International Water Management Institute

Identifying and Mapping Climate Risks in CAREC Countries

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Research and Innovation for Water Security
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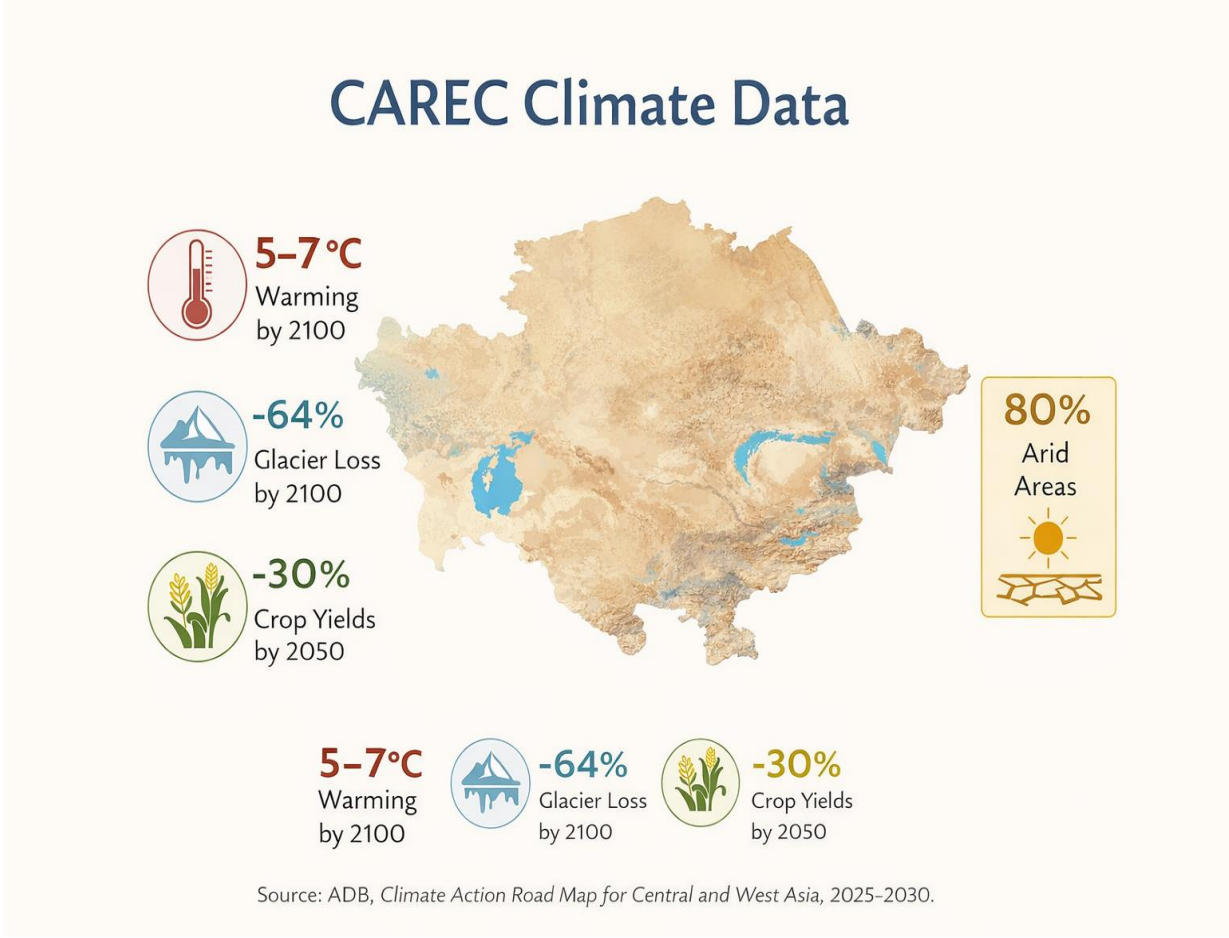
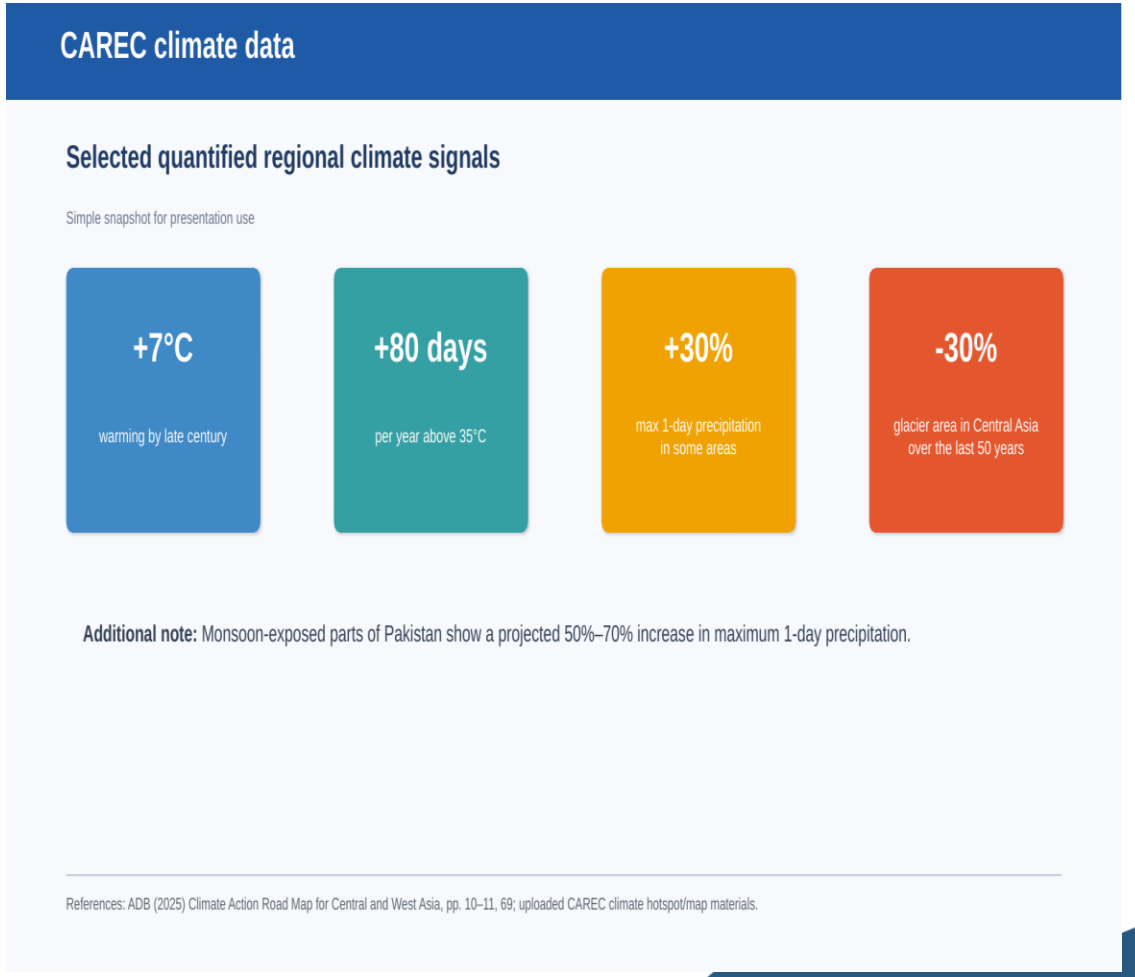
Selected quantified regional climate signals





