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Human influences of climate change

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Partners

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- Which human activities produce greenhouse gases ?
- Are there other human activities which impacts on climate ?

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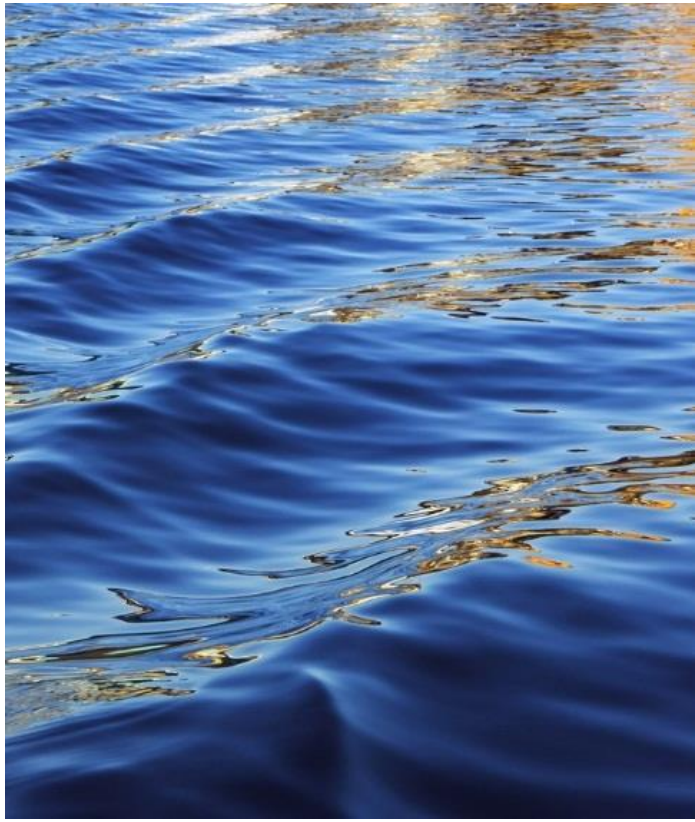
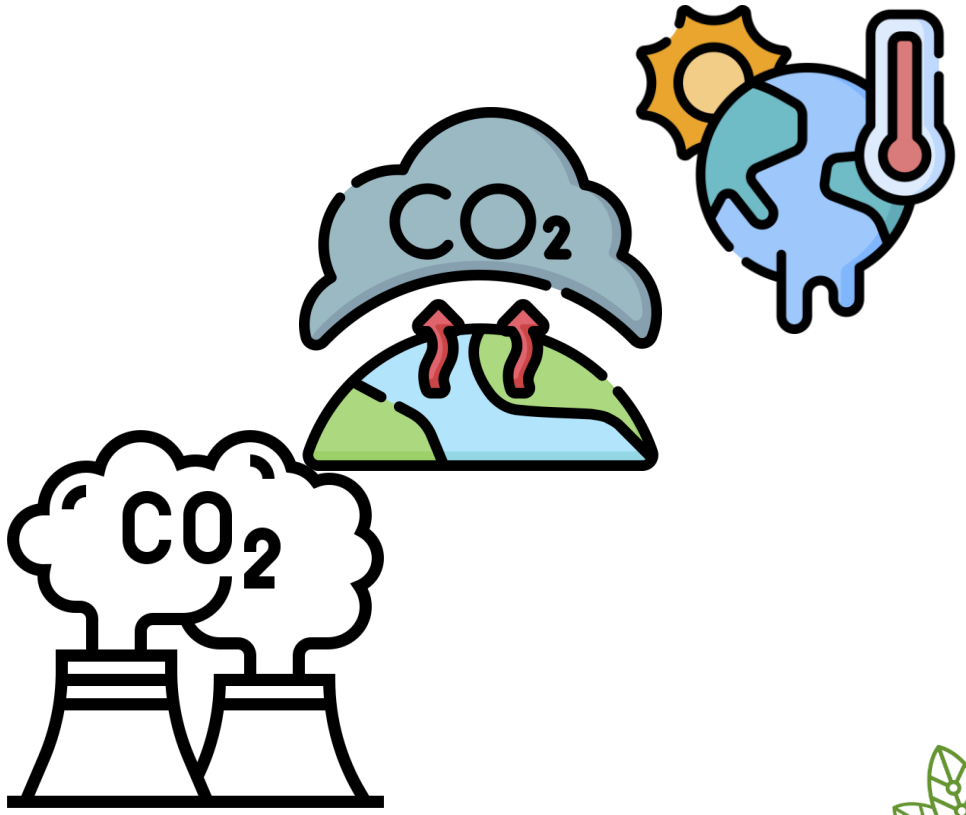
Global warming is due to human greenhouse gases emissions



Global warming is due to human greenhouse gases emissions

- How are we sure that human activities are responsible of the global warming ?
- What is the difference with natural warming or variability ?



