Moldova water resources in the face of climate change: Role of interstate cooperation in raising preparedness

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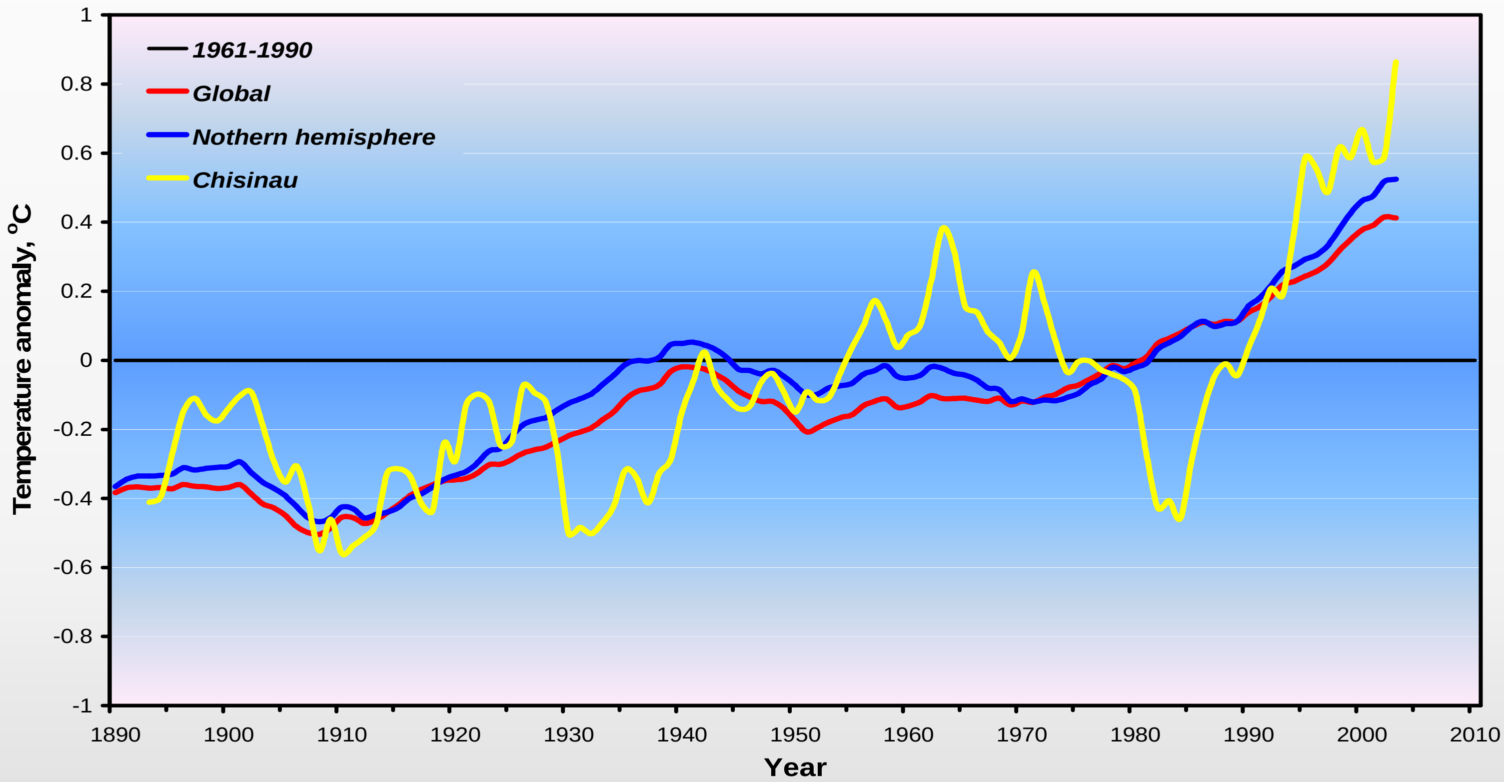
SOME NEGATIVE FACTORS AFFECTING ADOPTION AND IMPLEMENTATION OF INTERNATIONAL WATER DOCUMENTS RELATED TO CLIMATE CHANGE

- Formal approach to addressing the issues, including the establishment of official institutions
- Unstable economical and political situation
- Low efficiency of the authorities on all level and their potential inability to address principal demands of International Conventions and agreements
- Lack of openness and transparence in the work of governmental bodies that limits opportunities to provide independent monitoring of their actions
- Financial constraints resulting in the priority of today's needs over long-term environmental goals
- ***Absence of the comprehensive vision of future regional climate change and identity in transboundary projections***

NECESSITY IN THE STUDY OF REGIONAL CLIMATE

Moldova's temperature anomalies vs. global and planetary ones



	Global	N. Hemisphere
r	***0.405***	***0.457***
R^2, %	***16.4***	***20.1***

CLIMATE CHANGE SCENARIO DEVELOPMENT

- ***Country-scale projections*** **–** climate change information for a country on the whole
- ***River basin projections*** **–** likely changes in climate over a transboundary basin
- ***User-oriented projections*** **–** information satisfying the demands of particular water research.

NECESSITY IN THE UNIFICATION OF APPROACHES

Example 1. GCMs used for climate change downscaling in riparian countries

Ukraine		Moldova	
GCM	**Emissions**	**GCM**	**Emissions**
BCCR-BCM2.0	***SRES*** ***A1B*** ***A2*** ***B1***	CGCM2	***SRES*** ***A2*** ***B2***
NCAR-CCSM3		CSIRO Mk2	
CGCM3.1 (T47)		HadCM3	
CGCM3.1 (T63)		ECHAM4	
ECHAM5/MPI-OM		GFDL R-30	
GFDL-CM2.1		CCSR-NIES	
MIROC3.2 (hires)		CGCM2	
MIROC3.2 (medres)			
MRI-CGCM2.3.2			
UKMO-HadGEM1			
BCCR-BCM2.0			

Example 2. Ensemble averaged projections of annual mean temperature and precipitation change in comparison with baseline values

Moldova

Time slice	Temperature, ˚C		Precipitation, mm	
	A2	*B2*	*A2*	*B2*
Baseline period: 1961-1990				
2020s	1.7	2.0	-9	-17
2050s	3.4	3.2	-38	-11
2080s	5.4	4.1	-64	-23

Ukraine

Time slice	Temperature, ˚C		Precipitation,%	
	A2	*B1*	*A2*	*B1*
Baseline period: 2001- 2010				
2010s	0.2	0.3	3.7	2.0
2020s	0.4	0.7	1.2	0.8
2030s	0.7	0.9	0.5	0.0
2040s	1.2	1.1	1.6	-0.3
2050s	1.7	1.4	1.1	2.2
2060s	2.2	1.7	1.8	2.3
2070s	2.7	1.8	0.2	1.8
2080s	3.2	2.1	1.3	2.3
2090s	3.8	2.0	-2.9	1.8

Example 3. Projected relative change of Dniester flow

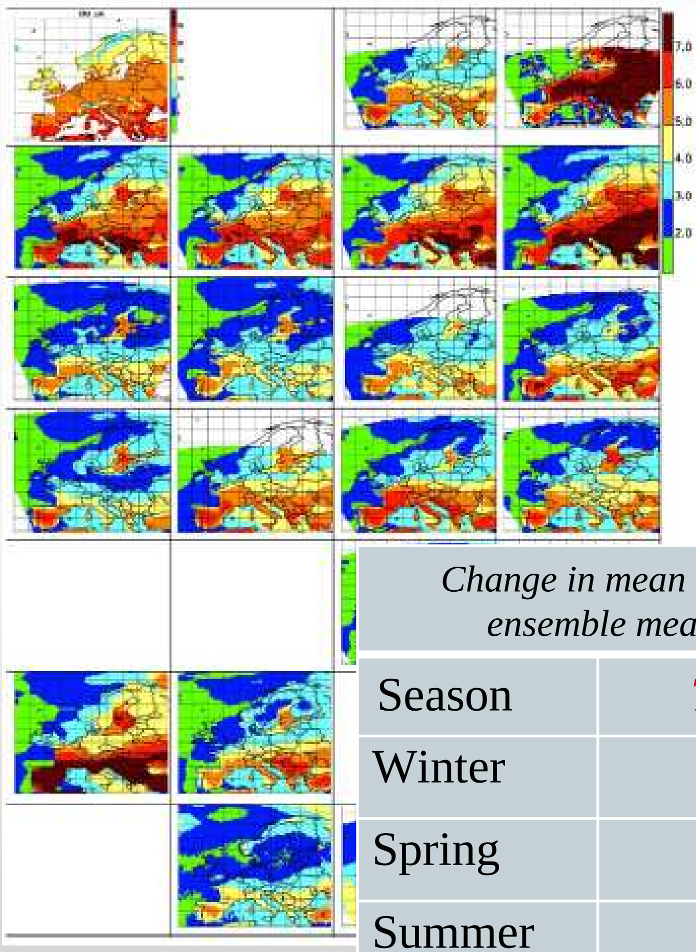
Moldova			Ukraine
Emission	***Time-slice***	***Change, %***	Total value of river stream flow will lessen by 5-7% in the North and 15-30% - in the South
SRES A2	2020s	-10	
	2050s	-22.8	
	2080s	-36.5	
SRES B2	2020s	-12.9	
	2050s	-18.4	
	2080s	-24.5	

