



# REGIONAL CLIMATE CHANGE IMPACTS STUDY FOR THE SOUTH CAUCASUS



## ASSESSMENT OF CLIMATE CHANGE IMPACTS ON WATER RESOURCES OF KHRAMI-DEBED AND AGHSTEV TRANSBOUNDARY RIVER BASINS

*Prepared for:*

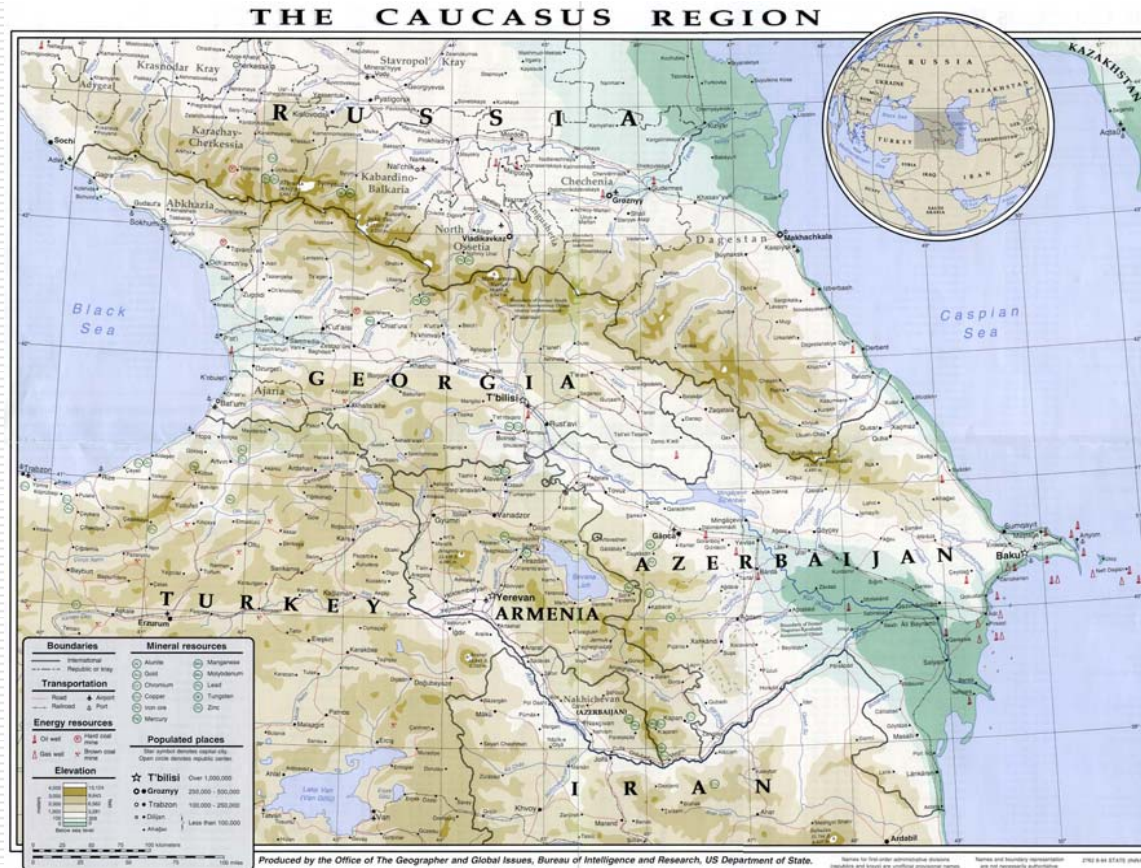
UNECE Second Workshop on  
Water and Adaptation to Climate  
Change in Transboundary Basins

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Palais des Nations  
Geneva, Switzerland