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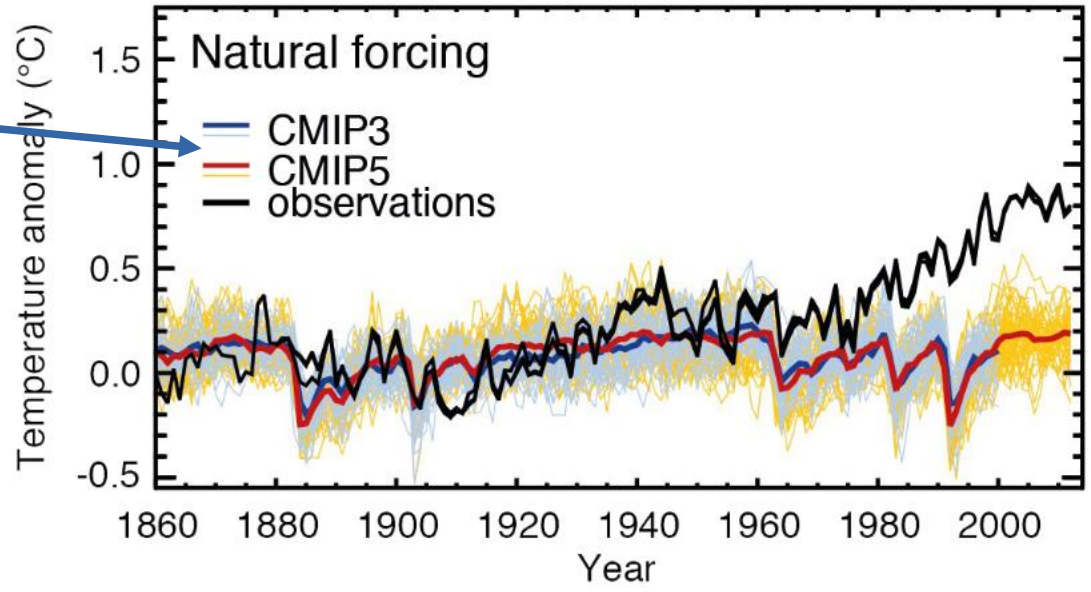
Natural warming

- **Black curve** is the observed warming
- **Red and blue curves** are simulations of the temperature evolution with only natural factors
  - Astronomical parameters (Sun-Earth distance)
  - Solar activity
  - Volcanic activity
- Conclusion :
  - simulated temperatures do not represent the observed temperature



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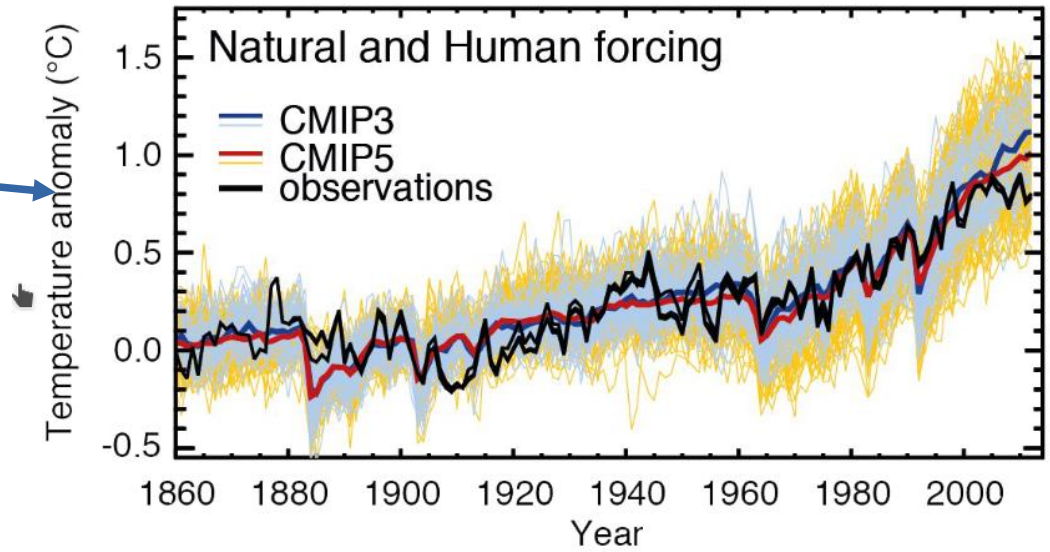
Natural + human warming

- **Black curve** is the observed warming
- **Red and blue curves** are simulations of the temperature evolution with natural factors + human factors :
  - Astronomical parameters
  - Solar activity
  - Volcanic activity
  - Greenhouse gases emissions
  - Land use changes
  - Others humans activities
- Conclusion :
  - simulated temperatures represent the observed temperature