POSSIBLE ALTERNATIVES

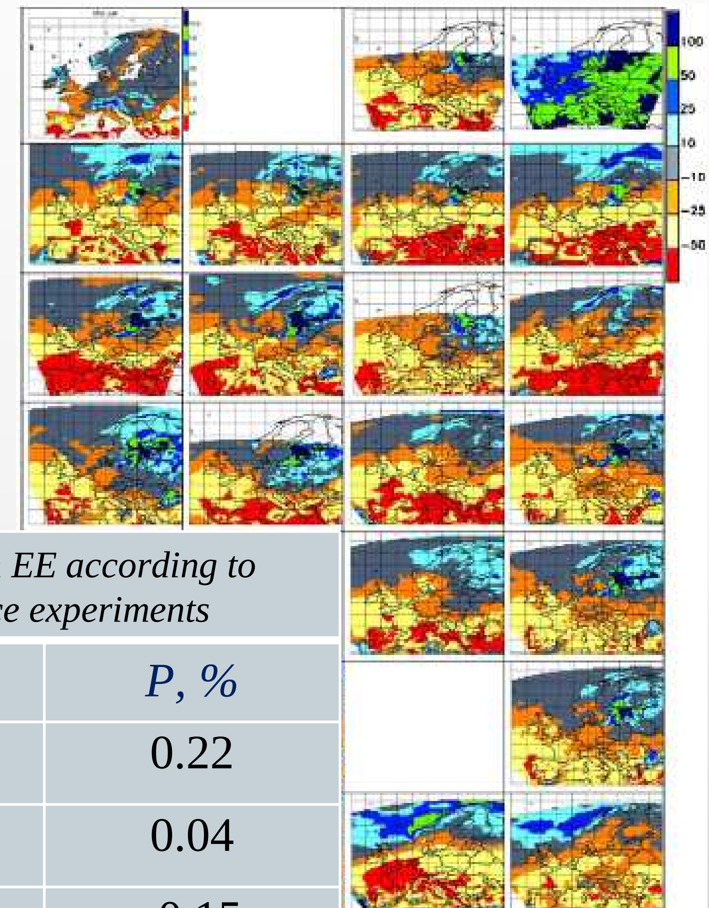
Preamble: today's science does not endorse the use of any single model or method for the national-scale assessment of climate change and encourages using the range of models and methods

- ***PRUDENCE*** *(**P**rediction of **R**egional scenarios and **U**ncertainties for **D**efining **E**uropean **C**limate change risks and **E**ffects)* project's model projections of changes in European climate by the end of this century (2071-2100) , based on nine regional and one global model with focus on the SRES A2 experiment.
- Generating high-resolution climate change scenarios using ***PRECIS*** software

Summer **temperature** and standard deviation change (ºC) according to different *Prudence* model experiments



Summer **precipitation** and standard deviation change (%) according to different *Prudence* model experiments



Change in mean T and P in EE according to ensemble mean Prudence experiments

Season	*T ,º C*	*P, %*
Winter	4.32	0.22
Spring	3.38	0.04
Summer	4.21	-0.15
Autumn	4.09	-0.09

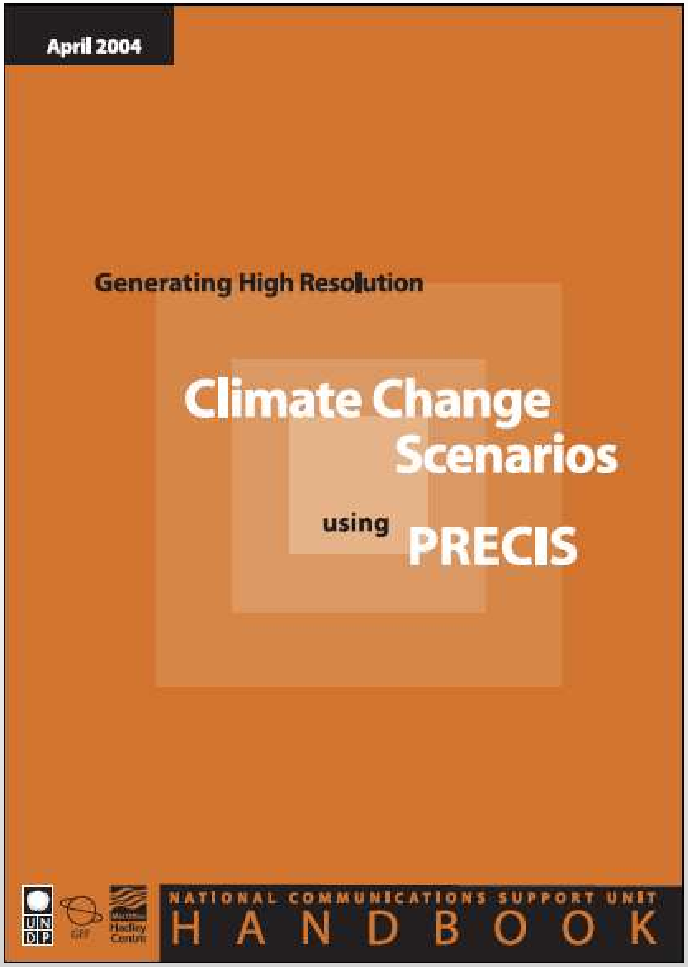
PRECIS: PROVIDING REGIONAL CLIMATES FOR IMPACTS STUDIES

PRESIS -- is a regional modeling system that can be run over ***any area*** on a relatively inexpensive, fast PC to provide climate information for impacts studies.

The system comprises:

