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CLIMATE CHANGES AND THEIR CONSEQUENCES FOR SECURITY

Outline: Climate changes are becoming a fact. They are caused by a human activity to a great extent and get out of control becoming a natural source of threats, whose consequences can shortly touch hundreds of millions of people all over the world. The article brings closer the issues connected with the term and the directions of climate changes, but mostly its main consequences for the common security systems .

Key words: common security, ecological threats, climate changes, consequences of climate changes

Introduction

Climate changes are one of the biggest challenges the humankind is facing these days. They are clearly visible not only at a local or regional scale but also global and it can be expected that they will be even more tangible becoming a serious threat to not only health and lives of people but also to plants and animals' species, and even the whole ecosystems.

Observations and measures of climate elements conducted in different parts of the world confirm that the climate at a global scale is getting warmer and the tendency of air temperature increase near the earth's surface is intensifying. The result of the increase of an average global air and ocean temperature is the common snow and ice melting and increase of a global average sea level. Those are not the only consequences of the changes the humankind will experience. Climate changes have already huge influence , which will become even stronger (directly and indirectly) on many sectors of economics and community also through its impact on physical and biological elements of ecosystems such as: water, soil, air and biodiversity.

Their consequences will not only be the changes of conditions of humans' lives but they will bring about more and more intensive and to a greater extent

extreme weather conditions[98] directly threatening health and life of a human. Because of that we need to observe it closely also from the perspective of functioning of the common security systems. Protection of population against consequences of climate changes should become a priority when forecasting directions
of evolution of security systems, since in such prognoses the starting point should be recognition
of the importance of the changes, and first of all consequences it will have for the humankind most often helpless when facing the phenomena that are the consequences of climate transformations. The article attempts at bringing closer the issues connected with the term and directions of climate changes, and mostly its consequences for security.

Climate and its features

Climate is a very important element decisive about the quality and lifestyle of a human as well as a factor conditioning to a great extent the direction of adaptational species changes. As such it is one of significant elements deciding about the security of a modern man not only in a personal dimension but also local, regional and even global.

In an encyclopedia meaning climate is a term originating from a Greek word *klima* meaning a slope / latitude. According to a dictionary it means „ characteristic for a given area set of phenomena and atmospheric processes[99]". In PWN encyclopedia it is defined as a „ characteristic for a given area set of phenomena and atmospheric processes (weather conditions), shaped under the influence of physical and geographical properties of a given area defined on the basis of results of year-long observations and meteorological measures[100]". Summing up and skipping here the analysis of terminological complexities it can be assumed that climate in its most general meaning is a characteristic for a given area and time set of processes and phenomena which are comprised

[98] Extreme weather phenomenon is a phenomenon rarely occurring in a given area and in a given season. The term "rare" is broad but the extreme weather phenomenon usually occurs so rarely that it falls within the range of the 10^{th} or 90th percentile of the observed probability density function or less frequently. The term determining the extreme weather in absolute terms may vary depending on the place of occurrence. See: http://klimada.mos.gov.pl, dictionary, access: 15/09/2017

[99] *Multimedialny Słownik Języka Polskiego PWN* [Multimedia Dictionary of the Polish Language PWN], entry: climate, available on the website: https:// sjp. pwn.pl/wordniki/ klimat.html, access: 15/03/2017

[100] *Multimedialna Encyklopedia PWN* [Multimedia PWN Encyclopedia], entry: climate, available at: https://tut encyclopedia. pwn.pl/haslo/klimat;3922951.html, access: 15/03/2017.

of temperature, humidity, rainfall, cloudiness, pressure, direction and speed of wind[101].

The above definitions draw attention to climatic factors, which decide about a given climate. Climatic factors are the most important quantities defining external conditions (extraterrestrial) and planetary (terrestrial) as well as physical or geographical conditions (not being the elements of climate) deciding about the condition of climate. They are divided into: astronomical, radiation, circulation, geographic, ecological and anthropogenic[102] factors. The climateof a given area is mostly influenced by its geographical position and is connected with the sunlight (angle of sunlight) and altitude above a sea level. Local climate, apart from sunlight, is shaped mostly by winds and rainfall. Climate factors cause that we have a number of climates on Earth.

Depending on the spatial scale we can distinguish: microclimate (climate of vast areas shaped by geographical factors, mostly: latitude, altitude above the sea level, terrain, distance from the oceans[103]) mesoclimate (climate of a small geographical area , basically with linear dimensions 10-100km characterized by internal variety and separateness in relation to climate conditions of the areas bordering with it [104]) , topoclimate (climate of a place or relatively small homogeneous area from 1-100 km^2, whose features are shaped under the influence of the factors present in a given area or its closest area) or a local climate and microclimate (climate of a small area with an area from some to some hundred m^2, e.g. climate of a field, slope or gorge)[105].

Tab. 1.

General classification of climates

Number	Climate type	Climate kind
1.	**Hot**	• equatorial • tropical

[101] *Biologia. Encyklopedia szkolna* [B iology. School Encyclopedia], collective work ed. A. Urbanek, L. Kaczmarek, Z. Podbielkowski, K. Sabath, P. Węgliński, Warsaw 1999, p. 353.

