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ESEMES

Educational Software and E-learning in Math for European Students



Climatic Changes

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Raelingen videregående skole, Raelingen, Norway

Description of the project

In this project, we have decided to look at climatic changes in Norway and Turkey from year 1971 to 2014. We will do some research on air temperature and precipitation, and examine and compare the results. We have made graphs in Geogebra to illustrate the developments, using regression.

Software

Geogebra, Microsoft Excell

School Subjects

Mathematics, Geography, Biology, Physics

Participating students

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Climatic Changes

1. Geography

Introduction

Clouds and precipitation is formed by warm air that goes up, cool off because air temperature usually decreases with height over the ocean. We can see a clear skyline in the height where the temperature is so low that the condensation (densification of steam to water) is bigger than the evaporation. We will then get raindrops that are visible as clouds. This we call the dew point. When the raindrops are big enough, they can fall down as precipitation.

Precipitation is formed in three different ways

- 1. Convective precipitation (squall precipitation):** The ground heats up (convection) and with that its ascent. During ascent condenses water vapor to precipitation. With strong buoyancy can form charge differences in cloud systems and we get lightning and thunder.
- 2. Front precipitation:** Front precipitation is formed when warm air is forced into the air, either by cold air wedged under the warm air and pushes this into the air (cold front), or by the forward offensive warm air masses raised above the underlying cold air (warm front). In both cases, we get condensation and precipitation when the warm air is cooled in height. Polar Front is a more or less sharp boundary where cold polar air meets warm subtropical air. Along the polar front, it is formed low pressure affecting weather throughout Norway.
- 3. Orographic precipitation:** We get orographic precipitation when moist sea air is forced over the Mountains. The air rises, moves cooled and condensed, with subsequent precipitation. On the rear side (leeward side) of mountains, air masses will sink, be heated and weather to dry, warm air. In the valleys on the leeward side of the mountains Håkan, we therefore get dry, warm winds called the Foehn wind.

2. Climate

2.1. Norway

Some important features of the weather in Norway

- Norway is elongated in a north- south direction, and temperature differences can be large
- North Atlantic current, which is an extension of the warm Gulf Stream makes the climate much warmer than its latitude would suggest.
- Westerlies hit the country and leads moist sea air against Western Norway and the coast of the northern regions.
- Polar Front (with associated frontal precipitation) hits usually Norway somewhere. It is rare that it is nice weather in all regions.
- Langfjella (mountains that runs from south to north in Norway) gives orographic enhancement of rainfall front and heavy precipitation in western and "rain shadow" in eastern Norway.
- Large parts of eastern and Finnmark plateau ("Finnmarksvidda") has inland climate. It is characterized by warm summers and cold winters, and relatively little precipitation.
- Along the coast, close to the sea, we get the coastal climate. It is characterized by cool summers, mild winters and heavy precipitation.

Climate in Oslo

The climate in Oslo is milder than what our northern latitude might indicate. This is because of the Gulf Stream, which brings warm water from the Gulf of Mexico to Oslofjorden. Langfjella (mountains that runs from south to north in Norway) protects East-Norway for a lot of precipitation and in this part of the country has less precipitation than many places in Norway. This means that this part of the country has more days with sun and warmer weather.

2.2. Turkey

The coastal areas of Turkey bordering the Aegean Sea the Mediterranean Sea have a hot-summer Mediterranean climate, with hot, dry summers and mild cool, wet winters.

Winters on the plateau are especially severe. Temperatures of -30°C to -40°C (-22°F to -40°F) can occur in eastern Anatolia, and snow may lie on the ground at least 120 days of the year. In the west, winter temperatures average below 1°C (34°F)

Summers are hot and dry, with temperatures generally above 30°C (86°F) in the day.

Annual precipitation averages about 400 millimetres (15 in), with actual amounts determined by elevation.

Aydin

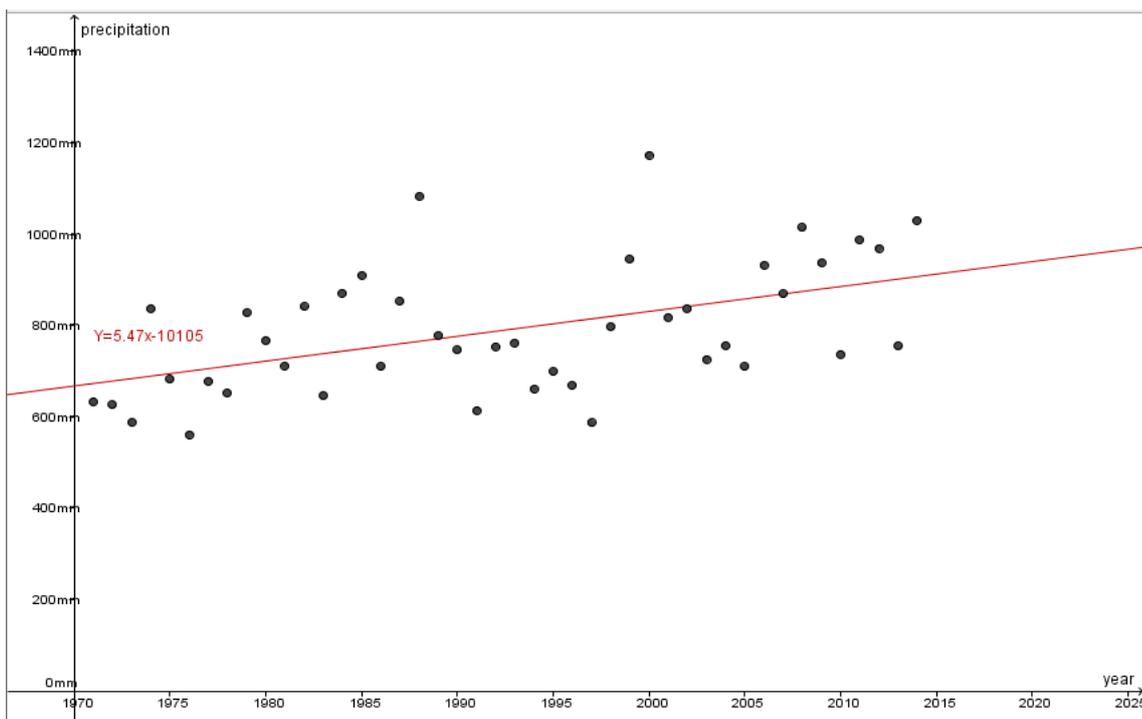
Mediterranean climate is observed in the city. Summers are hot and dry. Winters are warm and wet. Because the mountains stretch vertically to the sea the warming effect of the sea and winds bearing rain can move inland. Because of the North winds, Aydin is cooler than other cities, experiencing Mediterranean climate.

