unesco

Aga Khan Agency for Habitat

ICIMOD

CARGC

GLOFCA

ADAPTATION FUND

Cryosphere and related hazards in High Mountain Asia in a changing climate

1–4 November 2022 | Almaty, Kazakhstan

Presenter(s): Nina Pimankina, Zhasulan Takibayev

Date: November 4, 2022

Contemporary fluctuations of snow cover in the Arys River basin (Ogem Range), Tien Shan

Study area

Arys River is the right tributary of the Syrdarya River, 378 kms long, area 14 900 km², snowmelt-rain feeding. In the region about 2 mln residents live, major autoroads of great economical importance Korgas-Almaty-Tashkent, Shymkent-Samara pass. 37 water intake channels, 11 water reservoirs and 3 HPP were constructed.

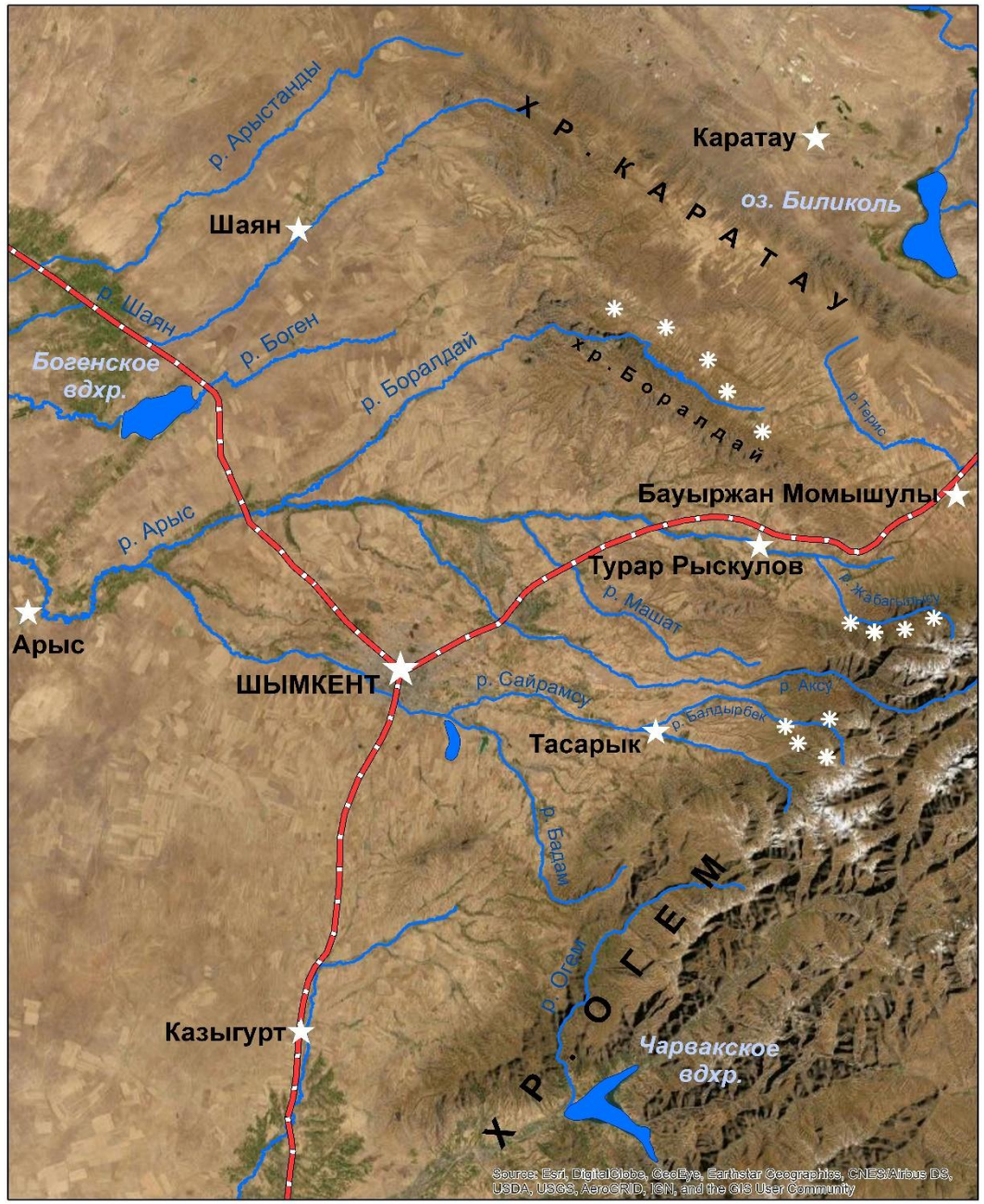
Typical dangerous phenomena are snow storms, snow drifts and accumulation, snow avalanches, snowmelt floods against the background of a thaw (rain-on-snow).

