מדעי המחשב

ויזואליזציה של מידע

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קישור לפרויקט:https://bawakny.github.io/Visualization

אוניברסיטת חיפה

מדעי המחשב

Introduction

There's many researches that show and proves that global warming is a real cause of concern, but still many people don’t believe that it's true.

So in this project I try to show that the Earth's temperature is really rising and not from natural forces.

First I'll be showing that the Earth's temperature is indeed rising through the years, and then I'll show how much of Natural and Human forces affects the temperature change, and then I'll one step further and show how does the Greenhouse effect the temperature change (greenhouse gases are also included in the Human forces).

I hope that this visualization can help people see that the earth's temperature is really rising and we the humans are the cause of it, and the biggest cause for the temperature rising is the Co2 levels in the atmosphere.

The Data

I have two different data sets from the different sources:

1. Earth's temperature changes from 1850-2016:
   I've got the data from "Met Office Hadley Centre observations datasets", the data contains monthly measurements from 1850 to 2016 (~2k measurements).
2. Human and Nature factors and how they are linked to the change in the change in the Earth's temperature.
   I've got the data from a visualization I found at Bloomberg, and the data itself was measured by NASA.
   The data contains yearly measurements from 1850-2016,
   Of how much human or nature forces affected the climate change.

The Human and Nature forces contains more than one force.

- Human forces includes:
  (*) Aerosol: sulfate aerosols from coal-burning can cause the climate to cool a little, however it causes acid rain.

(*) Land use: Humans have cut, plowed and paved more than half of the earth's surface, dark forests are yielding to lighter patches which reflects more sunlight which can lead to slight cooling effect.
(*) Ozone: Natural ozone high in the atmosphere blocks harmful sunlight and cools the earths slightly, but ozone created by pollution are closer to earth and it traps heat, making the climate a little bit hotter.
(*) Greenhouse Gases: Atmospheric CO2 levels.

- Natural forces include:
  (*) Earth's orbit: the earth wobbles on its axis, and its tilt and orbit change over many thousands of years, pushing the climate into and out of the ice age.
  (*) The Sun: The Sun's temperature varies over the decades.
  (*) Volcanoes: Volcano eruptions release sulfate chemicals that can cool the atmosphere.

Example of the first Dataset:

Date	Temp
1850/01	-0.69936
1850/02	-0.281
1850/03	-0.73327
1850/04	-0.56936
1850/05	-0.327

The first dataset is quite simple, it contains two columns the first one is the date (month and year) the measurements were taken.
And the second column is the Earth's surface temperature anomalies (deg C) relative to 1961-1990.

Example of the second Dataset:

Year	Natural	Human	Greenhouse
1850	287.4466	287.429	287.417
1851	287.4602	287.4337	287.39926
1852	287.5306	287.4738	287.415606
1853	287.5197	287.4547	287.433217
1854	287.5078	287.4178	287.420589

The first column is the year the measurements were taken.
From second to the fourth column are how much each climate factor contributes to the overall temperature of the Earth's surface.

The second column – contains how much the Natural factors contributes to the overall temperature.

The third column – contains how much the Human factors contributes to the overall temperature.

The fourth column – contains how much the Greenhouse gas contributes to the overall temperature, this factor is also included in the Human forces, it has its own column just to show that it's the main factor that causes the climate change.

Visualization description

When you load the site of the visualization, the results of the Earth's temperature change are shown.
You can select what forces you want to check how they affect the Earth's temperature, the effect of the different factors is presented as the width of the running line, so if the line gets wider and the temperature rises through the years, this mean that this factor as it gets bigger the temperature rises.
And as the line gets further from the center of the circle the temperature of the Earth is getting hotter.
The color of the line represents the time period, and above the circle the number of the current year shown with the same color as the line.
It's recommended to change the factors type only after the current animation finishes, and also it's recommended to run the site on chrome.
In conclusion you're expected to see a line that starts close to center of the circle and gets further from the center as the years go by, and in case of Human/Greenhouse effects the line is expected to get wider.

