



**WATER RESOURCES IN UKRAINE
UNDER CLIMATE CHANGES:
ASSESSMENT AND MEASURES OF
ADAPTATION**

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OBJECTIVES OF PRESENTATION

- **present information about climate research activity in Ukraine**
- **present some results of studies of climate change effect on hydrological regime and water resources of river basins located in different natural zones of Ukraine**
- **present the most likely affected Ukrainian economical sectors by impact of climate changes**
- **present following directions of activities in order to eliminate an effect of negative impact of climate changes**

BE

Main river basins and neighboring countries of Ukraine

PL

RU

SK

Forest zone

Mixed forest-steppe zone

HU

Carpatians mountains

MD

Steppe zone

Поділ водних об'єктів України за зонами гідропрогностичної відповідальності

RO

Басейни річок Причорномор'я

RU

Українська ділянка Дунаю

Crimea mountains



NATURAL CHARACTERISTICS OF UKRAINE

- **AREA – 603.7 sq. km**
- **CLIMATE TYPES – GENERALLY, MODERATE-CONTINENTAL TYPE, IN SOUTHERN PART OF CRIMEA – SUBTROPICAL TYPE**
- **AVERAGE ANNUAL PRECIPITATION DISTRIBUTION – FROM 300 mm IN SOUTH - EAST TO 1500 mm IN CARPATIANS**
- **NATURAL ZONES: FOREST (20% OF TERRITORY), MIXED-FOREST (35%), STEPPE (40%), MOUNTAINS (5%)**
- **TOTAL AVERAGE ANNUAL RUNOFF – 209.23 cub. Km (49.0 cub. Km FORMED IN UKRAINE)**
- **POTENTIAL WATER RESOURCES IN A YEAR PER AN INHABITANT – 1.6 CUB. KM**

AVERAGE ANNUAL RUNOFF OF MAIN UKRAINIAN RIVER BASINS

River basins	Average annual runoff, km ³		
	Total	Formed in Ukraine	Inflow from other countries
Bug	1.4	1.4	
Danube	133.8	10.8	123.0
Dnister	10.7	9.7	1.0
Southern Bug	3.2	3.2	
Dnipro	53.5	19.1	34.4
Siversky Donets	4.81	2.96	1.85
Black and Azov Seas river basins	1.82	1.82	
Total	209.23	48.98	160.25

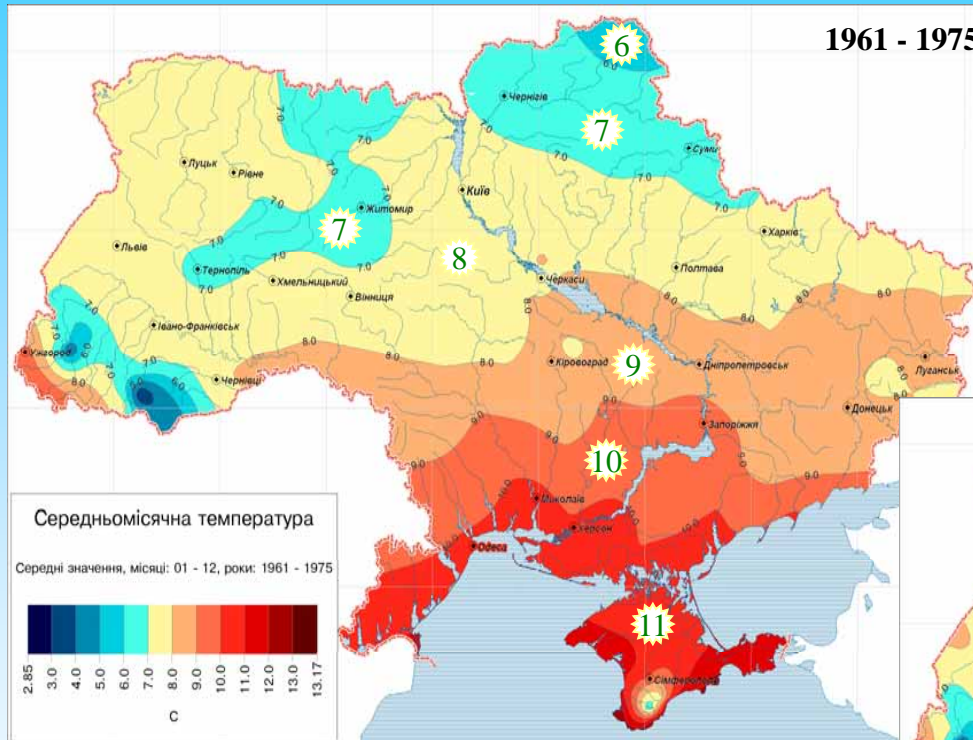
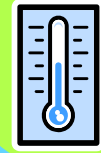
INSTITUTIONAL BASIS OF CLIMATE CHANGE RESEARCHES IN UKRAINE

