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ARTICLE

Wave Dynamics of the Average Annual Temperature Surface Air Layer New Delhi for 1931-2021

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ABSTRACT

The identification method revealed asymmetric fluctuations in the dynamics of the average annual temperature in New Delhi from 1931 to 2021, that is, for 90 years. An analysis of the wave patterns of climate until 2110 was carried out. Geotechnology of the Himalayan passage was proposed to reduce heat waves in India and China. Formulas containing four and 18 fluctuations were adopted for forecasting. Models give an increase in the heat wave from 2021, which is the fourth component. As a result, the landscape of the Himalayan mountains and the deserts of Thar and Takla Makan create a regional climate system that is original for the land of the Earth. In this system, oscillatory temperature adaptation in the future will be several times greater than the global warming rate predicted in the IPCC CMIP5 report. Between 2001 and 2019 the largest temperature increase wave maximum was observed in New Delhi at 0.65 °C in 2012-2013. In the sixth phase from 2036 to 2049, an ecological catastrophe will break out in New Delhi. According to calculations, the maximum value of the average annual temperature in New Delhi was 25.82 °C in 2017. Since then, the cooling has continued for four years, which will continue until 2028. The temperature will drop to 22.54 °C due to a change in solar activity by 3.28 °C. Then by 2044, the average annual temperature in New Delhi will increase to 31.03 °C, or the increment will be 31.03 – 22.54 = 8.49 °C. In 2035, the climate in New Delhi will become hotter compared to 2021. The increase in the heat wave is noticeable. From 1931 to 2049 there will be six half-periods of cooling and warming: 1) 23; 2) 23; 3) 20; 4) 18; 5) 15; 6) 13 years old. The most dangerous is the sixth stage. It is proposed at the fifth stage for 15 years until 2037 in northern India to the Takla Makan desert in China to build a passage up to 350 km long, 10 km-20 km wide and at least 4.5 km high.

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1. Introduction

In ancient times, most of India was covered with swamps and impenetrable tropical forests teeming with predators - the jungle. The farmers of India since ancient times waged a real war with the forests. They had to win back plots for crops [1].

The report of the McKinsey institute "What threatens India with global warming" notes that climate change and global warming can deal a severe blow to the Indian economy before the end of this decade. These findings are reported on March 9 by The Times of India. By 2050, parts of India and Pakistan are projected to experience such heatwaves with a probability greater than 60% per year. The seriousness of the problem is so great, the newspaper notes, that as one of the adaptive measures MGI proposes to consider the organization of mass "climatic migration".

The Indian Meteorological Department (IMD) annual climate report for the country states that not only was 2021 the fifth warmest year since 1901, but the last decade, 2012 - 2021, was also the warmest on record. In addition, 11 of the 15 warmest years on record were between 2007 and 2021. Rising average temperatures can have a cascading effect on extreme weather events [2].

New Delhi (Figure 1): It's only March, but intense heat has already gripped much of India. And it's clear that this early summer in India is proof that this is the era of climate change, and it could have major implications for water security, the Center for Science and the Environment said.

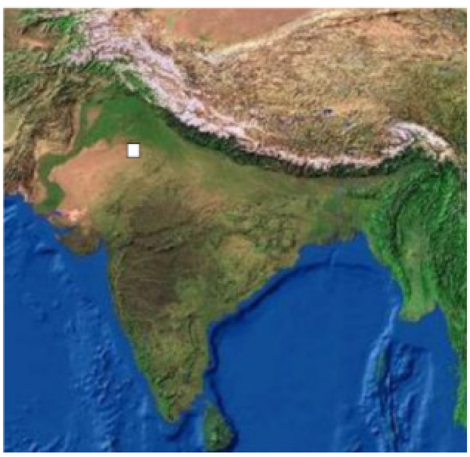


Figure 1. New Delhi weather station (marked with a white square)

Heat waves associated with abnormally high temperatures, which can also be fatal to humans and animals, are also on the rise throughout the country, while there is a downward trend in the frequency of occurrence of cold waves [3].

The climate of India is very diverse. Four types can be distinguished: dry tropical, humid tropical, subequatorial monsoon and high mountain. And at a time when the beach season begins in the south, real winter sets in the mountains, and the temperature drops below zero. There are areas where it rains almost all year round, while in others the plants suffer from drought. How can this be explained? In the north, the country is fenced off from the cold Asian winds by the Himalayas, and in the northwest, a large territory is occupied by the Thar Desert, which attracts warm, humid monsoons. They determine the peculiarities of the Indian climate [4].

Time series of global or regional surface air temperatures are of fundamental importance for climate change studies [5]. Monthly and annual temperature differences and their changes were considered, for example, in on the Tibetan plateau and its environs for 1963–2015 [6].

The sun heats the earth unevenly. In this case, the equator receives more heat, the poles less. This temperature gradient is one of the main forces that drives the ocean and atmosphere. In the tropics, the climate system of our planet receives energy, and in temperate and polar latitudes it gives it away. The main transfer of heat from the equator to the pole is carried out in the atmosphere. The ocean is the slow component of the climate system. It does not respond as sharply to external influences as the atmosphere does. In heat transfer, the ocean acts as a battery. Taking heat from the sun and heating up, it then shares it with the air [7].

The climate is mainly influenced by solar activity [8].

There are reasons to believe that global warming has almost ended and a slow decrease should be expected in the period up to 2040, especially in the Northern Hemisphere over land [9].

The purpose of the article is to identify asymmetric wavelets of the New Delhi average annual temperature dynamics from 1931 to 2021, that is, for 90 years, to analyze the wave patterns of climate fluctuations until 2110 by the identification method [10-12] in India and China.

2. Materials and Methods

For the possibility of modeling the dynamics of the average annual temperature of India by a set of wave equations, the initial time $\tau_0 = 0$ is taken for 1931.

Table 1 gives a fragment of the data array of the average annual temperature of the surface air layer at a height of 2 m according to measurements at the meteorological station in New Delhi. A series of surface mean annual temperatures for New Delhi was taken from the site http://www.pogodaiklimat.ru/history/42182.htm (Accessed 22.04.2022).

Table 1. New Delhi temperature

Year	Time τ, year	Temperature t, °C
1931	0	25.0
1932	1	25.1
1933	2	23.9
1934	3	24.7
1935	4	24.7
…	…	…
2017	86	25.9
2018	87	25.6
2019	88	25.1
2020	89	24.8
2021	90	24.9

It contains a total of 91 temperature values without gaps. Then the representativeness of the dynamic range is 100%. However, modeling is difficult due to the short time series, since it would be better to have data for New Delhi from 1831.

The dynamic series is approximately the same, so the trend was taken as an arithmetic mean of temperature. With a very low adequacy of less than 0.3, a trend appears in the form of the Mandelbrot law in the physics of exponential growth. The same Laplace law in mathematics, Zipf-Pearl in biology and Pareto in econometrics. In what follows, this law gives an additional critical wavelet.

Oscillations (asymmetric wavelet signals) are generally written by the wave formula [10-12] of the form.

$$y_i = A_i \cos(\pi x / p_i - a_{8i}),\ A_i = a_{1i} x^{a_{2i}} \exp(-a_{3i} x^{a_{4i}}),\ p_i = a_{5i} + a_{6i} x^{a_{7i}}, \quad (1)$$

where y is the indicator (dependent factor), i is the number of the component of the model (1), m is the number of members in the model (1), x is the explanatory variable (influencing factor), $a_1 \dots a_8$ are the parameters of the model (1) that take numerical values during structural and parametric identification in program environment CurveExpert-1.40 (URL: http://www.curveexpert.net/) according to statistical data, A_i is the amplitude (half) of the wavelet (axis y), P_i is the half-period of oscillation (axis x).

