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Air Pollution: Sources and Global Statistics

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Abstract

It has become clear that since even as early as the end of the 16th century the air pollution problem and the scale and seriousness of impacts of air pollution on health that have been detected by scientific investigations over the past decade are the subject of media reports and policy debate throughout Europe. It affects the health of human beings and animals, damages vegetation, soils and deteriorates materials, and generally concerns not only the large metropolitan areas but also the medium-size urban areas. Any kind or form of substances, noise or radiation found in the atmosphere in such a quantity, concentration or duration capable of causing harm in human health, living organisms and ecosystems. Obliviously, air quality creates a significant problem in Europe, especially in some densely populated urban areas and during certain weather conditions. Taking under consideration the serious impact of the air pollution on our society in this paper, firstly we try to define the term of air pollution. Mostly, statistical analysis of data need in order to provide the causes of the increasing rate of air pollution, under the view point of an historical analysis through to facts. In that, terms we focus to investigate the relation of increased level of technology and the increased level of air pollution percentages. By understanding the reasons behind the increase of air polluting substances in the atmosphere, we may have better chances of solving the problem in the future.

Keywords

Air pollution; Natural Sources; Human Sources; Industries; Transportation;

Introduction

Air pollution is called the presence of any kind or form of substances, noise or radiation found in the atmosphere in such a quantity, concentration or duration capable of causing harm in human health, living organisms and ecosystems [1], [2], [3].

The air pollution primarily results from:

- Natural processes (volcanic eruptions, seismic activities, geothermal activities, wild-land fires, high wind events or the atmospheric resuspension or transport of natural particles from dry regions)
- Human activity, which includes three major sources:
  - ✓ Industry pollution
  - ✓ Traffic pollution (air exhaust, brake and tire wear, dust resuspension from roads, air and sea traffic)
  - ✓ House heating

Natural Sources

In contrast to the common belief, the biggest margin of air pollution comes mostly from natural sources. With the term “natural sources” we are referring to the sources that are not connected with human activities. Still, emissions from these activities are held accountable for the great environmental problems that have surfaced. This is due to the upset of the natural balance and due to the high density of human activities’ emissions, which are located in small geographical zones (mostly in cities and industrial zones). On the other hand, the great dispersion of natural sources around the globe offers the opportunity for better mixture between the pollution and clean air. As a conclusion, with some minor exceptions, the gas emissions from natural sources alone do not result in high concentrations [4]

Analytically:

- Volcanic activities - volcanic eruptions emit a series of toxic gases (including sulfur and chlorine) as well as particles (ash particles) but are usually limited to local areas.
- Winds and air currents - can mobilize pollutants from the ground and transport them to large areas.
- Destruction - addition of carbon monoxide and particulates to the atmosphere (containing organic contaminants such as polycyclic aromatic hydrocarbons); they
-

- could affect important areas, although they are generally limited and may be restricted.
- Microbial decomposition processes - microorganisms present in any environment have a major role in the natural processes of decomposition of living organisms and environmental contaminants.
- Radioactive decay processes - for example, radon gas is emitted due to natural earthquake degradation processes, which are capable of accumulation in enclosed spaces such as underground
- Increased temperatures - help increase the amount of pollutants flowing from contaminated soil and water into the air

The oceans come as the second biggest source of “natural” pollution. Benthic and phytoplankton organisms lead to the production of massive quantities of Sulphur compounds. Furthermore, the waves’ mechanism causes the erosion of rocks and thus the production of particles, with such a size, capable of levitating in the atmosphere. Lastly, the wind drifts away hydro drops, which contain salts, becoming this way a constant source of atmospheric suspensions (aerosol). Moreover, suspensions such that are produced from the effect of the wind on the ground and the elements found on its surface

The combustion of biomass consists another great source of “natural” pollution. The above term contains the extended wildfires which occure and are not related to human activity. These wildfires are commonplace during summer periods due to high temperatures or due to lightning strikes. Lastly, speaking of natural sources, it is impossible to exclude volcanoes. The eruption of a volcano produces large quantities of levitating particles and , also , gases such as sulphur dioxide, methane and hydrogen sulphide.