- **Ukraine signed the UN Framework Convention on Climate Change in June 1992; Ukrainian Parliament ratified it in October 1996**
- **Observation data of the State Hydrometeorological Service is the principal source of information about present climate and its possible changes**
- **To strength climate research activity the National Climate Program was adopted by Ukrainian Governmental in 1997. The program has been implemented during 1998-2002**

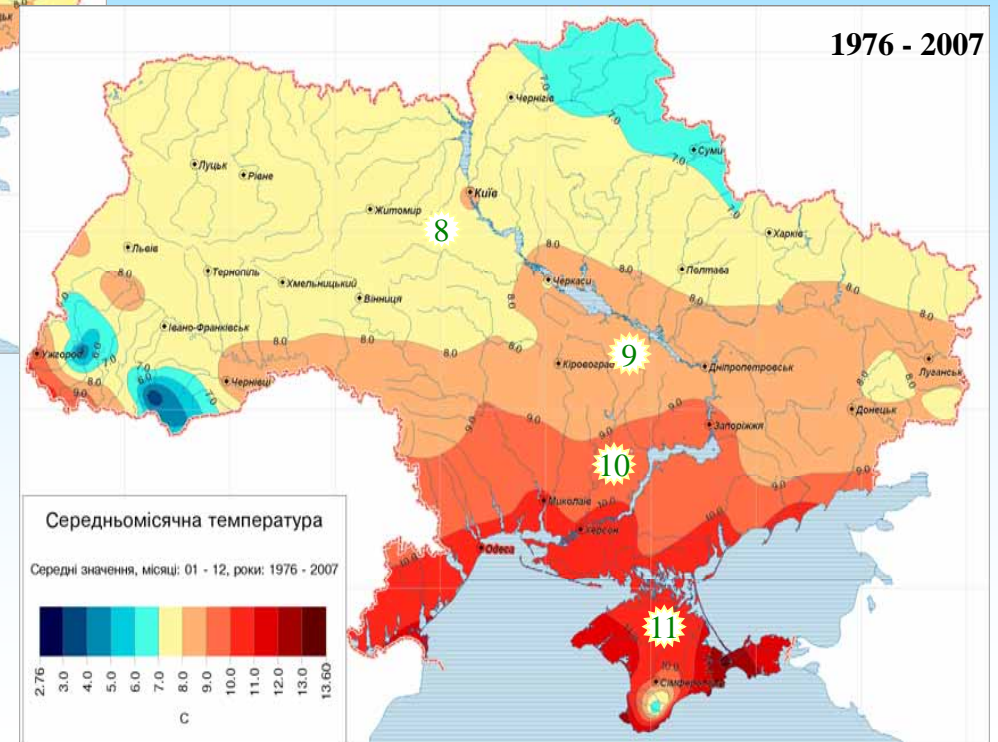
INSTITUTIONS INVOLVED IN THE IMPLEMENTATION OF THE CLIMATE PROGRAM

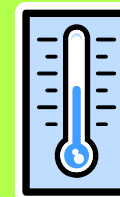
- **State Hydrometeorological Service was nominated as the governmental body responsible for coordination of researches**
- **Ukrainian research hydrometeorological institute – principal scientific organization**
- **Kyiv National Taras Shevchenko University and Odesa Hydrometeorological Institute**
- **Institute of Geography and Marine Geophysical Institute of Ukrainian Academy of Sciences**

2. Peculiarities of major climatic parameters changes in Ukraine in XXI century and estimation of their probable development tendencies (regional climate changes).

