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МОДЕЛИРОВАНИЕ И ПРОГНОЗ ДИНАМИКИ ГЛОБАЛЬНЫХ КЛИМАТИЧЕСКИХ АНОМАЛИЙ ТИПА ЭЛЬ-НИНЬО И ЛА-НИНЬЯ

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В работе обсуждаются вопросы моделирования и прогнозирования климата нашей планеты с использованием системы искусственного интеллекта AIDOS-X. Нами разработан ряд семантических информационных моделей, демонстрирующих наличие сходства между движением элементов лунной орбиты и смещением мгновенного полюса Земли. Установлено, что движение полюса Земли связано с вариациями магнитного поля, сейсмическими событиями, а также с нарушениями глобальной атмосферной и водной циркуляции, ведущими к возникновению эпизодов типа Эль-Ниньо и Ла-Нинья. Посредством семантических информационных моделей изучены отдельные экваториальные регионы Тихого океана, а также пространственные паттерны умеренных широт, выявлена их сравнительная значимость для прогнозирования глобальных климатических нарушений в тропической зоне и умеренных широтах. Выявлены причины появления Эль-Ниньо Modoki и их связь с движением элементов лунной орбиты в долговременных циклах. Ранее нами был сделан прогноз о возникновении эпизода Эль-Ниньо в 2015 году. На основе анализа семантических моделей сделан вывод о том, что ожидается Эль-Ниньо классического типа. На базе блока прогнозирования AIDOS-X рассчитан помесячный сценарий эволюции этой глобальной климатической аномалии. В настоящей работе выполнен анализ фактической реализации прогноза Эль-Ниньо с момента его опубликования в январе 2015 г – до июня 2015г. Показано, что реализовался предсказанный сценарий развития климатических аномалий. Расчеты в модуле распознавания системы «Aidos-X» будущих сценариев развития климата свидетельствуют о том, что

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SIMULATING AND PREDICTING GLOBAL CLIMATIC ANOMALIES SUCH AS EL NINO AND LA NINA

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The paper discusses the modeling and prediction of the climate of our planet with the use of artificial intelligence AIDOS-X. We have developed a number of semantic information models, demonstrating the presence of the elements of similarity between the motion of the lunar orbit and the displacement of the instantaneous pole of the Earth. It was found that the movement of the poles of the Earth leading to the variations in the magnetic field, seismic events, as well as violations of the global atmospheric circulation and water, and particular to the emergence of episodes such as El Niño and La Niña. Through semantic information models studied some equatorial regions of the Pacific Ocean, as well as spatial patterns of temperate latitudes, revealed their relative importance for the prediction of global climatic disturbances in the tropical and temperate latitudes. The reasons of occurrence of El Niño Modoki and their relationship with the movement of elements of the lunar orbit in the long-term cycles are established. Earlier, we had made a forecast of the occurrence of El Niño episode in 2015. Based on the analysis of semantic models concluded that the expected El Niño classical type. On the basis of the prediction block AIDOS-X calculated monthly evolution scenario of global climate anomalies. In this paper, the analysis of the actual implementation forecast of El Niño since its publication in January 2015 - before June 2015. It is shown that the predicted scenario of climatic anomalies actually realized. Calculations of future climate scenarios with system «Aidos-X» recognition module indicate that further possible abnormal excess temperature indicators of surface ocean waters in regions Nino 1,2 and Nino3,4 for 2015 may be comparable with similar abnormalities in the catastrophic El Niño of 1997-1998.

дальнейшее возможное аномальное превышение температурных показателей поверхностных вод океана в регионах Nino 1,2 и Nino3,4 в течение 2015 года может быть сопоставимо с подобными отклонениями при катастрофическом Эль-Ниньо 1997-1998 гг.

Ключевые слова: СЕМАНТИЧЕСКИЕ ИНФОРМАЦИОННЫЕ МОДЕЛИ, ВЫЧИСЛИТЕЛЬНЫЙ ЭКСПЕРИМЕНТ, ЭЛЬ-НИНЬО, ЭЛЬ-НИНЬО MODOKI, ДВИЖЕНИЕ ПОЛЮСА ЗЕМЛИ

Keywords: SEMANTIC INFORMATION MODEL, COMPUTATIONAL EXPERIMENT, EL NINO, EL NINO MODOKI, POLAR MOTION

Introduction

As we know, in the solar system, there are common causes and mechanisms of motion of celestial bodies, affecting, in turn, on the motion of the poles of the Earth, seismic activity, magnetic field variations and social-economic processes [1-24]. As was shown in our previous studies [1-18], astronomical parameters of celestial bodies can be used to create semantic data models in order to predict the effects of the space environment factors on the noosphere, the magnetosphere and the Earth's lithosphere.

The aim of this work is the development of semantic information models based on artificial intelligence systems «AIDOS-X», allowing to identify the correlation between the dynamics of the poles and the global climate shifts, emerging during periods of El Niño - La Niña [25-37], investigate the cause and effect relationship and the dependence of their origin from the influence of external to the Earth cosmic factors.

Identification of such mechanisms will contribute to improved understanding and prediction of global climatic disasters.

Formulating and solving problems

The scientific study of the El Niño underway for about 150 years, but historical records and legends of Native Americans suggest the existence of this natural phenomenon for at least 500 years old, and the excavations of archaeologists suggest the existence of already three thousand years BC [25-27].

The researchers [29-37] isolated oceanic component (El Niño), atmospheric constituents (southern oscillation or SOI), and the complete cycle of ENSO (El Niño Southern Oscillation). As we know, the warm phase of the El Niño often moves in the opposite cold phase - La Nina, and then replaced by a neutral phase. All together it forms a series of the most important manifestations of global climate change on the planet.

The classic El Niño - La Niña have a characteristic dynamics in violation of coherent and harmonized system of circulation in the tropical Pacific. Despite the fact that the basic processes occur in the tropics, catastrophic cycles apply to temperate latitudes, not only in the Pacific but also lead to climate change on the planet.

Normally, the macro-circulation processes, including in the Pacific, are relatively stationary system in the equatorial zone to form a powerful convective cells Hadley to 30 ° north and south of the equator [33, 38-39].

Solar radiation near the equator causes the maximum heating water and air due to evaporation and condensation of vapour above the dew point in the clouds, a large amount of heat due to reinforcing existing inter-latitudinal temperature difference circulation processes in the Hadley cells [39].

In the rotating coordinate system of the Coriolis force, which is absent on the equator, rejects high circulating air flow (jet air currents) in the northern hemisphere to the right and to the south - to the left, accelerated the Earth's rotation.

Dipped in both hemispheres the cooling air in the near-surface areas creates a constant trade winds blowing westward toward the equator, against the direction of rotation of the Earth, which are supported by the force of friction torque, shoulder strength, determines the distance from the axis of rotation of the existing world. Trade winds blowing over the oceans at maximum intensity, divided approximately in the equatorial band windless. Trade winds generated Rossby waves, therefore the sea level in the western Pacific Ocean about 60 cm higher than in the coastal regions of the Americas [38].

The polar latitudes direction of circulation of air flows changes to the opposite, which leads to the Ferrel cells formation within latitudes from 30 to 60°.

In the tropical Pacific isolated equatorial Walker circulation. Harmonious self-regulating global circulation due to the trade winds cause upwelling of deep cold waters of the western coastal areas of the American continent, local cooling of the atmosphere and the pressure increase. Due to the climate of the coast of Peru - a cold that contrasts sharply with the climate the same latitudes on the east coast of South America.

Outside the cycle of El Niño - La Niña carrying refrigerated air flows to the west is accompanied by a gradual heating and saturated water vapour, so the opposite of western tropical zone of the Pacific Ocean in the regions of Indonesia and Australia observed increase in temperature characteristics, reduced atmospheric pressure and loss of abundant seasonal rainfall.

Due to the movement of warm water to the coasts of Southeast Asia, where down-welling occurs - lowering the surface with warm water, leading to the formation of a thermocline - a narrow layer of water with a maximum temperature gradients. The depth of the warm water is up to 150 meters, as opposed to the opposite end of the ocean, where moving deep cold water and warm boundary layer and cold water is close to the surface.

El Niño and La Niña events occur on average once every 4 years, but some episodes end in a few months after the start, while others last for 3-4 years. During El Niño coherent system of air and ocean circulation is disturbed.

Southern Oscillation Index (SOI), based on the difference of the pressure between the eastern and western Pacific Ocean, is one of the main indicators of large-scale atmospheric fluctuations. The measurements are made on SOI weather stations Tahiti, Fr. Polynesia, and Darwin, Australia. The steady shift SOI below 8 indicates the occurrence of El Niño, the rise of the index above 8 is typical of La Niña episode [41]. Smoothed time series SOI well correspond to changes in temperature throughout the tropical zone of the Pacific. Another indicator of the end of the neutral phase is considered to be a three-month average increase of 0,5 ° C during El Niño or decrease in temperature during La Niña episode of surface waters in the central-eastern equatorial Pacific Ocean bounded by latitudes 5N - 5S and longitude 170W - 120W.

In the classic version of the episodes of El Niño and La Niña beginning to emerge in May-August, reaching a peak strength in December and April, and then there is their involution during May-July of the following year. The classic development of El Niño includes:

1. Increasing the temperature of surface and subsurface waters in the equatorial eastern and central Pacific Ocean on 1,5-3,5 ° C above the norm;

2. Raising the thermocline in the western half of the ocean and, consequently, a decrease in the level difference between the western and eastern part of the ocean;

3. The air temperature increase, pressure reduction and increased rainfall in the central-eastern region of the equatorial Pacific Ocean and a drop in temperature, increase in pressure and a decrease in rainfall in parts of Australia, Indonesia and Southeast Asia.

4. The decline in SOI, based on the difference of atmospheric pressure fluctuations between the eastern and western Pacific Ocean.

5. The weakening of the eastern trade winds throughout the eastern half of the equatorial Pacific Ocean in the lower atmosphere, as well as reducing the westerly winds in the upper atmosphere. The appearance of the winds at low levels of the atmosphere, blowing from west to east in the equatorial belt of the Pacific Ocean. The above steps 1-5 are violations of the equatorial Walker circulation [38].

6. The increase in vertical wind shear, the jet streams to offset the flanks Hadley cells [39]. Since hurricanes occur with moderate vertical wind shear in the season El Niño is a reduction in their number in the Atlantic, as the jet streams to come with high vertical shear. At the same time in the eastern Pacific is an increase in the number of hurricanes, since here the vertical misalignment is small.

7. Drought and fires in the regions of Indonesia and Australia, and heavy rains and landslides caused by them on the west coast of America. The emergence of multiple violations of the climate in temperate latitudes.

8. Economic, social and political disturbances associated with global climate disorders [25-28].

La Niña phase of the opposite warm El Niño phase, it is accompanied by increased equatorial Walker circulation and all that goes with it. A reduction in air temperatures and surface ocean waters near the western coast of America, there is increasing pressure and rising thermocline intensified trade winds on the other side of the ocean - increased temperature readings, respectively, decreases pressure and increases SOI, intensified storms, rising sea levels and lowered thermocline.

A reduction in vertical wind shear in the Hadley cells and the reduction of jet streams, which leads to increased hurricane activity across the tropical North Atlantic, above average vertical wind shear observed over the eastern tropical North Pacific, respectively, are reduced hurricane activity.

The above classic version of El Niño has recently been supplemented by one Modoki, in which warming does not begin off the coast of South America, and in the central tropical Pacific Ocean, which creates a low pressure area, respectively, and receive higher rainfall. Area warming spreads to the east of the ocean, reaching a maximum at the end of the year. In the western part of the ocean at the same time it has been an increase in atmospheric pressure.