[102] *Multimedialna Encyklopedia PWN[* Multimedia Encyclopedia PWN], entry: climate.

[103] *Multimedialna Encyklopedia PWN* [Multimedia Encyclopedia PWN], entry: macroclimate, available on the website: https:// enccyklopedia.pwn.pl/haslo/makroklimat;3936551.html, access: 15/03/2017.

[104] *Multimedialna Encyklopedia PWN* [Multimedia Encyclopedia PWN], entry: mezoclimat, available on the website: https:// enccyklopedia.pwn.pl/haslo/mezoklimat;3940267.html, access: 15/03/2017.

[105] *Multimedialna Encyklopedia PWN[* Multimedia Encyclopedia PWN], entry: climate.

Number	Climate type	Climate kind
		• monsoon hot
2.	**Dry**	• desert • steppe
3.	**Warm**	• mediterranean • monsoon Chinese
4.	**cool**	• moderate • land
5.	**cold**	• tundra • eternal cold • alpine

Source: N. Wolański N. Wolański, *Ekologia człowieka. Wrażliwość na czynniki środowiska i biologiczne zmiany przystosowawcze*, [Human's ecology. Sensitivity to enviromental factors and biological adaptation changes]vol.1, Warsaw 2006, p. 370

Because of various temperatures on the globe we can observe zonal climate distribution (climatic zones)[106]. Within climatic zones we can distinguish separate typological units (types of climates), depending on annual temperature and rainfall. According to W. Okołowicz we can distinguish the following zones: equatorial, tropic, subtropical, moderate, circumpolar [107].

The first classification of climate made by the Greeks in III B.C. divided Earth, depending on the angle of incidence of solar rays (solar climates) into 5 zones: hot, two moderate and two cool ones, divided by tropic and polar circles. The newer classifications appeared at the end of XIXth century. These days there are many various climate classifications , still the most common divides them into hot, dry, cool and cold. Details concerning the above classification are shown in Table 1.

Conditions of geo-climatic environment have a significant influence on a human body, having

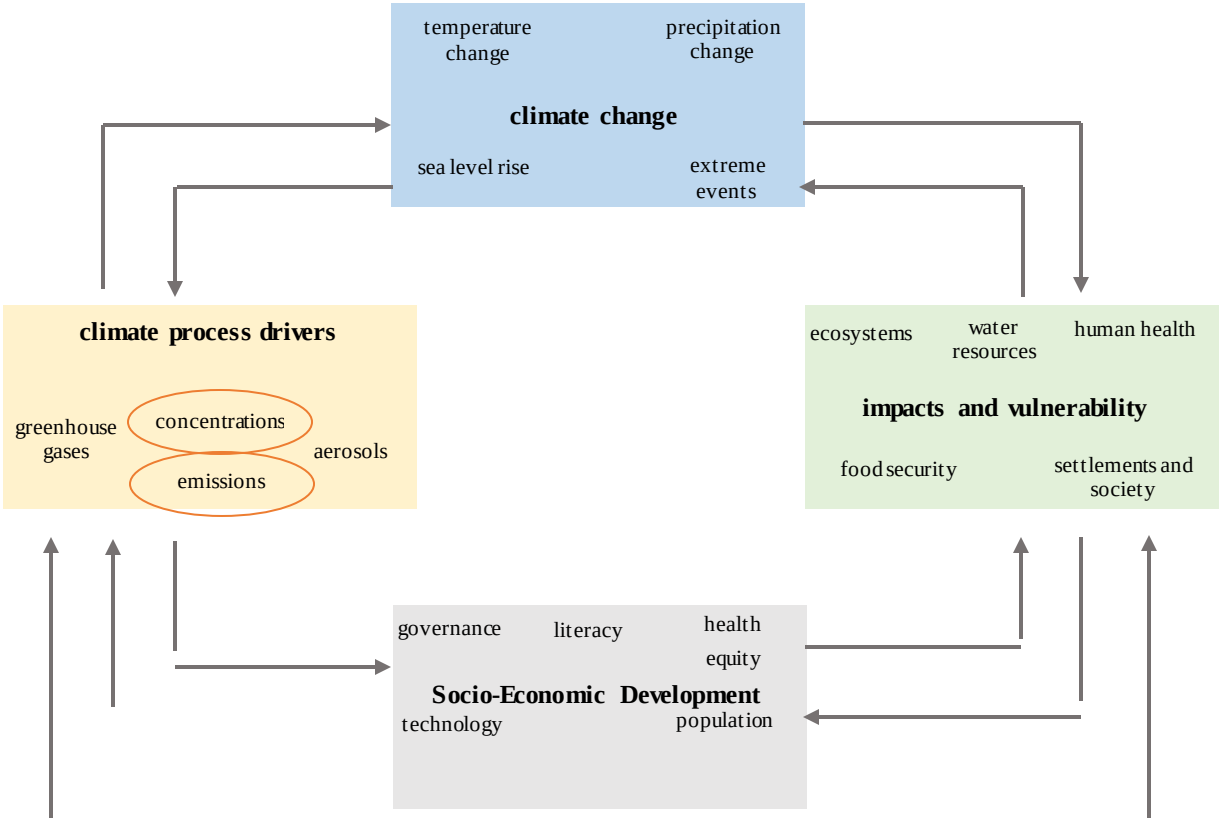
[106] Climatic zones are the largest units in the climatic divisions of the world, constituting an area in which similar macroclimatic conditions prevail; Multimedia Encyclopedia PWN, entry: climatic zones, available on the website:, https://encyklopedia.pwn.pl/haslo/ klimatyczne-strefy; 3922955.html; access: 15/03/2017.