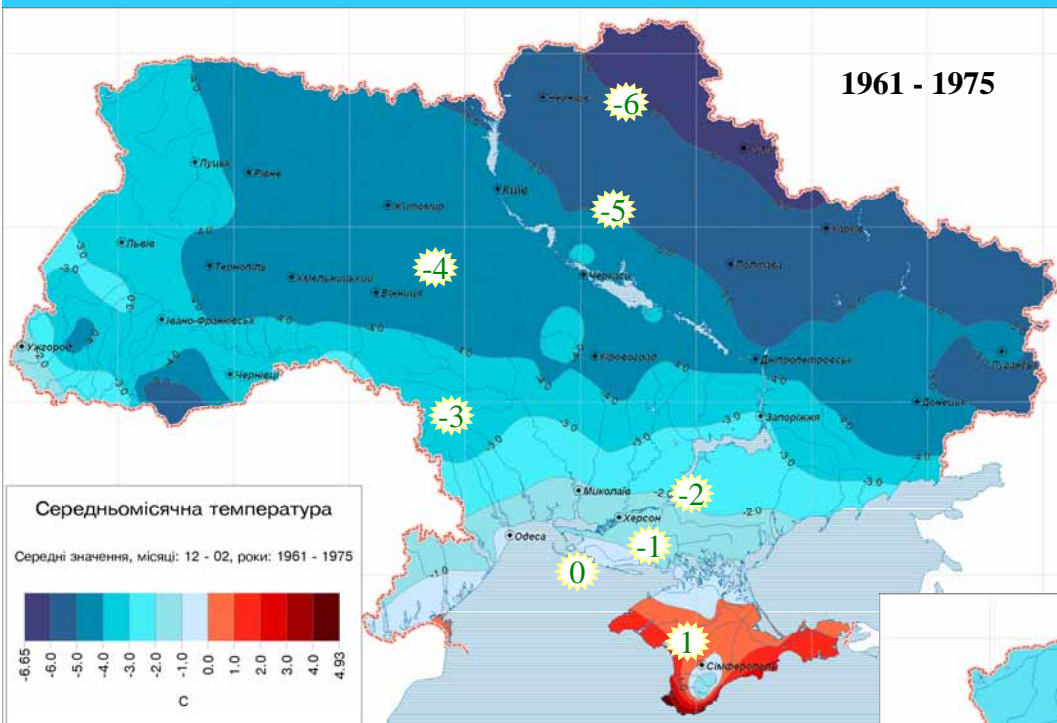


Mean annual air temperature
in Ukraine



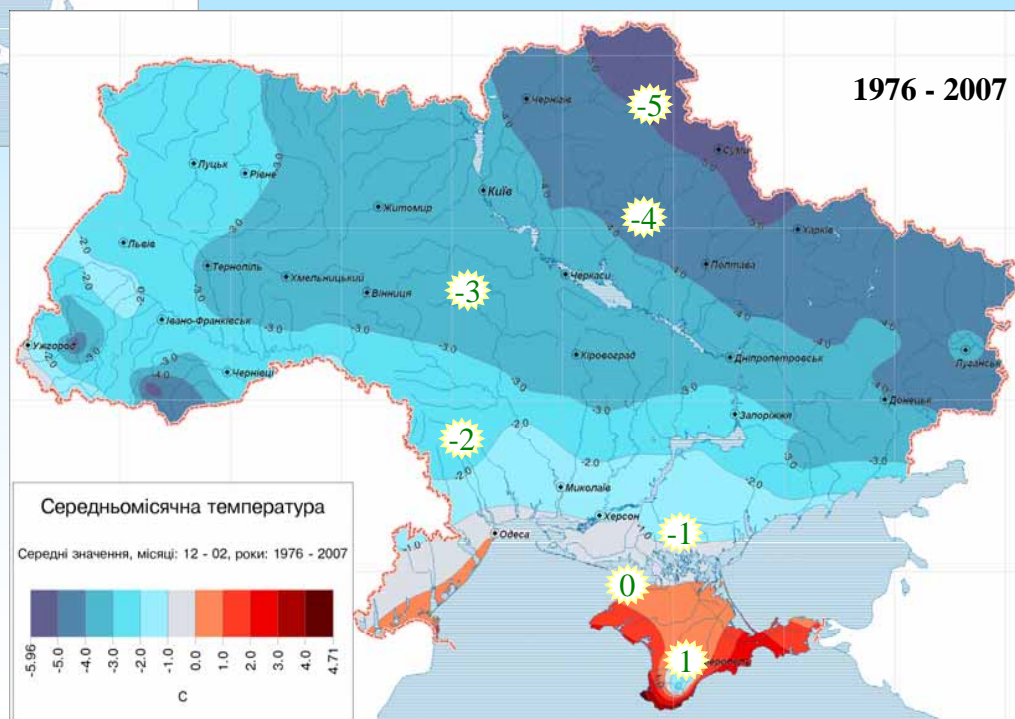


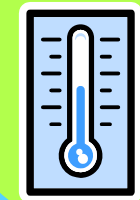
