WCC 1: Introduction to climate change

CTB3300WCx: Introduction to Water and Climate

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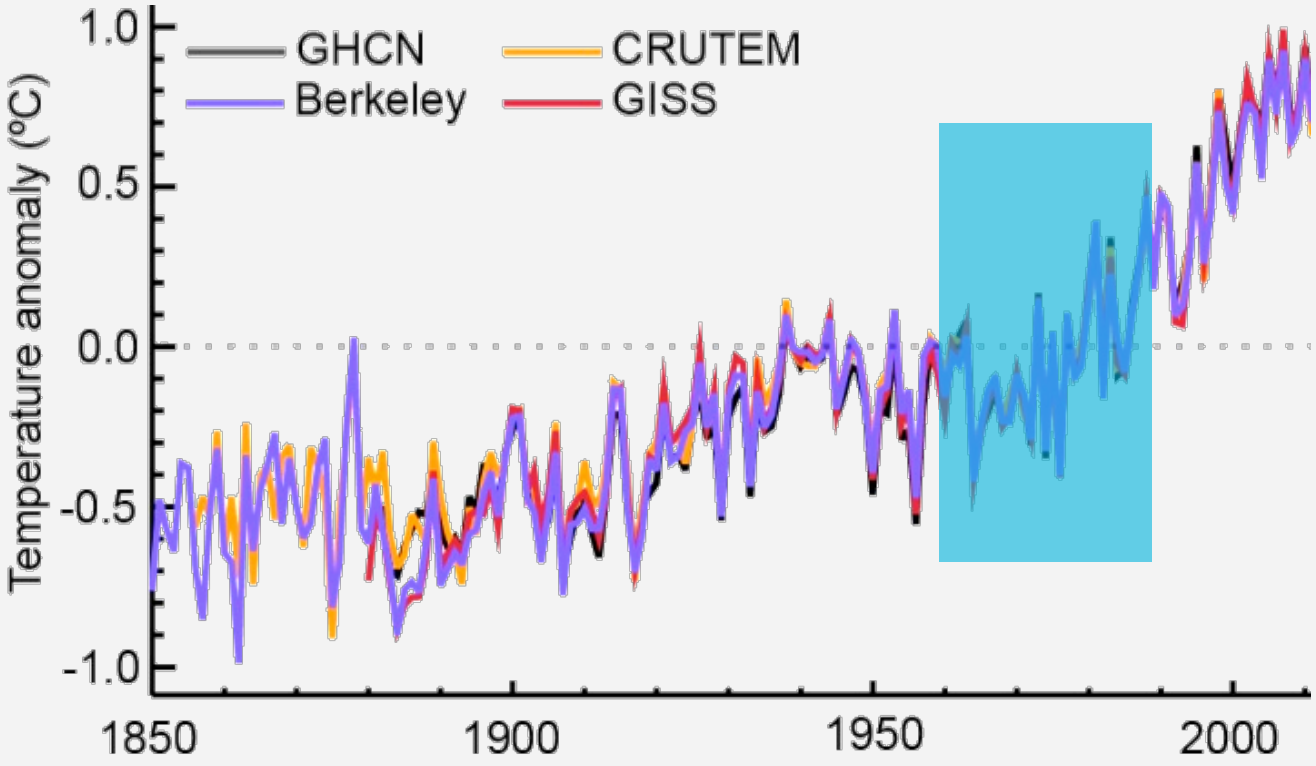
Module contents

- Evidence of global warming
- Principle of the greenhouse effect
- Sea level rise and ice cover
- Clouds and precipitation
- Future weather

The globally mean temperature



Climate

What is climate?

