



## Adaptation measures to climate change – examples of solutions

Szymon Sikorski<sup>1</sup>  0009-0009-4178-9582

Aleksander Sikorski<sup>2</sup>  0009-0002-1978-8937

<sup>1</sup> Rectorat, University of Agriculture in Krakow

<sup>2</sup> Faculty of Security, Logistics and Management, Military University of Technology, Warsaw

✉ Corresponding author: [s.sikorski@urk.edu.pl](mailto:s.sikorski@urk.edu.pl)

### Summary

This article presents examples of adaptation measures successfully implemented over many years, aimed at adjusting to the changing conditions in which humanity lives. The authors critically analyze current actions and views regarding climate change, drawing attention to often-overlooked positive facts and measures that fall outside the so-called mainstream narrative, which applies methods of inciting entire communities to hysteria. They highlight the prevailing tone of alarmism in the media and public debate, which often overlooks the tangible benefits of adaptation, and provide relevant examples. The analysis shows that adaptation programs have positive effects on property values as well as natural and landscape values. They are among the most frequently chosen climate protection measures. The climate is changing – it's a fact. However, there is no clear evidence that human activity is the main driver of these transformations. The authors emphasized that climate adaptation is not solely a product of ecological ideology, but rather a pragmatic approach whose effects, both economic and environmental, are increasingly outside the mainstream discussion. Their analysis is largely based on the report 'The Limits to Growth,' also known as the Rome Report. Both hurricane protection and water adaptation examples support the thesis that an effective response to climate change relies not on panic but on the ability to integrate scientific knowledge with long-term spatial planning.

### Keywords

spatial planning • climate policy • extreme weather phenomena • adaptation to climate change • urban heat islands

## 1. Introduction

In 1972, the report ‘The Limits to Growth,’ known as the Rome Report, was published. Prepared by a team of scientists from the Massachusetts Institute of Technology, it warned of the consequences of unlimited economic and demographic growth on a planet with limited natural resources. The authors of the document also warned with increasing certainty about climate change as one of the key consequences of excessive exploitation of the Earth, which became clearer in successive analyses (e.g., in 1992 and 2004). Over time, reproductive and technological restrictions and climate tariffs were considered sufficient measures to combat climate change (even though weather is not climate). However, as we observe today, paradoxically, these measures contribute to the further impoverishment of the inhabitants of the so-called ‘third world’ countries [Economist 2017]. In addition, misguided regulations are causing energy poverty and economic slowdown in entire areas, such as the European Union, which for decades were considered rich and modern regions [Draghi 2024].

Reports such as ‘The Limits to Growth’ continue to perpetuate the visions of human extinction as a result of overpopulation, famine, resource depletion, and extreme weather events. However, it is worth taking a critical look at this report, which has determined entire generations. As it seems, some of the theses stated in it do not stand up to scrutiny, and yet they continue to stimulate the imagination, directing humanity’s activity towards ‘fighting climate change’ instead of adapting to our current living conditions.

Extreme heat, cold, precipitation, and even climate zone changes have always occurred. Their causes can be attributed to natural phenomena that have been ongoing throughout Earth’s geological history. One such phenomenon is changing of magnetic declination. According to research published every five years by the National Oceanic and Atmospheric Administration, the North Pole is currently closer to Siberia [National Oceanic and Atmospheric Administration 2025]. This process not only affects navigation systems, but also shapes the North Atlantic Oscillation, determining wind directions and living conditions on our planet [Boryczka and Stopka-Boryczka 2004, Koonin 2023, Lomborg 2024].

## 2. Research methodology

This study uses a qualitative research approach based on critical analysis of sources and interdisciplinary synthesis, with the aim of identifying dominant trends in climate change adaptation. Both scientific achievements (including meta-analyses, IPCC, UNEP, and World Bank reports) and media reports were taken into account due to their impact on social perception of dangers and the legitimization of political actions. This selection of sources results from the emphasis on doubts over the causes of climate change that are overlooked in commonly cited reports. However, this should not be understood as a deliberate neglect by the mainstream media. An example of this are the IPCC reports, the content of which is well known and presented by the media as

a fact, but at the same time the doubts recorded therein are ignored (some of which will be mentioned). While appreciating the value of many analyses, they should be confronted with other sources and conclusions drawn on that basis. Therefore, the authors followed a research method based on critical analysis of sources, fully aware that it is impossible to address all available literature in such a short study. However, their goal, in accordance with the principle of *audiat et altera pars*, is to point to an existing alternative narrative, especially since in leading countries such as the US, China, and India, these arguments are applied in official government administration operations. Another methodological component was comparative synthesis, enabling the confrontation of theory with practice, especially in the context of grassroots initiatives, hybrid management models, and informal solutions, which are often more effective than institutional actions. Thus, the analysis process was embedded in four dimensions: adaptation typologies, management structures, socio-economic contexts, and the impact of media narratives.

The paper is organized into six thematically related sections. The first section analyzes the phenomenon of rising sea levels. This issue has been highlighted not only in scientific publications, but also by global media outlets. The second part focuses on urban heat islands, as reports on this topic influence the perception of climate change, especially among residents of urban agglomerations. The next segment discusses alarmist predictions of resource depletion and the sudden change in global bank financial flows, and the related phenomenon of poverty caused by climate change. Equally important is the mass fearmongering, which even in such a limited analysis does not stand up to objective criticism, and which has been exploited as a mobilizing mechanism for climate action. The last part concerns spatial planning as the result of many variables, linking climate change with social expectations and scientific findings.

This methodology allowed us to draw conclusions about the efficiency and social acceptability of adaptation in the context of the deepening climate crisis, based on various sources.

