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05.13.10 - Управление в социальных и
экономических системах (технические науки)**Сценарный автоматизированный системно-
когнитивный анализ климата Краснодара за
1933-2020 годы**

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В данной работе решается задача изучения структуры изменчивости метеорологических параметров: «Максимальная температура Минимальная температура Средняя температура Атмосферное давление Скорость ветра Осадки Эффективная температура» в городе Краснодаре по многолетним данным с 1933 по 2020 годы. Таким образом, исходные данные включают наблюдения в Краснодаре за 24834 суток по 7 климатическим параметрам. Для решения поставленной задачи применяется сценарный автоматизированный системно-когнитивный анализ (сценарный АСК-анализ) и его программный инструментарий – интеллектуальная система «Эйдос». Сценарный АСК-анализ отличается от классического тем, что кроме точечных значений факторов и результатов их действия на объект моделирования позволяет удобно исследовать и их динамику, т.е. Сценарии их изменения. АСК-анализ включает: теоретические основы, в частности базовую формализуемую когнитивную концепцию; математическую модель, основанную на системном обобщении теории информации (СТИ); методику численных расчетов (структуры баз данных и алгоритмы их обработки); программный инструментарий, в качестве которого в настоящее время выступает универсальная когнитивная аналитическая система «Эйдос» (интеллектуальная система «Эйдос»). Весь процесс создания моделей и их применения для решения задач в АСК-анализе и системе «Эйдос» предусматривает следующие этапы АСК-анализа. 1-й этап АСК-анализа: «Когнитивно-целевая структуризация предметной области». На 1-м и единственном неавтоматизированном этапе АСК-анализа, по сути, производится смысловая постановка задачи, т.е. определяются: объект моделирования (управления); факторы, действующие на объект моделирования (описательные шкалы) и будущие состояния, в которые объект моделирования переходит под действием этих факторов (классификационные шкалы). 2-й этап АСК-анализа: «Формализация предметной области». На этом этапе АСК-анализа с применением автоматизированных программных интерфейсов системы «Эйдос» (API-Эйдос) с внешними источниками данных разных

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05.13.10 - Management in social and economic
systems (technical sciences)**Scenario automated system-cognitive analysis of
Krasnodar climate for 1933-2020**

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This paper solves the problem of studying the structure of the variability of meteorological parameters: "Maximum temperature Minimum temperature Average temperature Atmospheric pressure Wind speed Precipitation Effective temperature" in the city of Krasnodar according to long-term data from 1933 to 2020. Thus, the initial data include observations in Krasnodar for 24834 days according to 7 climatic parameters. To solve the problem, scenario automated system-cognitive analysis (scenario ASC-analysis) and its software tools - the intellectual system "Eidos" are used. Scenario ASC analysis differs from the classical one in that, in addition to point values of factors and the results of their action on the modeling object, it makes it possible to conveniently study their dynamics, i.e. Scenarios for their change. ASC analysis includes: theoretical foundations, in particular, the basic formalizable cognitive concept; a mathematical model based on a systemic generalization of information theory (STI); methods of numerical calculations (database structures and algorithms for their processing); software tools, which is currently the universal cognitive analytical system "Eidos" (intellectual system "Eidos"). The entire process of creating models and applying them to solve problems in ASC analysis and the Eidos system includes the following stages of ASC analysis. 1st stage of ASC-analysis: "Cognitive-target structuring of the subject area". At the 1st and only non-automated stage of ASC-analysis, in fact, a semantic statement of the problem is made, i.e. are determined: object of modeling (control); factors acting on the object of modeling (descriptive scales) and future states, into which the modeling object passes under the influence of these factors (classification scales). 2nd stage of ASC-analysis: "Formalization of the subject area". At this stage of the ASC analysis using automated program interfaces of the Eidos system (API-Eidos) with external sources of data of various types, tabular, textual and graphic, classification and descriptive scales and gradations are first developed, and then the source data are encoded using classification and descriptive scales and gradations, as a result of which a training sample is formed, which, in fact, is a normalized base of the initial data. 3rd stage of ASC-analysis: "Synthesis and verification of models". At this stage of ASC-analysis: by means of multi-parameter typing, synthesis of 3 statistical and 7 system-cognitive models is

типов, табличных, текстовых и графических сначала разрабатываются классификационные и описательные шкалы и градации, а затем исходные данные кодируются с применением классификационных и описательных шкал и градаций, в результате чего формируется обучающая выборка, по сути, представляющая собой нормализованную базу исходных данных. 3-й этап АСК-анализа: «Синтез и верификация моделей». На этом этапе АСК-анализа: путем многопараметрической типизации осуществляется синтез 3 статистических и 7 системно-когнитивных моделей; проводится верификация всех созданных моделей, т.е. С помощью стандартной классической F-меры Ван Ризбергена и ее нечеткого мультиклассового обобщения, инвариантного относительно объема распознаваемой выборки, предложенного автором, оценивается достоверность моделей путем решения задачи идентификации объектов обучающей выборки, о которых уже достоверно известно к каким классам они относятся. В результате выбирается наиболее достоверная модель и определяется корректно ли ее использовать для решения различных задач. 4-й этап АСК-анализа: «Решение задач» в наиболее достоверной модели (если она для этого достаточно достоверна) решаются следующие задачи: задачи распознавания, системной идентификации, классификации, диагностики и прогнозирования; задачи принятия решений (управления и типологического анализа); задачи исследования моделируемой предметной области путем исследования ее модели: Инвертированные SWOT-диаграммы значений описательных шкал (семантические потенциалы); кластерно-конструктивный анализ классов; кластерно-конструктивный анализ значений факторов; Модель знаний системы «Эйдос» и нелокальные нейроны; нелокальная нейронная сеть; 3D-интегральные когнитивные карты; 2D-интегральные когнитивные карты содержательного сравнения классов (опосредованные нечеткие правдоподобные рассуждения); 2D-интегральные когнитивные карты содержательного сравнения значений факторов (опосредованные нечеткие правдоподобные рассуждения); когнитивные функции; значимость градаций описательных шкал (значений климатических параметров); значимость описательных шкал (климатических параметров); степень детерминированности классов (временных периодов) и классификационных шкал. Приводится подробный численный пример выполнения всех этих этапов и детальная пошаговая инструкция действий пользователя в системе «Эйдос» с пояснением их смысла, что обеспечивает возможность применения данной работы в учебных целях.

Ключевые слова: АВТОМАТИЗИРОВАННЫЙ СИСТЕМНО-КОГНИТИВНЫЙ АНАЛИЗ, АСК-АНАЛИЗ, ИНТЕЛЛЕКТУАЛЬНАЯ СИСТЕМА «ЭЙДОС»

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carried out; verification of all created models is carried out, i.e. Using the standard classical F-measure of Van Riesbergen and its fuzzy multiclass generalization, invariant with respect to the size of the recognizable sample, proposed by the author, the reliability of the models is estimated by solving the problem of identifying the objects of the training sample, which are already reliably known to which classes they belong. As a result, the most reliable model is selected and it is determined whether it is correct to use it for solving various problems. 4th stage of ASC-analysis: "Problem solving" in the most reliable model (if it is sufficiently reliable for this), the following tasks are solved: tasks of recognition, system identification, classification, diagnostics and forecasting; decision-making tasks (management and typological analysis); tasks of studying the modeled subject area by studying its model: Inverted SWOT-diagrams of the values of descriptive scales (semantic potentials); cluster-constructive analysis of classes; cluster-constructive analysis of factor values; The knowledge model of the "Eidos" system and non-local neurons; non-local neural network; 3D-integrated cognitive maps; 2D-integrated cognitive maps of meaningful class comparison (mediated fuzzy plausible reasoning); 2D-integrated cognitive maps of meaningful comparison of factor values (mediated fuzzy plausible reasoning); cognitive functions; the significance of gradations of descriptive scales (values of climatic parameters); the significance of descriptive scales (climatic parameters); the degree of determinism of classes (time periods) and classification scales. A detailed numerical example of the implementation of all these stages and a detailed step-by-step instruction of user actions in the Eidos system with an explanation of their meaning are given, which makes it possible to use this work for educational purposes.

Keywords: AUTOMATED SYSTEM-COGNITIVE ANALYSIS, FORMALIZED COGNITIVE CONCEPT, ASC-ANALYSIS, INTELLECTUAL SYSTEM "EIDOS"

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1. INTRODUCTION

1.1. Description of the researched subject area

This paper solves the problem of studying the structure of the variability of meteorological parameters: "Maximum temperature Minimum temperature Average temperature Atmospheric pressure Wind speed Precipitation Effective temperature" in the city of Krasnodar according to long-term data from 1933 to 2020.

Thus, the initial data includes 24834 observations for 7 climatic parameters.

1.2. Object and subject of research

Object of study in this paper is the climate in the city of Krasnodar according to long-term data from 1933 to 2020.

Subject of study in the work is the Scenario automated system-cognitive analysis of the climate of Krasnodar for 1933-2020, i.e. study of the influence of the dynamics of the values of 7 climatic parameters in the past on the dynamics of the values of the same 7 climatic parameters in the future.

1.3. The problem solved in the work and its relevance

At present, on the one hand, undoubtedly successes, obvious to all, have been achieved in the field of short-range weather forecasting. On the other hand, these successes have been achieved by processing information received by spacecraft on supercomputers.¹

However, both supercomputers and space sensing information are very expensive and require an extremely high level of technology development, which not all countries possess.

It is clear that at the regional level, and even more so at the level of individual farms, these technologies are completely inaccessible. Currently, these farms use weather forecasts received centrally using global telecommunications (Internet).

But as the experience of recent sanctions shows, access to these technologies may be terminated. Therefore, it is of interest to independently obtain reliable short-term weather forecasts for the main climatic indicators.

Thus, the problem solved in the work is to develop a technology for short-term weather forecasting available to agricultural enterprises according to the main climatic indicators without access to global resources solely on the basis of retrospective local data of a significant longitudinal (on the example of the city of Krasnodar).

¹See for example:<https://earth.nullschool.net/>

1.4. Purpose and tasks of the work

aimwork is to solve the problem posed above by decomposing the goal into the following sequence of tasks, the solution of which is the stages of achieving the goal:

Task-1.Cognitive structuring of the subject area. Two interpretations of classification and descriptive scales and gradations.

Task-2.Formalization of the subject area.

Task-3.Synthesis of statistical and system-cognitive models.

Multiparameter typification and particular knowledge criteria.

Task-4.Model verification.

Task-5.Selection of the most reliable model.

Task-6.System identification and forecasting.

Task-7.Decision support (A simplified version of decision making as an inverse forecasting problem, positive and negative information portraits of classes, SWOT analysis; Developed decision making algorithm in ASC analysis).

Task-8.Study of the modeling object by studying its model (Inverted SWOT diagrams of descriptive scale values (semantic potentials); Cluster-constructive analysis of classes; Cluster-constructive analysis of descriptive scale values; Eidos system knowledge model and non-local neurons; Non-local neural network; 3d- integral cognitive maps; 2d-integral cognitive maps of meaningful class comparison (mediated fuzzy plausible reasoning); 2d-integral cognitive maps of meaningful comparison of factor values (mediated fuzzy plausible reasoning); Cognitive functions; Significance of descriptive scales and their gradations; Degree of determinism of classes and classification scales).

2. METHODS

2.1. Justification of the requirements for the method of solving the problem

The method used to solve the problem posed should provide a stable identification in a comparable form of strength and direction of cause-and-effect relationships in incomplete noisy (inaccurate) interdependent (nonlinear) data of a very large dimension of numerical and non-numerical nature, measured in various types of scales (nominal, ordinal and numerical) and in various units of measurement (i.e., it should not impose strict requirements on data that cannot be met, but should ensure the processing of the data that really exists). In addition, the method should provide for taking into account not only point values in time series, but also the dynamics and nature, i.e. scenarios for changing them.

2.2. Literature review of problem solving methods, their characteristics and assessment of the degree of compliance with reasonable requirements

All the above requirements are met by a new method of artificial intelligence: scenario automated system-cognitive analysis (scenario ASC-analysis), which has its own software tools, which is currently the personal intellectual online environment "Eidos-Xpro".

Below we will briefly review this method and its software tools.

2.3. Automated system-cognitive analysis (ASC-analysis)

Automated system-cognitive analysis (ASC-analysis) was proposed by Prof. E.V. Lutsenko in 2002 in a number of articles and a fundamental monograph [1]. The term itself: "Automated system-cognitive analysis (ASC-analysis)" was proposed by Prof. E.V. Lutsenko. At that time, he did not meet on the Internet at all. Today, according to the corresponding request, Yandex has 9 million sites with this combination of words.².

ASC analysis includes:

- theoretical foundations, in particular the basic formalizable cognitive concept;
- a mathematical model based on a systemic generalization of information theory (STI);
- method of numerical calculations (database structures and algorithms for their processing);
- software tools, which is currently the universal cognitive analytical system "Eidos" (intellectual system "Eidos").

ASC analysis is described in more detail in [1, 2, 3] and a number of others. About half of the more than 650 scientific papers published by the author are devoted to the theoretical foundations of ASC analysis and its practical applications in a number of subject areas. At the time of writing this work, the author has published more than 40 monographs, 27 textbooks, incl. 3 textbooks with stamps of the UMO and the Ministry, 31 patents of the Russian Federation for artificial intelligence systems, 334 publications in publications included in the list of the Higher Attestation Commission of the Russian Federation and equivalent to them (according to the data [RSCI](#)), 6 articles in journals included in [WoS](#), 5 publications in journals included in [Scopus](#)³.

² [https://yandex.ru/search/?lr=35&clid=2327117-18&win=360&text=%20360&text=Automated+system-cognitive+analysis+\(ASC-analysis\)](https://yandex.ru/search/?lr=35&clid=2327117-18&win=360&text=%20360&text=Automated+system-cognitive+analysis+(ASC-analysis))

³ <http://lc.kubagro.ru/aidos/Sprab0802.pdf>

Three monographs are included in the holdings of the US Library of Congress⁴.

ASC analysis and the "Eidos" system were successfully applied in 8 doctoral and 8 master's theses in economic, technical, biological, psychological and medical sciences, several more doctoral and master's theses using ASC analysis at the stage of defense.

The author is the founder of the interdisciplinary scientific school: "Automated system-cognitive analysis"⁵. Scientific school: "Automated system-cognitive analysis" is an interdisciplinary scientific direction at the intersection of at least three scientific specialties (according to the recently approved new nomenclature of scientific specialties of the Higher Attestation Commission of the Russian Federation⁶). The main scientific specialties to which the scientific school corresponds:

- 5.12.4. cognitive modeling;
- 1.2.1. Artificial intelligence and machine learning;
- 2.3.1. System analysis, management and information processing.

Scientific school: "Automated system-cognitive analysis" includes the following interdisciplinary scientific areas:

- Automated system-cognitive analysis of numerical and textual tabular data;
- Automated system-cognitive analysis of text data;
- Spectral and contour automated system-cognitive analysis of images;
- Scenario automated system-cognitive analysis of time and dynamic series.

It is hardly expedient here to give references to all these works here. We only note that the author has a personal website [4] and a page in ResearchGate [5], where you can get more complete information about the ASC analysis method. Brief information about ASC-analysis and the Eidos system is in the material:http://lc.kubagro.ru/aidos/Presentation_Aidos-online.pdf.

2.4. "Eidos" system - ASC-analysis toolkit

There are many artificial intelligence systems. The universal cognitive analytical system "Eidos" differs from them in the following parameters:

- is universal and can be applied in many subject areas, because developed in a universal setting that does not depend on the subject area (<http://lc.kubagro.ru/aidos/index.htm>) and has 6 automated programming interfaces (API) for data entry from external data sources of various types:

⁴ <https://catalog.loc.gov/vwebv/search?searchArg=Lutsenko+EV>. (and click: "Search")

⁵ <https://www.famous-scientists.ru/school/1608>

⁶ <https://www.garant.ru/products/ipo/prime/doc/400450248/>

tables, texts and graphics. The Eidos system is an automated system, i.e. involves the direct participation of a person in real time in the process of creating models and using them to solve problems of identification, forecasting, decision-making and research of a subject area by studying its model (automatic systems work without such human participation);

- is in full open access free of charge (http://lc.kubagro.ru/aidos/_Aidos-X.htm), and with actual source texts (http://lc.kubagro.ru/_AidosALL.txt): open license:[CC BY SA 4.0](https://creativecommons.org/licenses/by-sa/4.0/)(<https://creativecommons.org/licenses/by-sa/4.0/>), and this means that anyone who wishes can use it, without any additional permission from the primary copyright holder - the author of the Eidos system prof. E.V. Lutsenko (we note that the Eidos system was created completely using only licensed tool software and there are 31 certificates of RosPatent of the Russian Federation for it);

- is one of the first domestic artificial intelligence systems of a personal level, i.e. does not require the user to have special training in the field of artificial intelligence technologies: "has a zero entry threshold" (there is an act of introducing the Eidos system in 1987) (<http://lc.kubagro.ru/aidos/aidos02/PR-4.htm>);

- really works, provides stable identification in a comparable form of strength and direction of cause-and-effect relationships in incomplete noisy interdependent (nonlinear) data of a very large dimension of numerical and non-numerical nature, measured in various types of scales (nominal, ordinal and numerical) and in various units measurements (i.e. does not impose strict requirements on data that cannot be met, but processes the data that is);

- has a "zero entry threshold", contains a large number of local (supplied with the installation) and cloud educational and scientific Eidos applications (currently there are 31 and more than 300, respectively:http://aidos.byethost5.com/Source_data_applications/WebAppls.htm) (http://lc.kubagro.ru/aidos/Presentation_Aidos-online.pdf);

– supports an on-line environment for knowledge accumulation and exchange, widely used throughout the world (<http://aidos.byethost5.com/map5.php>);

– provides multilingual interface support in 51 languages. Language databases are included in the installation and can be replenished automatically;

- the most computationally intensive operations of model synthesis and recognition are implemented using a graphics processor (GPU), which on some tasks accelerates the solution of these problems by several thousand times, which actually provides intelligent processing of big data, big information and big knowledge (graphic processor must be on an NVIDIA chipset);

- provides the transformation of the initial empirical data into information, and it into knowledge and the solution using this knowledge of the problems of classification, decision support and research of the subject area by studying its system-cognitive model, while generating a very large number of tabular and graphical output forms (development cognitive graphics), many of which have no analogues in other systems (examples of forms can be found in the work:http://lc.kubagro.ru/aidos/aidos18_LLS/aidos18_LLS.pdf);

- well imitates the human style of thinking: provides analysis results that are understandable to experts based on their experience, intuition and professional competence;

- instead of imposing practically impracticable requirements on the initial data (such as the normality of distribution, absolute accuracy and complete repetitions of all combinations of factor values and their complete independence and additivity), automated system-cognitive analysis (ASC-analysis) offers without any preliminary processing comprehend this data and thereby transform it into information, and then transform this information into knowledge by applying it to achieve goals (i.e. for management) and solve problems of classification, decision support and meaningful empirical research of the domain being modeled.

What is the strength of the approach implemented in the Eidos system?

The fact that it implements an approach whose effectiveness does not depend on what we think about the subject area and whether we think at all. It forms models directly on the basis of empirical data, and not on the basis of our ideas about the mechanisms for the implementation of patterns in these data. That is why Eidos models are effective even if our ideas about the subject area are erroneous or absent altogether.

This is the weakness of this approach implemented in the Eidos system.

Models of the Eidos system are phenomenological models that reflect empirical patterns in the facts of the training sample, i.e. they do not reflect the causal mechanism of determination, but only the very fact and nature of determination. A meaningful explanation of these empirical patterns is already formulated by experts at the theoretical level of knowledge in meaningful scientific laws.⁷

The development of the Eidos system included the following stages:

1st stage, "preparatory": 1979-1992. The mathematical model of the "Eidos" system was developed in 1979 and was first tested experimentally in 1981 (the first calculation on a computer based on the model). From 1981 to 1992, the Eidos system was repeatedly implemented on the Wang platform (on Wang-2200C computers). In 1987, for the first time received[implementation](#)

⁷Link to this brief description of the Eidos system in English:http://lc.kubagro.ru/aidos/The_Eidos_en.htm

actto one of the early versions of the "Eidos" system, implemented in the environment of the personal technological system "Vega-M" developed by the author (see Act 2).

Stage 2, "IBM PC and MS DOS era": 1992-2012. For IBM-compatible personal computers, the Eidos system was first implemented in the CLIPPER-87 and CLIPPER-5.01 (5.02) languages in 1992, and in 1994 thecertificates of RosPatent, the first in the Krasnodar Territory and, possibly, in Russia, on artificial intelligence systems (on the left is the title videogram of the final DOS version of the Eidos-12.5 system, June 2012). From then until now, the system has been continuously improved on the IBM PC.

Stage 3, "MS Windows xp, 8, 7 era": 2012-2020. From June 2012 to 12/14/2020, the Eidos system developed in the languageAlaska-1.9+Express++ library for working with Internet xb2net. The Eidos-X1.9 system worked well on all versions of MS Windows except Windows-10, which required special settings. The most computationally intensive operations of model synthesis and recognition are implemented with the help of a graphics processor (GPU), which, on some tasks, accelerates the solution of these problems by several thousand times, which really ensures the intelligent processing of big data, big information and big knowledge (the graphics processor must be on an NVIDIA chipset).

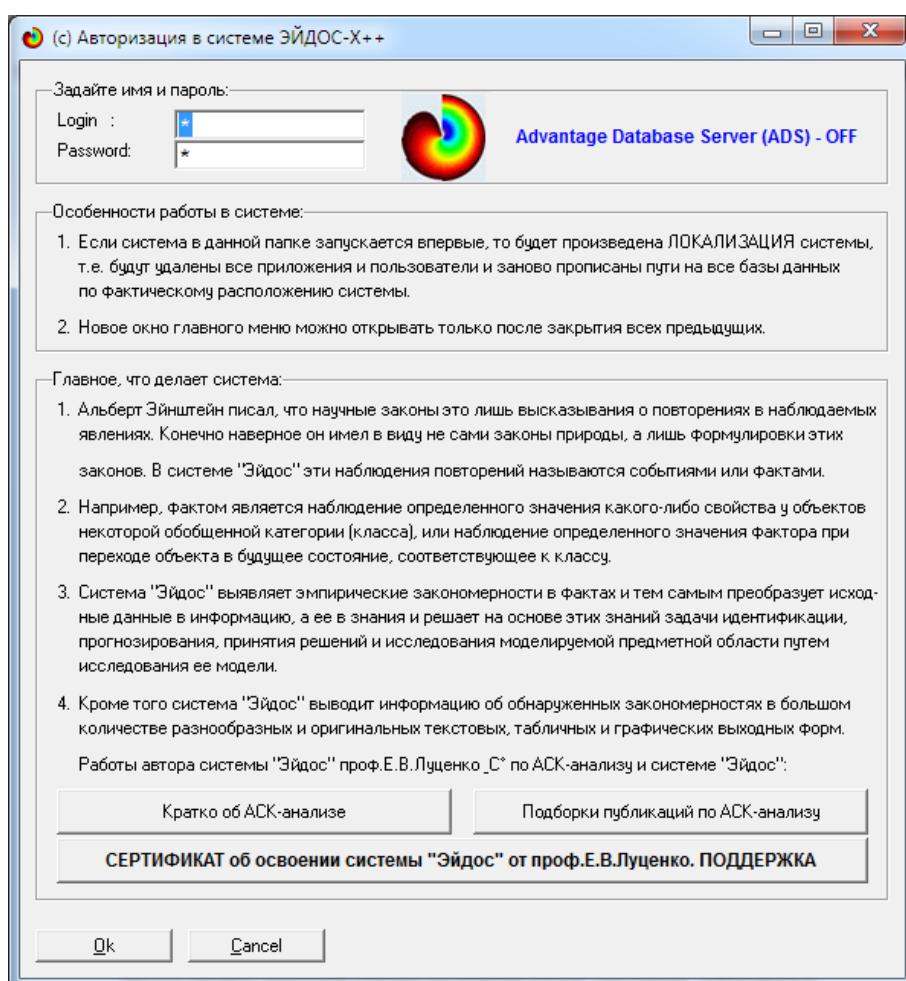
Stage 4, "MS Windows-10 era": 2020-2021. From 12/13/2020 to the present, the Eidos system has been developing in the languageAlaska-2.0+Express++. The xb2net library is no longer used in it, because all the possibilities of working with the Internet are included inbasic programming language features.

Stage 5, "the era of Big data, information and knowledge": from 2022 to the present. Since 2022, the author and developer of the Eidos system, Prof. E.V. Lutsenko, has come to grips with the development of a professional version of the Eidos system in the Alaska + Express language, which provides processing of big data, information and knowledge (Big Data, Big Information, Big Knowledge) using ADS (Advantage Database Server), as well as in C# (Visual Studio | C#).

Figure 1 shows the title videogram of the DOS version of the Eidos system, and Figure 2 shows the current version of the Eidos system, and Figure 3 shows the sequence of processing data, information and knowledge in the Eidos system:



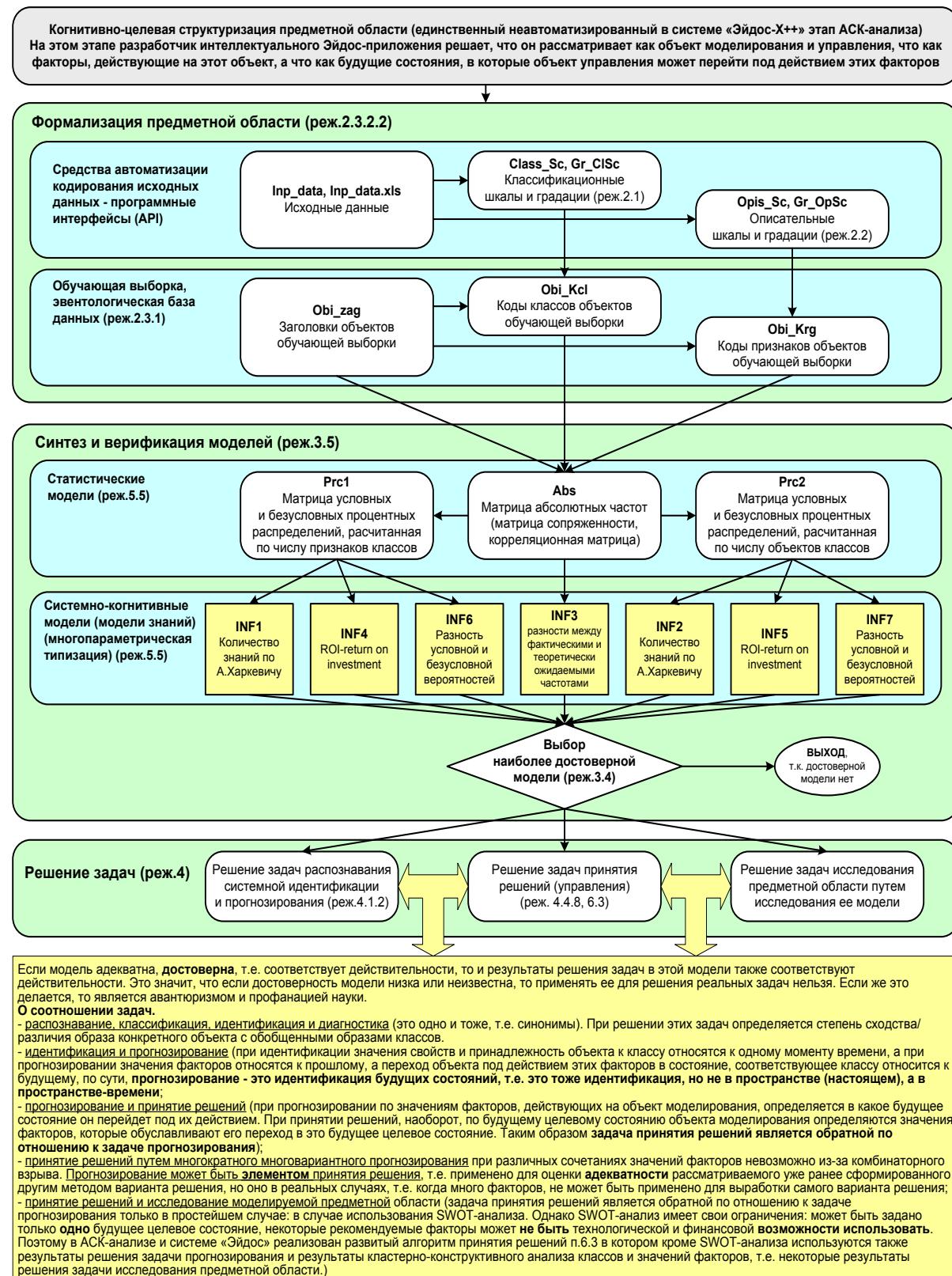
Picture1. Title videogram of the DOS version of the Eidos system (until 2012)⁸



Picture2. Title videogram of the current version of the Eidos system

⁸ http://lc.kubagro.ru/pic/aidos_titul.jpg

**Последовательность обработки данных, информации и знаний в системе «Эйдос»,
повышение уровня системности данных, информации и знаний,
повышение уровня системности моделей**



Picture3. The sequence of data, information and knowledge processing in the Eidos system

3.RESULTS

3.1. Task-1. Cognitive structuring of the subject area. Two interpretations of the classification and descriptive scales and gradations

The stage of cognitive-target structuring of the subject area is the only non-automated stage of scenario ASC analysis in the Eidos system.

At the stage of cognitive-target structuring of the subject area, we decide in a non-formalized way at a qualitative level what we will consider as factors acting on the modeled object (causes), and what as the results of these factors (consequences). In essence, this is a statement of the problem to be solved.

Descriptive scales serve to formally describe the factors, and classification scales - the results of their action on the modeling object. Scales can be numerical and textual. Text scales can be nominal and ordinal.

Cognitive structuring of the subject area is the first and only non-automated stage of ASC analysis in the Eidos system, i.e. all subsequent stages of ASC analysis in it are fully automated.

In ASC-analysis and the "Eidos" system, two interpretations of classification and descriptive scales and gradations are used: static and dynamic and the corresponding terminology (generalizing, static and dynamic).

Static interpretation and terminology:

- gradations of classification scales are generalizing categories of types of objects (classes);
- descriptive scales - properties of objects, gradations of descriptive scales - values of properties (attributes) of objects.

Dynamic interpretation and terminology:

- gradations of classification scales are generalizing categories of future states of the modeling object (classes);
- descriptive scales - factors acting on the object of modeling, gradations of descriptive scales - the values of factors acting on the object of modeling.

General terminology:

- classification scales and gradations;
- descriptive scales and gradations.

In this paper, we will mainly adhere to the dynamic interpretation and terminology.

As a result of the stage of cognitive-target structuring of the subject area:

- as an object of modeling, we will choose the climate in the city of Krasnodar (Russia. Southern Federal District);
- as factors influencing the object of modeling, we will choose the following past climatic factors (Table 1);
- as the results of the influence of factors on the modeling object, we will choose the following current and future climatic states (Table 2);

table1– Climatic factors affecting the modeling object (descriptive scales)

| KOD_OPSC | NAME_OPSC |
|----------|-----------------------------|
| 1 | MAXIMUM TEMPERATURE |
| 2 | MINIMUM TEMPERATURE |
| 3 | AVERAGE TEMPERATURE |
| 4 | ATMOSPHERE PRESSURE |
| 5 | WIND SPEED |
| 6 | PRECIPITATION |
| 7 | EFFICIENT TEMPERATURE |
| 8 | MAXIMUM TEMPERATURE-PAST3 |
| 9 | MINIMUM TEMPERATURE-PAST3 |
| 10 | MEDIUM TEMPERATURE-PAST3 |
| 11 | ATMOSPHERIC PRESSURE-PAST3 |
| 12 | WIND SPEED-PAST3 |
| 13 | RAIN-PAST3 |
| 14 | EFFECTIVE TEMPERATURE-PAST3 |

table2– The results of the influence of factors on the object of modeling (classification scales)

| KOD_CLSC | NAME_CLSC |
|----------|-------------------------------|
| 1 | MAXIMUM TEMPERATURE |
| 2 | MINIMUM TEMPERATURE |
| 3 | AVERAGE TEMPERATURE |
| 4 | ATMOSPHERE PRESSURE |
| 5 | WIND SPEED |
| 6 | PRECIPITATION |
| 7 | EFFICIENT TEMPERATURE |
| 8 | MAXIMUM TEMPERATURE-FUTURE3 |
| 9 | MINIMUM TEMPERATURE-FUTURE3 |
| 10 | AVERAGE TEMPERATURE-FUTURE3 |
| 11 | ATMOSPHERIC PRESSURE-FUTURE3 |
| 12 | WIND SPEED-FUTURE3 |
| 13 | RAIN-FUTURE3 |
| 14 | EFFECTIVE TEMPERATURE-FUTURE3 |

3.2. Task-2. Formalization of the subject area

At the stage of formalization of the subject area, classification and descriptive scales and gradations are developed, and then the initial data are encoded using them, resulting in a training sample. The training sample, in fact, is the original data, normalized with the help of classification and descriptive scales and gradations.

The Eidos system has a large number of various automated program interfaces (APIs) that provide input into the system of external data of various types: textual, tabular and graphic, as well as others that can be presented in this form, for example, audio or electroencephalogram (ECG) data.) or cardiogram (ECG).

This ensures the user-friendly use of the Eidos system for conducting scientific research in various areas of science and solving practical problems in various subject areas, almost everywhere where a person uses natural intelligence.

In this work, long-term weather data in Krasnodar, taken from the site, are used as initial data:

http://pogoda-service.ru/archive_gsod.php. However, data can be downloaded from this site in chunks no larger than 1000 lines. Therefore, these portions were downloaded and combined by the author into one file manually. In addition, dots have been replaced with commas in numeric columns. The result is an Excel table of initial data, a fragment of which is shown in Table 3.

table3– Initial data (fragment)

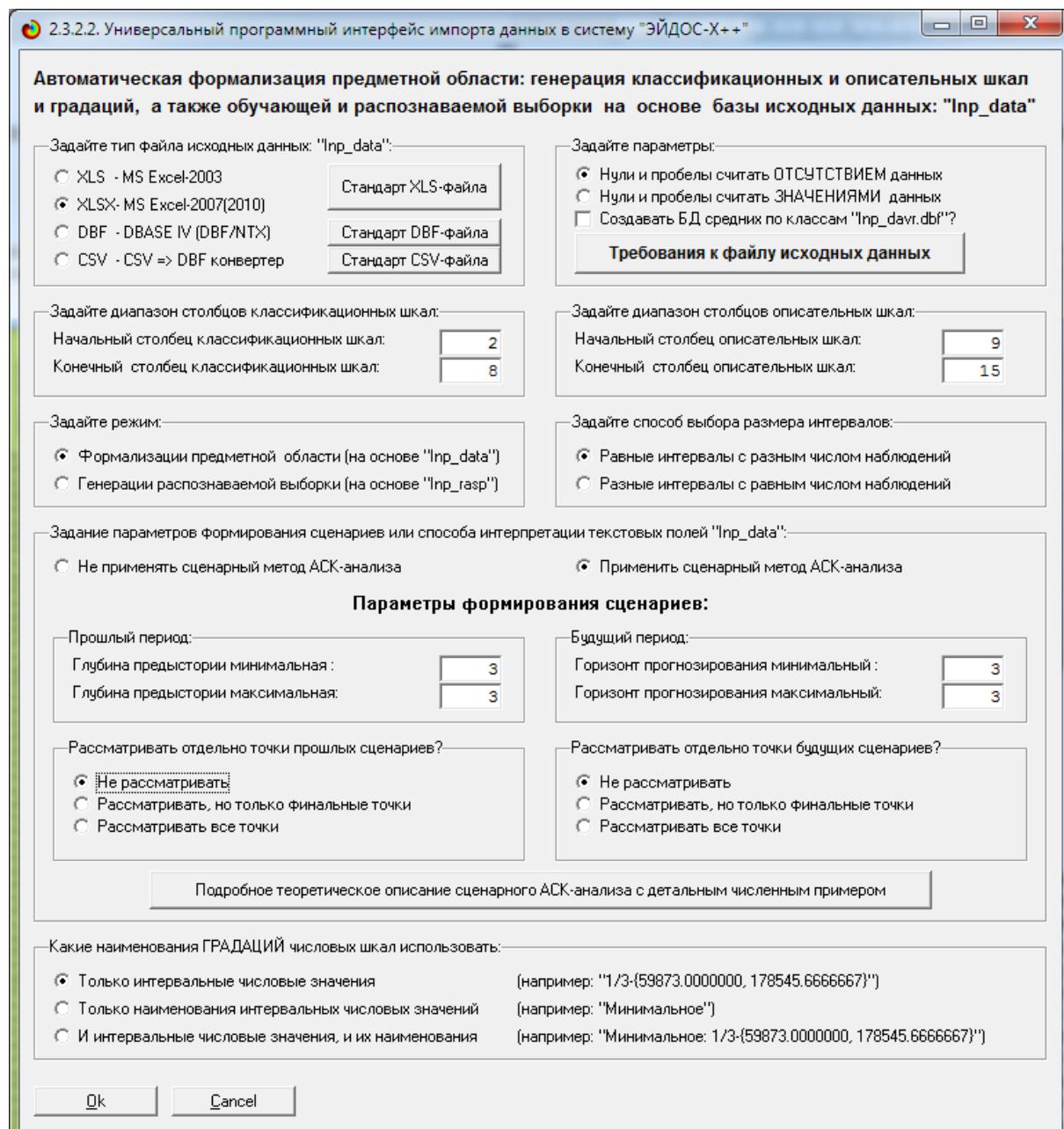
| date of | Maximum temperature | Minimum temperature | average temperature | Atmosphere pressure | Wind speed | Precipitation | Effective temperature | Maximum temperature | Minimum temperature | average temperature | Atmosphere pressure | Wind speed | Precipitation | Effective temperature |
|------------|---------------------|---------------------|---------------------|---------------------|------------|---------------|-----------------------|---------------------|---------------------|---------------------|---------------------|------------|---------------|-----------------------|
| 05.01.1933 | 0,0 | -5,0 | -1,5 | 0,0 | 2,0 | 0,0 | 0,0 | 0,0 | -5,0 | -1,5 | 0,0 | 2,0 | 0,0 | 0,0 |
| 06.01.1933 | 0,0 | -2,8 | -1,4 | 0,0 | 1,0 | 0,0 | 0,0 | 0,0 | -2,8 | -1,4 | 0,0 | 1,0 | 0,0 | 0,0 |
| 07.01.1933 | -1,1 | -5,0 | -3,5 | 0,0 | 4,0 | 0,0 | 0,0 | -1,1 | -5,0 | -3,5 | 0,0 | 4,0 | 0,0 | 0,0 |
| 08.01.1933 | -2,8 | -7,8 | -5,2 | 0,0 | 8,0 | 0,0 | 0,0 | -2,8 | -7,8 | -5,2 | 0,0 | 8,0 | 0,0 | 0,0 |
| 09.01.1933 | -2,8 | -11,1 | -7,7 | 0,0 | 4,0 | 0,0 | 0,0 | -2,8 | -11,1 | -7,7 | 0,0 | 4,0 | 0,0 | 0,0 |
| 10.01.1933 | -2,2 | -12,2 | -7,4 | 0,0 | 5,0 | 0,0 | 0,0 | -2,2 | -12,2 | -7,4 | 0,0 | 5,0 | 0,0 | 0,0 |
| 11.01.1933 | 0,0 | -10,0 | -2,3 | 0,0 | 2,0 | 0,0 | 0,0 | 0,0 | -10,0 | -2,3 | 0,0 | 2,0 | 0,0 | 0,0 |
| 12.01.1933 | 1,1 | -3,9 | -1,8 | 0,0 | 1,0 | 0,0 | 0,0 | 1,1 | -3,9 | -1,8 | 0,0 | 1,0 | 0,0 | 0,0 |
| 13.01.1933 | -2,8 | -6,1 | -4,4 | 0,0 | 1,0 | 0,0 | 0,0 | -2,8 | -6,1 | -4,4 | 0,0 | 1,0 | 0,0 | 0,0 |
| 14.01.1933 | -2,8 | -7,8 | -5,4 | 0,0 | 5,0 | 0,0 | 0,0 | -2,8 | -7,8 | -5,4 | 0,0 | 5,0 | 0,0 | 0,0 |
| 15.01.1933 | -7,8 | -12,2 | -9,2 | 0,0 | 4,0 | 0,0 | 0,0 | -7,8 | -12,2 | -9,2 | 0,0 | 4,0 | 0,0 | 0,0 |
| 16.01.1933 | -10,0 | -12,2 | -10,6 | 0,0 | 3,0 | 0,0 | 0,0 | -10,0 | -12,2 | -10,6 | 0,0 | 3,0 | 0,0 | 0,0 |
| 17.01.1933 | -3,9 | -11,1 | -6,2 | 0,0 | 2,0 | 0,0 | 0,0 | -3,9 | -11,1 | -6,2 | 0,0 | 2,0 | 0,0 | 0,0 |
| 18.01.1933 | 7,8 | -5,0 | 0,8 | 0,0 | 0,0 | 0,0 | 0,0 | 7,8 | -5,0 | 0,8 | 0,0 | 0,0 | 0,0 | 0,0 |
| 19.01.1933 | 2,2 | -5,0 | -0,4 | 0,0 | 1,0 | 0,0 | 0,0 | 2,2 | -5,0 | -0,4 | 0,0 | 1,0 | 0,0 | 0,0 |
| 20.01.1933 | 7,8 | -2,2 | 1,4 | 0,0 | 4,0 | 0,0 | 0,0 | 7,8 | -2,2 | 1,4 | 0,0 | 4,0 | 0,0 | 0,0 |
| 21.01.1933 | -2,8 | -10,0 | -5,7 | 0,0 | 6,0 | 0,0 | 0,0 | -2,8 | -10,0 | -5,7 | 0,0 | 6,0 | 0,0 | 0,0 |
| 22.01.1933 | 2,2 | -10,0 | -3,2 | 0,0 | 4,0 | 0,0 | 0,0 | 2,2 | -10,0 | -3,2 | 0,0 | 4,0 | 0,0 | 0,0 |
| 23.01.1933 | 2,8 | -7,2 | -1,7 | 0,0 | 4,0 | 0,0 | 0,0 | 2,8 | -7,2 | -1,7 | 0,0 | 4,0 | 0,0 | 0,0 |
| 24.01.1933 | -3,9 | -10,0 | -7,5 | 0,0 | 7,0 | 0,0 | 0,0 | -3,9 | -10,0 | -7,5 | 0,0 | 7,0 | 0,0 | 0,0 |
| 25.01.1933 | -10,0 | -12,8 | -11,5 | 0,0 | 2,0 | 0,0 | 0,0 | -10,0 | -12,8 | -11,5 | 0,0 | 2,0 | 0,0 | 0,0 |
| 26.01.1933 | -7,2 | -13,9 | -9,6 | 0,0 | 4,0 | 0,0 | 0,0 | -7,2 | -13,9 | -9,6 | 0,0 | 4,0 | 0,0 | 0,0 |
| 27.01.1933 | -7,8 | -12,8 | -11,1 | 0,0 | 1,0 | 0,0 | 0,0 | -7,8 | -12,8 | -11,1 | 0,0 | 1,0 | 0,0 | 0,0 |
| 29.01.1933 | 0,0 | -7,2 | -1,2 | 0,0 | 3,0 | 0,0 | 0,0 | 0,0 | -7,2 | -1,2 | 0,0 | 3,0 | 0,0 | 0,0 |
| 30.01.1933 | 2,2 | -7,2 | -1,2 | 0,0 | 1,0 | 0,0 | 0,0 | 2,2 | -7,2 | -1,2 | 0,0 | 1,0 | 0,0 | 0,0 |
| 31.01.1933 | 2,8 | -10,0 | -1,2 | 0,0 | 3,0 | 0,0 | 0,0 | 2,8 | -10,0 | -1,2 | 0,0 | 3,0 | 0,0 | 0,0 |
| 01.02.1933 | 5,0 | 0,0 | 1,4 | 0,0 | 1,0 | 0,0 | 0,0 | 5,0 | 0,0 | 1,4 | 0,0 | 1,0 | 0,0 | 0,0 |
| 02.02.1933 | 1,1 | -2,2 | -0,3 | 0,0 | 2,0 | 0,0 | 0,0 | 1,1 | -2,2 | -0,3 | 0,0 | 2,0 | 0,0 | 0,0 |
| 03.02.1933 | 1,1 | -2,8 | 0,1 | 0,0 | 1,0 | 0,0 | 0,0 | 1,1 | -2,8 | 0,1 | 0,0 | 1,0 | 0,0 | 0,0 |
| 04.02.1933 | 3,9 | 0,0 | 2,1 | 0,0 | 1,0 | 0,0 | 0,0 | 3,9 | 0,0 | 2,1 | 0,0 | 1,0 | 0,0 | 0,0 |
| 05.02.1933 | 0,0 | -3,9 | -2,5 | 0,0 | 2,0 | 0,0 | 0,0 | 0,0 | -3,9 | -2,5 | 0,0 | 2,0 | 0,0 | 0,0 |
| 07.02.1933 | 12,8 | -2,2 | 2,9 | 0,0 | 2,0 | 0,0 | 0,0 | 12,8 | -2,2 | 2,9 | 0,0 | 2,0 | 0,0 | 0,0 |
| 08.02.1933 | 2,2 | -2,8 | -0,6 | 0,0 | 1,0 | 0,0 | 0,0 | 2,2 | -2,8 | -0,6 | 0,0 | 1,0 | 0,0 | 0,0 |
| 09.02.1933 | -5,0 | -7,8 | -6,5 | 0,0 | 2,0 | 0,0 | 0,0 | -5,0 | -7,8 | -6,5 | 0,0 | 2,0 | 0,0 | 0,0 |
| 10.02.1933 | -5,0 | -8,9 | -6,5 | 0,0 | 1,0 | 0,0 | 0,0 | -5,0 | -8,9 | -6,5 | 0,0 | 1,0 | 0,0 | 0,0 |
| 13.02.1933 | 2,8 | -6,1 | -2,8 | 0,0 | 4,0 | 0,0 | 0,0 | 2,8 | -6,1 | -2,8 | 0,0 | 4,0 | 0,0 | 0,0 |
| 14.02.1933 | 2,2 | -12,2 | -1,7 | 0,0 | 3,0 | 0,0 | 0,0 | 2,2 | -12,2 | -1,7 | 0,0 | 3,0 | 0,0 | 0,0 |
| 15.02.1933 | 3,9 | -3,9 | 1,7 | 0,0 | 3,0 | 0,0 | 0,0 | 3,9 | -3,9 | 1,7 | 0,0 | 3,0 | 0,0 | 0,0 |
| 16.02.1933 | 2,2 | -3,9 | -1,2 | 0,0 | 4,0 | 0,0 | 0,0 | 2,2 | -3,9 | -1,2 | 0,0 | 4,0 | 0,0 | 0,0 |
| 17.02.1933 | 1,1 | -6,1 | -0,4 | 0,0 | 5,0 | 0,0 | 0,0 | 1,1 | -6,1 | -0,4 | 0,0 | 5,0 | 0,0 | 0,0 |
| 18.02.1933 | 0,0 | -1,1 | -0,3 | 0,0 | 1,0 | 0,0 | 0,0 | 0,0 | -1,1 | -0,3 | 0,0 | 1,0 | 0,0 | 0,0 |
| 19.02.1933 | 2,2 | -7,2 | 1,4 | 0,0 | 1,0 | 0,0 | 0,0 | 2,2 | -7,2 | 1,4 | 0,0 | 1,0 | 0,0 | 0,0 |
| 20.02.1933 | 2,2 | -1,1 | 0,6 | 0,0 | 1,0 | 0,0 | 0,0 | 2,2 | -1,1 | 0,6 | 0,0 | 1,0 | 0,0 | 0,0 |
| 21.02.1933 | 2,2 | -2,2 | -0,6 | 0,0 | 4,0 | 0,0 | 0,0 | 2,2 | -2,2 | -0,6 | 0,0 | 4,0 | 0,0 | 0,0 |
| 22.02.1933 | 6,1 | -1,1 | 0,4 | 0,0 | 3,0 | 0,0 | 0,0 | 6,1 | -1,1 | 0,4 | 0,0 | 3,0 | 0,0 | 0,0 |
| 23.02.1933 | 12,2 | -3,9 | 3,8 | 0,0 | 1,0 | 0,0 | 0,0 | 12,2 | -3,9 | 3,8 | 0,0 | 1,0 | 0,0 | 0,0 |

