



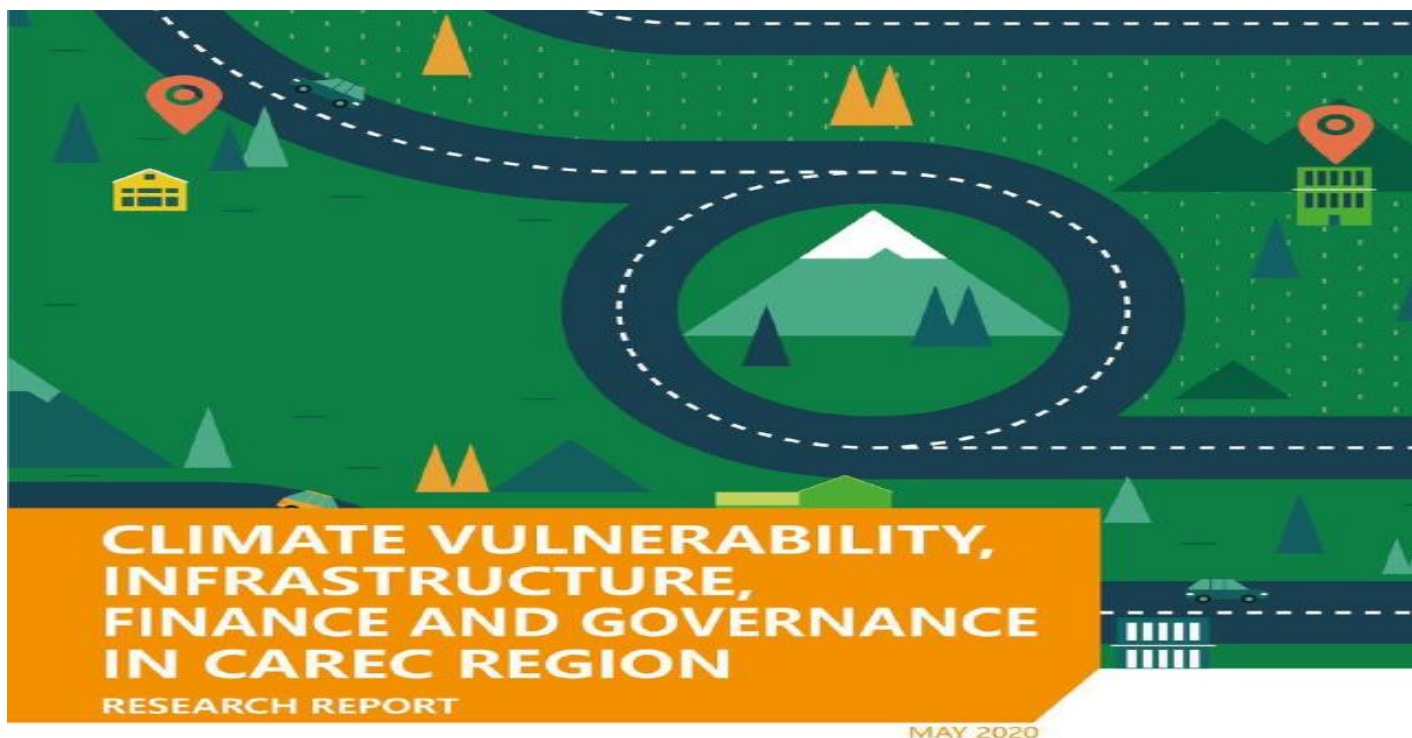
# Climate issues in Central Asia: review from CAREC Institute

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CAREC Institute



# CAREC INSTITUTE CLIMATE STUDY



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# CHALLENGES: CLIMATE IMPACT

- Central Asian countries exhibited much **higher rates of temperature growth** compared to the global averages over the past hundred years
- The Central Asian region reported an increasing frequency of adverse **natural disasters** of a wide spectrum
- Magnitude of future **rise of temperature and shifts in the precipitation patterns** in Central Asia will likely exceed the scale of the observed historical changes
- Climatic changes in the region will cause **significant changes in annual volume and seasonal patterns** of rivers` run-off

# CHALLENGES: CLIMATE IMPACT

- Decreased runoff and higher temperatures will exacerbate the **water scarcity** already observable in the southern part of the region
- Projected growth in temperatures, extend periods of extremely hot days coupled with changing precipitation patterns will lead to higher incidence of **drought conditions** for rainfed agriculture over the larger part of the region
- Reduced streamflow and higher demand for irrigation water will likely intensify **water shortages and crop failures** in arid and semi-arid parts of the region
- The fodder base for livestock farming in the northern part of the region, will be adversely affected by higher incidence of **unfavorable meteorological conditions**

# CLIMATE VULNERABILITY INDEX

	Exposure	Sensitivity	Adaptive capacity	Index
<b>Afghanistan</b>	1,20	0,48	0,14	4,14
<b>Azerbaijan</b>	1,40	0,40	0,70	0,80
<b>China</b>	1,00	0,14	0,88	0,16
<b>Georgia</b>	1,40	0,06	0,81	0,11
<b>Kazakhstan</b>	1,00	0,21	1,31	0,16
<b>Kyrgyzstan</b>	1,00	0,22	0,87	0,25
<b>Mongolia</b>	0,83	0,04	0,39	0,08
<b>Pakistan</b>	1,00	0,72	0,27	2,65
<b>Tajikistan</b>	1,00	0,31	0,67	0,47
<b>Turkmenistan</b>	1,20	0,90	0,31	3,52
<b>Uzbekistan</b>	1,20	0,87	0,28	3,71

