

THE IMPACTS OF CLIMATE CHANGES ON THE RISK OF NATURAL DISASTERS

ABSTRACT

Climate changes caused by uncontrolled emissions of greenhouse gases, increasingly, directly or indirectly threaten people and their material goods. In addition, the effects of the climate changes (increasing in the average temperature of the biosphere, the rising of the sea levels, melting glaciers, etc.), undoubtedly contribute to an increased risk of natural disasters. Moreover, climate changes have an impact on the gradual increase of their frequency, intensity and consequences. Around the world, numerous examples of natural disasters testify about the great and inevitable impact of the global warming on the change of the characteristics of floods, droughts, hurricanes, etc. It is therefore important to analyze the direct and indirect impacts of climate changes on all the aspects of natural disasters.

The article explicitly and implicitly explains the implications of climate changes on the emergence, intensity and frequency of natural disasters. In addition, it generally perceives the phenomenological structures of climate changes and natural disasters in order to analyze their mutual causality.

Keywords: climate changes, natural disasters, impacts, emergency situations, security.

INTRODUCTION

In the recent years, serious decisions are led at local and international level on the issue of climate change and its impact on natural disasters; they even become more numerous and more serious over the years. Exploring their mutual influences, scientists worldwide are mostly engaged in the issue of the link between the increase in the average temperature of the earth and the frequency (intensity) of natural disasters, with a special emphasis on hydrological and meteorological disasters. In order to analyze such influence, a solid knowledge of climate changes and natural disasters is necessary, as it is well known that global warming does not affect equally all kinds of those disasters, taking into account the origin of their occurrence. However, it should be noted that natural disasters have always existed, and that climate changes can only affect the increase in their number, intensity, and consequences that they cause to people and their material goods.

Without going into various multiplied multidimensional issues of climate change, it should be noted that climate changes are caused by emissions of different gases that directly or indirectly exacerbate the natural process by which infrared radiation is captured in the atmosphere, which causes heating of the lithosphere, hydrosphere and atmosphere. It is a fact that speaks that the temperature increase of land, sea, and air causes disorder of certain natural processes, thereby contributing to creation of more frequent floods, hurricanes, landslides and so on. Therefore, global warming which is characterized by increasing average temperatures on Earth can be direct or indirect cause of the increase in severity (number and intensity) of natural disasters. In order to examine this possibility, it is important to examine the effects of elevated temperatures of land, sea and air on the processes that contribute to the above-mentioned increase in severity of natural disasters. Besides the increase in the average temperature of the lithosphere, hydrosphere and atmosphere, which are direct consequences of climate changes, it is important to analyze its indirect effects as well, such as increasing the level of the oceans and seas affected by the rapid melting of large glaciers in Antarctica and Greenland. The aforementioned process also affects the natural disasters, but in different ways than the direct effects of climate change.

A large number of research studies worldwide have identified and demonstrated the interconnectedness of global warming and natural disasters using different statistical models. For example, if

we start from the fact that the strength of hurricanes is based on the heating of the oceans and seas, which is later transformed into mechanical strength, it is easy to examine the relationship between the changes in ocean temperature and hurricane strength over the past few years. Of course, it is necessary to bear in mind that the characteristics of a hurricane do not only depend on the water temperature, but also on other factors which we will not refer to in the paper.

Therefore, this paper will analyze the phenomenological structure of climate changes and natural disasters for further consideration of the relevant facts about their interrelation. Namely, in order to link those two phenomena we should consider each one of them separately. Therefore, the paper will consider the implications of climate changes on natural disasters with a special reference to their impact on specific species, the intensity and the increase in their number.

CLIMATE CHANGES

Across the Earth, climate changes and their serious consequences are discussed on a daily basis. And what exactly the climate changes are, and what they represent, is best explained by the process of warming of the Earth. Namely, the daily solar energy penetrates into the atmosphere in the form of light waves. Part of this energy heats the Earth, and the other part, in the form of infrared waves, goes back into space. Normally, part of the infrared radiation is usually captured by the atmosphere allowing the temperature that stays on Earth and it is within the acceptable limits. However, the problem we now face is that the thin layer of air became even thinner due to the large amounts of carbon dioxide and other gases that cause the greenhouse effect. Having become thicker, now that the layer retains a large amount of infrared radiation that would otherwise have left the atmosphere, causing the temperature of the Earth's atmosphere and oceans begin to rise.

According to the US Environmental Protection Agency – EPA, climate changes are significant changes in climatic conditions such as temperature, precipitation or winds, which last for a decade or longer, and may result from natural processes within the climate system (changes in ocean circulation), changes in the intensity of solar radiation, or human activities that affect the composition of the atmosphere (through the burning of fossil fuels) and the land surface (deforestation, urbanization, and desertification).¹⁰⁹ In addition, unlike climate changes, the term „global warming“ represents the troposphere temperature increase thus contributing to changes in the global weather patterns that emerge due to increased emissions of so-called greenhouse gases, mainly carbon dioxide and methane.¹¹⁰

Climate changes represent a serious threat to the basic elements of life for people in the world, such as access to drinking water, food production, food, and land use. They are multiple (from drought to floods) and multidimensional (local to global) risks that have short, medium, and long-term aspects and unknown outcomes. The signatories to the UN Convention on Climate Change and the Kyoto Protocol of 1997 have accepted that climate changes carry many potential hazards, such as sea level rise, increased frequency of storms and floods, the spread of infectious diseases, decline in biodiversity and reducing the availability of food and water. These impacts are a threat to human life and sustainable development.

