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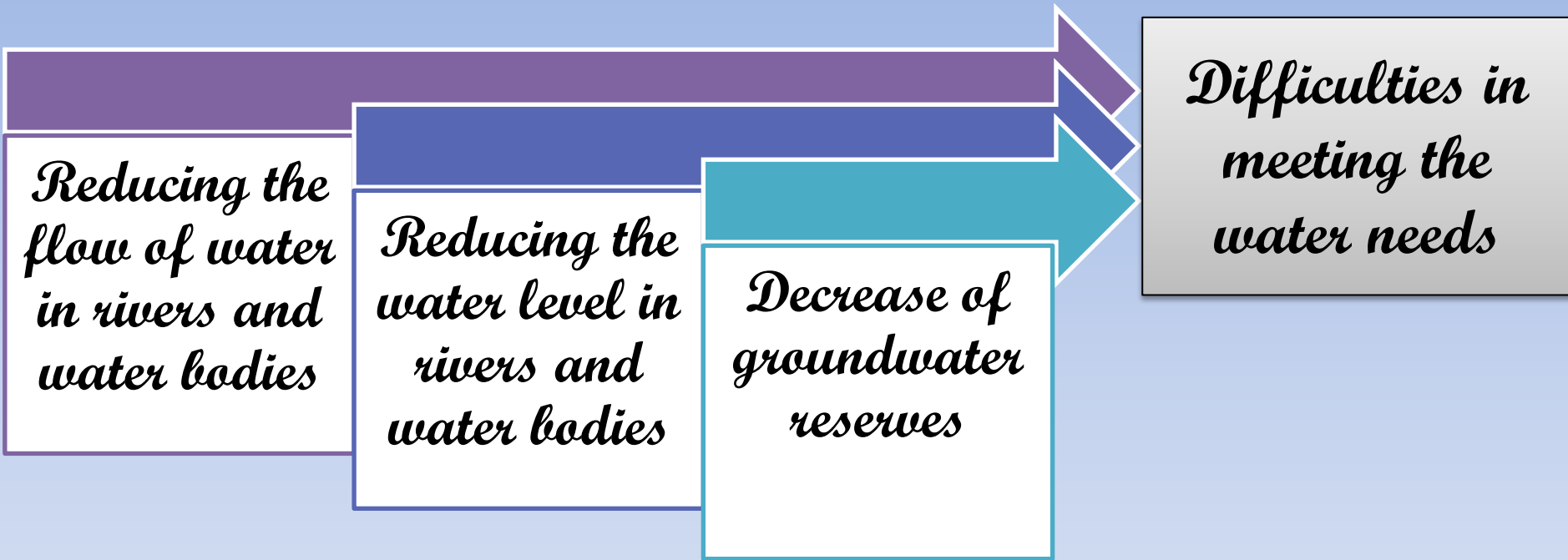



**REGIONAL ASSOCIATION II
WORKING GROUP ON
HYDROLOGICAL SERVICES**

Hydrological Aspects of Drought

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NIGMI of Uzhydromet**

Hydrological drought



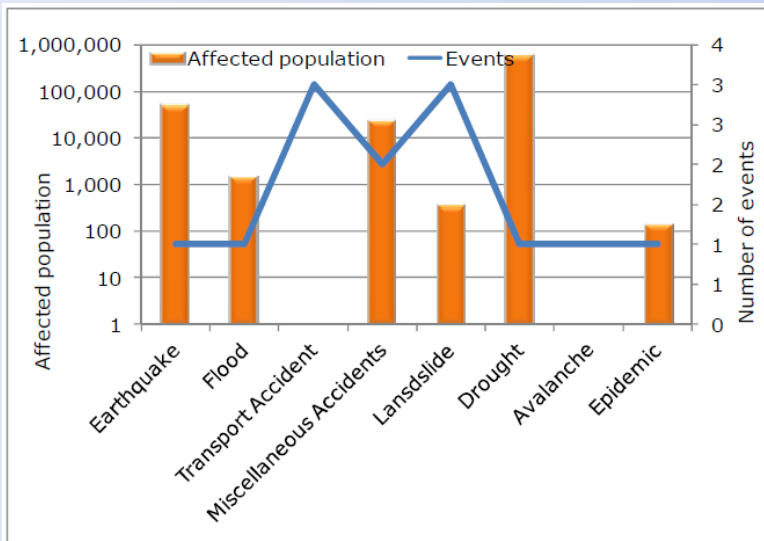
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- ✓ The degree of severity of hydrological drought is defined as a rule, watershed or river basin.
 - ✓ Hydrological drought usually comes with a delay compared with meteorological and agricultural drought.
 - ✓ Since the regions are interconnected hydrological systems, the area of distribution of hydrological drought may have a greater extent of than the area of caused it meteorological drought.
 - ✓ Identification of hydrological drought with a precipitation deficit, due to climatic reasons, are often complicated by the simultaneous influence on the hydrological characteristics of the river basin of factors of a different nature, such as land-use change (deforestation), land degradation, construction of dams.
 - ✓ Change in land use upstream may alter the hydrological characteristics such as the rate of infiltration and runoff, resulting in downstream river flow variability will increase the probability of occurrence of hydrological drought.
 - ✓ Land use change is one of the human activities that increase the number of situations with water shortages even in the absence of changes in the incidence of the primary conditions - meteorological drought.

Hydrological drought in Uzbekistan

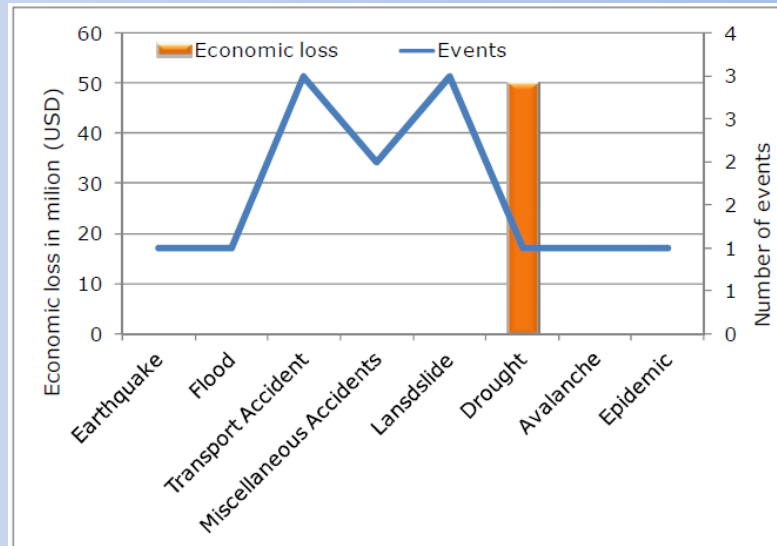
Coverage areas and scope of the negative impact on the population of drought is dominant among other natural disasters in Uzbekistan.

Extreme drought in Uzbekistan was observed in 2000, 2001, 2008 and 2011.