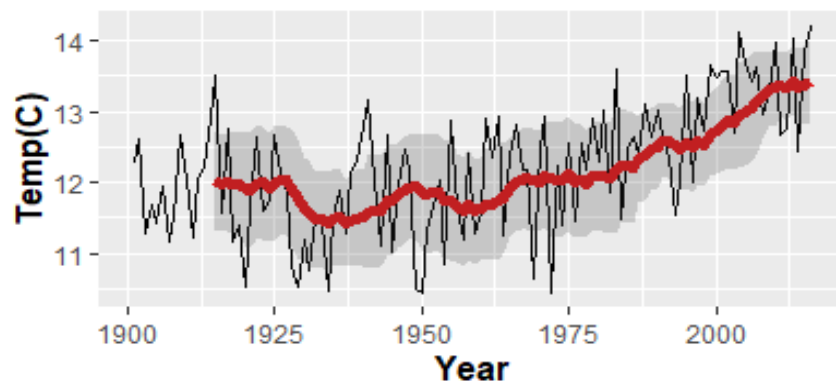
high risk

moderate risk

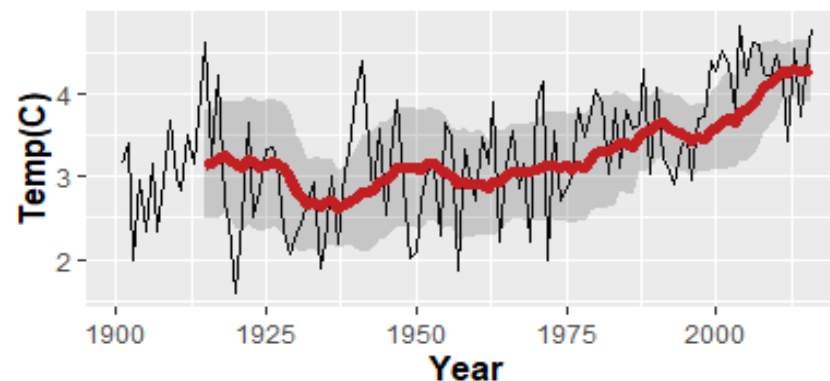
low risk

# KEY OBSERVED CLIMATE TRENDS IN CA

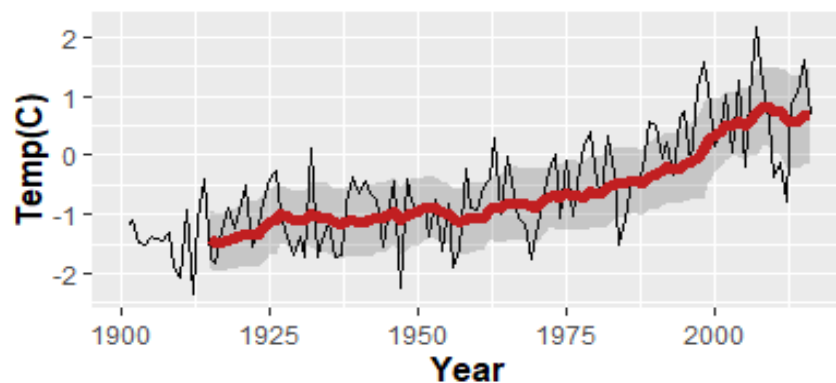
## Uzbekistan



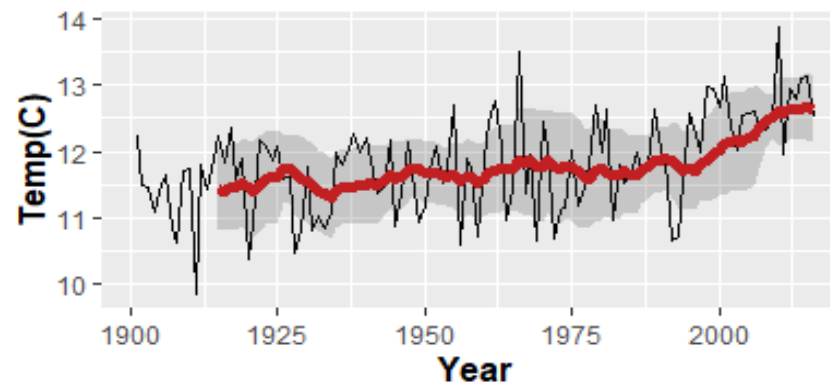