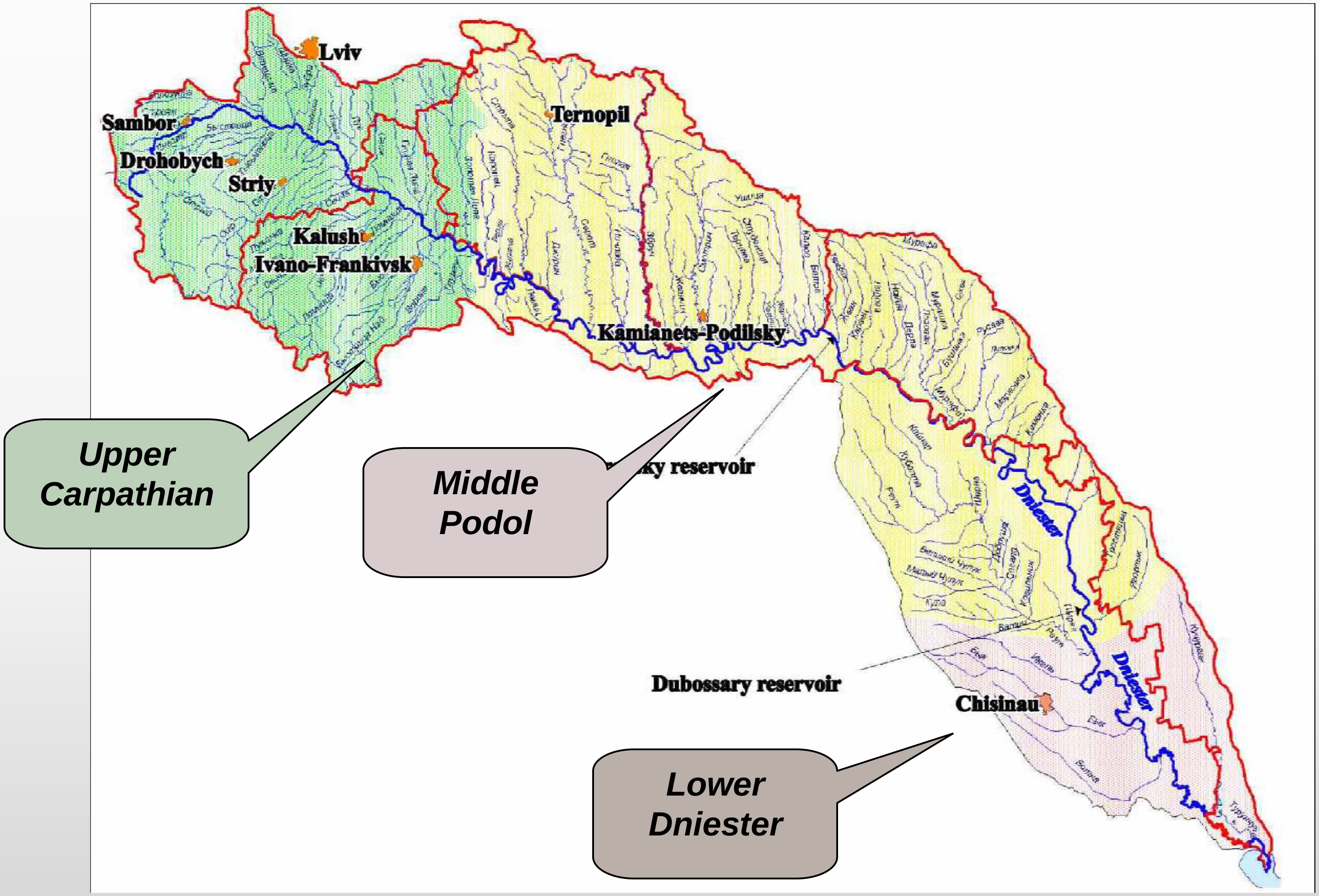
- A RCM to generate detailed climate change projections
- A simple user interface to allow the user to set up and run the RCM, and
- A visualization and data-processing package to allow display and manipulation of RCM output.

Advantage: Well-organized system of workshops



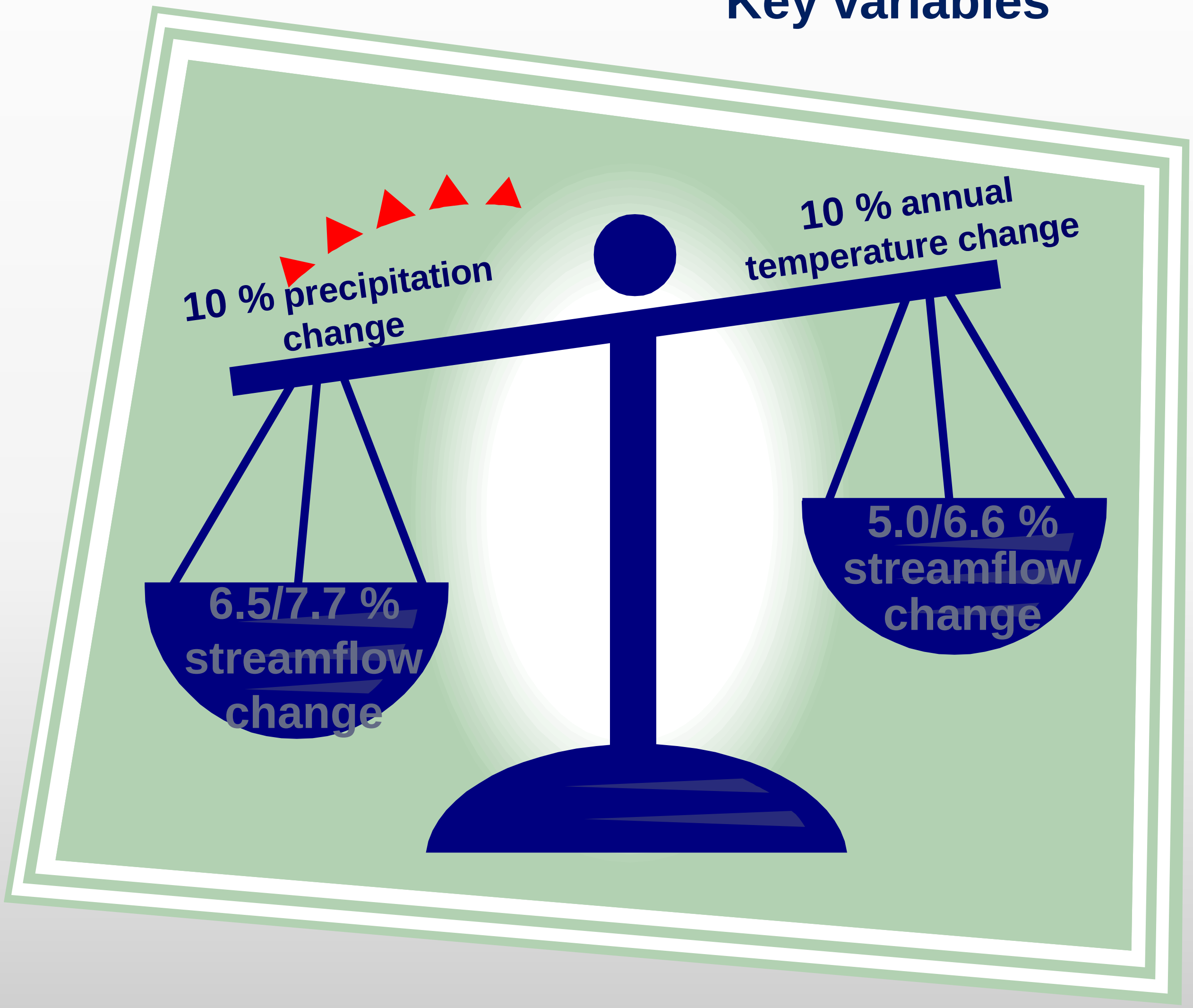

Some challenges and approaches in transboundary water impacts assessment

1. BASIN-BASED APPROACH



2. SELECTION OF CLIMATIC VARIABLES

Key variables



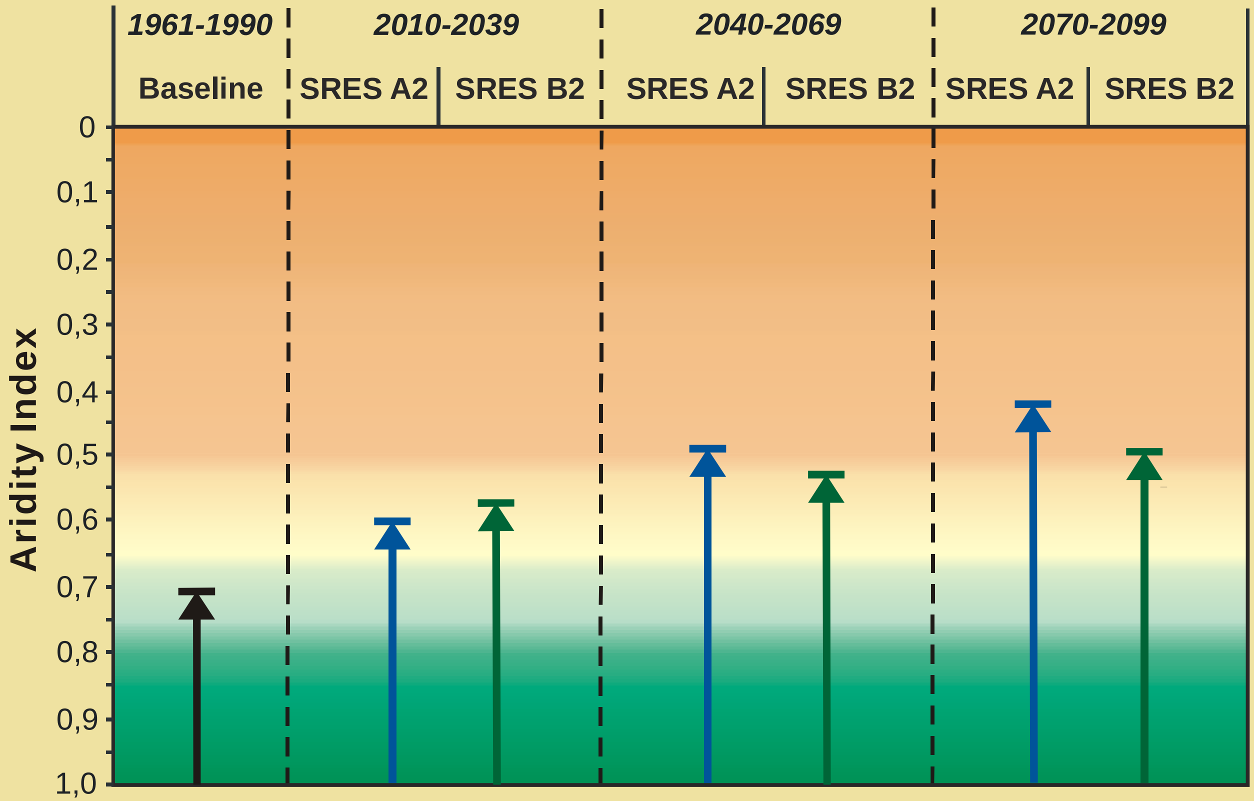
PROJECTIONS OF TEMPERATURE AND PRECIPITATION CHANGE FOR THE MIDDLE AND LOW DNIESTER BASIN AS TO BASELINE (1961-1990) CLIMATE

