Name of the committee : United Nations Environment Programme
Issue : Defining the role of AI in predicting, mitigating and adapting to the impacts of climate change
Names of the chairs : Sofya Korobitsyna, Khalid Lahbabi, Maxence Nicolet

Unprecedented challenges require unprecedented solutions: this is the reasoning behind the overall theme of FerMUN 2020, "ICTs for SDGs". Information and Communication Technologies (ICTs) have the potential to accelerate progress towards every one of the Sustainable Development Goals (SDGs), and the role of the International Telecommunication Union (ITU) is to maximise this potential. FerMUN 2020 is a chance for young people from across the world to come together in support of this mission.

Defining the role of AI in predicting, mitigating and adapting to the impacts of climate change

1. Introduction

In Angela Merkel's words, "Climate change knows no borders. It will not stop before the Pacific islands and the whole of the international community here has to shoulder a responsibility to bring about a sustainable development.". Climate change is a global problem and call for a knowledgeable response from all countries in order to be effectively addressed. Considerable attention has been given to climate change by the scientific community, government bodies and the public media. However, many issues are not fully understood. It is important that the professional operational community of meteorologists, hydrologists, and oceanographers become more knowledgeable on this subject in order to monitor climate change and incorporating its perspectives into their own work, to help governing bodies understanding the scientific issues, and providing information to the general public.

It is now possible to tackle some of the world's biggest problems with emerging technologies such as AI, a new tool to help these professional operational community better manage the impacts of climate change and protect the planet. The AI refers to computer systems that "can sense their environment, think, learn, and act in response to what they sense and their programmed objectives," according to a World Economic Forum report, Harnessing Artificial Intelligence for the Earth. It's time to put AI to work for the planet !

a. Key words

Artificial Intelligence (AI)
Processes who give machines the ability to learn from experience as they take in more data to perform tasks like humans. These processes include learning (the acquisition of information and rules for using the information), reasoning (using rules to reach approximate or definite conclusions) and self-correction.

Climate
The climate corresponds to average weather conditions (temperature, precipitation, sunshine, air humidity, wind speed, etc.) over a period of at least 30 years. As it is translated by averages, the climate is also characterized by extremes and variations, which are the result of the interaction of the three main reservoirs: the ocean, the atmosphere and the continental surfaces (including the ice caps polar).

Climate change
Change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.

- **Adverse effects of climate change**
  Changes in the physical environment or biota, which have significant deleterious effects on the composition, resilience or productivity of natural and managed ecosystems, on the operation of socio-economic systems and on human health and welfare.

Climate change mitigation
Efforts and actions to mitigate the extent of climate change by reducing greenhouse gas emissions or sequestering carbon dioxide from the atmosphere. Mitigation can mean using new technologies and renewable energies, making older equipment more energy efficient, or changing management practices or consumer behavior.

Climate change adaptation
Strategies, initiatives and measures of individuals, communities and organisations to reduce the vulnerability of natural and human systems to the (present and expected) effects of climate change. It involves taking practical actions to manage risks from climate impacts, protect communities and strengthen the resilience of the economy.

Climate system
Climate system is defined as the five components in the geophysical system, the atmosphere and four others which directly interact with the atmosphere and which jointly determine its climate. The five components are atmosphere, ocean, land surface, ice and snow surfaces (both land and ocean areas) and biosphere (both terrestrial and marine).

Greenhouse gases (GHGs)
Gas that absorbs and emits radiant energy, in other words, is a gas that trap heat in the atmosphere. Without greenhouse gases, the average temperature of Earth's surface would be about −18 °C rather than the present average of 15 °C. The primary greenhouse gases in Earth's atmosphere are carbon dioxide (CO_2), methane(CH_4), and ozone(O_3).

United Nations Environment Program (UNEP) :
The UNEP is a United Nations organization established in 1972 to sets the global environmental agenda, to catalyse and coordinate activities to increase scientific understanding of environmental change, to develop environmental management tools and promotes the coherent implementation of the environmental dimension of sustainable development within the United Nations system.

2. Overview of the issue

The Earth's climate has always changed and evolved. Just in the last 650,000 years there have been seven cycles of glacial advance and retreat, with the abrupt end of the last ice age about 7,000 years ago, marking the beginning of the modern climate era. Most of these climate changes have been due to natural causes. But the current climate change trend is of particular significance because most of it is extremely likely (greater than 95 percent probability) to be the result of human activity since the second part of the 20th century .

According to the NASA, the earth-orbiting satellites and other technological advances have enabled scientists to see the big picture, collecting many different types of information about our planet and its climate on a global scale. This body of data, collected over many years, reveals the signals of a changing climate.

a. Recap of the history and origins of the Artificial Intelligence

Artificial intelligence was born in the 1950s thanks to the mathematician Alan Turing. He describes a test now known as a Turing test in which a subject interacts blindly with another human, then with a machine programmed to formulate smart answers. If the subject can not tell the difference, then the machine has passed the test and, according to the scientist, can really be considered "intelligent".

From Google to Microsoft, via Apple, IBM or Facebook, all the new technology companies of the world are working now on the problems of the artificial intelligence trying to apply it to some specific fields. As the evolution of this work progresses, Artificial intelligence goes from simple speech recognition for an automatic fund management system in finance, a medical diagnostic aid, a decisional ally on the military field, or a new predictive tool of the climate changes. While in 2015 the artificial intelligence market was worth 200 $ million, it is estimated that in 2025, it will amount to nearly 90 $ billion.Today, AI is used in our daily lives and it is based on 5 different domains, according to a World Economic Forum report, Harnessing Artificial Intelligence for the Earth :

- **Big data**

Computers have given us access to vast amounts of data, both structured (in databases and spreadsheets) and unstructured (such as text, audio, video and images). All of this data documents our lives and improves humans' understanding of the world. AI-assisted processing of this information allows us to use this data to discover historical patterns, predict more efficiently, make more effective recommendations, and more.

- **Processing power**

Accelerating technologies such as cloud computing and graphics processing units have made cheaper and faster the managing of large volumes of data.

- **A connected globe**

Social media platforms have fundamentally changed the way people interact. This increased connectivity has accelerated the spread of information and encouraged knowledge sharing, leading to the emergence of a "collective intelligence", including open-source communities developing AI tools and sharing apps.

- **Open-source software and data**

Open-source software and data are accelerating the democratization and use of AI, as can be seen in the popularity of open-source machine learning standards and platforms. An open-source approach can mean less time spent on routine coding, industry standardization and wider application of emerging AI tools.

- **Improved algorithms**

Researchers have made advances in several aspects of AI, particularly in "deep learning", which involves layers of neural networks, designed in a fashion inspired by the human brain's approach to processing information.

The part below is partly extracted from a World Economic Forum report, Harnessing Artificial Intelligence for the Earth.

b. State of the climate indicators

The World Meteorological Organization uses a list of seven state-of-the-climate indicators that are drawn from the 55 Global Climate Observing System (GCOS) Essential Climate Variables, including surface temperature, ocean heat content, atmospheric carbon dioxide (CO_2), ocean acidification, sea level, glacier mass balance and Arctic and Antarctic sea ice extent. Additional indicators are usually assessed to allow a more detailed picture of the changes in the respective domain. These include, in particular (but are not limited to) precipitation, GHGs other than CO_2, snow cover, ice sheet, extreme events and climate impacts.