## Tajikistan



## Mongolia



## Azerbaijan

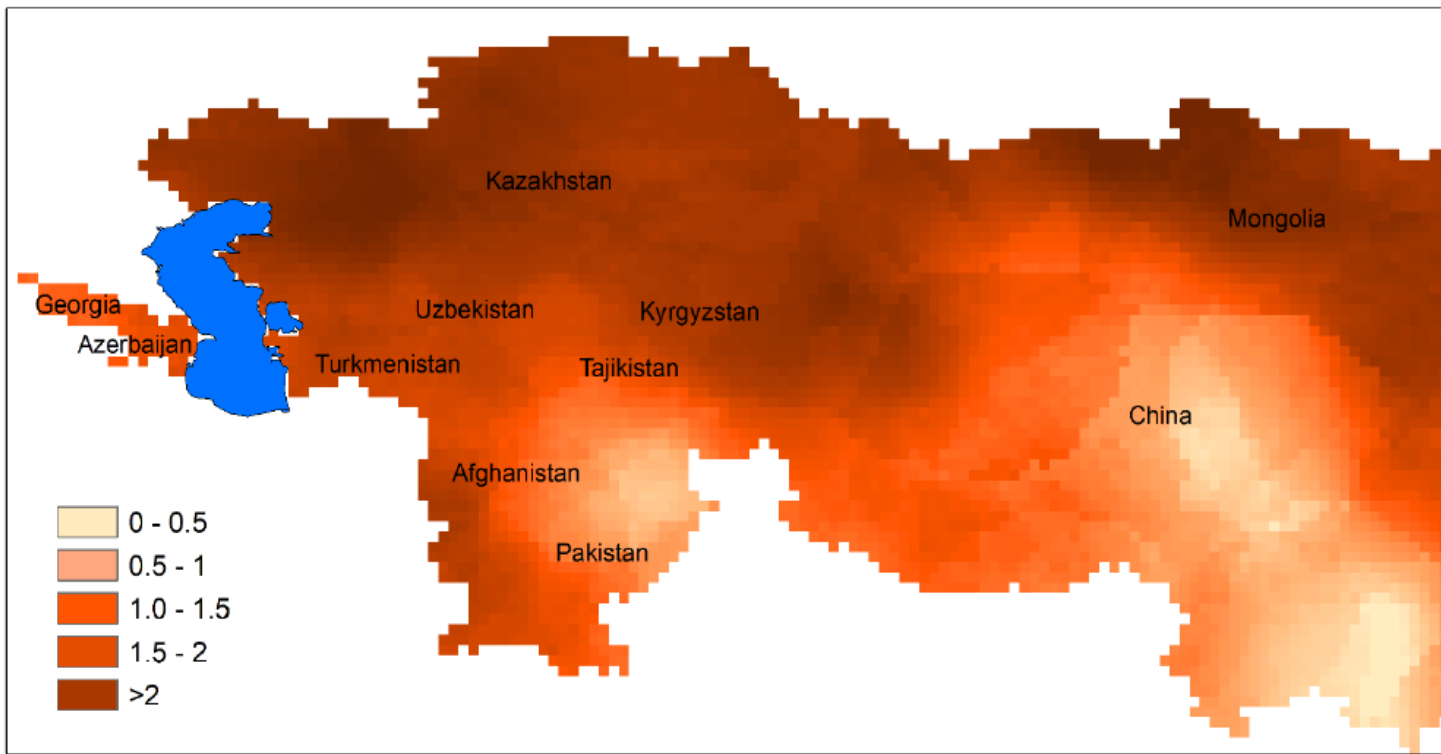


- Increasing annual temperatures over the past century in all countries of the region;
- The growth rate is from moderate (0.8-1.5 ° C) to high (1.8-2.2 ° C);

