

 EN-GB

Adults



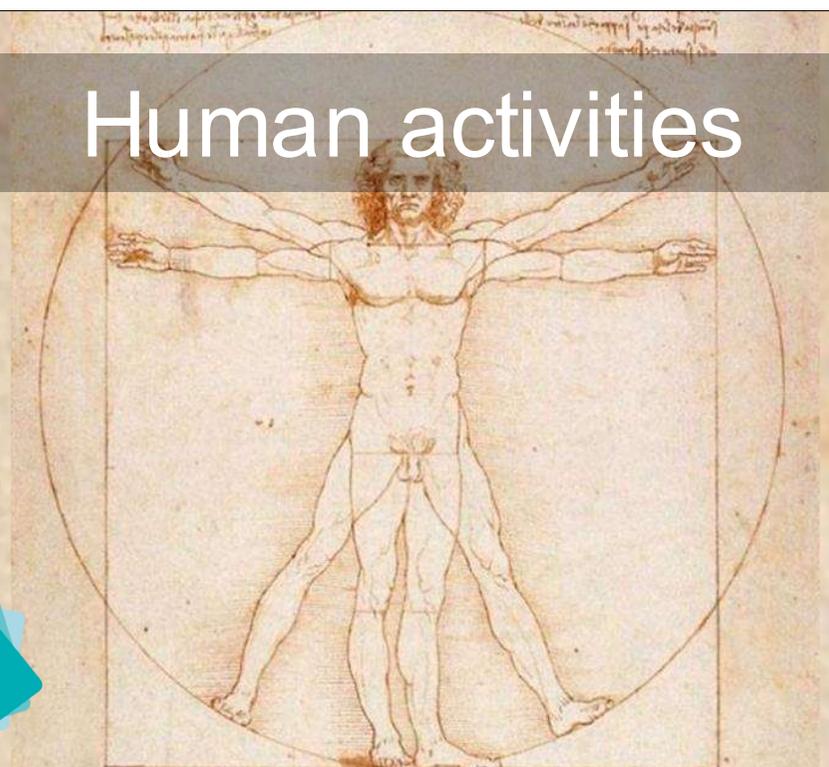
CLIMATE FRESH

All the cards are in your hands!

The Climate Fresh - EN-GB - Adults - V7.3.1 - 22/07/2021

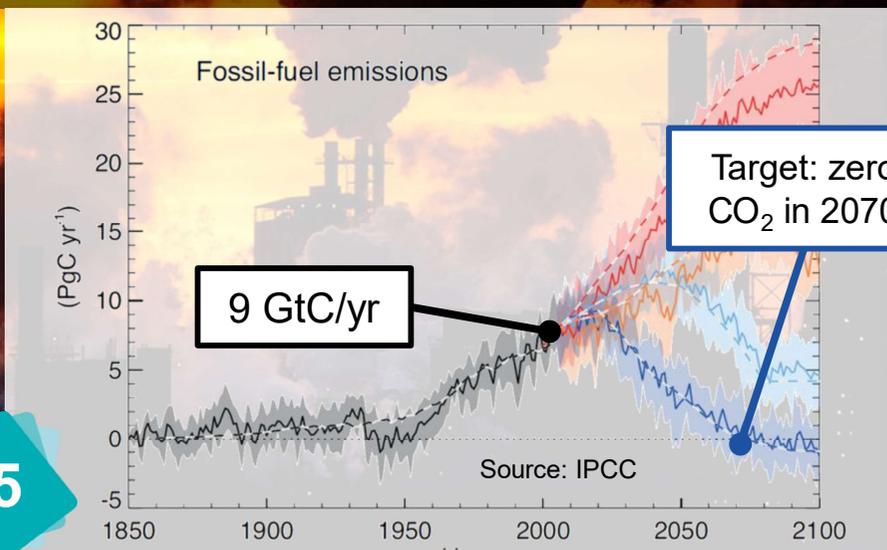
Human activities

1



Fossil Fuels

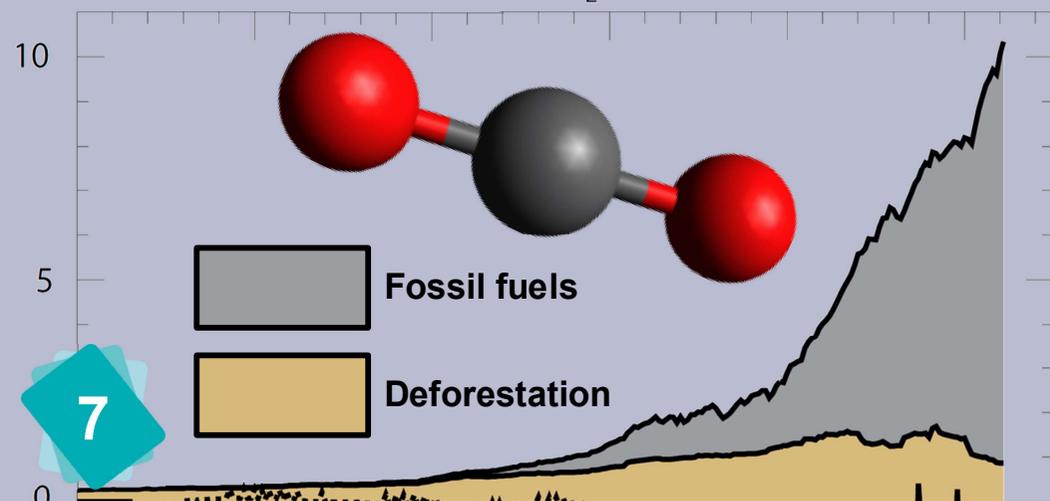
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CO₂ Emissions

7

Annual anthropogenic CO₂ emissions (PgC yr⁻¹)



5

Fossil fuels are coal, oil, and natural gas. They are used mainly in buildings, transportation, and industry. They emit CO₂ when burned.