3. Results and Discussion

The time series of New Delhi's mean annual temperature from 1931 to 2021 turned out to be relatively complex, but at the same time informative in comparison with other cities in Europe and Asia. The first forecasting scenario up to 2110 was carried out according to the model (1) containing four components. Then, with additional asymmetric wavelets, model (1) included 18 components.

Temperature is a physical quantity that is a measure of the average kinetic energy of the translational movement of molecules, in our case, air molecules in the surface layer at a height of 2 m above the land surface in the city of New Delhi. Therefore, the average annual temperature is a continuous physical quantity, the range of values of which should not be subjected to any transformations. Grouping by 10, 20 and other time intervals is not allowed to bring under linear models.

3.1 Wavelets of Dynamics of Mean Annual Temperature

3.1.1 Features of CurveExpert-1.40 Software Environment

The method for identifying asymmetric wavelets (1) was performed sequentially. At the same time, the arithmetic mean value of the average annual temperature in New Delhi for 91 years (Figure 2), equal to 25.14 °C, was taken as the beginning of the simulation. The standard deviation is only 0.4610 °C. the correlation coefficient as a measure of adequacy is 0.

The first wobble is an infinite-dimensional wavelet, meaning it starts much earlier than 1931 and will continue well beyond 2021. A distinctive feature is the continuous decrease in the amplitude of the fluctuation, which will favorably affect the regional climate. However, the climatic danger is represented by a decrease in the half-period of oscillations over the years, that is, the climatic system of the region becomes more frequent.

The second oscillation refers to finite-dimensional wavelets that have boundaries on the x-axis. It ended in 1964. Therefore, this wavelet does not affect the time after 2021.

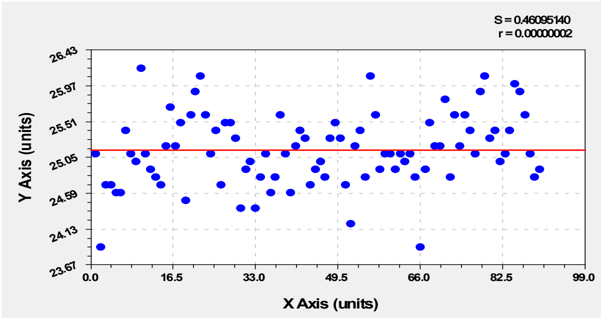
The third oscillation is also an infinite-dimensional wavelet, however, unlike the first oscillation, it has an amplitude increasing according to the Mandelbrot law. It's a small consolation that the half-cycle of the oscillation is slowly decreasing.

All four of these components were identified together.

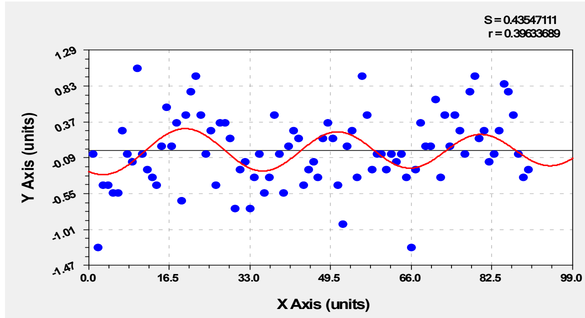
3.1.2 The Four Components of a Pattern

Table 2 shows the parameters of the model (1), and Figure 3 shows a graph of the general pattern.

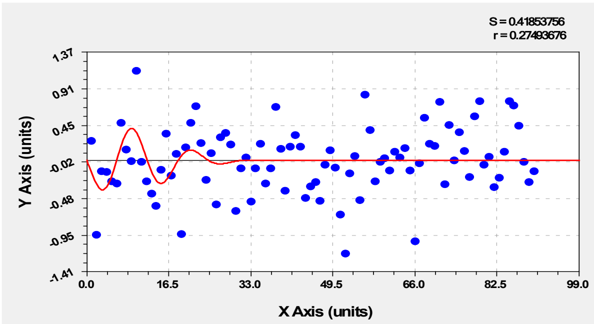
The correlation coefficient of 0.5688 relates the composite regularity in terms of the level of adequacy to the average strength of the factor connection. Then other wave components will appear, so the adequacy will increase significantly.



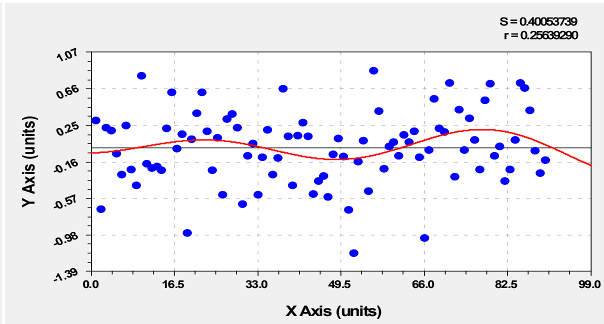
Arithmetic mean temperature for 91 years



First asymmetric wavelet



Second oscillation



Third critical swing

Figure 2. Graphs of the dynamics of the average annual temperature of New Delhi for the years 1931-2021 (in the upper right corner: S – standard deviation; r – correlation coefficient)

Table 2. Parameters of the dynamics of average annual temperatures in New Delhi for 1931-2021.

i	Asymmetric wavelet $y_i = a_{1i} x^{a_{2i}} \exp(-a_{3i} x^{a_{4i}}) \cos(\pi x (a_{5i} + a_{6i} x^{a_{7i}}) - a_{8i})$								Coef. correl. r
	Amplitude (half) oscillation				Half cycle oscillation			Shift	
	a_{1i}	a_{2i}	a_{3i}	a_{4i}	a_{5i}	a_{6i}	a_{7i}	a_{8i}	
1	25.10299	0	0	0	0	0	0	0	0.5688
2	0.50146	0	0.022460	1	–55.63167	60.36572	0.045774	1.27271	
3	0.097658	0.25091	9.67534e-6	2.39781	8.13641	0	0	–3.28657	
4	0.0023103	0	–0.070187	1	31.42437	–0.093036	1	4.07201	

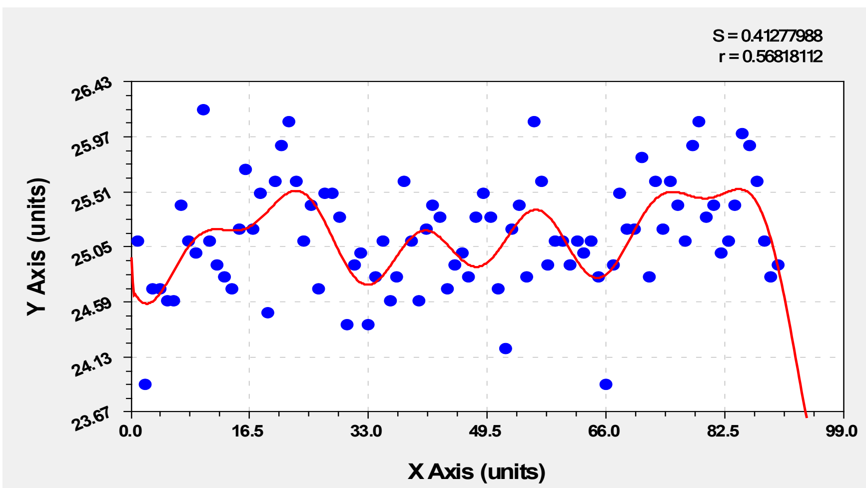


Figure 3. Plot of New Delhi's four-component annual average temperature formula

3.1.3 Error Distribution of the Four-component Model

The number of points n (pieces) distributed in intervals of 1 °C of the relative error $[\Delta]$ (°C) of the model (1) with the parameters from Table 2 is given in Table 3.