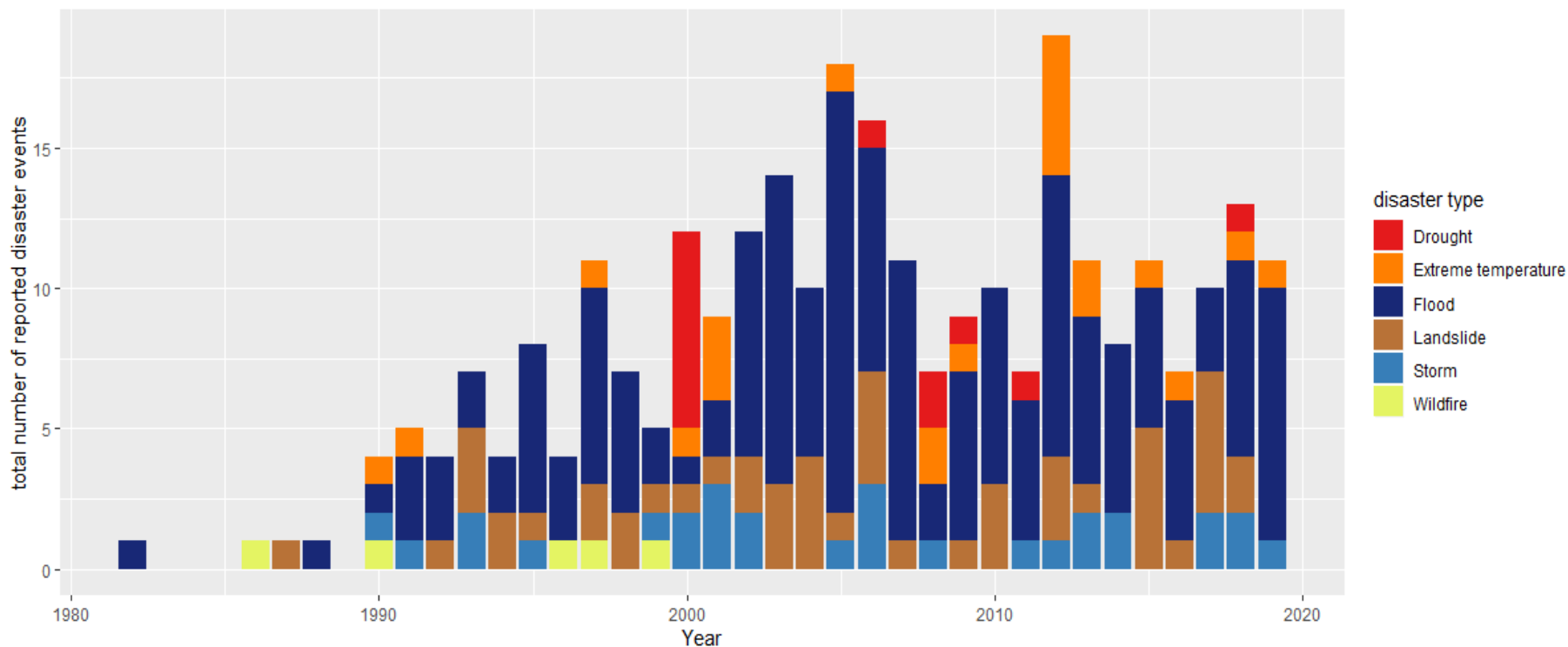
# CLIMATE VULNERABILITY INDEX

- High variability in annual temperature growth depending on geographic location;
- Relatively higher change in average annual temperatures from 1900 to 2000 in northwestern Central Asian plains, southern Afghanistan, eastern parts of the Tien Shan and Pamir mountains and in the north-west of Mongolia;

Change in mean annual temperatures across the CAREC countries by 2000-2020 with respect to 1900-1920 averages



# DYNAMICS OF EXTREME CLIMATE EVENTS - 1990s -2019



(based on EM-DAT 2019 database)

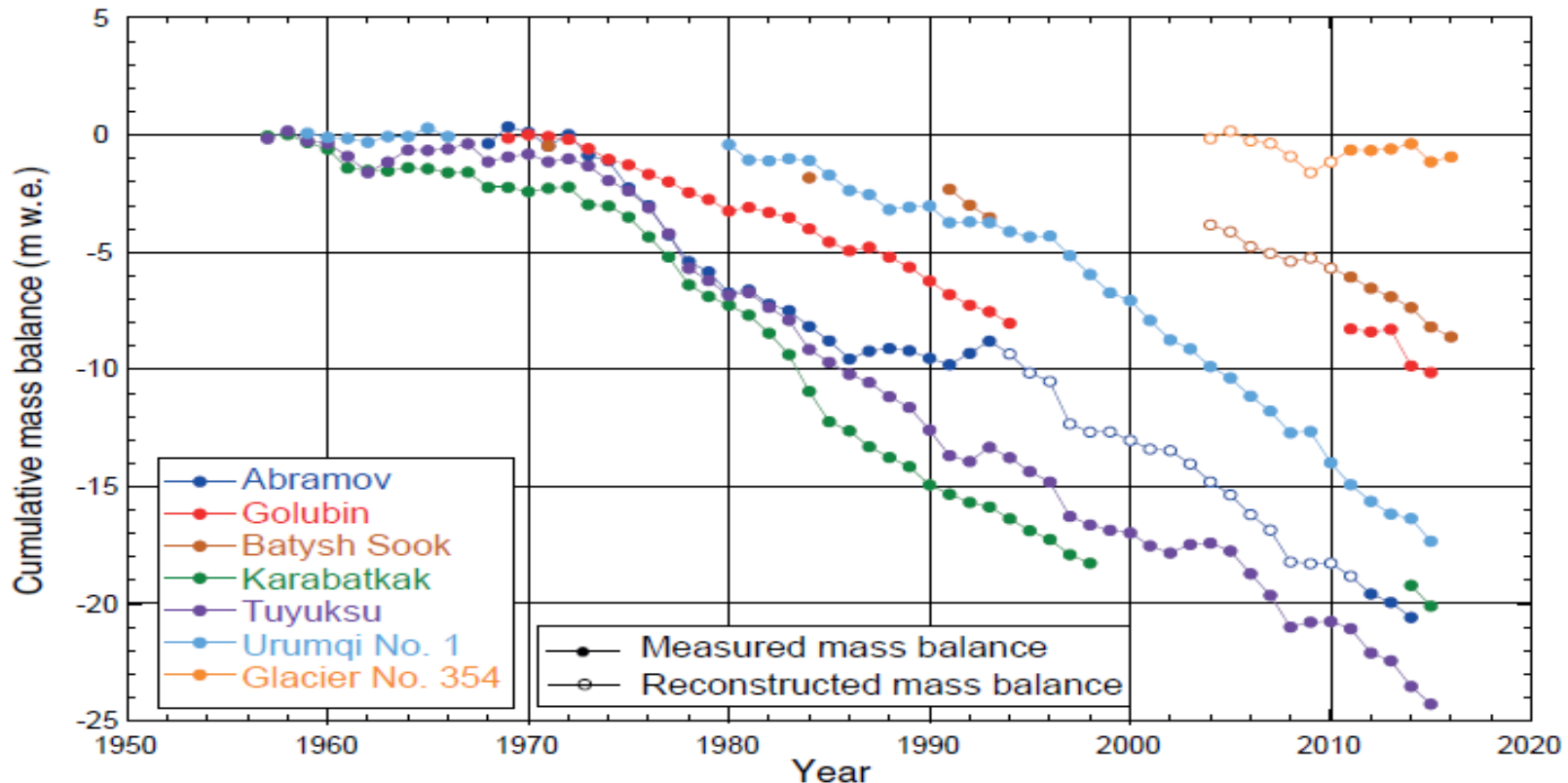
According to the National communications of the countries to UNFCCC there is :