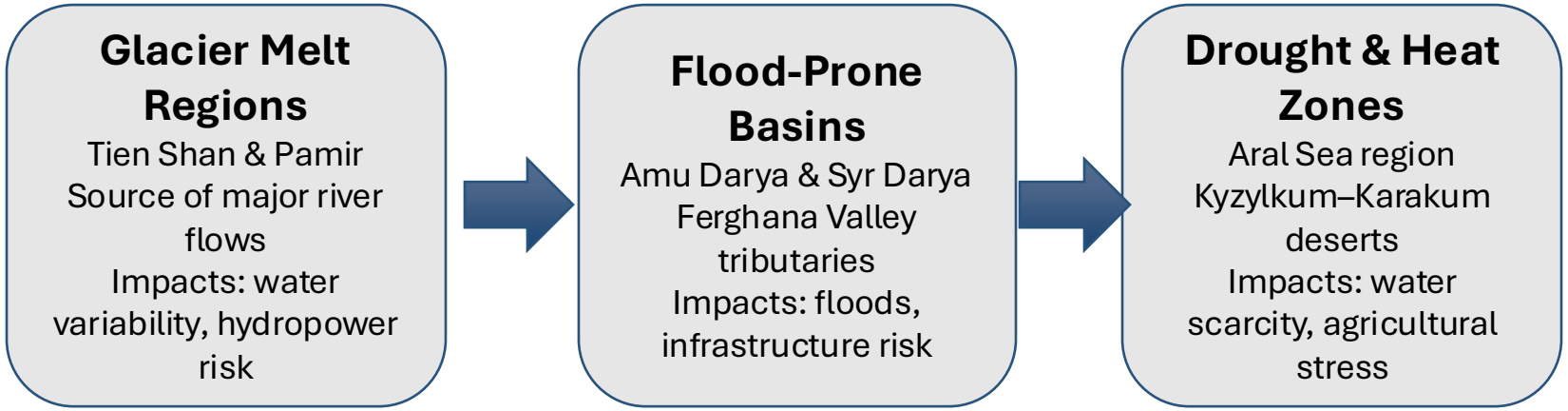
Sources: ADB. 2025. Climate Action Road Map for Central and West Asia

Selected quantified regional climate signals

- Strong **warming trend:** up to +7°C by the late century
- Increase in **extreme heat**: +80 days >35°C
- Intensification of **extreme rainfall**: +30% (1-day max)
- **Glacier loss**: ~30% decline over the last 50 years
- Implication: accelerating **hydro-climatic instability**

Climate Change Context in CAREC

- Rising temperatures, glacier retreat, and extreme weather are increasing risks to water, food, energy, and infrastructure across CAREC countries.



CAREC's climate risks are driven by interconnected cryosphere, hydrological, and arid-zone systems, requiring integrated water–energy–food and technology solutions.