Visualization Design

As I described above the first dataset contains a monthly measurements of Earth's surface temperature, and there's 12 months that are ordered and come at the same manner each year -like clockwork literally- so I represented the months as a clock (12-hour mark is December and 1-hour mark is January and so on).

The data is continuous so I thought if I mark the temperature measured from each month as point of the line between the month mark and the center of the circle and the point to as far as the temperature is- one the temperature is high the point will be further from the circle and vice versa, then in order to give a continuous feature I just connected each point with the point in front of it (next month's point).

So each full circle represents one year, and if the radius of the circle gets bigger it means that the Earth's temperature gets higher and if the circle gets smaller it means that the Earth is getting cooler.

I gave each line between two point a different color, overall I made a color transformation from green to red from start to finish, so each line gets part of the color transformation, that way you can distinguish between the years and you can see the progress if the Earth is getting hotter or cooler.

And then after I had a visualization that shows a progress over the years of the Earth climate behavior, I thought how to represent the second dataset.

The second dataset that contains different factors and how they contribute to the climate change, so I decided to map the amount a factor contribute to the temperature as the width of the line, this way you can visibly distinguish if the line is getting thinner or wider.
So if the circle radius gets bigger with the years and for one of the factors the line gets wider this mean that this factors contribute more to the change of temperature.
With this way you can see if there's a link between the first and second dataset.

Visualization value

Visualization value = T + I + E + C

T- Time: this visualization saves time, it shows the data of approx. 2k months in a circle, and because the color changes as the time progresses you can distinguish the years, and the same goes to contribution of the factors to the temperature change.

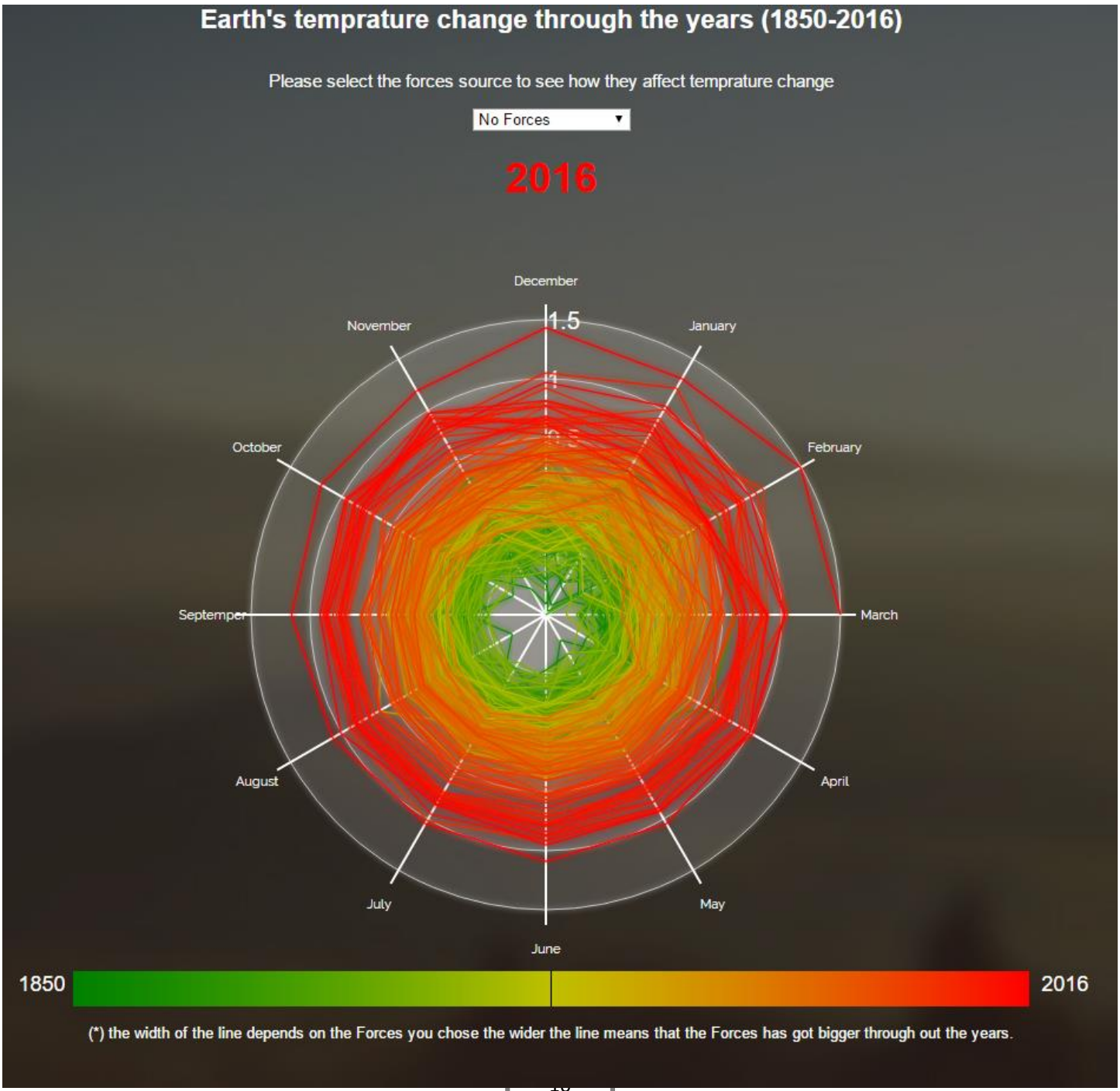
I- Insight: you can get to the conclusion of this visualization at your first glimpse of it, for example if the circle gets bigger over the years this means that the Earth's temperature gets higher over the years and if for some factors the line gets noticeably wider it means that's this factor contributes the most to this climate change.

