



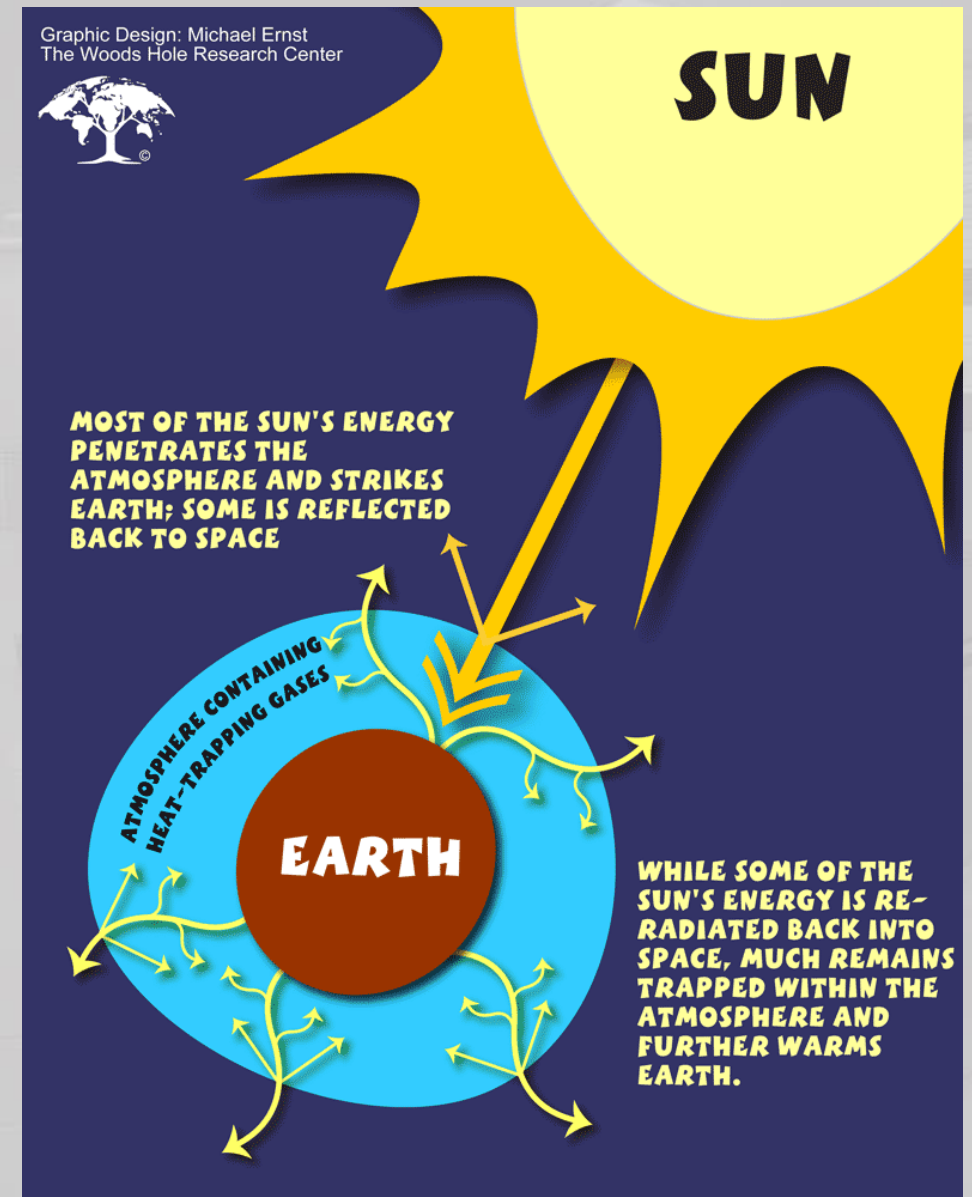
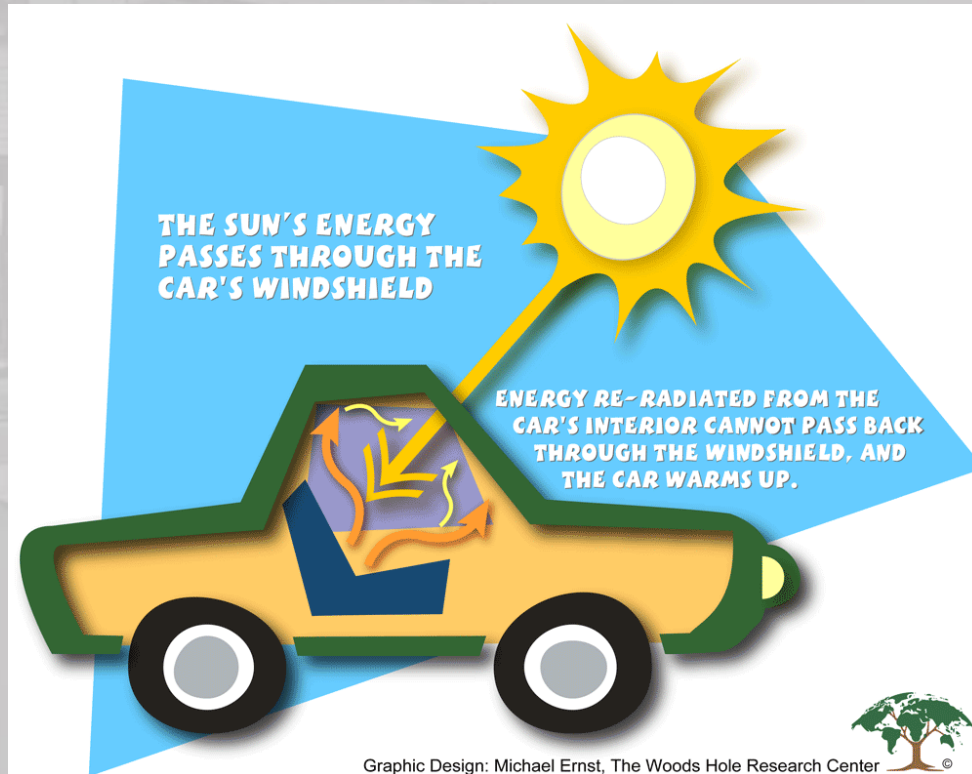
GREEN HOUSE EFFECT AND CLIMATE CHANGES