[107] Ibidem.

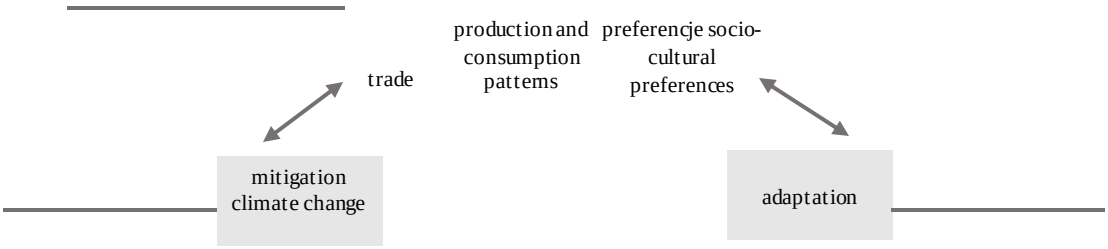
an impact on him by means of various stimuli, whose value once certain norms are exceeded is becoming harmful since they should be analyzed from the perspective of security. One can distinguish here the following stimuli[108]: *thermal* (impact of temperature and humidity together on a human, wind speed and thermal radiation with a wave length 800-1500mm), *foto-chemical* (ultraviolet radiation of the sun); l*ight* (radiation seen with a wave length 400-780mm); *chemical atmosphere* (oxygen pressure and air admixture); mechanical atmosphere (string winds and rainfall, rapid pressure changes); *electric* (air ionization, electromagnetic field); *nootropic* (group of weather factors).

Climate changes- definition and significance

Climate is subjected to periodical changes, sometimes quite drastic, which change the conditions of life on Earth completely. After the Ice Age in Europe, about 10 thousand years ago a warmer period started, called Holocene, within which there were climate fluctuations with a 1000-1500 year period. We should also draw attention to the warmest period, so-called Atlantic optimum, about 7700-5000 years ago when the temperature was even 2°C higher than now.



[108] N . Wolański, *Ekologia człowieka. Wrażliwość na czynniki środowiska i biologiczne zmiany przystosowawcze* [Ecology of aman. Sensitivity to environmental factors and biological adaptive changes, vol. 1, Warsaw 2006, pp. 371-372.



Pic. 1. Schematic framework of anthropogenic climate change drivers, impacts and responses to climate change and their linkages
Source: *Climate Change 2007 – Synthesis Report*, IPCC 2007.

Climate changes, according to UN arrangements „(…) refers to a change of climate attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods".[109]
It is differently defined by IPCC, Intergovernmental Panel on Climate Change[110]. According
to IPPC a climate change is a change of condition and qualities of climate which also
for a longer period of time, a decade or longer. It refers to any climate changes in time, whether resulting from natural changes or human activity[111].

There are stronger and stronger premises to claim that the climate changes we can observe these days differ significantly from any earlier periods of temperature increase in the history of our planet, which were evoked only by natural factors- changes in the Sun activity, orbital parameters or natural change of the composition of the Earth's atmosphere [112]. Climate changes up till the end of the last Ice Age had taken place without significant human presence. In 200 years, between 1800-2000 the population increased 8 times, the emission of carbon dioxide 21 times, production of primary energy 32 times, gross global product (considering inflation) 100

[109] United Nations Framework Convention on Climate Change, New York 9 May 1992, (Journal of Laws 1996, No. 53, item 238)

[110] In 1988, two United Nations organizations - the World Meteorological Organization (WMO) and the United Nations Environment Program (UNEP) created the Intergovernmental Panel on Climate Change, or the Intergovernmental Panel on Climate Change (IPCC). The purpose of the IPCC is to assess the risks associated with human activities on climate change and to define global regulations to reduce emissions into the atmosphere

[111] *Climate Change 2007 – Synthesis Report*, IPCC 2007.

[112] Z. W. Kundzewicz, *Zmiany klimatu, ich przyczyny i skutki- obserwacje projekcje* [Climate changes, their causes and effects - observations and projections], Landform Analysis, Vol. 15: 39-49 (2011).

times and the length of a daily human move (apart from walking and running) 1000 times[113].

A number of unprofitable human activities are among others atmosphere pollution. Many scientists are of the opinion that the present changes are the changes that a human is responsible for.

Global consequences of climate changes

These days the biggest threat is the **global warming**. It is brought about by a phenomenon called *greenhouse effect.* Greenhouse effect has always been present on Earth since the solar energyall the time goes into the atmosphere, its part is absorbed by the clouds and the rest is absorbed by Earth, which in consequence causes its warming. The gases present in the atmosphere absorb energy emitted by Earth in form of inferred radiation not letting it get into the space, because of which
the average temperature of Earth is now 15 ˚C (in the situation of lack of gases in the atmosphere the temperature would be minus 18 ˚C)[114].