*Disaster events and affected population
(by hazard type)*



*Disaster events and economic loss
(hazard type)*

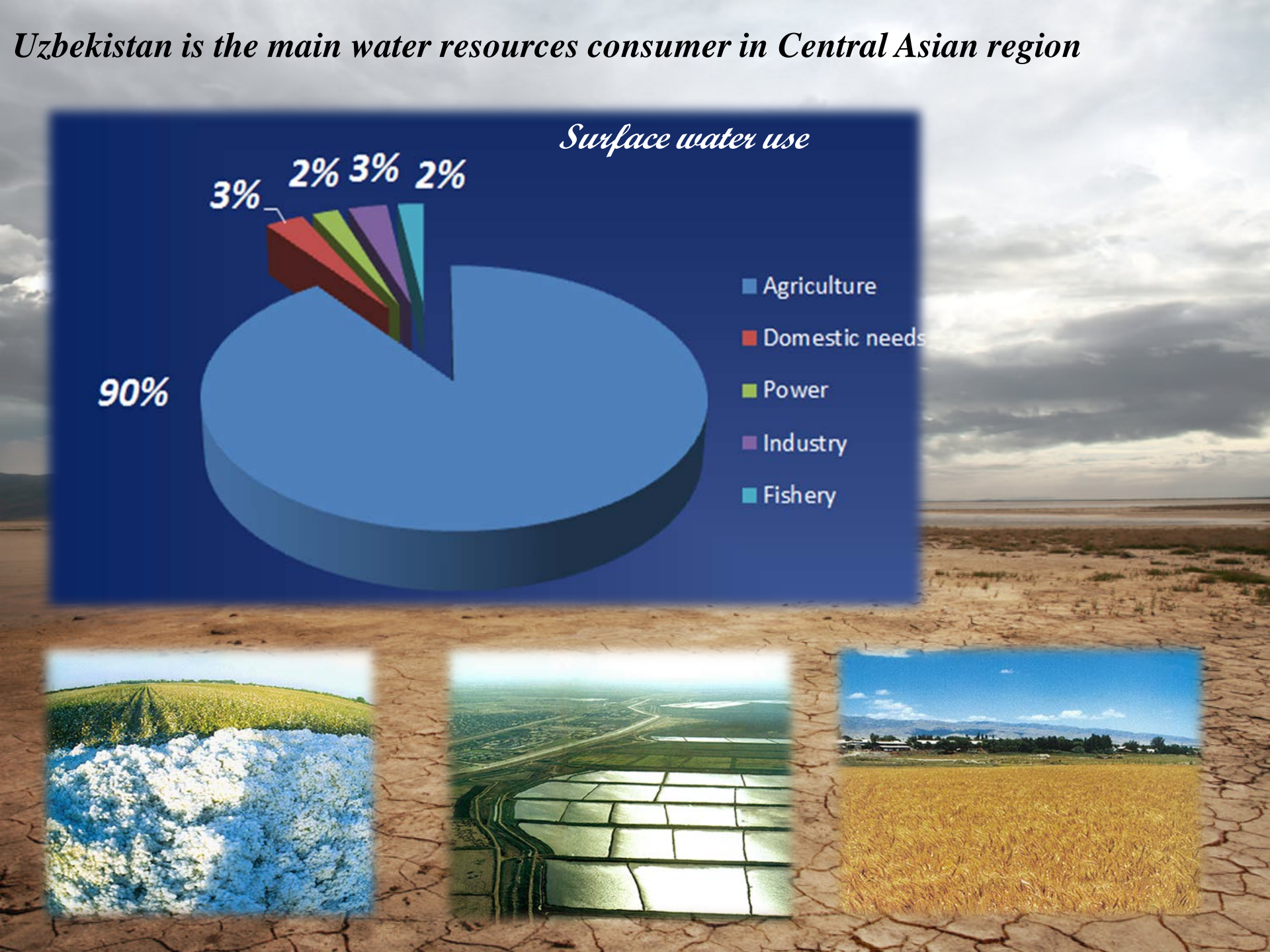
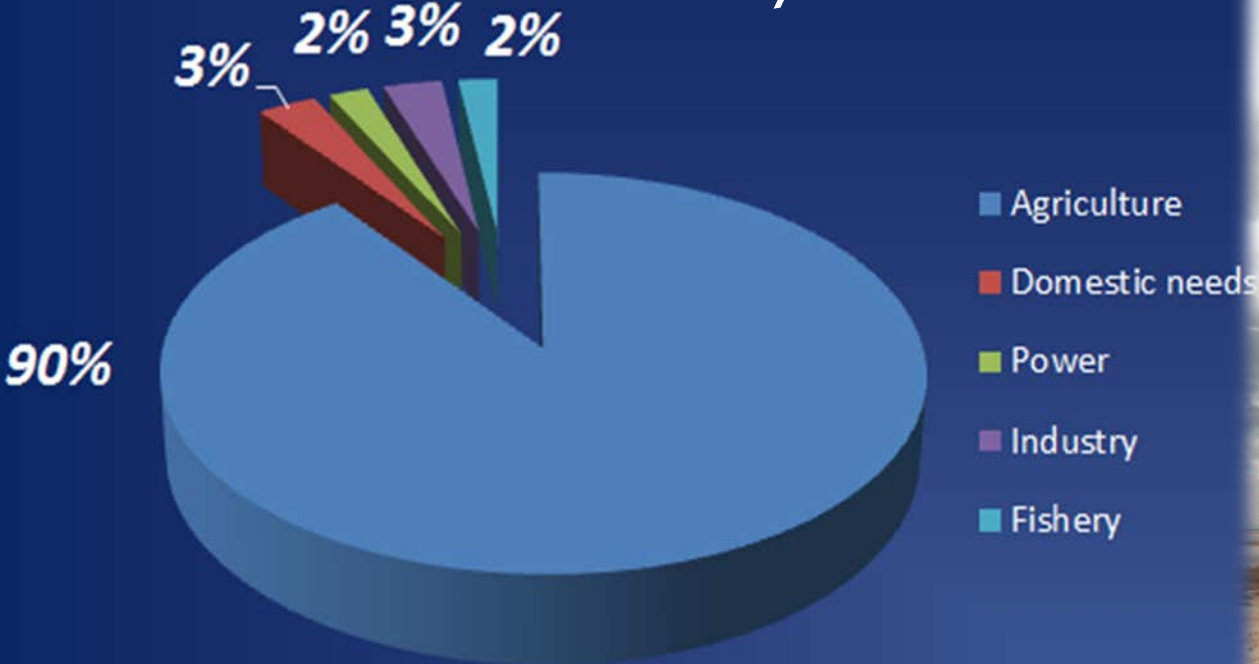


Percentage of population living in areas drought prone is 76.3%.