Set 1

7

CO₂ (or carbon dioxide) is the first anthropogenic (ie linked to human activity) greenhouse gas in terms of emissions. These emissions come from our use of fossil fuels and deforestation.

Set 1

How to play?

You need one deck of cards per team (6 to 8 pp), a paper roll or tablecloth of 1*2 meters, pencils, rubbers, colour felt pens and some tape.

The aim is for each team to place the cards in order on the table, find all the cause and effect relationships and draw arrows between the cards to illustrate what climate change is about.

Deal the cards set by set and wait until all cards are down on the table before dealing the next set.

Time indications: ~1hour to place the cards, ~1hour to decorate the Fresk and ~1hour to sit down together for a heart-to-heart discussion.



Reasoning



Creativity



Review



Debrief

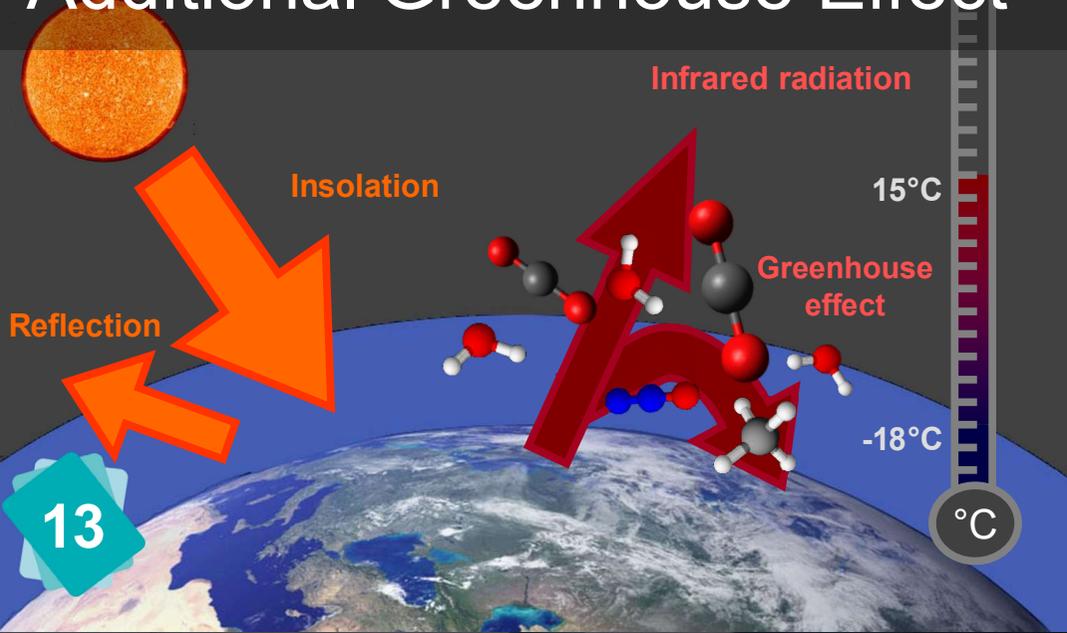
For a simpler (or quicker) version of the game, take off cards #10, #14, #15 and/or #41, #42.

1

That is where it all begins...

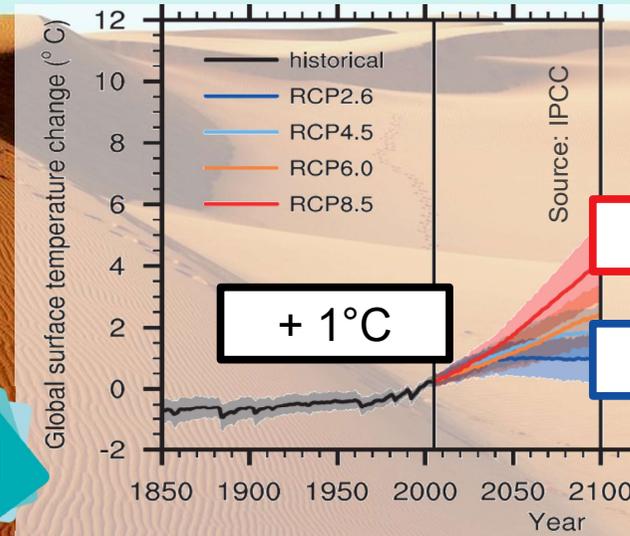
Set 1

Additional Greenhouse Effect



13

Temperature Rise



21

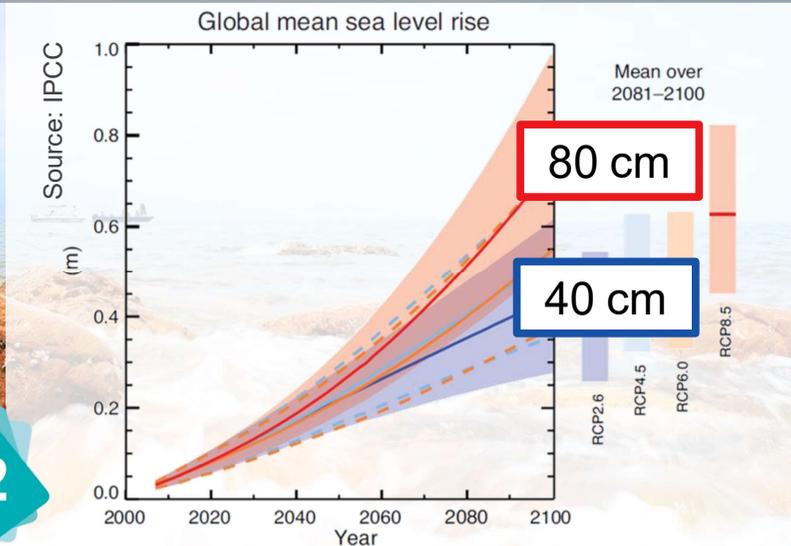
Melting of Sea Ice



18

Photo : NASA

Sea Level Rise



22

18

The melting of sea ice is not responsible for sea level rise (an ice cube that melts in a glass of water doesn't make the water overflow the glass). However, as sea ice melts, it leaves space for a much darker element (the sea), which therefore absorbs more sun rays than white ice.

