The conceptual-methodological evolution, from a geographical perspective, of the research of the atmospheric factors that affect the people in a community

Mihaela-Nicoleta ȚICULEANU-CIURLICĂ*[1] and Dumitru MIHĂILĂ[1]
[1]Department of Geography, Faculty of History and Geography, Ștefan cel Mare University of Suceava, Romania

* Correspondence to: Mihaela-Nicoleta Țiculeanu-Ciurlică. E-mail: decembra_2005@yahoo.com.

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ABSTRACT: In the current context, although modern man lives in an increasingly anthropized environment, aspiring to gain absolute control of his niche of development, we see that the influence of weather and climate factors on socio-dynamic homeostasis and population health is increasingly oscillating and more difficult to control/ predict. In this study we aim to supply the attention of environmental specialists with a selection of observations and papers belonging to researchers and specialists in fields that address the health of the population in relation to environmental factors, with a focus on weather and climate. Although scientifically accredited records and measurements show that there is great variability and marked changes in environmental factors in a relatively short time, and studies show that this variability and changes have a strong impact on the well-being of the population, such issues continue to be neglected at the level of institutions and decision-makers, who should focus on human health and safety.

KEYWORDS: population health, climate change, weather and climate factors, meteosensitivity.

1. Introduction

As a basic link of the evolution of all mankind and a survival factor, climate offers – more and more frequently, through weather conditions with risk potential (hurricanes, devastating droughts, cold or heat waves, massive rainfall etc.) – reasons for the study of these phenomena.
There is a close interdependence between the human body and climate / weather, as the climatic / meteorological elements are an inseparable part of daily life, playing a significant part in maintaining comfort and mental well-being, in maintaining health or, on the contrary, in installing the weather climatic risk, in generating discomfort in different degrees and pathologies at the level of individuals or larger human groups. The importance of the space-time impact, generated by the mutual relationships established between humans and environmental factors over time, can be only analyzed in the context in which such links are first perceived, identified and measured quantitatively.

The environment has always left its mark on man, but, over time, this influence has diminished, while the impact of anthropogenic actions on the environment has increased, with the expansion of their activities (lighting fires, deforestation, extensive agriculture, industrialization and urbanization), both locally and regionally, up to interventions with global consequences (massive pollution of air, water and soil, global warming, deterioration of the ozone layer, expansion of areas affected by acid rain, widespread degradation of ecosystems etc.).

2. Area of research

Our study aims to establish to what extent the observations and conclusions reached by some authors who addressed various issues regarding weather/ climate factors and health of people in various parts of the globe or Romania are also valid for the Suceava Metropolitan Area, since their experience and results could become models of approach for any community, including the human community of the city of Suceava and the neighboring towns.

3. Methods

After using various sources of documentation (internet, studies published in specialized journals, books, press articles, etc.), we drew a chronology, by groups and domains, of the data on how weather and climate influence the human body, our basic method being the critical-comparative and evolutionary analysis of the references made by various authors on this issue.
The analyzed studies also addressed a variety of methods: from observation, experiment, comparison, statistics, cartography to methods of data collection through sociological surveys or satellite monitoring.

4. Results and debates

4.1. Meteorological-climatic evolutions from the more distant past (antiquity, Middle Age) / closer past (modern and contemporary period) and the impact they exerted on the human body/ health status of the population

The beginnings of the concerns with the relation between weather/ climate and man date back to *antiquity*. In the first treatise on meteorology, Aristotle's *Meteorologica* (384 BC), he makes the connection between different changes in environmental factors (water, air, soil) and different human pathologies. In his work *Air, Waters and Places,* Hippocrates of Kos (460-337 BC), dubbed "the father of medicine", makes the first observations of medical geography and meteopathology, comparing the inhabitants of the mountain areas with those of the plains. He notes that between the inhabitants of the two floors there are differences related to physical appearance (height, weight), health, but also behavioral and social characteristics. Hippocrates also places his knowledge of meteorology and climatology at the foundation of the medical profession. In *Aphorisms* he makes the connection between weather and the appearance or possibility of curing some diseases, a subject to be approached later (1st century AD) by Celsus, also named the "*Hippocrates of the Latins*", who advised the sick to change the climate to improve various pathologies (Teodoreanu, 2002; Povară, 2005). Herodotus of Halicarnassus highlighted the beneficial properties of the sun rays for strengthening the immune system, for ameliorating and

treating bone diseases, by observing the behavior and practices of some peoples near the Mediterranean Sea, such as the Romans, the Greeks, or the Egyptians (Teodoreanu, 2002). Also in antiquity, people linked health, physical and mental comfort to heavenly bodies. Thus, Aristotle's observations (384-322 BC) regarding the "stars", the phases of the Moon and certain meteorological phenomena inoculated his descendants with his beliefs regarding the influence of meteorological phenomena on physiological phenomena of the human body and determined many parents of the time to carefully choose the moment of conception (Peterson, 1947; Povară, 2005).

In the *Middle Ages* the relationship between astrology and medicine was strong. After long voyages at sea, the Arabs noticed for the first time the different appearance and stature of the inhabitants of the northern lands compared to the appearance and stature of Asians and Africans, respectively. Over time, it has been shown that there is a correlation between height and climate, between body shape and weather conditions. Thus, the low height of the sub-Saharan populations and the Australian aborigines reduces the amount of internal metabolic heat which, otherwise, given the background of the existing climate, would be a stress factor for the body, severely affecting its capacity for effort. The height of the population in colder regions generates an additional amount of metabolic heat that covers daytime energy losses. In terms of body shape, it varies under the influence of weather and climate conditions to which people have adapted over time. Thus, the population in the warmer zones has long extremities in order to increase the emission surface, favoring the rapid dissipation of metabolic heat outside, while the population in the colder areas has short extremities, meant to help reduce the emission surface.

The Middle Age was also the period in which the first knowledge about the pathogenic germs of leprosy, plague, cholera, typhus, and rabies appeared, with the outbursts of major epidemics in Europe. They had great interest in the study of infectious diseases in the warm zone, in the study of diseases considered weather dependent (such as rheumatism), they made the connection between microclimate/ topoclimate and the spread of contagious diseases and noticed the importance of cleanliness and the sun in treating diseases, including infectious ones. In this context, Avicenna (930-1037), considered by the Arabs to be the third Aristotle, advised his patients suffering from tuberculosis to go to Egypt and Ethiopia for heat, but also to the mountains, in Crete, to alleviate this disease. The impact of climate/weather on people was also studied in the East during that period, which led to the emergence of the first notions of climate therapy. Between 1550 and 1850, the "Little Ice Age" settled in Europe, characterized by the intensification of storms and the decrease of solar radiation, the worsening of the climate resulting in a reduction in height and an increase in the number of people suffering from rickets (Neuberger, cf. Teodoreanu 1983, 2002).

The *19th and 20th centuries* were marked by observations, respectively research on the influence that the Earth's magnetic field, the Moon and the Sun, and the atmospheric pressure exert on human health and diseases. Traditions related to healing based on natural factors (mineral waters, salt water lakes, sunbathing, aerosols, mud) were resumed. In Germany, the foundations of modern medical geography were laid through works such as *Versuch einer allgemeinen medizinisch practischen geographie,* published by Finke in 1795, *Geographische Nosologie,* signed by Schnurrer in 1813, Hasper's *Über die Natur und Behandlung der Krankheiten der Tropenlander,* published in 1831, *Medizinische Geographie* published in 1853 by Fuchs. There have also been works on geographical medicine / medical geography, medical hygiene, tropical medicine, for example *The influence of tropical climates* (Martin, 1856). The first geographical pathology, entitled *Handbuch der historisch-geographischen Pathologie*, also appeared in Germany, in 1860, signed by Hirsch. Other works in which various authors have compiled statistics and correlations between different diseases and climate factors were: *Elements of medical statistics* by Bisset,

published in London in 1829, *The sanative influence of climate*, published in 1832 by Bisset, the three-volume treatise entitled *Traité de géographie et statistique médicale et des maladies endemiques*, belonging to Boudin, published in Paris in 1857 (Teodoreanu, 2004).