In 2010, the volume of snow avalanches that came down in the Zhabagyly River basin, amounted to 170 thousand cub m, in the Baldyrbek River basin around 50-70 thousand cubic m.

In 2010, 2017 strong snowmelt -and -rains floods caused a rise in the water level on the rivers by 2 m, flooding houses. In 2012, winter floods flooded 226 settlements, 1.5 thousand houses, 4 bridges were destroyed, more than 2.2 thousand people were evacuated. Economical damage was around 3 mln USD.

During dangerous snowfalls, 50-60 mm of precipitation or even more can fall, which leads to an increase in snow loads and to the destruction of small constructions.

Snow drifts can block passes and sections of roads for several days, interrupt traffic. Many snow removal equipment is needed.



Initial data

In our study we used the data of ground observations of the Kazakh Hydrometeorological Surveys at the stations, hydrological posts, and precipitation collectors for 1960-2022. Yearly data from the Aul Turar Ryskulov station, and also data of daily measurements of the snow depth at the sites of 4 meteostations were used. Data of snow surveys in 3 basins-tributaries of the Arys River were analysed. Data from 22 precipitation collectors, established on the slopes of different exposure , were taken into account. Period of observations at the network of Kazhydromet varies from 8 to 60 years and more. Data obtained from periodical field snow surveys over the area of the Arys River basin has made it possible to assess distribution and dynamics of solid precipitation and snow cover at the altitudes 700-3300 m a.s.l. Information from the Departments of Emergency situations was also analysed.

Название	Широта	Долгота	Высота, м
Аул Т. Рыскулова	42.29	70.18	801
Тасарык	42,2	70,2	1123
Шымкент	42,32	69,7	604
Арыс	42,4	68,8	238
Туркестан	43,3	68,3	205
Шульдак	42,3	70,4	1947
Ащысай	43,6	68,9	820
Жетысай	40,46, 31	68,19,38	255
Казыгурт	41,45,30	69,23,14	675
Кызылкум	41,54,40	67,59,18	184
Тасты	44,48,02	69,10,11	191
Шардара	41,15,17	67,58,09	271
Шаян	43,01,23	69,22,24	366
Шолаккурган	43,45,54	69,10,33	480

Table 1 – Data on meteo stations in the study area (Kazakhstan

Бассейн	Снегопункты, диапазон высот, м	Осадкомеры, диапазон высот установки, м
р. Боралдай	700-1560	700-1650
р. Балдырбек	1500-2440	1680-3270
р. Жабагылысу	1300-1840	1590-2400

