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DISTRIBUTION OF AIR TEMPERATURE AND PRECIPITATION IN THE JIZZAKH REGION IN 1991-2020

Abstract: The article discusses the analysis of climatic conditions in the Jizzakh Region based on information from meteorological stations located in the area for four 30-year periods: 1961-1990, 1971-2000, 1981-2010, and 1991-2020. The study compares temperature and precipitation data for these periods. The European Centre for Medium-Range Weather Forecasts (ECMWF) ERA5 reanalysis data for the years 1991-2020 is used to determine the distribution of temperature and precipitation during the climatic period. The obtained results illustrate the increasing trend of temperature and precipitation in the region over the specified time frames.

Keywords: climate change, air temperature, precipitation, ERA5, Jizzakh Region.

Global climate change is characterized by an increase in temperature, intense winds, heavy precipitation, melting glaciers, flash floods, and drought among other hazardous meteorological events. According to analytical data from the National Aeronautics and Space Administration's (NASA) Goddard Institute for Space Studies (GISS), it has been observed that the average global temperature has risen by 1.5 ºC since 1850 (Fig. 1) [1]. Climate change impacts various sectors of human activity, including agriculture, water resources, energy,

transportation, construction, healthcare, tourism, and many others. The consequences are significantly affecting these fields on a global scale.

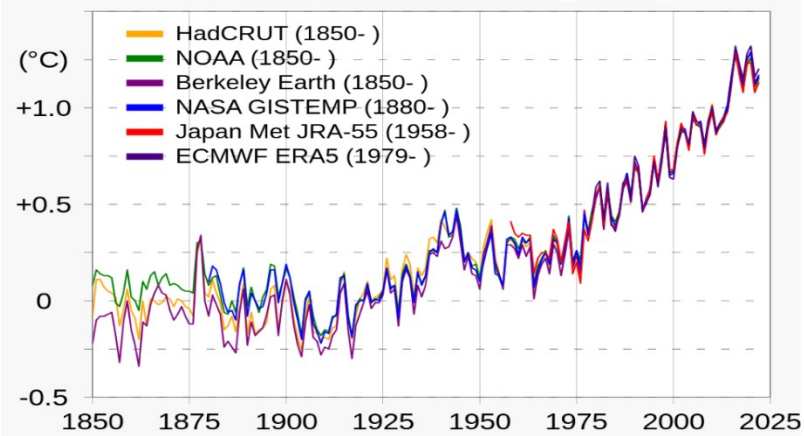


Fig. 1. Global average temperature change [1]

In describing local climate, temperature and precipitation data are fundamental climatic indicators. A wide range of scientific and practical issues benefit from utilizing information on temperature and precipitation regimes.

This article investigates the distribution of temperature and precipitation in the Jizzakh Region, located in the central part of Uzbekistan, during the latest 30-year climatic period (1991-2020). The region exhibits various relief forms, from northern plain and lowland areas to southern plains and foothills. Currently, the Jizzakh Region is equipped with seven meteorological stations of Uzhydromet, and data from six of them was used for analysis during the research (Table 1, Fig. 2).

Table 1. Information about meteorological stations located in the Jizzakh Region

№	Station	Absolute height, m	Descriptive area
1	Jizzakh	344	Plain
2	Gallaaral	573	Foothills
3	Bakhmal	1313	Mountainous
4	Yangikishlak	514	Foothills
5	Lalmikor	748	Mountainous
6	Dustlik	273	Plain
7	Western Arnasay	248	Plain

To assess changes in temperature and precipitation regimes in the region, meteorological data for four 30-year climatic periods (1961-1990, 1971-2000, 1981-2010, and 1991-2020) from meteorological stations were comparatively analyzed [2-5] (Fig. 3). The processing of observational data was conducted following the World Meteorological Organization (WMO) guidelines [6].