Table 3. Distribution of the relative error of the model from Table 2

Interval $[\Delta]$, °C	Quantity n, pcs.	Interval $[\Delta]$, °C	Quantity n, pcs.	Interval $[\Delta]$, °C	Quantity n, pcs.
4	1	1	25	–2	16
3	6	0	2	–3	5
2	16	–1	17	–4	3

From Table 3 it can be seen that the error of the four-term model from Table 2 changes between intervals of ± 4 °C.

Then the error changes according to the Gauss law (Figure 4) with the subtraction of the asymmetric wavelet in the form of a two-term equation.

$$n = 31.99860\exp(-0.20820([\Delta]+0.010940)^2) - \\ -3.73495\cdot 10^{-6}([\Delta]+5)^{29.06657}\exp(-6.17339([\Delta]+5)) \\ \cos(\pi([\Delta]+5)/2.36884-0.17169) \quad (2)$$

The normal distribution law, together with the wavelet, barks a very high level of adequacy with a correlation coefficient of 0.9982.

3.1.4 A Look into the Future

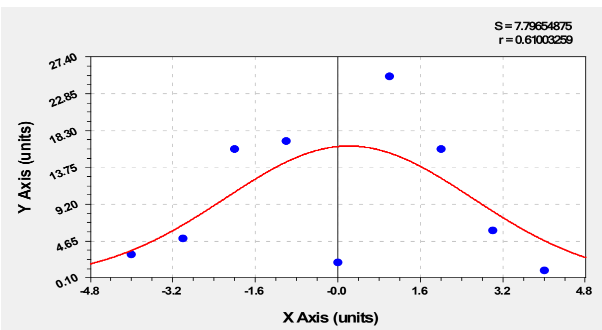
In the Excel software environment, using the formulas from Table 2, the graphs shown in Figure 5 were obtained for different forecast horizons.

On the forecast horizon until 2104, the temperature will reach about 450 °C. Then, apparently, starting from India, the same climate will be established on Earth as in the atmosphere of the planet Venus. But before that, in the beginning, in the period 2093 to 2100, a global cooling is likely to be expected. The forecast horizon up to 2084 gives that the climate in New Delhi will be similar to that in the Gobi Desert. Since 1973, a Sahara desert climate has been expected in India. After 2060, the whole territory of India will become like in the Thar Desert.

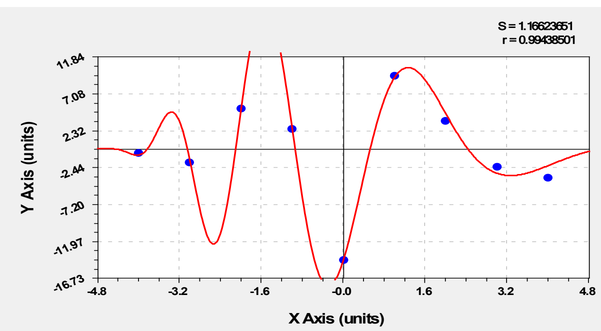
Thus, an indicative forecast is possible until 2050.

3.1.5 Forecast until 2050

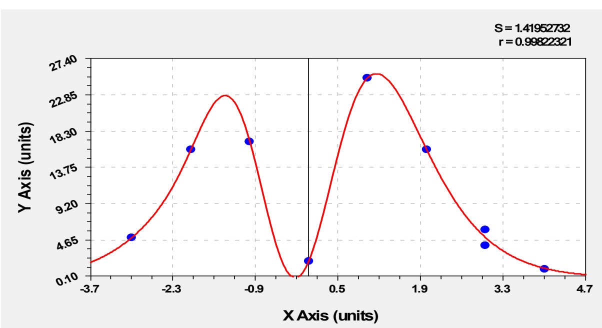
A four-component model makes it possible to make a plausible forecast only 30 years ahead, that is, until 2050 (Figure 6).



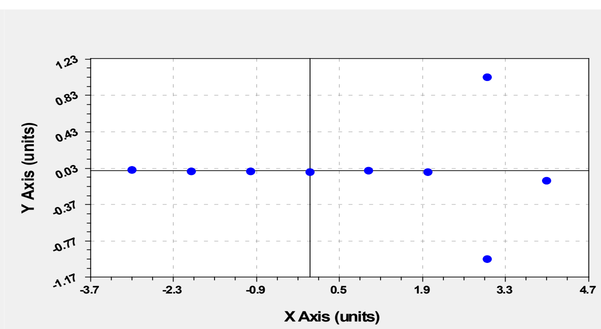
Gauss's law of normal distribution



Asymmetric wavelet

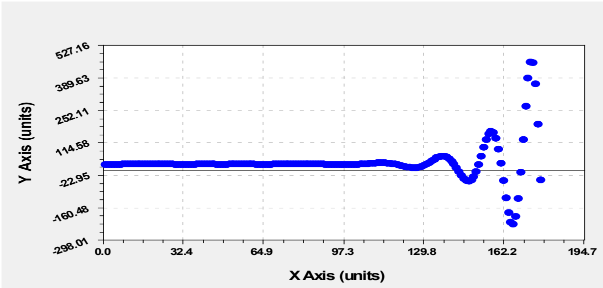


Gauss law and wavelet

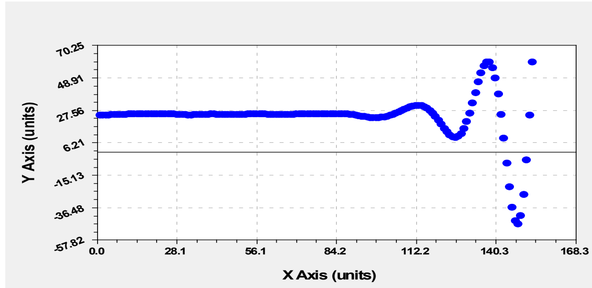


Residues after formula (2)

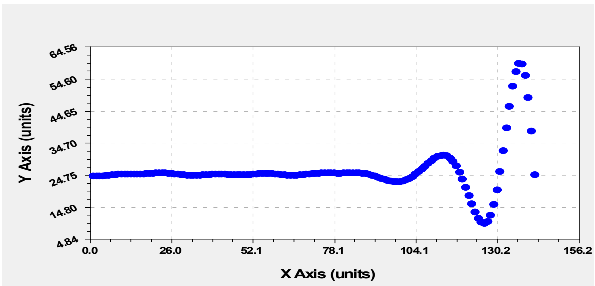
Figure 4. Graphs of the relative error of the four-component model



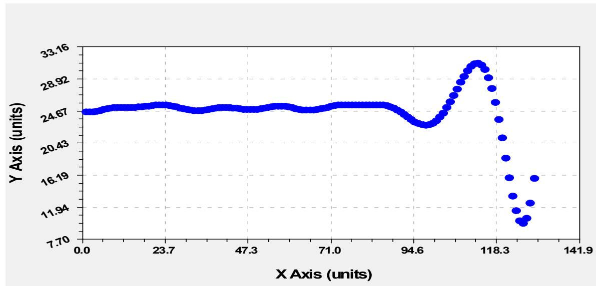
Forecast until 2104 (analogue - Venus)



Forecast to 2084 (Gobi Desert)



Forecast to 2073 (Sahara desert)



Forecast to 2060 (Thar Desert India)

Figure 5. Graphs of forecasts of average annual temperature in New Delhi

The maximum average annual temperature of 25.53 °C was in New Delhi in 2016. Then there will be a drop in temperature, due to the influence of the Sun [8], to 22.84 °C in 2030. After that, by 2044 there will be a sharp rise in the average annual temperature to 31.04 °C.