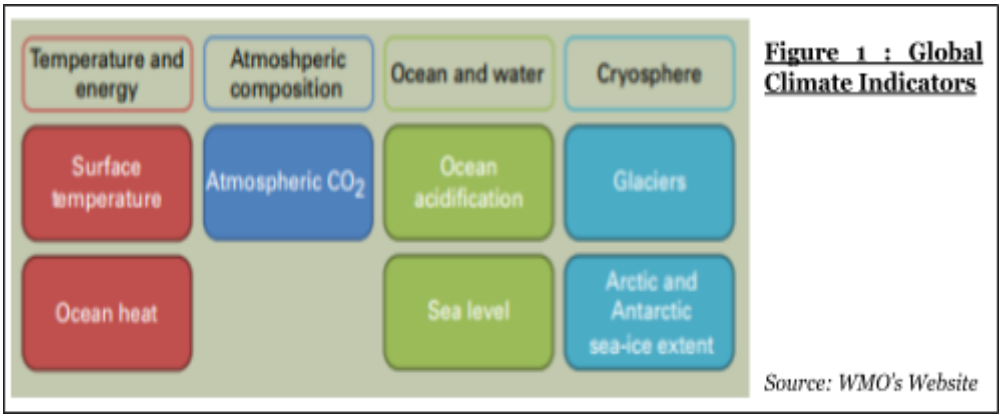


Figure 1 : Global Climate Indicators

Source: WMO's Website

❑ Temperature

Global temperature is the average temperature on the surface of the planet. The data used to determine the global temperature come from balloons, satellites and thousands of thermometers scattered all over the world, and are combined with thousands of sea surface temperature measurements. Based on these measurements, it appears that the planet's average surface temperature has risen about 0.9° Celsius since the late 19th century, a change driven largely by increased carbon dioxide and other human-made emissions into the atmosphere.

Most of the warming occurred in the past 35 years, with the five warmest years on record taking place since 2010 (2016 has been the warmest year on record since 1850, then 2015, 2017 and 2018). A warming of 0.9° Celsius seems to be a first sight very little and negligible. Impossible to feel the difference. But if we look at this planet, we see that it is a very important and very rapid increase. (Figure 2).

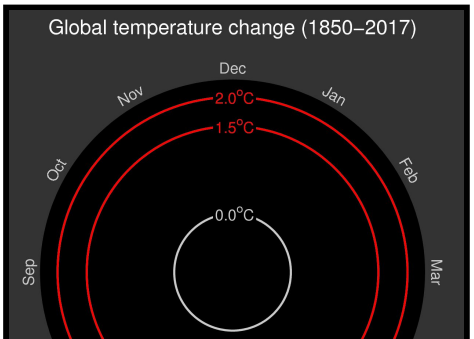


Figure 2 : Climate spiral representing global temperature change

This animated spiral presents global temperature change. The colours represent time.

Purple for early years, through blue, green to yellow for most recent years. The two red limits correspond to the two Paris Agreement's central aims (keeping a global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius). The pace of change is immediately obvious, especially over the past few decades.

Source : Climate Change Lab

❑ Ocean

The ocean absorbs vast quantities of heat as a result of increased concentrations of greenhouse gases in the atmosphere, mainly from fossil fuel consumption. The Fifth Assessment Report, published by the Intergovernmental Panel on Climate Change (IPCC) in 2013, revealed that the ocean had absorbed more than 93% of the excess heat from greenhouse gas emissions since the 1970s. This is causing ocean temperatures to rise, and researchers increasingly agree that the oceans are warming faster than previously thought. From 1901 through 2017, temperature rose at an average rate of 0.4° C.

In the present, warming of ocean water is rising global sea level because water expands when it warms. The average level of the oceans has increased by 22 cm from 1880 and 2 cm since the year 2000 because of the melting of glaciers but also with the thermal expansion of the water which, warmer, increases the volume. In the twentieth century, the level of characters increased by about 2 mm per year. From 1990 to 2017, it has reached the relatively constant pace of just over 3 mm a year.

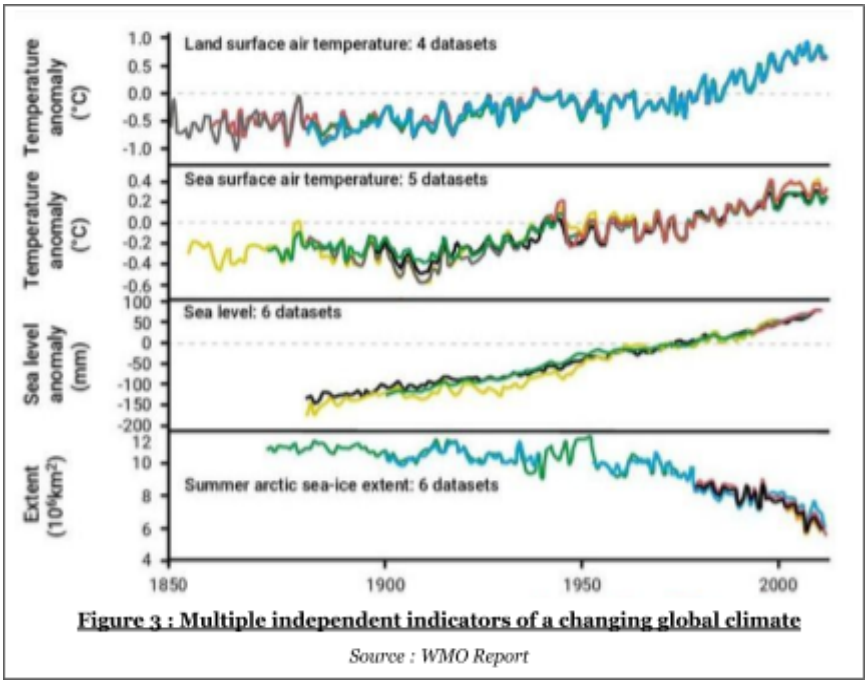


Figure 3 : Multiple independent indicators of a changing global climate

Source : WMO Report

Measurements made over the last few decades have demonstrated that ocean carbon dioxide levels have risen in response to increased carbon dioxide in the atmosphere, leading to an increase in acidity. Since the beginning of the Industrial Revolution, the acidity of surface ocean waters has increased by about 30%. This increase is the result of humans emitting more carbon dioxide into the atmosphere and hence more being absorbed into the oceans. The amount of carbon dioxide absorbed by the upper layer of the oceans is increasing by about 2 billion tons per year.

❑ Greenhouse Gases

- **Greenhouse effect**

Scientists attribute the global warming trend of the mid-twentieth century to the human expansion of the "greenhouse effect" that occurs when the atmosphere holds radiant heat from Earth to space. Atmospheric concentrations reflect a balance between sources (including emissions due to human activities) and sinks (for example, uptake by the biosphere and oceans). This natural phenomenon of trapping by the atmosphere of the fraction of solar radiation re-emitted by the Earth, the greenhouse effect, is amplified by the excessive releases of major gases : carbon

dioxide (CO_2), methane (CH_4), ozone (O_3) and minor gases.

- **Emissions and Concentrations of GHSs**

There are two main indicators related to greenhouse gases : the Global greenhouse gas emissions and atmospheric concentrations of greenhouse gases. Since the Industrial Revolution began in the 1700s, people have added a substantial amount of greenhouse gases into the atmosphere by burning fossil fuels, cutting down forests, and conducting other activities. Indeed, between 1990 and 2010, global emissions of all major greenhouse gases increased. Net emissions of carbon dioxide increased by 42 %, which is particularly important because carbon dioxide accounts for about three-fourths of the total global emissions. As an example, carbon dioxide concentrations have increased substantially since the beginning of the industrial era, rising from an annual average of 280 ppm in the late 1700s to more than 401 ppm as measured in 2015 (a 43 % increase). Almost all of this increase is due to human activities.