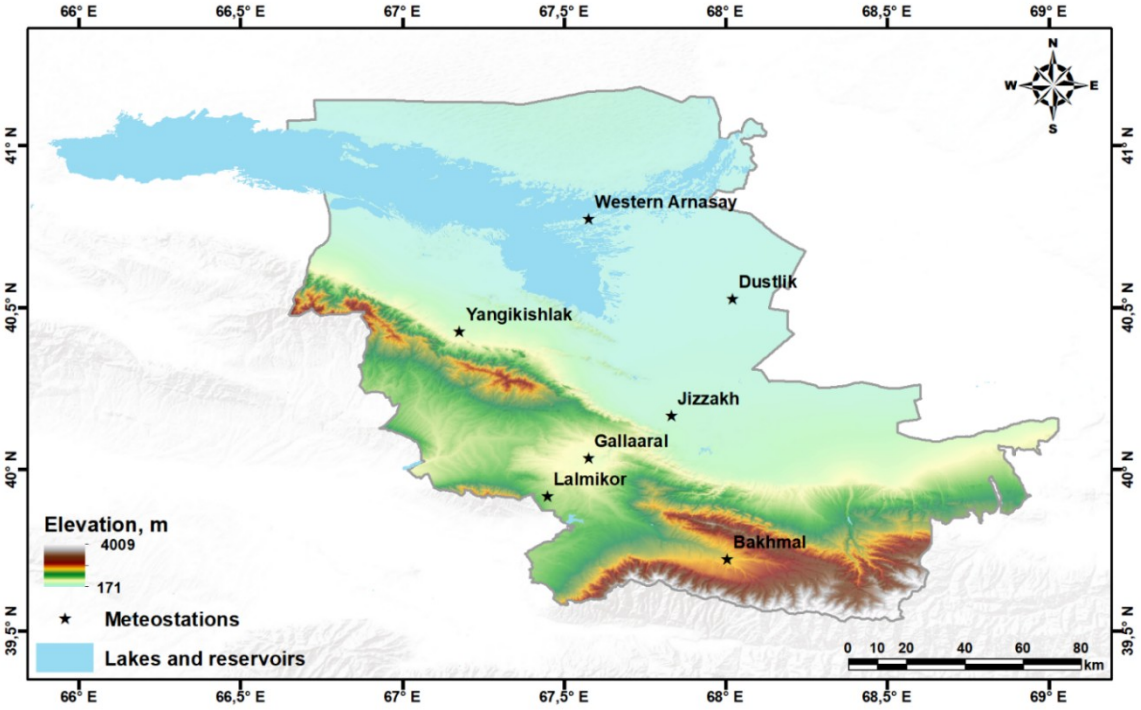
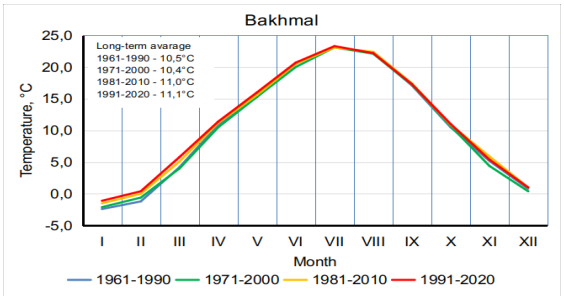
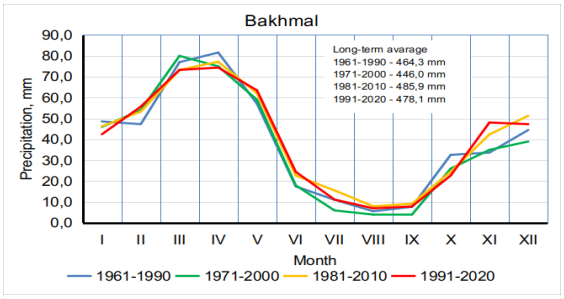


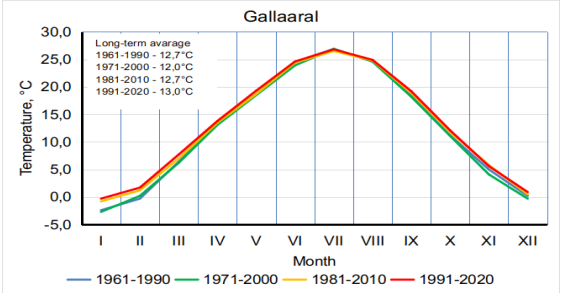
Fig. 2. Location of meteorological stations in Jizzakh Region

