

# Climate change - Nothing but data

12. november 2017

## Filter out

- ▶ Subjective experiences
- ▶ Beliefs

## Have a look

- ▶ Geological data
- ▶ Icecore data
- ▶ Direct measurements

## Validation of data

- ▶ Indirect measurements
- ▶ Very different geografi, animals, plants
- ▶ Very long periods of time

## Conclusion

- ▶ Climate has changed in the past
- ▶ The tilt of the Earth and position of the continents play a vital role in climate
- ▶ It has been hotter and cooler than today
- ▶ We need to know how to terraform a planet

## Validation of data

- ▶ Indirect measurements
- ▶ In a closed system  $\text{CO}_2$  and O isotopes is both a way to measure temperature

## Conclusion

- ▶ Climate has changed in the past
- ▶  $\text{CO}_2$  and temperature is correlated. This is not the same as saying they there is a cause and effect.
- ▶ Solar activity, volcanic eruption and ocean circulation play a role i climate and affect temperature directly.

## Validation of data

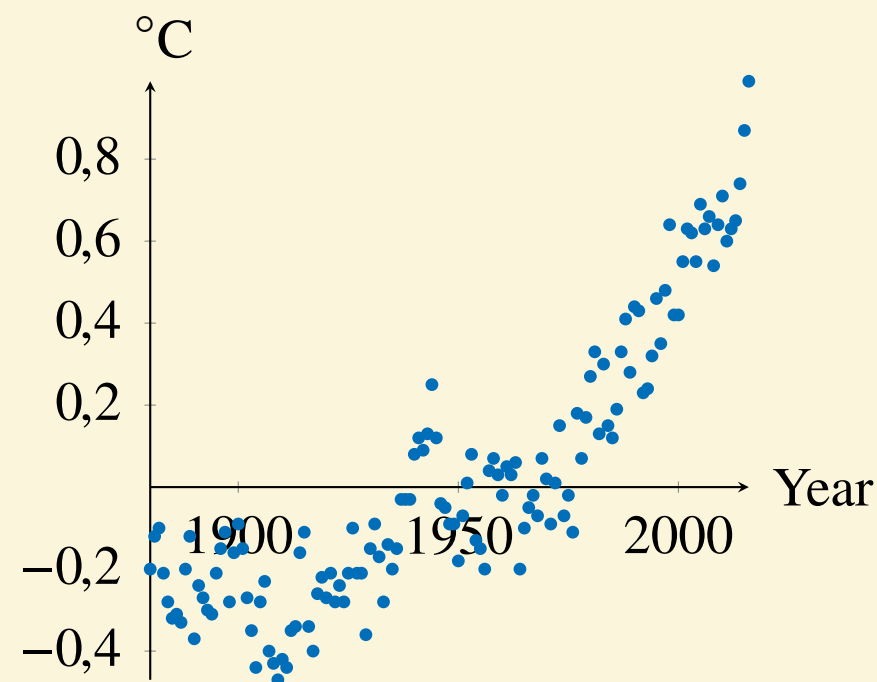
- ▶ CO<sub>2</sub> is measured using weather balloons (1958 - today)
- ▶ temperature is measured using satellites and thermometers (1881 - today)
- ▶ <https://climate.nasa.gov/>