E- Essence: as soon as you look at the visualization (after the animation end), you can see the bigger picture and the purpose of the visualization.

C- Confidence: both data I've got from a confident source either from NASA or Met Office, the data was made from thousand and thousands of measuring at taking in calculation error percent and sampling uncertainties.

Visualization results

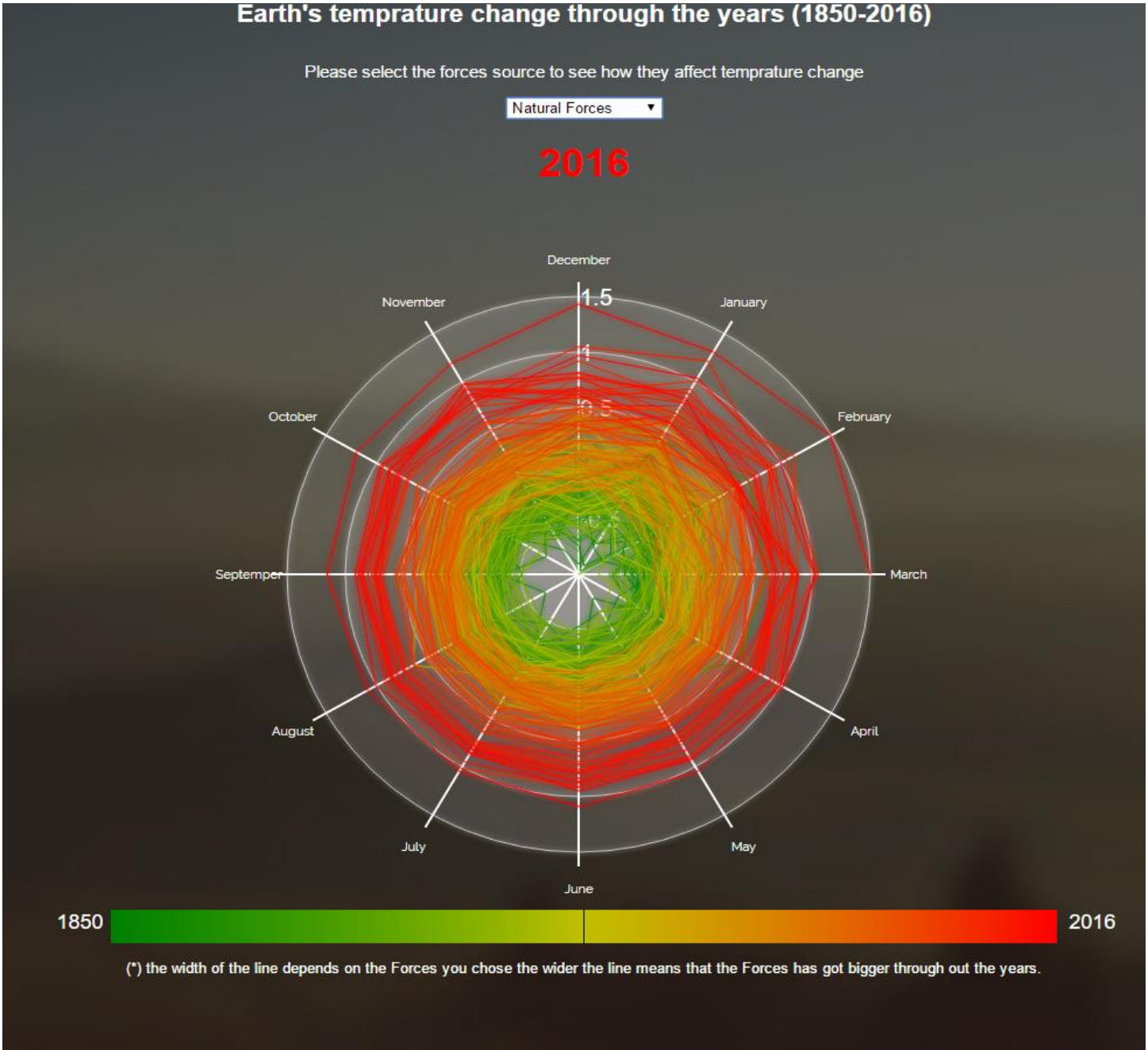
The first results are shown with no factors in calculation, and it looks like this:



We conclude from the first result that indeed the Earth is getting wormer and it's getting wormer in a more rapid amount than before.

