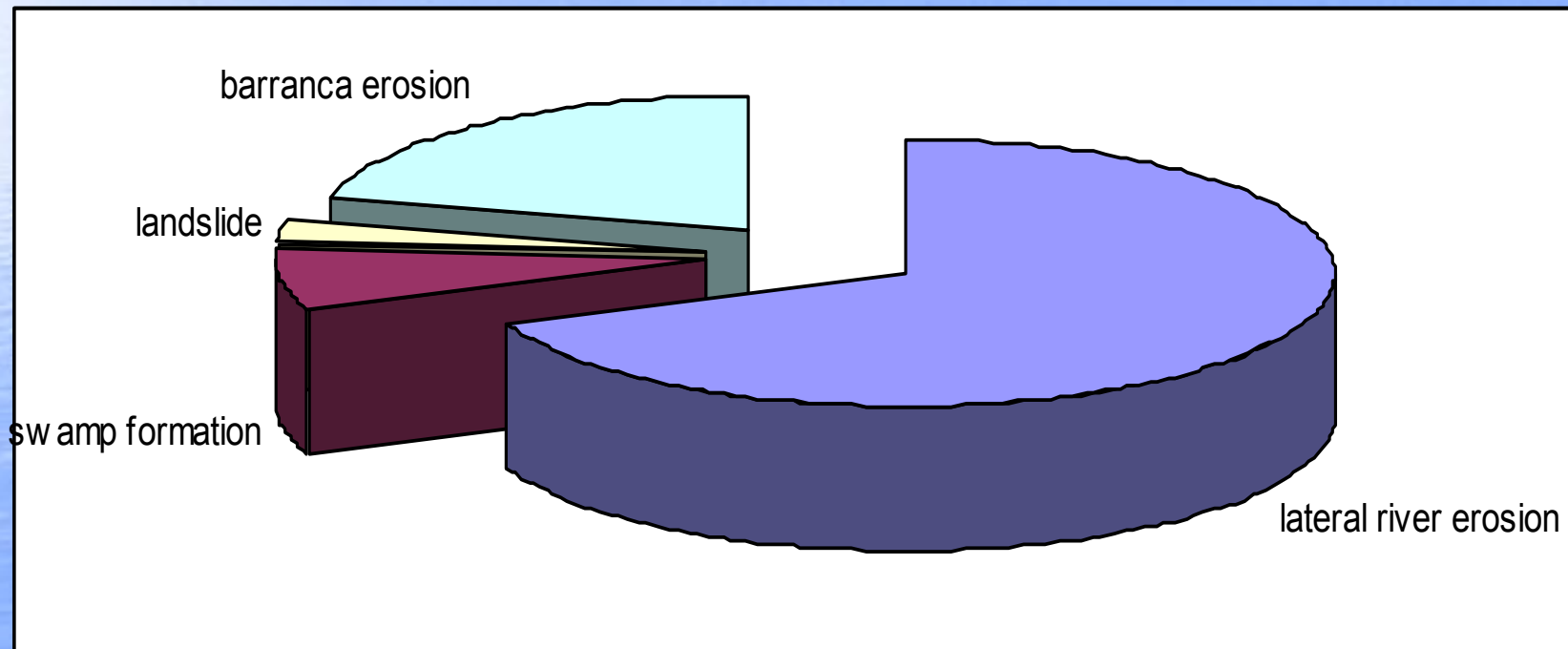


The liability of the Tomsk city territory to exogenic geological processes



- 1- landslide
- 2-barranca erosion
- 3-lateral river erosion
- 4-swamp formation
- 5-downhills with the rare development of EGP
- 6-roads
- 7- observation places

The types of exogenic geological processes activated by human activity in inhabited locality



Swamp formation(Waterlogging) as a form of land degradation should be distinguished from naturally occurring poorly drained areas, and also from the different problem of flooding



Landslide, village Ziryanskoe- A **landslide** is a geological phenomenon which includes a wide range of ground movement, such as rock falls, deep failure of slopes and shallow debris flows, which can occur in offshore, coastal and onshore environments.