Set 1

22

Since 1900, sea level has risen by 20 cm. Sea level rise is caused by the thermal expansion of ocean waters, and the melting of glaciers and continental glaciers.

Set 1

13

The greenhouse effect is a natural phenomenon (by the way, the first GHG is water vapor). Without greenhouse effect, the planet would be 33°C colder and life as we know it would not be possible...But CO₂ and other GHGs related to human activity increase the natural greenhouse effect and unbalance the climate.

Set 1

21

Here we are referring to the average temperature of air above the ground on Earth. It has increased by 1°C since 1900. Depending on the scenarios, the rise in temperature could reach 2°C to 5°C by 2100. At the end of the last ice age years, the average temperature was only 5°C lower than today's... And deglaciation lasted 10,000 years!

Set 1

Industry



2

3

Transportation



4

6

4

The transportation sector is highly dependent on oil. It accounts for 15% of greenhouse gas emissions.

Set 2

6

Deforestation consists in cutting or burning trees beyond the ability to restore the forest. 80% of the deforestation is related to agriculture.

Set 2

2

Industry uses fossil fuels and electricity. It accounts for 40% of greenhouse gas (GHG) emissions.

Set 2

3

The building sector (housing and commercial use) uses fossil fuels and electricity. It accounts for 20% of greenhouse gas (GHG) emissions.

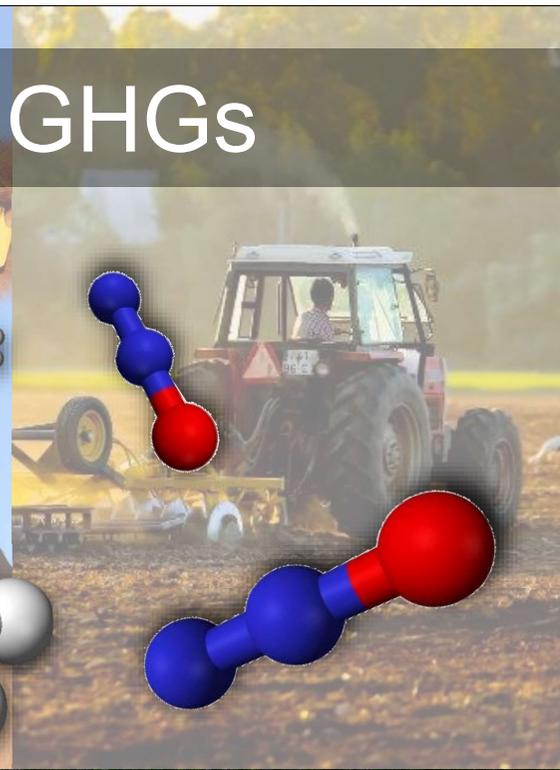
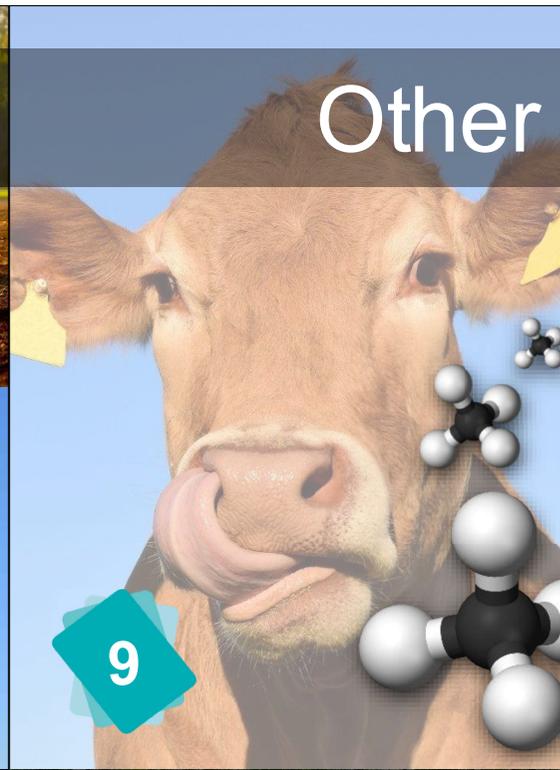
Set 2

Agriculture



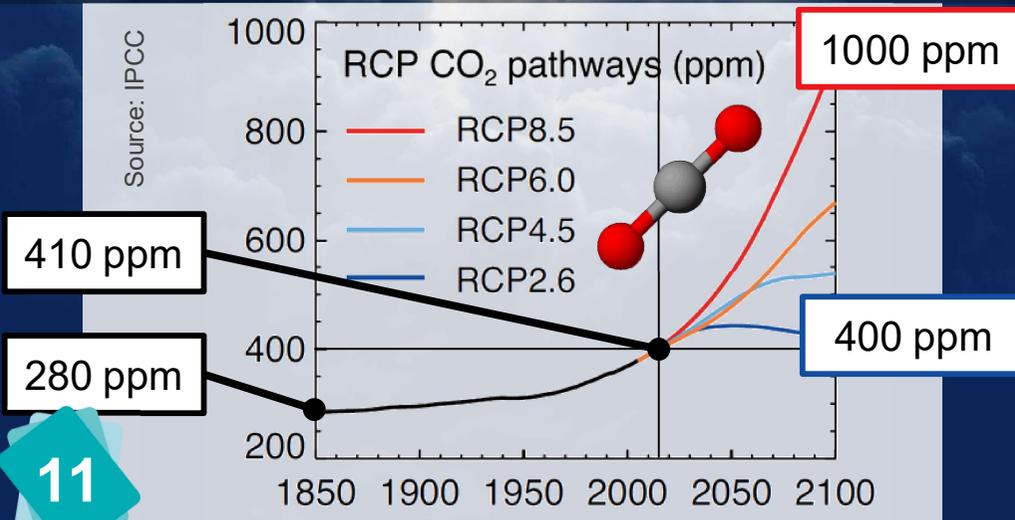
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Other GHGs



