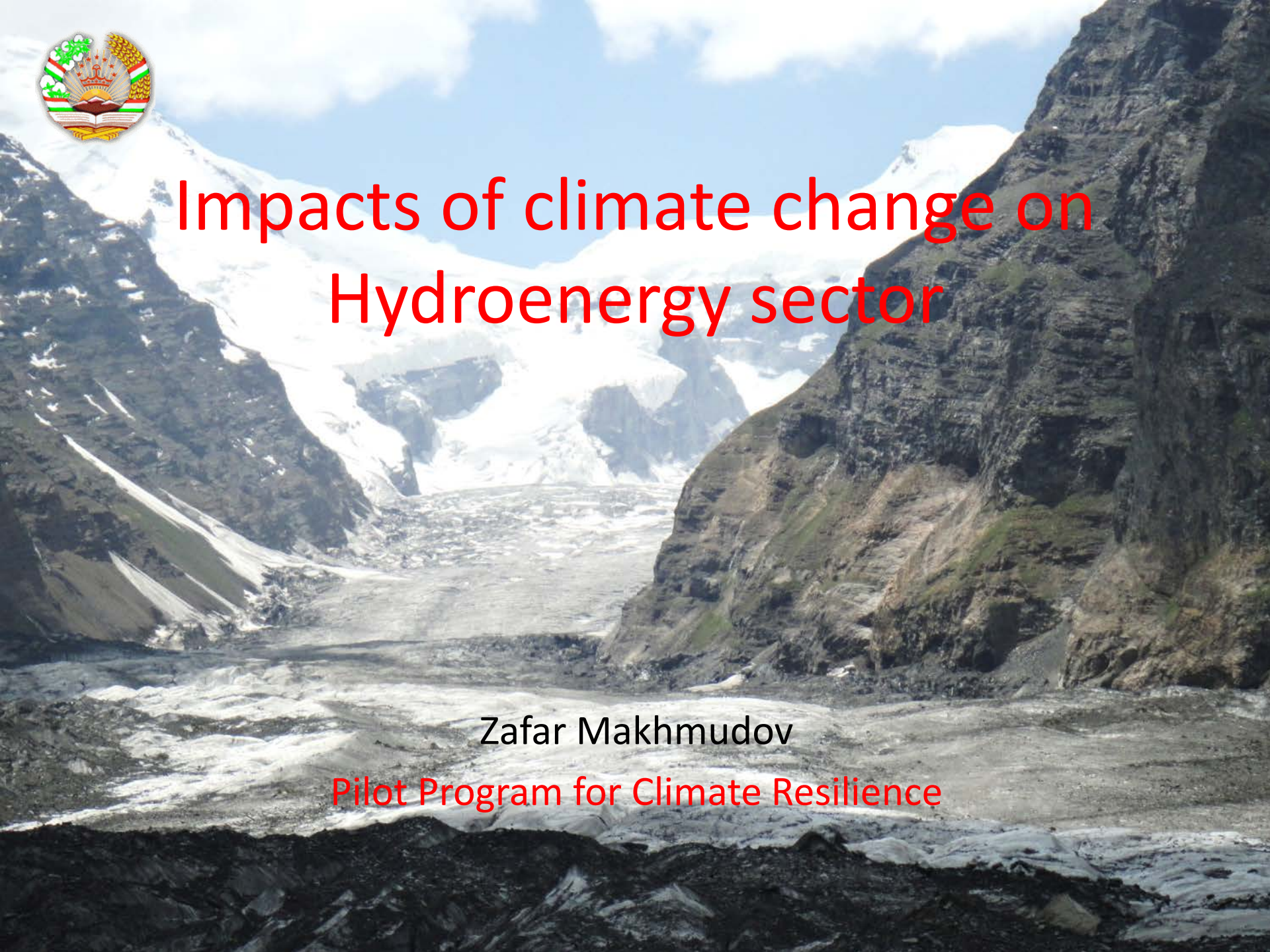


Impacts of climate change on Hydroenergy sector

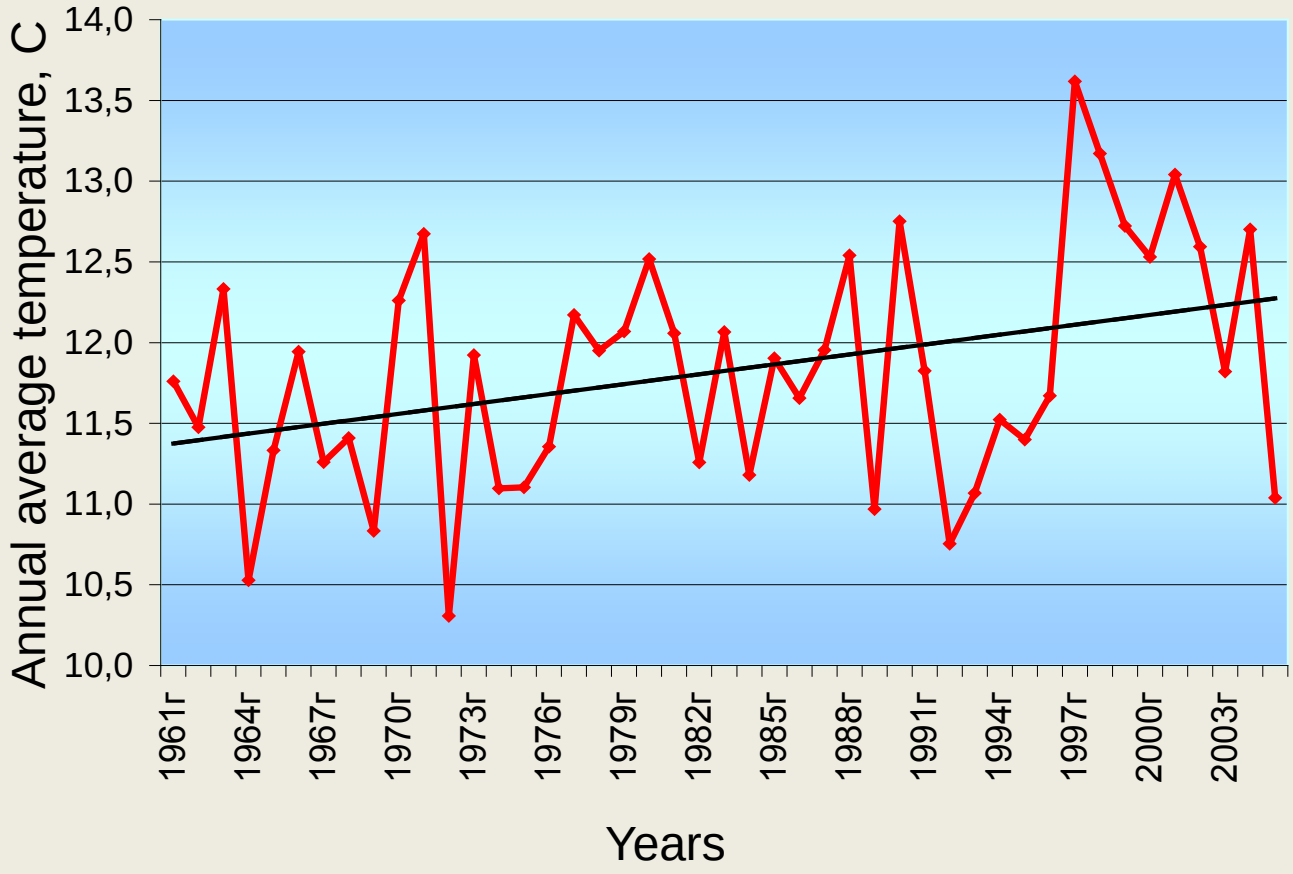
Zafar Makhmudov

Pilot Program for Climate Resilience

Projections of Water Resource Changes

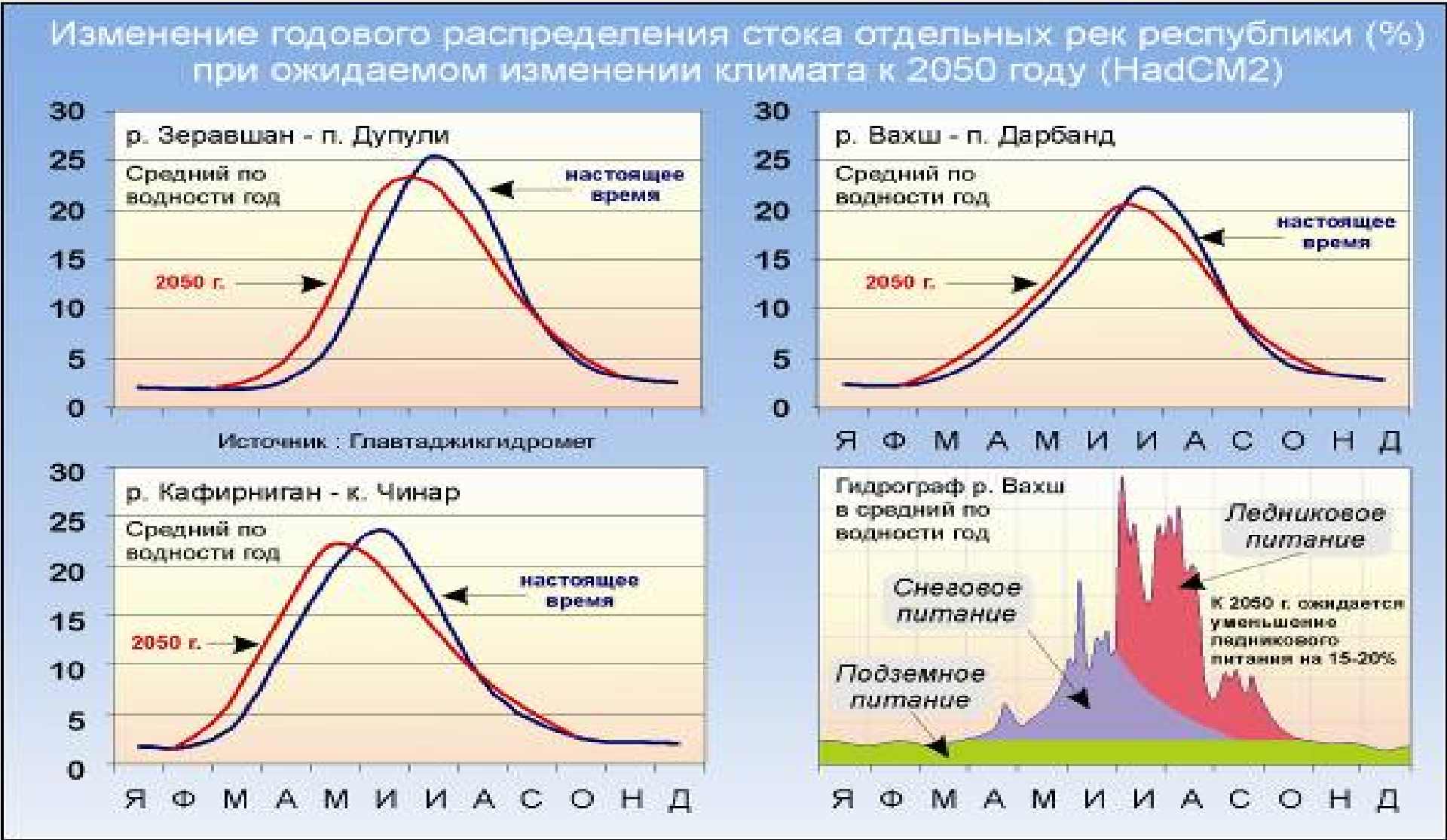
- The Second National Communication of Tajikistan to UNFCCC;
- PPCR Phase I:
  - Improving climate resiliency of hydro energy sector in Tajikistan (EBRD)
  - Tajikistan climate science and impact modeling partnership (ADB)
- Summary

Fluctuation of surface temperature according to reference weather stations in Tajikistan