## Analysis

- ▶ plotting temperature over time

## Conclusion

- ▶ The temperature has changed and it is getting hotter



## Validation of data

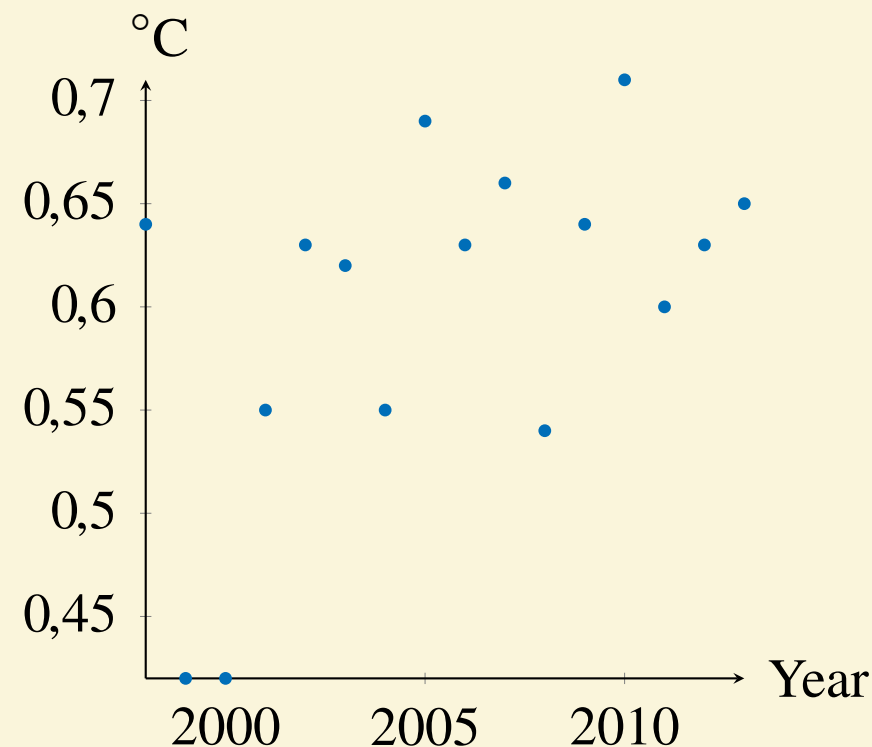
- ▶ CO<sub>2</sub> is measured using weather balloons (1958 - today)
- ▶ temperature is measured using satellites and thermometers (1881 - today)
- ▶ <https://climate.nasa.gov/>

## Analysis

- ▶ closer look on 1998 - 2013

## Conclusion

- ▶ The temperature did not change in this period.



## Validation of data

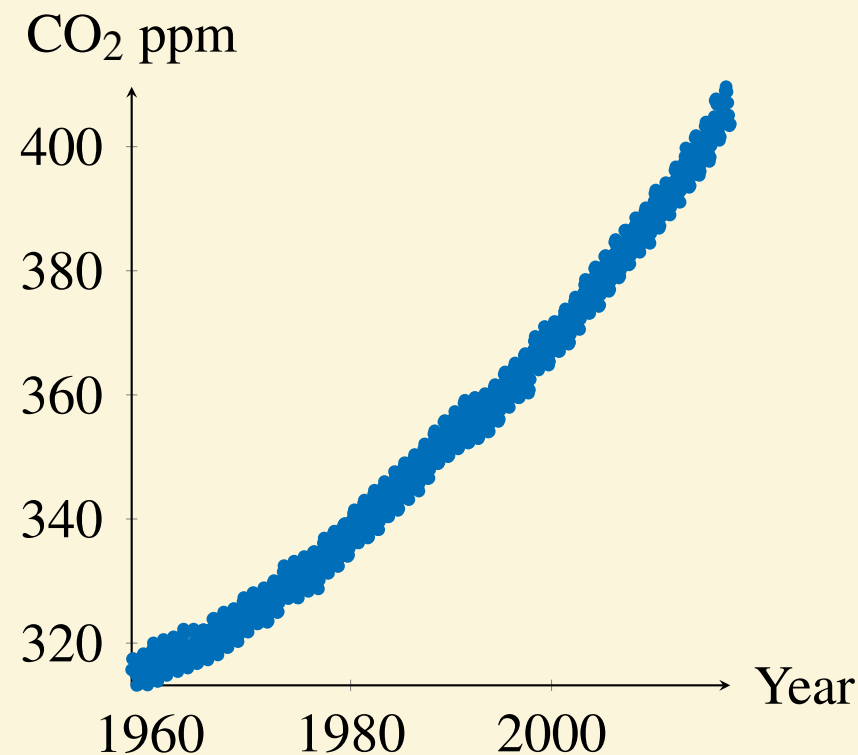
- ▶ CO<sub>2</sub> is measured using weather balloons (1958 - today)
- ▶ temperature is measured using satellites and thermometers (1881 - today)
- ▶ <https://climate.nasa.gov/>