A Greenhouse



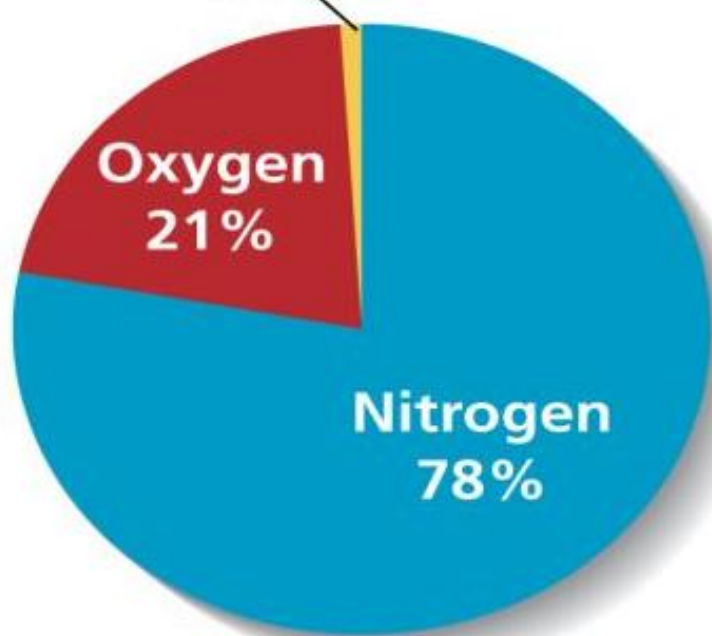
Greenhouse Effect





Earth's Atmosphere

All other gases
1%



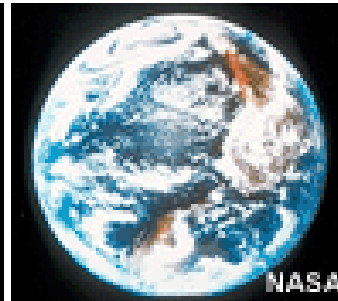
Gas	Percentage by Volume
Nitrogen (N ₂)	78.084
Oxygen (O ₂)	20.946
Argon (Ar)	0.934
Carbon dioxide (CO ₂)	0.037
Neon (Ne)	0.00182
Helium (He)	0.00052
Methane (CH ₄)	0.00015
Krypton (Kr)	0.00011