3.1.6 Critical Swing

Note that the forecast for 18 components gives almost similar results. Therefore, the critical oscillation, accelerating in amplitude, is among the two wavelets from Table 2. From it, we notice that the fourth component has an increasing amplitude. The rate of increase in the average annual temperature in New Delhi, this heat wave is shown in Figure 7.

The critical wobble or heat wave indicates that New Delhi's maximum annual mean temperature increase from 1931 to 2050 will be 6.06 °C in 2044. The average annual temperature will also reach a maximum of 31.04 °C. If nothing is done, then there will be an ecological disaster in India. Cardinal climate technologies need to start from 2022 to 2037, that is, in just 15 years.

Next, consider the stages of the heat wave for the period from 1931 to 2021 (Figure 8).

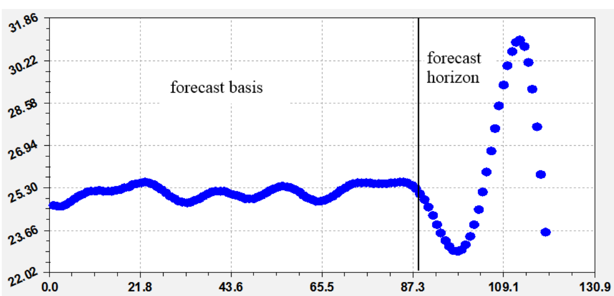


Figure 6. Average annual temperature forecast for New Delhi until 2050

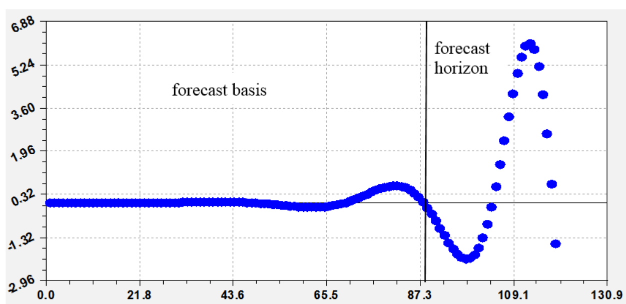
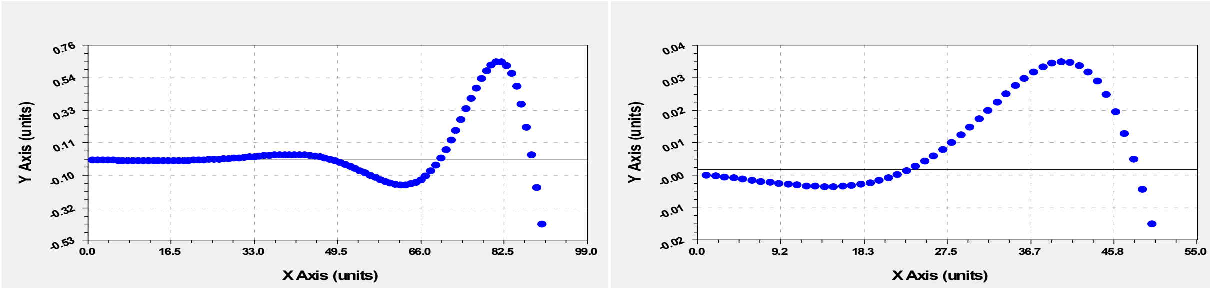


Figure 7. Critical fluctuation in the average annual temperature in New Delhi until 2050



Critical wave until 2021 Critical wave before 1981

Figure 8. Critical Line Plots at the Forecast Base

The first stage was in 1931-1954, when the heat wave in New Delhi had negative values of the average annual temperature of the surface air layer. Then it turns out that at the first stage the fluctuation was aimed at reducing regional warming. However, this decrease was very small.

Second stage 1955-1978 is characterized by a burst of warming with a maximum temperature increment in 1971 of 0.034 °C. At the third stage, the heat wave again became negative in the period 1980-2000 with a minimum temperature of –0.07 °C in 1993. In the period of 2001-2019 (fourth stage), the largest maximum wave of the average annual temperature in New Delhi was observed at 0.65 °C in 2012-2013. And finally, the fifth stage will be in 2020-2035 (coinciding with the forecast of solar activity [11]) with another cooling down to a minimum of –2.14 °C in 2029.

At the sixth stage from 2036 to 2049, if India and China do not make joint efforts in the geological technology called "Himalayan Passage", an ecological disaster will break out in New Delhi with a maximum increase in the average annual temperature of 6.06 °C in 2044. The temperature in 2044 is expected to be 31.04 °C. This will be higher than the level of 2021 on 31.04 – 24.9 = 6.14 °C.

The increase in the heat wave is noticeable. From 1931 to 2049 in the dynamics of the average annual temperature in New Delhi, there will be six half-periods of cooling and warming: 1) 23 years; 2) 23 years old; 3) 20 years; 4) 18 years old; 5) 15 years and 6) 13 years. The most environmentally dangerous is the sixth stage.

3.2. General Formula (1) with 18 Components

3.2.1 Features CurveExpert-1.40

Subsequently, the identification method was used to increase the asymmetric components up to 18 (Table 4). The first four components were placed together in the CurveExpert-1.40 software environment (Table 2), and the remaining components were identified separately. This technique allows you to achieve a level of adequacy in terms of the correlation coefficient up to 1.

Each component is a quantum of climate behavior at a given point on the Earth. The high quantum certainty of the mean annual temperature makes it possible to decompose the dynamic series into behavioral quanta to a level where the modeling error becomes even less than the measurement error of ± 0.05 °C.

In many examples, it was noted that with an increase in the number of components, the sensitivity of forecasting increases sharply. Therefore, models with several components, simultaneously identified in the CurveExpert-1.40 software environment, are sufficient for orientation. The possibilities of forecasting decrease with an increase in the number of wavelets in the general model due to the fact that in the near future new fluctuations appear that can drastically change the forecast trends. For verification, it is enough to wait one year to get the actual temperature. Then the predictive model is re-identified. This is how the forecasts are refined by the iterative forecasting mode every year.

3.2.2 Infinite-dimensional and Finite-dimensional Wavelets

All wavelets are divided into two groups: a) infinite-dimensional wavelets, when the amplitude of formula (1) has the form of a modified Mandelbrot law (or simply Mandelbrot law) under the condition a_{2i}=0; b) finite-dimensional wavelets, when the amplitude takes the form of a biotechnical law, provided that in this case there are boundaries of the beginning a_{2i}>0 and end of the wave.

When a_{2i}<0 the first component of the biotechnical law turns into a power law $y_1 = ax^{-b}$, which has no physical meaning. Therefore, the identification formula $A = ax^{-b}\exp(-cx^d)$ is converted into a modified Mandelbrot's law $A = a\exp(-cx^d)$. This means that the finite-dimensional wavelet becomes infinite-dimensional, having no boundary on the x-axis.