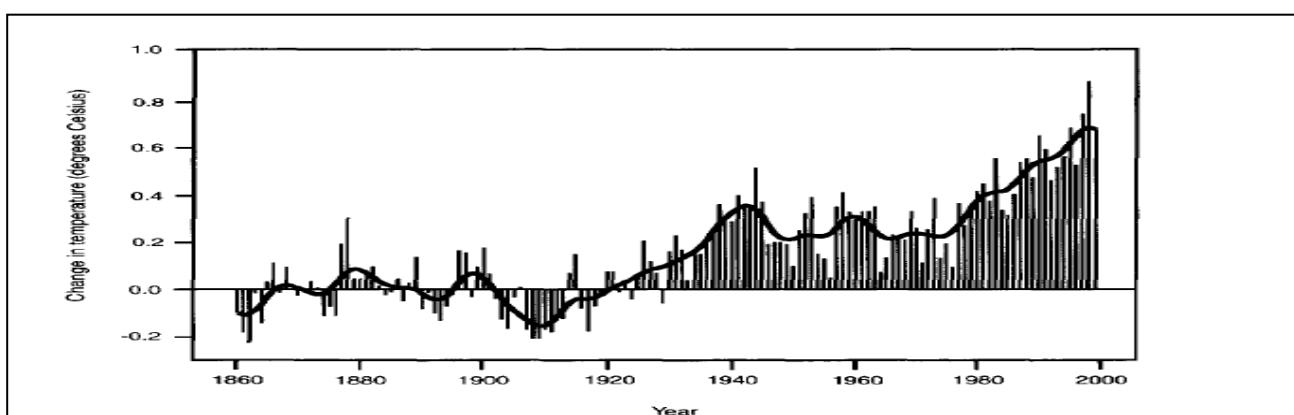


Figure 1.: Global mean surface air temperature records for each year since 1860 are shown, relative to that at the end of the 19th century, together with a smoothed curve. The planet as a whole has experienced

¹⁰⁹ Dimitrijević, D.: Trends of ecologic security in the 21st century. University of Belgrade: Faculty of Security, 2010.

¹¹⁰ US Environmental Protection Agency: Nanotechnology White Paper, Washington, 2007.

a temperature rise of 0.6-0.7 degrees Celsius since the beginning of the 12th century, and a rise of 0.4 degrees Celsius over the past three decades or so.¹¹¹

According to some current trends, the average global temperatures will rise by 2 or 3 °C over the next fifty years, which will cause many severe impacts often manifested through the water:¹¹² melting glaciers will firstly increase the risk of natural disasters (floods, droughts, storms), reduce water supplies largely; there will be a decline in crop yields (food safety will be compromised), especially in Africa, where millions of people can be left without the ability to produce or purchase sufficient food; a sea level rise will result in a situation where each year, tens to hundreds of million people will experience flooding additionally, natural disasters will be more intense, more frequent and more severe; the ecosystems will be particularly vulnerable to climate changes, about 15 to 40% of species will potentially face extinction after warming of only 2 °C.

Scientists agree that climate changes caused:¹¹³ a very possible sea level rise in the second half of the twentieth century; presumable changes in wind patterns, affecting the direction of extra tropical storms and the temperature patterns; presumable increased temperatures of extreme hot nights, cold nights and cold days; it is likely that they increased the risk of heat waves, areas affected by drought since 1970s, and the frequency of heavy rainfall; warming that is the greatest over land and the highest latitudes, and the smallest over the Southern Ocean and parts of the north Atlantic; contraction of the area covered by snow, increasing thaw depth in most areas and the reduction of sea ice; very possible increase in precipitation at high latitudes.

After all, climate changes have affected all natural processes, changing many of their features that will have different effects on people. And one of them is certainly the increasing in the frequency of natural disasters.

NATURAL DISASTERS

Natural disasters are consequences of mutual influence of natural events (geophysical processes and other processes in nature) and human systems (social - economic, cultural and physical). Consequently, they are different from natural hazards that generate natural disasters only when they threaten people and their material goods.¹¹⁴ More specifically, natural disasters are caused by the impact of natural hazards on people, property, infrastructure and natural resources. These are events that have a major and tragic impact on society, undermine the common ways of life, hinder economic, cultural, and sometimes political conditions of life and slow down the development of the community and require special measures by first responders in emergency situations.¹¹⁵ In general, they have polymorphous character (two instances of the same origin and intensity often produce a different overall effect), followed by the phenomenon of parallelism (affect only certain geospatial areas where they significantly alter the conditions of life and environment) and specific, usually massive consequences (social, health, physical and ecological).¹¹⁶

Natural disasters, such adverse events for people, their property and the environment, occur in different spheres of Earth (lithosphere, hydrosphere, atmosphere and biosphere). Such for example are earthquakes, floods, epidemics, hurricanes, etc.¹¹⁷ Depending on the nature of the process of formation, natural disasters can be divided into: geophysical (earthquakes, volcanoes, tsunamis, landslides, bog), meteorological (tropical cyclones / hurricanes, thunderstorms, tornadoes, lightning, hailstorm, snowstorm, ice storms, blizzards, cold and hot waves, landslides, snow, fog and frost), hydrological (flood, inundation), biological (epidemics and insect pests); extraterrestrial (meteors).¹¹⁸ Given the location of origin, natural disasters may be: originally from the atmosphere and hydrosphere (e.g., tropical cyclones, tornadoes, floods, torrents), originally from the lithosphere (earthquakes, volcanic eruptions, tsunamis) and originally from the biosphere (forest fires, bacteria).¹¹⁹ Also, with regard to the "source of origin", they can be divided into: "endogenous" (earthquakes and volcanic eruptions), „exogenous“ (floods and drought) and anthropogenic

¹¹¹ McGuire, B., Moson, J., & Kilburn, C.: Natural Hazards and Environmental Change. New York: Oxford University Press, 2002.

¹¹² Climate changes, studies and analyses. Beograd: European Movement, 2010.

¹¹³ The same

¹¹⁴ Wisner, B.: At Risk: Natural Hazards, People's Vulnerability and Disasters. London: Routledge, 2004.

¹¹⁵ Cvetković, V.: Intervention and Rescuing services in irregular situations. Beograd: Zadužbina Andrejević.

¹¹⁶ Jakovljević, V., Đarmati, Š.: Civil protection in the Federative Republic of Yugoslavia, Beograd: Studentski trg, 1998.

¹¹⁷ Degg, M.: Natural Disasters: Recent Trends and Future Prospects. Geography 77 (3): 198 - 209, 1992.

