SDG 3
Ensure healthy lives and promote well-being for all at all ages

SDG 13
Take urgent action to combat climate change and its impacts

DIRECT IMPACT OF CLIMATE CHANGE ON HUMAN HEALTH

Why?

Typically, researchers are focused on discussing the effects of climate change on animals and the environment. However, it is less common to address its direct impact on **human health,** at least in terms of disease evolution.

Climate change increases diverse risks worldwide. Rising sea levels increase the number of coastal floods, [1] with nearly 39% living within 100 kilometers of shorelines. Reducing emissions can slow this trend. Urban areas, especially with concrete, suffer severe flooding and property damage from overwhelmed drainage systems.
Extreme weather disrupts food access, impacting vulnerable populations. Climate change acts also as a "stress multiplier". [2] Heatwaves intensify, overcoming the human heat tolerance in hot regions. **However, climate change can also have an impact on human health**: heat-related illness, respiratory illness, and mental and psychosocial health. [3]

Emphasizing this aspect could potentially allow people to see the problem from another point of view, **increasing awareness and the reaction against climate change.**

Furthermore, knowing the specific health risks associated with climate change is possible for individuals and communities to take proactive measures to prepare for and **respond to these challenges**. From a governance perspective, in the long-term view, this knowledge will bring economic benefits through **reduced healthcare costs**, increased productivity, and improved overall well-being.

Story

The intersection of the dataset can be visualized as an interactive map of different colors.
Each color represents an **environmental indicator** (pollution, water quality, and so on) and points represent the **number of people affected by a certain disease** (selected at the beginning).
Then, a **timeline** at the bottom dynamically allows the user to analyze the passing of years. These dynamics can bring to light possible disease movements and trends..

Theme

Many things can influence the topic chosen, like the **cost of medicines** and **hospitalization**: higher costs for healthcare will increase the impact (and maybe the mortality rate) of the disease.

The **people's migrations** can influence the statistics: disease from the southern hemisphere will reach the northern one and vice-versa.

Higher **levels of pollution** can cause more respiratory disease and, at the same time, make the climate change consequences in that area harder to **generate a loop**, by strengthening some diseases.

It would be interesting to analyze better this probable loop and its effect

[1]https://www.nature.com/articles/s41467-021-27260-1
[2]https://www.metoffice.gov.uk/weather/climate-change/effects-of-climate-change
[3]https://www.who.int/news-room/fact-sheets/detail/climate-change-and-health

APPROACH

To create a visualization, all data should be collected and some procedures have to be followed:

1. Collect and categorize all data
   a. Create environmental indicator if no present
   b. Bind together similar diseases and categorize them according to the in-use convention (for example, asthma and bronchopneumonia under respiratory disease)
2. Implement the heatmap per each environmental indicator in order to see the consequences of climate change on the map
3. Implement the disease points.
   a. Based on the number of affected people, determine the size of the point (n patient per point)
   b. Assign a color for each disease category
   c. Draw points on the heatmap
4. Iterate the step 2 and the step 3 per each available year
5. Implement the bar for a dynamic information visualization

TOOLS

This study employs various **Python libraries** to visualize and analyze the relationship between environmental indicators and disease prevalence on a European map:

1. **Geopandas**: used for geospatial data manipulation, it provides the points and the border of each country and simplifies the integration of various datasets. [4][5][6]
2. **Geoplot**: is employed to create high-level, concise visualizations of geographical data. It enables the generation of choropleth maps and other spatial plots. [5]
3. **Folium**: is utilized for interactive mapping, allowing the integration of Leaflet maps within the Jupyter environment. This library enhances user interaction with the visualization. [7]
4. **Matplotlib**: is employed for additional customization and fine-tuning of visual elements. It offers a wide range of options to modify the appearance of plots and figures. [6]

DATA

Categorizing the disease data into distinct categories and then **intersecting** medical datasets with environmental ones. This analysis aims to understand if temperature fluctuations, pollution levels, or other factors correlate with **disease trends**. The data source for this investigation is **Eurostat** [8] and the **European Health Information Gateway.** [9]

The focus of this study will be on Europe, which shows significant heterogeneity as a continent, with varying behaviors and attitudes towards health and the environment among its countries.

However, it is also under consideration to expand the study globally. This expansion would enable us to **compare** the consequences of climate change across widely disparate geographic areas, highlighting disease patterns and environmental factors on a global scale.

Expected results

In recent years, there has been a **rise in the incidence of diseases**, including cancers, tumors, and allergies, and at the same time, the **environmental consequences of climate change are getting harder.**

The expectation is to identify specific illness categories closely linked to climate variations, such as respiratory diseases. However, it is important to acknowledge that other categories of diseases may also be influenced by these environmental shifts.

