

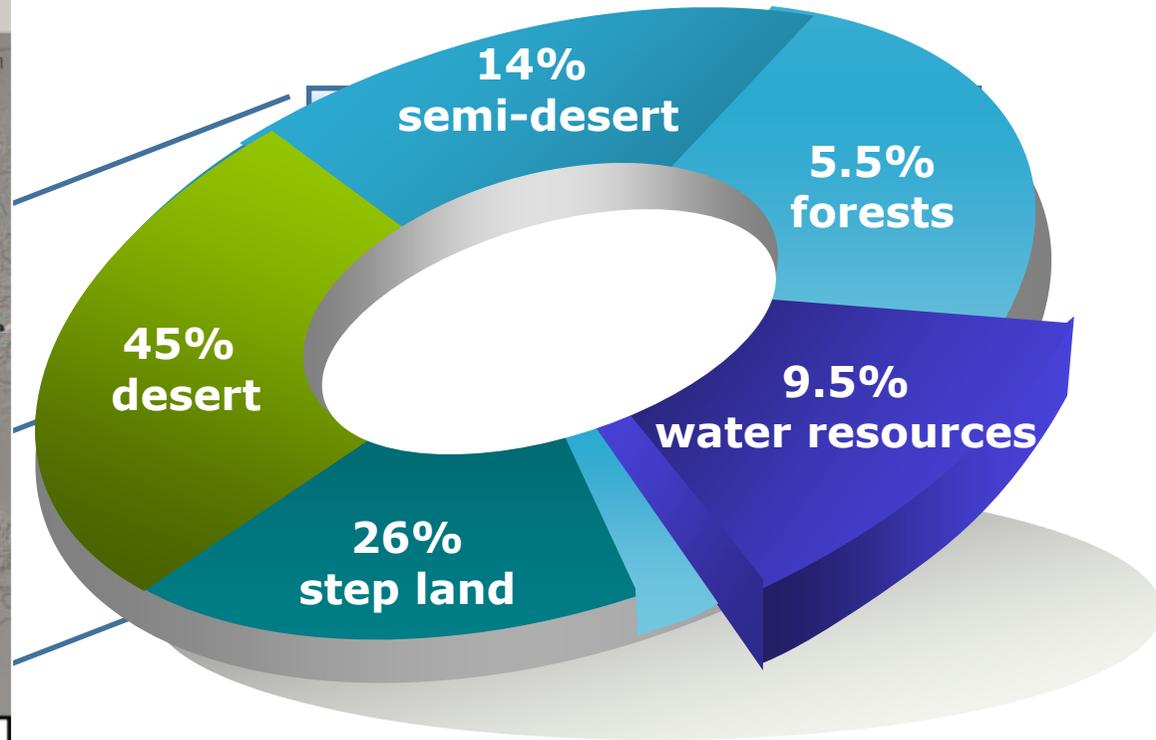


# Development of Climate Change Research in Kazakhstan

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# THE REPUBLIC OF KAZAKHSTAN



# CLIMATE – RELATED RISK AND IMPACTS IN KAZAKHSTAN



## **Agriculture**

Increased variability of  
wheat production  
Land degradation and crop loss

## **Human Health**

Increased extreme weather  
event-  
related mortality and morbidity  
Vector-borne disease expansion

## **Ecosystems**

Altered hydrology  
Land and habitat degradation

## **Water**

Increased glacial melt  
Altered seasonal river flow  
Diminished water availability after  
2050s

## **Energy**

Disruption of energy services  
Reduced hydropower potential

# NATIONAL POLICIES IN THE AREA OF CLIMATE CHANGE

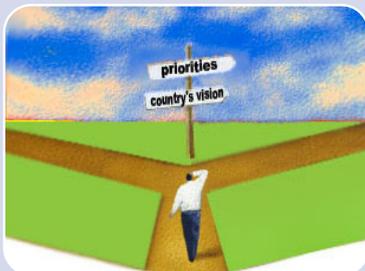


- ✓ Ratification of the United Nations Framework Convention on Climate Change of 4 May 1995
- ✓ Ratification of the Kyoto Protocol to the United Nations Framework Convention on Climate Change of March 26, 2009
- ✓ Signing of the Paris Agreement of July 20, 2016