Season	*Time-slices and emission scenarios*					
	2010-2039		2040-2069		2070-2099	
	A2	B2	A2	B2	A2	B2
Mean temperature, ºC						
Winter	1,2	1,8	3,0	2,4	4,6	3,3
Spring	0,9	1,7	2,2	1,8	3,5	2,5
Summer	1,9	2,4	3,8	3,4	6,4	4,5
Autumn	1,4	1,7	2,8	2,7	4,5	3,3
Year	***1,3***	***1,9***	***2,9***	***2,5***	***4,7***	***3,4***
Precipitation, mm						
Winter	3,3	6,4	7,7	13,2	14,7	19,8
Spring	2,1	6,2	5,5	16,4	4,5	12,6
Summer	-20,8	-31,8	-41,5	-34,8	-61,1	-48,5
Autumn	-5,3	-7,4	-7,5	-4,0	-10,3	-0,5
Year	***-21,6***	***-27,5***	***-36,7***	***-10,1***	***-53,1***	***-17,4***

PROJECTIONS OF ABSOLUTE (ABS) AND RELATIVE (%) CHANGES IN HUMIDITY CONDITIONS

Parameter		Time horizon and emission scenario					
		2010-2039		2040-2069		2070-2099	
		A2	B2	A2	B2	A2	B2
Annual							
Potential evaporation	Abs, mm	126	158	258	238	420	307
	%	16.0	20.1	32.6	30.2	53.1	38.9
Aridity Index	Abs, mm	-0.11	-0.14	-0.22	-0.18	-0.30	-0.22
	%	-15.8	-19.9	-30.3	-25.3	-42.7	-31.5
Vegetation period							
Potential evaporation	Abs, mm	105	135	221	205	366	266
	%	15.3	19.7	32.2	29.9	53.3	38.8
Aridity Index	Abs, mm	-0.10	-0.12	-0.19	-0.16	-0.27	-0.20
	%	-17.4	-22.0	-33.8	-28.9	-48.2	-37.1

POSSIBLE CHANGE OF MOLDOVA TERRITORY ARIDITY IN NEW CLIMATIC CONDITIONS

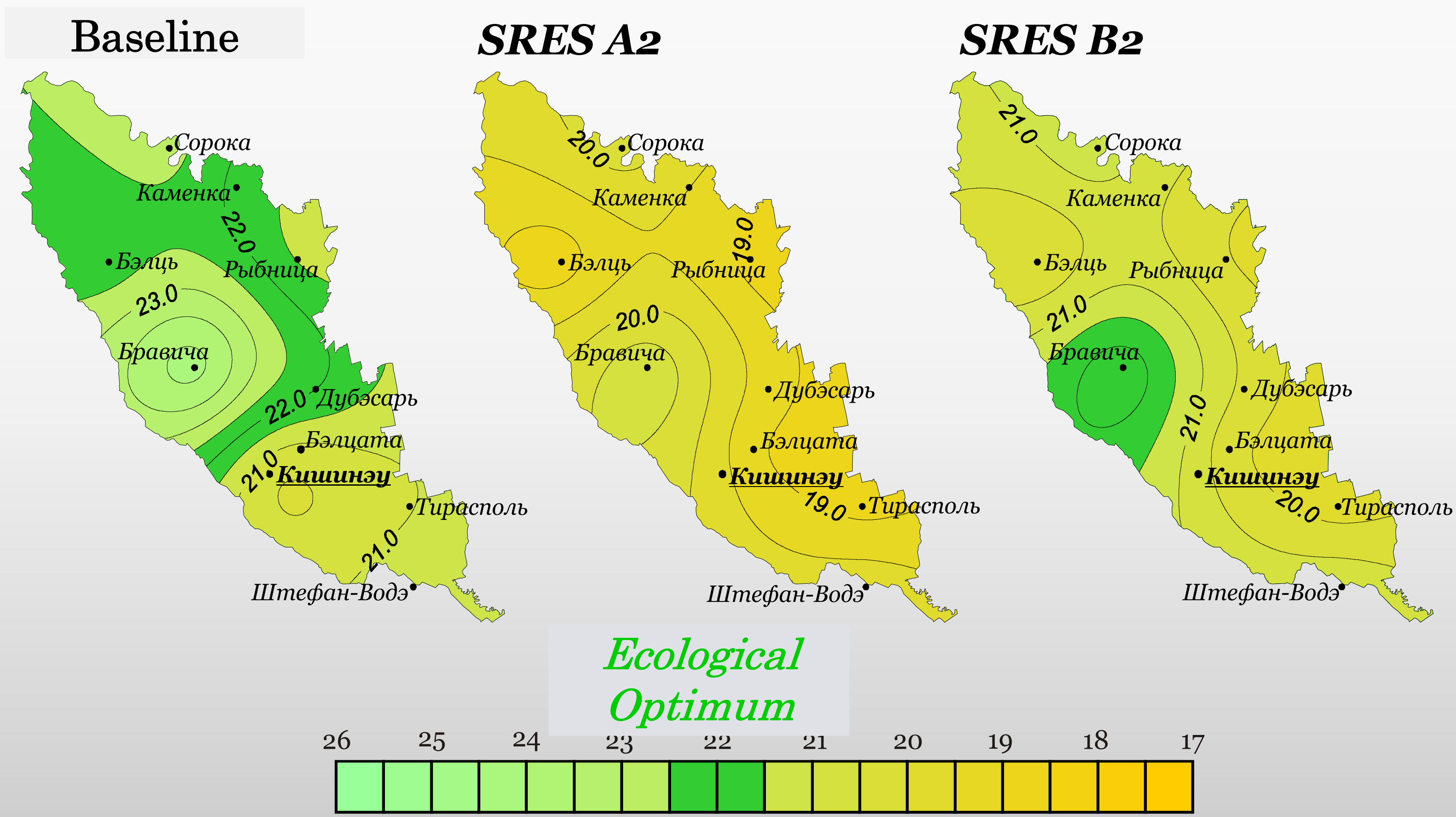


Aridity Zones:

< 0,03 - *Hyperarid zone*
0,03-0,20 - *Arid zone*
0,20-0,50 - *Semiarid zone*
0,50-0,65 - *Dry subhumid zone*
0,65-0,75 - *Wet subhumid zone*
0,75-1,00 - *Insufficiently wet zone*

BASELINE AND LIKELY IN THE 2050S SPATIAL DISTRIBUTION OF THE *INDEX OF CLIMATE BIOLOGICAL EFFICIENCY (ICBE)* IN THE MIDDLE AND LOW DNIESTER BASIN

$$ICBE = (0.01\sum T_{>10})^{*} AI$$



STATISTICAL MODELING OF WATER REGIME

- General streamflow
- Annual dynamics
- Underground water
- Surface water quality
- Water resources