Average temperature 17.6°C

Average precipitation 618.4 mm

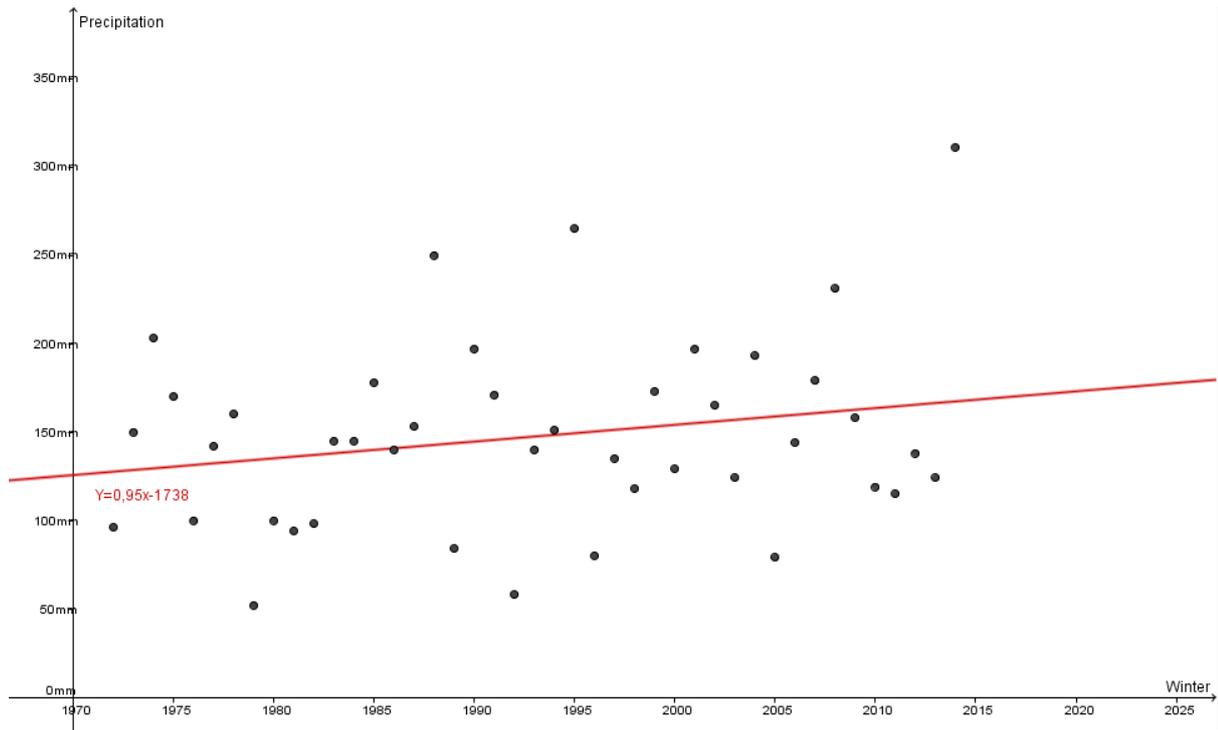
3. Precipitation

3.1. Norway – Oslo

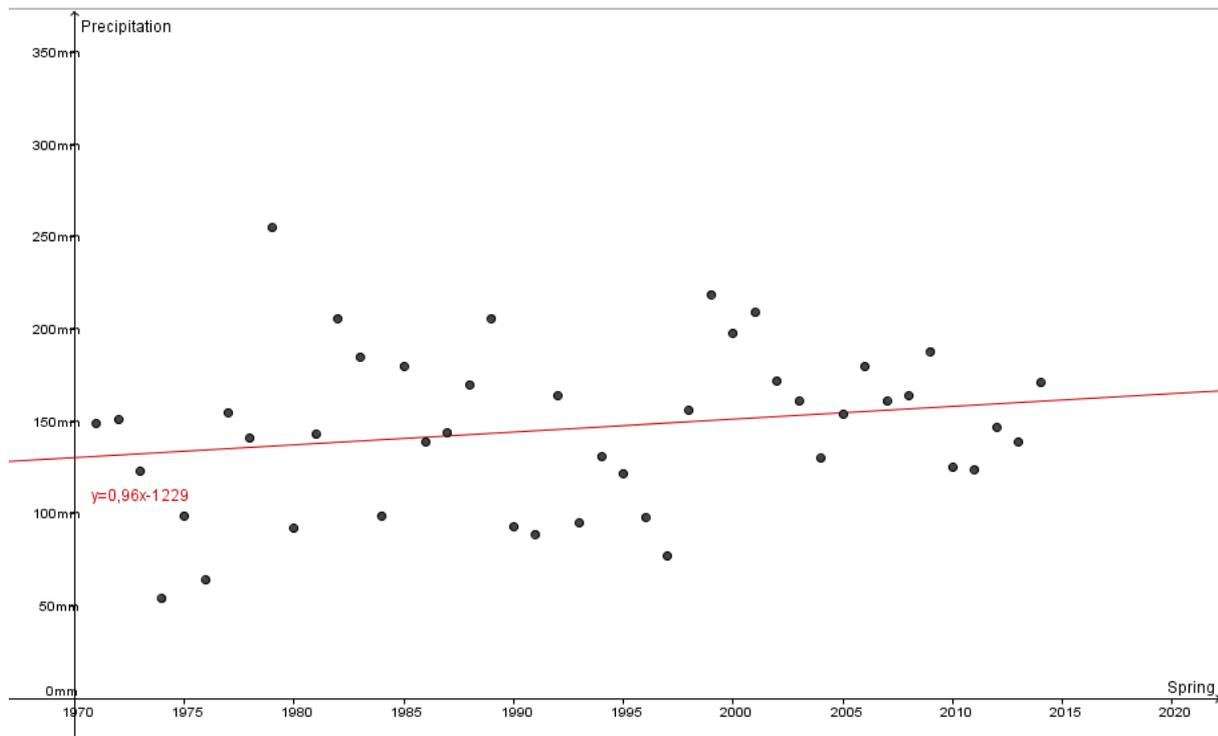


Graph for precipitation in Norway, from 1971-2012. Slope – 5.47