Today it is commonly accepted that global warming is caused by a human activity and the phenomenon itself is based on the increase of surface atmosphere layers temperature cased by emission of greenhouse gases (carbon dioxide, methane, nitrous oxide, freons and halons). Tendencies in terms of temperature rise are shown in pict.2.

Climatologists are of the opinion that contemporary climate can tolerate the warming at the level 1-2 ˚C, whereas forecasts predict that by 2100 the temperature rise is possible by 1,8-4,0 ˚C. The increase will be geographically varied, and the bigger changes will concern altitudes without winter and the land areas [115].

The consequences of climate changes include also the melting of ice surface on the poles. On the North Pole, the area of which is covered by arctic ice it has decreased by 10 %.
The thickness of ice under the water surface has decreased by 40%. The ice surface in Arctic has been subjected to similar changes [116]. The disappearance of ice surface can have a significant

nd various consequences. Undoubtedly, the existence of a number of polar animals will be threatened. There will be the end of the Inuit' culture and lifestyle

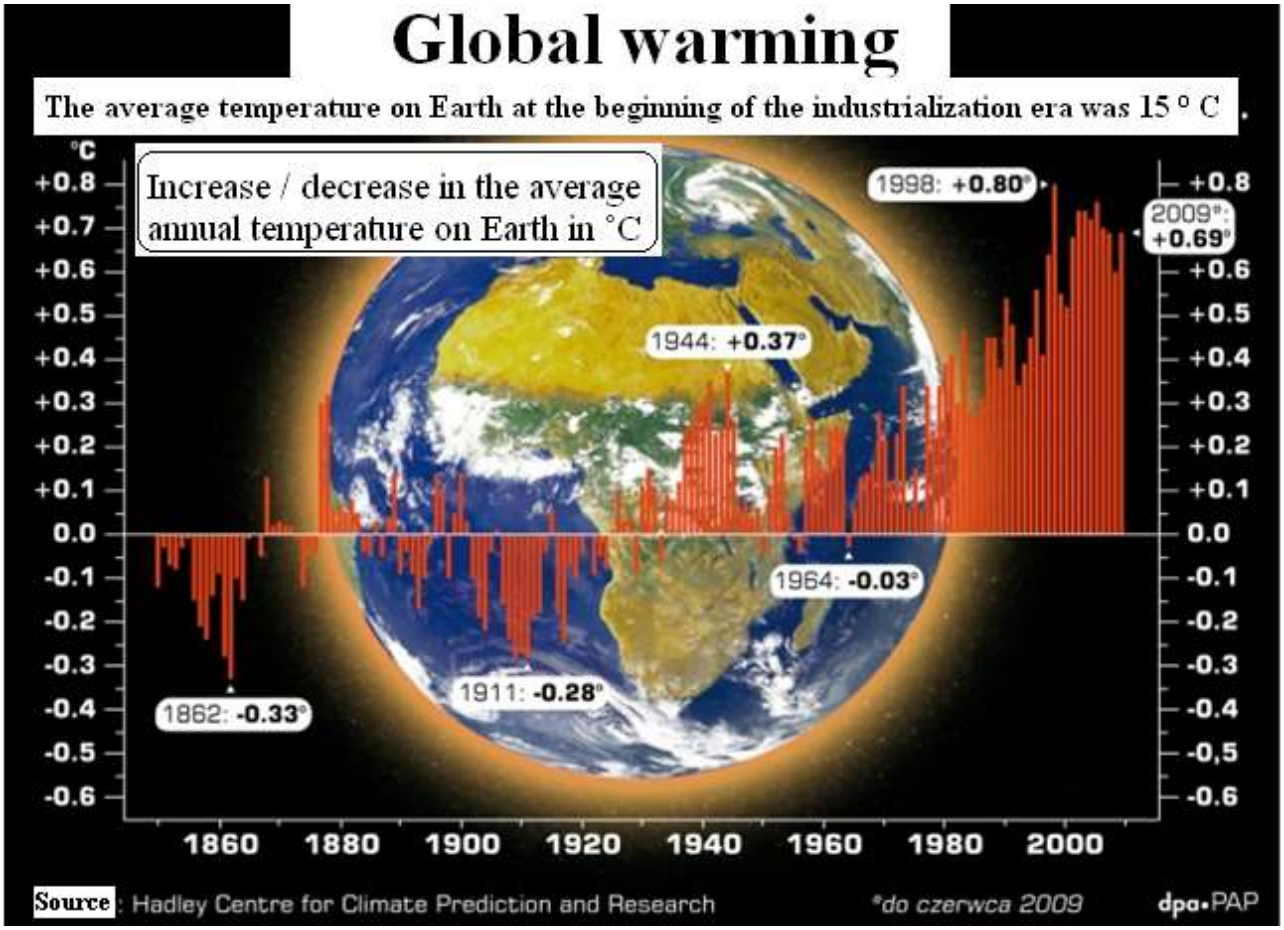
[113] Ibidem, p.4

[114] B. Dobrzańska, G. Dobrzański, D. Kiełczewski, *Ochrona środowiska przyrodniczego* [Protection of the natural environment], Warsaw 2012., p. 96.

