

Introduction to climate change science

Prof. Lučka Kajfež Bogataj
University of Ljubljana, Slovenia



Climate Change is a Large Issue

Majority of the sciences are involved.

Business/Industry has a stake.

Involves citizens, politicians, public policy experts.

Every sector of the economy affected.

All aspects of our lives touched:

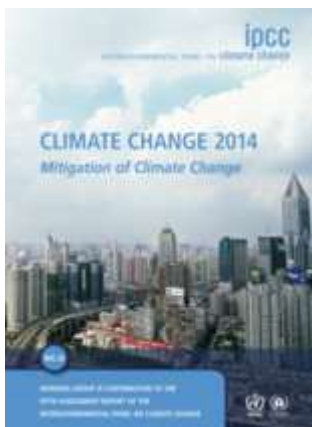
environment, jobs, health, politics, etc.



What is happening in the climate system?



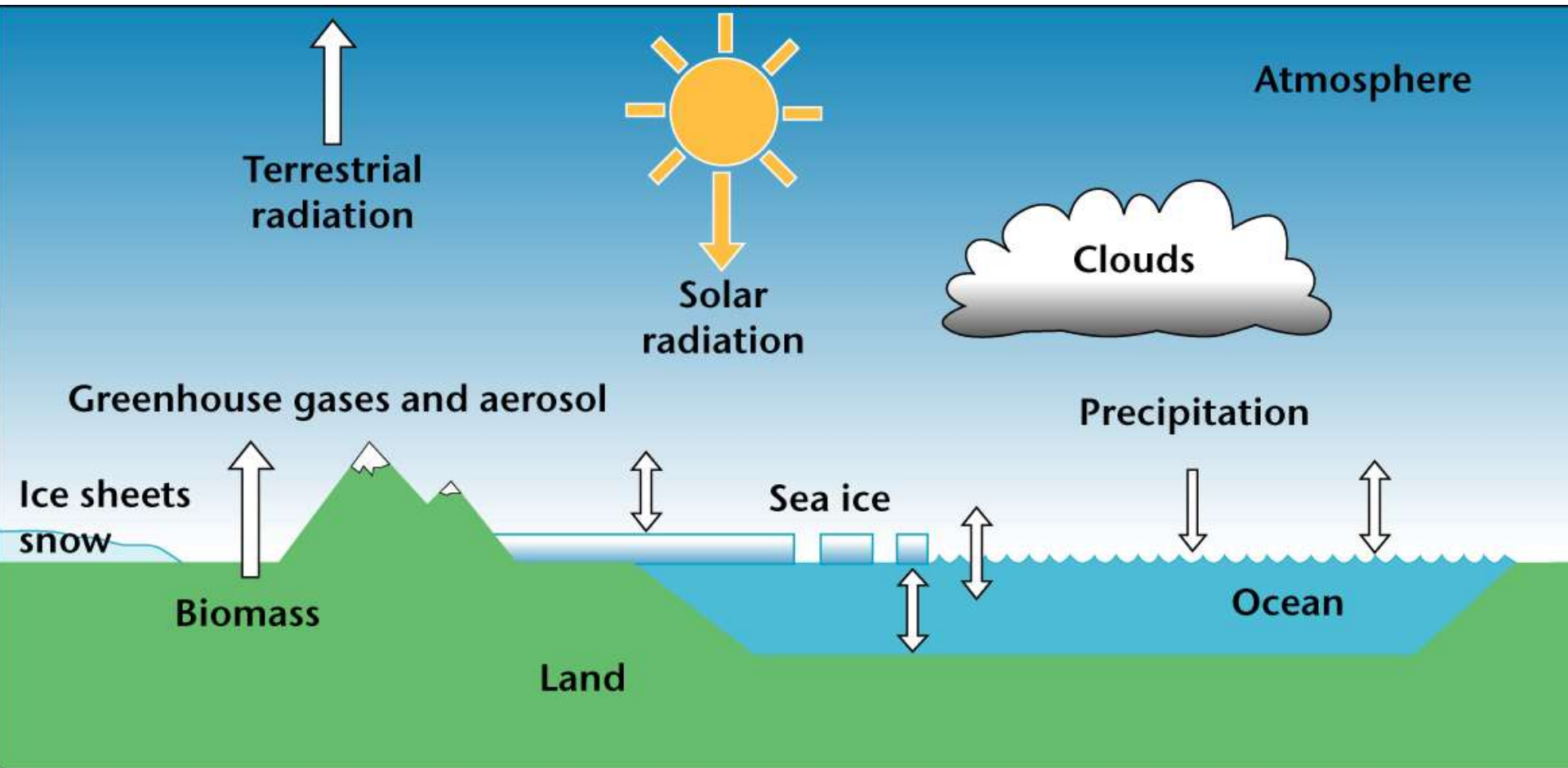
What are the risks?



What can be done?

Climate system

Main components: the atmosphere, hydrosphere [liquid water components], cryosphere [frozen water components], lithosphere [land surface] and biosphere [living things] and the interactions between them