### 3. Rising sea levels

As has already been mentioned, the climate is changing – that is a fact. However, there is no clear evidence that human activity is the main driver of these changes. This is also indicated by the IPCC report, which states that it is still difficult to quantify the impact of intrinsic variability of natural forces and anthropogenic impact on global warming [IPCC 2013]. The authors of the report suggest that the reasons for this uncertainty stem from a lack of knowledge about the scale of mutual interaction, as well as the methods of observation and analysis of results. When we look at the amount of carbon dioxide (CO<sub>2</sub>) in the Earth's atmosphere from a geological perspective, we find that the last time CO<sub>2</sub> levels were as low as they are today was in the Permian period, 300,000 years ago. However, it is different in the case of methane (CH<sub>4</sub>), as its concentration is rising rapidly, but this has been happening for about 4,000 years [National Research Council 2005]. The increase in greenhouse gas concentrations raises the Earth's temper-

ature and causes the ‘planet to burn.’ Yet it should be kept in mind that as recently as the 1970s, the prevailing view in climate discourse was that glaciation was imminent. Traces of this view can be found, among others, on the cover of the 1974 issue of ‘The Times’ and in the article *Another Ice Age?* published in that issue, which predicted the arrival of a new ice age [Peterson et al. 2008]. Another example is the cover of Science News from 1975, showing Manhattan buildings and the Statue of Liberty half-covered in ice. We have not experienced these phenomena, after all.

Global warming is also linked to the phenomenon of warming oceans. In 2020, CNN reported that ‘the oceans are warming at a rate comparable to dropping five Hiroshima-sized atomic bombs every second’ [Arb 2020]. However, it is worth looking at this data from the perspective of the entire planet. It then becomes apparent that every second, the Earth absorbs energy from the Sun equivalent to the explosion of 2,000 such bombs, so we have a conversion rate of 5:2,000 [Kottasová 2020].

The effort to raise awareness about the implications of rising sea levels has been supported by UN Secretary-General António Guterres, who appeared on the cover of Time magazine in 2019, standing knee-deep in water off the coast of Tuvalu in the Pacific Ocean [Time 2019]. The article devoted to this phenomenon argued that as a result of sea level rise, Tuvalu would be flooded and its people would be forced to emigrate. However, it turned out that despite an actual sea level rise of 31 cm over 150 years [Jevrejeva et al. 2014], Tuvalu’s land area increased by 2.9% as a result of accretion (i.e., the spontaneous deposition of sand by ocean waters) [Kench et al. 2018]. Similar studies have been conducted on other atolls, including Kiribati, Micronesia, the Maldives, and the Marshall Islands archipelago. Accurate measurements have proven that despite rising sea levels, the land area has maintained or increased in size as a result of accretion [Duvat 2019]. It is also worth pointing out that, contrary to popular belief, sea level rise is not a global phenomenon. Studies have shown that in the Gulf of Mexico, the water is rising by 9.65 mm, while in Alaska, it is falling by 17.91 mm per year [Koonin 2023]. It seems that analyses indicating that 20 million people will find themselves underwater in the near future as a result of climate change may have contributed to the sea flood panic. However, when we consider the current situation, it turns out that 110 million people live in low-lying areas, and their survival is guaranteed by their adaptation to living below sea level [Goodell 2019]. The vision of human settlements being flooded by the sea has already inspired numerous preventive solutions. One of them is the idea of houses on stilts called ‘Architr Adom,’ which was published in the magazine ‘Geomatrics, Landmanagement and Landscape [Fedyczkowski and Przysłał 2013]. It should also be remembered that, according to the estimates of urban planners, by the end of 2025, the number of people living below the high tide area will increase by 40 million, so this is a problem affecting approximately 150 million people, not 20 million [Lincke and Hinkel 2018]. In this scenario, adaptive solutions have been developed to mitigate the effects of sea level rise. Three solutions have proven to be the most successful: 1) building embankments on the edge of sand dunes; 2) building artificial beaches; and 3) planting mangrove trees. The first solution involves building a coastal embankment to prevent water from overflowing onto land. Analyses carried out in US

states threatened by storms show that flood embankments built on beaches effectively reduce damage. In Poland, on the Baltic Sea coast, we can also see such embankments established along the shoreline and then covered with appropriate vegetation. The second method involves transporting sea sand to the beaches. This artificially raises the level of the beach and slows down water erosion [Markanday et al. 2019]. The third method is the afforestation of coastal strips with mangroves. This method also has other benefits, such as the creation of protective ecosystems favorable to the development of the fishing industry and agritourism. Forests of this type are quite a popular attraction [Global Commission on Adaptation 2019]. The first and second methods described are used successfully in Europe. In addition, civil engineering also comes to the aid. The most well-known structures of this type are located in the Netherlands, which lie below or at sea level.

