

From GLOBE to Erasmus

Group 10



Foreword

This report regarding the atmosphere is a project from GLOBE & Erasmus. The research questions from the atmosphere are mostly about the climate and climate changes in Buzet, Nysa & Rotterdam. Buzet is a small town located in the county Istria in Croatia. Buzet has a population around 6000. Nysa is a town located in the south west of Poland on the Eastern Neisse river. It has a population around 60 000 people and it used to be a major industrial centre, now the economy is mainly based on agricultural goods. Rotterdam is the biggest city. It is located in the province Zuid-Holland in the Netherlands. Rotterdam has a population around 600 000 people and it has one of the most famous harbours in the world. Rotterdam is one of the most industrialised cities in the Netherlands due to the harbour and the bombing is the Second World War. In this report we compare the atmosphere of these three cities and do research about the quality of the air.

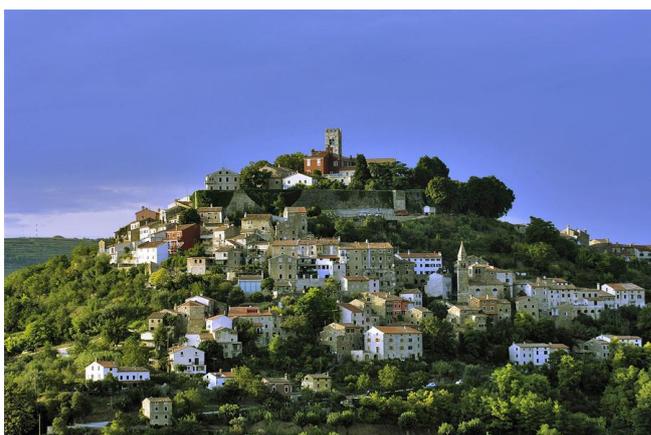


Table of contents

Summary	4
Preface	4
Research question and hypothesis	5
Research plan	5
Results and analysis	6
Conclusion	10
Evaluation and reflection	11
Resources	12



Summary

For this research project we got the assignment to do our own geographical and/ or environmental research. We are a group of six students, two from Rotterdam (The Netherlands), two from Buzet (Croatia), and two from Nysa (Poland). As a group we decided to answer the research question: How do people influence the quality of the air in Rotterdam, Buzet and Nysa?. In this research project we answered the question by measuring factors such as precipitation and particles in the air. Beforehand we did a lot of research about the three cities and looked at geographical factors that could influence the air. For example Rotterdam has a very big harbour. Because of this we concluded at the beginning that Rotterdam would be the most industrialised city and therefore was expected to have the highest amount of aerosols in the air and thus the least amount of precipitation. It was challenging to do such a big project with students from all over Europe, so we had to work together to get the best results. The most difficult part of the project was working together, mostly because we all have different hand-in dates and different vacation-dates. Sadly, Sara and Elin in the end did most of the work. Another hard part was trying to get the results in Rotterdam. The other cities did not have the right resources to measure the amount of aerosols in the air themselves. The problem with the sunphotometer was that it could only be used correctly, when the sun was shining. We were taking the results in the winter, so this was quite hard. The sunphotometer also turned out to have some flaws and did not always give proper answers, which made it not reliable. This is also why, unfortunately, Sara and Elin at the end did not use the sunphotometer anymore and looked up the data, like the other cities had done.

All the cities turned in their results at different moments, which made the teamwork even more difficult. At the end of analysing our results went quite easy, mainly because our hypothesis turned out true. Sadly, we found out that we did underestimate Nysa. Nysa apparently has a large amount of aerosols in the air, not

because of the industry, but because of other factors. Still, we did not foresee this at the beginning of the project.

So, in the end our hypothesis was correct, but the work towards the finishing of this project was very difficult and a lot of work. What was at the beginning a 6 people's job, turned out to become a 2 people's job.