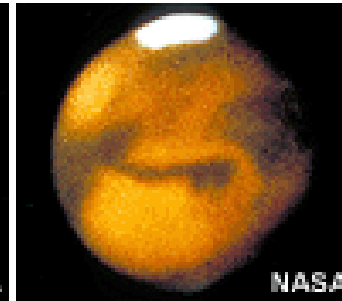
What if ... (The “Goldilocks” Principle)



Venus



Earth

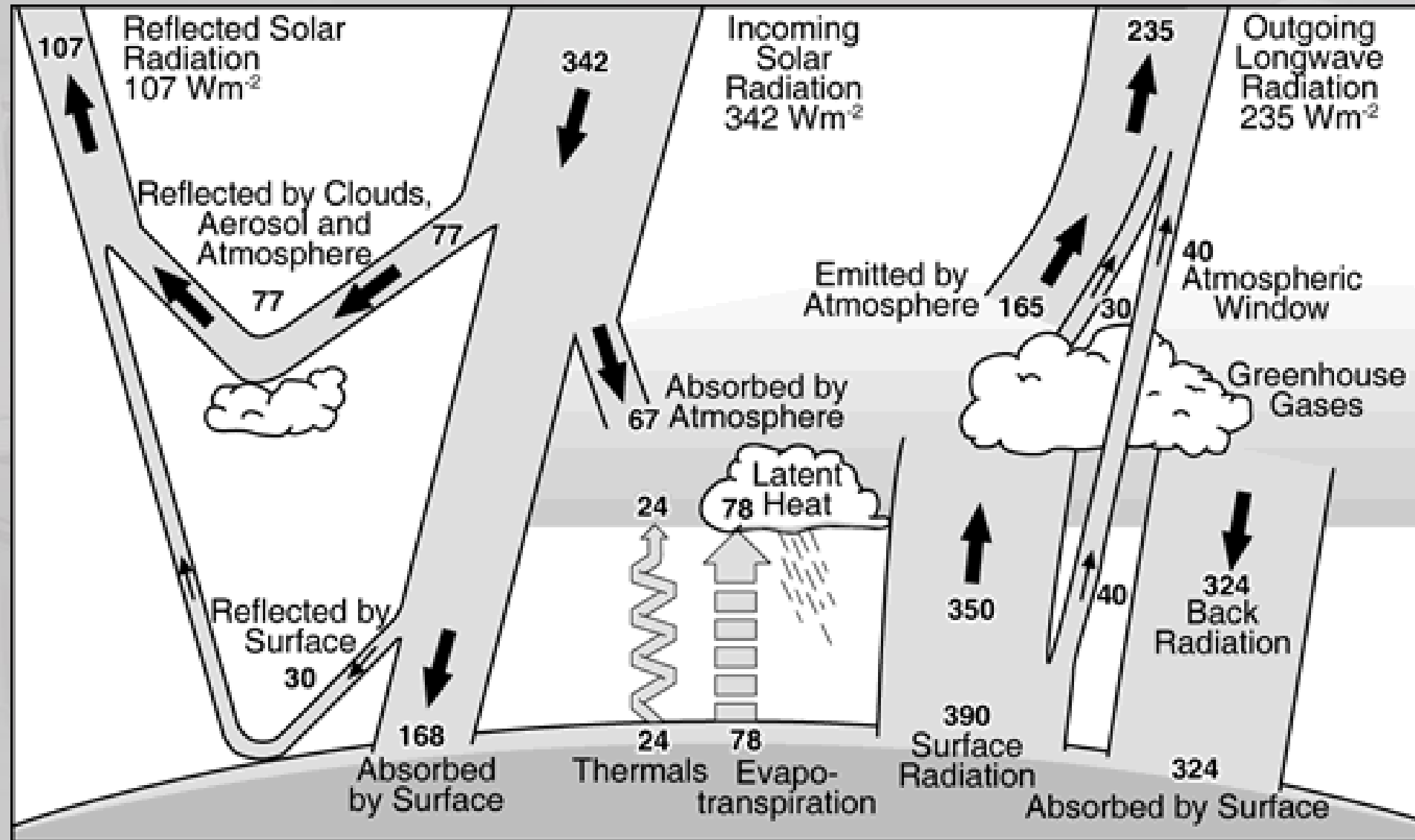


Mars

	Venus	Earth	Mars
Surface pressure relative to Earth (bars)	90	1	0.007