- - increasing trend in occurrence of severe droughts in the Central Asian countries (NC 2016c);
- - higher number of the devastating “dzud” phenomena in Mongolia over the past 20 years (NC 2018);
- - increasing frequency of floods, mudflows and avalanches in the Caucasus countries since the 1980s (NC 2015a, 2015b);



# SHRINKING GLACIERS IN THE MOUNTAIN SYSTEMS ACROSS THE REGION

- Glacier mass in the mountains of Caucasus and Central Asia declined:
  - Varying estimates of glacial losses: from 30% of loss in the Tien Shan and Pamir mountains 50% in certain areas of the Transcaucasian mountains (NC2015ab,2016a);
  - The rate of glacial melt accelerated by the end of the 20<sup>th</sup> century;



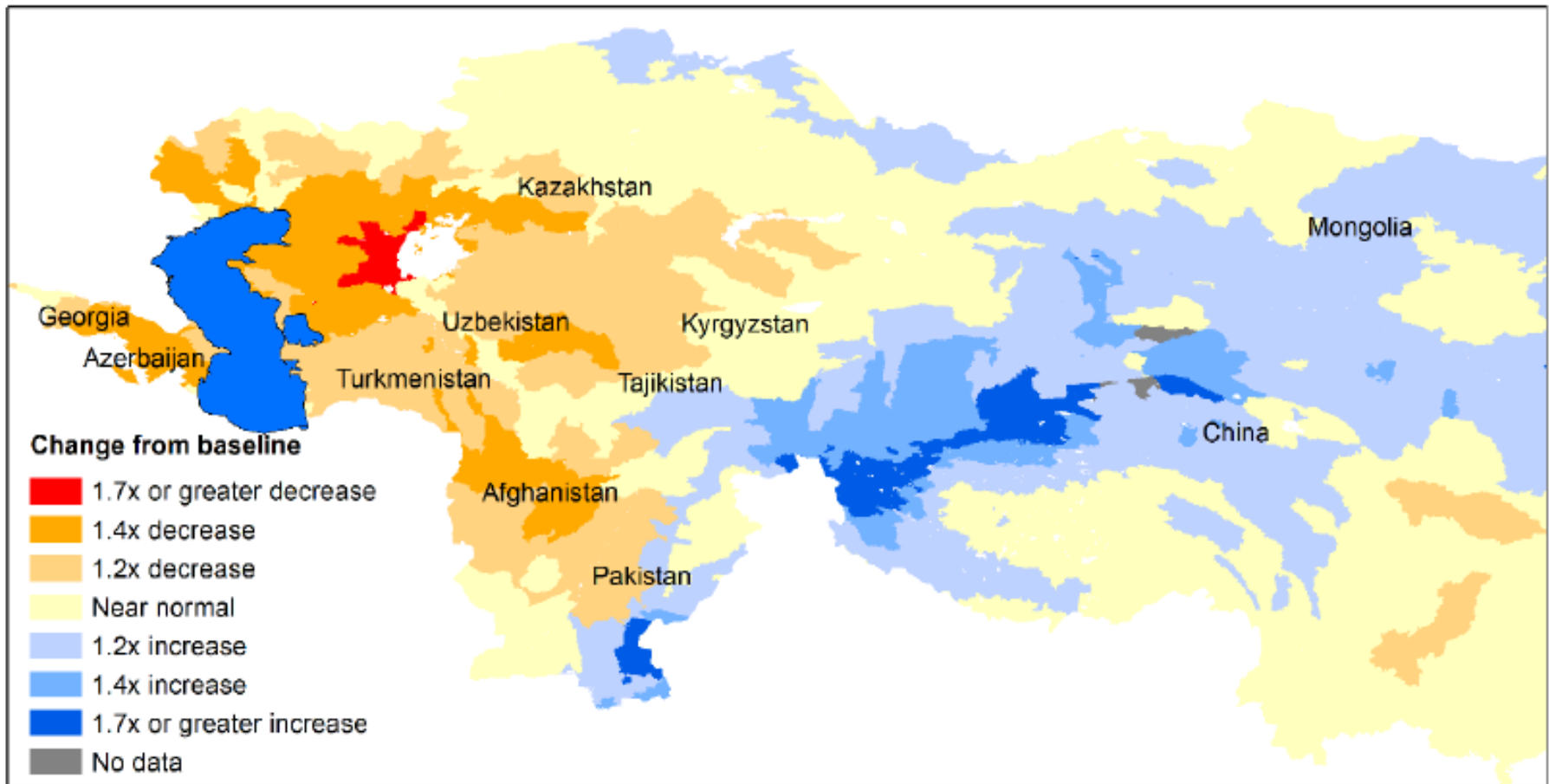
# CLIMATE CHANGE IMPACTS ON WATER RESOURCES

## ○ **Changes in rivers annual discharge:**

- Long term decrease in the average annual flow in rivers of the southern region, Central Asia (NC,2016);
- Upon high climate scenario, annual discharge may reduce by 25-30% on average (Punkarietal2014);
- In the short-run there might be a slight increase in rivers discharge due to more intensive glacial melt, though the same projections show decline in the long run due after disappearance of the glaciers (NC,2017).