Preface

Climate change is a current topic and caused by too many fossil fuels in the air. Aerosols are tiny particles that can be produced when we burn different types of fossil fuels. One of the sources of aerosols is pollution. More industrialised cities experience more problems with the forming of aerosols, for example the formation of soot, an aerosol that forms black layers on the windowsill. However, aerosols can also be produced naturally; they can be given off from trees or by burning vegetation. Not all types of aerosols are linked to climate change, but soot has a link between aerosols and climate change. The soot boosts the warming effects of greenhouse gasses in the atmosphere. This type of aerosol has a negative effect on the climate and is called a primary aerosol. Other primary aerosol types are dust and sea salt. These primary aerosols get lifted into the atmosphere by winds, volcanoes or fire. Secondary aerosols are formed when different things floating in the atmosphere (organic compounds for example) crash together, creating a chemical or physical reaction.

In general aerosols affect the climate in two different ways: by changing the amount of heat that gets in or out of the atmosphere, or by affecting the ways clouds form.

Some aerosols look a bit like little rocks and are reflective. When the sun is pointed at them, the heat is reflected and goes again directly out of the atmosphere. This makes it cooler. But other aerosols, like soot, absorb the heat from the sun. This makes the atmosphere warmer. Aerosols also influence the formation of clouds. Water droplets coalesce around particles, so a particle-rich atmosphere promotes cloud formation. White clouds reflect incoming sun, preventing it from getting to the surface and warming the land. But clouds can also absorb the heat and trap it in the lower atmosphere.

So, aerosols can both increase and decrease precipitation. Very polluted air contains a high concentration of water-soluble particles, which causes the clouds to have more numerous, but smaller, droplets. This makes the precipitation level lower. Black carbon (soot) warms the surrounding atmosphere and causes cloud droplets to evaporate. This process turns clouds into smoky haze, which suppresses precipitation.

So we are going to find out whether in more industrialised cities more aerosols are formed causing less precipitation and decreasing the quality of air. Rotterdam is the biggest city of our three cities (Nysa, Buzet and Rotterdam) and considering the enormous harbor in Rotterdam, we believe that Rotterdam will have the highest aerosol rate and the least amount of precipitation. During this project we are going to find out if we are actually correct and if aerosols really affect the amount of precipitation and the quality of air in a city. We will be doing this through the use of a sun photometer, to measure the amount of aerosols and a meter to measure the precipitation.

Research question:

How do people influence the quality of the air in Nysa, Buzet and Rotterdam?

Hypothesis:

In a more industrialised city more aerosols are formed causing less precipitation and decreasing the quality of air.

Research plan:

We are going to measure aerosols and precipitation in the various cities. These measurements are done in the centre of the city because we believe that the centre of a city is the most industrialised. Beforehand we decide which city is the most industrialised. Every group tries to do the measuring of the aerosols when the sun is shining, because this will lead to a better result. We think Rotterdam is the most industrialized city because it is the biggest and it has one of the most industrialized and biggest harbours of the world. Because we need the sun to shine for the sunphotometer to work we looked at the days of the upcoming weeks where it is predicted the sun will shine brightly in Rotterdam.

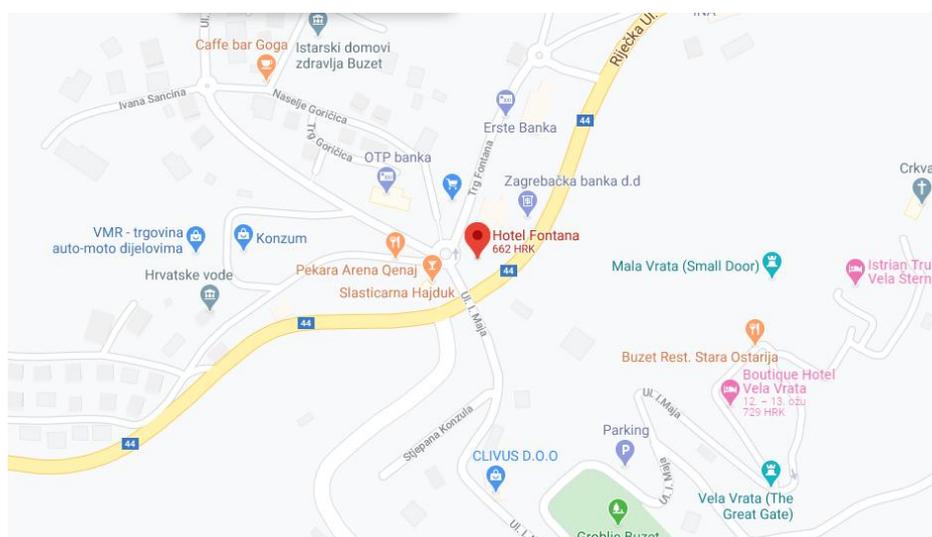
Rotterdam:



Nysa:



Buzet:

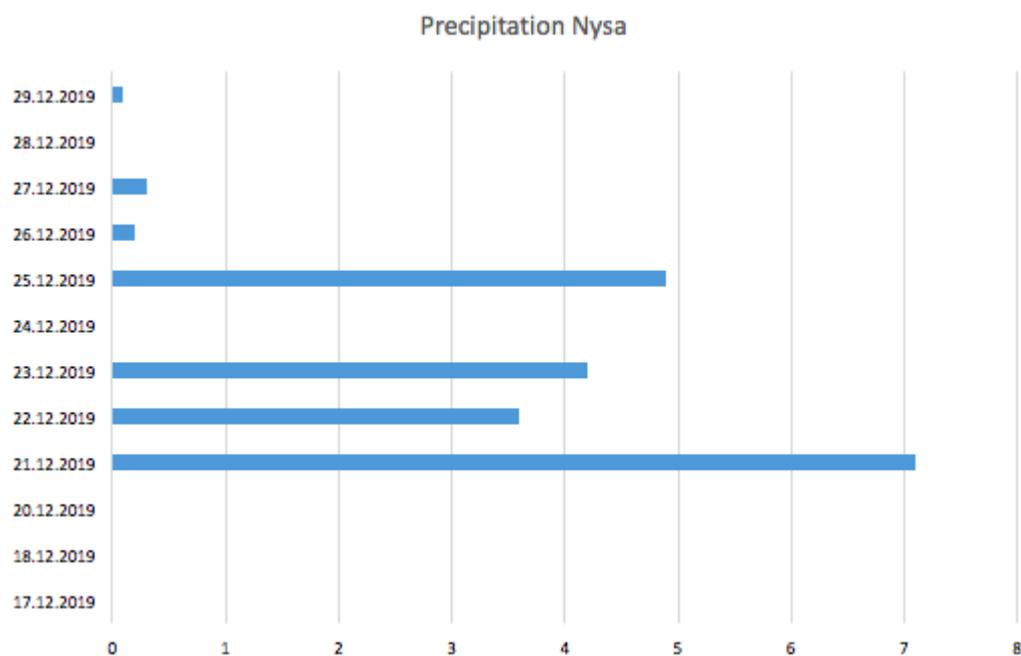


The results:

Nysa

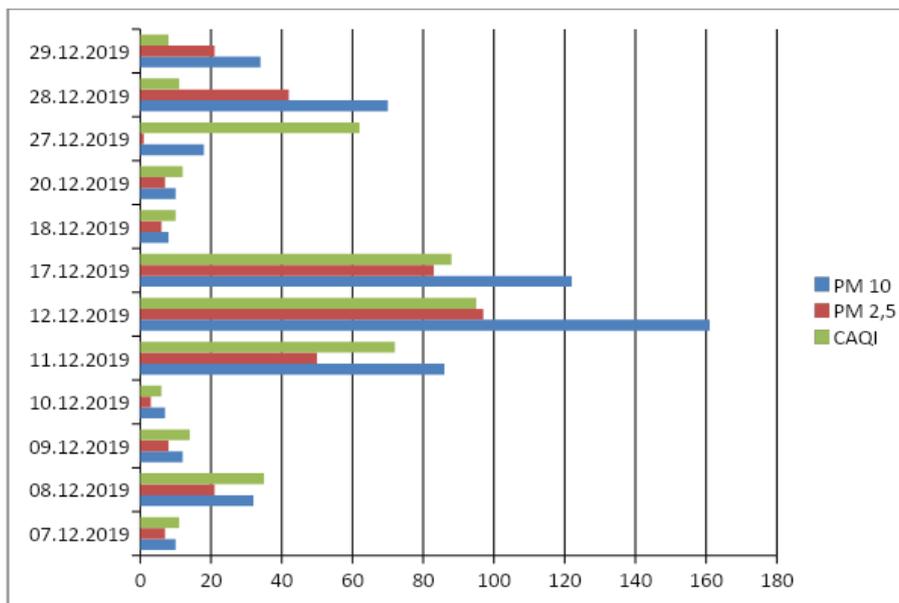
Place of measuring: ul.Wita Stwosza Nysa