Table 2 – Field Snow surveys in Arys River basin

Results

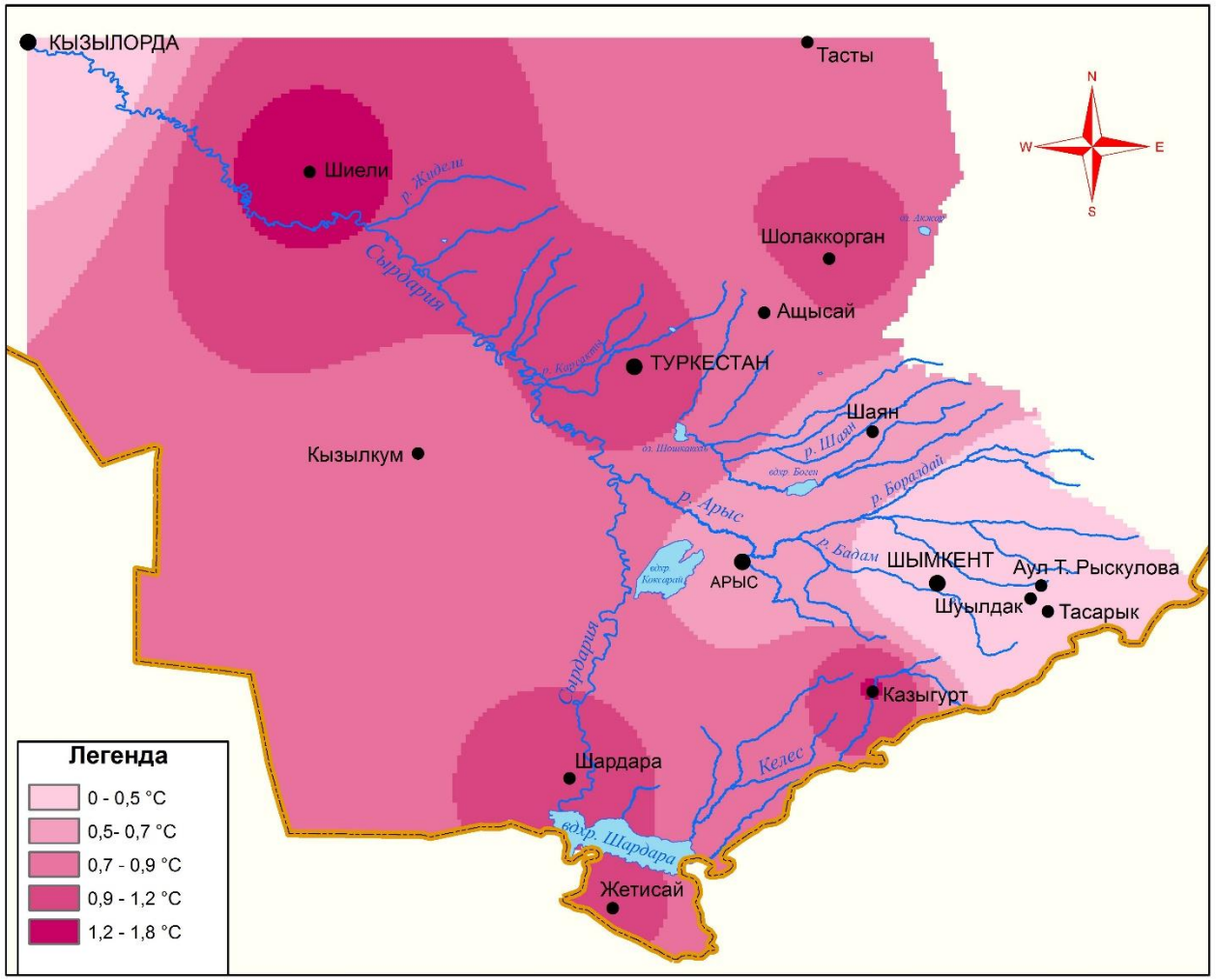


FIGURE 1. Positive difference in the mean yearly air temperature for 1960-1990 and 1991-2021 in the Syrdarya River basin