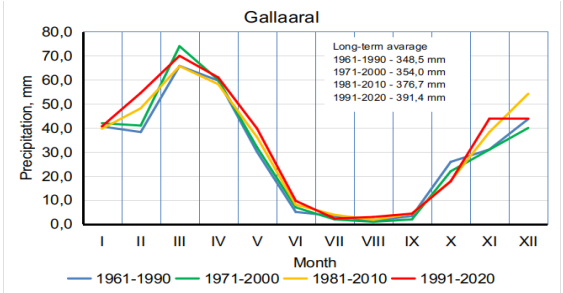
The changes in the average annual temperature over several decades indicate an overall increase in temperature at all stations. Comparing the first baseline climatic period (1961-1990) to the later climatic period (1991-2020), Lalmikor and Yangikishlak experienced an increase of 0.5°C (from 13.2°C to 13.7°C and from 15.1°C to 15.6°C, respectively). Similarly, in Bakhmal and Jizzakh, the average annual temperature increased by 0.6°C (from 10.5°C to 11.1°C and from 14.4°C to 15.0°C, respectively), and in Gallaaral and Dustlik, it increased by 0.8°C (from 12.2°C to 13.0°C and from 14.4°C to 15.2°C, respectively). The temperature rise is particularly notable during the cold half of the year (January, February, and March).

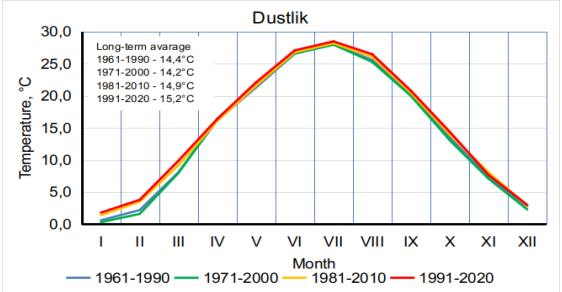
Changes in the precipitation regime in the region showed uneven character. For example, multi-year average precipitation in Bakhmal is lower in the second (1971-2000 – 446.0 mm) and last (1991-2020 – 478.1 mm) climatic