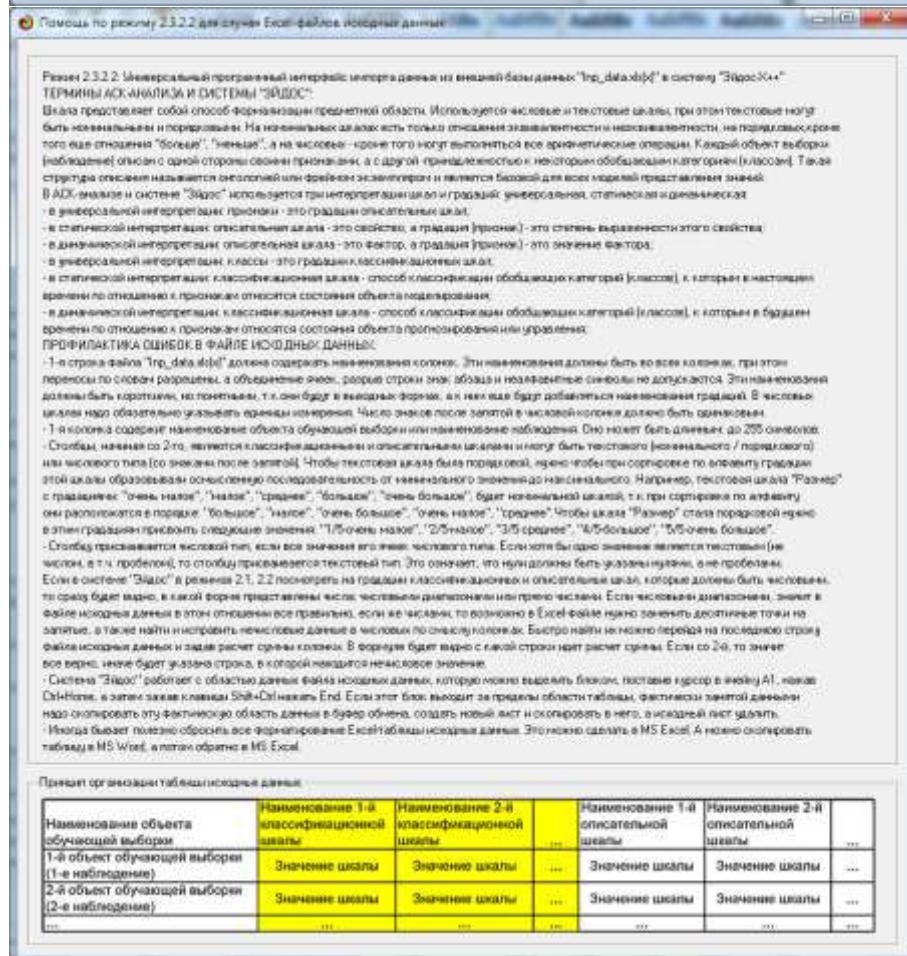
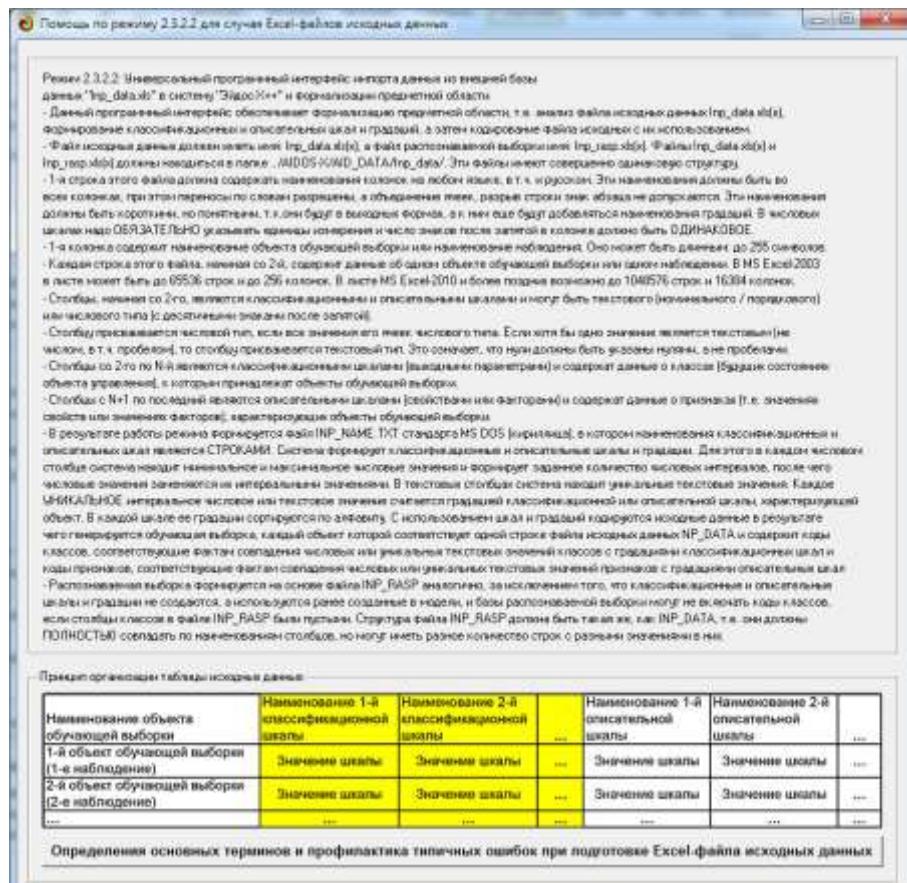
| | | | | | | | | | | | | | | | |
|------------|------|-------|------|-----|------|-----|-----|------|-------|------|-----|------|-----|-----|-----|
| 24.02.1933 | 7,8 | 0,0 | 3,5 | 0,0 | 2,0 | 0,0 | 0,0 | 7,8 | 0,0 | 3,5 | 0,0 | 2,0 | 0,0 | 0,0 | 0,0 |
| 25.02.1933 | 8,9 | 0,0 | 3,9 | 0,0 | 2,0 | 0,0 | 0,0 | 8,9 | 0,0 | 3,9 | 0,0 | 2,0 | 0,0 | 0,0 | 0,0 |
| 26.02.1933 | 11,1 | -1,1 | 3,5 | 0,0 | 2,0 | 0,0 | 0,0 | 11,1 | -1,1 | 3,5 | 0,0 | 2,0 | 0,0 | 0,0 | 0,0 |
| 27.02.1933 | 5,0 | -2,2 | 0,6 | 0,0 | 4,0 | 0,0 | 0,0 | 5,0 | -2,2 | 0,6 | 0,0 | 4,0 | 0,0 | 0,0 | 0,0 |
| 28.02.1933 | 2,2 | -3,9 | -0,3 | 0,0 | 1,0 | 0,0 | 0,0 | 2,2 | -3,9 | -0,3 | 0,0 | 1,0 | 0,0 | 0,0 | 0,0 |
| 01.03.1933 | 0,0 | -2,8 | -2,1 | 0,0 | 1,0 | 0,0 | 0,0 | 0,0 | -2,8 | -2,1 | 0,0 | 1,0 | 0,0 | 0,0 | 0,0 |
| 02.03.1933 | -2,8 | -6,1 | -5,0 | 0,0 | 2,0 | 0,0 | 0,0 | -2,8 | -6,1 | -5,0 | 0,0 | 2,0 | 0,0 | 0,0 | 0,0 |
| 03.03.1933 | -5,0 | -10,0 | -7,8 | 0,0 | 1,0 | 0,0 | 0,0 | -5,0 | -10,0 | -7,8 | 0,0 | 1,0 | 0,0 | 0,0 | 0,0 |
| 04.03.1933 | 2,8 | -11,1 | -3,1 | 0,0 | 1,0 | 0,0 | 0,0 | 2,8 | -11,1 | -3,1 | 0,0 | 1,0 | 0,0 | 0,0 | 0,0 |
| 05.03.1933 | 6,1 | -2,2 | 4,0 | 0,0 | 10,0 | 0,0 | 0,0 | 6,1 | -2,2 | 4,0 | 0,0 | 10,0 | 0,0 | 0,0 | 0,0 |
| 06.03.1933 | 10,0 | 3,9 | 7,7 | 0,0 | 11,0 | 0,0 | 0,0 | 10,0 | 3,9 | 7,7 | 0,0 | 11,0 | 0,0 | 0,0 | 0,0 |
| 07.03.1933 | 12,8 | 7,2 | 9,3 | 0,0 | 10,0 | 0,0 | 0,0 | 12,8 | 7,2 | 9,3 | 0,0 | 10,0 | 0,0 | 0,0 | 0,0 |
| 08.03.1933 | 0,0 | -5,0 | -2,5 | 0,0 | 6,0 | 0,0 | 0,0 | 0,0 | -5,0 | -2,5 | 0,0 | 6,0 | 0,0 | 0,0 | 0,0 |
| 09.03.1933 | 0,0 | -10,0 | -5,4 | 0,0 | 4,0 | 0,0 | 0,0 | 0,0 | -10,0 | -5,4 | 0,0 | 4,0 | 0,0 | 0,0 | 0,0 |
| 10.03.1933 | 5,0 | -8,9 | -2,3 | 0,0 | 4,0 | 0,0 | 0,0 | 5,0 | -8,9 | -2,3 | 0,0 | 4,0 | 0,0 | 0,0 | 0,0 |
| 12.03.1933 | 6,1 | -2,8 | 1,0 | 0,0 | 6,0 | 0,0 | 0,0 | 6,1 | -2,8 | 1,0 | 0,0 | 6,0 | 0,0 | 0,0 | 0,0 |
| 14.03.1933 | 2,8 | -2,8 | 0,3 | 0,0 | 1,0 | 0,0 | 0,0 | 2,8 | -2,8 | 0,3 | 0,0 | 1,0 | 0,0 | 0,0 | 0,0 |
| 15.03.1933 | 11,1 | -3,9 | 5,0 | 0,0 | 7,0 | 0,0 | 0,0 | 11,1 | -3,9 | 5,0 | 0,0 | 7,0 | 0,0 | 0,0 | 0,0 |
| 16.03.1933 | 11,1 | 3,9 | 6,8 | 0,0 | 9,0 | 0,0 | 0,0 | 11,1 | 3,9 | 6,8 | 0,0 | 9,0 | 0,0 | 0,0 | 0,0 |
| 17.03.1933 | 15,0 | 1,1 | 6,7 | 0,0 | 1,0 | 0,0 | 0,0 | 15,0 | 1,1 | 6,7 | 0,0 | 1,0 | 0,0 | 0,0 | 0,0 |
| 18.03.1933 | 21,1 | -7,2 | 6,9 | 0,0 | 2,0 | 0,0 | 0,0 | 21,1 | -7,2 | 6,9 | 0,0 | 2,0 | 0,0 | 0,0 | 0,0 |
| 20.03.1933 | 20,0 | 1,1 | 9,7 | 0,0 | 1,0 | 0,0 | 0,0 | 20,0 | 1,1 | 9,7 | 0,0 | 1,0 | 0,0 | 0,0 | 0,0 |
| 22.03.1933 | 22,8 | 1,1 | 10,4 | 0,0 | 2,0 | 0,0 | 0,0 | 22,8 | 1,1 | 10,4 | 0,0 | 2,0 | 0,0 | 0,0 | 0,0 |
| 24.03.1933 | 22,8 | 1,1 | 11,0 | 0,0 | 2,0 | 0,0 | 0,0 | 22,8 | 1,1 | 11,0 | 0,0 | 2,0 | 0,0 | 0,0 | 0,0 |
| 26.03.1933 | 3,9 | -2,2 | 1,2 | 0,0 | 2,0 | 0,0 | 0,0 | 3,9 | -2,2 | 1,2 | 0,0 | 2,0 | 0,0 | 0,0 | 0,0 |
| 27.03.1933 | 8,9 | -2,8 | 4,2 | 0,0 | 5,0 | 0,0 | 0,0 | 8,9 | -2,8 | 4,2 | 0,0 | 5,0 | 0,0 | 0,0 | 0,0 |
| 28.03.1933 | 3,9 | -2,8 | 0,8 | 0,0 | 3,0 | 0,0 | 0,0 | 3,9 | -2,8 | 0,8 | 0,0 | 3,0 | 0,0 | 0,0 | 0,0 |
| 29.03.1933 | 7,2 | -3,9 | 3,5 | 0,0 | 7,0 | 0,0 | 0,0 | 7,2 | -3,9 | 3,5 | 0,0 | 7,0 | 0,0 | 0,0 | 0,0 |
| 30.03.1933 | 6,1 | 2,2 | 3,8 | 0,0 | 1,0 | 0,0 | 0,0 | 6,1 | 2,2 | 3,8 | 0,0 | 1,0 | 0,0 | 0,0 | 0,0 |
| 31.03.1933 | 10,0 | 0,0 | 4,6 | 0,0 | 1,0 | 0,0 | 0,0 | 10,0 | 0,0 | 4,6 | 0,0 | 1,0 | 0,0 | 0,0 | 0,0 |
| 01.04.1933 | 13,9 | 0,0 | 6,0 | 0,0 | 3,0 | 0,0 | 0,0 | 13,9 | 0,0 | 6,0 | 0,0 | 3,0 | 0,0 | 0,0 | 0,0 |
| 02.04.1933 | 16,1 | -2,8 | 8,1 | 0,0 | 4,0 | 0,0 | 0,0 | 16,1 | -2,8 | 8,1 | 0,0 | 4,0 | 0,0 | 0,0 | 0,0 |
| 03.04.1933 | 10,0 | 1,1 | 6,5 | 0,0 | 2,0 | 0,0 | 0,0 | 10,0 | 1,1 | 6,5 | 0,0 | 2,0 | 0,0 | 0,0 | 0,0 |
| 04.04.1933 | 7,8 | 2,8 | 5,3 | 0,0 | 1,0 | 0,0 | 0,0 | 7,8 | 2,8 | 5,3 | 0,0 | 1,0 | 0,0 | 0,0 | 0,0 |
| 05.04.1933 | 11,1 | 2,2 | 5,6 | 0,0 | 2,0 | 0,0 | 0,0 | 11,1 | 2,2 | 5,6 | 0,0 | 2,0 | 0,0 | 0,0 | 0,0 |
| 06.04.1933 | 8,9 | 1,1 | 5,4 | 0,0 | 2,0 | 0,0 | 0,0 | 8,9 | 1,1 | 5,4 | 0,0 | 2,0 | 0,0 | 0,0 | 0,0 |
| 07.04.1933 | 10,0 | 1,1 | 4,9 | 0,0 | 5,0 | 0,0 | 0,0 | 10,0 | 1,1 | 4,9 | 0,0 | 5,0 | 0,0 | 0,0 | 0,0 |
| 08.04.1933 | 12,2 | 1,1 | 5,8 | 0,0 | 4,0 | 0,0 | 0,0 | 12,2 | 1,1 | 5,8 | 0,0 | 4,0 | 0,0 | 0,0 | 0,0 |
| 10.04.1933 | 6,1 | 1,1 | 3,9 | 0,0 | 1,0 | 0,0 | 0,0 | 6,1 | 1,1 | 3,9 | 0,0 | 1,0 | 0,0 | 0,0 | 0,0 |
| 11.04.1933 | 5,0 | 2,2 | 2,8 | 0,0 | 2,0 | 0,0 | 0,0 | 5,0 | 2,2 | 2,8 | 0,0 | 2,0 | 0,0 | 0,0 | 0,0 |
| 12.04.1933 | 10,0 | 1,1 | 5,3 | 0,0 | 4,0 | 0,0 | 0,0 | 10,0 | 1,1 | 5,3 | 0,0 | 4,0 | 0,0 | 0,0 | 0,0 |
| 13.04.1933 | 8,9 | -1,1 | 5,0 | 0,0 | 1,0 | 0,0 | 0,0 | 8,9 | -1,1 | 5,0 | 0,0 | 1,0 | 0,0 | 0,0 | 0,0 |
| 14.04.1933 | 16,1 | 2,2 | 9,0 | 0,0 | 2,0 | 0,0 | 0,0 | 16,1 | 2,2 | 9,0 | 0,0 | 2,0 | 0,0 | 0,0 | 0,0 |
| 17.04.1933 | 7,8 | 1,1 | 6,4 | 0,0 | 9,0 | 0,0 | 0,0 | 7,8 | 1,1 | 6,4 | 0,0 | 9,0 | 0,0 | 0,0 | 0,0 |
| 18.04.1933 | 10,0 | 2,8 | 4,6 | 0,0 | 5,0 | 0,0 | 0,0 | 10,0 | 2,8 | 4,6 | 0,0 | 5,0 | 0,0 | 0,0 | 0,0 |
| 19.04.1933 | 17,8 | 0,0 | 11,5 | 0,0 | 5,0 | 0,0 | 0,0 | 17,8 | 0,0 | 11,5 | 0,0 | 5,0 | 0,0 | 0,0 | 0,0 |
| 20.04.1933 | 27,8 | 2,8 | 17,7 | 0,0 | 4,0 | 0,0 | 0,0 | 27,8 | 2,8 | 17,7 | 0,0 | 4,0 | 0,0 | 0,0 | 0,0 |
| 23.04.1933 | 22,8 | 12,2 | 17,6 | 0,0 | 4,0 | 0,0 | 0,0 | 22,8 | 12,2 | 17,6 | 0,0 | 4,0 | 0,0 | 0,0 | 0,0 |
| 24.04.1933 | 30,0 | 10,0 | 18,5 | 0,0 | 2,0 | 0,0 | 0,0 | 30,0 | 10,0 | 18,5 | 0,0 | 2,0 | 0,0 | 0,0 | 0,0 |
| 25.04.1933 | 26,1 | 10,0 | 16,5 | 0,0 | 4,0 | 0,0 | 0,0 | 26,1 | 10,0 | 16,5 | 0,0 | 4,0 | 0,0 | 0,0 | 0,0 |
| 26.04.1933 | 13,9 | 10,0 | 11,8 | 0,0 | 1,0 | 0,0 | 0,0 | 13,9 | 10,0 | 11,8 | 0,0 | 1,0 | 0,0 | 0,0 | 0,0 |
| 27.04.1933 | 13,9 | 8,9 | 11,5 | 0,0 | 1,0 | 0,0 | 0,0 | 13,9 | 8,9 | 11,5 | 0,0 | 1,0 | 0,0 | 0,0 | 0,0 |
| 28.04.1933 | 12,2 | 6,1 | 9,6 | 0,0 | 3,0 | 0,0 | 0,0 | 12,2 | 6,1 | 9,6 | 0,0 | 3,0 | 0,0 | 0,0 | 0,0 |
| 29.04.1933 | 17,2 | 5,0 | 10,8 | 0,0 | 1,0 | 0,0 | 0,0 | 17,2 | 5,0 | 10,8 | 0,0 | 1,0 | 0,0 | 0,0 | 0,0 |
| 30.04.1933 | 13,9 | 7,2 | 10,3 | 0,0 | 2,0 | 0,0 | 0,0 | 13,9 | 7,2 | 10,3 | 0,0 | 2,0 | 0,0 | 0,0 | 0,0 |
| 01.05.1933 | 18,9 | 5,0 | 11,5 | 0,0 | 3,0 | 0,0 | 0,0 | 18,9 | 5,0 | 11,5 | 0,0 | 3,0 | 0,0 | 0,0 | 0,0 |
| 03.05.1933 | 20,0 | 8,9 | 15,6 | 0,0 | 4,0 | 0,0 | 0,0 | 20,0 | 8,9 | 15,6 | 0,0 | 4,0 | 0,0 | 0,0 | 0,0 |
| 04.05.1933 | 17,2 | 7,8 | 12,2 | 0,0 | 2,0 | 0,0 | 0,0 | 17,2 | 7,8 | 12,2 | 0,0 | 2,0 | 0,0 | 0,0 | 0,0 |
| 05.05.1933 | 22,2 | 5,0 | 15,4 | 0,0 | 1,0 | 0,0 | 0,0 | 22,2 | 5,0 | 15,4 | 0,0 | 1,0 | 0,0 | 0,0 | 0,0 |
| 06.05.1933 | 16,1 | 8,9 | 12,8 | 0,0 | 2,0 | 0,0 | 0,0 | 16,1 | 8,9 | 12,8 | 0,0 | 2,0 | 0,0 | 0,0 | 0,0 |
| 07.05.1933 | 17,8 | 6,1 | 11,8 | 0,0 | 4,0 | 0,0 | 0,0 | 17,8 | 6,1 | 11,8 | 0,0 | 4,0 | 0,0 | 0,0 | 0,0 |
| 09.05.1933 | 23,9 | 7,2 | 16,4 | 0,0 | 1,0 | 0,0 | 0,0 | 23,9 | 7,2 | 16,4 | 0,0 | 1,0 | 0,0 | 0,0 | 0,0 |
| 10.05.1933 | 27,8 | 10,0 | 18,8 | 0,0 | 1,0 | 0,0 | 0,0 | 27,8 | 10,0 | 18,8 | 0,0 | 1,0 | 0,0 | 0,0 | 0,0 |
| 11.05.1933 | 27,8 | 10,0 | 18,9 | 0,0 | 1,0 | 0,0 | 0,0 | 27,8 | 10,0 | 18,9 | 0,0 | 1,0 | 0,0 | 0,0 | 0,0 |
| 13.05.1933 | 23,9 | 12,2 | 18,6 | 0,0 | 2,0 | 0,0 | 0,0 | 23,9 | 12,2 | 18,6 | 0,0 | 2,0 | 0,0 | 0,0 | 0,0 |
| 15.05.1933 | 17,8 | 8,9 | 14,0 | 0,0 | 5,0 | 0,0 | 0,0 | 17,8 | 8,9 | 14,0 | 0,0 | 5,0 | 0,0 | 0,0 | 0,0 |
| 16.05.1933 | 21,1 | 7,8 | 14,6 | 0,0 | 1,0 | 0,0 | 0,0 | 21,1 | 7,8 | 14,6 | 0,0 | 1,0 | 0,0 | 0,0 | 0,0 |
| 17.05.1933 | 22,2 | 7,8 | 16,1 | 0,0 | 5,0 | 0,0 | 0,0 | 22,2 | 7,8 | 16,1 | 0,0 | 5,0 | 0,0 | 0,0 | 0,0 |
| 18.05.1933 | 20,0 | 12,2 | 15,3 | 0,0 | 7,0 | 0,0 | 0,0 | 20,0 | 12,2 | 15,3 | 0,0 | 7,0 | 0,0 | 0,0 | 0,0 |
| 21.05.1933 | 20,0 | 10,0 | 16,1 | 0,0 | 1,0 | 0,0 | 0,0 | 20,0 | 10,0 | 16,1 | 0,0 | 1,0 | 0,0 | 0,0 | 0,0 |
| 22.05.1933 | 17,2 | 12,8 | 15,0 | 0,0 | 1,0 | 0,0 | 0,0 | 17,2 | 12,8 | 15,0 | 0,0 | 1,0 | 0,0 | 0,0 | 0,0 |
| 23.05.1933 | 16,1 | 12,2 | 13,2 | 0,0 | 6,0 | 0,0 | 0,0 | 16,1 | 12,2 | 13,2 | 0,0 | 6,0 | 0,0 | 0,0 | 0,0 |

The full Excel table of the source data is in full open free access in the Eidos cloud at the link:

http://aidos.byethost5.com/Source_data_applications/Applications-000330/Inp_data.xlsx.

In this work, to enter the initial data (Table 3) into the Eidos system and the automated development of classification and descriptive scales and gradations and the training sample (Tables 4, 5, 6), i.e. for automated formalization of the subject area, the universal automated API-2.3.2.2 was applied, with the parameters shown in Figure 4:





Хелп по сценарному АСК-анализу

Когда сценарный метод АСК-анализа не применяется, то записи файла исходных данных "Inp_data" рассматриваются сами по себе независимо друг от друга. Если же он применяется, то как классы рассматриваются сценарии изменения значений полей классификационных шкал на заданное количество записей вперед от текущей записи (горизонт прогнозирования), а за значения факторов принимаются сценарии изменения значений полей описательных шкал на заданное их количество назад [глубина предистории].

Чтобы рассмотрение сценариев изменения значений шкал было осмысленным записи в файле исходных данных "Inp_data" должны упорядочены каким-либо образом, например по времени (временные ряды).

Подробное теоретическое описание сценарного АСК-анализа с детальными численными примерами приведено в работах автора:

Lutsenko E.V. Script ASC-analysis as a method for developing generalized basic functions and weight coefficients for the decomposition of a state function of an arbitrary concrete object or situation in the theorem by A. N. Kolmogorov (1957) // August 2020, DOI: 10.13140/RG.2.2.28017.92007, LicenseCC BY-SA 4.0, <https://www.researchgate.net/publication/343365649>

Lutsenko E.V. Forecasting in financial markets using scenario-based ASC-analysis and the Eidos system (using the example of Google shares) // July 2021, DOI: 10.13140/RG.2.2.28157.08168, LicenseCC BY-SA 4.0, <https://www.researchgate.net/publication/353157032>

Lutsenko E.V. ASC-analysis and the Eidos system as a method and tools for solving problems // November 2021, DOI: 10.13140/RG.2.2.29823.74407, License CC BY 4.0, <https://www.researchgate.net/publication/353555996>

Lutsenko E.V., Korzhakov V.E. Subsystem of intellectual system "Eidos-X++", which implements the scenario method of system-cognitive analysis ("Eidos-scenarios") // March 2019, <https://www.researchgate.net/publication/331745001>

Lutsenko E.V. Forecasting the values and scenarios of changes in the future economic indicators of the holding using scenario ASC-analysis // January 2022, DOI: 10.13140/RG.2.2.10006.47684, LicenseCC BY 4.0, <https://www.researchgate.net/publication/357671568>

2.3.2.2. Задание размерности модели системы "ЭЙДОС-Х++"

ЗАДАНИЕ В ДИАЛОГЕ РАЗМЕРНОСТИ МОДЕЛИ: (равные интервалы)

Количество градаций классификационных и описательных шкал в модели, т.е.: [21 классов x 21 признаков]

| Тип шкалы | Количество классификационных шкал | Количество градаций классификационных | Среднее количество градаций на класс.шкалу | Количество описательных шкал | Количество градаций описательных шкал | Среднее количество градаций на опис.шкалу |
|-----------|-----------------------------------|---------------------------------------|--|------------------------------|---------------------------------------|---|
| Числовые | 7 | 21 | 3,00 | 7 | 21 | 3,00 |
| Текстовые | 0 | 0 | 0,00 | 0 | 0 | 0,00 |
| ВСЕГО: | 7 | 21 | 3,00 | 7 | 21 | 3,00 |

Задайте количество числовых диапазонов (интервалов, градаций) в шкале:

В классификационных шкалах: В описательных шкалах:

2.3.2.2. Процесс импорта данных из внешней БД "Inp_data" в систему "ЭЙДОС-Х++"

Стадии выполнения процесса:

- 1/5: Формирование классификационных и описательных шкал и градаций на основе БД "Inp_data"- Готово
- 2/5: Создание базы событий "EventsKO" из "Inp_data" с кодами событий вместо значений шкал- Готово
- 3/5: Доформирование классиф.и описат.шкал и градаций на основе БД "EventsKO" (сценарии)- Готово
- 4/5: Генерация обучающей выборки на основе базы событий "EventsKO"- Готово
- 5/5: Переиндексация всех баз данных нового приложения- Готово

ПРОЦЕСС ФОРМАЛИЗАЦИИ ПРЕДМЕТНОЙ ОБЛАСТИ ЗАВЕРШЕН УСПЕШНО !!!

Прогноз времени исполнения

| | |
|-------------------|---------------------|
| Начало: 19:49:45 | Окончание: 20:12:09 |
| Прошло: 0:22:23 | |
| 100% | |
| Осталось: 0:00:00 | |

Picture4. Screen forms of the universal automated programming interface API-2.3.2.2 of the Eidos system

As a result of the work of API-2.3.2.2, classification and descriptive scales and gradations were formed (Tables 4 and 5).

table4– Classification scales and gradations (in full)

| KOD_CLS | NAME_CLS |
|---------|--|
| 1 | MAXIMUM TEMPERATURE-1/3-{-22.0, -0.3} |
| 2 | MAXIMUM TEMPERATURE-2/3-{-0.3, 21.3} |
| 3 | MAXIMUM TEMPERATURE-3/3-{21.3, 43.0} |
| 4 | MINIMUM TEMPERATURE-1/3-{-33.7, -14.0} |
| 5 | MINIMUM TEMPERATURE-2/3-{-14.0, 5.7} |
| 6 | MINIMUM TEMPERATURE-3/3-{5.7, 25.4} |
| 7 | AVERAGE TEMPERATURE-1/3-{-27.9, -8.2} |
| 8 | AVERAGE TEMPERATURE-2/3-{-8.2, 11.6} |
| 9 | AVERAGE TEMPERATURE-3/3-{11.6, 31.3} |
| 10 | ATMOSPHERIC PRESSURE-1/3-{989.1, 1006.9} |
| 11 | ATMOSPHERIC PRESSURE-2/3-{1006.9, 1024.8} |
| 12 | ATMOSPHERIC PRESSURE-3/3-{1024.8, 1042.6} |
| 13 | WIND SPEED-1/3-{1.0, 10.3} |
| 14 | WIND SPEED-2/3-{-10.3, 19.7} |
| 15 | WIND SPEED-3/3-{-19.7, 29.0} |
| 16 | RAIN-1/3-{-1.0, 100.7} |
| 17 | RAIN-2/3-{-100.7, 200.3} |
| 18 | RAIN-3/3-{-200.3, 300.0} |
| 19 | EFFECTIVE TEMPERATURE-1/3-{-31.6, -9.9} |
| 20 | EFFECTIVE TEMPERATURE-2/3-{-9.9, 11.7} |
| 21 | EFFECTIVE TEMPERATURE-3/3-{11.7, 33.4} |
| 22 | MAXIMUM TEMPERATURE-FUTURE3-MAXIMUM TEMPERATURE-FUTURE3-01,01,01 |
| 23 | MAXIMUM TEMPERATURE-FUTURE3-MAXIMUM TEMPERATURE-FUTURE3-01,01,02 |
| 24 | MAXIMUM TEMPERATURE-FUTURE3-MAXIMUM TEMPERATURE-FUTURE3-01,02,01 |
| 25 | MAXIMUM TEMPERATURE-FUTURE3-MAXIMUM TEMPERATURE-FUTURE3-01,02,02 |
| 26 | MAXIMUM TEMPERATURE-FUTURE3-MAXIMUM TEMPERATURE-FUTURE3-01,02,03 |
| 27 | MAXIMUM TEMPERATURE-FUTURE3-MAXIMUM TEMPERATURE-FUTURE3-01,03,03 |
| 28 | MAXIMUM TEMPERATURE-FUTURE3-MAXIMUM TEMPERATURE-FUTURE3-02,01,01 |
| 29 | MAXIMUM TEMPERATURE-FUTURE3-MAXIMUM TEMPERATURE-FUTURE3-02,01,02 |
| 30 | MAXIMUM TEMPERATURE-FUTURE3-MAXIMUM TEMPERATURE-FUTURE3-02,01,03 |
| 31 | MAXIMUM TEMPERATURE-FUTURE3-MAXIMUM TEMPERATURE-FUTURE3-02,02,01 |
| 32 | MAXIMUM TEMPERATURE-FUTURE3-MAXIMUM TEMPERATURE-FUTURE3-02,02,02 |
| 33 | MAXIMUM TEMPERATURE-FUTURE3-MAXIMUM TEMPERATURE-FUTURE3-02,02,03 |
| 34 | MAXIMUM TEMPERATURE-FUTURE3-MAXIMUM TEMPERATURE-FUTURE3-02,03,02 |
| 35 | MAXIMUM TEMPERATURE-FUTURE3-MAXIMUM TEMPERATURE-FUTURE3-02,03,03 |
| 36 | MAXIMUM TEMPERATURE-FUTURE3-MAXIMUM TEMPERATURE-FUTURE3-03,02,02 |
| 37 | MAXIMUM TEMPERATURE-FUTURE3-MAXIMUM TEMPERATURE-FUTURE3-03,02,03 |
| 38 | MAXIMUM TEMPERATURE-FUTURE3-MAXIMUM TEMPERATURE-FUTURE3-03,03,02 |
| 39 | MAXIMUM TEMPERATURE-FUTURE3-MAXIMUM TEMPERATURE-FUTURE3-03,03,03 |
| 40 | MINIMUM TEMPERATURE-FUTURE3-MINIMUM TEMPERATURE-FUTURE3-04,04,04 |
| 41 | MINIMUM TEMPERATURE-FUTURE3-MINIMUM TEMPERATURE-FUTURE3-04,04,05 |
| 42 | MINIMUM TEMPERATURE-FUTURE3-MINIMUM TEMPERATURE-FUTURE3-04,05,04 |
| 43 | MINIMUM TEMPERATURE-FUTURE3-MINIMUM TEMPERATURE-FUTURE3-04,05,05 |
| 44 | MINIMUM TEMPERATURE-FUTURE3-MINIMUM TEMPERATURE-FUTURE3-05,04,04 |
| 45 | MINIMUM TEMPERATURE-FUTURE3-MINIMUM TEMPERATURE-FUTURE3-05,04,05 |
| 46 | MINIMUM TEMPERATURE-FUTURE3-MINIMUM TEMPERATURE-FUTURE3-05,05,04 |
| 47 | MINIMUM TEMPERATURE-FUTURE3-MINIMUM TEMPERATURE-FUTURE3-05,05,05 |
| 48 | MINIMUM TEMPERATURE-FUTURE3-MINIMUM TEMPERATURE-FUTURE3-05,05,06 |
| 49 | MINIMUM TEMPERATURE-FUTURE3-MINIMUM TEMPERATURE-FUTURE3-05,06,05 |
| 50 | MINIMUM TEMPERATURE-FUTURE3-MINIMUM TEMPERATURE-FUTURE3-05,06,06 |
| 51 | MINIMUM TEMPERATURE-FUTURE3-MINIMUM TEMPERATURE-FUTURE3-06,05,05 |
| 52 | MINIMUM TEMPERATURE-FUTURE3-MINIMUM TEMPERATURE-FUTURE3-06,05,06 |
| 53 | MINIMUM TEMPERATURE-FUTURE3-MINIMUM TEMPERATURE-FUTURE3-06,06,05 |
| 54 | MINIMUM TEMPERATURE-FUTURE3-MINIMUM TEMPERATURE-FUTURE3-06,06,06 |
| 55 | AVERAGE TEMPERATURE-FUTURE3-AVERAGE TEMPERATURE-FUTURE3-07,07,07 |
| 56 | AVERAGE TEMPERATURE-FUTURE3-AVERAGE TEMPERATURE-FUTURE3-07,07,08 |
| 57 | AVERAGE TEMPERATURE-FUTURE3-AVERAGE TEMPERATURE-FUTURE3-07,08,07 |
| 58 | AVERAGE TEMPERATURE-FUTURE3-AVERAGE TEMPERATURE-FUTURE3-07,08,08 |
| 59 | AVERAGE TEMPERATURE-FUTURE3-AVERAGE TEMPERATURE-FUTURE3-08,07,07 |
| 60 | AVERAGE TEMPERATURE-FUTURE3-AVERAGE TEMPERATURE-FUTURE3-08,07,08 |
| 61 | AVERAGE TEMPERATURE-FUTURE3-AVERAGE TEMPERATURE-FUTURE3-08,08,07 |
| 62 | AVERAGE TEMPERATURE-FUTURE3-AVERAGE TEMPERATURE-FUTURE3-08,08,08 |
| 63 | AVERAGE TEMPERATURE-FUTURE3-AVERAGE TEMPERATURE-FUTURE3-08,08,09 |
| 64 | AVERAGE TEMPERATURE-FUTURE3-AVERAGE TEMPERATURE-FUTURE3-08,09,08 |
| 65 | AVERAGE TEMPERATURE-FUTURE3-AVERAGE TEMPERATURE-FUTURE3-08,09,09 |

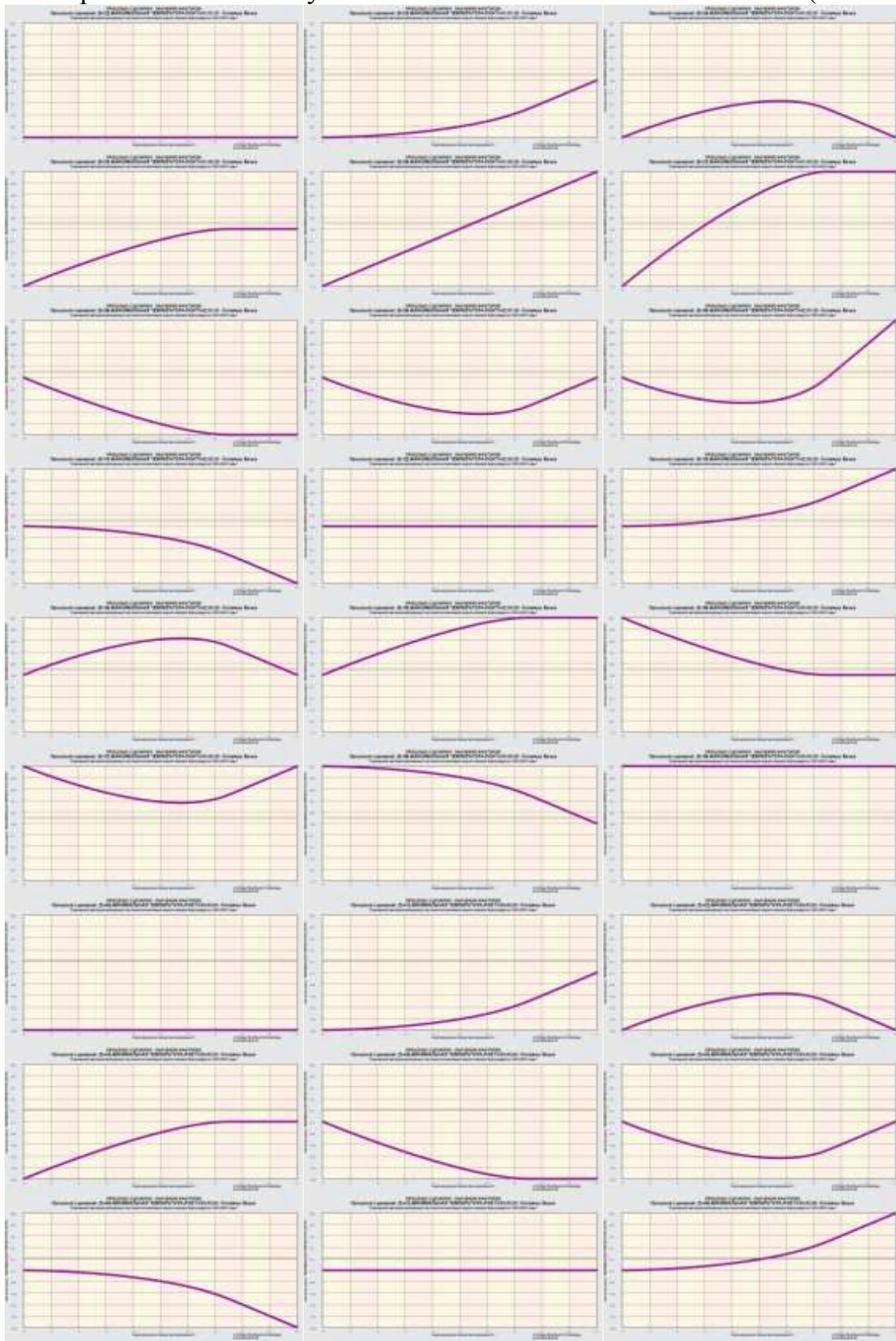
| | |
|-----|--|
| 66 | AVERAGE TEMPERATURE-FUTURE3-AVERAGE TEMPERATURE-FUTURE3-09,08,08 |
| 67 | AVERAGE TEMPERATURE-FUTURE3-AVERAGE TEMPERATURE-FUTURE3-09,08,09 |
| 68 | AVERAGE TEMPERATURE-FUTURE3-AVERAGE TEMPERATURE-FUTURE3-09,09,08 |
| 69 | AVERAGE TEMPERATURE-FUTURE3-AVERAGE TEMPERATURE-FUTURE3-09,09,09 |
| 70 | ATMOSPHERIC PRESSURE-FUTURE3-ATMOSPHERIC PRESSURE-FUTURE3-10,10,10 |
| 71 | ATMOSPHERIC PRESSURE-FUTURE3-ATMOSPHERIC PRESSURE-FUTURE3-10,10,11 |
| 72 | ATMOSPHERIC PRESSURE-FUTURE3-ATMOSPHERIC PRESSURE-FUTURE3-10,10,12 |
| 73 | ATMOSPHERIC PRESSURE-FUTURE3-ATMOSPHERIC PRESSURE-FUTURE3-10,11,10 |
| 74 | ATMOSPHERIC PRESSURE-FUTURE3-ATMOSPHERIC PRESSURE-FUTURE3-10,11,11 |
| 75 | ATMOSPHERIC PRESSURE-FUTURE3-ATMOSPHERIC PRESSURE-FUTURE3-10,11,12 |
| 76 | ATMOSPHERIC PRESSURE-FUTURE3-ATMOSPHERIC PRESSURE-FUTURE3-10,12,12 |
| 77 | ATMOSPHERIC PRESSURE-FUTURE3-ATMOSPHERIC PRESSURE-FUTURE3-11,10,10 |
| 78 | ATMOSPHERIC PRESSURE-FUTURE3-ATMOSPHERIC PRESSURE-FUTURE3-11,10,11 |
| 79 | ATMOSPHERIC PRESSURE-FUTURE3-ATMOSPHERIC PRESSURE-FUTURE3-11,11,10 |
| 80 | ATMOSPHERIC PRESSURE-FUTURE3-ATMOSPHERIC PRESSURE-FUTURE3-11,11,11 |
| 81 | ATMOSPHERIC PRESSURE-FUTURE3-ATMOSPHERIC PRESSURE-FUTURE3-11,11,12 |
| 82 | ATMOSPHERIC PRESSURE-FUTURE3-ATMOSPHERIC PRESSURE-FUTURE3-11,12,11 |
| 83 | ATMOSPHERIC PRESSURE-FUTURE3-ATMOSPHERIC PRESSURE-FUTURE3-11,12,12 |
| 84 | ATMOSPHERIC PRESSURE-FUTURE3-ATMOSPHERIC PRESSURE-FUTURE3-12,11,10 |
| 85 | ATMOSPHERIC PRESSURE-FUTURE3-ATMOSPHERIC PRESSURE-FUTURE3-12,11,11 |
| 86 | ATMOSPHERIC PRESSURE-FUTURE3-ATMOSPHERIC PRESSURE-FUTURE3-12,11,12 |
| 87 | ATMOSPHERIC PRESSURE-FUTURE3-ATMOSPHERIC PRESSURE-FUTURE3-12,12,11 |
| 88 | ATMOSPHERIC PRESSURE-FUTURE3-ATMOSPHERIC PRESSURE-FUTURE3-12,12,12 |
| 89 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-13,13,13 |
| 90 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-13,13,14 |
| 91 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-13,13,15 |
| 92 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-13,14,13 |
| 93 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-13,14,14 |
| 94 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-13,14,15 |
| 95 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-13,15,13 |
| 96 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-13,15,14 |
| 97 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-13,15,15 |
| 98 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-14,13,13 |
| 99 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-14,13,14 |
| 100 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-14,14,13 |
| 101 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-14,14,14 |
| 102 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-14,14,15 |
| 103 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-14,15,13 |
| 104 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-14,15,14 |
| 105 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-14,15,15 |
| 106 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-15,13,13 |
| 107 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-15,14,13 |
| 108 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-15,14,14 |
| 109 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-15,15,13 |
| 110 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-15,15,14 |
| 111 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-15,15,15 |
| 112 | REFERENCES-FUTURE3-REFERENCES-FUTURE3-16,16,16 |
| 113 | RAIN-FUTURE3-REFIT-FUTURE3-16,16,17 |
| 114 | REFERENCE-FUTURE3-REFERENCE-FUTURE3-16,16,18 |
| 115 | RAIN-FUTURE3-REFIT-FUTURE3-16,17,16 |
| 116 | RAIN-FUTURE3-REFERENCE-FUTURE3-16,17,17 |
| 117 | RAIN-FUTURE3-REFIT-FUTURE3-16,18,16 |
| 118 | RAIN-FUTURE3-REFIT-FUTURE3-17,16,16 |
| 119 | RAIN-FUTURE3-REFIT-FUTURE3-17,16,17 |
| 120 | REFERENCES-FUTURE3-REFERENCES-FUTURE3-17,17,16 |
| 121 | RAIN-FUTURE3-REFIT-FUTURE3-17,17,17 |
| 122 | RAIN-FUTURE3-REFIT-FUTURE3-18,16,16 |
| 123 | EFFECTIVE TEMPERATURE-FUTURE3-EFFECTIVE TEMPERATURE-FUTURE3-19,19,19 |
| 124 | EFFECTIVE TEMPERATURE-FUTURE3-EFFECTIVE TEMPERATURE-FUTURE3-19,19,20 |
| 125 | EFFECTIVE TEMPERATURE-FUTURE3-EFFECTIVE TEMPERATURE-FUTURE3-19,20,19 |
| 126 | EFFECTIVE TEMPERATURE-FUTURE3-EFFECTIVE TEMPERATURE-FUTURE3-19,20,20 |
| 127 | EFFECTIVE TEMPERATURE-FUTURE3-EFFECTIVE TEMPERATURE-FUTURE3-20,19,19 |
| 128 | EFFECTIVE TEMPERATURE-FUTURE3-EFFECTIVE TEMPERATURE-FUTURE3-20,19,20 |
| 129 | EFFECTIVE TEMPERATURE-FUTURE3-EFFECTIVE TEMPERATURE-FUTURE3-20,20,19 |
| 130 | EFFECTIVE TEMPERATURE-FUTURE3-EFFECTIVE TEMPERATURE-FUTURE3-20,20,20 |
| 131 | EFFECTIVE TEMPERATURE-FUTURE3-EFFECTIVE TEMPERATURE-FUTURE3-20,20,21 |
| 132 | EFFECTIVE TEMPERATURE-FUTURE3-EFFECTIVE TEMPERATURE-FUTURE3-20,21,20 |
| 133 | EFFECTIVE TEMPERATURE-FUTURE3-EFFECTIVE TEMPERATURE-FUTURE3-20,21,21 |
| 134 | EFFECTIVE TEMPERATURE-FUTURE3-EFFECTIVE TEMPERATURE-FUTURE3-21,20,20 |
| 135 | EFFECTIVE TEMPERATURE-FUTURE3-EFFECTIVE TEMPERATURE-FUTURE3-21,20,21 |
| 136 | EFFECTIVE TEMPERATURE-FUTURE3-EFFECTIVE TEMPERATURE-FUTURE3-21,21,20 |
| 137 | EFFECTIVE TEMPERATURE-FUTURE3-EFFECTIVE TEMPERATURE-FUTURE3-21,21,21 |

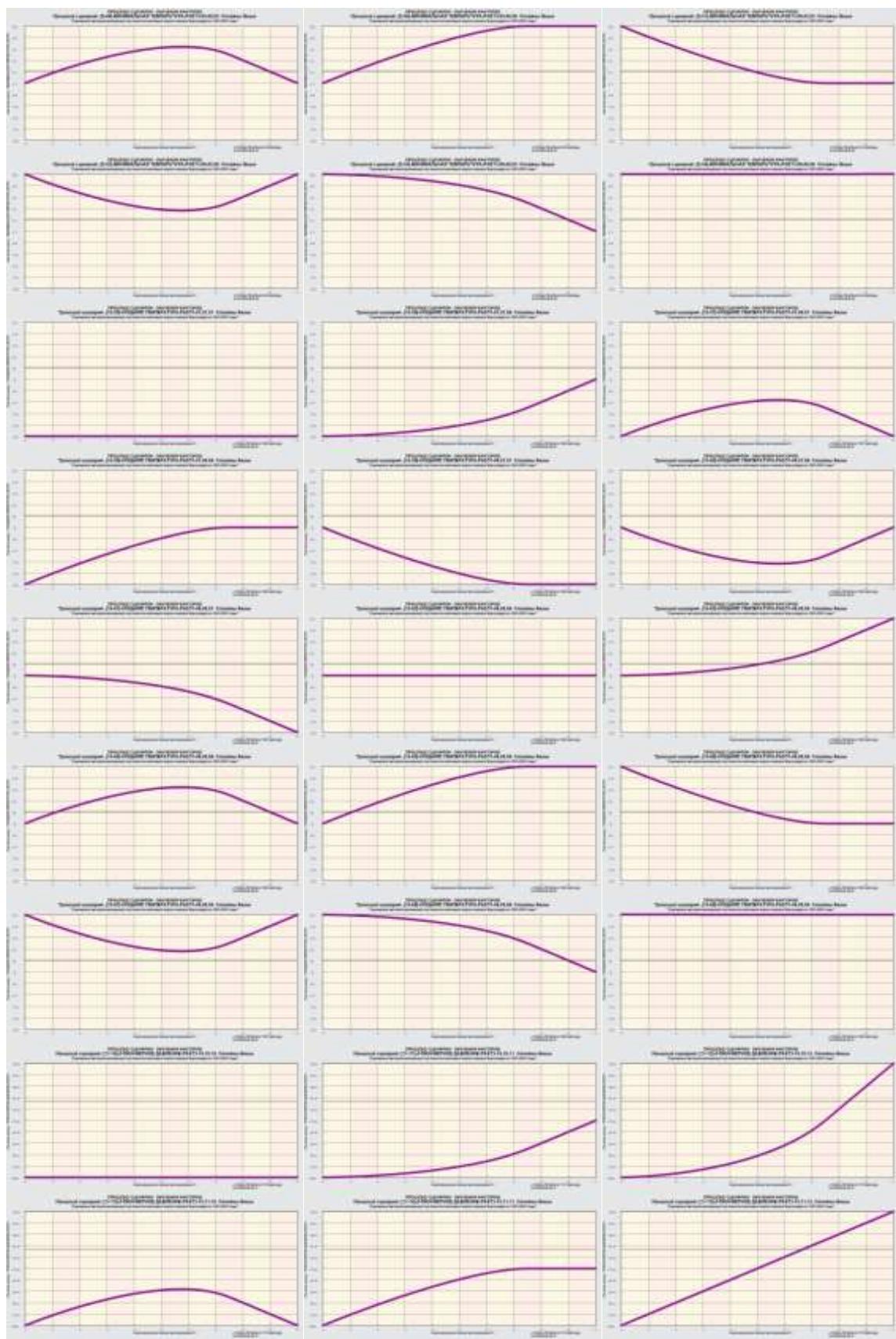
table5– Descriptive scales and gradations (in full)

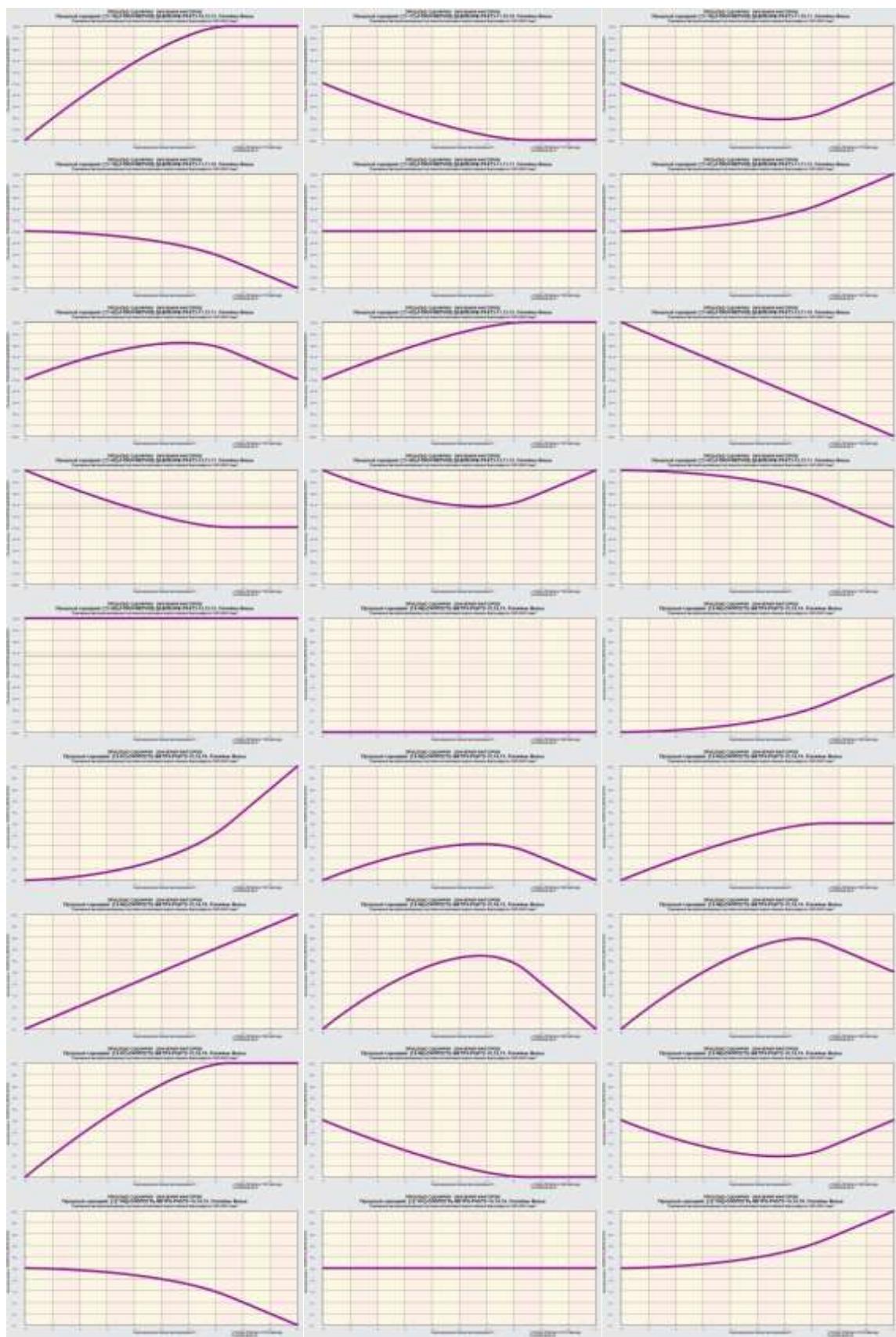
| KOD_ATR | NAME_ATR |
|---------|--|
| 1 | MAXIMUM TEMPERATURE-1/3-{-22.000000, -0.3333333} |
| 2 | MAXIMUM TEMPERATURE-2/3-{-0.3333333, 21.3333333} |
| 3 | MAXIMUM TEMPERATURE-3/3-{21.3333333, 43.0000000} |
| 4 | MINIMUM TEMPERATURE-1/3-{-33.7000000, -14.0000000} |
| 5 | MINIMUM TEMPERATURE-2/3-{-14.0000000, 5.7000000} |
| 6 | MINIMUM TEMPERATURE-3/3-{-5.7000000, 25.4000000} |
| 7 | AVERAGE TEMPERATURE-1/3-{-27.9000000, -8.1666667} |
| 8 | AVERAGE TEMPERATURE-2/3-{-8.1666667, 11.5666667} |
| 9 | AVERAGE TEMPERATURE-3/3-{-11.5666667, 31.3000000} |
| 10 | ATMOSPHERIC PRESSURE-1/3-{-989.1000000, 1006.9333333} |
| 11 | ATMOSPHERIC PRESSURE-2/3-{-1006.9333333, 1024.7666667} |
| 12 | ATMOSPHERIC PRESSURE-3/3-{-1024.7666667, 1042.6000000} |
| 13 | WIND SPEED-1/3-{-1.0000000, 10.3333333} |
| 14 | WIND SPEED-2/3-{-10.3333333, 19.6666667} |
| 15 | WIND SPEED-3/3-{-19.6666667, 29.0000000} |
| 16 | RAIN-1/3-{-1.0000000, 100.6666667} |
| 17 | RAIN-2/3-{-100.6666667, 200.3333333} |
| 18 | RAIN-3/3-{-200.3333333, 300.0000000} |
| 19 | EFFECTIVE TEMPERATURE-1/3-{-31.6000000, -9.9333333} |
| 20 | EFFECTIVE TEMPERATURE-2/3-{-9.9333333, 11.7333333} |
| 21 | EFFECTIVE TEMPERATURE-3/3-{-11.7333333, 33.4000000} |
| 22 | MAXIMUM TEMPERATURE-PAST3-MAXIMUM TEMPERATURE-PAST3-01,01,01 |
| 23 | MAXIMUM TEMPERATURE-PAST3-MAXIMUM TEMPERATURE-PAST3-01,01,02 |
| 24 | MAXIMUM TEMPERATURE-PAST3-MAXIMUM TEMPERATURE-PAST3-01,02,01 |
| 25 | MAXIMUM TEMPERATURE-PAST3-MAXIMUM TEMPERATURE-PAST3-01,02,02 |
| 26 | MAXIMUM TEMPERATURE-PAST3-MAXIMUM TEMPERATURE-PAST3-01,02,03 |
| 27 | MAXIMUM TEMPERATURE-PAST3-MAXIMUM TEMPERATURE-PAST3-01,03,03 |
| 28 | MAXIMUM TEMPERATURE-PAST3-MAXIMUM TEMPERATURE-PAST3-02,01,01 |
| 29 | MAXIMUM TEMPERATURE-PAST3-MAXIMUM TEMPERATURE-PAST3-02,01,02 |
| 30 | MAXIMUM TEMPERATURE-PAST3-MAXIMUM TEMPERATURE-PAST3-02,01,03 |
| 31 | MAXIMUM TEMPERATURE-PAST3-MAXIMUM TEMPERATURE-PAST3-02,02,01 |
| 32 | MAXIMUM TEMPERATURE-PAST3-MAXIMUM TEMPERATURE-PAST3-02,02,02 |
| 33 | MAXIMUM TEMPERATURE-PAST3-MAXIMUM TEMPERATURE-PAST3-02,02,03 |
| 34 | MAXIMUM TEMPERATURE-PAST3-MAXIMUM TEMPERATURE-PAST3-02,03,02 |
| 35 | MAXIMUM TEMPERATURE-PAST3-MAXIMUM TEMPERATURE-PAST3-02,03,03 |
| 36 | MAXIMUM TEMPERATURE-PAST3-MAXIMUM TEMPERATURE-PAST3-03,02,02 |
| 37 | MAXIMUM TEMPERATURE-PAST3-MAXIMUM TEMPERATURE-PAST3-03,02,03 |
| 38 | MAXIMUM TEMPERATURE-PAST3-MAXIMUM TEMPERATURE-PAST3-03,03,02 |
| 39 | MAXIMUM TEMPERATURE-PAST3-MAXIMUM TEMPERATURE-PAST3-03,03,03 |
| 40 | MINIMUM TEMPERATURE-PAST3-MINIMUM TEMPERATURE-PAST3-04,04,04 |
| 41 | MINIMUM TEMPERATURE-PAST3-MINIMUM TEMPERATURE-PAST3-04,04,05 |
| 42 | MINIMUM TEMPERATURE-PAST3-MINIMUM TEMPERATURE-PAST3-04,05,04 |
| 43 | MINIMUM TEMPERATURE-PAST3-MINIMUM TEMPERATURE-PAST3-04,05,05 |
| 44 | MINIMUM TEMPERATURE-PAST3-MINIMUM TEMPERATURE-PAST3-05,04,04 |
| 45 | MINIMUM TEMPERATURE-PAST3-MINIMUM TEMPERATURE-PAST3-05,04,05 |
| 46 | MINIMUM TEMPERATURE-PAST3-MINIMUM TEMPERATURE-PAST3-05,05,04 |
| 47 | MINIMUM TEMPERATURE-PAST3-MINIMUM TEMPERATURE-PAST3-05,05,05 |
| 48 | MINIMUM TEMPERATURE-PAST3-MINIMUM TEMPERATURE-PAST3-05,05,06 |
| 49 | MINIMUM TEMPERATURE-PAST3-MINIMUM TEMPERATURE-PAST3-05,06,05 |
| 50 | MINIMUM TEMPERATURE-PAST3-MINIMUM TEMPERATURE-PAST3-05,06,06 |
| 51 | MINIMUM TEMPERATURE-PAST3-MINIMUM TEMPERATURE-PAST3-06,05,05 |
| 52 | MINIMUM TEMPERATURE-PAST3-MINIMUM TEMPERATURE-PAST3-06,05,06 |
| 53 | MINIMUM TEMPERATURE-PAST3-MINIMUM TEMPERATURE-PAST3-06,06,05 |
| 54 | MINIMUM TEMPERATURE-PAST3-MINIMUM TEMPERATURE-PAST3-06,06,06 |
| 55 | AVERAGE TEMPERATURE-PAST3-AVERAGE TEMPERATURE-PAST3-07,07,07 |
| 56 | AVERAGE TEMPERATURE-PAST3-AVERAGE TEMPERATURE-PAST3-07,07,08 |
| 57 | AVERAGE TEMPERATURE-PAST3-AVERAGE TEMPERATURE-PAST3-07,08,07 |
| 58 | AVERAGE TEMPERATURE-PAST3-AVERAGE TEMPERATURE-PAST3-07,08,08 |
| 59 | AVERAGE TEMPERATURE-PAST3-AVERAGE TEMPERATURE-PAST3-08,07,07 |
| 60 | AVERAGE TEMPERATURE-PAST3-AVERAGE TEMPERATURE-PAST3-08,07,08 |
| 61 | AVERAGE TEMPERATURE-PAST3-AVERAGE TEMPERATURE-PAST3-08,08,07 |
| 62 | AVERAGE TEMPERATURE-PAST3-AVERAGE TEMPERATURE-PAST3-08,08,08 |
| 63 | AVERAGE TEMPERATURE-PAST3-AVERAGE TEMPERATURE-PAST3-08,08,09 |
| 64 | AVERAGE TEMPERATURE-PAST3-AVERAGE TEMPERATURE-PAST3-08,09,08 |
| 65 | AVERAGE TEMPERATURE-PAST3-AVERAGE TEMPERATURE-PAST3-08,09,09 |
| 66 | AVERAGE TEMPERATURE-PAST3-AVERAGE TEMPERATURE-PAST3-09,08,08 |
| 67 | AVERAGE TEMPERATURE-PAST3-AVERAGE TEMPERATURE-PAST3-09,08,09 |
| 68 | AVERAGE TEMPERATURE-PAST3-AVERAGE TEMPERATURE-PAST3-09,09,08 |
| 69 | AVERAGE TEMPERATURE-PAST3-AVERAGE TEMPERATURE-PAST3-09,09,09 |