Human Sources

There are 3 main categories of human pollution sources: a) Industrial activity (including the energy production sector) b) Transportation c) Central heating

a) Industries:

Industries constitute the biggest source of air pollution as it’s largest part is made of energy production sections. The large quantities of fossil fuels which are being used result in the production of equally great quantities of sulphur dioxide and nitrogen oxides. It is also the main source of heavy metals in a percentage off nearly 100%. [6]

b) Transportation:

Car use is the single greatest contribution a civilian can make in polluting the area. Despite the small contribution of every car solely, the pollution produced out of all of them consists the biggest threat of air quality in large cities especially in old cars. The energy needed to move the car come from the fuel combustion in the engine. The pollution comes not only from the combustion products (emitted through the exhaust) but also, from the vaporization of the fuel. Petrol and diesel are hydrocarbon mixtures, compounds that include hydrogen and carbon atoms. During the combustion in a perfect machine, oxygen would have to convert hydrogen into water and carbon into carbon dioxide. Nitrogen would not be affected. This can be represented as following:

FUEL (hydrocarbons) + AIR(oxygen and nitrogen)➔ CARBON DIOXIDE + WATER+ nitrogen+ heat

From the other hand, though, things are different. The combustion inside the car's engine is not perfect and as a result, harmful gases are emitted through its exhaust (mostly hydrocarbons and carbon monoxide). Additionally, due to high pressure and temperature rates which are developed inside the engine, oxygen and nitrogen from the air react, producing nitrogen oxides. In a typical occasion:

FUEL(hydrocarbons) + AIR(oxygen and nitrogen)➔ CARBON DIOXIDE + water + UNBURNT HYDROCARBONS + NITROGEN OXIDES + CARBON MONOXIDE + heat

(It should be mentioned that diesel engine combustions are more complete than those of petrol engines and so the emission of hydrocarbons and carbon monoxides are less. On the other hand, diesel engines have a greater contribution in particle emission and in scents)[10]

Hydrocarbons and nitrogen oxides emitted by cars , with the presence of sun radiation, form the ozone, maybe the most dangerous element of a city's smog. Adding to that, carbon dioxide, though not harmful for the health it is the most important greenhouse gas with a large contribution in the worldwide climate change.

c) Heating:

The contribution of heating in the air pollution problems is dependent on every season and has to do with the production of smoke, Sulphur dioxide and, in a smaller percentage, nitrogen oxides. Even though the pollution produced annually from central heating, consists a small percentage compared with the pollution by the other two sources, Sulphur dioxide, is the indicator for the function of central heating in large cities [9]. Another important finding are the very low chimneys which fail to spread the harmful gases in the broader area and therefore many advanced local problems can be created. The problem, however, is steadily

being improved due to the use better quality fuels (lower concentration of Sulphur) and due to the spread of district heating [5]. The highest pollution rates can be measured in the early morning and night hours. However, when there are adverse meteorological conditions, then the concentration of the emitted Sulphur dioxide that have caused, leads in the formation of smog.

The source of every harmful gas is:

- Sulphur Dioxide (SO_2): Industries (refinerys, energy production areas, etc.)
- Carbon Monoxide(CO): Transportation (imperfect combustion in patrol cars)
- Nitrogen Monoxides(NOx): Transportation (fuel)
- Ozone(O_3): Transportation
- Levitating Particles: Industries (Cement, plaster production)
- Lead(Pb): Transportation

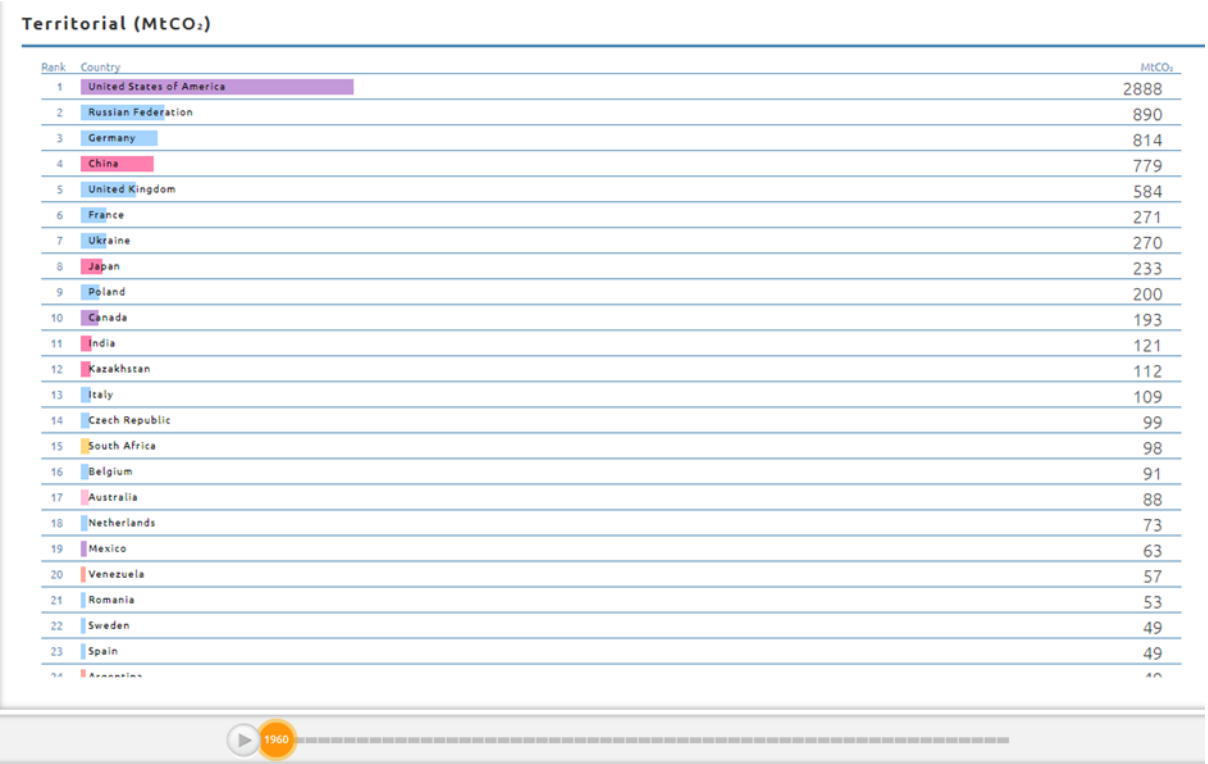
Particles can either be directly emitted into the air (primary PM) or be formed in the atmosphere from gaseous precursors such as sulfur dioxide, oxides of nitrogen, ammonia and non-methane volatile organic compounds (secondary particles). Primary PM and the precursor gases can have both man-made (anthropogenic) and natural (non-anthropogenic) sources. The WHO Environment and Health Information System (ENHIS), which is based to a large extent on data submitted by European Union (EU) member states to the European Environment Agency Airbase, includes PM_{10} monitoring data from urban and suburban background locations