In the work on biological and medical climatology entitled *Traité de climatologie biologique et medicale*, published in 1934 by Piery et al., several Romanian bioclimatic resorts are recorded. Between 1934 and 1938, in his four-volume work *The Patient and the Weather*, Petersen studied the influence of air masses on organisms, showing their correlation with human pathology. This paper was intended to explain how meteorological variations influence metabolism, intensifying or reducing burns, an explanation also accepted by biometeorologist Rudder (1894-1962).

The interest in the impact of weather and climate factors on the human body increased gradually, so that in 1956, at a symposium held at the UNESCO headquarters in Paris on 29-30 September, the *International Society of Biometeorology* was founded and its areas of interest were specified. Over time, bioclimatological research has become interdisciplinary, with close international collaboration between organizations such as the *International Society of Biometeorology*, as a non-governmental organization, and the *World Meteorological Organization*, the *World Health Organization*, the *Food and Agriculture Organization*, the *United Nations Education, Science and Culture*, the *United Nations Environment Program.*

In 1963, Tromp, a leading name in the history of Biometeorology, published the first part of his work *Medical Biometeorology. Weather, Climate and the Living Organism*, in which he made a synthesis of the main concepts underlying Biometeorology. In 1980 Tromp published *The Impact of Weather and Climate on Human and Their Environment*, in which he analyzed the influence of and geomagnetic forces on human health and behavior (Pat, 2007), and Landsberg, during his remarkable career (1906-1985) also made a classification of the types of weather, having atmospheric pressure as an essential meteorological element and correlating the human behavior with the predominant atmospheric conditions (Baer et al., 1991).

In 1967 a group of WHO experts included meteorological factors among the categories of etiological agents of chronic diseases (Ardeleanu, Barnea, 1972, Stan, 1996, Croitoru, 2012). The twentieth century was also characterized by the appearance of numerous specialized periodicals, such as: *WHO Bulletins*, *World Health Papers*, *World Health Forum*, as well as atlases of medical geography including: the *Atlas of Infectious Diseases in the US* (1971), Masor's *National Cancer Atlas* (1975), *Cancer Atlas in China* (1979), *Levin's Atlas* (1980), *Cancer Atlas in Central Europe* (1996), atlases showing a mapping of morbidity and compiled statistics on the leading causes of mortality in different parts of the globe. In 2008, Ciulache and Ionac published the *Bioclimatic Atlas of Romania*.

Although some physicians reject the existence of a significant link between weather and health, in some parts of the world not only is it recognized, but it is also exploited. For example, German doctors have been using *Deutscher Wetterdienst*, the daily bulletins of the National Meteorological Service, since 1997 to provide relevant health advice to their patients. The National Meteorological Offices in the United Kingdom and the United States are developing bulletins designed to help patients, especially those with allergic pathologies. Americans in the U.S. can check the health forecast (respiratory problems, changes in ability to concentrate and pay attention) since January 17, 2019, pregnant women can calculate the possibility of entering labor, by accessing the weather channel *Intellicast.com*, which became *wunderground.com*., which makes weather forecasts at 12, 24, 36 and 48 hours respectively. In the UK, the official meteorological agency, *Mett's Office*, has an early warning system based on weather changes, which allows hospitals to estimate how many patients will be hospitalized. This way a possible influx of patients can be avoided (by supplementing the number of beds for example). Another advantage is that, in the case of forecasts that predict a small number of emergencies in a certain time interval, several surgeries can be scheduled in that interval. This system is also able to monitor seasonal diseases such as

influenza and provide interested medical staff with data on the incidence of weather-related diseases, such as heart attacks, strokes, respiratory and infectious diseases or even fractures (Pat, 2007).

4.2. Current weather and climate evolution and its impact on the human body / population health

An important phenomenon that in recent years has increasingly affected people across the globe is the increase in climate variability, manifested in particular by the increase in the frequency and values of extreme temperatures. There are numerous studies in this direction of research, and some of the research in question will be exemplified. Bradley's 1985 study was based on one of the largest databases conducted by the Climatic Research Unit belonging to the University of East Anglia and the University of Massachusetts (1854-1992). The data collected from 400 meteorological satellites and 8000 stations around the world allowed him to appreciate how the temperature and precipitation evolved in the studied time period (Zăpârțan et al., 2009). In 1998, Ionac published the evolutionary work entitled *Climate and human behavior*, where he made an analysis of the role of climate in the anthropogenesis. In 1999, Bogdan and Niculescu published *Climate risks in Romania*, a paper that analyzes global warming and climate change. In 2003 Busuioc, Ianovici et al. initiated a series of researches of evolutionary climate trend following a Canadian model and using a meteorological database stored over a period of about 100 years, which showed that in our country there has been a general warming in the last century of + 0.3°C (Cuculeanu, 2003; Bogdan and Marinică, 2007). In 2007, the Romanian translation of Pat's work *Meteosensitivity. How climate factors influence our health* is published, in which the author emphasizes that "the human body is much more sensitive to the environment than we realize" and that the weather is able to influence people's lives in a surprising way. In the same year, Bogdan and Marinică published *Climatic hazards in the temperate zone. Genetic factors and vulnerability with applications in Romania*, a paper in which the authors devoted two chapters to global warming and the consequences of climate change on the geosphere, economy, population health and life standards.

In the paper *Climate change* (2009) edited by Professor Letcher, the complex problems of global warming were addressed in terms of their causality, but also their consequences. In 2015, the book was republished under the name *Climate change: impact seen on planet Earth* and 12 more chapters were added to the initial 24. *Climate Change Biology* appears in 2010, under Lee's signature. Using evidence from paleoecology, modeling, and current observation, this paper looks at the impact of past climate change on organisms, in order to better understand the current impact that human-induced climate change has on living things. The second edition of this paper appeared in 2015. It has four new chapters, which studied the reaction of some plant and animal species to climate change, and, as a novelty, analyses are made on the impact that these changes have on the human body. In 2016, under the signature of Tsangari and collaborators, during the 18th Electrotechnical Conference in Cyprus, a study entitled "*Temperature and health evolution of the impact on health for mortality associated with high temperatures*" appears, conducted during the years 2004-2009, which analyzed the way in which the extreme temperatures in Cyprus influenced the health of the population, but especially its mortality.

The National Atmospheric Research Center (N.C.A.R.) has tried to delineate the geographical areas that will be affected by extremely high temperatures between 2080 and 2099. Mehl, the representative of this institution, in an interview with the BBC radio station made the following statement: "*Extreme temperatures, caused by climate change, will have the most severe impact on*

human society", the main cause of which is greenhouse gases (Peterson, 1999; Zăpârțan et al., 2009).

A consequence of current climate change is natural disasters, which lead to the loss of many human lives. A report by the *International Strategy for Disaster Reduction* showed that in 2003 there were 76 more disasters than in 1990. It was the first time that the problem of people adapting to new climatic conditions was taken seriously (by developing sophisticated models for anticipating possible changes, by initiating strategies to facilitate the population's access to food and water), and for Europeans, in particular, to take measures to reduce these climate changes (by reducing greenhouse gas emissions and by reducing technology that affects the ionization of the atmosphere and soil).

In our country, too, there has been and is an active concern about the study of climate and the impact of climate change. Thus, the work entitled *În căutarea timpului pierdut* (Teodoreanu, 2017), presents in a chronological order some representative climatic events on the Globe and in Romania, from the geological past to the present. *Bazele teoretice ale climatologiei*, also published in 2017, by Bogdan, presents in detail the record meteorological-climatic hazards in Romania, the warming and the evolution of the climate, the consequences and the way in which the risks of this evolution are managed, as well as the observed trends in the climate evolution on our territory during 1961-2013.