Source : https://www.ipcc.ch/site/assets/uploads/2018/02/FigFAQ10.1-1-1.jpg

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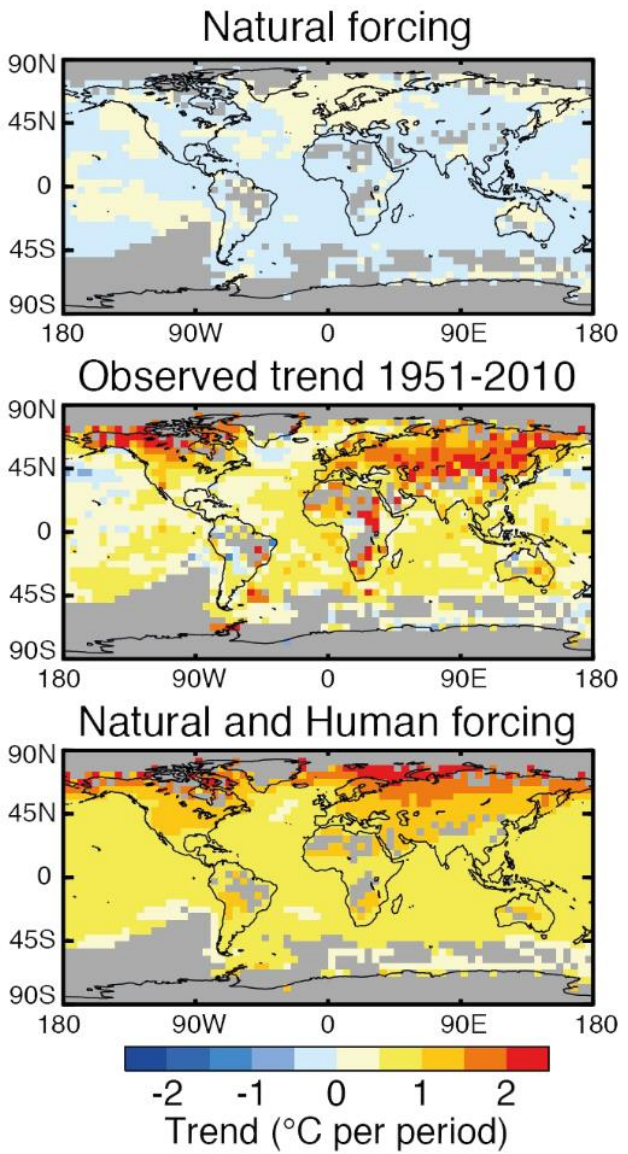
Same exercise in 2D

- This is the observed trend of temperature



Same exercise in 2D

- This is the simulated trend of temperature with only natural factors
  - Astronomical parameters
  - Solar activity
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- Conclusion :
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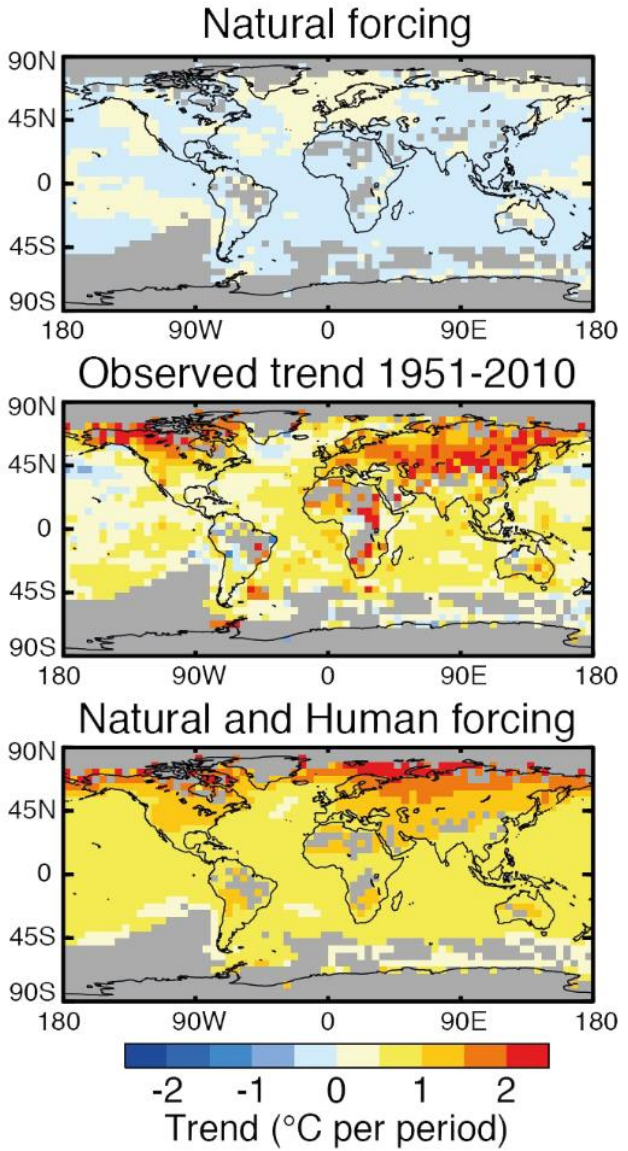
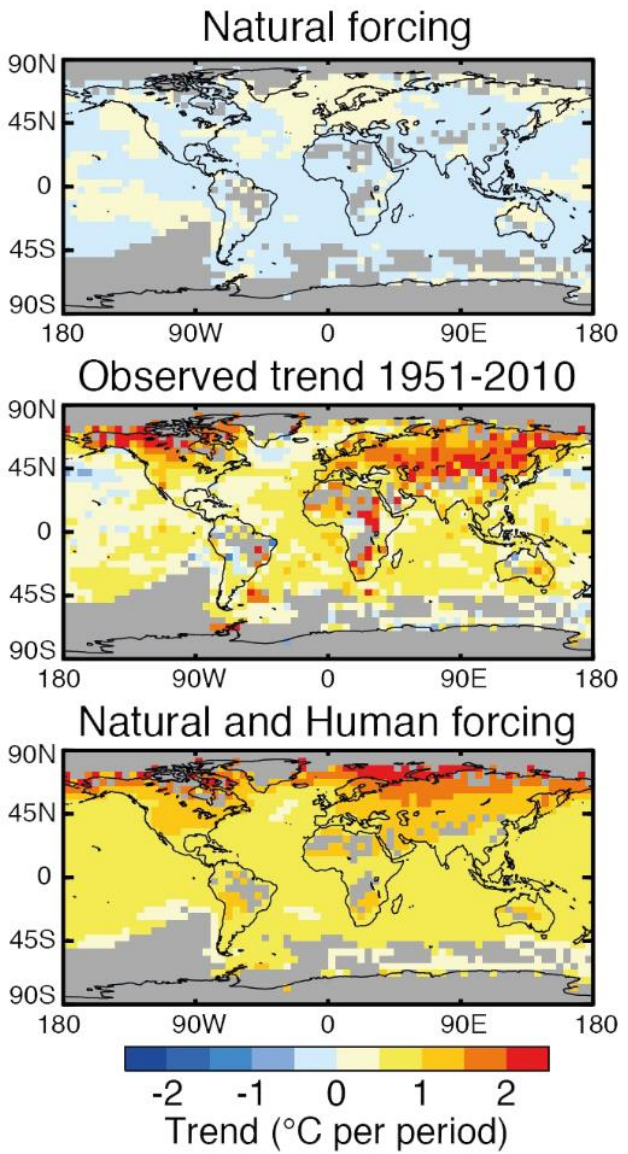