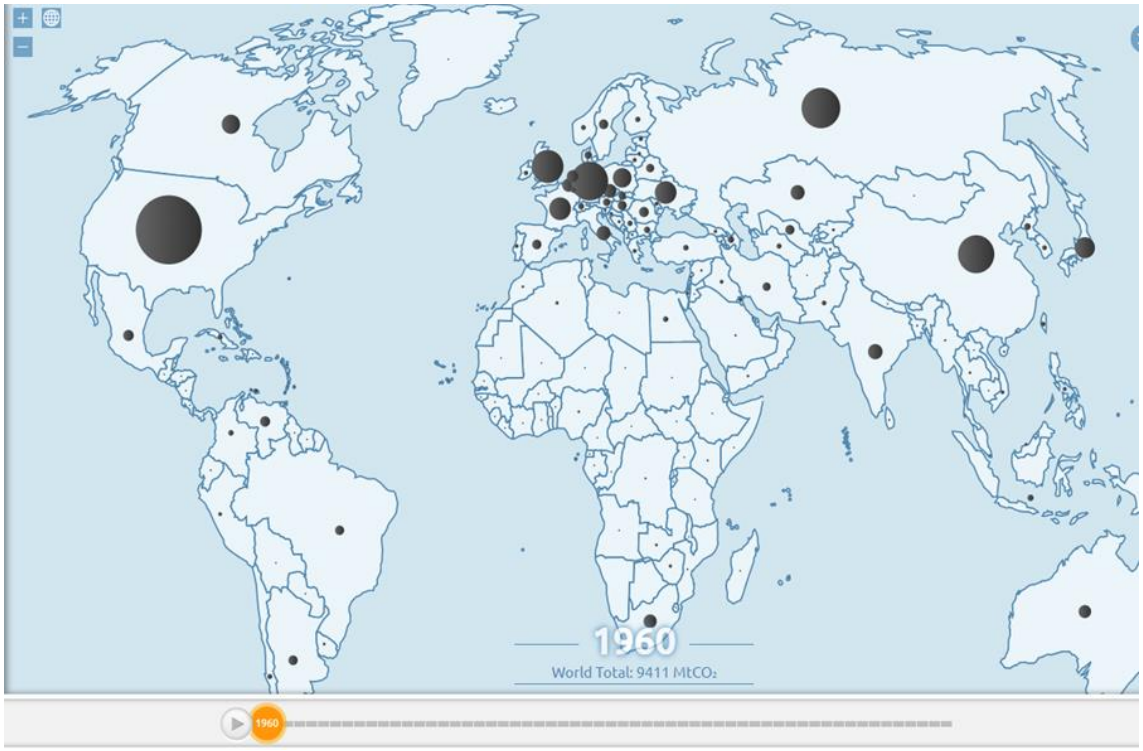
Methodology

The hypotheses of our research is the rabidly increased of technology is a basic factor that cause the air pollution. Additionally we will try to investigate the rate of increased the pollution of countries in order to provide relations with airpollution. The methodological analysis that we followed based on available data recourse of the Global Carbon Atlas [7] , that it is a platform to explore and visualize the most up-to-date data on carbon fluxes resulting from human activities and natural processes. The 1959-2014 estimates for fossil fuels and industry are from Boden et al. (2017) [8]. Where available (42 countries) the national estimates reported to the UNFCCC (2018) [9] during 1990-2016 are used instead of CDIAC data [10]. The 2015, 2016 and 2017 estimates (or just 2017 where UNFCCC data are available) are preliminary and based on energy statistics published by BP (2018) [11].The comparison of data added by facts held during the dacades in order to provide results.

