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Verification of the Squall Wind Formation Quantum Laws in New York

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Abstract

The article examines the state and urgent problems of the theoretical meteorology forecast the evolution of climatic risks in urban areas. The focus is on trends in the wind gusts formation. Given the wording of the authors' hypothesis about quantum regularity in the wind speeds formation. Briefly describes the author's method of meteorological observations data statistical analysis. In detail given the research results on verification of the quantum hypothesis according to the meteorological observations data in New York.

Keywords: urban areas, climatic risks, evolution, wind gusts, forecast, quantum hypothesis, meteorological observations, statistical analysis, verification, New York

1. Introduction

According to the latest report of the UN intergovernmental panel on climate change (IPCC) almost all Nations of the world are not ready for precautionary measures on vitally important sectors of economy and population adaptation to global warming (Climate Change 2013, Managing the Risks, 2012).

On the other hand, for example, Mottaki Nakamura of Japan's national Agency for marine research and a number of Russian and European scientists said that mankind should not prepare to global warming and global cooling.

The lack of progress and a common position for the world's leading scientific schools on the global climate change issue poses a particularly difficult situation of the construction industry practical of all States, including countries with highly developed economies (Climate Change 2013).

The relationship of this problem with the construction activity and its acuteness follows from direct dependence of design decisions from the global climate change risks assessment on the urban planning depth.

For example, on the life of construction objects, which, as a rule, reach 100 and more years (Hlystunov and Mogiljuk, 2011).

That is for the period until 2114 year and next.

Especially important to take into account extreme climatic processes, including wind, for building construction.

Thus, this problem acuteness for the construction industry not only theoretical problems of scientific discussions, and has the most direct practical meaning.

Construction activity in the world, connected with many trillions of dollars of long-term investments can not stop because of differences in meteorological science schools.

This is due to the daily necessity of such design solutions selection that will provide the necessary safety and stability of building structures to all forms of climatic and meteorological loads and impacts for a long period in the life cycle of industrial and civil construction objects.

Among such loads special place wind load, which is characterized as average daily wind speed and the maximum speed of the shock wind effects on building structures.

Theoretical meteorology over the last hundred years was focused mainly on statistical studies of the wind processes structure (Sallis, Claster, Herna´ndez, 2011; Cook and Gruenbacher, 2008; Brasseur, 2001; Mitsuta and Tsukamoto, 1989; Paulsen and Schroeder, 2005).

Labour-intensive statistical methods of research historically have an important place in almost all physics branches.

But we must bear in mind that its application, as a rule, is connected not so much with his uniqueness, as with the mathematical physics analytical methods difficulties.

It is also associated with the presence of the studied processes are poorly understood or previously unknown phenomena, effects and patterns.

In our opinion, the period of mainly statistical modeling in theoretical meteorology was delayed.

The classical laws of aerodynamics, thermodynamics and heat and mass transfer in the last decade, with not very significant additions and a practically unchanged form the theoretical basis of modern software systems modeling and meteorological processes forecasting.

Undoubtedly, the modern digital technologies and supercomputers use have significantly increased the level, volume and efficiency of full-scale meteorological information processing (Sallis, Claster, Herna´ndez, 2011; Cook and Gruenbacher, 2008).

However, this was insufficient for long-term prediction of the climatic and meteorological processes evolution in the life cycle of objects construction up to 100 years and more.

In this regard, in the framework of departmental programs ("Development of scientific potential of high school"), the authors conducted a comprehensive study poorly known regularities of the dangerous natural processes intensity evolution and changes, including climatic and geophysical.

The analysis of growth in ten times the global seismic activity on the Earth after the comet Shoemaker-Levy on Jupiter (July 1994) explosion were reliably the regularities of the solar system planets gravidynamic radial resonances influence on the geodynamic processes intensity (Mitsuta and Tsukamoto, 1989; Paulsen and Schroeder, 2005).