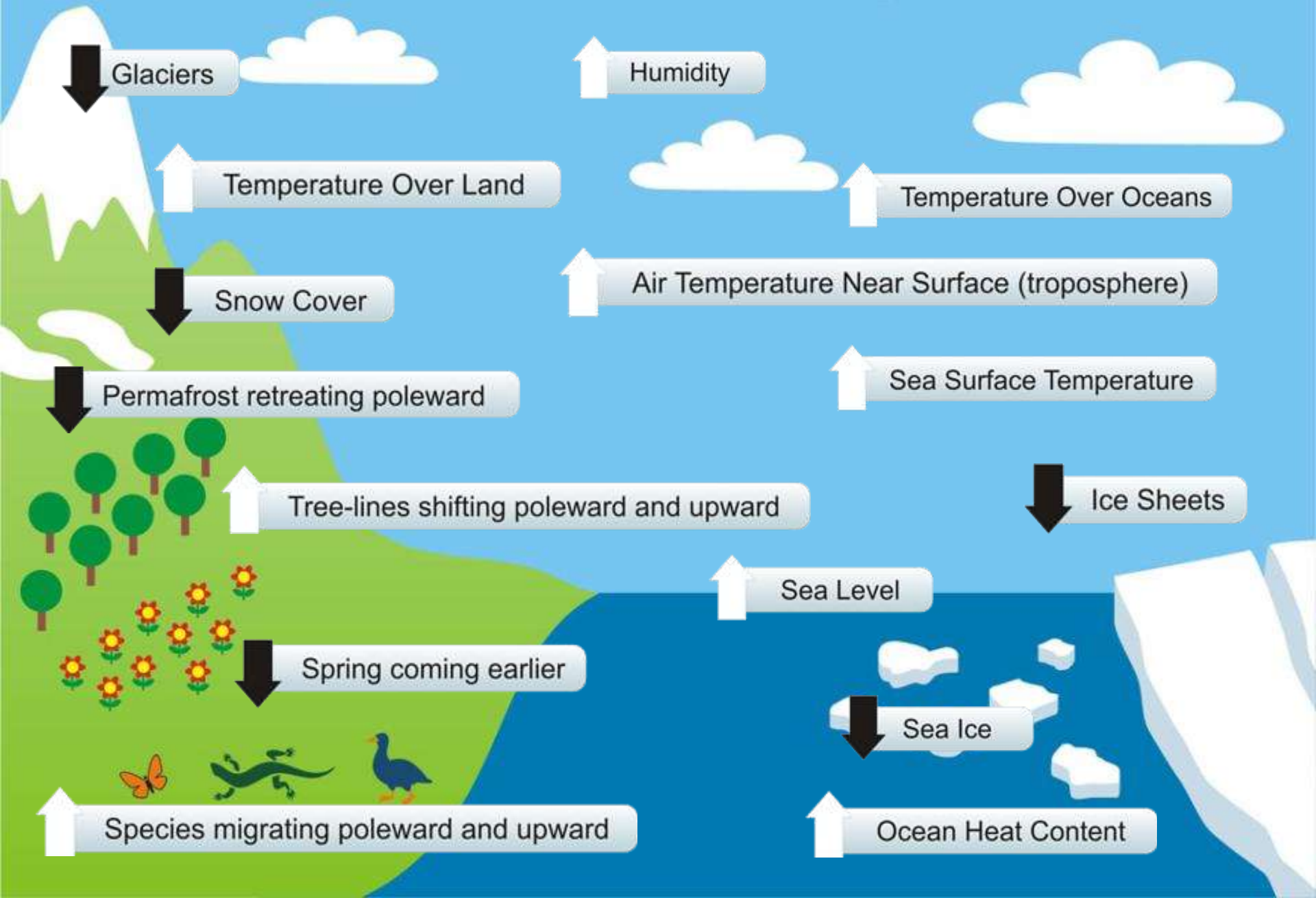
THE COMPOSITION OF AIR IS CHANGING RAPIDLY due to human activities:

- more GHG (CO₂, CH₄, NO_x...)
- more aerosol (air pollution)

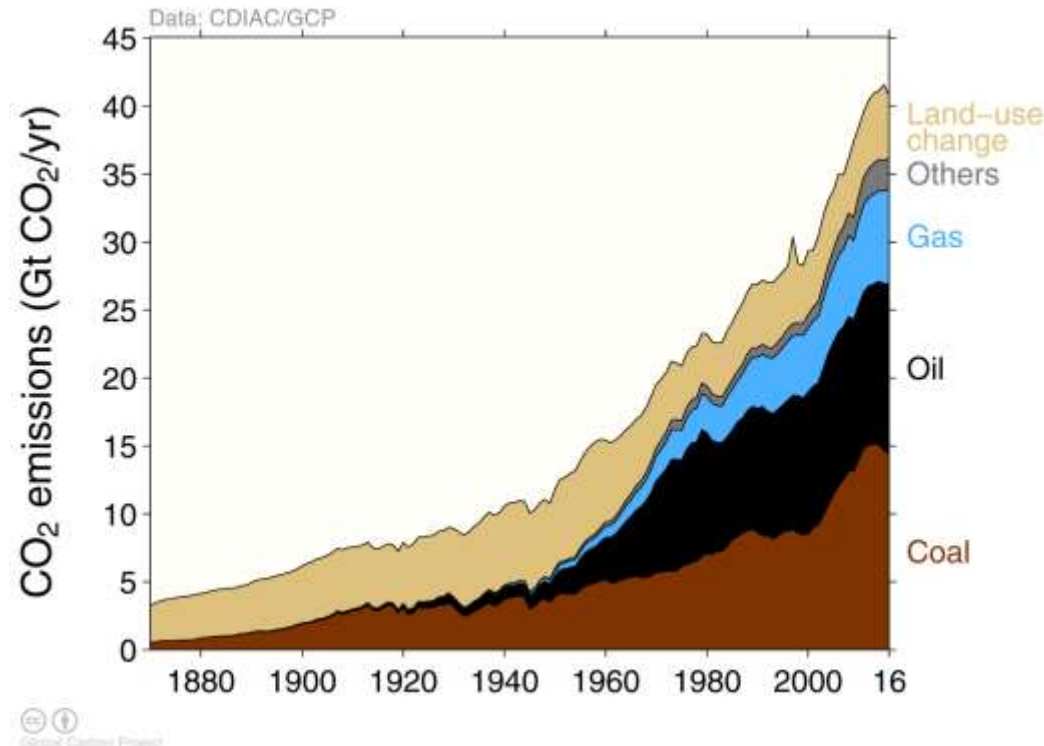
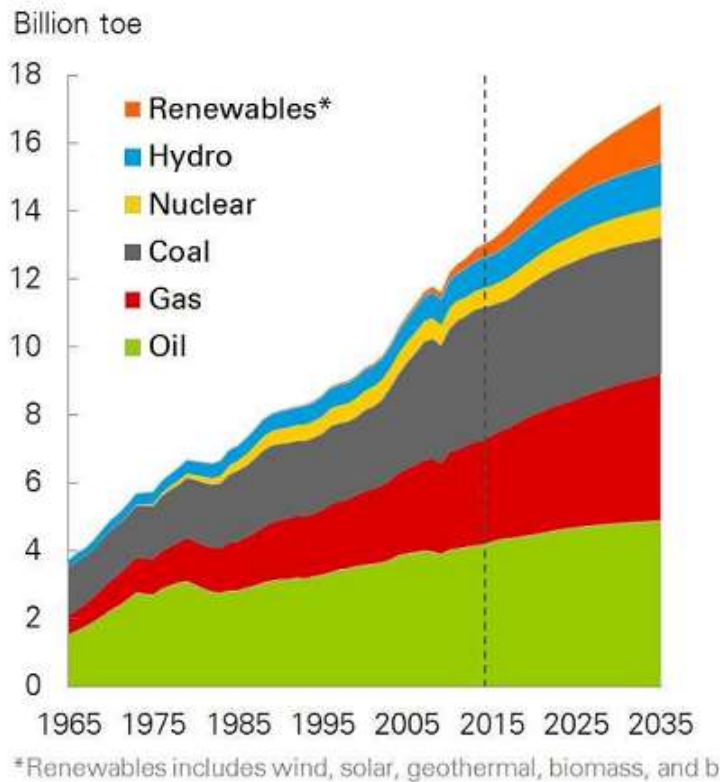
Human activities induced LAND USE CHANGES

- deforestation changed CO₂ balance, more GHG (CO₂)
- changes in albedo, water balance etc.