#### 4. Urban heat islands

Civilizational progress triggers urbanization processes, including the creation of megacities, as defined by Mauro Guillen, such as Singapore, Tokyo, Hong Kong, and London, and in local contexts: Rome, Paris, Warsaw, and Krakow. One of the problems generated by every city, especially large cities, is the formation of urban heat islands. However, this effect leads to a false signal of warming, which some experts have given global relevance [Spencer 2021]. Historically, a long period of rising temperatures lasting about 20,000 years (an increase of about 5°C) ended around 1000 AD, slowly leading to a minor ice age from 1450 to 1850 [Koonin 2023]. Poland also experienced this during the Polish-Swedish War of 1655–1660, known as the Deluge. This was followed by a warming period that continues to this day. This fact is also recognized in the IPCC report, which states that since 1950, the number of cold days and nights has most likely decreased, while the number of warm days and nights has increased [IPCC 2013a]. It was also noted that the frequency of periods of elevated temperatures has been increasing since the mid-20th century. This fact is also confirmed by everyday experience. However, it should not be forgotten that the warmest decade of the 20th century was the 1920s and 1930s, and this period is not mentioned in the 2013 IPCC report due to the adopted time frame. Nowadays, especially in summer, we often hear about deadly heat waves. Meanwhile, globally, for every 1 death caused by heat, there are 17 deaths caused by cold, related to severe cooling of human dwellings [Gasparrini et al. 2015]. In the United Kingdom, this ratio is 1:33 [Ward 2015], in India 1:23 [CNN 2019], and in Madrid 1:5 [Diaz et al. 2015]. Adaptation also steps in to help in this case. The biggest problems for cities remain the lack of parks and green spaces, as well as the ubiquitous black or dark colour of roofs, sidewalks, and road surfaces, which raises the temperature of the pavement. Research conducted in Poland, which is not considered a particularly sunny country, shows that the difference between the air temperature and the asphalt surface temperature in Poznań on the Niestachowska Route in July 2020 was 30°C [Kowalczak 2024]. Therefore, simply changing the colour of sidewalks, roofs, and streets is enough to bring about initial effects. In Los Angeles,

black asphalt began to be painted grey, which lowered the temperature of sidewalks and road surfaces by 5.5°C, and in New York, between 1995 and 2023, over 500,000 m<sup>2</sup> of roofs were covered with white polymer [Biello 2014, McPhate 2017]. In London, white roofs, grey roads and pavements can lower the temperature by around 10°C three days before a heatwave [Wolf 2006]. Green roofs are a relatively new feature in urban planning, combining a departure from black surfaces with an increase in biologically active areas in cities. However, this is not an optimal solution from a climate protection perspective [Estrada et al. 2017]. The advantages of this type of construction are not significantly greater than those of ordinary cooled roofs, and in addition, they are three times more expensive.

Denmark can boast an interesting solution that affects temperature change, this time in rural areas. As early as the 1990s, coniferous shelter forests were planted in the vicinity of Jutland (85% of the total area). As a result, the microclimate was mitigated and optimised for agricultural activities, while the forest area increased from 100,000 ha in 1881 to 300,000 ha in 2000 [Kowalczak 2024].

## 5. Resources and funds

One of the points of the Rome Report concerned the depletion of resources. Using computer models, it was predicted that gold would run out by 1979, and tin, tungsten, zinc and oil by 2004 [Meadows et al. 1972]. There were calls to move towards sustainable development in order to avoid collapse. However, thanks to technological developments, these resources have not only not been depleted, but new ones are constantly being discovered. This very point is behind Donald Trump's campaign slogan 'drill, baby, drill' [Knowski 2025]. Even earlier, at the COP 28 [Conference of the Parties], which took place in Dubai between 30 November and 12 December 2023 (during Joe Biden's presidency), Sultan Ahmed al-Jaber publicly stated: 'there is no scientific evidence to prove that abandoning fossil fuel extraction will protect us from a temperature increase of 1.5 degrees Celsius' [Perzyński 2023]. A year later, at the COP 29 climate summit in Baku (11–22 November 2024), OPEC+ representative Haitham al-Ghaisszef argued that oil and gas 'are a gift from God, and climate negotiations should focus on reducing emissions rather than choosing energy sources' [Volcovici and Withers 2024]. The energy policy of the new US administration was summed up by Chris Wright, head of the US Department of Energy (DOE), who remarked that 'there is no climate crisis and we are not in the midst of an energy transition either' [Ygi 2024].

It is also worth highlighting the links between the proliferation of climate narratives and the world of finance. Even before 20 January 2025, i.e. before Donald Trump was sworn in as the 47th President of the United States, six American banks (J.P. Morgan, Citigroup, Bank of America, Morgan Stanley, Wells Fargo and Goldman Sachs) announced their withdrawal from the Net-Zero Banking Alliance (NZBA) [KMA 2025]. This is an international initiative bringing together banks that commit to reaching net-zero greenhouse gas emissions in their financial portfolios by 2050 at the latest. The reason given for this decision was a change in approach to the direction of the US

economy, based on a shift back to fossil fuels. Furthermore, according to the website *businessinsider.pl*, Republicans, who have a majority in both houses, ‘accuse financial institutions (...) of blocking financing for the oil and gas industry’ [KMA 2025]. However, this decision does not imply that the EU is abandoning its climate policy objectives. This is due, among other things, to the fact that European banks constitute the majority of the 142 members of the NZBA, and many of them have assets related to the EU ETS, i.e. the European Emissions Trading System, in their portfolios. The ultimate symbol of the changing global trends was Black Rock’s decision to leave the Net Zero Asset Managers (NZAM) coalition. This is an international coalition of asset management companies that has also committed to achieving net zero greenhouse gas emissions in their investment portfolios by 2050 at the latest. Following this decision, it suspended its activities [Franey 2025].

## 6. Poverty caused by climate change?

Humanity itself is more responsible for the next threat identified in the Rome Report, namely poverty, than the climate change. It should be noted here that, according to reports by the International Institute for Strategic Studies (IISS), in December 2023 there were 183 armed conflicts around the world, more than three decades ago [PAP 2023]. Even if these figures have changed somewhat, the number is still striking. War destroys infrastructure, disrupts trade, production and agriculture, causes population displacement and increases unemployment, and funds are spent on military objectives instead of development.

Furthermore, legal regulations contribute to the increase in poverty, even in formerly wealthy European countries. As indicated in the report ‘The future of European competitiveness’ published in September 2024, electricity and gas prices in the European Union are almost five times higher than in the US [Draghi 2024]. What is more, European policy has led to energy poverty. For example, in the United Kingdom before Brexit, it was reported that for economic reasons (lack of funds to pay bills), one-third of senior citizens deliberately lower the temperature in their homes or flats, while two-thirds wear extra clothing [Belfast Telegraph 2014]. Meanwhile, according to a 2016 study, when the income of a poor person doubles, mortality from natural disasters falls by 27% [Bakkensen and Mendelsohn 2016]. The problem has been exacerbated by the disruption of cheap Russian hydrocarbon supplies, which was one of the consequences of the war that has been ongoing since 2022.