This variant of El Niño in its season generates a large number of hurricanes, for example, in the season of El Niño Modoki 2004 registered twelve tropical storms, including "Ivan", one of the strongest Atlantic hurricane since records began in climate. In general, the storms in 2004 brought about the same damage as the super El Niño in 1997-1998. In total, from 1850 to 1990 passed 32 classic El Niño and 7 El Niño Modoki, and after 1990 - only 3 classic El Niño and 6 El Niño Modoki.

According to the hypothesis [19-21], the basic dynamic impact on global air circulation has the Earth's rotation and the position of the axis of rotation. In December and April in the equatorial Pacific sea surface temperature is relatively high. At this time, the warm waters occupy the large areas, stretching from Indonesia to the meridian line 180E, and the trade winds - the weakest in the annual cycle, so even a small shift of the axis of rotation can lead to a significant redistribution of air circulation, strengthen it or cause a block circulation and, therefore lead to an increase or decrease in temperature. Therefore, the change in temperature of ocean surface water seems the most reliable criterion for the monitoring cycle ENSO, while the second most important figure - fluctuations in atmospheric pressure.

To study the temperature in the equatorial Pacific region marked 4, for which the collection and analysis of thermal parameters is performed separately. The zone is Nino4 indicator for the occurrence of El Niño Modoki, and the area Nino1,2 first responds to the El Niño classical type - Fig. 1.

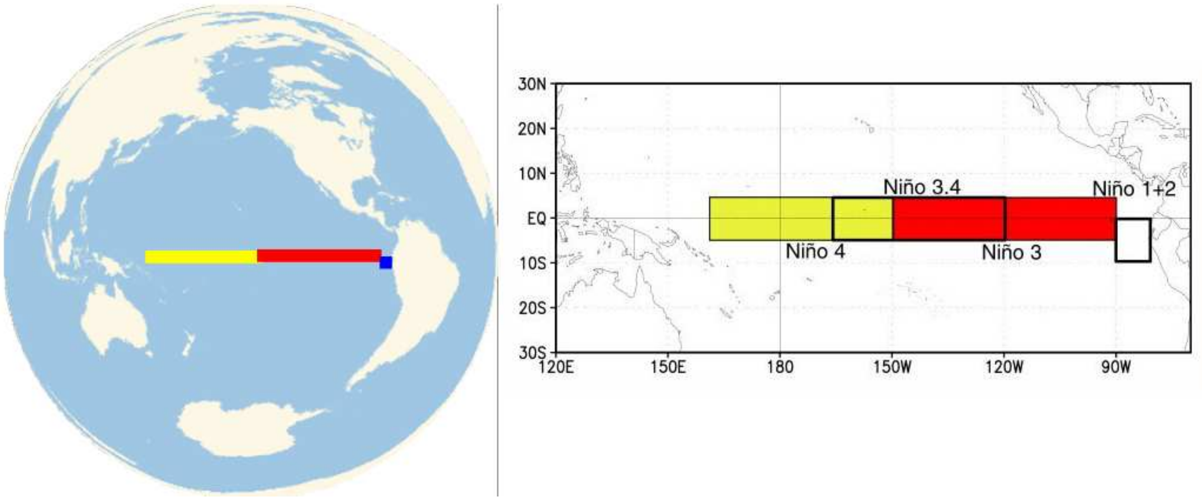


Figure 1. Zone temperature characteristics of the surface waters of the Pacific Ocean.

In a previous study [18] we have shown that the main driving force of the geographical displacement of the Earth's pole is the dynamics of the Earth-Moon system, resulting in a change in the position of nodes and apogee of the lunar orbit.

It is generally accepted offer Euler [42] used the plane of the ecliptic as the basis for a fixed coordinate system, the intersection of the equatorial plane with her as a moving coordinate system as a result of the drift of the vernal equinox determines the basic astronomic parameters and is a reflection of forced precession of the rotation axis of the Earth.

But in reality, the plane of the ecliptic is the plane of the orbit of the barycentre (centre of mass of the Earth-Moon), not the Earth's orbit, so all is well studied characteristics of the lunar movements are also characteristics of the orbital motion of the Earth [42].

Leonard Euler showed that the Earth's motion around the centre of mass of the Earth-Moon system is an accurate representation of the motion of the Moon with all the inequalities, so the movement of the Moon allows us to determine with great accuracy the disturbance in the movement of the Earth [42].

The decisive factor is that the direction of zero degree on the ecliptic, associated with the ascending lunar node gives the X-axis in the accounting system dynamics pole empirical data, and, respectively, the Y axis is spaced 90° from the X axis in this system.

There are two planes: the first - the plane of the lunar nodes, which coincides with the plane of the ecliptic, regresses clockwise revolves in 18.61 years, and the second, more mobile, plane apses. Since these two planes drifting towards each other, and the apogee of the ascending lunar node intersected three times during one revolution of the lunar nodes.

The velocity vector of this movement is directed along the axis of 90-270° of the ecliptic in the Western Hemisphere. In view of the triple point of climax connection with the node for one period of turnover of nodes along the ecliptic, it can be expected that the vector will describe a complex curve having three cycles of 120°, with dynamically changing the amplitude of the curve, which depends on the values of the declination and latitude.

Hence, a change in the parameters of the astronomical axis 0-180° ecliptic longitude - provides instantaneous dynamic offset pole carried at the X, and the dynamics of astronomical parameters through the 90-270° ecliptic longitude - provides dynamic offset pole-axis Y. This offset the axis X - perhaps as a plus sign and a minus sign, and the axis Y - almost exclusively with a plus sign, since the normal vector is always directed along the axis of 90-270° towards the western hemisphere due to the fact that the plane of the ecliptic is at angle of 23° to the plane of the celestial equator, and declination of the Sun is always a positive for a maximum of 90° E. Thus, a positive declination of a celestial body having longitude (right ascension, RA), 90° E, as well as the negative declination near longitude 90° W, will increase the positive trend on the axis Y.

Good repeatability of geometric configurations of lunar and solar eclipses over the centuries clearly demonstrates how closely the movement of the Sun barycentre - to the exact periodic motion, therefore, all the other disturbances including the planets have a very small amount [18].

The dynamics of the instantaneous pole is spinning and unwinding spiral with a period of rise and fall of the amplitude fluctuations of about 6 years, and the trajectory of the poles are open curves, the size and shape of the contour varies from cycle to cycle, and the amplitude of the oscillation may vary by 5 times.

Theoretically, the motion of the lunar apogee and node can lead to a shift of the poles of the Earth [1, 18], which should lead to changes in temperature and pressure, and the displacement along the axis Y - must be recorded in the region Nino1,2, and the dynamics of the axis X - should reflected in the region Nino4 (Nino3.4).

Apse (apogee-perigee) is a mobile system, besides having a drift with respect to the zero point of the ecliptic, the movement of the apogee is mainly determined by the dynamics of the poles inside the six-year cycle, so we can expect peak predominant influence in the dynamics of the empirical data relating to the global atmospheric and water circulation.

The Y-axis is the lead in shifting geographic poles of the Earth (the normal vector is always directed along the axis 90E - 90W in the Western Hemisphere), the dynamics of the Y-axis should dominate the observations in the region Nino1,2, as in El Niño classical type, and when La Niña episodes.

When the compounds of the lunar apogee and node in the long cycle of close to zero degrees of the ecliptic, so movement along the Y-axis is relatively weak, the leading role belongs to the movement of the poles along the axis X, there are abnormal deviations in the region and Nino1,2 Nino4 (Nino3.4), that It means the occurrence of El Niño Modoki - Fig. 2-3.

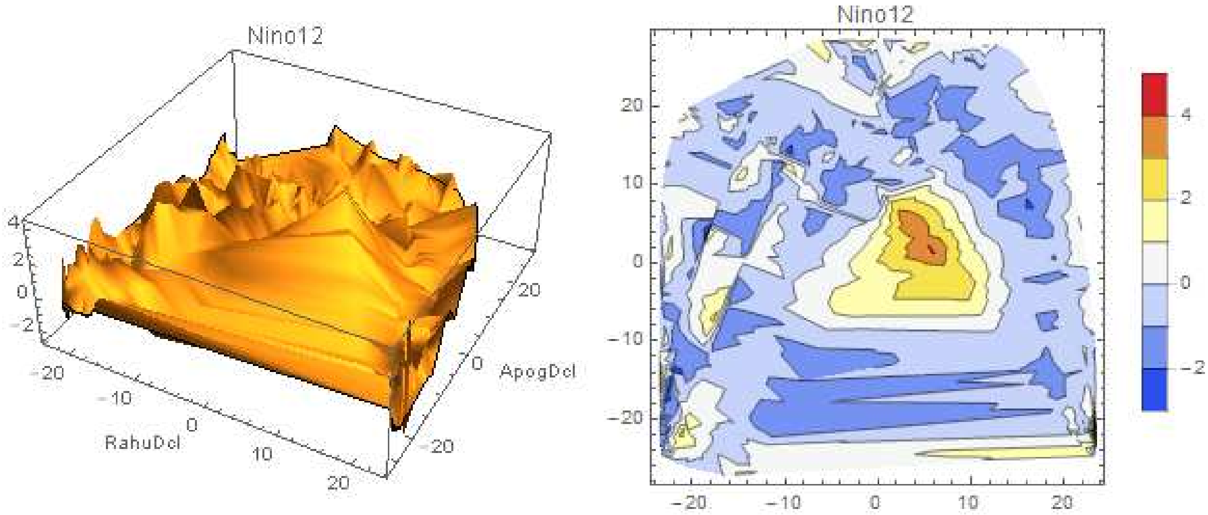


Fig. 2. Distribution of temperature deviations from the average in the area Nino1,2 depending on declination of Apogee and the North Node of the Moon's orbit.

Thus, we can expect the existence of a correlation between the position of the elements of the lunar orbit, the geographic poles of the Earth and changes in temperature indicators, and the Southern Oscillation Index (SOI), with the predominant influence of the polar motion along the Y-axis of motion along the axis X.

ASK-analysis [11] allows us to identify patterns in large arrays of diverse empirical data that enables you to search the correlation between heterogeneous global earth processes and the movement of celestial bodies in the solar system [1-18].

This study was performed on the basis of artificial intelligence systems «AIDOS-X». At any information and measurement system information of the object of study to the information processing system (part of the IIS) is always passed on some of the channels of information transmission. The physical and astronomical studies as channel information often protrude electromagnetic waves of various ranges: light, radio waves and X-rays. Our knowledge of these transmission channels are incomplete.