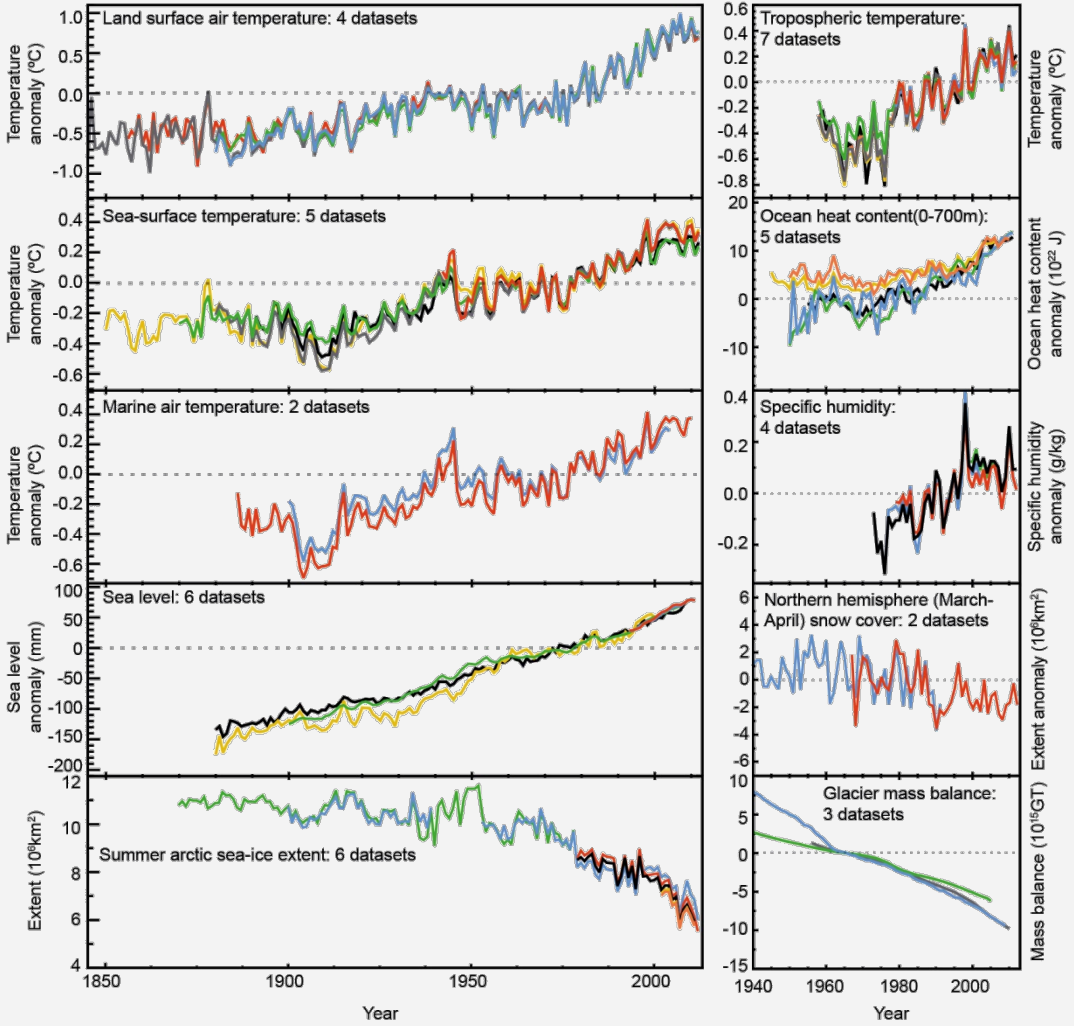
- *Long term averaged weather (30 years)*

What is climate change?