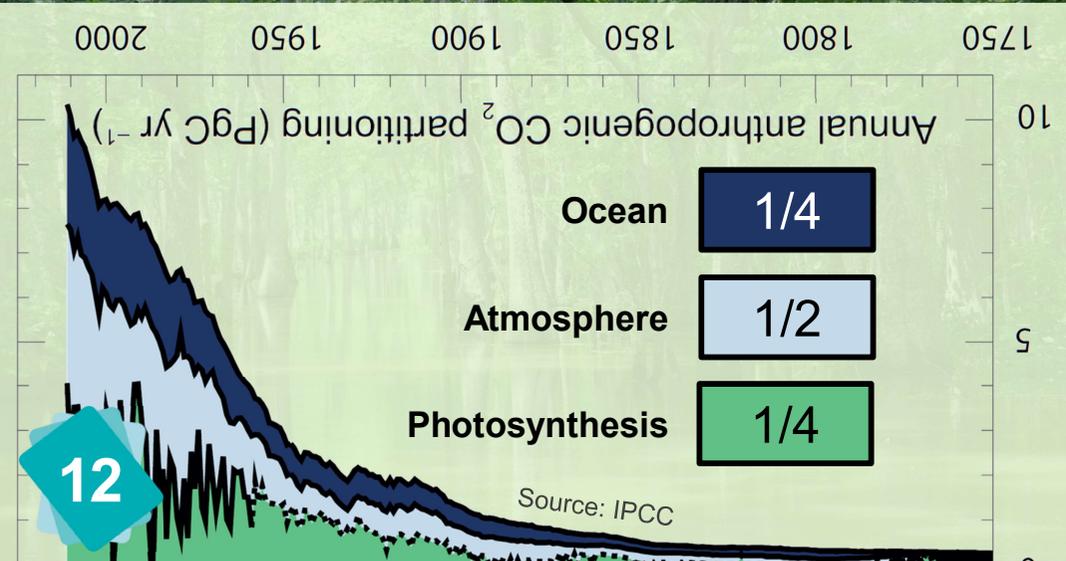
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Concentration of CO₂ (ppm)



11

Carbon Sinks



12

11

About half of our CO₂ emissions are captured by natural carbon sinks. The other half remains in the atmosphere; the concentration of CO₂ in the air has increased from 280 to 410 ppm (parts per million) in 150 years.

Set 2

12

Half of the CO₂ we emit every year is absorbed by carbon sinks:

- 1/4 by the vegetation (through photosynthesis)
- 1/4 by the ocean

The remaining half (1/2) stays in the atmosphere.

Set 2

8

Agriculture does not emit a lot of CO₂, but is responsible for the emission of methane (cows and paddy fields) and nitrous oxide (fertilizers) in high quantity. In all, it is 25% of GHGs if we include induced deforestation.

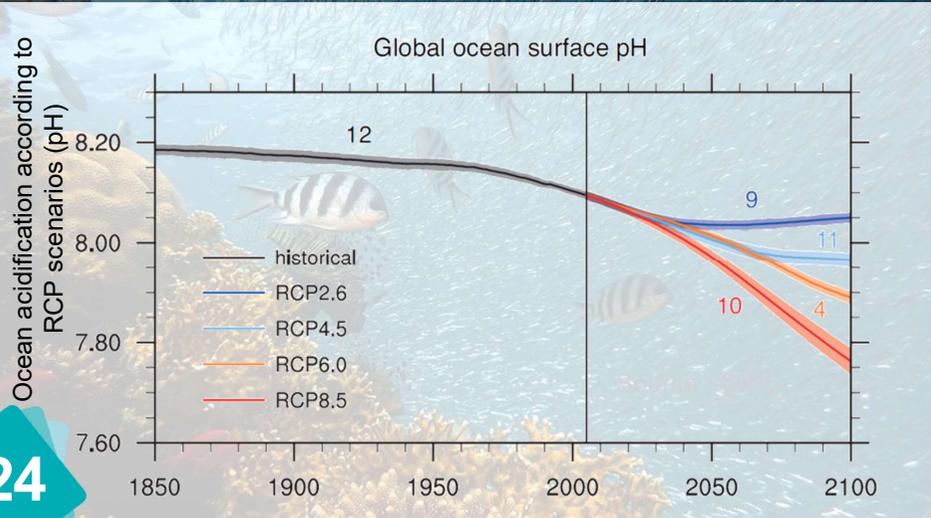
Set 2

9

CO₂ is not the only greenhouse gas (GHG). Among others are methane (CH₄), and nitrous oxide (N₂O), two gases mainly emitted by agricultural activities.