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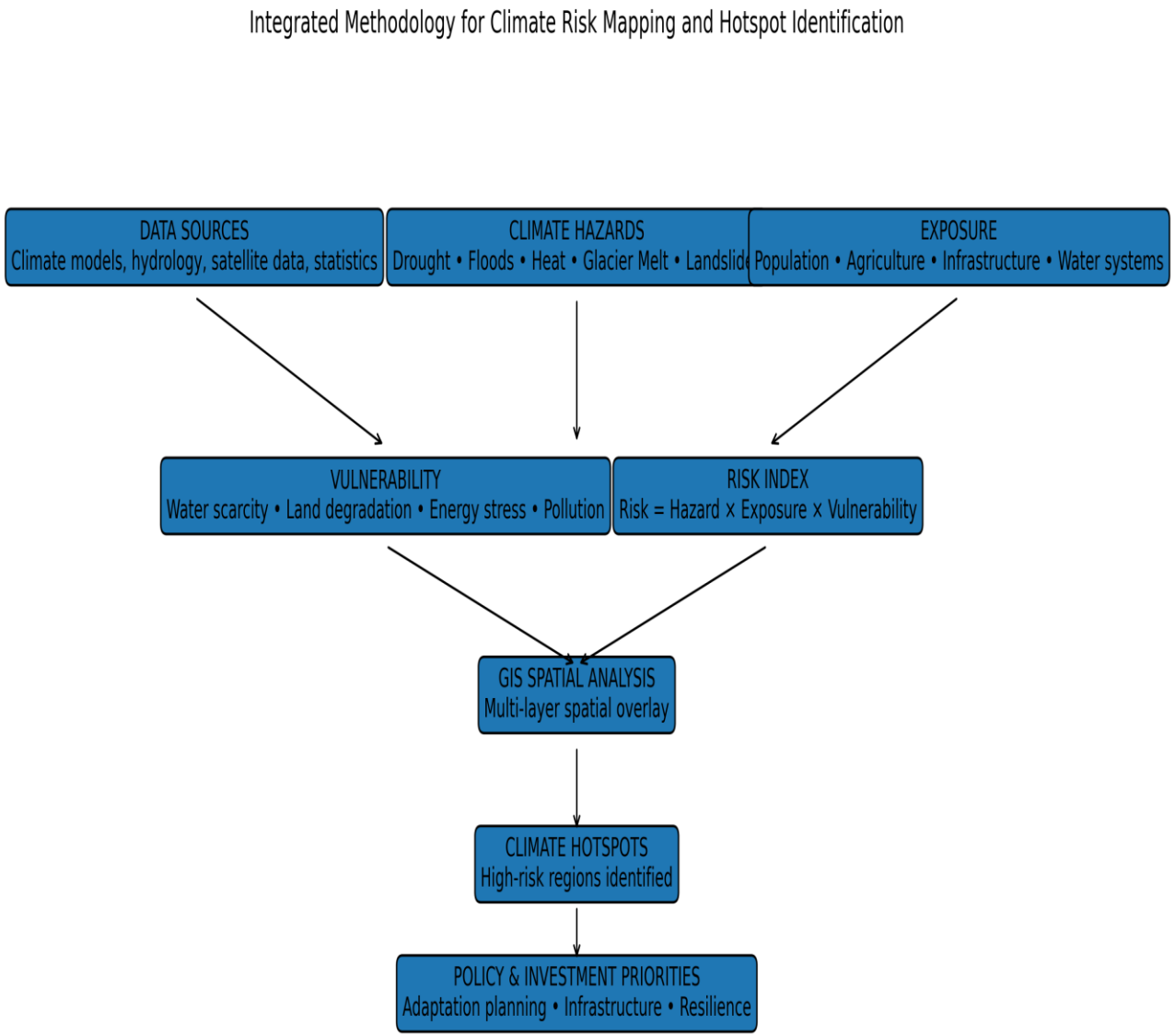
Climate Change Context in CAREC

- Climate risks affect **water, food, energy, and infrastructure**

- **Key systems:**
- Cryosphere (Tien Shan, Pamir) → water supply risks
- River basins (Amu/Syr Darya) → flood exposure
- Arid zones (Aral Sea, deserts) → drought stress

- Strong **interlinkages across systems** (WEF nexus)

Methodology

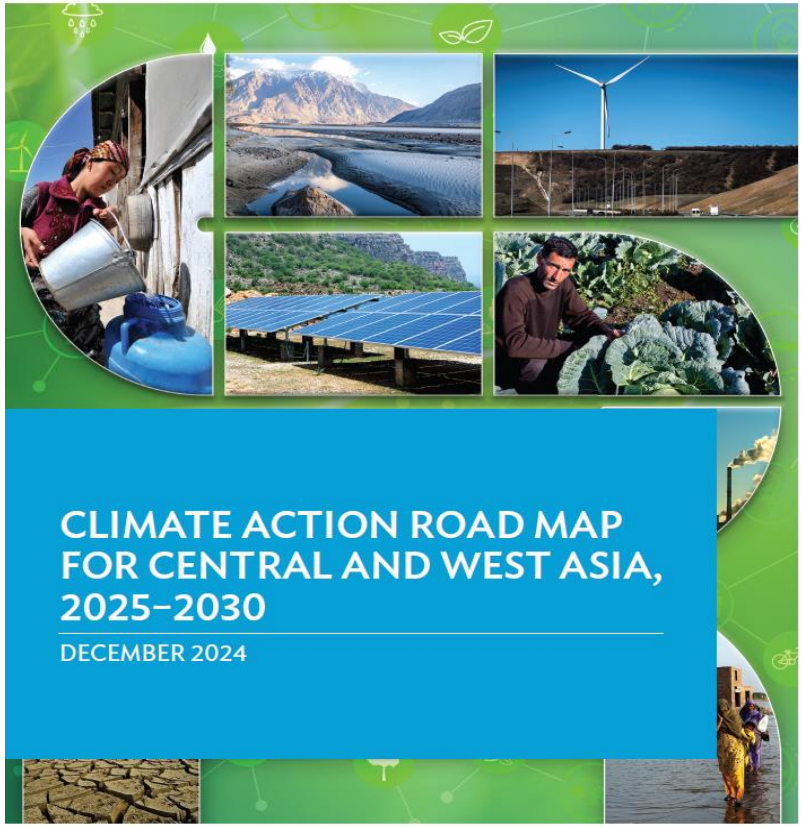


- Integrated **risk assessment** framework

- **Components:**
  - Hazard analysis (climate extremes)
  - Exposure (population, assets, systems)
  - Vulnerability (institutional, economic capacity)