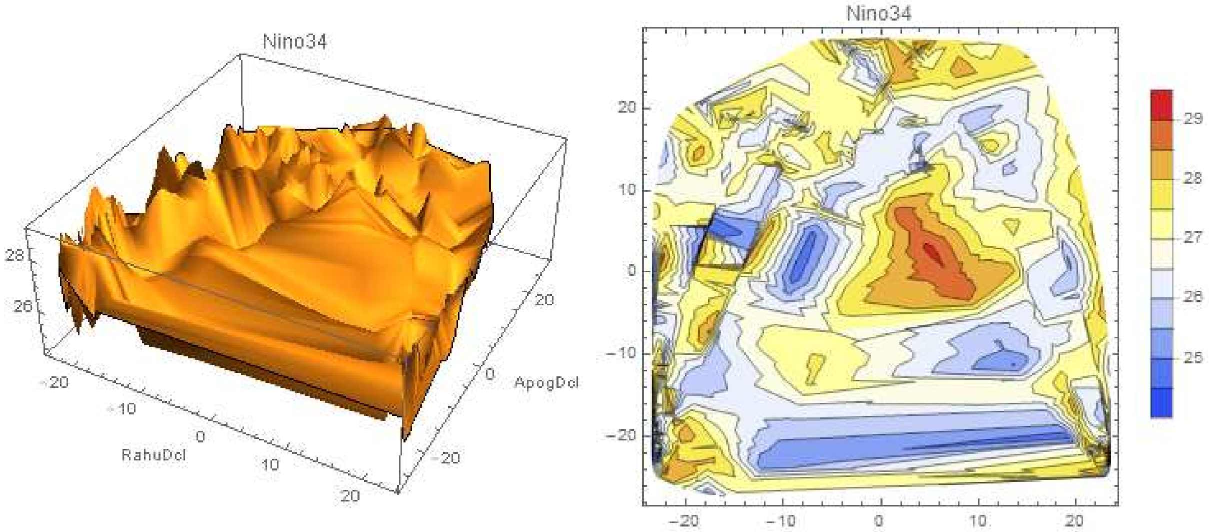


Fig. 3. Distribution of Celsius temperature zone Nino 3,4 depending on the declination of Apogee and the North Node of the Moon's orbit.

Note that in our opinion the lack of knowledge about the transmission channels of interaction or lack of understanding is not a fatal obstacle to the study of the properties of objects by means of this interaction. This means that it is possible to obtain adequate information about the object of little-studied channel or channels, the nature of which are unknown. In the process of learning the basic meaning is information obtained about the object of knowledge through the channels of interaction with him, not understanding the nature of these channels, which is not critical in the early stages of cognition. This approach will call information by studies [11, 15-16].

In order to identify causes of the global atmospheric circulation and water have been developed semantic information models with a high level of emergence. Since systemic effect - the existence of a system of qualitatively new, emergent properties that cannot be reduced to the sum of the properties of its parts, the more elements in the system, the greater the proportion of the information contained therein is the information available in the relationship of its elements.

The semantic information model is based on the fact that the Earth is included in the global active hierarchical information system components which, in addition to our planet, are the Sun, the Moon and the planets of the solar system.

Each of these components has a complex internal organization, meanwhile, has a systemic effect is higher the more complex active ingredients, its components, the more of them, and the more intense the relationship between the elements of the information system.

The solution of the direct problem involves the valuation of input parameters and bringing them to the same scale of measurement range, the partition slots on the M pieces of the matrix calculation of the absolute frequency of informativeness.

The solution of the inverse problem involves recognition of the categories specified by the astronomical parameters. A special case of the recognition problem is to determine the reliability of the identification of the categories of astronomical data in each model.

In order to identify the existence of a correlation between the dynamics of the poles and violations of global circulation models formed №1 and №2, modelling was carried out in the parameter of similarity, which is similar to the coefficient of correlation statistics between indicators of global circulation disorders - and the performance dynamics of the poles on the XY axes, respectively.

The problem of the recognition of the event categories in the field of central forces

Consider the problem of recognition of categories of astronomical data [4-18]. There are a number of events A, which is associated with many categories Ci. An event can be considered, for example, a daily check of the instantaneous pole position in X and Y, and category - the dynamics of the instantaneous displacement of the pole. From these data, we can construct a matrix containing the corresponding coordinates of celestial objects such as angles longitude (Right Ascension) and latitude (declination). We assume that the set frequency distributions Ni - number of events related to the category Ci.

Define the number of cases of this category, which accounts for a predetermined interval of variation of astronomical parameters have in the discrete case:

$$N_{ij}(x_j, k) = N_i w(\tilde{x}_j, k)\Delta x, \quad x_j < \tilde{x}_j < x_j + \Delta x$$
$$1 \le i \le n, \quad 1 \le j \le 2m, \quad k = 1,\dots,k_0 \qquad (1)$$

Here w –density of distribution of events along the normalized coordinates [3], k_0 – - number of celestial objects used in the task.

The normalized variable is defined by angular and radial coordinate as follows:

$$x_{jk} = \begin{cases} \vartheta_j(k)/2\pi, & 1 \le j \le m, \quad 1 \le k \le k_0 \\ \dfrac{r_{\max}(k) - r(k)}{r_{\max}(k) - r_{\min}(k)}, & m+1 \le \mathrm{j} \le 2\mathrm{m} \end{cases}$$

Here $r_{\min}, r_{\max}$ - the minimum and maximum values of astronomical parameters.

We define the matrix according to the information content [11]

$$I_{ijk} = \log_2 \frac{N_{ij} / \sum_j N_{ij}}{\sum_i N_{ij} / \sum_{i,j} N_{ij}},\ N_{ij}(x_{jk}) \neq 0$$

$$I_{ijk} = 0,\ \ N_{ij}(x_{jk}) = 0,$$

$$\delta I_{jk} = \sqrt{\frac{1}{n}\sum_i \left(I_{ijk} - \frac{1}{n}\sum_i I_{ijk} \right)^2}$$

$$1 \le i \le n,\quad 1 \le j \le 2m,\quad 1 \le k \le k_0 \qquad (2)$$

The first value (2) is informative features, and the second value is the standard deviation of descriptiveness or integrated informative.

Each category can be associated vector information content astronomical parameters dimension $2mk_0$, composed of elements of information content by sequential write columns corresponding normalized coordinate in one column, ie.

$$c_{is} = I_{ijk}\Big|_{jk=s},\quad 1 \le s \le 2mk_0 \qquad (3)$$

On the other hand, the process of identification and recognition can be viewed as a vector decomposition recognizable object in a series of vectors categories (classes recognition) [4-16]. This vector consisting of ones and zeros, we can determine the coordinates of celestial objects, the relevant date and the empirical indicators of events in the form of

$$a_{ls} = \begin{cases} 1, & (j-1)\Delta x \le x_{jk}(l) \le j\Delta x, \quad jk = s \\ 0, & 1 \le s \le 2mk_0 \end{cases} \qquad (4)$$

Thus, if the normalized coordinates of a celestial object from the data on the object of the study sample enters the preset time, the element of the vector is given a value of 1, and in all other cases - a value of 0. The enumeration of coordinates is carried out sequentially for each celestial object.

In the case where the system (3) is full, it can be any vector (4) in the form of a linear combination of vectors of (3). The coefficients of this expansion will match the level of similarity of this event with this category. In the case of an incomplete system of vectors (3) is replaced by the recognition of the exact procedure. The level of similarity with the event data in a category can be defined by the value of the scalar product of the vector (4) the vector (3),

$$K_{il} = \frac{1}{|a_l||c_i|} \sum_{s=1}^{2mk_0} a_{ls}(A)c_{is} \qquad (5)$$

Note that there are four possible outcomes for which can be true or false, or does not include the event attributed to this category. To account for these outcomes recognition categories in artificial intelligence systems "Aidos-astro" [10, 14] and «AIDOS-X» is carried out on the parameter of similarity, which is defined as follows [4-16]:

$$S_i = \frac{1}{N} \sum_{l=1}^{N} (BT_{il} + T_{il} - BF_{il} - F_{il}) \cdot 100\ \% \qquad (6)$$

Si- authenticity identifying «i-th" category;

N - the number of events in a recognizable sample;

BTil- level of similarity «l-th" event «i-th" category, to which it has been properly assigned by the system;

Til - level of similarity «l-th" event «i-th" category, to which he was not properly assigned by the system;

BFil - level of similarity «l-th" event «i-th" category, to which he was wrongly classified as a system;

Fil - level of similarity «l-th" event «i-th" category, to which he was not wrongly attributed the system.

With this definition, the similarity parameter ranges from -100% to 100%, as a regular correlation coefficient in statistics. Obviously, the similarity parameter must meet the criterion of a simple test

$$S_i(N_i = 1) = 100\ \%$$

In [4-16], and others have shown that the procedure for recognition of the parameter similarity (6), implemented in the system of artificial intelligence "Aidos-astro" [10, 14] is a relatively stable sample size, and relative to the number of cells model. Mathematical justification of this procedure is given in [11]. The reason that it is possible to identify subsets (categories) of various events, even the random nature of using astronomical parameters is fairly obvious. After all, in fact, identified the distribution, which are formed by modulating the initial distributions of astronomical parameters [3]. In some cases, this is sufficient to carry out the recognition categories [4-16].

In Model №1 as a classification scale taken a three-month average performance of surface water temperature anomalies in the region Nino3.4 (5° N-5°

S, 120° -170° W), divided into 72 classes. We used data ERSST (Extended Reconstructed Sea Surface Temperature), for the period 1900-2012 y. [43]. Depending they set the parameters of the polar motion of the axes X and Y according to IERS [44] - a model EOPC 01 for the period 1900 - 2012. Is also divided into 72 classes.

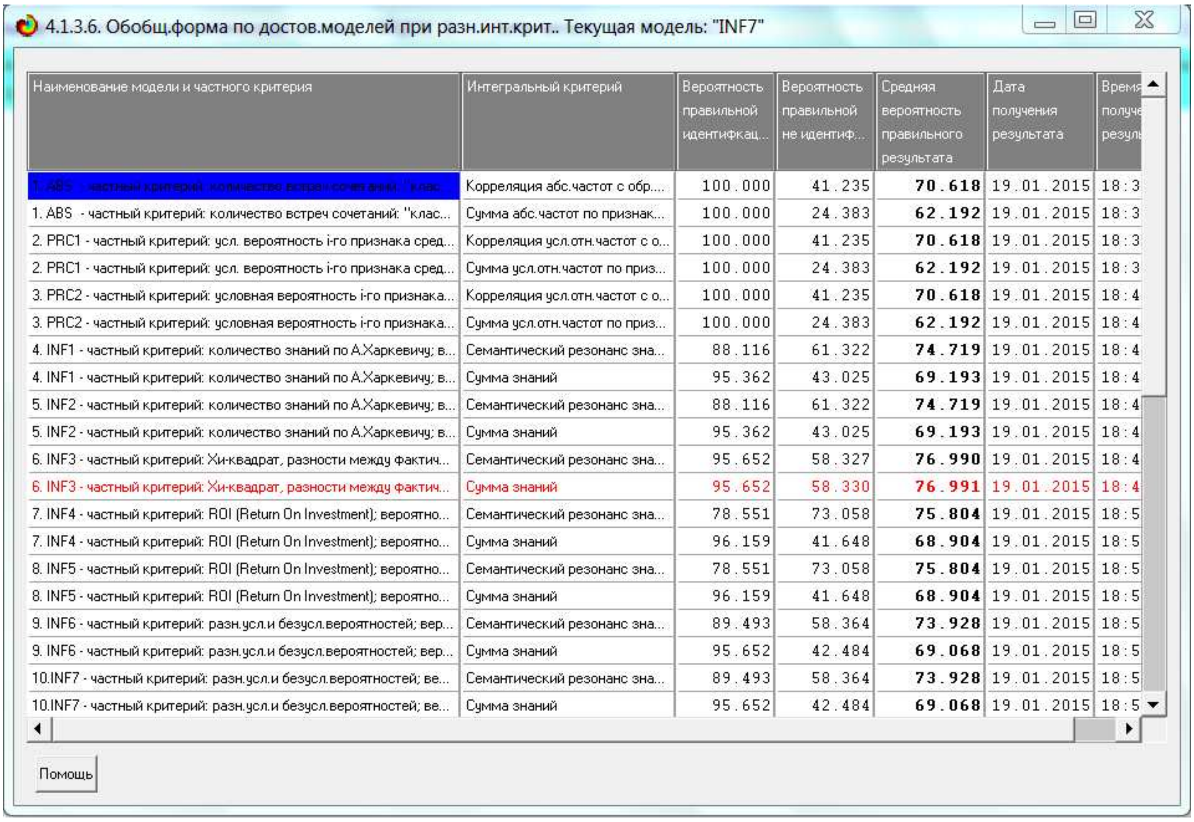
The findings in the models №1 with the value of the parameter S = 86.609 similarities indicate a data communication between the dynamics of the geographic poles of the Earth and the surface water temperature anomalies in the region Nino3,4. Integral informative value due to the shift of the poles along the X-axis is - 4 490, and along the axis Y - 4.988, in line with the hypothesis discussed.