Set 2

Ocean Acidification



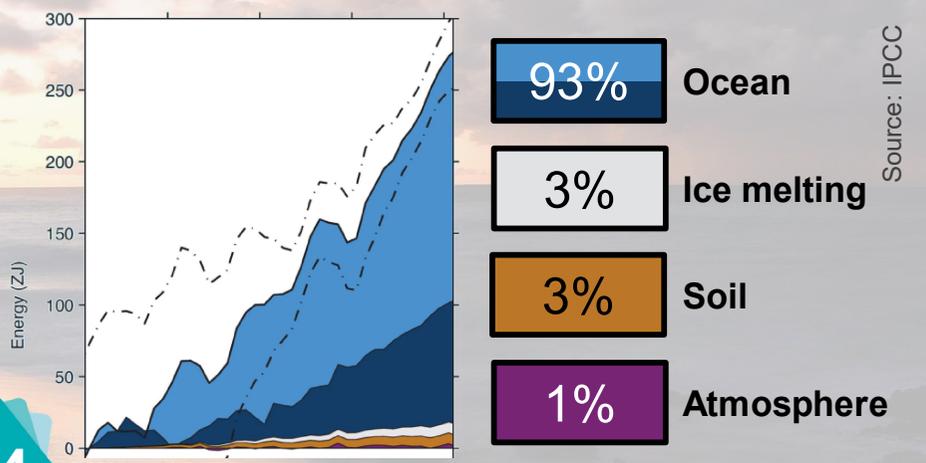
24

Aerosols



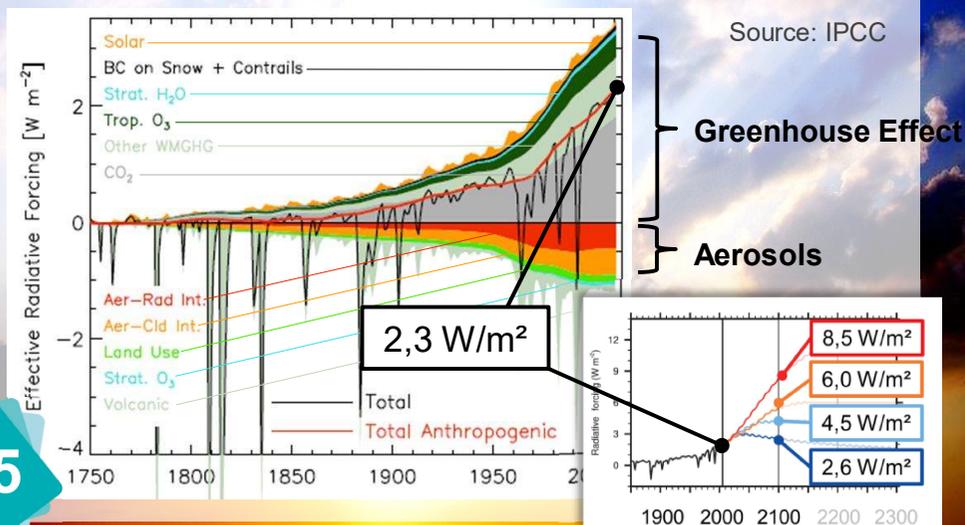
10

Energy Budget



14

Radiative Forcing



15

14

This graph explains where the energy accumulated on Earth due to radiative forcing goes: it warms up the ocean, melts ice, dissipates into the ground, and warms up the atmosphere.

Set 3

15

Radiative forcing represents the difference (caused by human being) between the energy that arrives on earth each second and the energy that is released. In the 5th assessment report of IPCC, it is rated at 2.3 W/m^2 (Watt per square meter).

Set 3

24

When CO_2 dissolves into the ocean, it turns into acid ions (H_2CO_3 and HCO_3^-). The effect of this transformation is the acidification of ocean (the pH decreases).

Set 2

10

Nothing to do with aerosol spray cans. Aerosols are a type of local pollution that comes from the incomplete combustion of fossil fuels. They are bad for human health and they contribute negatively to radiative forcing (they cool the climate).