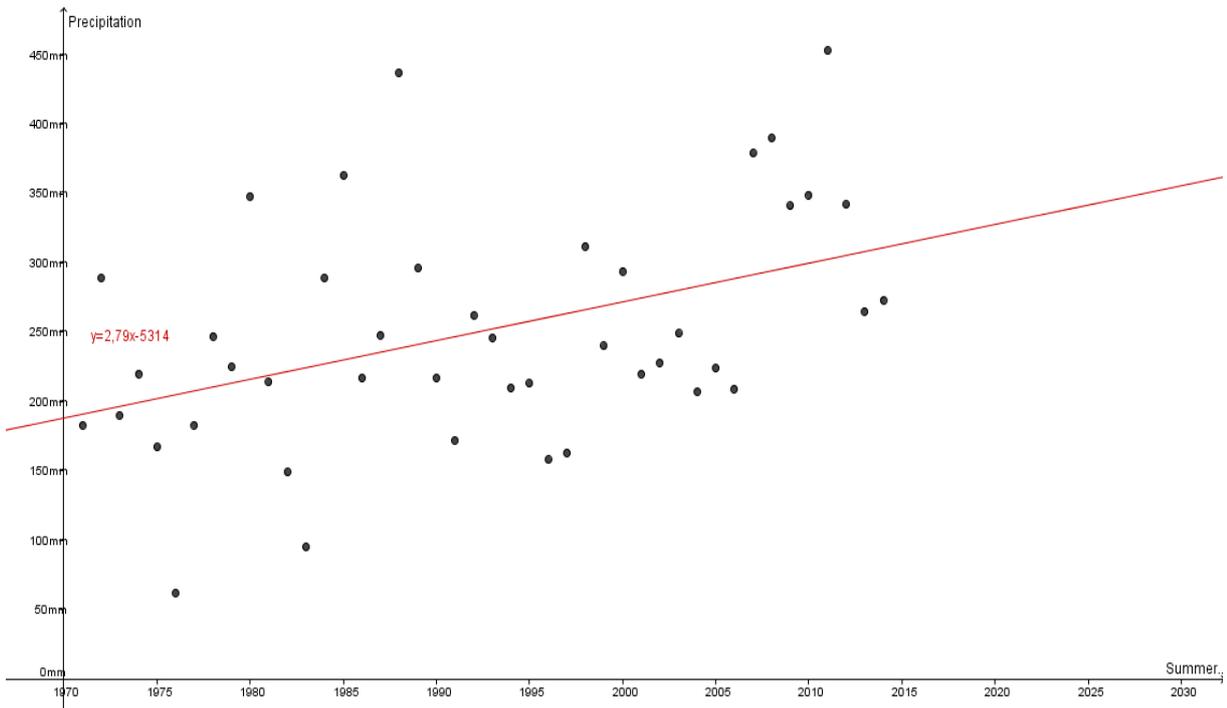
Precipitation every season



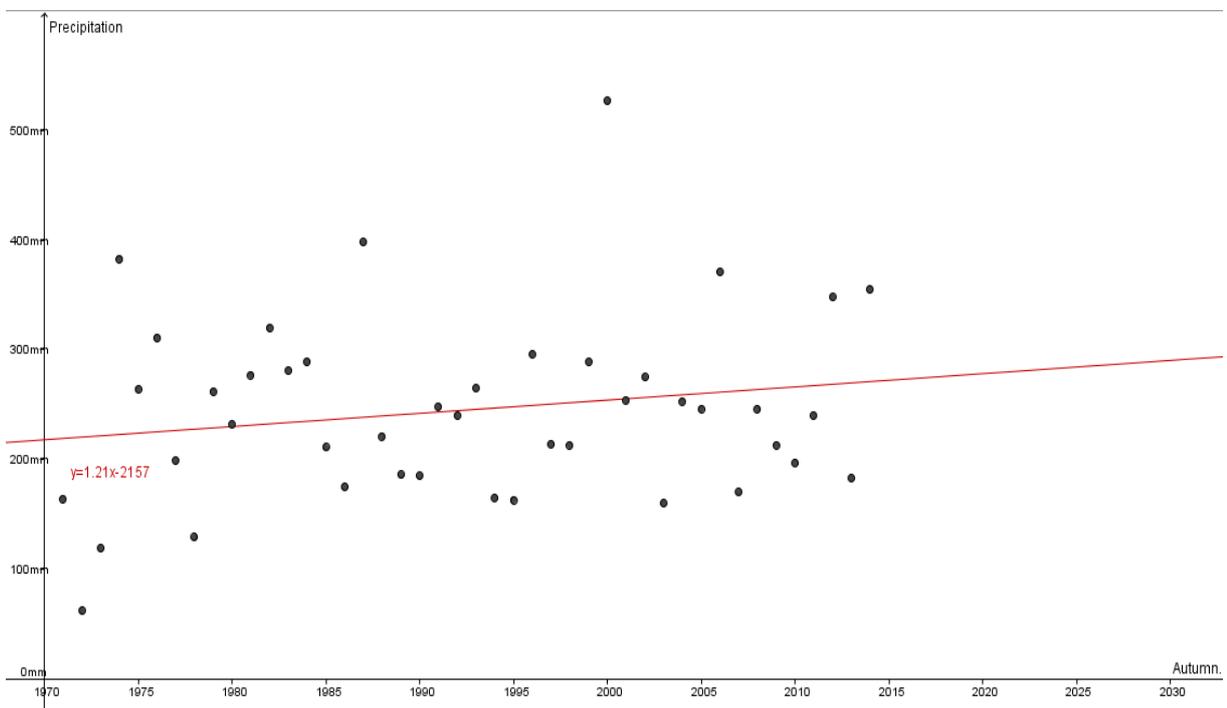
Winter includes January, February and December from the previous year.