## Analysis

- ▶ plotting CO<sub>2</sub> over time

## Conclusion

- ▶ The CO<sub>2</sub> has changed and here is more and more CO<sub>2</sub> in the air.



## Validation of data

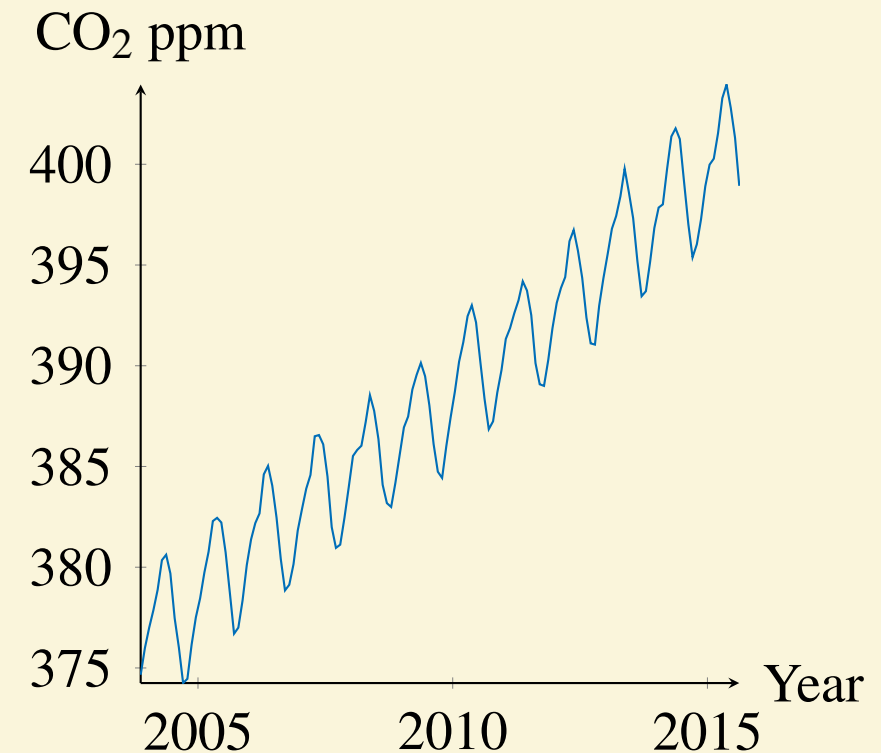
- ▶ CO<sub>2</sub> is measured using weather balloons (1958 - today)
- ▶ temperature is measured using satellites and thermometers (1881 - today)
- ▶ <https://climate.nasa.gov/>

## Analysis

- ▶ closer look on 2003 - 2016

## Conclusion

- ▶ The CO<sub>2</sub> changes with a period of 12 months.