Indicators of a Warming World

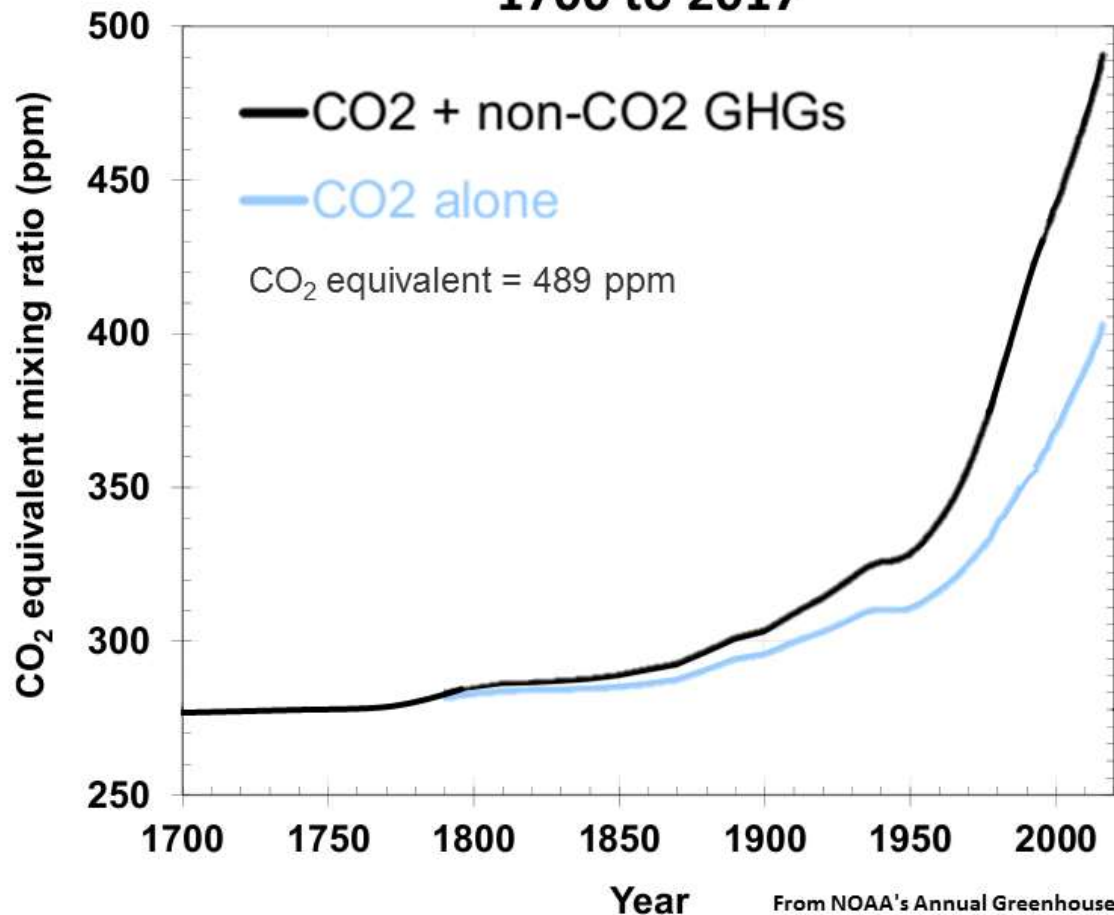


Primary energy consumption and total global emissions are increasing



The atmospheric concentrations of CO₂, methane, and nitrous oxide have increased to levels unprecedented in at least the last 800,000 years.