# CLIMATE CHANGE IMPACTS ON WATER RESOURCES

Projected changes in water supply by 2040 under RCP 8.5 scenario

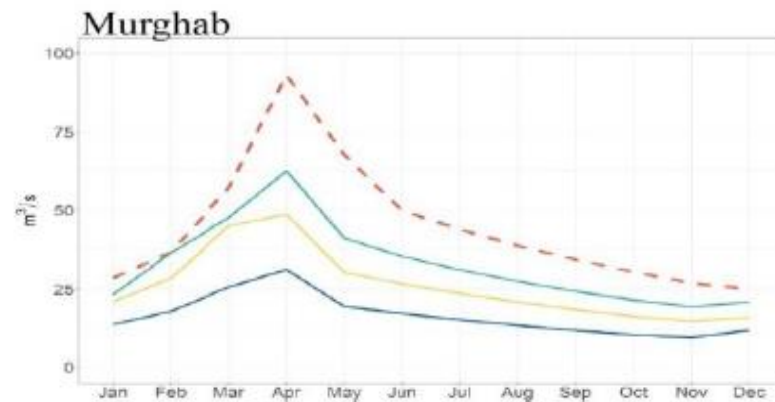
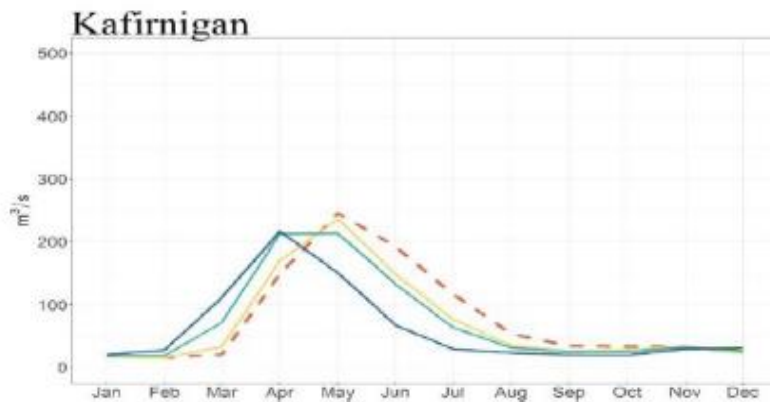
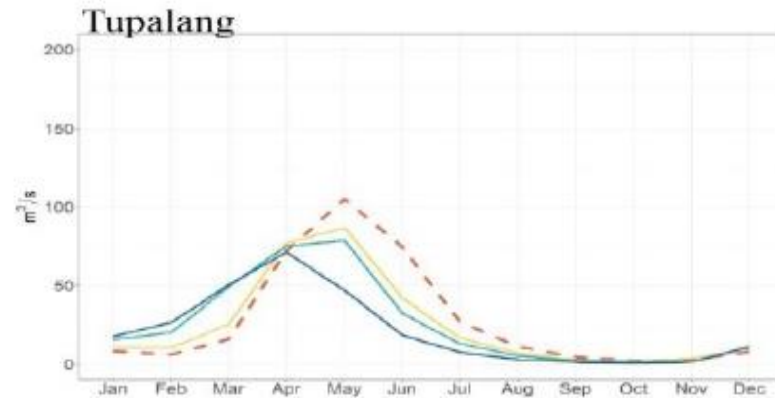
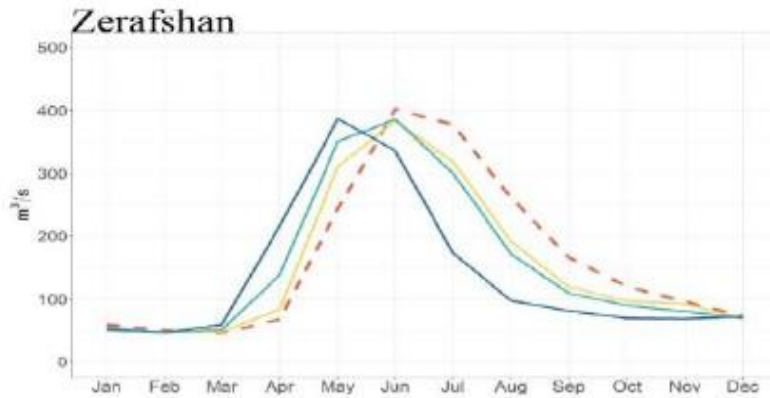


# CLIMATE CHANGE IMPACTS ON WATER RESOURCES

- **Projected changes in seasonal run-off:**
- Peak discharges will be shifting to earlier dates in the most rivers of the region;
- Increase in likelihood of early springs floods in mountainous parts of the Caucasus and CentralAsia, as well as in plain land river basins in the northern Kazakhstan;
- Reduced run off during summers accompanied with increased evapotranspiration rates;

# CLIMATE CHANGE IMPACTS ON WATER RESOURCES

Projected seasonal shifts in monthly discharges of selected Central Asian rivers under RCP 8.5 scenario