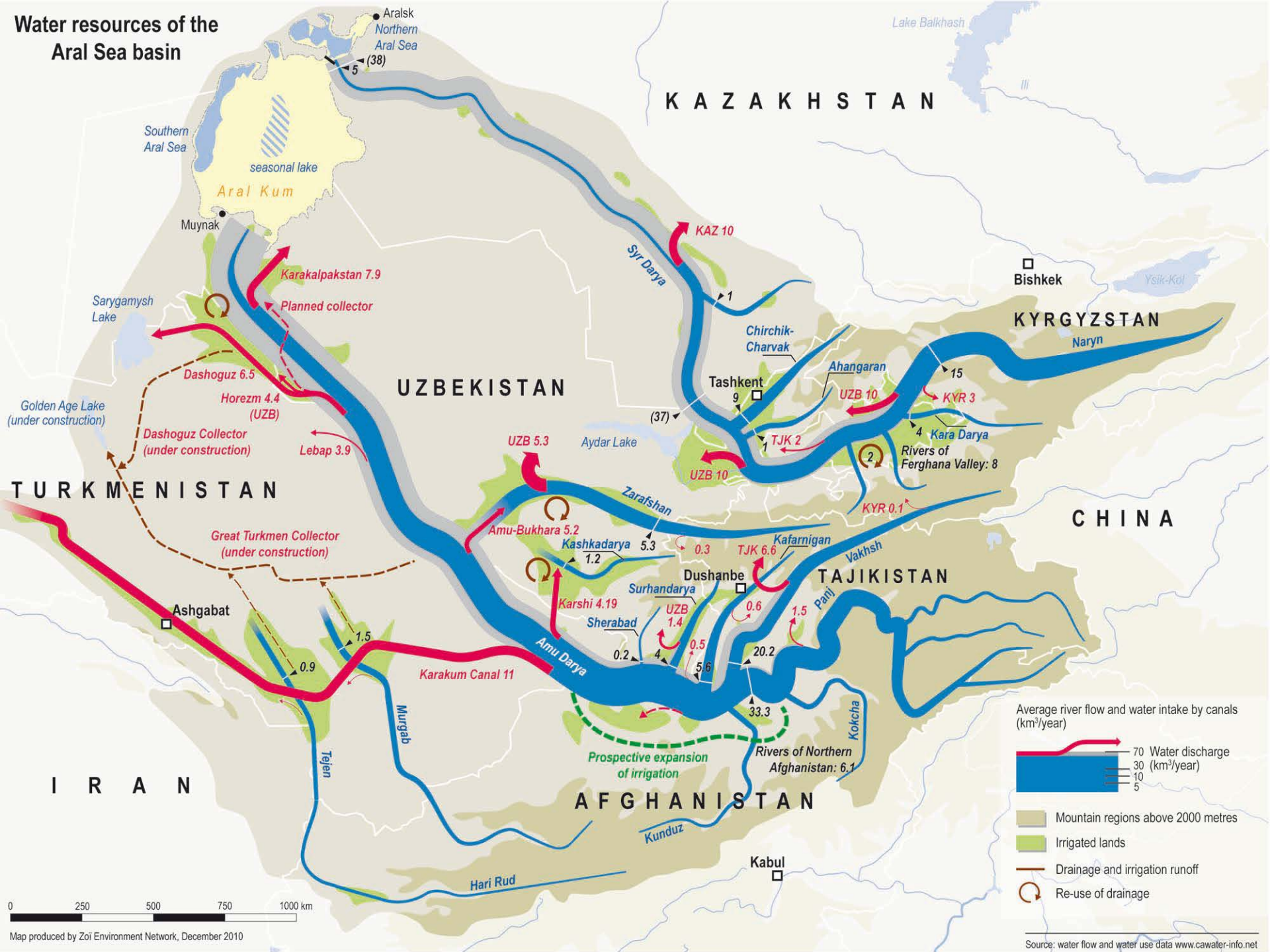


Uzbekistan is the main water resources consumer in Central Asian region

Surface water use



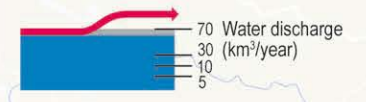
Water resources of the Aral Sea basin



0 250 500 750 1000 km

Map produced by Zoi Environment Network, December 2010

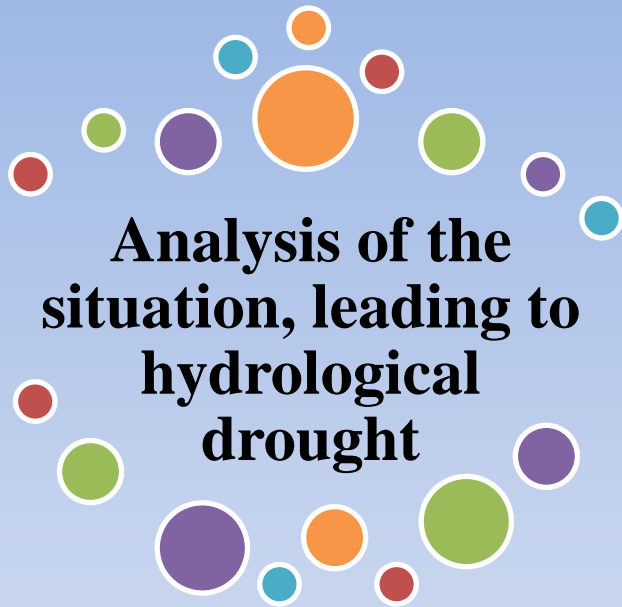
Average river flow and water intake by canals (km³/year)



- Mountain regions above 2000 metres
- Irrigated lands
- Drainage and irrigation runoff
- Re-use of drainage

Source: water flow and water use data www.cawater-info.net


Early identification of drought is the key to develop a set of measures aimed at mitigating the effects of drought and food security of the country.



Development of drought early warning

Advance preparation for the conditions of water shortage

Event planning mitigation of water shortage



Early warning of a possible drought in 2007 and 2011 contributed to the adoption of timely measures and solutions to mitigate water shortage.

Depending on the severity of the shortage of water in order to ensure the rational use of limited water resources, this complex may include the following:

- Establishment of the Government Commission, which approves water withdrawal limits in the basin authorities and irrigation systems, as well as monitors compliance with limits;
- Strict observance of the limits on water withdrawals;
- Construction of wells to supply additional water for irrigation;
- Construction and reconstruction of pumping stations for guaranteed water supply;
- Optimization of cotton and rice and water withdrawal limits with the new crops;
- Nightly watering's of crops;
- Development and implementation of measures for the rational use and attract additional water by cleaning collectors and channels, dredging activity, construction of retaining structures on the collectors, the use of available water volumes in the waste waters;
- Changing the Operating Mode of the reservoirs of the republic for an irrigation operation.

1995 - the Parliament of the Republic of Uzbekistan has ratified the United Nations Convention to Combat Desertification and Drought.

1999 - developed a National Action Plan to Combat Desertification in the Republic of Uzbekistan. In the near future update will start the program in accordance with the ten-year strategy action UNCCD.

2009 - the Decree of the President of the Republic of Uzbekistan in the public investment program launched a project to modernize the network of weather radars and install stations for receiving satellite imagery from the platform TERRA / MODIS.

2008 - at Uzhydromet established the National Centre Monitoring of Drought. Purpose - serve as a coordinating and consultative center for drought preparedness, monitoring, prevention and mitigation of the adverse effects of drought. Centre in Uzbekistan uses the accumulated scientific base in the country to study the problem of drought, promotes informing of stakeholders on various aspects of drought and its prevention.

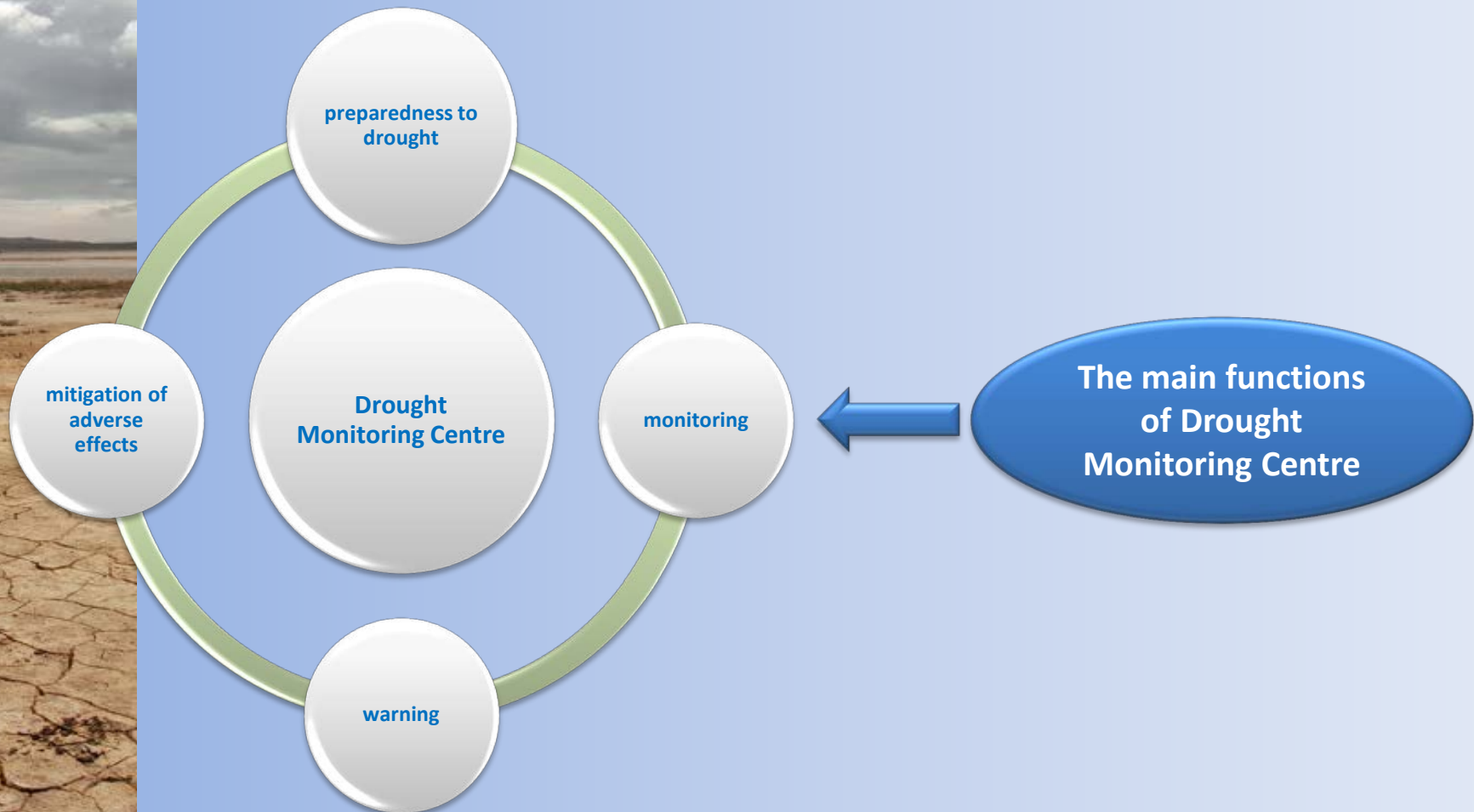
2015 - Project on Climate Risk Management in Uzbekistan - developing an Drought Early Warning System and approves the individual components of the system on the example of a pilot Kashkadarya region.