Model №2 - Fig. 4, is formed in a similar manner, but as a classification scale taken monthly Southern Oscillation Index figures (SOI), indicating a dynamic difference in atmospheric pressure between Tahiti (Fr. Polynesia) and Darwin (Australia).

As a classification scale used standardized monthly average anomalies of pressure difference between Tahiti and Darwin (SOI) for the 1900-2014 biennium. According to [45], divided into 72 classes. Depending they put the same data IERS, as in Model №1, with appropriate division into 72 classes.

As a result of research models №2 obtained similarity parameter S = 76.991, which is lower than in Model №1, so further studies as a leading indicator of temperature anomalies in selected regions of the collection of empirical data Nino1,2-3,4. In Model №2 integral informativeness, reflecting climatic parameters connection with the movement of the poles along the Y is - 3,498, and the coordinates along the X - 3. 483, which is consistent with the hypothesis discussed.

In the model №3 and №4 take the same classification scale, as in the model №1 and №2, divided into 18 classes, but put them at the mercy of 18 astronomical parameters, divided into 180 gradations. Astronomical parameters longitude and declination of Mercury, Venus, Mars, Jupiter, Saturn, Uranus and Neptune, the apogee of the orbit of the Moon and units were calculated at a particular time, which is set in a semantic information model. In view of the increasing emergence of each option becomes astronomical inherent system properties. Astronomical parameters were calculated at the beginning of the day (00:00:00 GMT) at a fixed point with geographic coordinates (00. 00E; 55. 08N) in the tropical coordinate system.



4.1.3.6. Обобщ.форма по достов.моделей при разн.инт.крит.. Текущая модель: "INF7"

Наименование модели и частного критерия	Интегральный критерий	Вероятность правильной идентификац...	Вероятность правильной не идентиф...	Средняя вероятность правильного результата	Дата получения результата	Время получе... резуль...
1. ABS - частный критерий: количество встреч сочетаний: "клас...	Корреляция абс.частот с обр....	100.000	41.235	70.618	19.01.2015	18:3
1. ABS - частный критерий: количество встреч сочетаний: "клас...	Сумма абс.частот по признак...	100.000	24.383	62.192	19.01.2015	18:3
2. PRC1 - частный критерий: усл. вероятность i-го признака сред...	Корреляция усл.отн.частот с о...	100.000	41.235	70.618	19.01.2015	18:3
2. PRC1 - частный критерий: усл. вероятность i-го признака сред...	Сумма усл.отн.частот по приз...	100.000	24.383	62.192	19.01.2015	18:3
3. PRC2 - частный критерий: условная вероятность i-го признака...	Корреляция усл.отн.частот с о...	100.000	41.235	70.618	19.01.2015	18:4
3. PRC2 - частный критерий: условная вероятность i-го признака...	Сумма усл.отн.частот по приз...	100.000	24.383	62.192	19.01.2015	18:4
4. INF1 - частный критерий: количество знаний по А.Харкевичу; в...	Семантический резонанс зна...	88.116	61.322	74.719	19.01.2015	18:4
4. INF1 - частный критерий: количество знаний по А.Харкевичу; в...	Сумма знаний	95.362	43.025	69.193	19.01.2015	18:4
5. INF2 - частный критерий: количество знаний по А.Харкевичу; в...	Семантический резонанс зна...	88.116	61.322	74.719	19.01.2015	18:4
5. INF2 - частный критерий: количество знаний по А.Харкевичу; в...	Сумма знаний	95.362	43.025	69.193	19.01.2015	18:4
6. INF3 - частный критерий: Хи-квадрат, разности между фактич...	Семантический резонанс зна...	95.652	58.327	76.990	19.01.2015	18:4
6. INF3 - частный критерий: Хи-квадрат, разности между фактич...	Сумма знаний	95.652	58.330	76.991	19.01.2015	18:4
7. INF4 - частный критерий: ROI (Return On Investment); вероятно...	Семантический резонанс зна...	78.551	73.058	75.804	19.01.2015	18:5
7. INF4 - частный критерий: ROI (Return On Investment); вероятно...	Сумма знаний	96.159	41.648	68.904	19.01.2015	18:5
8. INF5 - частный критерий: ROI (Return On Investment); вероятно...	Семантический резонанс зна...	78.551	73.058	75.804	19.01.2015	18:5
8. INF5 - частный критерий: ROI (Return On Investment); вероятно...	Сумма знаний	96.159	41.648	68.904	19.01.2015	18:5
9. INF6 - частный критерий: разн.усл.и безусл.вероятностей; вер...	Семантический резонанс зна...	89.493	58.364	73.928	19.01.2015	18:5
9. INF6 - частный критерий: разн.усл.и безусл.вероятностей; вер...	Сумма знаний	95.652	42.484	69.068	19.01.2015	18:5
10.INF7 - частный критерий: разн.усл.и безусл.вероятностей; ве...	Семантический резонанс зна...	89.493	58.364	73.928	19.01.2015	18:5
10.INF7 - частный критерий: разн.усл.и безусл.вероятностей; ве...	Сумма знаний	95.652	42.484	69.068	19.01.2015	18:5

Помощь

Figure 4. Model calculation results №2 (with program «AIDOS-X»).

Table 1. Results of the calculations in the model №№3-4

Model number	Classification scale	Descriptive scales	Parameter similarity
Model №3	Temperature anomalies in the region Nino3.4	18 astronomical parameters	89. 597
Model №4	SOI Index	18 astronomical parameters	87. 189

Information on the impact of the astronomical parameters of the temperatures of the surface waters of the ocean is higher than atmospheric pressure indicators. Indeed, according to [41] SST induces are leading indicators of the global circulation disorders, so the SST induces based our further research.

Table 2. Integral informativeness of descriptive scales in Model №3

The name descriptive scales	Integral informativeness of descriptive scales
APOG LNG	1,326
RAHU LNG	1,317
SAT LNG	1,303
APOG DCL	1,293
MA LNG	1,293
SAT DCL	1,292
UR LNG	1,288
JUP LNG	1,278
VEN DCL	1,247
MA DCL	1,238

UR DCL	1,221
MER DCL	1,192
JUP DCL	1,192
VEN LNG	1,183
RAHU DCL	1,137
NEP LNG	1,013
NEP DCL	1,012
MER LNG	1,005

Integral informative elements in the lunar orbit models №3 is the highest, which means their lead in the event of an abnormal temperature of ocean surface water in the region Nino3,4.

Thus, changing the elements of the lunar orbit is not only a geographical shift of the poles of the Earth, which has been proved in our previous paper [18], but, apparently, is the reason for violations of the oceanic and atmospheric global circulation, leading to the appearance of El Niño and La Niña.

In the model №№5,6 the dependence of the dynamics of the motion of the lunar poles node and apogee. As a classification scale figures are taken daily dynamics of the poles of Y and X. The data were obtained from the site IERS [44], model EOPC04_08_IAU2000A for the period 1962 -2014 years. The data were divided into 72 classes depending on their put options astronomical longitude and declination of the lunar apogee and node also divided into 72 gradations. The study results in this model are shown in Fig. 5.

The data obtained can construct a matrix of information content, which can be used in solving the direct problem for the detection and imaging of cognitive functional dependencies in the noisy data of high dimensionality, and the inverse problem of forecasting.

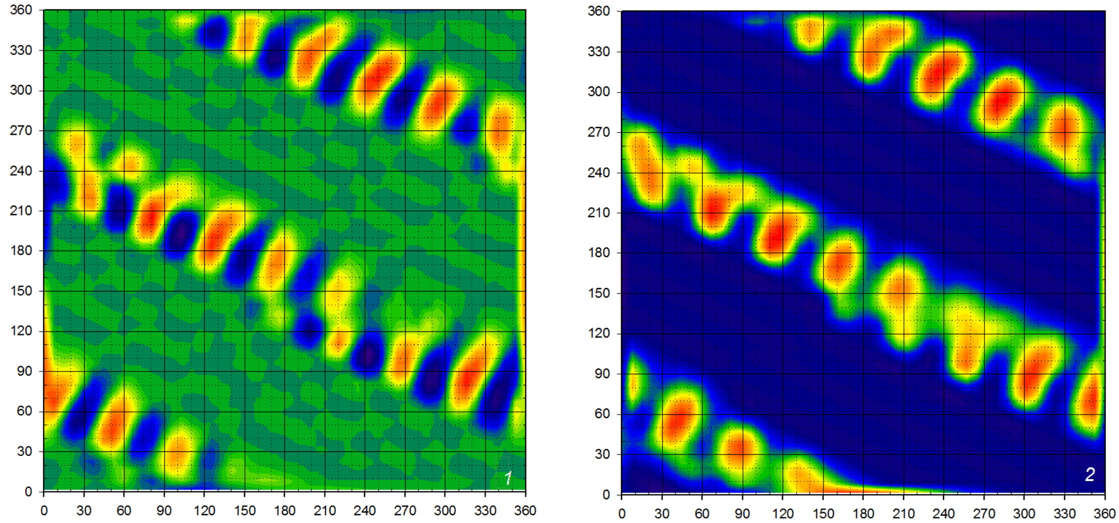


Figure 5. Matrix informativeness in the model №№ 5 and 6, showing the dependence of the pole coordinates X (left figure) and Y (right figure) from the longitude of the Lunar Apogee and assembly.

The movement of the geographic pole axes in the direction of positive values reflected in the chart as a red stain in the direction of negative values - in the form of spots of blue. Each of the colour spots on the chart 2 is a six-year cycle of expanding and collapsing pole trajectory [18].

Fig. 6 is a matrix of information content model №3 depending on the length of the lunar apogee and node. Colour stains from blue to red reflects the dependence of occurrence of temperature anomalies in the region Nino3,4, thus, during the onset of El Niño, the reflected red and periods of La Niña, the reflected blue alternate depending on the movement of elements of the lunar orbit.

Briefly explain the essence of this method. Matrix informativeness (2) is a table in which the columns correspond to the generic image of the class. The future states of the simulated system, the line - the value of the factors influencing this system [11]. At the intersections of rows and columns of the matrix is the amount of information that is contained in the fact that the action values of the factor corresponding to the line on the system to the state corresponding column.

The maximum amount of information that can be a factor in the value, determined by the number of future states of the simulated system. Unit amounts of information reflects the strength of influence factor values, and - the direction of this influence. That it helps or hinders the offensive of the state.

If the sequence of classes and values of the factors form ordinal scales or scale relationships. Respectively, they determined the relationship "more-less" or, in addition, the unit of measurement, origin and arithmetic operations, the information content of the matrix allows an intuitive graphical visualization, the traditional type functions. Then the values of the factors considered as values of the argument, and the classes, the occurrence of which of these factors, see the values of the maximum amount of information - as the values of the function.