Source: Didovets et al 2020

# CLIMATE CHANGE IMPACTS ON AGRICULTURE

## **1. Increase in average monthly temperatures - potential benefits:**

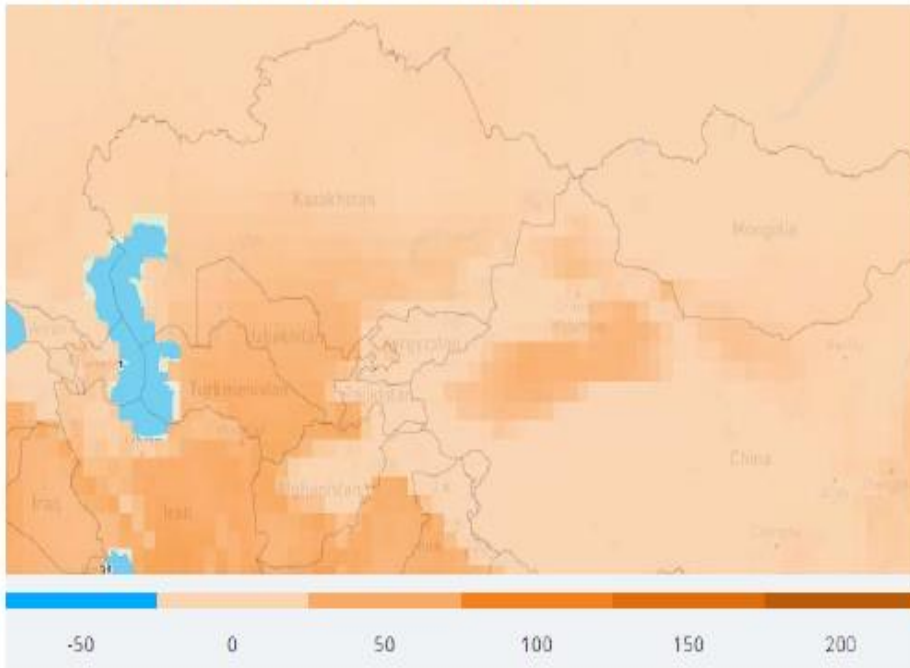
- Earlier sowing of crops;
- Lengthening of the growing season;

## **2. Increase in average monthly temperatures - threats:**

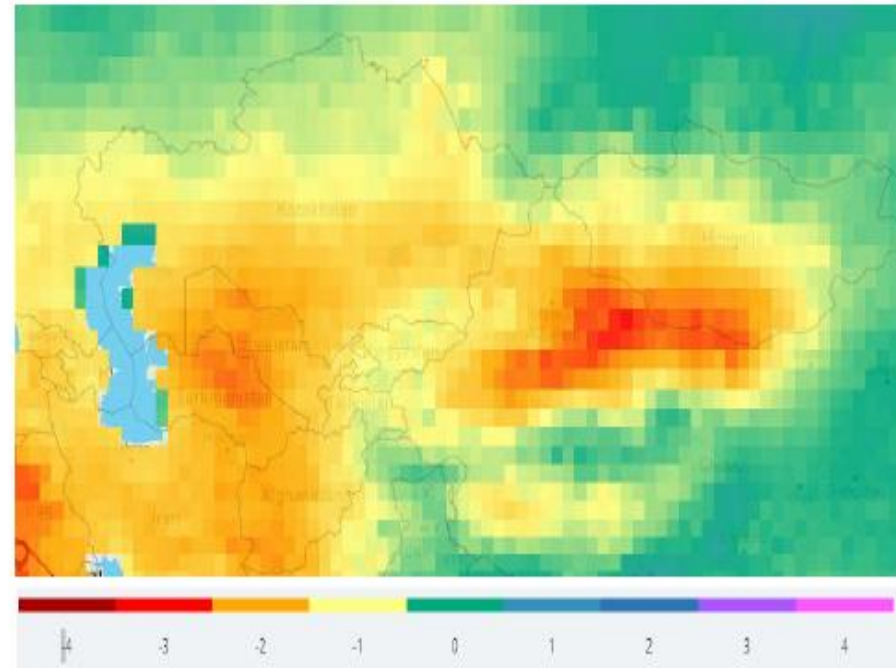
- Increase of number of days with hot temperatures (>40C);

# CLIMATE CHANGE IMPACTS ON AGRICULTURE

Projected increase in the number of days with temperatures above 40 °C, and in the region by 2070 under the RCP8.5 scenario



Projected changes in Mean Drought Index in the region by 2070 under the RCP8.5 scenario



Source: based on CMIP5 ensemble projections, retrieved through WB CCKP 2020

# CLIMATE IMPACTS ON RAINFED AGRICULTURE

## 1. Increase in average monthly temperatures - potential benefits:

- earlier sowing of crops;
- Lengthening of the growing season;

## 2. Increase in average monthly temperatures - threats:

- Increase of number of days with hot temperatures (>40C);



higher vulnerability for rainfed agriculture in Kazakhstan,  
Mongolia and the Caucasus countries

Projected decrease in grain yields by 2050:

- by 15% and more in Kazakhstan and Mongolia (NC2017, NC2018).
- by 3-28% the Caucasus countries under moderate climate scenario (Ahouissoussi et al 2014).