To explore this information, the visualization concept involves utilizing a map of the **European continent** with **two adjustable parameters: environmental indicator and disease**.

The environmental indicator will be shown as a **heatmap**, providing a visual representation of its intensity. Concurrently, the prevalence of a particular disease will be denoted by **points** on the map.

Furthermore, based on the dataset availability, a bar behind the information visualization will be present to give the user the possibility to **navigate during years** and looking to the **trends**.

USEFUL DATASETS

Eurostat

Comprehensive Eurostat dataset on Europe's environmental metrics, encompassing air quality, water, waste, energy, and land use statistics.

European Health Information Gateway

Robust repository offering EU health data, spanning demographics, diseases, healthcare systems, and public health indicators for evidence-based policymaking.

[4]https://towardsdatascience.com/the-easiest-way-to-plot-data-from-pandas-on-a-world-map-1a62962a27f3
[5]https://towardsdatascience.com/plotting-geographical-data-with-geopandas-338cc7e17e4e
[6]https://towardsdatascience.com/how-to-make-a-gif-map-using-python-geopandas-and-matplotlib-cd8827cefbc8
[7]https://towardsdatascience.com/how-to-make-stunning-interactive-maps-with-python-and-folium-in-minutes-e3aff3b0ed43
[8]https://ec.europa.eu/eurostat/web/main/data/database
[9]https://gateway.euro.who.int/en/hfa-explorer/

*Thanks to this visualization, doctors and politicians will learn **disease trends and their causes** by selecting an environmental indicator and a disease type.*

*When **new regulations** and policy will be approved, we will know that the visualization has been effective.*

User interaction

The utilization of a heatmap in tandem with points to detect diseases is a newer approach in the face of **escalating disease incidence and the escalating environmental ramifications of climate change**. This method aims to individuate specific categories of illnesses intricately linked to climate fluctuations.

The visualization concept consists of a **dynamic** map of the European continent, boasting **two adjustable parameters**: the environmental indicator and the specific disease in focus. The environmental indicator is graphically depicted as a heatmap, offering a vivid image of its intensity across regions. Simultaneously, the prevalence of a particular disease is represented by distinct points scattered across the map.

To enhance user navigation and facilitate trend analysis, a year-wise dataset is accompanied by a **navigable bar** integrated into the information visualization interface.

This approach allows researchers and healthcare professionals to **discern intricate patterns and correlations**, not only from the environmental combination, but it would be possible to look also at **geographical trends**.

This study deliberately maintains a *non-specific focus* on disease types and environmental indicators. This intentional breadth allows for the inclusion of even **unconventional combinations** of data, enabling a thorough examination of potential trends.

In a few words, the user will select two parameters and they will be able to see what happened in the last years.

DATA STRUCTURE & DATA QUALITY

The data utilized in this study have been sourced from Eurostat, the **statistical office of the European Union**, and the World Health Organization. Eurostat is tasked with disseminating **high-quality** statistical information spanning Europe, enabling comprehensive comparisons across countries and regions. Meanwhile, the medical datasets were obtained from **The Data and Digital Health Unit** (DDH) of WHO, which oversees the flagship initiative, Empowerment through Digital Health.

Eurostat conducts data validation to ensure that the provided data align with specific criteria, evaluating their plausibility. This process involves confirming whether a set of values constitutes an acceptable combination. This validation is a crucial step across all statistical domains, and the European Statistical System (ESS) is working towards more standardized validation practices to enhance data quality and workflow efficiency.

Looking deeper into the Eurostat datasets, one can appreciate their **exceptional level of detail** and the high quality of the information they provide. These datasets offer a comprehensive view of various aspects, spanning over multiple years, some even covering an impressive **range of up to 60 years**. This extensive temporal scope allows for thoroughly examining trends and patterns, providing valuable insights for in-depth analyses.

In contrast, the World Health Organization (WHO) datasets*, while undoubtedly valuable, exhibit a different characteristic. They tend to be somewhat **more sparse** in comparison to Eurostat's comprehensive offerings. This may be attributed to differences in data collection methodologies and the diverse scope of the organizations' respective mission: in Europe there is **no a unique way to collect data** among hospitals. This also means that data could not be correctly updated or the country for some political reason prefer to keep them private.

However, the WHO datasets remain a critical resource for understanding European health trends and patterns in this study, offering a unique perspective that complements the rich and detailed information provided by Eurostat.

