Forecast of Uzbekistan's Climate for the Next Millennia

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Abstract: Currently, there are three main hypotheses regarding global climate change: astronomical, physical, and geological-geographical causes. Astronomical causes include changes in the Earth's orbital eccentricity, the tilt, and precession of the Earth's axis, which will be examined separately below. Physical causes involve factors like volcanic-induced contamination affecting atmospheric composition. These are clearly reflected in current climate changes.

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The changes in climate due to astronomical, physical, and geological-geographical factors have been discussed above. Astronomical factors include changes in the Earth's orbital eccentricity, the tilt, and precession of the Earth's axis, which we will discuss separately below. Physical causes include factors such as volcanic-induced air pollution. These factors are clearly reflected in current climate changes. Geological-geographical factors include the characteristics of the locations of oceans and continents, neotectonic movements, and polar shifts, with permanent impacts on the climate. Among these, the impact of polar shifts is notable. However, the difficulty of polar shifts is determined by the Earth's equatorial bulge or ellipsoid shape, preventing major shifts. Observations conducted over nearly a hundred years at latitude stations on Earth show that polar shifts do not exceed 20 meters, which could be within measurement error.

Compared to the other reasons mentioned above, the impact of astronomical causes on climate change is more apparent. These include the eccentricity of the Earth's orbit, the tilt, and precession. The eccentricity of the Earth's orbit is defined as the ratio of the difference between the Earth's farthest and closest distances from the sun to the sum of those distances.

$$\frac{152 \text{ mln km} - 147 \text{ mln km}}{152 \text{ mln km} + 147 \text{ mln km}} = 0.017$$

Currently, the Earth’s orbital eccentricity ranges between 0.007 and 0.066, with a variation amplitude of 0.059. The periodicity of Earth’s orbital eccentricity is 100,000 years. Based on this, it can be calculated that a 0.001 change in Earth’s orbital eccentricity takes 100,000:59=1695 years. Hence, it may be ignored in predictions of climate over the next millennium.

The second astronomical factor is the tilt of the Earth’s axis, which ranges from 22°0.4' to 24°34' and varies by 2°30'. The periodicity of Earth’s axial tilt is 41,000 years. Dividing the 2.5° tilt amplitude by 41, we find the millennial variation to be only 0.06°, making it negligible in short-term climate forecasts.

The precession of the Earth’s axis, which affects whether perihelion and aphelion occur in winter or summer, significantly influences climate. Currently, aphelion occurs in early July and perihelion in early January, leading to milder summers and warmer winters.

In contrast, during the onset of the Holocene 10,000–11,000 years ago, perihelion occurred in summer and aphelion in winter, the reverse of current conditions. This indicates that we are currently in the warmest phase of the Holocene.

The precession period is 21,000 years, and dividing it by the number of days in a year, we find that perihelion and aphelion shift by one day every 57.53 years.

For a millennium forecast, this would mean a shift of 1000:57.53 = 17.4 days. Thus, if perihelion is on January 5 in 2024, in a thousand years, it will shift to January 22. This is not a major change.

Thus, it is evident that the climate in the next millennium will be similar to today's, with perihelion occurring in winter and aphelion in summer, resembling current climate patterns.

However, climate change in Central Asia could be expected due to the ecological catastrophe caused by the drying of the Aral Sea. Approximately 12 billion tons of salt particles mixed with sand cover the dried basin, spreading across large areas due to winds. Typically, mild winds blow from northeast to southwest, while strong winds move from west to east, dispersing large quantities of sand and salt particles over eastern regions and mountains. As a result, decreased precipitation has been observed in some areas, for example, in Tashkent region [Erkin Abdulahatov], while a negative trend has been noted in the water flow of rivers in Namangan region [ ]. This process may intensify in the future, accelerating desertification in Central Asia.

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