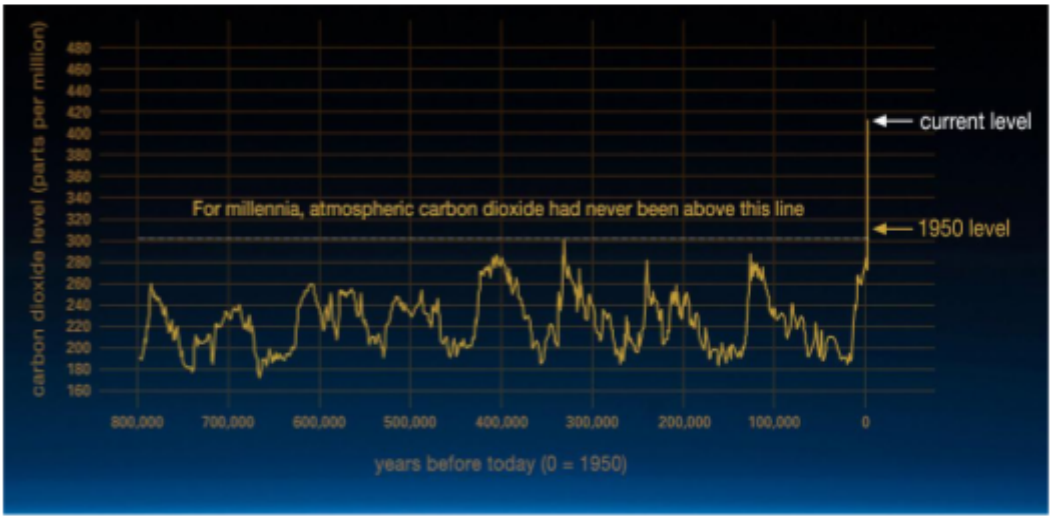


Figure 5 : Atmospheric carbon dioxide concentrations
(in parts per million (ppm) for the past 800,000 years, based on NASA's data.)

❑ Cryosphere (Sea Ice, Glaciers, Snow Cover)

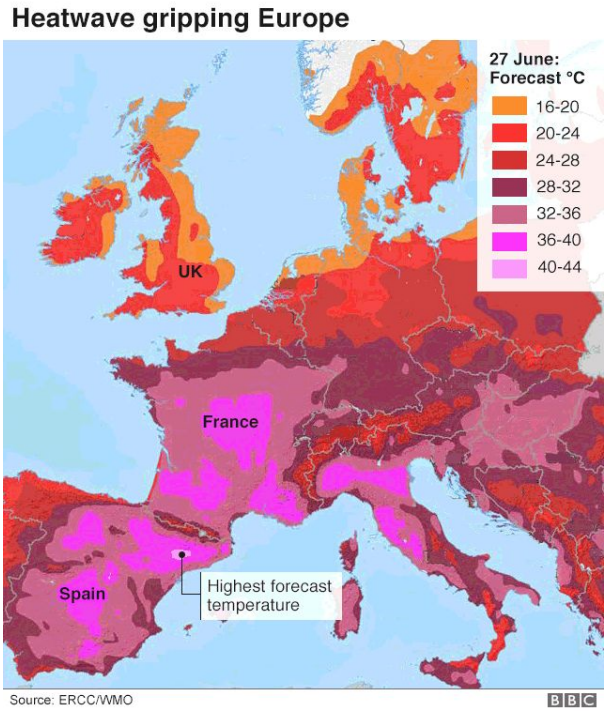
The Earth's surface contains many forms of snow and ice, including sea, lake, and river ice. Climate change can dramatically alter the Earth's snow- and ice-covered areas because snow and ice can easily change between solid and liquid states in response to relatively minor changes in temperature. For example, the Greenland and Antarctic ice sheets have decreased in mass. Data from NASA's Gravity Recovery and Climate Experiment show Greenland lost an average of 286 billion tons of ice per year between 1993 and 2016, while Antarctica lost about 127 billion tons of ice per year during the same time period. In another context, glaciers are retreating almost everywhere around the world including in the Alps, Himalayas, Andes, Rockies, Alaska and Africa.

Figure 6 : Panoramic view of Mount Everest.
(Taken in 1921 (top) by Major E.O. Wheeler and in 2009 (bottom) by David Breashears. Photo courtesy of the Royal Geographical Society)

❑ Extreme events (Doughts, Floodings, Heatwaves, Stroms)

Extreme weather events such as hurricanes, tornadoes and heatwaves are, by definition, unusual events. They are therefore very difficult to take into account in climate models that attempt to give averages. It is therefore difficult to know whether these extreme phenomena will multiply and intensify in the future, in the context of climate change. However, some clues suggest to scientists that increasing the frequency and magnitude of these events is very likely Observations made over the last 50 years show a tendency towards heat, intensification of the water cycle and, more randomly, a strengthening of storms.

Large parts of Europe experienced exceptional heat and drought through the late spring and summer of 2019. Temperatures were well above average and rainfall well below average from April onwards in much of northern and western Europe. For example, after the 2003 heatwave, France experienced one of the most striking heat waves in its recent history this summer. This year's heatwave was unprecedented in its intensity for a month in June since 1947, according to Météo-France. The weather agency says that heat waves, already significantly more frequent in the last 35 years, are expected to double by 2050, due to global warming.



c. Brief overview of the different consequences of climate change

Depending on the different climate models, the effects of climate change will be very diverse and geographically unequal. But the global climate change of the planet by the increase of the greenhouse effect should modify the major climatic mechanisms such as average temperature levels, oceanic and atmospheric circulations, the water cycle, etc. Several possible consequences of these climate changes are the subject of scientific consensus. Some have already been observed.(Such as you see in the first part of our report)

❑ Consequences of global warming for the planet

Melting ice is expected to open up access to new arable land, new mineral and energy resources, and new shipping routes. In 2016, the Arctic sea ice recorded record fonts. This melting ice will also cause ocean levels to rise, flooding areas of very low altitudes and altering coastal geography. Over the last 50 years, the ocean level has risen by about 10 centimeters. And Nasa estimates that in 100 to 200 years, it will rise again by at least one meter. The CNRS (French National Center for Scientific Research), for its part, provides that between 10 and 20,000 islands could be removed from the map. The amplification of evaporation and precipitation phenomena and the disruption of jet streams - these huge high-altitude currents - are all factors that are already increasing the frequency and intensity of droughts - such as California in 2016 - and floods. Shifting ranges of organisms and diseases, and therefore large agricultural areas, would result in the disappearance of species and ecosystems and a transformation of landscapes.
Thus, in 2016 and 2017, the Great Barrier Reef, a treasure of biodiversity inscribed on the World Heritage List, experienced two consecutive years of record bleaching (1,500 km out of 2,300 affected in 2017). And according to a US study, one in six animal species could be extinct. A threat that would vary according to

the regions of the world. Thus 23% of the species would be threatened in South America against 14% in Australia and New Zealand.Finally, our planet could see an increase in frequency and intensity of extreme weather events (storms, torrential rains, etc.).