- **Tools:**
  - Spatial mapping (GIS)
  - Multi-source datasets (climate + socio-economic)

Data sources/References



OECD
Organisation for Economic Co-operation and Development

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Mapping Water, Energy and Land-use Hotspots in Central Asia (title - TBD)

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Disaster Risk and Resilience Assessment (DRRA)

Country Drought Profile – Kazakhstan

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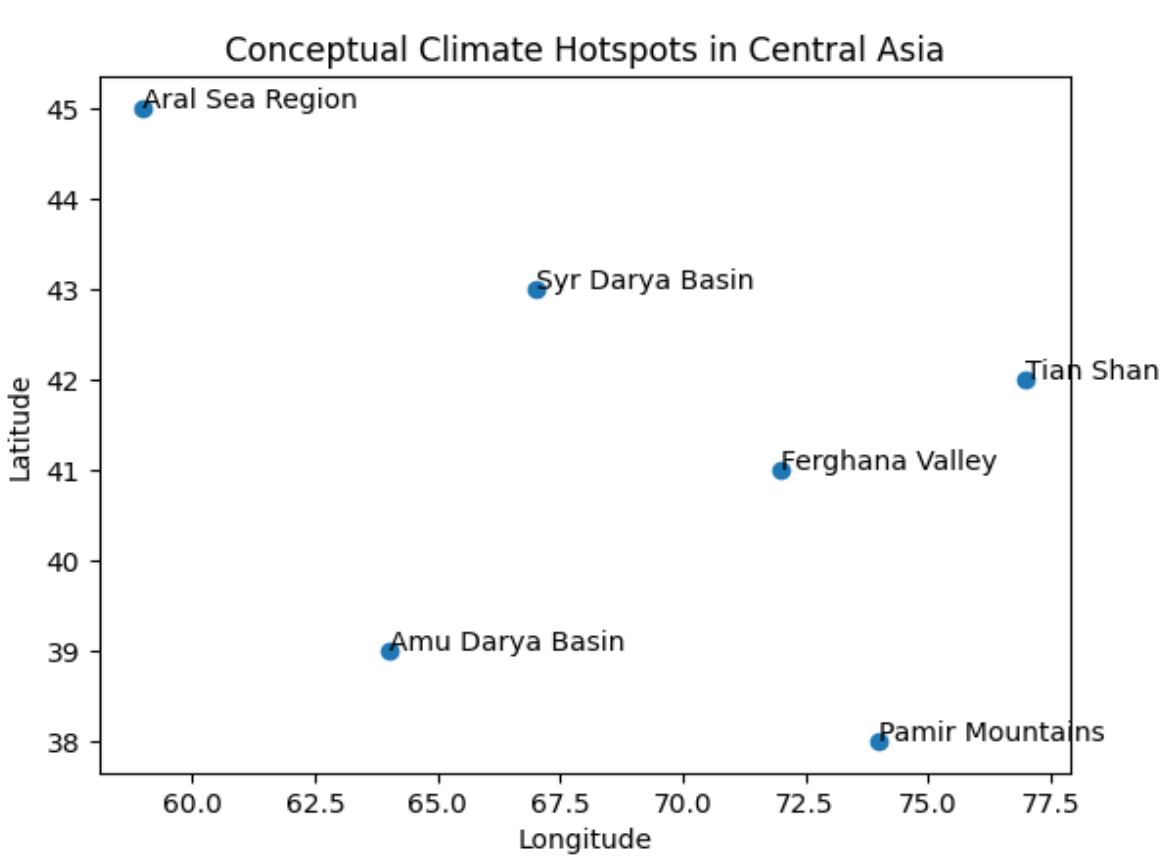
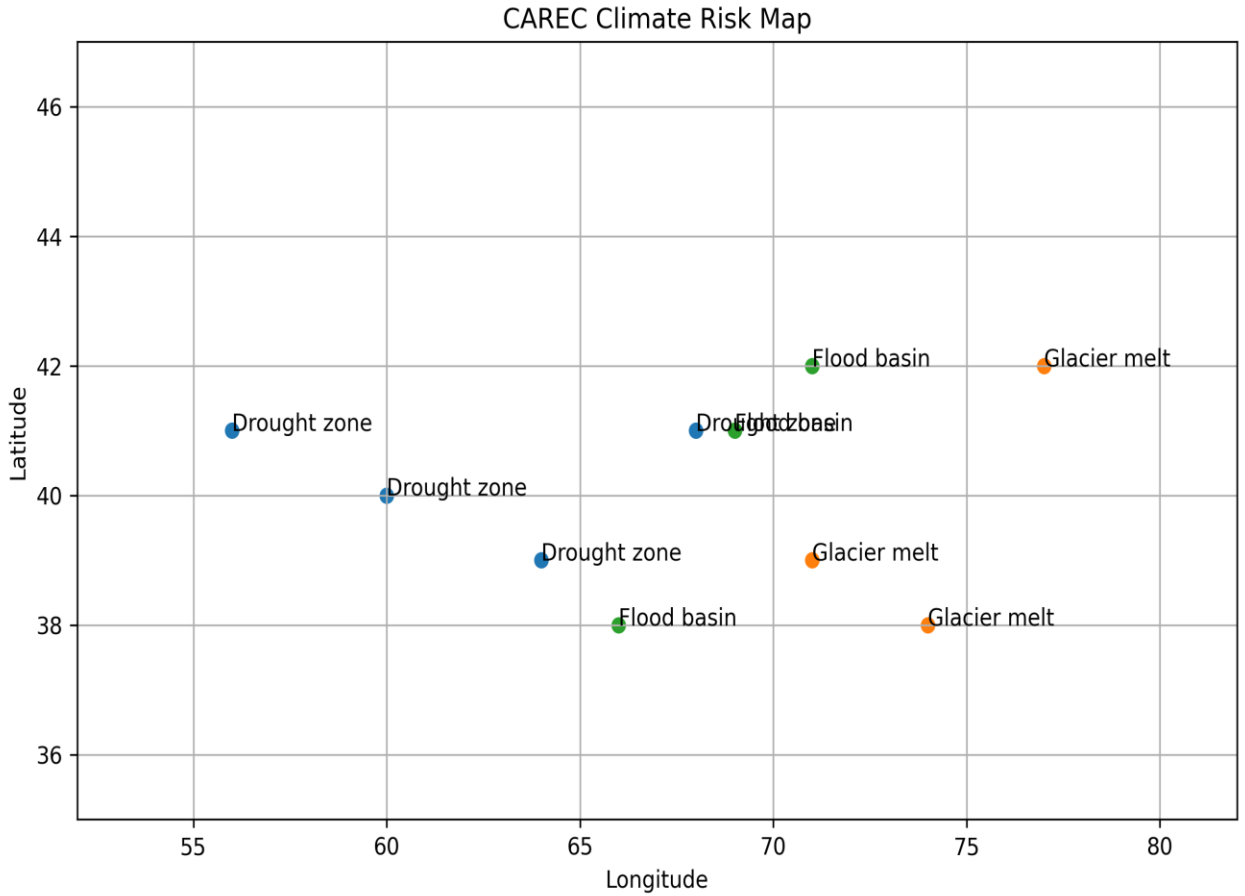
Data sources/References