Same exercise in 2D

- This is the simulated trend of temperature with natural factors + + human factors
  - Astronomical parameters
  - Solar activity
  - Volcanic activity
  - Greenhouse gases emissions
  - Land use changes
  - Others humans activities
- Conclusion :
  - simulated temperatures represent the observed temperature



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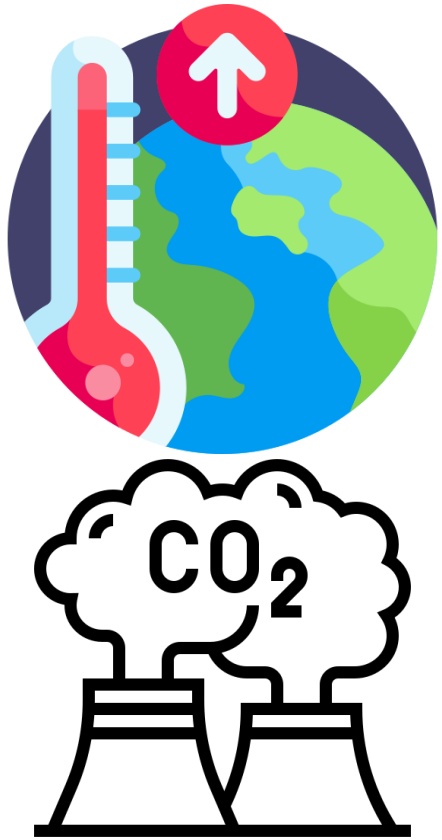
This modeling exercise teaches us two important things:

- evolution of current temperatures can only be explained by taking into account both natural and human factors
- Warming related to human factors is much larger than the warming related to natural factors alone
  - +0.1°C of increase attributed to natural factors
  - +0.5 and +1.3°C of increase attributed to human activities