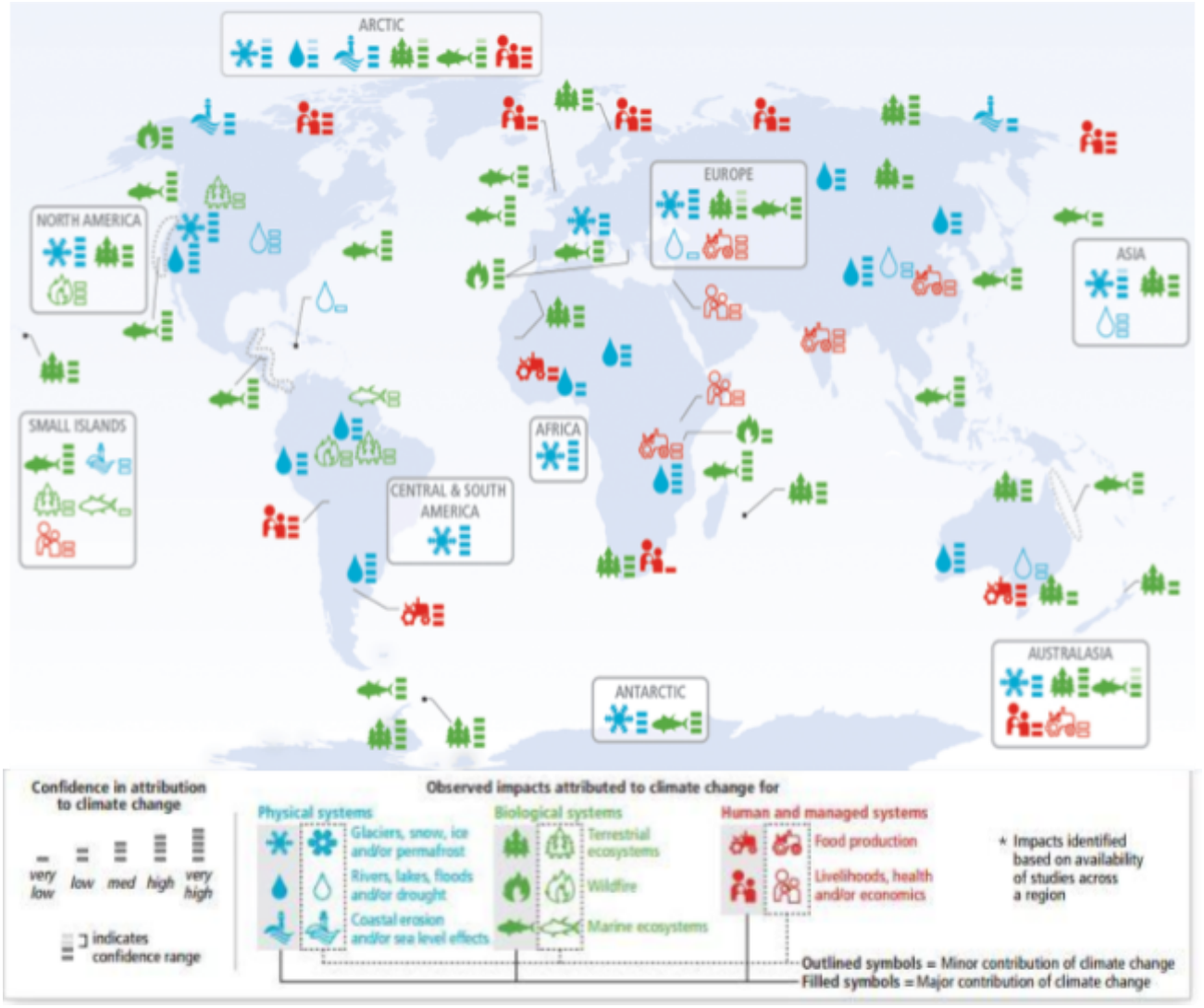


Figure 7 : Widespread impacts due to Climate Change
Source : IPCC Fifth Assessment Report

❑ Consequences of the climate change for the society

All of these changes in the environment will probably have a profound impact on human societies. Agricultural and fisheries production will be affected as will water resources. Consequences, according to the Food Bank and the UN: more than 100 million people could turn into extreme poverty and nearly 600 million could suffer from malnutrition by 2080. The health consequences of climate change could also be important. A warming of 2 to 3 ° C would be enough to increase by 5% the number of inhabitants exposed to malaria. And by 2080, WHO estimates that two billion more people may be at risk of dengue transmission. Diarrheal diseases - resulting from water contamination - could increase by 10% in the next 15 years. The consequences of these climate change should therefore be reflected in the increasing number of climate refugees and the increase in geopolitical instability.

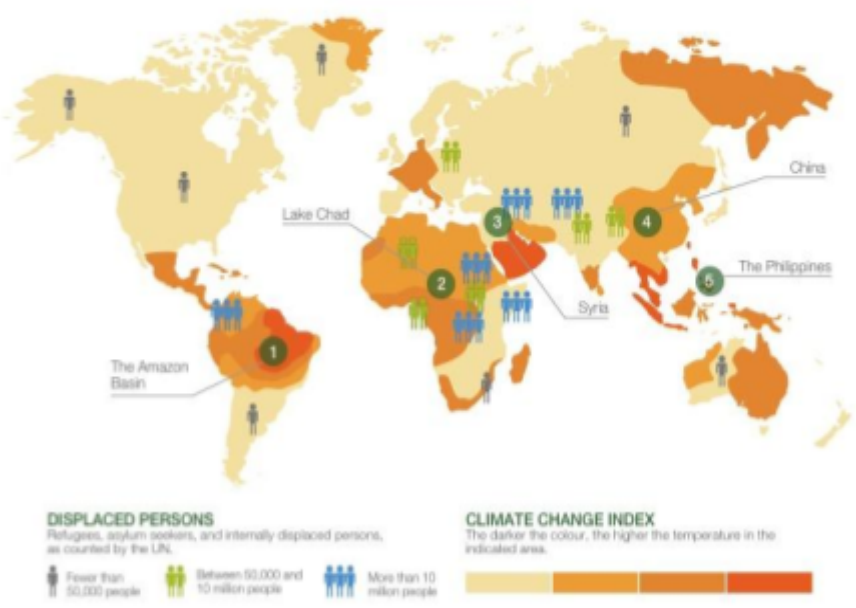


Figure 8 : Environmental Migration : a global scale reality
Source : UN

Already the people of Bikini Atoll in the Pacific have sought asylum in the United States. And the Internally Displacement Monitoring Center counted some 83.5 million climate refugees, between 2011 and 2014 while the UN predicts they will be 250 million by 2050. Finally, in 2007, the economist Nicolas Stern evaluated the economic cost induced by global warming, between 1% and 10% of global GDP in 2100, or 5,500 billion euros.

d. Prediction of climate change

Scientists have developed several computer-run simulations, or models, that combine and express in mathematical form what we know about the processes that control the atmospheric and hydrologic systems. The most advanced climate models are called General Circulation Models, or GCM's. These models are the primary tools used by scientists to try to predict the impacts of increased greenhouse gas concentration. The strength of these models is their ability to replicate input-response activities and relationships within complex systems that are far too elaborate for simple interpretation or logic. They have the ability to integrate various feedback processes in order to determine their effects on overall impact, and quickly generate different scenarios under varied assumptions about human activities.