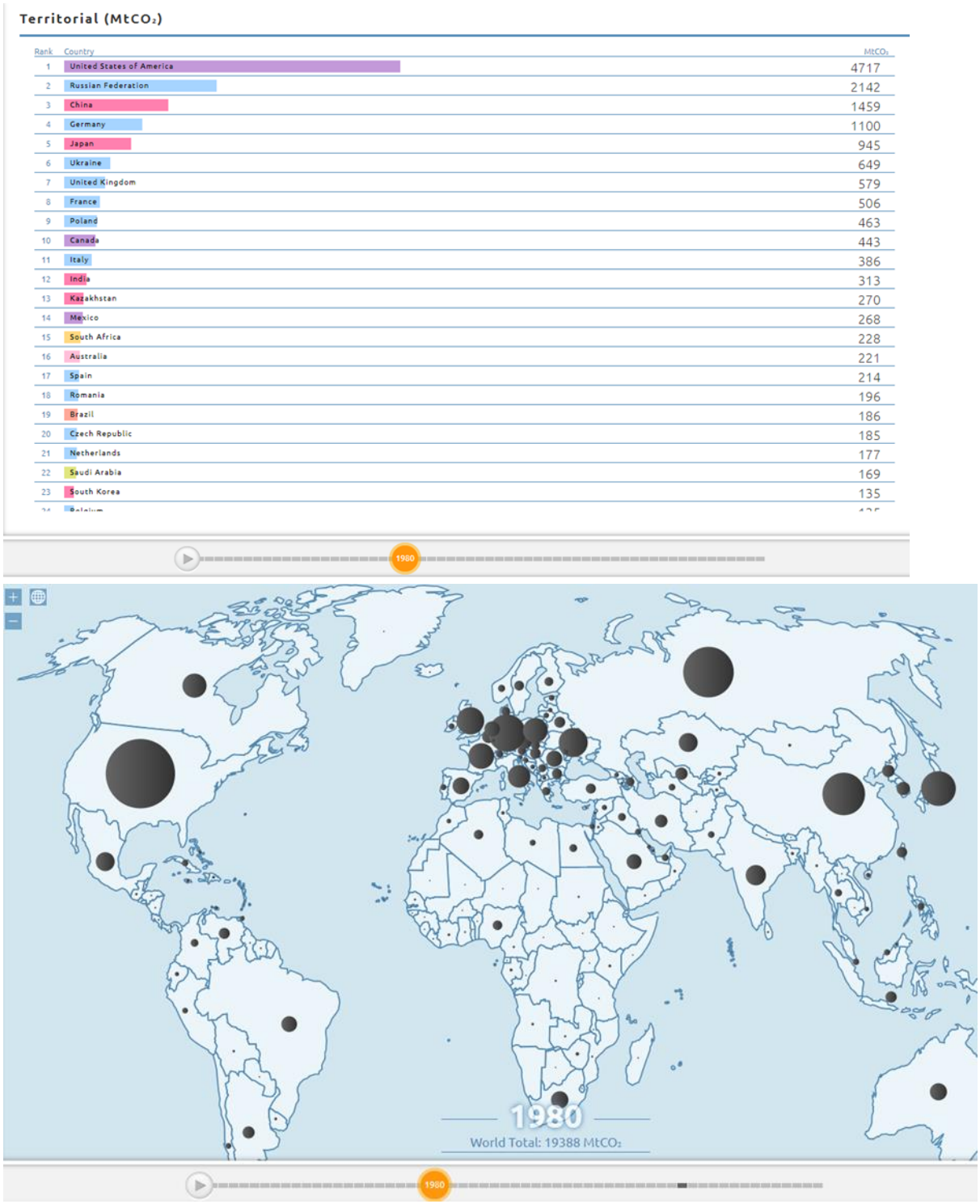
Statistical Analysis and Interpretation of Results

1960: The Second World War has devastated the planet and the results are obvious. The sovereign countries that have participated in it seem to be the ones with the highest levels of pollution rates on the planet as powerful industrial forces, which explains their prominent position both pre-war and post-war. At the same time, we notice that the United States of America accounts for about 25% of global CO2 emissions, probably due to the country's rapid growth at that time, both in technology and industry.