Currently, most scientists believe that by the end of the 21st century humanity will be subjected to a process of global warming – 1-3.5°C according to Cuculeanu et al. (2003), respectively 3-5°C, according to Farcaș and Croitoru (2003), quoted by Bogdan and Marinică (2007), the anthropogenic factor being involved in particular by the release into the atmosphere of greenhouse gases (CO_2, CH_4, CFC, SO_2, NO_2 etc.), in a concentration higher than the tolerability limit of the geospheres.

4.3. Climatic factors and their influence on the human body

Solar radiation

The Sun was glorified by ancient civilizations and elevated to the rank of deity, served to compile the calendars on which the events in the lives of the people of those times were based, was always an important part of physical life, but especially the spiritual, and was always the first factor that sustains life on Earth. Solar activity is cyclical and takes place between the limits of a "solar minimum", with a small number of sunspots on the photosphere, and a "solar maximum", with a maximum number of sunspots. The spots have been observed by Chinese astronomers since the 4th century BC and have been mentioned in the works of Greek philosophers of the same century. In 1843 the amateur chemist and astronomer Schwabe discovered that the periods of "solar minimum" and "solar maximum" are cyclical, each cycle lasting 11 years. In 1849 the Swiss mathematician and astronomer Rudolf Wolf developed a method for determining the number of sunspots and groups of sunspots on the surface of the Sun. Detailed results on the instrumental observations of sunspots were first obtained by the *Royal Observatory in Greenwich* since 1874. Returning to the present day, we find that most observations show a slowdown in solar activity in recent years, most scientists claiming that the Sun is heading to "a historic low". Thus Lockwood et al., in an article published in the *Journal of Geophysical Research* in 2009, noted that solar activity is declining and that it is at its lowest level in 400 years. Lockwood et al. compared the phenomenon of the absence of sunspots that they should have seen in large numbers, with the Maunder Minimum (Last Grand Minimum) from the end of the 17th century, when for 70 years they could not be observed.

There are numerous studies that demonstrate the effect of solar activity on the human body, as well as on social activities, and we will mention some of them. In the work entitled "*Dependence of*

the health status of the population on medial factors of astronomical, meteorological and geomagnetic nature (1997-1998)" from the Horizon 2000 Program, Predeanu (quoted by Teodoreanu, 2002, Mihăilă, 2014), specified that an intense solar activity triggers, in addition to chronic heart disease, an exacerbation of respiratory, psychosomatic, rheumatic, allergic diseases. Following research in the 1960s (over a period of 30 years), using the blood of 730,000 male donors, Tromp found that the erythrocyte sedimentation rate (index for the quality of gamma globulins, antibodies that fight infectious germs) varies according to the cyclic activity of sunspots. Another study by Tromp, supported in the early 1970s by the report "*Strange Types of Accidents Based on Specific Environmental Traits*" conducted in the *Albuquerque Project*, funded by the US Atomic Energy Commission, highlighted the link that exists between sunspots and work accidents (Pat, 2007). A theory by Chizhevsky (argued successively in 1924, 1938 and 1976), divides the 11-year cycle of sunspots into four periods, 2-3 years each, correlating social phenomena such as: peace, wars, social riots, protests, elections results, with the way the "solar maximum" state evolves. In support of this theory, an article appeared in 1984 in the journal *Cycles*, stating that "periods of world peace coincide with the sunspot cycles". An article published in 2009 by *Europapress*, cited by *Agerpres* and the *Jurnalul Spiritual* reveals the findings of a study by Norwegian researchers and published in the journal *Proceedings of the Royal Society B: Biological Sciences*, according to which people born in periods of lower solar activity could live longer than those born when solar activity is more pronounced (for the simple fact that in the first years of life they were exposed to a higher amount of ultraviolet radiation). The results were supported by demographic data on 8,600 people born between 1667 and 1878, corroborated with those on solar activity in the same timeframe.

Concerning the effect of solar radiation with different wavelengths on the skin, hair, eyes, blood pressure, endocrine glands such as thyroid and pituitary gland, cholesterol, blood sugar, calcium fixation in bones by stimulating the synthesis of vitamins D_2 and D_3, and concerning the role of some of them in the appearance skin cancer, we will mention the works of several authors such as: Swerdlow, 1990, Harris et al., 2001, Ellinger, Tromp, cited by Teodoreanu, 2002, Croitoru and Sorocovschi, 2012, Rădulescu, Teodoreanu, 2014. The link between behavior and sun exposure was first studied in 1979 by American physicians Rosenthal and Lewy, then in 1980 Peterson and in 1981 Wolfe (cited by Croitoru and Sorocovschi in 2012) presented the effects of light, respectively of its absence, on the physical and mental condition of people. According to studies conducted by California *Tan's Scientific Research Center*, light influences the regulation of over 100 functions of the human body (Croitoru and Sorocovschi, 2012).

Atmosphere electricity

During electric discharges the human body is subjected to extreme physiological stress, generated by the electric field of the atmosphere, which acquires a very high potential.

The way healthy or sick people react to the electrical changes of the air around them was first analyzed in 1775 and 1777 by Beccaria, and then in 1780 by Bertholon (Tromp, 1974, Enache 2017). In 1877, in the article "*The Relationship of Pain to Weather*" in the *American Journal of Medical Sciences*, neurologist Weir demonstrated that pain is influenced by changes in the electrical state of the atmosphere. At the beginning of the 20th century, Tromp and Landsberg have shown that the electrical activity of the brain and the human behavior fluctuate depending on how the natural electric fields fluctuate. At the same time, it was demonstrated that the electrical manifestations of the atmosphere are reflected in the nervous, endocrine, and cardiovascular systems, that a disturbance of the atmospheric electric field causes exacerbation of amputation pain, depression, increase in birth rate and number of accidents, increase in general pathological symptoms, and also in mortality (Hentschel, 1978; Enache, 2016).

A number of Romanian authors also wrote about the electric field and its influence on the human body: Povară (2001), Croitoru and Sorocovschi (2012), Mihăilă (2014), maintaining that a positive electric field "offers a better overall tone, speed in decision making, accuracy in thinking, increased physical mobility", Moraru and Lascu, (1980), Golovina and Trubina, (1999), Croitoru, (2012), who found that a negative electric field causes drowsiness, headaches and decreased memory. Other authors who approached the relation between the human being and the electrical state of the atmosphere are: Dumitrescu in *"Omul şi mediul electric. Fenomene bioelectrice de suprafaţă"* (1976), Moraru and Lascu in *"Electricitatea atmosferică și organismul uman"* (1980), Moraru in "*Aeroionii, câmpul electric și organismul*" (1981), Croitoru and Sorocovchi in (2012), Mihăilă (2014) in "*Atmosfera terestră. Elemente favorabile sau nefavorabile pentru organismul uman și activitățile turistice*".

Ionization of the atmosphere

Ionization of the atmosphere was first studied as early as 1751, when Franklin invented the lightning rod, and in 1752 Lemonier, in a paper presented at the Paris *Academy of Sciences*, showed that particles with electric charges appear in the atmosphere not only during storms, but also when the sky is clear, intuiting the possible effects that atmospheric ionization has on humans and plants.

In 1899, Caspar and Asshkinasi suggested that the excess of ions in the air may be the cause of "mountain sickness", which later proved to be erroneous. Subsequent studies have shown that for 75% of the population negative ions are beneficial and only 25 % react positively in the presence of positive ions. (Croitoru and Sorocovschi, 2012).

Gradually, specialists began to recommend the treatment of certain medical conditions with the help of atmospheric ions. The first ion therapy experiments were made in 1910 by Steffens. The physicist linked the positive or negative response of rheumatic and nervous diseases to the type of predominant ions in the atmosphere, and tried to ameliorate and treat such diseases by using artificially generated negative ions. As experimental data accumulated, the idea that atmospheric ions are vital factors took shape, so that at one point, with the help of devices that modified atmospheric electricity, some doctors and naturalists sought to alleviate diseases or to influence the development of plants, respectively the breeding of animals (Povară, 2005).