# OUTLINE

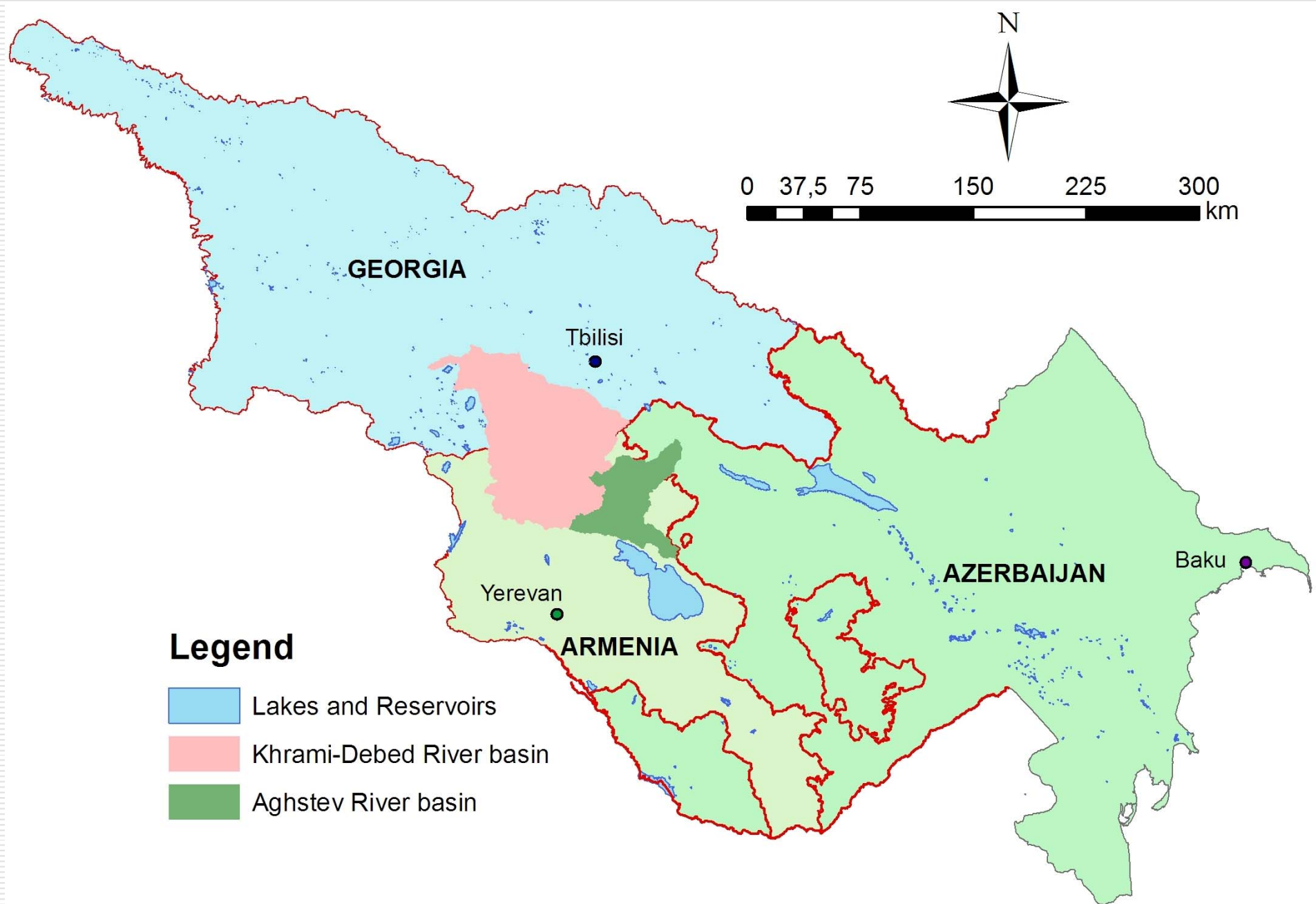
- Scope
- Methodology
- River flow projections
- Water quality projections
- Achievements
- Policy Recommendations
- Adaptation Measures
- Difficulties Encountered
- Lessons Learnt



# SCOPE

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- UNDP/ENVSEC "Regional Climate Change Impacts Study for the South Caucasus Region"
    - improve understanding of South Caucasus countries on regional climate change impact
    - enhance cooperation among them to address common climate change concerns
  
  - Undertake technical discussions which will help to decrease uncertainties with predicting potential climate change risks
  