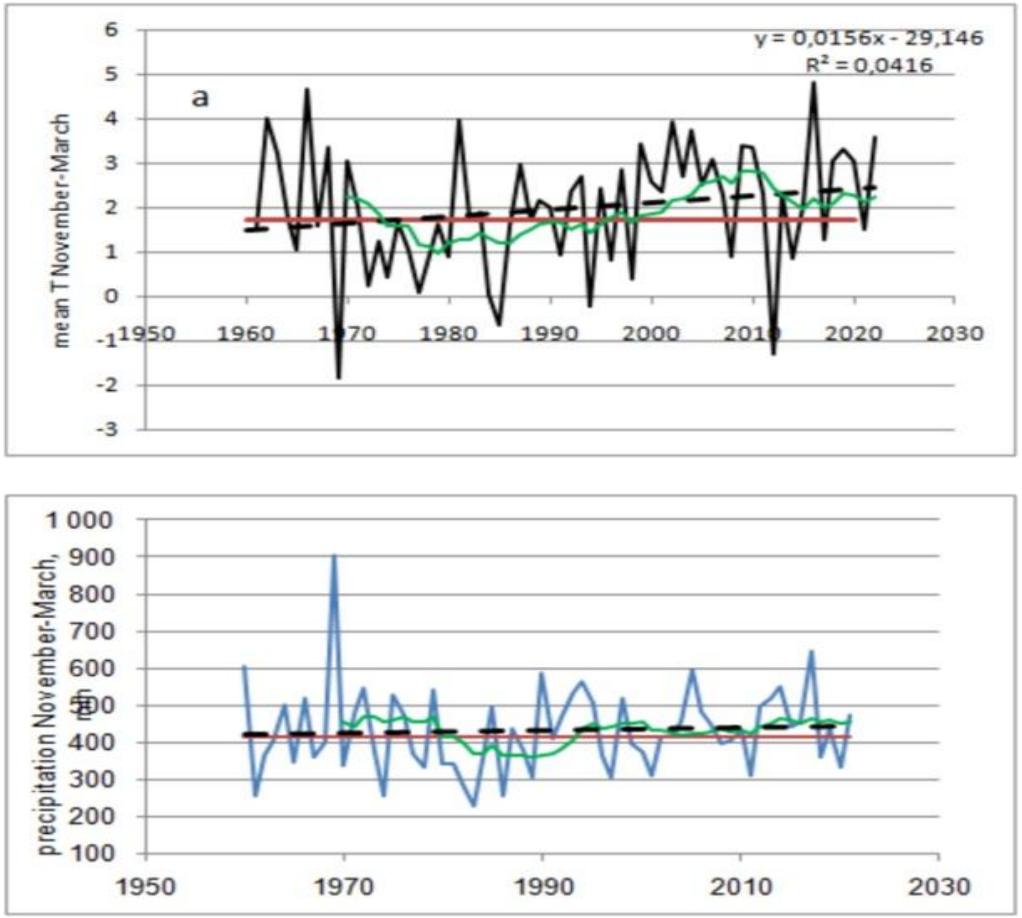


Figure 2 - Variations in the mean air temperature (a) and sums
of precipitation (November-March) , 1960-2021, Aul T.
Ryskulov meteo station