In 1915 Pollak first succeeded in highlighting the presence of intermediate-sized ions, and Langevin demonstrated the existence of large ions, based on Aitken's discovery of condensation nuclei (Enache, 2007). Further observations on the existence of aerial gas ions were made during the 1930s and 1950s by the German physicist Ladenburg and the French Panthenier and Bricard. They found the connection between the content of small ions in the air and the micropollution of the atmosphere, as well as between negative ions and human health, confirming that the presence of ions (especially negative ones) in the atmospheric air is indispensable to life.

Air ionization and its effects have been described in several works of general and medical hygiene, in works of physics and electricity of the atmosphere and, last but not least, in works of bioclimatology, and there have been conflicting opinions. Some authors, such as Yaglou et al. (1931, 1934) showed that "free air ions in the environment would not be a factor that influences the body", others, such as Sokolov (1903, 1925), Tzhevschi (1934, 1938), Vasiliev, 1935, Minh, 1963, argued the importance of air ionization on the human or animal body (Enache, 2007).

It is now accepted that air ionization has a major influence on human health. Ionization is caused by the charging of air particles with negative or positive electrical charges. Atmospheric ions can be solid, gaseous or liquid, large, medium or small in size and are generated by cosmic or solar radiation, radioactive substances in the air, water or soil, by the spraying and dispersion of water droplets near waterfalls, along the rapid courses of the mountain rivers, in the vicinity of the

shores where the sea waves break, by the storms with electric discharges and last but not least by the process of photosynthesis (Rădulescu, Teodoreanu, 2014; Enache, 2017). The influence that ions exert on the human body depends on their electrical charge, their size and their concentration.

Negative ions, also called the "air vitamins", produced by lightning, waves, waterfalls, telluric radiation, but also vegetation (especially evergreen forests), have beneficial effects on the body. The positive ions that appear in the atmosphere of some territories with poor vegetation, or depleted of vegetation, as well as in polluted areas, in closed spaces, in spaces where electrical and household appliances operate, cause various symptoms: insomnia, ulcers, kidney failure, etc. when their concentration is exceeded (Mihăilă, 2014).

In Romania, a major reference in the study of atmospheric ionization is Enache. In 1999 he published the work *Ionizarea aerului și efectele sale biologice*, and in 2017, *Aspecte biomedicale ale aeronizării aerului*, works in which he presented air ionization in terms of the effects it produces naturally and/ or artificially on all organisms, but especially on the human body, gave indications and made recommendations for air ion therapy. Enache mentions that globally there are so far over 250000 publications in the field.

4.4 Climatic elements and their influence on the body

Air temperature

Temperature is the weather climate element that most influences the human body. There are several researchers who have studied and written about its adaptation to temperature variations, namely: Stan (1996), Ward (2001), Povară (2002), Teodorescu (2004), Makinen (2006), O'Neil (2011), Croitoru and Sorocovschi (2012). Most of them agree that the human being is adapted to survive in a warm, tropical or subtropical climate, and the fact that they currently populate even temperate and cold areas is due to their predominantly behavioral and less physiological adaptations (Croitoru and Sorocovschi, 2012). However, much research shows that, although man is a tropical creature, they are more resistant to cold (up to temperatures of 0°- 5°C they feel very well) than hot (withstands up to 35-40°C) climates (Teodoreanu, 2002, Enache 2011, Croitoru and Sorocovschi, 2012), and stress caused by *extremely low temperatures* mainly affects people with immune problems, the elderly, newborns, alcoholics and people suffering from chronic conditions (Hudson and Conn, 1974, Fitzgerald and Jessop, 1982, Massachusetts General Hospital, 1982, Croitoru and Sorocovschi 2012). According to studies conducted in Japan in the 1990s, a greater vulnerability to hypothermia is found in Caucasian women and men who belong to other ethnic groups (Rango, 1984; Croitoru and Sorocovschi, 2012). Women tolerate high temperatures more easily, but are more sensitive to temperature variations, and men are more perceptive to humidity variations and sweat intensely in the heat (Karjalalainen, 2007; Lan et al., 2008; Croitoru and Sorocovschi, 2012). The way in which the human body maintains its homeostasis against temperature variations is achieved by an alternation between thermogenesis and thermolysis, both mechanisms acting in order to achieve *thermal comfort*, which is generally ensured by temperatures between 22.5°C și 23.5°C (measured inside a controlled environment with a dry thermometer) (Ionac, 1998, Povară, 2001, Croitoru, 2014). The concept of *thermal comfort* was defined in the British Standard BS EN ISO 7730. This concept is linked to that of *thermal stress* or *thermal discomfort,* which occurs through prolonged exposure of the body to high temperatures (hot thermal stress) or low temperatures (cold thermal stress) (Croitoru and Sorocovschi, 2012). At the IX National Conference of Balneology in Neptun, Enache (2011) demonstrated how thermal comfort is influenced not only by air temperature, radiant temperature, air humidity, its speed, but also by personal factors (thermal insulation provided by clothes, metabolic heat), in turn

dependent on elements such as: age, sex, weight, activity, which he called "human thermal environment".

The effect of exposure of the body to low temperatures depends on the intensity of the cold, the duration of exposure, the association of low temperature with other factors such as wind and/ or humidity. When the ambient temperature causes the body temperature to drop below 37^{o}C (±0.5) (Croitoru, Sorocovschi, 2012), (±0.6) (Petrea, 2006), the phenomenon of thermogenesis occurs, manifested by chills, involuntary muscle contractures that intensify metabolic processes and increase the internal temperature of the body (Povară, 2001). This form of adaptation of the body to the hypothermic environment is complemented by a second mechanism, namely thermal insulation, manifested by "changing blood circulation and reducing the thermal conductivity of skin tissues" (Croitoru, Sorocovschi, 2012). If the human body is exposed to cold for several hours, heat loss of 3-4 kcal/min. can be compensated. When the mechanisms of temogenesis are exceeded (4-5 kcal/min.), the body cools very quickly (Enache, 2016). Then "physiological deficiencies" appear, such as hypothermia (lowering of body temperature below 35^{o}C), asphyxia, rashes, facial paralysis, neuritis, nephritis, certain infectious diseases, especially respiratory ones, and frostbite (Teodoreanu, 2002, 2004). At the same time there is an intensification of thyroid and adrenal function. This happens especially in winter, when the body makes a greater effort to maintain the temperature. Cold waves and negative thermal singularities are part of the climatic risks of this season, with sometimes quite serious effects both for human individuals and for society, respectively the environment. Sharp decreases in air temperature below the annual average are generated by cold flows that carry polar air. All people can be affected by very low temperatures, but the most vulnerable categories are: the elderly, newborns, unconscious people, malnourished people, alcoholics, and people with cardiovascular and respiratory diseases. A study conducted over 12 years on a group of 6500 people in a Canadian town, as well as numerous studies conducted in northern European countries, but also in the United States, showed that the main causes of frostbite are: alcohol consumption, psychiatric illnesses, lack of shelter and adequate clothing, fatigue, atherosclerosis, diabetes and, last but not least, smoking (Pat, 2007). If the internal body temperature drops below 24^{o}C, then the thermoregulation mechanisms stop. Heat loss will lead to coma and death.

Most like exposure to cold, excessive exposure to heat can generate multiple phenomena such as: muscle cramps, exhaustion, syncope, sunstroke. Heat waves accentuate the suffering of people with cardiovascular, cerebrovascular, respiratory diseases, and can cause depression, when the amount of vapors in the air is high. For the first time this connection (temperature-humidity-depression) was officially observed in British soldiers who contributed to the colonization of India and the Far East (1858-1947) (Pat, 2007). At the same time, high air temperature can induce other behavioral changes, manifested in increased aggression, loss of concentration, increased suicidal tendencies.

A study conducted in 1987 in the U.S., which looked at the frequency of violent and non-violent crimes committed during the years 1971-1980, showed that violent crimes (armed robbery, murder, beatings, rape) began in spring and became very common in summer. It is important to remember that the study took into account the temperature data collected from over 200 weather stations, for each year of the analyzed period. It was also shown that the high temperatures caused the number of violent crimes to exceed the number of non-violent crimes (arson, robbery).