1961 - 1975



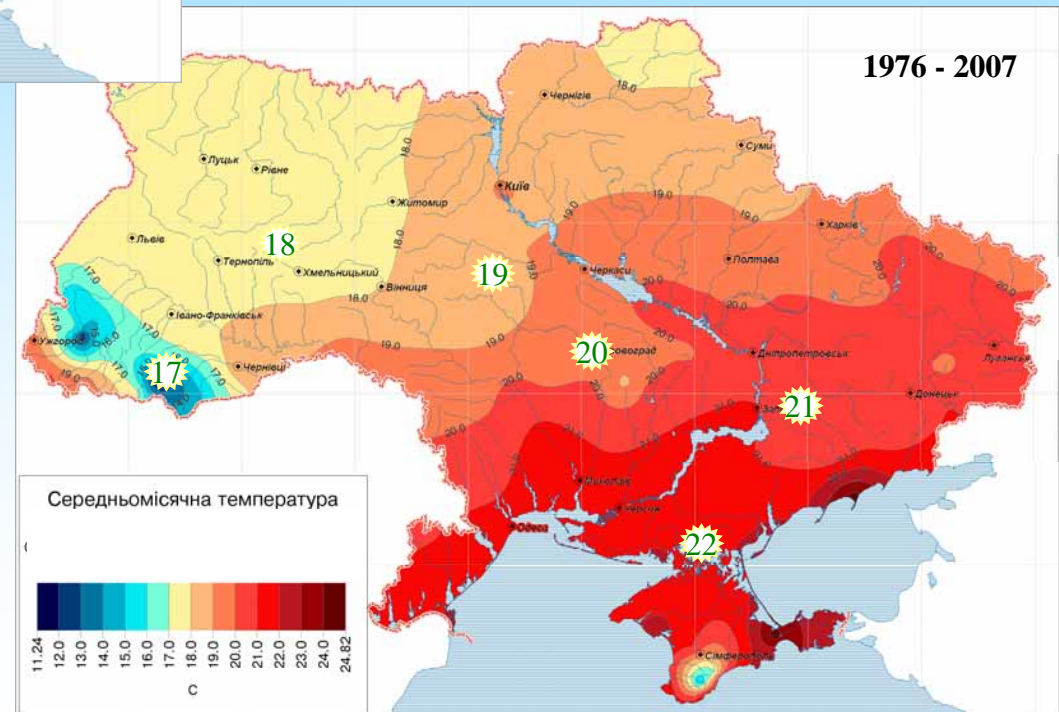
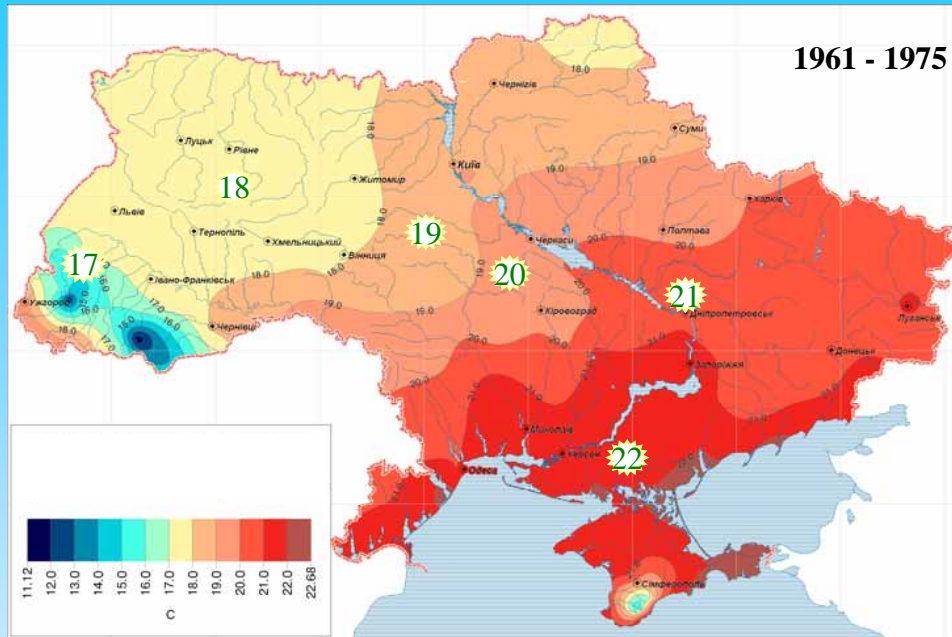
Mean air temperature in Ukraine (winter)