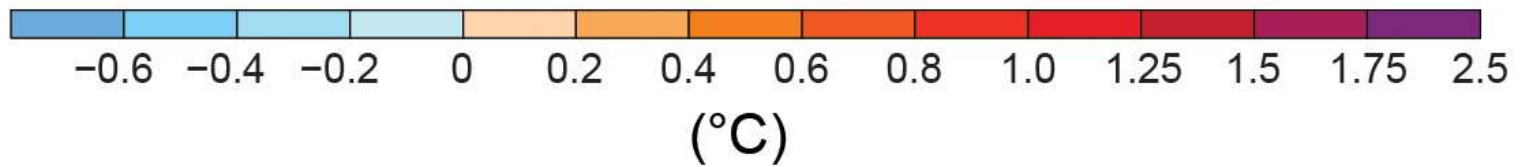
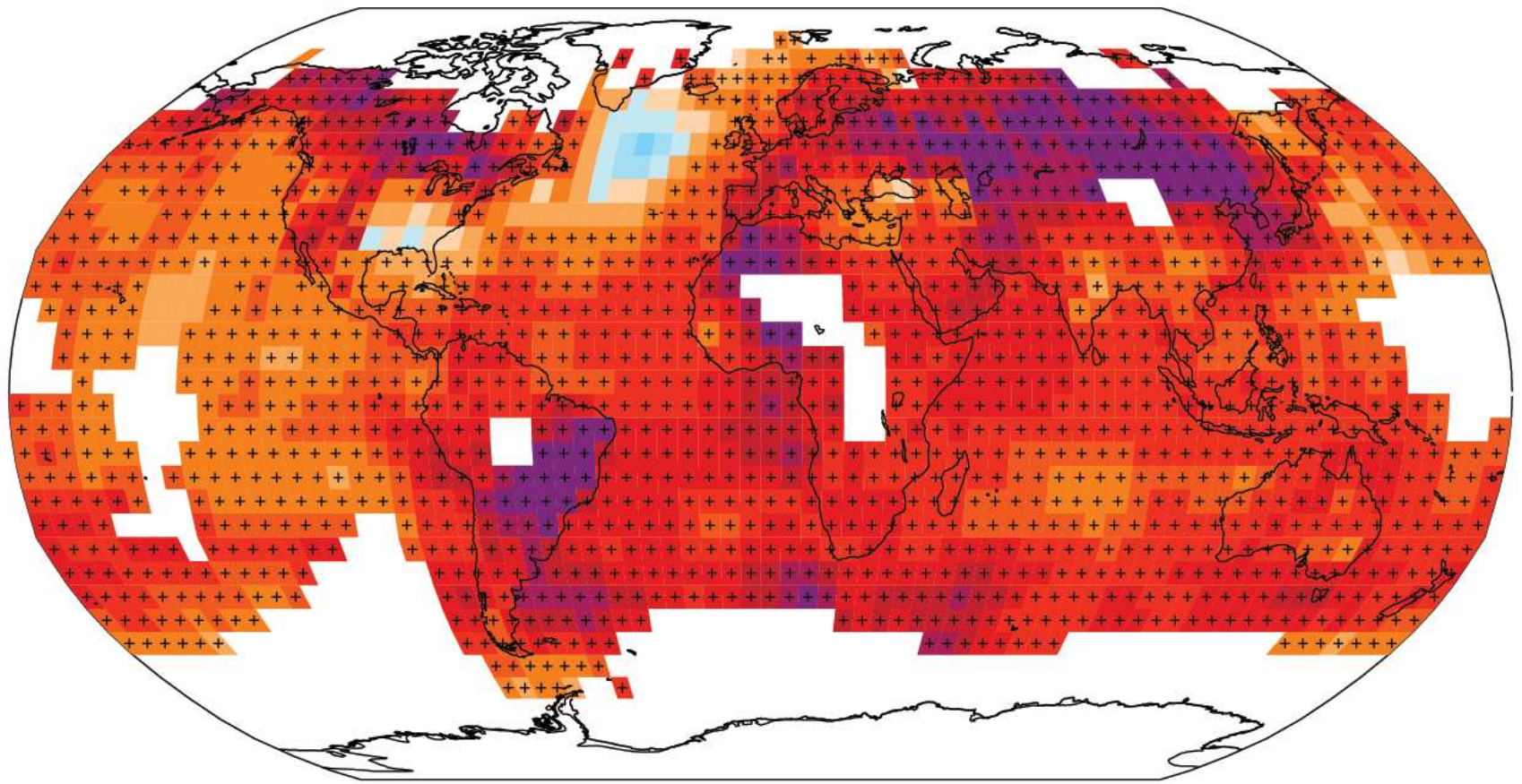
**Atmospheric Concentrations of CO₂ and CO₂ Equivalent
1700 to 2017**



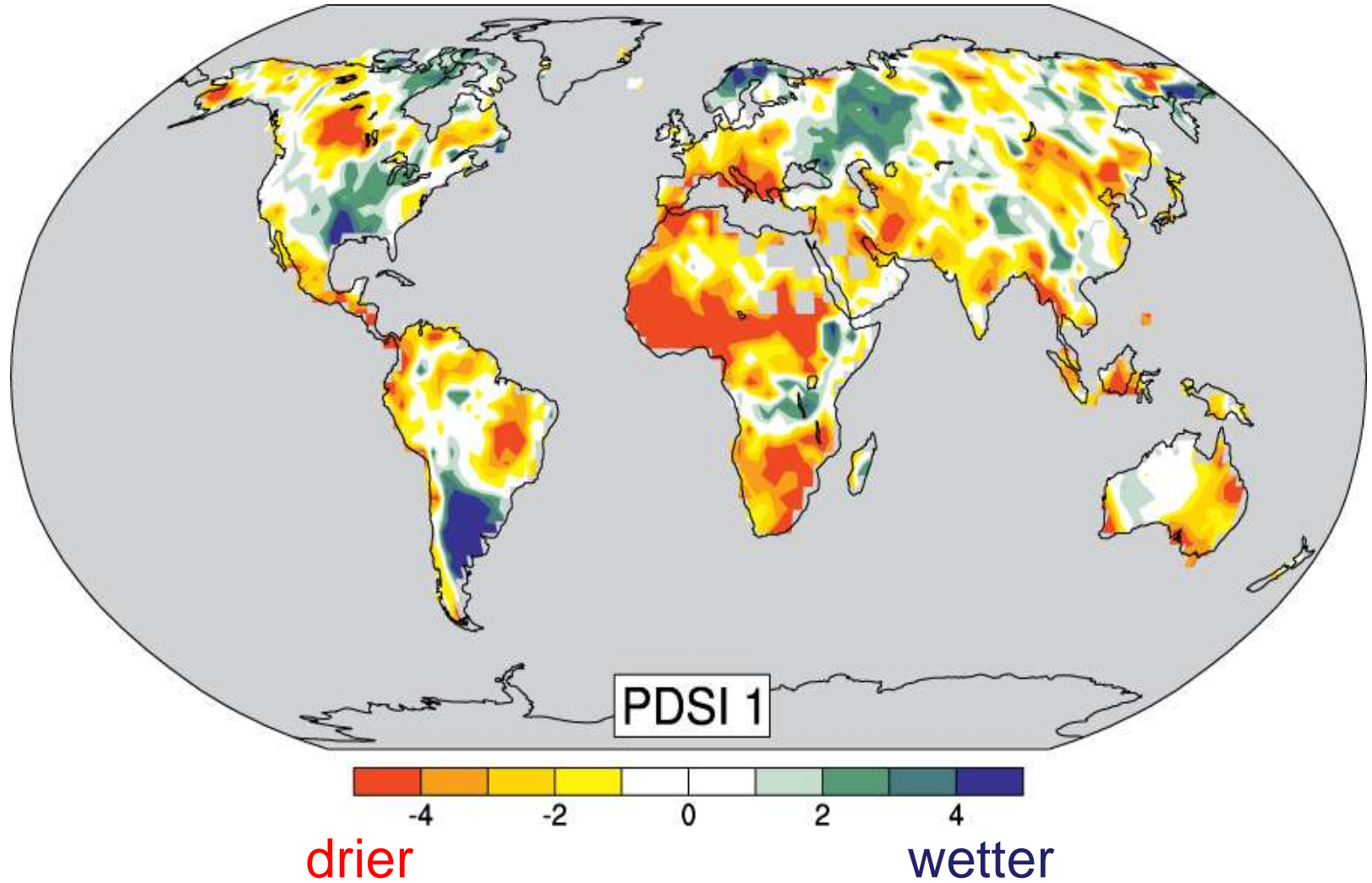
From NOAA's Annual Greenhouse Gas Index Spring 2017

