Climate Changes in the Aydar Arnasoy Lake System and Its Surroundings

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Abstract: In this article, the morphometric parameters of the Aydar-Arnasoy lake system and micro-level change of climate elements such as temperature, relative humidity, precipitation and fog in its surrounding landscapes were studied and analysed.

1 INTRODUCTION

The investigation of the emergence of the Aydar-Arnasoy lake system and its environmental impacts has become increasingly significant, not only for the Jizzakh and Navoi regions but also for our republic as a whole. This is evident as the water area of the Aydar-Arnasoy lake system expands, accompanied by an increase in water volume. Covering an area of 3,702 km2, it is the second-largest lake system in our republic, surpassed only by the Aral Sea. The water volume is measured at 44.1 km3, which is twice the volume of water found in all other reservoirs in our country.

The expansion of the Aydar-Arnasoy lake system's water area and the subsequent rise in water volume are leading to observable micro-level climate changes. This has resulted in alterations to climatic elements such as temperature, relative humidity, rainfall, and fog in the vicinity of the lake. Subsequently, we will delve into the specifics of these climate element changes.

2 DISCUSSIONS

The climate of the Aydar-Arnasoy lake system and its surroundings was characterized using long-term data from eight meteorological stations and posts. While the Arnasoy hydrometeorological post, established in 1985, was not included in the description due to its later inception, its data was utilized for comparing microclimate elements between the lake and the desert climate, given its proximity to the Aydar-Arnasoy lake system.

Situated in the Kyzylkum desert to the north-west, the Aydar-Arnasoy lake system and its surroundings experience hot air flows from the desert during the summer months. A notable difference in average July temperatures is observed from Ayakogit to the central part of Mirzachol, with Ayakogit experiencing a decrease of 3.1°C, Forish 2.8°C, Jizzakh 2.6°C, and Syrdarya 2.7°C. Such temperature variations persist from May to September.

The plains to the north of the Aydar-Arnasoy lake system allow the influx of cold Arctic air without hindrance. Consequently, in December and January, the air temperature drops to -34°C in Mirzachol, -32°C in Nurota j/x, and -29°C in Forish. However, despite these low temperatures, the average temperature in January is relatively mild: 0.1°C in

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Forish, -0.6°C in Jizzakh, and -1.6°C in Nurota j/x, indicating the presence of numerous warm days during winter.

Throughout most of the year, the high air temperature contributes to low relative humidity. In the Kyzylkum desert on the western side of the Aydar-Arnasoy lake system, average relative humidity remains below 50%, dropping to 20-23% in June and July (Ayakogitma, Mashikuduq). Relative humidity slightly increases towards the foothills, reaching 24% in Forish and 32% in Jizzakh in July. By this month, it stands at 46% at the Mirzachol station and 50% at Syrdarya (refer to Table 1).

Table 1: Average monthly and annual changes in relative humidity(%).

т/р	Station	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII
1	oyoqogitma	78	70	64	50	33	23	20	21	25	39	58	76	46
2	Mashikuduk	78	73	64	51	33	22	20	28	29	39	62	76	48
3	Farish	72	70	70	60	45	29	24	27	29	43	59	71	50
4	Jizzakh	77	75	73	63	50	35	32	34	37	50	65	76	56
5	Mirzachol	77	75	76	66	57	47	46	50	53	60	71	80	63
6	Syr Darya	85	84	76	70	59	49	50	58	61	68	74	84	68

Precipitation distribution exhibits an increase in the eastern and mountainous areas of the Kyzylkum region. In the eastern part of Kyzylkum, the Ayokogitma station records an average annual rainfall of 112 mm, Mashikuduk with 137 mm, Nurota j/x with 237 mm, and Forish with 366 mm. Therefore, in the western part of the Aydar-Arnasoy lake system, the eastern region receives 2.5-3.0 times more rainfall compared to the arid desert areas (refer to Table 2).