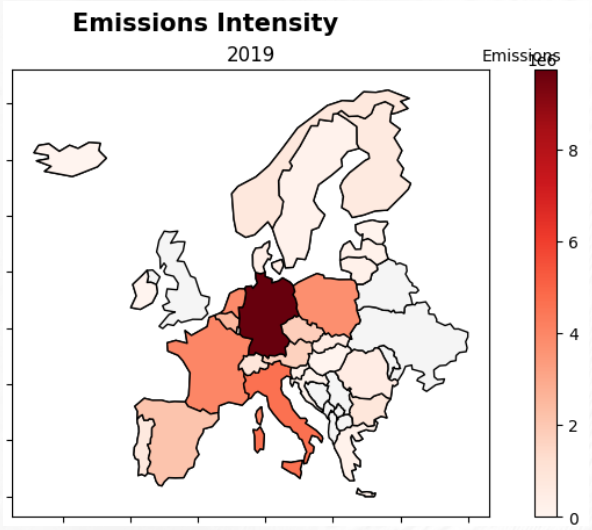
Together, these datasets form a robust foundation for comprehensive studies in the field of public health and healthcare analysis.

** Medical datasets are easier to use, thanks to the WHO API for developers. (For further information: https://gateway.euro.who.int/en/api/specification/#nav-example-11)

Time

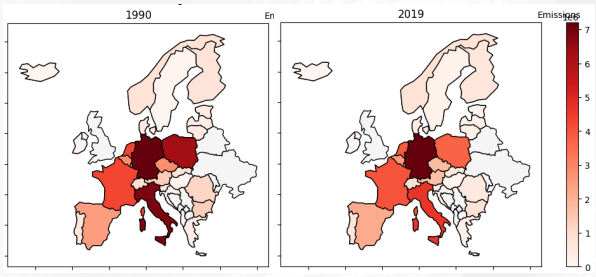
The goal of this project is to assist policymakers and decision-makers in understanding the effects of climate change on human health.
Time plays a **crucial role** in this, as we need to compare various eras, years, or even months to highlight the magnitude of the impact.

Only one image cannot properly shows the impact, in fact from the picture below, **we can only understand what happened in 2019.**



Utilizing a **minimum of two images** provides a clearer view of the differences and changes between the two inputs.

By comparing these visuals side by side, we can more effectively **discern the variations**, nuances, and shifts that might otherwise go unnoticed.



Understanding the impact of climate change over time allows us to **recognize trends, anticipate future challenges**, and implement timely interventions.

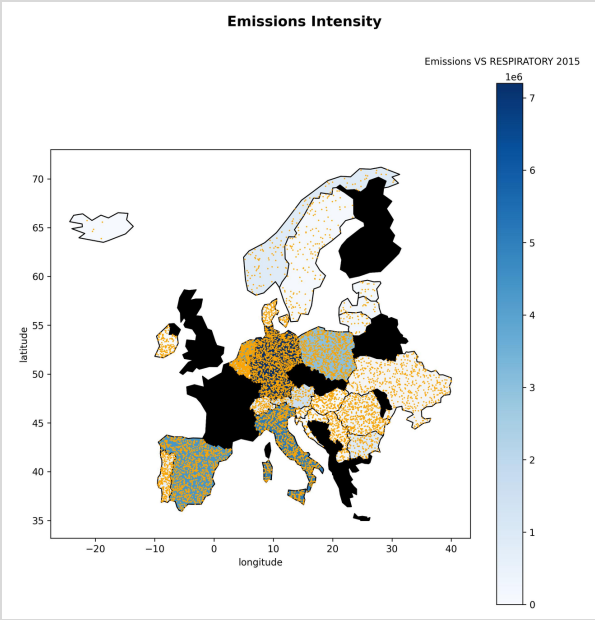
In fact, in the previous example, it is possible to notice that some countries have reduced their impacts over the years. It may not be enough, but the trend is “reducing emissions”

COMBINE MULTIPLE DATASETS

In this section, the main idea is to combine multiple datasets, in specific:

- The **environmental** dataset of Eurostat: SDG_1310IP_A_4D_2023_0000
- The **medical** dataset of WHO on respiratory disease: HSA_212_EN
- The **population** dataset of Eurostat: tps00001

Our objective is to discern patterns and shifts related to the interplay between environmental indicators and diseases.



The presented visualization draws a correlation between **environmental pollution and respiratory diseases in European countries**. The blue heatmap indicates the intensity of emissions in different countries, with darker nuances representing higher emissions. On the other hand, the orange points denote regions with reported respiratory death disease cases, with a higher density of points indicating a higher number of cases.

Notably, countries with intense blue shades tend to have a more substantial clustering of orange points. This **overlap** suggests that countries with higher pollution levels have higher instances of respiratory diseases. Such a correlation can be attributed to the **effects of pollutants on the respiratory system.** Airborne contaminants, like fine particulate matter, can penetrate deep into the lungs and cause or exacerbate respiratory problems.

Countries devoid of data, represented in black, prevent a comprehensive European analysis. However, the visible data illustrates the critical connection between environmental health and public health.