In addition, the authors ' attention was drawn by the results of two unique researches:

-Geochemist Graham Pearson from the Canadian University of Alberta and Michael Vaisesika , Professor of seismology from Washington University (St. Louis), which concluded that under the Eurasia Eastern part and North America are huge reservoirs of water (up to 10 Pacific oceans). They are his breath have a significant impact on atmospheric and hydrological processes, including catastrophic floods and hurricanes (Graham Pearson, dx.doi.org/10.1038/nature13080);

-Fundamental nonlinearity weather theory by Edward Lorenz and arising from his theory risks of causing hurricanes remote local aerodynamic micro processes (Hilborn, 2004).

The research results on meteorological risks were published in a articles series by the authors (Hlystunov, Prokopiev and Mogiljuk, 2013; Hlystunov, Poduvaltsev and Zavalishin, 2004).

This article presents the fundamental research results of the micro-processes role on the Gale-force wind gusts formation (Hlystunov, Prokopiev and Mogiljuk, 2013).

We hope that the obtained results can be useful to developers of software systems modeling meteorological processes and can be used as addition to the basic classical models used for simulating weather forecasts.

In our view, there is a new stage in the theoretical meteorology development, connected with regard to the quantum laws and phenomena along with the classic.

A similar stage in a number of other applied physics areas was overcome for more than 50-100 years ago.

On the one hand, this article is fundamental.

However, on the other, new knowledge about the quantum character of shock wind loads formation opens up new opportunities for the development of quantum methods damping and protection of high-rise buildings and constructions from such loads.

2. Formulation of the Quantum Hypothesis

According to the fundamental law of quantum mechanics to change the parameters of micro particles motion (in this case, the molecules of the atmosphere) it is necessary to give the angular momentum equal to Planck's constant $\hbar=1.054571726*10^{-34}$ J*s.

Then, for excitation of wind every air molecule, participating in the wind formation, you need to give the angular momentum $h_m = \Delta H_m$ equal to Planck's constant, i.e.

$$h_m = \Delta H_m = m_m \Delta V_m r_{mm} = \hbar, \quad (1)$$

where $m_m, \Delta V_m, r_{mm}$ - respectively, the molecule mass, the molecules velocity increment required for the formation of the next wind gust and the distance between molecules.

Following on growth velocity and angular momentum wind gust that also must be different from the impulse at a slower rate on the Planck constant value.

In fidelity case of the hypothesis wind speed statistical distribution for dry air must have a "comb-like character ", that is

$$nh_m = n\Delta H_m = nm_m \Delta V_m r_{mm} = n\hbar$$

or

$$n\Delta V_m = \frac{n\hbar}{m_m r_{mm}}, \quad (2)$$

where n is the account number of maximum in the dependence function of the wind speed implementation frequency.

Also note that the number of molecules per the atmosphere air volume unit in General (Relativity?) depends on the pressure increments in the wind gust, temperature, humidity and aerosols concentration.

Along with this, during the wind formation in the air increases the solid and liquid aerosols concentration (mineral and organic dust, fog and precipitation in the form of liquid water and ice crystals)

For example, taking into account the aerosol impurities formula (2) will have the following form:

$$n\Delta V_m + n\Delta V_{dust} = \frac{n\hbar}{m_m r_{mm}} + \frac{n\hbar}{m_{dust} r_{dm}}, \quad (3)$$

where $\Delta V_{dust} \approx \Delta V_m, m_d, r_{dm}$ - respectively, the increment rate of aerosols captured by a wind gust, average weight of aerosols and precipitation, the distance between the particles and air molecules.

Summarizing the basic position of hypotheses, draw quantum calculations on the wind formation for the atmosphere volume unit.

3. Statistical Analysis of the Meteorological Observations Data

The only criterion of the hypothesis truth in this case there comb nature of the statistical distribution of the wind velocities obeys the quantum mechanics laws are relevant observations in a variety of geographic locations of the planet.

For example, the increment wind speed ΔV, allegedly necessary angular momentum increment for the wind formation per unit dry air volume is

$$\bar{K} = \Delta V_s \rho_o r_{mmo}. \quad (4)$$

As the molecules number per an air volume unit under normal conditions N, then each molecule, it is necessary to give angular momentum

$$k = \frac{\bar{K}}{N}. \quad (5)$$

Similar estimates for changes in humidity, temperature and concentration of aerosols, including dust, showed that the degree of their maximum aggregate impact on value of k does not exceed 10%.