## The main project components



Strengthening works on the national inventory and research of release Of Greenhouse Gas Emissions following the international requirements of the Intergovernmental Panel on Climate change



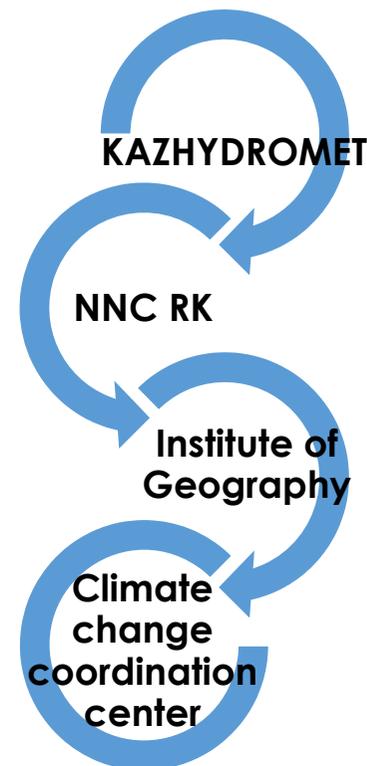
Assistance in the development of research and measures to reduce climate change effect and to improve decision-making on climate policy



Assistance in the development of measures to Climate change adaptation for planning further development of Kazakhstan, taking into account climatic conditions



Enhancing of activities for the development of knowledge management, monitoring, and evaluation system of Climate change



# NNC RK ACTIVITY



## STRATEGIC AREAS OF NNC RK ACTIVITY

- I. Development of RK atomic energy
- II. Radiation Ecology of Kazakhstan and STS
- III. Support of non-proliferation regime
- IV. Information and human resources support for atomic branch



**“NATIONAL NUCLEAR CENTER OF THE REPUBLIC OF KAZAKHSTAN”  
(NNC RK)**

### BRANCHES

**Institute of Atomic Energy (IAE)**

**Institute of Radiation Safety and Ecology (IRSE)**

**Institute of Geophysical Research (IGR)**

**“Baikal” enterprise**

# INSTITUTE OF RADIATION SAFETY AND ECOLOGY (IRSE)



## Primary Activity Areas

- radioecology and radiation monitoring of national regions where nuclear tests have been conducted or nuclear facilities are available;
- decontamination of radioactively contaminated areas;
- study of medical and biological aspects of radiation impact on the environment;
- **research of Climate change (new direction)**



# Climate Change Studies Using Nuclear Isotope Techniques *(under development)*

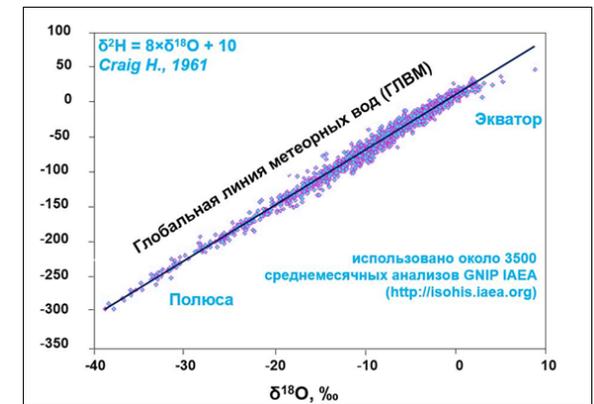
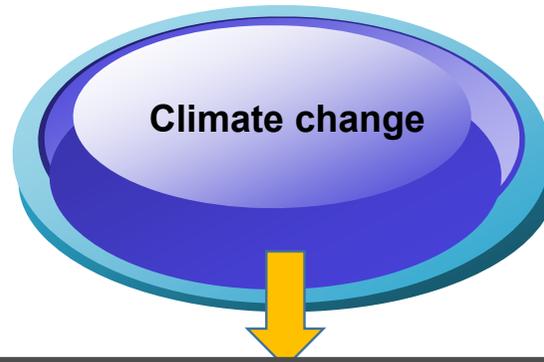


# PROGRAM OBJECTIVE



Research and assessment of the climate change effect in Kazakhstan with development of recommendations on adaptation to possible environmental changes using nuclear and radiological methods.