1976 - 2007





Mean air temperature in Ukraine (summer)

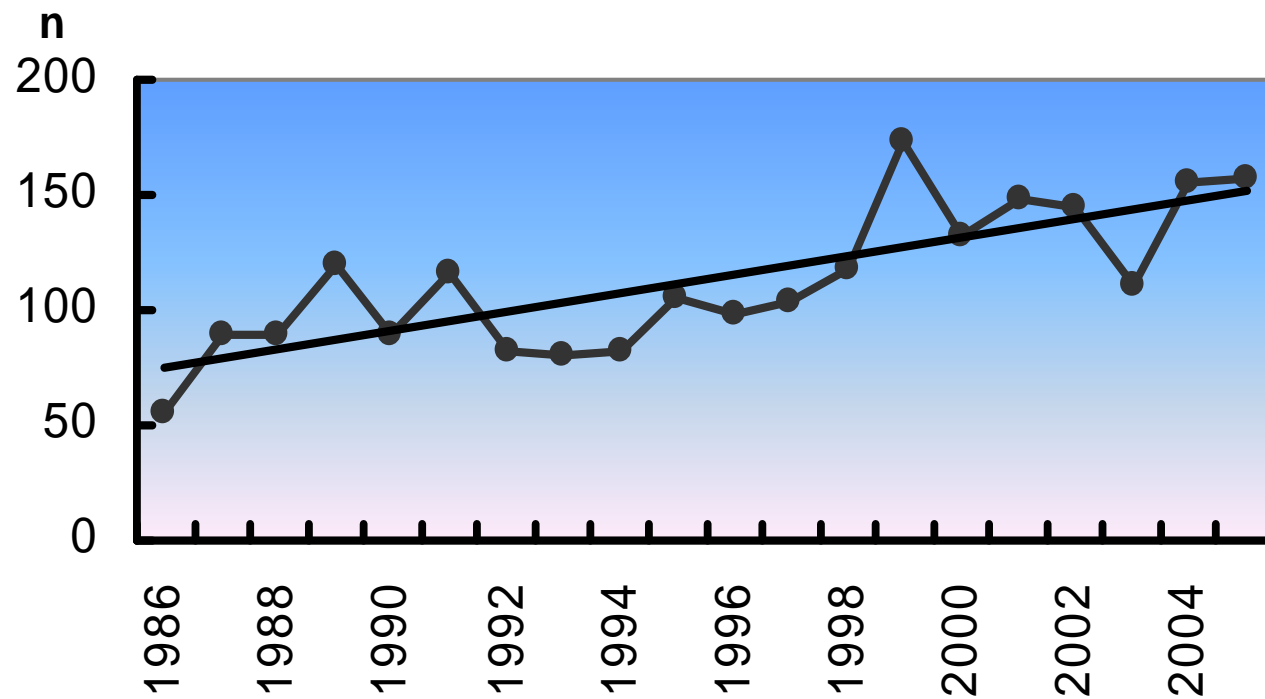


REGRESSION'S EQUATION OF TRENDS OF MEAN ANNUAL DISCHARGES

River – Station	Observ. period	Regression
Dnipro – Kyiv HEP	1928-2000	$Y = 0.47X + 163$
Desna – Chernigiv	1895-2000	$Y = 0.02X + 328$
Siverskyi Donets	1923-2000	$Y = -0.04X + 48.3$
Pivdennyi Bug	1914-2000	$Y = 0.10X + 85.5$
Prut –Chernivtsy	1895-2000	$Y = -0.43X + 100$
Psel – Zapsilia	1950 - 2000	$Y = -0.37X + 43.3$
Uzh - Uzhgorod	1947 - 2000	$Y = -0.04X + 30.2$
Dnister – Zalischyk	1895 - 2000	$Y = -0.17X + 236$
Latorisa -Mukachev	1847 - 2000	$Y = -0.12X + 22.7$