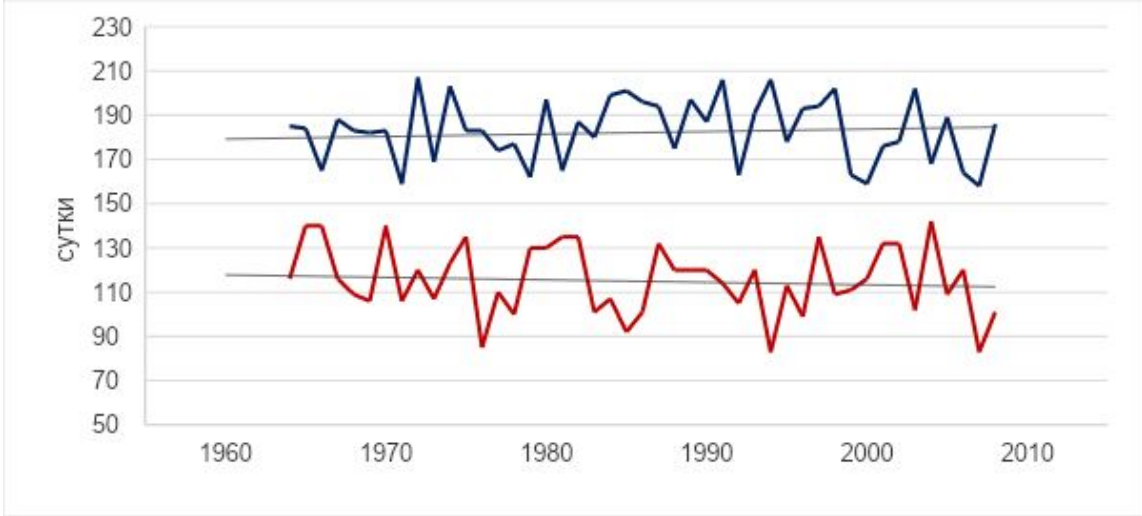
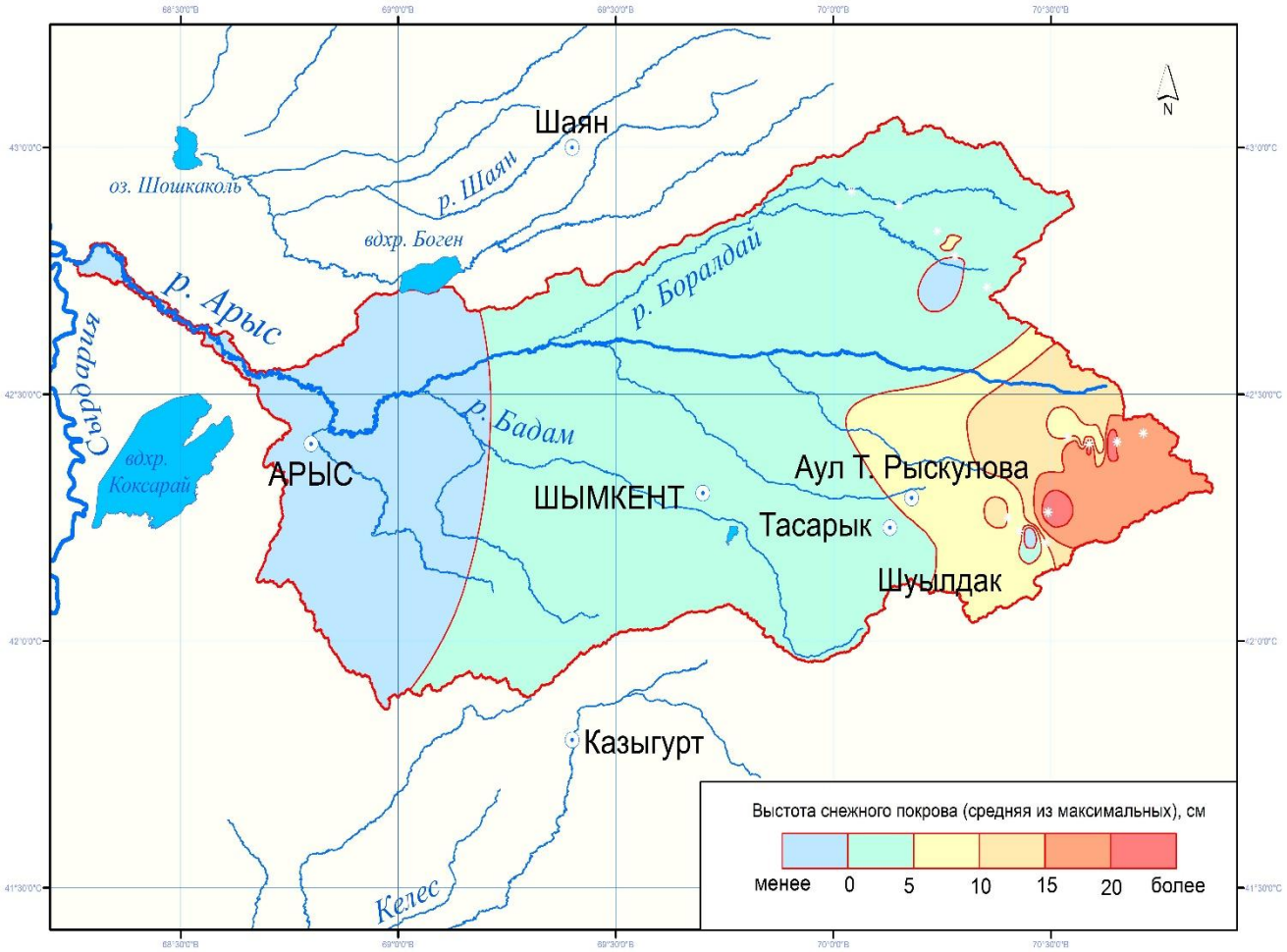


