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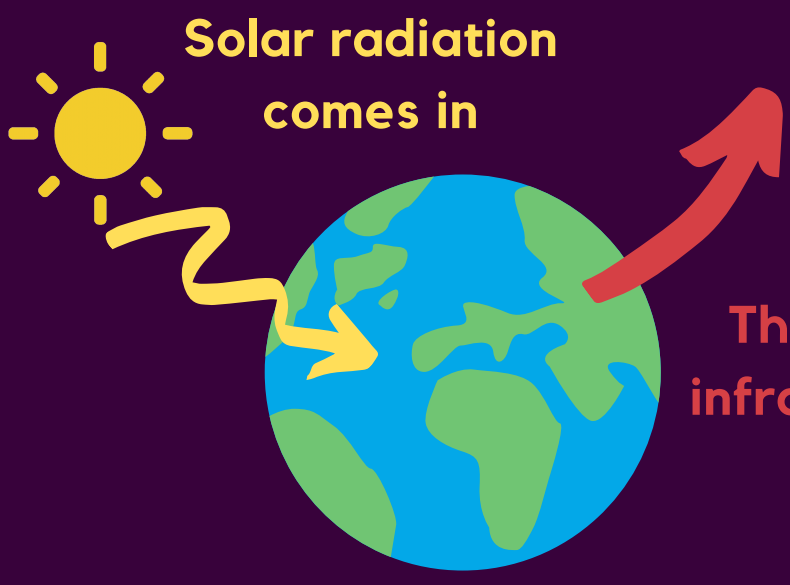
Section 7.2 - Earth's Energy Budget

THE EARTH IS GAINING ENERGY DUE TO ANTHROPOGENIC CLIMATE CHANGE

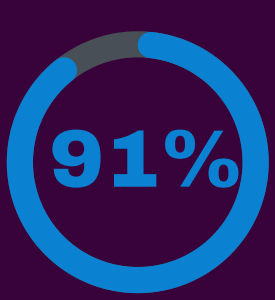


Solar radiation in < Infrared radiation out

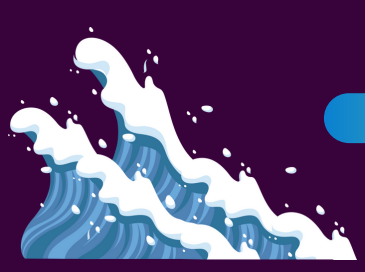
Earth loses energy and cools

Solar radiation in > Infrared radiation out

Earth gains energy and warms

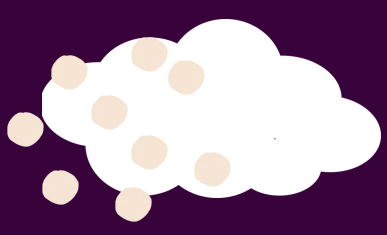


Of energy accumulated is stored in the ocean

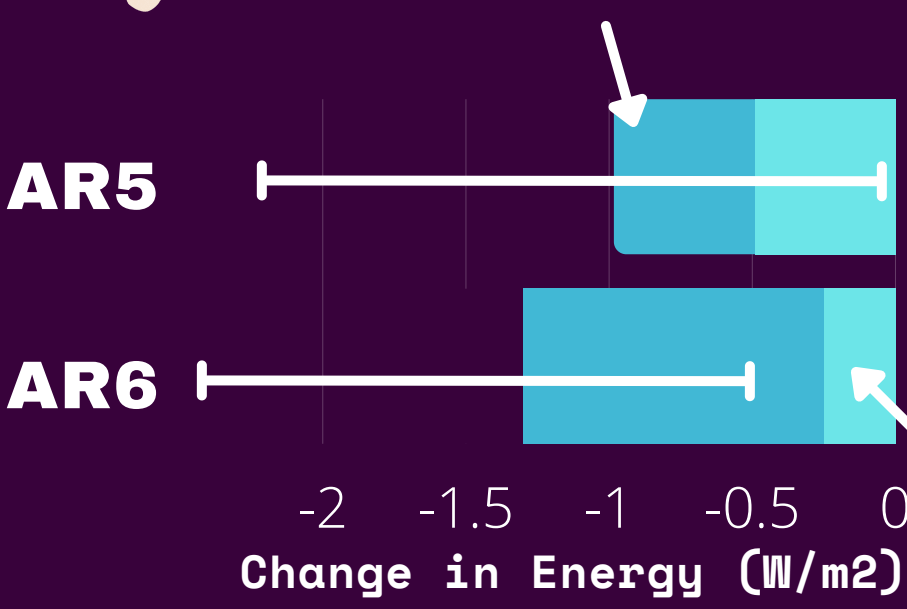


Section 7.3- Effective Radiative Forcings

WHAT DRIVES CHANGES IN EARTH'S ENERGY BUDGET?