MODELS OF RIVER ANNUAL STREAMFLOW

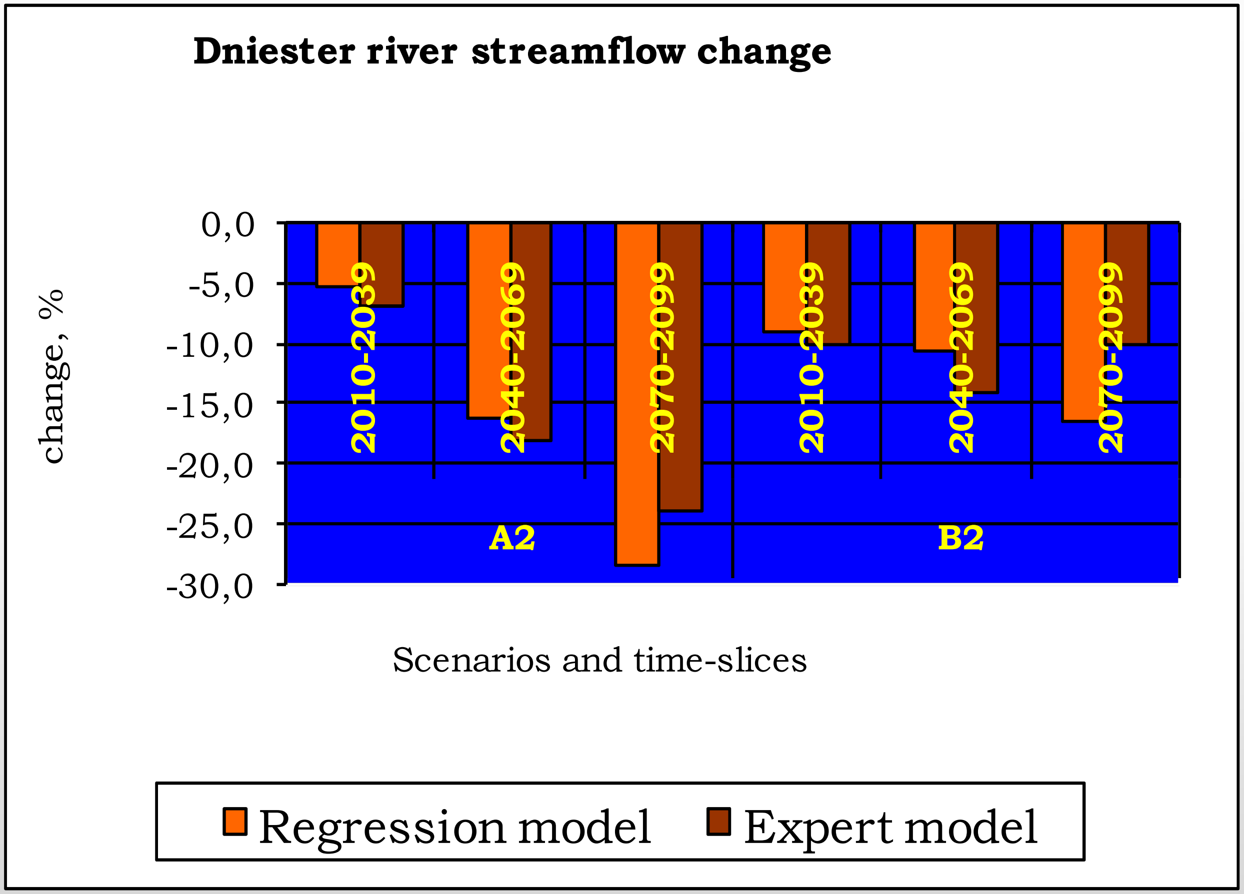
1. Expert model:

$$\overline{Y}_{np} = \left(\overline{X} \pm \Delta \overline{X}\right) - \overline{E}_m \left(1 + \frac{\varepsilon \Delta \overline{t}}{100}\right) \left\{ 1 + \left[\frac{\overline{E}_m \left(1 + \frac{\varepsilon \Delta \overline{t}}{100}\right)}{\overline{X} \pm \Delta \overline{X}} \right]^n \right\}^{-1/n}$$

2. Statistical model:

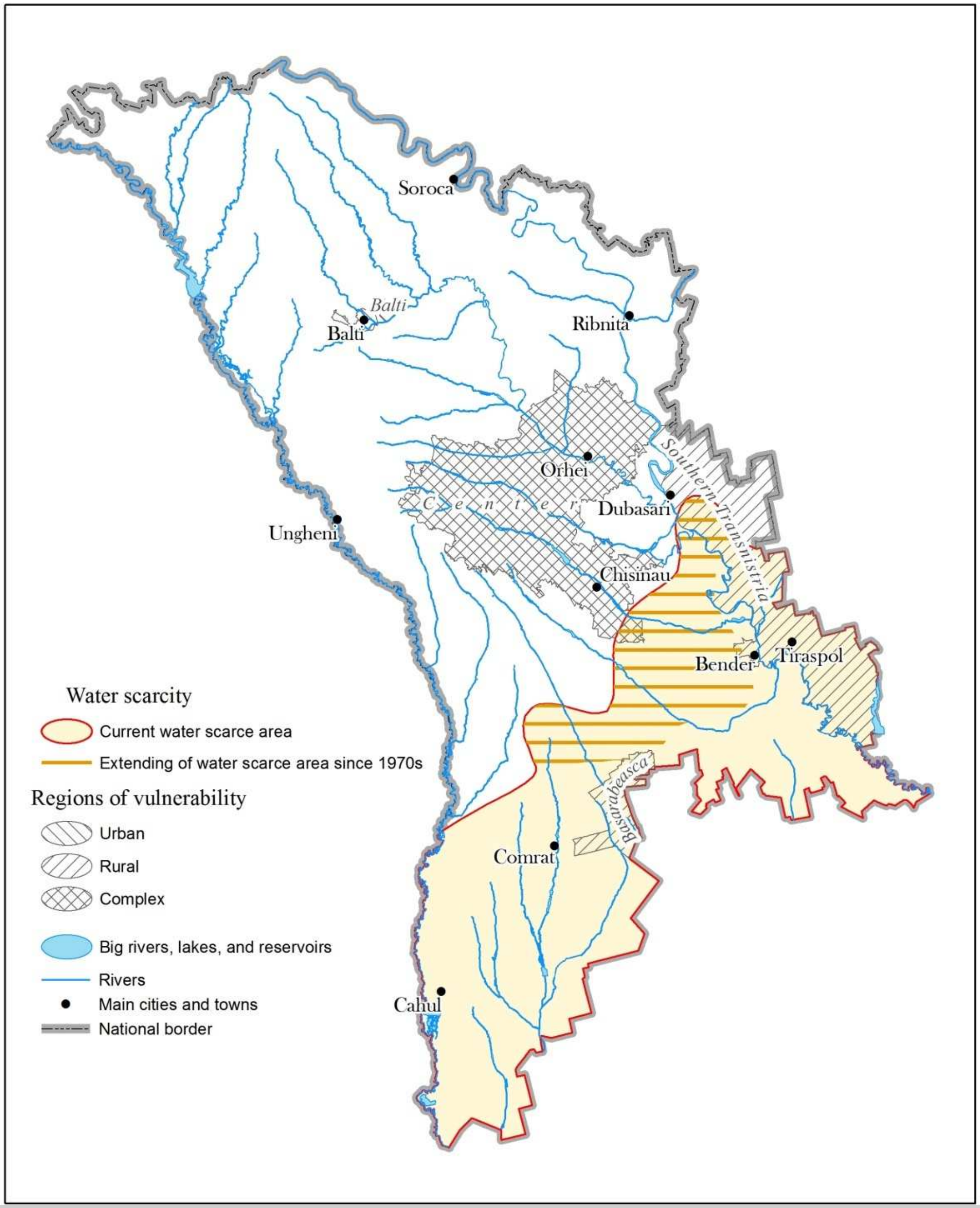
$$Y = 277.6 - 17.1\, T_{^\circ C} + 0.36\, P_{mm};\ r = 0.517$$