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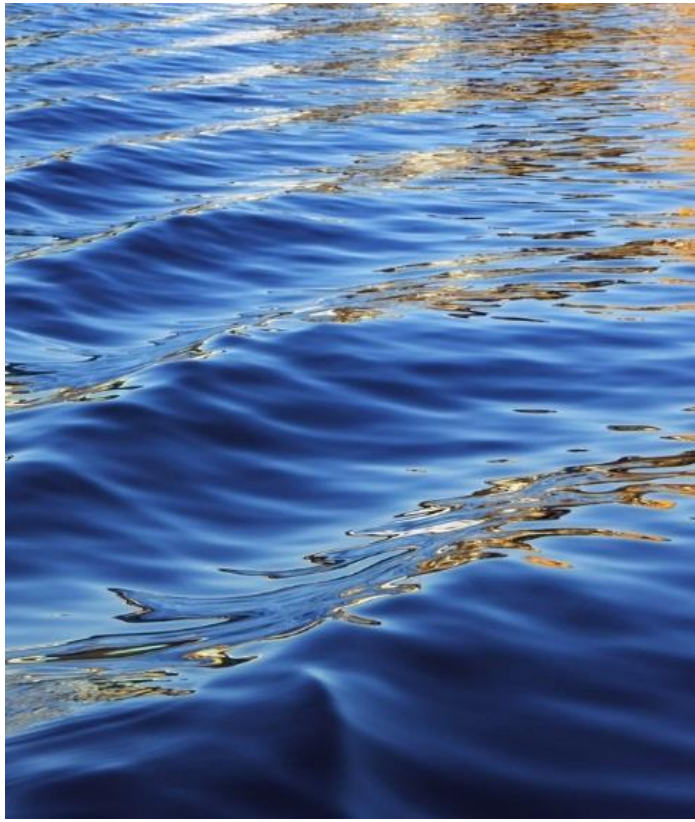
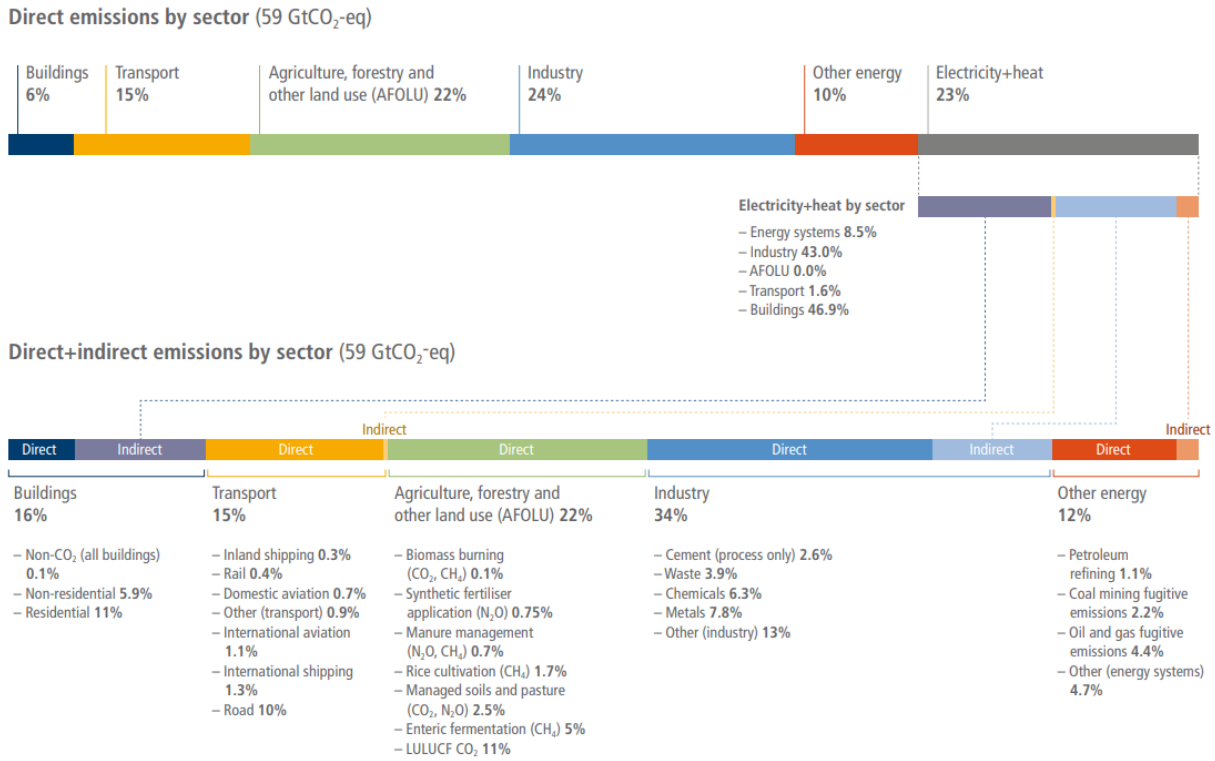
Which human activities produce greenhouse gases ?



Which human activities produce greenhouse gases ?

- In 2019, for the whole world :
  - 24 % : industry
  - 23 % : electricity and heat production
  - 22 % : agriculture, forestry and land use activities
  - 15 % : transports
  - 6 % : buildings
  - …