¹¹⁸ Edward, B.: Natural Hazards, Second Edition. Cambridge, University Press, 2005.

¹¹⁹ Mlađan, D., Cvetković, V.: Classification of irregular situations, Beograd: Days of Archibald Raise, 2013.

(human) origin (floods caused by dam failure).¹²⁰ Some attempts of classification of natural disaster with criteria of distribution (size) risk classify natural disasters into those whose influences are intense and restricted (e.g., earthquakes and tornadoes) or scattered (diffuse) and pervasive (floods and droughts).¹²¹ Also, according to the speed of events, disasters may be: sudden (rapid, surprising - earthquake and tsunami). They can occur suddenly and develop very rapidly slow (drought) formations, which can last for a long time, although they occur gradually.¹²²

Table 1: Types of natural disasters with regard to their definitions and major representatives¹²³

Natural disaster type	Definition	Major representatives
Geophysical	Events which originate from the solid land	Earthquakes, volcanoes, landslides
Meteorological	Events caused by atmospheric processes	Storm
Hydrological	Events caused by leakage or overflow of water caused by wind.	Floods
Climate	Events triggered by macro processes in climate.	Extreme temperatures, drought
Biological	Events triggered by exposure of living organisms to germs	Epidemic, infections

Clarification of complex phenomenology of natural disasters requires their empirical research and scientific monitoring. An important scientific source is the international scientific database on natural disasters. Since 1998 the CRED - Centre of Research Epidemiology of Disasters updates the database on disasters. The database registers natural disasters only if they meet the following requirements: if they have caused fatalities of 10 people, that 100 or more people suffered health effects, the declared emergency call for help is sent to international organizations or countries.¹²⁴

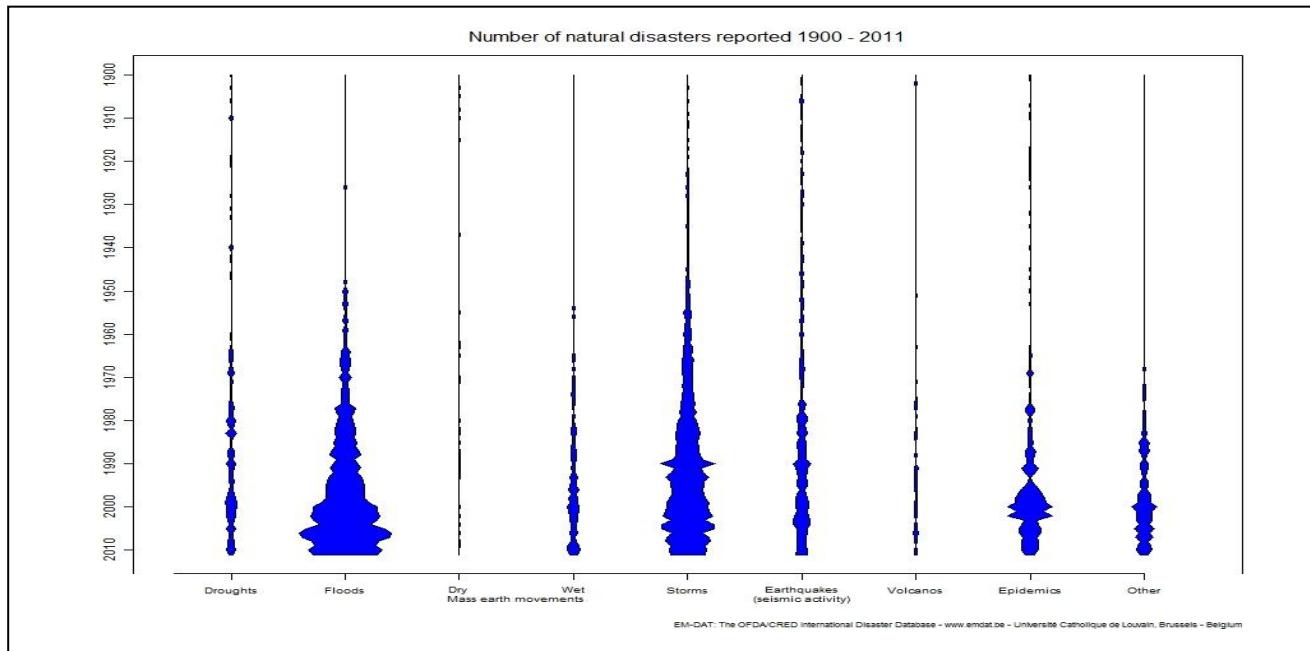


Figure 1: The trend of natural disasters from 1900 to 2011. year¹²⁵

¹²⁰ Bimal, P.: Environmental Hazards and Disasters Contexts, Perspectives and Management. Kansas State University, Wiley - Blackwell, 2012, p. 23.

¹²¹ Smith, K.: Environmental Hazards: Assessing Risk and Reducing Disaster. London: Routledge, 2001.

¹²² Edward, B: The same

¹²³ Debby, S., Femce, S., Regina, B., Sylvain, P: Annual Disaster Statistical Review 2011. The numbers and trends, CRED, 2011.

¹²⁴ EM-DAT, Emergency Events Database, 2009.

¹²⁵ The same

Based on the presented figure, it can be seen that the number of climate disasters such as droughts, floods and storms greatly increased in the past few years. According to the trend it can be concluded that this number will continue to grow. Whether the increase in the number of climate disasters is associated with global warming or some other factors, it should be thoroughly studied and analyzed in order to scientifically explain this trend.

The statistical analyses of natural disasters show that their number increased in the recent decades causing increasingly serious consequences for the people and their material goods. Each type of natural disaster has its own specific cause of the formation, which is affected by numerous factors. Certainly, the climate disasters that are directly related to changes in temperature on the planet are dependent in the biggest extent on these changes as opposed to the others.