LIKELY CHANGES OF DNIESTER STREAMFLOW ACCORDING TWO APPROACHES



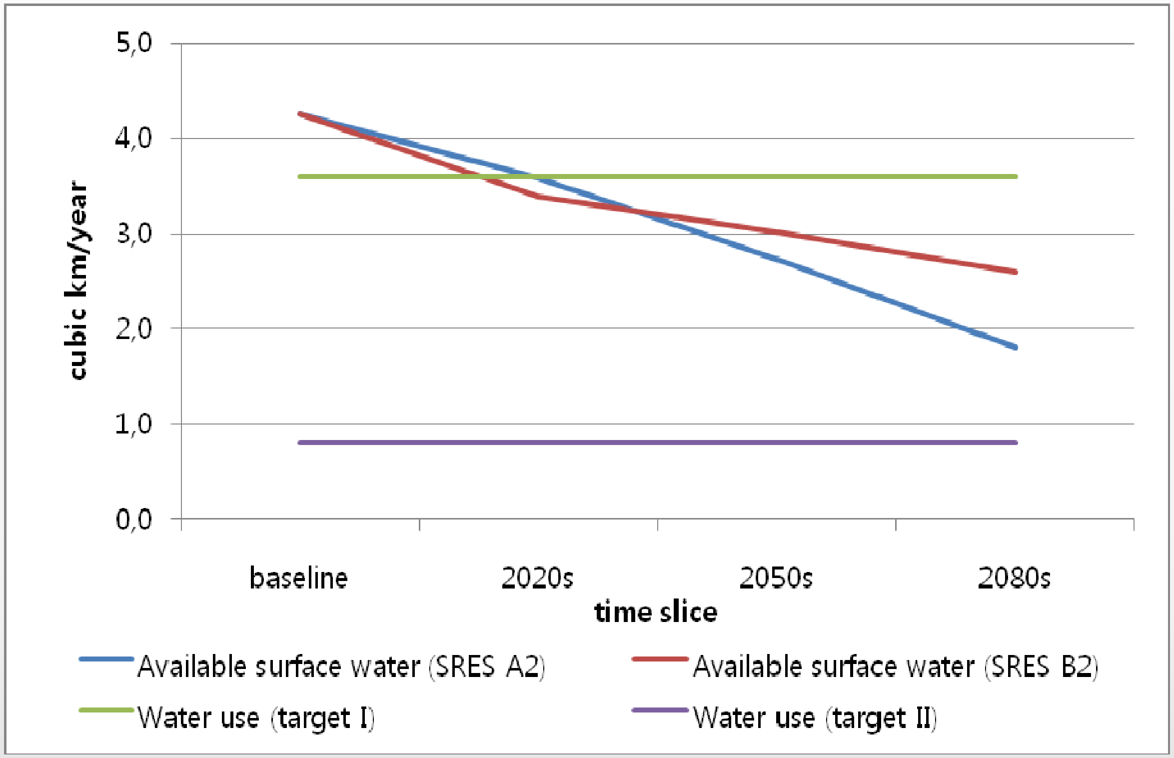
PROJECTED RELATIVE CHANGE OF AVAILABLE SURFACE WATER RECOURSES IN DNIESTER CATCHMENT

Scenario	***Time-slice***	***%-change***
SRES A2	2020s	-15.9
	2050s	-36.0
	2080s	-57.7
SRES B2	2020s	-20.3
	2050s	-29.2
	2080s	-38.9



POTENTIAL VULNERABILITY OF MOLDOVA TERRITORY TO WATER SCARCITY

AVAILABILITY OF WATER RESOURCES ACCORDING TWO TARGETS OF MOLDOVA ECONOMIC DEVELOPMENT



Target 1 - *water-intensive* – the 1990s' state of national economy *(max water use)*

Target 2 - *water-independent* – the average state of national economy in the 2000s *(stagnation in water use).*

Source: Moldova's 2009 Human Development Report

Toward a transboundary adaptation strategy:

the on-going and planned projects as a benchmark

I. OSCE/UNECE PROJECT: ***TRANSBOUNDARY CO-OPERATION AND SUSTAINABLE MANAGEMENT OF THE DNIESTER RIVER***

(PHASE 1 – 2005; PHASE 2 – 2007-10; PHASE 3 – FROM 2009)

II. WORLD BANK PROJECT: ***NATIONAL WATER SUPPLY AND SANITATION PROGRAM FOR MOLDOVA***

(13.05.08 -- 30.05.13)

III. WORLD BANK PROJECT *(ECSSD)*: ***DISASTER RISK MITIGATION AND ADAPTATION PROJECT IN MOLDOVA***

(CONCEPT STAGE)

THE PROJECTS’ ACTIVITY SOME OUTPUTS:

“Diagnostic study for the Dniester River Basin as an example”