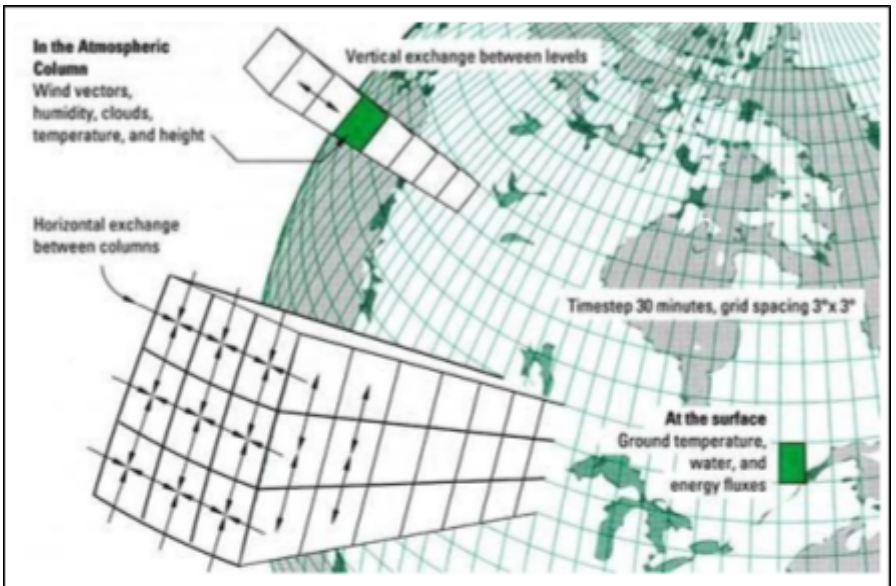


Figure 9 : Schematic of General Circulation Model
Source : IPCC report

To predict climate change, various means are possible. Based on the existence of climate change related to human activities, the IPCC (Intergovernmental Panel on Climate Change) has created a number of emission scenarios, called the RCP (Representative Concentration Pathway). Their purpose is to obtain a simple but possible representation of the future world on different aspects. They are based on assumptions about the evolution of the "driving forces" determining greenhouse gas (GHG) emissions. They also provide future emissions of these gases and predict climate change in advance and their future impacts. Established in 1988 at the request of the G7 is spearheaded by two bodies of the UN, the World Meteorological Organization (WMO) and the United Nations Environment Program (UNEP), the IPCC is an intergovernmental body that evaluates the scientific, technical and socio-economic information published in scientific journals, related to the issue of climate change. Its objective is to consider adaptation and mitigation strategies, based on an understanding of the scientific underpinnings of man-made climate change.

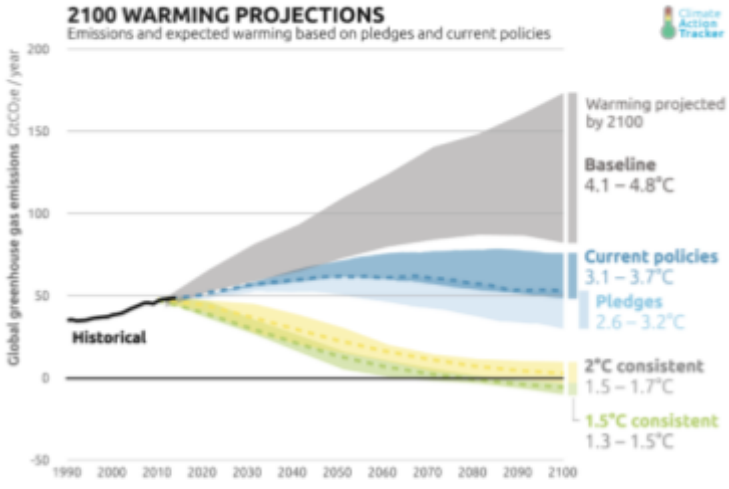


Figure 10 : Example of climate projections depending on different scenarios

Source : Climate Action Tracker

e. Mitigation of climate change and Adaptation to climate change

Mitigation and adaptation, these two components of the fight against climate change have often been treated independently of one another.

At first glance, in fact, they oppose terms of reference. One is preventive, the other curative. The necessary strategies lead one to the global management of a global public good and the other to the development of region-wide plans. One is quantifiable with a universal measure - tons of CO2 emitted or avoided - the other is based on various indicators that are difficult to compress to a universal index. One seems urgent: we must reduce emissions now avoid the worst consequences of climate change; the other seems more distant: the most serious effects will take place rather in the second half of the twenty-first century.

❑ Mitigation of climate change

According to the UNEP, Climate Change Mitigation refers to efforts to reduce or prevent emission of greenhouse gases. Mitigation can mean using new technologies and renewable energies, making older equipment more energy efficient, or changing management practices or consumer behavior. It can be as complex as a plan for a new city, or as a simple as improvements for a high-tech subway systems or bicycling paths. Mitigation is about addressing the causes of climate change by reducing greenhouse gas emissions that cause global warming. For this, two types of action are possible:

- The first type of action is to reduce the sources of emissions in the various sectors of activity, for example by substituting electric-powered cars to gas cars, by better isolating buildings to reduce their heating requirements, or by replacing electricity production from coal through the development of renewable energies.

- Second type of action: absorb CO_2 from the atmosphere by developing "carbon sinks". These can be natural, such as forest, or artificial, like the technology of "carbon capture and storage" which consists of recovering the CO_2 emitted in large quantities by heavy industries and storing it underground.

The climate change mitigation requires all countries, keeping in mind their responsibilities and capabilities, to formulate and implement programmes containing measures to mitigate climate change. Such programmes target economic activity with an aim to incentivize actions that are cleaner or disincentive those that result in large amounts of GHGs. They include policies, incentives schemes and investment programmes which address all sectors, including energy generation and use, transport, buildings, industry, agriculture, forestry and other land use, and waste management. Mitigation measures are translated in, for example, an increased use of renewable energy, the application of new technologies such as electric cars, or changes in practices or behaviours, such as driving less or changing one's diet. Further, they include expanding forests and other sinks to remove greater amounts of CO_2 from the atmosphere, or simply making improvements to a cookstove design.

❑ Adaptation to climate change

Climate change exposes economies, societies and ecosystems to serious and very diverse risks. These risks include damage to coastal infrastructure, the evolution of infectious diseases or the degradation of food security. Adapting to the adverse effects of climate change is, along with mitigation, a major area of action for all the countries. The world is already experiencing changes in mean temperature, shifts in the seasons, and an increasing frequency of extreme weather events. These are set to continue, for the global climate system has great inertia. Adaptation is therefore essential.

Based on the prediction of climate change in the future, countries all over the world identify the fields that will have got particularly big impacts or have high priority for implementing adaptation measures. They also estimate the damages from climate change and costs of these adaptation measures. These adaptation measures differ depending on the country and region, such as constructing levees to protect the land from storm surges caused by sea level rise, and taking measures against the heat-induced damage to agricultural products.