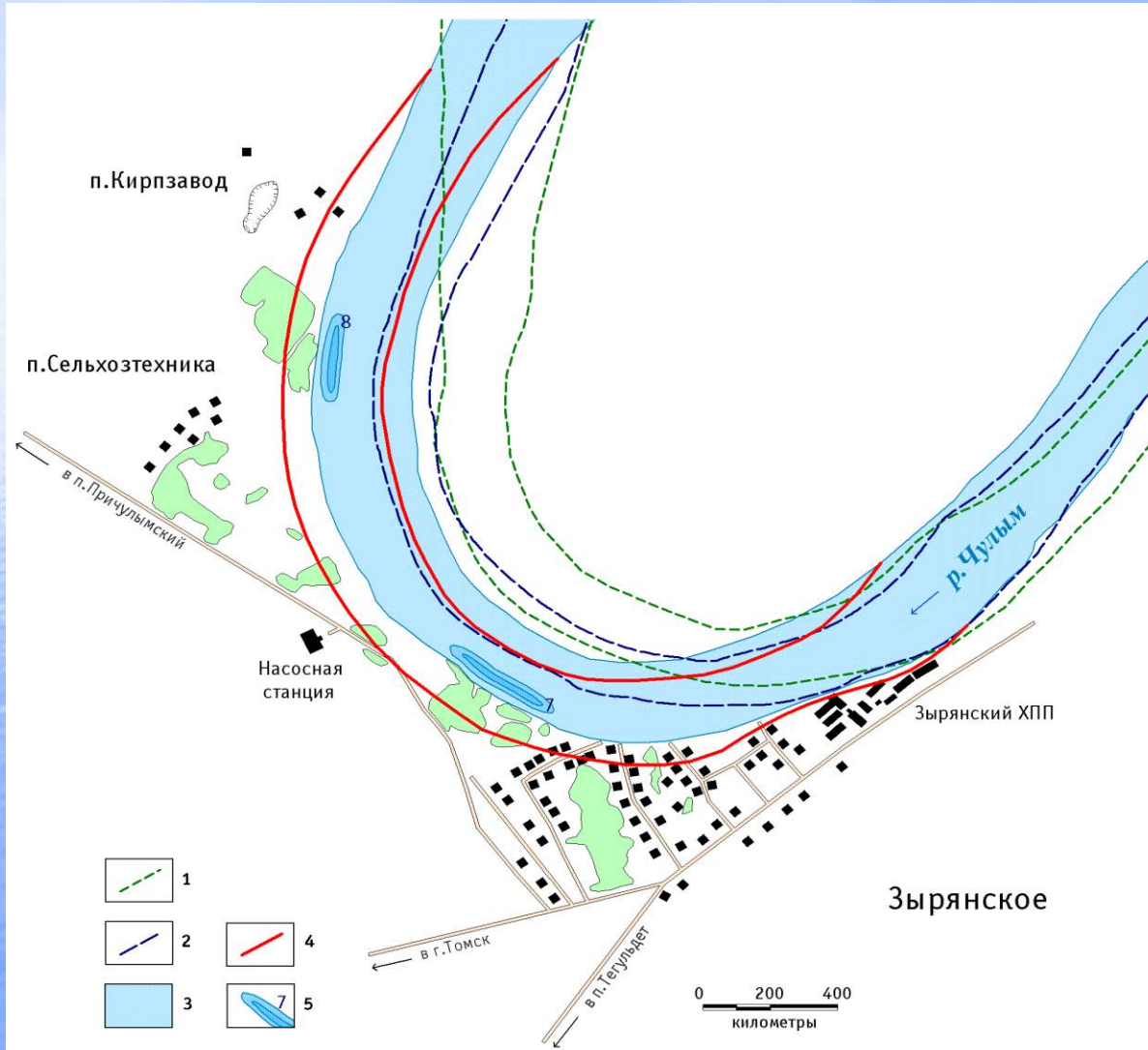


Erosion includes the transportation of eroded or weathered material from the point of degradation, but not the deposition of material at a new site.

Modern erosive breakout

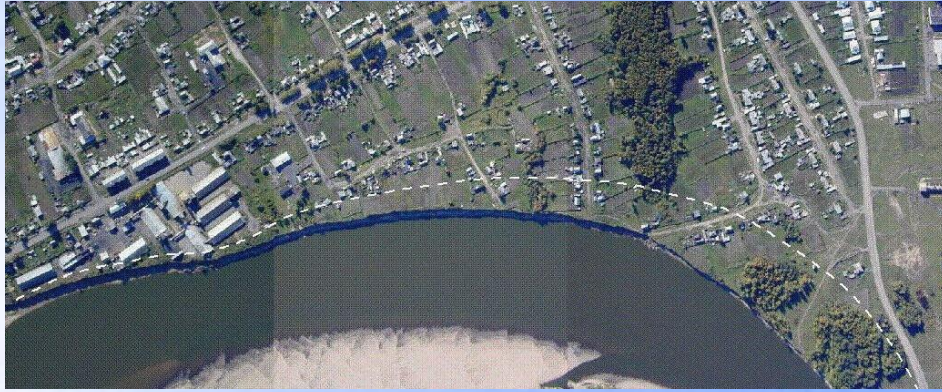


Forecast of bank erosion (shore man-induced) development, village Ziryanskoe



- The position of stream canal:
- 1 - 1947.,
- 2 - 1966.,
- 3 - 2000.,
- 4 - 2010. (Forecast),
- 5 - reach of river, depth, m

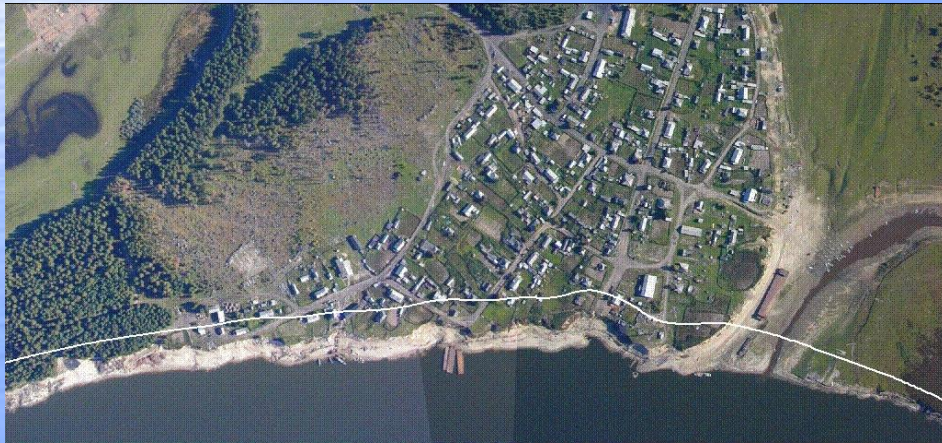
Forecast of EGP development in settlements



village Ziryanskoe-



village Komsomolsk



village Timsk

dotted line – forecast of the position of the coast line in 2010 years

Erosion processes development in the area of the town bridge, Tomsk