In general, most heat-related deaths occur in people suffering from a certain condition (cardiac, cerebrovascular, respiratory). Their rate increases rapidly during a heat wave, "usually 1-2 days after the temperature reaches its peak" (Pat, 2007) and when the atmospheric humidity is high (perspiration being high, the body cannot cool down).

According to *earthobservatory.nasa.gov*, in 2003 Europe experienced a heat wave, which led to the hottest summer since 1540. In France, the wave caused the higher number of deaths (14802),

out of the total deaths at European level (70000), then in Portugal, countries where the heat lasted from June to August. Other countries affected by the heat wave that year were: Italy, Spain, the United Kingdom and Germany. The temperature record that France has reached in the last 45 years was recorded on June 25, 2019.

The heat waves that have followed one another since 2000 in the world have started fires that have caused great damage and loss of life. Among the most devastating, according to *News* and *The Epoch Times*, were: July-August 2000, USA, with 13 deaths, 560000 ha destroyed, January 2003, Australia, with 4 deaths, 800000 ha destroyed, April 23, 2003 Russia , when 12 people lost their lives in the crash of a helicopter used to extinguish the fire, August 5, 2003, Spain, when 5 members of a family lost their lives, October 21, 2003 USA/ Mexico, 22 people died, 300000 ha were damaged, August 2007, Greece, 77 deaths and 250000 ha destroyed (according to *The Epoch Times*).

In an article published on April 3, 2019, in *Monitorul de Suceava*, the spokesman of the "Sfântul Ioan cel Nou" County Emergency Hospital in Suceava stated that between April 1-2, 2019, at the Emergency Reception Unit (UPU) there were more chronic patients than usual, attributing this to the decompensations suffered as a result of the sudden transition from a cold to a warm thermal regime, but also due to the large differences in temperature from one day to the next.

In recent years there has been a trend of rising temperatures, manifested globally, a trend that results in major climate change, with sometimes catastrophic effect on human health and safety; this aspect was captured in 2009 in the report "*Impacts of Climate Change on Human, Animal and Plant Health*", a document accompanying the *White Paper* of the European Commission "*Adapting to climate change: towards a European framework for action"* (important given that plants and animals are sources of food for humans), issued in Brussels and conducted on the basis of impact assessments and research funded by the EU and by the WHO/EUROPE in certain European countries, supported by 7 reports from the WHO and the I.P.C.C. According to this paper, *"Climate change will affect human health, either directly - in relation to the physiological effects of extreme weather events, or indirectly through altered human behaviors (e.g. environmentally induced migration, more time spent outdoors), the increased transmission of food or vector-borne diseases, or other effects of climate change, such as flooding".* At the same time, they appreciated that the impact of these developments will be reflected on the health systems, by increasing the demand for medical services and influencing the ability to respond to requests, on infrastructure, on technological resources etc.

Since 1990, when the first report of the *Intergovernmental Panel on Climate Change - I.P.C.C.* was presented, renowned climatologists have been meeting every six years to bring the world's most important climate change data to the attention of the world's governments. The last report (5^{th}) was presented in Copenhagen, Denmark in 2014.

Global warming is a process unanimously accepted by the international scientific community, highlighted by the analysis of data from observations over long periods of time, determined in particular by the increase in the concentration of greenhouse gases in the atmosphere, with a growth rate 10 times faster than in the last 100 years. At present, it is estimated that the average annual temperature increased by over 1°C, between 1880-2000, and by the end of 2100 there is a risk of an increase of over 4°C. 2017 was the warmest year since 1880, when the first measurements began.

At the CPO21 summit in Paris in December 2017, the nations of the world agreed that global warming of more than 2°C should be prevented by all means, starting with reducing pollution.

Humidity

There are many scientists and there are many studies that highlight how humidity, alone or in conjunction with other factors or climatic elements acts on the human body. The first to study the effects of temperature, humidity and pressure on the human body was Petersen (1935).

Decreased humidity, especially associated with lower temperatures, leads to drying of the skin, eyes, sinuses and or pharyngeal mucosa, which makes the body more receptive to contracting viruses or pathogenic bacteria. In 1916, the renowned rheumatologist Hollander undertook a study that looked at the relationship between humidity/ barometric pressure and increased pain and joint stiffness, which showed that joint inflammation intensifies as atmospheric humidity increases and barometric pressure decreases.

Air humidity is an element whose effect on the body is manifested mainly in correlation with atmospheric temperature. In 1964, Licht, following observations on humidity and its effects on the body, introduced the notion of "psychological humidity", a notion supported by the fact that when atmospheric humidity is high, man perceives air temperature as higher than the real one (Persinger, 1980, cited by Croitoru and Socorovshi, 2012, Enache, 2016), because evapotranspiration can no longer be performed efficiently. The consequence is an overheating of the body, followed by dehydration and loss of salts, with more or less severe mineral imbalances. Dehydration causes the blood to thicken, its pressure to increase, and the heart and blood vessels to make a greater effort to pump it and drive it into the body. Moving mostly on the outside of the body, the blood does not reach the muscles and brain in sufficient quantity, which leads to: muscle cramps, decreased attention and concentration, exhaustion, fainting and even myocardial infarction (when the body temperature exceeds 40.5°C). At the same time, the increase in humidity, correlated or not with the increase in temperature, causes the number of mites and molds to increase, these being the main allergenic factors in the environment.

It has been demonstrated that there are many links between seasonal influenza and absolute atmospheric humidity (Shaman et al., 2009; Shaman et al., 2010).

In the context of the effect it has on people's health, the relative humidity has been studied the most. Theoretically its variations can be between 0 % when the air is dry and 100 % when the air is saturated (Croitoru and Sorocovschi, 2012). For the human body, humidity becomes relevant when its values are lower or higher than normal (30 % - 60 %). According to Ardeleanu and Barnea (1972), cited by Croitoru and Sorocovschi (2012), people feel best when the relative humidity of the air is around 45 % (correlated with air temperature and the body's thermoregulatory capacity).

Numerous studies published in the *Environmental Health Perspective Journal* show that people who live and work in areas where the relative humidity is average, rarely contract respiratory infections.

Among the Romanian authors who have studied the influence of humidity on the human body we can mention: Croitoru and Sorocovschi (2012), Mihăilă (2014), Enache (2011, 2016) etc.

In 2013, in the work entitled "*Turismul balneoclimatic în România*", Teodoreanu and Gaceu characterize the climatic elements and the influence they have on the body, stating that: "*for the human body, water vapor pressure is a more effective indicator of the hygrometric state of the air*", referring to the fact that dry air is unfavorable to the mucous membranes of the respiratory organs.

Cloudiness and sunshine duration

The influence of cloudiness on the human body is indirect (except for the situation of people at high altitudes that reach the cloud ceiling (Croitor and Sorocovschi, 2012). The composition of the clouds, their thickness and distribution are elements that can affect the mental state (for better or worse), respectively the quality of the activity carried out by people in the open air. Cloudiness affects the sunshine duration, being a parameter for heliotherapy.

In winter, when the days are shorter (due to the reduced sunshine duration) and when the cloudiness is accentuated, seasonal affective depression or S.A.D. syndrome sets in, which manifests with: apathy, anxiety, melancholy, nervousness and inaction (Rosenthal et. al., 1984; Croitoru and Sorocovschi, 2012). Doctors have shown that sun exposure is an effective remedy in treating this condition. The characterization of cloudiness has appeared in climatology works by numerous authors such as Milescu "*Meteorologie și climatologie"* (1993), Mihăilă, "*Câmpia Moldovei: Studiu climatic"* (2006), Sandu et al., "*Clima României"* (2008) etc., and the connections between cloudiness and the human body have been described in biometeorology, bioclimatology and medical geography works (Teodoreanu, 2004).

Precipitation

In 1934, Spillman cf. Piery, cited by Teodoreanu (2002) and Mihăilă (2014), refer to the negative influence of rain on the psyche of sensitive persons.

Although they are one of the most important climatic elements, precipitation has only an indirect influence on the human body (Mihăilă, 2017).