- OECD (2026) – climate risk analytics
- ADB (2025) – regional climate projections
- CAREC Institute (2022) – regional assessments
- Use of **harmonized and validated** datasets
- Ensures **credibility and comparability**

Climate Risks in CAREC





Mapping of different climate risks in the CAREC region

Sources: OECD.2026

CAREC Climate Risk Hotspots

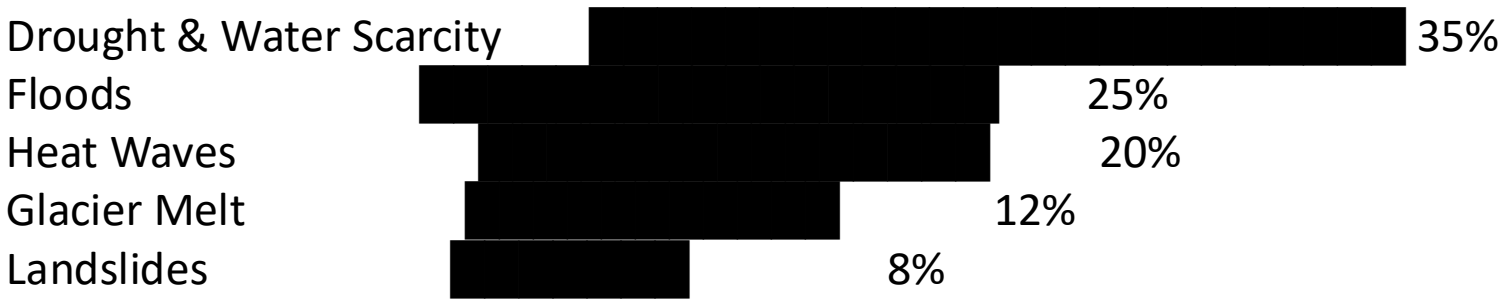
Sources: OECD.2026

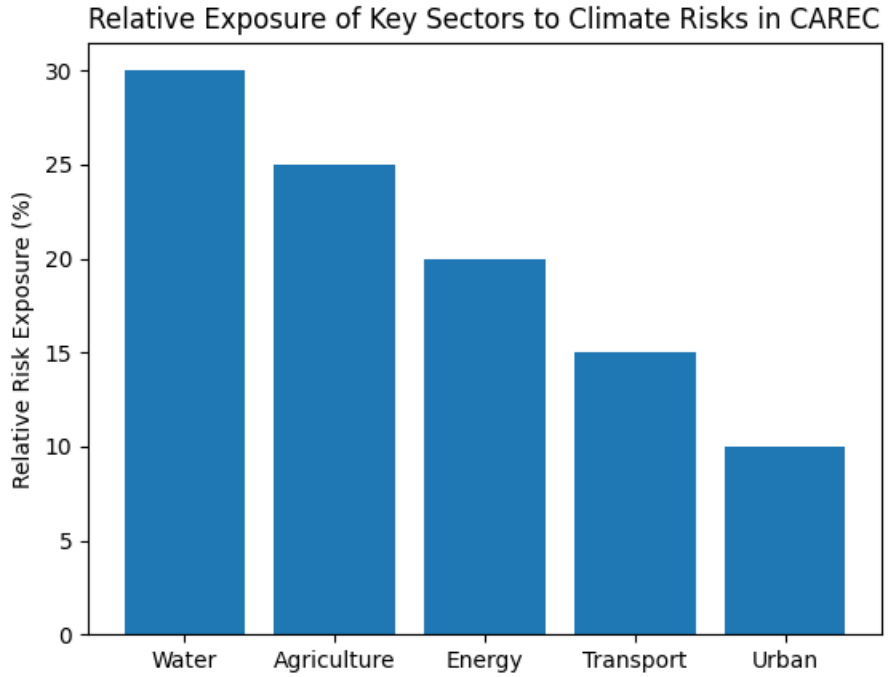
Climate Risks in CAREC: country profile

Country	Drought & Water Scarcity	Floods	Heat Waves	Glacier Melt	Landslides	Estimated Economic Exposure (% GDP by 2080)
Kazakhstan	High	Medium	High	Low	Low	40–80%
Uzbekistan	Very High	Medium	High	Low	Low	30–45%
Turkmenistan	Very High	Low	Very High	Low	Low	20–60%
Kyrgyz Republic	Medium	High	Medium	Very High	High	70–120%
Tajikistan	Medium	Very High	Medium	Very High	High	80–130%
Georgia	Medium	High	Medium	Medium	High	40–60%
Armenia	Medium	Medium	High	Medium	High	20–30%
Azerbaijan	Medium	Medium	High	Low	Medium	5–10%

Sources: ADB. 2025. Climate Action Road Map for Central and West Asia

Climate Risks in CAREC: Risks and exposure of sectors





Sources: ADB. 2025. Climate Action Road Map for Central and West Asia

Climate Change Risks in Central Asia: Impacts

- **Rising temperatures** increase evapotranspiration