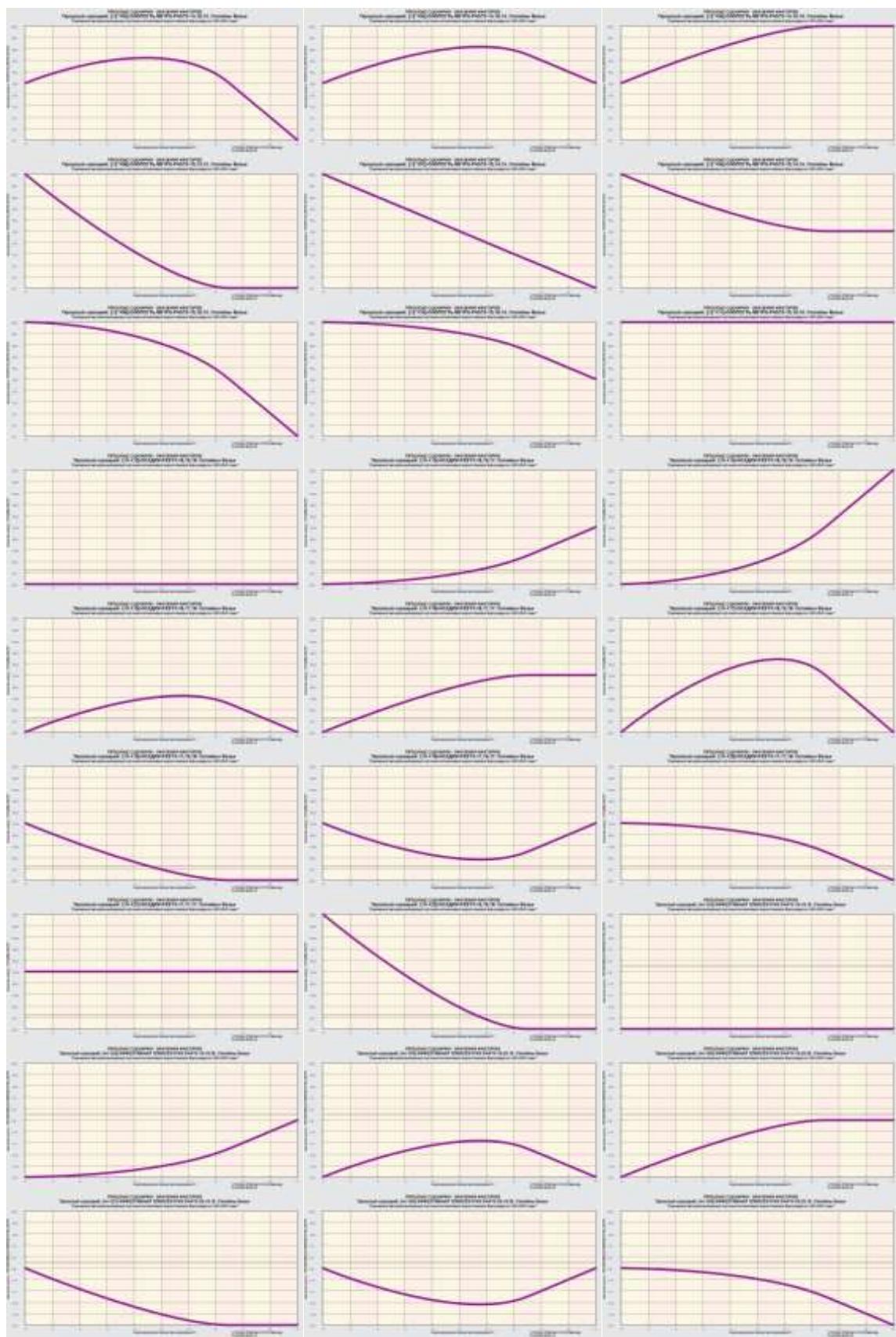
| | |
|-----|--|
| 70 | ATMOSPHERIC PRESSURE-PAST3-ATMOSPHERIC PRESSURE-PAST3-10,10,10 |
| 71 | ATMOSPHERIC PRESSURE-PAST3-ATMOSPHERIC PRESSURE-PAST3-10,10,11 |
| 72 | ATMOSPHERIC PRESSURE-PAST3-ATMOSPHERIC PRESSURE-PAST3-10,10,12 |
| 73 | ATMOSPHERIC PRESSURE-PAST3-ATMOSPHERIC PRESSURE-PAST3-10,11,10 |
| 74 | ATMOSPHERIC PRESSURE-PAST3-ATMOSPHERIC PRESSURE-PAST3-10,11,11 |
| 75 | ATMOSPHERIC PRESSURE-PAST3-ATMOSPHERIC PRESSURE-PAST3-10,11,12 |
| 76 | ATMOSPHERIC PRESSURE-PAST3-ATMOSPHERIC PRESSURE-PAST3-10,12,12 |
| 77 | ATMOSPHERIC PRESSURE-PAST3-ATMOSPHERIC PRESSURE-PAST3-11,10,10 |
| 78 | ATMOSPHERIC PRESSURE-PAST3-ATMOSPHERIC PRESSURE-PAST3-11,10,11 |
| 79 | ATMOSPHERIC PRESSURE-PAST3-ATMOSPHERIC PRESSURE-PAST3-11,11,10 |
| 80 | ATMOSPHERIC PRESSURE-PAST3-ATMOSPHERIC PRESSURE-PAST3-11,11,11 |
| 81 | ATMOSPHERIC PRESSURE-PAST3-ATMOSPHERIC PRESSURE-PAST3-11,11,12 |
| 82 | ATMOSPHERIC PRESSURE-PAST3-ATMOSPHERIC PRESSURE-PAST3-11,12,11 |
| 83 | ATMOSPHERIC PRESSURE-PAST3-ATMOSPHERIC PRESSURE-PAST3-11,12,12 |
| 84 | ATMOSPHERIC PRESSURE-PAST3-ATMOSPHERIC PRESSURE-PAST3-12,11,10 |
| 85 | ATMOSPHERIC PRESSURE-PAST3-ATMOSPHERIC PRESSURE-PAST3-12,11,11 |
| 86 | ATMOSPHERIC PRESSURE-PAST3-ATMOSPHERIC PRESSURE-PAST3-12,11,12 |
| 87 | ATMOSPHERIC PRESSURE-PAST3-ATMOSPHERIC PRESSURE-PAST3-12,12,11 |
| 88 | ATMOSPHERIC PRESSURE-PAST3-ATMOSPHERIC PRESSURE-PAST3-12,12,12 |
| 89 | WIND SPEED-PAST3-WIND SPEED-PAST3-13,13,13 |
| 90 | WIND SPEED-PAST3-WIND SPEED-PAST3-13,13,14 |
| 91 | WIND SPEED-PAST3-WIND SPEED-PAST3-13,13,15 |
| 92 | WIND SPEED-PAST3-WIND SPEED-PAST3-13,14,13 |
| 93 | WIND SPEED-PAST3-WIND SPEED-PAST3-13,14,14 |
| 94 | WIND SPEED-PAST3-WIND SPEED-PAST3-13,14,15 |
| 95 | WIND SPEED-PAST3-WIND SPEED-PAST3-13,15,13 |
| 96 | WIND SPEED-PAST3-WIND SPEED-PAST3-13,15,14 |
| 97 | WIND SPEED-PAST3-WIND SPEED-PAST3-13,15,15 |
| 98 | WIND SPEED-PAST3-WIND SPEED-PAST3-14,13,13 |
| 99 | WIND SPEED-PAST3-WIND SPEED-PAST3-14,13,14 |
| 100 | WIND SPEED-PAST3-WIND SPEED-PAST3-14,14,13 |
| 101 | WIND SPEED-PAST3-WIND SPEED-PAST3-14,14,14 |
| 102 | WIND SPEED-PAST3-WIND SPEED-PAST3-14,14,15 |
| 103 | WIND SPEED-PAST3-WIND SPEED-PAST3-14,15,13 |
| 104 | WIND SPEED-PAST3-WIND SPEED-PAST3-14,15,14 |
| 105 | WIND SPEED-PAST3-WIND SPEED-PAST3-14,15,15 |
| 106 | WIND SPEED-PAST3-WIND SPEED-PAST3-15,13,13 |
| 107 | WIND SPEED-PAST3-WIND SPEED-PAST3-15,14,13 |
| 108 | WIND SPEED-PAST3-WIND SPEED-PAST3-15,14,14 |
| 109 | WIND SPEED-PAST3-WIND SPEED-PAST3-15,15,13 |
| 110 | WIND SPEED-PAST3-WIND SPEED-PAST3-15,15,14 |
| 111 | WIND SPEED-PAST3-WIND SPEED-PAST3-15,15,15 |
| 112 | DRAINAGE-PAST3-RAIDITATION-PAST3-16,16,16 |
| 113 | DRAINAGE-PAST3-RAIDITATION-PAST3-16,16,17 |
| 114 | DRAINAGE-PAST3-RADIATION-PAST3-16,16,18 |
| 115 | DRAINAGE-PAST3-RADIATION-PAST3-16,17,16 |
| 116 | DRAINAGE-PAST3-RADIATION-PAST3-16,17,17 |
| 117 | DRAINAGE-PAST3-RADIATION-PAST3-16,18,16 |
| 118 | DRAINAGE-PAST3-RAIDITATION-PAST3-17,16,16 |
| 119 | DRAINAGE-PAST3-RADIATION-PAST3-17,16,17 |
| 120 | DRAINAGE-PAST3-RAIDITATION-PAST3-17,17,16 |
| 121 | DRAINAGE-PAST3-RADIATION-PAST3-17,17,17 |
| 122 | DRAINAGE-PAST3-RAIDITATION-PAST3-18,16,16 |
| 123 | EFFICIENT TEMPERATURE-PAST3-EFFICIENT TEMPERATURE-PAST3-19,19,19 |
| 124 | EFFICIENT TEMPERATURE-PAST3-EFFICIENT TEMPERATURE-PAST3-19,19,20 |
| 125 | EFFICIENT TEMPERATURE-PAST3-EFFICIENT TEMPERATURE-PAST3-19,20,19 |
| 126 | EFFICIENT TEMPERATURE-PAST3-EFFICIENT TEMPERATURE-PAST3-19,20,20 |
| 127 | EFFICIENT TEMPERATURE-PAST3-EFFICIENT TEMPERATURE-PAST3-20,19,19 |
| 128 | EFFICIENT TEMPERATURE-PAST3-EFFICIENT TEMPERATURE-PAST3-20,19,20 |
| 129 | EFFICIENT TEMPERATURE-PAST3-EFFICIENT TEMPERATURE-PAST3-20,20,19 |
| 130 | EFFICIENT TEMPERATURE-PAST3-EFFICIENT TEMPERATURE-PAST3-20,20,20 |
| 131 | EFFICIENT TEMPERATURE-PAST3-EFFICIENT TEMPERATURE-PAST3-20,20,21 |
| 132 | EFFICIENT TEMPERATURE-PAST3-EFFICIENT TEMPERATURE-PAST3-20,21,20 |
| 133 | EFFICIENT TEMPERATURE-PAST3-EFFICIENT TEMPERATURE-PAST3-20,21,21 |
| 134 | EFFICIENT TEMPERATURE-PAST3-EFFICIENT TEMPERATURE-PAST3-21,20,20 |
| 135 | EFFICIENT TEMPERATURE-PAST3-EFFICIENT TEMPERATURE-PAST3-21,20,21 |
| 136 | EFFICIENT TEMPERATURE-PAST3-EFFICIENT TEMPERATURE-PAST3-21,21,20 |
| 137 | EFFICIENT TEMPERATURE-PAST3-EFFICIENT TEMPERATURE-PAST3-21,21,21 |

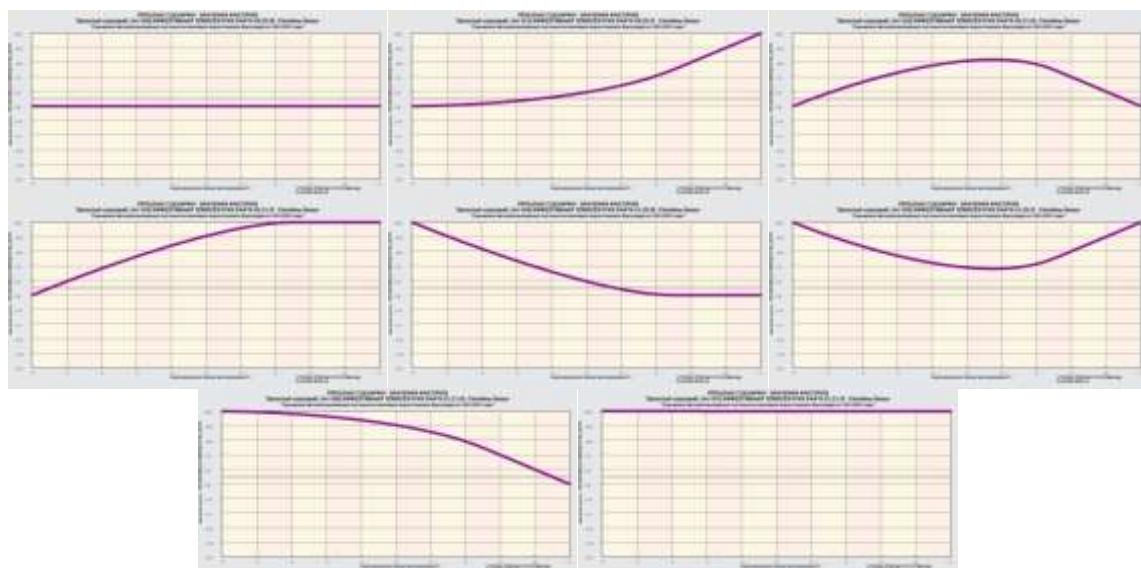
At risks 4 and 5, past and future scenarios for changing the values of climatic parameters found by API-2.3.2.2 in the initial data are shown (Table 3).



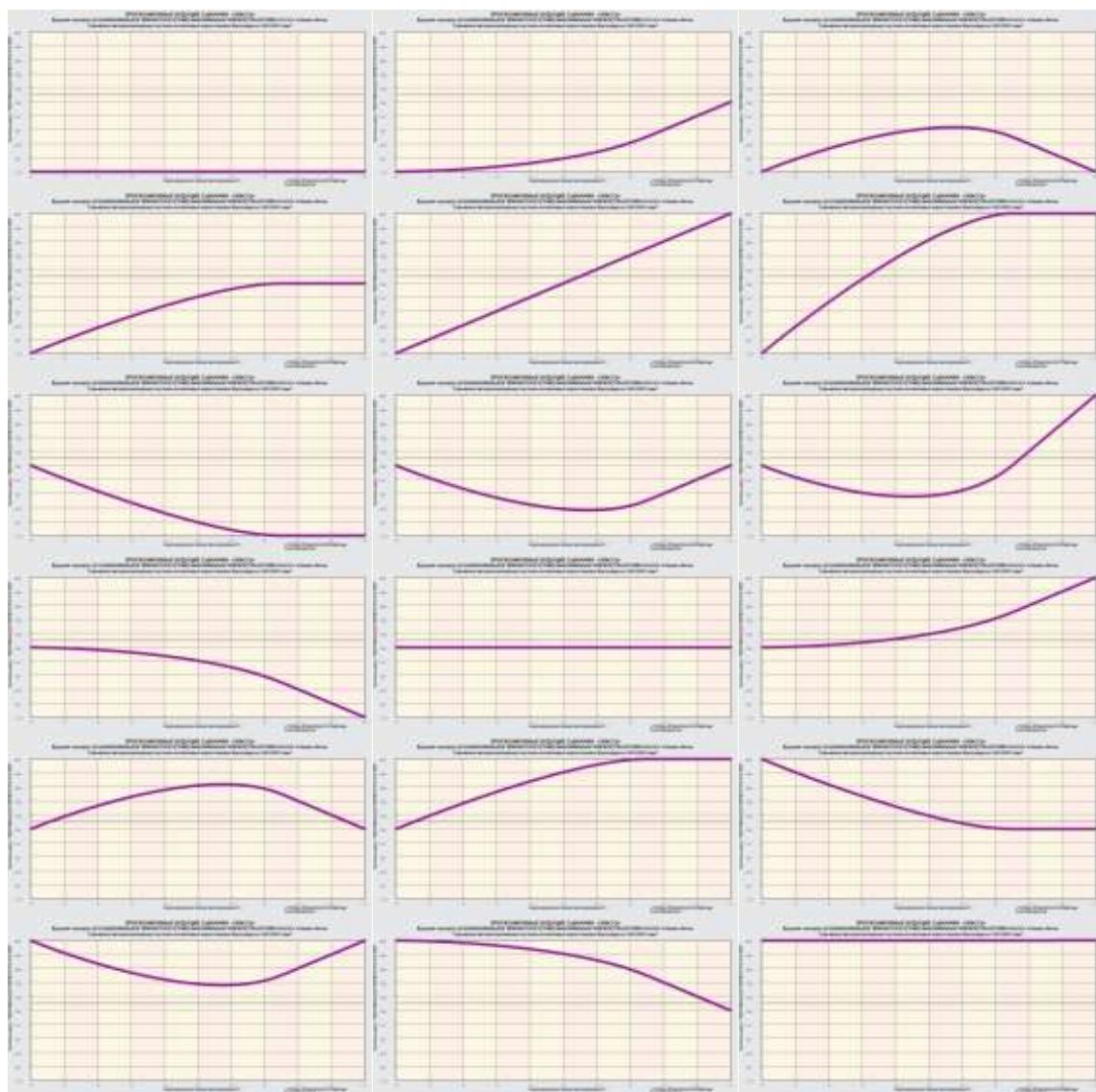


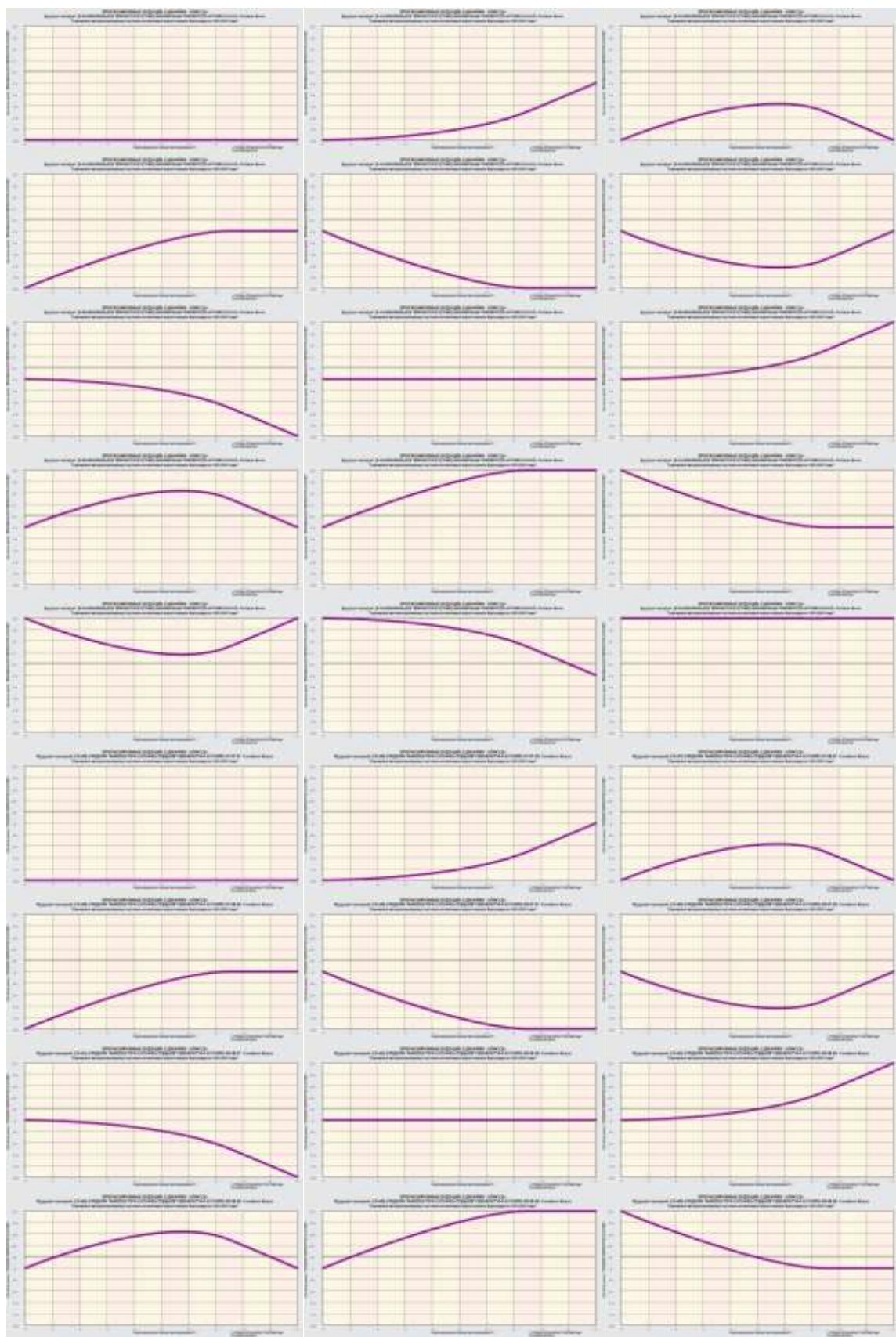


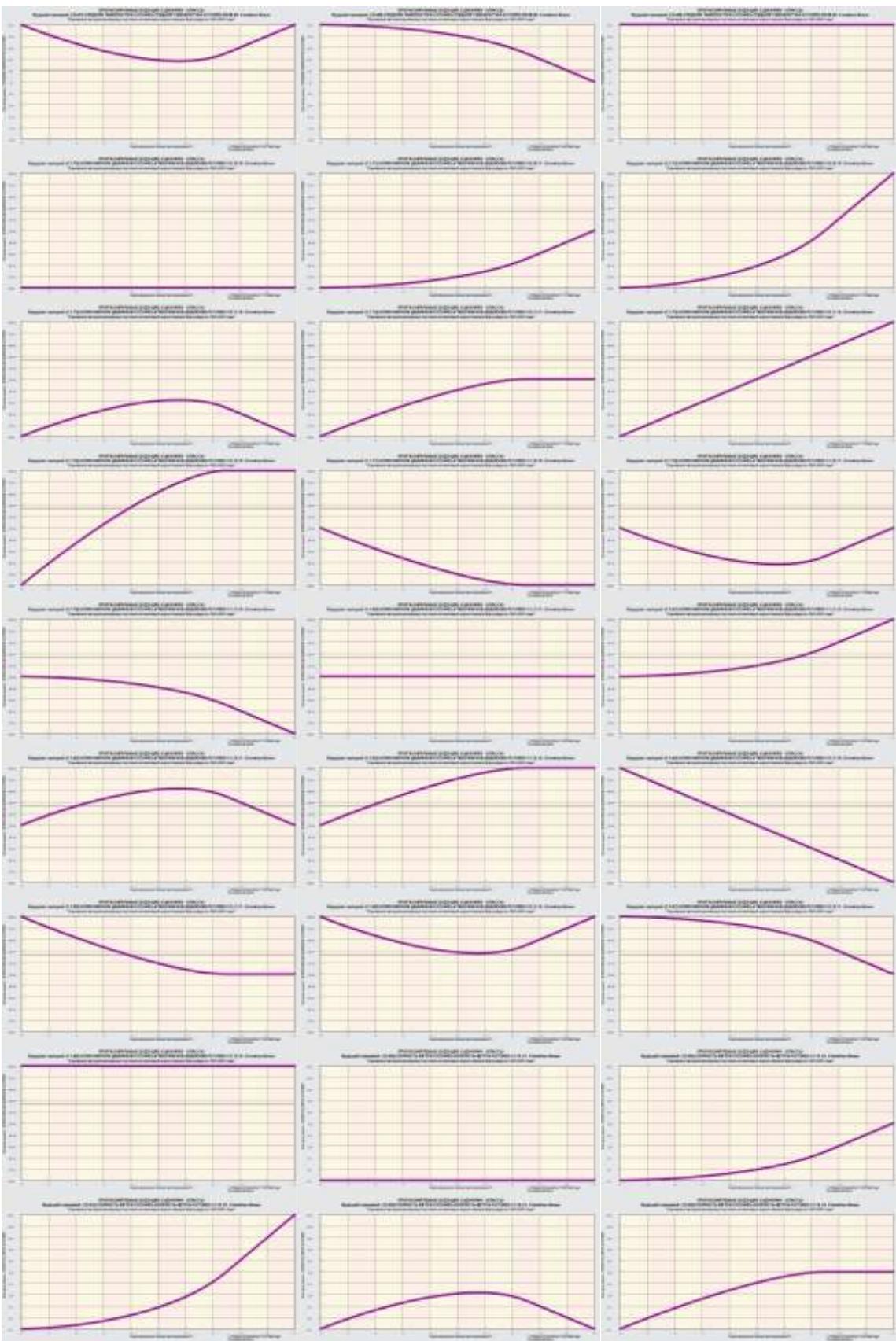


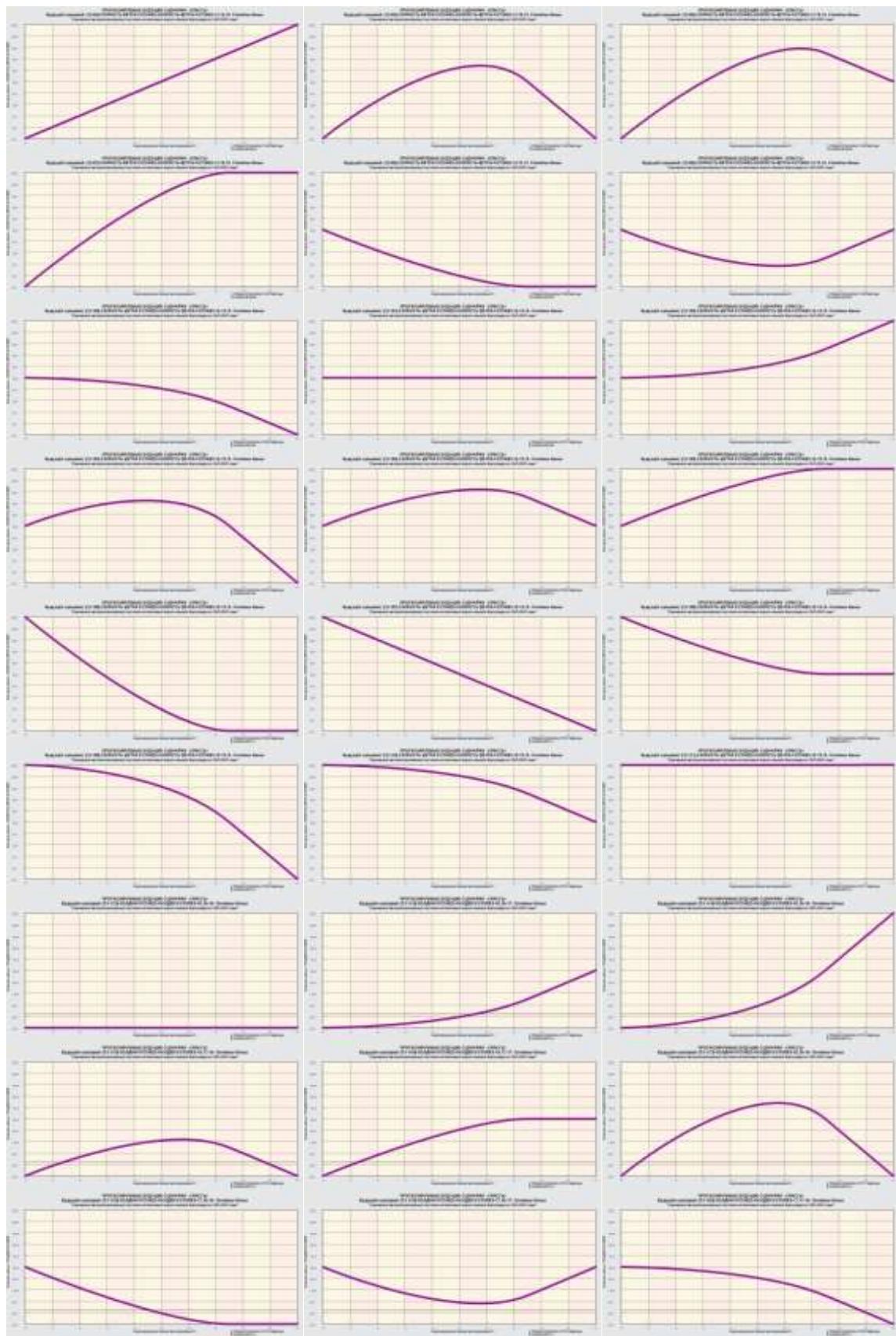


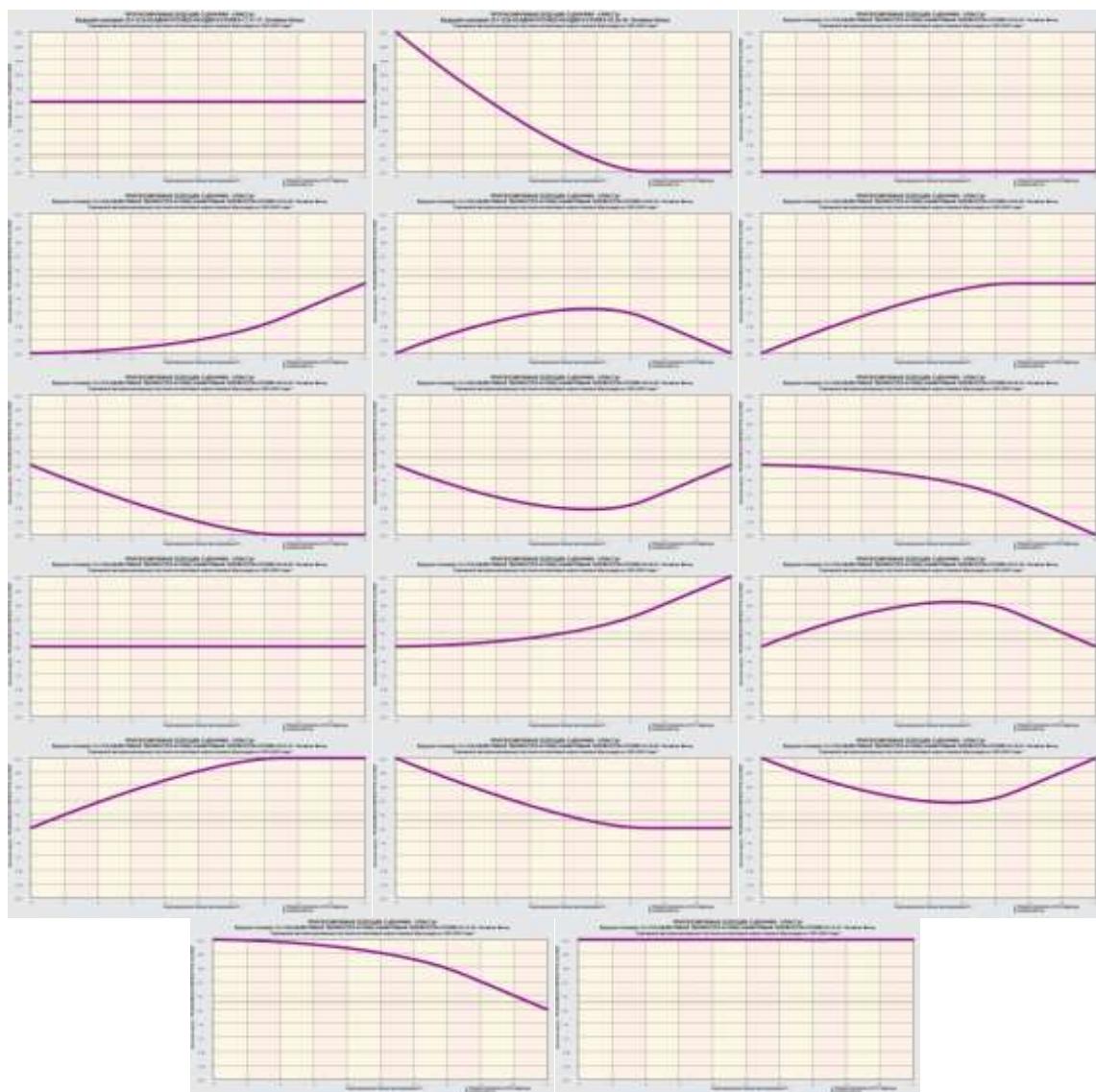
Picture5. Past scenarios of changing climate parameter values detected by API-2.3.2.2 in the raw data (Table 3)











Picture6. Future scenarios for changing climate parameter values detected by API-2.3.2.2 in the raw data (Table 3).

In the process of formalizing the subject area using API-2.3.2.2, the initial data (Table 3) were encoded using classification and descriptive scales and gradations (Tables 4 and 5), resulting in a training sample (Table 6), in fact, which is the initial data normalized with the help of these directories.

Figure 7 shows a screen form with a fragment of the training set:

2.3.1. Ручной ввод-корректировка обучающей выборки. Текущий модуль: "ИНФ".

| Код объекта | Начало наблюдения | Воз. | Время |
|-------------|-------------------|------|-------|
| 24825 | 22.12.2020 | | |
| 24826 | 23.12.2020 | | |
| 24827 | 24.12.2020 | | |
| 24828 | 25.12.2020 | | |
| 24829 | 26.12.2020 | | |
| 24830 | 27.12.2020 | | |
| 24831 | 28.12.2020 | | |
| 24832 | 29.12.2020 | | |
| 24833 | 30.12.2020 | | |
| 24834 | 31.12.2020 | | |

| Код объекта | Класс 1 | Класс 2 | Класс 3 | Класс 4 | Код объекта | Признак 1 | Признак 2 | Признак 3 | Признак 4 | Признак 5 | Признак 6 | Признак 7 |
|-------------|---------|---------|---------|---------|-------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| 24826 | 1 | 25 | 5 | 47 | 24826 | 1 | 24 | 5 | 47 | 8 | 62 | 0 |
| 24826 | 8 | 62 | 0 | 13 | 24826 | 12 | 89 | 0 | 20 | 130 | 0 | 0 |
| 24826 | 89 | 0 | 20 | 130 | | | | | | | | |

Picture7. Training sample (fragment)

The full training sample is not presented due to its very large volume (24826 daily observations over 88 years from 1933 to 2020).

3.3. Task-3. Synthesis of statistical and system-cognitive models. Multiparameter typing and partial knowledge criteria

Synthesis and verification of statistical and system-cognitive models (SC-models) of models is carried out in mode 3.5 of the Eidos system. Mathematical models, on the basis of which statistical and SC models are calculated, are described in detail in a number of monographs and articles by the author. Therefore, in this paper, we will consider these issues very briefly. We only note that the models of the "Eidos" system are based on the matrix of absolute frequencies, which reflects the number of meetings of gradations of descriptive scales by gradations of classification scales (facts). But to solve all the problems, this matrix itself is not used directly, but matrices of conditional and unconditional percentage distributions and system-cognitive models that are calculated on its basis and reflect how much information is contained in the fact of observing a certain gradation of the descriptive scale about

The mathematical model of ASC analysis and the Eidos system is based on systemic fuzzy interval mathematics [7, 14, 18, 50] and provides comparable processing of large volumes of fragmented and noisy interdependent data presented in various types of scales (nominal, ordinal and numerical) and different units of measurement.

The essence of the mathematical model of ASC-analysis is as follows.

Directly on the basis of empirical data (see Help mode 2.3.2.2) the matrix of absolute frequencies is calculated (Table 6).

table6– Absolute frequency matrix (ABS statistical model)

| | | Classes | | | | | Sum |
|--|-----------------------------------|------------|-----|--------------------------------------|-----|----------|---|
| | | <i>one</i> | ... | <i>j</i> | ... | <i>W</i> | |
| Factor values | <i>one</i> | N_{11} | | N_{1j} | | N_{1W} | |
| | ... | | | | | | |
| | <i>i</i> | N_{i1} | | N_{ij} | | N_{iW} | $N_{i\Sigma} = \sum_{j=1}^W N_{ij}$ |
| | ... | | | | | | |
| | <i>M</i> | N_{M1} | | N_{Mj} | | N_{MW} | |
| | Total number of features by class | | | $N_{\Sigma j} = \sum_{i=1}^M N_{ij}$ | | | $N_{\Sigma\Sigma} = \sum_{i=1}^W \sum_{j=1}^M N_{ij}$ |
| The total number of training sample objects by class | | | | $N_{\Sigma j}$ | | | $N_{\Sigma\Sigma} = \sum_{j=1}^W N_{\Sigma j}$ |

On its basis matrices of conditional and unconditional percentage distributions are calculated (Table 7).

table7 – Matrix of conditional and unconditional percentage distributions (statistical models PRC1 and PRC2)

| | | Classes | | | | | Unconditional Feature Probability |
|---------------|---------------------------------|------------|-----|--|-----|----------|--|
| | | <i>one</i> | ... | <i>j</i> | ... | <i>W</i> | |
| Factor values | <i>one</i> | P_{11} | | P_{1j} | | P_{1W} | |
| | ... | | | | | | |
| | <i>i</i> | P_{i1} | | $P_{ij} = \frac{N_{ij}}{N_{\Sigma j}}$ | | P_{iW} | $P_{i\Sigma} = \frac{N_{i\Sigma}}{N_{\Sigma\Sigma}}$ |
| | ... | | | | | | |
| | <i>M</i> | P_{M1} | | P_{Mj} | | P_{MW} | |
| | Unconditional class probability | | | $P_{\Sigma j}$ | | | |

It should be noted that in the ASC-analysis and its software tools, the intellectual system "Eidos" uses two methods for calculating the matrices of conditional and unconditional percentage distributions:

1st way: as $N_{\Sigma j}$ the total number of features by class is used;

2nd way: as $N_{\Sigma j}$ the total number of training sample objects by class is used.

In practice, there is often a significant imbalance in the data, which is understood as a very different number of objects in the training sample belonging to different classes. Therefore, it would be very unreasonable to solve the problem on the basis of the matrix of absolute frequencies directly (Table 6), and the transition from absolute frequencies to conditional and unconditional relative frequencies (frequencies) is very reasonable and logical.

This transition completely removes the problem of data imbalance, since in the subsequent analysis, not the matrix of absolute frequencies is used, but matrices of conditional and unconditional percentage distributions and matrices of system-cognitive models (SC-models, Table 9), in particular, the matrix of informativeness.

This approach also removes the problem of ensuring the comparability of processing in one model of the initial data presented in different types of scales (nominal, ordinal and numerical) and in different units of measurement [6].

In the Eidos system, all this is always carried out when solving any problems.

Then, on the basis of table 7, using particular criteria, the knowledge given in table 8, matrices of system-cognitive models are calculated (table 9).

Table 8 shows the formulas:

- to compare actual and theoretical absolute frequencies;
- to compare conditional and unconditional relative frequencies ("probabilities").

And this comparison in table 8 is carried out in two possible ways: by subtraction and by division.

When we compare the actual and theoretical absolute frequencies by subtraction, we get a private criterion of knowledge: "chi-square" (IC-model INF3), when we compare them by dividing, we get a private criterion: "the amount of information on A. Kharkevich" (SC-models INF1, INF2) or "return on investment ratio ROI" - Return On Investment (SC-models INF4, INF5), depending on the normalization method.

When we compare the conditional and unconditional relative frequencies by subtraction, we get a private criterion of knowledge: "relationship coefficient" (CK-models INF6, INF7), when we compare them by dividing, then we get a private criterion: "the amount of information on A .Kharkevich" (SC-models INF1, INF2).

table8– Various analytical forms of partial knowledge criteria used in ASC analysis and the Eidos system

| Name of the knowledge model and particular criterion | Expression for a particular criterion | |
|---|---------------------------------------|---|
| | through relative frequencies | through absolute frequencies |
| ABS , the matrix of absolute frequencies, N_{ij} - the actual number of occurrences of the i-th attribute in objects of the j-th class; \bar{N}_{ij} - the theoretical number of occurrences of the i-th feature in objects of the j-th class; N_i is the total number of features in the i-th line; N_j is the total number of features or objects of the training sample in the j-th class; N is the total number of features in the entire sample (Table 1) | | $N_i = \sum_{j=1}^W N_{ij}; N_j = \sum_{i=1}^M N_{ij}; N = \sum_{i=1}^W \sum_{j=1}^M N_{ij};$ $N_{ij} - \text{фактическая частота};$ $\bar{N}_{ij} = \frac{N_i N_j}{N} - \text{теоретическая частота}.$ |
| PRC1 , conditional matrix P_{ij} and unconditional P_i percentage distributions, N_j is the total number of features in the class | --- | $P_{ij} = \frac{N_{ij}}{N_j}; P_i = \frac{N_i}{N}$ |
| PRC2 , conditional matrix P_{ij} and unconditional P_i percentage distributions, N_j is the total number of training sample objects by class | | |
| INF1 , particular criterion: the amount of knowledge according to A. Kharkevich, the 1st option for calculating probabilities: N_j - the total number of features for the j-th class. The probability that if an object of the j-th class has a feature, then this is the i-th feature | | |
| INF2 , particular criterion: the amount of knowledge according to A. Kharkevich, the 2nd option for calculating probabilities: N_j is the total number of objects in the j-th class. The probability that if an object of the j-th class is presented, then the i-th attribute will be found in it. | | $I_{ij} = \Psi \times \log_2 \frac{P_{ij}}{P_i}$ |
| INF3 , partial criterion: Chi-square: differences between actual and theoretically expected absolute frequencies | --- | $I_{ij} = N_{ij} - \bar{N}_{ij} = N_{ij} - \frac{N_i N_j}{N}$ |
| INF4 , partial criterion: ROI - Return On Investment, 1st option for calculating probabilities: N_j - the total number of features for the j-th class | | $I_{ij} = \frac{P_{ij}}{P_i} - 1 = \frac{P_{ij} - P_i}{P_i}$ |
| INF5 , partial criterion: ROI - Return On Investment, 2nd option for calculating probabilities: N_j - the total number of objects in the j-th class | | $I_{ij} = \frac{N_{ij}}{\bar{N}_{ij}} - 1 = \frac{N_{ij} N}{N_i N_j} - 1$ |
| INF6 , particular criterion: difference between conditional and unconditional probabilities, 1st option for calculating probabilities: N_j – total number of features in the j-th class | | |
| INF7 , particular criterion: the difference between conditional and unconditional probabilities, 2nd option for calculating probabilities: N_j - the total number of objects in the j-th class | $I_{ij} = P_{ij} - P_i$ | $I_{ij} = \frac{N_{ij}}{N_j} - \frac{N_i}{N}$ |

Legend for table 3:*i*- value of the past parameter;*j*- value of the future parameter;*Nij*-the number of meetings of the *j*-th value of the future parameter with the *i*-th value of the past parameter;*M*is the total number of values of all past parameters;*W*- total number of values of all future parameters.*Ni*-the number of occurrences of the *i*-th value of the past parameter throughout the sample;*Nj*-the number of occurrences of the *j*-th value of the future parameter throughout the sample;*N*-the number of occurrences of the *j*-th value of the future parameter with the *i*-th value of the past parameter throughout the sample.*Iij*-private criterion of knowledge: the amount of knowledge in the fact of observing the *i*-th value of the past parameter that the object will go into a state corresponding to the *j*-th value of the future parameter; Ψ is a normalization coefficient (E.V. Lutsenko, 2002), which converts the amount of information in the A. Kharkevich formula into bits and ensures compliance with the principle of correspondence with the R. Hartley formula for it;*Pi*- unconditional relative frequency of meeting the *i*-th value of the past parameter in the training sample;*Pij*- conditional relative frequency of meeting the *i*-th value of the past parameter at the *j*-th value of the future parameter.

Thus, we see that all particular criteria of knowledge are closely interconnected with each other. Of particular interest is the connection between the famous Pearson's chi-square criterion with the remarkable measure of the amount of information by A. Kharkevich and with the well-known ROI coefficient in economics.

Probability is considered as the limit to which the relative frequency (the ratio of the number of favorable outcomes to the number of trials) tends with an unlimited increase in the number of trials. It is clear that probability is a mathematical abstraction that never occurs in practice (as well as other mathematical and physical abstractions, such as a mathematical point, a material point, an infinitesimal point, etc.). In practice, only relative frequency occurs. But it can be very close to the probability. For example, at 480 observations the difference between the relative frequency and probability (error) is about 5%, at 1250 observations it is about 2.5%, at 10000 observations it is 1%.

table9– Matrix of the system-cognitive model

| | | Classes | | | | | Significance of the factor |
|---------------|------------------------|---------------------|-----|---------------------|-----|---------------------|--|
| | | one | ... | <i>j</i> | ... | <i>W</i> | |
| Factor values | one | I_{11} | | I_{1j} | | I_{1W} | $\sigma_{1\Sigma} = \sqrt[2]{\frac{1}{W-1} \sum_{j=1}^W (I_{1j} - \bar{I}_1)^2}$ |
| | ... | | | | | | |
| | <i>i</i> | I_{i1} | | I_{ij} | | I_{iW} | $\sigma_{i\Sigma} = \sqrt[2]{\frac{1}{W-1} \sum_{j=1}^W (I_{ij} - \bar{I}_i)^2}$ |
| | ... | | | | | | |
| | <i>M</i> | I_{M1} | | I_{Mj} | | I_{MW} | $\sigma_{M\Sigma} = \sqrt[2]{\frac{1}{W-1} \sum_{j=1}^W (I_{Mj} - \bar{I}_M)^2}$ |
| | Class reduction degree | $\sigma_{\Sigma 1}$ | | $\sigma_{\Sigma j}$ | | $\sigma_{\Sigma W}$ | $H = \sqrt[2]{\frac{1}{(W \cdot M - 1)} \sum_{j=1}^W \sum_{i=1}^M (I_{ij} - \bar{I})^2}$ |

The essence of these methods is that the amount of information in the value of the factor is calculated that the modeling object will pass under its action to a certain state corresponding to the class. This allows comparable and correct processing of heterogeneous information about the observations of the simulation object, presented in different types of measuring scales and different units of measurement [6].

Based on the system-cognitive models presented in Table 9 (they differ in frequent criteria given in Table 8), the problems of identification (classification, recognition, diagnostics, forecasting), decision support (the inverse problem of forecasting), as well as the problem of studying the modeled subject matter are solved. area by studying its system-cognitive model [10-64].

Note that as the significance of the factor value, the degree of determinism of the class and the value or quality of the model in ASC analysis, the variability of the values of particular criteria of this factor value, class or model as a whole is considered (Table 10).

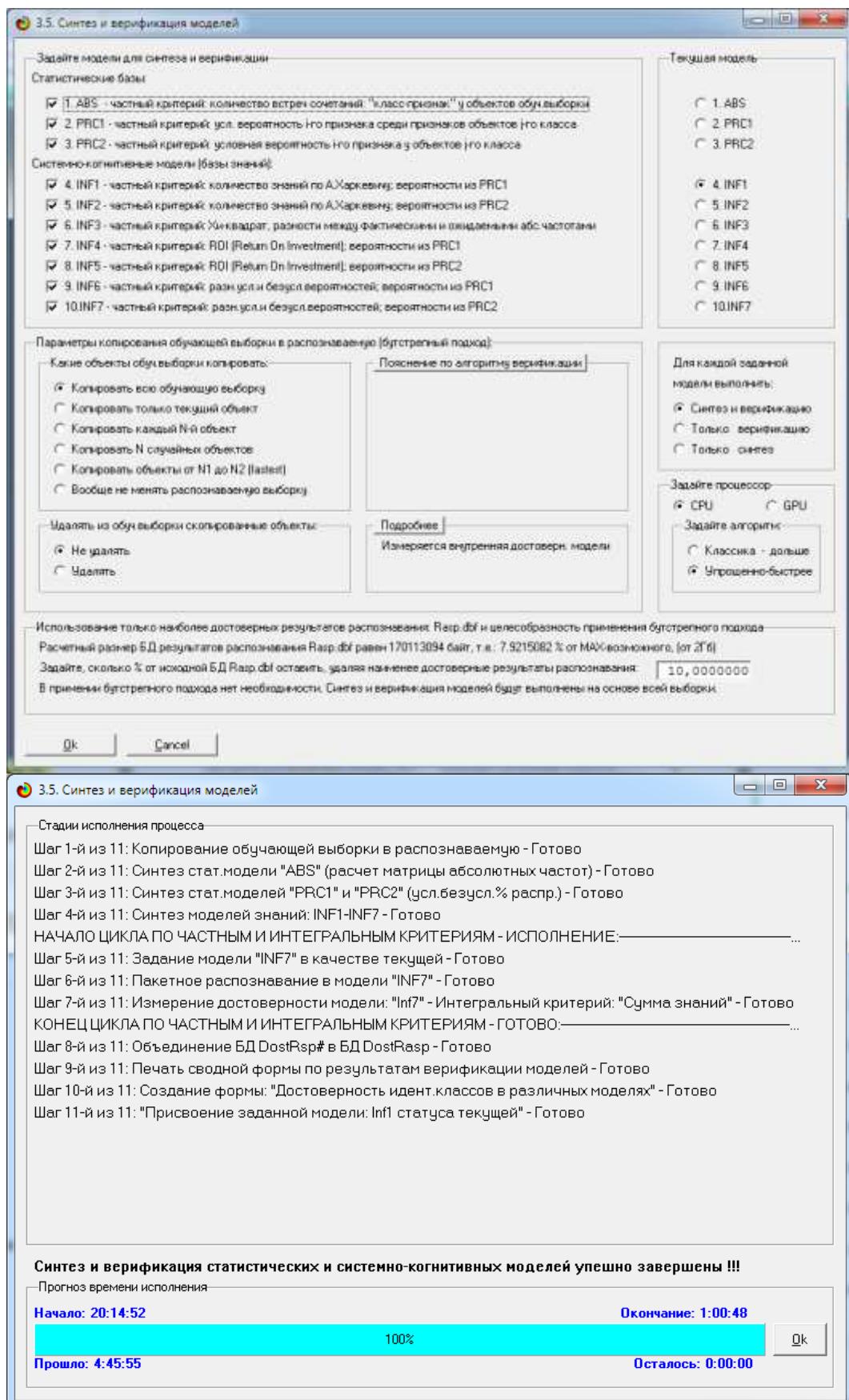
Numerically, this variability can be measured in different ways, for example, the average deviation of the modules of partial criteria from the mean, dispersion or standard deviation or its square. In the Eidos system, the latter option is adopted, because. this value coincides with the power of the signal, in particular, the power of information, and in the ASC analysis, all models are considered as a source of information about the modeling object.