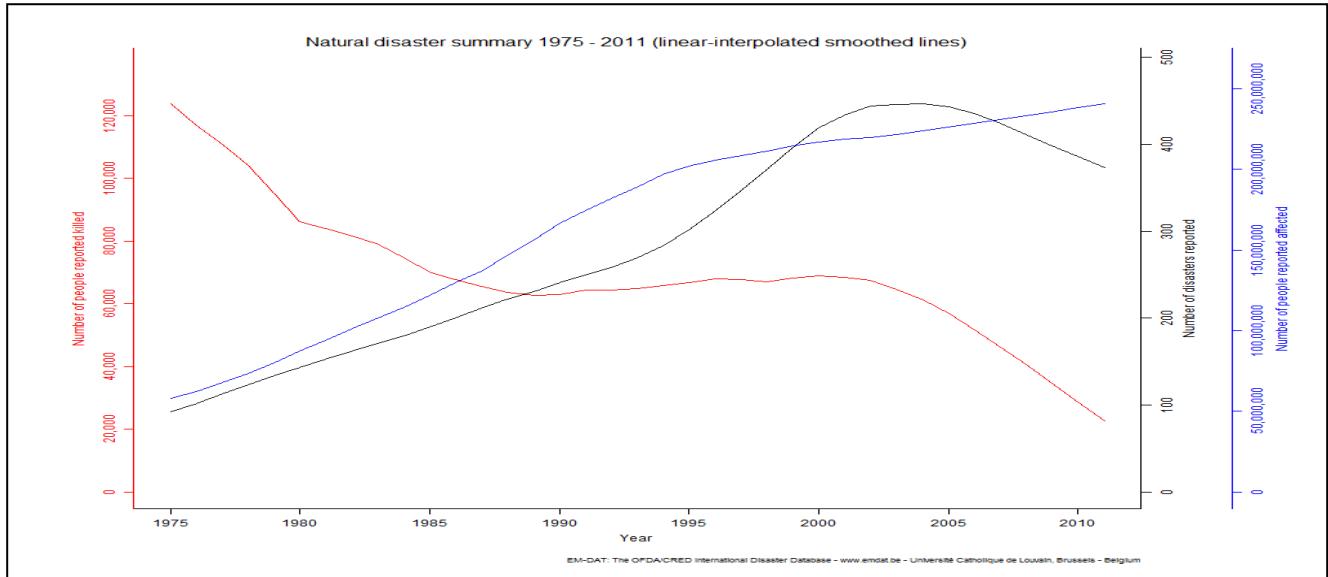


Figure 2: Natural disaster summary 1975-2011. year¹²⁶

Natural disasters pose a serious threat to people and their material goods. Day by day, their number is increasing, and the consequences are becoming more serious. Statistically speaking, the state of natural disaster is the following: the number of disasters recorded in the first half of the last century is only 6% of the total number of disasters that have occurred over a period of 105 years, 62% of disasters in the last 100 years happened in the last 15 years of the period (the question is what has contributed that in the last 15 years so many disasters have happened? Were it climate changes?) 80% of disasters that were recorded over the past 100 years occurred in the last 25 years of this period, in each month in the last 100 years, there is an average of 12 disasters.

Disasters threaten all parts of the world, especially in poor countries; redistribution of disasters by different continents is different and more than 60% of disasters occur in Asia and Africa, almost 50% of disasters have meteorological character, 30% have technological character, 12% geological and 8% have biological nature; the worst cases of earthquakes, floods and famines in the last 100 years occurred in China; the worst cases of landslides, avalanches and volcanic eruptions have occurred in Latin America; the largest natural geological disaster is the earthquake in the Indian Ocean followed by the tsunami in 2004. In the last five years the most difficult cases of landslides, tsunamis, snowstorms, hellish heat and terrorist attacks in recent world history have occurred, and if we divided 100 years of observed period by the total number of victims of a disaster, we would get the fact that every hour, 88 people are killed and 7,137 people are directly affected by a disaster, and the total number of killed in disasters in the last 105 years is greater than the population of France and the Netherlands together, and the total number of affected / killed people in that period is higher than the current world population; epidemics are the most dangerous type of natural disasters, because of the total number of killed / dead people even 65% suffered from an epidemics of diseases, drought and famine are in the second and third place with a total share of 13% and 9%, the most devastating type of disaster in regard to the affected / killed are floods with 43% share, followed by drought with 33% and at the end, hurricanes / typhoons / tornadoes with 10%, the most damaging forms of disaster

¹²⁶ The same

considering the average number of affected and dead people is drought with 2,673,429 per cycle, followed by the famine with 1,028,350 and flood with 1,006 827; more than 90% of the affected and dead people are from Asia or Africa, in average, each disaster takes away 5,395 lives, and the number of affected approximately 435 100 and so on.¹²⁷ Based on the facts presented, it can be concluded that in the last decade, the number and severity of natural disasters greatly increased compared to the previous decade. Particularly noticeable is the increase in climatic disasters that are directly related to the atmosphere, hydrosphere and lithosphere.

CONSEQUENCE OF CLIMATE CHANGES ON NATURAL DISASTERS

Climate changes that represent increase in average temperatures of the atmosphere, hydrosphere and lithosphere in various ways affect the increase in frequency and intensity of natural disasters. Global warming particularly affects hydrological and meteorological disasters as they are in closest relationship with the consequences of climate changes.