- **Glacier retreat** threatens long-term water supply
- More frequent **drought** events
- Increasing **seasonal variability** of water flows

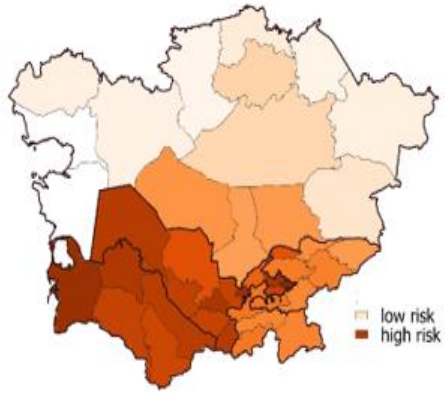
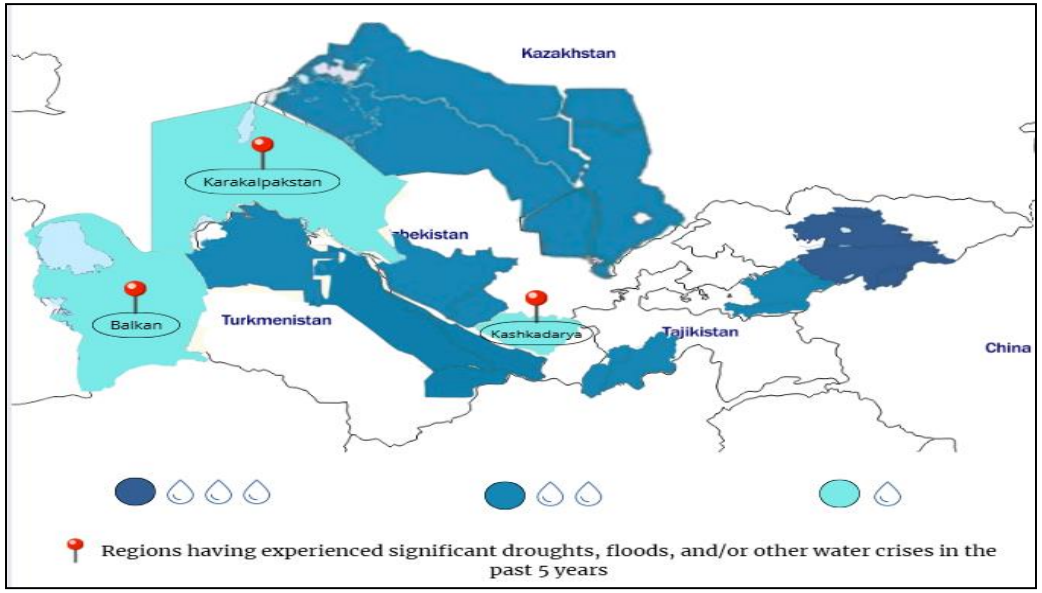


Figure 6. **Climate vulnerability at the provincial level in Central Asia in water and agricultural sectors.** Based on estimated CAREC climate vulnerability index that takes into account projected shifts in water availability, current structure of agriculture, and reliance on irrigation water. Source: CAREC Institute, 2022

Source: CAREC Institute.2022



Sources: OECD.2026

Climate Riks in CAREC region, some aspects

- **Climate-sensitive sectors dominate** regional economies, increasing exposure to climate shocks
- **Climate hotspots combine** water scarcity, environmental degradation, and socio-economic vulnerability
- Interlinked systems **require integrated climate solutions**

CAREC region climate risks: summary

O Snapshot

Cryosphere loss, heat stress, flood volatility and transition pressure are reinforcing one another across CAREC.

1 Cryosphere and water stress

Up to 7C warming by late century; hot days above 35C may increase by up to 80 days per year; glacier area in Central Asia has already declined by about 30% over the last 50 years.