Spring includes March, April and May.

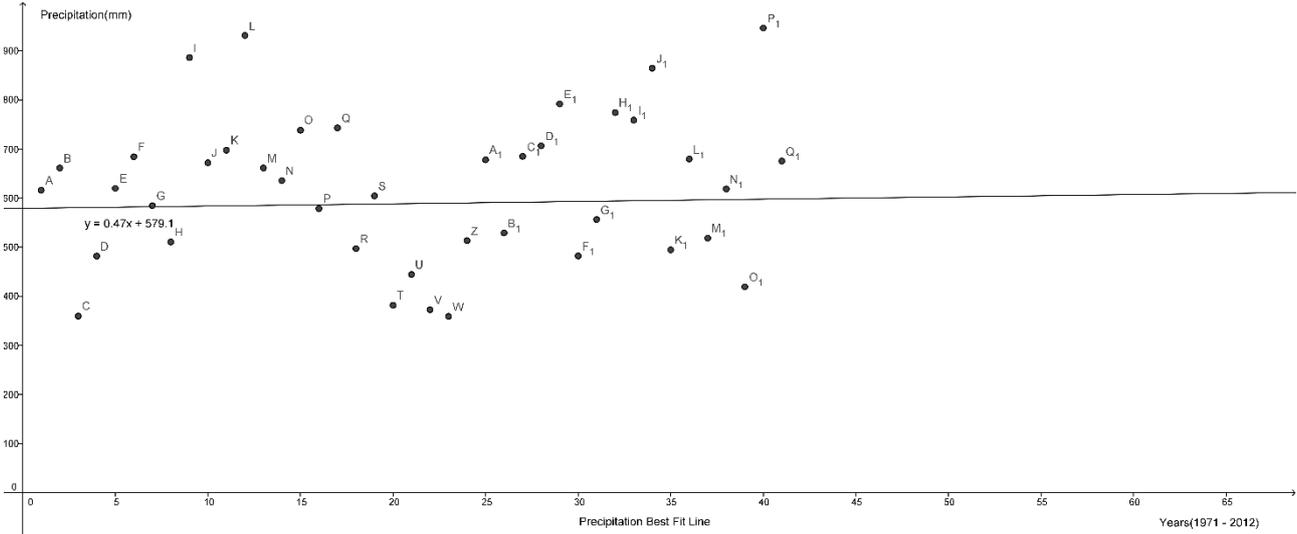


Summer includes June, July and August.



Autumn includes September, October and November.