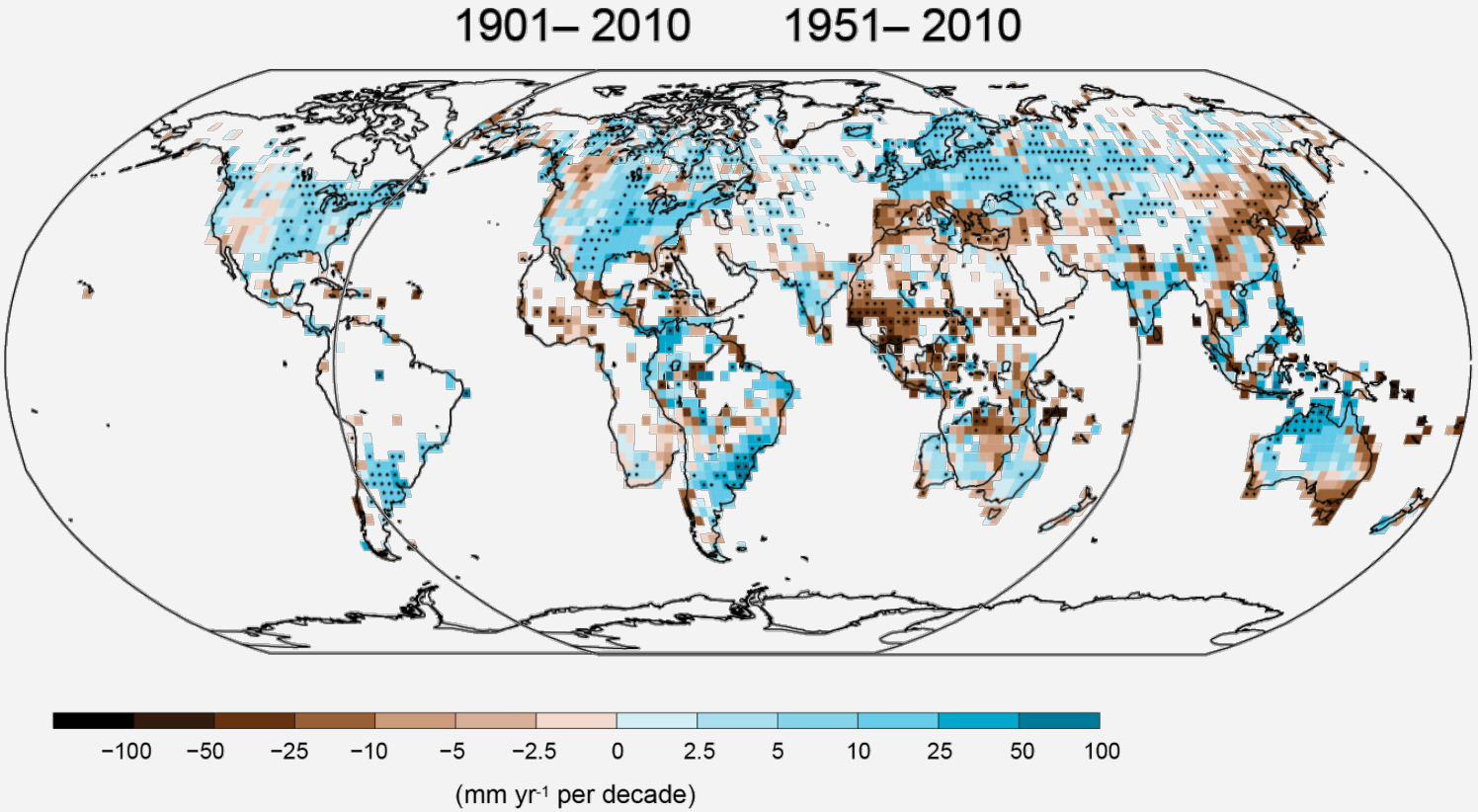
- ***Changes** of long term averaged weather (30 years)*

What is anthropogenic climate change?