  - Adjusting climate change scenarios taking into account a regional perspective
  
  - Concerted adaptation responses on cross-border geographic areas – water
    - Khrami-Debed basin between Armenia and Georgia
    - Aghstev basin between Armenia and Azerbaijan
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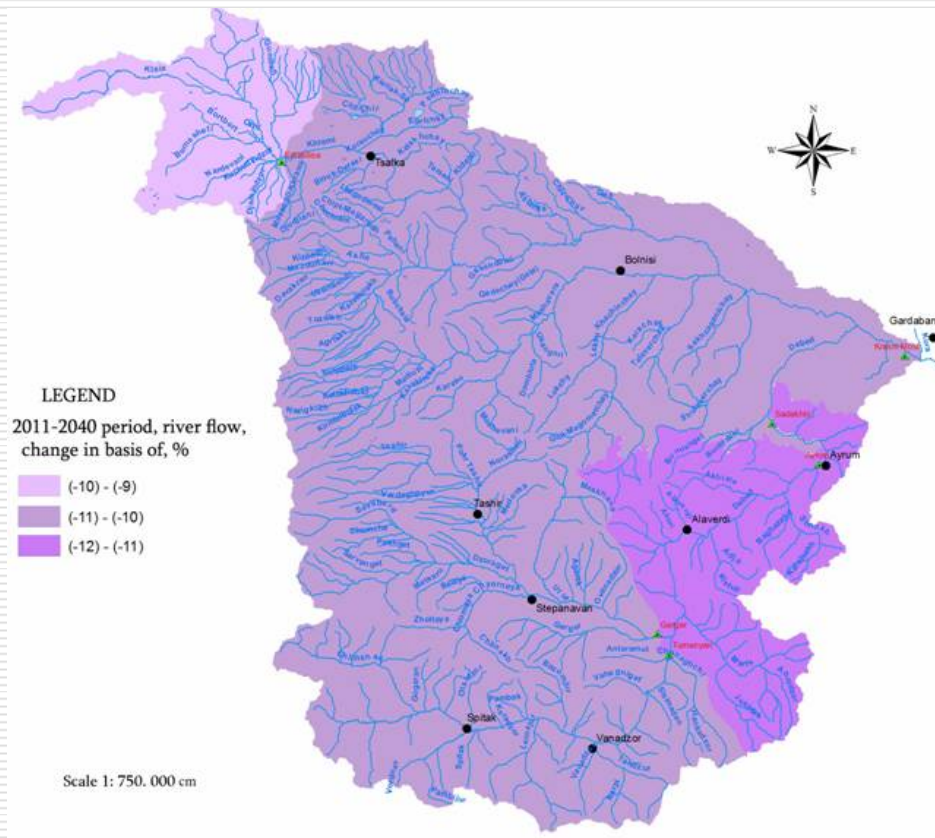
# METHODOLOGY

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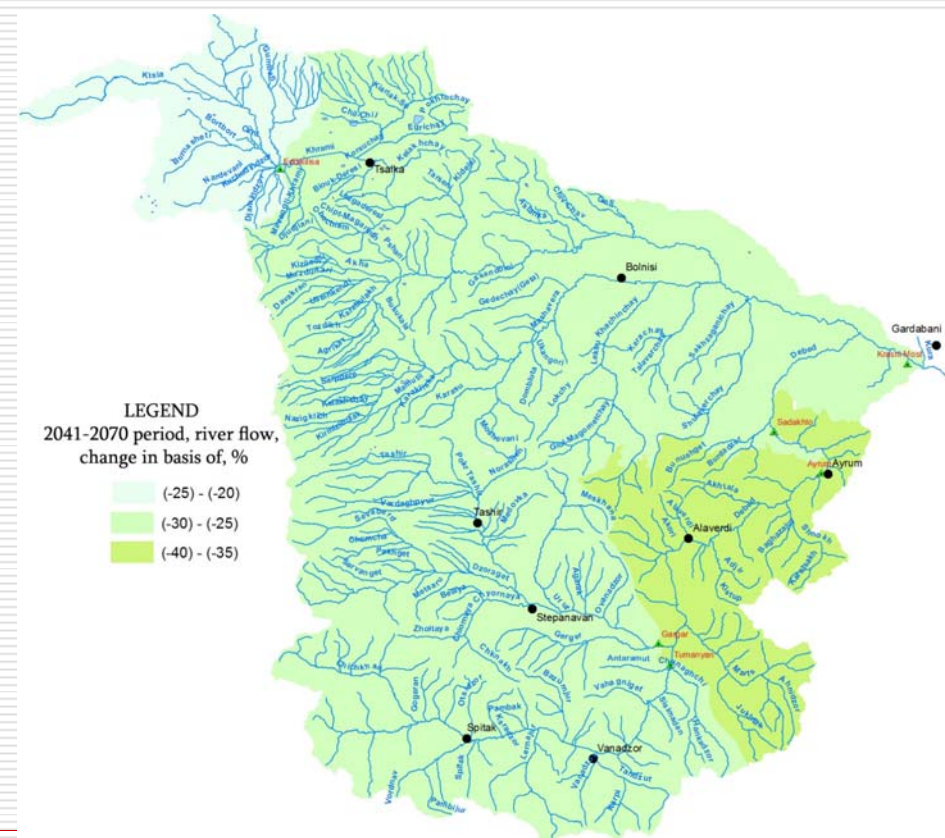
- Development and use of shared database on air temperature, atmospheric precipitation and river flow
  - ArcGIS 9.3 & Physical-statistical or regression model  
$$W = K_1X + K_2T + B$$
  - Linking annual changes in air temperature and atmospheric precipitation with the river flow
  - The periods 2011-2040; 2041-2070; 2071-2100 were compared to 1961-1990 baseline
  - Selected global circulation models:  
*ECHAM5, GFDL, GISS ER and Had\_CM3*
  - First attempt to forecast changes in water quality due to reduction of water quantity
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# RIVER FLOW PROJECTIONS