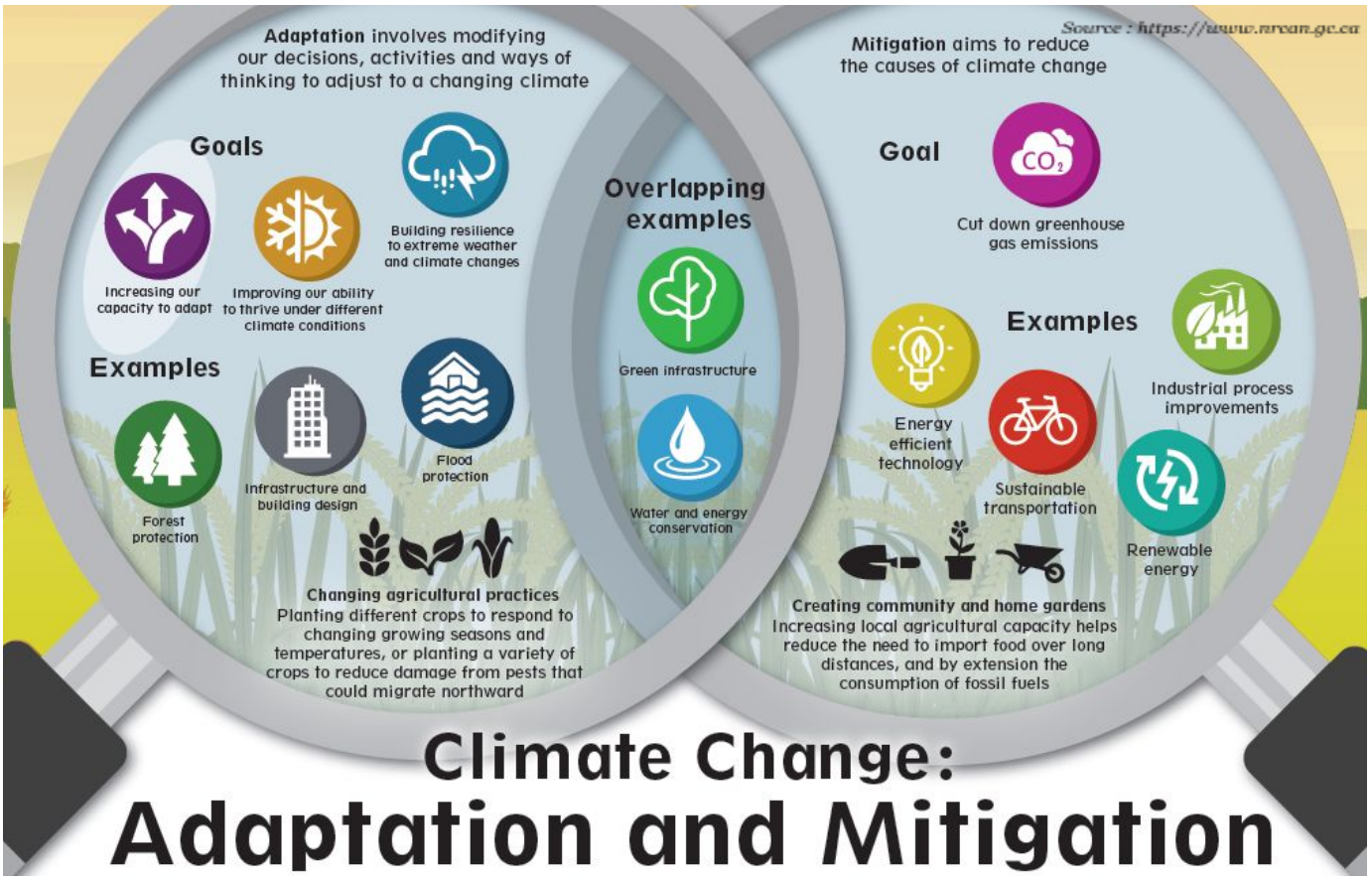
The Paris Agreement aims to strengthen the global climate change response by increasing the ability of all to adapt to adverse impacts of climate change and foster climate resilience. It defines a global goal on adaptation – the goal is :

- to enhance adaptive capacity and resilience;
- to reduce vulnerability, with a view to contributing to sustainable development;
- to ensure an adequate adaptation response in the context of the goal of holding average global warming well below 2 degrees C and pursuing efforts to hold it below 1.5 degrees C.

For example, UK launched an adaptation program in 2012, and is taking adaptation measures such as for flood risk management, water resources, freshwater ecology, as the high-priority areas. In the improvement project at the Thames Estuary, the Thames Barrier which expands 18 km has been installed to protect the lowlands from flooding. The gates are closed about 10 times a year during storm surges to prevent flooding.

Figure 11 : The Thames Barrier
Source : Totally Thames (Website)

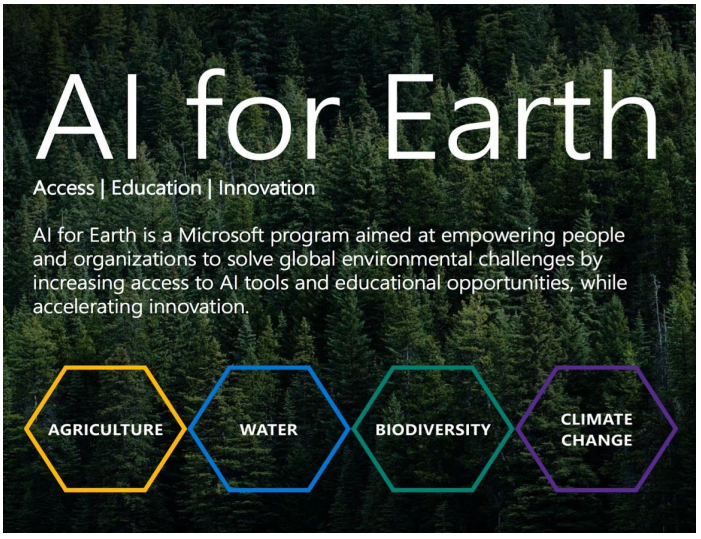
❑ The Big Challenge of the mitigation and the adaptation



3. Case studies

a. First case study : AI for Earth / Microsoft

Microsoft has stepped forward in bringing Artificial Intelligence into application. At an Artificial Intelligence (AI) event, recently, Microsoft has announced it AI initiative called AI for Earth. As technology is developing, it is causing huge damage to the environment. Addressing this issue, Microsoft is going to implement AI for sustainability. AI for Earth is using AI technology and cloud computing to solve the world's most challenging environmental issues. AI can help in areas like: Climate resilience, Extreme weather and climate modeling, Sustainable land-use change, Ecosystem services (including carbon sequestration). As part of the AI for Earth project, Microsoft support projects on the front lines of sustainability. For example, the **Terrafuse** project, Terrafuse uses machine learning algorithms to create sophisticated climate-risk models. In partnership with Microsoft, Terrafuse is combining historical data, existing wildfire simulations, and real-time satellite observations to create hyperlocal models of wildfire risk.

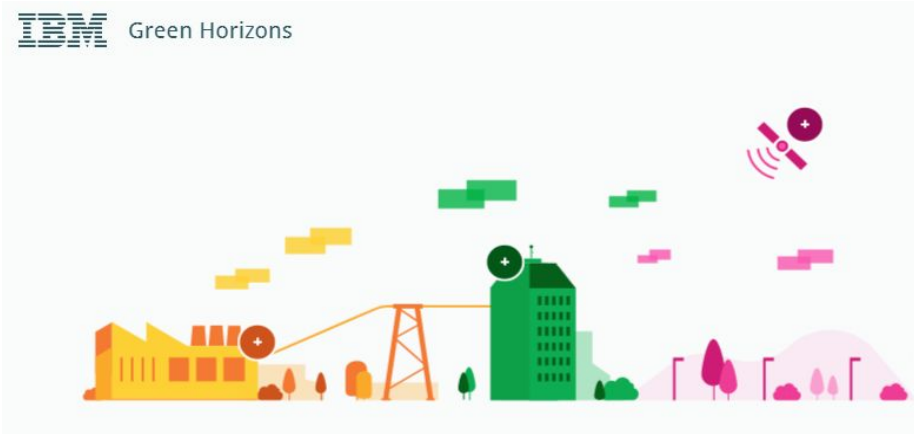


For more information check out this link : Link 1

The part below is extracted from the Microsoft Website, you can consult the link above.

b. Second case study : Green Horizons / IBM

IBM combines the power of the Internet of Things, Big Data processing and Artificial Intelligence to analyze environmental data from thousands of sources and create accurate, self-configuring weather and pollution forecasts. This allows city planners and utilities to model a cleaner and more sustainable future. Green Horizons is a global initiative to help improve humanity's relationship with the environment, supporting cleaner air and increasing the use of renewable energy. This project touches on 4 particular domains :



- **Environment**
  With increasing levels of car ownership worldwide, vehicle emissions are a growing problem in cities. Reducing traffic is politically sensitive and can be inconvenient for citizens. Artificial Intelligence can help to model different scenarios for restricting traffic so that city officials can calculate the potential gains in air quality.