Therefore, the overall increase in the temperature leads to an increase in the number of hot days, reducing the number of cold days in all areas of the planet.¹²⁸ In the middle and upper parts of the northern hemisphere, observations indicate an increase in precipitation that contributes to the development of different types of floods and landslides and soil erosion. In some areas, such as Africa and Asia, the frequency and intensity of droughts have increased in the recent decades. Such changes are consistent with the intensification of the hydrological system.¹²⁹ From 1900 to 2005, precipitation increased significantly in the eastern parts of North and South America, northern Europe and northern and central Asia, and declined in the Sahel, the Mediterranean, southern Africa and parts of South Asia. At the global level, the area affected by the drought has probably increased since the 1970s. It is likely that over the past 50 years, cold days, cold nights and frost have been less frequent over most land areas, that the hot days and hot nights have been more frequent. Also, it is likely that heat waves are more common in most terrestrial areas and that most areas have increased frequency of heavy rainfall and that since 1975 it has increased frequency of extreme sea level rise worldwide.¹³⁰ There is also evidence, based on observation, about increased intensity of tropical cyclone activity in the North Atlantic around since 1970 with limited evidence of an increase in other places. Changes in snow, ice and frozen ground with certainty influenced the increase in the number and size of glacial lakes, increasing the instability of the land in the mountains and other regions, causing numerous landslides and floods. Predictions for the next century indicate that the number of hot days and very hot days will continue to grow, and that the number of cold and very cold days will drop in almost all regions of the world.¹³¹ In addition, the intensity and frequency of extreme precipitation will very likely increase in many areas, and this will cause numerous floods and landslides. Moderate continental areas will be mainly dry, which will increase the risk of summer droughts and fires. Table 1, presented on the following page shows an overview of these impacts. While the extreme temperature changes are quite expected, in many areas, changes in the frequency of rainfall or drought can be foreseen with certainty, some small atmospheric changes are subject to greater uncertainty. There are no reliable predictions for minor phenomena, including thunderstorms, tornadoes, storms, lightning and thunder.¹³²

It has already been stated that global warming raises the temperature of the oceans and seas, which further causes the following changes: warmer water increases the amount of moisture in the hurricane, as the warmer air contains more moisture. In the appropriate conditions, most of the moisture is released in the form of large one-off rain and snowfall, causing the floods and snow storms. In part because of this, the number of major flooding on all continents has increased from decade to decade.

¹²⁷ Kourosh E., Richard L.: Disasters: Lessons from the Past 105 Years, Disaster Prevention and Management, Vol.17 Iss: 1 pp. 62 – 82, 2008.

¹²⁸ Smith, L.: Statistical Trend Analysis in Weather and Climate Extremes in a Changing Climate. Regions of Focus: North America, Hawaii, Caribbean, and U.S. Pacific Islands, T.R. Karl, G.A. Meehl, C.D. Miller, S.J. Hassol, A.M. Waple, and W.L. Murray (eds.). A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research, Washington, DC., 2008.

¹²⁹ The same

¹³⁰ Wisner, B.: The same

¹³¹ Lynch, A., Uotila, P., Cassano, J.: Changes in Synoptic Weather Patterns in the Polar Regions in the 20th and 21st Centuries, Part 2: Antarctic. International Journal of Climate, 26 (9), 1181 - 1199, 2009.

¹³² Yoshimura, J., Sugi, M., Noda, A.: Influence of Greenhouse Warming on Tropical Cyclone Frequency. Journal of the Meteorological Society of Japan, 84 (3), 405 - 428, 2006.

In many parts of the world, global warming increases the percentage of annual precipitation in the form of rain rather than snow, causing major flooding in the spring and early summer. Year 2005 in Europe was marked by unusual natural disasters. In the same year, in the United States, unprecedented series of strong hurricanes took place. In 2005, the news agency UPI summarized the feelings of many Europeans when it reported that: "Nature in Europe gone wrong". Floods in Asia were also more frequent. In Mumbai (India), height of water sediment reached 94 cm in 24 hours. It was arguably the greatest rainfall ever recorded in an Indian city. Record floods were recorded in China that, as one of the oldest civilization possesses the best record of flooding than any other country in the world. On the other hand, paradoxically, global warming causes not only more frequent floods, but also more droughts.

Global warming, on the one hand, leads to more water evaporation from oceans which is accumulated in the atmosphere as hot steam, and on the other hand drains more moisture from the ground. Partly because of this, deserts worldwide from decade to decade, increasingly expand. One of the reasons for this paradox is the fact that global warming not only increases the amount of rainfall causing severe flooding around the world, but it partially diverts them. Statistical analysis showed that the amount of rainfall in the world over the past ten years has grown by 20%. However, the impact of climate changes on the precipitation amount is not the same everywhere. Precipitation has increased in some regions, and in others it has decreased.

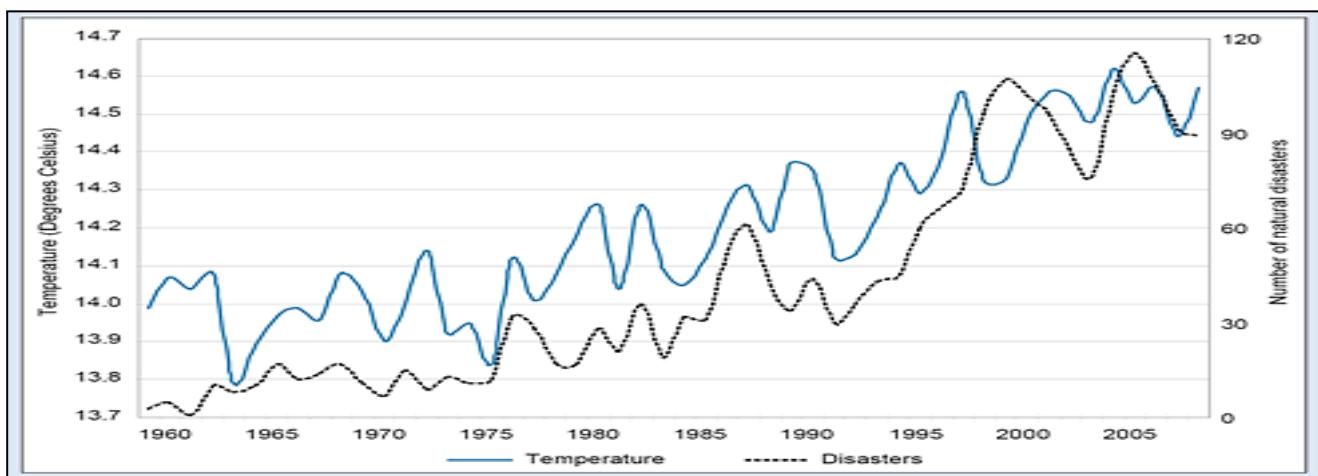


Figure 3: World temperature and natural disasters in LDCs, 1960 - 2005¹³³

The presented diagram shows an increasing trend in the average temperatures and the number of natural disasters from 1960 to 2005. Based on the graph, one can clearly see that the rise in temperatures is accompanied by a rise in natural disasters. Of course, given that natural disasters result from a combination of natural processes and their consequences for people, it is clear that the violation of the natural process, which is reflected in temperature changes, affect the natural disasters that are part of the same process in the nature. Over the past decade, the disasters that were associated with the weather were the cause of up to 90% of the natural disasters, 60% of deaths and were responsible for 98% of cases of the decline in the quality of life in the populated areas. The World Meteorological Organization reported in December, 2005, that that year would be remembered by dozens of records of natural disasters, from drought in Brazil, cold in Pakistan, to hurricanes in the Atlantic Ocean. Except for 1996, the past 10 years have been in the range of the warmest years on the Earth since 1850.