# CLIMATE IMPACTS ON THE IRRIGATED AGRICULTURE

1. Increases evapotranspiration rates due to growth of temperatures;
  - higher demand for irrigation water;
2. Decreased water availability and seasonal shifts in rivers run-offs:
  - rise in likelihood of water shortage during middle of the vegetation season;
  - higher likelihood of hydrological droughts



Higher exposure and vulnerability in irrigated agriculture of southern parts of Central Asia (Afghanistan, Pakistan, Turkmenistan, Uzbekistan, south of Kazakhstan):

- Significant impacts on irrigated crop production except winter wheat (Sutton et al 2013)
- Decrease in rice yields by 20-30% under high climate scenario

# CLIMATE CHANGE IMPACTS ON THE LIVESTOCK FARMING

- Potential benefits for fodder crops in piedmont and mountainous areas (alfa-alfa) upon sufficient soil moisture condition
- Decrease in productivity of pastures in Mongolia, Kazakhstan and Kyrgyzstan due to decline in summer precipitation coupled with higher evapotranspiration (NC2016b,2017b,2018)
- Higher likelihood of more frequent dzud events in Mongolia - loss of livestock due to dzuds may increase by 50% (NC2018)

# COSTS WITHOUT ADAPTATION IN USD

## **Costs of reduced water flow in 2100**

- 1.2 billion for Afghanistan
- 103 million for the Kyrgyzstan
- 177 million for Tajikistan

## **Costs of natural disasters in 2100**

- 50 million for Afghanistan
- 23 to 60 million for Kyrgyzstan
- 280 million for Tajikistan

*Source: ADB, 2013*



# ADAPTATION MEASURES

*Source: INDC and NDCs*

<b>Country</b>	<b>Measures</b>
<b>Afghanistan</b>	Increase irrigated land, climate friendly irrigation, increased rangelands
<b>Azerbaijan</b>	Improved pasture and land management; plant new tree, windbreaks
<b>China</b>	Drought-resistant crops, water-saving irrigation; restore grassland; shelter belts
<b>Georgia</b>	Innovative irrigation; anti-erosion measures
<b>Kazakhstan</b>	Modernization of irrigation and collectors; efficient irrigation; crop rotation; increased soil fertility
<b>Kyrgyzstan</b>	drought-resistant; salt-tolerant crops; phytomeliorative actions; pasture management, agricultural infrastructure
<b>Mongolia</b>	Reduce bare fallow; expand irrigated cropland; zero-tillage technology; pasture management; soil protection; forest management
<b>Pakistan</b>	organic fertilizer; gm crops; irrigation and water management; no-till technique; fast-growing tree species
<b>Tajikistan</b>	Green infrastructure in agriculture and irrigation systems
<b>Turkmenistan</b>	Drainage water collection and use after desalinization
<b>Uzbekistan</b>	Diversification of food crops; droughts, pests and disease resistant crops; irrigation and drainage infrastructure; afforestation; indigenous plant species

# MITIGATION MEASURES

*Source: INDC and NDCs*

<b>Country</b>	<b>Measure</b>
<b>Afghanistan</b>	Biomass recovery measures for energy; reduction in fuel used, or cleaner fuel technologies; optimal timing of fertilizer application
<b>Azerbaijan</b>	Methane gas from manure
<b>China</b>	Reutilization of forestry and animal wastes; zero growth of fertilizer and pesticide use; methane and nitrous oxide emissions control
<b>Georgia</b>	Increased forest area; expand protected area; carbon monitoring in forest areas
<b>Mongolia</b>	Sustainable grassland management; forest protections; zero-tillage and crop rotation
<b>Pakistan</b>	Green manure; biogas and organic fertilizer; genetically modified crops; no-till farming
<b>Tajikistan</b>	Sustainable forest management, afforestation and reforestation
<b>Uzbekistan</b>	Conservation and restoration of forest resources; combating desertification

## IV. OUTLOOK

### **Observed climate change trends over the CAREC region**

- higher rates of temperature growth;
- seasonal and spatial changes in the precipitation;
- frequencies of adverse weather events;

### **Long term climate outlook:**

- substantial growth of temperatures;
- changes in precipitation sums across seasons, mountain areas;

### **Impact on water resources and agriculture:**

- altered water availability in semi arid and arid zones;
- shifting seasonal runoff;
- challenges for Irrigated crop production in the southern part;
- mixed prospects on rainfed agriculture;
- increase in weather shock for livestock farming in northern region

## IV. OUTLOOK

- **Climatic change** - economic losses in economies of Central Asian countries- highest in agricultural sector. Prioritize investment strategies in the future. Suitable mitigation and adaptation mechanisms -reduce environmental externalities, vulnerability of population, especially in rural areas
- Suitable **adaptation and mitigation** mechanisms :
  - higher water use efficiency technologies,
  - establishment of early warning systems for climate related extreme events,
  - implementation of no-till technologies and crop diversification, afforestation, improved crop management
- **Financial tools and mechanisms:** credit, insurance, subsidies, carbon market and taxation - suitable financial mechanisms- yet underdeveloped in the region, except few cases and countries

# CENTRAL ASIA REGIONAL ECONOMIC COOPERATION (CAREC) INSTITUTE

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