Other classes, less than a given value due to factors, as well as those that attack this value prevents a greater or lesser extent, can also be displayed matching colours, and it can also be of interest. Lets you use the powerful human ability to analyze images. Cognitive functions presented in the form of a matrix of informativeness (2), of a very general form of functional dependence: a multivalued function of many arguments. Each factor affects the value of all the states of the simulated object, and each condition is caused by all the values of the factors.

In view of the selected regions to collect empirical data and separate study of temperature anomalies in them formed Models №№7-10. As classification scales are taken monthly average temperature (matrix informativeness 1-4) and temperature anomalies (matrix informativeness 5-8) allocated regions of the equatorial zone of the Pacific Ocean for the period 1950-2014 - SSTOI - indices according to [43]. Classification scale regions Nino3, Nino4, Nino3,4 are for ease of analysis and prediction of 10 gradations, and the region Nino1,2 - 14 grades. Descriptive scale divided into 180 gradations.

Comparative analysis of the results shows that the highest temperature setting similarities with the longitude of the lunar apogee and node regions have Nino1,2 and Nino4. Region Nino3 is intermediate between regions and Nino1,2

Nino4, and the region Nino3.4, dedicated to the study of the El Niño Modoki, the information is less important than the region Nino4.

A characteristic feature shown in Fig. 7 matrices informativeness - pronounced temperature anomalies in the compounds of the lunar apogee and node near the axis 0-180° of the ecliptic, and the connection point near 180 ° allow the temperature anomaly leading to the El Niño-like period of El Niño observed during 1997-1998, and near 0° ecliptic - periods of La Niña (2008-2009).

The data presented in Fig. 7 shows that the temperature anomalies as a plus sign and a minus sign, most clearly manifested in the region Nino1,2, which means that its leading role in the occurrence of violations of the global circulation, and corresponds to the appearance of the classic El Niño and La Niña. Nino4 Region is the most important for learning and early prediction of the El Niño Modoki.

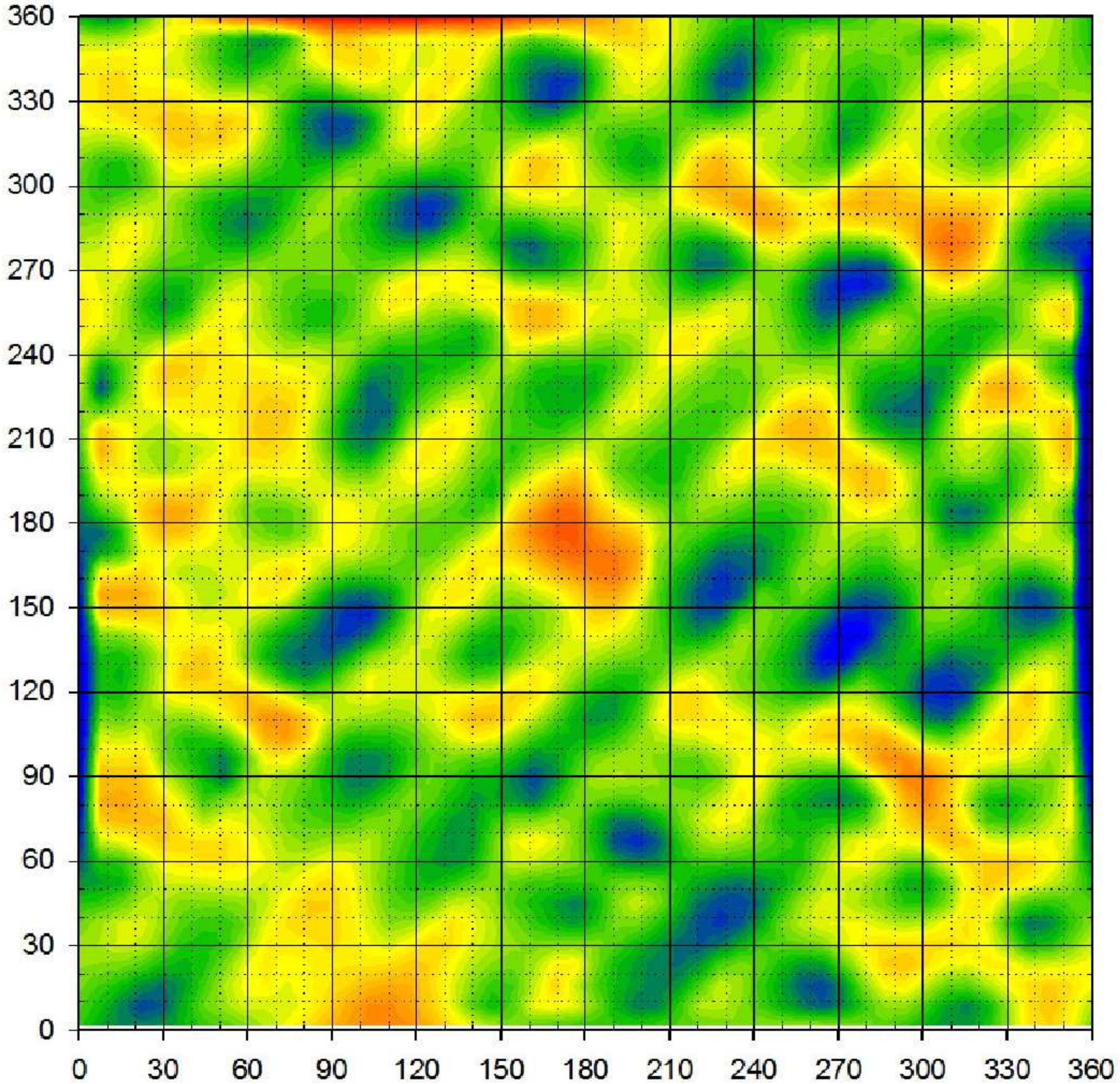
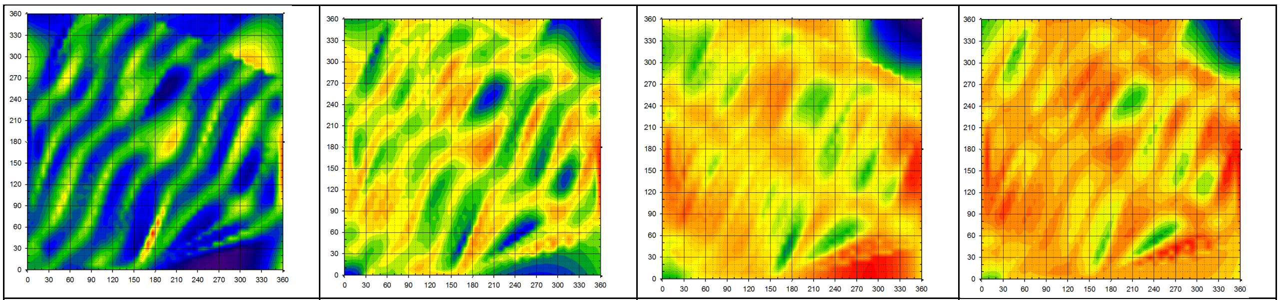
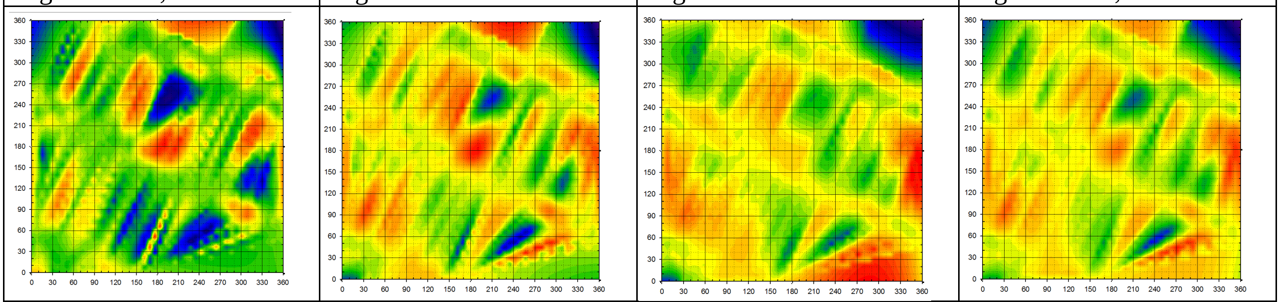


Fig. 6. Matrix informativeness models №3, showing the dependence of the temperature anomalies of ocean surface waters in the region Nino3,4 the longitude of the lunar apogee and node.



1. Data temperature in the region Nino1,2	2. Data temperature in the region Nino3	3. Data temperature in the region Nino4	4. Data temperature in the region Nino3,4



5. Temperature anomalies in the region Nino1,2	6. Temperature anomalies in the region Nino3	7. Temperature anomalies in the region Nino4	8. Temperature anomalies in the region Nino3,4

Рис. 7. Matrix Models of informative №№7-10 depending on the longitude of the lunar apogee and node.

Table 3. Comparative results of studies in the model №№7-10

Region	**Parameter similarity**
Nino1.2	84. 522
Nino3	83. 821
Nino4	84. 058
Nino3.4	82. 931

Despite the fact that the main events associated with El Niño occurs in the tropical Pacific, they are closely related to the processes taking place in other regions of the globe. This is seen in the phenomena teleconnection or in distant space-time relationships. During El Niño increases the transfer of energy in the temperate latitudes of the troposphere, which is manifested in the increase of thermal contrasts between tropical and polar latitudes, the intensification of cyclonic and anticyclonic activity in the temperate latitudes.

Induces teleconnection calculated on the basis of standardized monthly anomalies with the high-altitude drops and spatial rotation. As a result, emit nine time series induces teleconnection different spatial patterns for the period 1950-2014.

In the model we studied №№11-18 information links between the dynamics of indicators at different spatial patterns and movement of the lunar apogee and node. As classification scales are taken sequentially codes teleconnection eight spatial-temporal patterns, divided into 18 grades, dependent on their performance delivered longitude and apogee Lunar nodes, divided into 72 gradations. Data source - the database [43] containing Tele-index. The results are given in Table 4.

Table 4. Results of the study index teleconnection

Model	**Similarity parameter**
NAO	77. 583
EA	76. 824
EA/WR	77. 317
SCA	76. 742
WP	77. 578
POL	77. 632
PNA	76. 751
EP/NP	70. 395

The most informative exhibit patterns NAO (North Atlantic Oscillation), WP (Western Pacific pattern), POL (polar Eurasian pattern), which means that a single mechanism of formation of planetary climate anomalies and the possibility of predicting global circulation disturbances in some regions. On the representation of matrix informativeness is visually similar to the dynamics of the matrix pole on the axis X.