Centre of Hydrometeorological Service at Cabinet of Ministers of Republic of Uzbekistan (Uzhydromet)

By decision of the Government of the Republic of Uzbekistan in 2008 the Centre of Drought Monitoring was established at Uzhydromet.



The concept of Drought Early Warning System

- Drought monitoring.
- Assessment and Prevention of Drought.
- Monitoring and Assessment of functioning of Drought Early Warning System

*Monitoring,
Assessment,
Warning*

- Analysis and Assessment of potential threats.

*Knowledge
about the
risk*

*Drought Early
Warning
System*

- Development and testing of programs and plans, policies and actions.
- Defining criteria situation to start activities

*Response
Capacity*

*Distribution of
Information &
Communications*

- Alerting, Informing of all stakeholders

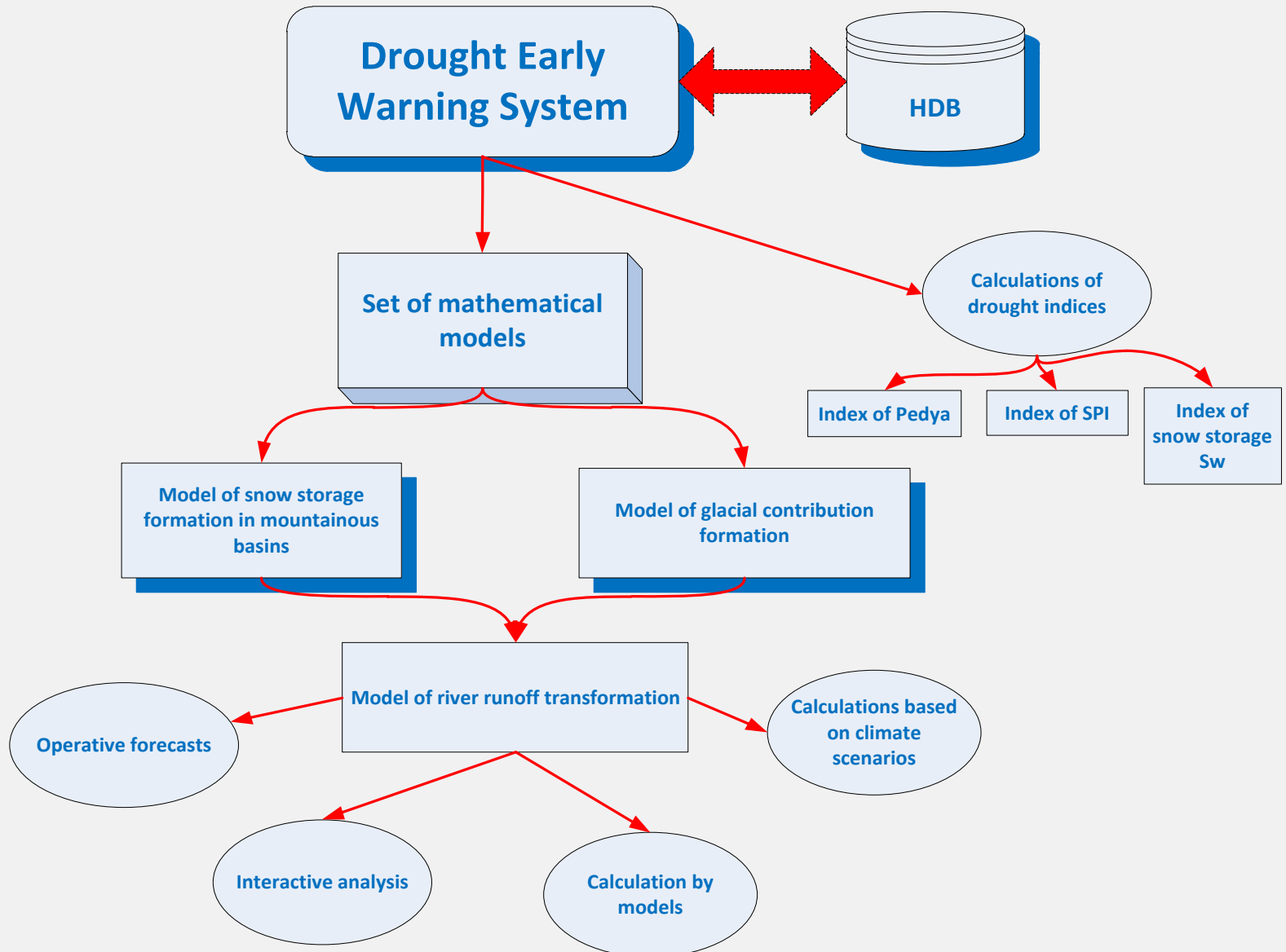
Drought Early Warning System



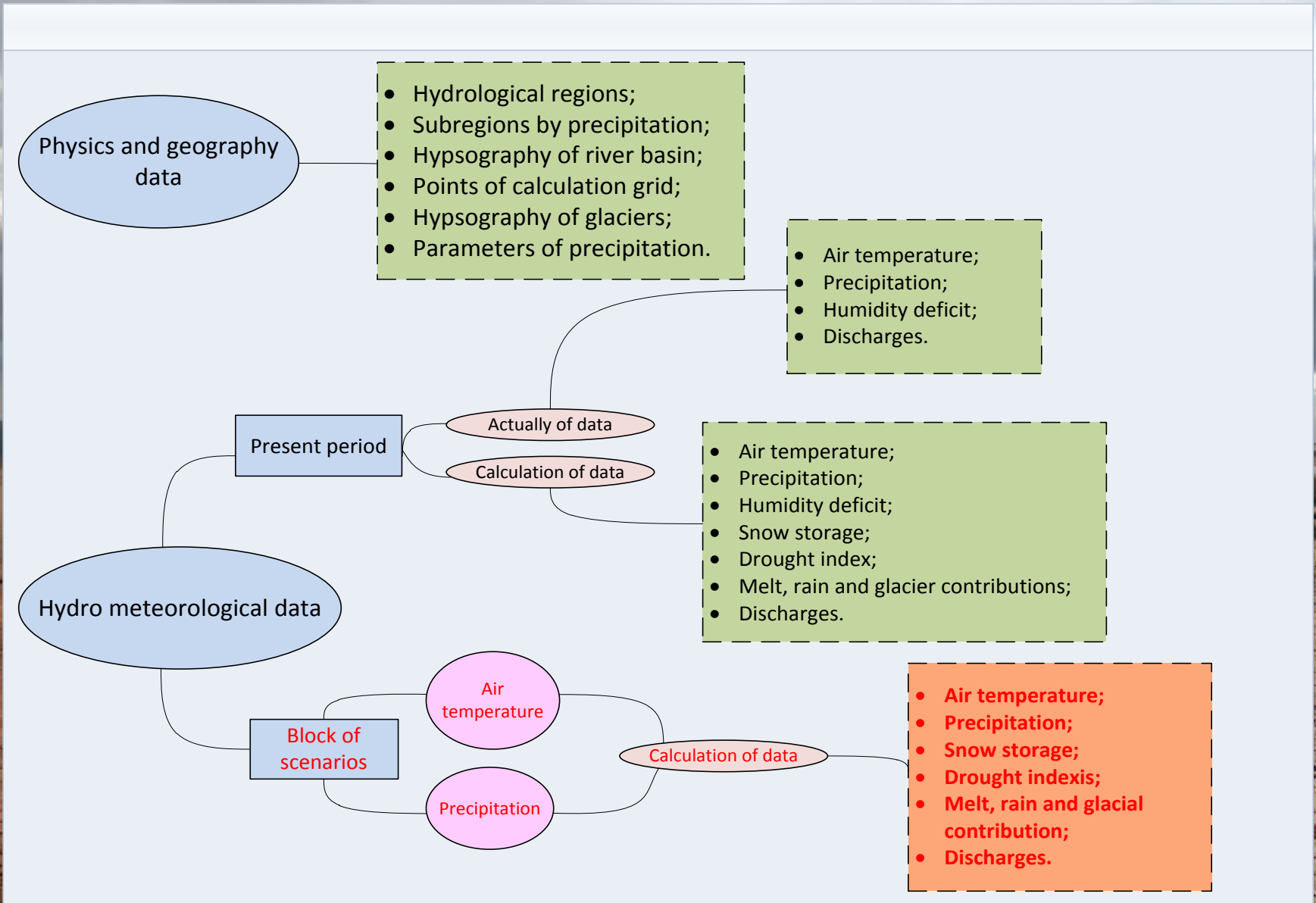
- A Drought Early Warning System is a tool for assessment, monitoring, warning, information and decision making, supported by the necessary information platform and providing dissemination (warning) and exchange of necessary information.
- The objective of the Drought Early Warning System is to provide decision makers and population with early information about a possibility of drought occurrence with a view to reduce the drought risk as much as possible.