## Validation of data

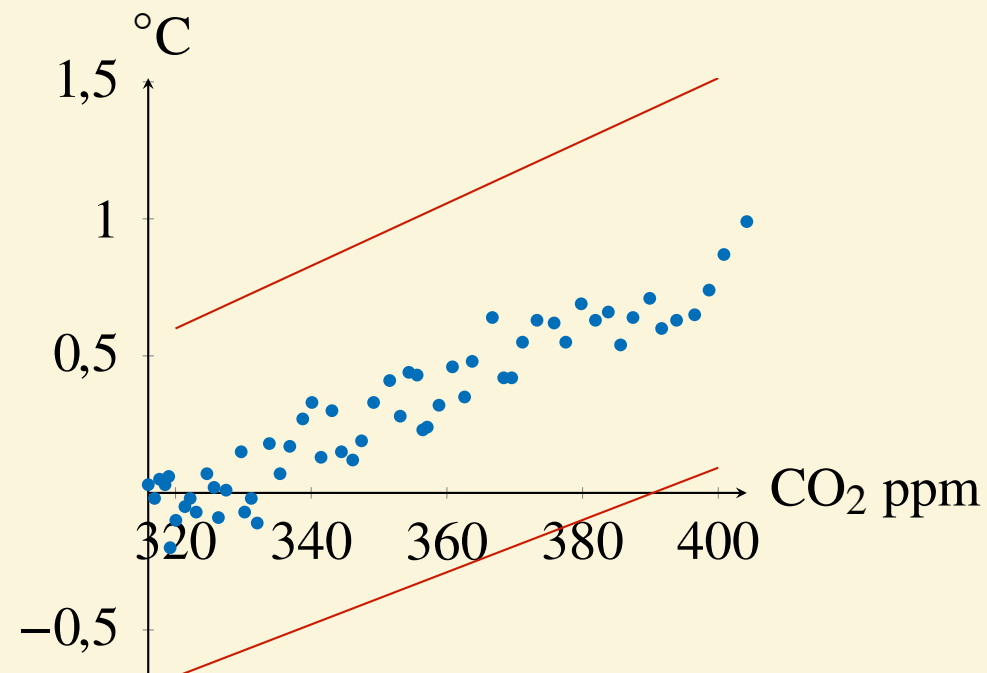
- ▶ CO<sub>2</sub> is measured using weather balloons (1958 - today)
- ▶ temperature is measured using satellites and thermometers (1881 - today)
- ▶ <https://climate.nasa.gov/>

## Analysis

- ▶ plotting temperature versus CO<sub>2</sub> from 1959 to 2016

## Conclusion

- ▶ Unclear relation between CO<sub>2</sub> and temperature,  $R^2 < 0.99$ .





## Validation of data

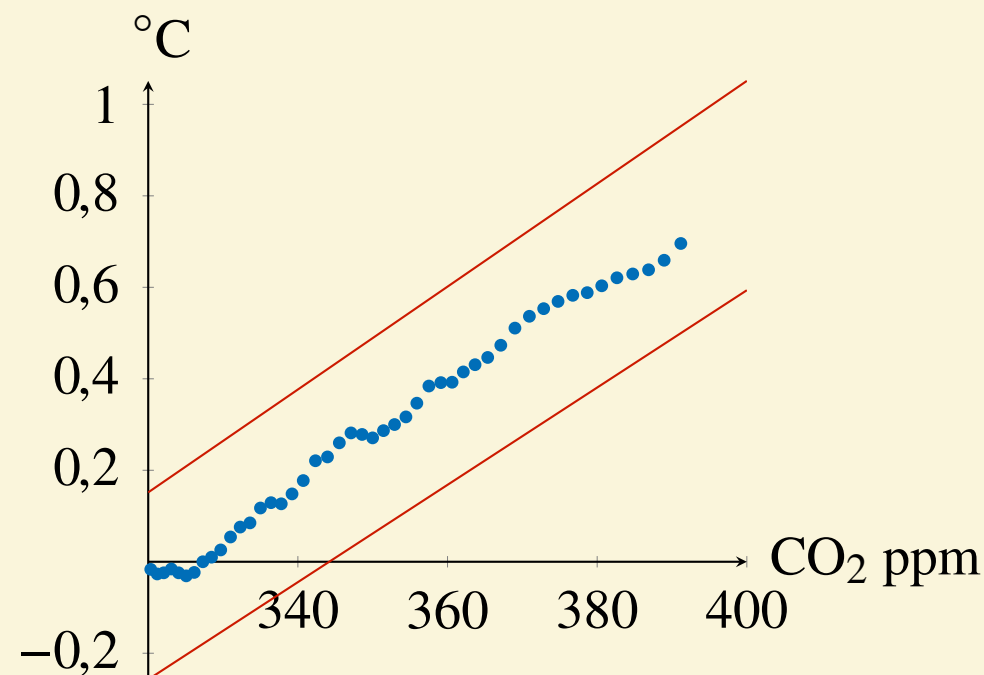
- ▶ CO<sub>2</sub> is measured using weather balloons (1958 - today)
- ▶ temperature is measured using satellites and thermometers (1881 - today)
- ▶ <https://climate.nasa.gov/>