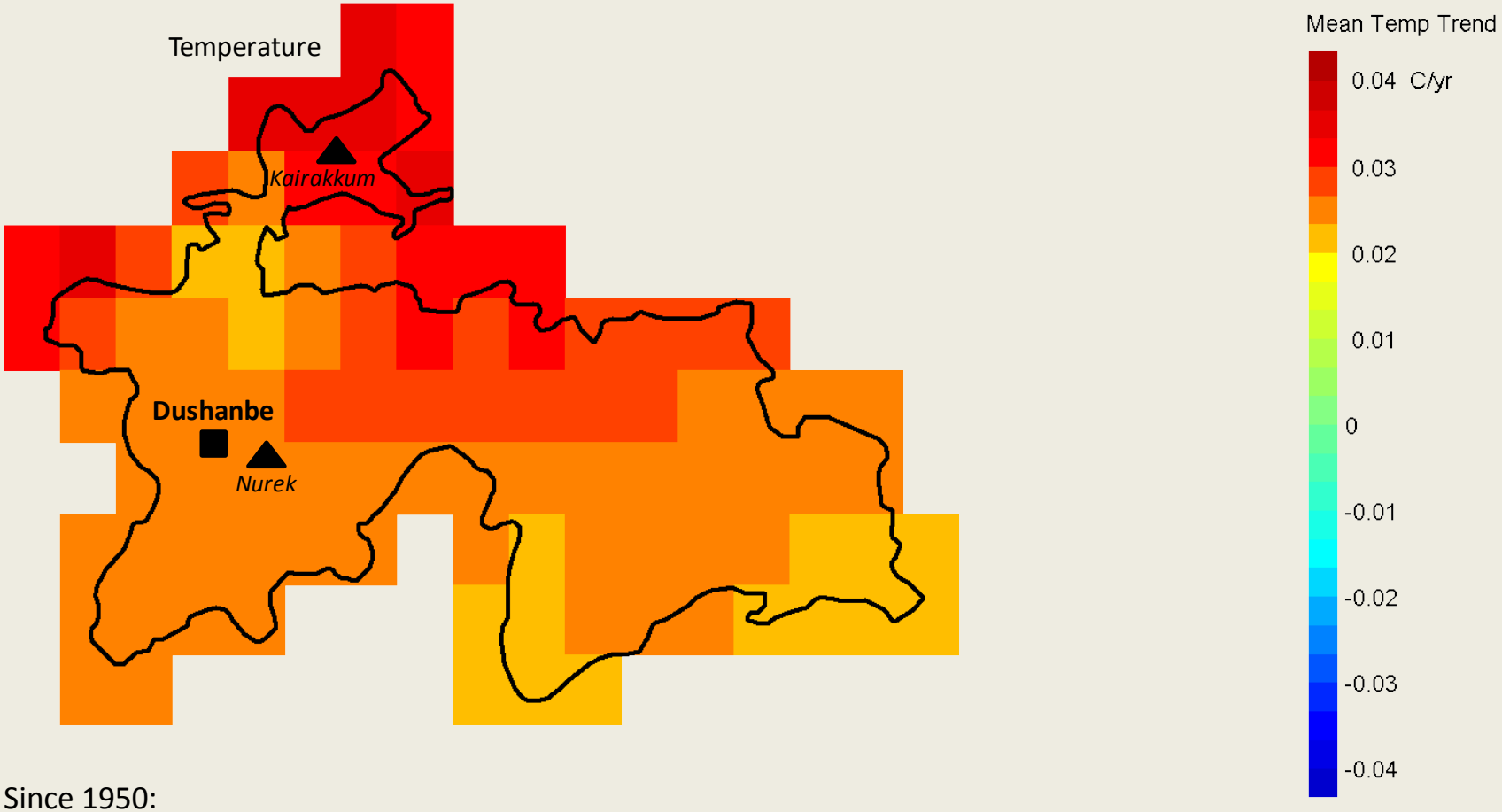


Estimation of Water Resources up to 2050

Estimation of Water Resources up to 2050



Observed changes of temperature

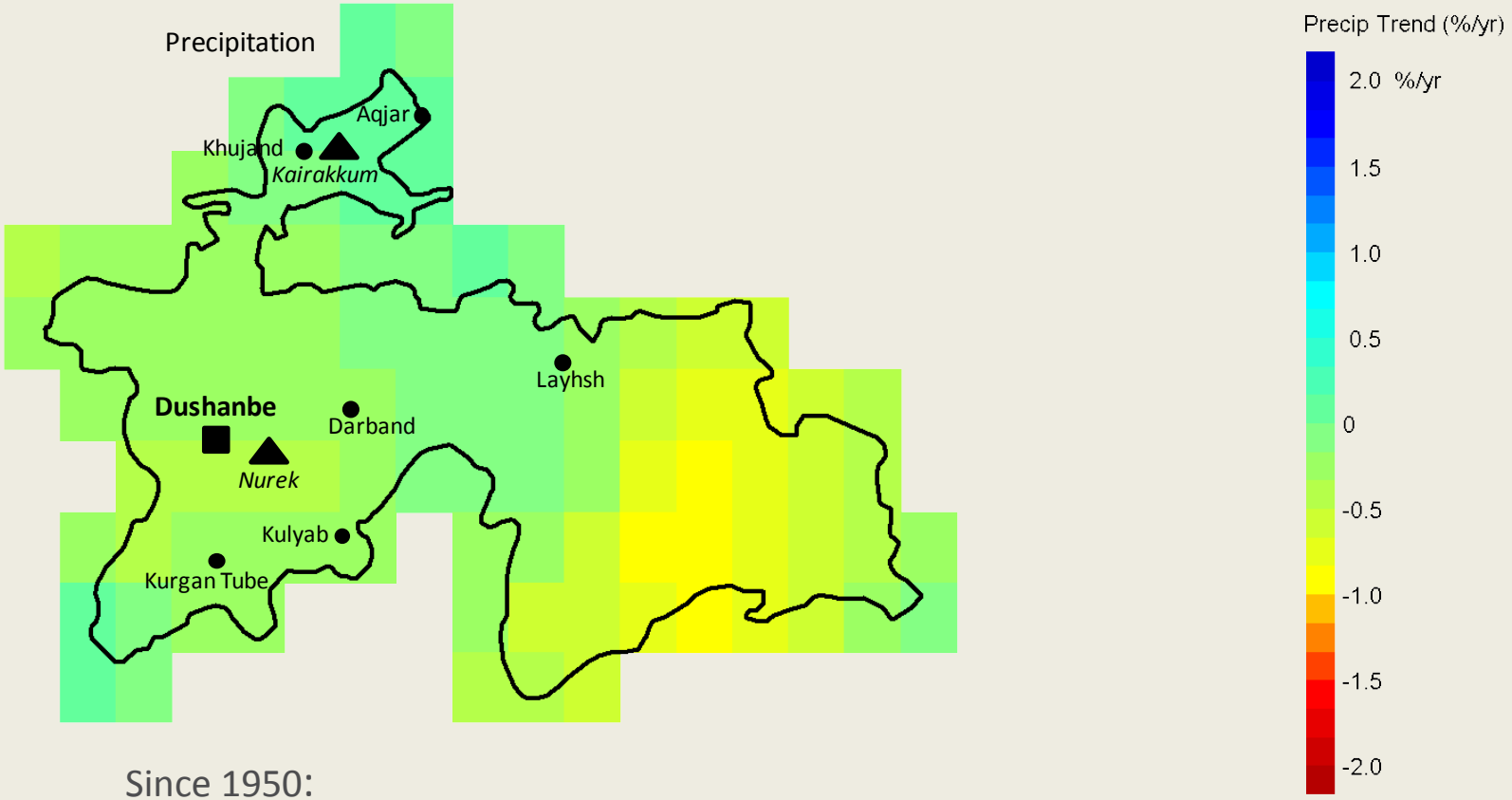


Since 1950:

- Annual temperature increase ↑1.2°C
- Rapid warming is observed in:
  - –In the north
  - –During autumn and winter seasons

Source: PPCR, EBRD (2011)

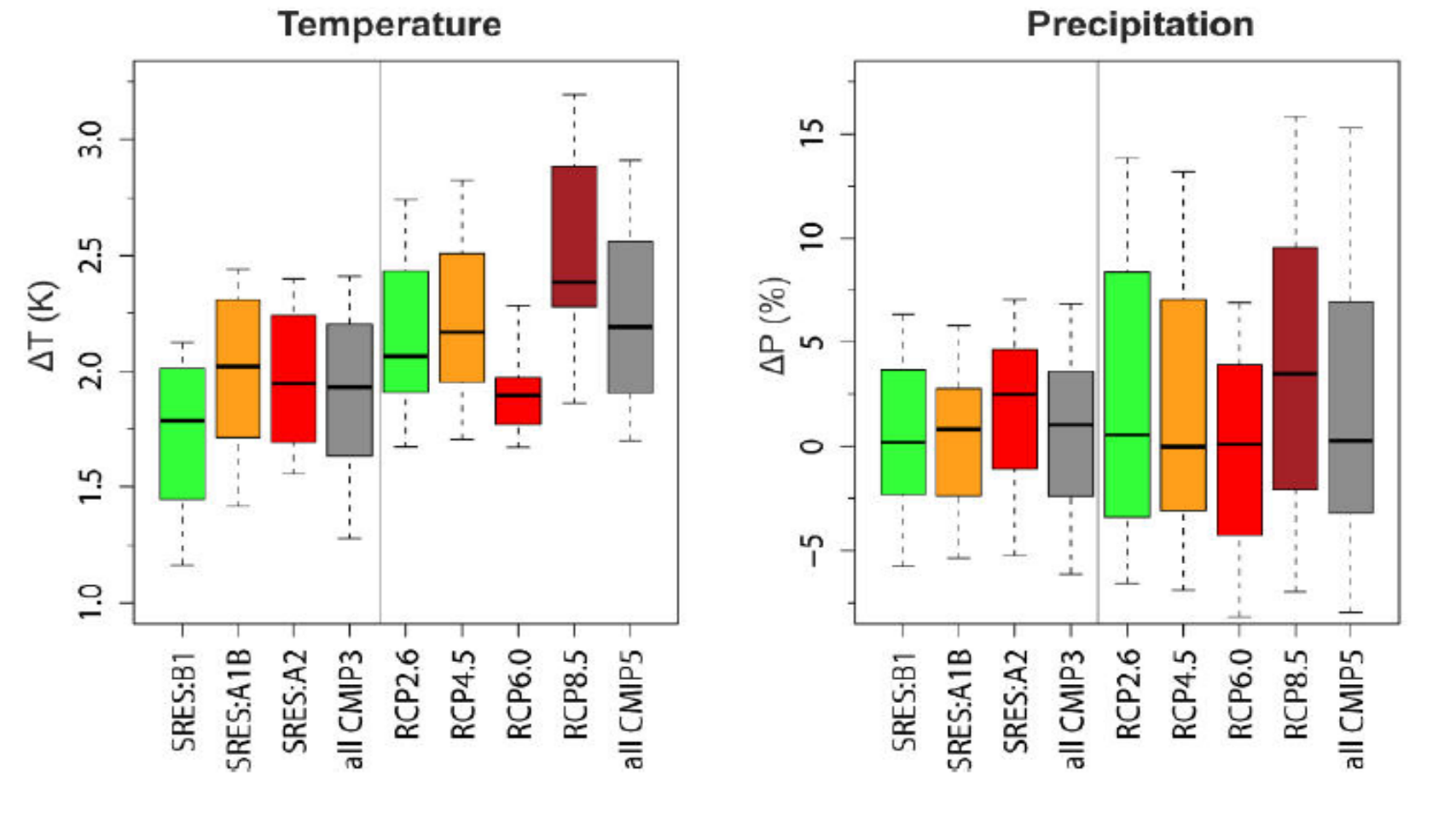
Observed changes of precipitation



Since 1950:

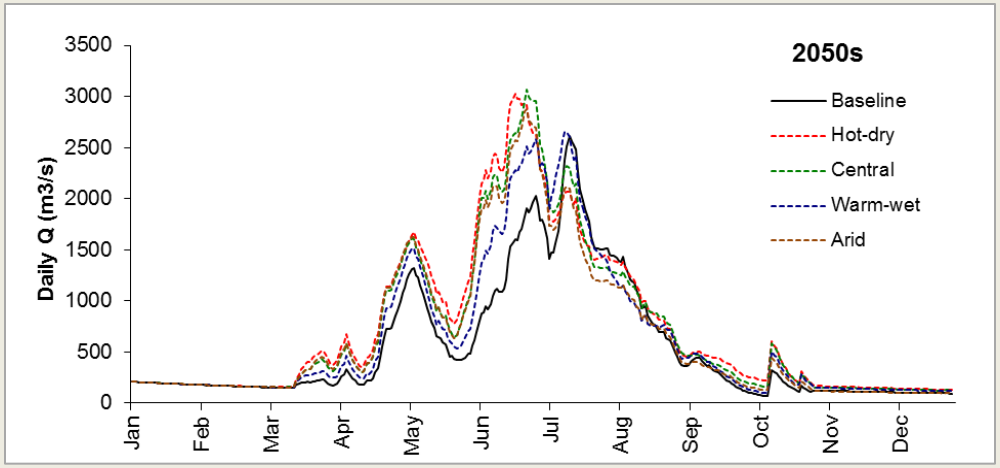
- Annual precipitation ↑↓ 20%
- In the Pamirs decrease of precipitation is expected during the autumn andwinter seasons (level of precipitation in winter remains the same)