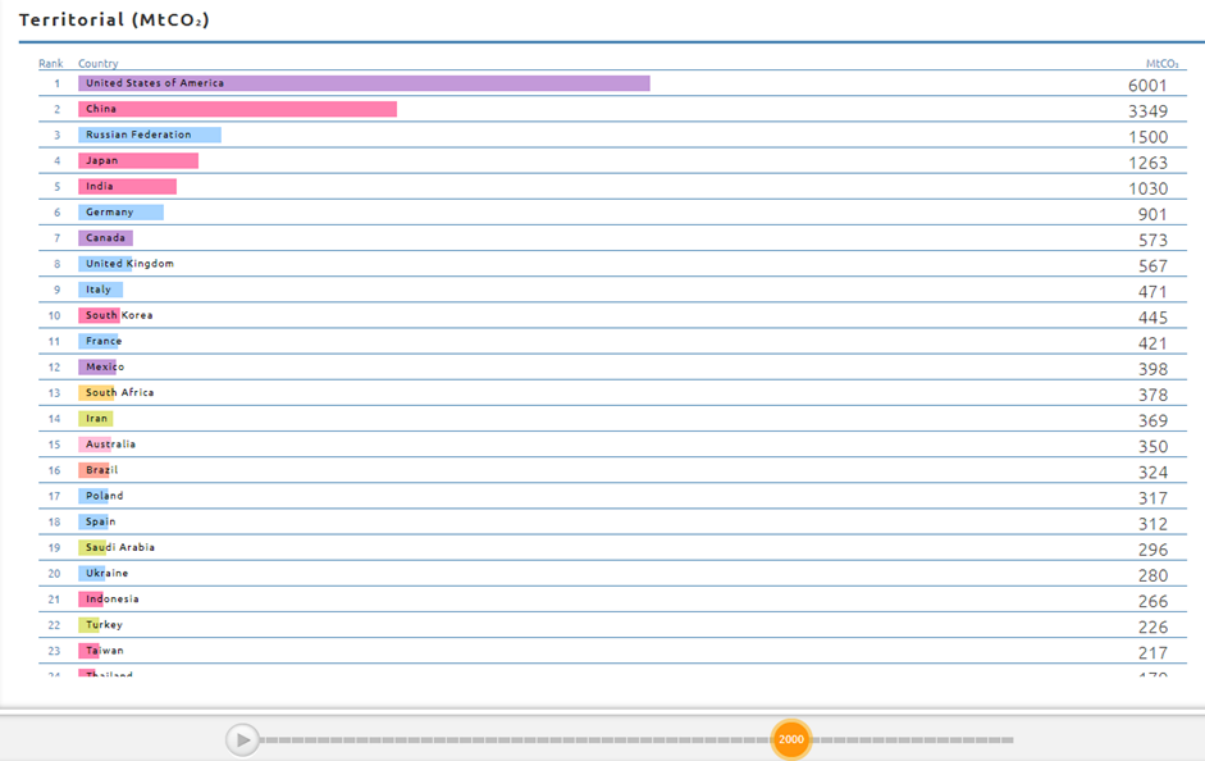


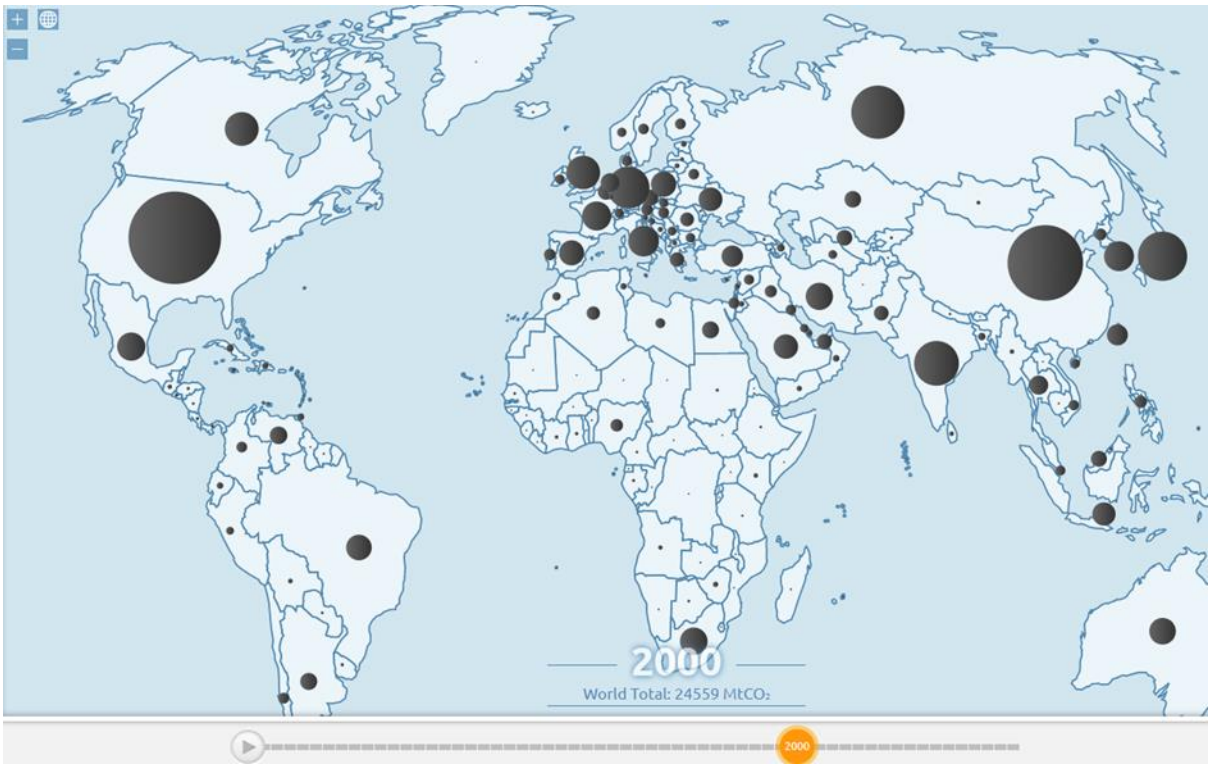
1980: The main feature of the 20-year period in terms of carbon dioxide emissions is the doubling of global emissions. Probable reasons for this increase are the increase in the world's population (from 3 billion -> 4.5 billion), which has led to the need to produce more goods (and faster) and the increase in the circulation of petrol cars on the streets . The reigns are still held by the United States, while we see that China is gradually rising to the top.