## Analysis

- ▶ plotting moving average over a periode of 12 years temperature versus CO<sub>2</sub> from 1959 to 2016

## Conclusion

- ▶ Clear relation between CO<sub>2</sub> and temperature,  $R^2 > 0.99$ . And 10 ppm increase in CO<sub>2</sub> gives a 0.1°C temperature increase.



## Validation of data

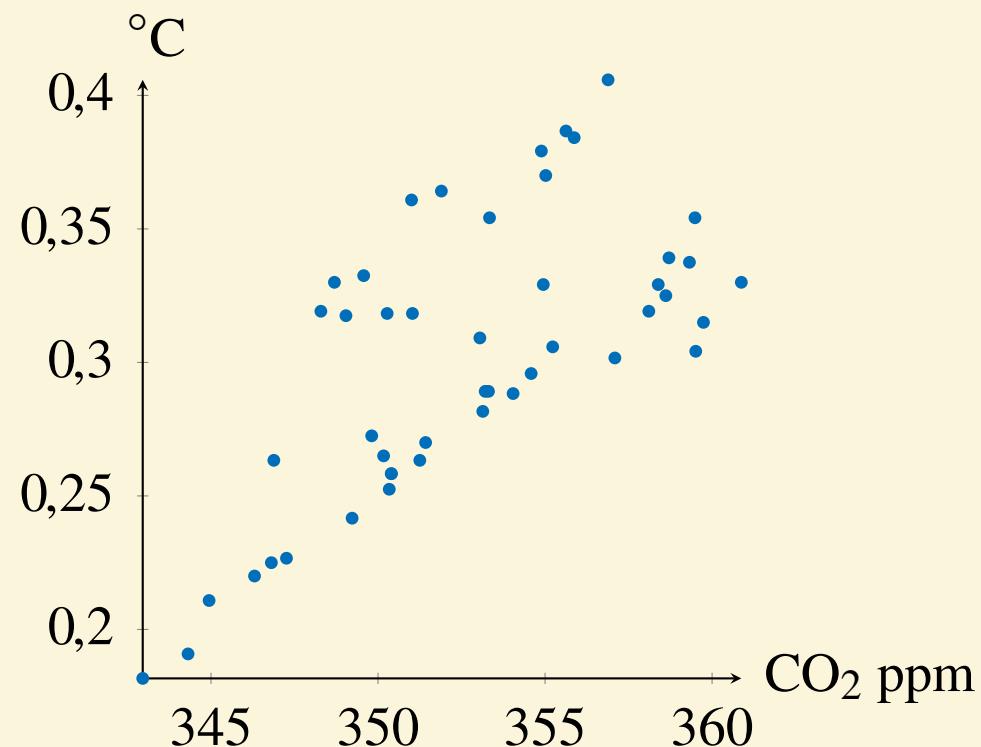
- ▶ CO<sub>2</sub> is measured using weather balloons (1958 - today)
- ▶ temperature is measured using satellites and thermometers (1881 - today)
- ▶ <https://climate.nasa.gov/>

## Analysis

- ▶ plotting moving average over a periode of 12 random years temperature versus CO<sub>2</sub> from 1959 to 2016