Major greenhouse gases (GHG)	CO ₂	H ₂ O, CO ₂	CO ₂
Temperature if no GHG (°C)	-46	-18	-57
Actual temperature (°C)	477	15	-47
Temperature change due to GHG	+523	+33	+10

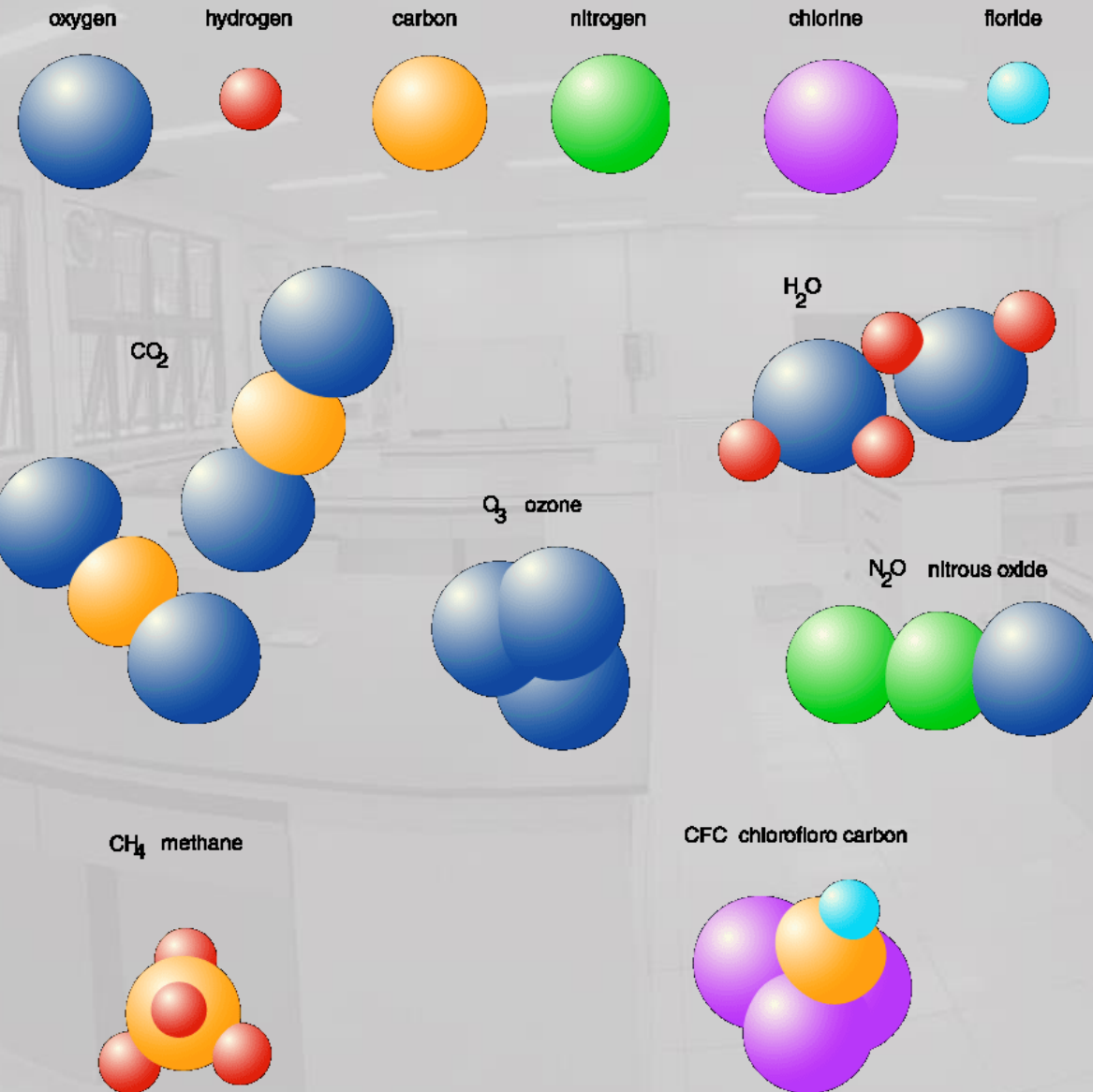
Mars is too cold, Venus is too hot,
and Earth is just right!