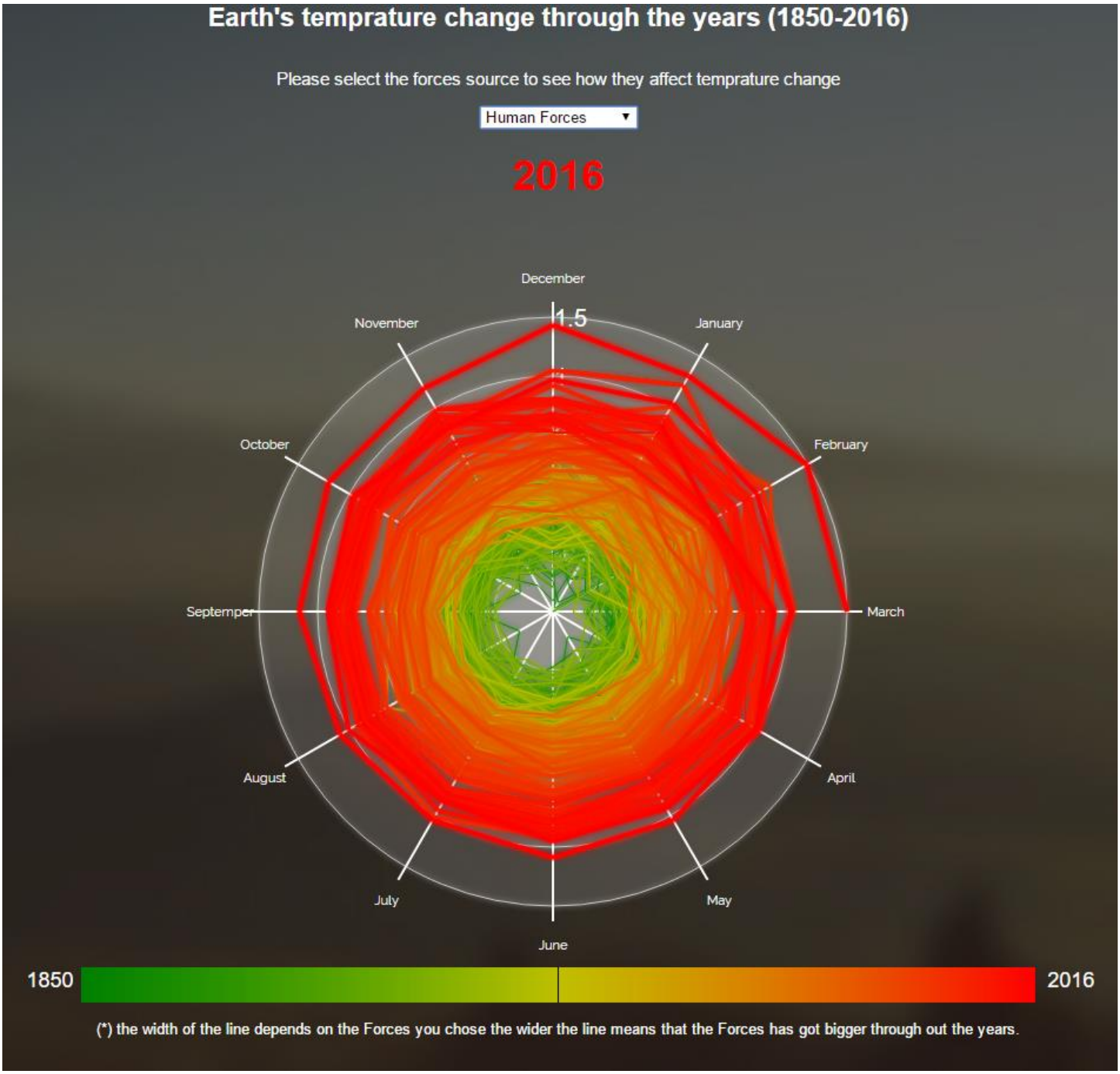
We can see that the first 100 years (1850-1950) lines are stacked above each other, which means that the Earth's climate was approximately the same, but after 1950 to 2016 the Earth is getting warmer in a rapid manner.

If we select the Nature factor, we get this results:



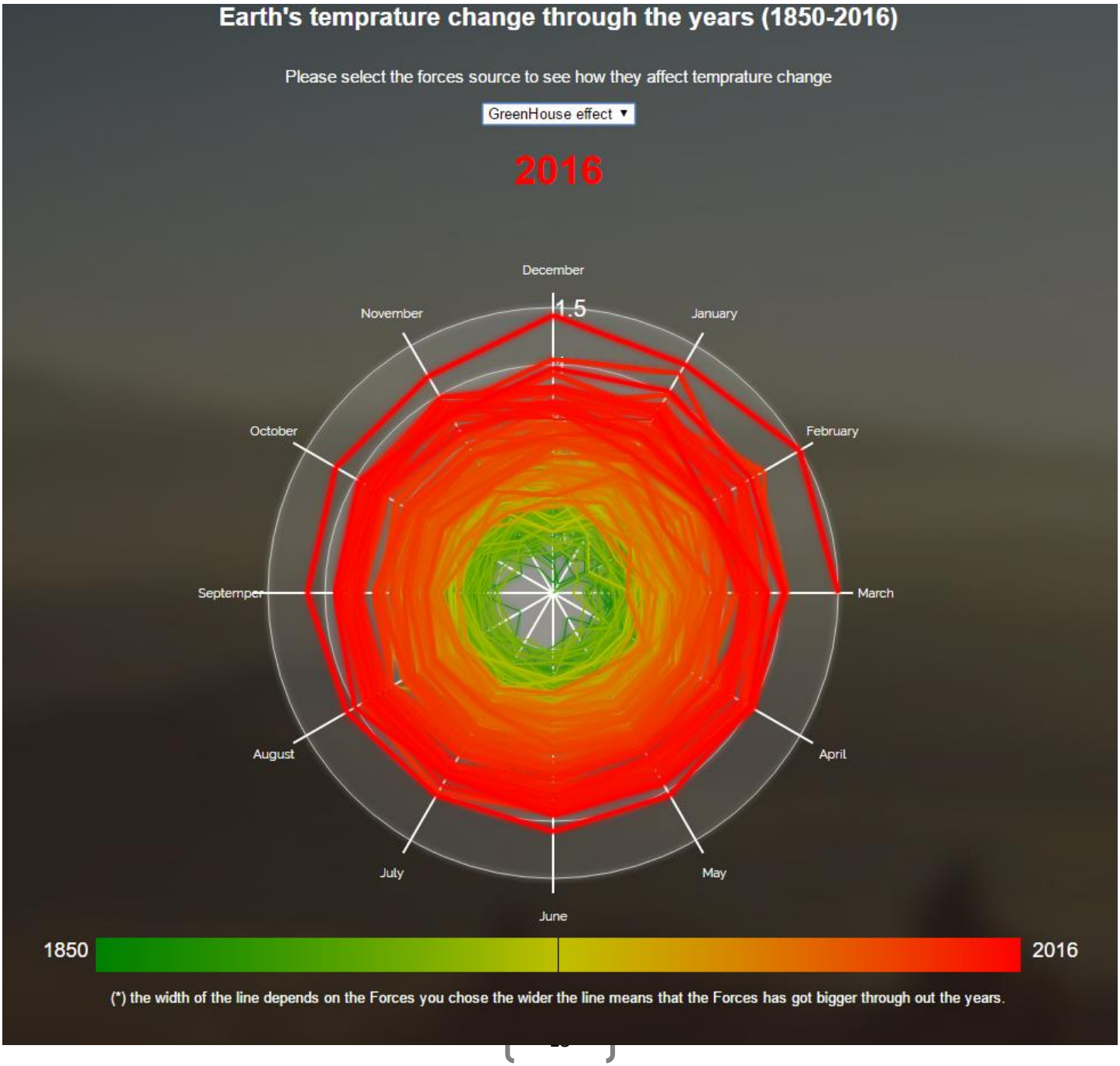
We can see that there's no difference in the width of the line which means that nature forces stayed the same for the past 160 years, and they didn’t contribute to the change of the climate.

We then turn to the Human factors and the result is:



We can clearly see that the line gets noticeably wider in the last 15 years, this means that the Human factors do contribute to the climate change.

The last select option is the Greenhouse gas factor, and the results we've got are:



The results are very similar to the results of the Human forces,

which include the greenhouse factor in them, this means that the greenhouse effect is the main factor that in the Human factors that contributes to the climate change.

If the greenhouse effect result is similar to the Human forces-which includes the greenhouse effect in them- this means that the other Human factors doesn’t contribute to the result very much.

Self-assessment and conclusion

From the visualization results we can clearly assess that the Earth is indeed getting hotter and the rate which the temperature is rising is getting bigger.

And as we saw in the visualization the increase in the temperature is not due to Nature forces, and that this increase is not a normal to the Earth's climate.

The humans are the main cause for this climate change, especially the greenhouse gases (factories, cars, airplanes, trains, etc.) are the main human factor that is causing the Earth to get hotter.