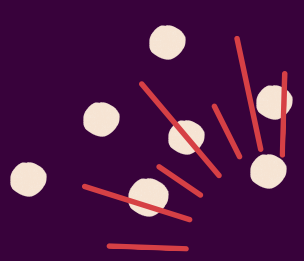


Aerosol-cloud interactions



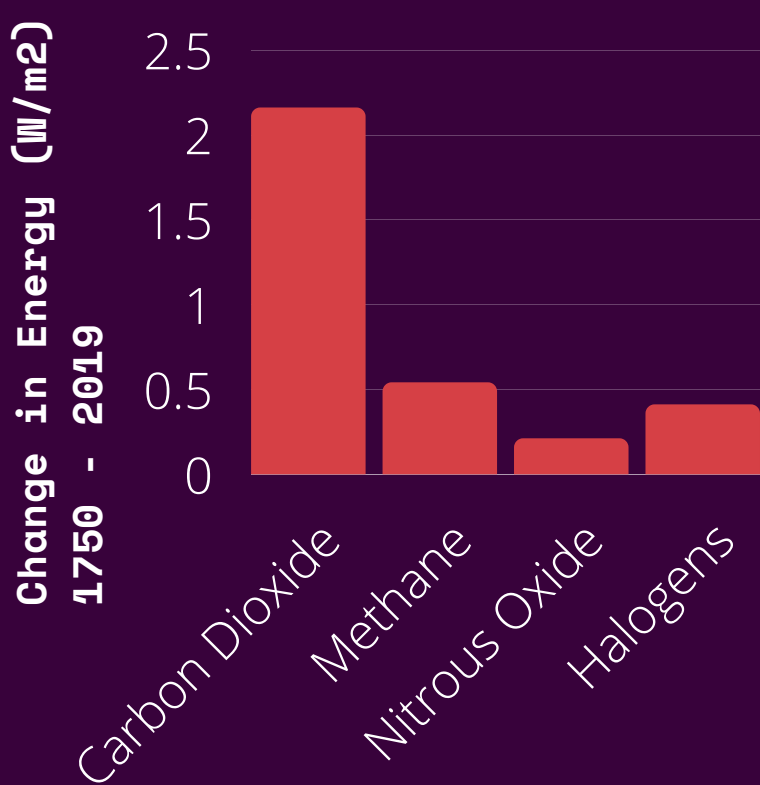
EFFECTIVE RADIATIVE FORCINGS

Quantify the energy gain or loss caused by a change to the climate system (like an increase in CO2 emissions)

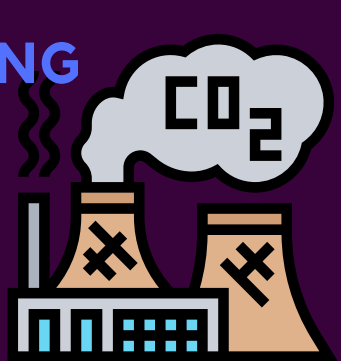


Aerosol-radiation interactions

AR6 found that aerosol-radiation interactions are not as strong of a forcing as are aerosol-cloud interactions.



CARBON DIOXIDE HAS THE LARGEST EFFECTIVE RADIATIVE FORCING AMONG GREENHOUSE GASSES



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Section 7.4 - Climate Feedbacks

WHAT ARE CLIMATE FEEDBACKS?

Things that amplify or reduce energy going in and out of the earth

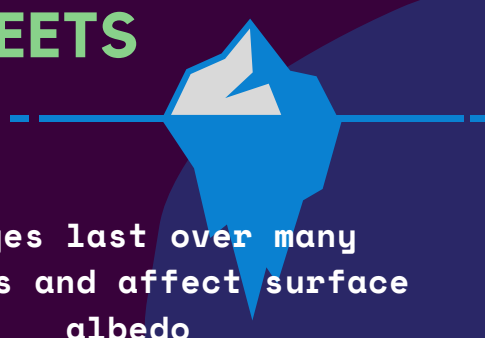
THESE INCLUDE...