[115] Ibidem, p.99-100.

[116] More: Raport International Arctic Research Center - Japan Aerosace Exploration Agency (IARC---JAXA), Atmospheric pressure, 2013.

as well as other peoples of the North. There is a likelihood the sea levels will rise by even a couple of metres[117] . On the other hand the disappearance of the Arctic ice surface can have beneficial economic consequences. First of all, the northern water route can be opened and there will be an opportunity to explore the wealth of Arctic, including the Arctic fields assessed at ¼ of undiscovered world gas and oil resources.



Pic. 2. Tendencies of temperature changes on the Earth
Source: PAP/DPA photo: Małgorzata Brylant

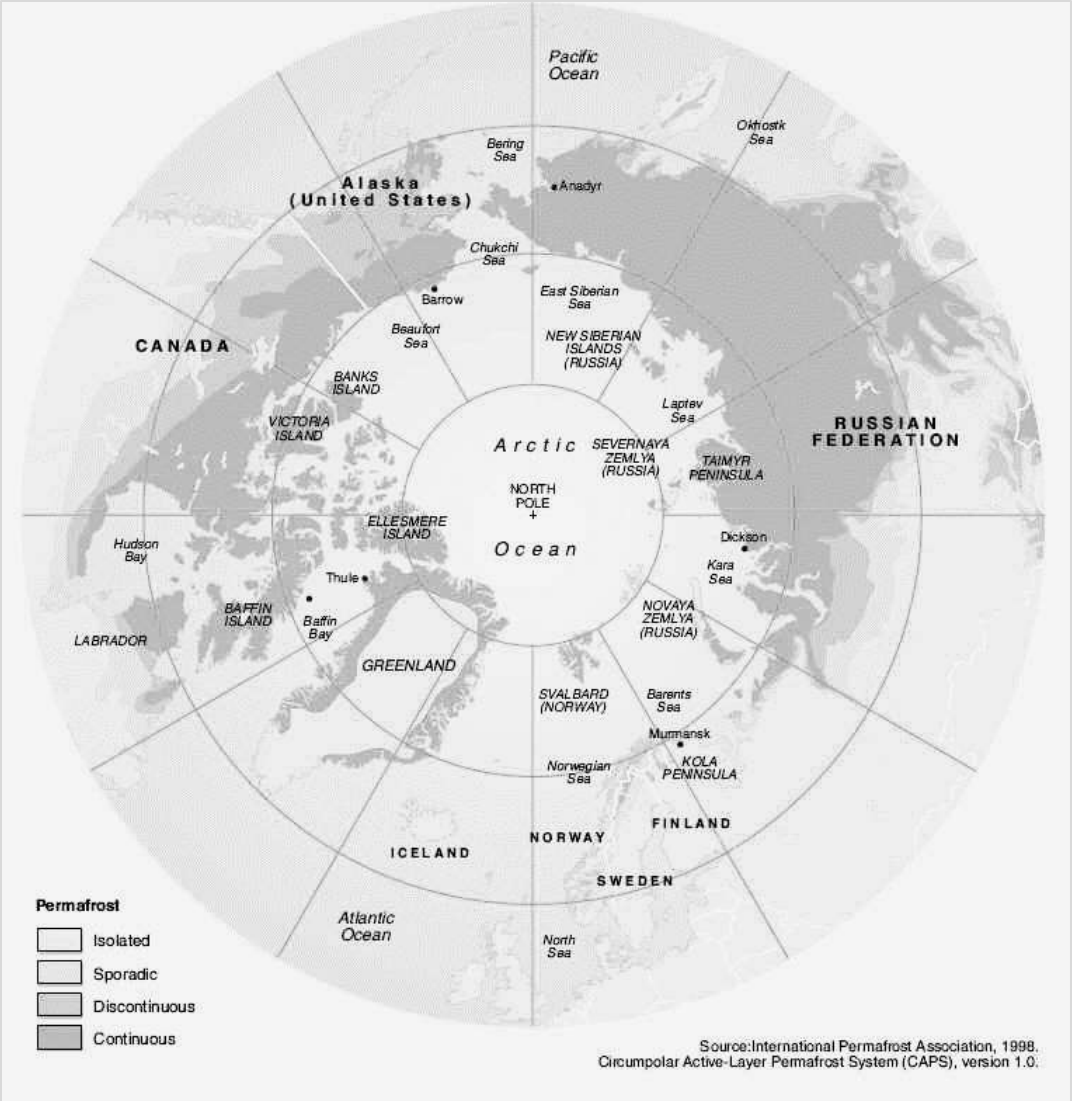
Another significant change is glaciers' shrinking. It is estimated that by 2050 in the Swiss Alps as many as 75% of glaciers will have disappeared. Even sooner, by 2020 the glacier covering Kilimanjaro most probably will have melted. The scientists warn us that the snow line in Tibet recedes each day by 100-150 metres and in some places even 350 metres. The irrigated areas shrink at the pace of 10% a year. It is predicted that because of glaciers' melting in the Himalayas China will have lost 2/3 of its glaciers by 2050.