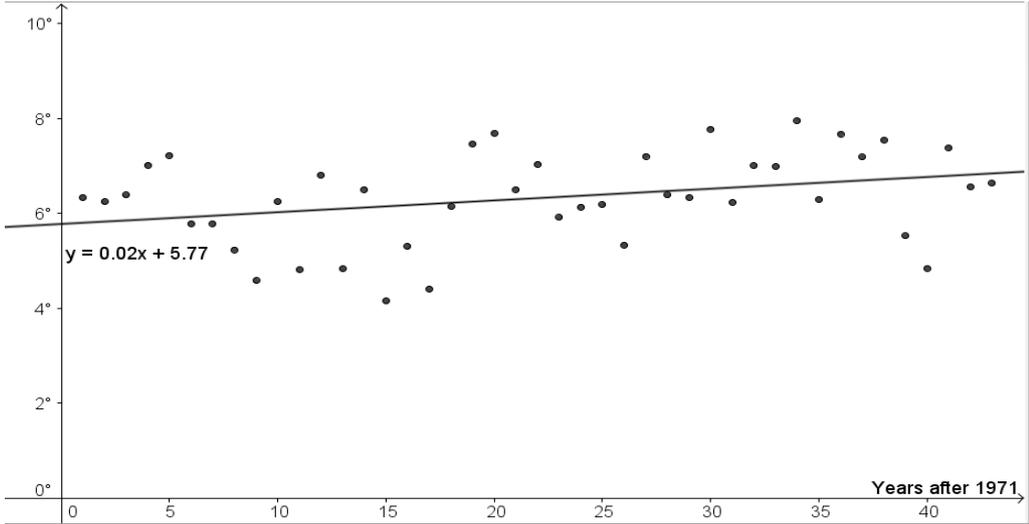
3.2. Turkey – Aydin



Graph for precipitation in Turkey, from 1971-2012. Slope = 0.47

4. Air temperature

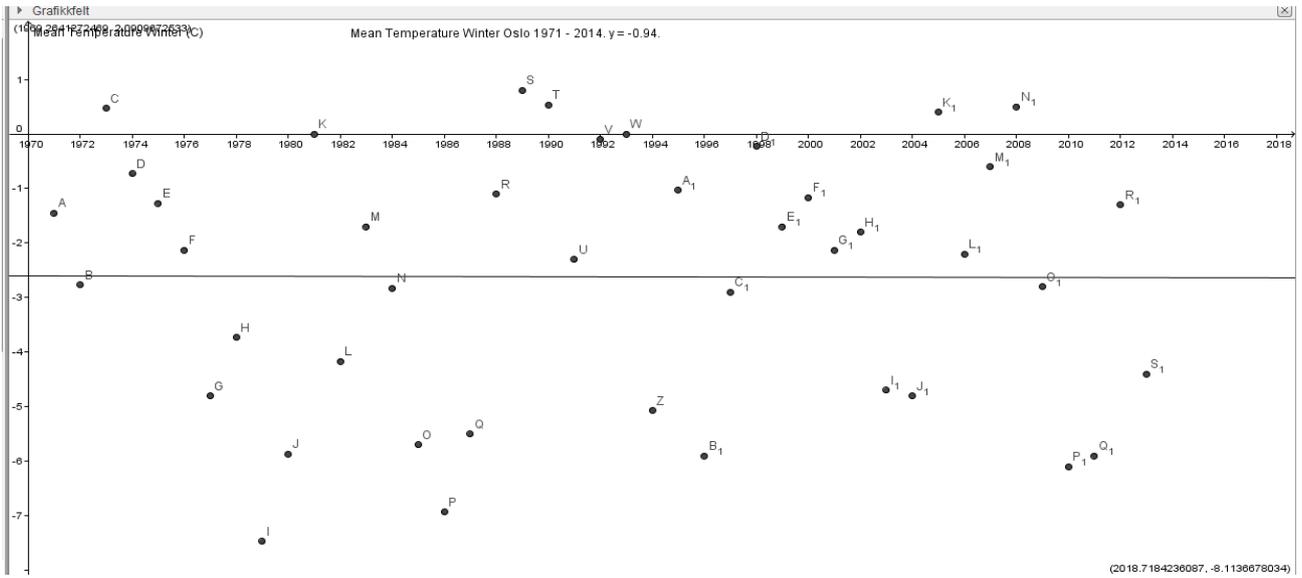
4.1. Norway – Oslo



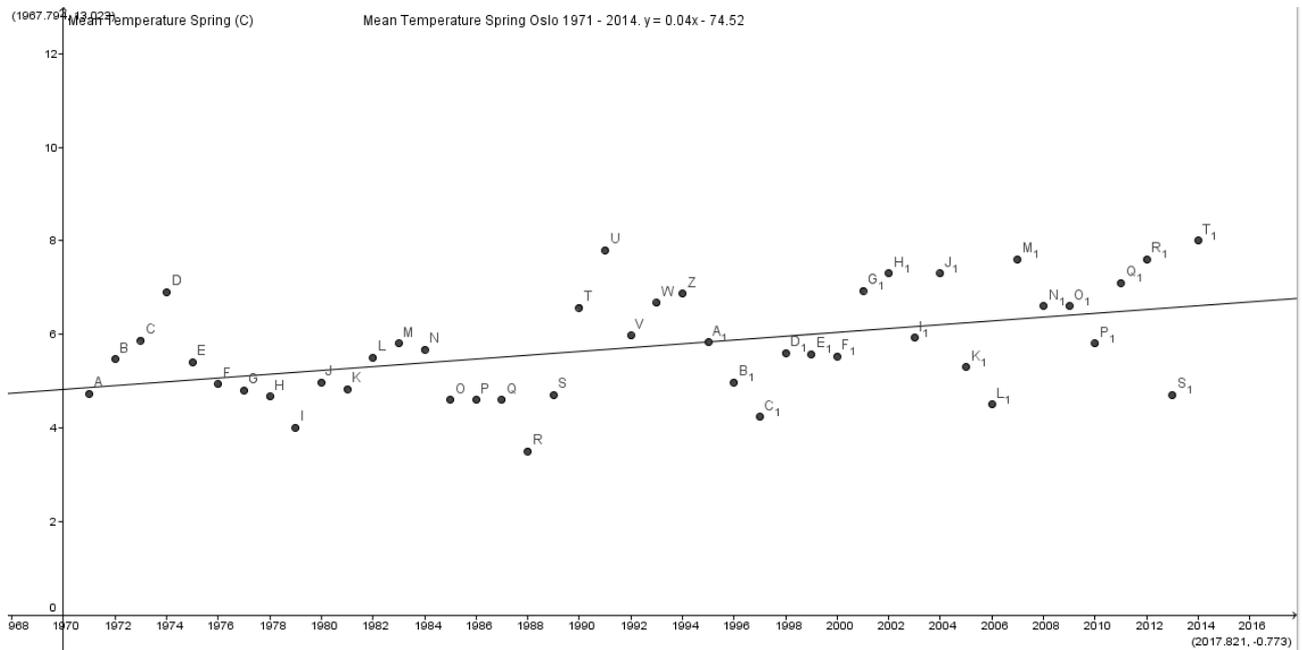
Graph for air temperature in Norway from 1971-2012. Slope = 0.02

We decided to look at the air temperature in the different seasons as well.