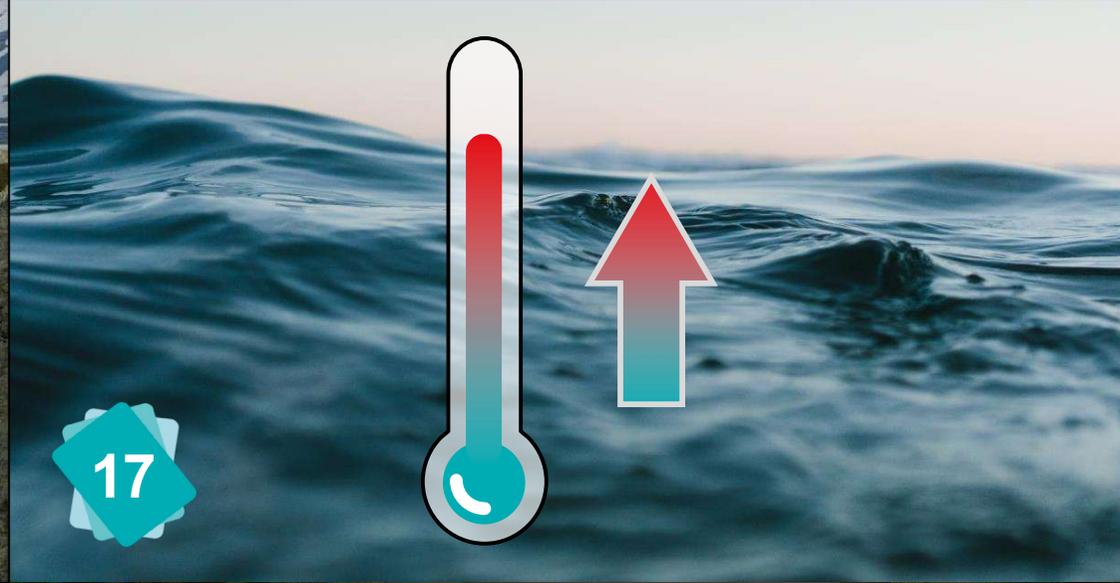
Set 3

Melting of Glaciers



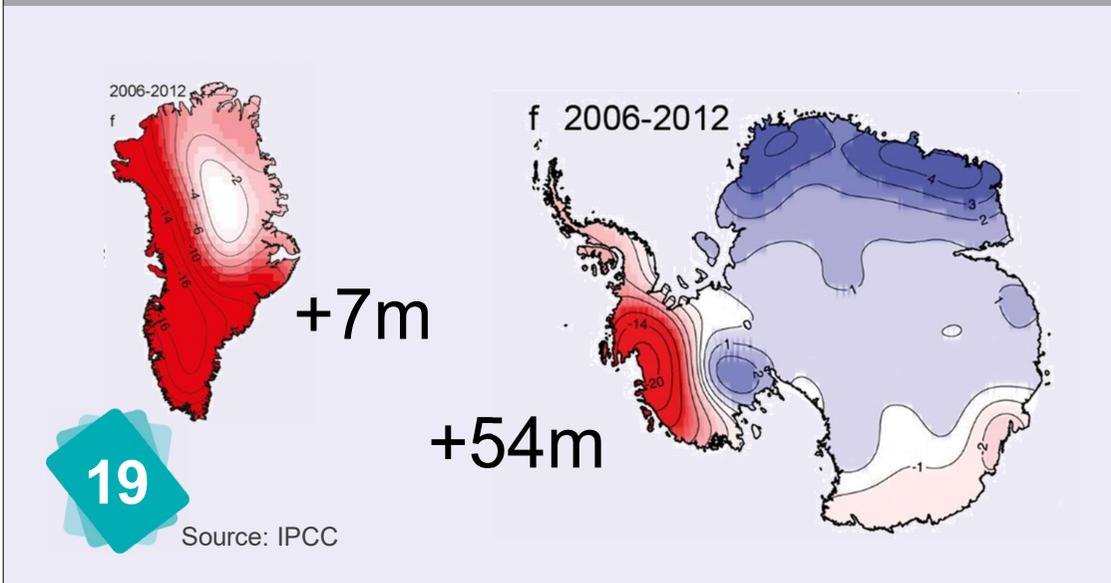
16

Increase in Water Temperature



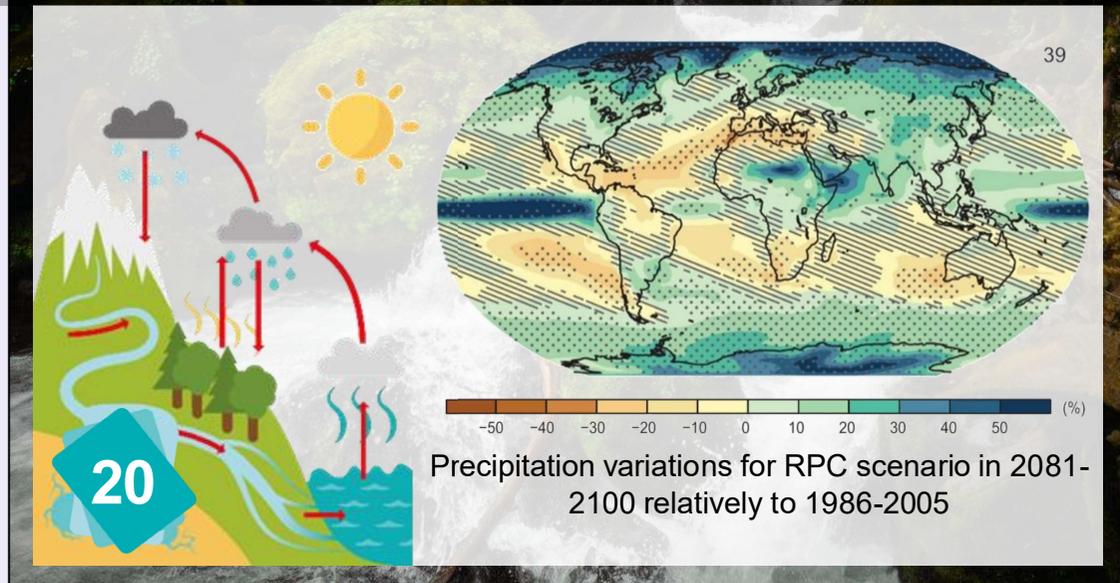
17

Melting of Ice Sheets



19

Disruption of the Water Cycle



20

19

Continental glaciers (or ice sheets) are in Greenland and Antarctica. If they melt completely, they will cause a rise in ocean levels of 7 meters for Greenland and 54 meters for Antarctica. During the last ice age, ice caps were so huge that the sea level was 120 m lower than today.

Set 3

20

The evaporation that happens at the ocean surface increases if the temperatures of the ocean and of the atmosphere increase. That means more rain clouds. The same evaporation phenomenon exists between soil and air, then the soil dries out.

Set 3

16

Almost all of the glaciers have lost mass. Hundreds of them have even disappeared. These glaciers play a regulating role as a source of fresh water.

Set 3

17

The Ocean absorbs 93% of the energy accumulated on Earth. Its temperature has therefore increased, especially in the upper layers. While heating, water expands.

Set 3

Hindered calcification process

HOW WILL CHANGES IN OCEAN CHEMISTRY AFFECT MARINE LIFE?

CO₂ absorbed from the atmosphere

$CO_2 + H_2O + CO_3^{2-} \rightarrow 2 HCO_3^-$

carbon dioxide water carbonate ion 2 bicarbonate ions

23 consumption of carbonate ions impedes calcification

© noaa

Terrestrial Biodiversity

25

River Flooding

26

Marine Biodiversity

27

26

The disruption of the water cycle can cause more water or less water. More water can lead to river flooding. If the soil is dried by drought it's worse because the water runs off.

Set 4

27

Pteropods and coccolithophores are at the basis of the food chain in the ocean. Therefore, if they disappear, all marine biodiversity is threatened. The warming of ocean waters also threatens marine biodiversity.

Set 4

23

When the pH drops, the formation of calcium carbonate (and more specifically, of calcified shells) becomes more difficult.

Set 4

25

Animals and plants are affected by the changes in temperature and the perturbation of the water cycle: they migrate, die, or, more infrequently, proliferate.