Figure 3 – Multiyear variations of the dates of start (lower line)

Changes in snow cover

Figure 4 – Difference between mean snow depth (cm) for 1960-1990 and 1991-2017 in the Arys River basin

The map, compiled in GIS-program, show that the area where mean maximum depth of snow has increased for the last 30 years, is the greater part of the basin and reaches maximum at higher altitudes , in the upstreams of the Arys River



For the period 1991-2017 the depth of snow
cover measured at the permanent stakes on
6 meteostations) has increased by 2-20% (or 1-7 cm) compared to1960-1990 .
In mountains the difference reaches 5-25 cm
(or 10-30 %).

Figure 5 –Snow cover in the basin of the Arys River. Snow fence. March, 2008.

Conclusions

- In the mountains of the Arys River basin the amount of precipitation, the depth and water content of the snow cover distributed unevenly depending on the orography and topography of the area.
- At the end of the 20th - beginning of the 21st century in the basin of the Arys river an increase in the air temperature and precipitation for the cold period was found. The interannual variation of the sums of precipitation, depth and water content of the snow cover has a common spatial relationship.
- The interannual fluctuations of the depth and water content of the snow cover, have mostly positive trends. The depth and water content of the snow cover in the mountains increased by more than 80% of the points of snow surveys. The last 10-20 years have been quite snowy.
- When comparing the periods 1960-1990 and 1991-2022, it was found that the average values of the snow cover depth in February increased by 5-30%. It is currently not possible to assess the causes of significant changes (climatic or technical).
- Trends in long-term changes in the dates of snow cover duration indicate a somewhat earlier establishment and early melting of snow.
- No evident regularities in the distribution of the observed changes depending on the altitude or slope exposure have been identified, which is the subject of further analysis.

•GIS-map of the spatial distribution of changes in the depth of the snow cover over the territory of the

Arys River basin has showed that the area covering the middle- and high mountains, where the snow

depth exceeds 30 cm and the snow accumulation exceeds 200 mm. The prediction of snow-related hazards is

primarily a prediction of climate change. An analysis of long-term ground-based observations confirms

the data on the warming of the winter months and some increase in the amount of precipitation during the cold season. At the same time, the impact of changes in snow cover on water resources,

social and economic processes in the area is obvious.

•Additional efforts are needed for glacio-climatic monitoring and assessment of the state of alpine landscapes.

•Taking into account inaccessibility of remote mountain catchments, it is necessary to use available

satellite images for the early recognition and warning residents about possible hazardous situations

Data Sources:

https://meteo.kazhydromet.kz/climate_kadastr, Pogodaiklimat.ru, http://www.rp5.ru

Data of field snow surveys in mountains. -Almaty. 1960-2019

Monthly Meteorological data . Issue 18. Part 2. Almaty, 1960-2021. №№1-12 (13).

Thank you