2 Flood and corridor risk

Maximum 1-day precipitation may rise by up to 30% in some areas, and by 50%-70% in monsoon-exposed Pakistan, increasing flood, landslide and infrastructure disruption risk.

3 Finance and transition pressure

The wider Central and West Asia region contributes about 1.5% of global GHG emissions and is estimated to require up to $100 billion per year in climate finance.

Why it matters

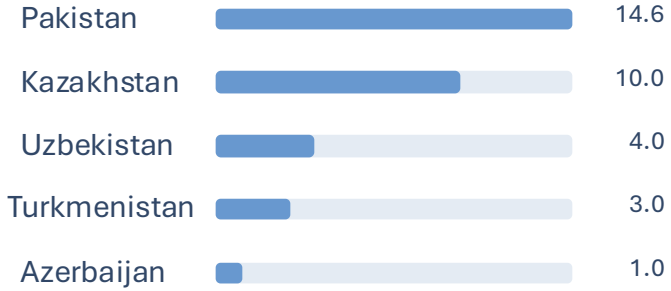
Under a business-as-usual scenario, Central Asia's water supply-demand gap could widen from 8% today to 37%.

Quantified regional snapshot

+7C	+80 days	+50-70%	$100bn
warming by late century	>35C days per year	1-day rain in monsoon Pakistan	annual climate finance need

1:100 year flood exposure - present ($ bn)

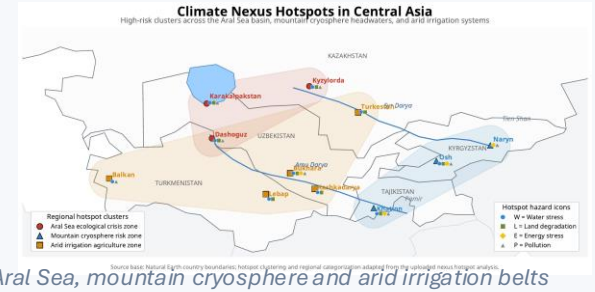
Selected CAREC economies



By 2080, projected 1:100 flood exposure rises to $60-$100bn in Kazakhstan and $20-$30bn in Uzbekistan.

Central Asia hotspot clusters

Uploaded nexus hotspot analysis



Aral Sea, mountain cryosphere and arid irrigation belts form the dominant Central Asian hotspot system within CAREC.

Water and cryosphere | Flood and slope hazards | Heat and drought | Transition

Takeaway

CAREC climate risk is compound: mountain melt, heat, flood volatility and water scarcity reinforce each other across infrastructure, food systems and cities.

References: ADB (2025) Climate Action Road Map for Central and West Asia, pp. 6, 10-11, 69; uploaded CAREC climate hotspot map.

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Central Asia Hotspot Systems

- Three **dominant systems**:
  - Mountain cryosphere (water source)
  - River flood systems (basin risks)
  - Arid irrigation zones (drought stress)

- Strong **spatial clus**tering of risks

- **Cross-border** implications

- Risks are compound (multiple hazards interact)

- Reinforcing **effects across sectors:**
  - Water
  - Agriculture
  - Infrastructure

- Increasing systemic vulnerability

- Need for integrated adaptation planning

Adaptation Measures for CAREC Countries

- **Water and agriculture**
  - Modernize irrigation, reuse water, and introduce drought-resilient crops in arid zones.
  - Improve reservoir operations and seasonal forecasting in glacier-fed basins.
  - Restore watersheds, rangelands, and soils to reduce erosion and retain moisture.
- **Disaster risk and infrastructure**
  - Expand flood forecasting, early warning, and emergency response systems.
  - Climate-proof roads, bridges, power assets, and irrigation canals in hotspots.
  - Use risk zoning, slope stabilization, and floodplain management to limit losses.
- **Cities, health, and livelihoods**
  - Deploy heat-action plans, urban cooling, and backup water and health services.
  - Protect vulnerable households through insurance, safety nets, and climate information.
- **Regional cooperation**
  - Share basin data, glacier monitoring, and hazard maps across borders.
  - Coordinate adaptation pipelines around the water-energy-food nexus.
  - Prioritize bankable projects for blended finance and concessional funding.

Sources: ADB. 2025. Climate Action Road Map for Central and West Asia; CAREC Institute. 2022; OECD. 2026.