Precipitation can have an indirect negative impact on the health of the population through flow and abundance, as the excess water exceeds the collection capacity of sewerage systems, and their overflow can carry impurities in the active surface in drinking water sources, or when water enters improvised outhouses that are not in accordance with sanitary standards and drags dejections into the groundwater. This issue is described by Mukabutera et al., who published, in 2016 in the *BMC Public Health*, a study in which more than 8601 children under the age of 5 participated, entitled "*Rainfall variation and child health: effect of rainfall on diarrhea among under 5 children in Rwanda, 2010*". Observations showed that heavy rainfall was a risk factor for children living in households with makeshift latrines, with runoff during periods of heavy rainfall triggering diarrhea, but without any effect on children in households with properly arranged toilets.

There are studies linking precipitation to malaria transmission, such as: "*An online operational rainfall-monitoring resource for epidemic malaria early warning systems in Africa*" written by Kopec et al. in 2005, in the *Malaria Journal*, the article "Temporal correlation between malaria and rainfall in Sri Lanka", under the signature of Briët et al., in 2008, in the same journal, "*Could Malaria Control Program be timed to coincide with onset of rainfall*", published in 2017 by Komen.

While rain can be a factor in water pollution, things are exactly the opposite for the atmosphere. Precipitation purifies the air by entraining chemical or microbial pollutants into the soil and water (Mihăilă, 2017).

When abundant, rainfall can become a risk factor, causing material damage and even loss of life. In 2006, Grecu published the work *Hazards and natural risks*, in which he refers to the rains causing floods and the impact of the latter on the population.

Just like too much rain affects people, the lack of rainfall can cause discomfort or become a risk factor. Prolonged drought leads to pollution of the atmosphere, to a water deficit in the soil, which endangers crops and drinking water reserves. In Romania the greatest period of excessive drought of the twentieth century was recorded between 1945 and 1946 (Bogdan and Niculescu, 1999; Grecu, 2006; Bogdan and Marinică, 2007).

Atmospheric pressure

The human body bears as a result of air pressure, a weight of 1033 g per centimeter of the total body surface of 15000 cm^2, so a total weight of 15,400 kg (Croitoru and Sorocovschi, 2014). The normal value of atmospheric pressure is 760 mm Hg. Under normal conditions of evolution of weather conditions, on the surface of the Earth its oscillations can be small (10-30 mm) and

healthy people can easily stand them and do not perceive them. This was demonstrated by an experiment performed on 12 volunteers locked for 12 months in a barometric chamber, during which time they underwent mental exercises while the pressure was changed in a controlled manner (www.anapsid.org., cited by Croitoru and Sorocovschi, 2014). Sometimes, when the atmospheric pressure drops within a few hours by only 10 mm Hg compared to the normal value, people may experience drowsiness, fatigue, nervousness and sadness. This happens to sensitive people, and especially the sick. Atmospheric pressure increases twice during the day: morning and evening. During the year, the maximum pressure occurs in winter. A sudden increase in atmospheric pressure can lead to high blood pressure, joint pain, an intensification of allergic diseases, and in the long run a decrease in immunity by decreasing the number of white blood cells. Studies show that in people with mental disorders, the increase in atmospheric pressure intensifies phobias and obsessive states. Atmospheric pressure that accompanies atmospheric calm indirectly leads to intensified air pollution, especially in big cities.

On a vertical axis, pressure usually decreases as the altitude increases and increases with the depth of the oceans. It can adversely affect the human body when it is subject to mountain ascents above 2000 meters, performed quickly, with or without proper acclimatization. The decrease in the oxygen concentration by 1 mm Hg for every 10 m of altitude generates a form of hypoxia, called "*altitude baric stress*" or "*mountain sickness*", manifested by: nervous system dysfunction, increased respiratory volume, changes in frequency cardiac, polycythemia, hypercholesterolemia, hyperglycemia, etc. Another symptom of ascents to great heights is altitude-related cough, the characteristics of which were described by Thompson in 2007, in the paper "High Altitude Cough", cited by Croitoru and Sorocovschi (2012). Aspects related to baric stress are treated in detail in a chapter of the work entitled *Biometeorologie și bioclimatologie* Enache (2016), as well as in: Povară (2001), Teodoreanu (2004, 2002), Croitoru and Socorovchi (2012), Mihăilă (2014) etc. Numerous studies and research on "*altitude sickness*" ("*soroche*" in South America) have been conducted since 2000. They showed that the three forms in which it manifests (acute form, pulmonary edema and critical form) or four forms, according to Hurtado (1964), cited by Ionac (1998), *apud* Croitoru and Sorocovschi (2012) are different depending on the susceptibility of each person. In some people the first disorders (respiratory or sleep problems) start at an altitude of 1,500 m, but in most people manifestations of "mountain sickness" settle in at over 2,500 m (Thomas, 2000; Hall et al., 2011; Croitoru and Sorocovschi, 2014).

Just like in rapid ascent the low pressure has an influence on the human body, in the rapid descent the high pressure can trigger physiological reactions that endanger health. The rapid increase in pressure occurs mainly during scuba diving, inducing the so-called "nitrogen narcosis", by the accumulation of nitrogen in the blood and fatty tissues. Its manifestations are correlated with depth. At 30-50 m dizziness and the inability of the diver to concentrate intervene, at 58 m a false euphoric state appears, an increase in muscle strength, the conservation instinct disappears and the person may faint. Gradual lifting to the surface is not dangerous; however, sudden lifting can lead to "decompression sickness", which can lead to gas embolism, emphysema, ischemia, tissue changes accompanied by pain and even death. This disease can also occur in aviators, paratroopers, people working in caissons, tunnels, barrel rooms etc. (Enache, 2016).

If we refer to the temporality of this element, atmospheric pressure is important for the human body when it varies non-periodically, accidentally. It can become a factor of "physiological stress" if other climatic parameters change a lot, such as temperature or atmospheric humidity (Povară, 2001; Teodoreanu, 2004; Croitoru and Sorocovschi, 2012; Mihăilă, 2014).

A study by astrobiologist Som at the University of Washington, whose report was published in *Nature Geoscience* in 2009, shows that 2.7 billion years ago the Earth was subjected to a depressurization phenomenon that led to the decrease in atmospheric pressure at half its current value. The cause of this decrease was the consumption of nitrogen from the atmosphere by a

species of nitrogen-fixing bacteria. At present, nitrogen-fixing bacteria that live in symbiosis with the roots of leguminous plants do nothing but increase soil fertility, providing people with an alternative to healthy agriculture. Such events, if they were to occur today, would be fatal to the human race.

One of the researchers who studied pressure in correlation with atmospheric fronts, as well as their effect on the human body, is Peterson. In 1935, in his work, *The patient and the weather*, he argued that the approach of a polar front, accompanied by a decrease in atmospheric pressure, first triggers a contraction of blood vessels (to reduce oxygen supply to vital organs) accompanied by high blood pressure, then, to counteract blood hypoxia, the body triggers vasodilation and lowers blood pressure. These phenomena could be the explanation for why some people feel deprived of energy one day and feel more energetic the next day (Pat, 2007). Another researcher who shared Peterson's ideas about pressure and the reaction of the human body was Tromp, who published the book *Biometeorology: The impact of the weather and climate on humans and their environment* in 1980. Tromp also maintained that change in people's health is not only triggered by pressure, but also by other climatic factors.

Sudden, accidental variations, caused by thermal or dynamic factors, as well as accentuated variations in air pressure, are the ones that have important "meteotropic reactions", observed especially in chronic patients. When blood pressure varies a lot, cardiovascular diseases may worsen, blood pressure may change, and cerebral hemorrhage may occur. A sharp drop in pressure has greater negative effects than its increase. If the pressure drops, asthma attacks intensify and other diseases of the respiratory system may occur, the frequency of myocardial infarction and renal colic increases, as well as mortality. High blood pressure can trigger ulcer attacks, increase blood pressure and intensify mental disorders in people with hyperthyroidism. Sudden changes in blood pressure cause an increase in the frequency of respiratory infections, trigger migraines, labor in pregnant women, aggravate joint pain (Teodoreanu, 2002; Croitoru and Sorocovschi, 2012).