Measures related to the implementation of targets for reducing greenhouse gas emissions and human impact on the climate are also not without significance, as is the artificially restricted freedom to use stable energy resources accumulated in and on the earth’s surface. This forces people to use unstable atmospheric phenomena (sunlight and wind) as their dominant sources of energy, which are additionally remotely switched on and off, i.e. potentially vulnerable to cyberattacks [Nowak et al. 2021].

## 7. Creating fear

It should also be noted that language has become militarised, as evidenced by phrases such as ‘the fight against climate change’. This has resulted in a shift in the tone of words describing natural changes from neutral to alarmist. This is evident in influential media outlets such as The New York Times, Time, and The Guardian. They were among the first to introduce terms such as ‘climate crisis,’ ‘climate threat,’ and ‘global warming’ into public discourse [Oreskes 2015, Carrington 2019]. These efforts can be considered propaganda and neurolinguistic programming. This thesis seems to be confirmed by research conducted in 2019 by The Washington Post. It shows that when asked about their feelings towards climate change, young US residents aged 13–17 responded with fear (57%), anger (52%) and guilt (42%) [Strife 2012, Kaplan and Guskin 2019]. This rhetoric has also influenced young people’s decisions not to have children. This correlation was analysed on a sample of 607 people at Yale-NUS College in Singapore. They declared that the issue of climate change was important to their decision about parenthood. When asked about their level of concern about the future carbon footprint their child would leave behind, nearly 60% of respondents declared to be ‘very’ or ‘extremely’ concerned. Concern for the health and life of a child who could be born in times of a progressive climate crisis was also pronounced. In this case, 96.5% of respondents expressed ‘very high’ or ‘extreme’ concern. These analyses were published in Climatic Change [Schneider-Mayerson 2020]. These data may explain the growing conviction among young people of the need to radically combat not only climate change, but also the consumerist model of the economy, known as techno-feudalism [Varoufakis 2024].

The report ‘The Limits to Growth’ also contains theses on overpopulation of the Earth. However, day-to-day observation shows, among other things, that the planned reduction of the population in Asian and European countries has led to rapid ageing of the society, an increase in the costs of geriatric medical care and, as a consequence, the failure of the social security system. As a result, this has generated a trend in Western Europe to seek labour among the rapidly growing populations of Africa and South America.

It is difficult to identify tangible changes in social attitudes that would demonstrate adaptation. However, a shift in narrative can be noticed. An example of this is President Joe Biden’s Executive Order on America’s Supply Chains, passed on 24 February 2021, which aims to reindustrialise the American economy. It was reinforced by Donald Trump’s ‘Make America Great Again’ plan, which is based on the ‘Declaring a National Energy Emergency’ document signed on the day of his inauguration, 20 January 2025. These documents indicate that the US needs a reliable, diverse and affordable energy supply to power its manufacturing, transport, agricultural and defence industries and to maintain the foundations of modern life and military readiness. There is therefore a noticeable change in the US administration’s narrative, which has also impacted the actions of the rest of the world, including the EU. In order to avoid customs barriers and energy prices that are five times higher [Draghi 2024], EU industry is moving its

production overseas. It is also worth mentioning that the International Energy Agency (IEA) has estimated global coal consumption in 2024 at a record level of 8.79 billion tonnes. It also reported an upward trend from 2021 onwards, with growth rates of 7.7% (2021), 4.4% (2022), 2.3% (2023) and 1.5% (2024). China and India have emerged as the main consumers of this raw material, accounting for over 60% of total consumption. Meanwhile, in 2024, the European Union reached its lowest consumption level in 34 years [Coal Mid-Year Update 2025]. Coinciding with these data, there has also been a shift in the narrative away from the phrase ‘clean vs. dirty energy’ towards highlighting the benefits to society of increased living standards and security based on the development of industry harnessing scientific achievements [Morano 2022]. There are many indications that we are therefore witnessing a change not only in language, but also in the paradigm of the discussion, i.e. the beginning of adaptation.

## 8. Adaptive spatial planning

Growing urbanisation pressure is driving people to inhabiting areas previously considered unsuitable. This is related to economic and reputational pressure, as new housing estates and neighbourhoods are often built in floodplains. Analyses indicate that if we do not take any adaptation measures, by the end of 2100, approximately 350 million people per year will experience the effects of flooding, and the costs of these disasters could reach 11% of global GDP, or approximately USD 55 trillion (55,000 billion). At the same time, by using adaptation measures that have been known for years, by the same year 2100, the number of people affected by the effects of flooding will fall to around 15,000 per year, and losses will reach USD 38 billion, or 0.0076% of GDP [Lomborg 2024].

However, adaptation does not only mean raising sea or river embankments, it also involves a spatial planning programme based on three points: 1) avoiding floodplains; 2) ‘space for rivers’ – i.e. restoring the natural space of rivers instead of straightening them and limiting them with embankments; 3) moving away from ‘concretosis’, i.e. paving squares with granite slabs. It is worth adding that in 2022, scientists from the University of Agriculture in Krakow pointed out in *Rzeczpospolita* newspaper: ‘it is illusory to believe that there will be no shortage of water in large rivers. There will be less and less rainfall and snow. We are unable to retain rain, which will increasingly be brief and torrential, in agricultural areas’ [Pijanowski et al. 2022].