Therefore, there is every reason to clarify the traditional terminology of ASC analysis (Table 10):

table10– Clarification of the terminology of ASC analysis

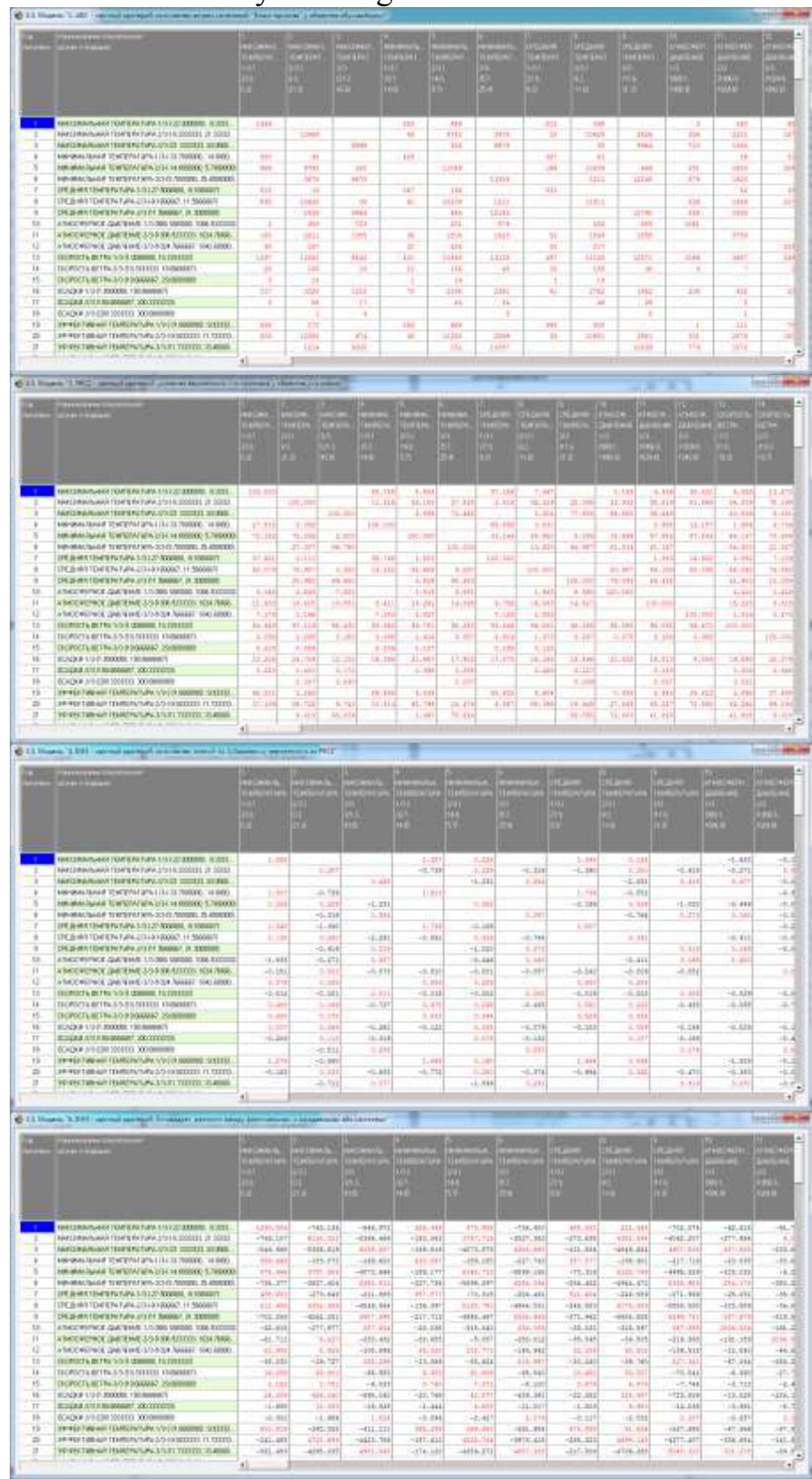
| No. | Traditional terms (synonyms) | New term | Formula |
|-----|--|---|--|
| one | 1. Significance of the value of the factor (attribute). 2. Differentiating power of the value of the factor (attribute). 3. The value of the factor (attribute) value for solving the problem of identification and other problems | The root of the information power of the factor value | $\sigma_{i\Sigma} = \sqrt[2]{\frac{1}{W-1} \sum_{j=1}^W (I_{ij} - \bar{I}_i)^2}$ |
| 2 | 1. The degree of determinism of the class. 2. The degree of conditionality of the class. | Root of class information power | $\sigma_{\Sigma j} = \sqrt[2]{\frac{1}{M-1} \sum_{i=1}^M (I_{ij} - \bar{I}_j)^2}$ |
| 3 | 1. The quality of the model. 2. The value of the model. 3. The degree of formation of the model. 4. Quantitative measure of the degree of severity of regularities in the modeled subject area | The root of the information power of the model | $H = \sqrt[2]{\frac{1}{(W \cdot M - 1)} \sum_{j=1}^W \sum_{i=1}^M (I_{ij} - \bar{I})^2}$ |

All the above calculations are carried out in mode 3.5 of the Eidos system. The screen forms of this mode with the parameters actually used in this work are shown in Figures 8:



Picture8. Screen forms of mode 3.5 of the Eidos system, in which the synthesis and verification of 3 statistical and 7 system-cognitive models

Figure 9 shows screen forms of mode 5.5. "Eidos" systems, which display fragments of statistical and system-cognitive models created in the 3.5 mode:



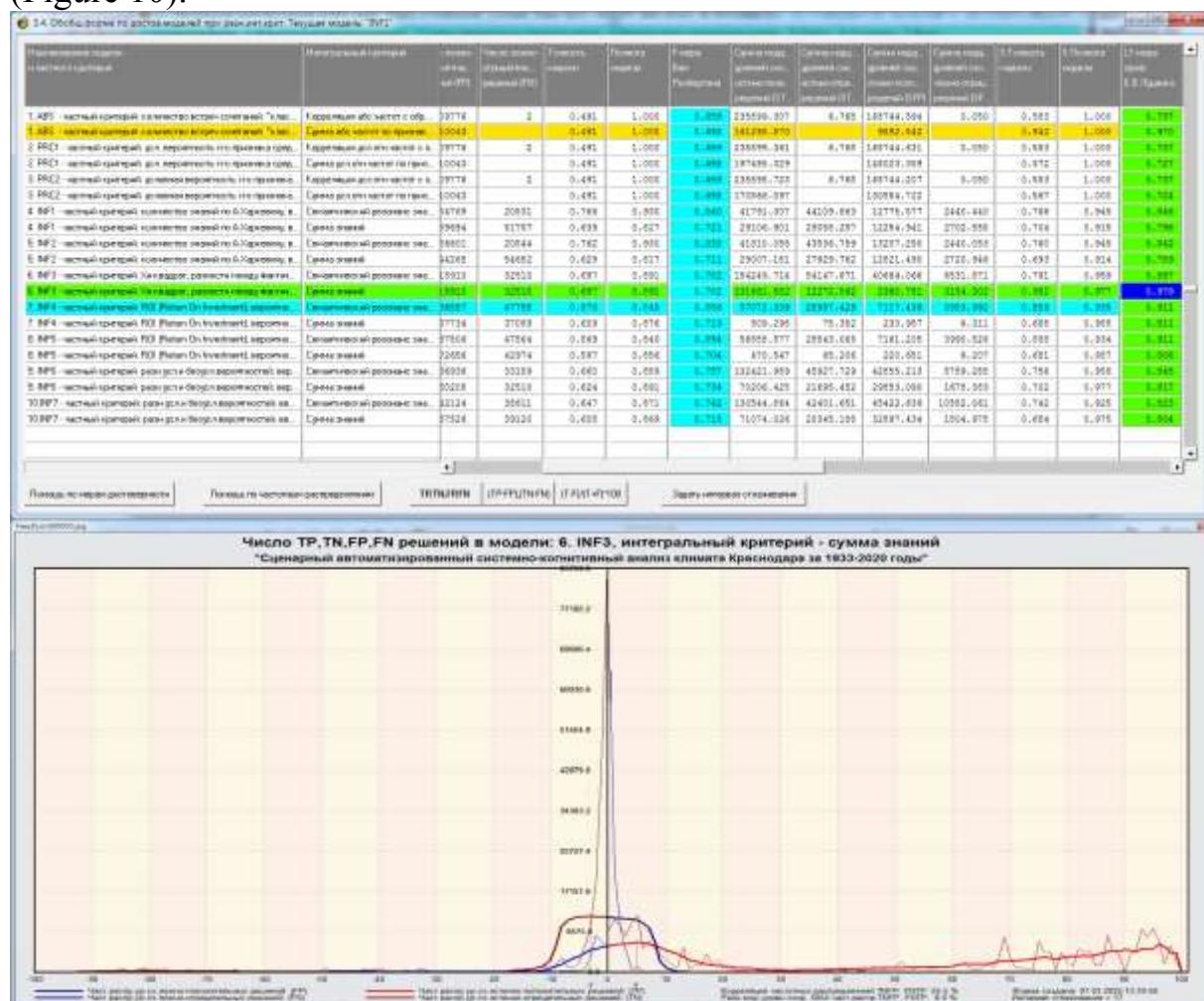
Picture9. Screen forms of mode 5.5 of the Eidos system, with fragments of statistical system-cognitive models created in mode 3.5

3.4. Task-4. Model Verification

The assessment of the reliability of models in the "Eidos" system is carried out by solving the problem of classifying objects of the training sample according to generalized images of classes and counting the number of true and false positive and negative solutions by Van Riesbergen's F-measure, as well as by the criteria of L1-L2-measures of prof. E.V. Lutsenko, which are proposed in order to mitigate or completely overcome some of the shortcomings of the F-measure [8].

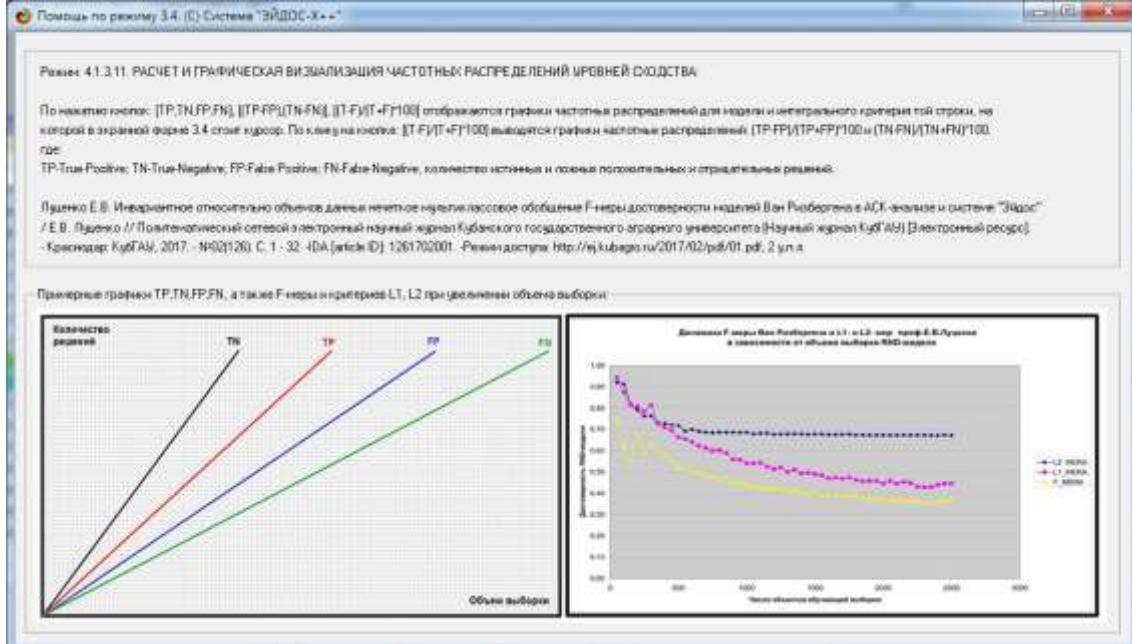
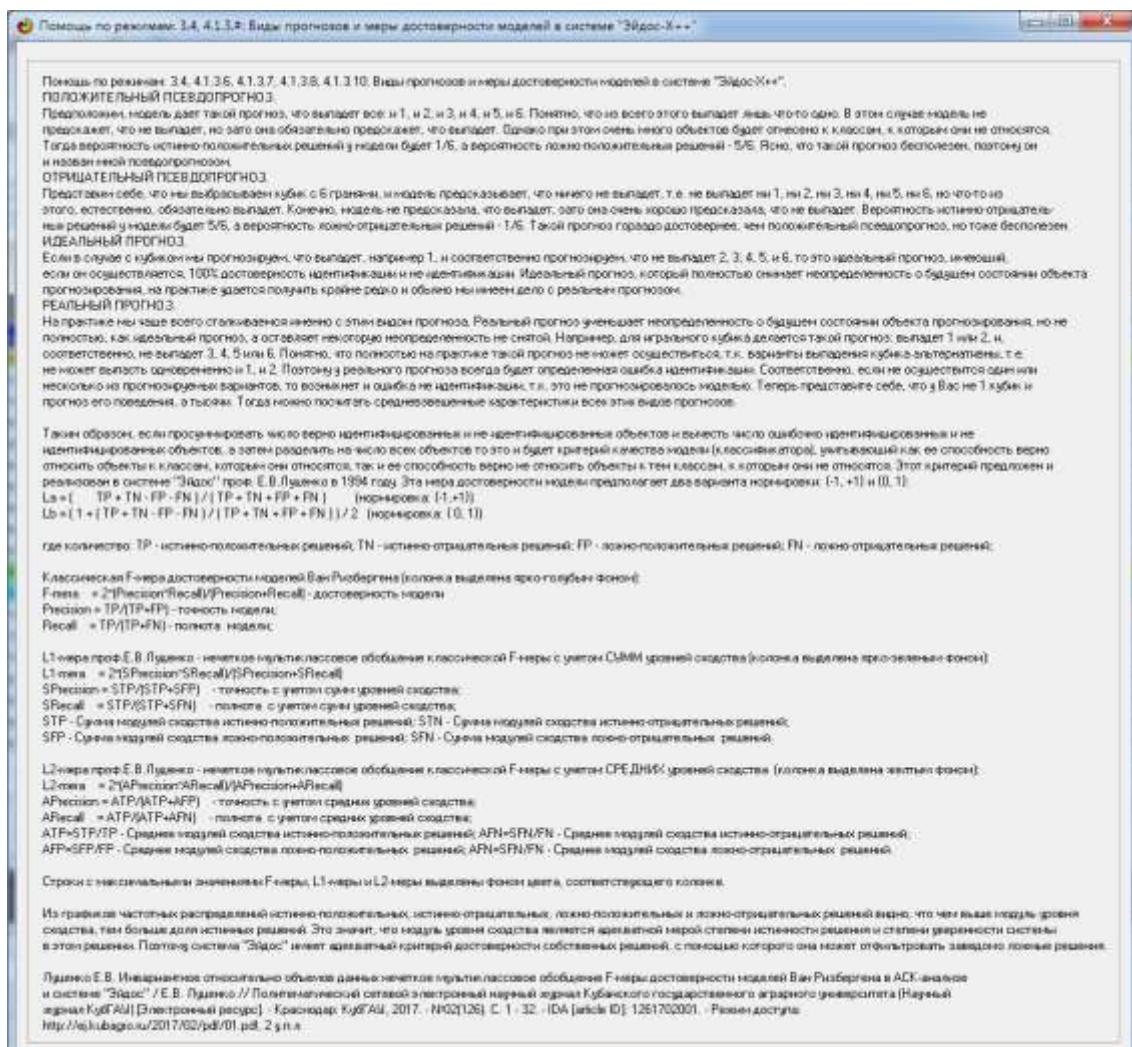
The reliability of models can also be assessed by solving other problems, such as forecasting problems, developing control decisions, studying the modeling object by studying its model. But it is more laborious and even always possible, especially on economic and political models.

In mode 3.4 of the Eidos system and a number of others, the reliability of each particular model is studied in accordance with these reliability measures (Figure 10).



Picture10. Screen forms of mode 3.4 of the Eidos system, with information on the results of assessing the reliability of statistical and system-cognitive models created in mode 3.5

Figures 11 show screen forms with help modes 3.4:



Picture11. Screen forms Helps of mode 3.4 of the Eidos system,

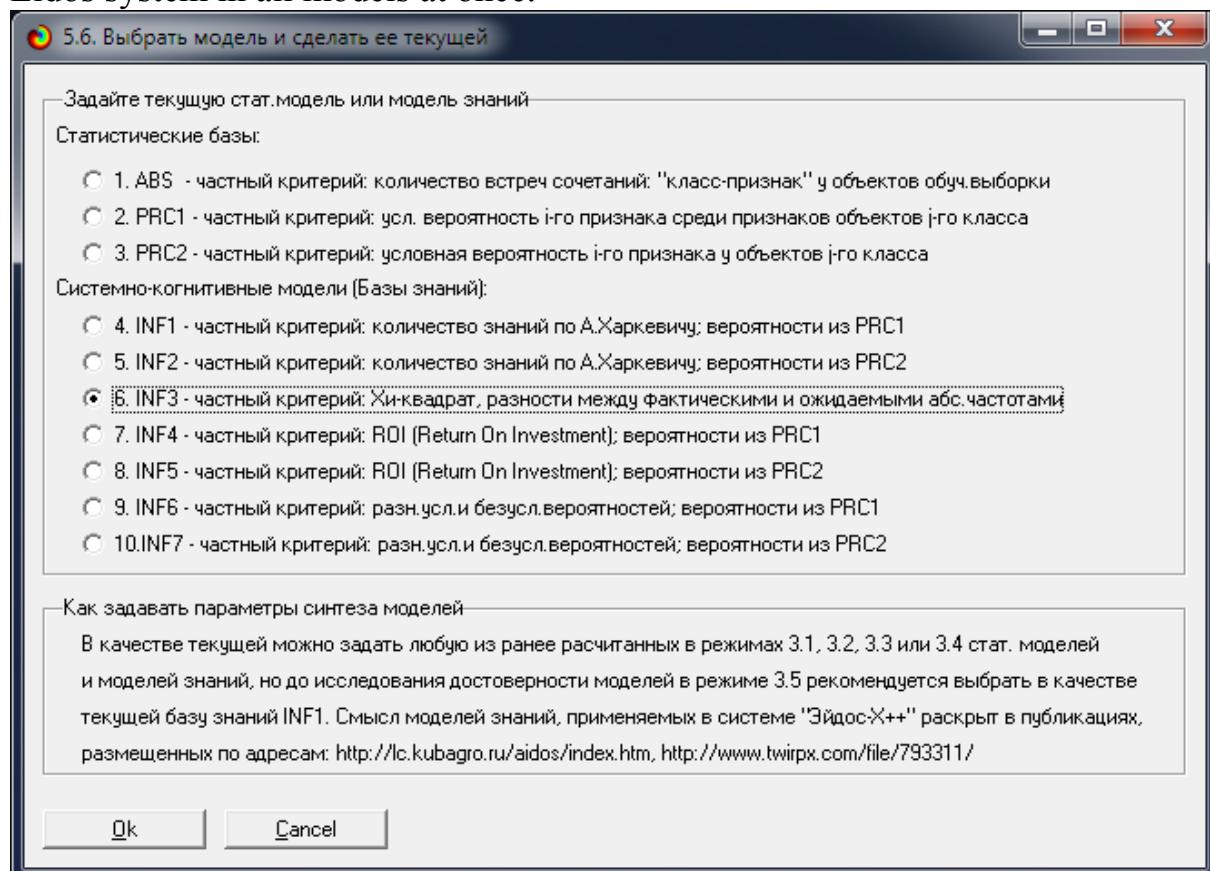
3.5. Task-5. Choosing the Most Reliable Model

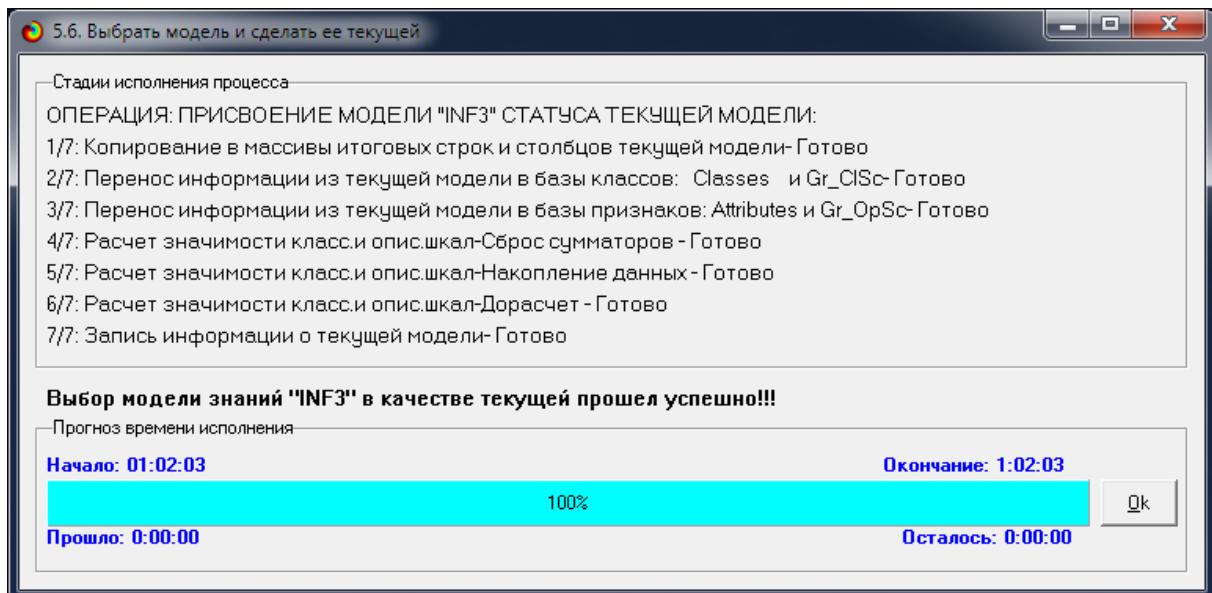
All subsequent tasks are solved in the most reliable model.

The reasons for this are simple. If the model is valid, then:

- identification of an object with a class is reliable, i.e. the model refers objects to the classes to which they actually belong;
- forecasting is reliable, i.e. those events that are predicted actually occur;
- making decisions adequately (reliably), i.e. after the implementation of the adopted control decisions, the control object actually passes into the target future states;
- the study is reliable, i.e. the conclusions obtained as a result of the study of the model of the object of simulation can be rightly attributed to the object of simulation.

Technically, the selection of the most reliable model is carried out in mode 5.6 of the Eidos system and is fast (Figure 12). This is necessary only for solving the problem of identification and prediction (in mode 4.1.2), which requires the most computational resources and therefore is solved only for the model specified by the current one. All other calculations are carried out in the Eidos system in all models at once.





**Picture12. Screen forms of mode 5.6 of the Eidos system:
Setting the current model**

3.6. Task-6. System identification and forecasting

When solving the identification problem, each object of the recognizable sample is compared in all its features with each of the generalized class images. The meaning of solving the identification problem lies in the fact that when determining whether a particular object belongs to a generalized image of a class, everything that is known about objects of this class becomes known by analogy, at least the most essential about them, i.e. how they differ from objects of other classes.

The tasks of identification and forecasting are interrelated and differ little from each other. The main difference between them is that when identifying the property values and the object belonging to the class refer to the same moment in time, and when predicting the values of the factors refer to the past, and the transition of the object under the influence of these factors to the state corresponding to the class refers to the future (Figure 3).).

The problem is solved in the model set as the current one, because is very computationally intensive. True, with the use of a graphics processor (GPU) for calculations, this problem has practically disappeared.

Comparison is carried out by applying non-metric integral criteria, of which two are currently used in the Eidos system. These integral criteria are interesting because they are correct⁹ in non-orthonormal spaces, which are always encountered in practice and are noise suppression filters.

3.6.1. Integral criterion "Amount of knowledge"

Integral criterion "Amount of knowledge" represents the total amount of knowledge contained in the system of factors of various nature, characterizing

⁹In contrast to the Euclidean distance, which is used for such purposes most often

the control object itself, control factors and the environment, about the transition of the object to future target or undesirable states.

The integral criterion is an additive function of the particular knowledge criteria presented in the help mode 5.5:

$$I_j = (\vec{I}_{ij}, \vec{L}_i).$$

In the expression, parentheses denote the scalar product. In coordinate form, this expression looks like:

$$I_j = \sum_{i=1}^M I_{ij} L_i,$$

where: M is the number of gradations of descriptive scales (features);

$\vec{I}_{ij} = \{I_{ij}\}$ is the state vector of the jth class;

$\vec{L}_i = \{L_i\}$ is the state vector of the recognizable object, which includes all types of factors that characterize the object itself, control actions and the environment (locator array), i.e.:

$$\vec{L}_i = \begin{cases} 1, & \text{если } i - \text{ий фактор действует;} \\ n, & \text{где: } n > 0, \text{ если } i - \text{ий фактор действует с истинностью } n; \\ 0, & \text{если } i - \text{ий фактор не действует.} \end{cases}$$

In the current version of the Eidos-X++ system, the values of the coordinates of the state vector of the recognized object were taken equal to either 0 if there is no sign, or n, if it is present in the object with intensity n, i.e. presented n times (for example, the letter "o" in the word "milk" is presented 3 times, and the letter "m" - once).

3.6.2. Integral criterion "Semantic resonance of knowledge"

Integral criterion "Semantic resonance of knowledge" represents a normalized total amount of knowledge contained in a system of factors of various nature, characterizing the control object itself, control factors and the environment, about the transition of the object to future target or undesirable states.

The integral criterion is an additive function of partial knowledge criteria presented in help mode 3.3 and has the form:

$$I_j = \frac{1}{\sigma_j \sigma_l M} \sum_{i=1}^M (I_{ij} - \bar{I}_j)(L_i - \bar{L}),$$

where:

M -the number of gradations of descriptive scales (features); \bar{I}_j - average informativeness by class vector; \bar{L} -average over the object vector;

σ_j -standard deviation of particular criteria of knowledge of the class vector; σ_l -root-mean-square deviation along the vector of the recognized object.

$\vec{I}_j = \{I_{ij}\}$ is the state vector of the jth class; $\vec{L}_i = \{L_i\}$ is the state vector of the recognizable object (state or phenomenon), which includes all types of factors that characterize the object itself, control actions and the environment (locator array), i.e.:

$$\vec{L}_i = \begin{cases} 1, & \text{если } i - \text{ий фактор действует;} \\ n, & \text{где: } n > 0, \text{ если } i - \text{ий фактор действует с истинностью } n; \\ 0, & \text{если } i - \text{ий фактор не действует.} \end{cases}$$

In the current version of the Eidos-X++ system, the values of the coordinates of the state vector of the recognized object were taken equal to either 0 if there is no sign, or n, if it is present in the object with intensity n, i.e. presented n times (for example, the letter "o" in the word "milk" is presented 3 times, and the letter "m" - once).

The above expression for the integral criterion "Semantic resonance of knowledge" is obtained directly from the expression for the criterion "Amount of knowledge" after replacing the coordinates of the multiplied vectors with their standardized values: $I_{ij} \rightarrow \frac{I_{ij} - \bar{I}_j}{\sigma_j}$, $L_i \rightarrow \frac{L_i - \bar{L}}{\sigma_l}$. Therefore, in its essence, it is also the scalar product of two standardized (unit) vectors of a class and an object. There are many other ways to normalize, for example, by applying splines, in particular linear interpolation: $I_{ij} \rightarrow \frac{I_{ij} - I_j^{\min}}{I_j^{\max} - I_j^{\min}}$, $L_i \rightarrow \frac{L_i - L^{\min}}{L^{\max} - L^{\min}}$. This allows us to propose other types of integral criteria. But they are not currently implemented in the Eidos system.

3.6.3. Important Mathematical Properties of Integral Criteria

These integral criteria have very interesting mathematical properties that provide it with important advantages:

Firstly, the integral criterion has a non-metric nature, i.e. it is a measure of the similarity of the class and object vectors, but not the distance between them, but the cosine of the angle between them, i.e. this is the inter-vector or informational distance. Therefore, its application is correct in non-orthonormal spaces, which, as a rule, are encountered in practice and in which the application of the Euclidean distance (Pythagorean theorem) is incorrect.

Secondly, this integral criterion is a filter that suppresses white noise, which is always present in empirical initial data and in models created on their basis. This property of suppressing white noise is manifested in this criterion the brighter, the more gradations of descriptive scales in the model.

Thirdly, the integral criterion of similarity is a quantitative measure of the similarity/difference of a particular object with a generalized image of a class and has the same meaning as the membership function of an element in a set in the fuzzy logic of Lotfi Zadeh. However, in fuzzy logic, this function is set a priori by the researcher by choosing from several possible options, and in ASC analysis and its software tools - the Eidos intellectual system, it is calculated in accordance with a well-founded mathematical model directly based on empirical data.

Fourth, in addition, the value of the integral criterion of similarity is an adequate self-assessment of the degree of confidence of the system in a positive or negative decision about the belonging / non-membership of an object to a class or the risk of error in such a decision.

Fifth, in fact, during recognition, the coefficients I_{ij} of the expansion of the function of the object L_i in a series of functions of the classes I_{ij} are calculated, i.e. the weight of each generalized class image in the object image is determined, which is described in more detail in monographs [46, 50].

3.6.4. Output forms of the Eidos system based on the results of numerical calculations

Figure 13 shows the screen forms of the identification and forecasting mode 4.1.2 of the Eidos system:

4.1.2. Пакетное распознавание в текущей модели

На каком процессоре выполнять распознавание:

На центральном процессоре (CPU)
 На графическом процессоре (GPU)

Задайте алгоритм идентификации:

Классический, работает дольше
 Упрощенный, работает быстрее

Модель для распознавания задается в режиме 5.6

Ok **Cancel**

4.1.2. Пакетное распознавание. Текущая модель: "INF3".

Стадии выполнения процесса:

ОПЕРАЦИЯ ПАКЕТНОЕ РАСПОЗНАВАНИЕ В ТЕКУЩЕЙ МОДЕЛИ "INF3":

1/11: CPU-распознавание объектов распознаваемой выборки: 100.000000%-Готово
 2/11: Расчет распределений уровней сходства верно и ошиб. идент.объектов: 100.000000%-Готово
 3/11: Создание скатых полных форм результатов распознавания по двум интегр. крит.: 100.000000%-Готово
 4/11: Создание подр.нагл.формы: "Объект-классы". Инт.крит.-корреляция: 100.000000%-Готово
 5/11: Создание итоговой наглядной формы: "Объект-классы". Инт.крит.-сумма инф.: 100.000000%-Готово
 6/11: Создание итоговой наглядной формы: "Объект-класс". Инт.крит.-корреляция: 100.000000%-Готово
 7/11: Создание итоговой наглядной формы: "Объект-класс". Инт.крит.-сумма инф.: 100.000000%-Готово
 8/11: Создание подробной наглядной формы: "Класс-объекты". Инт.крит.-корреляция: 100.000000%-Готово
 9/11: Создание подробной наглядной формы: "Класс-объекты". Инт.крит.-сумма инф.: 100.000000%-Готово
 10/11: Создание итоговой наглядной формы: "Класс-объекты". Инт.крит.-корреляция: 100.000000%-Готово
 11/11: Создание итоговой наглядной формы: "Класс-объекты". Инт.крит.-сумма инф.: 100.000000%-Готово

ПАКЕТНОЕ РАСПОЗНАВАНИЕ ОБЪЕКТОВ РАСПОЗНАВАЕМОЙ ВЫБОРКИ ЗАВЕРШЕНО УСПЕШНО!

Прогноз времени исполнения:

| | |
|-------------------|---------------------|
| Начало: 14:08:06 | Окончание: 14:36:52 |
| Продолж.: 0:28:46 | Оставш.: 0:00:00 |

4.1.3. Вывод результатов распознавания

- 4.1.3.1. Подробно наглядно: "Объект - классы"
- 4.1.3.2. Подробно наглядно: "Класс - объекты"
- 4.1.3.3. Итоги наглядно: "Объект - класс"
- 4.1.3.4. Итоги наглядно: "Класс - объект"
- 4.1.3.5. Подробно скжато: "Объекты - классы"

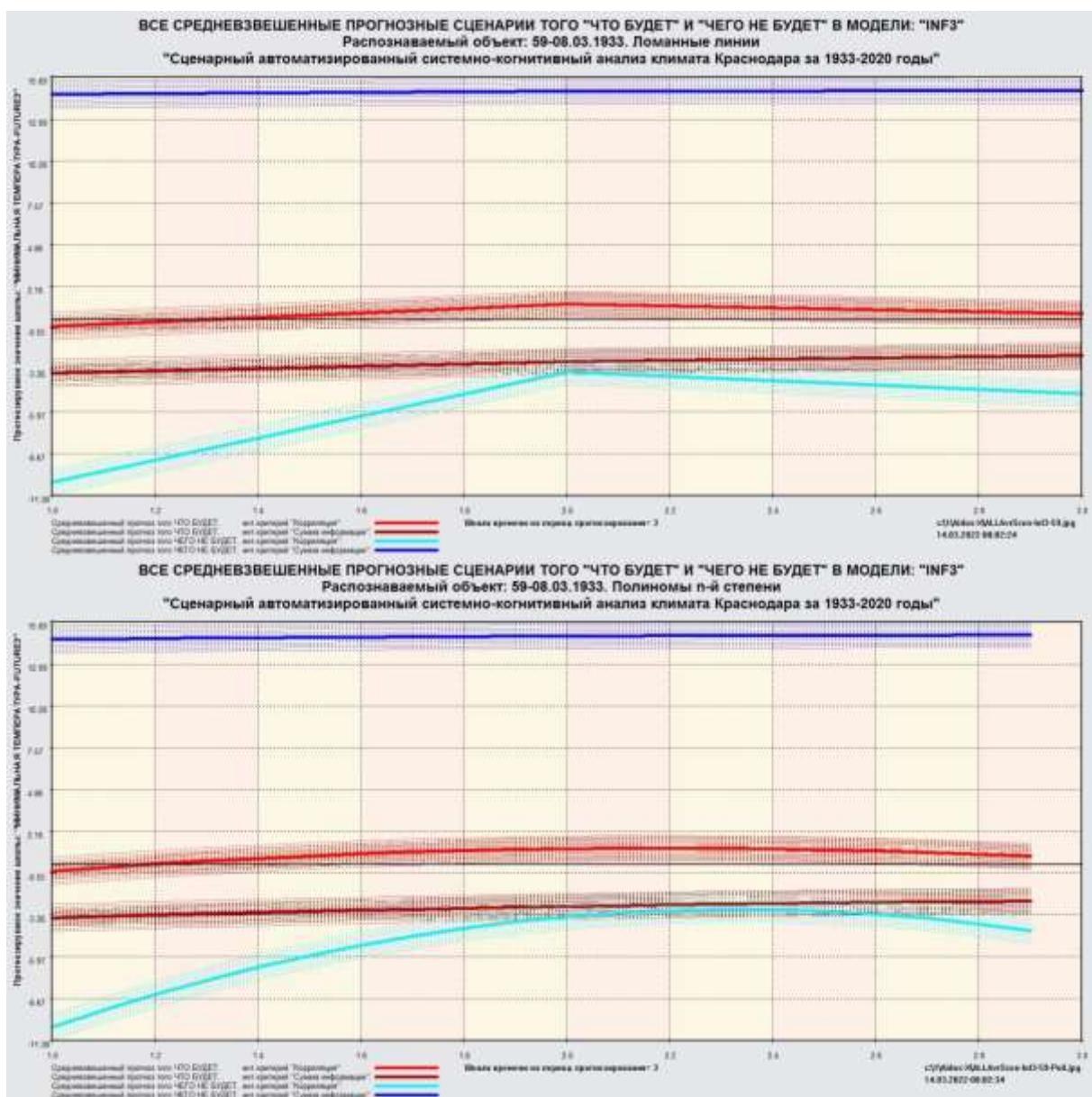
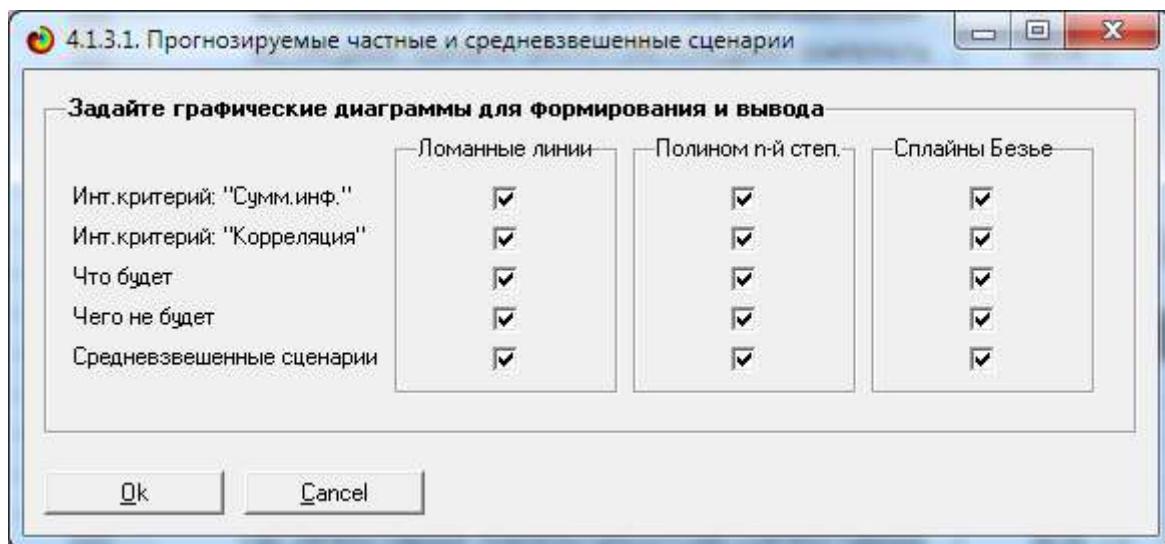
- 4.1.3.6. Обобщ.форма по достов.моделей при разных интегральных крит.
- 4.1.3.7. Обобщ.стат.анализ результатов идент. по моделям и инт.крит.
- 4.1.3.8. Стат.анализ результ. идент. по классам, моделям и инт.крит.
- 4.1.3.9. Достоверность идент.объектов при разных моделях и инт.крит.
- 4.1.3.10. Достоверность идент.классов при разных моделях и инт.крит.
- 4.1.3.11. Объединение в одной БД строк по самым достоверным моделям

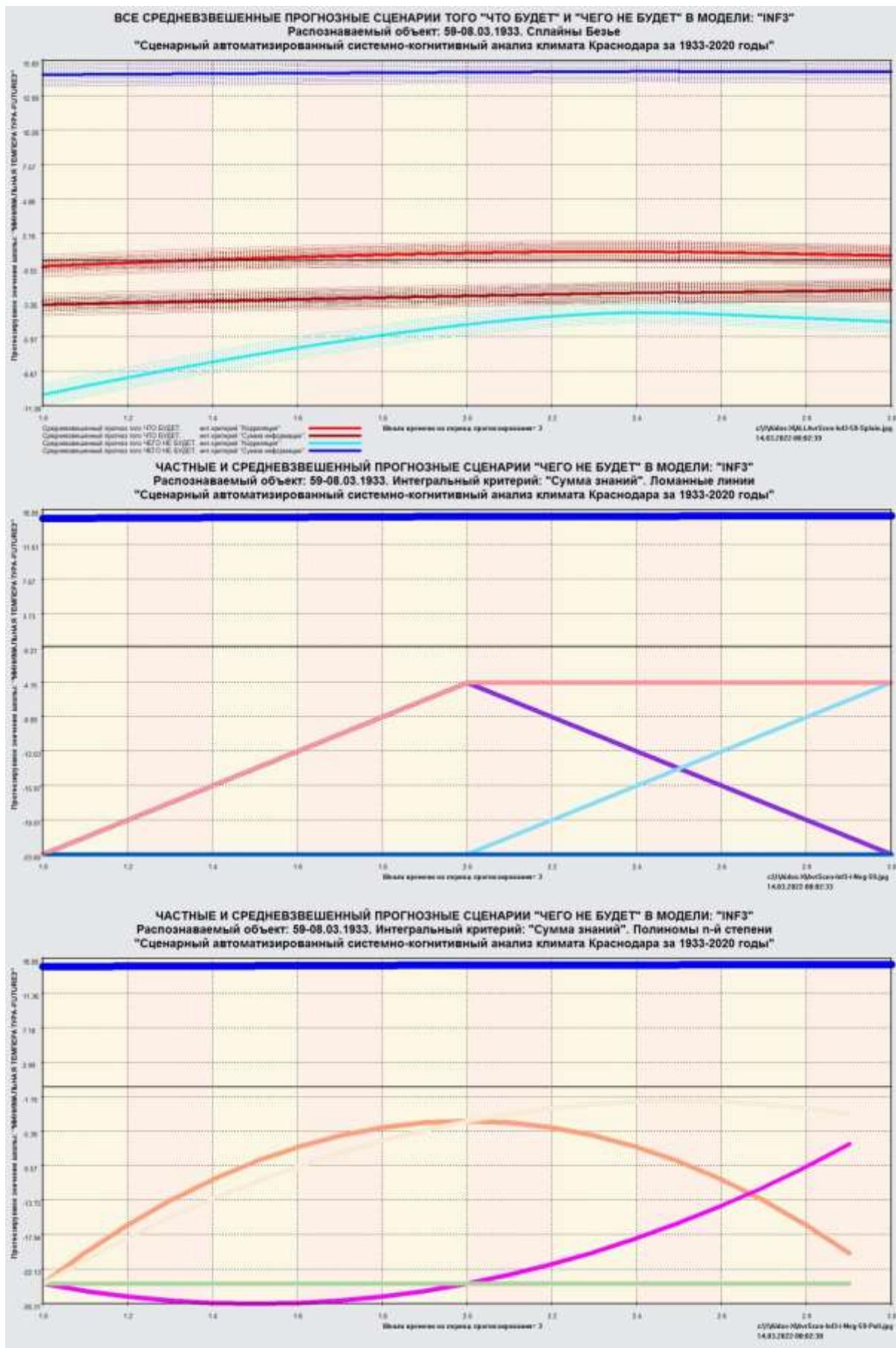
| Интегральный критерий сходства: "Семантический резонанс знаний" | | | | | | |
|---|---|----------|----|---|--|--|
| Код | Наименование класса | Сходство | Ф. | Сходство | | |
| 11... | МАКСИМАЛЬНАЯ ТЕМПЕРАТУРА-FUTURE3-МАКСИМАЛЬНА... | 46,39... | ✓ | <div style="width: 100%;"><div style="width: 100%; background-color: #ff0000; height: 10px;"></div></div> | | |
| 11... | МИНИМАЛЬНАЯ ТЕМПЕРАТУРА-3/3-{5,7, 25,4} | 46,06... | ✓ | <div style="width: 100%;"><div style="width: 100%; background-color: #ff0000; height: 10px;"></div></div> | | |
| 11... | МАКСИМАЛЬНАЯ ТЕМПЕРАТУРА-3/3-{21,3, 43,0} | 45,45... | ✓ | <div style="width: 100%;"><div style="width: 100%; background-color: #ff0000; height: 10px;"></div></div> | | |
| 11... | МАКСИМАЛЬНАЯ ТЕМПЕРАТУРА-FUTURE3-МАКСИМАЛЬНА... | 45,21... | ✓ | <div style="width: 100%;"><div style="width: 100%; background-color: #ff0000; height: 10px;"></div></div> | | |
| 11... | СРЕДНЯЯ ТЕМПЕРАТУРА-3/3-{11,6, 31,3} | 45,14... | ✓ | <div style="width: 100%;"><div style="width: 100%; background-color: #ff0000; height: 10px;"></div></div> | | |
| 11... | СРЕДНЯЯ ТЕМПЕРАТУРА-FUTURE3-СРЕДНЯЯ ТЕМПЕРАТУ... | 44,84... | ✓ | <div style="width: 100%;"><div style="width: 100%; background-color: #ff0000; height: 10px;"></div></div> | | |
| 11... | МИНИМАЛЬНАЯ ТЕМПЕРАТУРА-FUTURE3-МИНИМАЛЬНАЯ ... | 44,60... | ✓ | <div style="width: 100%;"><div style="width: 100%; background-color: #ff0000; height: 10px;"></div></div> | | |
| 11... | СКОРОСТЬ ВЕТРА-FUTURE3-СКОРОСТЬ ВЕТРА-FUTURE3-13... | 44,48... | ✓ | <div style="width: 100%;"><div style="width: 100%; background-color: #ff0000; height: 10px;"></div></div> | | |
| 11... | МАКСИМАЛЬНАЯ ТЕМПЕРАТУРА-FUTURE3-МАКСИМАЛЬНА... | 44,15... | ✓ | <div style="width: 100%;"><div style="width: 100%; background-color: #ff0000; height: 10px;"></div></div> | | |
| 11... | СКОРОСТЬ ВЕТРА-1/3-{1,0, 10,3} | 43,43... | ✓ | <div style="width: 100%;"><div style="width: 100%; background-color: #ff0000; height: 10px;"></div></div> | | |

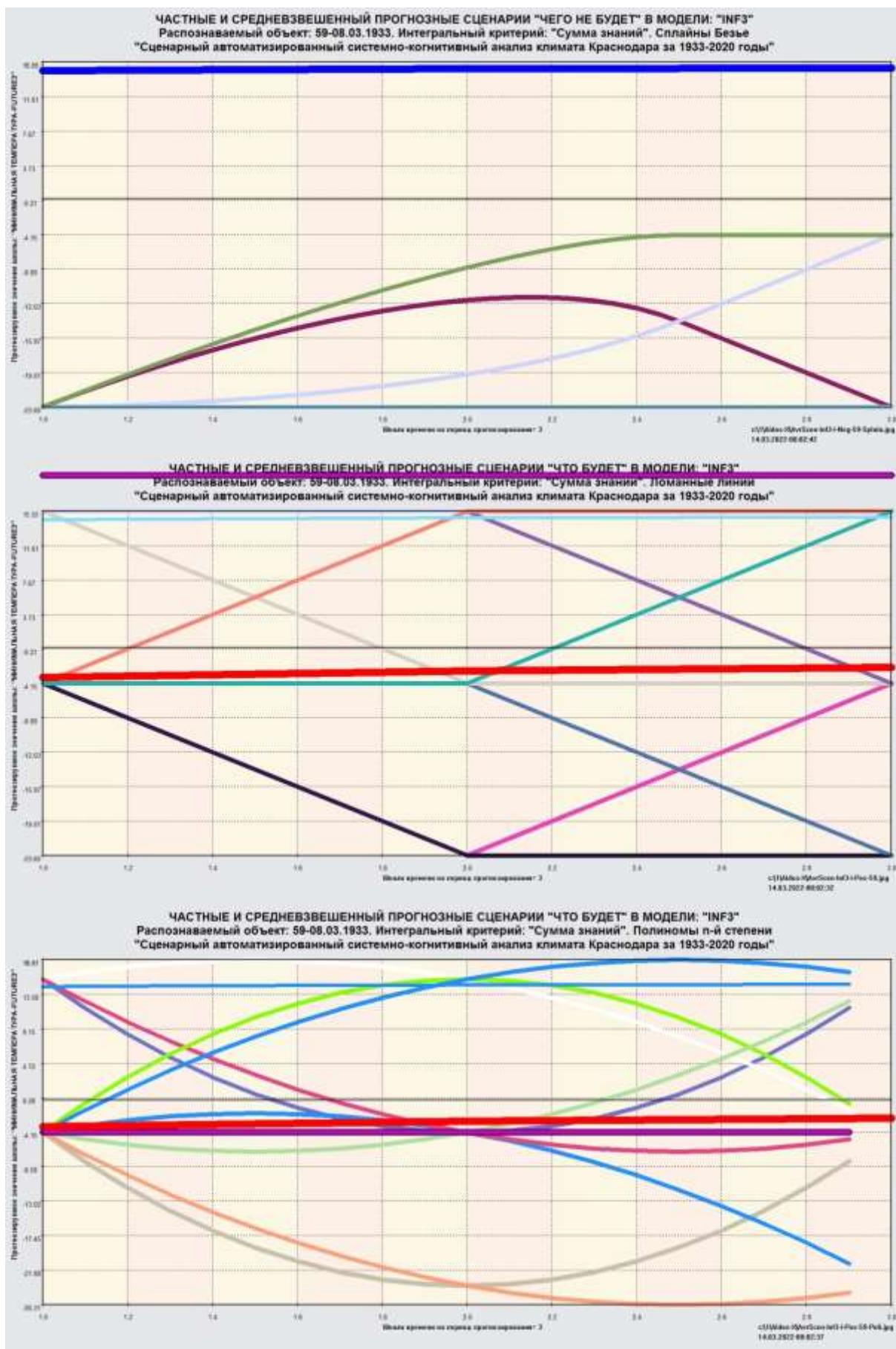
| Интегральный критерий сходства: "Снимки знаний" | | | | | | |
|---|--|----------|----|---|--|--|
| Код | Наименование класса | Сходство | Ф. | Сходство | | |
| 11... | СРЕДНЯЯ ТЕМПЕРАТУРА-3/3-{11,6, 31,3} | 54,88... | ✓ | <div style="width: 100%;"><div style="width: 100%; background-color: #ff0000; height: 10px;"></div></div> | | |
| 11... | МИНИМАЛЬНАЯ ТЕМПЕРАТУРА-3/3-{5,7, 25,4} | 53,87... | ✓ | <div style="width: 100%;"><div style="width: 100%; background-color: #ff0000; height: 10px;"></div></div> | | |
| 11... | МАКСИМАЛЬНАЯ ТЕМПЕРАТУРА-3/3-{21,3, 43,0} | 52,23... | ✓ | <div style="width: 100%;"><div style="width: 100%; background-color: #ff0000; height: 10px;"></div></div> | | |
| 11... | СРЕДНЯЯ ТЕМПЕРАТУРА-FUTURE3-СРЕДНЯЯ ТЕМПЕРАТУ... | 51,00... | ✓ | <div style="width: 100%;"><div style="width: 100%; background-color: #ff0000; height: 10px;"></div></div> | | |
| 11... | МИНИМАЛЬНАЯ ТЕМПЕРАТУРА-FUTURE3-МИНИМАЛЬНАЯ ... | 50,80... | ✓ | <div style="width: 100%;"><div style="width: 100%; background-color: #ff0000; height: 10px;"></div></div> | | |
| 11... | ЭФФЕКТИВНАЯ ТЕМПЕРАТУРА-3/3-{11,7, 33,4} | 43,86... | ✓ | <div style="width: 100%;"><div style="width: 100%; background-color: #ff0000; height: 10px;"></div></div> | | |
| 11... | МАКСИМАЛЬНАЯ ТЕМПЕРАТУРА-FUTURE3-МАКСИМАЛЬНА... | 42,63... | ✓ | <div style="width: 100%;"><div style="width: 100%; background-color: #ff0000; height: 10px;"></div></div> | | |
| 11... | ЭФФЕКТИВНАЯ ТЕМПЕРАТУРА-FUTURE3-ЭФФЕКТИВНАЯ ... | 41,21... | ✓ | <div style="width: 100%;"><div style="width: 100%; background-color: #ff0000; height: 10px;"></div></div> | | |
| 11... | АТМОСФЕРНОЕ ДАВЛЕНИЕ-FUTURE3-АТМОСФЕРНОЕ ДАВ... | 16,25... | ✓ | <div style="width: 100%;"><div style="width: 100%; background-color: #ff0000; height: 10px;"></div></div> | | |
| 11... | ОСАДКИ-FUTURE3-ОСАДКИ-FUTURE3-16,16,16 | 6,156... | ✓ | <div style="width: 100%;"><div style="width: 100%; background-color: #ff0000; height: 10px;"></div></div> | | |

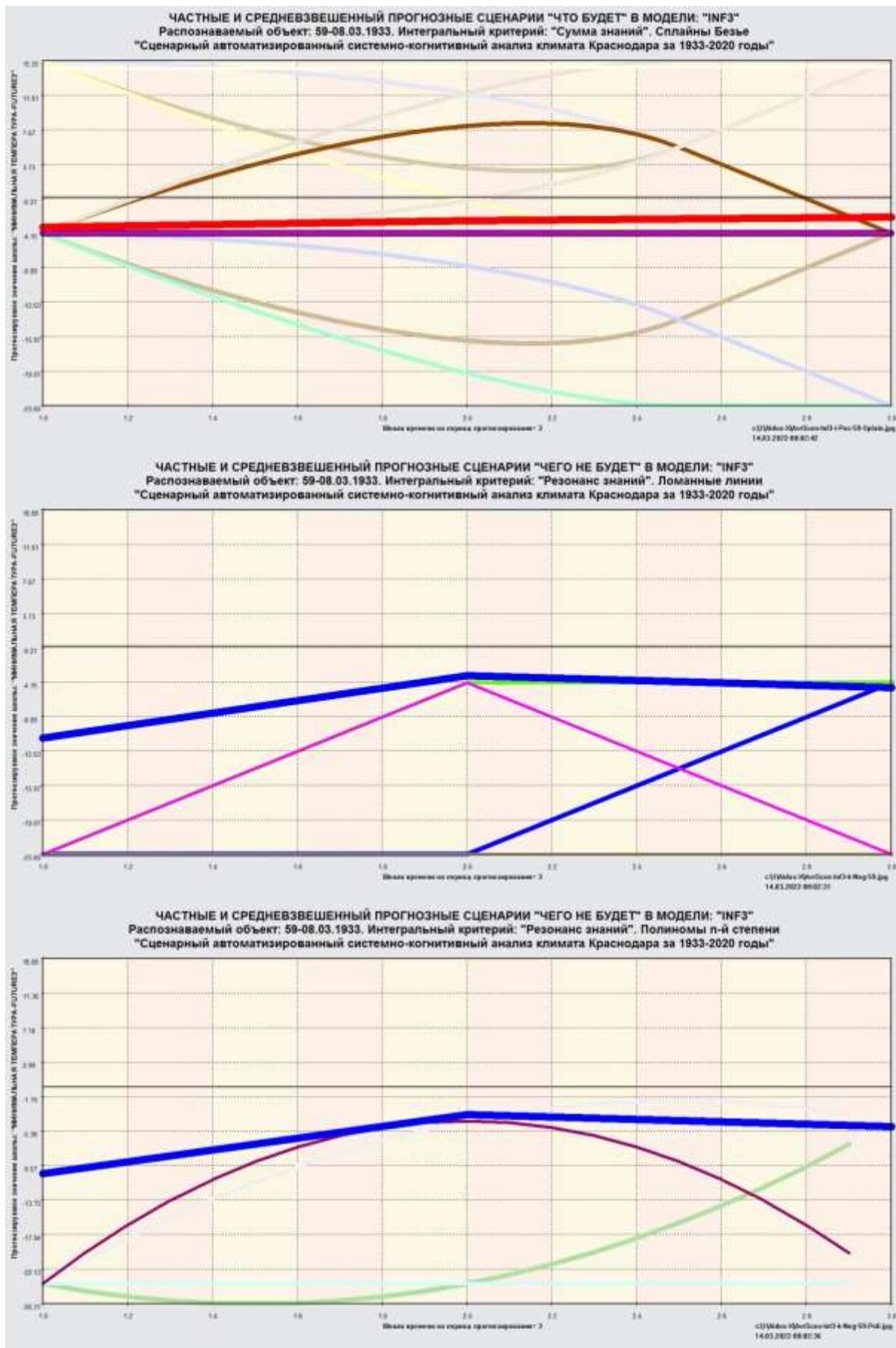
| Интегральный критерий сходства: "Семантический резонанс знаний" | | | | | |
|---|----------------------|----------|------|----------|--|
| Код | Наименование объекта | Сходство | Ф... | Сходство | |
| 21... | 09.03.2011 | 85,26... | ✓ | | |
| 23... | 25.10.2016 | 85,26... | ✓ | | |
| 23... | 08.12.2016 | 85,26... | ✓ | | |
| 23... | 23.02.2017 | 85,26... | ✓ | | |
| 23... | 28.03.2017 | 85,26... | ✓ | | |
| 21... | 11.03.2011 | 85,09... | ✓ | | |
| 23... | 21.03.2016 | 85,09... | ✓ | | |
| 23... | 27.10.2016 | 85,09... | ✓ | | |
| 23... | 11.12.2016 | 85,09... | ✓ | | |
| 21... | 10.03.2011 | 85,08... | ✓ | | |