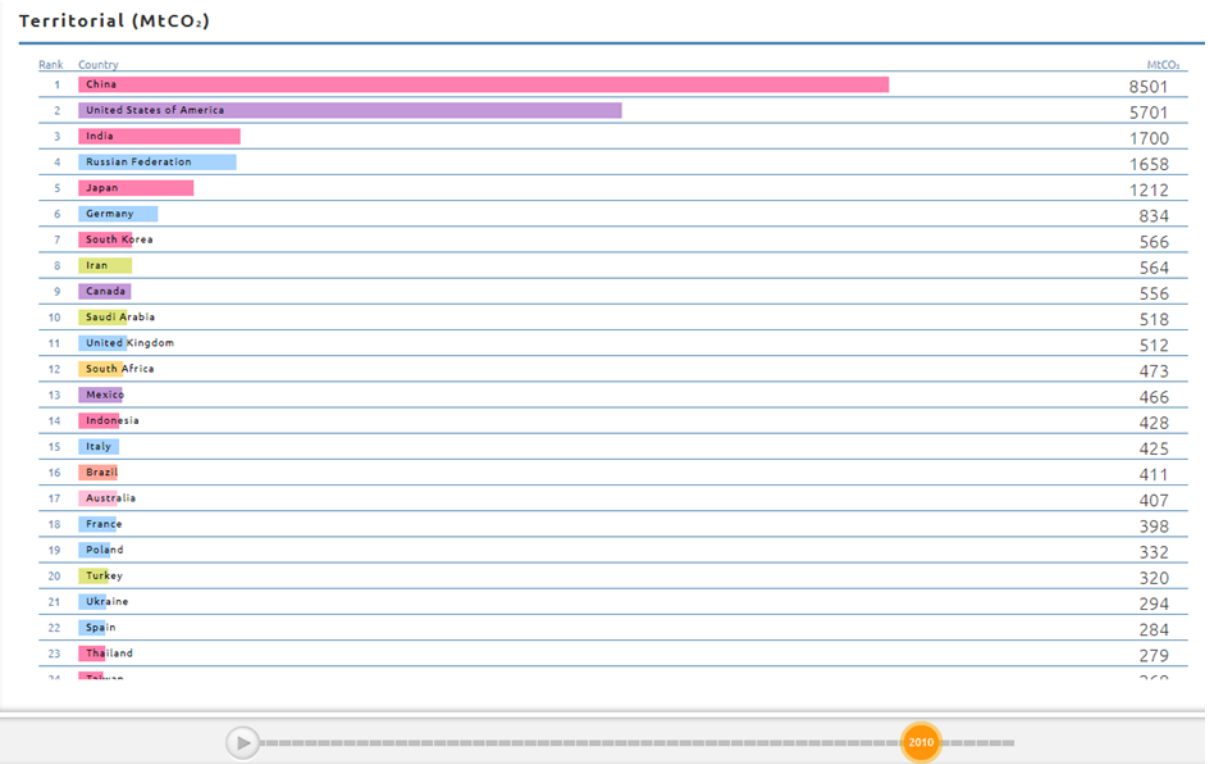
2000: We see that the increase in global pollutant emissions has fallen over the previous 20 years, although population growth remains stable (4.5bp -> 6bp). Probably the realization of the impact of pollutants on the scientific community and the development of technology has