- **Traffic**
  Weather is the most significant factor in daily pollution levels. Artificial Intelligence allows IBM to produce accurate weather forecasts, and to model the impact on pollution levels, civic happiness and economic output by switching to renewable such as solar. Long-term reductions in traffic pollution rely on better vehicle technology and provision of alternate transport infrastructure.

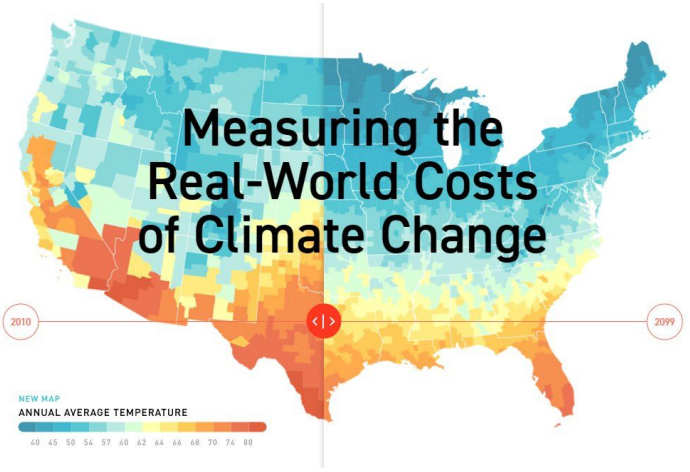
- **Industry**
  The industry is one of the biggest causes of air pollution and lowers life expectancy in heavily industrialized areas. The sector comprises millions of small and large producers and is hard to monitor and regulate. Factories can undertake a range of measures to go green including; increasing energy efficiency by monitoring and modernizing equipment; generating their own renewable energy; and reusing and recycling materials where possible.

- **Power Generation**
  Power generation is the largest global source of pollutants and emissions. Using renewable energy forecasting systems, utilities can accurately forecast the output of wind and solar plants enabling, more renewable energy to be incorporated into the grid.

For more information check out this link : Link 2
The part below is extracted from the IBM Website, you can consult the link above.

c. Third case study : Climate Impact Lab

The Climate Impact Lab's team of economists, climate scientists, data engineers, and risk analysts are building the world's most comprehensive body of research quantifying the impacts of climate change sector-by-sector,community-by-community around the world. This research will allow decision-makers in the public and private sectors to understand the risks climate change presents and mitigate those risks through smarter investments and public policy. The research will also produce the world's first derived estimate of the social cost of carbon — the cost to society from each ton of carbon dioxide emitted.



Combining local climate projections with historical observations yields a highly localized picture of future climate impacts. Cutting-edge research has identified ways in which changes to climatic conditions – such as abnormally warm summers – reduce economic activity, damage food production systems, increase social conflict, and generate migrants. The Lab employs detailed, risk-based, probabilistic, local climate projections to analyze how these impacts may evolve in the years ahead as a result of a changing climate.

For more information, check out this link : Link 3

The part below is extracted from the Climate Impacts Lab Website, you can consult the link above.

4. Possible solutions

The possible solutions proposed here represent only a small part of all the solutions offered by AI to respond to climate change, in no way can this list be considered exhaustive.

Optimizing Transportation

Many areas of transportation lack data, and decision-makers often plan infrastructure and policy based on uncertain information. In recent years, new types of sensors have become available, and the AI can provide relevant information from these data. AI methods, such as SVMs (Support Vector Machine) and neural networks, can made it easier to classify roads with similar traffic patterns and also permit to reduce the costly installation and maintenance of the As ground-based counters require costly installation and maintenance Similarly, AI methods can help with imputing missing data for precise bottom-up estimation of GHG emissions and they are also can applied in simulation models of vehicle emissions.

Electrifying vehicles is regarded as a primary means to decarbonize transport. Electric vehicle (EV) technologies rely on batteries, hydrogen fuel cells, or electrified roads and railways, and can have very low GHG emissions – assuming, of course, that the electricity is generated with mostly low-carbon generators. AI is vital for a range of different problems related to EVs : AI can improve charge scheduling, congestion management, and vehicle-to-grid algorithms. AI have also been applied to battery energy management (for example charge estimation or optimization in hybrid EVs).

Optimizing Buildings and Cities

Intelligent control systems in buildings can decrease the carbon footprint both by reducing the energy consumed and by providing means to integrate lower-carbon sources into the electricity mix . Specifically, AI can reduce energy usage by allowing devices and systems to adapt to usage patterns. Further, buildings can respond to signals from the electricity grid, providing flexibility to the grid operator and lowering costs

to the consumer.

Many regions of the world have almost no energy consumption data, which can make it difficult to design targeted mitigation strategies. AI is uniquely capable of predicting energy consumption and GHG mitigation potential at scale from other types of available data. Information about building footprint, usage, material, roof type, immediate surroundings etc. can be predictive of energy consumption.

Optimizing Industry

Industrial production, logistics, and building materials are leading causes of difficult-to-eliminate GHG emissions. AI researchers can potentially reduce global emissions by helping to streamline supply chains, improve production quality, predict machine breakdowns, optimize heating and cooling systems, and prioritize the use of clean electricity over fossil fuels

The complexity of today's globalized supply chains, defined as the processes and systems of organizations and the shipping networks that are required to bring a product from producer to final consumer, offer a huge potential to use AI. While AI can help minimize emissions by optimizing shipping routes , reducing waste, and helping firms identify local producers and suppliers, firms' financial incentives must also align with climate change mitigation through carbon pricing or other policy mechanisms. AI could reduce emissions in supply chains by intelligently predicting supply and demand, identifying lower-carbon products, and optimizing shipping routes, it can also able to mitigate issues of overproducing and/or overstocking goods by improving demand forecasting.

Optimizing Agriculture

Agriculture is responsible for 14% of GHG emissions. This might come as a surprise, since one might expect that growing plants would take up CO2 from the air. However, modern industrial agriculture

involves more than just growing plants. The current approach to agriculture is based on making farmland more uniform and predictable. This approach is often known as "precision agriculture."

The potential for precision agriculture goes beyond robots in the field. Simple macroeconomic models can help farmers predict crop demand and decide what to plant at the beginning of the season. More intelligent irrigation systems can save large amounts of water while reducing pests that thrive under excessive moisture . Overall, AI can improve crop yield prediction, disease detection, weed detection, and soil sensing.

This part is inspired from the solutions proposed in "Tackling Climate Change with Machine Learning" report , you can consult it in the Bibliography.