[117] Two phenomena are the reason for rising the sea level : increase in water volume with rising temperatures and melting of glaciers

Climate warming will also influence defrosting of permafrost. Permafrost is an area on which the temperature of the top layer of the Earth is constantly (according to a definition for at least 2 years) below zero. Permafrost covers now 10 million km^2 (it is about 20% of land area).

Recently we have been witnessing gradual defrost of permafrost (pic. 3). The areas which since the time immemorial have been frozen are now defrosting. Soil as hard as concrete is turning into steppe or swamp and on the surface of defrosting permafrost there are the whole fields of small lakes. The local infrastructure is threatened . The buildings built without foundations, indirectly

in permafrost are now standing on the area turning into swamps, because of which they are leaning and collapsing. It also refers to roads, pipelines, railways. It takes place in Siberia, Canada, Alaska and also in Tibet . Countless amount of methane is now getting through to the atmosphere, which is released from defrosting surface, which in turn threatens the increase of pace of warming the atmosphere.



Pic. 3. Area covered by permafrost
Source: http://www.earthlyissues.com/arctic.htm.

The consequences of climate changes , including global warming are complex in character and can be considered in many aspects. It can be expected that the frequency of intensity of some extreme phenomena (droughts, floods, hurricanes) connected with the climate changes will increase, which in turn can influence the economic costs and social warming, since phenomena of this type bring about significant losses[118]. Hurricanes can be stronger than modern ones by even 40-50 %. The changes were visible e.g. during Katrina hurricane, which damaged New Orleans and cost the USA at least 120 billion dollars, or the strongest of them- " Wilma" hurricane, which in October 2005 ravaged the Carribean Islands[119].

[118] See.: K. Kożuchowski, R. Przybylak, *Efekt cieplarniany*,[Greenhouse effect] Warsaw 1995, p. 7.
[119] E. Bendyk, *Groza ozonowa*,[The ozone terror] „Polityka" [The Politics] 14.04.2007 r., nr 15, p. 116

Climate changes can indirectly influence people's health by creating conditions to increase air (secondary dusting and ozone) and water pollution, development of bacteria causing food infections as well as infectious diseases transmitted by insects [120] .

Thus, climate changes have had and will have a huge (direct and indirect) influence on many sectors of economy and community by physical and biological impact on ecosystems elements such as: water, soil, air and biodiversity. The most visible and significant from the perspective of security consequences of climate warming are[121]:

- changes in the hydrological cycle and atmospheric circulation;
- changes in the level of seas and oceans;
- threat to ecological species and systems
- changes in food production;
- health effects;
- social and economic effects

Their characteristics are presented in Table 2.

Tab. 2

General characteristic of climate changes consequences

Type	Characteristic features
changes in the hydrological cycle and atmospheric circulation	**General tendency:** increase of intensity of evaporation and atmospheric precipitation. **Visible phenomena**: • the occurrence of sharper droughts and floods in some places • extreme conditions in deserts (higher temperature with minimal increase in humidity); • in moderate latitudes: snow cover disappearance, reduction of ground retention, elevation of groundwater.

[120] *Strategiczny plan adaptacji dla sektorów i obszarów wrażliwych na zmiany klimatu do roku 2020 z perspektywą do 2030,* [A strategic adaptation plan for sectors and areas sensitive to climate change by 2020 with a view to 2030]Ministry of the Environment, Warsaw 2013.

[121] More: B. Dobrzańska, G. Dobrzański, D. Kiełczewski, *Ochrona środowiska przyrodniczego*, [Protection of the natural environment] , p. 100-104.

Type	Characteristic features
changes in the level of seas and oceans	**General tendency** : by the end of the century it can be predicted that the sea level will have risen by 18 to 59 cm. **Visible phenomena**: • losses of parts of land mainly in depression areas (eg the Netherlands); • increased coastal erosion and flooding of islands; • increased risk of flooding in the coastal lowlands; • disturbance of the ecological balance of coastal zones; • increasing the negative effects of storms, • increased salinity of estuary areas of rivers and groundwater.
threat to ecological species and systems	**General tendency**: phenomena is hard to diagnose, however visible reduction of biodiversity will be. **Visible phenomena** • elimination of cold-blooded organisms will occur; • many coral species will be killed; • some organisms (especially plants) will not keep pace with the movement of climate zones; • mangrove ecosystems and coastal swamps will suffer due to an increase in the level of water in the seas.
changes in food production	**General tendency**: it is hard to state today whether climate warming will bring about increase or decrease in food production. **Visible phenomena** • an increase in carbon dioxide content should accelerate plant vegetation; • warming will create favorable conditions for the development of animal pests and parasites; • there will be shifts in the food production sector; • some regions of the world will suffer because of this, especially Africa.