Less than a month before the Hurricane Katrina hit the United States in 2005, an extensive research done at the Massachusetts Institute of Technology confirmed the scientific consensus that global warming makes hurricanes stronger and more destructive. Large hurricanes that occur in the Atlantic and Pacific Oceans from 1970's, for about 50% are stronger and longer lasting than before.¹³⁴

Growing consensus that global warming is associated with more destructive power of hurricanes partially is based on a research that shows a significant increase in hurricane in category four and five. One particular study predicts that global warming will increase the average hurricane strength by as much as half

¹³³ Source: Goddard Institute for Space Studies (GISS). NASA GISS Surface Temperature Analysis (GISTEMP) (<http://data.giss.nasa.gov/gistemp/>); and UNCTAD secretariat estimates, based on EM-DAT: The OFDA/CRED International Disaster database (www.emdat.net), Université catholique de Louvain, Louvain-La-Neuve.

¹³⁴ Research MIT-a, 2005.

of degree on a well known scale of 5. National Authority for the US Oceanic and Atmospheric Administration (NOAA) has summarized some basic elements which are common to new researches. As the temperature of water increases, wind speed also rises as well as the condensation of moisture in the air. Therefore, the oceans are warmer, the winds are stronger. An increasing number of new scientific researches that confirm the warmer water on the surface of the ocean can cause a greater convective energy that causes more hurricanes. Recent evidence suggests to the scientists to claim that global warming increases the frequency of hurricanes that was long thought to be the result of natural cycles in the movement of deep currents in the ocean.

Therefore, there is resonable scientific evidence which indicates an increase in water temperature that could affect the cyclonic intensity and frequency, thus contributing to the increase in the number of strong storms and floods. This could have fatal consequences for countries like Bangladesh, because it is barely located above the sea level. As Peling and Uito noted: "Even modest sea level rise is likely to result in significant erosion and shifting soil, increased flooding, salinization of drinking water, and the loss of coral reefs and sandy beaches will only increase the openness to hurricanes and severe storms in coastal areas where the highest natural diversity is found, where majority of population is settled, and the agricultural land and capital goods are located". Although climate models do not currently provide detailed, confidential forecasts for each island, several island nations are already considered as "nations without water" (eg, Barbados and the West African islands). In this environment, climate changes are likely to increase the intensity and frequency of droughts and floods.

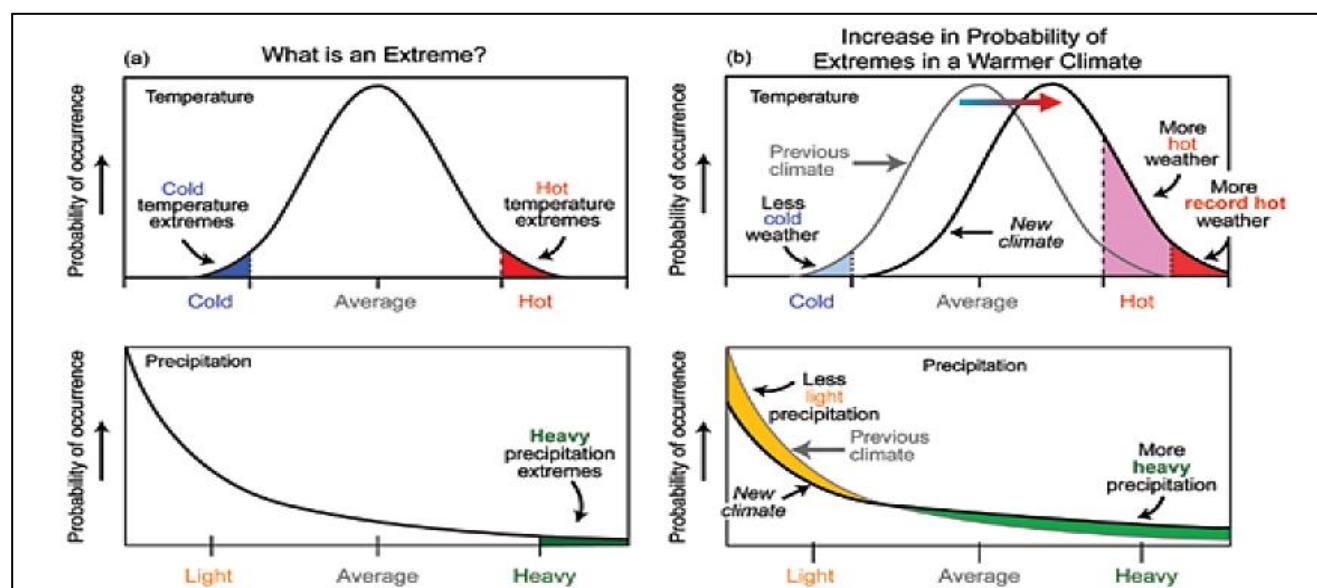


Figure 4.: Extreme and increase in probability of extreme in a warmer climate

Most measurements of temperature (top) will tend to fall within a range close to the average, so their probability of occurrence is high. A very few measurements will be considered extreme and these occur very infrequently. Similarly, for rainfalls (bottom), there tend to be more days with relatively light precipitation and only very infrequently there are extremely heavy precipitation events, meaning their probability of occurrence is low. The exact threshold for what is classified as an extreme varies from one analysis to another, but would normally be as rare as, or rarer than, the top or bottom 10% of all occurrences. A relatively small shift in the mean produces a larger change in the number of extremes for both temperature and precipitation (top right, bottom right). Changes in the shape of the distribution (not shown), such as might occur from the effects of a change in atmospheric circulation could also affect changes in extremes.¹³⁵