Precipitation in mm average= 1,7 mm



Place of measuring: ul.Wita Stwosza Nysa

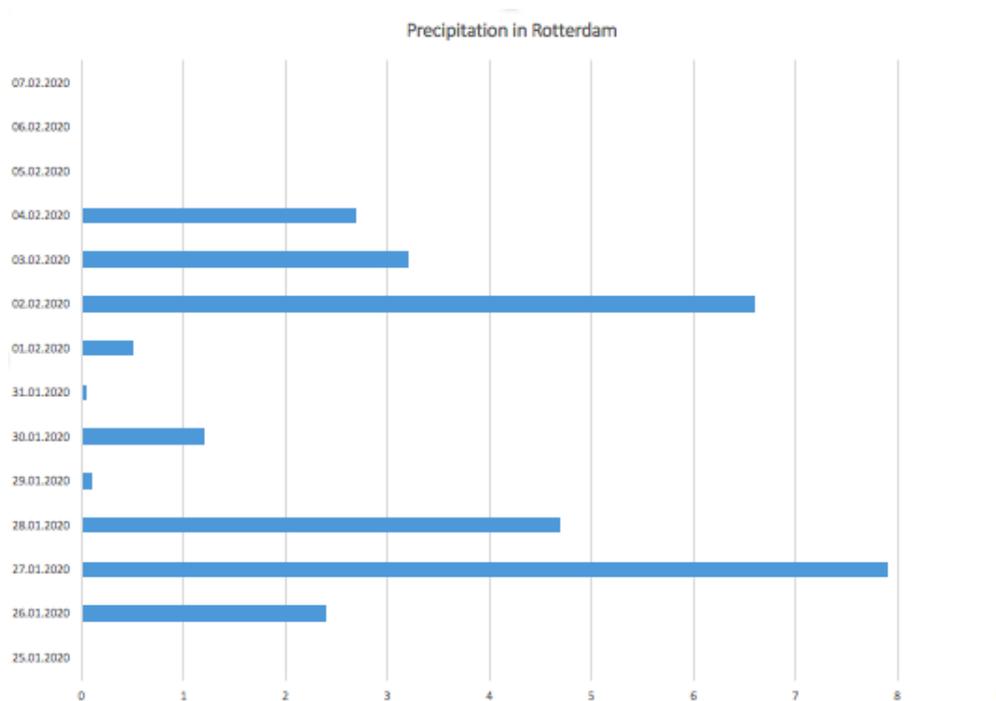
Aerosols - Average PM_{2,5} = 24,86 Average PM₁₀ = 40,86