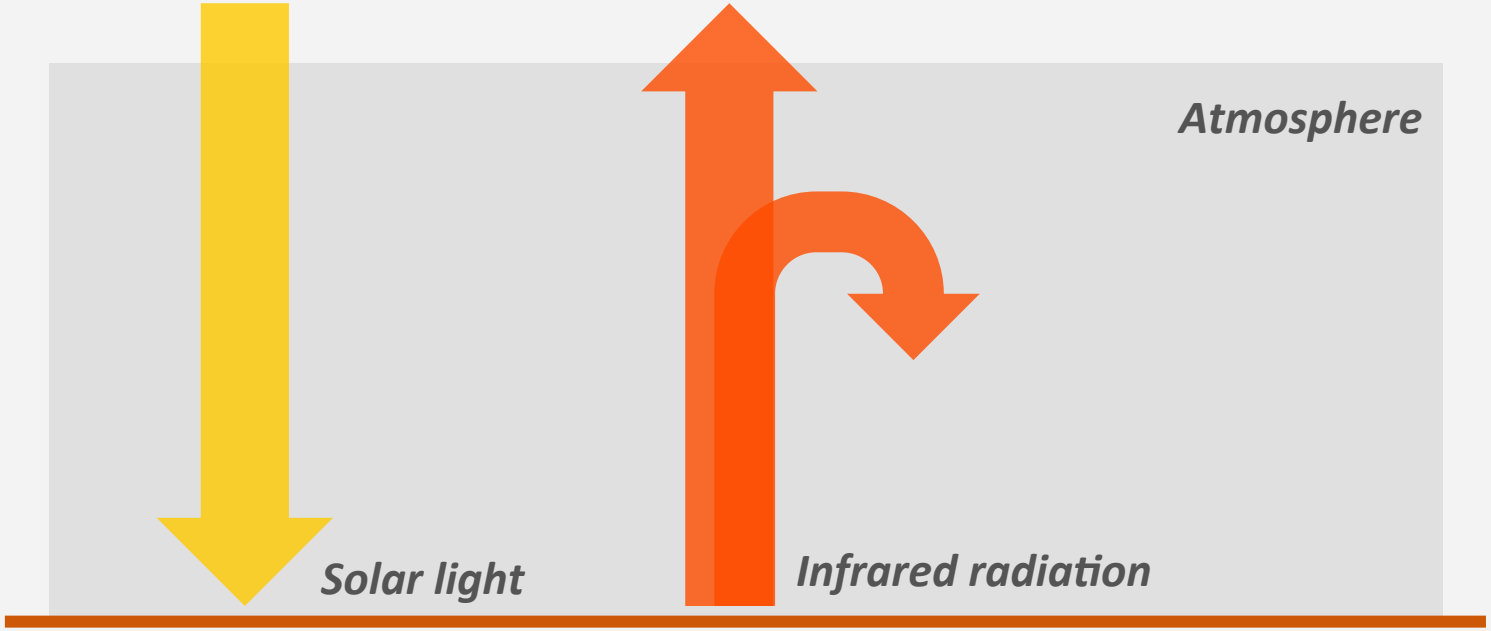
- ***Man-induced** changes of long term averaged weather (30 years)*


Land surface air temperature: 4 datasets
Temperature anomaly (°C)
Sea-surface temperature: 5 datasets
Temperature anomaly (°C)
Marine air temperature: 2 datasets
Temperature anomaly (°C)
Sea level: 6 datasets
Sea level anomaly (mm)
Summer arctic sea-ice extent: 6 datasets
Extent (10^6km^2)
1850
1900
1950
2000
Year
Tropospheric temperature: 7 datasets
Temperature anomaly (°C)
Ocean heat content(0-700m): 5 datasets
Ocean heat content anomaly (10^{22} J)
Specific humidity: 4 datasets
Specific humidity anomaly (g/kg)
Northern hemisphere (March-April) snow cover: 2 datasets
Extent anomaly (10^6km^2)
Glacier mass balance: 3 datasets
Mass balance (10^{15}GT)
1940
1960
1980
2000
Year