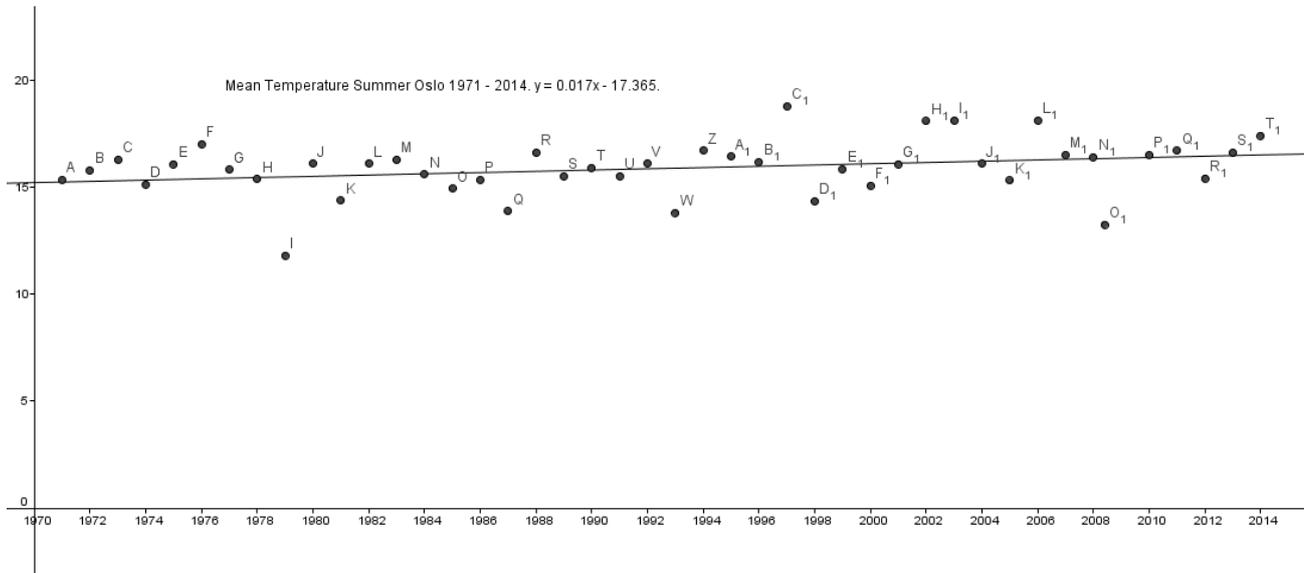
WINTER 1971-2014



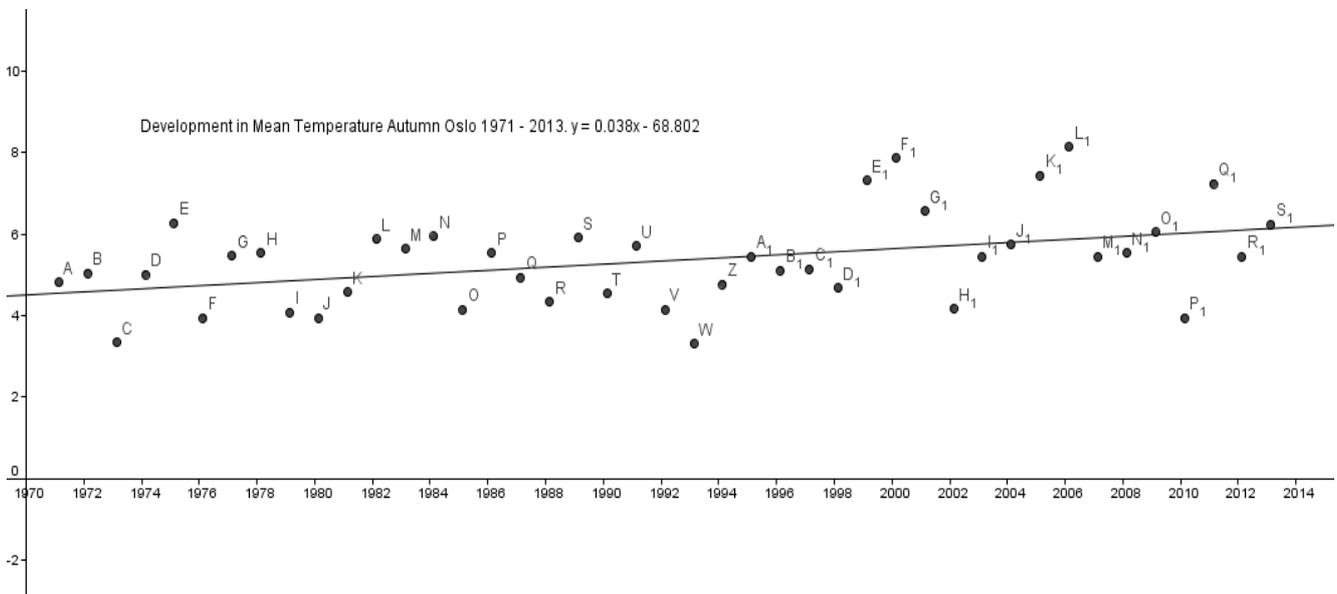
SPRING 1971-2014



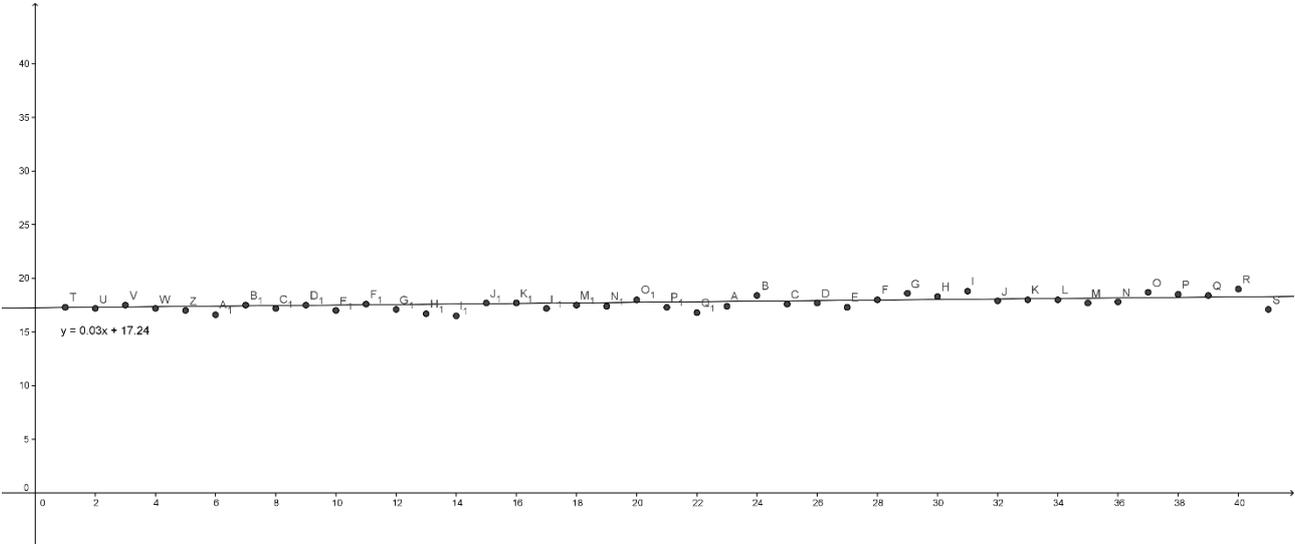
SUMMER 1971-2014



AUTUMN OSLO 1971-2013



4.2. Turkey – Aydın



Graph for air temperature in Turkey from 1971-2012. Slope = 0.03

5. Why has this happened?

5.1. Global warming

Global warming

There are many different reports that the temperature changes. Some believe that it is because of greenhouse graphs and some believe it is cosmic radiation and variations in the solar magnetic field.