New Delhi is characterized by the fact that the first

Table 4. Parameters of the dynamics of average annual temperatures in New Delhi for 1931-2021

i	Asymmetric wavelet $y_i = a_{1i}x^{a_{2i}}\exp(-a_{3i}x^{a_{4i}})\cos(\pi x/(a_{5i}+a_{6i}x^{a_{7i}})-a_{8i})$								Coef. correl. r
	Amplitude (half) oscillation				Half cycle oscillation			Shift	
	a_{1i}	a_{2i}	a_{3i}	a_{4i}	a_{5i}	a_{6i}	a_{7i}	a_{8i}	
5	0.00054435	4.22926	0.49910	0.82454	3.50187	–0.014887	0.98802	–3.44314	0.3967
6	0.00078737	1.81738	0.00071581	1.88069	1.80573	0	0	–1.90137	0.4433
7	–0.017298	1.98575	0.14897	1	1.67777	–0.013562	1	–1.56286	0.4101
8	4292.4895	1.72566	4.85364	1.04222	0.66531	0	0	–0.004365	0.2973
9	4.01010e–6	4.23534	0.53036	0.60570	4.26620	–0.013578	0.93421	–2.62647	0.4756
10	3.09870e-9	5.70583	0.11295	0.97011	3.56199	–0.0080408	1.02558	–1.67364	0.2145
11	7.49041e-13	15.85123	4.68050	0.52311	1.55376	0	0	1.01110	0.2960
12	–2.2294e-18	11.92441	0.17376	1	1.23694	0	0	–5.64086	0.2260
13	–7.4047e-11	5.82239	0.016214	1.75224	3.78946	0	0	–1.16050	0.5241
14	–6.7307e-16	34.07655	4.79541	0.98230	9.55288	–0.58031	1.06987	–4.32146	0.2406
15	–0.043993	0.37746	0.039086	0.92935	1.9311	0	0	0.83091	0.2020
16	–0.032169	0.52255	0.023195	0.89865	4.67504	0.00010175	1.65349	–2.48032	0.4187
17	0.0067699	1.18317	0.041962	1.03570	6.40214	5.33348e-5	1.78867	–2.34360	0.2745
18	3.9665e-19	13.17326	0.21263	1.00114	1.31855	0.00066014	0.96384	5.52885	0.7574

component receives the arithmetic mean value. It becomes an infinite-dimensional wavelet that goes on infinitely and therefore has no boundaries on the x-axis. Similarly, the second and fourth wavelets are infinite-dimensional wavelets. All other 15 components belong to the group of finite-dimensional wavelets. The latter are divided into two subgroups: 1) their boundaries are within (Figure 8) the basis of the forecast (wavelets 3, 5, 7, 8, 11, 14, 17); 2) the right border is located outside the right border of the forecast base, that is, in the interval of the forecast horizon (Figure 9, Figure 10), at least even at its beginning (wavelets 6, 9, 10, 12, 13, 15, 16, 18). The predictive model will include three infinite-dimensional wavelets and, additionally, the second subgroup of finite-dimensional wavelets.

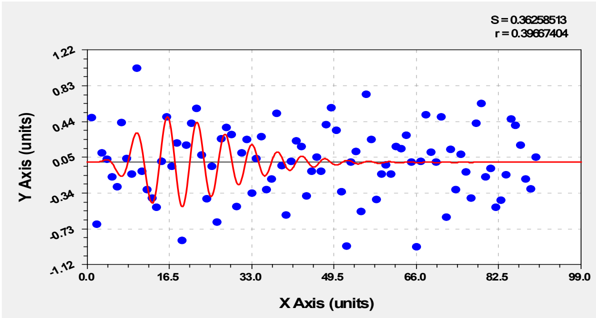
In Figure 8, there is an eighth wavelet that allows you to jump from the abs-ciss axis before 1931. The remaining finite-dimensional wavelets with left and right boundaries on the x-axis are located at the base of the forecast, that is, in the time interval from 1931 to 2021. As a result, they do not participate in the predictive model and therefore do not affect the future. However, when building a general graph, they allow you to visually show the change in the average annual temperature in New Delhi. Retrospective historical research is needed to explain these fluctuations.

As can be seen from the graphs in Figure 9, the length of oscillations is different.

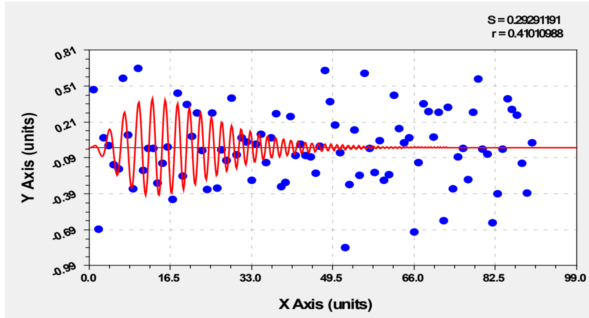
As can be seen from the graphs in Figures 10 and 11, all graphs affect the forecast in the near future, but some of them penetrate far into the future. At the end of the dynamic series, new fluctuations may occur, which will then continue into the future. It is this circumstance that does not allow us to make working forecasts.

As a result, the average annual temperature has two contradictory properties.

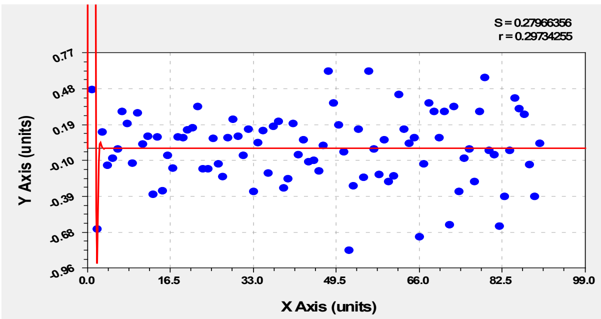
Firstly, the dynamic series allows decomposing up to the measurement error into a large number of asymmetric wavelets. Then it turns out that the average annual temperature gets a quantum certainty due to the fact that each wavelet in isolation represents a separate quantum of the behavior of the climate system in New Delhi. Note that other meteorological parameters do not have quantum certainty.



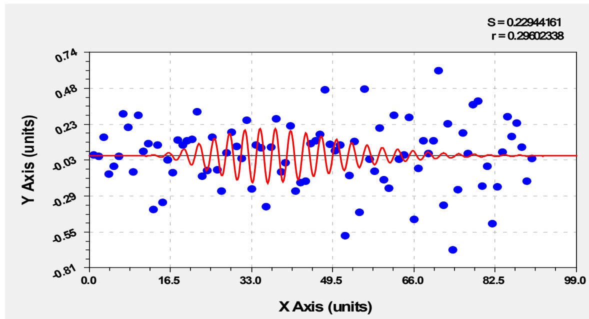
Fifth component



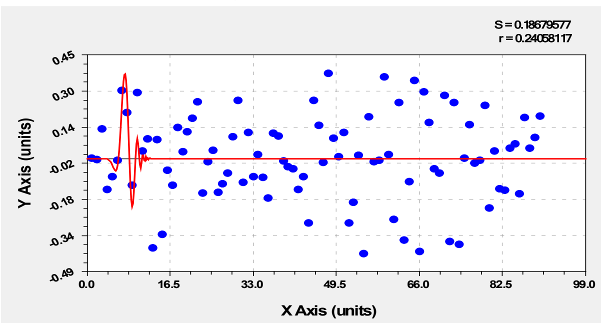
Seventh component



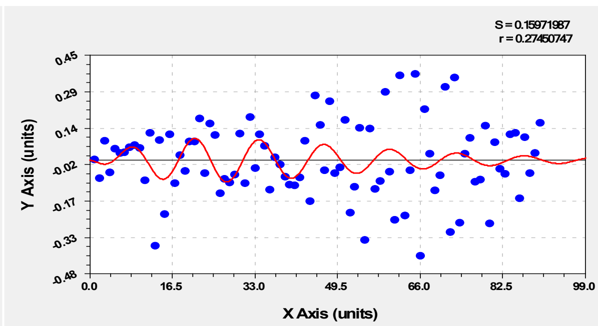
Eighth component



11th component



14th component



17th componen

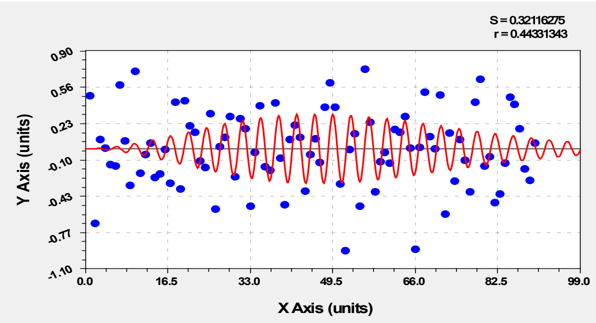
Figure 9. New Delhi annual mean temperature charts at the base of the forecast

Secondly, with an increase in the number of components in the general model (1), the predictive ability is gradually lost. It turns out that even the next year, the calculated average annual temperature may not coincide with the actual temperature. In this regard, it turns out to be sufficient for a look into the future, the model by the parameters in Table 2. And for New Delhi, the fourth component becomes the decisive wavelet, which becomes the critical wavelet or the decisive heat wave.