## *Khrami-Debed transboundary basin (Armenia & Georgia)*



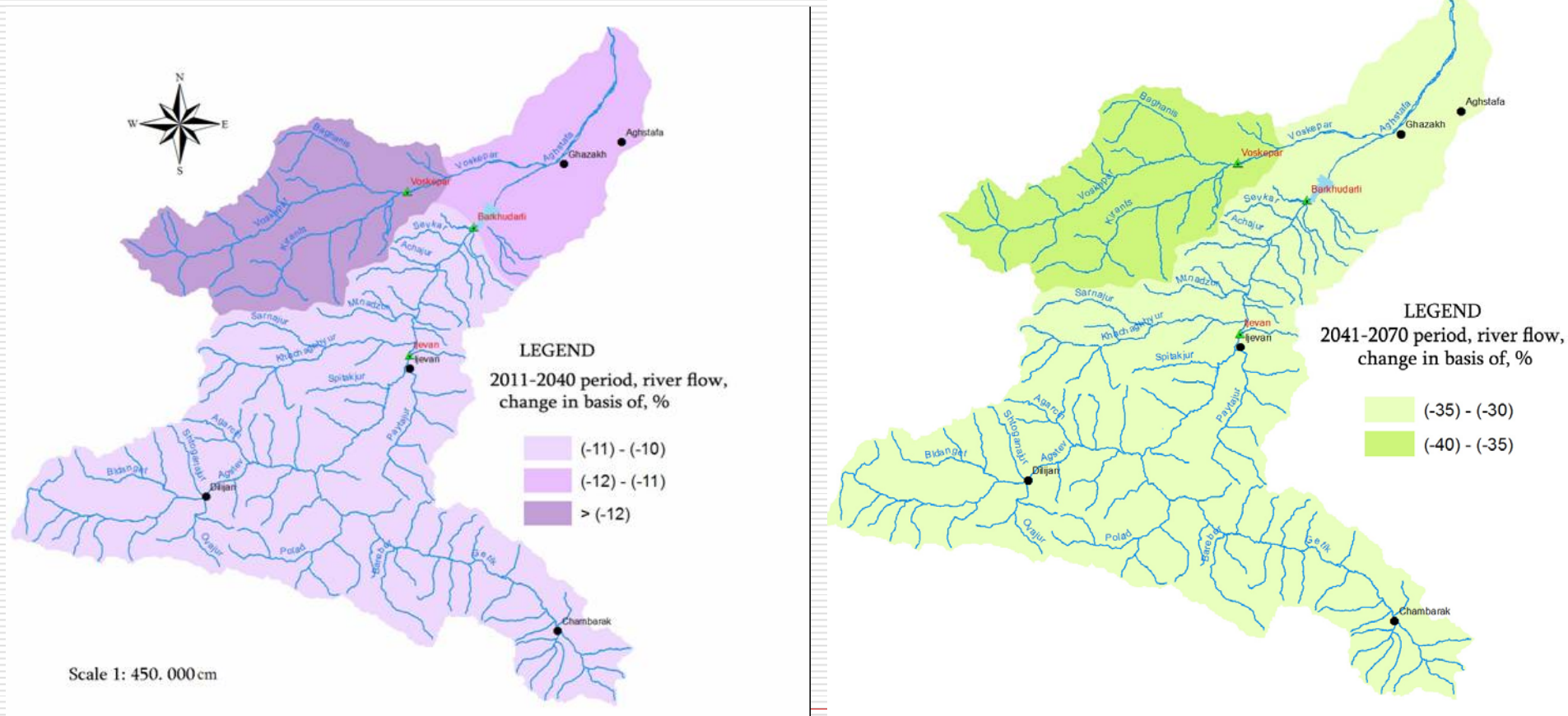
**9-12% reduction in 2011-2040 compared to 1961-1990 baseline**