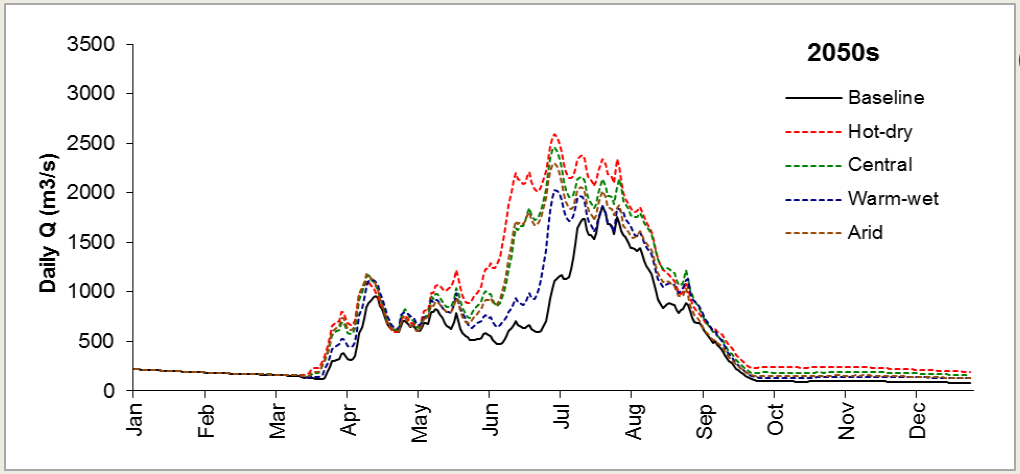
Source: PPCR, EBRD (2011)



Forecasted changes of average weather temperature and precipitations for Amudarya and Syrdarya basins as per different projecsion of emissions up to 2030.
Source: Lutz et al. (2013).

Annual runoff changes



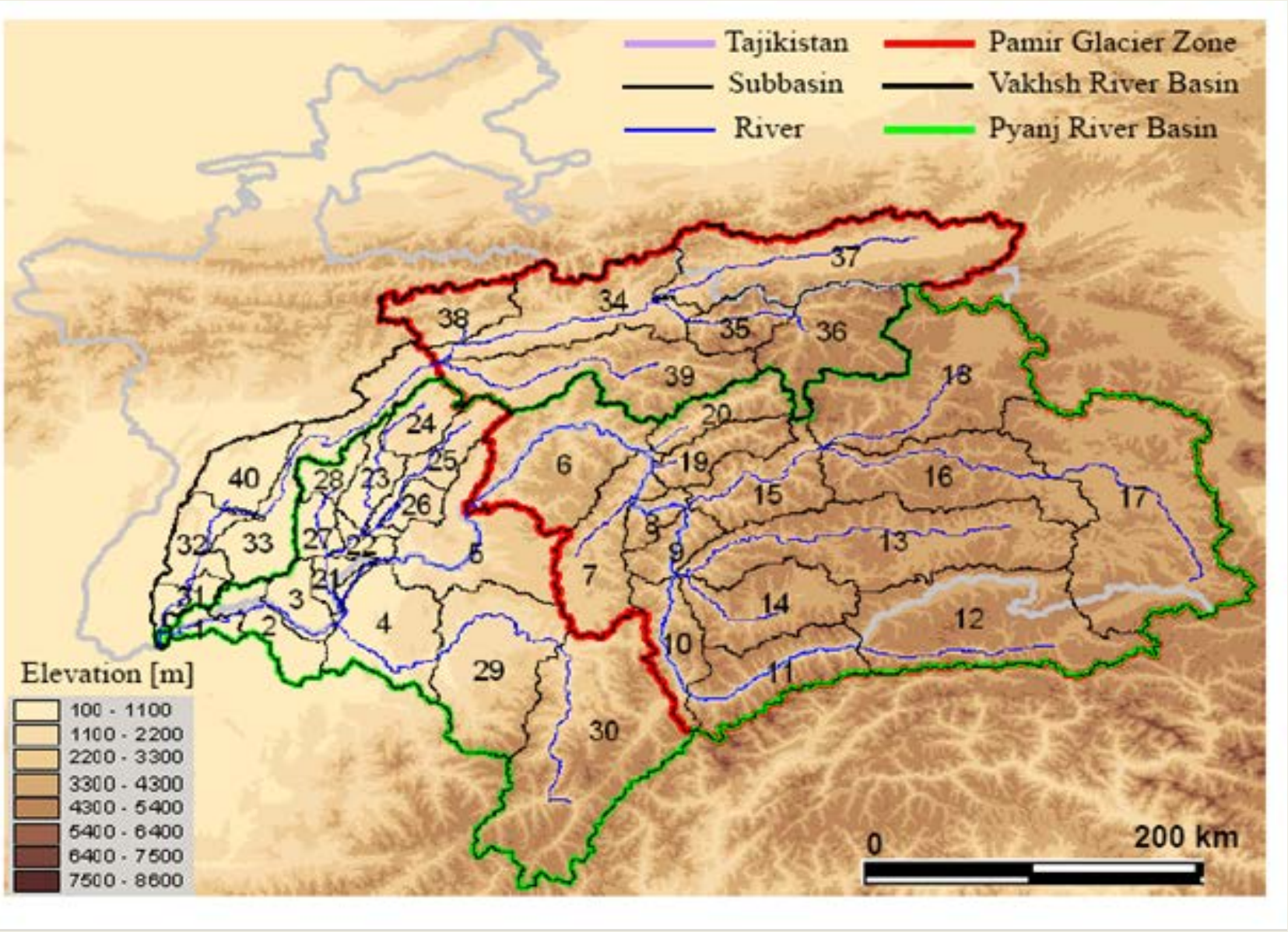


Modeling of daily water runoff in the headwaters of Vakhsh (Nurek dam) using runoff modeling based on icemelting (SRM):

•Black line= modeling of 'base data' on runoff (upper line) 2005 and (lower line) 2001