Table 2: Average monthly and annual precipitation(mm).

No	Station	м/б	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII
1	oyoqogitma	184	12	15	20	21	12	5	2	0,5	1	5	8	11	112
2	Mashikuduk	199	16	18	26	23	13	4	2	0,4	1	6	12	16	137
3	Nurota farm.	380	20	27	41	40	22	4	0,2	0,3	1	12	34	35	237
4	Farish	525	38	41	60	47	25	6	1	1	3	19	34	41	316
5	Jizzakh	392	45	48	69	56	28	8	1	1	2	21	41	46	366
6	Mirzachol	276	32	33	48	42	27	9	2	2	3	18	30	30	276
7	Yangiyer	224	37	42	63	59	34	9	3	1	3	24	32	33	340
8	Syr Darya	204	41	40	59	50	27	6	2	1	1	24	33	40	324

The productivity of grassland plants in the vicinity of the Aydar-Arnasoy lake system is contingent upon both the quantity and timing of precipitation, particularly during the spring months. Based on data from the Jizzakh meteorological station, the year with the highest rainfall recorded 575 mm, whereas the driest year saw only 147 mm of rain (Gudalov., 2019). Consequently, there is a fourfold difference in precipitation between the wettest and driest years.

In dry years, a substantial amount of water flows from streams in the Syrdarya, Sangzor River, and Nurota mountains to the Aydar-Arnasoy lake system and its surroundings. This phenomenon results in the formation of lakes instead of marshes during wetter years, while in drier years, these areas revert to marshes. A comparison between the data from the dry year 2003 and the relatively dry year 2007 illustrates this variability (refer to Table 3).

Table 3: The amount of precipitation around the Aydar-Arnasoy lake system(mm).

T/p	station	2003 (seriocephalic)	2007 (arid)	More than average annual rainfall
1	Нурота ж/х	418,3	149,9	237
2	Фориш	421,5	132,0	241
3	Жиззах	444,6	160,3	283
4	Мирзачўл	356,2	98,7	198

As depicted in Table 3, the precipitation levels recorded in Nurota district, Forish, Jizzakh, and Mirzachol in 2003 were three times higher than those observed in 2007 and nearly twice the average amount of long-term rainfall. This illustrates the considerable variation in precipitation around the Aydar-Arnasoy lake system across different years.

The wind direction around the Aydar-Arnasoy lake system and its environs is influenced by the general circulation of the atmosphere and the local topography. Generally, during winter, the Aydar-Arnasoy lake system and the adjacent plains experience predominantly northerly and northeasterly winds. In the foothills and on the northern slopes of the Nurota Mountains (Forish and Jizzakh stations), westerly and southwestern winds prevail. In the summer months, with the formation of the Central Asian thermal depression, the baric gradient shifts from the northwest to the southwest, consequently altering the direction of air flow (Alibekov et. al., 2012).

In recent years, due to the expansion of the water area of the Aydar-Arnasoy lake system (3702 km2) and the increase in distance from east to west (350 km), there is a notable difference in air temperature between the east and west sides of the lake, amounting to 0.8°C. Additionally, the air humidity shows a variance of 1.4 mb. This shift is indicative of an increasing continental influence on the climate as one moves westward (refer to Table 4).

Table 4: Annual state of air humidity and temperature in different regions of the Aydar-Arnasoy lake system.