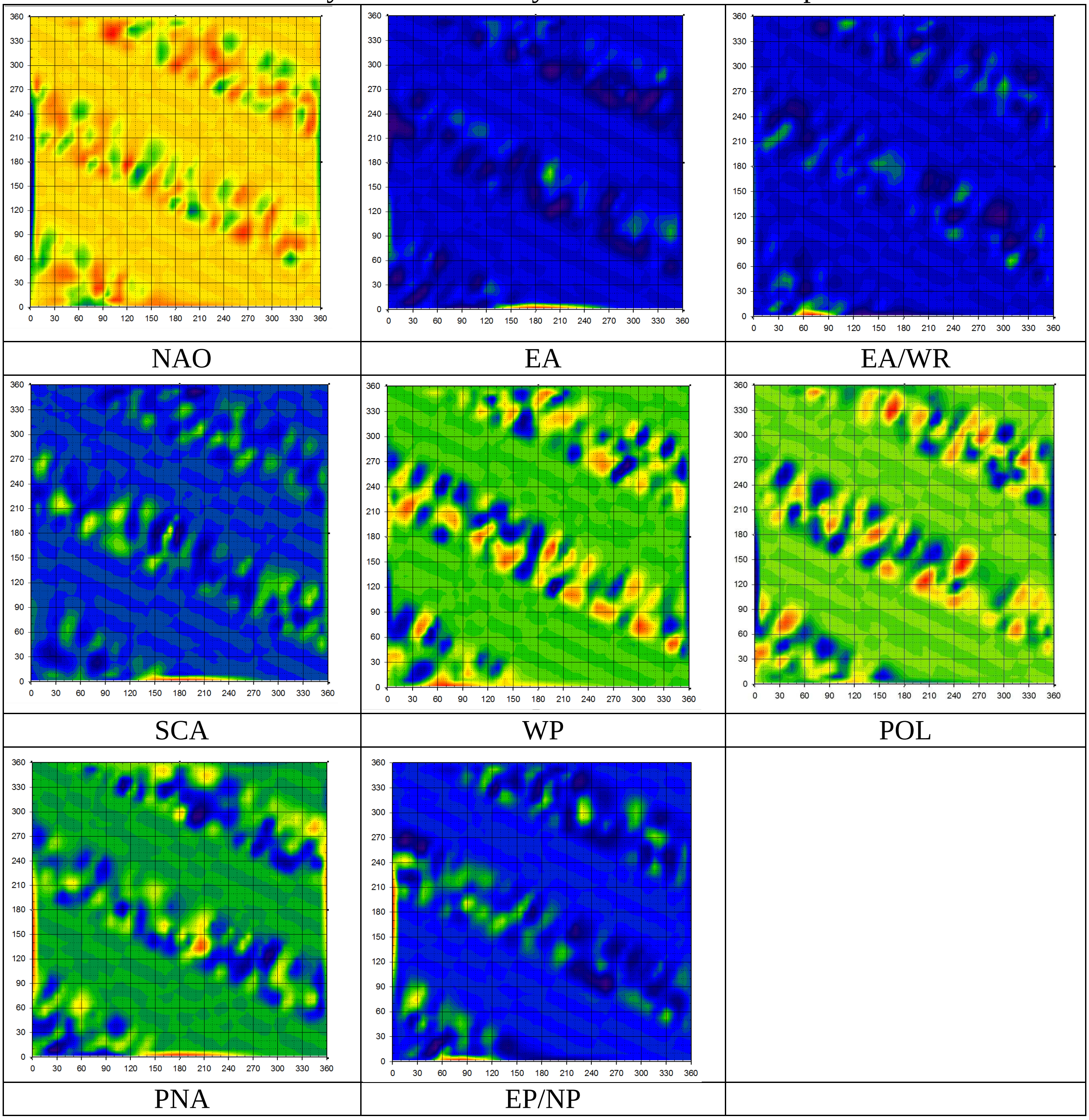


Fig. 8. Informative Matrix of Models №№11-18

Recognition module in the program «AIDOS-X» allows on the basis of the future provisions of the elements of the lunar orbit is not only count the dynamics of the pole, as was demonstrated in our previous work [18], but also to predict the occurrence of climatic anomalies El Niño and La Niña.

The model №19 as a classification scale used monthly average, smoothed seasonally indicators of temperature anomalies in the study region Nino3.4 according to [43], divided into 10 grades. As the descriptive scales used data on longitude apogee and the lunar node, divided into 180 gradations. In this model, a correlation coefficient of 82,102. Matrix informativeness model №19 gives an idea not only of past temperature anomalies, or periods of El Niño and La Niña, but also about the future of global violations. On matrix bear years with temperature anomalies, as well as marked next track elements of the lunar orbit with white dots. Apogee is moving along the ecliptic in the forward direction, and the Node – opposite direction, so their joint dynamics observed in the matrix of informative accordingly.

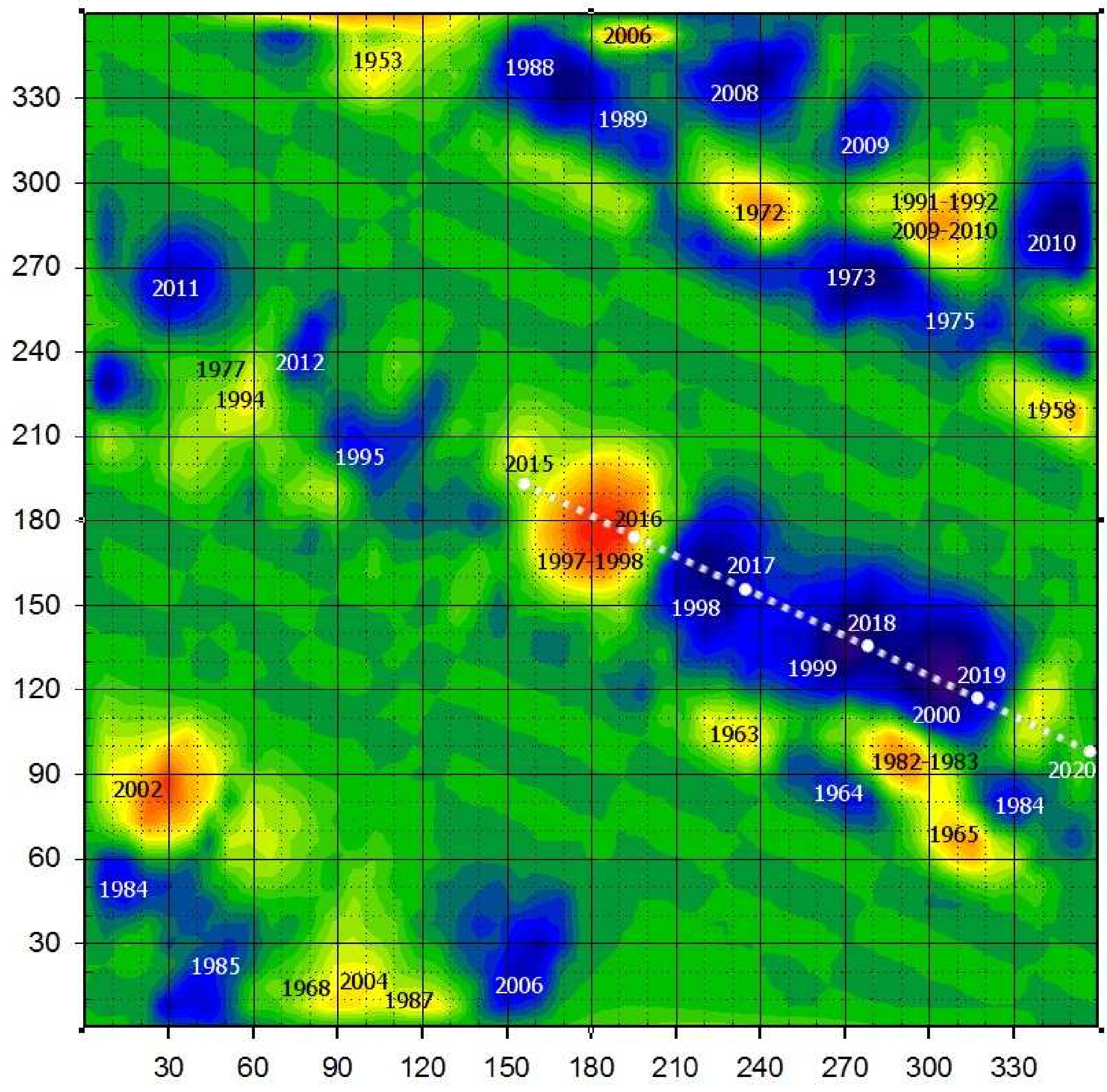


Figure 9. Matrix of informative models №19 with recognition results.

Fig. 10-13 shows the results of recognition of the future scenarios of climate and temperature anomalies in regions Nino 1,2 - Fig. 10, Nino 4 Fig. 11, Nino 3 - Fig. 12, Nino 3,4 - Fig. 13.

According to calculations in the study region Nino1,2 84,522% probability happen abnormal deviation of temperature of surface waters in the direction of positive values, which will begin in March 2015. Since the recognition was carried out for monthly intervals, and the official forecast for the necessary temperature deviation at + 0,5 ° C from the average in the three months period of El Niño is forecast to come in April and May 2015 and will continue for the whole period 2015.

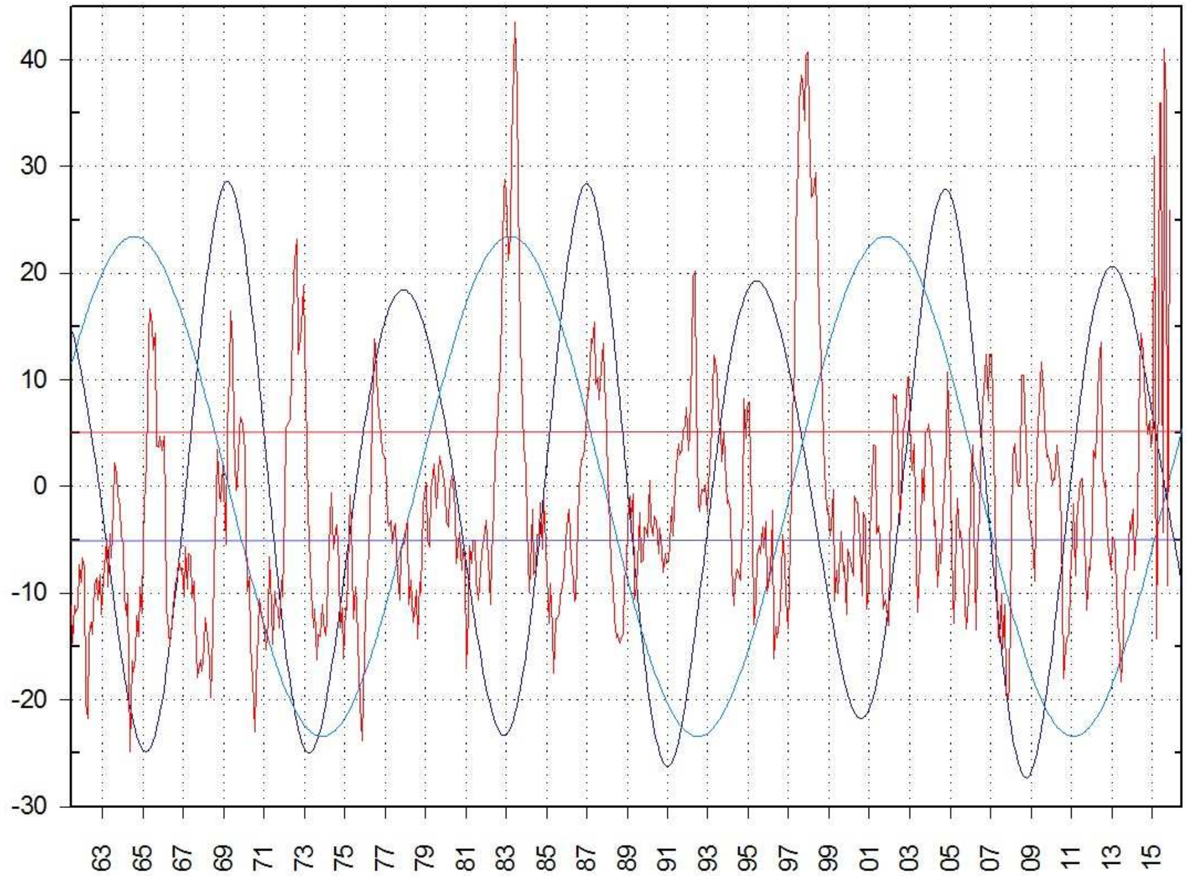


Figure. 10: The recognition results in Model №7 - dynamics of temperature anomalies in the region Nino1,2 and forecast for 2015. Red colour indicates the average monthly temperature anomalies of surface water, normalized for ease of analysis. Red and blue horizontal lines - the threshold deviations above and below which there is a period of El Niña and La Niña, respectively, blue and blue lines - the decline of the lunar apogee and node respectively.