Rotterdam

Place of measuring: Bentincklaan, Rotterdam

Precipitation - average = 8.283 mm in twelve days

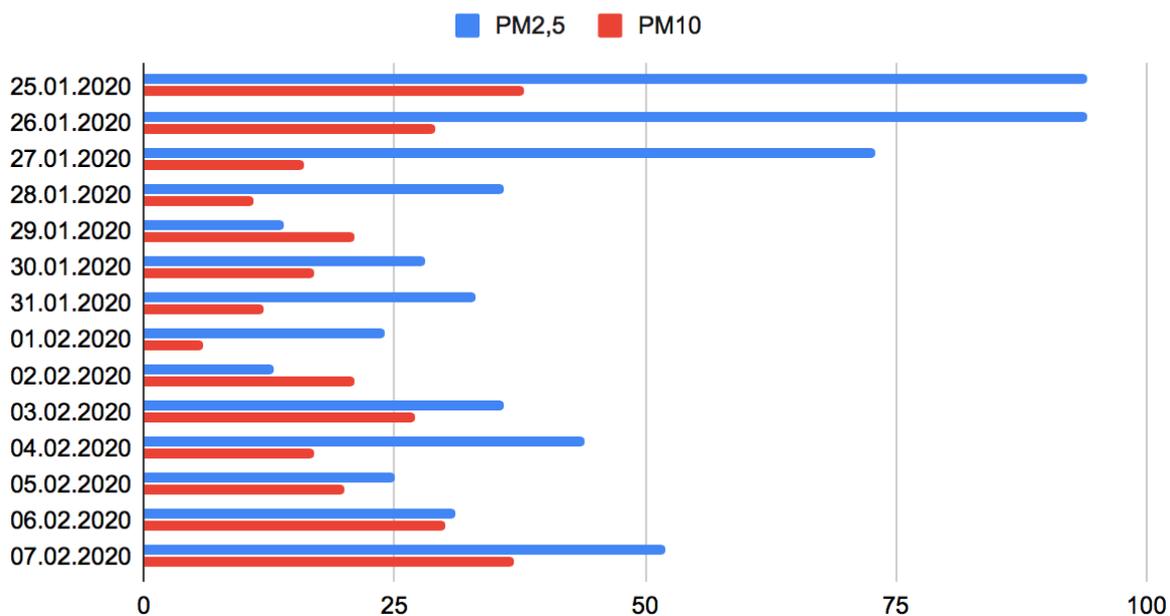


Place of

measuring: Bentinckplein, Rotterdam City

Aerosols - Average PM2,5 = 40,79 Average PM10 = 20,29

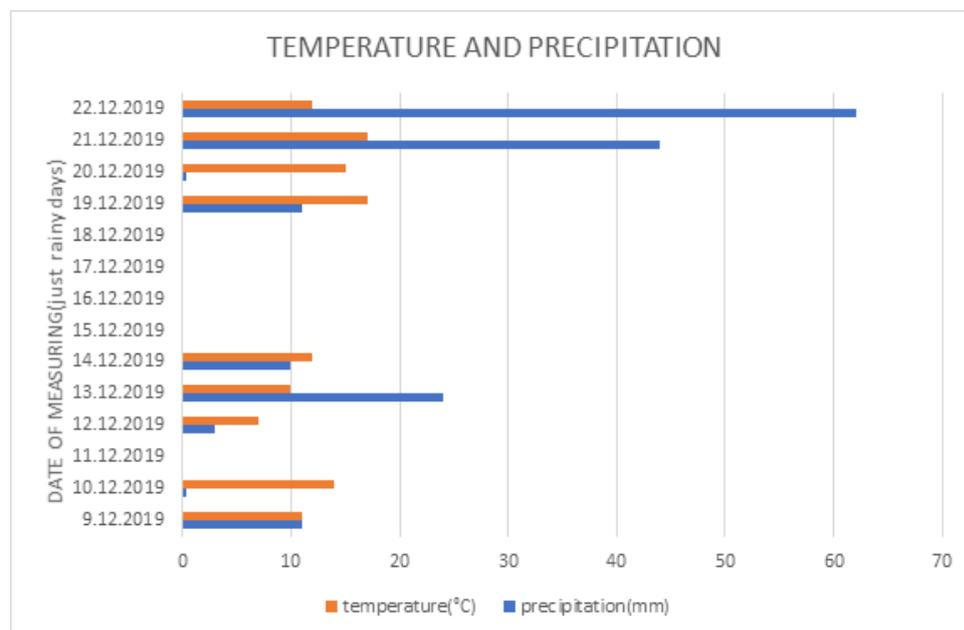
Aerosols Bentinckplein



Buzet

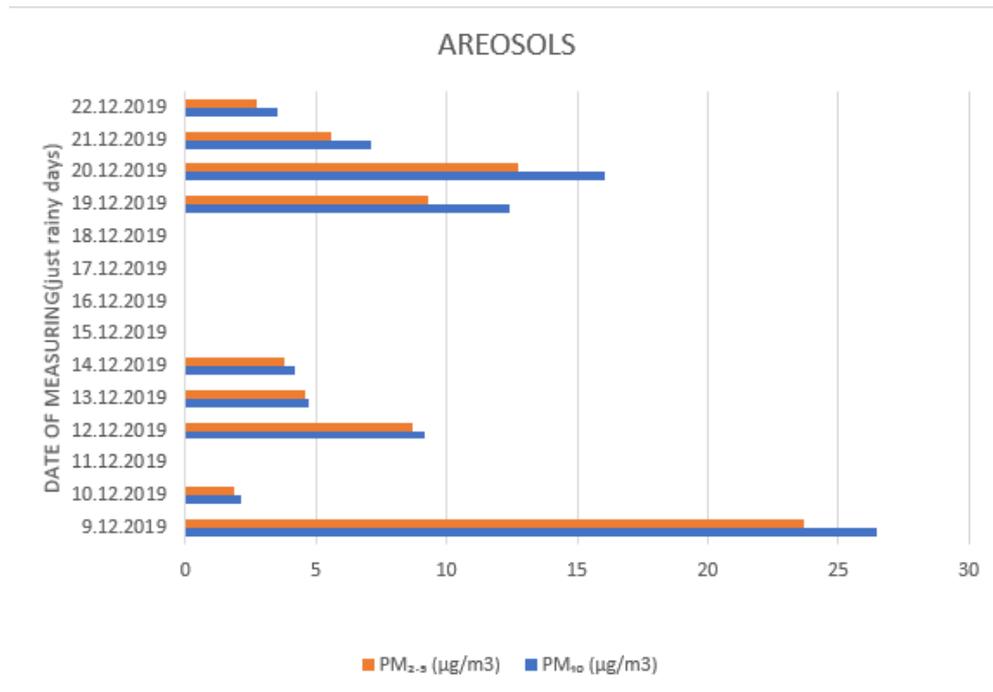
Place of measuring: city centre of Buzet

Precipitation - average = 12.167 mm in twelve days



Place of measuring: city centre of Buzet

Aerosols - Average PM_{2,5} = 4,96 Average PM₁₀ = 5,86



Analysis

For this project we decided to measure the aerosols with a sunphotometer and the precipitation in Rotterdam, Buzet and Nysa. Unfortunately not every city had access to a sunphotometer, so in Buzet and Nysa they used research from other projects. To get the best results we decided to measure the aerosols in the city centre as well as outside the city, so we can compare those results. The different cities all have a different climate so some amounts of the precipitation will not be directly linked to aerosols.

To use the sunphotometer we found out that a bright sunshine is needed to measure the aerosols and because it is winter it was really hard to find the right time to measure it. It has been very cloudy the past few weeks. But in order to get the best possible outcome, the protocol said that, we only measured at noon because the air is less turbulent. However, though we did this, we still had some trouble with using the sunphotometer.

The sunphotometer has three channels. The temperature of the sunphotometer, greenlight and redlight. The greenlight measures the hazy sky that is visible with the human eye, a hazy sky is likely to have a large amount of aerosols in the air. The red light is more sensitive to larger aerosols. Data from one single channel will not show the size distribution of the aerosols. Luckily, combining the data from more than one channel will provide this information. The measurements taken with this device are measured in volts. After measuring, we have converted these measurements into aerosol optical thickness. The results we got from the sun photometer were not accurate and after discussing that with an expert, he told us that the sky was too hazy to measure it with the sunphotometer. So we tried again later, but we still got the same results. Because we did not have any time left to measure it again we decided to use research from research that has already been done by other people.