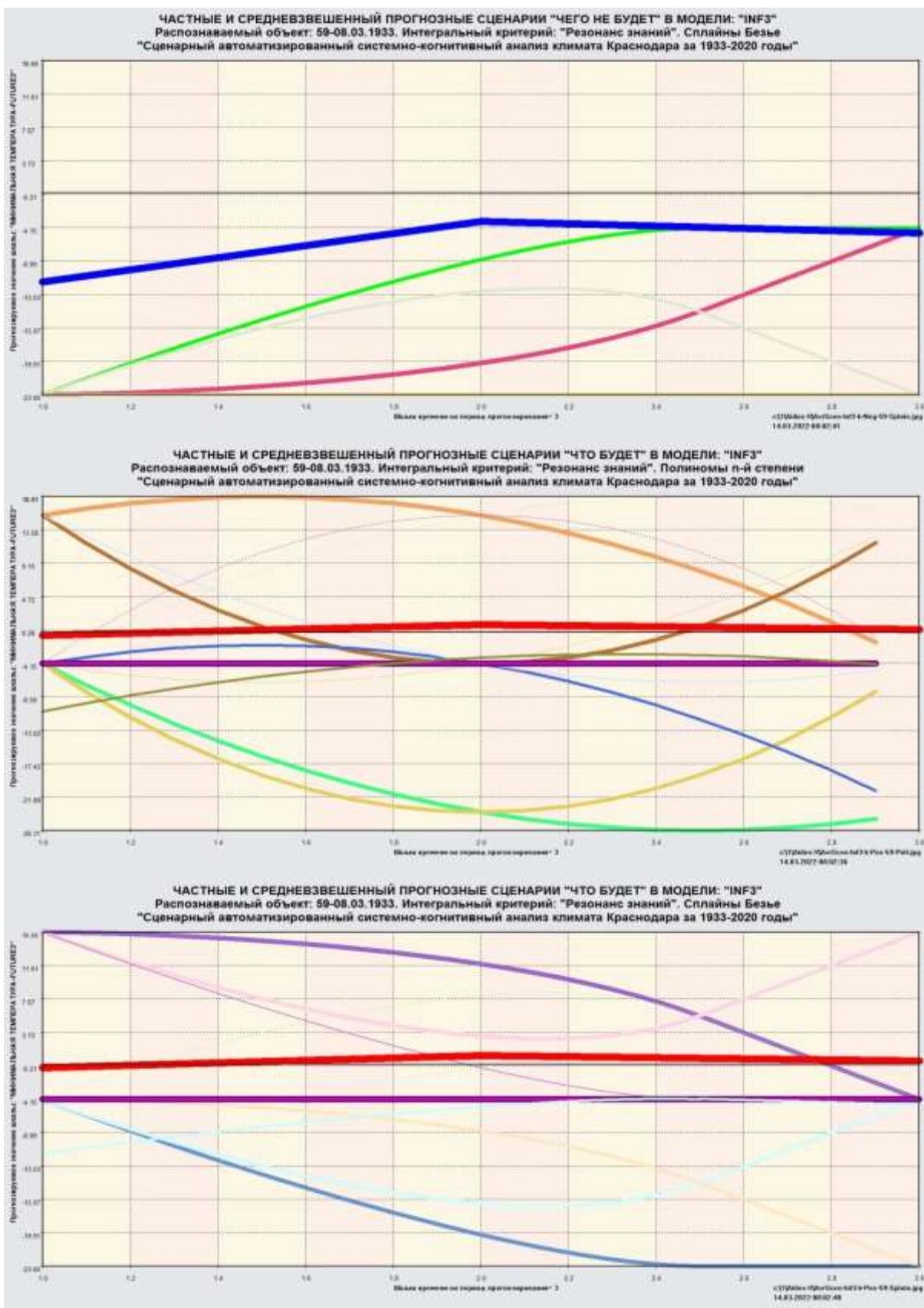
| Интегральный критерий сходства: "Сумма знаний" | | | | | |
|--|----------------------|----------|------|----------|--|
| Код | Наименование объекта | Сходство | Ф... | Сходство | |
| 14... | 28.11.1992 | 84,25... | ✓ | | |
| 14... | 30.11.1992 | 84,25... | ✓ | | |
| 19... | 06.01.2005 | 84,21... | ✓ | | |
| 15... | 04.01.1994 | 84,11... | ✓ | | |
| 14... | 10.12.1992 | 84,09... | ✓ | | |
| 47... | 11.03.1963 | 84,06... | ✓ | | |
| 68... | 27.02.1969 | 84,05... | ✓ | | |
| 15... | 23.01.1993 | 84,04... | ✓ | | |
| 47... | 10.03.1963 | 83,99... | ✓ | | |
| 15... | 25.01.1993 | 83,95... | ✓ | | |











Picture13. Screen forms of the identification and forecasting models 4.1.2, 4.1.3.1, 4.1.3.2 of the Eidos system

3.7. Task-7. Decision Support

3.7.1. Simplified decision-making as an inverse forecasting problem, positive and negative information portraits of classes, SWOT analysis

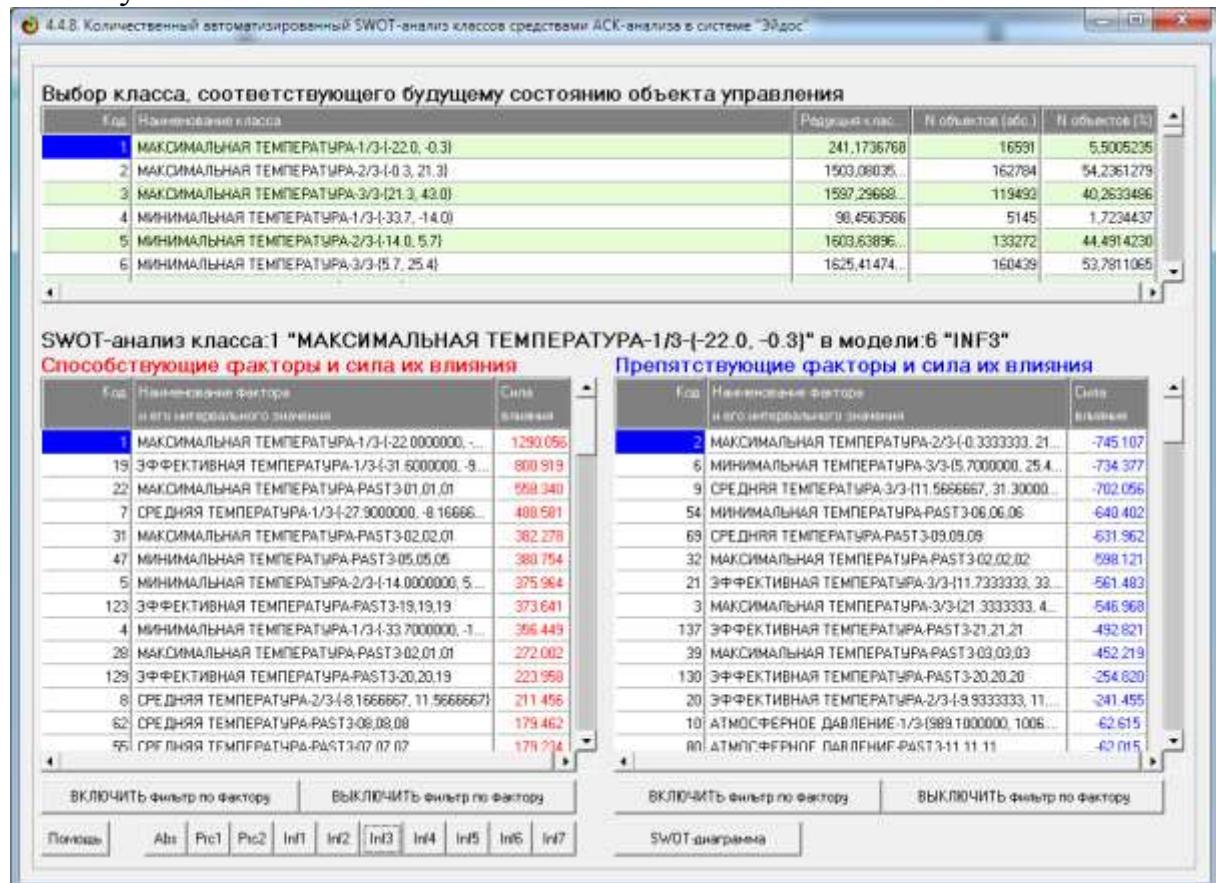
The problems of forecasting and decision making are related to each other as direct and inverse problems:

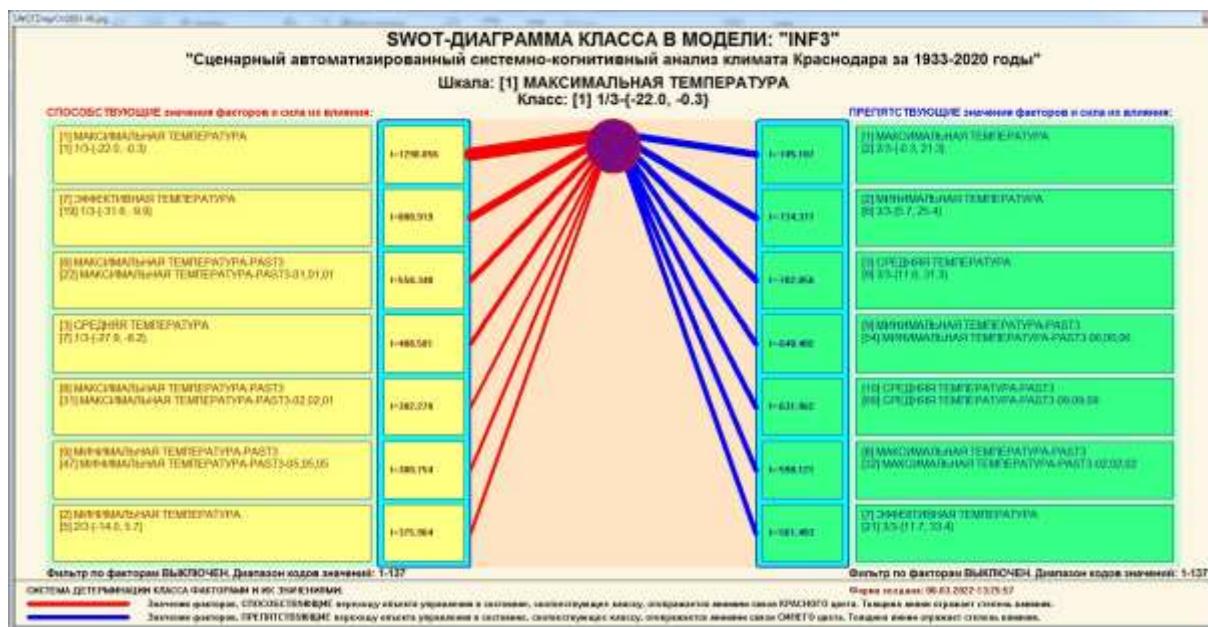
- when forecasting by the values of the factors acting on the modeling object, it is determined in what future state it will go under their action;

- when making decisions, on the contrary, according to the future target state of the modeling object, the values of the factors that determine its transition to this future target state are determined.

Thus, the decision-making problem is the inverse of the forecasting problem. But this is true only in the simplest case: in the case of using SWOT analysis (mode 4.4.8 of the Eidos system) [9].

Figure 14 shows the screen forms of the SWOT analysis mode 4.4.8 of the Eidos system:





4.4.8. Качественный автоматизированный SWOT-анализ классов средствами АСК-анализа в системе "Эдос"

Выбор класса, соответствующего будущему состоянию объекта управления

| Код | Наименование класса | Родительский класс | N объектов (акт.) | N объектов |
|-----|--|--------------------|-------------------|------------|
| 37 | МАКСИМАЛЬНАЯ ТЕМПЕРАТУРА_FUTURE3-МАКСИМАЛЬНАЯ ТЕМПЕРАТУРА_FUTURE3-03.02.03 | 39.9040742 | 3520 | 1.30063 |
| 38 | МАКСИМАЛЬНАЯ ТЕМПЕРАТУРА_FUTURE3-МАКСИМАЛЬНАЯ ТЕМПЕРАТУРА_FUTURE3-03.03.02 | 78.8246747 | 8338 | 2.78654 |
| 39 | МАКСИМАЛЬНАЯ ТЕМПЕРАТУРА_FUTURE3-МАКСИМАЛЬНАЯ ТЕМПЕРАТУРА_FUTURE3-03.03.03 | 131.6525066 | 98806 | 39.33333 |
| 40 | МИНИМАЛЬНАЯ ТЕМПЕРАТУРА_FUTURE3-МИНИМАЛЬНАЯ ТЕМПЕРАТУРА_FUTURE3-04.04.04 | 27.5563989 | 1683 | 0.55971 |
| 41 | МИНИМАЛЬНАЯ ТЕМПЕРАТУРА_FUTURE3-МИНИМАЛЬНАЯ ТЕМПЕРАТУРА_FUTURE3-04.04.05 | 20.5668074 | 1376 | 0.49502 |
| 42 | МИНИМАЛЬНАЯ ТЕМПЕРАТУРА_FUTURE3-МИНИМАЛЬНАЯ ТЕМПЕРАТУРА_FUTURE3-04.05.04 | 5.3228951 | 271 | 0.09261 |

SWOT-анализ класса: 40 "МИНИМАЛЬНАЯ ТЕМПЕРАТУРА_FUTURE3-МИНИМАЛЬНАЯ ТЕМПЕРАТУРА_FUTU...
 Способствующие факторы и сила их влияния Препятствующие факторы и сила их влияния

| Код | Наименование фактора и его интервального значения | Сила влияния |
|-----|---|--------------|
| 19 | ЭФФЕКТИВНАЯ ТЕМПЕРАТУРА_1/3-[31.6000000, -9] | 114.210 |
| 1 | МАКСИМАЛЬНАЯ ТЕМПЕРАТУРА_1/3-[12.0000000, -] | 112.295 |
| 7 | СРЕДНЯЯ ТЕМПЕРАТУРА_1/3-[27.9000000, -8.16686] | 96.016 |
| 4 | МИНИМАЛЬНАЯ ТЕМПЕРАТУРА_1/3-[33.7000000, -1] | 81.611 |
| 22 | МАКСИМАЛЬНАЯ ТЕМПЕРАТУРА_PAST3-01.01.01 | 78.687 |
| 123 | ЭФФЕКТИВНАЯ ТЕМПЕРАТУРА_PAST3-19.19.19 | 73.428 |
| 55 | СРЕДНЯЯ ТЕМПЕРАТУРА_PAST3-07.07.07 | 41.908 |
| 40 | МИНИМАЛЬНАЯ ТЕМПЕРАТУРА_PAST3-04.04.04 | 31.229 |
| 46 | МИНИМАЛЬНАЯ ТЕМПЕРАТУРА_PAST3-05.05.04 | 22.132 |
| 59 | СРЕДНЯЯ ТЕМПЕРАТУРА_PAST3-08.07.07 | 21.297 |
| 61 | СРЕДНЯЯ ТЕМПЕРАТУРА_PAST3-08.08.07 | 20.967 |
| 44 | МИНИМАЛЬНАЯ ТЕМПЕРАТУРА_PAST3-05.04.04 | 19.374 |
| 129 | ЭФФЕКТИВНАЯ ТЕМПЕРАТУРА_PAST3-20.20.19 | 19.271 |
| 177 | ЭФФЕКТИВНАЯ ТЕМПЕРАТУРА_PAST3-20.19.19 | 16.764 |

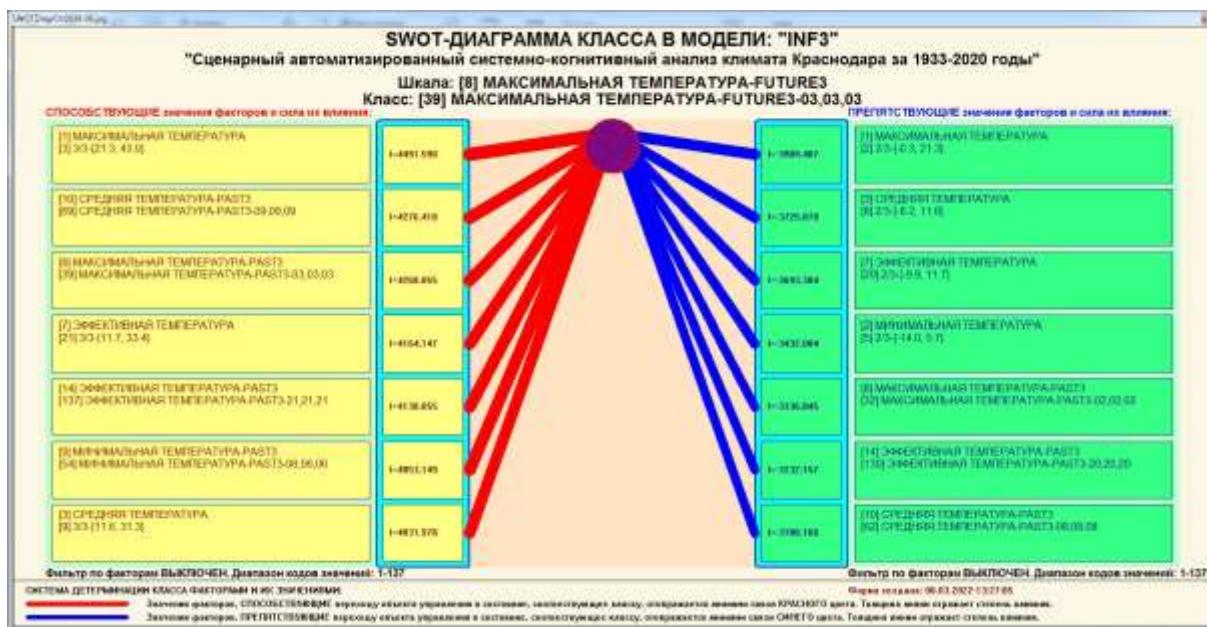
| Код | Наименование фактора и его интервального значения | Сила влияния |
|-----|---|--------------|
| 6 | МИНИМАЛЬНАЯ ТЕМПЕРАТУРА_3/3-[5.7000000, 25.4... | -74.496 |
| 9 | СРЕДНЯЯ ТЕМПЕРАТУРА_3/3-[11.5666667, 31.30000... | -71.217 |
| 54 | МИНИМАЛЬНАЯ ТЕМПЕРАТУРА_PAST3-06.06.06 | -64.963 |
| 69 | СРЕДНЯЯ ТЕМПЕРАТУРА_PAST3-09.09.09 | -64.107 |
| 20 | ЭФФЕКТИВНАЯ ТЕМПЕРАТУРА_2/3-[8.9333333, 11... | -57.025 |
| 21 | ЭФФЕКТИВНАЯ ТЕМПЕРАТУРА_3/3-[11.7333333, 33... | -56.957 |
| 2 | МАКСИМАЛЬНАЯ ТЕМПЕРАТУРА_2/3-[0.3333333, 21... | -56.504 |
| 3 | МАКСИМАЛЬНАЯ ТЕМПЕРАТУРА_3/3-[21.3333333, 4... | -55.485 |
| 32 | МАКСИМАЛЬНАЯ ТЕМПЕРАТУРА_PAST3-02.02.02 | -52.674 |
| 130 | ЭФФЕКТИВНАЯ ТЕМПЕРАТУРА_PAST3-20.20.20 | -50.411 |
| 137 | ЭФФЕКТИВНАЯ ТЕМПЕРАТУРА_PAST3-21.21.21 | -49.992 |
| 39 | МАКСИМАЛЬНАЯ ТЕМПЕРАТУРА_PAST3-03.03.03 | -45.873 |
| 62 | СРЕДНЯЯ ТЕМПЕРАТУРА_PAST3-09.08.08 | -28.731 |
| 81 | СРЕДНЯЯ ТЕМПЕРАТУРА_2/3-[8.1666667, 11.5666667) | -24.571 |

ВКЛЮЧИТЬ фильтр по фактору ВЫКЛЮЧИТЬ фильтр по фактору

ВКЛЮЧИТЬ фильтр по фактору ВЫКЛЮЧИТЬ фильтр по фактору

Помощь Alt Prt1 Prt2 Inf1 Inf2 Inf3 Inf4 Inf5 Inf6 Inf7

SWOT-диаграмма



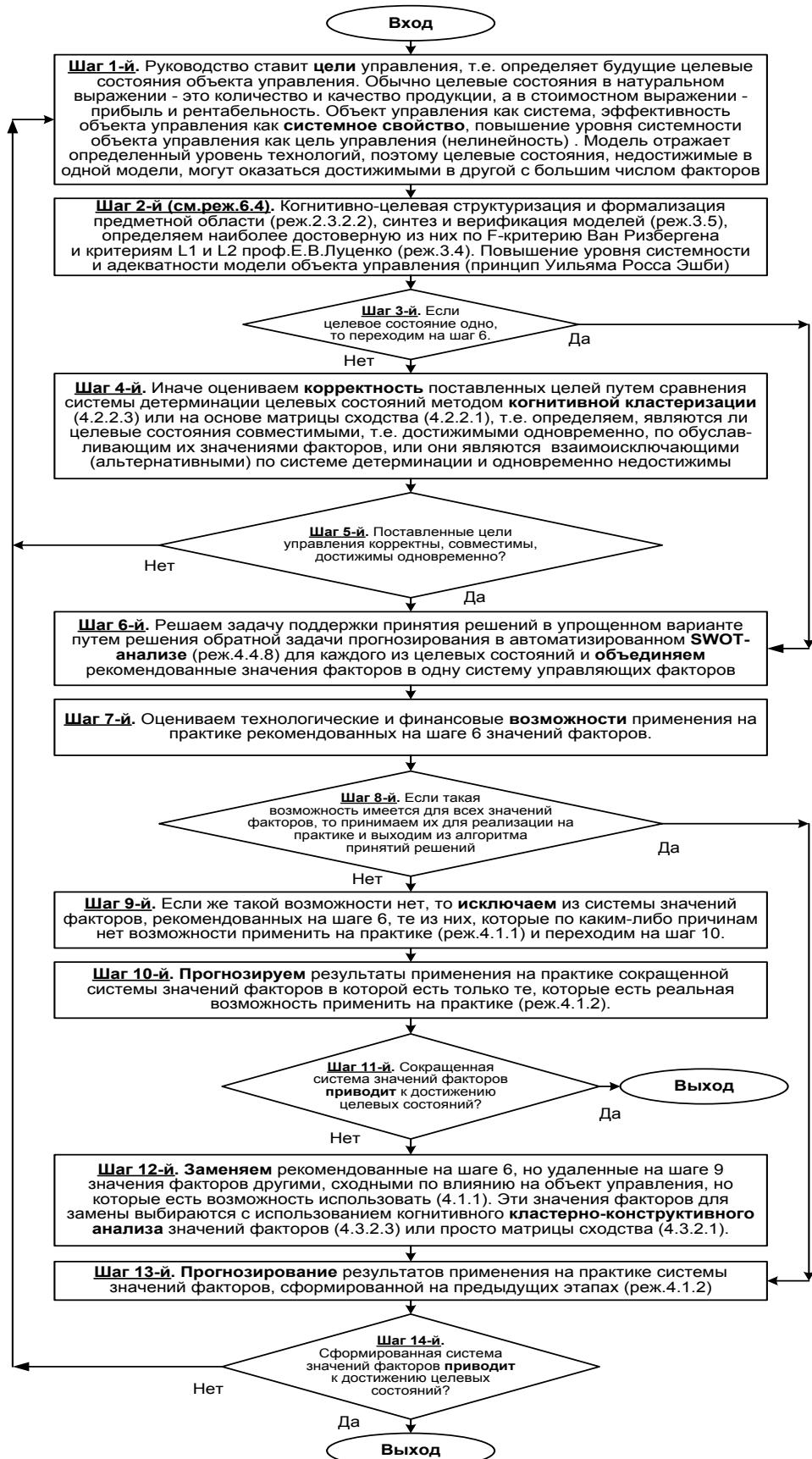
Picture14. Screen forms of the SWOT-analysis mode 4.4.8 of the Eidos system

3.7.2. Advanced Decision-Making Algorithm in ASC Analysis

However, the SWOT analysis (mode 4.4.8 of the Eidos system) has its limitations: only one future target state can be set, some recommended factors may not be technologically and financially feasible to use.

Therefore, in the ASC analysis and the Eidos system, a developed decision-making algorithm (mode 6.3) is implemented, in which, in addition to the SWOT analysis, the results of solving the forecasting problem and the results of a cluster-constructive analysis of the classes and values of factors are also used, i.e. some results of solving the problem of researching the subject area. This algorithm is described in [10] and a number of subsequent works (Figure 15).

Step 1. Management sets management goals, i.e. determines the future target states of the control object. Typically, the target states in physical terms are the quantity and quality of products, and in value terms - profit and profitability. The control object as a system, the effectiveness of the control object as a system property, increasing the level of systemicity of the control object as a control goal (nonlinearity). The model reflects a certain level of technology, so the target states that are unattainable in one model may be achievable in another with a large number of factors.



Picture15. Developed decision-making algorithm in intelligent control systems based on ASC-analysis and the Eidos system

Step 2 (see dir.6.4).Cognitive-targeted structuring and formalization of the subject area (dir. 2.3.2.2), synthesis and verification of models (dir. 3.5), we determine the most reliable of them according to the Van Riesbergen F-criterion and the L1 and L2 criteria of Prof. E.V. Lutsenko (dir.3.4). Increasing the level of consistency and adequacy of the control object model (principle of William Ross Ashby).

Step 3.If the target state is one, then go to step 6, otherwise go to step 4.

Step 4.Otherwise, we evaluate the correctness of the goals set by comparing the target state determination system using the cognitive clustering method (4.2.2.3) or based on the similarity matrix (4.2.2.1), i.e. determine whether the target states are compatible, i.e. achievable simultaneously, according to the factors that determine them, or they are mutually exclusive (alternative) according to the system of determination and at the same time unattainable.

Step 5.Are the goals of management correct, compatible, achievable at the same time? If yes, go to step 6, otherwise go to step 1.

Step 6.We solve the decision support problem in a simplified version by solving the inverse forecasting problem in an automated SWOT analysis (dir.4.4.8) for each of the target states and combine the recommended factor values into one system of control factors.

Step 7.We evaluate the technological and financial possibilities of applying in practice the values of the factors recommended in step 6.

Step 8.If such a possibility exists for all factor values, then we accept them for implementation in practice and go to step 13 to check the effectiveness of the decisions made, otherwise go to step 9.

Step 9.If this is not possible, then we exclude from the system of factor values recommended in step 6 those of them that for some reason cannot be put into practice (dir. 4.1.1) and go to step 10.

Step 10.We predict the results of the application in practice of a reduced system of factor values in which there are only those that have a real opportunity to be applied in practice (dir. 4.1.2).

Step 11.Does the abbreviated system of factor values lead to the achievement of target states? If yes, then exit the decision algorithm, otherwise go to step 12.

Step 12.We replace the values of the factors recommended in step 6, but removed in step 9, with others similar in their effect on the control object, but which can be used (4.1.1). These replacement factor values are selected using cognitive cluster-constructive analysis of factor values (4.3.2.3) or simply a similarity matrix (4.3.2.1).

Step 13.Forecasting the results of applying in practice the system of factor values formed at the previous stages (dir.4.1.2)

Step 14. Does the formed system of factor values lead to the achievement of target states? If yes, then exit the decision-making algorithm, otherwise go to step 1.

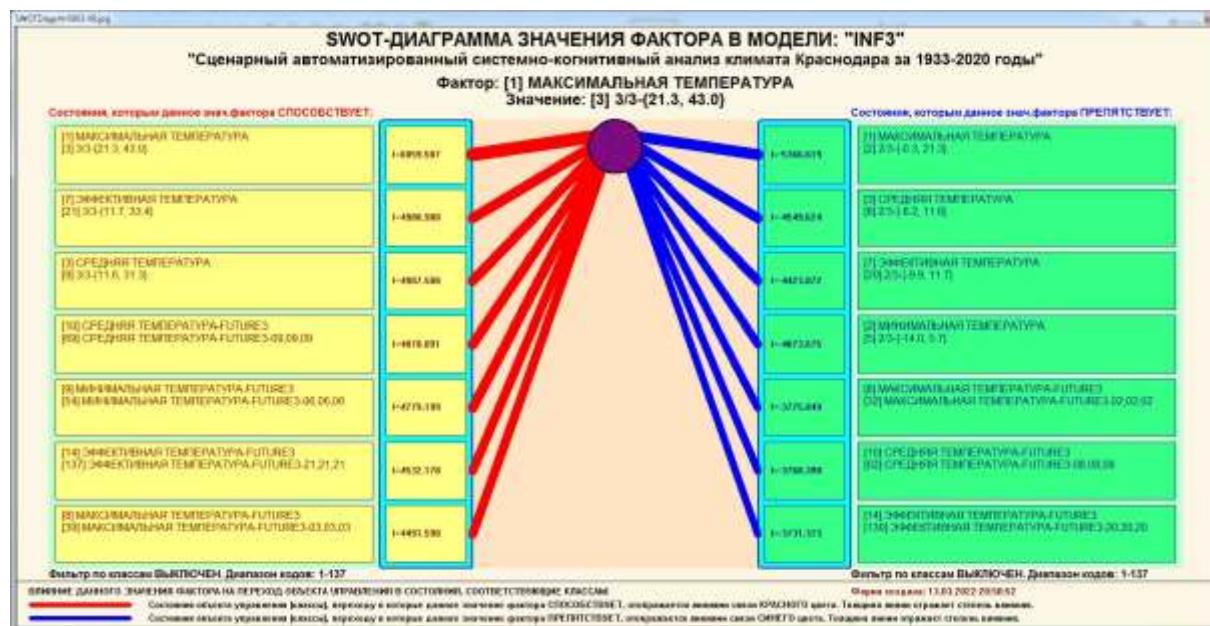
As we can see, in the developed decision-making algorithm, the results of solving various problems are widely used: both the forecasting problem and some problems of studying the modeling object by studying its model. It should be specially noted that all these tasks are solved in the Eidos system.

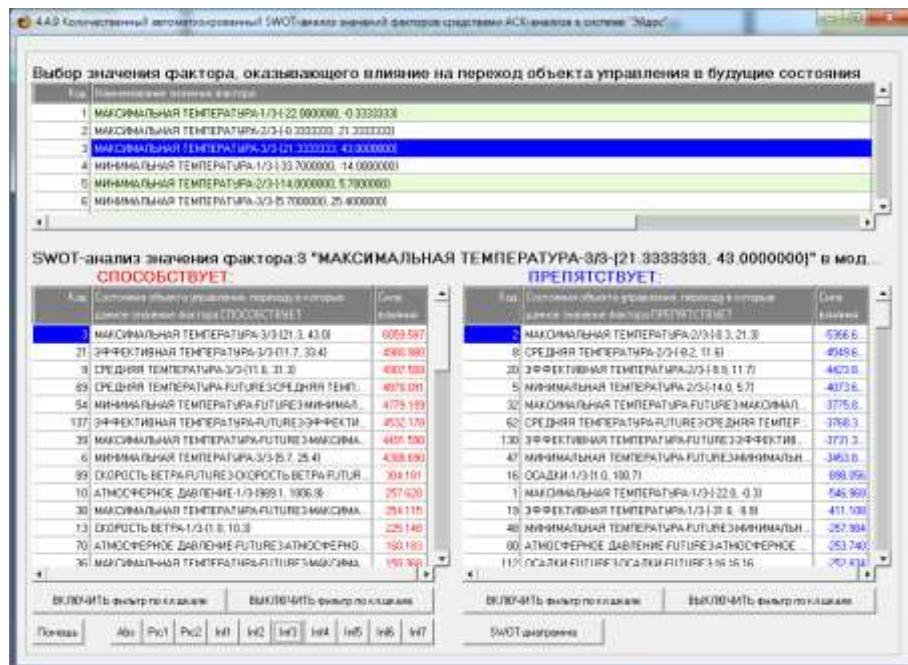
Therefore, below we briefly consider the solution of these problems.

3.8. Task-8. Examining the object of modeling by examining its model

3.8.1. Inverted SWOT Diagrams of Descriptive Scale Values (Semantic Potentials)

Inverted SWOT-diagrams (proposed by the author in [9]) reflect the strength and direction of the influence of a particular gradation of the descriptive scale on the transition of the modeling object to states corresponding to the gradations of classification scales (classes). This is the meaning (semantic potential) of this gradation of the descriptive scale. Inverted SWOT-diagrams are displayed in mode 4.4.9 of the Eidos system (Figure 16).



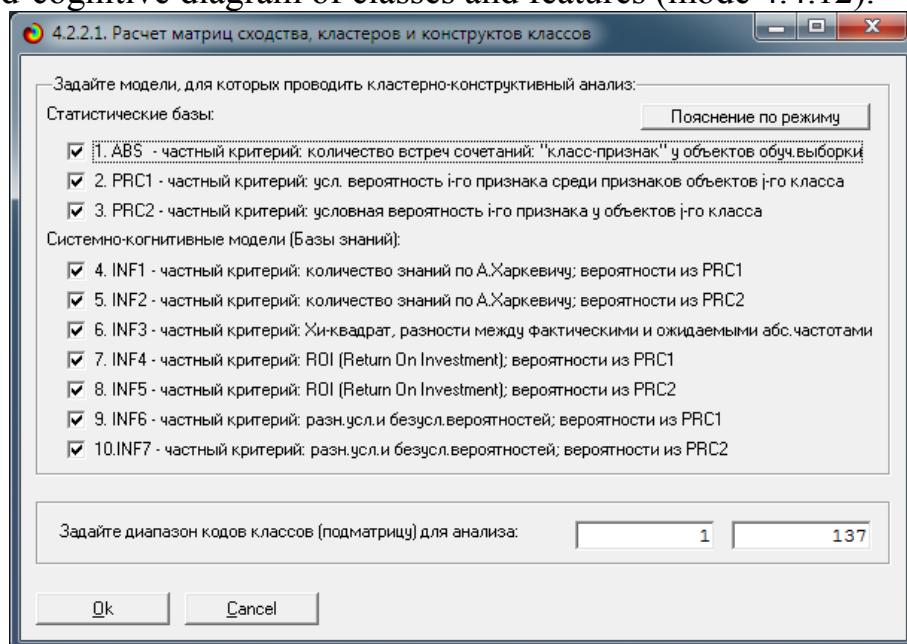


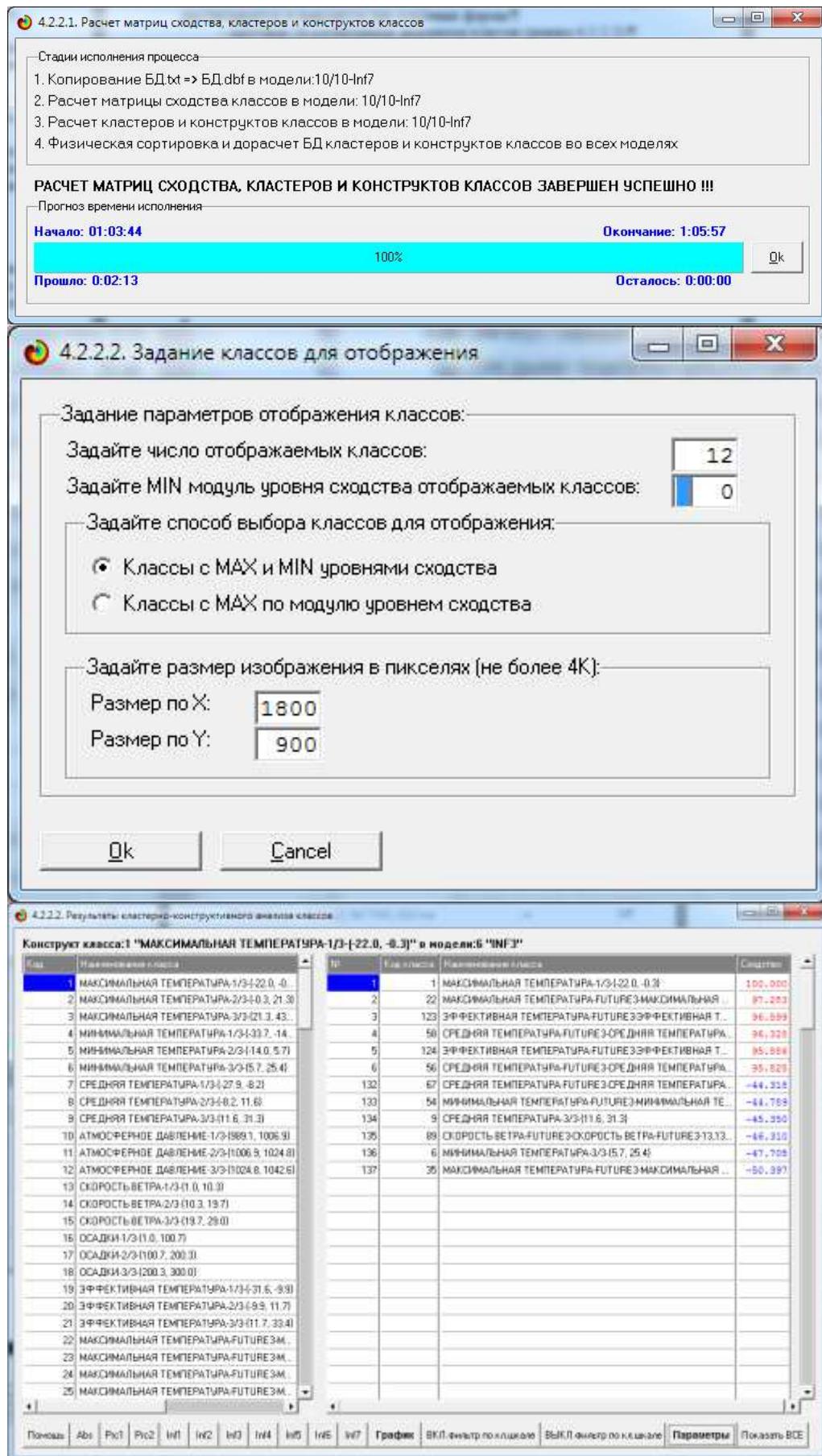
Picture16. Screen forms of the SWOT-analysis mode 4.4.9 of the Eidos system

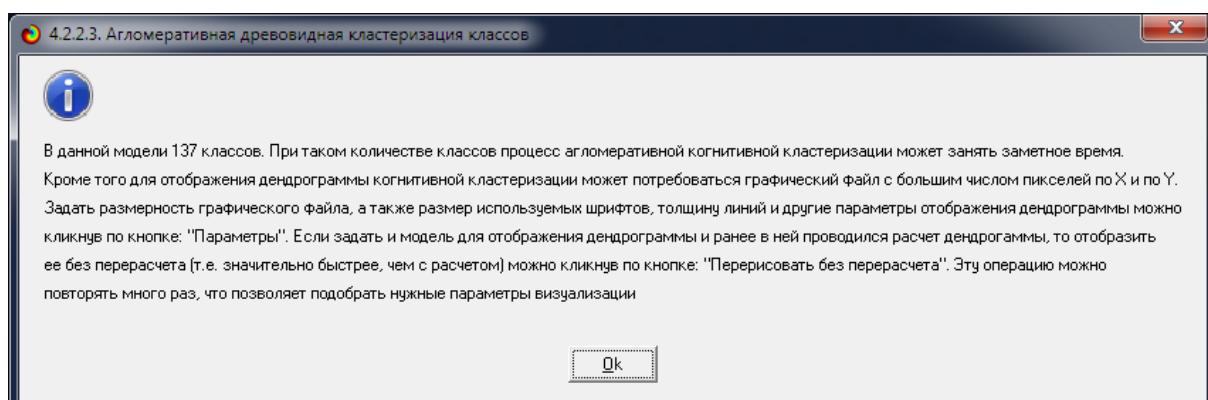
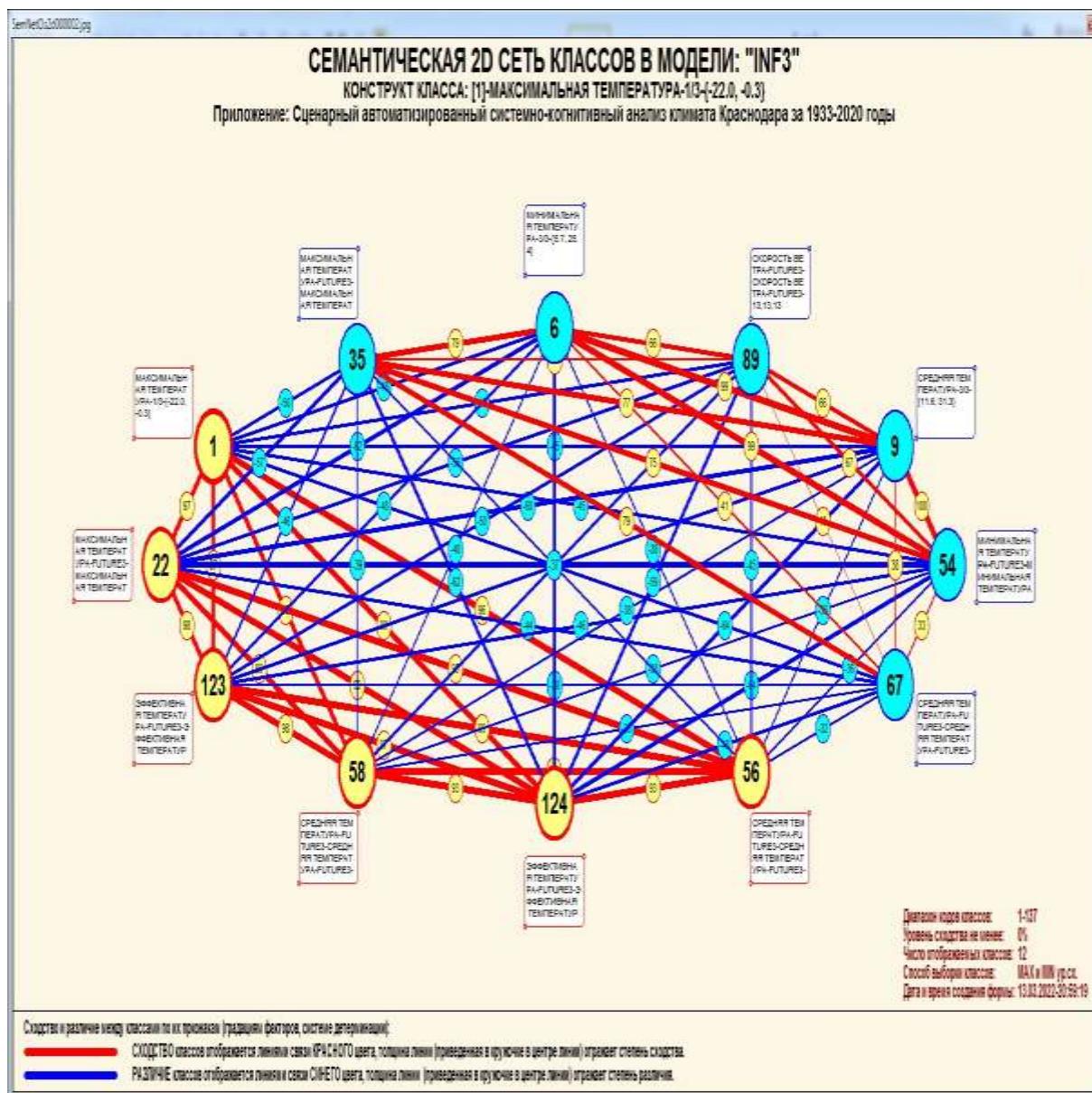
3.8.2. Cluster-constructive analysis of classes

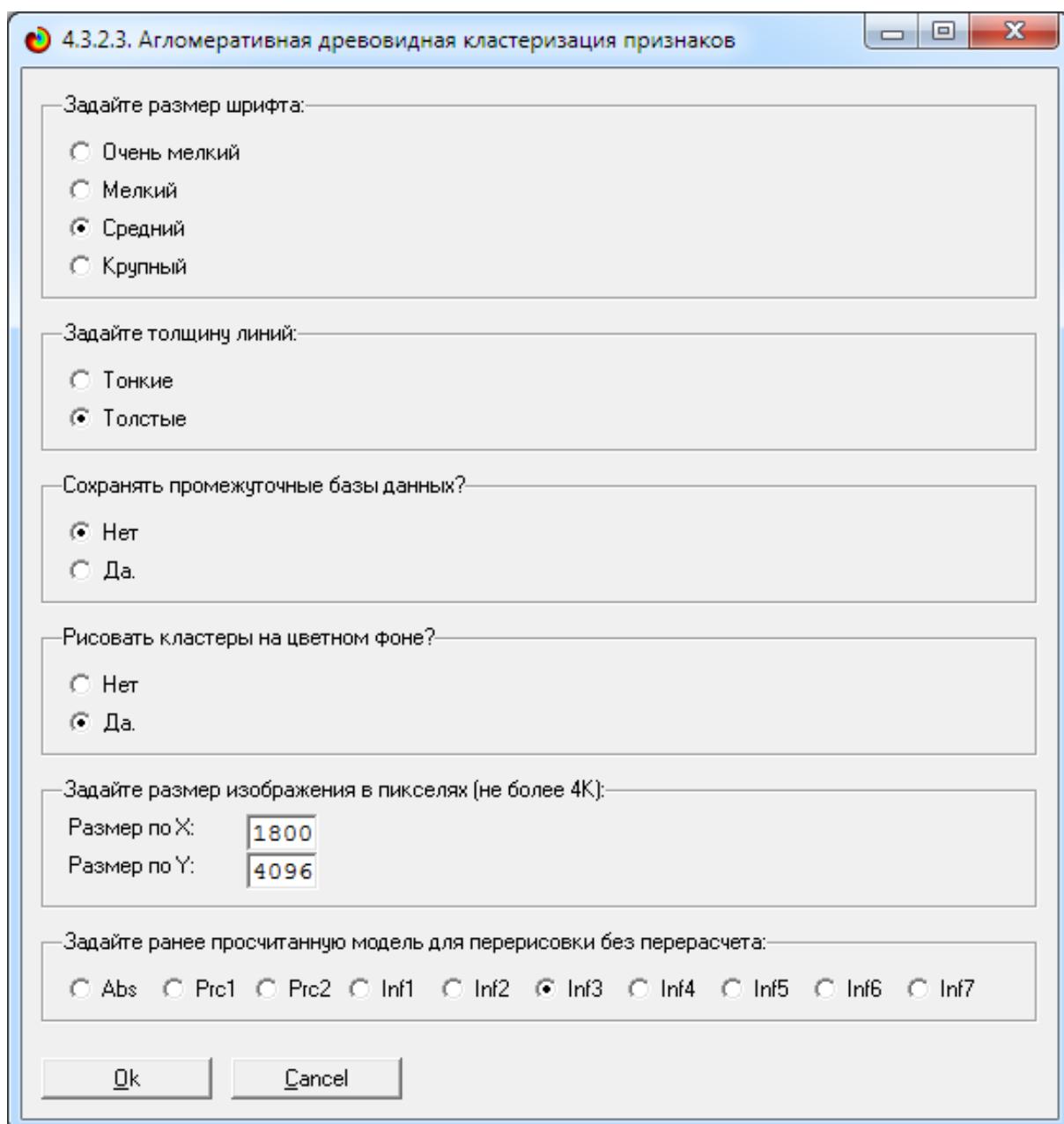
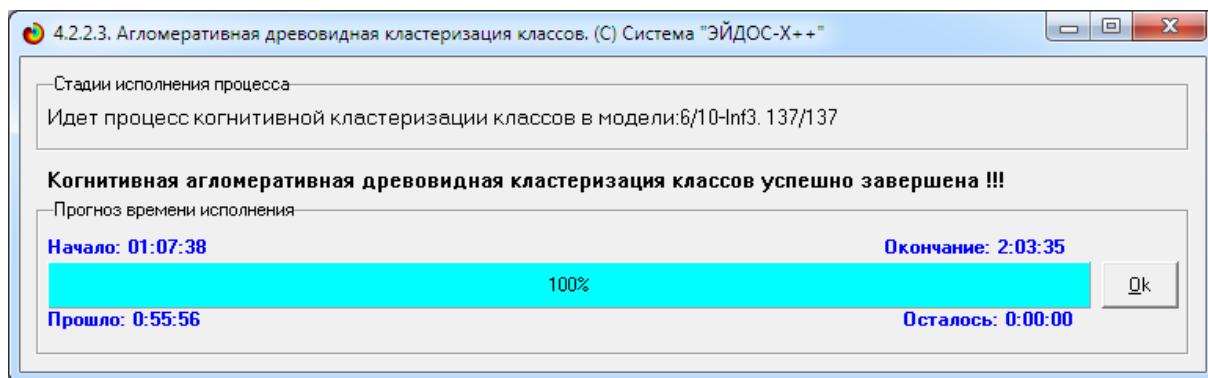
In the Eidos system (in mode 4.2.2.1), the matrix of similarity of classes is calculated according to the system of their determination, and on the basis of this matrix, four main forms are calculated and displayed (Figure 17):

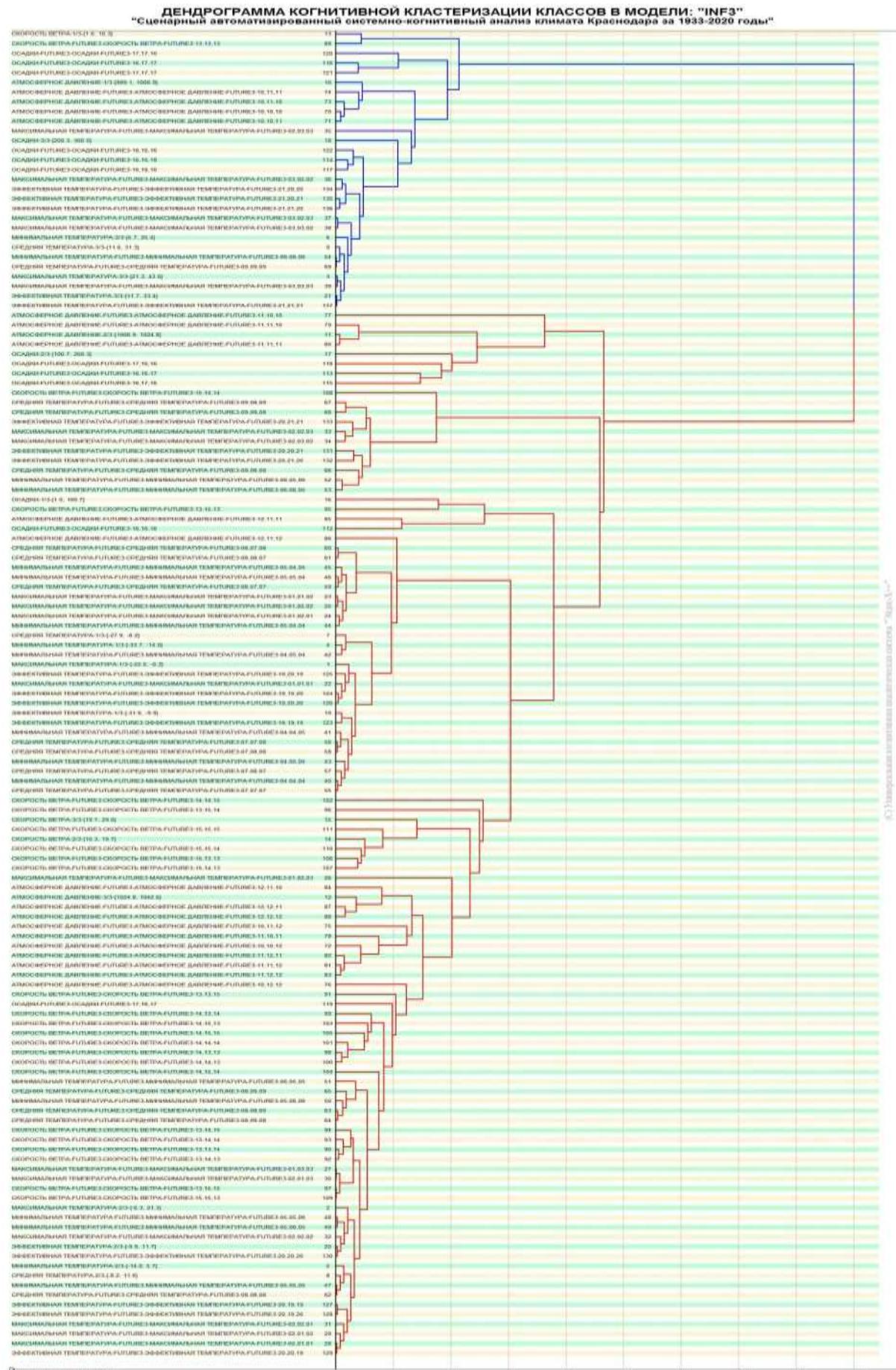
- circular 2d-cognitive class diagram (mode 4.2.2.2);
- agglomerative dendrograms obtained as a result of cognitive (true) class clustering (proposed by the author in 2011 in [11]) (mode 4.2.2.3);
- graph of changes in intercluster distances (mode 4.2.2.3);
- 3d-cognitive diagram of classes and features (mode 4.4.12).