In this regard, we will use the obtained expressions for the proof of the quantum hypothesis.

To this end, and to justify the fundamental conclusions of the authors carried out an analysis of the real data of meteorological observations at the speed of the wind formation in cities across the globe, including, in Anchorage, London, Moscow, Niamey, New York and Tokyo. These materials are published by the authors in a special series of articles and presentations at international conferences

Some results of the quantum laws studying of wind gusts formation were published by authors earlier (Hlystunov, Prokopiev and Mogiljuk, 2013). This article examines the generalized detailed results of similar studies in Moscow.

4. Verification of Quantum Hypotheses on the Data of Meteorological Observations in New York

As the baseline dataset we use meteorological observations data in New York for the period from 01.01.1973 on 31.08.1987 (5355 days=14.66 years), and as an data array about the current state meteorological processes similar meteorological observations data for the period from 01.01.1995 on 31.08.2009 (5355 days=14.66 years).

The time interval between arrays is 22 years.

Great choice of interval between arrays observations fixes a potential accidental correlation manifestations and mutual influence of data statistical analysis on each other.

Figure 1 shows a plot of the wind impulses number *s(V)* in New York speed (*m/*s) wind in the period from 01.01.1973 on 31.08.1987 and in the period from 01.01.1995 on 31.08.2009 (resolution *dV=0.5 m/S*)

Curves in figure 1 for both periods' observations are of comb-like character. However, there has been a significant expansion of curves that can affect the calculations accuracy.

In this regard, the authors have made a more detailed analysis of data with a resolution *dV=0.1m/S.*

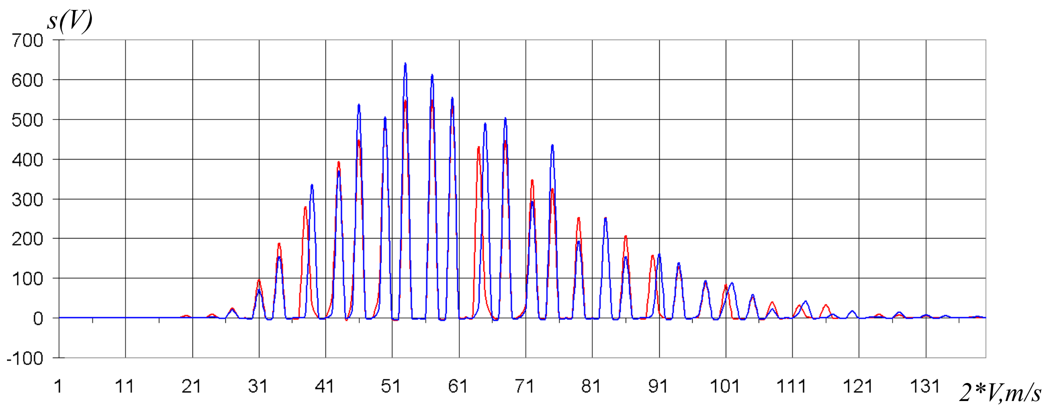

Figure 1. The graph of the wind impulses amount in New York on wind speed (resolution *dV=0.5 m/s*): the blue curve according to 01.01.1973 on 31.08.1987; the red curve according to 01.01.1995 on 31.08.2009

The result was obtained in fact ruled nature of the statistical distribution of wind velocity (*m/s*), as shown in Figure 2, for a period of 01.01.1973 on 31.08.1987.