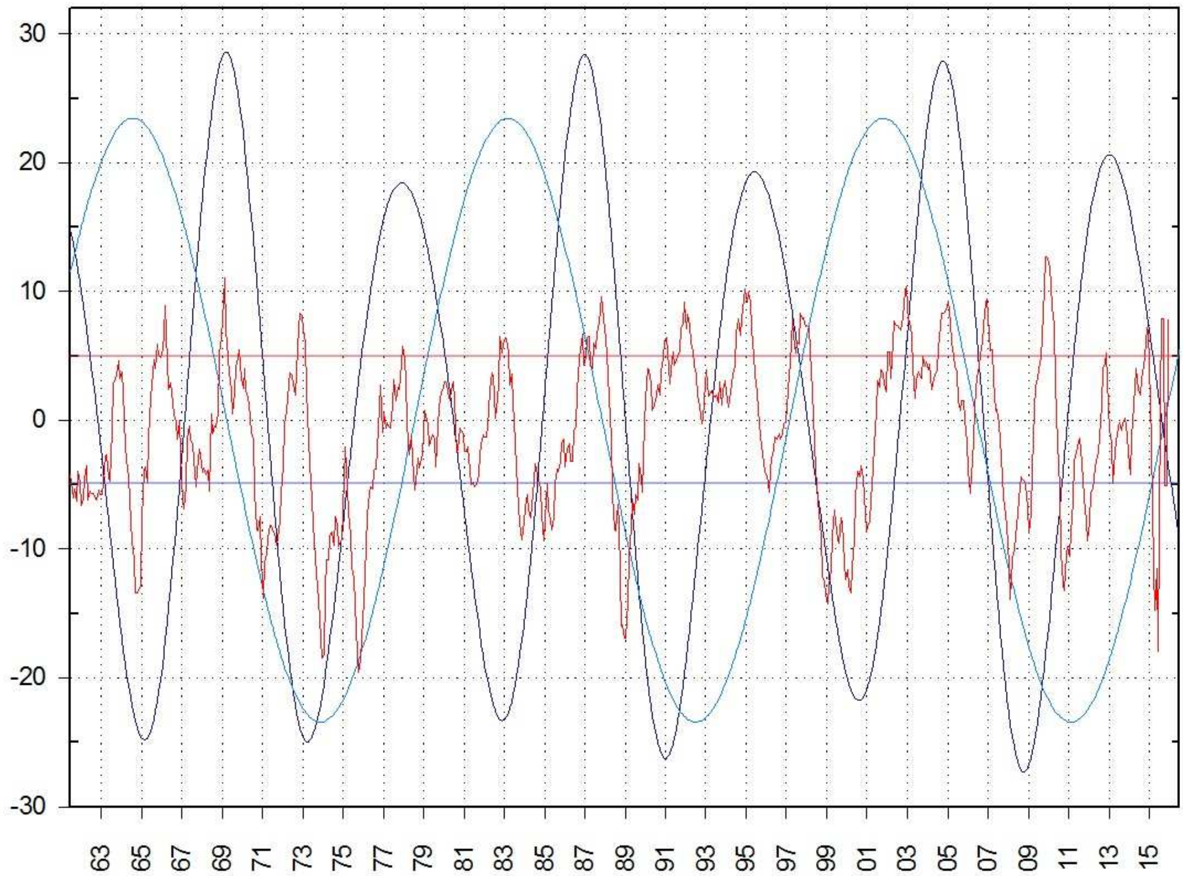


Figure 11. The recognition results in Model №9 - forecast temperature anomalies of surface ocean waters in the region Nino4. Red colour indicates the average monthly temperature anomalies of surface water, normalized for ease of analysis. Red and blue horizontal lines - the threshold deviations above and below which there is a period of El Niña and La Niña, respectively, blue and blue lines - the decline of the lunar apogee and node respectively.

There is also a correlation observed abnormal excess of 84,058 temperature readings over + 0,5 ° C, but this short period, the main deviation observed abnormal downward temperature. Thus, according to the calculations in the recognition module in the model №7 and №9 can make a prediction about the occurrence in April-May 2015 El Niño classical type.

Since the magnitude of the temperature anomalies comparable to abnormalities in 1997-1998, we can expect significant disruption of the global oceanic and atmospheric circulation.

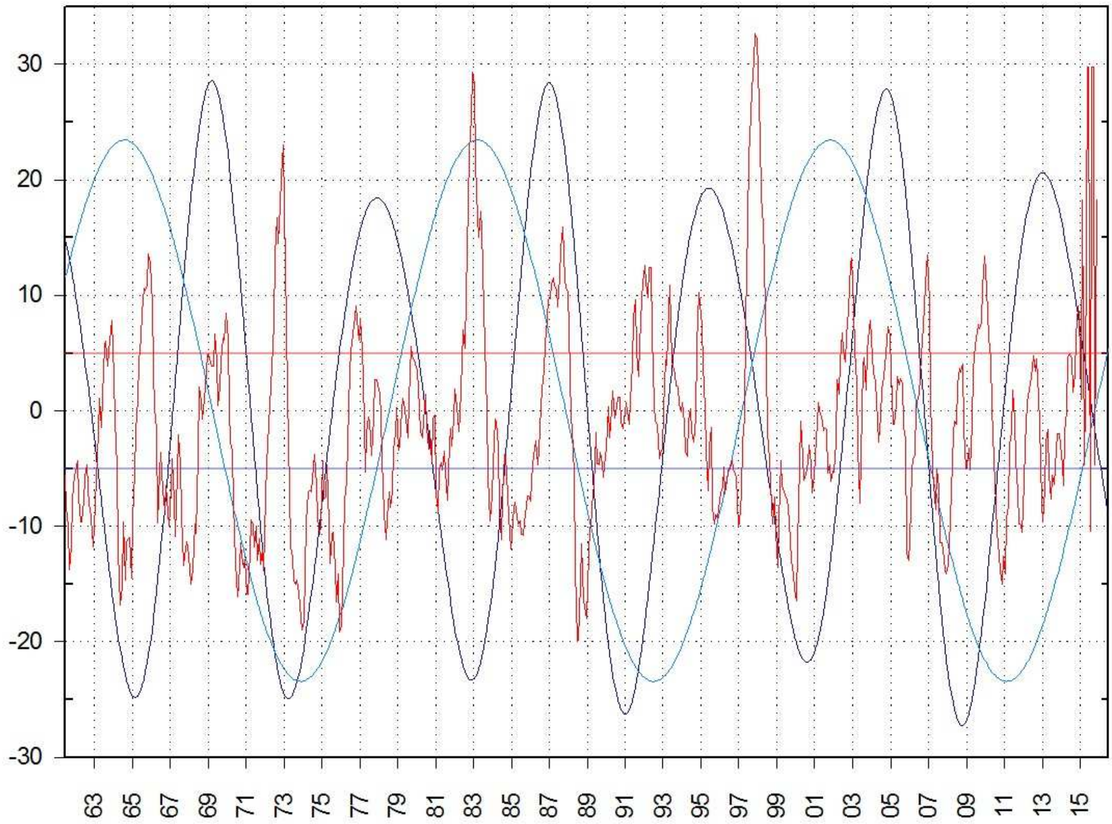


Figure 12: The recognition results in Model №8 - forecast temperature anomalies of surface ocean waters in the region Nino3. Notation see in Figure 10-11.

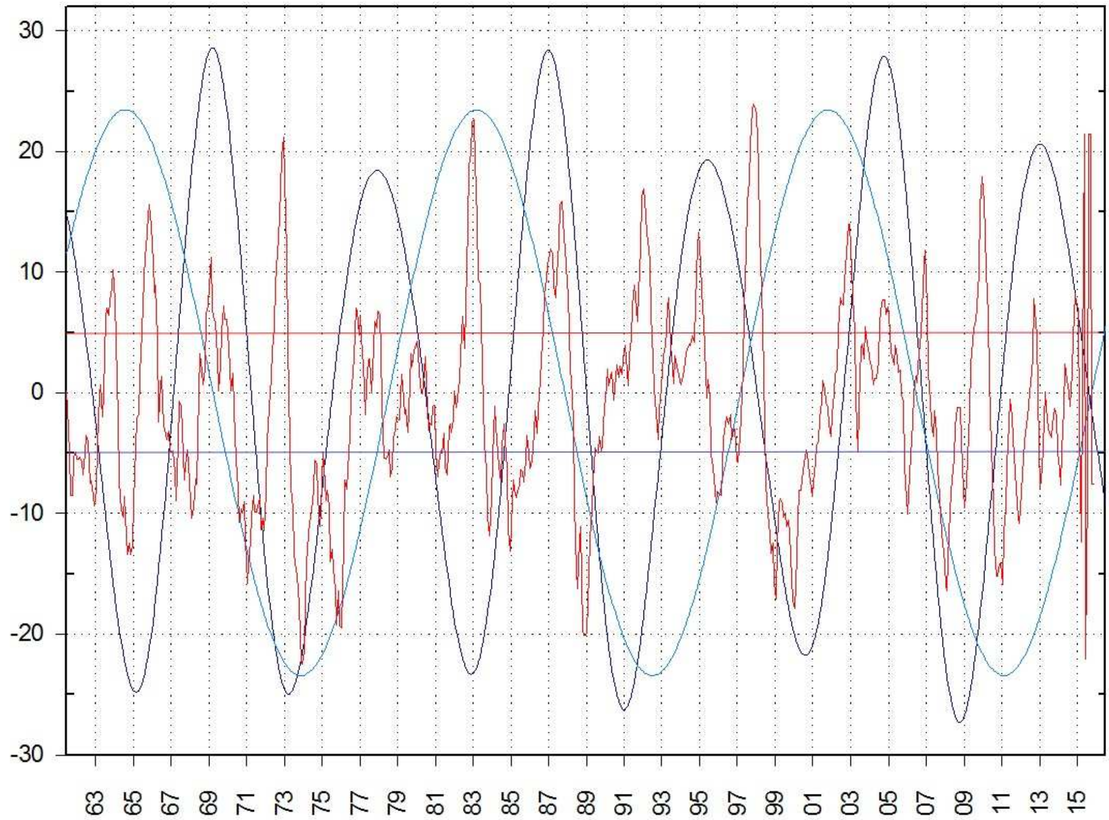


Figure 13: The recognition results in Model №10 - forecast temperature anomalies of surface ocean waters in the region Nino3,4. Notation see in Fig. 10-11.

The recognition results in the model №№8,10 confirm abnormal deviation in the positive direction of the temperature of ocean surface water indicators in April-May 2015.

There is a feature in the dynamics of the pole and the movements of the lunar nodes and apses in different coordinate systems. Latitude apses, captured in ecliptic system changes uniformly with increasing latitude, while in the equatorial system, where the dynamics of decline depends on the movement apsidal nodes of zero declination is observed only at the approach of longitude to the intersection of the axis of the ecliptic plane and the equatorial plane, the have axes 0-180 degrees.

Lunar nodes move relatively evenly, and with zero decline in the equatorial tropical coordinate system of longitude can move within one degree, it is - the plane stable system.