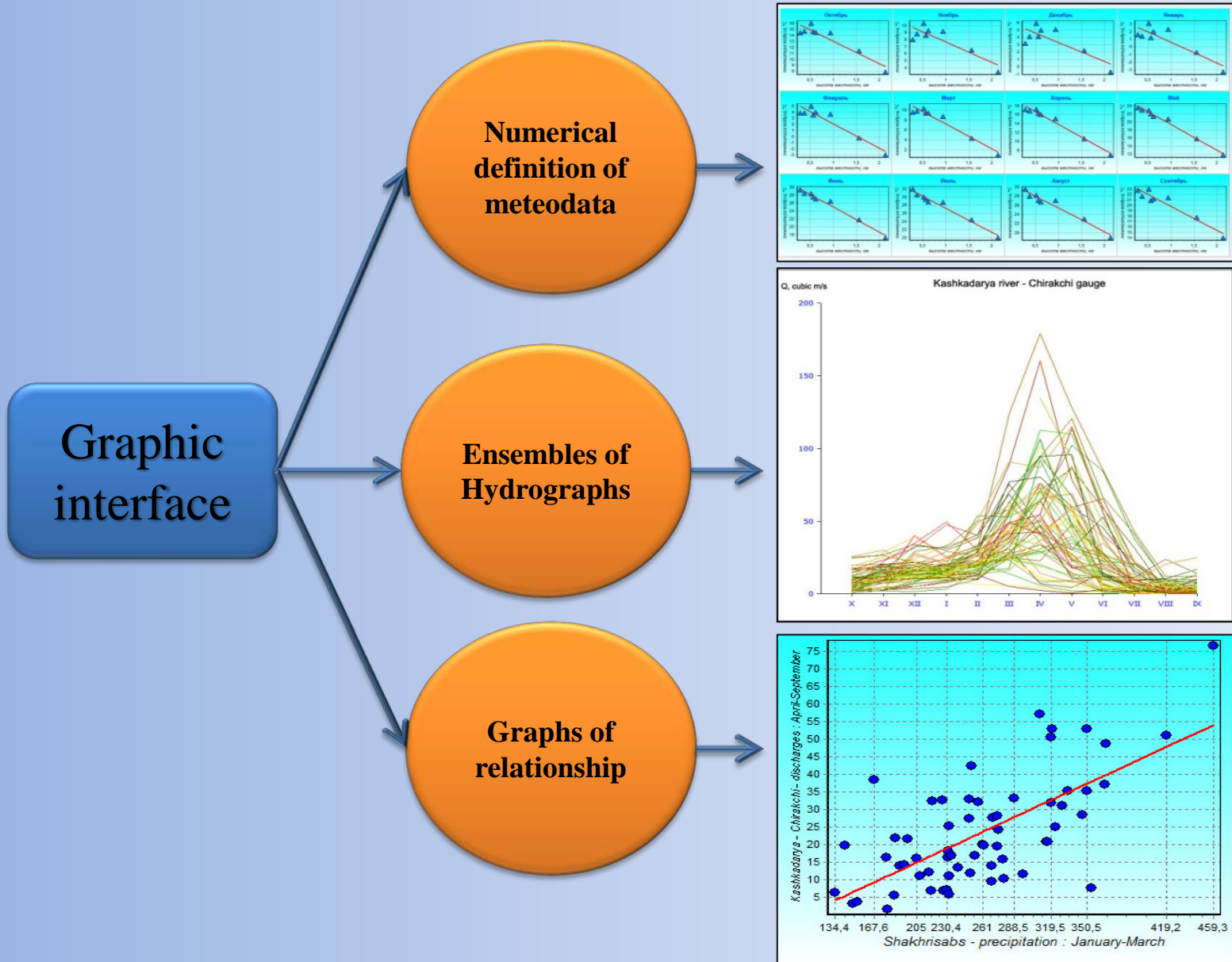
Structure of the Drought Early Warning System



Structure of the Database of the Drought Early Warning System



“Graphic Interface” regime



Functional capabilities of the Drought Early Warning System :

Assessment of water resources

Analysis of low water availability and drought formation conditions.

Analysis of low water availability and drought repetition

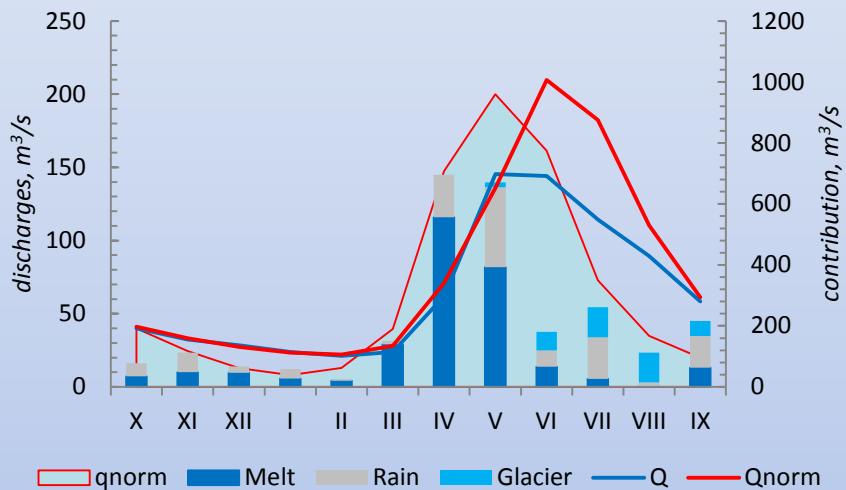
Assessment of water resources conditions based on climate scenarios

Assessment of low water availability and drought occurrences possibilities based on climate scenarios