Peter Carter Climate Emergency Institute

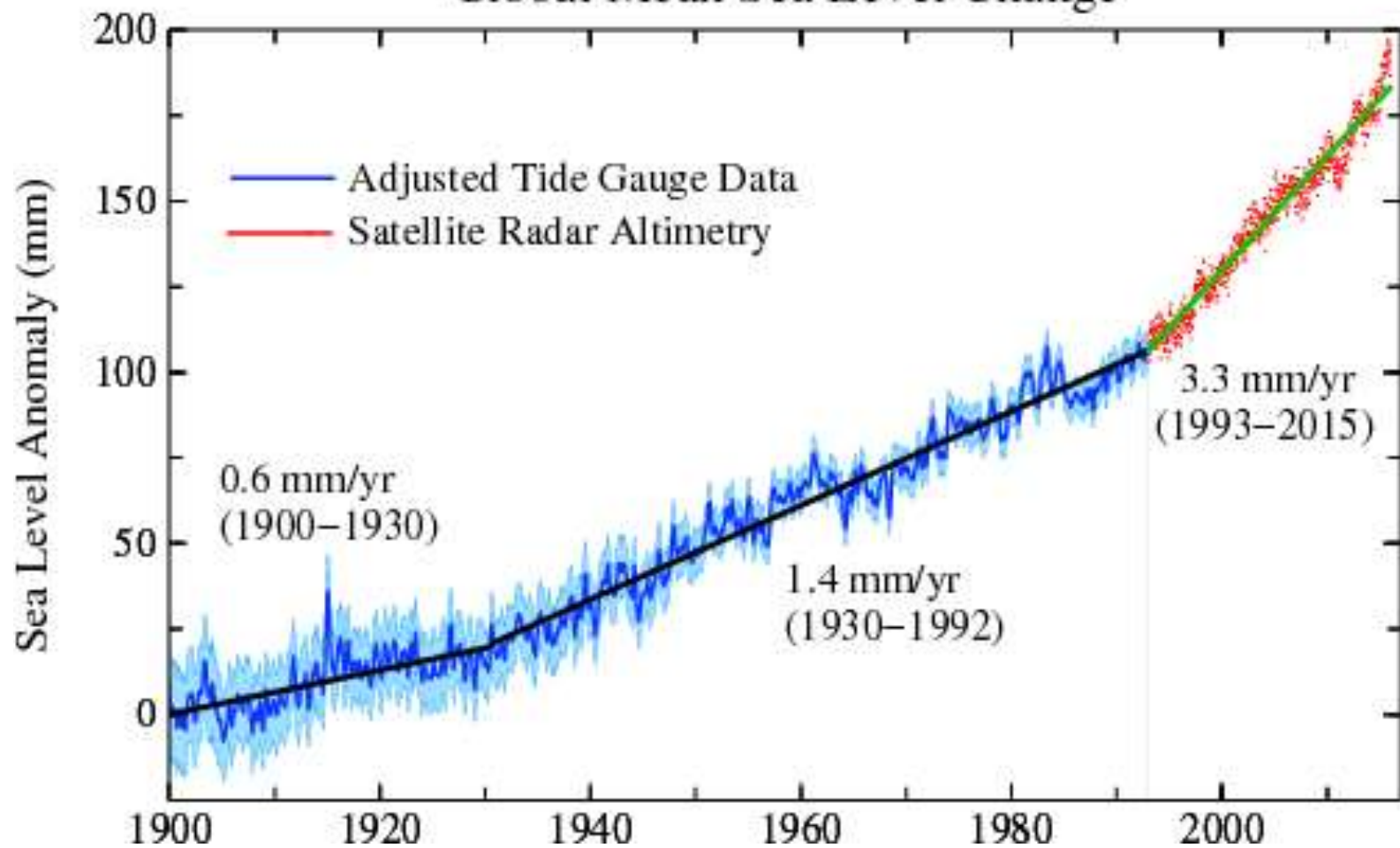
Warming rate K/100 y



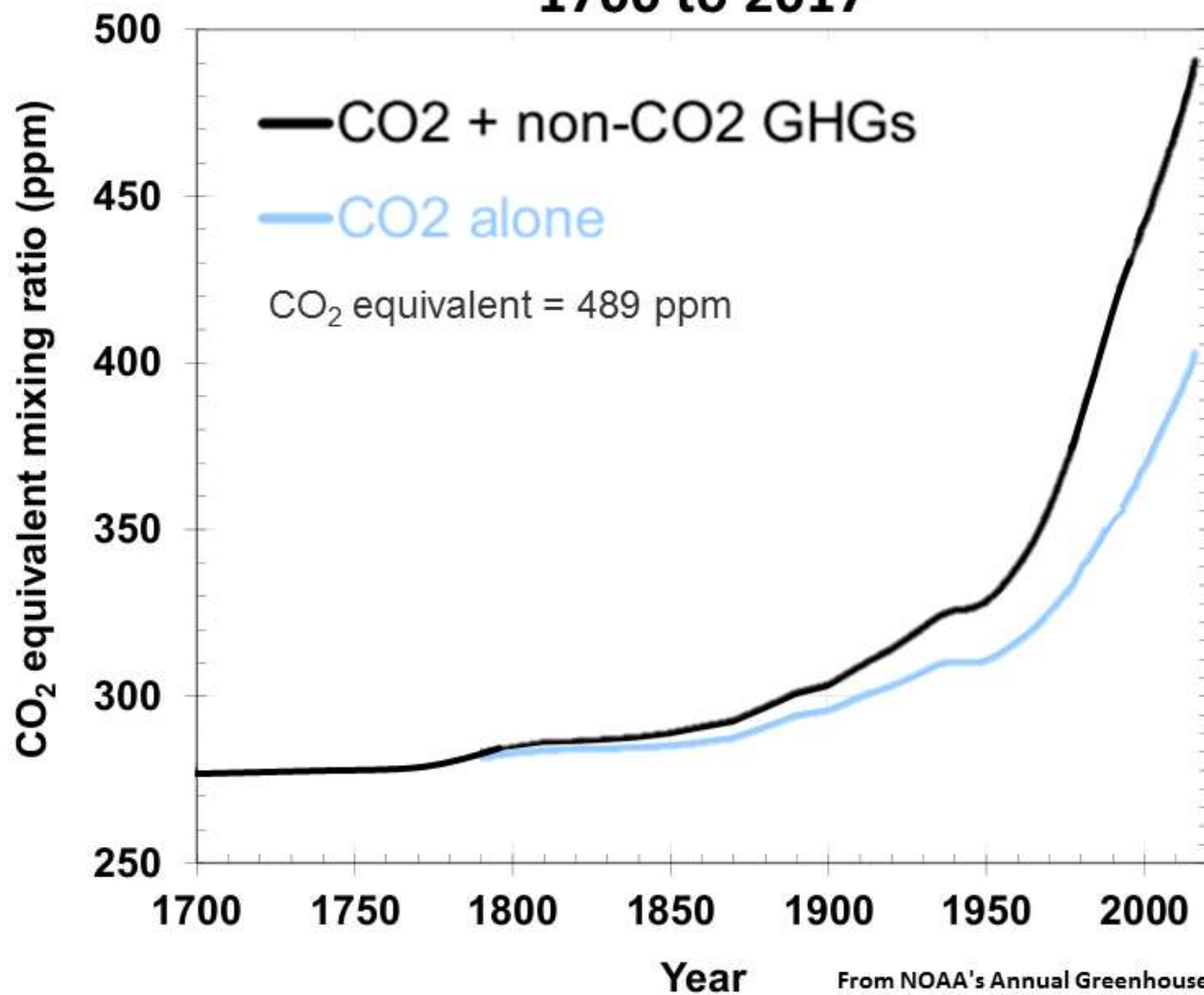
Changes in water cycle



Global Mean Sea Level Change

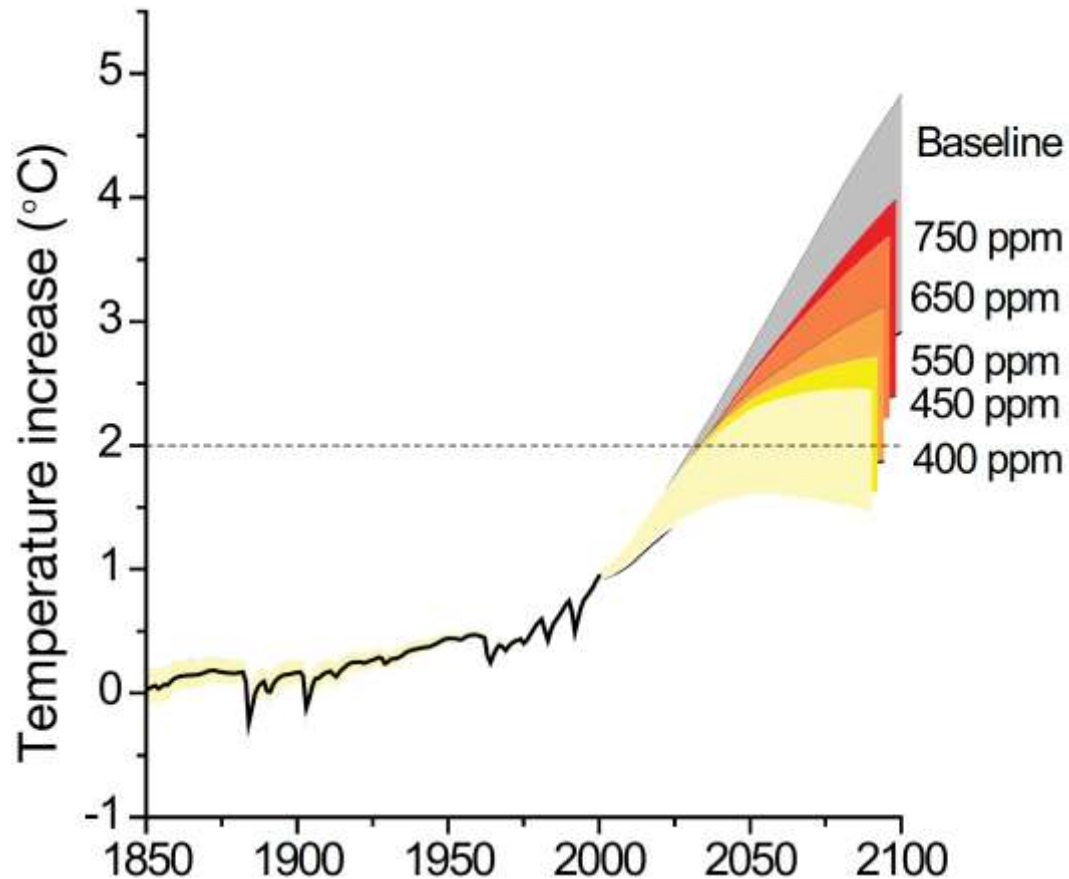


Atmospheric Concentrations of CO₂ and CO₂ Equivalent 1700 to 2017



From NOAA's Annual Greenhouse Gas Index Spring 2017

Peter Carter Climate Emergency Institute



Climate models have improved in the last decade. Models reproduce observed surface temperature patterns and trends over many decades and **are used for climate projections**.