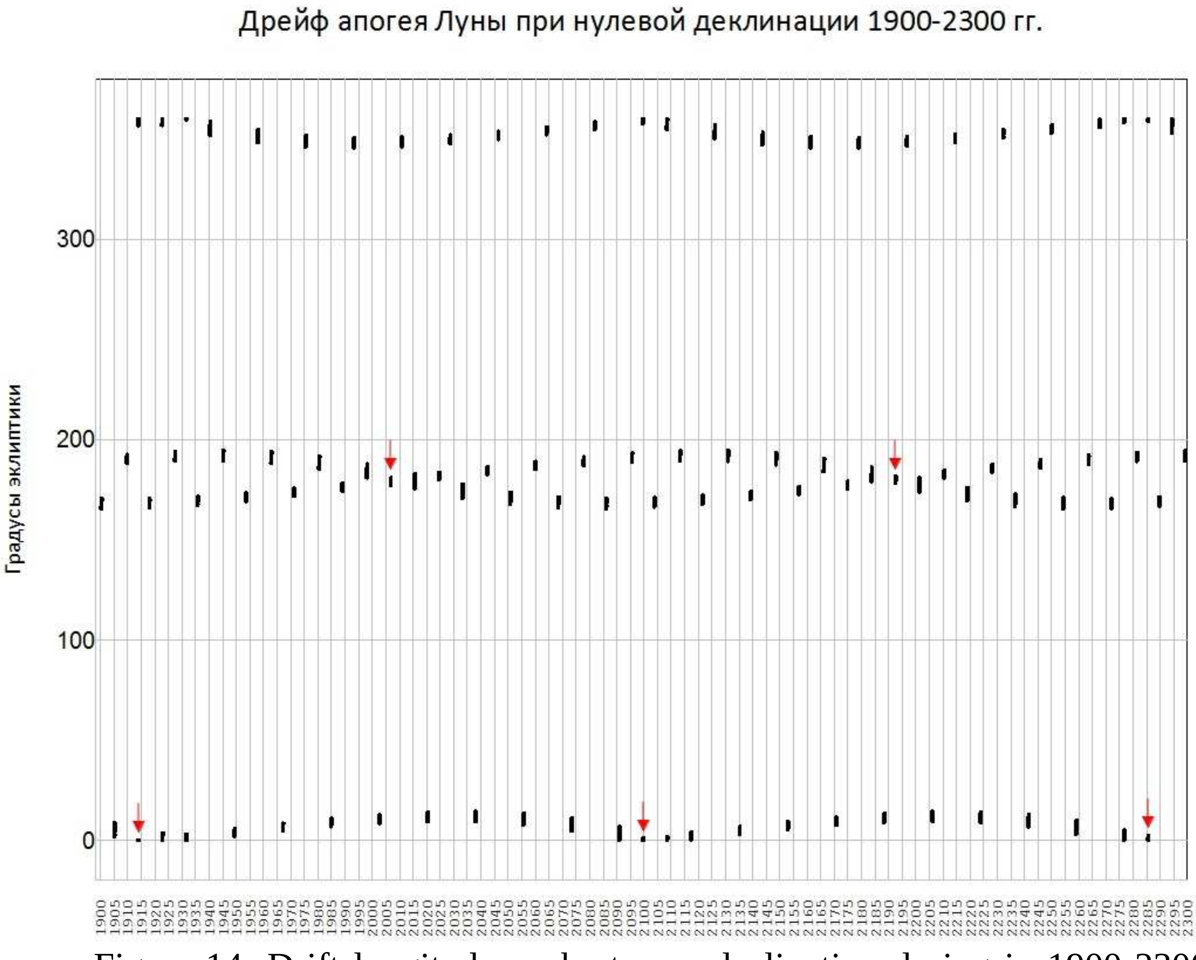


Figure 14: Drift longitude peak at zero declination during in 1900-2300 years.

Movement zenith in equatorial uneven. Due to disturbances, on motion of the moon, there is a change in zero longitude apses decline in the range of 15 degrees to the axis of 0-180 °, to which zero declination "tied." And it is - dynamic correction plane of the Earth-Moon at the same time in long time cycles -

all lunar perturbations and inequality themselves compensate, as evidenced by the existence of Saros.

In the long-term period, when the compounds of the lunar apogee and node occur near the line of 0-180 ° ecliptic occur due to inactivity polar motion along the axis Y, El Niño Modoki. It is this period is observed in the present, when the temperature anomalies do not start in a typical classical version of the El Niño region Nino1,2, and in the region Nino4, or on the axis X. The next such period will be in 2099.

El Niño forecasts

Our forecast was published in January 2015 [46]. In addition to the theoretical foundation capabilities for the prediction of global climate anomalies based on the dynamics of the lunar nodes and apses, the article made a practical forecast of occurrence of El Niño, which contained the following basic criteria.

Regions Nino1,2 and Nino4 are key in predicting the emergence of global climate anomalies, and an increase in temperature of the ocean surface waters in these regions - a leading predictor of El Niño.

Start abnormal rise in temperature of ocean surface water in the regions studied Nino1,2 - Nino4 forecast in March 2015, while in the region Nino4, determines the appearance of El Niño Modoki, this temperature increase will be short-lived, and major changes are expected in the region Nino1,2, starting in April-May 2015.

Thus, it was not only a differentiated forecast of what is expected climatic anomaly, but that it will be a classic El Niño type.

In fact, 09.03.2015 Climate Prediction Center (NCEP) announced the threshold is exceeded, the temperature anomalies and El Niño occurs, thus defining the anomaly changes observed in the region Nino4, while in the region Nino1,2 observed deviation in the direction of lowering the temperature, respectively 1,1 and -0,5ºC.

But the situation has changed to 03.28.2015 so that the temperature anomalies in the region began to outpace Nino1,2 deviations in the region Nino4, respectively, 1,2 and 1,1ºC.

This expert assessment was made based on an average weekly data of temperature variations of the surface waters of the ocean from the base period 1981-2010. The following illustration (fig. 15-16) are all from NCEP and demonstrate the dynamics of temperature anomalies in the development of El Niño.

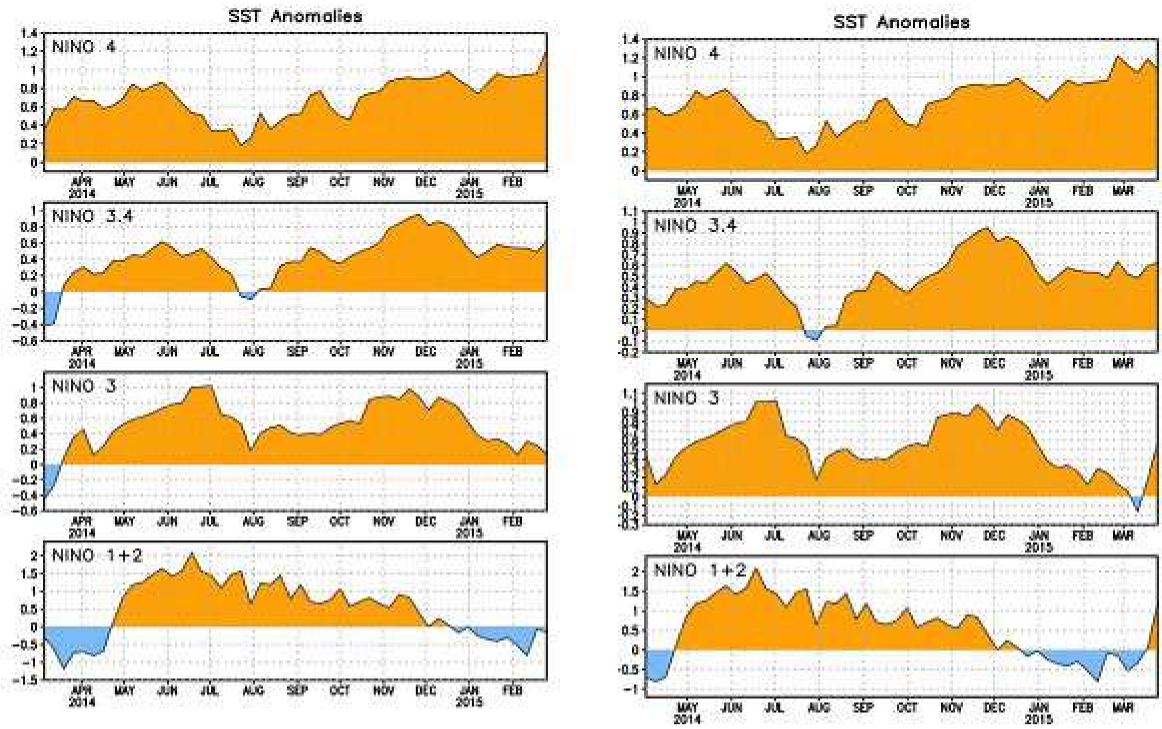


Figure 15. Anomalies deflection temperature of ocean surface water in the regions studied on 03.05.2015 and on 03.28.2015 from the reference period of weekly data 1981-2010 biennium.

Later during April and May 2015 there was a rapid development of the global climate anomaly El Niño with a predominance of temperature variations in the region Nino1,2. On 06.01.2015 the temperature anomalies in the region make already Nino1,2 2,6 ºC against 1,1ºC region Nino4.

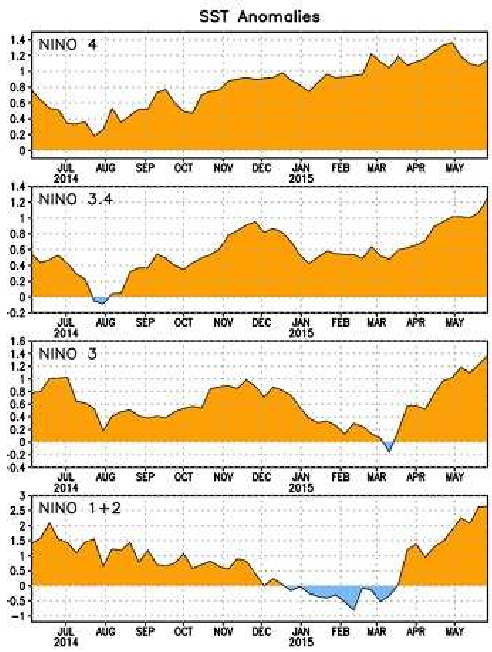


Figure 16. Anomalies deflection temperature of ocean surface water in the regions studied in the base period from 06.01.2015 weekly data 1981-2010 biennium.

Calculations with module recognition system «Aidos-X» future climate scenarios indicate that further possible abnormal excess temperature indicators of surface ocean waters in regions Nino 1,2 and Nino3,4 for 2015 may be comparable with similar abnormalities in the catastrophic El Niño of 1997-1998.

CONCLUSION

A number of semantic information models to prove the presence of elements of similarity between the motion of the lunar orbit and the dynamics of the instantaneous pole of the Earth, as well as violations of the global atmospheric circulation and water, leading to the emergence of episodes of El Niño and La Niña.

Shows the comparative importance of information regions Nino 1.2, 3, 4, 3.4, dedicated to the study of the temperature anomalies of surface waters of the equatorial zone of the Pacific Ocean, as well as their role in the prediction of possible anomalies.

Studied semantic information models spatial-temporal patterns to predict the climatic disturbances in the temperate latitudes.

On the basis of artificial intelligence AIDOS-X made a forecast of the global ocean circulation disorders, or occurrence of El Niño episode of the classical type in 2015, which is implemented in accordance with the forecast.

The results of this study extend the capabilities of the study and forecasting of the global processes of climate change on the planet.

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