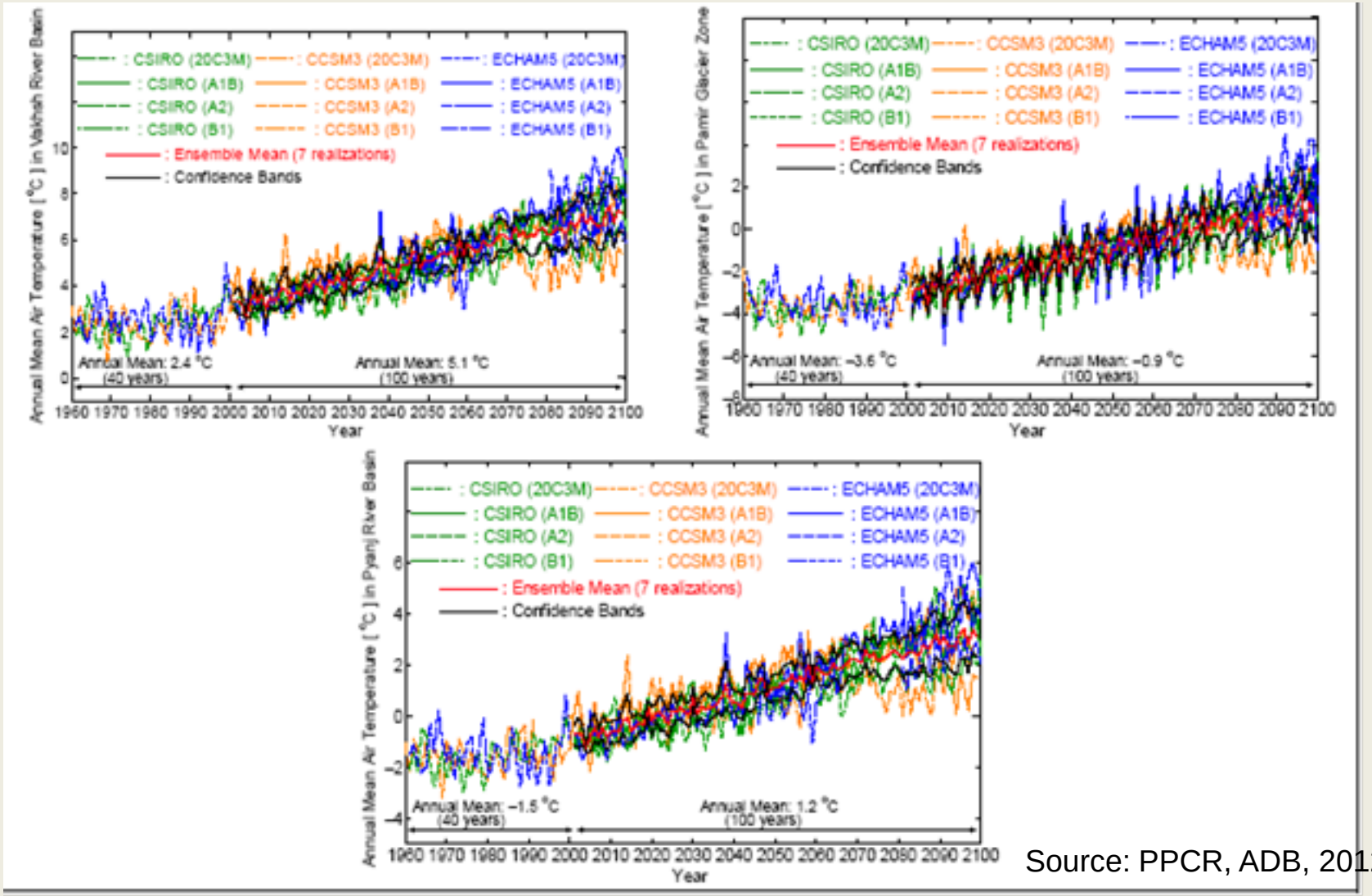
•Dashed line – runoff in 2050, on the basis 4 climatic scenarios (hot - dry, Central, warm - wet, and arid)

Source: Professor Robert Wilby, Loughborough University, UK



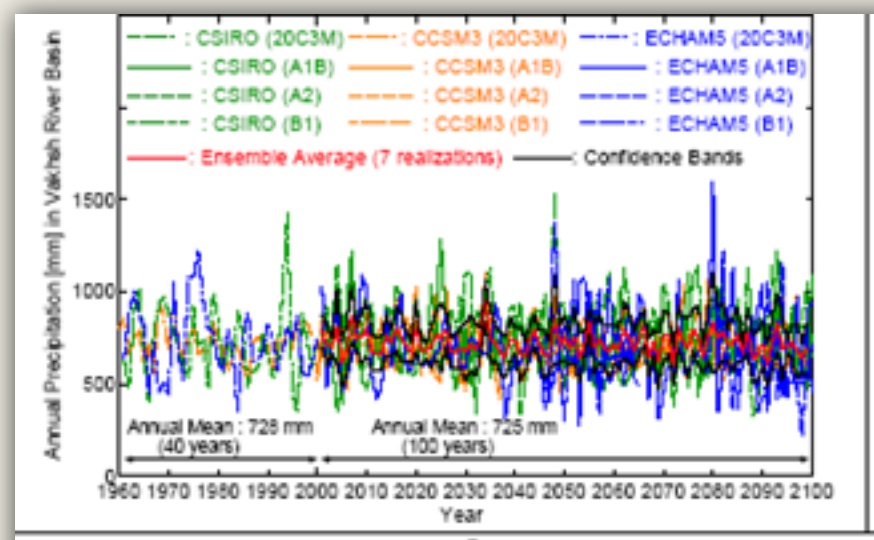
Source: PPCR, ADB, 2012

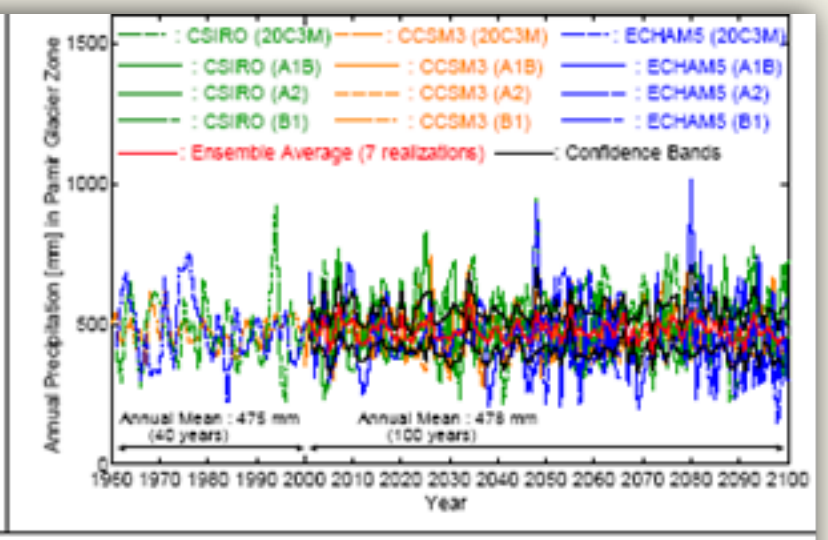
Historic and future annual average weather temperature for Vakhsh and Pyanj river basins, also for the Pamirs' glaciation area