Moving on to the first concept – dry years weaken the vigilance of urban planners and developers. However, all it takes is a combination of adverse weather conditions for a disaster to strike. It is worth reminding that the flood that hit Wrocław in 2024 particularly affected residents of areas marked as floodplains on maps from 1927 [<https://grafikahistoryczna.pl/niemiecka-mapa-wroclawia-z-terenami-zalewowymi/>]. A similar situation occurred in Katowice, where a Lidl store was built in a floodplain [Jedlecki 2024]. The second assumption – ‘space for the river’ – was implemented by the authorities in Houston, Texas. The city is partly built on wetlands that were drained for urban development to accommodate a growing population. In

2019, a 1.7 billion USD Rainy Day Fund programme was adopted there. As part of the planned measures, concrete pavements are gradually being replaced with permeable ones, so are the roadsides. In the northern part of the city, some houses will be purchased and demolished to make way for flood polders [Baddour 2017]. The third component is putting an end to ‘concretosis’. After the urban floods that hit Krakow and other Polish cities in 2019–2024, the idea of water retention was revisited. This was achieved through the government programme ‘No more concrete in city centres’ [gov.pl 2022]. Also worth mentioning is that the tragic effects of the floods that hit Spain in the autumn of 2024 in autumn 2024 were caused not only by natural factors (the terrain) but also, according to Polish firefighters participating in rescue operations, by ‘concretosis’ which included, among other things, garden walls, driveways, roads and river channels [Kałach 2024].

## 9. Summary and conclusions

Since the publication of *The Limits to Growth* (1972), public debate has been dominated by narratives of climate risks, often creating an alarmist attitude. However, this analysis reveals that adaptation to climate change – as an alternative response strategy – remains an underrepresented area in the discourse, despite its documented effectiveness.

Empirical data shows that adaptation measures can significantly reduce the impact of natural disasters. The example of Bangladesh, which introduced a comprehensive Cyclone Preparedness Programme after the tragic experience of the Bhola cyclone in 1970, is one of the most prominent examples of the effectiveness of such measures. Systematic modifications in spatial planning, public education and construction have led to a significant decrease in the number of victims of subsequent disasters – from hundreds of thousands to several thousand people [Bimal 2009, Hossain 2018]. In summary, the case of Bangladesh demonstrates that effective adaptation stems from a combination of empirical data, political determination and spatial risk management. Meanwhile, analysis of data on hurricanes and tornadoes indicates that despite media reports of an intensification of extreme events, many sources [e.g. USGCRP 2014, 2017, Rice 2020] do not confirm any sustained upward trends in their number or strength, at least on a global or American scale. This suggests a need for more careful discrimination between correlation and causation in analyses of weather extremes.

In the context of water resources, a similar dichotomy can be observed between alarmist media reports and historical hydrological data. Analyses indicate that drought severity in the US was higher in previous centuries than in the 21st century [e.g. Hansen et al. 1999]. Furthermore, Annex 3 of the US National Climate Assessment notes that no significant trends have been observed in the number of tropical cyclones and hurricanes reaching the US coast [USGCRP 2014]. Furthermore, the 2014 IPCC report noted several times that it is unconvincing to attribute changes in hurricane activity to humanity [IPCC 2014]. On the other hand, there is a growing importance of systemic retention measures, including solutions such as riverbed retention and drain-

age, which are proving to be crucial in building the resilience of cities and agricultural areas [e.g. Pijanowski et al. 2021].

Both examples of hurricane protection and water adaptation reinforce the argument that an effective response to climate change is based not on panic, but on the ability to integrate scientific knowledge with long-term spatial planning. Adaptation as a transdisciplinary process becomes a tool not only for responding, but above all for proactively shaping the space of the future, integrating climatic, social and technological variables. This approach provides the foundation for building sustainable, resilient and balanced settlement systems.

## References

- Boryczka J., Stopka-Boryczka M. 2004. Cykliczne wahania temperatury i opadów w Polsce w XIX-XX wieku. *Acta Agrophysica*, 3(1).
- Draghi M. 2024. The future of European competitiveness, September 2024.
- IPCC. 2013. Intergovernmental Panel on Climate Change, AR5 WGI, p. 887.
- IPCC. 2013. Intergovernmental Panel on Climate Change, AR5 WGI, section 2.6.1.
- IPCC. 2014. Cambridge University Press, p. 7, 50, 113.
- Koonin S.E. 2023. Kryzys klimatyczny? Prawdy, półprawdy i kłamstwa – co wiemy, czego się nam nie mówi i jaka nas czeka przyszłość, T. Woińska (translation), Prześwity.
- Kowalczak P. 2024. Zmiany klimatu. Polityka. Ideologia. Nauka. Fakty, 3S Media.
- Lomborg B. 2024. Fałszywy alarm. Jak panika związana ze zmianami klimatu kosztuje nas biliony, krzywdzi biednych i nie ratuje planety, WEI, Warszawa.
- Meadows D.H., Meadows D.L., Randers J., Behrens III W.W. 1972. *The Limits to Growth: A Report for the Club of Rome's Project on the Predicament of Mankind*, Universe Books, New York.
- Morano M. 2022. *The Great Reset: Global Elites and the Permanent Lockdown*, Regnery Publishing, Washington, D.C.
- Nowak A.Z., Kurtyka M., Tchorek G. 2021. Transformacja energetyczna i klimatyczna – wybrane dylematy i rekomendacje. Wydawnictwa Uniwersytetu Warszawskiego, Warszawa.
- Pijanowski J.M., Bogdał A., Książek L., Wojewodzic T., Kowalik T., Wałęga A., Zarzycki J., Zadrożny P., Nicia P., Strużyński A., Dacko M., Wyrębek M., Goleniowski K., Skorupka M. 2021. Środowiskowe i społeczne efekty scaleń gruntów. Monografia pod redakcją naukową J.M. Pijanowskiego. Wydawnictwo Uniwersytetu Rolniczego w Krakowie. <https://dx.doi.org/10.15576/978-83-66602-22-9>
- Varoufakis Y. 2024. *Technofeudalizm. What Killed Capitalism*, Wydawnictwo Vintage.