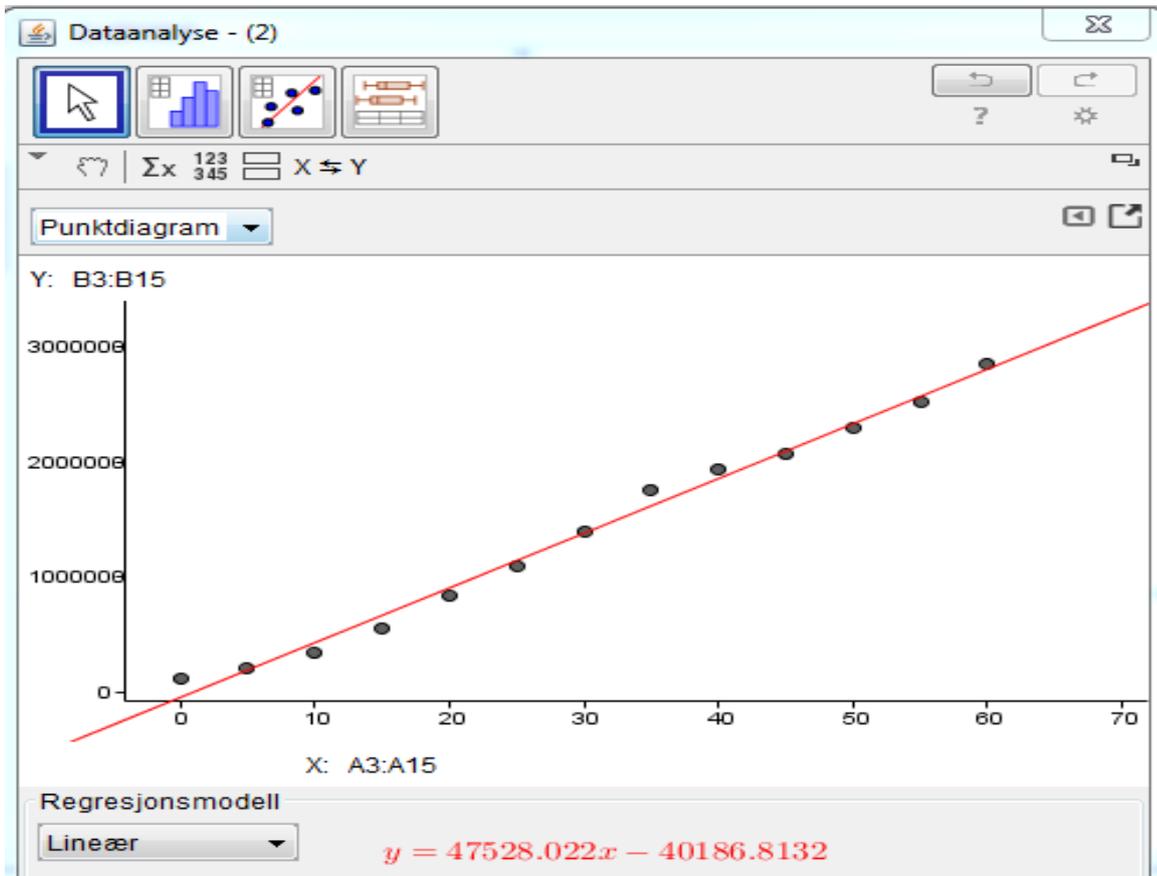
The greenhouse effect is not a new phenomenon and without the natural greenhouse effect the normal temperature of earth would be 33 degrees colder (Celsius). The natural greenhouse effect is due to clouds and various gases in the atmosphere trap heat radiated back from the earth. The gases that create a greenhouse effect, called a collective term for greenhouse gases (CICERO). Human activity reinforces this greenhouse effect. We humans also produce greenhouse gases that settle into the atmosphere by burning oil, coal and gas, this increases the greenhouse effect. Human activities also increases mean when we run with deforestation. When we are doing deforestation, it causes the woods absorb less CO₂ through photosynthesis.

The greenhouse effect

The sun heats the earth's surface, which then emits heat energy. Greenhouse gases prevent this heat energy from disappearing into space. The sun emits short-wave electromagnetic radiation toward Earth. 25% is reflected back to space, 20% is absorbed gradually into the atmosphere, 5% being reflected on the ground, particularly in areas covering of snow and ice. 50% is absorbed by the soil surface.

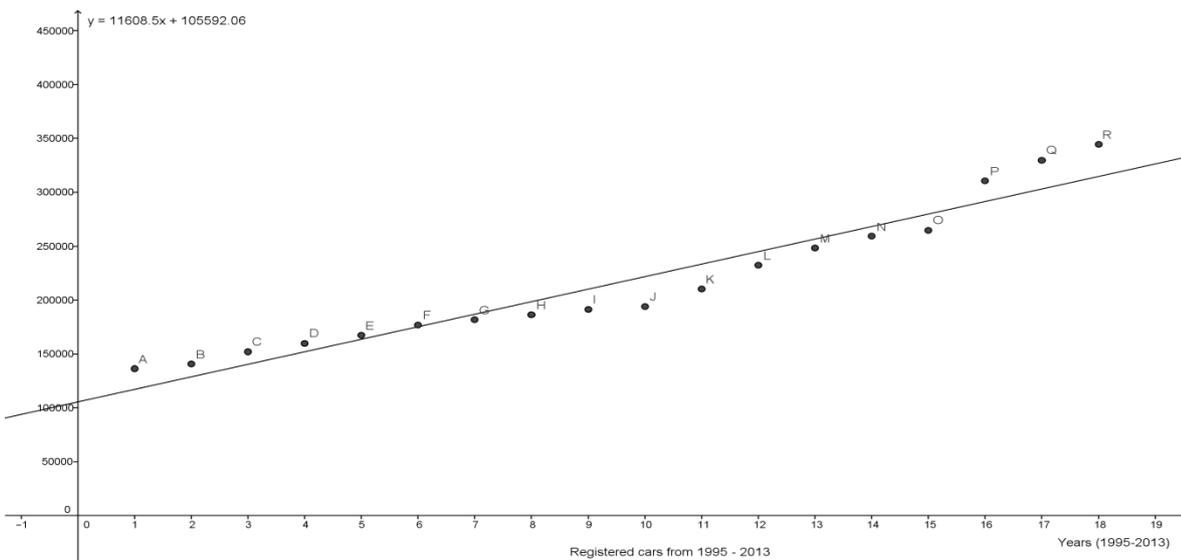
5.2. Cars and pollution

Graph norway – number of cars has exploded, what will happen if this continues?