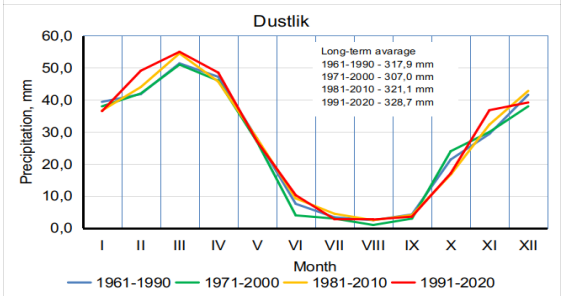


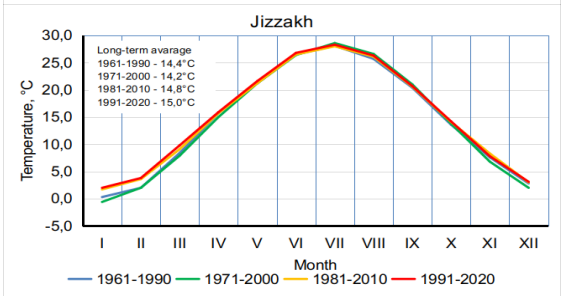


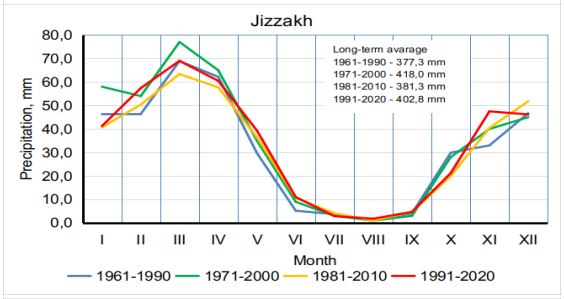


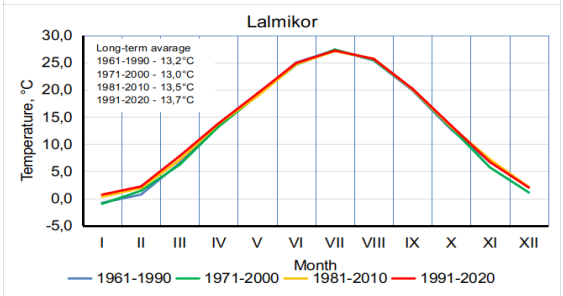


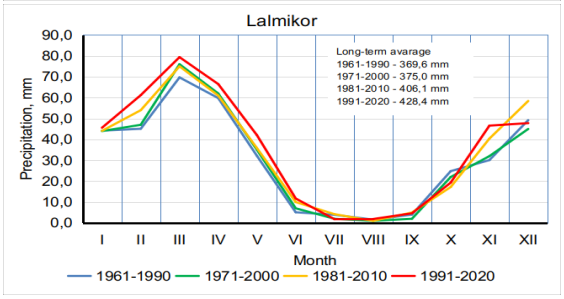












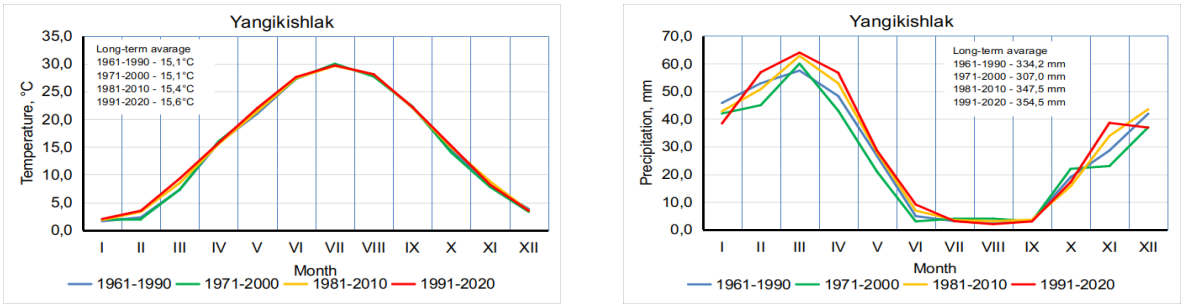


Fig. 3. Intra-annual distribution of air temperature and precipitation at Jizzakh Region's weather stations in periods 1961-1990, 1971-2000, 1981-2010 and 1991-2020

periods than in the first (1961-1990 – 484.3 mm) and third (1981-2010 – 485.9 mm) climatic periods. The opposite trend was observed in Jizzakh. Gallaaral witnessed an overall increase in precipitation over the climatic periods. The differences in the average annual precipitation between the first and fourth climatic periods were +13.8 mm in Bakhmal, +42.9 mm in Gallaaral, +10.8 mm in Dustlik, +25.5 mm in Jizzakh, +58.8 mm in Lalmikor, and +20.3 mm in Yangikishlak.

According to M.L. Arushanov, Uzbekistan has established a network of 82 meteorological stations with a coverage density of 1 meteorological station per 6000 km^2, which is less than 2 times than the requirements of the WMO [7]. However, this distribution does not allow for an accurate spatiotemporal distribution of meteorological parameters.

The challenge of insufficient coverage in meteorological data can be addressed through one of the methods of overcoming observational gaps: utilizing reanalysis data from meteorological field analyses. Reanalysis involves regularly updating meteorological observation data in the reanalysis process, and it interpolates atmospheric parameters globally in a regular grid, even in regions with no direct observations. Importantly, this method has been effectively applied in scientific research in Uzbekistan [8-10].

In the Jizzakh Region, the distribution of temperature and precipitation for the period 1991-2020 was mapped using data from the ECMWF ERA5 reanalysis (Fig. 4-5). The southern part of the region, considering locations like Molguzar, Gubdin, and Zaamin, experiences the lowest average temperatures

(3-4°C) and the highest annual precipitation (>1000 mm). Conversely, areas in the northern and southern parts, like Mirzachul, exhibit higher temperatures and lower precipitation levels.