## Internet sources

- Arb. 2020. Cztery bomby atomowe co sekundę. Tak ciepłe są oceany <https://www.rp.pl/nauka/art939341-cztery-bomby-atomowe-co-sekunde-tak-cieplo-sa-oceany> [accessed: 20.04.2025].
- Baddour D. 2017. High-tech flood study calls for buyouts of North Houston apartments. <https://www.houstonchronicle.com/business/article/High-tech-flood-study-calls-for-buyouts-of-North-11198088.php> [accessed: 20.04.2025].
- Bakkensen L.A., Mendelsohn R.O. 2016. Risk and Adaptation: Evidence from Global Hurricane Damages and Fatalities. *Journal of the Association of Environmental and Resource Economists*, 3, 3, 555–587. <https://ideas.repec.org/a/ucp/jaerec/doi10.1086-685908.html>

- Belfast Telegraph. 2014. OAPs staying in bed to keep warm. <https://www.belfasttelegraph.co.uk/news/oaps-staying-in-bed-to-keep-warm/29890928.html> [accessed: 20.04.2025].
- Biello D. 2014. Cool Roofs Might Be Enough to Save Cities from Climate Overheating. <https://www.scientificamerican.com/article/cool-roofs-might-be-enough-to-save-cities-from-climate-overheating/> [accessed: 20.04.2025].
- Bimal K.P. 2009. Why relatively fewer people died? The case of Bangladesh's Cyclone Sidr, *Nat Hazards*, 50, 289–304. <https://doi.org/10.1007/s11069-008-9340-5> [accessed: 20.04.2025].
- Carrington D. 2019. Why the Guardian is changing the language it uses about the environment <https://www.theguardian.com/environment/2019/may/17/why-the-guardian-is-changing-the-language-it-uses-about-the-environment> [accessed: 20.04.2025].
- Economist. 2017. Climate change and inequality. The rich pollute, the poor suffer. <https://www.economist.com/finance-and-economics/2017/07/13/climate-change-and-inequality> [accessed: 20.04.2025].
- Coal Mid-Year Update. 2025. <https://iea.blob.core.windows.net/assets/1e9f8356-4ec9-4c7d-9673-beaea204b44d/CoalMid-YearUpdate2025.pdf> [accessed: 6.08.2025].
- CNN. 2019. Dozens dead in one of India's longest heat waves. <https://edition.cnn.com/videos/world/2019/06/14/india-heatwave-kk-lon-orig.cnn> [accessed: 20.04.2025].
- Diaz J., Carmona R., Mirón J., Ortiz C., Linares C. 2015. Comparison of the effects of extreme temperatures on daily mortality in Madrid (Spain), by age group: The need for a cold wave prevention plan, 143, Part A, 186–191. *Environmental Research*. <https://www.sciencedirect.com/science/article/abs/pii/S001393511530116X?via%3Dihub> [accessed: 20.04.2025].
- Declaring a National Energy Emergency 2025. <https://www.federalregister.gov/documents/2025/01/29/2025-02003/declaring-a-national-energy-emergency> [accessed: 6.08.2025].
- Duvat V.K.E. 2019. A global assessment of atoll island planform changes over the past decades. *WIRES Climate Change*, 10, 1. <https://wires.onlinelibrary.wiley.com/doi/10.1002/wcc.557> [accessed: 20.04.2025].
- Estrada F., Botzen W.J., Tol R.S.J. 2017. A global economic assessment of city policies to reduce climate change impacts. *Nature Climate Change*, 7(6), 403–406. [https://www.researchgate.net/publication/317648223\\_A\\_global\\_economic\\_assessment\\_of\\_city\\_policies\\_to\\_reduce\\_climate\\_change\\_impacts](https://www.researchgate.net/publication/317648223_A_global_economic_assessment_of_city_policies_to_reduce_climate_change_impacts) [accessed: 20.04.2025].
- Executive Order on America's Supply Chains. 2021. <https://bidenwhitehouse.archives.gov/briefing-room/presidential-actions/2021/02/24/executive-order-on-americas-supply-chains/> [accessed: 6.08.2025].
- Fedyczkowski Z.E., Przysłał G. 2013. The concept of ecologically sensitive residential development for areas at risk from natural disasters. *Geomatics, Landmanagement and Landscape*, 3, 37–47. <https://doi.org/10.15576/GLL/2013.3.37> [accessed: 20.04. 2025].
- Franey J. 2025. Climate group Net Zero Asset Managers suspends activities days after BlackRock quits. <https://nypost.com/2025/01/13/business/climate-group-suspends-activities-days-after-blackrock-quits/> [accessed: 20.04.2025].
- Gasparrini A., Guo Y., Hashizume M., Lavigne E., Antonella Zanobetti A., Joel Schwartz J., Tobias A. et al. 2015. Mortality risk attribute able to high and low ambient temperature: a multicountry observational study. *Lancet*, 386, 9991, 369–375. <https://www.thelancet.com/journals/lancet/article/PIIS0140-67361462114-0/fulltext> [accessed: 20.04.2025].
- Global Commission on Adaptation. 2019. Adapt Now: A Global Call for Leadership on Climate Resilience. [https://gca.org/wp-content/uploads/2019/09/GlobalCommission\\_Report\\_FINAL.pdf](https://gca.org/wp-content/uploads/2019/09/GlobalCommission_Report_FINAL.pdf) [accessed: 20.04.2025].
- Goodell J. 2019. The Coming Flood: A Data Error Is Corrected, and Our Future Is Rewritten. A new study on sea level rise reveals parts of Asia and the Middle East are in far more