Set 4

Cyclones



34

Pteropods and Coccolithophores



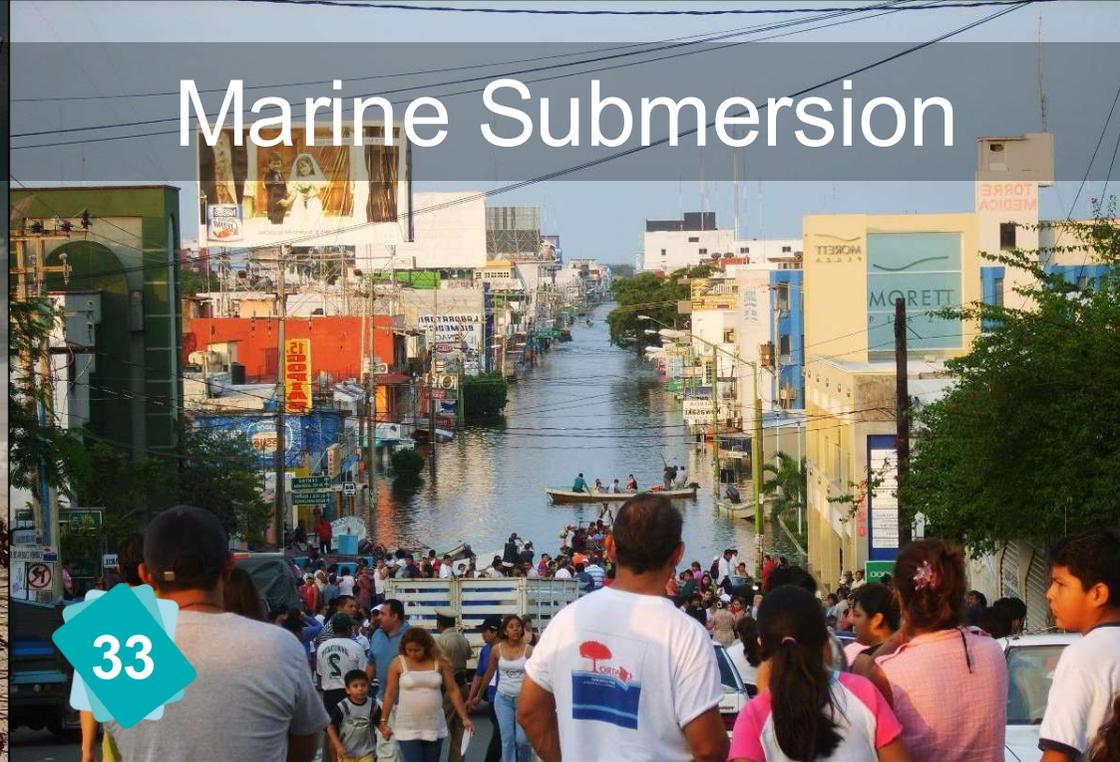
29

Droughts



30

Marine Submersion



33

30

The disruption of the water cycle means more or less water in different places. When these perturbations lead to less water, it's a drought. Droughts are likely to be more frequent in the future.

Set 4

33

Cyclones and weather disturbances bring wind (therefore waves) and low pressure. Now, 1 hectopascal less means a 1 cm sea level rise. Therefore cyclones can cause marine submersions (or coastal flooding), amplified by the sea level rise already caused by global warming.

Set 4

34

Cyclones use energy from warm waters at the ocean's surface. Because of global warming, they are becoming stronger.

Set 4

29

Pteropods are a kind of zooplankton and Coccolithophores a kind of phytoplankton. These organisms have a calcified shell.

Set 4

Vectors of Disease



28

Freshwater Resources



31

Decline in Agricultural Yields



32

Forest Fires



35

32

Food production can be affected by temperature, droughts, extreme weather events, floods and marine submersion (eg: the Nile Delta).

Set 5

35

Forest fires start more easily during droughts and heat waves.

Set 5

28

With global warming, animals migrate. Some of them carry diseases and will reach areas where the population is not immunized against those diseases.

Set 5

31

Freshwater resources are affected by changes in rainfall and by the disappearance of glaciers that play a regulatory role in streams flow.

Set 5

Heat Waves



36

Starvation



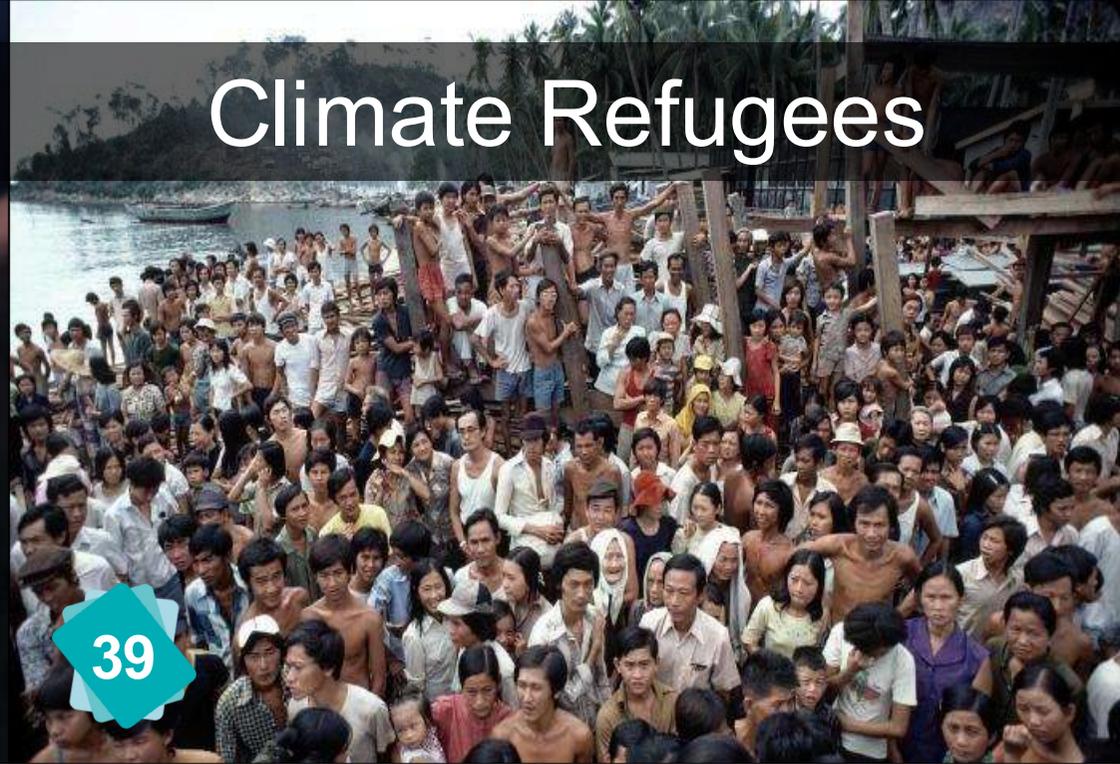
37

Human Health



38

Climate Refugees



39

38

Starvation, displacement of disease vectors, heat waves and armed conflicts can affect human health.