REGRESSION'S EQUATION OF TRENDS OF MEAN SEASON'S DISCHARGES

RIVER-STATION	DECEM.-FEBR.	MARCH-JUNE	JULY-NOVEMB.
Dnipro – Kyiv	$Y=7.28X + 460$	$Y=-7.33X+ 2131$	$Y=3.63X+ 556$
Desna–Chernigiv	$Y=1.91X + 142$	$Y=-1.36X+ 626$	$Y=1.86X+ 134$
Siverskyi Donets	$Y=2.71X + 324$	$Y=-3.82X+ 112$	$Y=0.91X+ 97.5$
Pivdennyi Bug	$Y=2.86X + 87.5$	$Y=-3.72X+98.5$	$Y=1.13X+ 77.7$
Prut –Chernivtsy	$Y=3.67X + 111$	$Y=-5.25X+140$	$Y=1.33X+ 106$
Psel – Zapsilia	$Y=2.49X + 55.7$	$Y=-2.85X+78.5$	$Y=1.33X+ 106$
Uzh - Uzhgorod	$Y=3.77X + 28.2$	$Y=-3.45X+50.0$	$Y=-0.42X+ 33.5$
Dnister–Zalischk	$Y=3.00X + 182$	$Y=-2.68X+176$	$Y=-0.39X+ 167$
Latorisa-Mukach	$Y=3.55X + 37.9$	$Y=-2.93X+61.2$	$Y=-0.69X+ 67.0$



Annual fluctuations of severe hydrometeorological events at the territory of Ukraine. Number of cases (n) and linear trend.



Consequences of severe hydrometeorological events

PRIOR EVALUATION OF EXPECTED CHANGES IN HYDROLOGICAL REGIME

- **NORTHERN PART OF TERRITORY (FOREST ZONE):**
A) 15-25% RISE OF MEAN ANNUAL RUNOFF; B) RISE OF WINTER RUNOFF AND FALL OF SPRING RUNOFF
- **SOUTH AND SOUTH-EASTERN PART (FOREST-STEPPE AND STEPPE ZONES):**
A) 30-50% DECREASING MEAN ANNUAL RUNOFF;
B) ABOUT 50% OF ANNUAL FLOW WILL PASS IN WINTER MONTHS; C) INCREASING DROUGHTS RISK
- **CARPATHIANS MOUNTAIN RIVERS:**
INCREASING FREQUENCY AND MAGNITUDE OF EXTREM FLOODS

THE MOST LIKELY EFFECTED SECTORS AND TERRITORIES OF UKRAINE BY IMPACT OF CLIMATE CHANGE

- **AGRICULTURE IN THE SOUTHERN PART OF COUNTRY**
- **HUMAN SETTLEMENTS AND INDUSTRY WATER SUPPLY IN SOUTHERN AND SOUTH-EASTERN PART**
- **EXTREM HYDROMETEOROLOGICAL EVENTS PREVENTION IN THE MOST PART OF COUNTRY**
- **GETTING WORSE OF WATER QUALITY IN WATER BODIES IN SOUTHERN AND SOUTH-EASTERN PART OF COUNTRY**

DIRECTIONS OF FOLLOWING RESEARCHES

- **DEVELOPMENT OF COMPLEX WATER BALANCE RESEARCHES USING DATA ABOUT: RIVER FLOW; EVAPORATION FROM SOIL, LAND AND WATER SURFACE; SOIL WATER SUPPLY; WATER EQUIVALENT OF SNOW PACK**
- **ASSESSMENT OF EXPECTED CHANGES IN HYDROLOGICAL REGIME AND WATER RESOURCES USING NEW ACHIEVEMENTS IN THE AREA OF CLIMATE CHANGE MODELLING**
- **ELABORATION OF RECOMMENDATION ADDRESSED ON PREPARATION OF ADAPTATION MEASURES**



**Thank you very much
for attention !**