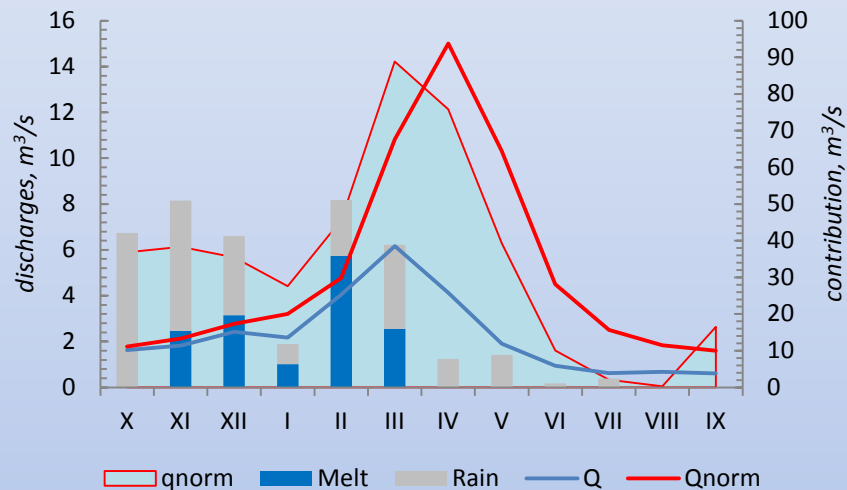
Drought Early Warning System

Analysis of the conditions of formation of low water and drought

Pskem river - Mullala gauge of 2000



Kashkadarya river - Varganza gauge of 2001

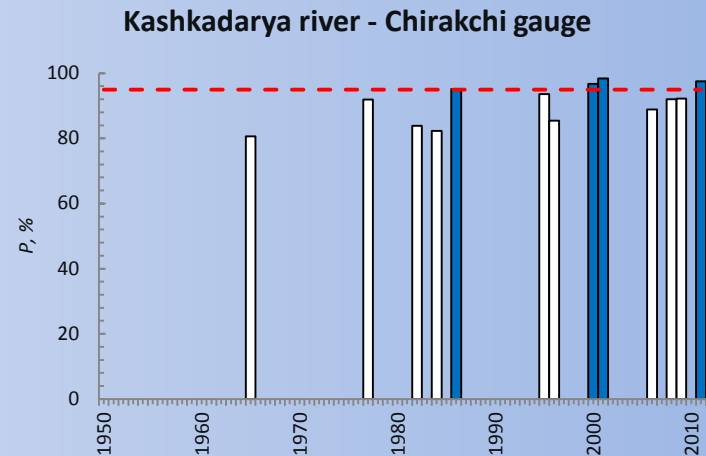
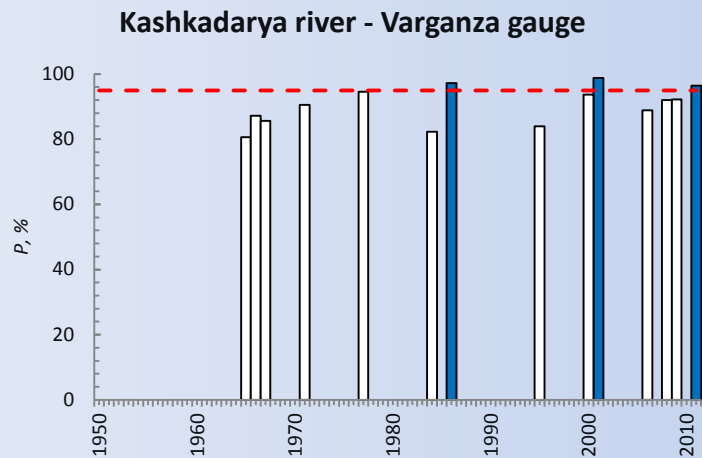
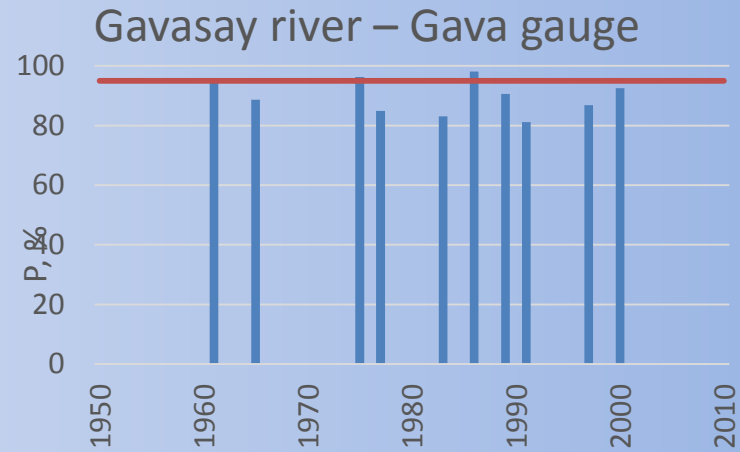
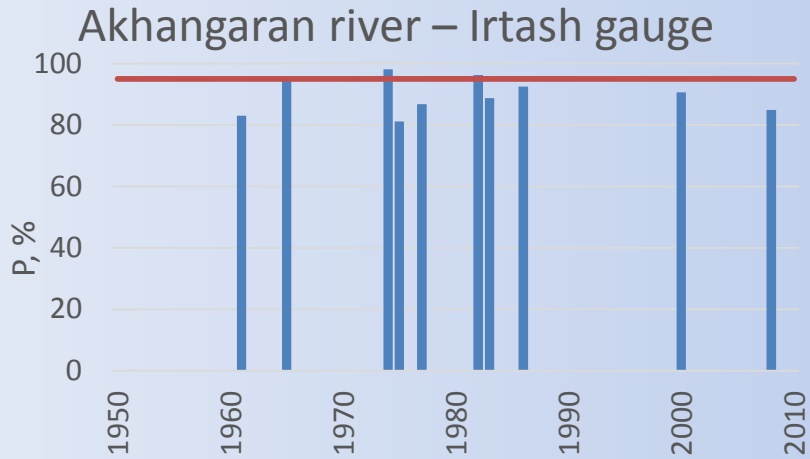


The main factors contributing to the formation of low water and drought:

- ✓ a significant decrease of precipitation (up to 50% of norms) in the period of snow accumulation in the mountains (January - March)
- ✓ reduction of snow storage in mountainous basin;
- ✓ decrease in volume of contributions for surface watershed, especially melted ones.



Analysis of the frequency of low water and drought



Strengthening natural variability and tendency of growth of extreme low water years, especially in recent years, starting from 2000.

Pedya drought index

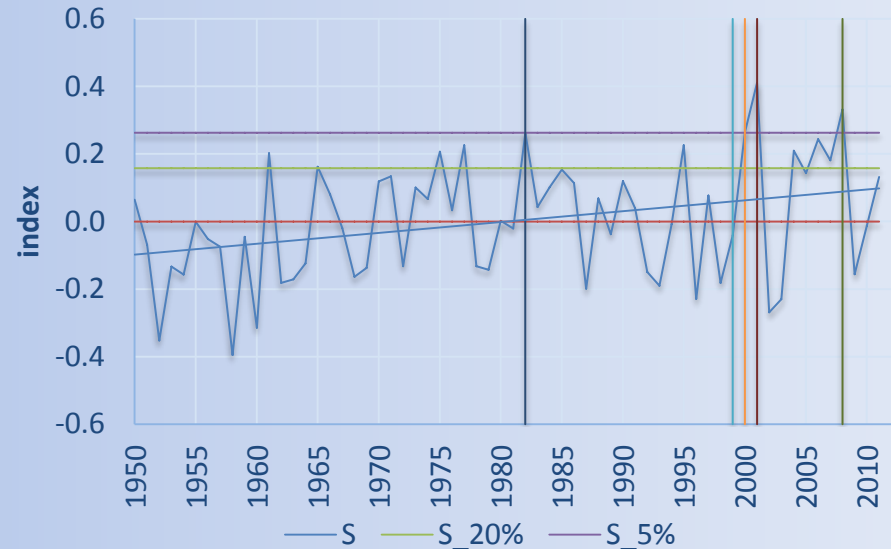
Pedya index S:

$$S = \frac{t_i - \bar{t}}{\sigma_t} - \frac{P_i - \bar{P}}{\sigma_p},$$

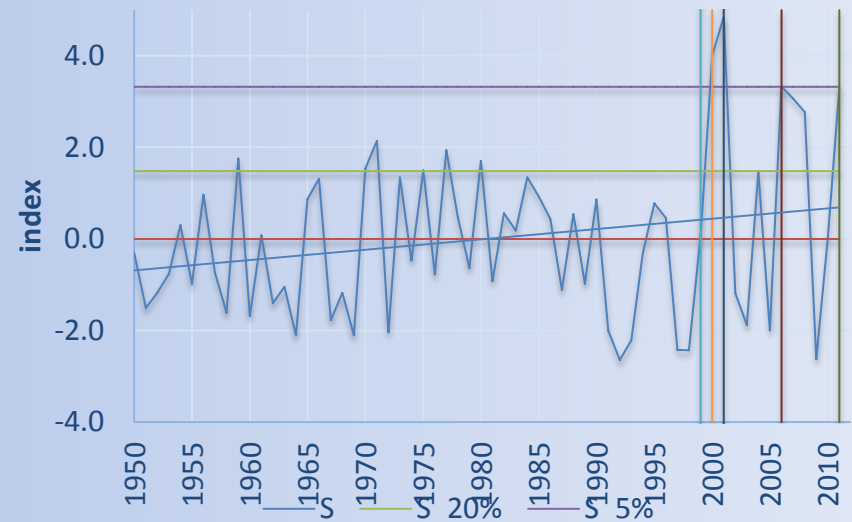
where t_i, P_i – the current values of monthly and seasonal air temperature and precipitation; \bar{t}, \bar{P} – average multiple years air temperature and precipitation; σ_t, σ_p – standard deviation.

- sustainable tendency of increase in the Pedya index S;
- increase of the index S indicates the possibility of increasing the frequency of low water and drought (extreme low water).