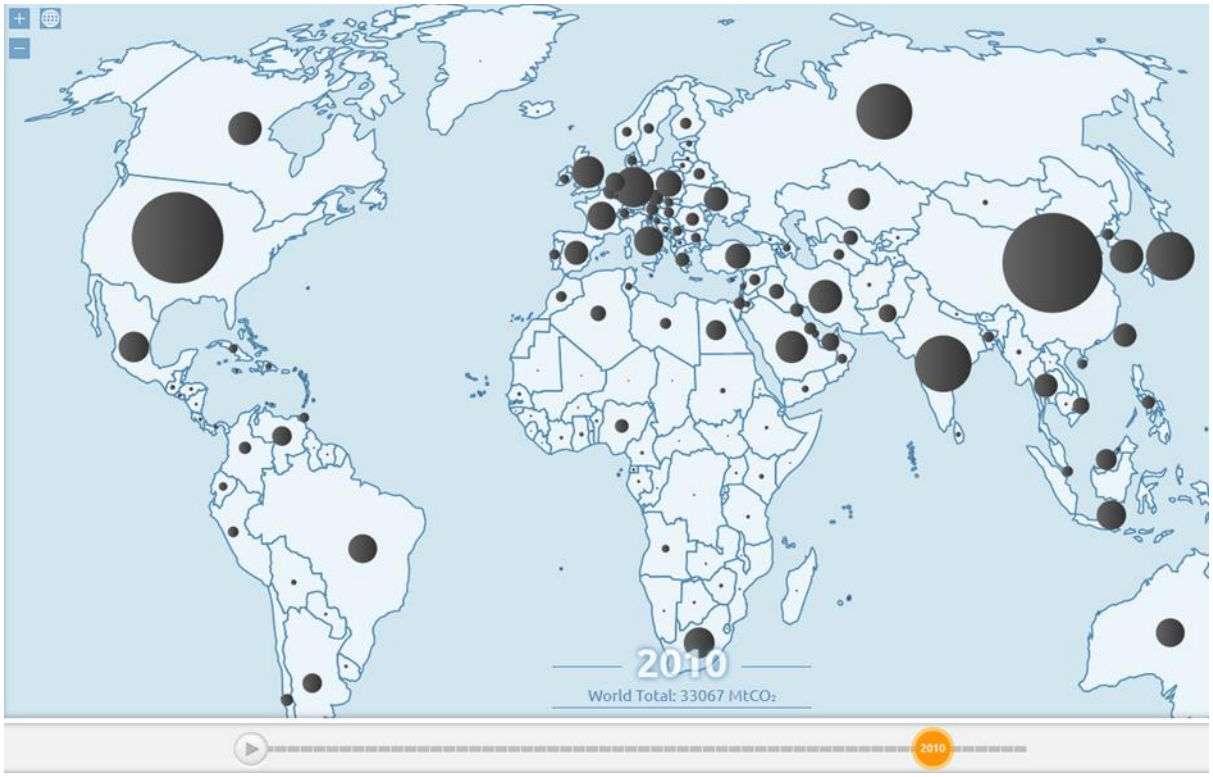
led to the creation of more environmentally friendly and to improving the existing technologies aimed at reducing the production of pollutants.