Set 5

39

Imagine that you live in a place that has been miraculously spared by climate change. Several billions of human beings might want to share this space with you.

Set 5

36

A manifestation of temperature increase is the multiplication of heat waves.

Set 5

37

Starvation can be caused by lower agricultural yields and by the reduction of marine biodiversity.

Set 5

Armed Conflicts



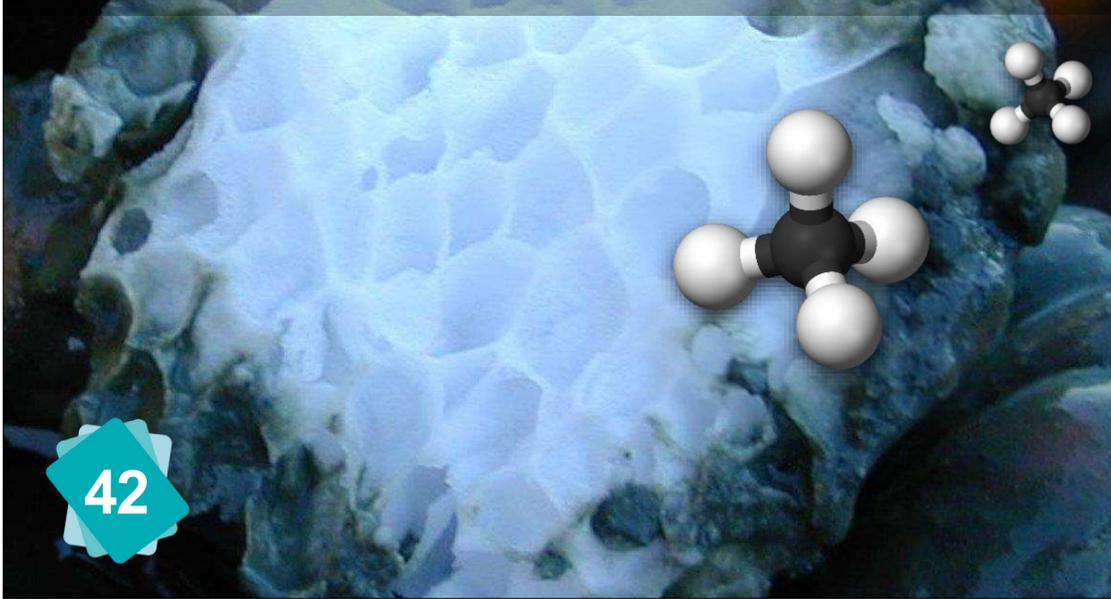
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Permafrost



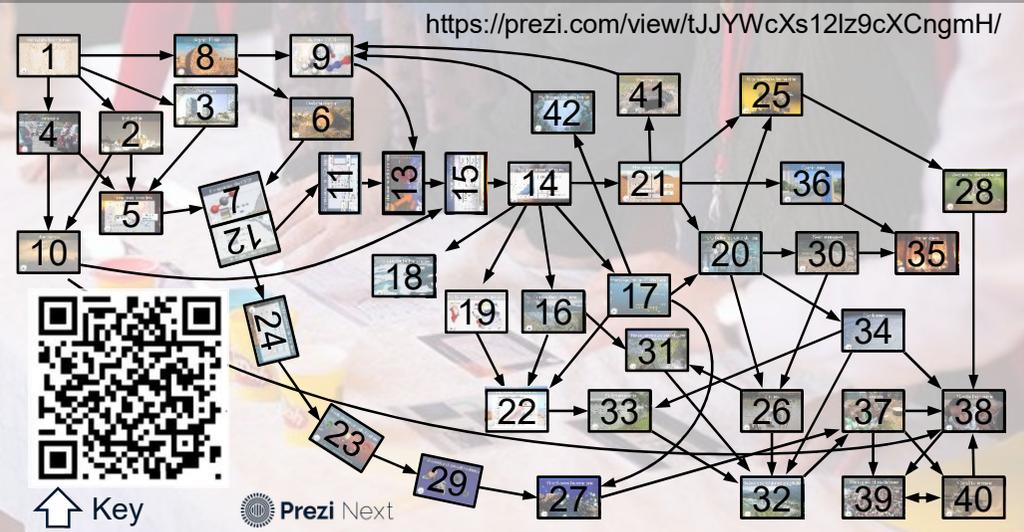
41

Methane Hydrates



42

Key



42

Methane hydrates (or methane clathrates) are a form of ice on the ocean floor, along continental slopes, that traps methane molecules. They can become unstable above +2°C.

Set 5

The Climate Fresk was developed by Cédric Ringenbach. Its distribution is managed by the non-profit association "La Fresque du Climat".



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English

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All the cards are in your hands!



Scan to join us !

40

That's how we shouldn't let it end...

Set 5

41

Permafrost refers to permanently frozen ground. Permafrost thawing leads to the decomposition of organic matter previously frozen underground, a phenomenon that releases methane and CO₂ into the atmosphere. Beyond +2°C of warming, it is almost certain this phenomenon will accelerate and lead to a climate uproar.

Set 5