Type	Characteristic features
health effects	**General tendency**: climate changes will have a significant influence on health of a vast majority of human population. **Visible phenomena (negative)**: • injuries and deaths due to extreme weather events; • higher frequency of circulatory and respiratory problems the spread of some infectious diseases (malaria, yellow fever).
social and economic effects	**General tendency**: significant losses and increased migrations on the ecological ground are expected . **Visible phenomena:** • the coastal zones (including coastal cities) and small islands will suffer, which may cause a wave of population migration inland; • economic losses will amount to about 3% of the net product per person, • the economies of poor countries will suffer particularly, which may lead to their bankruptcy.

Source: own elaboration on the basis : B. Dobrzańska, G. Dobrzański, D. Kiełczewski, *Ochrona środowiska przyrodniczego*, [Protection of natural environment], p. 100-104.

Climate changes can lead to increase of chaos and violence in the world, contributing to the growth of internal and international armed conflicts. The indirect motif of the conflict can be[122]: competition for resources, pressure connected with energy supply, high economic losses, border and territorial arguments , migration of population on ecological grounds, pressure on international structures. As it is rightly noticed by Javier Solana: (…) climate changes cause humanitarian crises, political and economic instability, border

[122] R. Białoskórski, *Wyzwania i zagrożenia bezpieczeństwa XXI wieku*,[Challenges and security threats of XXI century] Warszawa 2010, p. 157.

disputes over land, water and other resources, ethnic tensions and migrations to Europe of millions of people from Africa and the Middle East"[123].

Climate changes in Europe and in Poland

Climate changes concern all the Earth, thus they are visible in Europe. The most sensitive regions in Europe is the south of our continent, the Mediterranean, the outermost regions and the Arctic. Particular problems concern mountain regions (especially the Alps), islands, coastal areas and urban areas, as well as densely populated floodplains[124].

In the years 2002-2011, the surface temperature of land in Europe was on average 1,3 °C above the pre-industrial level, which means that the temperature rise in Europe is faster than the global average[125]. There has been a high frequency of some extreme weather events and more frequent heat waves, forest fires and droughts in southern and central Europe for several years. More rainfall and floods are foreseen in North and North-Eastern Europe as well as higher risk of flooding and erosion of coastal areas, mainly in the Mediterranean. A greater number of such phenomena will lead to an increase in the scale of natural disasters, which in turn will cause significant economic losses and problems related to public health; the number of deaths will also increase, which means that the changes directly influence increase in the risk of threats of the European states' population[126].

Tab.3.

Consequences of the climate changes in Europe

World region	Predicted scope of changes
Europe	• Climate change is predicted to increase Europe's regional diversity in terms of natural and capital resources. The negative consequences will also be greater risk of rapid floods, more frequent coastal floods and increased erosion of sea coasts (due to more frequent storms and sea level rise).

[123] Javier Solana - High Representative of the European Union for Common Foreign and Security Policy, secretary general of the Council of the European Union, EU 2008 Report, quote found in: http://ziemianarozdrozu.pl/encyclopedia/94/susze-i-pustynnienie, access: 10.05. 2014.

[124] *Biała Księga, Adaptacja do zmian klimatu: europejskie ramy działania*, [White Paper. Adapting to cli mate change. Towards a European Framework for action]Brussels 2009, KOM(2009) 147.

[125] EEA Report nr 12/2012. *Climate change, impacts and vulnerability in Europe 2012* .

[126] The EU strategy for adaptation to climate change, Brussels, 16.4.2013 COM (2013) 216 final.

	• In mountain areas melting and disappearing of glaciers, reduction of snow cover should be expected, which will contribute to limiting winter tourism as well as widespread extinction of species of fauna and flora (in some areas up to 60% by 2080 according to high-emission scenarios). • For southern Europe, a region particularly sensitive to climate change, it is predicted that climate change (high air temperature, droughts) will result in worsening living conditions, as well as limited access to water, hydroelectric potential of rivers, summer tourism and agricultural production. • Expected heat waves and fires, resulting from climate change, will increase the risk of losing health.

Source: IPPC 2007: *Zmiana klimatu 2007. Raport syntetyczny*, Climate change 2007. Synthetic report, contribution of Working Groups I, II, III to the Fourth Assessing Intergovernmental Panel on Climate Change, (ed.)The main team of authors:, Pachauri R. K. and Reisinger A., Publishing House. IOŚ, Warsaw 2009.

Climate changes are not indifferent to Poland. Poland lies in a moderate climate zone.
The climate of Poland is characterized by high variability of weather and significant changes
in the course of seasons in consecutive years.

Based on the average annual temperature of air in Poland, six seasons are distinguished: early spring (0-5 °C), spring (5-15 °C), summer (above 15 °C), autumn (5-15 °C), the interval
(0-5 °C), winter (below 0°C). The duration of the seasons varies regionally: the summer lasts from 60-70 days in the northern part of Poland to 100 days in the south-east, in the central, western and south-west parts, winter - from 10-40 days by the sea and in the west to 3 -4 months in the north-east, and up to six months in the Tatras.