Chirchik-Akhangaran region



Kashkadarya river basin



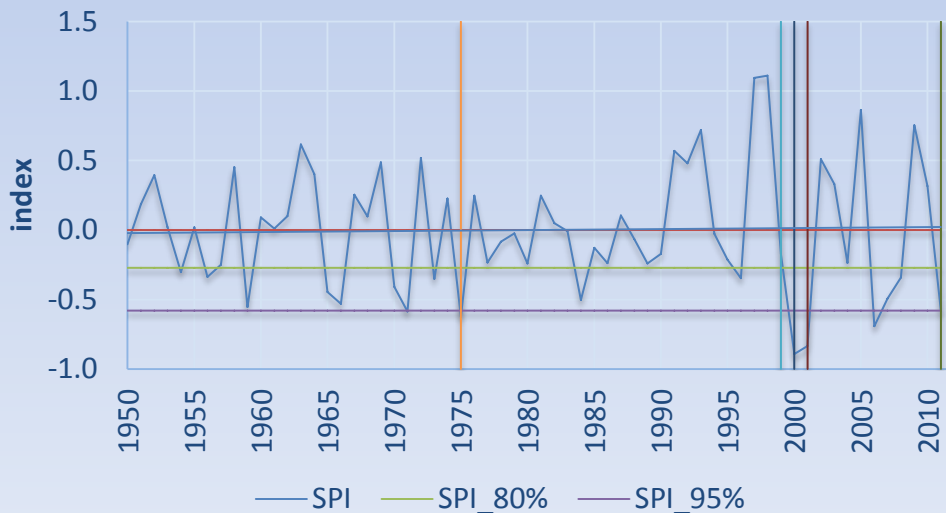
Standardized Precipitation Index SPI

Standardized Precipitation Index SPI:

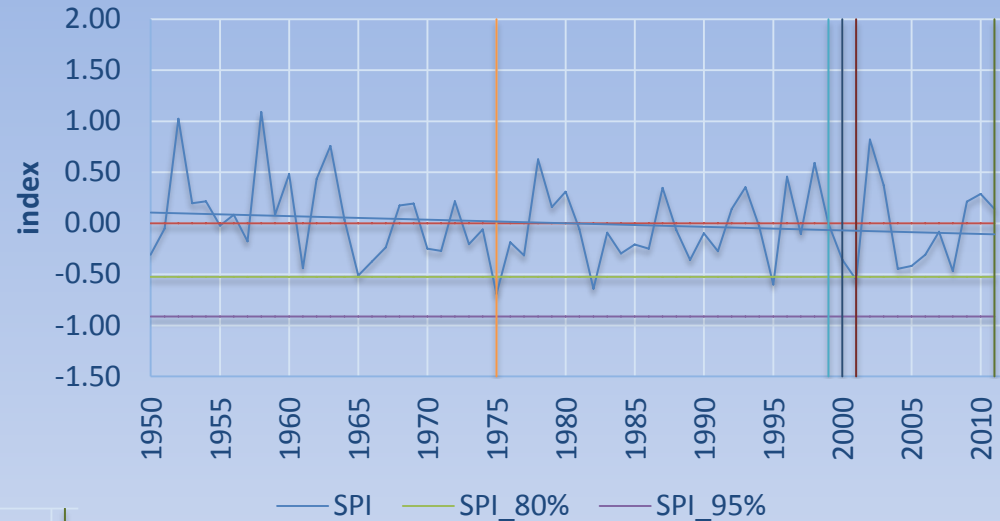
$$SPI = \frac{P - \bar{P}}{\bar{P}} \cdot 100\%,$$

where P – rainfall,
 \bar{P} – their average value.

Kashkadarya river basin (Guzar)



Chirchik – Akhangaran region



- a sustainable reduction of the index SPI ;
- decrease of index SPI shows increase of frequency of low water and drought (extreme low water).

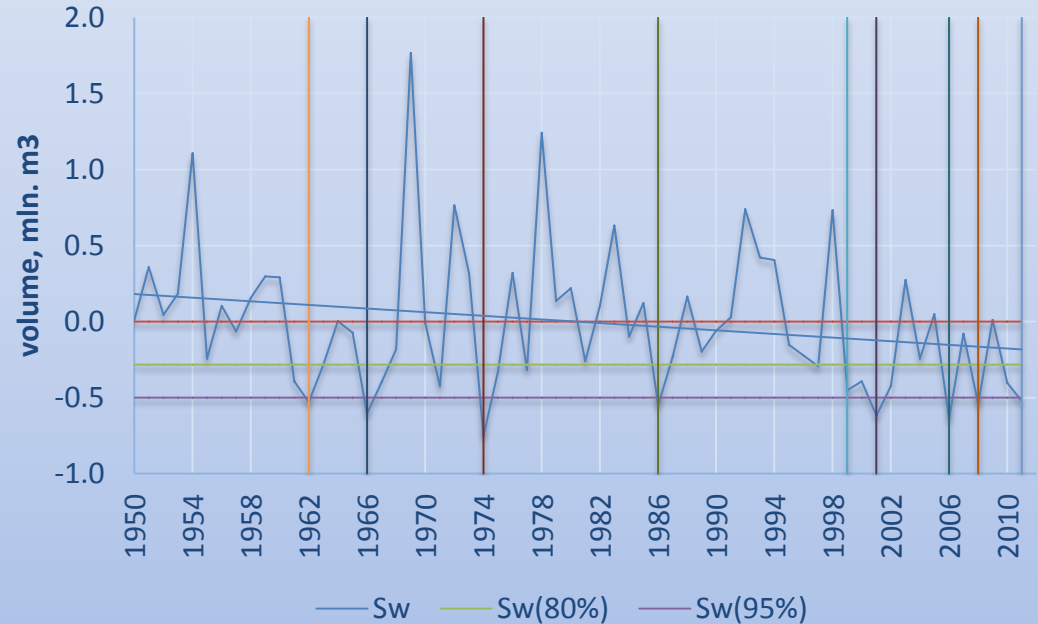
Drought index for snow storage S_w

For rivers with snow and snow-glacial type of intake, water availability determined by the accumulation of snow in the mountains in winter. Therefore, it is advisable to use the accumulation of snow in the mountains as a criterion (index) of the water availability S_w :

$$S_w = \frac{W - \bar{W}}{\bar{W}}$$

where W, \bar{W} – snow storage for a certain period of time (the end of January, the end of February, and so on) and the average multiple years values of snow storage, respectively.

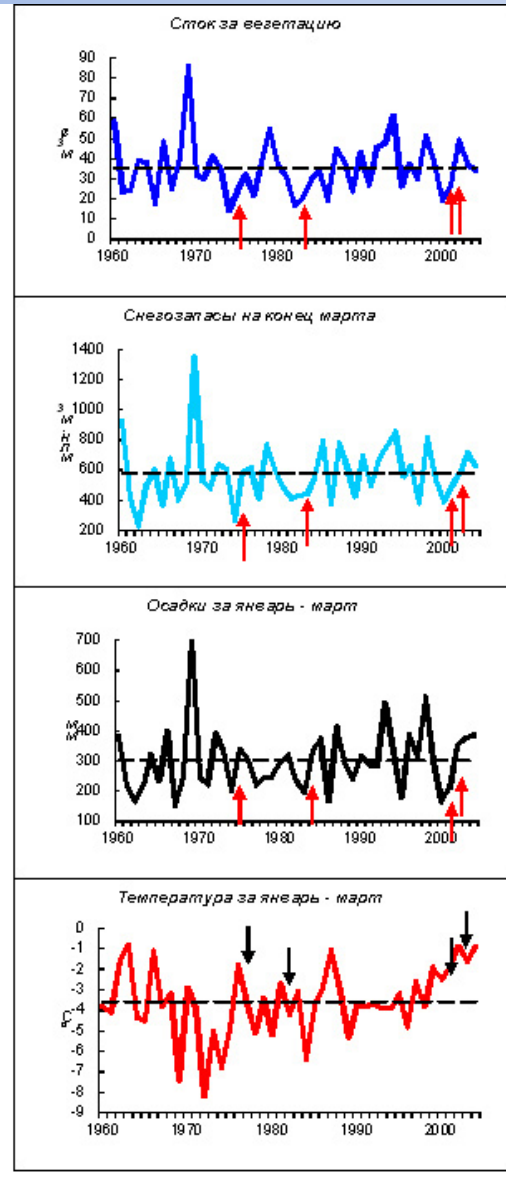
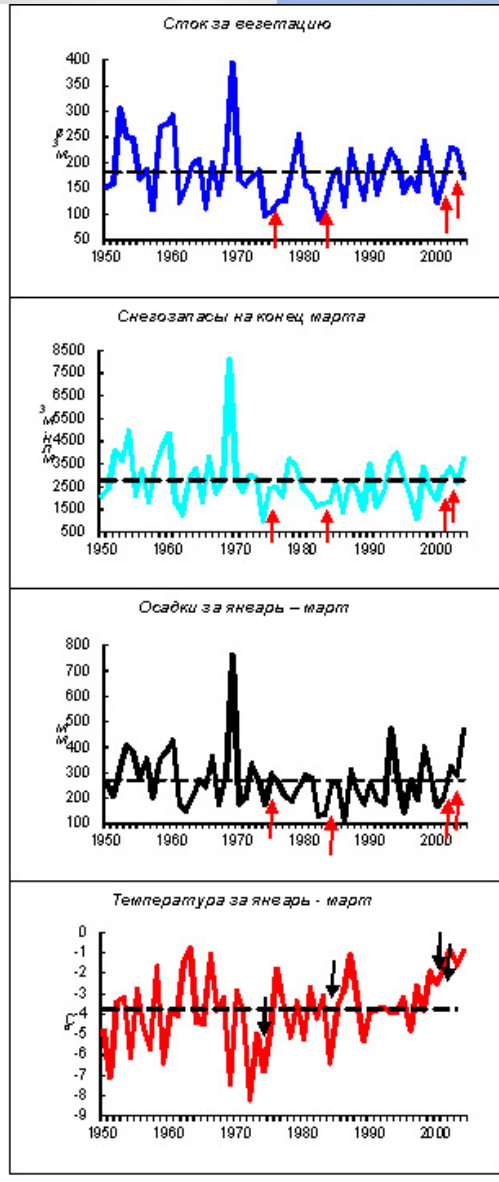
Kashkadarya river - Chrakchi gauge