кўл	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	йил
average multi-year air temperature (C0)													
Arnasoy	-3,1	-0,5	7,9	15,2	22,0	27,1	28,8	25,0	19,7	12,8	6,4	0,1	13,4
Tuzkon	-2,1	0,2	8,0	14,6	22,2	26,8	29,4	26,5	21,0	13,0	7,0	1,0	14,0
Eastern Aydarkol	-2,5	0,1	7,8	14,0	22,1	26,6	29,7	26,7	21,2	12,8	6,9	0,5	13,8
Western Aydarkol	-1,1	0,6	7,6	13,6	22,2	27,1	30,1	27,6	21,4	12,8	7,1	1,0	14,2
annual average humidity (mb)													
Arnasoy	4,2	4,8	7,3	10,9	12,3	13,0	14,2	12,5	9,8	7,8	6,9	4,9	9,0
Tuzkon	4,3	4,9	7,2	10,4	11,1	11,5	11,4	10,5	8,5	7,2	6,7	5,1	8,2
Eastern Aydarkol	4,2	4,7	7,1	10,2	10,4	10,6	10,8	9,7	8,0	6,9	6,7	5,0	7,9
Western Aydarkol	4,2	4,8	6,9	9,8	9,8	10,3	10,5	9,2	7,5	6,5	6,6	5,1	7,6

Upon analysing the precipitation distribution in the Aydar-Arnasoy Lake system and its environs, a notable increase is observed from the northwestern to the southeastern regions. The highest rainfall is recorded in March and April, whereas the lowest precipitation levels occur in June and July (refer to Figure 1).

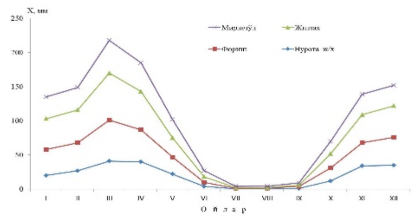

Figure 1: Changes in the amount of precipitation around the Aydar-Arnasoy Lake system by month during the year.

Utilizing data from the Nurota j/x, Forish, Jizzakh, and Mirzachol meteorological stations around the Aydar-Arnasoy lake system, the average multi-year precipitation levels were calculated (refer to Fig. 2).

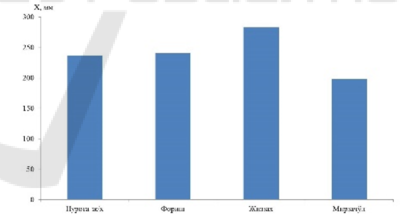

Figure 2: Average multi-year rainfall recorded at meteorological stations around the Aydar-Arnasoy lake system.

Many experts anticipate a positive impact on increased rainfall in the Aydar-Arnasoy basin in the coming years due to the presence of the Aydar-Arnasoy lake system. A significant factor contributing to this expectation is the development of a cold air layer, several hundred meters thick, above the lakes, characterized by higher humidity and lower temperature. During the spring, winter, and autumn months, when west and northwest air currents approach the lakes, they glide over this cool air layer, ascending in the process. This leads to a drop in temperature and saturation with moisture, resulting in an increase in precipitation. Even during the summer months, a cool air layer persists, but owing to the high air temperature and low humidity, the air currents sliding over the layer remain far from the saturation level, preventing rainfall.

3 CONCLUSIONS

According to observations from the Arnasoy Lake station, the Aydar-Arnasoy Lake system experiences the formation of cool air during the summer months, creating daytime breezes that extend several kilometers along the coast. Consequently, the air temperature on coastal beaches decreases by 2-30°C during the day compared to the surrounding desert areas.

The influence of the Aydar-Arnasoy Lake system has led to an increase in foggy days from 10-13 days to 20-25 days (Gudalov., 2020). One contributing factor is the presence of evaporative and advective fog associated with the lake system. Evaporation fog arises through the condensation of water vapor in the air rising from the lake surface when the air above the lake cools. For this process, the temperature of the water should be higher than the temperature of the air above it. A gentle breeze or light wind carries some of the formed fog ashore, resulting in the formation of fog around the lake.

Advective fogs occur in winter and late autumn when the land surface surrounding the lakes experiences significant cooling. Under these conditions, when the wind carries moist air from the lake surface towards the land, the moist lake air quickly condenses over the cold land surface, forming dense fog around the lakes. These phenomena are frequently observed on the southern shores of the Aydar-Arnasoy Lake system, at the base of the Nurota Mountains.

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