Energy Balance Model



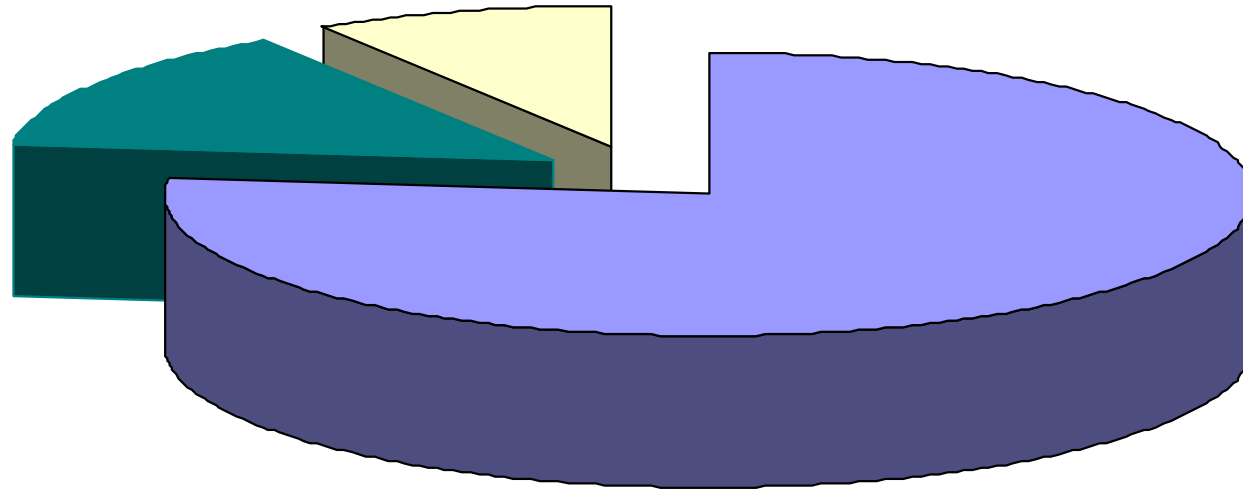


Green House Gases (GHGs)





Current contribution to global warming



- Carbon dioxide, mainly from burning of fossil fuels and deforestation: 77%
- Methane, mainly from land-use and agriculture changes: 14%
- Nitrous oxide (agriculture), ozone (e.g. vehicles), and halocarbons and other industrial process gases: 9%