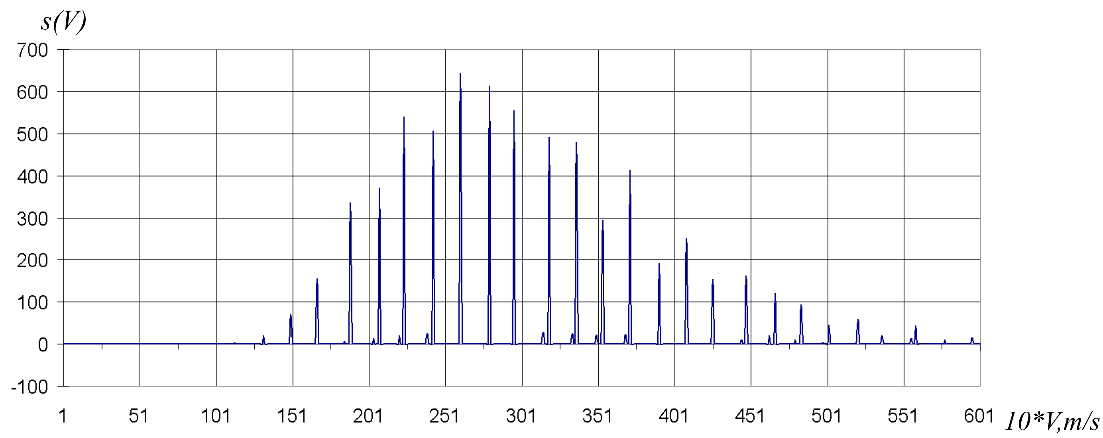

Figure 2. Graph according to the number of a wind impulses in New York on wind speed (*m/s*)

For the observation period from 01.01.1995 on 31.08.2009 was also obtained in fact ruled nature of the statistical distribution of the wind velocity, as shown in Figure 3.

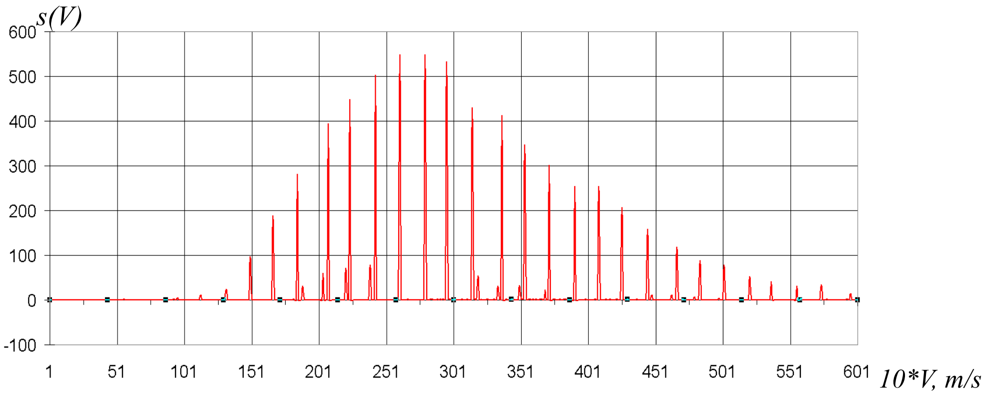

Figure 3. Graph according to the number of a wind impulses in New York on wind speed (*m/s*) in the period from 01.01.1995 on 31.08.2009 (resolution *dV=0.1 m/s*)

The analysis results of the wind speed statistical distribution nature for both observations periods allow to determine dependence of the wind gusts formation velocities from peak non *V(n)* their statistical distribution (see Figure4). Start numbering peaks in this case was selected conditionally, that is, starting with the most pronounced on the curves in figure 2 and figure 3. Background peaks of low intensity were considered by the authors as insignificant deviations associated with extreme variations of temperature, humidity and aerosols concentration.

The velocity peaks values noted in m/s above the relevant column of the chart in figure 4.