Observed change in annual precipitation over land

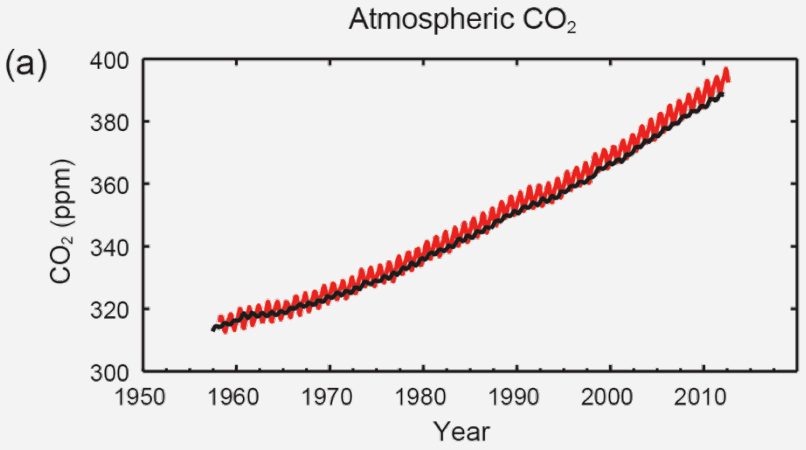


Radiation

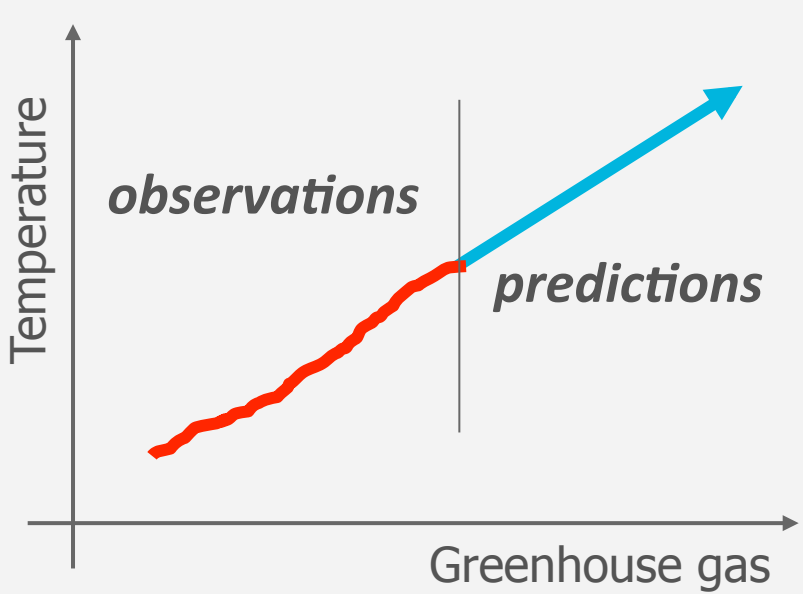


CO_2 observation

- CO_2 concentration in the atmosphere has increased

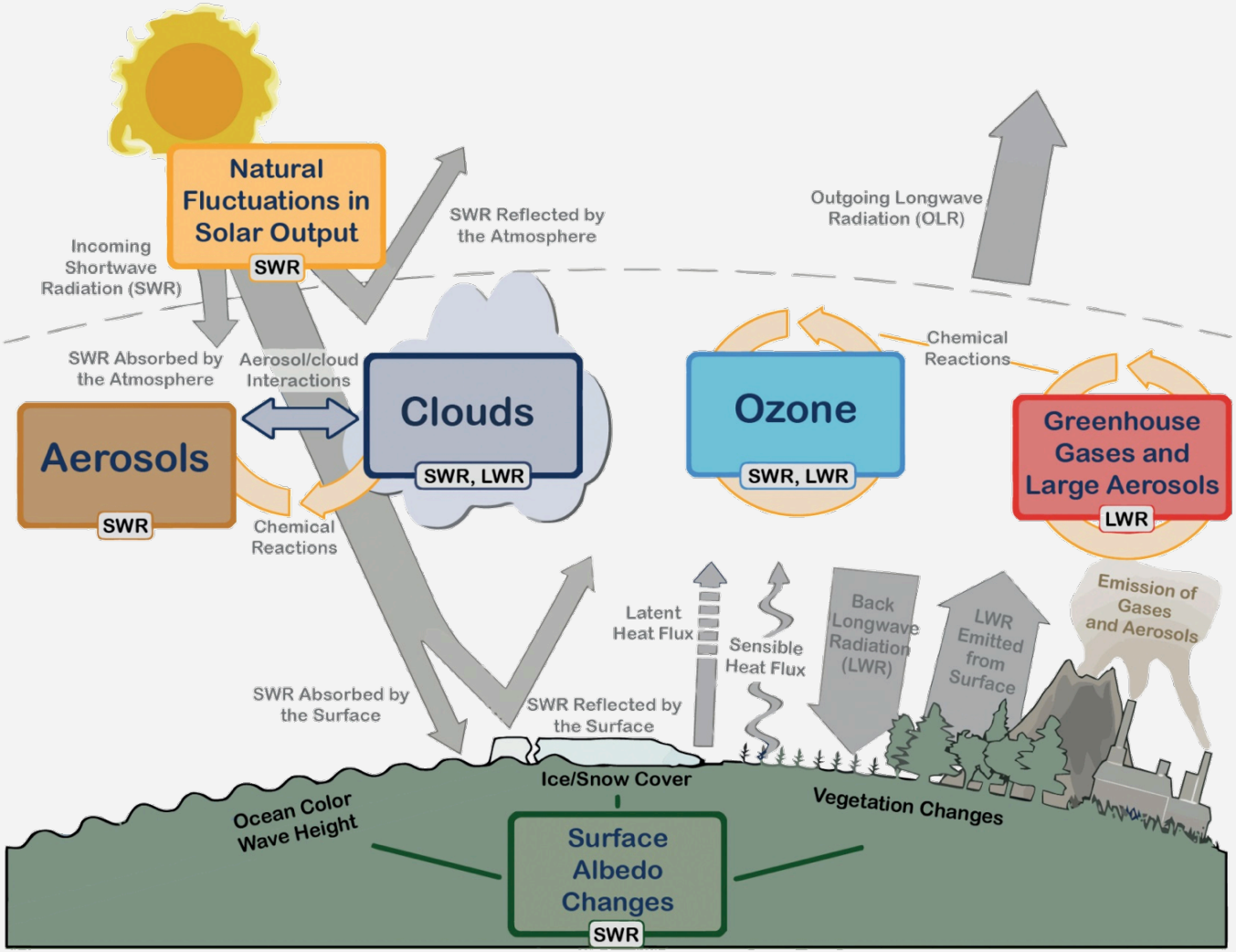


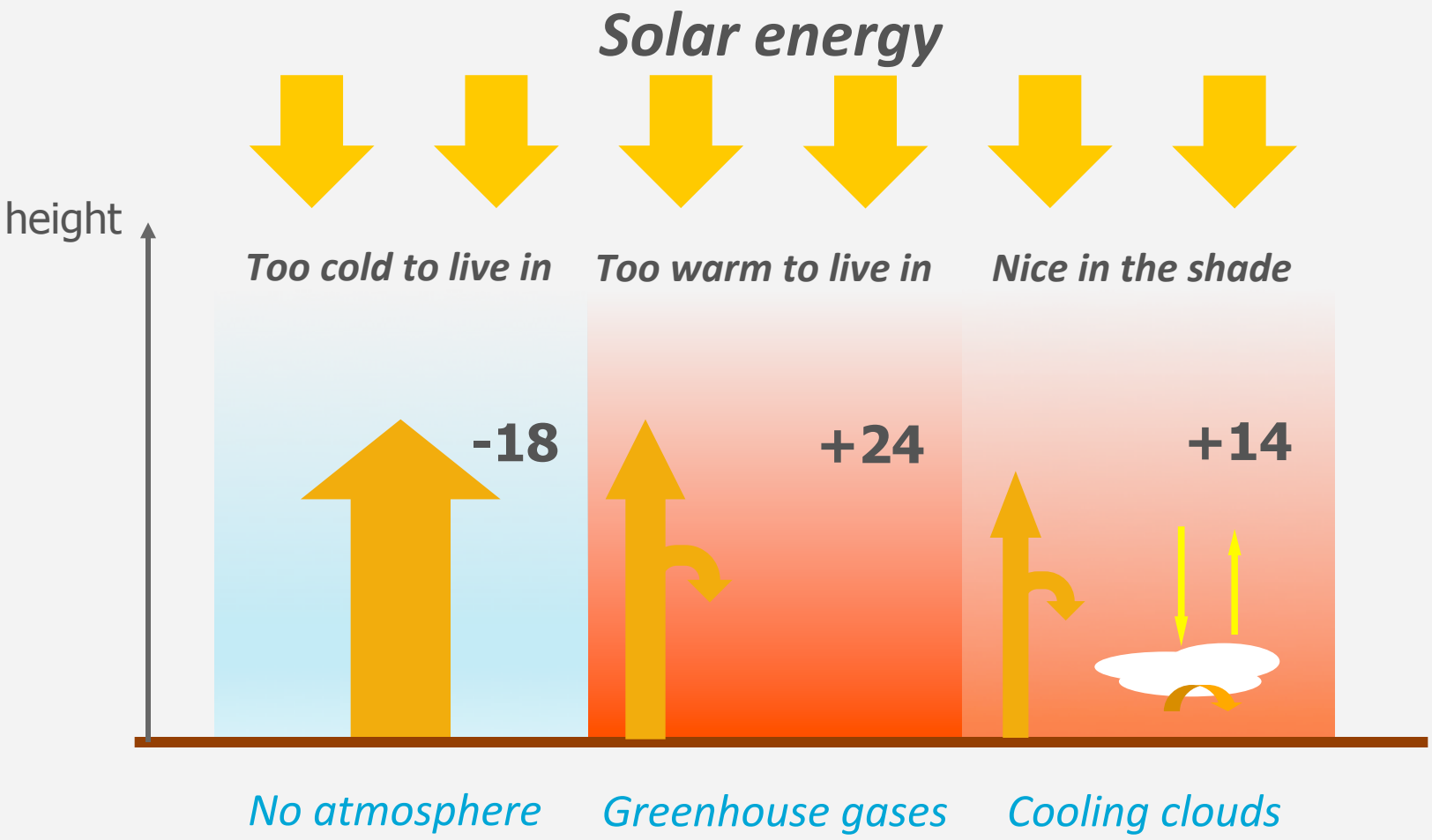
About predictions



Is it really that simple?

- *No, we have to understand the physical processes in the climate system*


Natural Fluctuations in Solar Output
SWR
Incoming Shortwave Radiation (SWR)
SWR Reflected by the Atmosphere
Outgoing Longwave Radiation (OLR)
SWR Absorbed by the Atmosphere
Aerosol/cloud Interactions
Clouds
SWR, LWR
Aerosols
SWR
Chemical Reactions
Ozone
SWR, LWR
Chemical Reactions
Greenhouse Gases and Large Aerosols
LWR
Latent Heat Flux
Sensible Heat Flux
Back Longwave Radiation (LWR)
LWR Emitted from Surface
Emission of Gases and Aerosols
SWR Absorbed by the Surface
SWR Reflected by the Surface
Ice/Snow Cover
Ocean Color Wave Height
Vegetation Changes
Surface Albedo Changes
SWR


Solar energy
height
Too cold to live in
Too warm to live in
Nice in the shade
-18
+24
+14
No atmosphere
Greenhouse gases
Cooling clouds

Sea level

Antartic ice sheets

Clouds and precipitation

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