**25-29% reduction in 2041-2070 compared to 1961-1990 baseline**

# RIVER FLOW PROJECTIONS

## *Aghstev transboundary basin (Armenia & Azerbaijan)*



**11-14% reduction in 2011-2040 compared to 1961-1990 baseline**

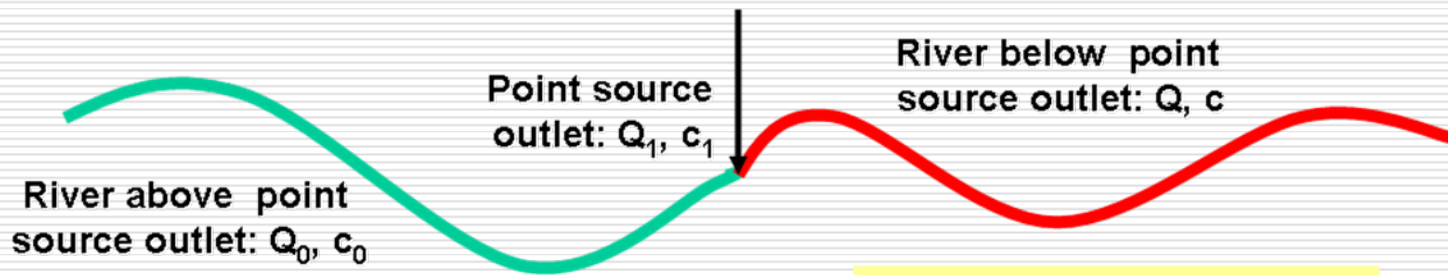
**31-37% reduction in 2041-2070 compared to 1961-1990 baseline**