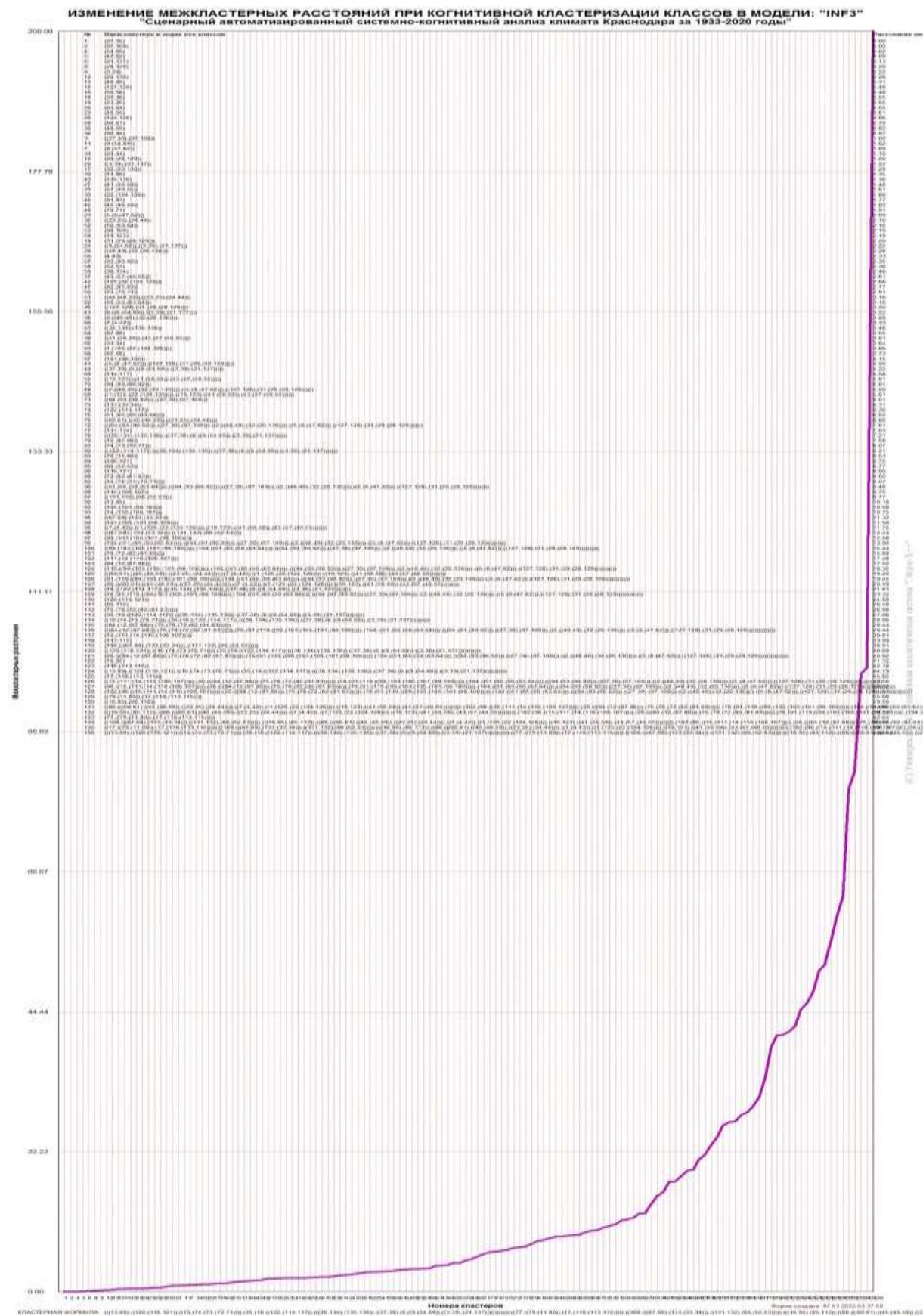










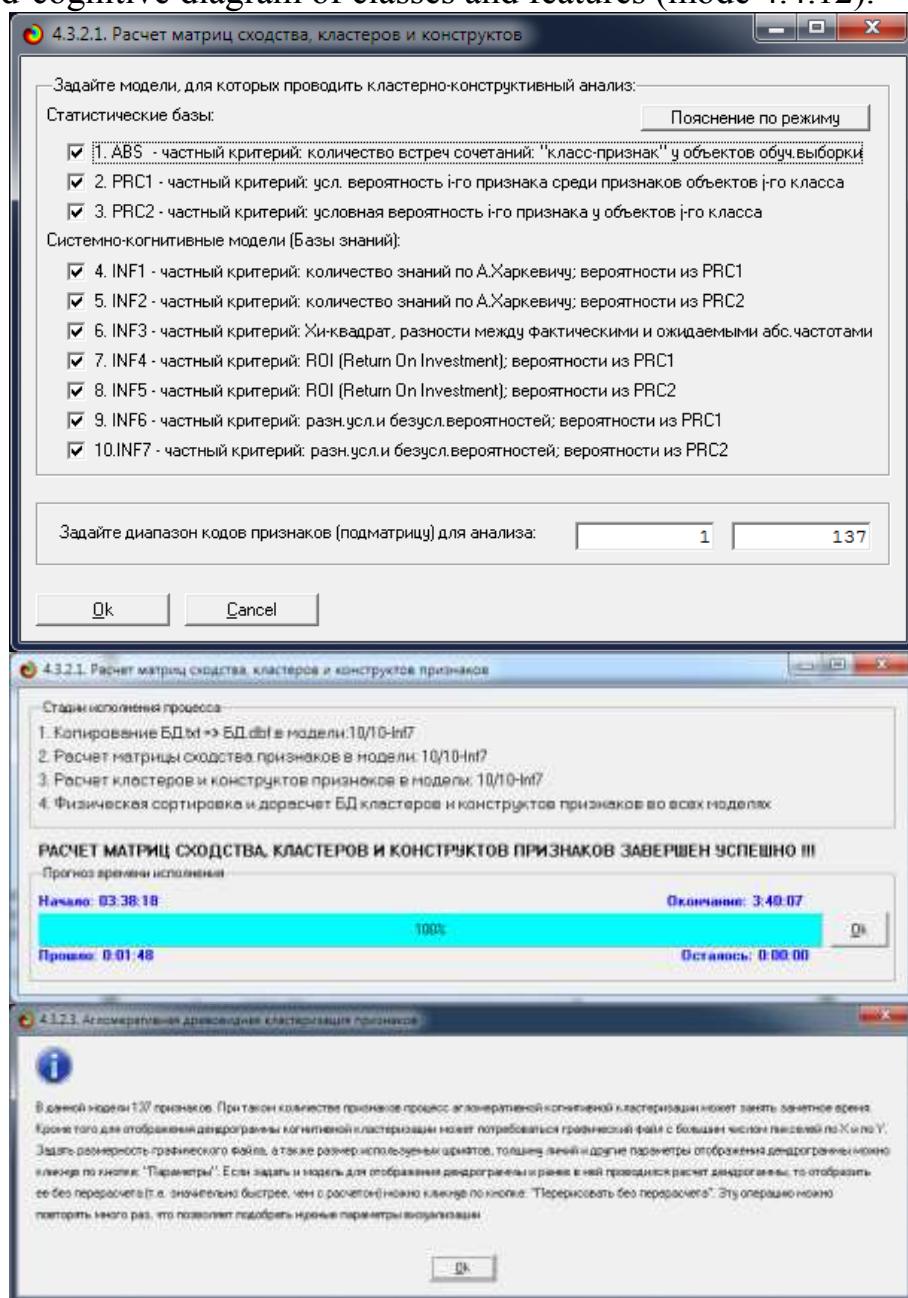


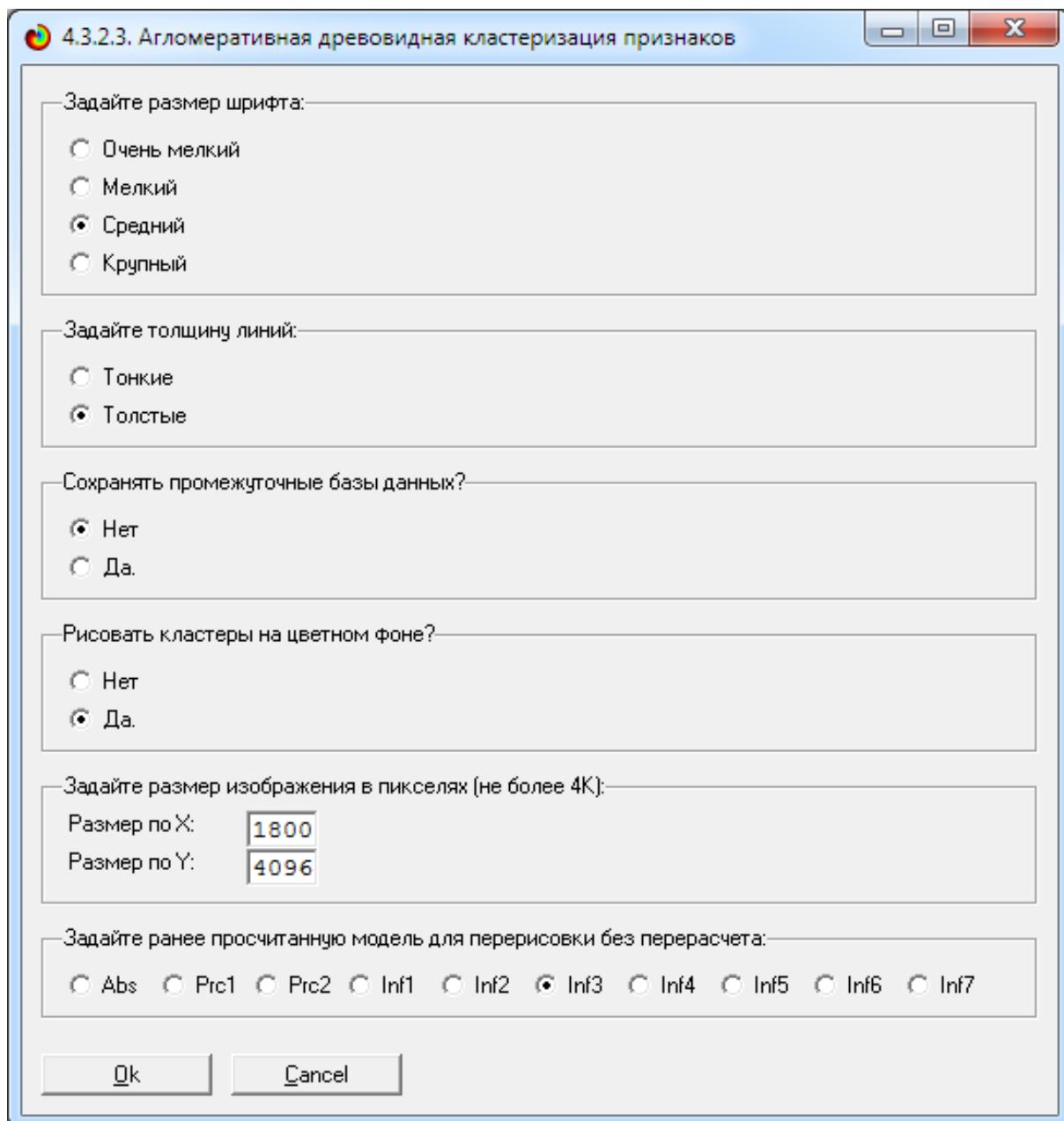
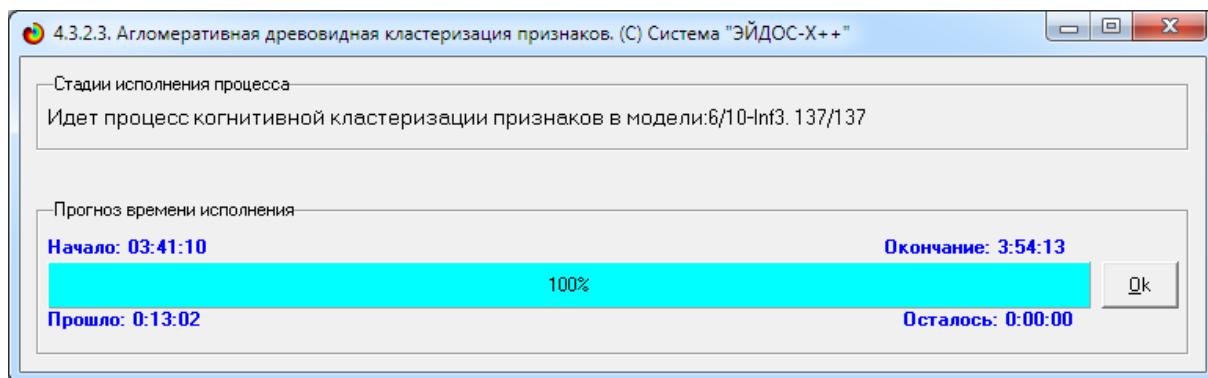
Picture17. Screen forms of subsystem 4.2.2: "Cluster-constructive analysis of classes"

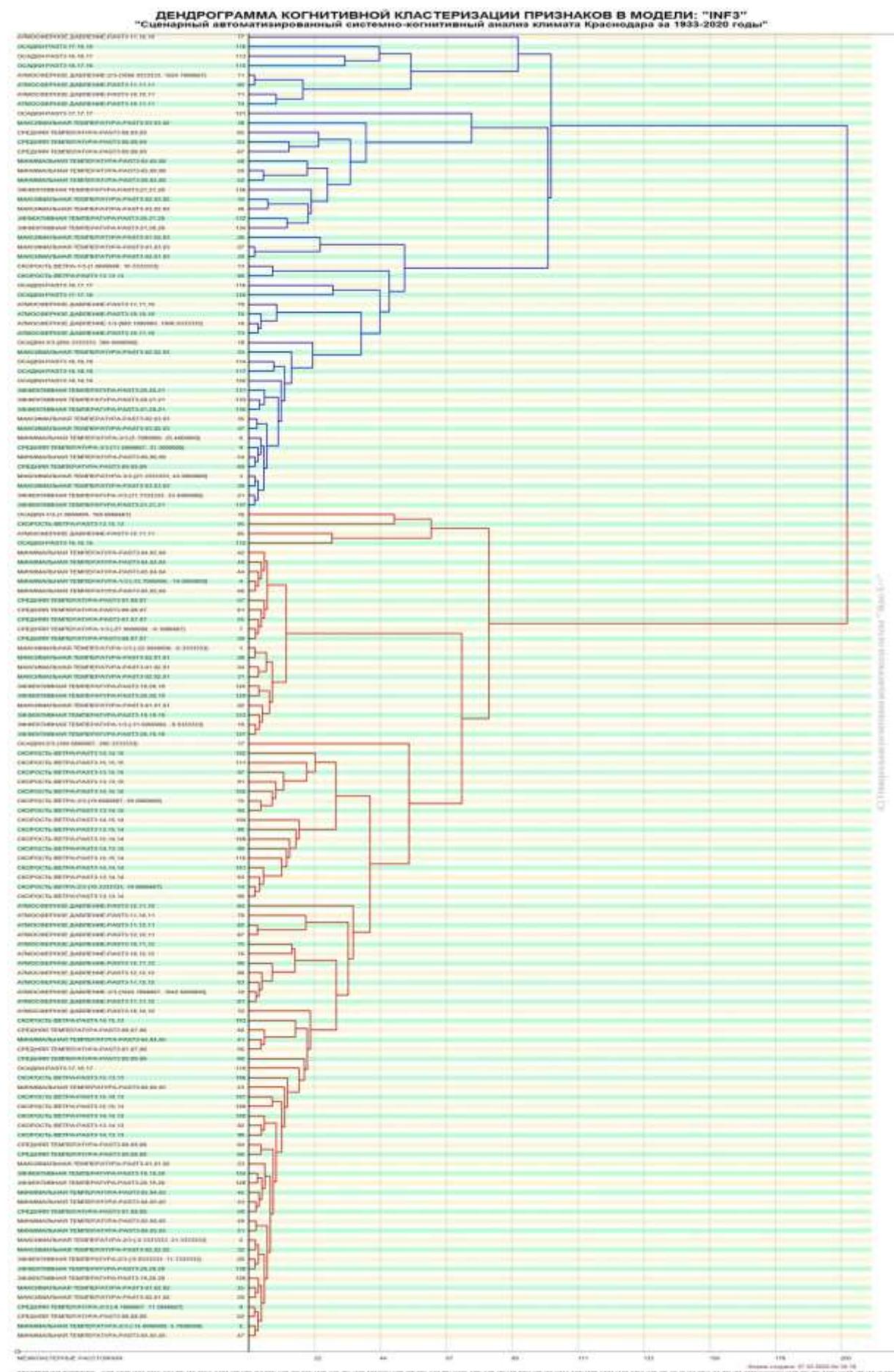
3.8.3. Cluster-constructive analysis of the values of descriptive scales

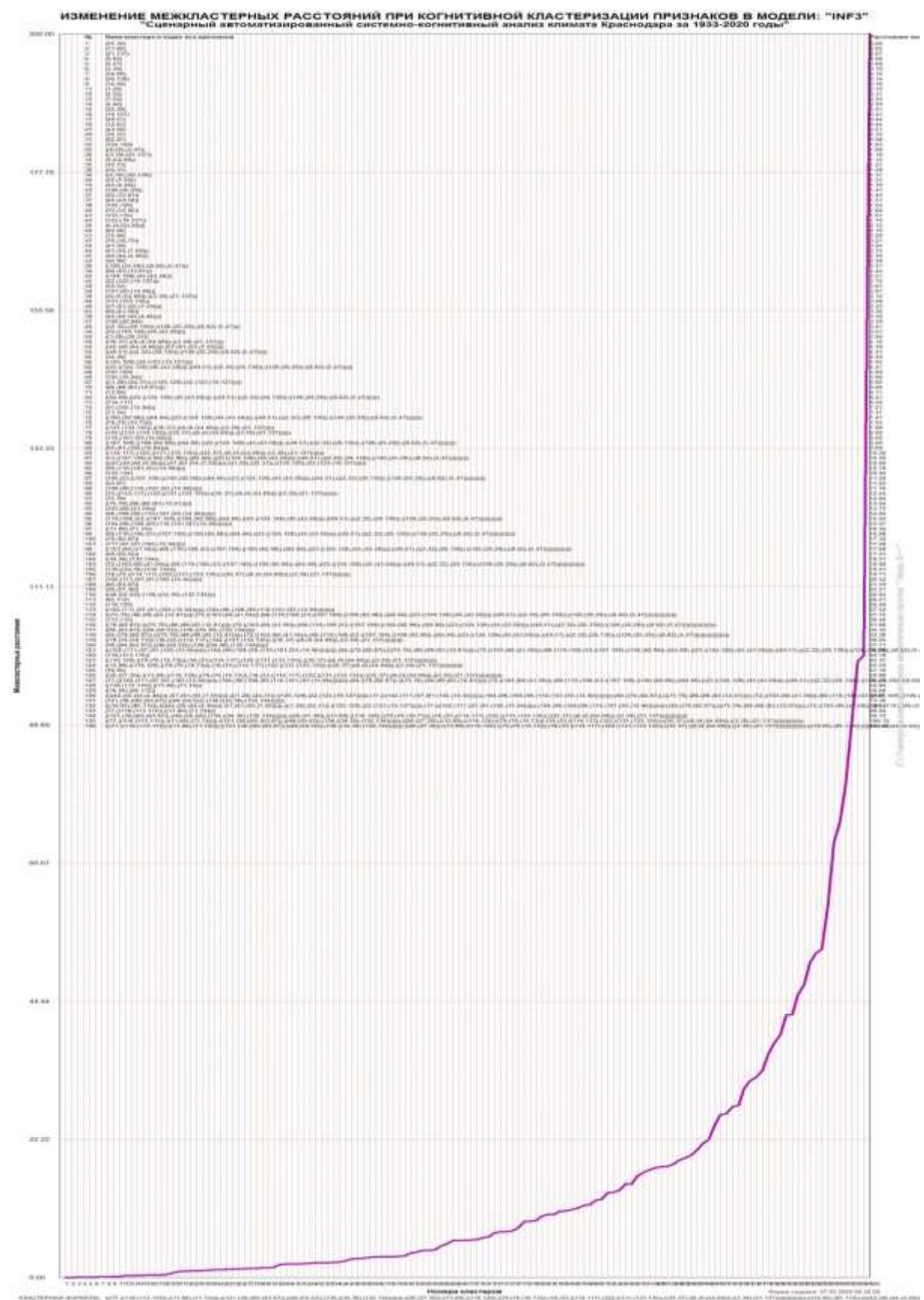
In the "Eidos" system (in mode 4.3.2.1), a matrix of similarity of features is calculated according to the system of their meaning, and on the basis of this matrix, three main forms are calculated and displayed (Figure 18):

- circular 2d cognitive feature diagram (mode 4.3.2.2);
- agglomerative dendograms obtained as a result of cognitive (true) feature clustering (proposed by the author in 2011 in [11]) (mode 4.3.2.3);
- graph of changes in intercluster distances (mode 4.3.2.3);
- 3d-cognitive diagram of classes and features (mode 4.4.12).









Picture18. Screen forms of subsystem 4.3.2: "Cluster-constructive analysis of factor values"

3.8.4. Knowledge Model of the Eidos System and Nonlocal Neurons

The knowledge model of the Eidos system belongs to fuzzy declarative hybrid models and combines some positive features of the neural network and frame models of knowledge representation.

Classes in this model correspond to neurons and frames, and signs correspond to receptors and spaces (descriptive scales correspond to slots).

From frame model knowledge representation model of the "Eidos" system is distinguished by its efficient and simple software implementation, obtained due to the fact that different frames differ from each other not in a set of slots and spaces, but only in the information in them. Therefore, in the Eidos system, with an increase in the number of frames, the number of databases does not increase, but only their dimension increases. This is a very important property of the Eidos system models, which greatly facilitates and simplifies software implementation.

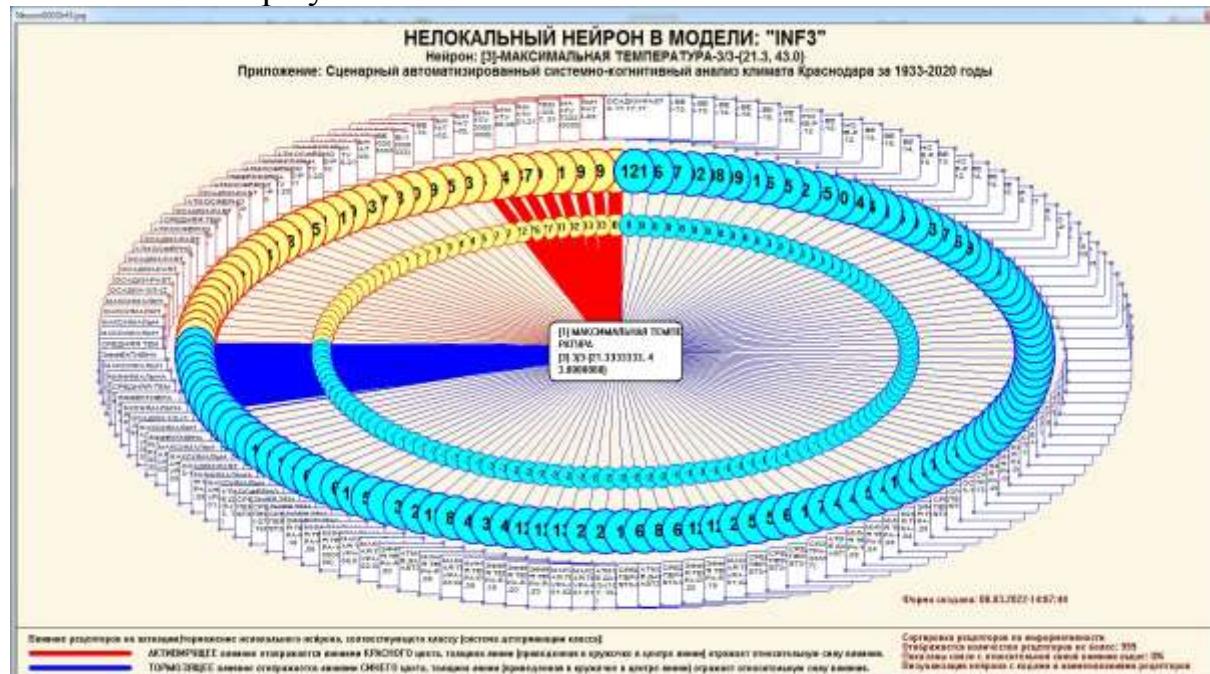
From the neural network model knowledge representation model of the system "Eidos" differs in that [12]:

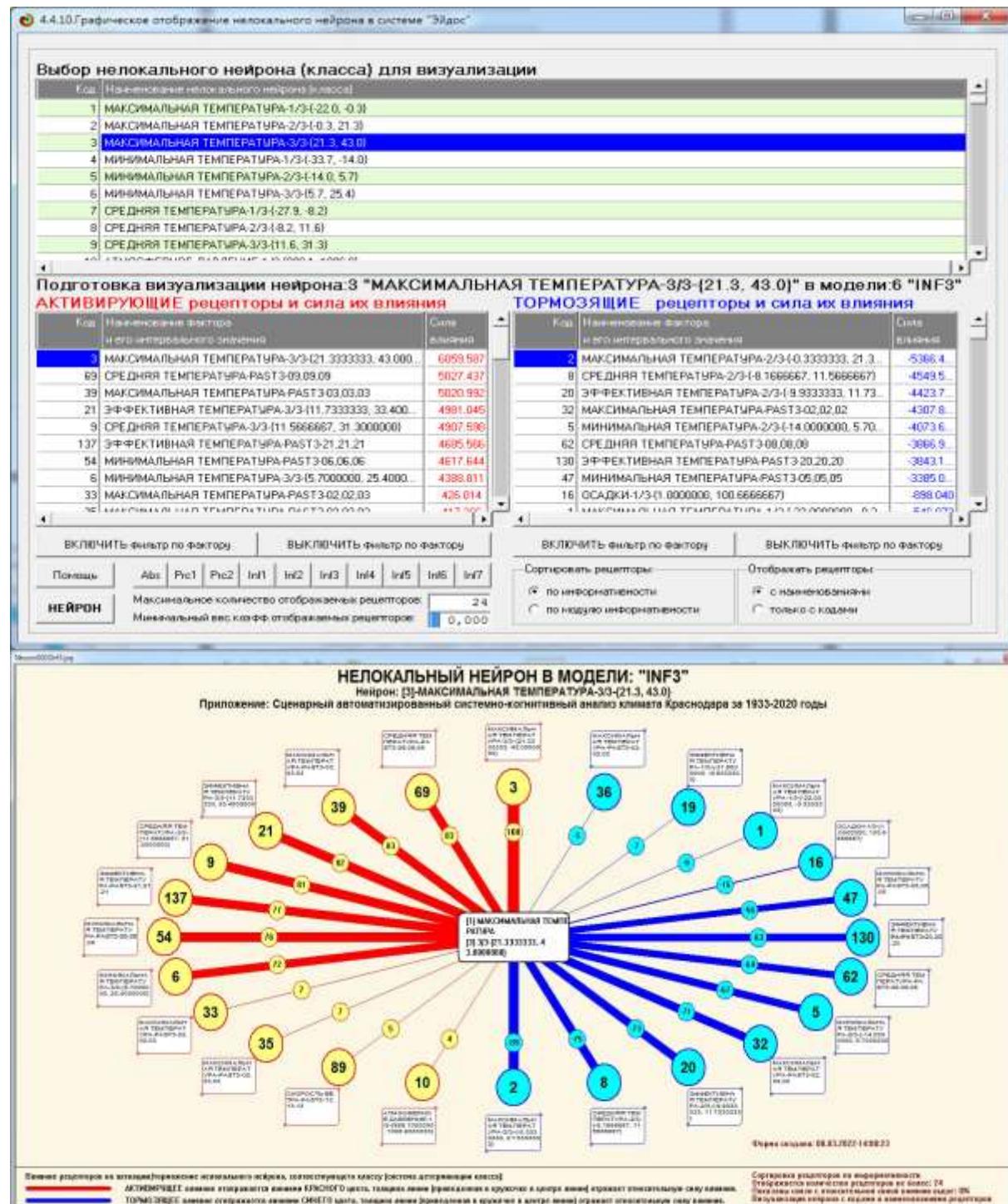
1) the weight coefficients on the receptors are not selected by the iterative backpropagation method, but are calculated by the direct counting method based on a well theoretically substantiated model based on information theory (this resembles Bayesian networks);

2) weight coefficients have a well theoretically substantiated meaningful interpretation based on information theory;

3) the neural network is non-local, as they say now “fully connected”.

In the "Eidos" system, non-local neurons are visualized (mode 4.4.10 of the "Eidos" system) in the form of special graphic forms, on which the strength and direction of the influence of neuron receptors on the degree of its activation / inhibition is displayed in the form of color and thickness of the dendrite.





Picture19. Screen forms of subsystem 4.4.8 of the Eidos system

3.8.5. Non-local neural network

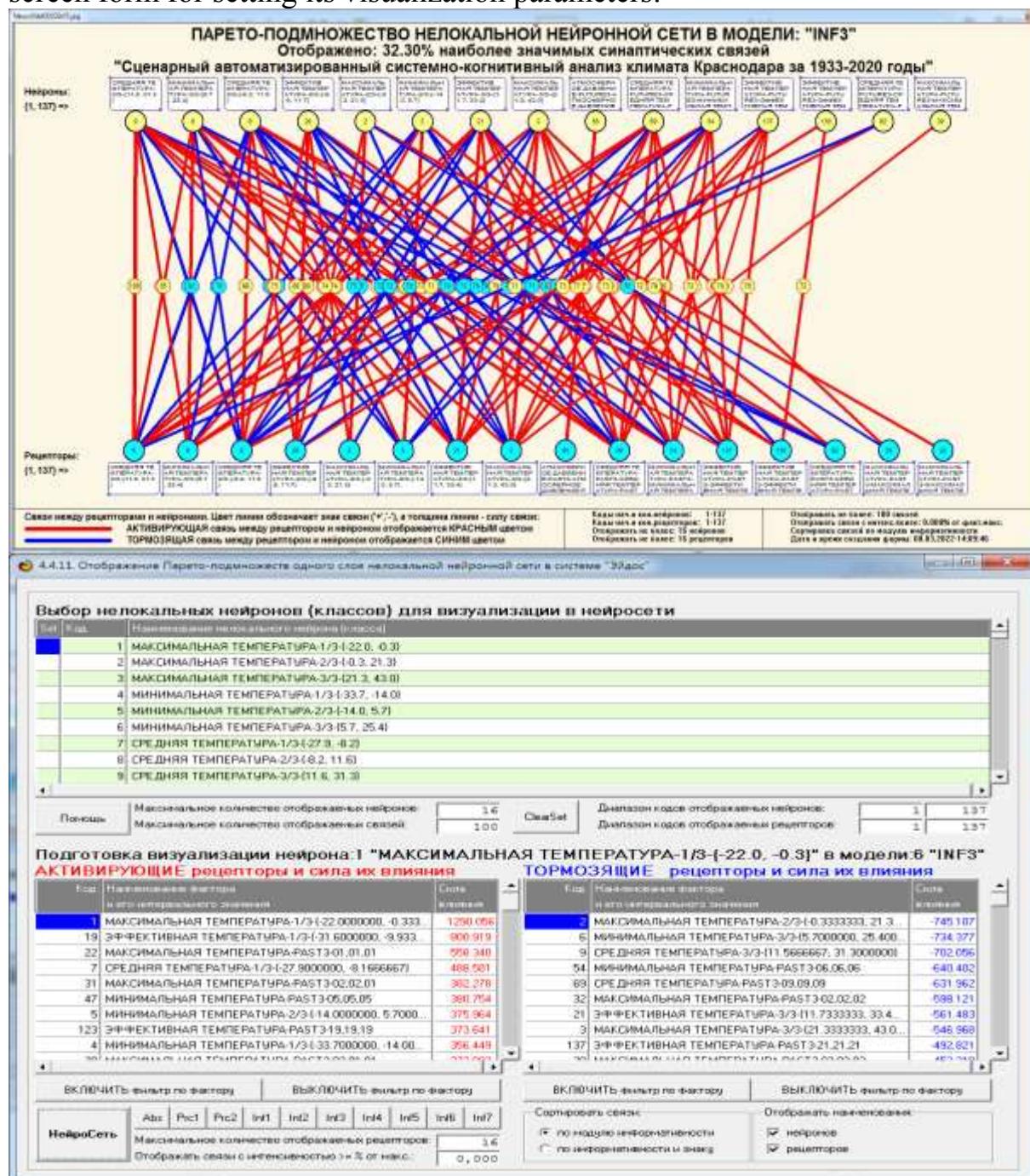
The Eidos system has the ability to build models corresponding to multilayer neural networks [12].

It is also possible to visualize any one layer of a non-local neural network (mode 4.4.11 of the Eidos system).

Such a layer in a visual form reflects the strength and direction of the influence of the receptors of a number of neurons on the degree of their activation/inhibition in the form of color and thickness of the dendrites.

Neurons in the image of the neural network layer are located from left to right in descending order of the modulus of the total strength of their determination by receptors, i.e. on the left are the results that are most rigidly conditioned by the values of the factors acting on them, and on the right - less rigidly conditioned.

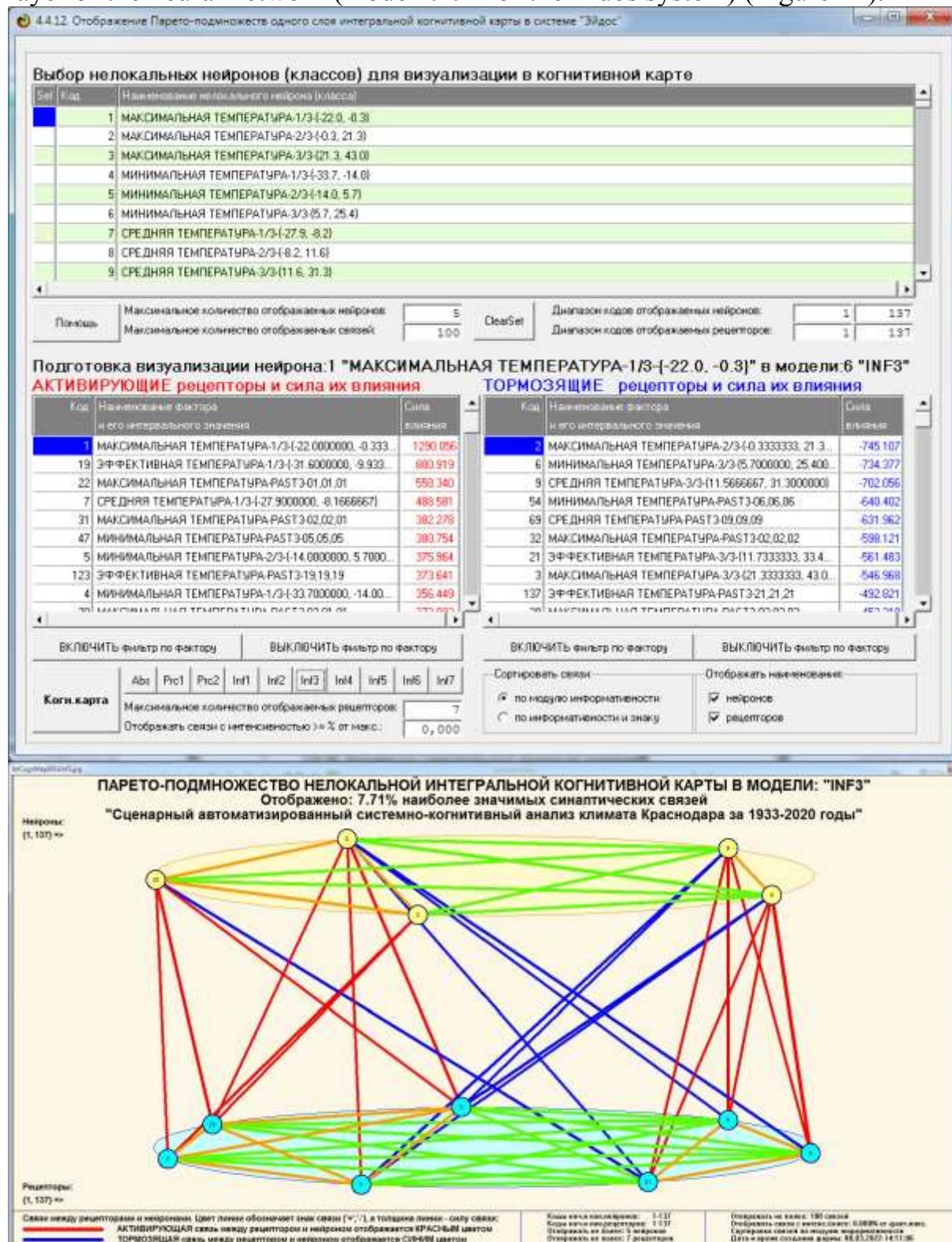
Figure 20 shows a small fragment of one layer of a neural network and a screen form for setting its visualization parameters:



Picture20. Screen forms of subsystem 4.4.11 of the Eidos system

3.8.6. 3D Integral Cognitive Maps

The 3d-integrated cognitive map is a display in one figure of cognitive class diagrams and factor values at the top and bottom, respectively, and one layer of the neural network (mode 4.4.12 of the Eidos system) (Figure 21).



Picture21. Screen forms of subsystem 4.4.12 of the Eidos system

3.8.7. 2D Integral Cognitive Maps of Meaningful Class Comparison (Mediated Fuzzy Plausible Reasoning)

In 2d-cognitive diagrams of class comparison according to the system of their determination, one can see how similar or how different the classes are from each other according to the values of the factors that determine them.

However, we do not see from this diagram how exactly these classes are similar and how exactly these classes differ in terms of the values of the factors that determine them.

We can see this from the cognitive diagram of meaningful class comparison, which is displayed in mode 4.2.3 of the Eidos system.

2D cognitive maps of meaningful class comparisons are examples of mediated fuzzy plausible logical conclusions, which Gyorgy Poya may have been the first to write about [13]. For the first time, the automated implementation of reasoning of this type in the Eidos intellectual system was written in 2002 in [1] on page 521¹⁰. This was later discussed in [7]¹¹and a number of other works of the author, so it is inappropriate to consider this issue in more detail here.

For example We know that one person has blue eyes and the other has black hair. The question is, do these features contribute to the similarity or difference between these two people? In the ASC-analysis and the Eidos system, this issue is solved in the following way. In a model based on a cluster-constructive analysis of classes and values of factors (features), it is known how similar or different features are in terms of their influence on the modeling object. Therefore, it is clear that a person with blue eyes is most likely blond, and a brunette is most likely to have dark eyes. So it is clear that these features contribute to the difference between these two people.

Figure 22 shows the screen forms of the Eidos system that provide the setting of visualization parameters for cognitive diagrams of meaningful class comparison and examples of such diagrams:

¹⁰ https://www.elibrary.ru/download/elibrary_18632909_64818704.pdf, Table 7. 17, p. 521
¹¹ <http://ej.kubagro.ru/2013/07/pdf/15.pdf>, p.44.

4.2.3. Когнитивные диаграммы классов. Задание параметров генерации выходных форм

Выбор классов для когнитивной диаграммы

Задайте коды двух классов, для левого и правого информационных портретов когнитивной диаграммы по очереди выбирая их курсором в таблице и кликая на соответствующей кнопке ниже нее

| Код | Название класса |
|-----|---|
| 0 | ВСЕ КЛАССЫ |
| 1 | МАКСИМАЛЬНАЯ ТЕМПЕРАТУРА-1/3(-22.0, -0.3) |
| 2 | МАКСИМАЛЬНАЯ ТЕМПЕРАТУРА-2/3(-33.2, 21.3) |
| 3 | МАКСИМАЛЬНАЯ ТЕМПЕРАТУРА-3/3(21.3, 43.0) |
| 4 | МИНИМАЛЬНАЯ ТЕМПЕРАТУРА-1/3(33.7, -14.0) |
| 5 | МИНИМАЛЬНАЯ ТЕМПЕРАТУРА-2/3(-14.0, 5.7) |
| 6 | МИНИМАЛЬНАЯ ТЕМПЕРАТУРА-3/3(5.7, 26.4) |

Выбор кода класса левого инф.портрета Выбор кода класса правого инф.портрета

Выбор способа фильтрации признаков в информационных портретах когнитивной диаграммы

Задайте коды двух описательных шкал, для левого и правого информационных портретов когнитивной диаграммы по очереди выбирая их курсором в таблице и кликая на соответствующей кнопке ниже нее

| Код | Название описательной шкалы | Минимальный код градации | Максимальный код градации |
|-----|-----------------------------|--------------------------|---------------------------|
| 0 | ВСЕ ОПИСАТЕЛЬНЫЕ ШКАЛЫ | 1 | 137 |
| 1 | МАКСИМАЛЬНАЯ ТЕМПЕРАТУРА | 1 | 3 |
| 2 | МИНИМАЛЬНАЯ ТЕМПЕРАТУРА | 4 | 6 |
| 3 | СРЕДНЯЯ ТЕМПЕРАТУРА | 7 | 9 |
| 4 | АТМОСФЕРНОЕ ДАВЛЕНИЕ | 10 | 12 |
| 5 | СКОРОСТЬ ВЕТРА | 13 | 15 |

Выбор кода описательной шкалы левого инф.портрета Выбор кода описательной шкалы правого инф.портрета

Задайте модели, в которых проводить расчеты когнитивных диаграмм

Abs Prc1 Prc2 Inf1 Inf2 Inf3 Inf4 Inf5 Inf6 Inf7

Задайте так количество отображаемых связей:

100

В диалоге заданы следующие параметры расчета когнитивных диаграмм:

Класс для левого инф.портрета: [0] ВСЕ КЛАССЫ
 Класс для правого инф.портрета: [0] ВСЕ КЛАССЫ
 Описательная шкала для левого инф.портрета: [0] ВСЕ ОПИСАТЕЛЬНЫЕ ШКАЛЫ
 Описательная шкала для правого инф.портрета: [0] ВСЕ ОПИСАТЕЛЬНЫЕ ШКАЛЫ
 Модели, заданные для расчета: Abs, Prc1, Prc2, Inf1, Inf2, Inf3, Inf4, Inf5, Inf6, Inf7

OK Cancel

КОГНИТИВНАЯ ДИАГРАММА КЛАССОВ В МОДЕЛИ: "INF3"
 "Сценарный автоматизированный системно-когнитивный анализ климата Краснодара за 1933-2020 годы"

Классы: [0] МАКСИМАЛЬНАЯ ТЕМПЕРАТУРА
 Класс: [1] 10(-22.0, -0.3)

Классы: [0] МИНИМАЛЬНАЯ ТЕМПЕРАТУРА
 Класс: [1] 23(-14.0, 5.7)

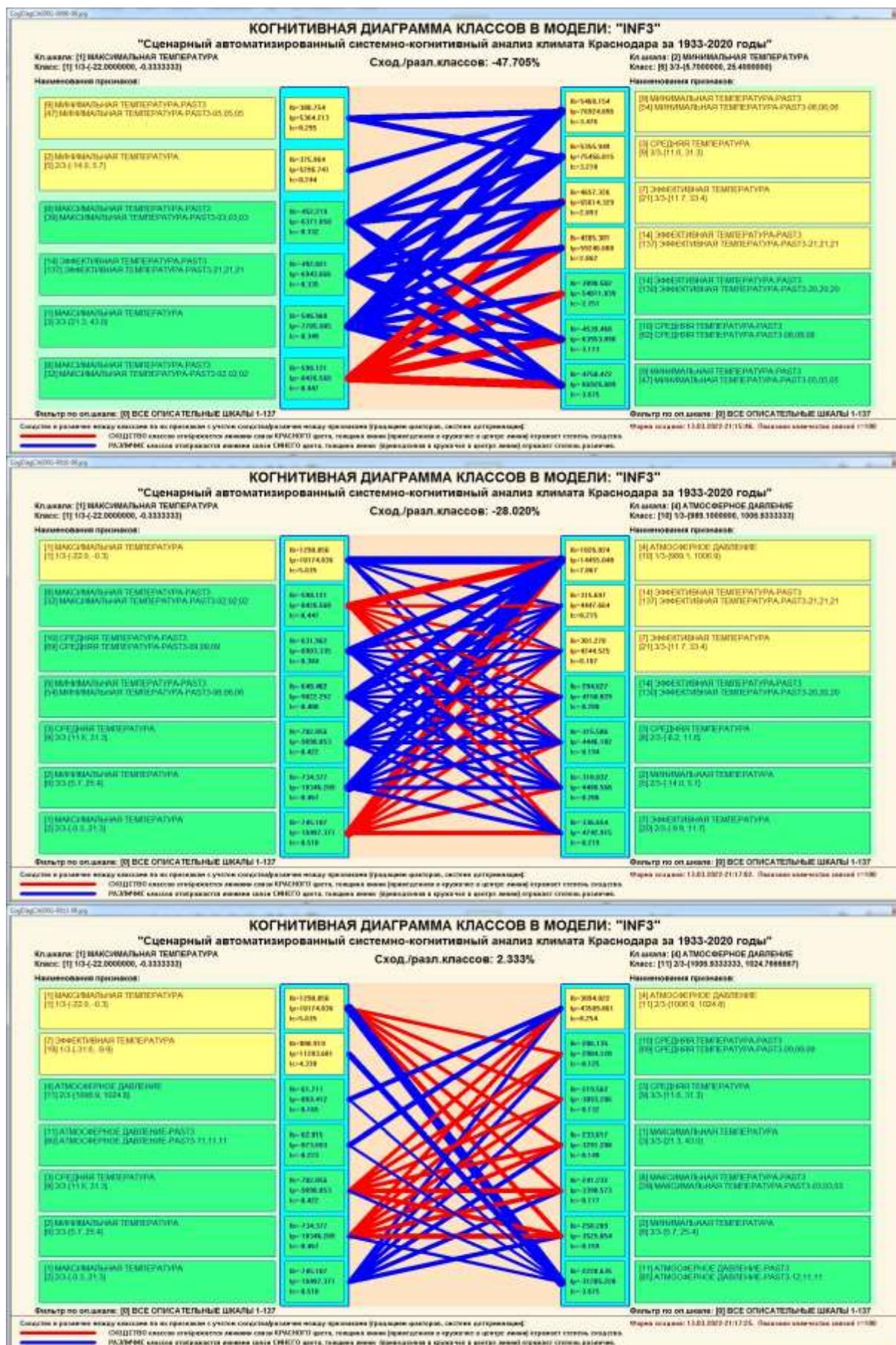
Сход./разл. классов: 42.207%

Напоминания признаков:

Фильтр по опискам: [0] ВСЕ ОПИСАТЕЛЬНЫЕ ШКАЛЫ 1-137

Фильтр по описание: [0] ВСЕ ОПИСАТЕЛЬНЫЕ ШКАЛЫ 1-137

Связи в результате между классами по избранным с учетом существующим методу признакам (выделены фильтром, остальные отключены).
 СОСТОЯНИЕ классов определяется значением поля КРАСНОГО цвета, текущее значение (раскраска в кругах) в центре ячейки) отражает статус модели.
 РАЗМЕРЫ классов отражают значение поля СЧЕТ (цвет, текущее значение (раскраска в кругах) в центре ячейки) отражает статус модели.



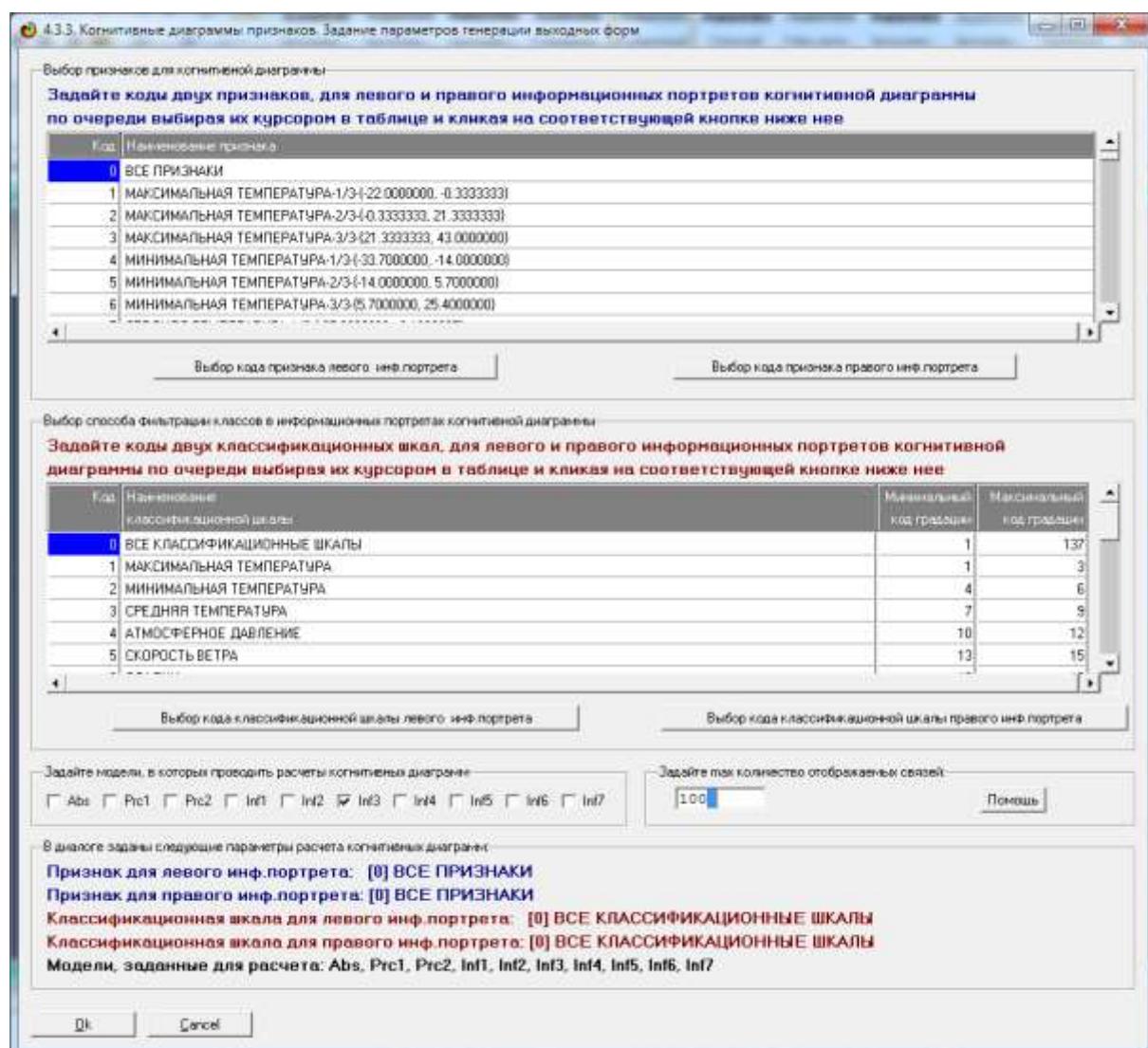
3.8.8. 2D-integrated cognitive maps of meaningful comparison of factor values (mediated fuzzy plausible reasoning)

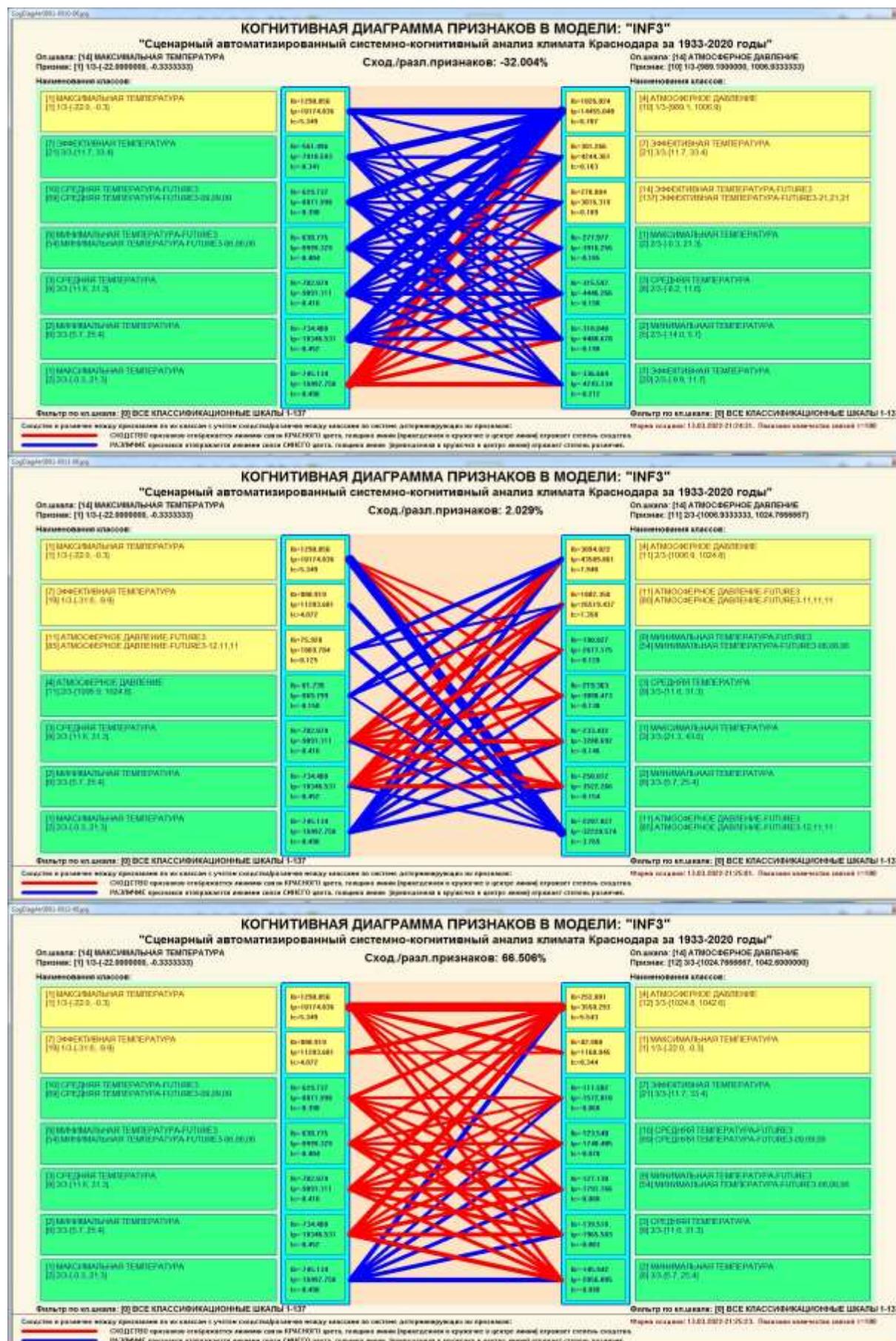
From 2d-cognitive diagrams comparing the values of factors according to their influence on the object of modeling, i.e. on its transitions to states corresponding to classes, it is quite clear how similar or different any two values of factors are in their meaning.

Recall that meaning, according to the Schenk-Abelson concept of meaning used in ASC analysis, consists in knowing the causes and consequences [14].

However, it is not clear from this diagram how exactly the values of the factors are similar or differ in their meaning.