Wind

The wind influences the human body through a series of parameters such as: thermal character (hot / cold), hygric (wet/dry), direction (horizontally analyzed according to the cardinal and intercardinal points and vertically, when the wind turns into ascendant/descendant currents) duration, speed. The direct mechanical action is manifested in the skin, by the power with which the wind cools the body surface, having a role in thermoregulation, but also by the way it creates discomfort by: disturbing the hair or outfit, by projecting solid particles to the uncovered parts of the body. The indirect action is exerted in correlation with temperature and pressure (Povară, 2001).

Eagan, in "*Review of research on military problems in cold region*", published in 1969, and Rozell and Dissing, in "*The wind as Heat Thief*", 1995, explained why the body feels cold more acutely when the air temperature is lower than the body temperature and the wind blows, than during the calm of the atmosphere (Croitoru și Sorocovschi, 2012).

Winds with moderate intensity (below 0.5 m/s) are beneficial because they purify the air and stimulate the body. Therefore, localities with such winds are recommended for practicing climate therapy. Strong winds (> 4 m/s), through the pressure it exerts on the body, cause respiratory disorders, the feeling of exhaustion (especially if they prevent movement), angina attacks, also being a factor of psychological stress (Povară, 2001; Mihăilă 2014; Enache, 2016).

The winds with important effects on humans are the periodic regional ones (monsoon, breeze) and the non-periodic Katabatic winds (föhn and bora) (Teodoreanu, 2004). Katabatic winds have a positive ionizing effect on the air during the descent (Tuller, 1980; Croitoru and Sorocovschi,

2012). The consequence of this phenomenon in the body is the hypersecretion of serotonin, manifested by: anxiety, irritation, apathy, low school and professional results, depression etc. The föhn, a warm and dry wind, has a significant impact on the body. According to Rudder (1952) in "*Grundriss einer Meteorologie des Menschen*", this wind causes hypertension, headache, irritability, edema, venous stasis. When it blows it leads to an increase in the number of road accidents, suicides and murders (Teodoreanu, 2002, 2004). Where winds generally blow, measures must be taken to protect the population (Povară, 2001).

5. Conclusions

From ancient times people have made the connection between climate / weather and certain reactions of the body to them. Over time, enthusiasts of natural sciences, geography, medicine, scientists in general, began to study all these reactions and to show that there is interdependence between weather-climatic factors / elements and various conditions / illnesses, that certain diseases can be treated with the help of natural factors/ elements such as sunlight, atmospheric aerosols, ozone, aerosols etc.

Therefore, nature can offer us many alternatives that we can benefit from for a balanced and healthy life. But first we need to know what it offers us. Through knowledge we will appreciate and protect the air environment and nature, we will better adapt our lifestyle to the temporality and spatiality of environmental factors and elements, in this case the air.

Knowledge requires research into what our predecessors achieved and demonstrated. This study reviews the progress made over time in understanding the atmosphere-human relations, through the experience, means and various methods available to them and used by various specialists in various fields. Our paper shows that remarkable progress has been made in understanding the effects of the atmosphere on the human body, and we should now take a different approach: starting from the knowledge of the human-atmosphere relationship, it is necessary to take all steps to protect our living environment which is increasingly stressed and vulnerable by anthropogenic influences, which are increasing in intensity. This requires efforts to change the lifestyle from the individual level to that of society.

Based on these premises, we see an important aspect that concerns the health of the population in most geographical regions, namely, the signs of climate change that have become more and more numerous in recent years. In the context of these changes we can say that there is a need to study even more the factors / elements of climate and weather, to analyze to what extent the impact of these "mutations" will be reflected on the quality of environment, life and health of the planet's inhabitants in general and on the population of an urban agglomeration such as Suceava, in particular.

References

Ardeleanu I., Barnea, M., (1972)*, Elemente de biometeorologie medicală*, Ed. Medicală, București

August H., (1860), reproduced in Handbuch Der Historisch-Geographischen Pathologie, Volume 3 (German Edition), Paperback – March 7, 2010, 566 p

Baer F., Canfield N. L., Mitchell J. M. (1991) *Climate in Human Perspective - A tribute to Helmut E. Landsberg, Atmospheric and Oceanographic Sciences Library* (ATSL, volume 15)

Bisset H., (1829), *Elements of medical statistics*, London: Longman, Rees, Orme, Brown, and Green, 1829

Bogdan O., (2017), *Bazele teoretice ale climatologiei*, Ed. „Transversal", Târgoviște

Bogdan O., Marinică I., (2007), *Hazarde meteo-climatice din zona temperate. Factorii genetici și vulnerabilitate cu aplicații la România*, Ed. „Lucian Blaga", Sibiu

Bogdan O., Niculescu El., (1999), *Riscurile climatice din România,* Ed. Academia Română. Institutul de Geografie, București

Boudin J., Ch., M., (1832), *Traité de géographie et statistique médicale et des maladies endemiques*, Tome premier, Paris, 575 p

Bradley R., (1985), *Quaternary paleoclimatology, methods of paleoclimatic reconstruction*, Allen &Unwin, London

Chizhevsky A. (1924), *Physical Factors of the Historical Process. Kaluga*, [А.Чижевский. Физ и ческ и е факт оры и ст ори ческ ого п роц есса. Калуга, 1-я Гостиполитография]

Chizhevsky A. (1938), *Les Epidemies et les Perturbations Electro-magnetiques du Milieu Exterieur*, Paris: Hippocrate

Chizhevsky A., (1976), *The Terrestrial Echo of Solar Storms. Moscow: Thought*, [А. Л. Чижевский. Земн ое эх о солн ечн ых бур ь]

Croitoru A.-E., Sorocovschi V., (2012), *Introducere în Biometeorologia umană,* Ed. „Casa Cărții de Știință", Cluj-Napoca

De Rudder B. (1952), *Grundriss einer Meteorologie des Menschen*, Springer-Varlag, Berlin, Göttingen, Heidelberg

Dumitrescu I., (1976), *Omul și mediul electric - fenomene bioelectrice de suprafață*, Ed. Științifică și Enciclopedică, București

Eagan C., J., (1966), *Biometeorogical aspects in the ecology of man at hight latitudes*, Internat. J.

Enache L., (2016), *Biometeorologie și Bioclimatologie. Climatul și bioclimatul stațiunilor balneare din România,* Ed. „SITECH", Craiova

Enache L., (2017), *Aspecte biomedicale ale ionizării aerului,* Ed. „SITECH", Craiova

Fărcaș I., Croitoru, A.-E., (2003), *Poluarea atmosferei și schimbările climatice, cauze, efecte, măsuri de protecție*, Casa Cărții de Șiință, Cluj-Napoca

Finke L., L., (1795), *Versuch einer allgemeinen medizinisch-praktischen Geographie*, Volumul 3

Fuchs C., F., (1853), *Medizinische Geographie*, Berlin, 158 p

Grecu F., (2004), *Hazarde și riscuri naturale,* Ed. „Universitară", București

Grecu F., (2016), *Hazarde și riscuri naturale,* ediția a VI-a cu adăugiri*,* Ed. „Universitară", București

Hall D.P., Duncan K., Baillie J.K., (2011), *High altitude pulmonary oedema*, Journal of the Royal Army Medical Corps

Harris R., B.,Griffith K., Moon T.E.,(2001), *Trends in the incidence of nonmelanoma skin cancers in southeastern Arizona 1985-1996,* Am. Acad. Dermatol. 45 (4): 528-36, [PubMed]

Hasper M. (1831), *Ueber die Natur und Behandlung der Krankheiten der Tropenländer durch die medizinische Topographie jener Länder erläutert nebst der in den Tropenländern zur Verhütung derselben zu beobachtenden Diätetik : nach den besten ältern und neueren Quellen in geschichtlicher, literärischer und medizinisch-praktischer Hinsicht für Aerzte und für Diejenigen, welche nach den Tropenländern reisen*, Leipzig, Path. 546 f-2, http://mdz-nbn-resolving.de/ urn:nbn:de:bvb:12-bsb10472314-5