- peril than we thought. <https://www.rollingstone.com/politics/politics-news/sea-level-rise-climate-central-study-906178/> [accessed: 20.04.2025].
- gov.pl. 2022. Wiceminister Zyska o inicjatywie 'Koniec z betonem w centrach miast'. <https://www.gov.pl/web/klimat/wiceminister-zyska-o-inicjatywie-koniec-z-betonem-w-centrach-miast> [accessed: 20.04.2025].
- Hansen J., Ruedy R., Lacis A., Sato M., Nazarenko L., Taucnev N., Tegen I., Koch D. 1999. Climate modeling in the global warming debate. [https://www.researchgate.net/publication/313701649\\_Climate\\_modeling\\_in\\_the\\_global\\_warming\\_debate](https://www.researchgate.net/publication/313701649_Climate_modeling_in_the_global_warming_debate) [accessed: 20.04.2025].
- Hossain N. 2018. The 1970 Bhola cyclone, nationalist politics, and the subsistence crisis contract in Bangladesh. *Disasters*, 42, 1, 187–203. <https://onlinelibrary.wiley.com/doi/abs/10.1111/disa.12235> [accessed: 20.04.2025].
- Jedlecki P. 2024. W Katowicach zbudowano Lidla na terenie zalewowym. Mieszkańcy przestrzegali, teraz sami ratują się przed wodą. <https://katowice.wyborcza.pl/katowice/7,35063,31305823,w-katowicach-postawiono-lidla-na-terenie-zalewowym-mieszkancy.html> [accessed: 20.04.2025].
- Jevrejeva S., Moore J.C., Grinsted A., Matthews A., Spada G. 2013. Trends and acceleration in global and regional sea levels since 1807. *Global and Planetary Change*, 113, 11–22. [https://www.researchgate.net/publication/259517529\\_Trends\\_and\\_acceleration\\_in\\_global\\_and\\_regional\\_sea\\_levels\\_since\\_1807](https://www.researchgate.net/publication/259517529_Trends_and_acceleration_in_global_and_regional_sea_levels_since_1807) [accessed: 20.04.2025].
- Kałach M. 2024. Dlaczego powódzie w Hiszpanii pochłonęły więcej ofiar niż w Polsce? Eksperti tłumaczą. <https://wiadomosci.onet.pl/kraj/dlaczego-powodzie-w-hiszpanii-pochlonely-wiecej-ofiar-niz-w-polsce-eksperti-tlumacza/e8kqy9v> [accessed: 20.04.2025].
- Kaplan S., Guskin E. 2019. Most American Teens Are Frightened by Climate Change, Pool Finds, and about 1 in 4 Are Taking Action. [https://www.washingtonpost.com/science/most-american-teens-are-frightened-by-climate-change-poll-finds-and-about-1-in-4-are-taking-action/2019/09/15/1936da1c-d639-11e9-9610-fb56c5522e1c\\_story.html](https://www.washingtonpost.com/science/most-american-teens-are-frightened-by-climate-change-poll-finds-and-about-1-in-4-are-taking-action/2019/09/15/1936da1c-d639-11e9-9610-fb56c5522e1c_story.html) [accessed: 20.04.2025].
- Kench P.S., Ford M.R., Owen S.D. 2018. Patterns of island change and persistence offer alternate adaptation pathways for atoll nations. *Nature Communications*. <https://www.nature.com/articles/s41467-018-02954-1> [accessed: 20.04.2025].
- KMA. 2025. Sześć banków opuszcza sojusz klimatyczny. Szykują się na powrót Donalda Trumpa. <https://businessinsider.com.pl/wiadomosci/uciekaja-z-sojuszu-klimatycznego-bank-szykuja-sie-na-powrot-trumpa/40mtrel> [accessed: 20.04.2025].
- Knowski W. 2025. Wierć kochanie! Oto co polityka klimatyczna Trumpa może oznaczać dla Polski. <https://innpoland.pl/210812,wierc-kochanie-co-polityka-klimatyczna-trumpa-moze-oznaczac-dla-polski> [accessed: 20.04.2025].
- Kottasová I. 2020. Oceans are warming at the same rate as if five Hiroshima bombs were dropped in every second. <https://edition.cnn.com/2020/01/13/world/climate-change-oceans-heat-intl/index.html> [accessed: 20.04.2025].
- Lincke D., Hinkel J. 2018. Economically Robust Protection against 21st Century Sea-Level Rise. *Global Environmental Change*, 51(371), 67–71. [https://www.researchgate.net/publication/326102090\\_Economically\\_robust\\_protection\\_against\\_21st\\_century\\_sea-level\\_rise](https://www.researchgate.net/publication/326102090_Economically_robust_protection_against_21st_century_sea-level_rise) [accessed: 20.04.2025].
- Markanday A., Galarraga I. 2019. A Critical Review of Cost-Benefit Analysis For Climate Change Adaptation in Cities. *Change Economics*, 10, 4, 1–31. <https://www.worldscientific.com/doi/abs/10.1142/S2010007819500143> [accessed: 20.04.2025].
- McPhate M. 2017. California Today: A Plan to Cool Down L.A. <https://www.nytimes.com/2017/07/07/us/california-today-cool-pavements-la.html> [accessed: 20.04.2025].