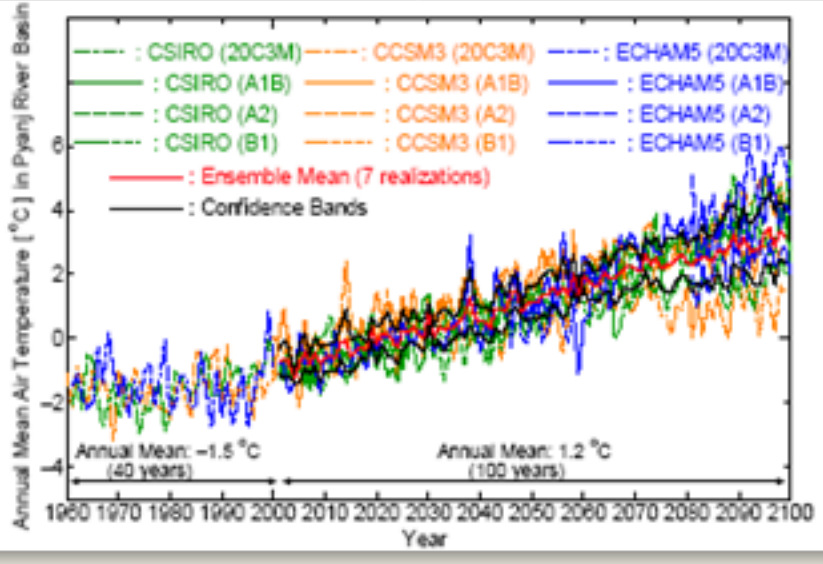


Source: PPCR, ADB, 2012

Historic and future annual average precipitation for Vakhsh and Pyanj river basins, also for the Pamirs' glaciation area