CLOUDS

Future climate will prevent energy from leaving due to higher clouds

... while lower clouds will reflect less incoming energy

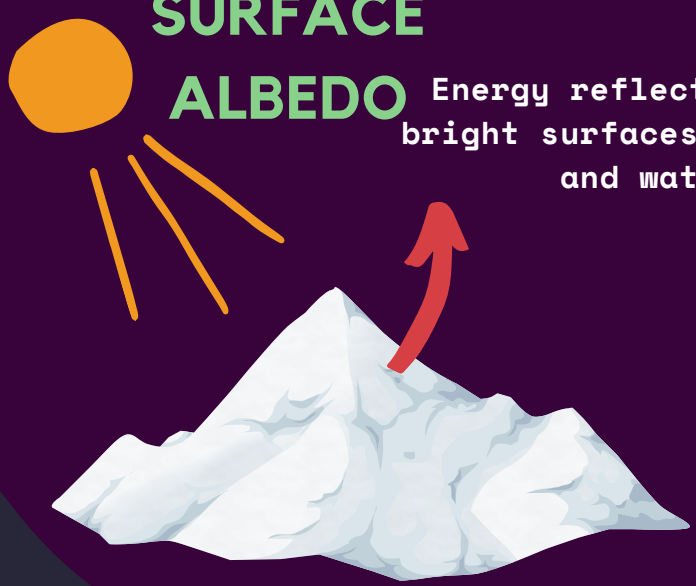
ICE SHEETS



Changes last over many centures and affect surface albedo

SURFACE ALBEDO

Energy reflecting from bright surfaces like snow and water

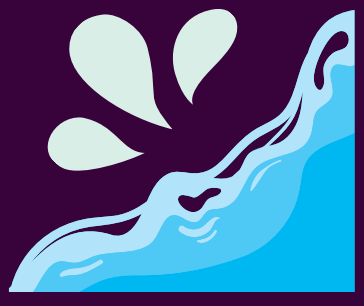


PLANCK RESPONSE

Energy reflecting from bright surfaces like snow and water

WATER VAPOR AND UPPER ATMOSPHERE AIR TEMPERATURE

Temperature changes in the atmosphere depending on the water vapor - related to cloud feedbacks

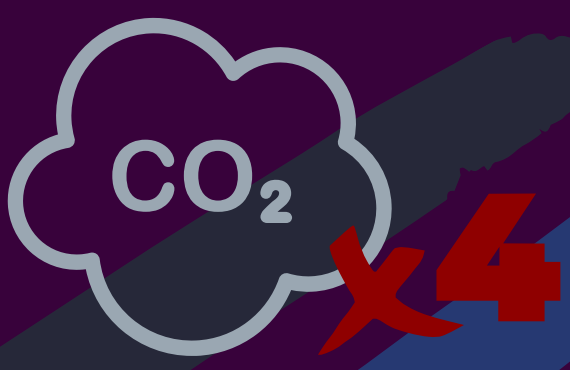


CAN WE PREDICT CLIMATE FORCING DURING DIFFERENT TIME PERIODS?

It's unrealistic to think that climate feedbacks stayed the same during the dinosaur ages as they do today

Interestingly enough, currently models DO assume that!

Even though previous models demonstrate weaker sensitivity to 4x the current carbon dioxide levels



Models that assume carbon dioxide quadruples from historical times OVERESTIMATE climate feedback

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Section 7.5 - Equilibrium Climate Sensitivity (ECS) and Transient Climate Response (TCR)

WHAT ARE ECS & TCR?

... measures of how much the earth system warms from greenhouse gases

ECS

Sudden 2xCO2 Concentration

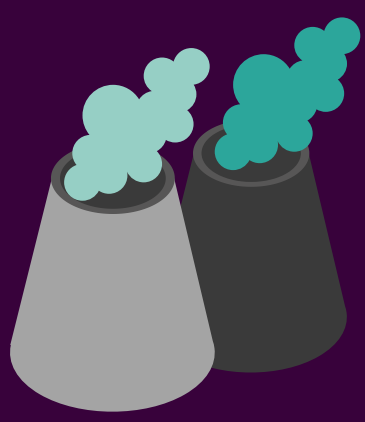
TCR

1% increased CO2 per Year over 70 years

IPCC AR6 is more confident than its predecessors, with a ...