This can be seen from the cognitive diagrams that can be obtained in mode 4.3.3 of the Eidos system (Figure 23):





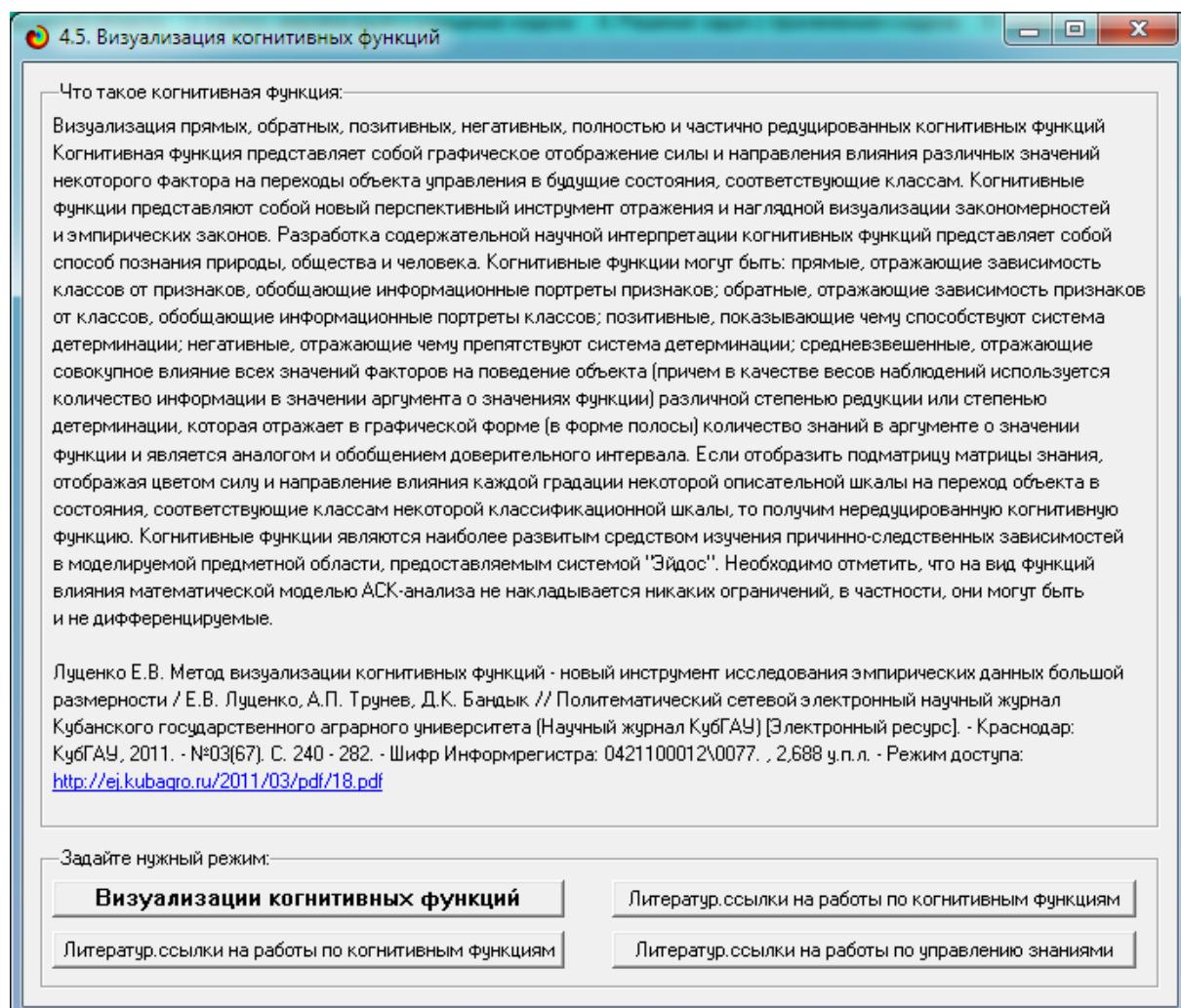
Picture23. Screen forms of mode 4.3.3 of the Eidos system

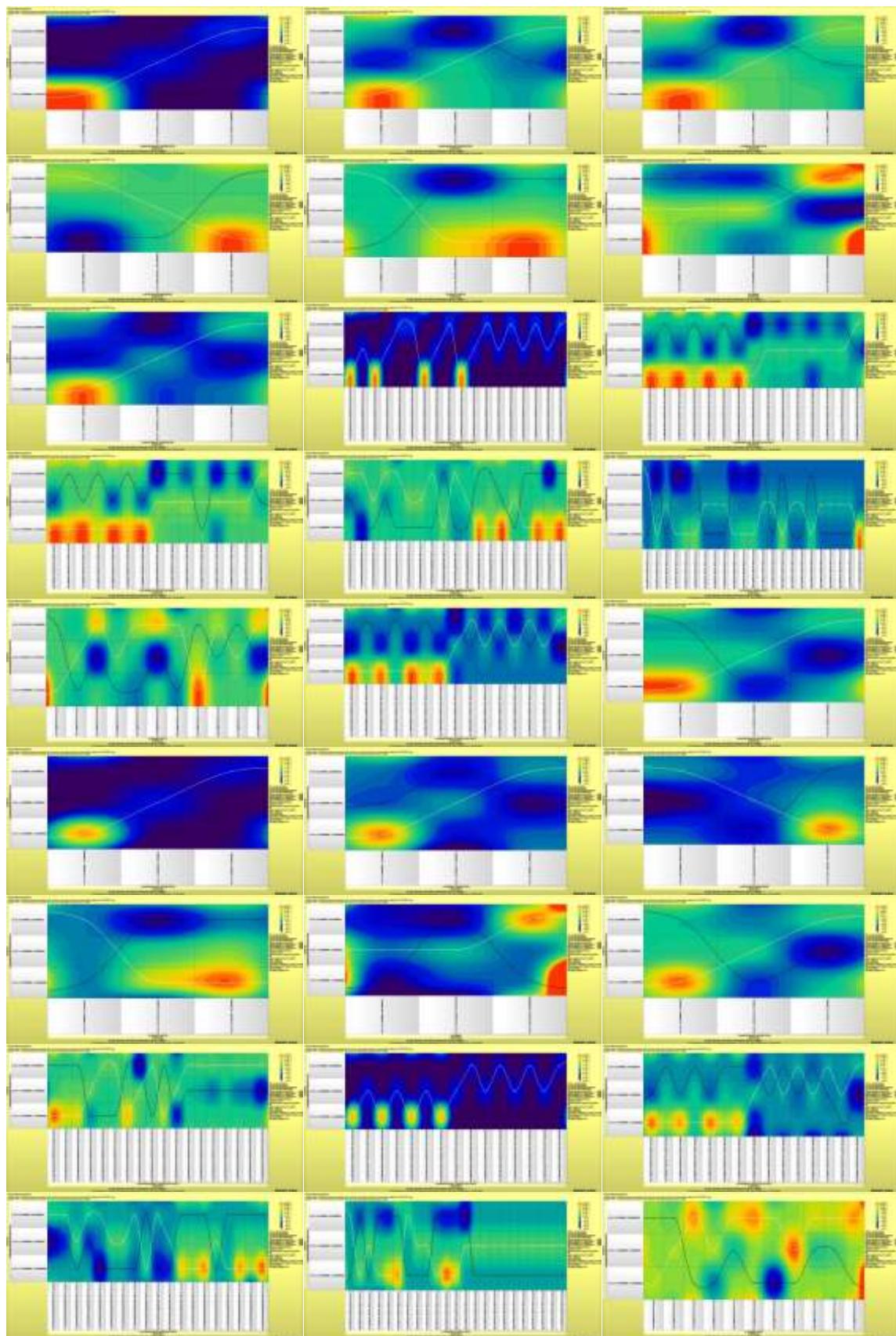
3.8.9. cognitive functions

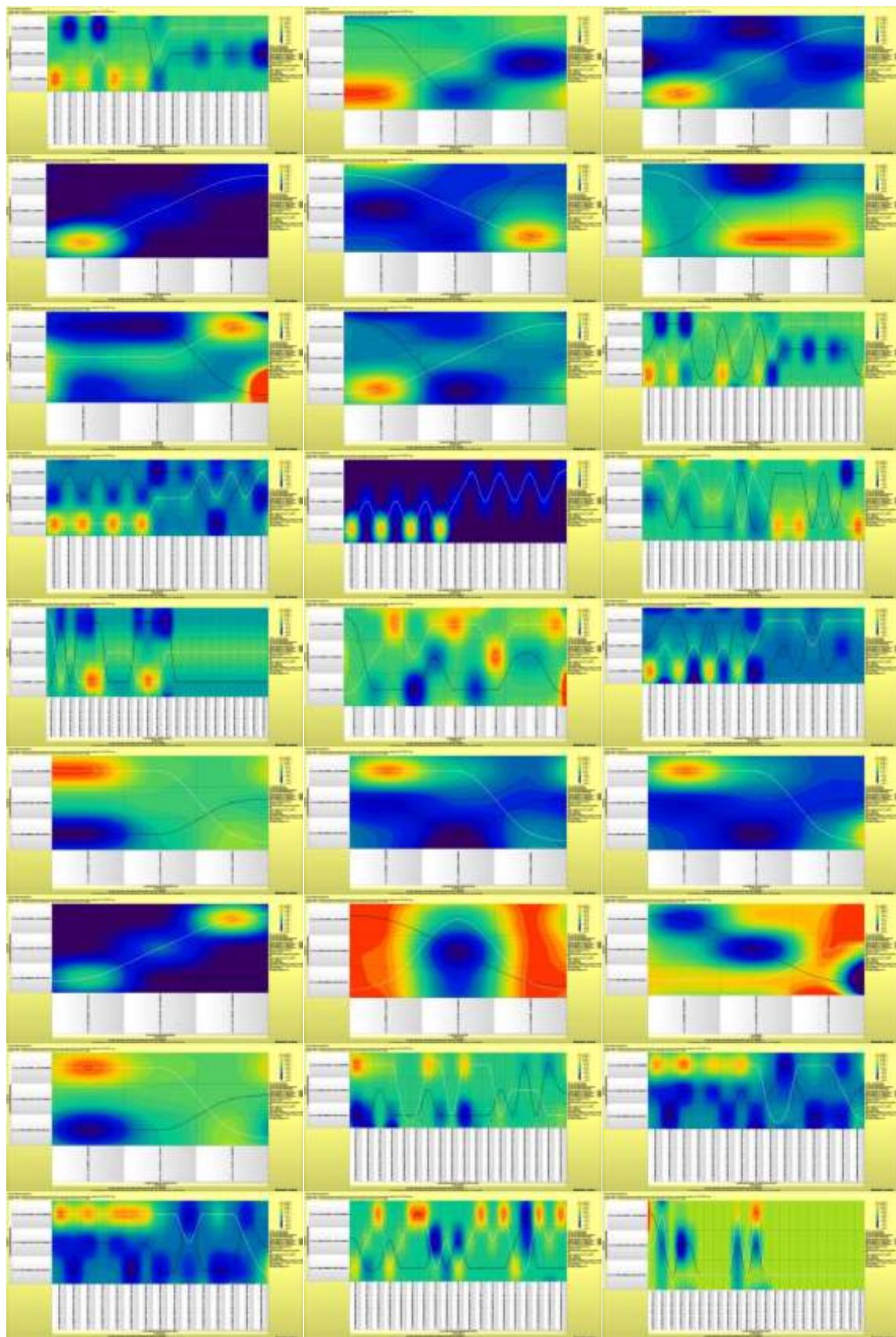
Cognitive functions are a generalization of the classical mathematical concept of a function based on system information theory and were proposed by E.V. Lutsenko in 2005 [7, 15-22].

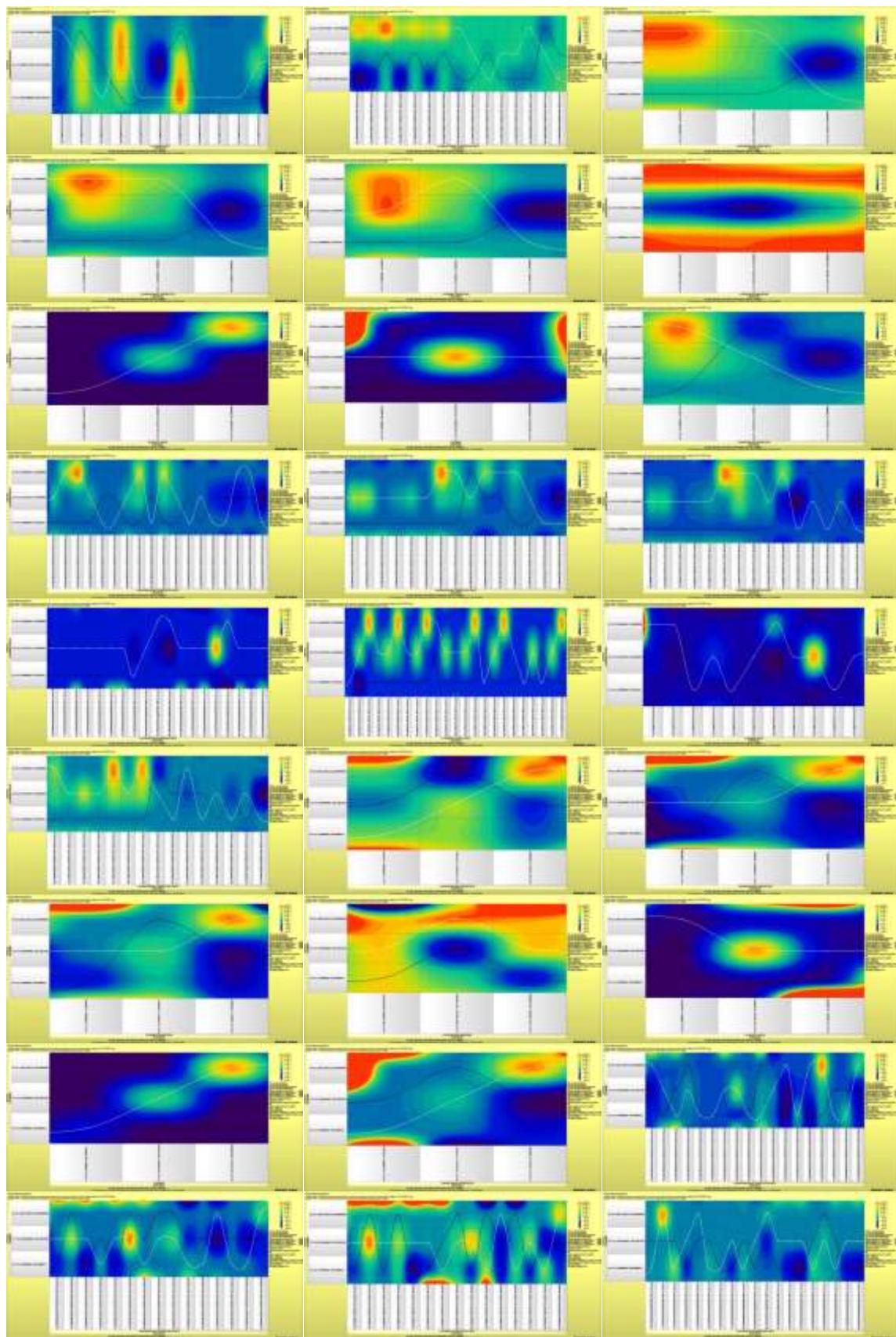
Cognitive functions reflect how much information is contained in the gradations of the descriptive scale about the transition of the modeling object to the states corresponding to the gradations of the classification scale. At the same time, in statistical and system-cognitive models, each gradation of the descriptive scale contains information about all gradations of the classification scale, i.e. each value of the argument corresponds to all values of the function, but they correspond to varying degrees, both positive and negative, which is displayed in color.

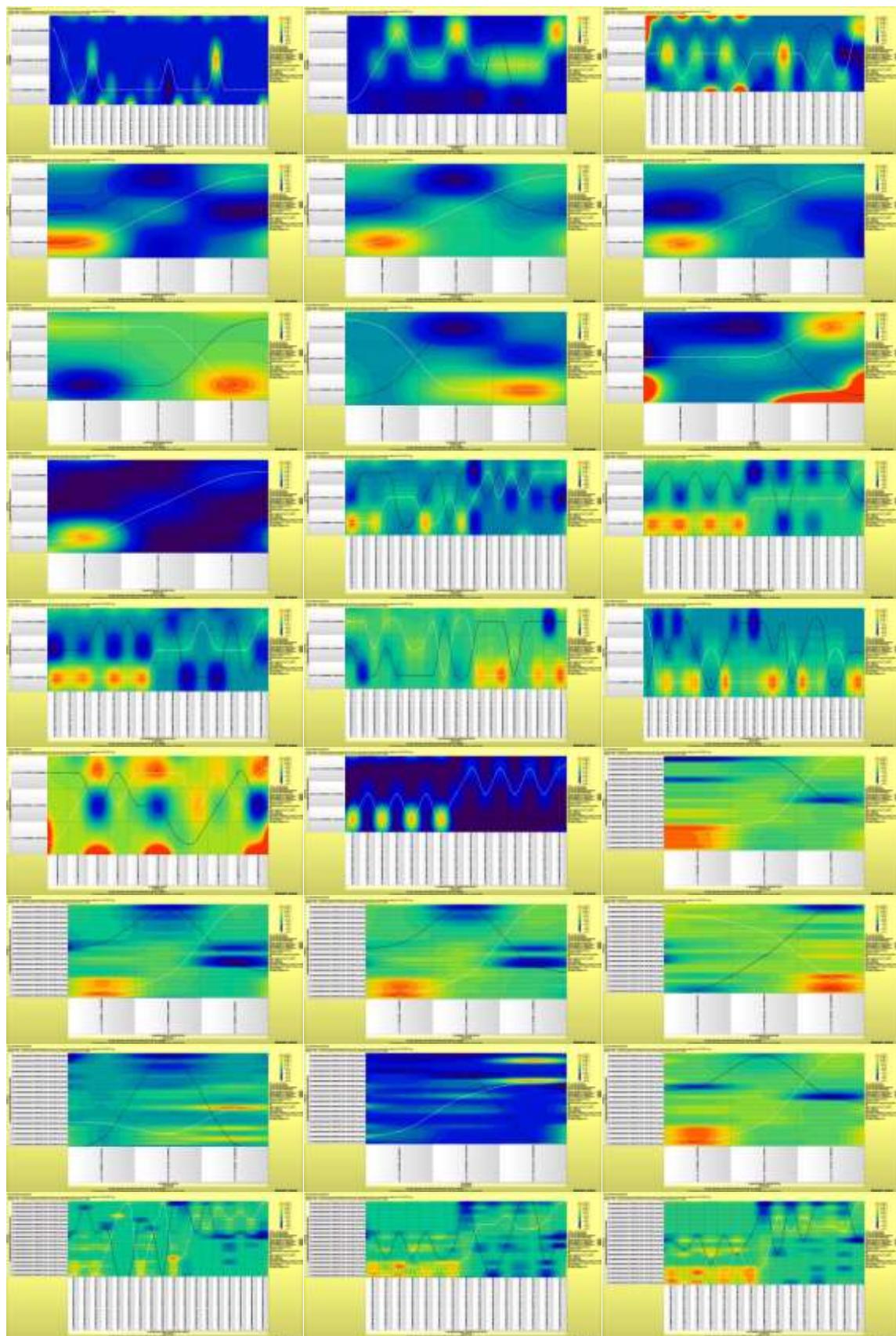
In the Eidos system, cognitive functions are displayed in mode 4.5 (Figure 24).

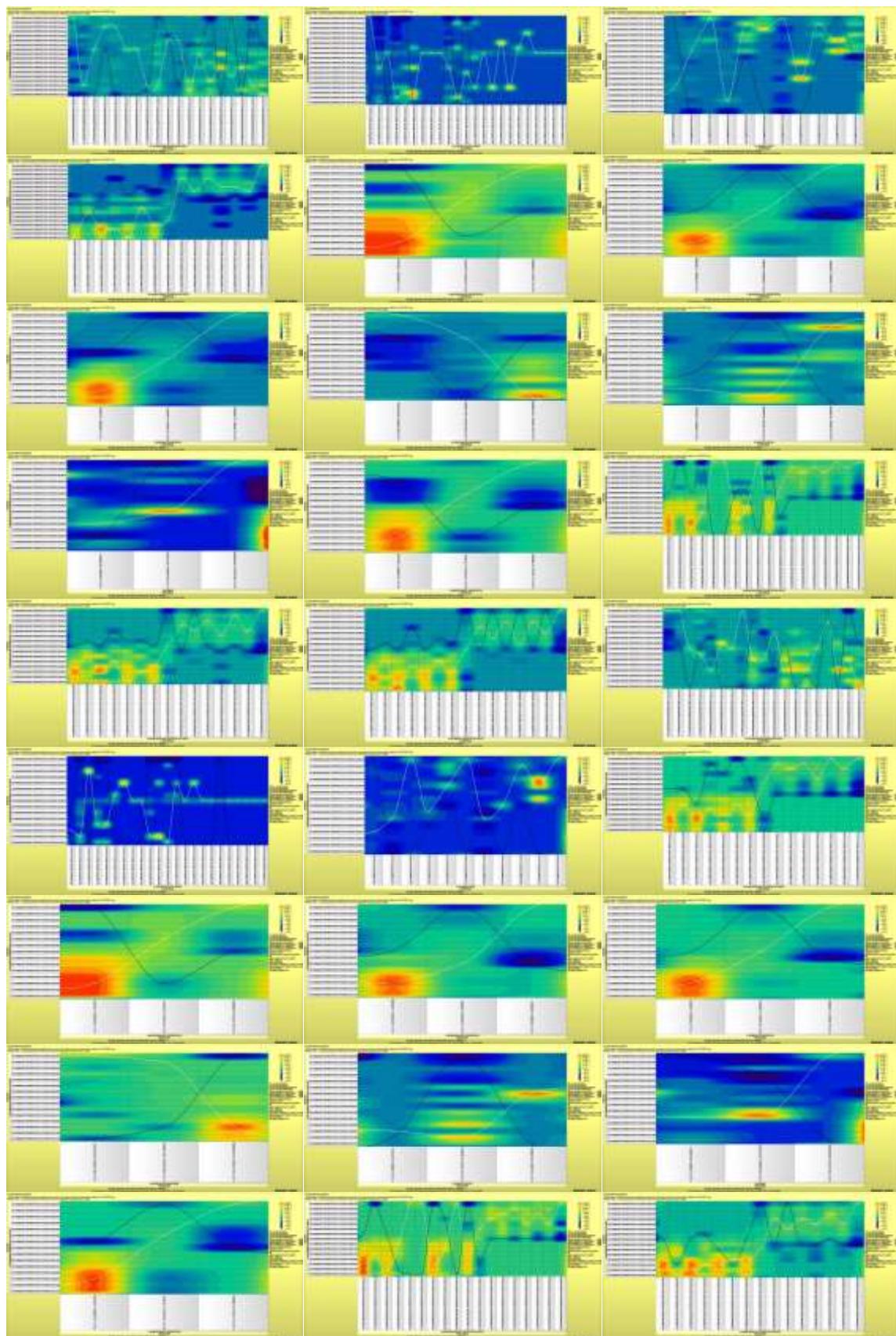


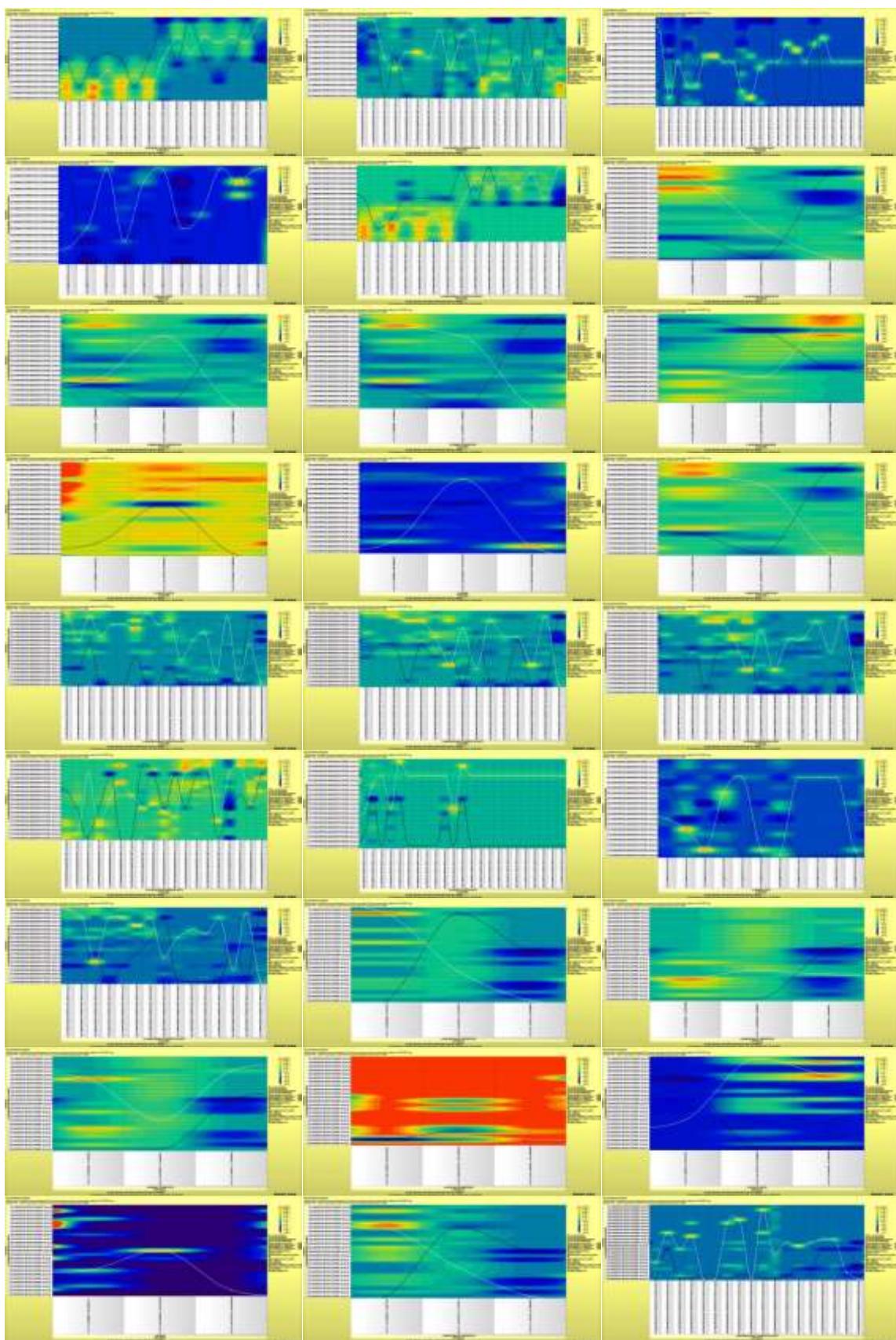


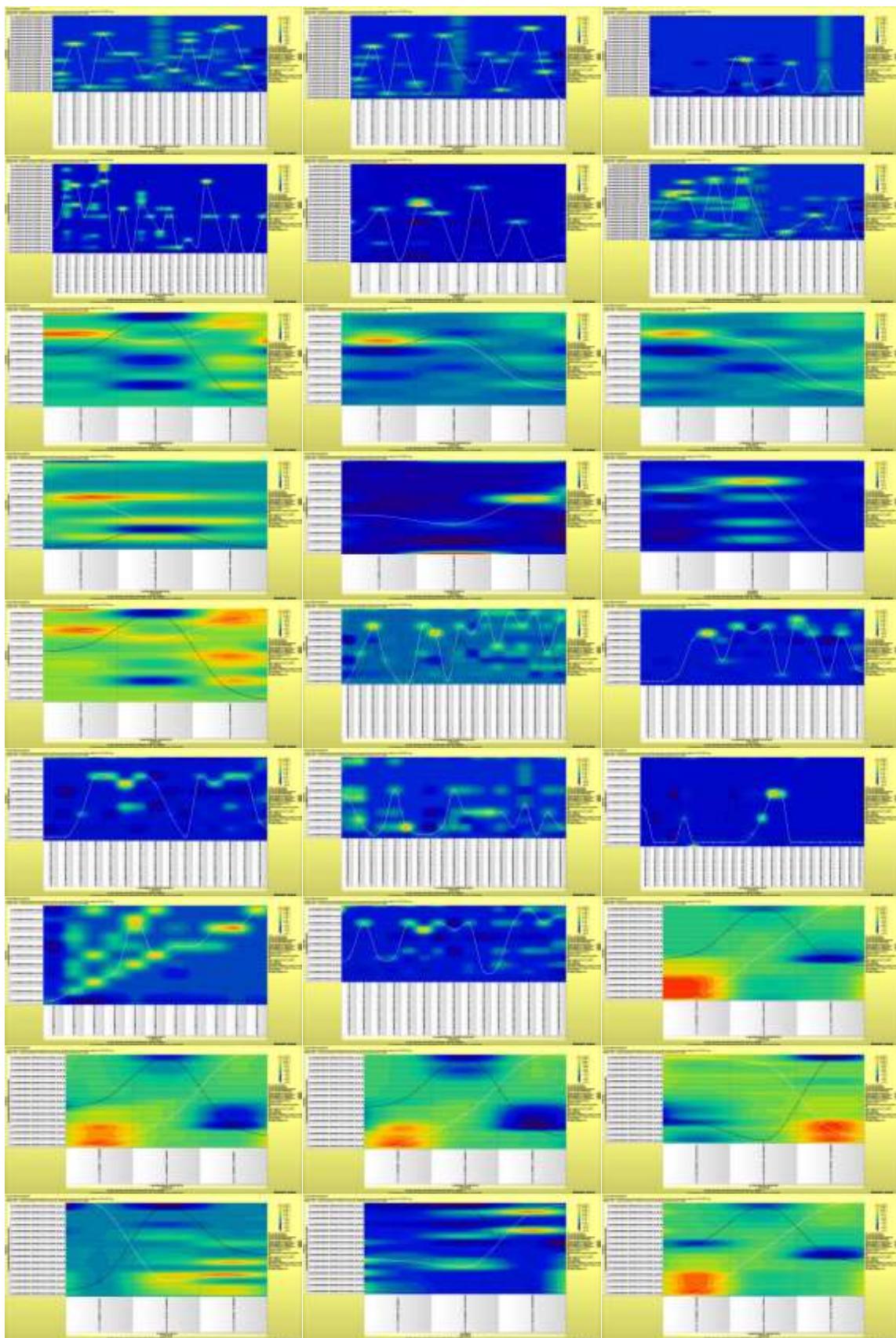


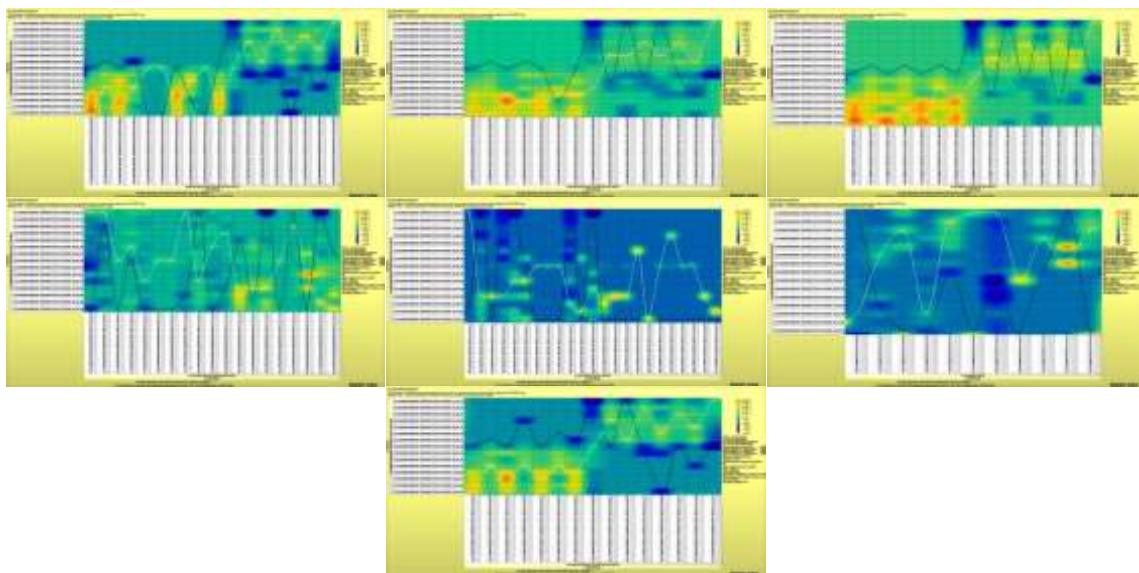












Picture24. Screen forms of mode 4.5 of the Eidos system: Cognitive functions

Among the given cognitive functions, there are interesting regularities in the modeled subject area. But a meaningful interpretation of these patterns is the business of climatologists.

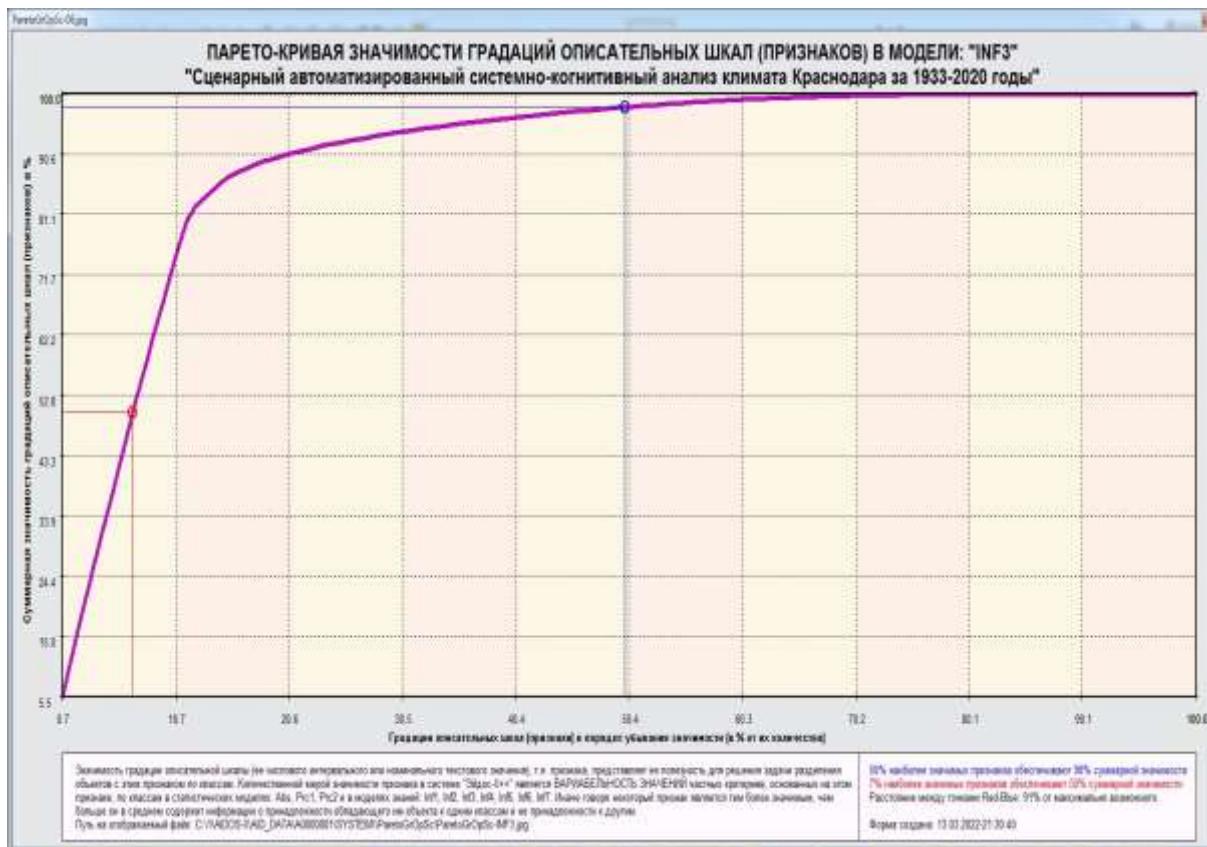
3.8.10. Significance of descriptive scales and their gradations

In the ASC analysis, all factors are considered from one single point of view: how much information is contained in their values about the transition of the modeling and control object, on which they act, to a certain future state described by the class (gradation of the classification scale), and at the same time the strength and direction the influence of all factor values on an object is measured in one unit of measurement common to all factors: units of the amount of information [6].

Significance (selective power) of gradations of descriptive scales in ASC analysis, this is the variability of particular criteria in statistical and system-cognitive models, for example, in the Infl model, this is the variability of informativeness (mode 3.7.5 of the Eidos system).

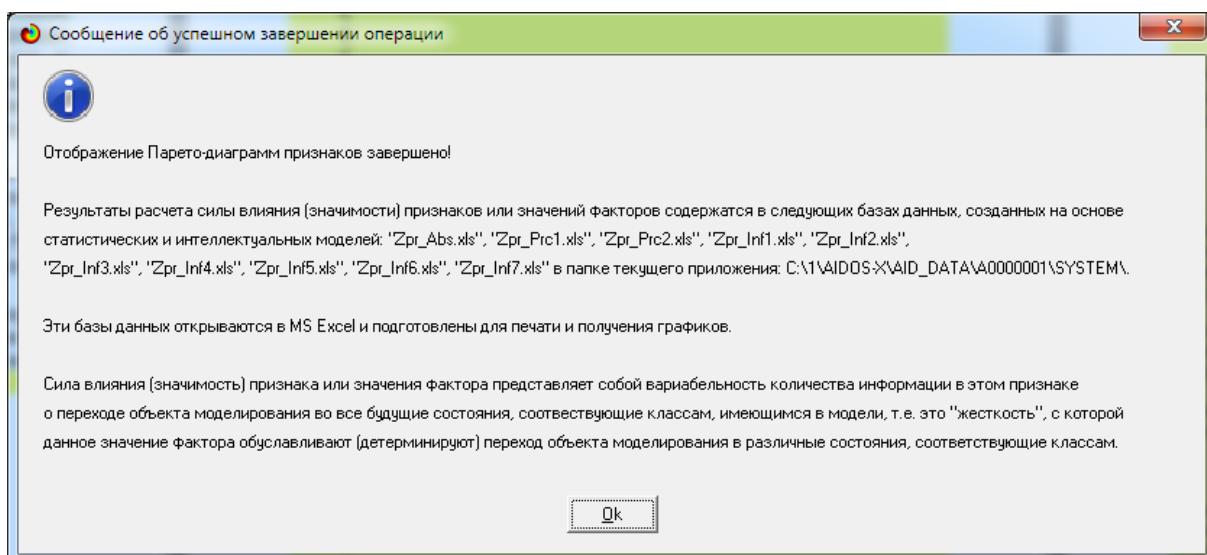
Significance of the entire descriptive scale is the average of the degree of significance of its gradations (mode 3.7.4 of the Eidos system).

If we sort all the gradations of factors (features) in descending order of selective power and get the sum of the selective power of the system of factor values on an accrual basis, we will get the Pareto curve shown in Figure 25.



Picture25. The significance of the values of factors on a cumulative basis: mode 3.75 of the Eidos system

The names of the Excel tables with the information on the basis of which Figure 25 is built are shown in Figure 26:



Picture26. Names of Excel tables with information on the basis of which Figure 25 is built

Table 11 provides information on the significance of the values of climatic factors on a cumulative basis:

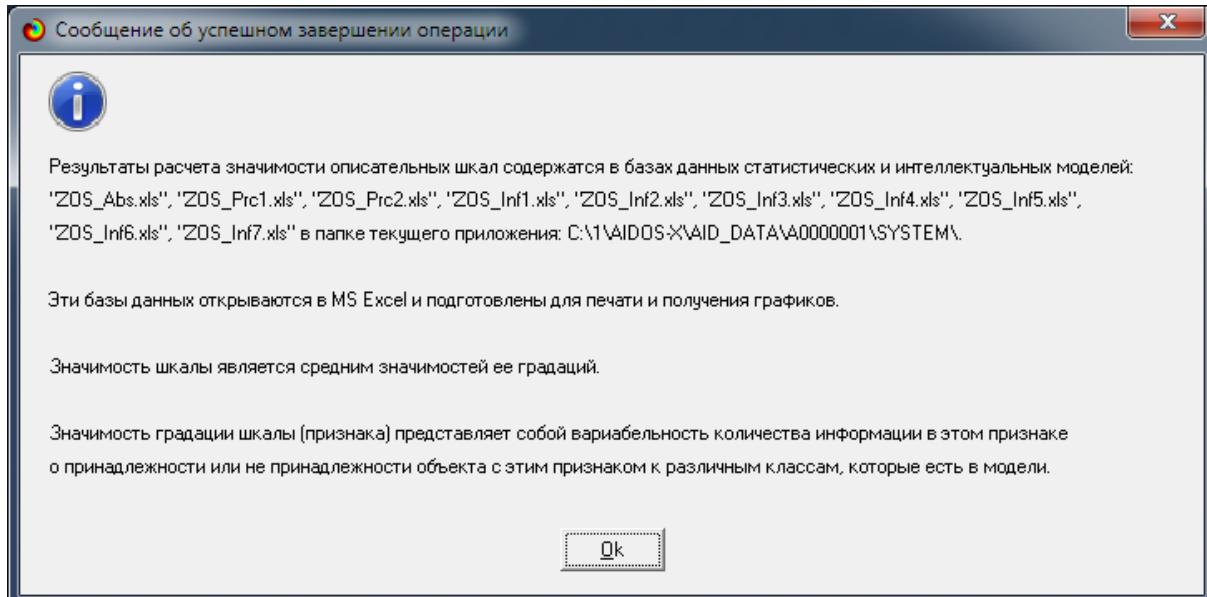
table11– The significance of the values of climatic factors

| No. | No.% | Factor value code | Factor value name | Factor code | Significance of the factor value, % | Significance of the factor value, % cumulatively |
|-----|-------|-------------------|--|-------------|-------------------------------------|--|
| 1 | 0,73 | 9 | AVERAGE TEMPERATURE-3/3-[11.56666667, 31.3000000] | 3 | 5.54 | 5.54 |
| 2 | 1,46 | 69 | AVERAGE TEMPERATURE-PAST3-AVERAGE TEMPERATURE-PAST3-09,09,09 | 10 | 5.47 | 11.01 |
| 3 | 2,19 | 8 | AVERAGE TEMPERATURE-2/3-{-8.16666667, 11.56666667} | 3 | 5.42 | 16.43 |
| 4 | 2,92 | 21 | EFFECTIVE TEMPERATURE-3/3-[11.7333333, 33.4000000] | 7 | 5.36 | 21.79 |
| 5 | 3,65 | 6 | MINIMUM TEMPERATURE-3/3-[5.7000000, 25.4000000] | 2 | 5.23 | 27.03 |
| 6 | 4,38 | 54 | MINIMUM TEMPERATURE-PAST3-MINIMUM TEMPERATURE-PAST3-06,06,06 | 9 | 5.23 | 32.25 |
| 7 | 5,11 | 3 | MAXIMUM TEMPERATURE-3/3-[21.3333333, 43.0000000] | 1 | 5.22 | 37.47 |
| 8 | 5,84 | 5 | MINIMUM TEMPERATURE-2/3-{-14.0000000, 5.7000000} | 2 | 5.13 | 42.60 |
| 9 | 6,57 | 20 | EFFECTIVE TEMPERATURE-2/3-{-9.9333333, 11.7333333} | 7 | 5.12 | 47.72 |
| 10 | 7,30 | 137 | EFFICIENT TEMPERATURE-PAST3-EFFICIENT TEMPERATURE-PAST3-21,21,21 | 14 | 4.89 | 52.61 |
| 11 | 8,03 | 2 | MAXIMUM TEMPERATURE-2/3-{-0.3333333, 21.3333333} | 1 | 4.86 | 57.47 |
| 12 | 8,76 | 62 | AVERAGE TEMPERATURE-PAST3-AVERAGE TEMPERATURE-PAST3-08,08,08 | 10 | 4.76 | 62.23 |
| 13 | 9,49 | 130 | EFFICIENT TEMPERATURE-PAST3-EFFICIENT TEMPERATURE-PAST3-20,20,20 | 14 | 4.71 | 66.94 |
| 14 | 10,22 | 39 | MAXIMUM TEMPERATURE-PAST3-MAXIMUM TEMPERATURE-PAST3-03,03,03 | 8 | 4.54 | 71.48 |
| 15 | 10,95 | 32 | MAXIMUM TEMPERATURE-PAST3-MAXIMUM TEMPERATURE-PAST3-02,02,02 | 8 | 4.46 | 75.94 |
| 16 | 11,68 | 47 | MINIMUM TEMPERATURE-PAST3-MINIMUM TEMPERATURE-PAST3-05,05,05 | 9 | 4.30 | 80.24 |
| 17 | 12,41 | 85 | ATMOSPHERIC PRESSURE-PAST3-ATMOSPHERIC PRESSURE-PAST3-12,11,11 | 11 | 2.01 | 82.25 |
| 18 | 13,14 | 112 | DRAINAGE-PAST3-RAIDITATION-PAST3-16,16,16 | 13 | 1.28 | 83.53 |
| 19 | 13,87 | 16 | RAIN-1/3-{1.0000000, 100.6666667} | 6 | 1.25 | 84.78 |
| 20 | 14,60 | 11 | ATMOSPHERIC PRESSURE-2/3-{1006.9333333, 1024.7666667} | 4 | 1.25 | 86.03 |
| 21 | 15,33 | 80 | ATMOSPHERIC PRESSURE-PAST3-ATMOSPHERIC PRESSURE-PAST3-11,11,11 | 11 | 0.93 | 86.96 |
| 22 | 16,06 | 1 | MAXIMUM TEMPERATURE-1/3-{-22.0000000, -0.3333333} | 1 | 0.76 | 87.72 |
| 23 | 16,79 | 19 | EFFECTIVE TEMPERATURE-1/3-{-31.6000000, -9.9333333} | 7 | 0.62 | 88.33 |
| 24 | 17,52 | 77 | ATMOSPHERIC PRESSURE-PAST3-ATMOSPHERIC PRESSURE-PAST3-11,10,10 | 11 | 0.53 | 88.86 |
| 25 | 18,25 | 10 | ATMOSPHERIC PRESSURE-1/3-{989.1000000, 1006.9333333} | 4 | 0.48 | 89.35 |
| 26 | 18,98 | 13 | WIND SPEED-1/3-{1.0000000, 10.3333333} | 5 | 0.38 | 89.73 |
| 27 | 19,71 | 89 | WIND SPEED-PAST3-WIND SPEED-PAST3-13,13,13 | 12 | 0.38 | 90.11 |
| 28 | 20,44 | 7 | AVERAGE TEMPERATURE-1/3-{-27.9000000, -8.1666667} | 3 | 0.37 | 90.49 |
| 29 | 21,17 | 22 | MAXIMUM TEMPERATURE-PAST3-MAXIMUM TEMPERATURE-PAST3-01,01,01 | 8 | 0.35 | 90.84 |
| 30 | 21,90 | 35 | MAXIMUM TEMPERATURE-PAST3-MAXIMUM TEMPERATURE-PAST3-02,03,03 | 8 | 0.32 | 91.16 |
| 31 | 22,63 | 51 | MINIMUM TEMPERATURE-PAST3-MINIMUM TEMPERATURE-PAST3-06,05,05 | 9 | 0.31 | 91.47 |
| 32 | 23,36 | 4 | MINIMUM TEMPERATURE-1/3-{-33.7000000, -14.0000000} | 2 | 0.30 | 91.77 |
| 33 | 24,09 | 123 | EFFICIENT TEMPERATURE-PAST3-EFFICIENT TEMPERATURE-PAST3-19,19,19 | 14 | 0.29 | 92.06 |
| 34 | 24,82 | 33 | MAXIMUM TEMPERATURE-PAST3-MAXIMUM TEMPERATURE-PAST3-02,02,03 | 8 | 0.26 | 92.32 |
| 35 | 25,55 | 66 | AVERAGE TEMPERATURE-PAST3-AVERAGE TEMPERATURE-PAST3-09,08,08 | 10 | 0.24 | 92.56 |
| 36 | 26,28 | 38 | MAXIMUM TEMPERATURE-PAST3-MAXIMUM TEMPERATURE-PAST3-03,03,02 | 8 | 0.23 | 92.79 |
| 37 | 27,01 | 53 | MINIMUM TEMPERATURE-PAST3-MINIMUM TEMPERATURE-PAST3-06,06,05 | 9 | 0.23 | 93.02 |
| 38 | 27,74 | 133 | EFFICIENT TEMPERATURE-PAST3-EFFICIENT TEMPERATURE-PAST3-20,21,21 | 14 | 0.23 | 93.25 |
| 39 | 28,47 | 31 | MAXIMUM TEMPERATURE-PAST3-MAXIMUM TEMPERATURE-PAST3-02,02,01 | 8 | 0.22 | 93.47 |
| 40 | 29,20 | 48 | MINIMUM TEMPERATURE-PAST3-MINIMUM TEMPERATURE-PAST3-05,05,06 | 9 | 0.22 | 93.69 |
| 41 | 29,93 | 70 | ATMOSPHERIC PRESSURE-PAST3-ATMOSPHERIC PRESSURE-PAST3-10,10,10 | 11 | 0.22 | 93.91 |
| 42 | 30,66 | 25 | MAXIMUM TEMPERATURE-PAST3-MAXIMUM TEMPERATURE-PAST3-01,02,02 | 8 | 0.21 | 94.12 |
| 43 | 31,39 | 68 | AVERAGE TEMPERATURE-PAST3-AVERAGE TEMPERATURE-PAST3-09,09,08 | 10 | 0.20 | 94.32 |
| 44 | 32,12 | 131 | EFFICIENT TEMPERATURE-PAST3-EFFICIENT TEMPERATURE-PAST3-20,20,21 | 14 | 0.19 | 94.50 |
| 45 | 32,85 | 129 | EFFICIENT TEMPERATURE-PAST3-EFFICIENT TEMPERATURE-PAST3-20,20,19 | 14 | 0.18 | 94.68 |
| 46 | 33,58 | 49 | MINIMUM TEMPERATURE-PAST3-MINIMUM TEMPERATURE-PAST3-05,06,05 | 9 | 0.17 | 94.86 |
| 47 | 34,31 | 63 | AVERAGE TEMPERATURE-PAST3-AVERAGE TEMPERATURE-PAST3-08,08,09 | 10 | 0.17 | 95.02 |
| 48 | 35,04 | 36 | MAXIMUM TEMPERATURE-PAST3-MAXIMUM TEMPERATURE-PAST3-03,02,02 | 8 | 0.16 | 95.19 |
| 49 | 35,77 | 28 | MAXIMUM TEMPERATURE-PAST3-MAXIMUM TEMPERATURE-PAST3-02,01,01 | 8 | 0.16 | 95.35 |
| 50 | 36,50 | 136 | EFFICIENT TEMPERATURE-PAST3-EFFICIENT TEMPERATURE-PAST3-21,21,20 | 14 | 0.16 | 95.51 |
| 51 | 37,23 | 50 | MINIMUM TEMPERATURE-PAST3-MINIMUM TEMPERATURE-PAST3-05,06,06 | 9 | 0.15 | 95.66 |
| 52 | 37,96 | 126 | EFFICIENT TEMPERATURE-PAST3-EFFICIENT TEMPERATURE-PAST3-19,20,20 | 14 | 0.15 | 95.81 |
| 53 | 38,69 | 37 | MAXIMUM TEMPERATURE-PAST3-MAXIMUM TEMPERATURE-PAST3-03,02,03 | 8 | 0.15 | 95.96 |
| 54 | 39,42 | 12 | ATMOSPHERIC PRESSURE-3/3-{1024.7666667, 1042.6000000} | 4 | 0.14 | 96.11 |
| 55 | 40,15 | 55 | AVERAGE TEMPERATURE-PAST3-AVERAGE TEMPERATURE-PAST3-07,07,07 | 10 | 0.14 | 96.25 |
| 56 | 40,88 | 118 | DRAINAGE-PAST3-RAIDITATION-PAST3-17,16,16 | 13 | 0.14 | 96.39 |
| 57 | 41,61 | 23 | MAXIMUM TEMPERATURE-PAST3-MAXIMUM TEMPERATURE-PAST3-01,01,02 | 8 | 0.14 | 96.53 |
| 58 | 42,34 | 79 | ATMOSPHERIC PRESSURE-PAST3-ATMOSPHERIC PRESSURE-PAST3-11,11,10 | 11 | 0.14 | 96.67 |
| 59 | 43,07 | 134 | EFFICIENT TEMPERATURE-PAST3-EFFICIENT TEMPERATURE-PAST3-21,20,20 | 14 | 0.13 | 96.80 |
| 60 | 43,80 | 127 | EFFICIENT TEMPERATURE-PAST3-EFFICIENT TEMPERATURE-PAST3-20,19,19 | 14 | 0.13 | 96.93 |
| 61 | 44,53 | 65 | AVERAGE TEMPERATURE-PAST3-AVERAGE TEMPERATURE-PAST3-08,09,09 | 10 | 0.13 | 97.06 |
| 62 | 45,26 | 74 | ATMOSPHERIC PRESSURE-PAST3-ATMOSPHERIC PRESSURE-PAST3-10,11,11 | 11 | 0.13 | 97.19 |
| 63 | 45,99 | 113 | DRAINAGE-PAST3-RAIDITATION-PAST3-16,16,17 | 13 | 0.13 | 97.32 |
| 64 | 46,72 | 61 | AVERAGE TEMPERATURE-PAST3-AVERAGE TEMPERATURE-PAST3-08,08,07 | 10 | 0.12 | 97.44 |
| 65 | 47,45 | 71 | ATMOSPHERIC PRESSURE-PAST3-ATMOSPHERIC PRESSURE-PAST3-10,10,11 | 11 | 0.12 | 97.56 |
| 66 | 48,18 | 14 | WIND SPEED-2/3-{10.3333333, 19.6666667} | 5 | 0.11 | 97.67 |
| 67 | 48,91 | 124 | EFFICIENT TEMPERATURE-PAST3-EFFICIENT TEMPERATURE-PAST3-19,19,20 | 14 | 0.11 | 97.78 |