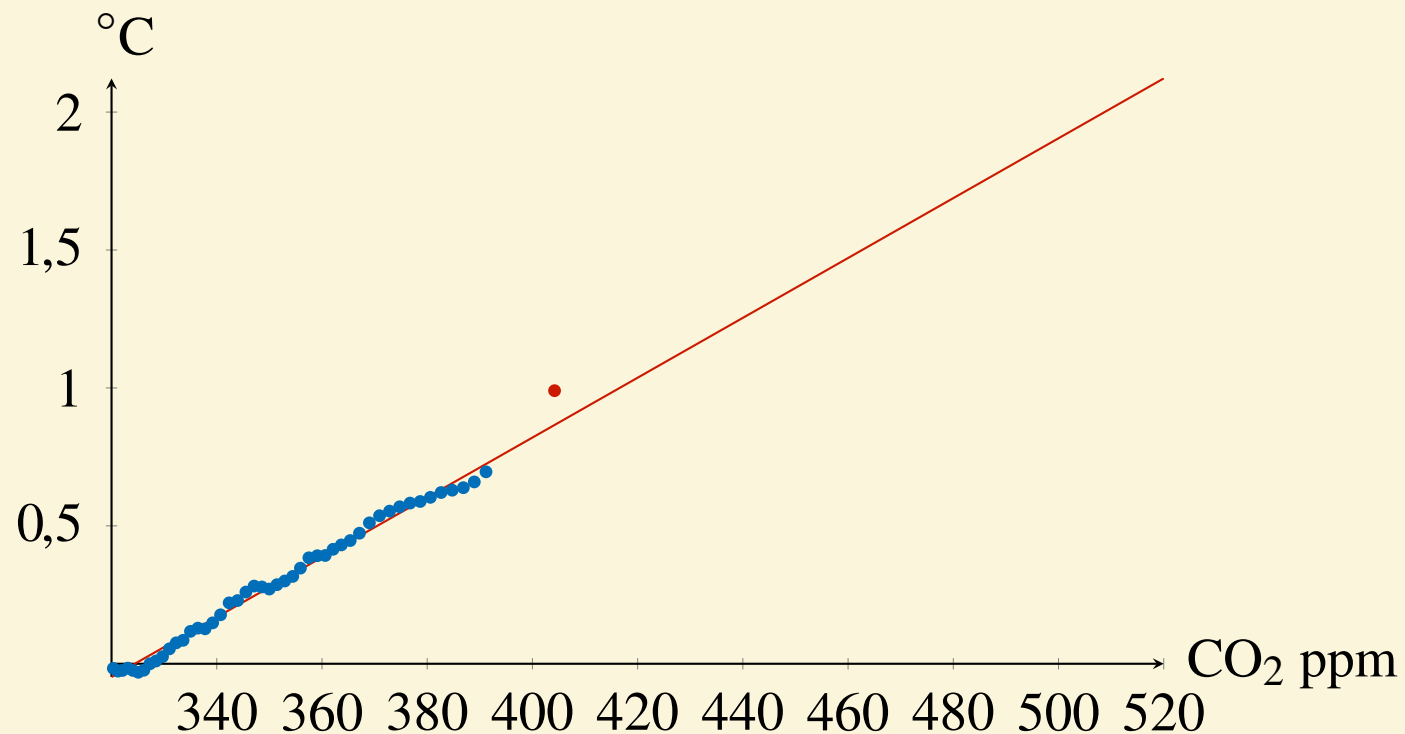
## Conclusion

- ▶ The relation between CO<sub>2</sub> and temperature has confounding bias.



# Climate change - Predictions

12. november 2017



When the 12 years moving average CO<sub>2</sub> ppm is 510 then will the 12 years moving average temperature be +2°C anomaly.

Every government use more money adapting to climate change the they use reducing CO<sub>2</sub> outlet.

## Energy sources

- ▶ organic fuels (fx wood, ethanol)
- ▶ ocean or lake heat
- ▶ wind, wave and solar power (- need storing)

## New habits

- ▶ plant trees (part of city planning, reduce CO<sub>2</sub>)
- ▶ recycle