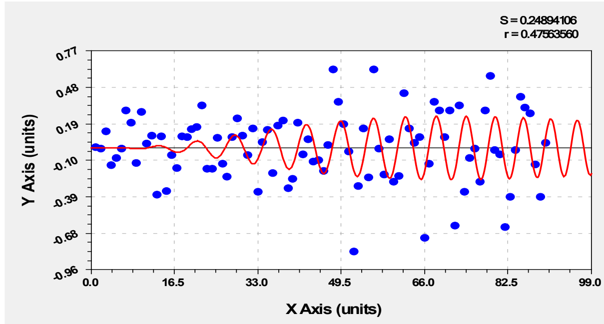
Everything in nature is subject to vibrational adaptation. The air is so changeable that there are many fluctuations on the surface of the Earth, first of all, the air temperature. Why can a dynamic series be decomposed into a large number of oscillations? Other meteorological parameters are not amenable to wavelet analysis. We don't know yet. Also, New Delhi is a unique geographic point on Earth, the dynamics of the average annual temperature in which is clearly determined by a heat wave in the form of a critical fluctuation.

3.2.3 Model Error Distribution

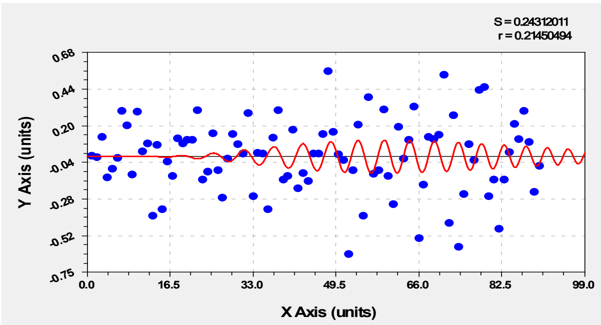
With an increase in the number of wavelets in model (1), the relative modeling error decreases. The number of points n, equal to 91, is distributed without gaps in the dynamic range. Due to the small error of modeling by the general equation (1) with 18 components, the temperature interval was taken equal to 0.5 °C. Then the permissible relative error [Δ] (°C) of model (1) with parameters from Tables 2 and 4 is given in Table 5.



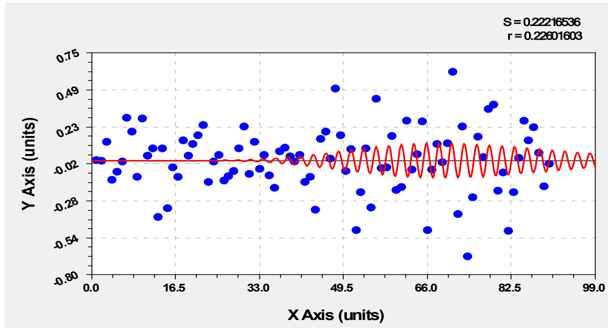
Sixth component (1)



Ninth component

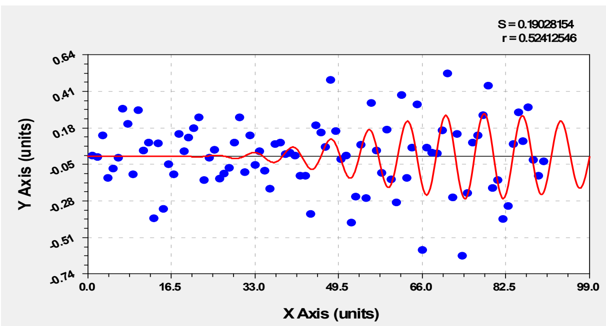


10th component

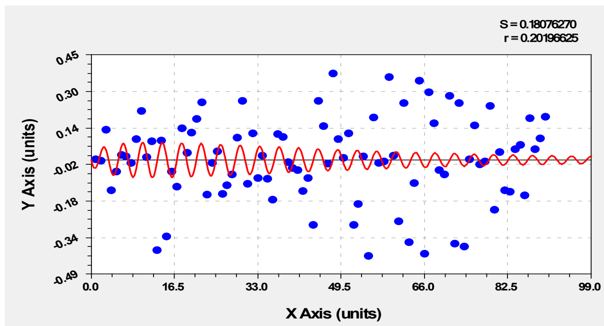


12th component

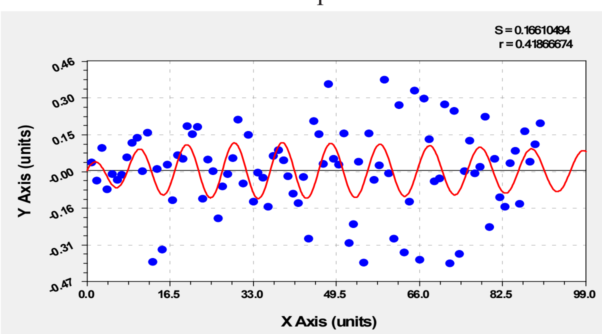
Figure 10. New Delhi annual average temperature plots after moving from the base of the forecast



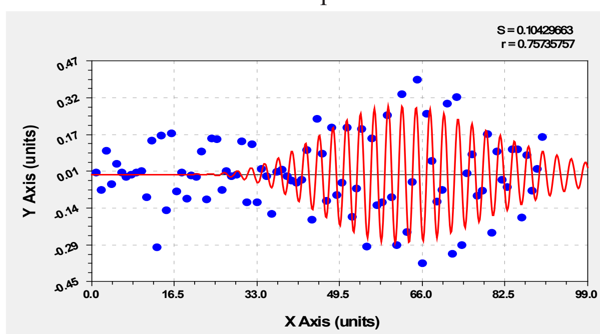
13th component



15th component



16th component



18th component

Figure 11. Additional temperature plots for New Delhi after forecast base

The relative error is in the range from 2 °C to –2.5 °C.

Then the error changes according to the Gauss law (Figure 12) in the form of the equation.

$$n = 21.57717\exp(-0.45215([\Delta] - 0.036538)^2) \quad (3)$$

The normal distribution law is observed with an adequacy of 0.9612.

3.2.4 Looking Ahead to 2050

In the Excel software environment, using the formulas from Tables 2 and 4, the graph shown in Figure 12 was obtained.

Table 6 shows the actual and estimated average annual temperatures in New Delhi from 2010 to 2021. According to the calculated values in Figure 13, a small wave of oscillatory climate adaptation is noticeable.

The hottest year in New Delhi was in 2010. The actual temperature was 26.1 °C, and the calculated one was 26.029 °C. The remainder after calculations using 18 wavelets is 26.1 – 26.029 = 0.071 °C. then the relative error is 100 × 0.071 / 26.1 = 0.27%. In 2021, the relative modulo error is only 0.07%. At the same time, the actual temperature has been decreasing since 2016 (calculated since 2017).