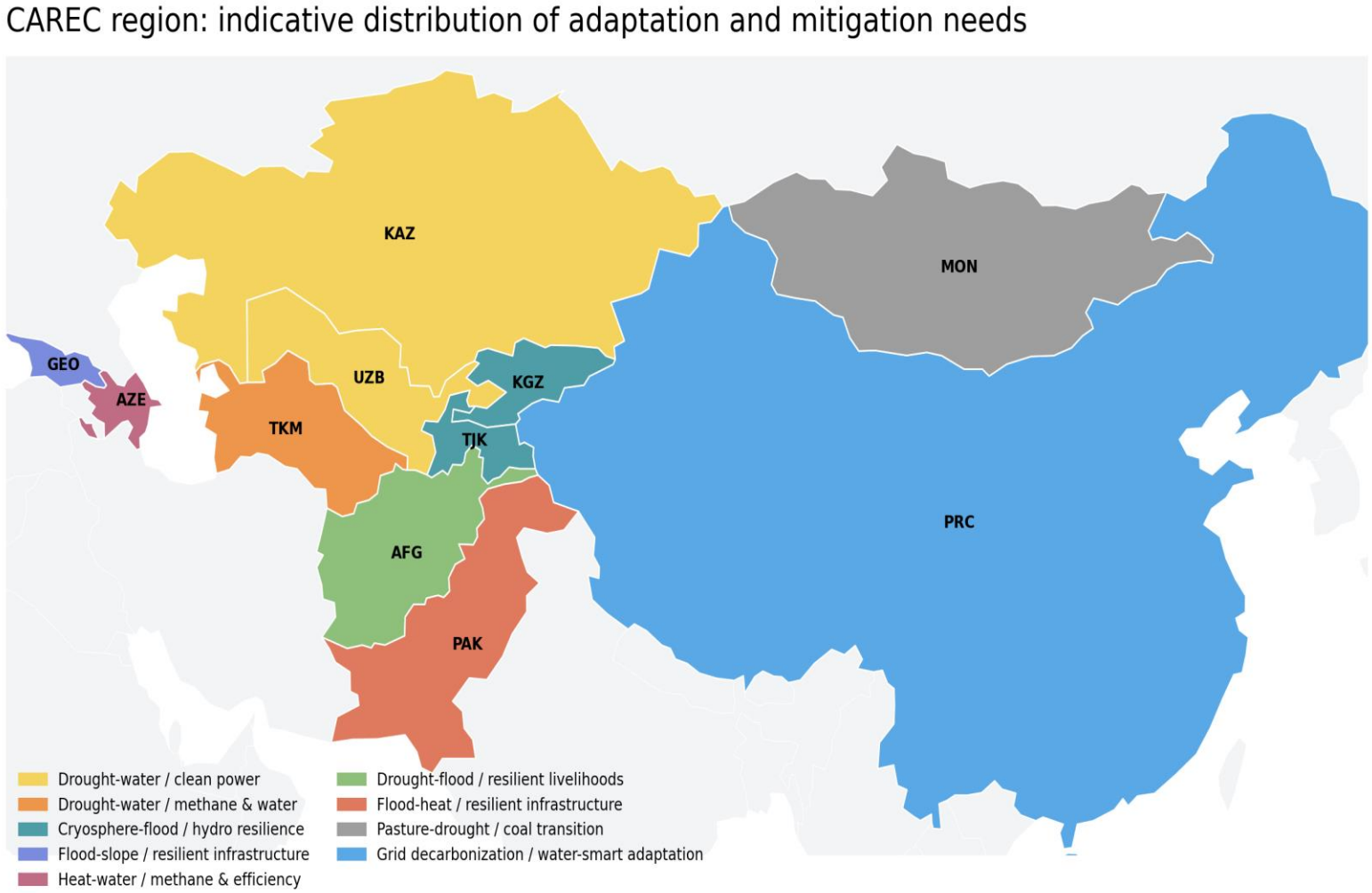
Mitigation Measures for CAREC Countries

- **Energy systems**
  - Scale solar and wind, strengthen grids, and add storage for reliability.
  - Rehabilitate existing hydropower and reduce network losses where climate risks are managed.
  - Phase down inefficient fossil-fuel use and improve power-sector efficiency.
- **Industry and buildings**
  - Retrofit public buildings, district heating, and cooling systems for energy efficiency.
  - Adopt cleaner industrial processes, waste-heat recovery, and efficient pumping.
- **Transport, methane, and land**
  - Shift freight and passengers toward rail and public transport; electrify urban fleets.
  - Cut methane from oil, gas, waste, and agriculture through monitoring and capture.
  - Support afforestation, rangeland restoration, and soil-carbon measures where suitable.
- **Policy and finance enablers**
  - Strengthen MRV, green procurement, carbon pricing or equivalent incentives, and disclosure.
  - Use regional platforms to mobilize private capital and climate finance at scale.

Priority should differ by country, but the common objective is lower emissions with higher resilience.

CAREC region: adaptation and mitigation needs

Indicative distribution by dominant climate-response priority



Adaptation priorities

Central Asia: drought resilience, irrigation efficiency, storage, reuse, and climate-smart agriculture.
Kyrgyz Republic–Tajikistan–Georgia: glacier, flood, and landslide monitoring; resilient hydropower and transport links.
Afghanistan–Pakistan: flood protection, watershed restoration, heat-health measures, and livelihood resilience.

Mitigation priorities

Kazakhstan, Uzbekistan, PRC, and Mongolia: power-sector decarbonization, grid upgrades, and energy efficiency.
Turkmenistan and Azerbaijan: methane abatement, gas-system efficiency, and lower-emission industry.
Regional need: more climate finance, cleaner corridors, and cross-border energy–water planning.

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Concluding Remarks

- **Key risks** remain drought, floods, heat, glacier retreat, landslides, and growing water stress across CAREC.
- **Adaptation needs** differ by geography: cryosphere resilience in mountain countries, drought management in arid lowlands, and flood-resilient infrastructure in Pakistan, Afghanistan, and the Caucasus.
- **Mitigation needs** are also uneven: power-sector decarbonization, methane reduction, energy efficiency, and cleaner transport corridors should be prioritized according to country profiles.

Concluding Remarks

- **Regional mapping** should now guide **investment targeting**: where to build drought resilience, where to strengthen flood protection, and where low-carbon transition finance can be absorbed fastest.

- Future CAREC action **should combine adaptation and mitigation** rather than treat them separately—especially in water, energy, agriculture, and transport systems.

- The strongest next step is a **portfolio approach**: climate-risk hotspots + adaptation needs + mitigation opportunities + bankable regional projects.