2°C - 5°C

..."*very likely*" ECS range because it used multiple lines of evidence to estimate ECS, instead of just using climate models.



What were the lines of evidence?

- Process Understanding
- Instrumental Record
- Paleoclimate Data
- Emergent Constraints

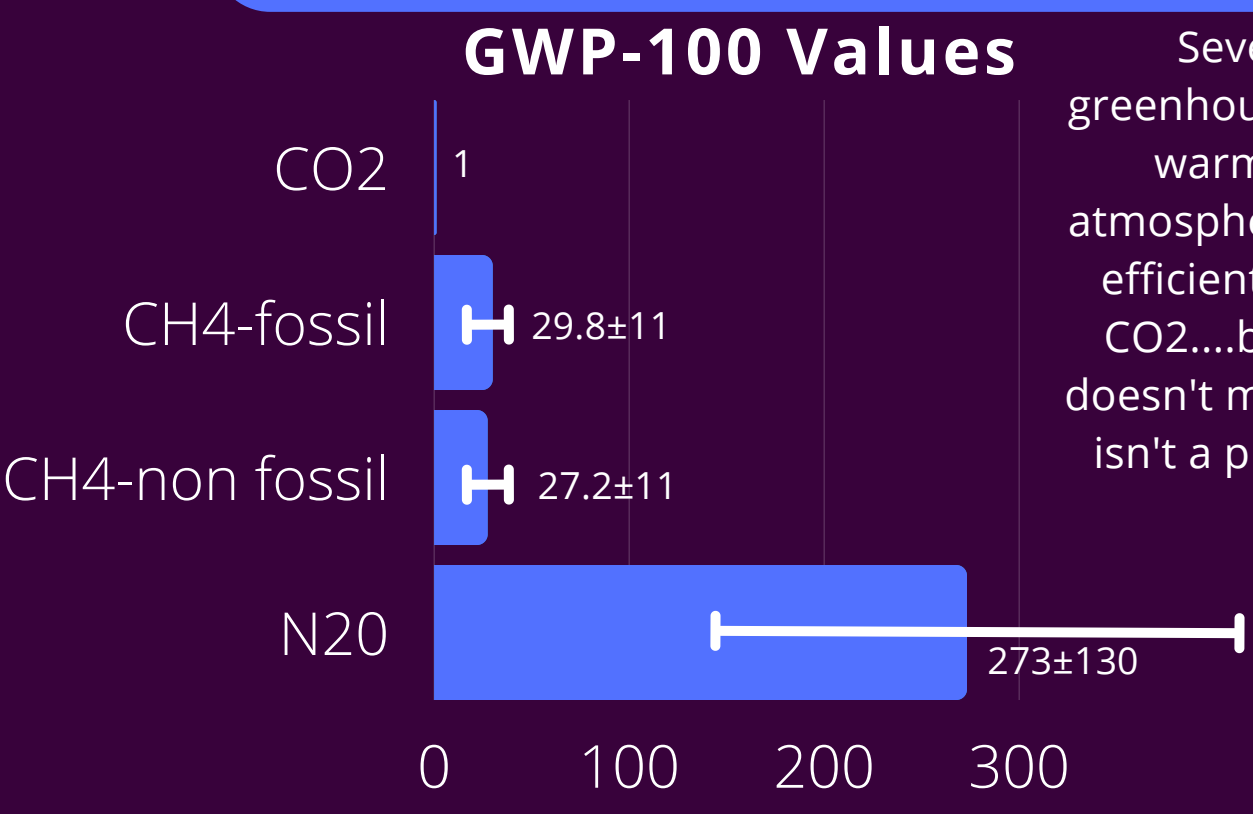
Why aren't the new CMIP6 models used for ECS?

...because several models include unrealistic ECS values that are outside of the paleoclimate ECS range. Studies have found this to be partially due to the way they simulate cloud feedbacks!

Section 7.6- Evaluation Metrics

GWP-100

GWP-100, or 100-year Global Warming Potential, is a metric used to compare the heating efficiency of greenhouse gases to CO2.



Several greenhouse gases warm the atmosphere more efficiently than CO2....but that doesn't mean CO2 isn't a problem!