What we first of all can see is that the precipitation, as expected, is lower in Rotterdam than in Buzet. Rotterdam has an average of 8.28 mm in twelve days, while Buzet has 12.17 mm.

Nysa has 1.7 mm precipitation in two weeks. This is because of the high amount of aerosols Nysa has. It has almost the same amount of aerosols as Rotterdam.

The amount of aerosols is the lowest in Buzet, which would then considering our hypothesis to be the least industrialised city. Which is true, looking at the amount of people living in this town. There only live 6000 people in Buzet, while in Nysa there live 60 000 people and in Rotterdam 600 000. Looking at the difference in amount of aerosols between Nysa and Rotterdam, a clear difference is seen between the levels of PM_{2,5} and PM₁₀. The difference between these two, is size. PM_{2,5} are particles that are 2,5 micrometers in diameter and PM₁₀ is 10 micrometers in diameter. Both these substances are very bad for people's health when inhaling them. They are so small, that they can not be seen through the human eye and form part of aerosols. These particles are formed mostly through humans, for example through car emissions, incomplete combustion, dust and cooking. So, the industry plays a big role in the amount of PM_{2,5} and PM₁₀ in the air. In Nysa we can see that there is quite a high amount of PM₁₀, while in Rotterdam the high amount lays with the PM_{2,5}, both are in the 40. PM_{2,5} contains mostly combustion particles, so from fire, cars or factories (the harbour as well), organic compounds and metals. PM₁₀ contains mostly dust, pollen and mold. So, though the PM₁₀ level is higher in Nysa, we can still conclude that Rotterdam is the most industrialised of all the cities analysed, because its aerosol level is more based on industrialisation then on other quality of air factors. Both these types of aerosols are very bad for your health. Because both these particles are so small, they act as gas. When breathing, these particles penetrate into the lungs, which can cause coughing and asthma. High blood pressure, heart attack and a stroke are also effects of these particles. This would mean that the quality of air in Nysa and Rotterdam is very bad and in Buzet it is actually better, mainly due to less industry.

In our data from Rotterdam we can also see that on the days that it rains the most, the aerosol level is the lowest. During the end of January it did not rain for a few days. The aerosols during the end of January were very high and during the beginning of February it rained a lot and the aerosols in the air were less. In Nysa this is also the case. On December 17 the amount of aerosols was very high, but on that same day there was no precipitation.

Conclusion

So, in our conclusion, we can say that our hypothesis is correct. It is true that the more aerosols in a city, the less precipitation there is and the worse quality of air there is. One point where we were wrong, is that Rotterdam is the most industrialised city and thus has the most aerosols. Nysa, is less industrialised, but also has a lot of aerosols. This is because aerosols are not only caused by polluted air of greenhouse gases, but also have other reasons, such as dust, pollen and mold.

We can see that Rotterdam is the most industrialised because of how many people there live and how many PM_{2,5} particles (aerosols) there are in the air. And we know that Buzet is the least industrialised because of the small amount of people living there and the low amount of aerosols in the air.

Evaluation and reflection

At the start of this project Julia sent an email to everyone that we were a group for this project. We decided to create a group chat and discuss what had to be done for this project. Creating a good hypothesis was hard for the pairs from Buzet and Nysa because their English was an obstacle. So Sara and Elin came up with a hypothesis with the ideas from

the rest of the group in mind and did some research about the effect of aerosols on the quality of the air. The group knew what measurements every pair had to do. The sunphotometer was only available in Rotterdam, so after discussing the problem with our teachers we came to the conclusion that the other pairs could use measurements from other research that they could find. Julia and Oliwia had their aerosols results early on in the project, but they did not put in the precipitation. Sara and Elin's results, especially the one of the aerosols, came quite late because the measuring with the sunphotometer had some obstacles. They could only measure when the sun was shining and even when the sun was shining, they were unsure if the meter worked properly. Eventually they did not use the sunphotometer for their measurements because it was simply too difficult with the amount of time they had. Another reason why they stopped using the sunphotometer was because the measured value was different to the measured values of Croatia and Poland, which made it difficult because they had to convert their measured value to those of Croatia and Poland. Karla and Ema also put in their results very late. Because Sara and Elin had to hand in the project on Thursday, while the others had to hand it in later, it was a bit stressful and chaotic at the end. Everyone wanted to help with the project, but because Sara and Elin had to end it earlier, it needed to be before Thursday and Karla, Ema, Julia and Oliwia did not know that at the beginning. Because of the bad planning, Sara and Elin tried to do everything as fast as possible at the end and did most of the work.

