C302

Historical analysis of anthropogenic and climate change impact in Uzbekistan

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Over the last several decades of the 20th century, Uzbekistan has seen a serious expansion in agriculture in the development of the wide irrigation network at the expense of the environment. The consequences of the Soviet development strategy have had various long-lasting impacts on the environment and completely changed the whole region. For example, the rapid expansion of irrigated agriculture in Central Asia has significantly reduced the natural flow of the two major rivers (the Syr Darya and the Amu Darya) into the Aral Sea, resulting in an acute environmental problem that affects much of the region. Although environmental protection, sustainable agriculture, and socio-economic development remain priority in Central Asian countries' national agendas, the sheer scale of problems, combined with economic difficulties in these developing countries, leaves governments short of simple solutions.

Water availability and the regional hydrology of main river catchments are uncertain due to arguments over the transboundary water sharing between countries, and the impact of global climate change requires urgent steps to address recent extreme events. Droughts, including scarcity of irrigation water and increased temperature extremes, will undoubtedly exacerbate water resource problems in arid and semiarid zones, including Central Asia. Thus, defining these effects and adaptation strategies will play an essential role in the Central Asian countries' future agenda. Uzbekistan is already classified as one of the top water user consumers regarding net water usage to GDP and population. Recent droughts and increased sand storms from the former sea's dried bed will be intensified without proper actions.

The major challenge in the near future is above-average temperatures increase, especially in a dry season, predicted to be 1.2-2.1°C, which is double of the predicted global average of 0.7°C. On the other hand, the Aral Sea's shrinking has transformed previous large water bodies into the desert and undoubtedly affected local climate and temperature variations. To understand the impacts of human activity and define how these environmental changes had affected temperature variations, 60 years of historical temperature data were analyzed from 1960 until 2010. This period was chosen to find correlation to the environmental changes that was observed in the region and estimate human activity impact and the climate change trends in the region of the Aral Sea and address future adaptation measures required for the sustainable livelihood.

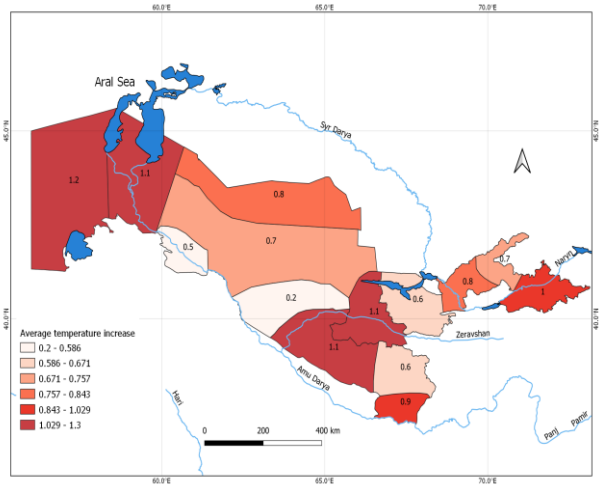

Fig. 1. The average temperature increase in Uzbekistan over 1960-2010 compared to 1960-1990.

Historical air temperature observation data were divided into two sets with the base period described as 1960-1990, which corresponds to the largest increase of the irrigation area in the Aral Sea Basin and the present period of 1990-2010. According to several estimates, the Aral Sea has started shrinking from 1950-1960, and thus this period can be connected to the original microclimate in the region and compare current weather conditions to the previously observed ones. The choice of stations for analysis was based on availability and duration. These are major stations with the longest observation record and show relatively common climatic conditions to the representative zone.

The results show air temperature rise for the whole of Uzbekistan; however, changes are uneven, both spatially and temporally. Perennial monthly, semi-annual, and annual mean long-term temperature values showed warming in Uzbekistan's climatic regions (figure 1). Winters and springs are becoming comparatively warmer on average to 1.3 °C to the baseline period across the entire Uzbekistan territory. A significant rise in the mean annual temperature (more than 1 °C) is observed in the country's north-west and central parts. On the other hand, the desert zone and some of the oasis areas in the south and northeast part has shown a moderate rise in mean annual temperature of 0.5 to 0.9 °C. Monthly analysis of the average temperature values in the Uzbekistan climatic zones shows that the main net increase in temperature values is attributed to the year's first part, mainly the winter and spring months. It is especially noticeable in the North-west part of the country over January, February, and March, with an average increase in temperature during this period of over 2.0 °C. Although this is also true for the Uzbekistan territory, the northern region (Aral Sea area) has observed the largest increase in temperature both for the warm and cold half-year. The number of cold days and possibly precipitation in the region has decreased over this period and increased days with a dry and hot period of the year with extreme temperatures. It may have impacted the natural vegetation cover that forms in the first half of the year.

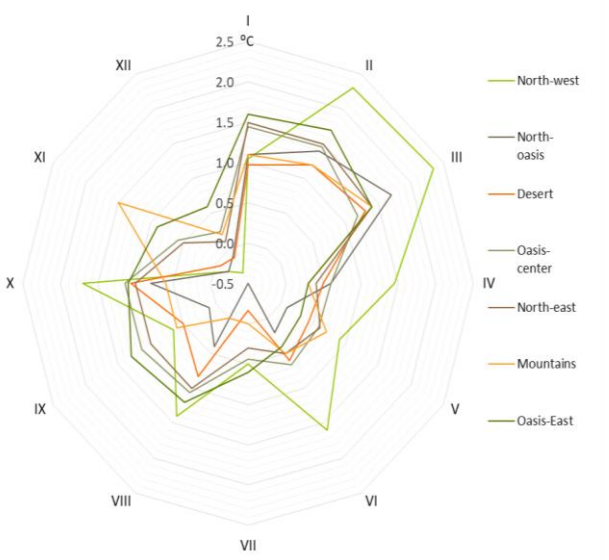

Fig. 2. Average temperature increase by months for 1990-2010 in selected various Uzbekistan regions compared to the base period of 1960-1990.

The drying of the Aral Sea and consequently created saline desert have highly likely influenced regional microclimate. This might be one of the possibilities in circulation processes change and consequentially temperature rise in the region. The large water body's disappearance, large enough to force convection effect to the vast area, has increased temperature for both cold and warm half-years. From 1960th, the Aral Sea has shrunk to 10% of its original size and created a salty dust desert in the place of the previous water body. This area is effortlessly heated up, which increases air pressure and creates a different dynamic of the synoptic processes. Unfortunately, there is not enough data from the region to prove this hypothesis; nevertheless, it should be an important topic for discussion.