- sustainable tendency in the decrease of index for snow storage S_w ;
- decrease of index S_w shows possibility of increase in frequency of low water and drought (extreme low water).



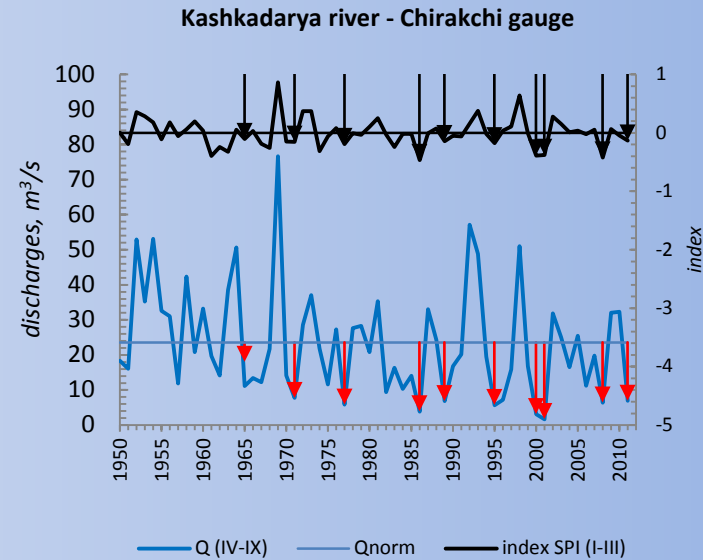
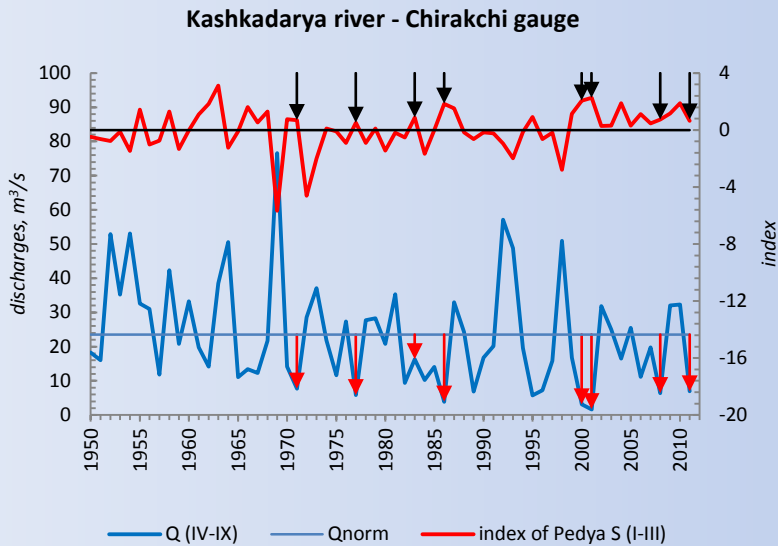
Analysis of conditions for formation of low water and drought



Hydrological drought is defined first of all by natural processes in the flow formation zone – processes of precipitation formation, and seasonal snow cover formation and melting.

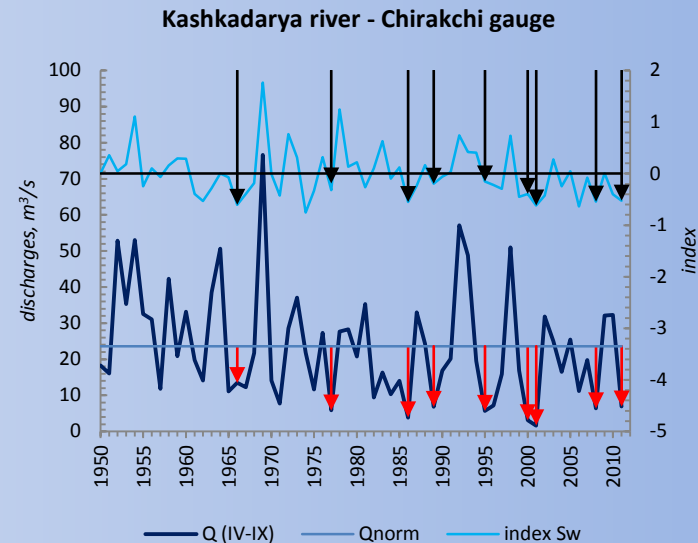
The calculations of snow storage, assessments of precipitation and temperatures enabled to analyze the conditions for river runoff formation in the low water years and the factors for its formation *for all indicator basins in the runoff formation zone of the Amudarya and Syrdarya rivers.*

Assessment of water shortage and drought by the indices



Assessment of low water and drought by the indices showed

- low water and drought correspond to positive values of the Pedyas index that indicates an increase in air temperatures and low precipitation;
- low water and drought correspond to negative values of the index SPI .





Strengthening the adaptive capacity will require implementation of the following measures and actions:

- ✓ Strengthening / development of hydro-meteorological monitoring as a basis for early warning of drought;
- ✓ Development of integrated monitoring of drought;
- ✓ Development component of early warning of forthcoming drought, not only at the level of key ministries and agencies, but also at the level of information to end users - farmers and rural residents;
- ✓ Development of the educational potential of local stakeholders on how to reduce climate risks and adaptation to climate change by: Meetings of round tables, seminars, workshops, publications, the media, etc.

Potential mitigations:

- ✓ *Ex ante* identification of supplemental and alternative sources of water;
- ✓ Use of reserve sources of groundwater;
- ✓ Technical optimization of water resources;
- ✓ Water laws and rules for special circumstances dry-year options (sale, expropriation, restrictions) using critical drought thresholds;
- ✓ Development of critical thresholds; prediction of future water use to determine zoning, realization of water reservoirs or farm ponds;
- ✓ Interconnection of urban or rural water supply systems; establish a water security plan for all rural and urban areas with respect to climate change;
- ✓ Water rationing; water allocation review;
- ✓ Sowing dryland crops;
- ✓ Introduction of water banks for temporary transfer of water rights.



Central Asia Flash Flood Guidance system



Completely avoid dangerous climate-dependent phenomenon is impossible, but the management of hazards, particularly drought, should go towards the creation of a set of measures and actions that can help prevent or mitigate the negative effects and risks of these phenomena

Thank you for your attention !

Working Plan of Theme of Hydrological Aspects of Drought

Activities	Action	Outputs
Hydrological Drought Early Warning Systems	<ul style="list-style-type: none">- Develop Hydrological Drought Early Warning Methodology including a review of best practices;- Develop end users (farmers and rural residents) – oriented recommendations to reduce the risks and damage from hydrological drought. <p>Taking into account the recommendations from the HMNDP</p>	<ul style="list-style-type: none">- Methodology of Hydrological Drought Early Warning;- Recommendations to reduce the risks and damage from hydrological drought.