In Tables 2 and 4, the parameters of the model (1) are given with five significant figures. However, in the calculations we used all 11 significant figures. For example, the fourth component is written as an expression:

User-Defined Model: y=a*exp(b*x)*cos(pi*x/(c+d*x)–e)

Coefficient Data:

a = 6.24682600130E–002

b = 1.54780416027E–002

c = 2.31517776521E+001

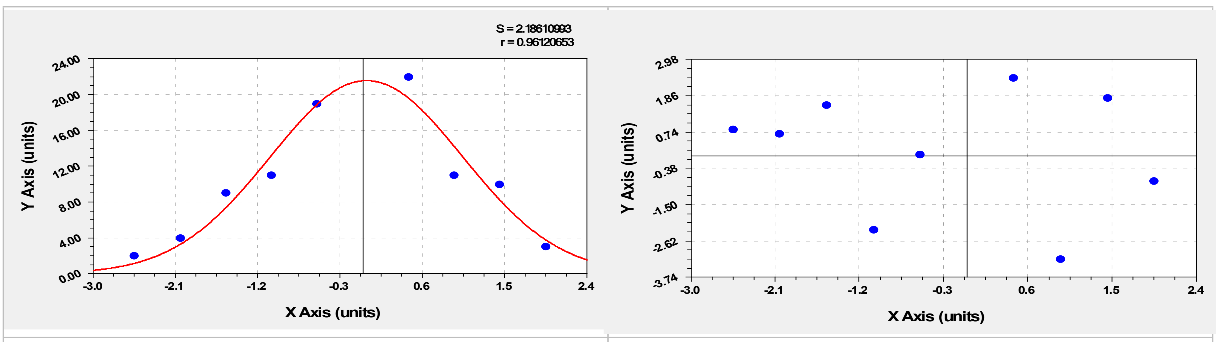
d = 4.18674722591E–002

e = 2.78089604956E+000

According to calculations, the maximum value of the average annual temperature in New Delhi is 25.82 °C in 2017. Since then, the cooling has been going on for four years, which will continue until 2028. The temperature will drop to 22.54 °C due to the change in solar activity [11]

Table 5. Distribution of the relative error of the model from Tables 2 and 4

Interval [Δ], °C	Quantity *n*, pcs.	Interval [Δ], °C	Quantity *n*, pcs.	Interval [Δ], °C	Quantity *n*, pcs.
2	3	0.5	22	–1.5	9
1.5	10	–0.5	19	–2	4
1	11	–1	11	–2.5	2



Gauss's law of normal distribution | Leftovers after model (3)

Figure 12. Relative error distribution plot for 18 wavelets

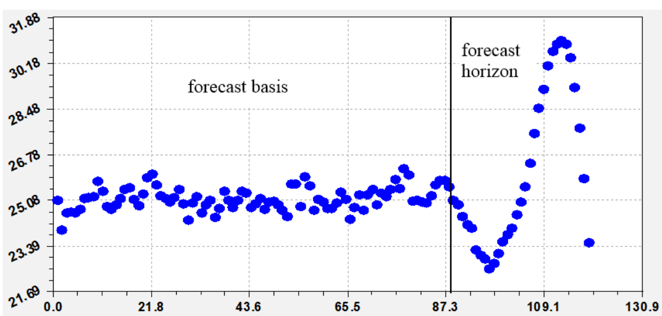


Figure 13. New Delhi 2050 Forecast Graph for the 18-Component Model

Table 6. Average annual temperature in New Delhi since 2010

Year	Time τ, year	Fact t_f, °C	Design temperature		
			t, °C	ε, °C	Δ, %
2010	79	**26.1**	**26.029**	0.071	0.27
2011	80	25.3	25.068	0.232	0.92
2012	81	25.4	25.091	0.309	1.22
2013	82	25.0	25.026	–0.026	–0.10
2014	83	25.1	25.004	0.096	0.38
2015	84	25.4	25.266	0.134	0.53
2016	85	**26.0**	25.657	0.343	1.32
2017	86	25.9	**25.818**	0.082	0.32
2018	87	25.6	25.814	–0.214	–0.84
2019	88	25.1	25.592	–0.492	–1.**96**
2020	89	24.8	25.092	–0.292	–1.18
2021	90	24.9	24.916	–0.016	–0.07

by 25.82 – 22.54 = 3.28 °C. Then by 2044, the average annual temperature in New Delhi will increase to 31.03 °C, or the increment will be 31.03 – 22.54 = 8.49 °C. In 2035, the climate in New Delhi will become hotter than in 2021.

3.2.5 Fractal Distribution of Wavelets

Each fluctuation is a quantum of behavior, in our case, of the New Delhi regional climate system in terms of the average annual temperature of the surface air layer at a height of 2 m from the surface.

Then the sequence of 18 wavelets must itself be distributed fractally according to the modified Mandelbrot law (Table 7, Figure 13).

For the fractal distribution, the standard deviation is taken, the value of which is shown on the graphs in the upper right corner.

Table 7. Relative errors of the calculated values of the standard deviation

Rank R	Coef. correl. r	Standard Deviation σ_f	Estimated standard deviation		
			σ	Remainder ε	Error Δ,%
0	0	0.4610	0.4608	0.0002	0.05
1	0.3963	0.4355	0.4443	–0.0088	–2.02
2	0.3971	0.4185	0.4232	–0.0047	–1.11
3	0.4772	0.4005	0.4006	–0.0001	–0.01
4	**0.5682**	0.4128	0.3775	0.0353	8.55
5	0.3967	0.3626	0.3546	0.0080	2.22
6	0.4433	0.3212	0.3320	–0.0108	–3.37
7	0.4101	0.2929	0.3101	–0.0172	–5.88
8	0.2973	0.296	0.2890	0.0070	2.35
9	0.4756	0.2489	0.2688	–0.0199	–8.01
10	0.2145	0.2431	0.2496	–0.0065	–2.66
11	0.2960	0.2294	0.2313	–0.0019	–0.83
12	0.2260	0.2222	0.2140	0.0082	3.68
13	0.5241	0.1903	0.1978	–0.0075	–3.92
14	0.2406	0.1868	0.1825	0.0043	2.32
15	0.2020	0.1806	0.1681	0.0125	6.90
16	0.4187	0.1661	0.1547	0.0114	6.84
17	0.2745	0.1597	0.1422	0.0175	10.94
18	0.7524	0.1043	0.1306	–0.0263	–25.21

Regardless of the appearance in the CurveExpert-1.40 software environment, the fractal sequence is expressed by the formula.

$$\sigma = 0.46078\exp(-0.036403R^{1.22643}) \qquad (4)$$

where σ is the standard deviation (root-mean-square error), R is the rank of the asymmetric wavelet, starting from the arithmetic mean (it is a special case of the wavelet).

In Table 7, the arithmetic mean formula gets the zero rank. Code 1 refers to the Mandelbrot law, and rank 2 refers to the sum of the arithmetic mean and the first asymmetric wavelet. Rank 3 is given to a three-component model, while rank 4 is given to a model from Table 2 containing four components.

According to the remainders of formula (4) from Figure 14, it can be seen that an oscillation is additionally possible, which will reduce the relative error at the end of the fractal series of all 18 asymmetric wavelets.