# WATER QUALITY PROJECTIONS

Effluent



Impact



$$Q = Q_0 + Q_1$$

$$c = \frac{Q_0 c_0 + Q_1 c_1}{Q}$$

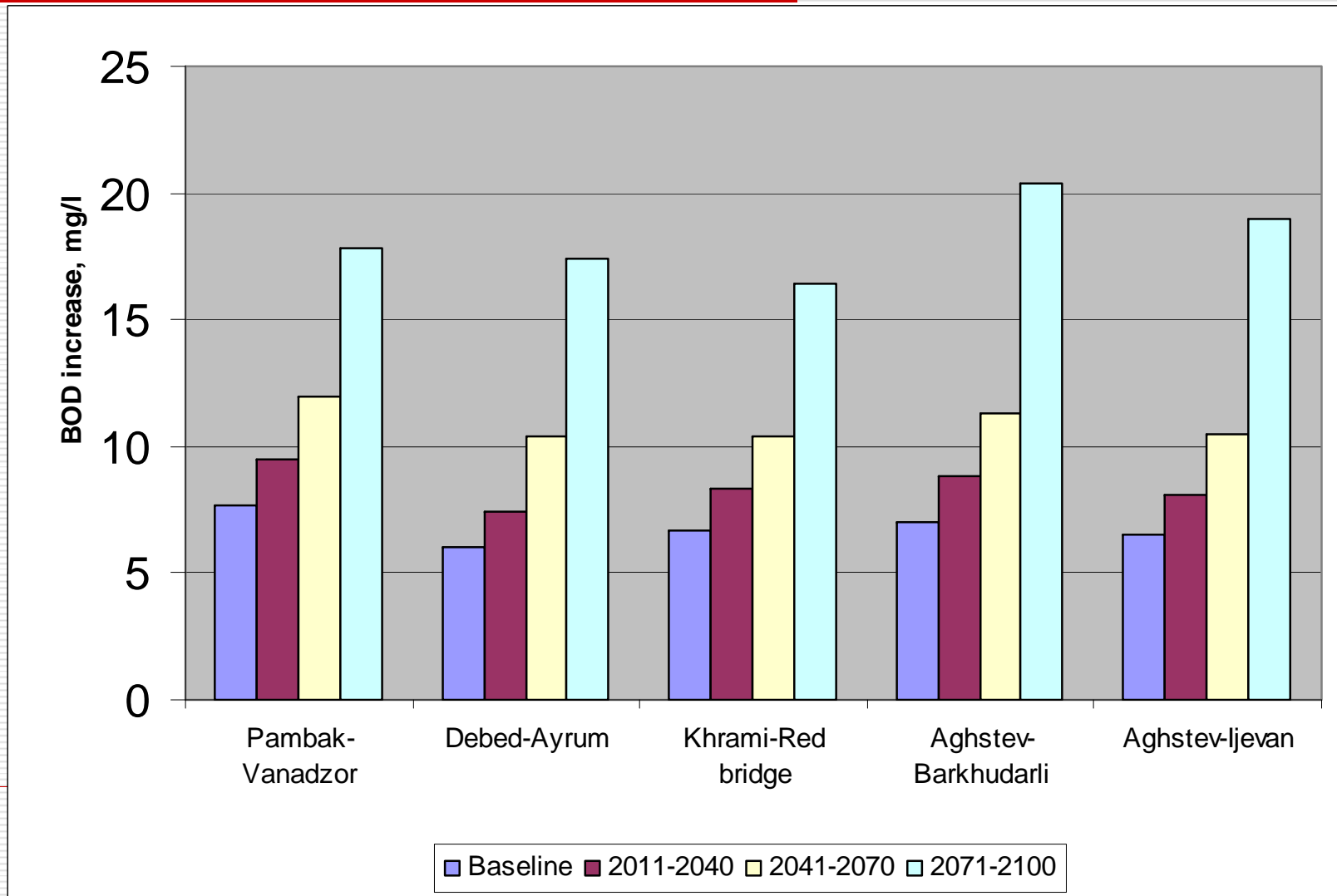
$$Q_1 c_1 = \text{amount (A)}$$

$$\text{Concentration increase: } \Delta c = A/Q$$

$$\text{Simplified concentration increase: } \Delta c = A/Q_0$$



# WATER QUALITY PROJECTIONS



# ACHIEVEMENTS

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- Identification of the most appropriate scenarios for the South Caucasus region
  - For the first time in the region:
    - Cooperation between the sectoral specialists and Hydromets to develop common climate change scenario for the region;
    - Sharing of hydro-meteorological data and expertise;
    - Assessment of forecasted changes in water quality;
    - Joint assessment in a transboundary basin between Armenia and Azerbaijan;
  - Quantitative figures on river flow reduction which resulted in policy makers mainstreaming climate change into Northern (Aghstev and Debed) River basin management plan (Protocol of Government of Armenia Session No 4 of February 3, 2011)
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# POLICY RECOMEDNATIONS

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- “No-regrets” adaptation measures
    - measures that will improve economic and social outcomes regardless of climate change
  - “Low-regrets” measures
    - benefits of avoiding climate damages outweigh the costs of new infrastructure or other responses
  
  - In the context of climate change, there should be no regret about funds spent to avoid what would have been costly future damage
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# ADAPTAION MEASURES

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<b>Measure</b>	<b>Application</b>
Support essential research needs with state funding	Assess groundwater reserves and the impact of climate change on them
Improve existing water infrastructure	Additional water diversion between rivers, the replacement of much of the existing infrastructure
Promote water efficiency in households, farms and other businesses	Using monetary incentives, public education, regulations on new building designs
Prepare farms for a changing climate	Agricultural extension services, choose new crops, install irrigation equipment, or adopt a more efficient use of water
Prepare for natural disasters	Through prevention and emergency response readiness

# DIFFICULTIES ENCOUNTERED

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- ❑ Availability of data,
  - ❑ Incomplete hydrological observations,
  - ❑ Gaps in the water quality time-series data,
  - ❑ Absence of groundwater data,
  - ❑ Outdated methods of data collection processing and analysis,
  - ❑ Uncertainties in dealing with climate change adaptation planning, so in some cases trend is important and not the magnitude
  - ❑ Risk of not implementing the proposed recommendations & adaptation measures due to insufficient political will, as well as financial and institutional shortcomings
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# LESSONS LEARNT

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- ❑ The ability to adapt will depend upon provision of sufficient importance given to "climate proofing of development programs",
  - ❑ Proper adaptation will be contingent upon how quickly the policies are implemented,
  - ❑ Priority must be given to "no regret" measures, and then, potentially, to "low regret measures",
  - ❑ Proposed communication of the results of assessment to primary stakeholders (governments, local self-governance authorities, private sectors, farmers, businesses, insurance companies, banks and others) is critical,
  - ❑ Cooperation on regional level is key for success in assessing the climate change impact on transboundary river basins and reducing transboundary climate risks
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