Hentschel G., (1978), *Das Bioklima des MensChen, Veb Verlag Volk und Gesundheit*, Berlin

Hungtington E., (1915), (1924), „*Civilization and Climate*", New Haven: Yale University Press, Pp. xii 333, The American Historical Review, vol. 21, Issue 4, July 1916, page. 781-782, University Press of the Pacific, Copyright 2001

Ionac N., (1998) *Clima și comportamentul uman,* Ed. ,,Enciclopedică", București

Lansberg H., (1939), *Atmospheric condensation-nuclei*, Ergebnisse der Koemischen Physik, T. III, Leipzig, 155-252

Letcher T., M., (2009), *Climate change,* 1st Edition: *Observed impacts on Planet Earth*, Elsevier Science

Lich S., (1964), *Medical Climatology,* Elisabath Licht Publisher, Waverly Press, New Haven, Maryland MD

Lockwood M., Owens M., Roillard A., P., (2009), *Exces open solar magnetic flux from satellite data: 1. Analysis of the third perihelion Ulysses pass,* J. Geophys., Res., 114, A11103, doi:10.1029/2009JA014449

Lupchian M.-M., (2009), *Starea de sănătate a populației Municipiului Suceava,* Analele Universității „Ștefan cel Mare" Suceava, Secțiunea Geografie, Anul XVIII

Martin J., R., (1856), The Influence of Tropical Climates on European Constitutions: Including Practical Observations on the Nature and Treatment of the Diseases of Europeans on Their Return from Tropical Climates, London, 597 p

Mihăilă D., (2014), *Atmosfera terestră. Elemente de favorabilitate și nefavorabilitate pentru organismul uman și activitățile turistice*, Ed. „SEDCOM Libris", Iași

Mihăilă D., (2017), *Atmosfera terestră*, Ed. „Univ. Ștefan cel Mare", Suceava

Mihăilă D., Tanasă I. (2010), ,,*Introducere in meteorologia practică*, Ed. Univ. ,,Stefan cel Mare" din Suceava

Minh A., A., (1963), *Ionizatia vazduha i ee ghighienicescoe znacenie*, Ed. II, Gos. Izd. Med. Lit., Moskova

Minh A., A., (1963), *The efects of ionized air on work capacity and vitamin metabolism*, Académie des Sciences médicales, Moscou, Bull, 2, 336-338

Moraru S., Lascu, O., (1980), *Electricitatea atmosferică și organismul uman*, Ed. ,,Medicală", București

Pat Th., (2007), *Under the Weather: How Weather and Climate Affect Our Health,* traducere de Ionescu A. I., cu titlul *Meteosensibilitatea. Cum ne influențează factorii climatici starea de sănătate*, Editura Ştiinţelor Medicale, Lider, Bucureşti, 254p

Petersen W., F., (1939), *The patient and the weather*, with the assistance of Margaret E. Milliken, S.M. Ann Arbor, Michigan (Edwards Brothers, Inc.) 1934-1938. 8, https://rmets.onlinelibrary.wiley.com /doi/abs/10.1002/qj.49706528018

Piéry M., Van der Elst R.. Milhaud M., Arsène d' Arsonv J., (1934), *Traité de climatologie biologique et médicale*, Masson et Cie; Masson Et Cie edition (January 1, 1934), 2664 p

Povară R., (2001), *Biometeorologie și Bioclimatologie*, Edition du Goeland, București

Povară R., (2004), *Climatologie generală*, Ed. „Fundația România de mâine", București

Povară R., (2005), *Biometeorologie și Bioclimatologie*, Ed. Universității „Spiru Haret", București

Rădulescu D., N., (1971), *The determination of condensation nuclei in several towns with various atmospheric pollution degree*, în vol. „Lacustrine Climatology", sub red. R. Gaultierotti și U. Solimene, Cam. Comercio, Como, pp.470

Rozell N., Dessing D., (1995), *The wind as heat thief,* Alaska Science Forum

Sanyoy M., (2009), Som, *Nature Geoscience*, Vol. 106, pp. 3243-3248

Schnurrer S., F., (1813), Geographische Nosologie, book republished in German in 2011, Nabu Press, ebook: https://play.google.com/books/reader?id=oJtNAAAAcAAJ&hl=ro&pg=GBS.PA1, 590 p

Shaman J., Goldstein E., Lipsitch M., (2010), *Absolute humidity and pandemic versus epidemic influenza*, American Journal of Epidemiology 173(2):127-135

Shaman J., Kohn M., Singer H., (2009), *Absolute humidity modulates influenza survival transmission and seasonality*, Proceedings of the National Academy of Sciences of the United States of America, Vol. 106, No. 9, pp. 3243-324

Shaman J., Pitzer V., E., Viboud C., Grenfell B., T., Lipsitch M., (2010), *Absolute humidity and the seasonal onset of influenza in the continental United States*, PLoS Biology 8(2):e100031.

Teodoreanu E., (2002), *Bioclimatologie umană*, Ed. ,,Academiei Române", București

Teodoreanu E., (2004), *Geografie medicală*, Ed. ,,Academiei Române", București

Teodoreanu E., (2007), *Bioclimatologie umană*, Ed. ,,Academiei Române", București

Teodoreanu E., (2017), *În căutarea timpului trecut. Schită de climatologie istorică*, Ed. ,,Paidea", București

Thomas P., K., King R., Mudle J., R., Feng S., F., (2000*), Neurogical manifestation in chronic montain sickness: the burnind feet-burning hands Syndrome*, J. Neurol., Neurosurg. Psychiatry 69, 447-52

Thompson R., A., A., Baillie K., J., Bates M., G., D., Schnopp M., F., Simpson A., Partridge R., W., Drummond, G., B., Mason N., P. (2009), *The citric acid cough threshold and ventilatory response to carbon dioxide on ascendent to high altitude*. Respir. Med. 103, 1182-1188

Tromp S., W. (1963), *Medical Biometeorology. Weather, climate and the living organism*, Elsevier Publishing Company, Amsterdam – London – New York

Tromp S., W. (1974), *Progress in biometeorology*. SwetsetZeitlinger B.V., Amsterdam

Tromp S., W. (1980), *Biometeorology -The impact of the weather and climate on Human and their environment (animals and plants)*, Editor L.C. Thomas, Heyden & Son Ltd. WHO -World Health Organization 2014

Tromp S., W., (1980), *Aspects médicaux de la biometeortology*, vol.1, Part 1 A, Part 1 B, Swets et Zeitlinger B V., Amsterdam

Tuller E., S., (1980), *The efect of the foehn wind of the human thermal exchanges*, New Zeland Geographer, 36 (1)

Vasiliev L., (1953), *Teoria i praktika lecenia ionizovannâm vazduhom*, Izd. Gos. Universiteta, Leningrad

Zăpârțan M., Mintaș O., Moza A., Agud E., (2009), *Biometeorologie și Bioclimatologie,* Ed. „Eikon" Cluj-Napoca

***Monitorul de Suceava, (03 aprilie 2009), *„Val de pacienți cu decompensări ale bolilor cronice, la Urgențe, din cauza alternanței cald / frig*, pg. 9

http://www. who.int/gho/publications/ world_health_statistics/en/

http://www.altitude.org

https://link.springer.com/chapter/10.1007/978-3-319-24660-4_27

www.anapsid.org

http://www.ipcc.ch

https://www.worldcat.org

https://archive.org/details/civilization

http://aero.conferenceubbcluj.ro

http://dx.doi.org/

https://www.jstor.org/stable]

http://earthobservatory.nasa.gov/

https://uzp.org.ro/13886/sa-cunoastemromania-balneo-turistica-i/

https://irgp2.ru/ro/naibolshee-znachenie-atmosfernogo-davleniya-kakoe-atmosfernoe/

https://doi.org/10.1086/ahr/21.4.781