Registered cars from 1950 until 2010 in Norway. (x=0 refers to year 1950)

Graph Turkey



Registered cars from 1971-2012 in Turkey

6. Consequences

6.1. Norway

Consequences of climate change in Norway

- Agriculture could be better. Those who are engaged in the cultivation of food such as grain, vegetables, potatoes Etc. for longer seasons to harvest their food. When they get longer and warmer periods, the growth potential increases and we will get better opportunities to grow other food products that we usually do not have in Norway for example oranges and lemons. Some places in Norway can also be drought damage in the summer and growth potential can be destroyed. It can also be more surface water in areas with high rainfall and this can lead to increased attacks by fungi and pests. This will again lead to expensive costs for the society.
- Estimated strong warming of surface waters in our waters can alter species composition and behavior of the marine ecosystem. Climate change may also affect one of the most important trades, fishing. If the climate increases, the sea temperature increases and there will be difference in species. Climate change may lead to it being increased production in the northeast Arctic cod stock and less production in Norway.
- Climate change reduce ice cover in Norwegian rivers and lead to increased mortality of salmon fry. Coast south of Norway may be unsuitable for salmon farming, while the potential may increase along the coast off northern Norway.
- Climate change will also create problems for Norwegian houses and buildings. More intense precipitation involves greater risk for moisture and mold damage, and several basement flooding unless drainage capacity is increased.
- Climate change is not expected to cause major changes in the potential for wind and solar, but climate change leading to more precipitation can lead to financial gain due. Norway ways to use hydropower to generate electricity. Climate change can also lead to economic costs, and it can be expensive to build out the magazine capacity with adequate dam safety.
- Weather and climate are important for people's travel patterns. Climate change could therefore have significant local impacts on places with great weather dependent tourist industry, such as winter destinations or glacier tourism.
- Species that are adapted to the Arctic environment is particularly vulnerable to climate change
- Sami existence is rooted in traditional resource-based activities, which will be affected

significantly by climate change. International agreements to ensure indigenous peoples' right to preserve their culture, including through ensuring conditions for the traditional business activity. Climate change will have major consequences for reindeer herding, while the effects of other traditional Sami employment is poorly documented.

6.2. Turkey

Consequences of climate change in Turkey

- The slide of the winter months to the spring.
- The average precipitation of April 2015 remains much lower comparing to average of many years precipitation
- The late arrival and late leave of the winter season.
- During the years 2009 and 2012 positive anomalies on precipitation have been absorbed.
- In Central Anatolia the overusage of ground water caused lake draughts and running out of the water springs.
- The regions that grow corn have been affected positively on the other hand the regions growing apples have been affected badly by the global warming.

6.3. What will happen in 20-30 years?

6.4. Norway

Climate change will probably lead to the greatest changes in the growing season on the west coast, in Nordland and in the northern parts of the country. Oslo, Trondheim areas and inner parts of Finnmark plateau will get at least change. Longer growing season is expected to contribute to better growth conditions, higher yields and larger areas may be suitable for cultivation, and with greater scope for choice of crops. It should nevertheless be considered that other factors such as the need for irrigation may increase in areas with less rainfall and higher temperatures, more precipitation in other periods may increase the erosion and nitrogen turnover in the soil. The industry itself is concerned that the increase in moisture and rot and the development of new types of plant disease must be carefully monitored under changing climate conditions.

6.5. Turkey

→Fertile plains will turn into deserts:

→Rivers will dry: Some touristic activities such as rafting on the rivers like Dalaman and Köprülü will no longer be available which will end in loss of income in tourism. Besides, we will have difficulty in irrigation of the fields with the water from the rivers. The disappearing of the streams and little rivers will have a negative effect on the routes of the birds travelling.

→There will be fewer springs. We will have problem to find fresh drinkable water.

→Some species will become extinct. This will affect Turkey's ecology in a bad way.

→Average temperatures will rise by 6 °C: Agricultural production of wheat, barley, maize, cotton, sugar beet, tobacco, sunflower, other oilseeds, olives, nuts, fig, tea, apricot, potatoes, grape will decrease but this increase in temperature might also let us grow new kind of fruits and vegetables.

→Our country will have less precipitation.

→The water level in dams will fall: Less energy will be gained from hydro- electric dams. As 34% of Turkey's electric necessity is provided by hydro – electric dams it will have devastating effects on energy production.

→The tropical- like climate caused by the slide of high-pressure line to the North will affect Turkey by irregular sudden and heavy precipitation and will cause floods, storms, tornados, land slide and erosion. These weather disasters will affect agricultural production in a very bad way.

→The migration routes followed by fish species will change: As Blacksea Region is a big fish exporter it will have a bad effect on Turkey's economy.

→Population will move to further North.

Student's experiences with this project :

Aydin Science High School, Aydin, Turkey

Text Arial, 12pt

Raelingen videregående skole, Raelingen, Norway

Text Arial, 12pt

List of our sources:

We have taken some parts of the Linear function, Quadratic Functions and Polynomial Functions of higher order notebook of the e-learning software *M@th Desktop 5.0* and edited it.

M@th Desktop 5.0 is based on *Mathematica*.

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