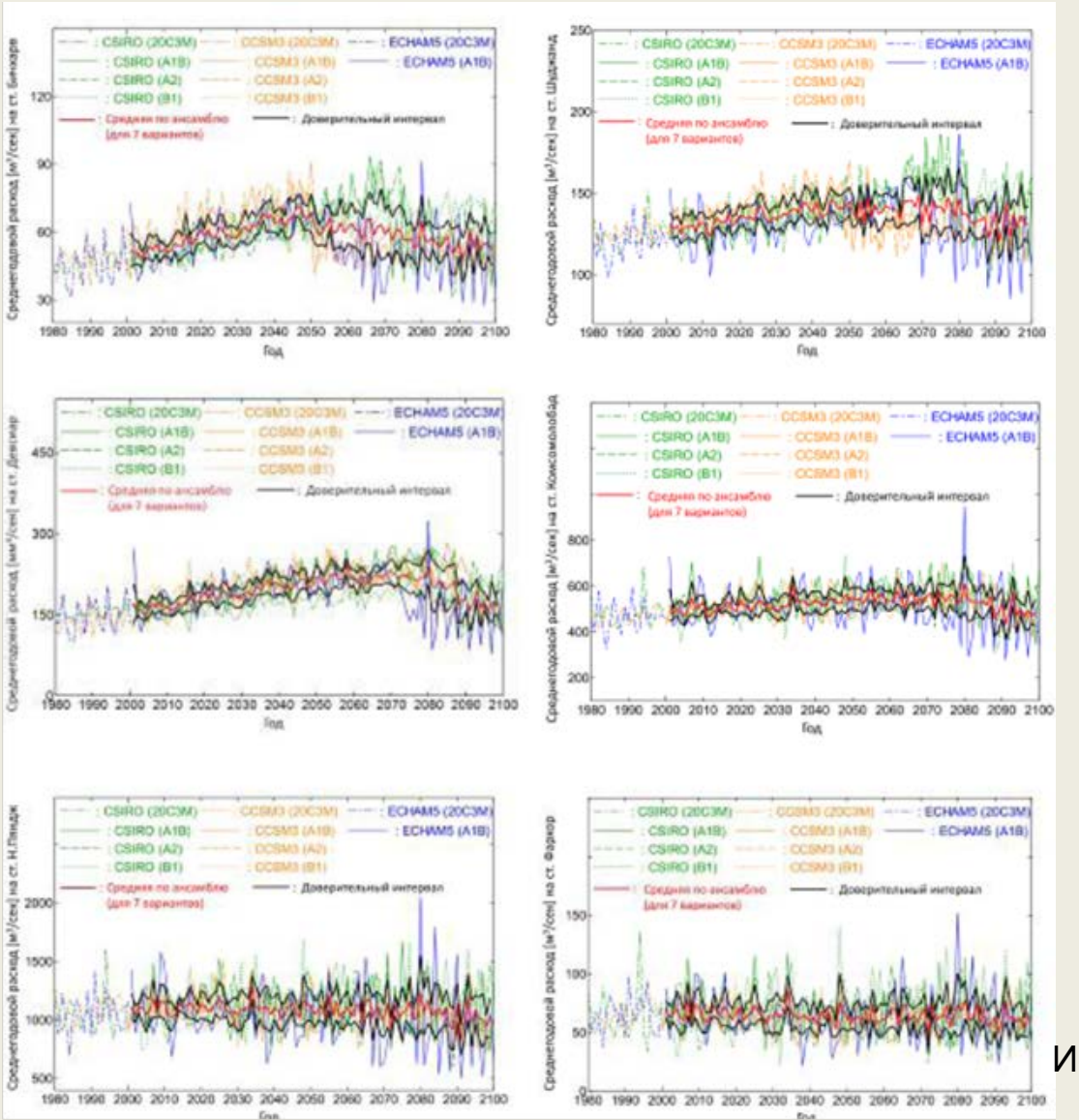






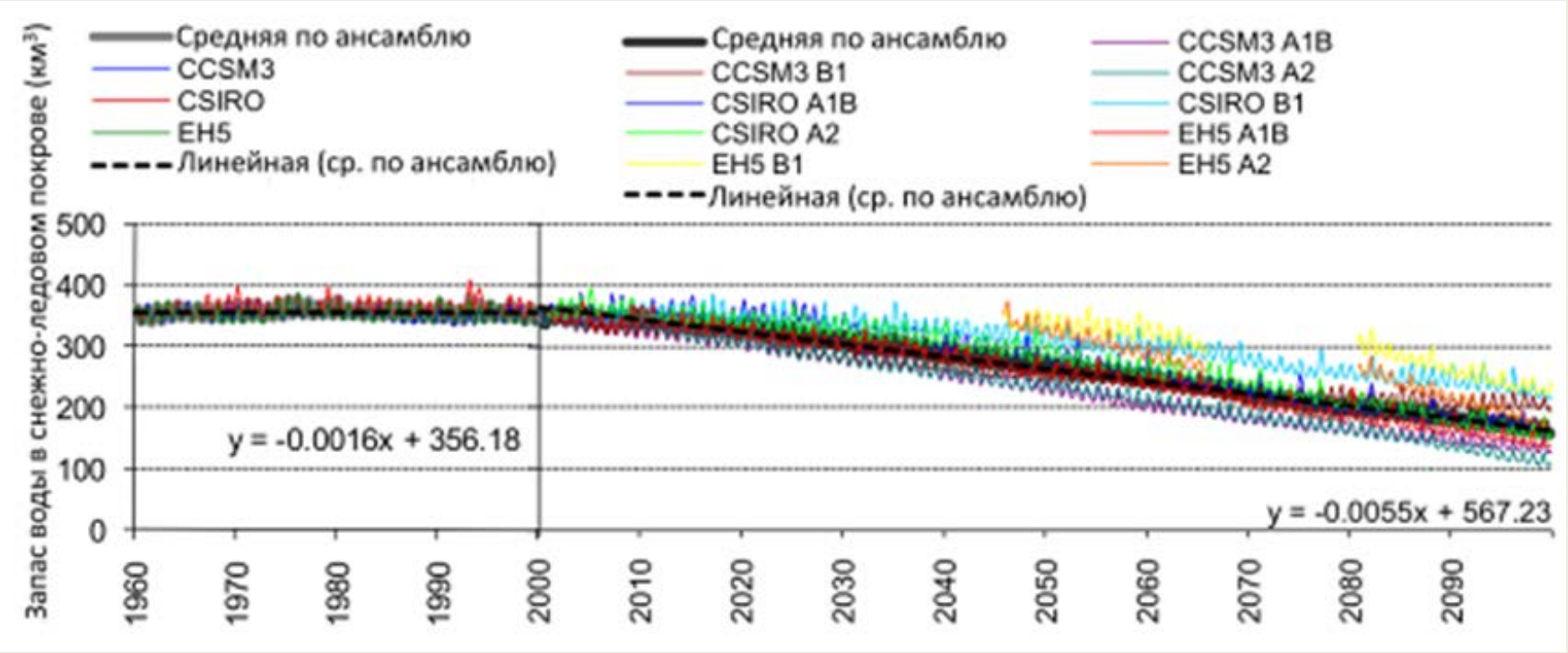
Source: PPCR, ADB, 2012

Historic and future annual average river flow in Vakhsh and Pyanj river basins



Источник: ППАИК, АБР, 2012

Estimated full ice volume of Pamir's glaciation area for the past and future periods



Источник: ППАИК, АБР, 2012

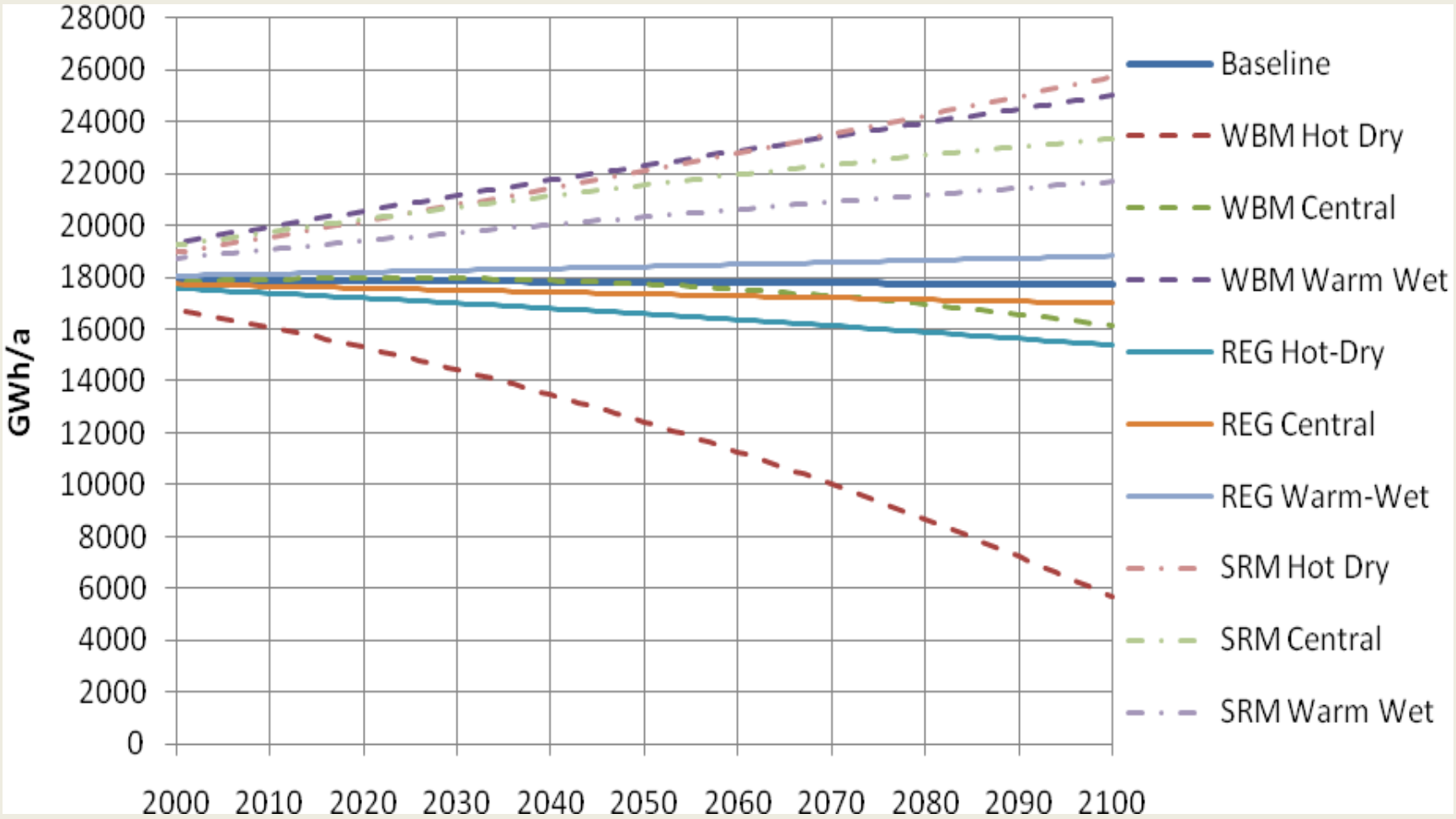
Unidentified implications of climate change on energy production

- Single projections for 2050: Temperature increase (no changes in precipitation level) → Increased level of snow and ice melting → Increased level of water flow → Improving capacity of hydroenergy?

OR

- Other projections for 2050: Temperature increase, decreasing the level of precipitation → rapid melting of snow and ice resources → Decreasing capacity of hydroenergy sector?

Unidentified implications of climate change for hydropower generation



Projections of future annual average energy production in Vakhsh Cascade

Source: PPCR, EBRD (2011)

- Future average annual water flow in all stations, until a certain moment increases as a result of ice melting caused by temperature warming
- Approximately starting from 2060-2080 annual average water flow will decrease, because by that time most of the glaciers will melt down and disappear
- Such results show that identifying the exact time of glaciers disappearing is critical for water balance in the basins. Types of local characteristics for future water conditions can be identified only by upscaling models of water runoffs.

Thank you!