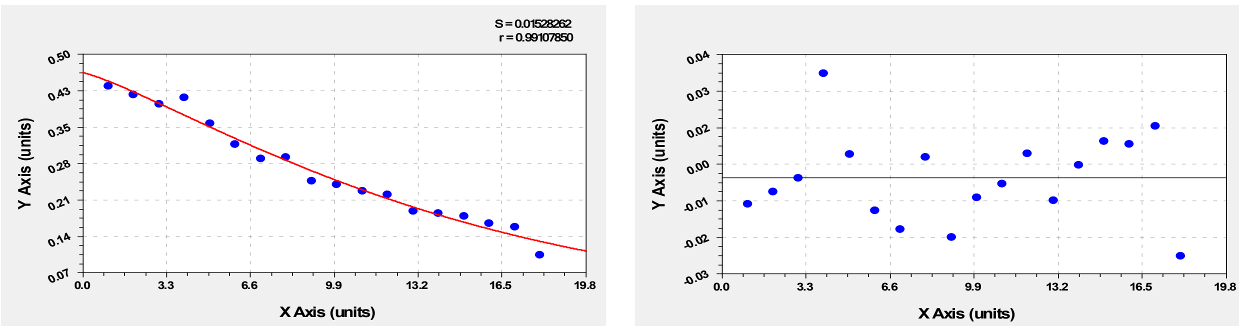
Formula (4) receives adequacy in the form of a correlation coefficient of 0.9911.

3.3 Passage for the Winds in the Himalayas

In India, experts are thinking about how to resettle the population from the growing Thar Desert to other regions of the country. However, instead of this pessimistic alternative, we propose a radical change in the landscape in northern India and southwestern China (Figure 15). The passage is shown as a double line. The maximum length of the passage will be 350 km with a width of 10 km-20 km.

The idea is to connect a 10 km-20 km wide passage between the Thar desert and the Takla Makan desert. For 15 years until 2037, such a volume of earthworks can be mastered by explosive methods.

The wind passage may have two entrances to the foothills from India.



Modified Mandelbrot's Law | Leftovers after model (4)

Figure 14. Graph of the fractal distribution of the standard deviation for 18 wavelets

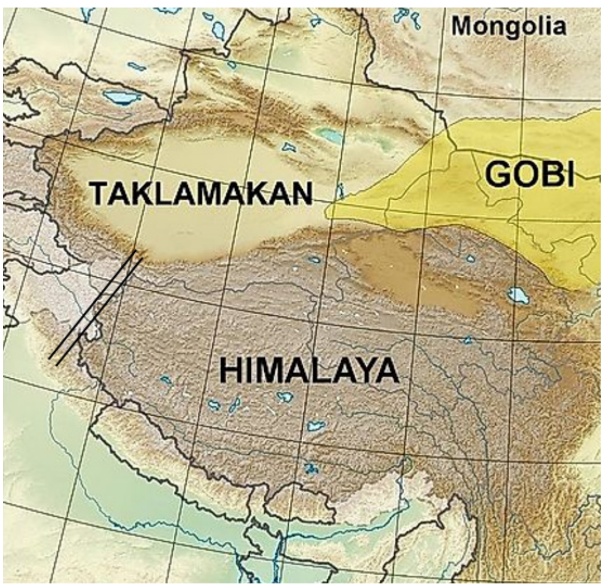


Figure 15. Himalayan Passage for Winds (shown by double line)

After the construction of the passage is completed, the wind with rains will be transferred to the Takla-Makan desert and the steppe with rich herbs will come to life there. At the same time, the intensity of rains will decrease in India. And from the north side, along the passage through the Himalayas, cold winds will blow, cool both deserts.

Now the monsoons bring rain and heat to the country. In India, there is the rainiest place on Earth - Cherrapunji, where more than 12,000 millimeters of precipitation falls annually. And in the north-west of the country, in the Thar Desert, there is not a drop of rain for about 10 months [4]. An ecological passage in the Himalayas will be able to reduce the maximum rainfall to 8-9 meters and part of the monsoons will move towards the Takla-Makan desert. The new direction of the monsoons will noticeably cool the climate of the Thar Desert.

For 4000 years of the life of the population in India, the Himalayan mountains have grown by 400 m (every year by 10 mm). Over the increased mountains it is difficult for birds to fly. I saw the film, how the geese waited in the northern part of the Himalayas, so that strong winds appeared in the direction of the south across the mountains. Birds will use the man-made passage for flights. The climate will change and rich steppe grasses will appear in the Thar and Takla Makan deserts.

For India and China, such passage construction will be a planetary undertaking.

4. Conclusions

The Himalayas are rising 10 mm per year. For 4 thousand years of the existence of civilizations on the island of Hindustan, the mountains have risen by at least 400 m. As a result, the heat is increasing, which can only be reduced by geotechnological measures to reduce the height of the ridges by 4.5 km and create a wide passage 10 km-20 km wide. This will allow the north winds to penetrate into India, and the monsoons to reach the territory of China. The construction of the passage must be completed by 2037.

The wave patterns of the average annual temperature of New Delhi from 1931 to 2021, revealed by the identification method, made it possible to answer that models with four and 18 asymmetric wavelets have been giving a continuous increase in the heat wave since 2021. As a result, the landscape of the Himalayan mountains and the deserts of Thar and Takla Makan create a regional climate system that is original for the land of the Earth. In this system, the oscillatory adaptation of the mean annual temperature in the future will be several times higher than the rate of global warming predicted in the IPCC CMIP5 report.

On the forecast horizon until 2104, the temperature will reach about 450 °C. Then, apparently, starting from India, the same climate will be established on Earth as in the atmosphere of the planet Venus. But before that, in the beginning, in the period 2093 to 2100, a global cooling is likely to be expected. The forecast horizon up to 2084 gives that the climate in New Delhi will be similar to that in the Gobi Desert. Since 1973, a Sahara desert climate has been expected in India. After 2060, the whole territory of India will become like in the Thar Desert.

Thus, an indicative forecast is possible until 2050.

The critical wobble or heat wave indicates that New Delhi's maximum annual mean temperature increase from 1931 to 2050 will be 6.06 °C in 2044. The average annual temperature will also reach a maximum of 31.04 °C. If nothing is done, then there will be an ecological disaster in India.

In dynamics, the first stage of the heat wave according to the fourth component of the model was in 1931-1954, when the critical fluctuation in New Delhi had negative values of the average annual temperature of the surface air layer. Then it turns out that at the first stage, the fluctuation was aimed at reducing regional warming.

Second stage 1955-1978 is characterized by a burst of warming with a maximum temperature increment in 1971 of 0.034 °C. At the third stage, the heat wave again became negative in the period 1980-2000 with a minimum temperature of –0.07 °C in 1993. In the period of 2001-2019 (the fourth stage), the largest maximum of the temperature increment wave in New Delhi was observed in 0.65 °C in 2012-2013. And finally, the fifth stage will be in 2020-2035 (coinciding with the forecast of solar activity) with another cooling down to a minimum of –2.14 °C in 2029.

At the sixth stage from 2036 to 2049, if India and China do not make joint efforts in the geological technology called "Himalayan Passage", an ecological disaster will break out in New Delhi with a maximum increase in the average annual temperature of 6.06 °C in 2044. The temperature in 2044 is expected to be 31.04 °C. This will be higher than the level of 2021 on 31.04 – 24.9 = 6.14 °C.

An increase in the frequency of the thermal wave is noticeable. From 1931 to 2049 in the dynamics of the average annual temperature in New Delhi, there will be six half-periods of cooling and warming: 1) 23 years; 2) 23 years old; 3) 20 years; 4) 18 years old; 5) 15 years and 6) 13 years. The most dangerous in ecological terms is the sixth stage.

According to calculations, the maximum value of the average annual temperature in New Delhi is 25.82 °C in 2017. Since then, the cooling has been going on for four years, which will continue until 2028. The temperature will drop to 22.54 °C due to the change in solar activity [8] by 25.82 – 22.54 = 3.28 °C. Then by 2044, the average annual temperature in New Delhi will increase to 31.03 °C, or the increment will be 31.03 – 22.54 = 8.49 °C. In 2035, the climate in New Delhi will become hotter than in 2021.

Conflict of Interest

There is no conflict of interest.

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