WATER ABSTRACTION IN THE DNIESTER RIVER' BASIN IN 2002

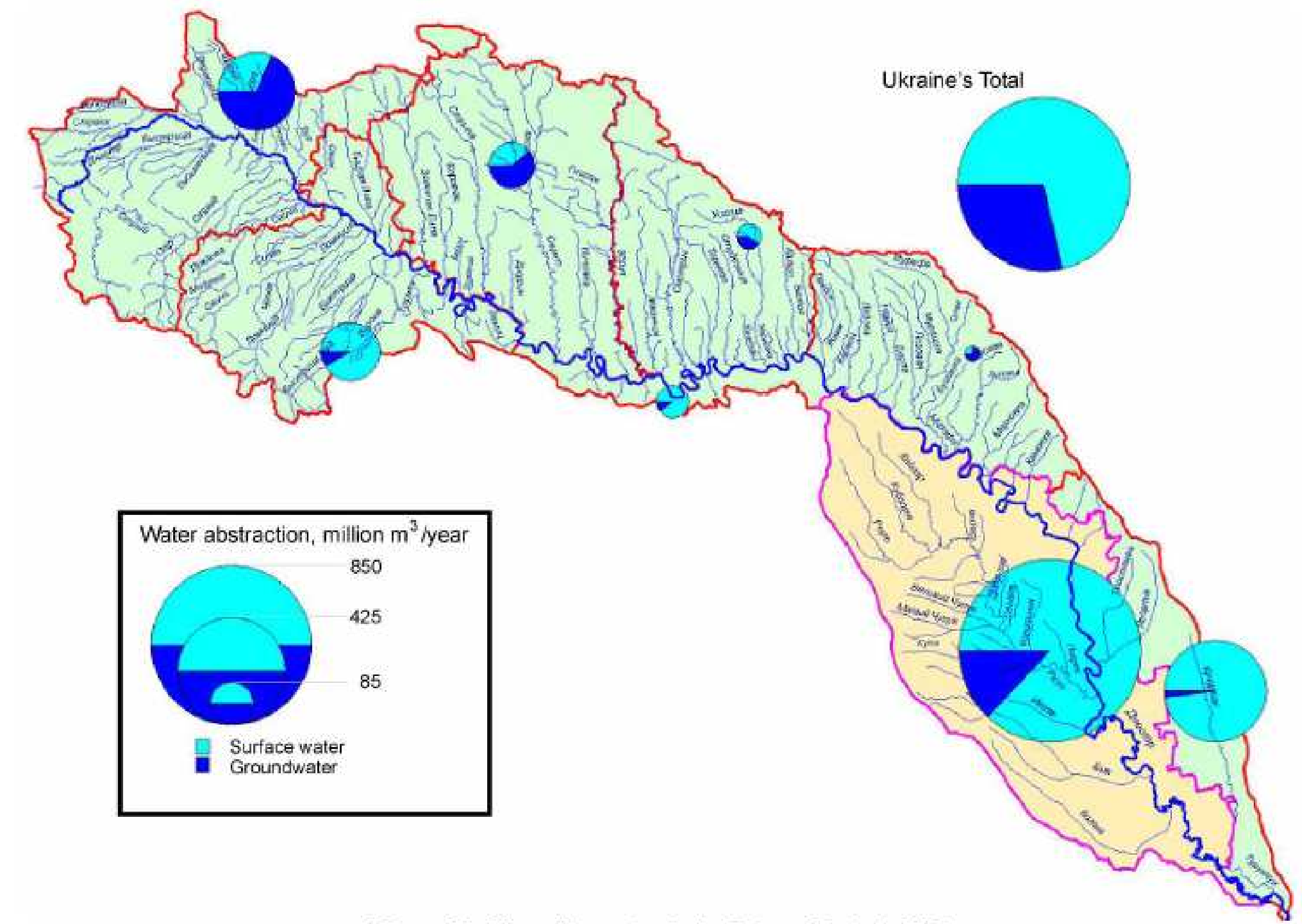


Figure 3.1. Water Abstraction in the Dniester Basin in 2002

WASTEWATER DISCHARGE IN IN THE DNIESTER BASIN IN 2002

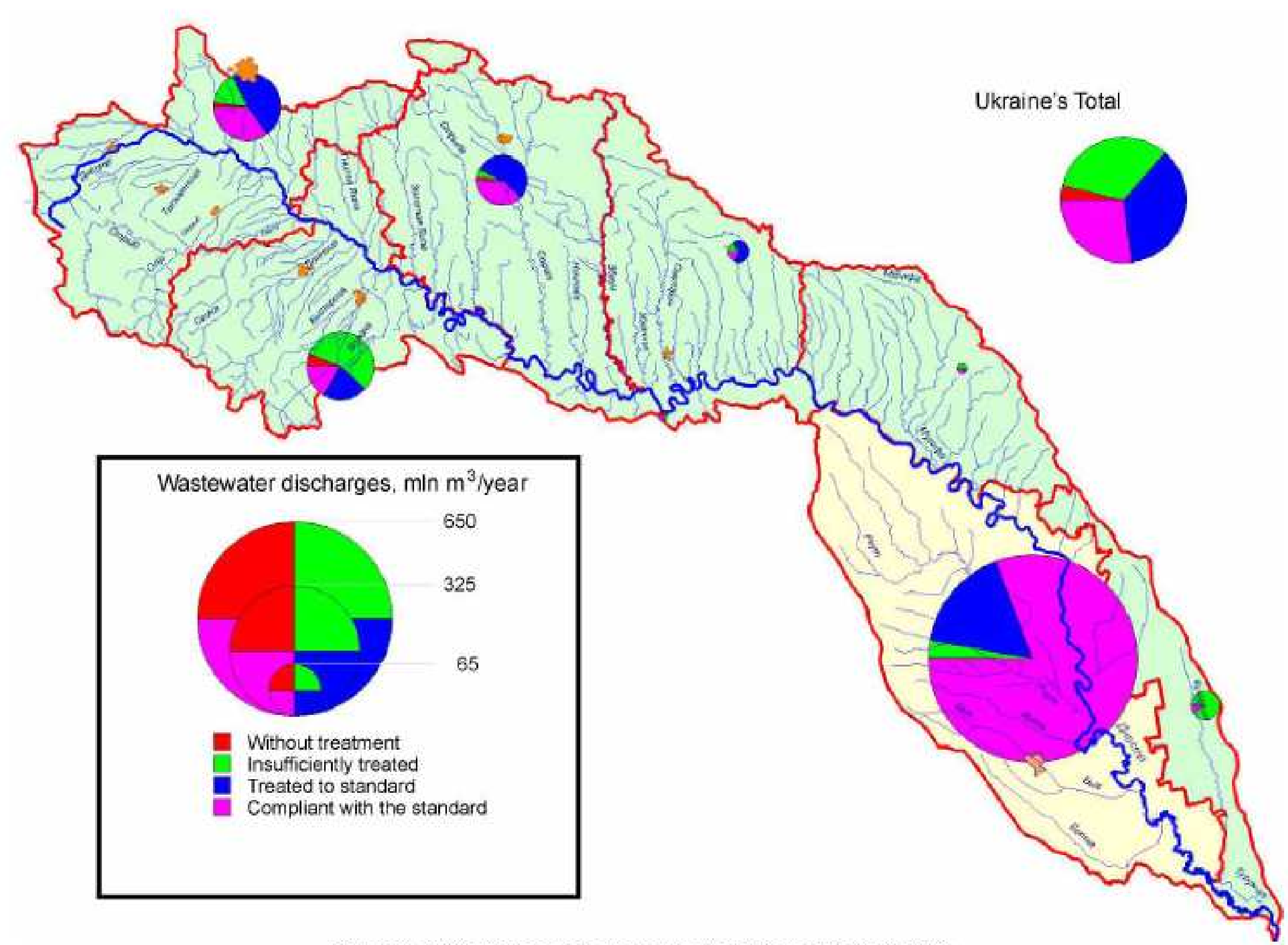
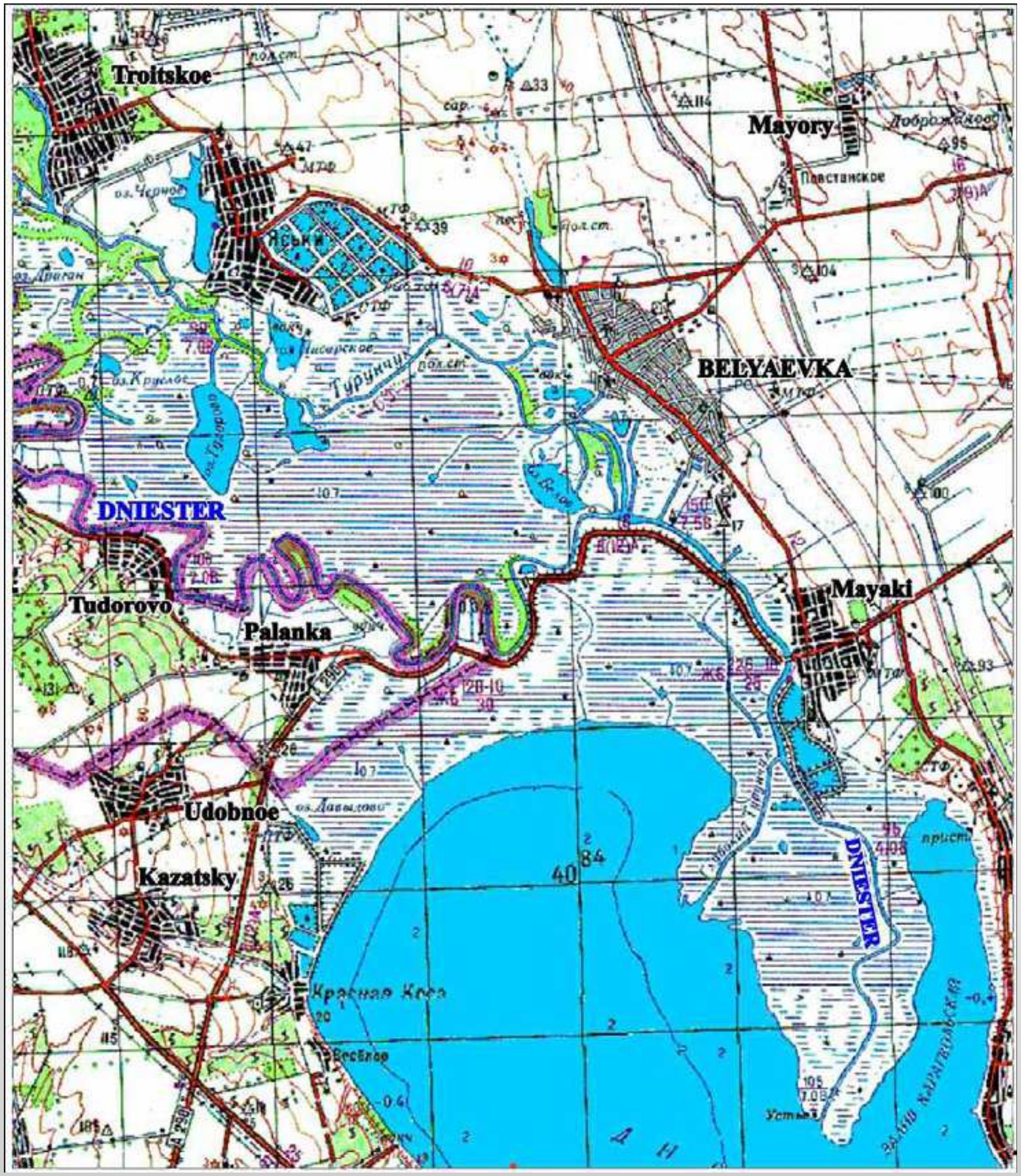
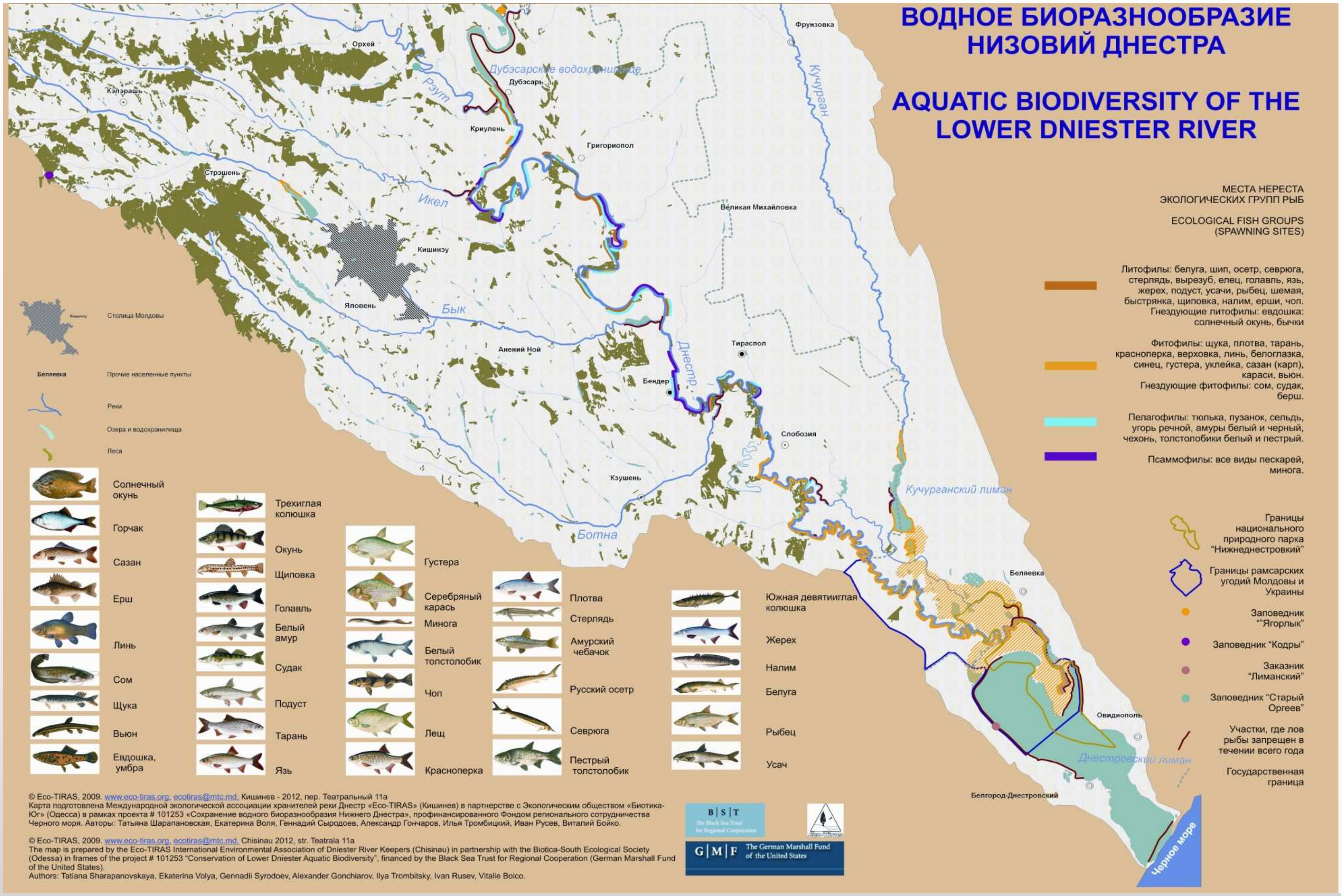