Therefore, natural hazards related to sea level change are surprisingly many and varied, and the relationship between the two is often far from clear. Broadly speaking, rising sea levels can be expected to increase the threat to coastal zones, primarily owing to the inundation or flooding of low-lying terrain but

¹³⁵ Peterson, C., Anderson, D., Cohen, S., Murnane, R., Parmesan, C., Phillips, D., Pulwarty, R., Stone, J.: Why Weather and Climate Extremes Matter in Weather and Climate Extremes in a Changing Climate. Regions of Focus: North America, Hawaii, Caribbean, and U.S. Pacific Islands. T.R. Karl, G.A. Meehl, C.D. Miller, S.J. Hassol, A.M. Waple, and W.L. Murray, 2008.(eds.). A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research, Washington, DC.

also through increased erosion, destabilization and collapse of elevated coastlines. Higher sea levels will also exacerbate the impact and destructive potential of storm surges and tsunami, partly because of the elevated level of the sea surface but also through increasing the exposure of many coastlines as a result of inundation of wetlands and other protective environments. The hazard implications of falling sea levels are less obvious, although it has been suggested that rapid drops in the sea level may trigger submarine landslides. On a much broader scale, a number of authors have proposed that large sea-level changes - either up or down - may trigger increased volcanism and seismicity along continental margins.

CONCLUSION

Climate change caused by excessive emission of greenhouse gases greatly affect the various processes in nature and consequently to natural disasters. Exploring the impacts of climate changes on natural disasters, the following conclusions have been crystallized:

- The consequences of climate changes that are real, seriously directly or indirectly threaten people, the environment and their material goods;
- The overall increase in temperature leads to an increase in the number of hot days, reducing the number of cold days in all areas of the Earth;
- Increasingly more attention is paid to research on climate change effects to natural disasters;
- The increasing trend in average temperatures follows the almost identical trend of increasing number of natural disasters;
- The number of natural disasters, year in year out rises, and the highest level occurred in the last decade;
- An increase in the average temperature of the Earth, sea level rise and soon lead to an increase in the number and intensity of natural disasters such as floods, droughts, hurricanes, storms, etc.,,
- Climate changes mostly affect the hydrological-meteorological disasters,
- Climate changes, a statistically speaking the most affect the floods, droughts and various storms;
- Global warming increases the percentage of annual precipitation in the form of rain, leading to major flooding in the spring and early summer;
- Global warming affects hurricane destructiveness;

REFERENCES

1. *America, Hawaii, Caribbean, and U.S. Pacific Islands*. T.R. Karl, G.A. Meehl, C.D. Miller, S.J. Hassol, A.M. Waple, and W.L. Murray (eds.). A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research, Washington, DC., 2008.
2. Bimal, P.: *Environmental Hazards and Disasters Contexts, Perspectives and Management*. Kansas, State University, Wiley - Blackwell, 2012, str. 23.
3. Cvetković, V.: *Interventno-spasilačke službe u vanrednim situacijama*. Beograd: Zadužbina Andrejević, 2013. godina.
4. Debby, S., Femce, S., Regina, B., Sylvain, P: *Godišnji statistički pregled u 2011. godini, brojevi i trendovi, CRED, 2011.*
5. Degg, M. : *Natural Disasters: Recent Trends and Future Prospects*. Geography 77 (3): 198-209 1992.
6. Dimitrijević, D.: *Trendovi ekološke bezbednosti u XXI veku*. Univerzitet u Beogradu: Fakultet bezbednosti, 2010. godine.
7. Edward, B.: *Natural Hazards, Second Edition*. Cambridge, University Press, 2005.
8. Emanuel, K.: *Increasing Destructiveness of Tropical Cyclones over the Past 30 Years*. Nature. 436. pp. 686–688, 2005.
9. EM-DAT, *Emergency Events Database*, 2009.
10. Environmental Protection Agency, U.S. Environmental Protection Agency: *Nanotechnology White Paper*, Washington, 2007.
11. Evropski pokret u Srbiji: *Klimatske promene: studije i analize*. Beograd: Mladost group, 2010. godine.
12. Goddard Institute for Space Studies (GISS), NASA GISS Surface Temperature Analysis (GISTEMP) (<http://data.giss.nasa.gov/gistemp/>); and UNCTAD secretariat estimates, based on EM-

DAT: The OFDA/CRED International Disaster Database (www.emdat.net), Université catholique de Louvain, Louvain-La-Neuve.