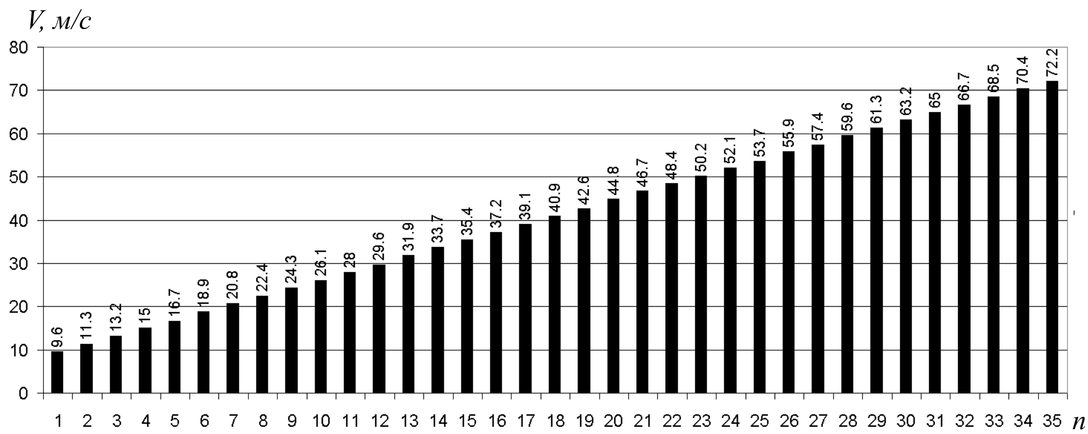

Figure 4. The diagram of dependence of the wind formation speed from conventional peak non *V(n)* their statistical distribution in New York

In accordance with the diagram in figure 4 increase in speed between the wind formation peaks is (on average)

$$\Delta V = \frac{V_{35} - V_1}{34} = \frac{72.2 - 9.6}{34} m/s = 1{,}84\ m/s. \qquad \text{(change to 1.84)} \tag{6}$$

By analogy with calculations (4) and (5), using obtained value (6) for the average velocity increment between adjacent peaks distribution of formation wind speed, we calculate the angular momentum needed to form a wind gust as in a air volume unit, and for a single molecule:

$$\bar{K} = \Delta V_s \rho_o r_{mmo} = 1.84 \frac{m}{s} \times 1.228 \frac{kg}{m^3} \times 1.025 \times 10^{-9} m = 2.316 \times 10^{-9} J \times s \times m^{-3} \ . \tag{7}$$

Where the angular momentum in average per one molecule will be

$$\bar{k} = \frac{\bar{K}}{N} = \frac{2.316\times10^{-9}}{2.07689\times10^{25}} J\times s = 1.115\times10^{-34} J\times s\ . \quad (8)$$

Thus the resulting momentum exceeds the Planck constant value is not more than 5.4%

$$\frac{\Delta\bar{k}}{\bar{k}}\times100\% = \frac{\bar{k}-\hbar}{\bar{k}}\times100\% = \frac{1.115\times10^{-34} - 1.054571726\times10^{-34}}{1.115\times10^{-34}}\times100\% = +5.4\%\ . \quad (9)$$

The excess of the Planck constant value is quite understandable and is the result of fluctuations of temperature, humidity and aerosols concentration.

Also for New York city characterized by fog and precipitation in the form of liquid water and ice crystals.

Only the temperature change within the 10^{o}C can lead to a density change by 11.3%.

5. Conclusion

The rising risks problem of building constructions accidents, both in Russia and abroad, greatly exacerbated not earlier forecast of aerodynamic processes fluctuations power amplitude growth.

A special place among the phenomena associated with aerodynamic processes in high-rise building occupied by sudden gusts of wind, storms, hurricanes and tornadoes.

Generalized the statistical analysis results of aerodynamic manifestations of global climate change show that the greatest threat to various human activity spheres, including for the building industry is not only global warming, but also the extreme states risks of wind processes.

The wind processes extreme states realization risk in urban areas, both stagnant and hurricane, also poses a threat to forestry and parks, marine and air transport.

At preservation of this trend for the current period of urban planning (for example, 100 years) very real risk of these fluctuations rising intensity.

This is quite probable development of the global climate change process cannot be ignored by investors, self-regulatory organizations, owners of construction objects control and energy companies, insurers and, first of all, municipal, regional and Federal services regulation and urban development planning, as well as aviation and marine transport companies.

This problem both in Russia and abroad, greatly exacerbated not earlier forecast of the intensity growth and non-dangerous man-made and natural climatic and geological-geophysical processes and factors, which are responsible for the implementation of new and, consequently, irregular comprehensive excess loads and impacts on the techno sphere objects (Hlystunov and Mogiljuk, 2011).

Fundamental quantum laws of the squall wind formation in New York are global in nature and were also verified by authors in other cities across the globe, including London, Moscow, Niamey, Tokyo and Anchorage.

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