Projected Temperature Change



Difference from 1986–2005 mean (°C)

Solid Color

Very strong agreement

White Dots

Strong agreement

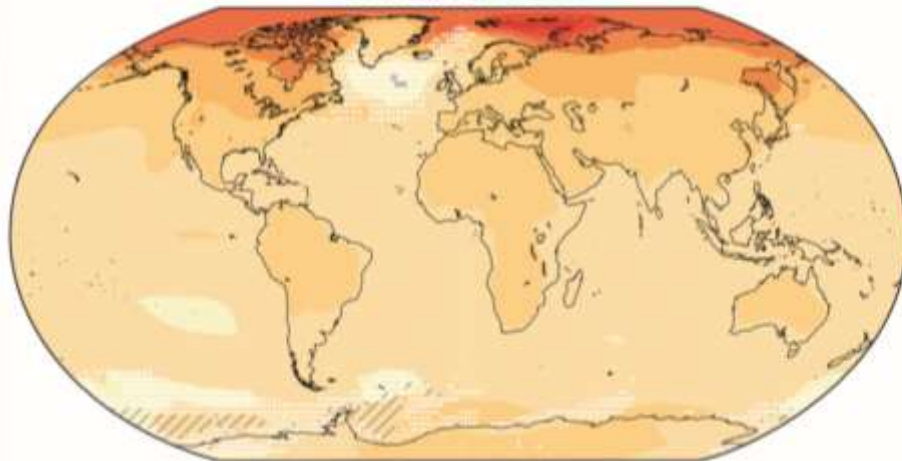
Gray

Divergent changes

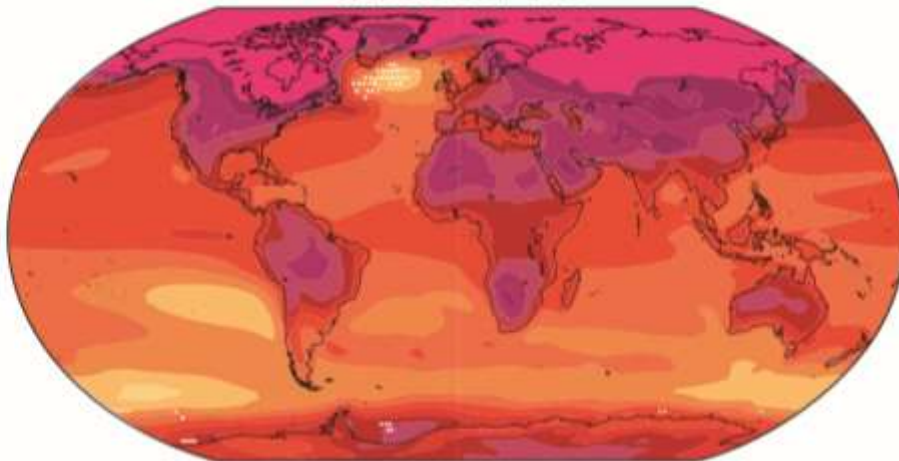
Diagonal Lines

Little or no change

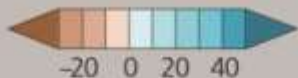
RCP2.6 2081–2100



RCP8.5 2081–2100



Projected Precipitation Change



Difference from 1986–2005 mean (%)