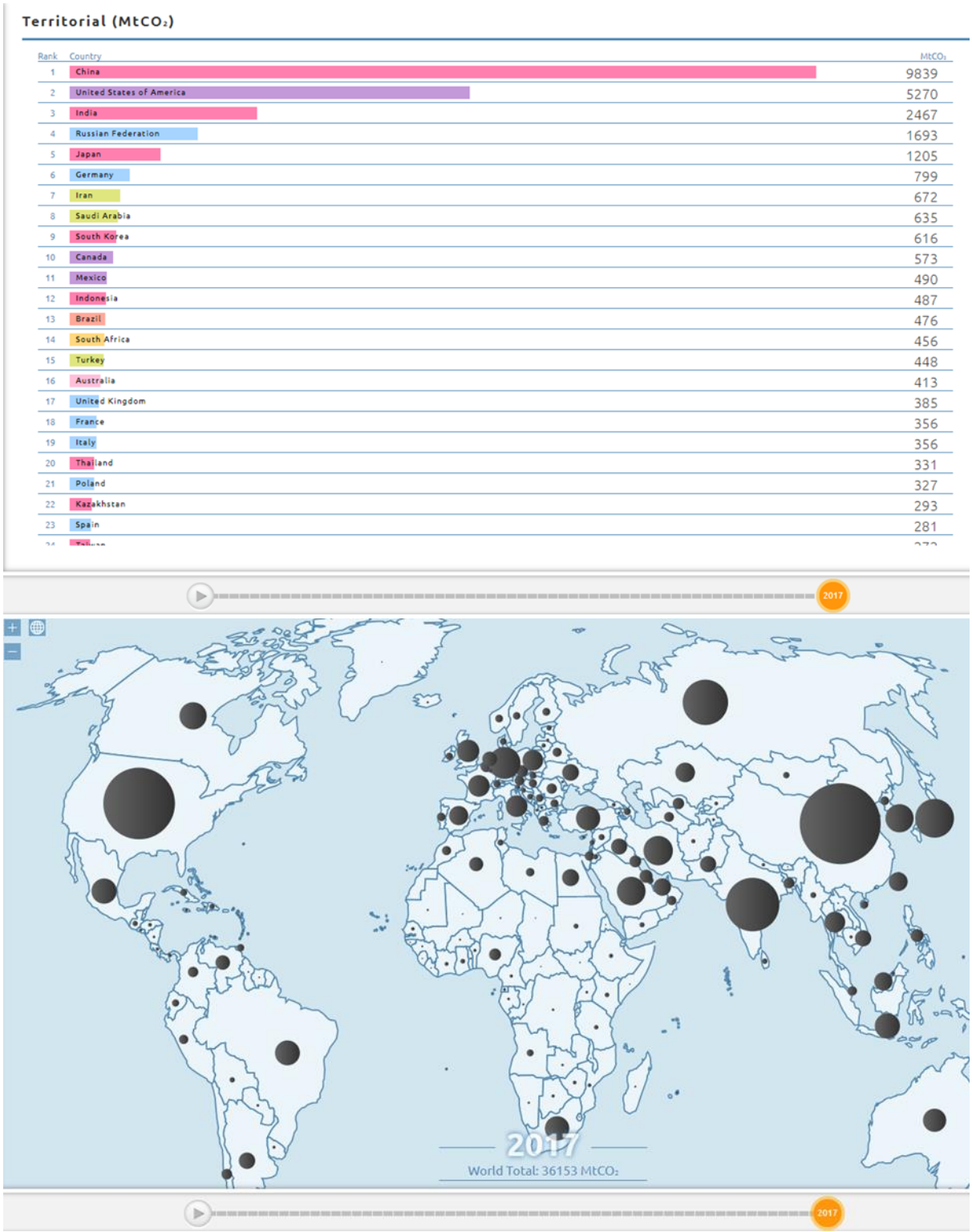


2010: The pollutants rates of industries are as similar with the period 1960-1980. The intensification of the consumerism phenomenon has led to a greater need for material goods, coupled with the technological development of the 21st century, leading to an acceleration of industrial production. In addition, the revolution of increase in pollutants emitted by China results from the transfer of the industry to countries with cheap labor.





2017: The development of 21st century technology seems to have positive effects on the environment. Although the population has grown to 7.5 billion and the use of machines is constantly increasing, environmentally friendly technologies have resulted in lower polluting rates. The fact that pollutant rates in developed countries (e.g. the USA) are gradually decreasing, while growing in the least developed (e.g. India), show more strongly the transfer of industry to the tertiary countries.


Territorial (MtCO₂)
Rank Country MtCO₂
1 China 9839
2 United States of America 5270
3 India 2467
4 Russian Federation 1693
5 Japan 1205
6 Germany 799
7 Iran 672
8 Saudi Arabia 635
9 South Korea 616
10 Canada 573
11 Mexico 490
12 Indonesia 487
13 Brazil 476
14 South Africa 456
15 Turkey 448
16 Australia 413
17 United Kingdom 385
18 France 356
19 Italy 356
20 Thailand 331
21 Poland 327
22 Kazakhstan 293
23 Spain 281
2017
2017
World Total: 36153 MtCO₂
2017

Conclusion

Taking into account the developments in technology, industry and human activity development, it is perfectly reasonable to assume that the pollution levels present in the atmosphere nowadays will be much higher than decades ago. To begin with, one of the reasons for this increase could be population growth (3 billion in 1960- 7 billion in 2018).

Greater population means greater need for land and food, which leads to machine use and hence to higher harmful emissions. However, the increase in pollution emitted by human organisms is not considered quite remarkable in relation to other factors.

In addition, the lifestyle of a modern human differs a lot from a human's everyday life in the 70's. The amount of energy they consume is significantly higher as they have more material needs. This has contributed to the arise of the phenomenon of consumerism. Technology has a double role for our life and our hypotheses rejected in some cases. Though the positive advances in technology and its contribution to humanity are indisputable, we cannot omit its impact on the environment. However, both the increase of vehicles on the road and deforestation, in order for factories and industries to be created, are equally important factors leading to pollution.

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