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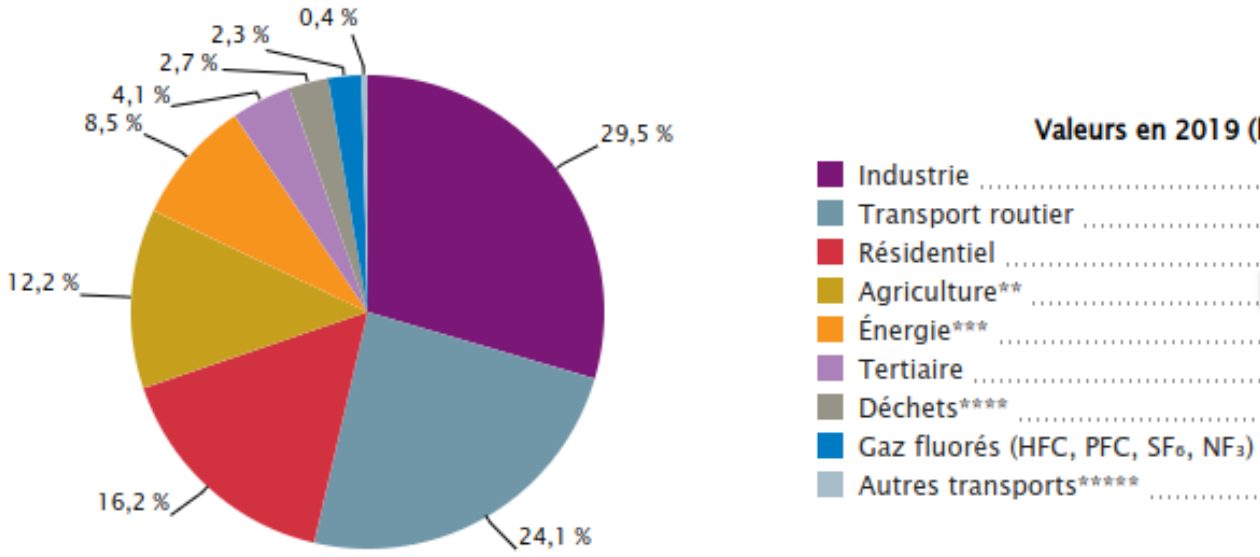
Is this the same distribution everywhere in the world ?

Which human activities produce greenhouse gases in french speaking part of Belgium ?

- In 2019, for the Wallonia :
- 29 % : industry
- 24 % : transports
- 16 % : buildings
- 12 % : agriculture, forestry and land use activities
- 8 % : energy
- ...



Therefore, efforts to reduce emissions will have to be established differently for each country.

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What about emissions of schools ?

- Difficult to answer to this question
- School are part of the tertiary sector → 4 % of the greenhouse gas emissions
- One might think that this is not much
- But :
- Students use transport to go to schools → 24%
- Schools use energy → 8%
- To heat, to light, to use computer …
- Schools produce wastes → 3%
- Canteens of school use agricultural products → 12%
- Schools furniture are made by industries → 29%
- schools have a lot of power to reduce their greenhouse gas emissions !

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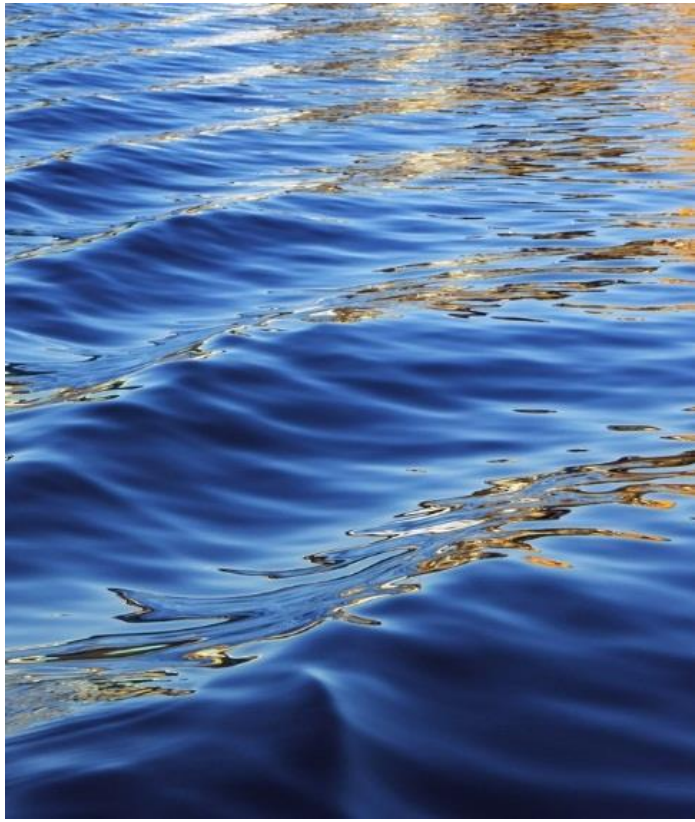
Are there other human activities which impacts on climate ?