Solid Color

Very strong agreement

White Dots

Strong agreement

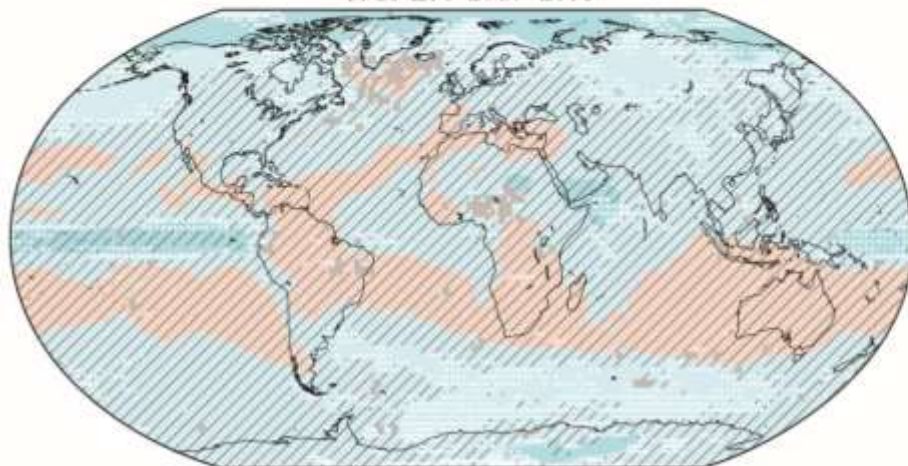
Gray

Divergent changes

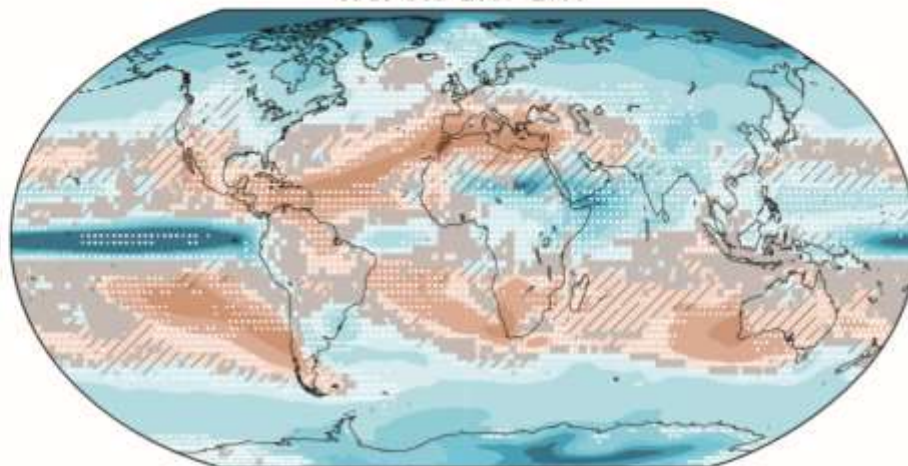
Diagonal Lines

Little or no change

RCP2.6 2081–2100



RCP8.5 2081–2100



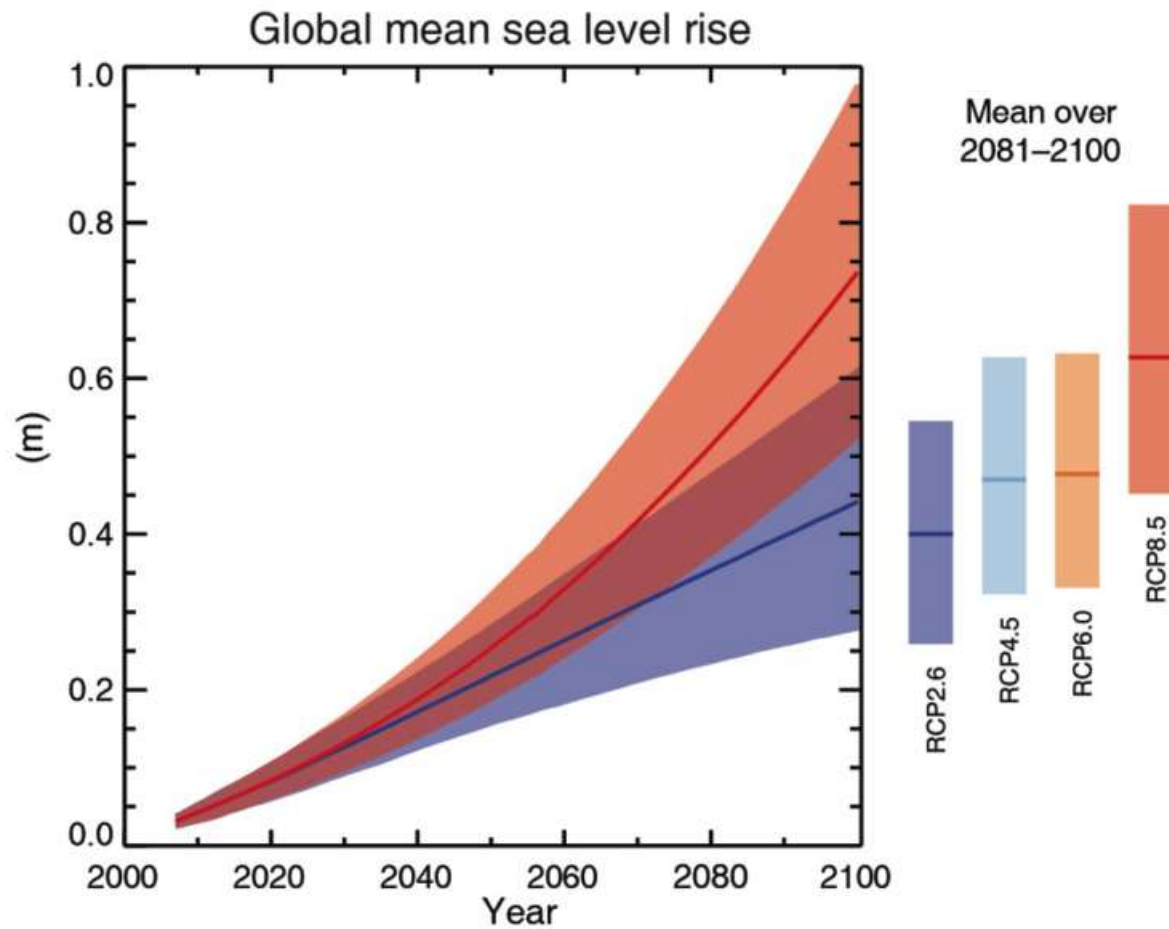


Fig. SPM.9

RCP2.6 (2081-2100), *likely* range: 26 to 55 cm

RCP8.5 (2081-2100), *likely* range: 45 to 82 cm

Projections Europe (RCP4.5) 2081-2100 versus 1986-2005

Temperature (°C)

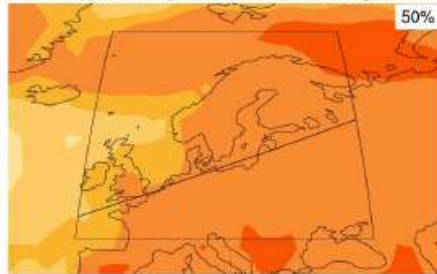
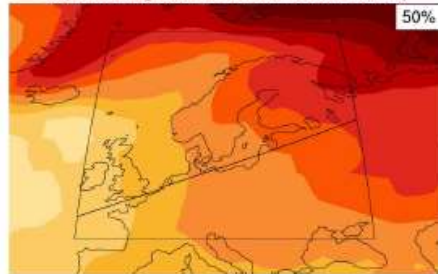
Precipitation (%)

Temperature change RCP4.5 in 2081-2100: December-February

Temperature change RCP4.5 in 2081-2100: June-August

Precipitation change RCP4.5 in 2081-2100: October-March

Precipitation change RCP4.5 in 2081-2100: April-September

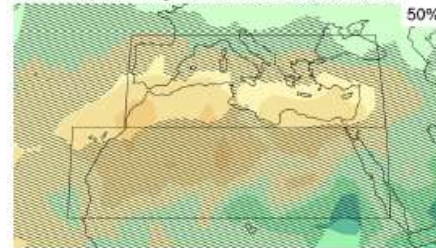
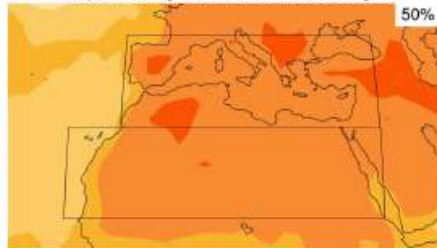
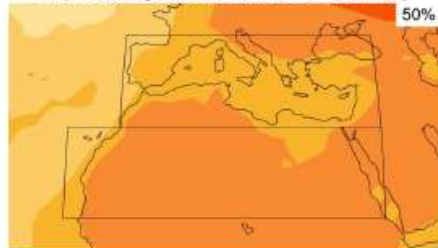


Temperature change RCP4.5 in 2081-2100: December-February

Temperature change RCP4.5 in 2081-2100: June-August

Precipitation change RCP4.5 in 2081-2100: October-March

Precipitation change RCP4.5 in 2081-2100: April-September



-2 -1.5 -1 -0.5 0 0.5 1 1.5 2 3 4 5 7 9 11

winter

summer

-50 -40 -30 -20 -10 0 10 20 30 40 50

winter half

summer half

Impacts are already underway

- **Tropics to the poles**
- **On all continents and in the ocean**
- **Affecting rich and poor countries (but the poor are more vulnerable everywhere)**



Facing the dangers from climate change...

...there are only **three** options:

Mitigation, meaning measures to reduce the pace & magnitude of the changes in global climate being caused by human activities.

Adaptation, meaning measures to reduce the adverse impacts on human well-being resulting from the changes in climate that do occur.

Suffering the adverse impacts that are not avoided by either mitigation or adaptation.

Concluding thoughts

- Human influence on the climate system is clear. This is evident from the increasing GHG concentrations, observed warming, and understanding of the climate system.
- Continued emissions of GHG will cause further warming and changes in all components of the climate system.
- We can still limit climate change by substantial and sustained reductions of greenhouse gas emissions.