- National Oceanic and Atmospheric Administration. 2025. <https://www.ngdc.noaa.gov/geomag/declination.shtml> [accessed: 20.04. 2025].
- National Research Council. 2005. Radiative Forcing of Climate Change: Expanding the Concept and Addressing Uncertainties. Chapter: 3. Radiative Forcing Over Earths History, National Academies of Sciences, Engineering, and Medicine. 2005. Radiative Forcing of Climate Change: Expanding the Concept and Addressing Uncertainties. Washington, DC: The National Academies Press. <https://doi.org/10.17226/11175> [accessed: 20.04.2025].
- Oreskes N. 2015. Playing Dumb on Climate Change. <https://www.nytimes.com/2015/01/04/opinion/sunday/playing-dumb-on-climate-change.html> [accessed: 20.04.2025].
- PAP, pkur. Szokująca liczba. 'Financial Times' podliczył, ile na świecie toczy się konfliktów zbrojnych, w których giną cywile. <https://polskieradio24.pl/artykul/3307071,szokujaca-liczba-financial-times-podliczyl-ile-na-swiecie-toczy-sie-konfliktow-zbrojnych-w-ktorych-gina-cywile> [accessed: 20.04.2025].
- Perzyński J. 2023. Przewodniczący szczytu COP28 kwestionuje zmiany klimatu. <https://biznesalert.pl/cop-28-polityka-klimatyczna-adnoc-ropa-gaz-emisje/> [accessed: 20.04.2025].
- Peterson T.C., Connolley W.M., Fleck J. 2008. The Myth of the 1970s Global Cooling Scientific Consensus. <https://cnslibrary.com/wp-content/uploads/Myth-of-1970s-global-cooling-scientific-consensus.pdf> [accessed: 20.04.2025].
- Pijanowski J.M., Książek L., Wałęga A. 2022. Jak zatrzymać wodę. <https://www.rp.pl/opinie-ekonomiczne/art36859111-pijanowski-ksiazek-walega-jak-zatrzymac-wode> [accessed: 20.04.2025].
- Rice D. 2020. Global warming is making hurricanes stronger, study says. <https://eu.usatoday.com/story/news/nation/2020/05/18/global-warming-making-hurricanes-stronger-study-suggests/5216028002/> [accessed: 20.04. 2025].
- Schneider-Mayerson M. 2020. Eco-reproductive concerns in the age of climate change. *Climatic Change*, 163, 1007–1023. <https://doi.org/10.1007/s10584-020-02923-y>. <https://link.springer.com/article/10.1007/s10584-020-02923-y> [accessed: 20.04.2025].
- Spencer R.W. 2021. Urban Heat Island Effects on U.S. Temperature Trends, 1973–2020, USHCN vs. Hourly Weather Stations. <https://www.drroyspencer.com/2021/02/urban-heat-island-effects-on-u-s-temperature-trends-1973-2020-ushcn-vs-hourly-weather-stations/> [accessed: 20.04.2025].
- Strife S.J. 2012. Children's Environmental Concerns: Expressing Ecophobia. *Journal of Environmental Education*, 43, 1, 37–54. <https://eric.ed.gov/?id=EJ947229> [accessed: 20.04.2025].
- Time Magazine. 2019. Our Sinking Planet U.N. Secretary-General António Guterres Cover. <https://www.amazon.com/Magazine-Sinking-Secretary-General-Ant%C3%B3nio-Guterres/dp/B07T4JDH26> [accessed: 20.04.2025].
- U.S. Global Change Research Program (USGCRP). 2017. Climate Science Special Report: Fourth National Climate Assessment, 8.1.2. <https://science2017.globalchange.gov/> [accessed: 20.04.2025].
- USGCRP. Walsh J., Wuebbles D. (red.). 2014. Climate Change Impacts in the United States: The Third National Climate Assessment, Appendix 3: Climate Science Supplement. [https://nca2014.globalchange.gov/downloads/low/NCA3\\_Full\\_Report\\_Appendix\\_3\\_Climate\\_Science\\_Supplement\\_LowRes.pdf](https://nca2014.globalchange.gov/downloads/low/NCA3_Full_Report_Appendix_3_Climate_Science_Supplement_LowRes.pdf) [accessed: 20.04.2025].
- USGCRP. 2014. Appendix 3, p. 769. [https://s3.amazonaws.com/nca2014/low/NCA3\\_Full\\_Report\\_Appendix\\_3\\_Climate\\_Science\\_Supplement\\_LowRes.pdf?download=1](https://s3.amazonaws.com/nca2014/low/NCA3_Full_Report_Appendix_3_Climate_Science_Supplement_LowRes.pdf?download=1) [accessed: 10.08.2025].
- Volcovici V., Withers A. 2024. OPEC Secretary General tells COP29 oil is a gift from God. <https://www.reuters.com/business/energy/opec-secretary-general-tells-cop29-oil-is-gift-god-2024-11-20/> [accessed: 20.04.2025].

- Ward V.** 2015. Winter Death Toll 'to Exceed 40,000'. <https://www.telegraph.co.uk/news/weather/11382808/Winter-death-toll-to-exceed-40000.html> [accessed: 20.04.2025].
- Wolf T.** 2006. London's Urban Heat Island: A Summary for Decision Makers. [https://www.researchgate.net/publication/277003200\\_London%27s\\_Urban\\_Heat\\_Island\\_A\\_Summary\\_for\\_Decision\\_Makers](https://www.researchgate.net/publication/277003200_London%27s_Urban_Heat_Island_A_Summary_for_Decision_Makers) [accessed: 20.04.2025].
- Ygi.** 2024. To on ma zatrzymać 'zielony ład' w USA. Trump: biznesmen od ropy zajmie się energetyką. <https://businessinsider.com.pl/wiadomosci/to-on-ma-zatrzymac-zielony-lad-w-usa-trump-biznesmen-od-ropy-zajmie-sie-energetyka/nht3sse> [accessed: 20.04.2025].