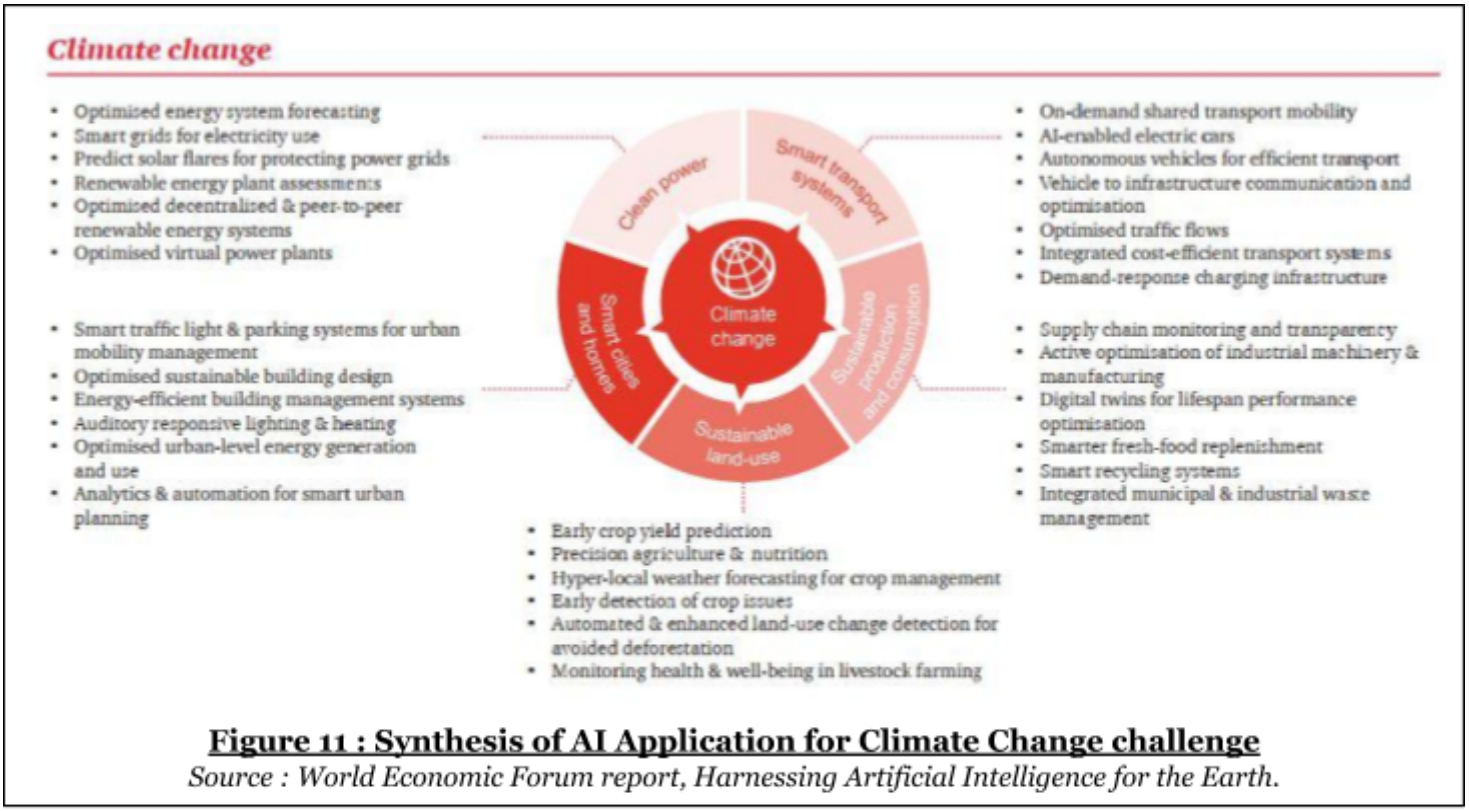


Figure 11 : Synthesis of AI Application for Climate Change challenge

Source : World Economic Forum report, Harnessing Artificial Intelligence for the Earth.

5. Main international actors

China : The world's most populated country has an enormous export market, which has seen its industry grow to become a serious danger to the planet. In fact, its CO2 emissions represents 30 % of the global CO2 emissions. China has long held high ambitions for AI. China is already a world leader in AI research. The country has published more research papers on deep learning and artificial intelligence than other leading countries in the past few years.

USA : The United States has odds as favorable as China when it comes to leading the AI race. The US has long benefited from a well-established tech culture. But with recent funding reductions for AI, increased education costs, and tightening immigration restrictions for international research professionals, the future of AI in the U.S. is looking a bit uncertain.

IPCC : The Intergovernmental Panel on Climate Change (IPCC) was established in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) to assess climate change based on the latest science. Through the IPCC, thousands of experts from around the world synthesize the most recent developments in climate science, adaptation, vulnerability, and mitigation every five to seven years. Governments request these reports through the intergovernmental process and the content is deliberately policy-relevant, but steers clear of any policy-prescriptive statements.

European Union : The European Union has taken many climate-related initiatives since 1991, when it issued the first Community strategy to limit carbon dioxide (CO 2) emissions and improve energy efficiency. The EU adopted an european adaptation strategy in April 2013 which has been welcomed by the Member States. Due to the varying severity and nature of climate impacts between regions in Europe, most adaptation initiatives will be taken at the regional or local levels, by using new tools, new technologies such as AI.

6. Guidelines for research

- How does AI help to respond more effectively to climatic changes than pre-existent technologies?
- How to increase the use of AI in developing countries?
- How to generalize and promote the use of AI to respond to climate issues?
- How to ensure cooperation between countries, developing and developed , to have a global impact and not only local through AI?

In order to prepare you in the best possible way, I invite you to use in your searches the various articles, websites and documents of the Bibliography/ Sitography but also to view these two videos, presenting two conferences related to our theme :

- *Conference 1*
- *Conference 2*

7. Bibliography / Sitography

❑ Articles

- ***AI - A game changer for Climate Change and the Environment***

https://blogs.ei.columbia.edu/2018/06/05/artificial-intelligence-climate-environment/

- ***AI could better predict climate change impacts, some experts believe***

https://www.cbc.ca/news/technology/ai-climate-change-1.5206402

- ***Here's how AI can help fight climate change according to the field's top thinkers***

https://www.theverge.com/2019/6/25/18744034/ai-artificial-intelligence-ml-climate-change-fight

- ***The Amazing Ways We Can Use AI To Tackle Climate Change***

http://bernardmarr.com/default.asp?contentID=1360

❑ WebSites

- ***UNenvironment (UNEP)***

https://www.unenvironment.org/explore-topics/climate-change

- ***IPCC (Intergovernmental Panel on Climate Change)***

https://www.ipcc.ch/

- ***UNFCCC (United Nations Framework Convention on Climate Change)***

https://unfccc.int/fr

- ***CLIMATE NASA (National Aeronautics and Space Administration)***

https://climate.nasa.gov/

- ***NOAA Climate (National Oceanic and Atmospheric Administration | U.S.)***

https://www.climate.gov/

- ***EPA (United States Environmental Protection Agency / U.S.)***

https://www.epa.gov/climate-indicators/

- ***UNDP (United Nations Development Programme / Climate Change Adaptation***

https://www.adaptation-undp.org/

❑ Documents / Official Reports

- ***IPCC / Glossary of Climate Change Terms***

https://www.ipcc.ch/site/assets/uploads/2019/01/SYRAR5-Glossary_en.pdf

- ***IPCC / Climate Change 2014 / Mitigation of Climate Change***

https://digital.library.unt.edu/ark:/67531/metadc950314/m2/1/high_res_d/WGIIIAR5_SPM_TS_Volum

- ***UNenvironment /Sixth Edition of the Global Environment Outlook Report***

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- ***UNFCCC / Climate changes : Impacts, Vulnerabilities and Adaptation in dev countries***

https://unfccc.int/resource/docs/publications/impacts.pdf

- ***UNFCCC / Example Resolution about Climate Change***

https://unfccc.int/resource/docs/convkp/conveng.pdf

- ***WMO / Introduction to climate change***

https://library.wmo.int/pmb_ged/wmo_926e.pdf

- ***WMO / Statement on the State of the Global Climate in 2018***

https://library.wmo.int/doc_num.php?explnum_id=5789

- ***WEF / Harnessing Artificial Intelligence for the Earth report 2018***

http://www3.weforum.org/docs/Harnessing_Artificial_Intelligence_for_the_Earth_report_2018.

- ***Tackling Climate Change with Machine Learning***

https://arxiv.org/pdf/1906.05433.pdf