The last two decades of the 20th century and the first decade of the 21st century are the warmest in the history of climate observation in Poland. In all seasons, an increase in air temperature is observed, but it is definitely stronger in the winter, and weaker in the summer. The noticeable increase in extreme temperatures has been taking place since 1981. The greatest impact on climatic conditions in Poland has been exerted in the last thirty years by extreme weather phenomena, whose current intensification noticeably changes the dynamics of climate features. Among thermal phenomena disadvantageous and troublesome

for people, environment and economy one should mention the particularly severe heat waves (strings of days with a maximum air temperature of ≥30 ° C lasting for at least three days) and hot days (with maximum temperature ≥30 ° C), most frequently occurring in region of south-western Poland. In most of Poland, there is a downward trend in the number of frosty and very cold days. On the majority of Poland, the structure of rainfall has changed. Among others, an increase in the number of days with heavy rainfall (daily rainfall ≥ 50 mm) has been observed, especially in the southern regions, which results in a serious flood risk. On the other hand, it can be seen that in the last period, in the entire eastern Poland (from the Vistula to the east), the rainless period is extended, even by 5 days / decade, which in turn affects the phenomenon of hydrological drought. The hydrological situation is aggravated by low snowfall in winter. In the period of cold season (X-IV) there is an increased share of wind speed in gusts up to 17 m / s which pose a significant threat, while in the summer (VI-VII) hurricane wind speeds appear. The occurrence of very high wind speeds lasting many hours or even several days is observed[127].

Climate change, and above all the accompanying extreme weather events cause direct and indirect damage affecting both people and the economy as well as the environment. Direct damage arises as a direct result of factors accompanying extreme weather events. They concern loss of health and life of people, destruction of technical infrastructure, loss of livestock and crops or destruction of ecosystems. Indirect damages are in turn the result of long-term consequences of extreme weather and climate phenomena and they cover an area much larger than the one affected by the phenomenon itself. They arise as a result of the loss of corporate profits caused by communication problems, reduced production resulting in a decline in the competitiveness of selected industries or reduced demand in the affected market. The impact of

[127] See.: *Strategiczny plan adaptacji dla sektorów i obszarów wrażliwych na zmiany klimatu do roku 2020 z perspektywą do roku 2030*, [Strategic adaptation plan for sectors and areas sensitive to climate change by 2020 with a view to 2030]Ministry of the Environment, Warsaw , October 2013.

weather phenomena on the occurrence of damage in various sectors of the economy is presented in table 4.

Tab.4.

The impact of weather phenomena on various sectors of the economy

Sector	Weather phenomena causing damages
Agriculture, biodiversity, water resources	flood, hurricane, lightning, drought, negative effects of overwintering, spring frosts, heavy rain, hail
Forestry	flood, strong winds, drought, floods and landslides, rainfall, intense snowfalls, lightning, hail, waves of heat
Health, local communities	heat waves, cold waves, extreme events causing psychosocial damage, damage to health and loss of life, landslides, drought
Infrastructure	flood, flooding, hurricane, lightning, hailstorm, landslides, snowfall and snowfall, icing

Source: *Strategiczny plan adaptacji dla sektorów i obszarów wrażliwych na zmiany klimatu do roku 2020 z perspektywą do roku 2030*, [Strategic adaptation plan for sectors and areas sensitive to climate change by 2020 with a view to 2030] p. 14.

The highest losses are often caused by the occurrence of the entire complex of phenomena. In infrastructure and forestry, losses may arise as a result of strong winds combined with rain, hail and lightning discharges. Currently, in Poland the greatest damage is caused by floods and hurricane winds. The flood, which occurred in Poland in May and June 2010, affected as many as 14 out of 16 provinces, both those from the Vistula and Odra basin. The total value of losses caused by the flood in 2010 was estimated at approximately PLN 12.5 billion. However, the total value of direct losses caused by unfavorable weather and climate phenomena in Poland in the years 2001-2011 was estimated at over PLN 56 billion[128].

Summary and conclusions

[128] Ibidem, p.15.

Taking into account the scope and nature of climate change, it is clear that these problems cannot be neglected with contemporary security analyzes not only on a national but also on a global scale. This is one of the main factors that in the coming years will determine the structure and shape of the ecological security space. The article contains several important remarks and conclusions:

1) The scope and nature of climate change will have a fundamental impact on changing the living conditions not only of man, but also of entire ecosystems. They will also have negative impact on many sectors of the economy, including agriculture and energy, which may have direct effects on the possibility of providing adequate living conditions and development not only for the societies of individual countries, but also for the global society.
2) The consequences of climate change, mainly through increasing the intensity of extreme weather events, should be the subject of a thorough analysis by specialists dealing with the issues of general security.
3) Civil protection systems should evolve towards solutions that allow quick and effective relief for numerous victims of extreme weather events. The wide range of negative effects of extreme weather events also means that budgets should have adequate financial reserves to help victims of such phenomena, as well as to restore critical infrastructure on which the normal living conditions of people depend.
4) All adaptation to climate change is associated with huge costs. In the global perspective, the largest costs will be incurred by developing countries, in which the necessary expenses can reach up to USD 100 billion annually. These costs, however, are worth bearing, because the health and life of man is priceless, and our moral duty is to ensure the survival of human civilization and provide appropriate living conditions for future generations.

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