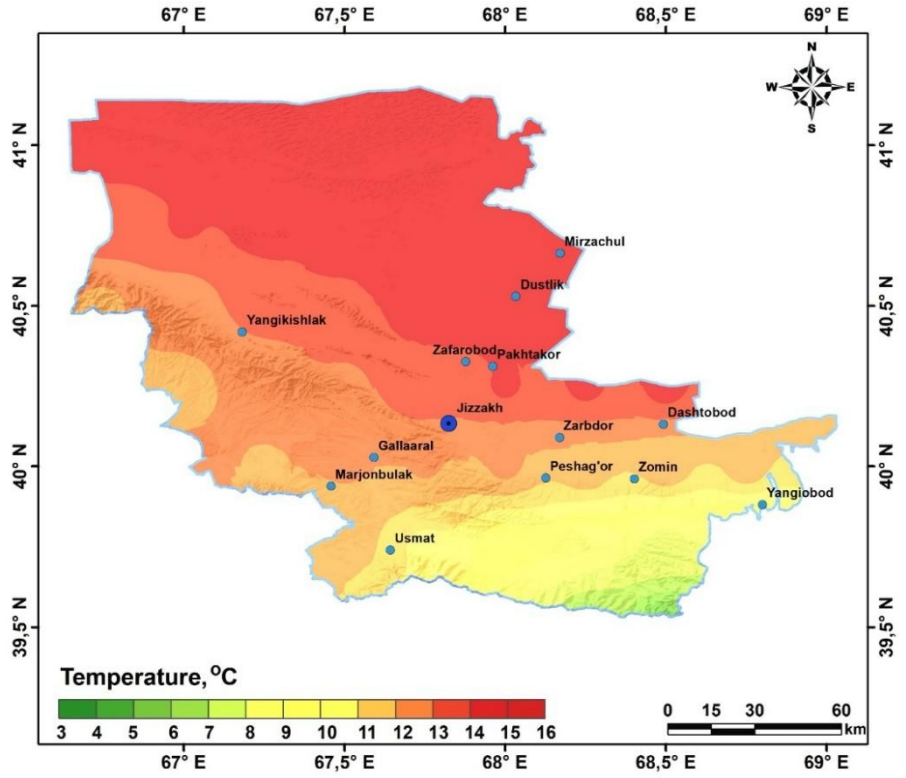


Fig. 4. The distribution of the annual average temperature in the Jizzakh Region (based on ERA5 reanalysis data)

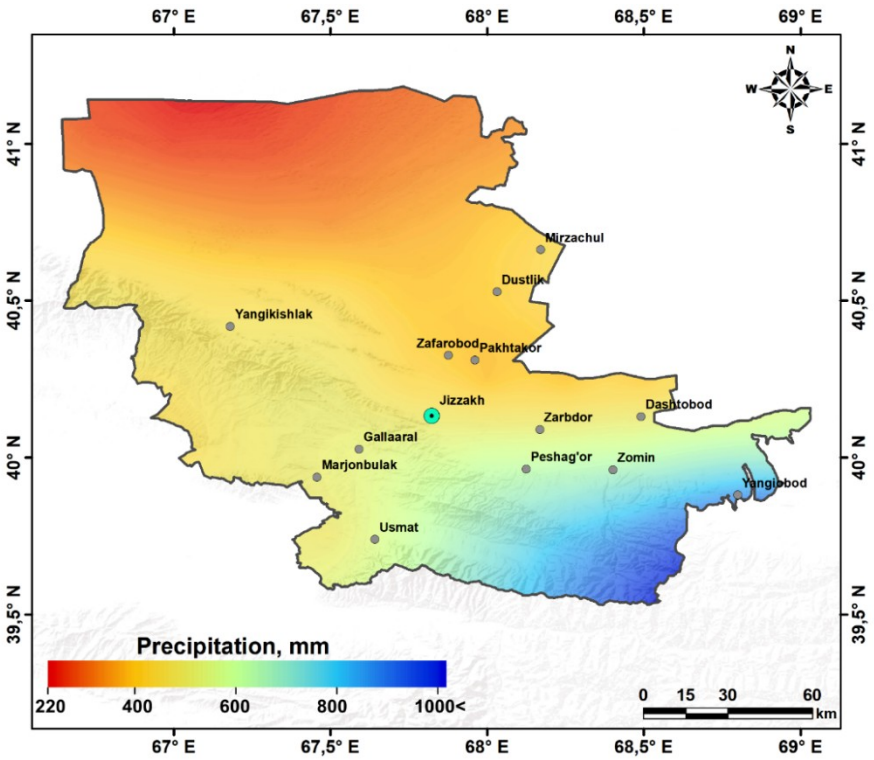


Fig. 5. The distribution of the annual average precipitation in the Jizzakh Region (based on ERA5 reanalysis data)

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