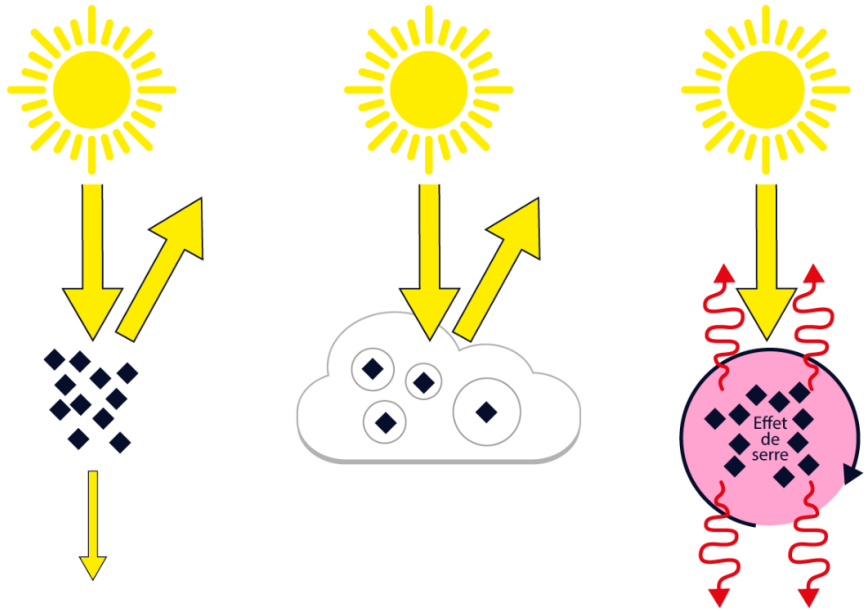


Are there other human activities which impacts on climate ?

- Yes :
  - Aerosols emissions 
  - Contrails 
  - Land use changes 

Aerosols emissions

- Double game :
  - Climate cooling
    - Sunshade effect
    - Condensation nucleus
  - Climate warming
    - Absorbing energy vs. emission of infrared radiation
  - → large sources of uncertainties



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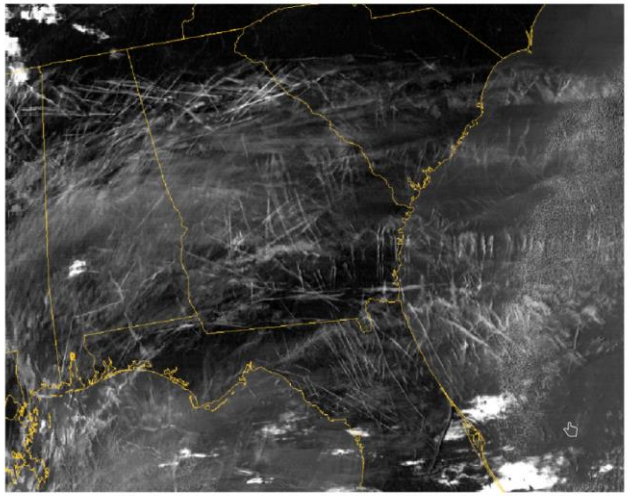
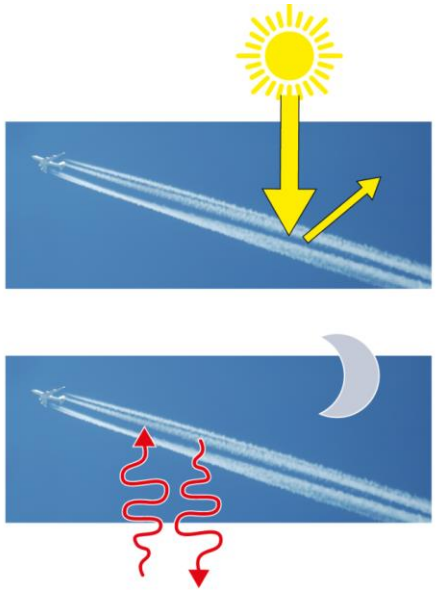
Contrails

- Formed by ice crystals
- During the day :
  - Contrails reflect the sun's ray
    - Cooling of the atmosphere
- During the night :
  - Contrails accentuate greenhouse effect
    - Increase temperature
    - Increase global warming





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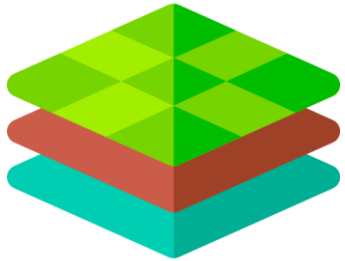
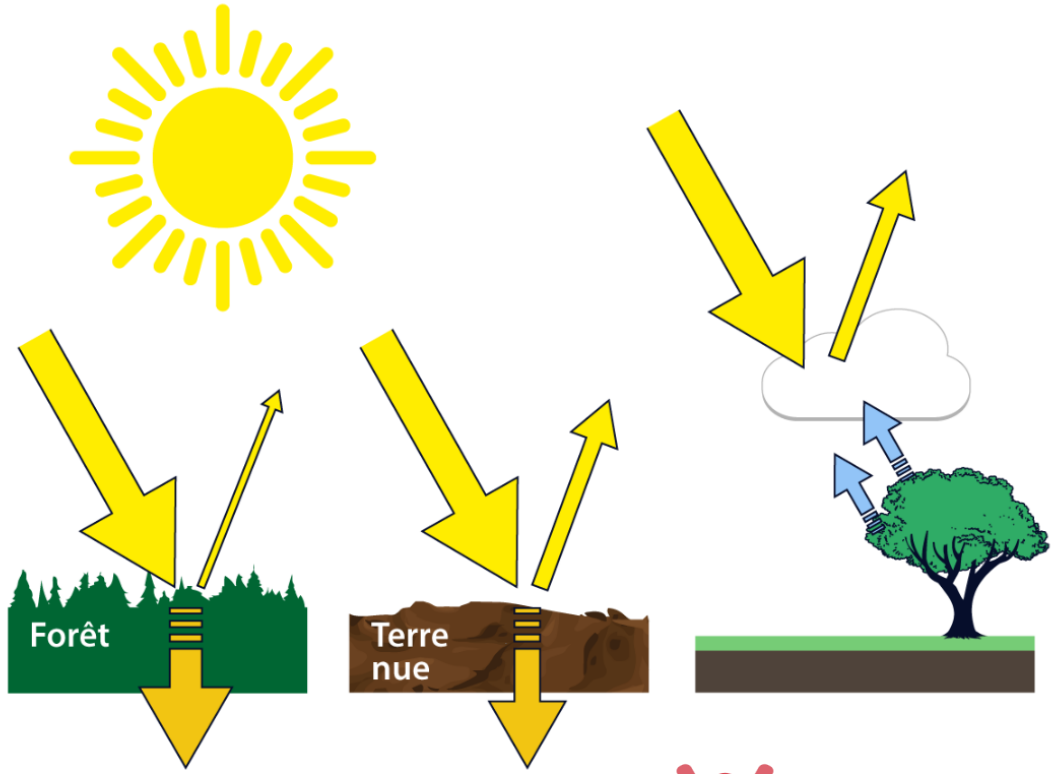
Landuse changes