We (Karla and Ema) didn't have appropriate equipment for measuring precipitation and aerosols in Buzet so we used information from few web sites. However, we have been able to measure temperature with regular thermometer. We measured temperature for one month, just on days when precipitation was present and we formed table and a graf about it and about precipitation and aerosols, too.

Individual reflection

Elin:

I found the overall project quite interesting. I like how the scientific part and the social part of geography come together in our project. It was, though, very stressful. Mainly because working together was so hard. Sara and I worked together well. But working together with the other cities was hard, because we had different hand-in dates and different vacation-dates. This also made it very stressful. I have learned a lot from this project, like how to use the sunphotometer and how to write a report. I also learned how to work together with people I did not know from a different country. But in the end I can not say I liked the project. The amount of stress I got from it, with asking the others when they are going to give us the results, or how we were going to approach this guiding question, etc, was just too much and made it not a nice project. I think that I had more stress, than I actually learned something from this project.

Julia:

I think the project was stressful and took a lot of time to make, but it was worth it. Because of the project I can clearly see right now how bad our air can be. It made me see that and it was really interesting to see the differences day by day. The hardest part was to make

something together, because of the differences on the vacation- terms and things like that. Overall the project was fine.

Sara

At the beginning I really liked the idea of the project because we could chose our research question and work together with a lot of different people. But during the project there were a lot of obstacles and it wasn't easy to finish it in time. Early on in the project I noticed that the communication was going to be an issue and measuring the aerosols. It was really hard to work with the sunphotometer because we could only measure it when the sun was out. The communication was hard because not everyone had the same idea in mind so someone had to step forward to take the lead and after a while Elin and I decided to make a plan and decide what the hypothesis should be. In the end it was really hard to work together because of the different vacation dates and miscommunication. We all tried to do our best but it didn't work out the way I would have wanted it to, but I think in the end we can be proud that we finished the project and luckily it was a really interesting subject. It is already hard for six people from the same country and school to work together, so to make a project with six people from different countries and different schools is an achievement. The research itself was really interesting and I have learned a lot about planning and teamwork.

Karla:

Firstly i thought this project very intresting and no so hard because i was in the project las year and it went very well, maybe because the question was easier than this year and we had less measurements to do. One of problems was that we don't have equipment for measuring things like areosols in our school, however we found i way of collecting informations. Another problem was different schedule of vacations and sometimes bad understanding between countries (language barriers) but most important is that we finished all and all in all it wasn't so bed, I learned something new and interesting which could help me in the future.

Ema:

The very topic and idea of the research at the beginning seemed interesting without any reason for the difficulty in making the measurements themselves. Personally, I am sorry that the most of the project is based on data from the Internet (as far as measurements for Buzet are concerned), but because of the lack of equipment, it was the only option. Of course, everyone worked to the best of their ability. The girls from the Nysa and Rotterdam did a great job. Given that I think the project turned out to be the best it can be in these circumstances.

Resources

- <https://www.nationalgeographic.com/environment/global-warming/aerosols/>
- <https://airly.eu/map/pl/>
- <https://aqicn.org/city/netherland/rotterdam/bentinckplein/>
- <https://climate.nasa.gov/news/215/just-5-questions-aerosols/>
- <https://sites.google.com/a/wolfert.nl/wolfert-examentraining-ak/>

- <https://www.nationalgeographic.com/environment/global-warming/aerosols/>
- <https://drive.google.com/drive/folders/1DPF-L2Ebv9nZ8aAWgwcQRRonq1enxybf>
- <http://iszz.azo.hr/iskz/>
- <https://meteo.hr>