13. Hilhorst, D., Bankoff, G.: *Mapping Vulnerability*. In G. Bankoff, G. Frerks and D. Hilhorst (eds.) *Mapping Vulnerability: Disaster, Development and People*. Earthscan, London. pp. 1–10, 2004.
14. IFRC (International Federation of Red Cross and Red Crescent Societies), *World Disasters Report 2005: Focus on information in disasters*. IFRC, Geneva, 2005.
15. IFRC (International Federation of Red Cross and Red Crescent Societies), *Heatwaves, the developed world's hidden disaster*. World Disasters Report 2004. IFRC, Geneva. pp. 36–55, 2004.
16. IPCC, Climate Change 2001: *The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge.
17. Jakovljević, V., Đarmati, Š.: *Civilna zaštita u Saveznoj Republici Jugoslaviji*, Beograd: Studentski trg 1998.
18. *Klimatske promene, studije i analize*. Beograd: Evropski pokret, 2010.
19. Kourosh E., Richard L.: *Disasters: Lessons from the Past 105 years*, Disaster Prevention and Management, Vol.17 Iss: 1 pp. 62 – 82, 2008.
20. Ljuština, A.: *Ekološka bezbednost*. Beograd: Kriminalističko-policijска akademija, 2012. godine.
21. Lynch, A., Uotila, P., Cassano, J.: *Changes in Synoptic Weather Patterns in the Polar Regions in the 20th and 21st Centuries*, Part 2: Antarctic. International Journal of Climate, 26(9), 1181-1199, 2009.
22. Masika, G.: *Development and Climate Change*. Oxfam, Oxford, 2004.
23. McGuire, B., Moson, J., Kilburn, C.: *Natural Hazards and Environmental Change*. New York: Oxford University Press, 2002.
24. Mlađan, D., Cvetković, V.: *Klasifikovanje vanrednih situacija*. Beograd: Dani Arčibalda Rajsja, 2013. godine.
25. Mudelsee, M., Börngen, G., Tetzlaff, G.: *No Upward Trends in the Occurrence of Extreme Floods in Central Europe*. Nature. 425. pp. 166–169, 2003.
26. National Climatic Data Center, Climate of 2004. Atlantic Hurricane Season. National Climatic Data, 2004.
27. Palmer, N., Räisänen, J.: *Quantifying the Risk of Extreme Seasonal Precipitation in a Changing Climate*. Nature. 415. pp. 512–514, 2002.
28. Peterson, C., Anderson, D., Cohen, S., Murnane, R., Parmesan, C., Phillips, D., Pulwarty, R., Stone, J.: Why Weather and Climate Extremes Matter in *Weather and Climate Extremes in a Changing Climate. Regions of Focus: North America, Hawaii, Caribbean, and U.S. Pacific Islands*. T.R. Karl, G.A. Meehl, C.D. Miller, S.J. Hassol, A.M. Waple, and W.L. Murray, 2008. (eds.). A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research, Washington, DC.
29. Reisner, M.: *A Dangerous Place: California's Unsettling Fate*. Pantheon, New York, NY 2003.
30. Scawthorn, C.: *Emergency Water Supply and Disaster Vulnerability*. In J. Uitto and A. Biswas (eds.) *Water for Urban Areas*. United Nations University Press, Tokyo. pp. 200–225, 2000.
31. Smith, K.: *Environmental Hazards: Assessing Risk and Reducing Disaster*. London: Routledge, 2001.
32. Smith, L.: Statistical Trend Analysis in *Weather and Climate Extremes in a Changing Climate. Regions of Focus: North*
33. Stott, A., Stone, R. A.: *Human Contribution to the European Heatwave of 2003*. Nature. 432. pp. 610–614.
34. Studija MIT-a, 2005.
35. Trenberth, K.: *Uncertainty in Hurricanes and Global Warming Science*. New York, Routledge, 308. pp. 1753–1754, 2005.
36. Webster, J., Holland, A. Curry, R.: *Changes in Tropical Cyclone Number, Duration, and Intensity in a Warming Environment*. New York: Science. 309. pp 1844–1846, 2005.
37. Wisner, B.: *At Risk: Natural Hazards, People's Vulnerability and Disasters*. London: Routledge 2004.
38. Yoshimura, J., Sugi, M., Noda, A.: *Influence of Greenhouse Warming on Tropical Cyclone Frequency*. Journal of the Meteorological Society of Japan, 84(3), 405-428, 2006.

INTERNACIONAL SECURITY

EFFICIENCY OF INTEGRATED NATIONAL SECURITY INSTITUTIONS IN PREVENTION AND ELIMINATION OF THREATS ON THE BALKANS

ABSTRACT

Over the recent years, the Balkan region has been jeopardized more than ever before. The term jeopardy implies to all existing and prospective threats and dangers on the safety of society, social systems and all other values established in each society of the region. Emergence of any kind of destructive danger will probably generate a huge risk for the respective society first, then consequently for the surrounding societies and eventually for the region as a whole. Threats and dangers are manifested in various forms expressed through social activities, including war threats, pressures, and even interventions and aggressions when inter-state conflicts arise. However, threats, dangers, and risks referring to one or more societies are mostly imposed by destructive groups or bunches intending to accomplish their own goals for corruption purposes, organized crime purposes, terrorism etc.

In such cases, states or societies of the Balkan region, regardless of whether they are willing to act so, would be compelled to get integrated and concentrated on a unique and coordinated prevention and suppression of the above mentioned threats and risks, especially if they are getting larger and more dangerous. Otherwise, a single society will be inefficient and likely to lose the battle with corruption, organized crime, natural calamities and all other threats. Such threats would be increasingly dangerous for the entire region. Integration and the above mentioned activities refer to agreements, communication and decisions, as well as training, equipment and common activities in the whole region, with common motives and tasks. In this regard, integration does not include formation of common entities within the region, but refers to security assignments and tasks with the same goals and final results. All these activities will bring to sincere and adequate cooperation, coordination and systematic orientation towards integration in common actions of security departments in terms of joint activities, cooperation, help and direct involvement into a unique, common security and protection system.

Key words: the Balkans, system, cooperation, integration, threats, risks.

INTRODUCTION

Contemporary world and the advanced international relations bring for new technologies and technical improvements in terms of development of technical tools and equipment, and a need for mutual cooperation and coordination among the national police establishments and other security departments. Regardless of our will to improve security affairs, we have to do it as we are threatened by new modern methods of technological and technical jeopardy and threats directed towards the security of the state organization, security system and the safety of people in all regional countries. Therefore, each country is considered jeopardized to a minor or major extent, and similar threats and risks apply for all countries in the region.

Modern technology brings to a very quick progress in the development of mass destruction weapons in the disturbed social relations in the world, in the time of frequent occurrences of local wars, internal riots, terrorist and crime activities caused by multiplied and motivated intentions; many examples point to this issue (known both from earlier and recent times). In this sense, modern forms of jeopardy and threats are multiplied, widely spread, technologically improved for the new forms of violence, and directed to general security of the region, which in our case is the Balkans. In certain conflicts, all jeopardizing tools are utilized with all available means and materially dangerous substances, threatening the entire international community.