- Landuse changes examples :
  - Urbanization
  - Deforestation
  - Reforestation
  - …
- Change of albedo (= % of sun ray reflected) will change radiative budget
  - And thus temperature
- Example with deforestation
  - Replace a forest by bare soil
  - Increasing albedo (forest = 15%, bare soil = 30%)
  - More energy is reflected by surface
    - Decreasing temperature
  - But also … Less trees
    - Less moisture
    - Less clouds (which can reflect solar radiation)
      - Increasing temperature
      - At global scale : less trees = more carbon in atmosphere



Influence of the "Landuse factor" on the global warming is very complex to understand with antagonistic effects

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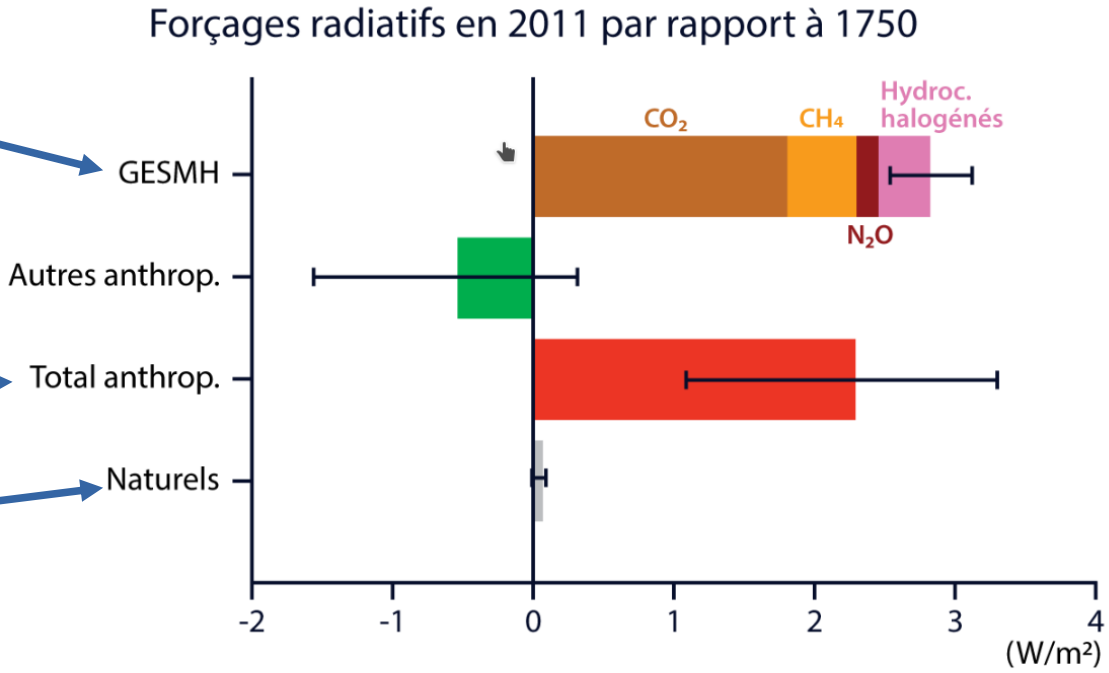
Conclusions of all humans factors

- The first line :
  - all the factors of the different greenhouse gases
- The second line :
  - other human factors (aerosols, land use, etc.)
- The third line :
  - a balance of the human factors
- The fourth line :
  - all natural factors (solar energy, astronomic factors, volcanic activity)
- This figure is very clear :
  - Even taking into account the margin of uncertainty, human activities participate almost fully to global warming.



Source : https://www.ipcc.ch/site/assets/uploads/2018/02/SYR_AR5_FINAL_full_fr.pdf

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