Figure 3.6. Wastewater Discharges in the Dniester Basin in 2002



DNIESTER WETLAND



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Карта подготовлена Международной экологической ассоциации хранителей реки Днестр «Eco-TIRAS» (Кишинев) в партнерстве с Экологическим обществом «Биотика-Юг» (Одесса) в рамках проекта # 101253 «Сохранение водного биоразнообразия Нижнего Днестра», профинансированного Фондом регионального сотрудничества Черного моря. Авторы: Татьяна Шарапановская, Екатерина Воля, Геннадий Сыродоев, Александр Гончаров, Илья Тромбицкий, Иван Русев, Виталий Бойко.

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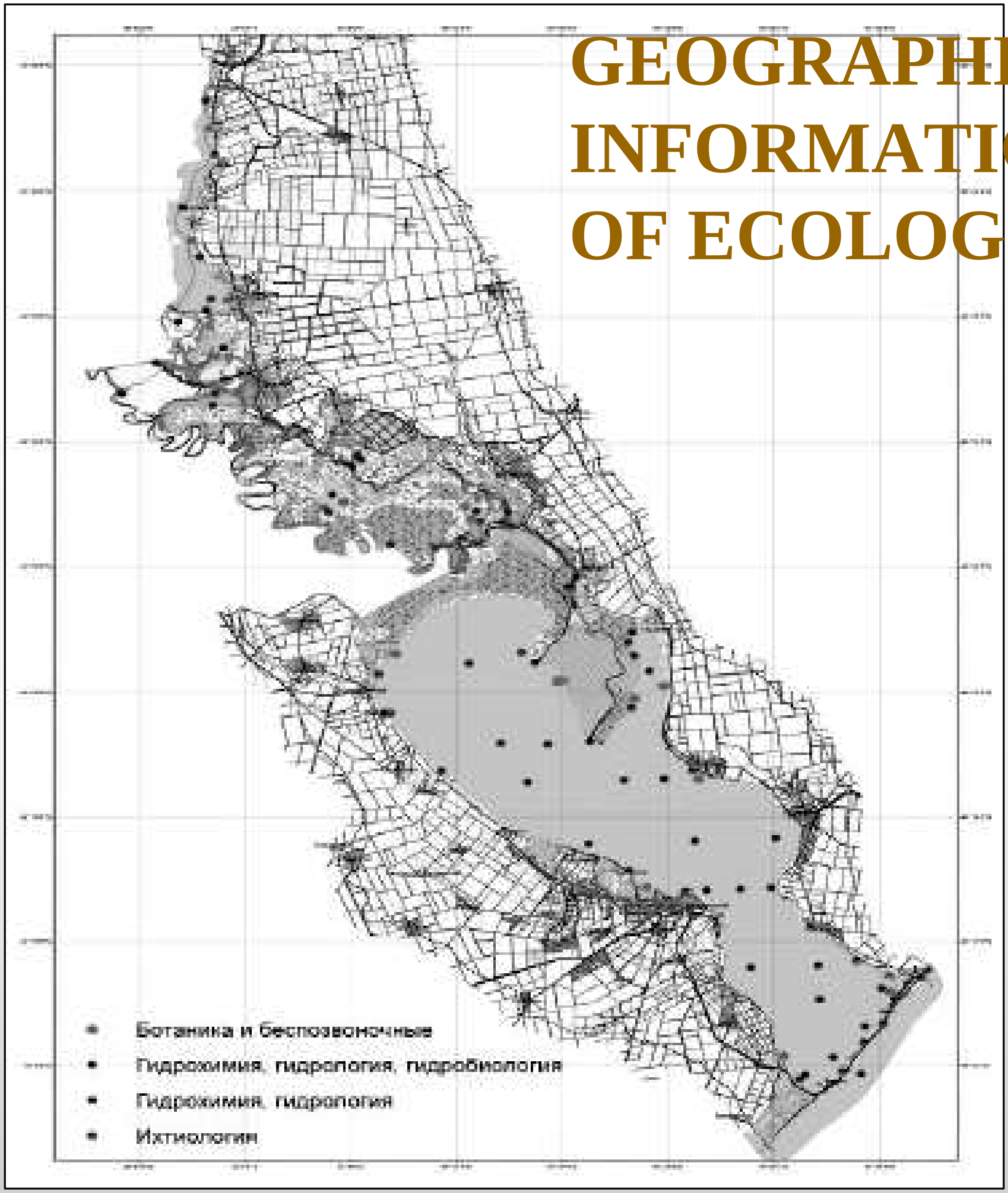
The map is prepared by the Eco-TIRAS International Environmental Association of Dniester River Keepers (Chisinau) in partnership with the Biotica-South Ecological Society (Odessa) in frames of the project # 101253 "Conservation of Lower Dniester Aquatic Biodiversity", financed by the Black Sea Trust for Regional Cooperation (German Marshall Fund of the United States).
Authors: Tatiana Sharapanovskaya, Ekaterina Volya, Gennadii Syrodoev, Alexander Gonchiarov, Ilya Trombitsky, Ivan Rusev, Vitalie Boico.

LOW-DNIESTER' GEOGRAPHICAL INFORMATION SYSTEM (GIS) OF ECOLOGICAL DATA



Monitoring stations of the TASIS project in 2006-2007

Source: Gazetov & Medinets, I. Mechnikov Odessa National University

SOME LATEST USEFUL NATIONAL DOCUMENTS

National communications to UNFCCC:

Moldova – the Second (2010)

Ukraine - the Third –Five (2009)

Moldova's Human Development Report 2009/2010:

Climate Change in Moldova. Socio-Economic Impacts and Policy Options for Adaptation