| | | | | | | |
|-----|--------|-----|--|----|------|--------|
| 68 | 49,64 | 64 | AVERAGE TEMPERATURE-PAST3-AVERAGE TEMPERATURE-PAST3-08,09,08 | 10 | 0.11 | 97.89 |
| 69 | 50,36 | 46 | MINIMUM TEMPERATURE-PAST3-MINIMUM TEMPERATURE-PAST3-05,05,04 | 9 | 0.11 | 97.99 |
| 70 | 51,09 | 29 | MAXIMUM TEMPERATURE-PAST3-MAXIMUM TEMPERATURE-PAST3-02,01,02 | 8 | 0.10 | 98.09 |
| 71 | 51,82 | 40 | MINIMUM TEMPERATURE-PAST3-MINIMUM TEMPERATURE-PAST3-04,04,04 | 9 | 0.10 | 98.19 |
| 72 | 52,55 | 115 | DRAINAGE-PAST3-RADIATION-PAST3-16,17,16 | 13 | 0.10 | 98.29 |
| 73 | 53,28 | 135 | EFFICIENT TEMPERATURE-PAST3-EFFICIENT TEMPERATURE-PAST3-21,20,21 | 14 | 0.10 | 98.39 |
| 74 | 54,01 | 59 | AVERAGE TEMPERATURE-PAST3-AVERAGE TEMPERATURE-PAST3-08,07,07 | 10 | 0.09 | 98.48 |
| 75 | 54,74 | 58 | AVERAGE TEMPERATURE-PAST3-AVERAGE TEMPERATURE-PAST3-07,08,08 | 10 | 0.09 | 98.57 |
| 76 | 55,47 | 78 | ATMOSPHERIC PRESSURE-PAST3-ATMOSPHERIC PRESSURE-PAST3-11,10,11 | 11 | 0.09 | 98.65 |
| 77 | 56,20 | 34 | MAXIMUM TEMPERATURE-PAST3-MAXIMUM TEMPERATURE-PAST3-02,03,02 | 8 | 0.08 | 98.74 |
| 78 | 56,93 | 90 | WIND SPEED-PAST3-WIND SPEED-PAST3-13,13,14 | 12 | 0.08 | 98.82 |
| 79 | 57,66 | 44 | MINIMUM TEMPERATURE-PAST3-MINIMUM TEMPERATURE-PAST3-05,04,04 | 9 | 0.08 | 98.89 |
| 80 | 58,39 | 43 | MINIMUM TEMPERATURE-PAST3-MINIMUM TEMPERATURE-PAST3-04,05,05 | 9 | 0.07 | 98.97 |
| 81 | 59,12 | 52 | MINIMUM TEMPERATURE-PAST3-MINIMUM TEMPERATURE-PAST3-06,05,06 | 9 | 0.07 | 99.04 |
| 82 | 59,85 | 128 | EFFICIENT TEMPERATURE-PAST3-EFFICIENT TEMPERATURE-PAST3-20,19,20 | 14 | 0.06 | 99.10 |
| 83 | 60,58 | 56 | AVERAGE TEMPERATURE-PAST3-AVERAGE TEMPERATURE-PAST3-07,07,08 | 10 | 0.06 | 99.16 |
| 84 | 61,31 | 132 | EFFICIENT TEMPERATURE-PAST3-EFFICIENT TEMPERATURE-PAST3-20,21,20 | 14 | 0.06 | 99.22 |
| 85 | 62,04 | 81 | ATMOSPHERIC PRESSURE-PAST3-ATMOSPHERIC PRESSURE-PAST3-11,11,12 | 11 | 0.05 | 99.27 |
| 86 | 62,77 | 41 | MINIMUM TEMPERATURE-PAST3-MINIMUM TEMPERATURE-PAST3-04,04,05 | 9 | 0.05 | 99.32 |
| 87 | 63,50 | 67 | AVERAGE TEMPERATURE-PAST3-AVERAGE TEMPERATURE-PAST3-09,08,09 | 10 | 0.05 | 99.37 |
| 88 | 64,23 | 98 | WIND SPEED-PAST3-WIND SPEED-PAST3-14,13,13 | 12 | 0.05 | 99.42 |
| 89 | 64,96 | 88 | ATMOSPHERIC PRESSURE-PAST3-ATMOSPHERIC PRESSURE-PAST3-12,12,12 | 11 | 0.05 | 99.47 |
| 90 | 65,69 | 24 | MAXIMUM TEMPERATURE-PAST3-MAXIMUM TEMPERATURE-PAST3-01,02,01 | 8 | 0.04 | 99.51 |
| 91 | 66,42 | 60 | AVERAGE TEMPERATURE-PAST3-AVERAGE TEMPERATURE-PAST3-08,07,08 | 10 | 0.04 | 99.55 |
| 92 | 67,15 | 92 | WIND SPEED-PAST3-WIND SPEED-PAST3-13,14,13 | 12 | 0.04 | 99.59 |
| 93 | 67,88 | 87 | ATMOSPHERIC PRESSURE-PAST3-ATMOSPHERIC PRESSURE-PAST3-12,12,11 | 11 | 0.04 | 99.63 |
| 94 | 68,61 | 83 | ATMOSPHERIC PRESSURE-PAST3-ATMOSPHERIC PRESSURE-PAST3-11,12,12 | 11 | 0.04 | 99.67 |
| 95 | 69,34 | 45 | MINIMUM TEMPERATURE-PAST3-MINIMUM TEMPERATURE-PAST3-05,04,05 | 9 | 0.03 | 99.70 |
| 96 | 70,07 | 17 | RAIN-2/3-{100.6666667, 200.3333333} | 6 | 0.03 | 99.73 |
| 97 | 70,80 | 125 | EFFICIENT TEMPERATURE-PAST3-EFFICIENT TEMPERATURE-PAST3-19,20,19 | 14 | 0.03 | 99.76 |
| 98 | 71,53 | 73 | ATMOSPHERIC PRESSURE-PAST3-ATMOSPHERIC PRESSURE-PAST3-10,11,10 | 11 | 0.02 | 99.78 |
| 99 | 72,26 | 82 | ATMOSPHERIC PRESSURE-PAST3-ATMOSPHERIC PRESSURE-PAST3-11,12,11 | 11 | 0.02 | 99.80 |
| 100 | 72,99 | 114 | DRAINAGE-PAST3-RADIATION-PAST3-16,16,18 | 13 | 0.02 | 99.82 |
| 101 | 73,72 | 93 | WIND SPEED-PAST3-WIND SPEED-PAST3-13,14,14 | 12 | 0.02 | 99.84 |
| 102 | 74,45 | 57 | AVERAGE TEMPERATURE-PAST3-AVERAGE TEMPERATURE-PAST3-07,08,07 | 10 | 0.02 | 99.86 |
| 103 | 75,18 | 42 | MINIMUM TEMPERATURE-PAST3-MINIMUM TEMPERATURE-PAST3-04,05,04 | 9 | 0.02 | 99.88 |
| 104 | 75,91 | 116 | DRAINAGE-PAST3-RADIATION-PAST3-16,17,17 | 13 | 0.01 | 99.89 |
| 105 | 76,64 | 100 | WIND SPEED-PAST3-WIND SPEED-PAST3-14,14,13 | 12 | 0.01 | 99.91 |
| 106 | 77,37 | 122 | DRAINAGE-PAST3-RAIDITATION-PAST3-18,16,16 | 13 | 0.01 | 99.92 |
| 107 | 78,10 | 15 | WIND SPEED-3/3-{19.6666667, 29.0000000} | 5 | 0.01 | 99.93 |
| 108 | 78,83 | 101 | WIND SPEED-PAST3-WIND SPEED-PAST3-14,14,14 | 12 | 0.01 | 99.94 |
| 109 | 79,56 | 117 | DRAINAGE-PAST3-RADIATION-PAST3-16,18,16 | 13 | 0.01 | 99.95 |
| 110 | 80,29 | 94 | WIND SPEED-PAST3-WIND SPEED-PAST3-13,14,15 | 12 | 0.01 | 99.95 |
| 111 | 81,02 | 120 | DRAINAGE-PAST3-RAIDITATION-PAST3-17,17,16 | 13 | 0.01 | 99.96 |
| 112 | 81,75 | 86 | ATMOSPHERIC PRESSURE-PAST3-ATMOSPHERIC PRESSURE-PAST3-12,11,12 | 11 | 0.00 | 99.96 |
| 113 | 82,48 | 119 | DRAINAGE-PAST3-RADIATION-PAST3-17,16,17 | 13 | 0.00 | 99.97 |
| 114 | 83,21 | 99 | WIND SPEED-PAST3-WIND SPEED-PAST3-14,13,14 | 12 | 0.00 | 99.97 |
| 115 | 83,94 | 18 | RAIN-3/3-{200.3333333, 300.0000000} | 6 | 0.00 | 99.97 |
| 116 | 84,67 | 106 | WIND SPEED-PAST3-WIND SPEED-PAST3-15,13,13 | 12 | 0.00 | 99.98 |
| 117 | 85,40 | 91 | WIND SPEED-PAST3-WIND SPEED-PAST3-13,13,15 | 12 | 0.00 | 99.98 |
| 118 | 86,13 | 107 | WIND SPEED-PAST3-WIND SPEED-PAST3-15,14,13 | 12 | 0.00 | 99.98 |
| 119 | 86,86 | 103 | WIND SPEED-PAST3-WIND SPEED-PAST3-14,15,13 | 12 | 0.00 | 99.98 |
| 120 | 87,59 | 75 | ATMOSPHERIC PRESSURE-PAST3-ATMOSPHERIC PRESSURE-PAST3-10,11,12 | 11 | 0.00 | 99.98 |
| 121 | 88,32 | 121 | DRAINAGE-PAST3-RADIATION-PAST3-17,17,17 | 13 | 0.00 | 99.99 |
| 122 | 89,05 | 105 | WIND SPEED-PAST3-WIND SPEED-PAST3-14,15,15 | 12 | 0.00 | 99.99 |
| 123 | 89,78 | 84 | ATMOSPHERIC PRESSURE-PAST3-ATMOSPHERIC PRESSURE-PAST3-12,11,10 | 11 | 0.00 | 99.99 |
| 124 | 90,51 | 110 | WIND SPEED-PAST3-WIND SPEED-PAST3-15,15,14 | 12 | 0.00 | 99.99 |
| 125 | 91,24 | 104 | WIND SPEED-PAST3-WIND SPEED-PAST3-14,15,14 | 12 | 0.00 | 99.99 |
| 126 | 91,97 | 102 | WIND SPEED-PAST3-WIND SPEED-PAST3-14,14,15 | 12 | 0.00 | 99.99 |
| 127 | 92,70 | 111 | WIND SPEED-PAST3-WIND SPEED-PAST3-15,15,15 | 12 | 0.00 | 99.99 |
| 128 | 93,43 | 96 | WIND SPEED-PAST3-WIND SPEED-PAST3-13,15,14 | 12 | 0.00 | 99.99 |
| 129 | 94,16 | 108 | WIND SPEED-PAST3-WIND SPEED-PAST3-15,14,14 | 12 | 0.00 | 99.99 |
| 130 | 94,89 | 97 | WIND SPEED-PAST3-WIND SPEED-PAST3-13,15,15 | 12 | 0.00 | 100.00 |
| 131 | 95,62 | 76 | ATMOSPHERIC PRESSURE-PAST3-ATMOSPHERIC PRESSURE-PAST3-10,12,12 | 11 | 0.00 | 100.00 |
| 132 | 96,35 | 95 | WIND SPEED-PAST3-WIND SPEED-PAST3-13,15,13 | 12 | 0.00 | 100.00 |
| 133 | 97,08 | 72 | ATMOSPHERIC PRESSURE-PAST3-ATMOSPHERIC PRESSURE-PAST3-10,10,12 | 11 | 0.00 | 100.00 |
| 134 | 97,81 | 26 | MAXIMUM TEMPERATURE-PAST3-MAXIMUM TEMPERATURE-PAST3-01,02,03 | 8 | 0.00 | 100.00 |
| 135 | 98,54 | 109 | WIND SPEED-PAST3-WIND SPEED-PAST3-15,15,13 | 12 | 0.00 | 100.00 |
| 136 | 99,27 | 27 | MAXIMUM TEMPERATURE-PAST3-MAXIMUM TEMPERATURE-PAST3-01,03,03 | 8 | 0.00 | 100.00 |
| 137 | 100,00 | 30 | MAXIMUM TEMPERATURE-PAST3-MAXIMUM TEMPERATURE-PAST3-02,01,03 | 8 | 0.00 | 100.00 |

From Figure 25 and Table 11, we see that only 7% of the factor values provide 50% of their total significance, and 50% of the factor values provide almost 98% of the total significance.

Figure 27 shows a screen form with the names of Excel tables containing information on the significance of climatic factors for forecasting:



Picture27. Names of Excel tables with information on the significance of climatic factors

table12 – Significance of climatic factors for climate forecasting

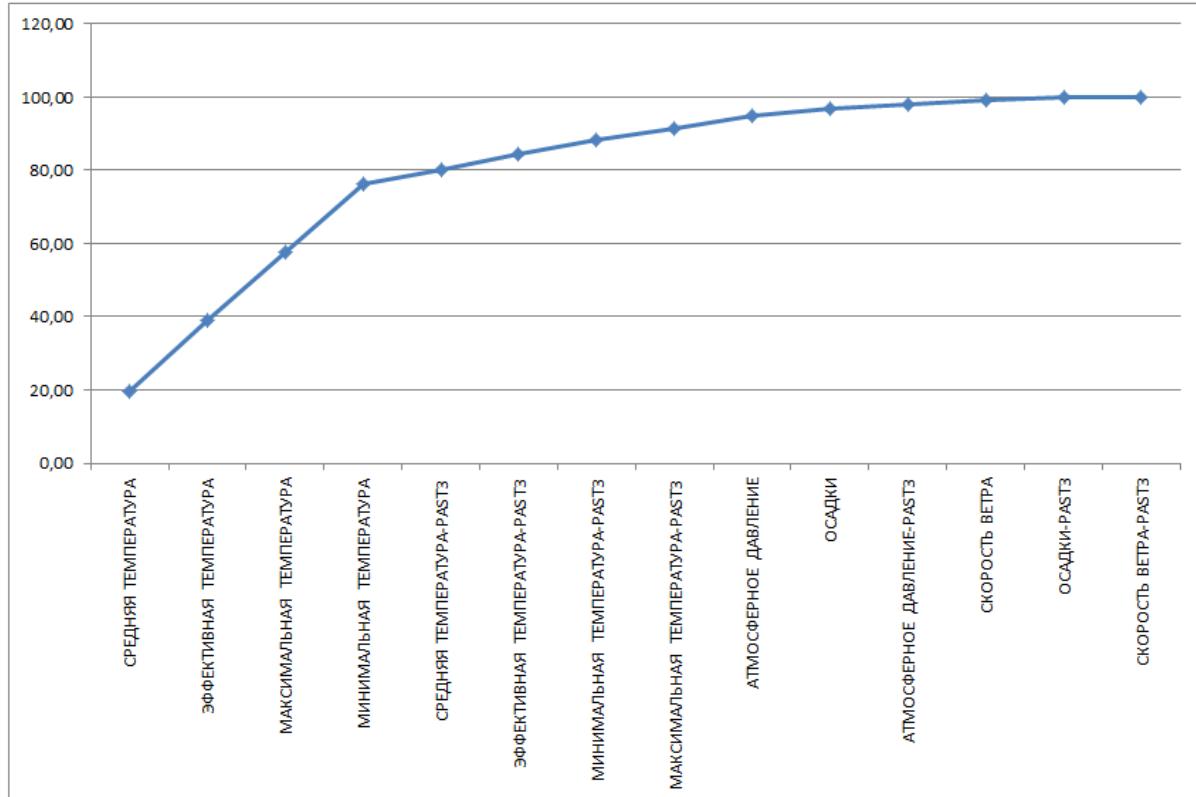
| No. | No.% | The code | Factor name | Significance, % | Significance, %, cumulative |
|-----|--------|----------|-----------------------------|-----------------|-----------------------------|
| 1 | 7,14 | 3 | AVERAGE TEMPERATURE | 19,68 | 19,68 |
| 2 | 14,29 | 7 | EFFICIENT TEMPERATURE | 19,25 | 38,94 |
| 3 | 21,43 | 1 | MAXIMUM TEMPERATURE | 18,83 | 57,77 |
| 4 | 28,57 | 2 | MINIMUM TEMPERATURE | 18,50 | 76,28 |
| 5 | 35,71 | 10 | MEDIUM TEMPERATURE-PAST3 | 4,06 | 80,34 |
| 6 | 42,86 | 14 | EFFECTIVE TEMPERATURE-PAST3 | 3,96 | 84,30 |
| 7 | 50,00 | 9 | MINIMUM TEMPERATURE-PAST3 | 3,87 | 88,17 |
| 8 | 57,14 | 8 | MAXIMUM TEMPERATURE-PAST3 | 3,31 | 91,48 |
| 9 | 64,29 | 4 | ATMOSPHERE PRESSURE | 3,26 | 94,73 |
| 10 | 71,43 | 6 | PRECIPITATION | 2,23 | 96,96 |
| 11 | 78,57 | 11 | ATMOSPHERIC PRESSURE-PAST3 | 1,20 | 98,16 |
| 12 | 85,71 | 5 | WIND SPEED | 0,89 | 99,05 |
| 13 | 92,86 | 13 | RAIN-PAST3 | 0,81 | 99,86 |
| 14 | 100,00 | 12 | WIND SPEED-PAST3 | 0,14 | 100,00 |

From Table 12 and the graph in Figure 28 built on the basis of it, we see that the following climatic factors are the most valuable for climate forecasting:

- average temperature;
- is the effective temperature;
- Maximum temperature;
- And the least significant:

- wind speed;
- precipitation-past3;
- wind speed-past3.

The significance of the most and least significant climatic indicators differs by about 150 times, which is very, very significant.



Picture28. Significance of climatic factors

3.8.11. Degree of determinism of classes and classification scales

The degree of determinism (conditionality) of a class in the Eidos system is quantified by the degree of variability in the values of factors (gradations of descriptive scales) in the column of the model matrix corresponding to this class.

The higher the degree of determinism of the class, the more reliably it is predicted by the values of the factors.

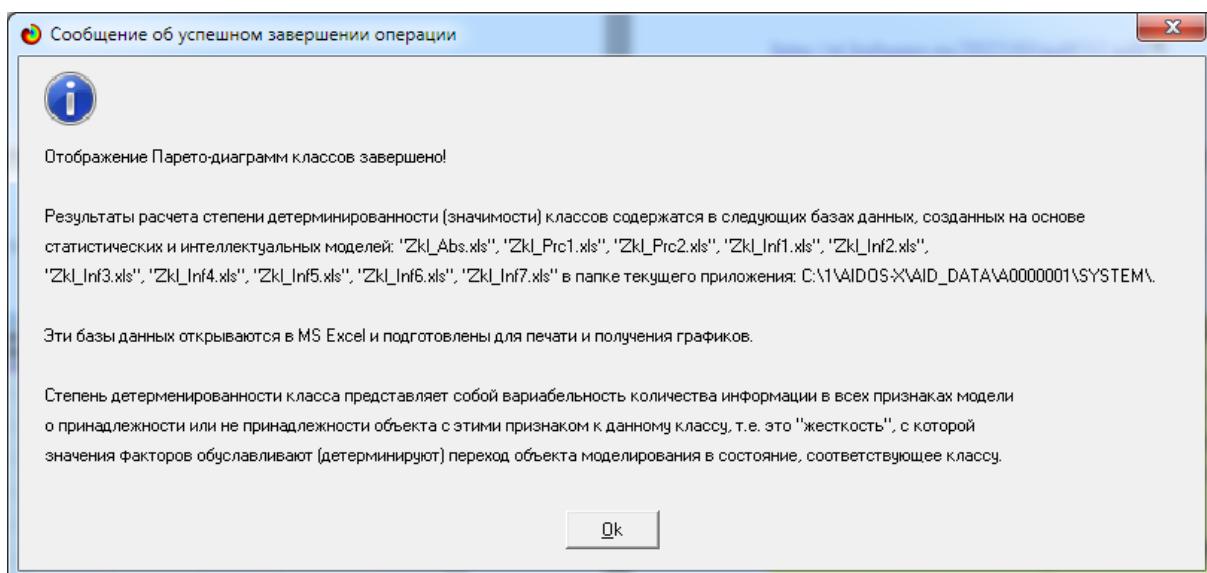
The degree of determination (conditionality) of the entire classification scale is the average of the degree of determination of its gradations, i.e. classes (mode 3.7.2 of the Eidos system).

If we sort all classes in descending order of selective power and get the sum of the selective power of the system of classes on an accrual basis (cumulatively), then we get the Pareto curve shown in Figure 29.



Picture29. The degree of determinism of classes on a cumulative basis: mode 3.73 of the Eidos system

The names of the Excel tables with the information on the basis of which Figure 39 is built are shown in Figure 30:



Picture30. Names of Excel tables with information on the basis of which Figure 29 is built

Table 13 provides information on the degree of determinism of the classes corresponding to the future values of the values of climatic indicators, on an accrual basis:

table13– Degree of determinism of classes

| No. | No.% | The code class | Class name | Indicator code | Degree of determination, % | Degree of determination, % cumulative |
|-----|-------|----------------|--|----------------|----------------------------|---------------------------------------|
| 1 | 0,73 | 9 | AVERAGE TEMPERATURE-3/3-{11,6, 31,3} | 3 | 5,69 | 5,69 |
| 2 | 1,46 | 8 | AVERAGE TEMPERATURE-2/3-{8,2, 11,6} | 3 | 5,61 | 11,30 |
| 3 | 2,19 | 21 | EFFECTIVE TEMPERATURE-3/3-{11,7, 33,4} | 7 | 5,54 | 16,84 |
| 4 | 2,92 | 6 | MINIMUM TEMPERATURE-3/3-{5,7, 25,4} | 2 | 5,48 | 22,32 |
| 5 | 3,65 | 5 | MINIMUM TEMPERATURE-2/3-{14,0, 5,7} | 2 | 5,40 | 27,72 |
| 6 | 4,38 | 3 | MAXIMUM TEMPERATURE-3/3-{21,3, 43,0} | 1 | 5,38 | 33,10 |
| 7 | 5,11 | 20 | EFFECTIVE TEMPERATURE-2/3-{9,9, 11,7} | 7 | 5,34 | 38,44 |
| 8 | 5,84 | 54 | MINIMUM TEMPERATURE-FUTURE3-MINIMUM TEMPERATURE-FUTURE3-06,06,06 | 9 | 5,33 | 43,77 |
| 9 | 6,57 | 69 | AVERAGE TEMPERATURE-FUTURE3-AVERAGE TEMPERATURE-FUTURE3-09,09,09 | 10 | 5,32 | 49,10 |
| 10 | 7,30 | 2 | MAXIMUM TEMPERATURE-2/3-{0,3, 21,3} | 1 | 5,06 | 54,16 |
| 11 | 8,03 | 137 | EFFECTIVE TEMPERATURE-FUTURE3-EFFECTIVE TEMPERATURE-FUTURE3-21,21,21 | 14 | 4,84 | 59,00 |
| 12 | 8,76 | 62 | AVERAGE TEMPERATURE-FUTURE3-AVERAGE TEMPERATURE-FUTURE3-08,08,08 | 10 | 4,59 | 63,59 |
| 13 | 9,49 | 130 | EFFECTIVE TEMPERATURE-FUTURE3-EFFECTIVE TEMPERATURE-FUTURE3-20,20,20 | 14 | 4,59 | 68,19 |
| 14 | 10,22 | 39 | MAXIMUM TEMPERATURE-FUTURE3-MAXIMUM TEMPERATURE-FUTURE3-03,03,03 | 8 | 4,42 | 72,60 |
| 15 | 10,95 | 47 | MINIMUM TEMPERATURE-FUTURE3-MINIMUM TEMPERATURE-FUTURE3-05,05,05 | 9 | 4,30 | 76,90 |
| 16 | 11,68 | 32 | MAXIMUM TEMPERATURE-FUTURE3-MAXIMUM TEMPERATURE-FUTURE3-02,02,02 | 8 | 4,19 | 81,09 |
| 17 | 12,41 | 85 | ATMOSPHERIC PRESSURE-FUTURE3-ATMOSPHERIC PRESSURE-FUTURE3-12,11,11 | 11 | 2,04 | 83,14 |
| 18 | 13,14 | 11 | ATMOSPHERIC PRESSURE-2/3-{1006,9, 1024,8} | 4 | 1,31 | 84,45 |
| 19 | 13,87 | 112 | REFERENCES-FUTURE3-REFERENCES-FUTURE3-16,16,16 | 13 | 1,29 | 85,74 |
| 20 | 14,60 | 16 | RAIN-1/3-{1,0, 100,7} | 6 | 1,26 | 87,00 |
| 21 | 15,33 | 80 | ATMOSPHERIC PRESSURE-FUTURE3-ATMOSPHERIC PRESSURE-FUTURE3-11,11,11 | 11 | 0,86 | 87,87 |
| 22 | 16,06 | 1 | MAXIMUM TEMPERATURE-1/3-{22,0, -0,3} | 1 | 0,81 | 88,68 |
| 23 | 16,79 | 19 | EFFECTIVE TEMPERATURE-1/3-{31,6, -9,9} | 7 | 0,66 | 89,34 |
| 24 | 17,52 | 77 | ATMOSPHERIC PRESSURE-FUTURE3-ATMOSPHERIC PRESSURE-FUTURE3-11,10,10 | 11 | 0,53 | 89,87 |
| 25 | 18,25 | 10 | ATMOSPHERIC PRESSURE-1/3-{989,1, 1006,9} | 4 | 0,52 | 90,38 |
| 26 | 18,98 | 7 | AVERAGE TEMPERATURE-1/3-{27,9, -8,2} | 3 | 0,41 | 90,79 |
| 27 | 19,71 | 13 | WIND SPEED-1/3-{1,0, 10,3} | 5 | 0,40 | 91,19 |
| 28 | 20,44 | 89 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-13,13,13 | 12 | 0,37 | 91,57 |
| 29 | 21,17 | 4 | MINIMUM TEMPERATURE-1/3-{33,7, -14,0} | 2 | 0,33 | 91,90 |
| 30 | 21,90 | 48 | MINIMUM TEMPERATURE-FUTURE3-MINIMUM TEMPERATURE-FUTURE3-05,05,06 | 9 | 0,30 | 92,20 |
| 31 | 22,63 | 22 | MAXIMUM TEMPERATURE-FUTURE3-MAXIMUM TEMPERATURE-FUTURE3-01,01,01 | 8 | 0,30 | 92,50 |
| 32 | 23,36 | 38 | MAXIMUM TEMPERATURE-FUTURE3-MAXIMUM TEMPERATURE-FUTURE3-03,03,02 | 8 | 0,27 | 92,77 |
| 33 | 24,09 | 123 | EFFECTIVE TEMPERATURE-FUTURE3-EFFECTIVE TEMPERATURE-FUTURE3-19,19,19 | 14 | 0,26 | 93,03 |
| 34 | 24,82 | 70 | ATMOSPHERIC PRESSURE-FUTURE3-ATMOSPHERIC PRESSURE-FUTURE3-10,10,10 | 11 | 0,21 | 93,23 |
| 35 | 25,55 | 63 | AVERAGE TEMPERATURE-FUTURE3-AVERAGE TEMPERATURE-FUTURE3-08,08,09 | 10 | 0,20 | 93,44 |
| 36 | 26,28 | 50 | MINIMUM TEMPERATURE-FUTURE3-MINIMUM TEMPERATURE-FUTURE3-05,06,06 | 9 | 0,20 | 93,64 |
| 37 | 27,01 | 31 | MAXIMUM TEMPERATURE-FUTURE3-MAXIMUM TEMPERATURE-FUTURE3-02,02,01 | 8 | 0,20 | 93,83 |
| 38 | 27,74 | 36 | MAXIMUM TEMPERATURE-FUTURE3-MAXIMUM TEMPERATURE-FUTURE3-03,02,02 | 8 | 0,20 | 94,03 |
| 39 | 28,47 | 25 | MAXIMUM TEMPERATURE-FUTURE3-MAXIMUM TEMPERATURE-FUTURE3-01,02,02 | 8 | 0,19 | 94,22 |
| 40 | 29,20 | 136 | EFFECTIVE TEMPERATURE-FUTURE3-EFFECTIVE TEMPERATURE-FUTURE3-21,21,20 | 14 | 0,19 | 94,42 |
| 41 | 29,93 | 51 | MINIMUM TEMPERATURE-FUTURE3-MINIMUM TEMPERATURE-FUTURE3-06,05,05 | 9 | 0,19 | 94,61 |
| 42 | 30,66 | 49 | MINIMUM TEMPERATURE-FUTURE3-MINIMUM TEMPERATURE-FUTURE3-05,06,05 | 9 | 0,17 | 94,78 |
| 43 | 31,39 | 65 | AVERAGE TEMPERATURE-FUTURE3-AVERAGE TEMPERATURE-FUTURE3-08,09,09 | 10 | 0,16 | 94,94 |
| 44 | 32,12 | 118 | RAIN-FUTURE3-REFIT-FUTURE3-17,16,16 | 13 | 0,16 | 95,10 |
| 45 | 32,85 | 35 | MAXIMUM TEMPERATURE-FUTURE3-MAXIMUM TEMPERATURE-FUTURE3-02,03,03 | 8 | 0,16 | 95,26 |
| 46 | 33,58 | 126 | EFFECTIVE TEMPERATURE-FUTURE3-EFFECTIVE TEMPERATURE-FUTURE3-19,20,20 | 14 | 0,15 | 95,42 |
| 47 | 34,31 | 12 | ATMOSPHERIC PRESSURE-3/3-{1024,8, 1042,6} | 4 | 0,15 | 95,57 |
| 48 | 35,04 | 134 | EFFECTIVE TEMPERATURE-FUTURE3-EFFECTIVE TEMPERATURE-FUTURE3-21,20,20 | 14 | 0,15 | 95,72 |
| 49 | 35,77 | 129 | EFFECTIVE TEMPERATURE-FUTURE3-EFFECTIVE TEMPERATURE-FUTURE3-20,20,19 | 14 | 0,15 | 95,87 |
| 50 | 36,50 | 23 | MAXIMUM TEMPERATURE-FUTURE3-MAXIMUM TEMPERATURE-FUTURE3-01,01,02 | 8 | 0,14 | 96,01 |
| 51 | 37,23 | 28 | MAXIMUM TEMPERATURE-FUTURE3-MAXIMUM TEMPERATURE-FUTURE3-02,01,01 | 8 | 0,14 | 96,15 |
| 52 | 37,96 | 14 | WIND SPEED-2/3-{10,3, 19,7} | 5 | 0,13 | 96,28 |
| 53 | 38,69 | 37 | MAXIMUM TEMPERATURE-FUTURE3-MAXIMUM TEMPERATURE-FUTURE3-03,02,03 | 8 | 0,13 | 96,42 |
| 54 | 39,42 | 55 | AVERAGE TEMPERATURE-FUTURE3-AVERAGE TEMPERATURE-FUTURE3-07,07,07 | 10 | 0,12 | 96,54 |
| 55 | 40,15 | 71 | ATMOSPHERIC PRESSURE-FUTURE3-ATMOSPHERIC PRESSURE-FUTURE3-10,10,11 | 11 | 0,12 | 96,66 |
| 56 | 40,88 | 79 | ATMOSPHERIC PRESSURE-FUTURE3-ATMOSPHERIC PRESSURE-FUTURE3-11,11,10 | 11 | 0,12 | 96,78 |
| 57 | 41,61 | 74 | ATMOSPHERIC PRESSURE-FUTURE3-ATMOSPHERIC PRESSURE-FUTURE3-10,11,11 | 11 | 0,12 | 96,90 |
| 58 | 42,34 | 133 | EFFECTIVE TEMPERATURE-FUTURE3-EFFECTIVE TEMPERATURE-FUTURE3-20,21,21 | 14 | 0,11 | 97,01 |
| 59 | 43,07 | 33 | MAXIMUM TEMPERATURE-FUTURE3-MAXIMUM TEMPERATURE-FUTURE3-02,02,03 | 8 | 0,11 | 97,13 |
| 60 | 43,80 | 124 | EFFECTIVE TEMPERATURE-FUTURE3-EFFECTIVE TEMPERATURE-FUTURE3-19,19,20 | 14 | 0,11 | 97,24 |
| 61 | 44,53 | 113 | RAIN-FUTURE3-REFIT-FUTURE3-16,16,17 | 13 | 0,11 | 97,35 |
| 62 | 45,26 | 58 | AVERAGE TEMPERATURE-FUTURE3-AVERAGE TEMPERATURE-FUTURE3-07,08,08 | 10 | 0,11 | 97,46 |
| 63 | 45,99 | 66 | AVERAGE TEMPERATURE-FUTURE3-AVERAGE TEMPERATURE-FUTURE3-09,08,08 | 10 | 0,11 | 97,57 |
| 64 | 46,72 | 53 | MINIMUM TEMPERATURE-FUTURE3-MINIMUM TEMPERATURE-FUTURE3-06,06,05 | 9 | 0,11 | 97,67 |
| 65 | 47,45 | 127 | EFFECTIVE TEMPERATURE-FUTURE3-EFFECTIVE TEMPERATURE-FUTURE3-20,19,19 | 14 | 0,11 | 97,78 |

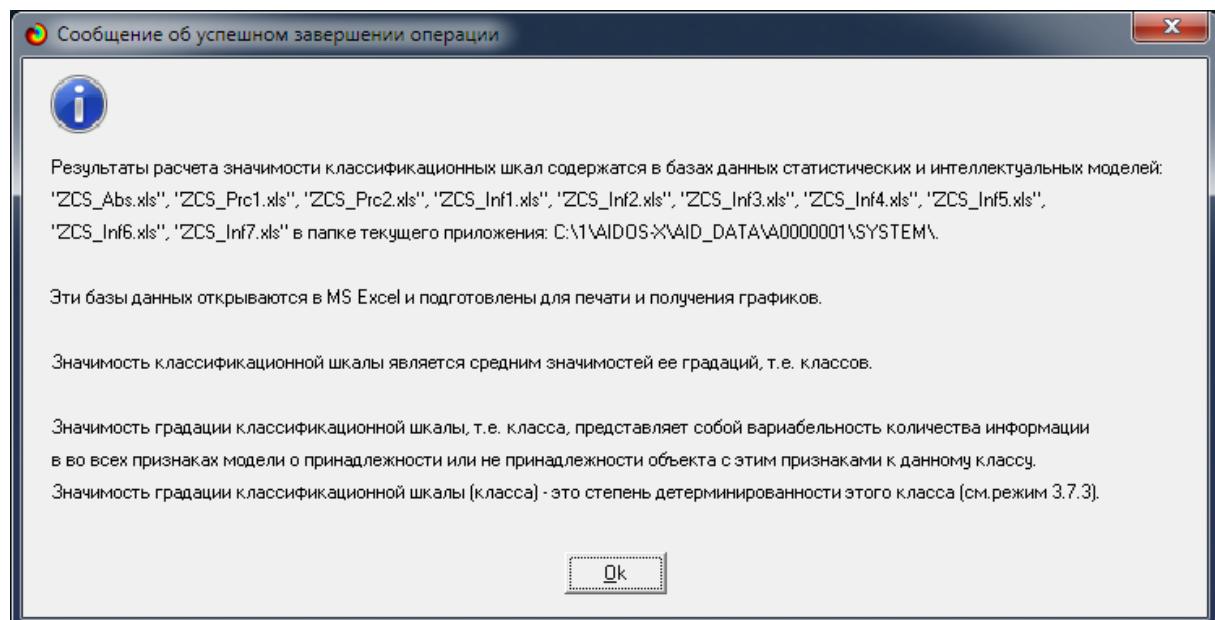
| | | | | | | |
|-----|--------|-----|--|----|------|--------|
| 66 | 48,18 | 43 | MINIMUM TEMPERATURE-FUTURE3-MINIMUM TEMPERATURE-FUTURE3-04,05,05 | 9 | 0,10 | 97,88 |
| 67 | 48,91 | 115 | RAIN-FUTURE3-REFIT-FUTURE3-16,17,16 | 13 | 0,10 | 97,98 |
| 68 | 49,64 | 64 | AVERAGE TEMPERATURE-FUTURE3-AVERAGE TEMPERATURE-FUTURE3-08,09,08 | 10 | 0,10 | 98,08 |
| 69 | 50,36 | 131 | EFFECTIVE TEMPERATURE-FUTURE3-EFFECTIVE TEMPERATURE-FUTURE3-20,20,21 | 14 | 0,10 | 98,17 |
| 70 | 51,09 | 29 | MAXIMUM TEMPERATURE-FUTURE3-MAXIMUM TEMPERATURE-FUTURE3-02,01,02 | 8 | 0,10 | 98,27 |
| 71 | 51,82 | 40 | MINIMUM TEMPERATURE-FUTURE3-MINIMUM TEMPERATURE-FUTURE3-04,04,04 | 9 | 0,09 | 98,36 |
| 72 | 52,55 | 135 | EFFECTIVE TEMPERATURE-FUTURE3-EFFECTIVE TEMPERATURE-FUTURE3-21,20,21 | 14 | 0,09 | 98,45 |
| 73 | 53,28 | 61 | AVERAGE TEMPERATURE-FUTURE3-AVERAGE TEMPERATURE-FUTURE3-08,08,07 | 10 | 0,09 | 98,54 |
| 74 | 54,01 | 68 | AVERAGE TEMPERATURE-FUTURE3-AVERAGE TEMPERATURE-FUTURE3-09,09,08 | 10 | 0,09 | 98,63 |
| 75 | 54,74 | 78 | ATMOSPHERIC PRESSURE-FUTURE3-ATMOSPHERIC PRESSURE-FUTURE3-11,10,11 | 11 | 0,09 | 98,71 |
| 76 | 55,47 | 56 | AVERAGE TEMPERATURE-FUTURE3-AVERAGE TEMPERATURE-FUTURE3-07,07,08 | 10 | 0,08 | 98,79 |
| 77 | 56,20 | 46 | MINIMUM TEMPERATURE-FUTURE3-MINIMUM TEMPERATURE-FUTURE3-05,05,04 | 9 | 0,07 | 98,86 |
| 78 | 56,93 | 41 | MINIMUM TEMPERATURE-FUTURE3-MINIMUM TEMPERATURE-FUTURE3-04,04,05 | 9 | 0,07 | 98,93 |
| 79 | 57,66 | 128 | EFFECTIVE TEMPERATURE-FUTURE3-EFFECTIVE TEMPERATURE-FUTURE3-20,19,20 | 14 | 0,06 | 98,99 |
| 80 | 58,39 | 59 | AVERAGE TEMPERATURE-FUTURE3-AVERAGE TEMPERATURE-FUTURE3-08,07,07 | 10 | 0,06 | 99,05 |
| 81 | 59,12 | 34 | MAXIMUM TEMPERATURE-FUTURE3-MAXIMUM TEMPERATURE-FUTURE3-02,03,02 | 8 | 0,06 | 99,11 |
| 82 | 59,85 | 44 | MINIMUM TEMPERATURE-FUTURE3-MINIMUM TEMPERATURE-FUTURE3-05,04,04 | 9 | 0,05 | 99,16 |
| 83 | 60,58 | 98 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-14,13,13 | 12 | 0,05 | 99,22 |
| 84 | 61,31 | 52 | MINIMUM TEMPERATURE-FUTURE3-MINIMUM TEMPERATURE-FUTURE3-06,05,06 | 9 | 0,05 | 99,27 |
| 85 | 62,04 | 90 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-13,13,14 | 12 | 0,05 | 99,32 |
| 86 | 62,77 | 81 | ATMOSPHERIC PRESSURE-FUTURE3-ATMOSPHERIC PRESSURE-FUTURE3-11,11,12 | 11 | 0,05 | 99,37 |
| 87 | 63,50 | 88 | ATMOSPHERIC PRESSURE-FUTURE3-ATMOSPHERIC PRESSURE-FUTURE3-12,12,12 | 11 | 0,04 | 99,41 |
| 88 | 64,23 | 92 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-13,14,13 | 12 | 0,04 | 99,45 |
| 89 | 64,96 | 24 | MAXIMUM TEMPERATURE-FUTURE3-MAXIMUM TEMPERATURE-FUTURE3-01,02,01 | 8 | 0,04 | 99,50 |
| 90 | 65,69 | 60 | AVERAGE TEMPERATURE-FUTURE3-AVERAGE TEMPERATURE-FUTURE3-08,07,08 | 10 | 0,04 | 99,54 |
| 91 | 66,42 | 132 | EFFECTIVE TEMPERATURE-FUTURE3-EFFECTIVE TEMPERATURE-FUTURE3-20,21,20 | 14 | 0,04 | 99,57 |
| 92 | 67,15 | 67 | AVERAGE TEMPERATURE-FUTURE3-AVERAGE TEMPERATURE-FUTURE3-09,08,09 | 10 | 0,04 | 99,61 |
| 93 | 67,88 | 17 | RAIN-2/3-{100.7, 200.3} | 6 | 0,04 | 99,65 |
| 94 | 68,61 | 87 | ATMOSPHERIC PRESSURE-FUTURE3-ATMOSPHERIC PRESSURE-FUTURE3-12,12,11 | 11 | 0,04 | 99,68 |
| 95 | 69,34 | 83 | ATMOSPHERIC PRESSURE-FUTURE3-ATMOSPHERIC PRESSURE-FUTURE3-11,12,12 | 11 | 0,03 | 99,72 |
| 96 | 70,07 | 45 | MINIMUM TEMPERATURE-FUTURE3-MINIMUM TEMPERATURE-FUTURE3-05,04,05 | 9 | 0,03 | 99,75 |
| 97 | 70,80 | 125 | EFFECTIVE TEMPERATURE-FUTURE3-EFFECTIVE TEMPERATURE-FUTURE3-19,20,19 | 14 | 0,02 | 99,77 |
| 98 | 71,53 | 73 | ATMOSPHERIC PRESSURE-FUTURE3-ATMOSPHERIC PRESSURE-FUTURE3-10,11,10 | 11 | 0,02 | 99,79 |
| 99 | 72,26 | 82 | ATMOSPHERIC PRESSURE-FUTURE3-ATMOSPHERIC PRESSURE-FUTURE3-11,12,11 | 11 | 0,02 | 99,81 |
| 100 | 72,99 | 57 | AVERAGE TEMPERATURE-FUTURE3-AVERAGE TEMPERATURE-FUTURE3-07,08,07 | 10 | 0,02 | 99,83 |
| 101 | 73,72 | 114 | REFERENCE-FUTURE3-REFERENCE-FUTURE3-16,16,18 | 13 | 0,02 | 99,84 |
| 102 | 74,45 | 42 | MINIMUM TEMPERATURE-FUTURE3-MINIMUM TEMPERATURE-FUTURE3-04,05,04 | 9 | 0,02 | 99,86 |
| 103 | 75,18 | 116 | RAIN-FUTURE3-REFERENCE-FUTURE3-16,17,17 | 13 | 0,01 | 99,88 |
| 104 | 75,91 | 122 | RAIN-FUTURE3-REFIT-FUTURE3-18,16,16 | 13 | 0,01 | 99,89 |
| 105 | 76,64 | 100 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-14,14,13 | 12 | 0,01 | 99,91 |
| 106 | 77,37 | 93 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-13,14,14 | 12 | 0,01 | 99,92 |
| 107 | 78,10 | 15 | WIND SPEED-3/3-{19.7, 29.0} | 5 | 0,01 | 99,93 |
| 108 | 78,83 | 117 | RAIN-FUTURE3-REFIT-FUTURE3-16,18,16 | 13 | 0,01 | 99,94 |
| 109 | 79,56 | 101 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-14,14,14 | 12 | 0,01 | 99,95 |
| 110 | 80,29 | 120 | REFERENCES-FUTURE3-REFERENCES-FUTURE3-17,17,16 | 13 | 0,01 | 99,95 |
| 111 | 81,02 | 86 | ATMOSPHERIC PRESSURE-FUTURE3-ATMOSPHERIC PRESSURE-FUTURE3-12,11,12 | 11 | 0,00 | 99,96 |
| 112 | 81,75 | 94 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-13,14,15 | 12 | 0,00 | 99,96 |
| 113 | 82,48 | 106 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-15,13,13 | 12 | 0,00 | 99,97 |
| 114 | 83,21 | 18 | RAIN-3/3-{200.3, 300.0} | 6 | 0,00 | 99,97 |
| 115 | 83,94 | 119 | RAIN-FUTURE3-REFIT-FUTURE3-17,16,17 | 13 | 0,00 | 99,97 |
| 116 | 84,67 | 99 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-14,13,14 | 12 | 0,00 | 99,98 |
| 117 | 85,40 | 107 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-15,14,13 | 12 | 0,00 | 99,98 |
| 118 | 86,13 | 103 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-14,15,13 | 12 | 0,00 | 99,98 |
| 119 | 86,86 | 121 | RAIN-FUTURE3-REFIT-FUTURE3-17,17,17 | 13 | 0,00 | 99,98 |
| 120 | 87,59 | 75 | ATMOSPHERIC PRESSURE-FUTURE3-ATMOSPHERIC PRESSURE-FUTURE3-10,11,12 | 11 | 0,00 | 99,98 |
| 121 | 88,32 | 110 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-15,15,14 | 12 | 0,00 | 99,99 |
| 122 | 89,05 | 91 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-13,13,15 | 12 | 0,00 | 99,99 |
| 123 | 89,78 | 84 | ATMOSPHERIC PRESSURE-FUTURE3-ATMOSPHERIC PRESSURE-FUTURE3-12,11,10 | 11 | 0,00 | 99,99 |
| 124 | 90,51 | 105 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-14,15,15 | 12 | 0,00 | 99,99 |
| 125 | 91,24 | 104 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-14,15,14 | 12 | 0,00 | 99,99 |
| 126 | 91,97 | 102 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-14,14,15 | 12 | 0,00 | 99,99 |
| 127 | 92,70 | 111 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-15,15,15 | 12 | 0,00 | 99,99 |
| 128 | 93,43 | 96 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-13,15,14 | 12 | 0,00 | 99,99 |
| 129 | 94,16 | 72 | ATMOSPHERIC PRESSURE-FUTURE3-ATMOSPHERIC PRESSURE-FUTURE3-10,10,12 | 11 | 0,00 | 99,99 |
| 130 | 94,89 | 76 | ATMOSPHERIC PRESSURE-FUTURE3-ATMOSPHERIC PRESSURE-FUTURE3-10,12,12 | 11 | 0,00 | 100,00 |
| 131 | 95,62 | 26 | MAXIMUM TEMPERATURE-FUTURE3-MAXIMUM TEMPERATURE-FUTURE3-01,02,03 | 8 | 0,00 | 100,00 |
| 132 | 96,35 | 108 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-15,14,14 | 12 | 0,00 | 100,00 |
| 133 | 97,08 | 95 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-13,15,13 | 12 | 0,00 | 100,00 |
| 134 | 97,81 | 27 | MAXIMUM TEMPERATURE-FUTURE3-MAXIMUM TEMPERATURE-FUTURE3-01,03,03 | 8 | 0,00 | 100,00 |
| 135 | 98,54 | 30 | MAXIMUM TEMPERATURE-FUTURE3-MAXIMUM TEMPERATURE-FUTURE3-02,01,03 | 8 | 0,00 | 100,00 |
| 136 | 99,27 | 97 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-13,15,15 | 12 | 0,00 | 100,00 |
| 137 | 100,00 | 109 | WIND SPEED-FUTURE3-WIND SPEED-FUTURE3-15,15,13 | 12 | 0,00 | 100,00 |

Table 13 and Figure 29 show that about 7% of the most deterministic classes provide approximately 50% of the total determinism of future climate situations, and 50% of the most strongly deterministic classes provide about 98% of the total climate determinism.

The following values of climatic indicators are most rigidly determined:

- average temperature-3/3-{11.6, 31.3};
- average temperature-2/3-{-8.2, 11.6};
- effective temperature-3/3-{11.7, 33.4};
- minimum temperature-3/3-{5.7, 25.4};
- minimum temperature-2/3-{-14.0, 5.7};
- maximum temperature-3/3-{21.3, 43.0};
- effective temperature-2/3-{-9.9, 11.7};
- minimum temperature-future3-minimum temperature-future3-06,06,06;
- average temperature-future3-average temperature-future3-09,09,09.

The most weakly determined values of climatic indicators are at the end of Table 13.

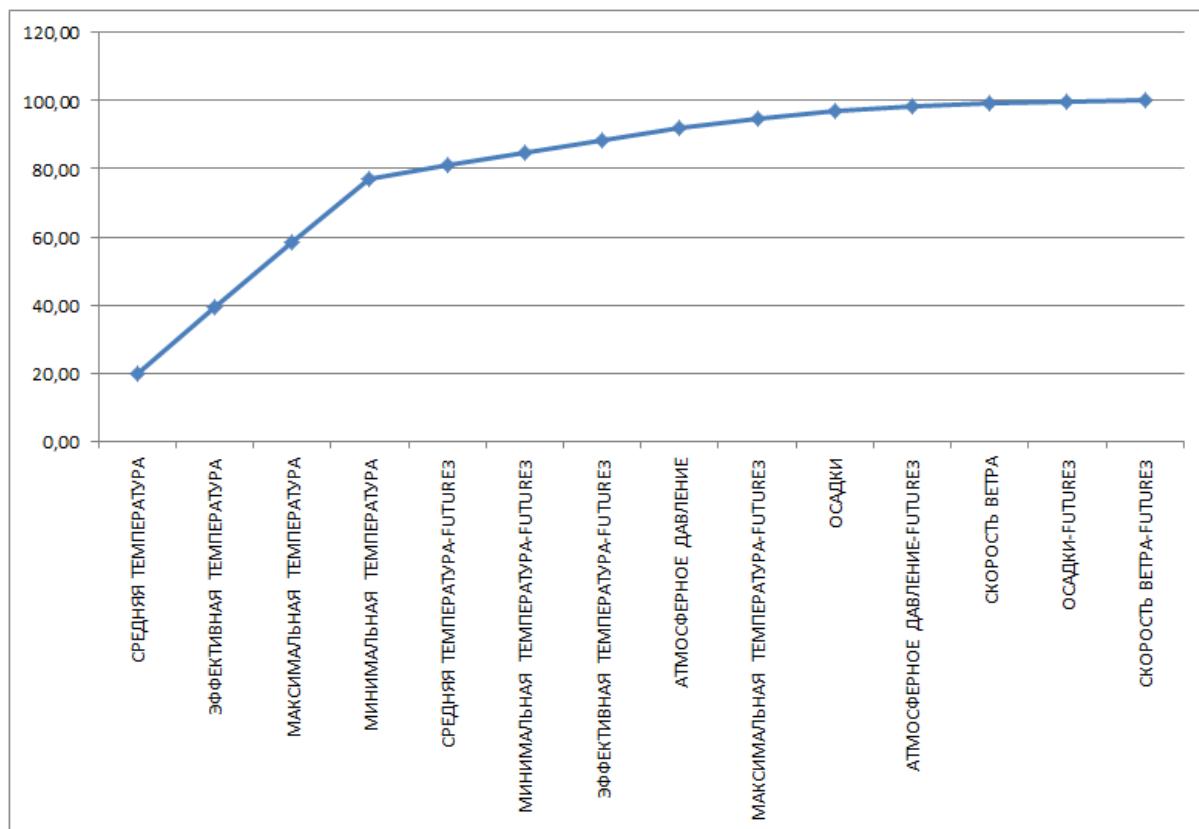


Picture31. Names of Excel tables with information on the degree of determinism of future climate indicators and scenarios for changing their values

Table 14 and the figure built on its basis provide information on the degree of determinism of future climate indicators and scenarios for changing their values:

table14– The degree of determinism of future climate indicators and scenarios for changing their values

| No. | No.% | The code | Name | Degree determinism, % | Degree determinism, % cumulative |
|-----|--------|----------|-------------------------------|-----------------------|----------------------------------|
| 1 | 7,14 | 3 | AVERAGE TEMPERATURE | 19,78 | 19,78 |
| 2 | 14,29 | 7 | EFFICIENT TEMPERATURE | 19,50 | 39,28 |
| 3 | 21,43 | 1 | MAXIMUM TEMPERATURE | 19,02 | 58,30 |
| 4 | 28,57 | 2 | MINIMUM TEMPERATURE | 18,94 | 77,24 |
| 5 | 35,71 | 10 | AVERAGE TEMPERATURE-FUTURE3 | 3,76 | 81,00 |
| 6 | 42,86 | 9 | MINIMUM TEMPERATURE-FUTURE3 | 3,75 | 84,75 |
| 7 | 50,00 | 14 | EFFECTIVE TEMPERATURE-FUTURE3 | 3,71 | 88,46 |
| 8 | 57,14 | 4 | ATMOSPHERE PRESSURE | 3,35 | 91,80 |
| 9 | 64,29 | 8 | MAXIMUM TEMPERATURE-FUTURE3 | 3,00 | 94,80 |
| 10 | 71,43 | 6 | PRECIPITATION | 2,20 | 97,01 |
| 11 | 78,57 | 11 | ATMOSPHERIC PRESSURE-FUTURE3 | 1,15 | 98,15 |
| 12 | 85,71 | 5 | WIND SPEED | 0,92 | 99,08 |
| 13 | 92,86 | 13 | RAIN-FUTURE3 | 0,80 | 99,87 |
| 14 | 100,00 | 12 | WIND SPEED-FUTURE3 | 0,13 | 100,00 |



Picture32. The degree of determinism of future climate indicators and scenarios for changing their values

From table 14 and figure 32, built on its basis, it can be seen that the following values of future economic indicators are most strictly determined by past climatic factors:

- average temperature;
- is the effective temperature;
- Maximum temperature.

The following future climate indicators are the least rigidly conditioned:

- atmospheric pressure-future3;
- wind speed;
- precipitation-future3;
- wind speed-future3.

The degree of determination of the most and least rigidly conditioned by the past future climatic states differs by more than 150 times, i.e. very, very significant.

4. DISCUSSION

So, we conducted an Automated system-cognitive analysis of the climate of the city of Krasnodar for a period of 88 years: from 1933 to 2020.

According to the L2 measure of Prof. E.V. Lutsenko [6], the reliability of the system-cognitive model INF3 (chi-square) with the integral criterion "Amount of knowledge" is: $L2=0.979$, which is very, very good for applications related to analysis and forecasting climate indicators.

It should be noted that in [41] the value of the L2-significance criterion for the most reliable INF3 model was only 0.771. Such a significant increase in the reliability of the models was achieved through the use of scenario ASC analysis and is one of the main results of this work.

This means that the created system-cognitive models as a whole correctly reflect the modeled subject area and they can reasonably be used to solve various problems of identification, forecasting, decision-making and research of the modeled subject area by studying its model, which is done in this work.

In particular:

- the INF3 system-cognitive model can reasonably be used to solve various problems;

- at the disposal of the researcher there is an adequate criterion for evaluating the results of solving the identification problem: this is the level of similarity (ie the value of the integral criterion) of an object with a class.

It should be noted that the models of the Eidos system are phenomenological models that reflect empirical patterns in the facts of the training sample, i.e. they do not reflect the mechanism of causal determination, but only the very fact and nature of determination. A meaningful explanation of these empirical patterns is already formulated by experts at the theoretical level of knowledge in meaningful scientific laws [52].

5. CONCLUSIONS

Based on the analysis carried out, we can make a reasonable conclusion that when solving the problem of analyzing the climate of the city of Krasnodar Territory for 1933-2020, posed in this work, Automated system-cognitive analysis is an adequate tool, both in terms of its mathematical model, and in terms of the software that implements it. tools, which is currently the intellectual system "Eidos".

Problem set in the work is solved, the goal of the work is achieved.

You can personally get acquainted with the proposed solution by downloading at: http://lc.kubagro.ru/aidos/_Aidos-X.htm and installing the Eidos system on your computer, and then installing the intelligent cloud Eidos application in the application manager (mode 1.3) №330.

As a perspective, we note that in the future it is planned to fulfill the research and development plans justified in [51], i.e., for example:

- apply scenario ASC analysis for weather forecasting;
- to identify the strength and direction of the influence of climatic factors on the quantitative, qualitative and financial and economic results of growing various crops;
- predict the results of growing crops in kind and value terms of crops in a given microzone;
- it is reasonable to choose microzones for growing crops.

Specifically, the author has at his disposal all the necessary artificial intelligence technologies that make it possible to identify cause-and-effect relationships between natural and climatic factors and success and efficiency in kind (quantity and quality of products, its technical and consumer properties) and in value terms of growing various agricultural crops.

Knowing these cause-and-effect relationships, it is possible to reasonably recommend growing zones and microzones for various crops.

To carry out these researches and developments, only initial data on the actual results of growing crops in various natural and climatic conditions, the will of management and funding are needed.

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