## RESEARCH METHODS



### Radiocarbon dating

The radiometric method, based on the determination of radiocarbon ( $^{14}\text{C}$ ) concentrations in the environmental objects

### Assessment of soil gas exchange

Assessment of  $\text{CO}_2$  emissions and gas exchange for regional types of soil and factors contributing to these processes

### Isotopic hydrology method

Isotopic method, based on measurement of concentrations of stable isotopes ( $^{18}\text{O}$  and  $^2\text{H}$ ) in water environment and atmospheric precipitations

# Study of radiocarbon distribution in soils of forest ecosystems to predict climatic changes in the Republic of Kazakhstan

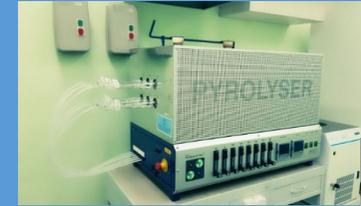


**Aim:** Assessment of climatic changes and the degree of impact of anthropogenic activities to these changes in the RK

## Tasks:

- ✓ Development of the technique to collect and prepare soil samples for research  $^{14}\text{C}$ .
- ✓ Field researches, including selecting suitable areas for soil sampling.
- ✓ Laboratory works to determine  $^{14}\text{C}$  concentrations in soil samples, as well as physical and chemical properties of soil, and concentrations of radioactive substances.
- ✓ Comparative analysis between the temperature of atmospheric air and  $^{14}\text{C}$  concentration in soil.
- ✓ Processing, analysis and interpretation of results.

**The essence of radiocarbon method** consists of comparison of three different radiocarbon isotopes (stable  $^{12}\text{C}$  and  $^{13}\text{C}$ , and  $^{14}\text{C}$  radioisotope).

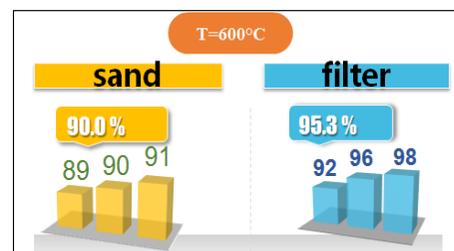


## Basic stages:

- ❖ analysis of  $^{12}\text{C}$  and  $^{13}\text{C}$  stable isotopes;
- ❖ obtaining  $\text{CO}_2$ ;
- ❖ determining concentration of  $^{14}\text{C}$ ;
- ❖ calculation of radiocarbon age (converted using a formula, for this purpose the data on International standard samples is required);
- ❖ calculation of the real age (using computer software);
- ❖ modeling climatic changes using computer software (for this purpose the results of stable isotopes analysis, radiocarbon analysis data massif and climatic parameters are required).



## Influence of temperature and type of substrate for chemical yield $^{14}\text{C}$



# Study of climatic change using isotope hydrology method

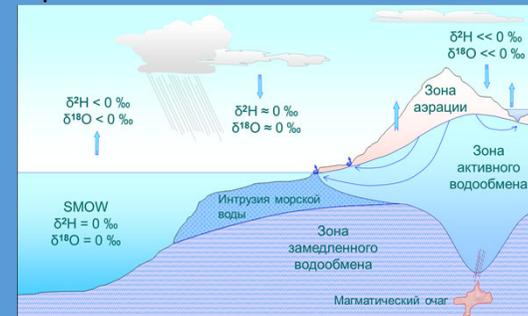


**Aim:** To study impact of the consequences of climatic changes to the water reserves of Kazakhstan

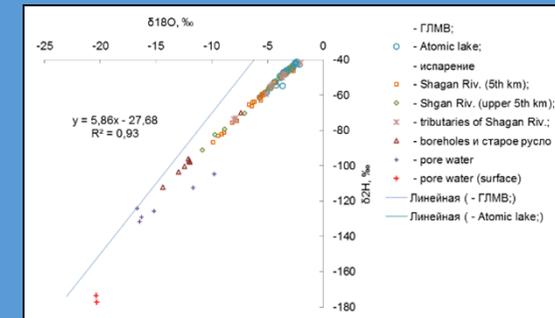
## Tasks:

- ✓ To get the source data on the state of water resources (underground and surface waters).
- ✓ To identify conditions, under that the water resources are formed (sources of supply for underground and surface waters).
- ✓ To determine whether the water exchange processes take place between different aquifers takes place or nor and to determine the time interval when they take place.
- ✓ To identify climatic factors – impact of temperature and amount of precipitations to the state of water resources.

**Method of isotope hydrology** allows getting reliable information on the sources of various water objects and atmospheric precipitations and study the climate change impact on them.



**System of  $^2\text{H}/^{18}\text{O}$  ratios in the environment**



**Typical distribution of stable isotopes in the system – Global line of meteoric water**

At present, for the first time in Kazakhstan, data on concentrations of  $^2\text{H}$  and  $^{18}\text{O}$  in atmospheric precipitation under different natural and climatic conditions have been obtained. Based on those results local line of meteoric waters and regression equation were determined. At this stage, this will enable us to trace the possible changes in the water environment.



# Assessment of regional soil gas exchange as a source of CO<sub>2</sub>, entering into the atmosphere



**Aim:** Assessment of soil CO<sub>2</sub> gas exchange as a source of CO<sub>2</sub> emitted into the atmosphere

## Tasks:

- ✓ To study seasonal quantitative parameters of CO<sub>2</sub> gas exchange for the background regional types of soil taking into account natural moisture content, air and soil temperature.
- ✓ To study seasonal quantitative parameters of CO<sub>2</sub> gas exchange for the regional types of soil, suffering anthropogenic impact taking into account natural moisture content, air and soil temperature.
- ✓ To build regression models allowing to predict the dependence of soil CO<sub>2</sub> streams on moisture content in soil as well as on air and soil temperature.

**Objects of research:** background regional soils, pasturelands, farming lands.

**Methods of research :** complex of field, instrumental, laboratory and statistical methods of analysis.



## Expected results

- Quantitative parameters of CO<sub>2</sub> emission- gas exchange for regional soil types, both background and those subjected to anthropogenic impact will be assessed, taking into account moisture content, air temperature, and soil temperature.
- Regression models, allowing to predict the intensity of soil CO<sub>2</sub> streams depending on soil moisture, air temperature, and soil temperature will be obtained.

# CONCLUSION



- Obtained data will allow improving the understanding of the processes of climatic change and the factors, causing the development of these processes
- Scientific-methodological approaches should contribute to an assessment of sensibility of economics and population to climatic changes, to development of various scenarios of potential consequences of climatic changes and take adequate measures in a timely manner for adaptation, and finally, to assure stable development of Kazakhstan.
- The target consumer of the program resources is the Ministry of Ecology, Geology, and Natural Resources of RK. On the global scale, target consumers are countries and international organizations actively responding to climatic change.
- Results of the research will be used to develop recommendations for responding to climatic changes and for the development of measures to adapt to such changes in the Republic of Kazakhstan.

## COLLABORATION WITH THE ISTC



**The Project Proposal KZ-2611** - Revealing climate change and impact of man-made factors on contamination of the natural environment by studying radiocarbon concentration in the earth crust of the forest ecosystems of Kazakhstan

### Foreign collaborators



Japan Atomic  
Energy Agency

**Aim** of this project is to determine the level of climate change in the environment of Kazakhstan and the degree of impact of human activities to this change.

### Tasks:

1. Development of a technique for soil samples collection and preparation for  $^{14}\text{C}$  research.
2. Field researches, including selection of suitable areas for soil sampling provided for climate, landscape and other natural peculiarities.
3. Laboratory researches for determining  $^{14}\text{C}$  concentration in soil samples, structure and physical and chemical properties of soil, concentration of radioactive substances in soil samples.
4. Processing, analysis and interpretation of the data obtained.



**We are open for friendship and cooperation!**

**Thank you for your attention!**