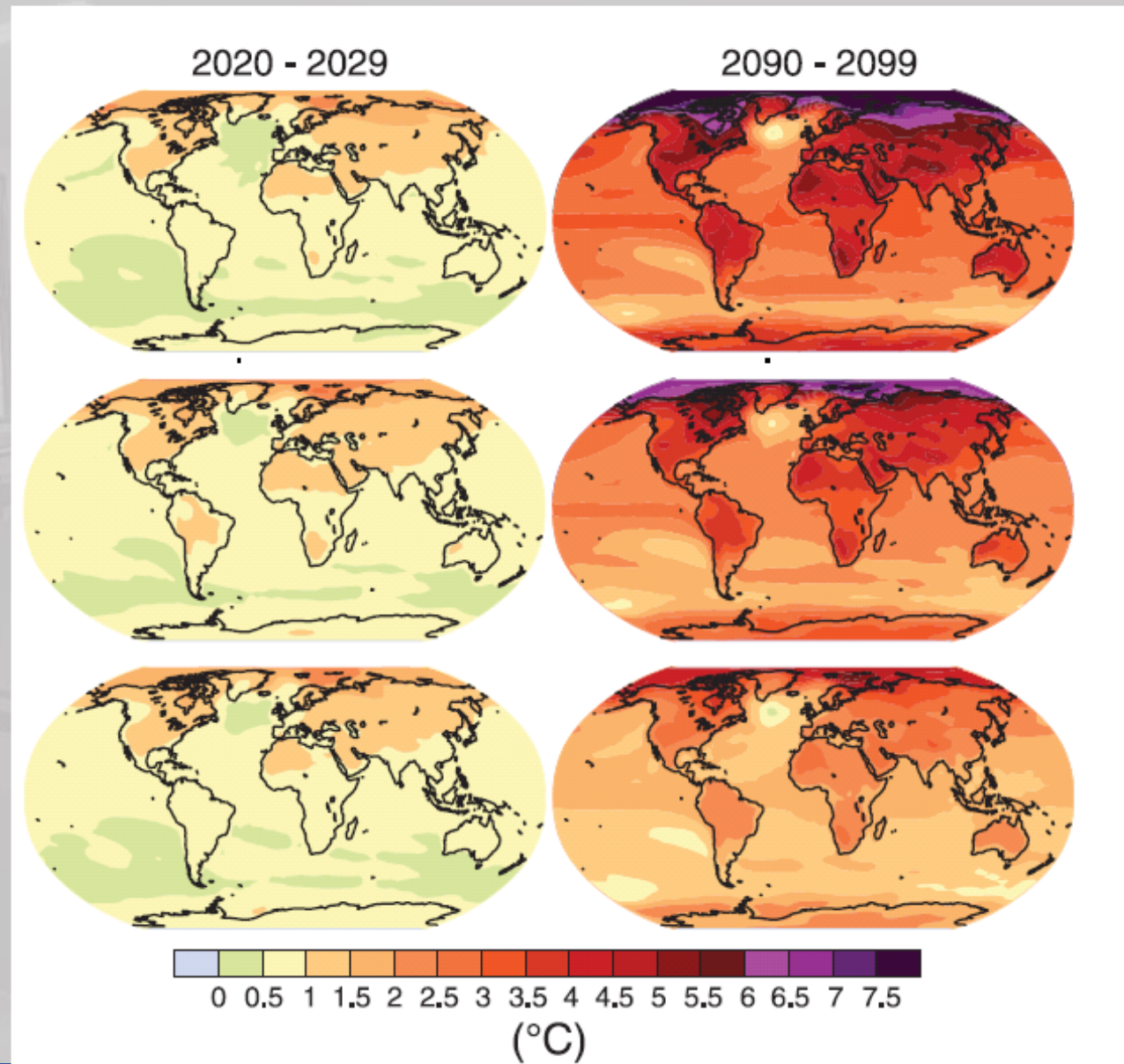


Climate versus weather

- Climate: A statistical description of the mean and variability of temperature, precipitation, wind, etc. over a period of time ranging from months to thousands or millions of years
- Weather: The present condition of the above elements, typically over periods up to two weeks
- Climate change: A change in the state of the mean and/or variability of these elements that can be identified statistically and that persists over a longer period, typically decades or longer.



Model projections of surface warming





Climate variability and extreme events

- Frequency and intensity of extreme weather events are observed and are projected to increase even with small temperature increases
- Heavy precipitation events projected to have potential negative impacts on trade through disruption to infrastructure and as a result of may not be limited to direct damage to agricultural outputs
- Climate variability and extreme events exacerbate the general impacts of climate change in specific locations at specific points in time





Sea level rise and changes in snow, ice and frozen ground

- Sea level rise projections vary significantly depending on climate models and assumptions
- Changes in sea ice may lead to availability of new shipping routes with significant implications for transport and exploitation of resources, including fossil fuels
- Changes in permafrost and increasing ground instability has implications for transport, industry and infrastructure





Global flow of GHG emissions

