Climate science, data and projections

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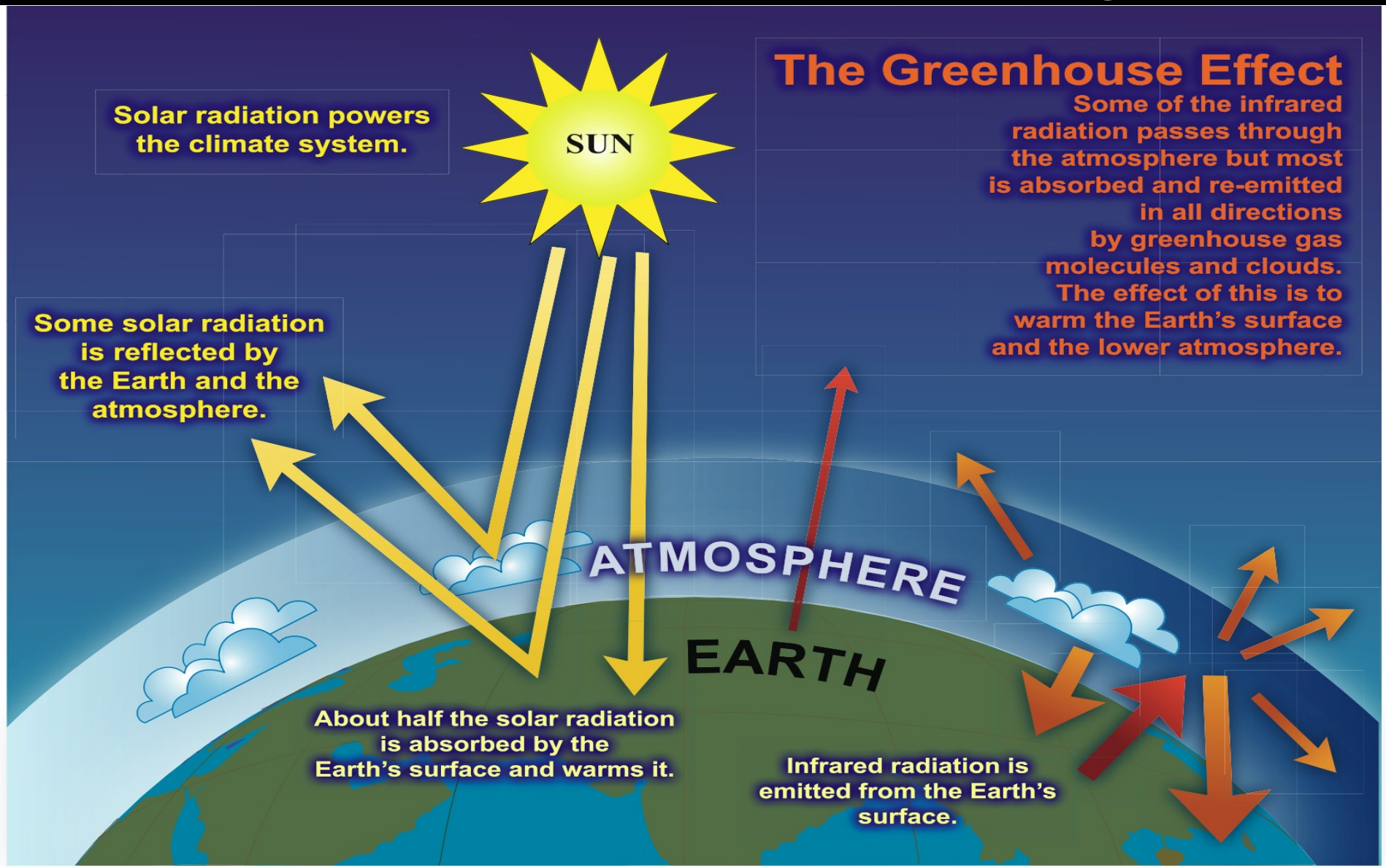
Fundamentals of Climate Change Science

The effect of greenhouse gases and the warming potential of the enhanced greenhouse effect

Observed global and regional warming and demonstrating this is attributable to human activities

Global and regional temperatures and sea-level will continue to change – current and future climate will not be the same as in the past

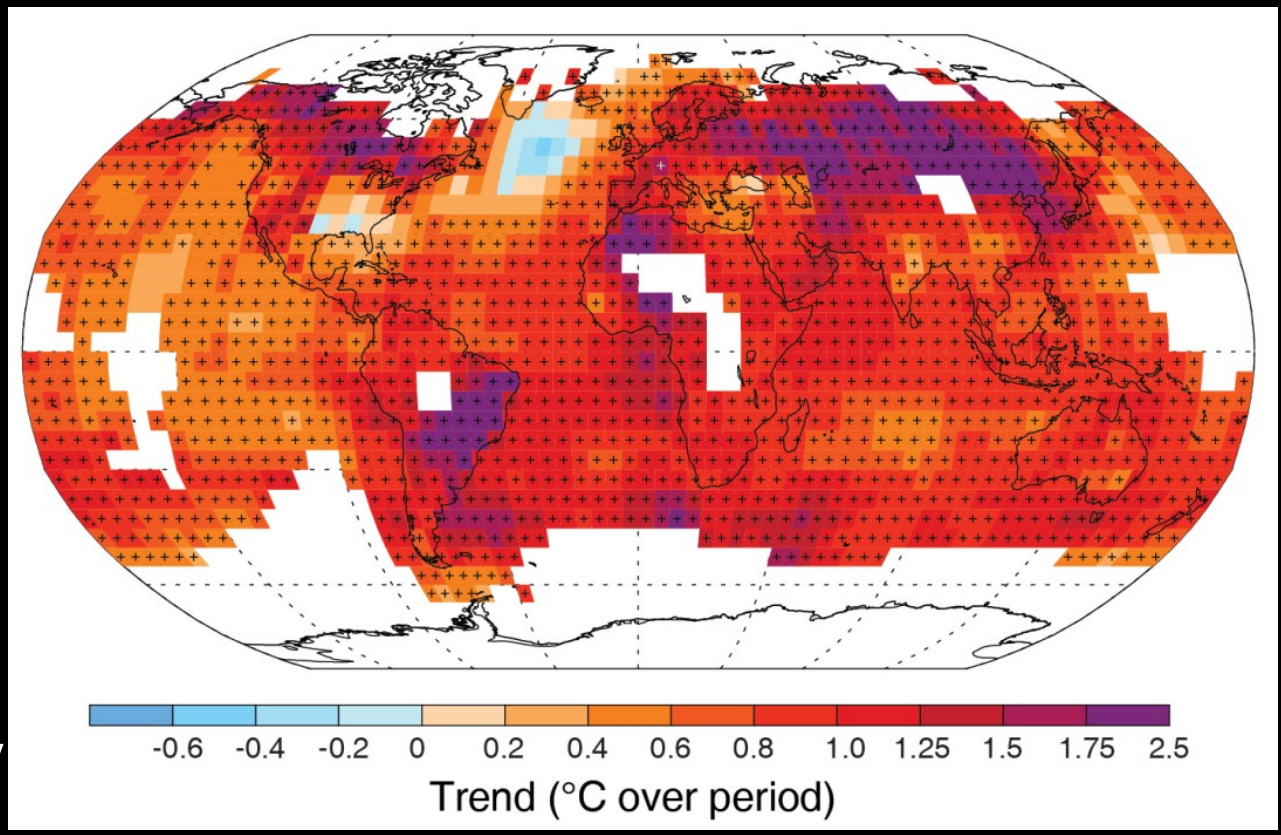
The greenhouse effect and its role in climate change



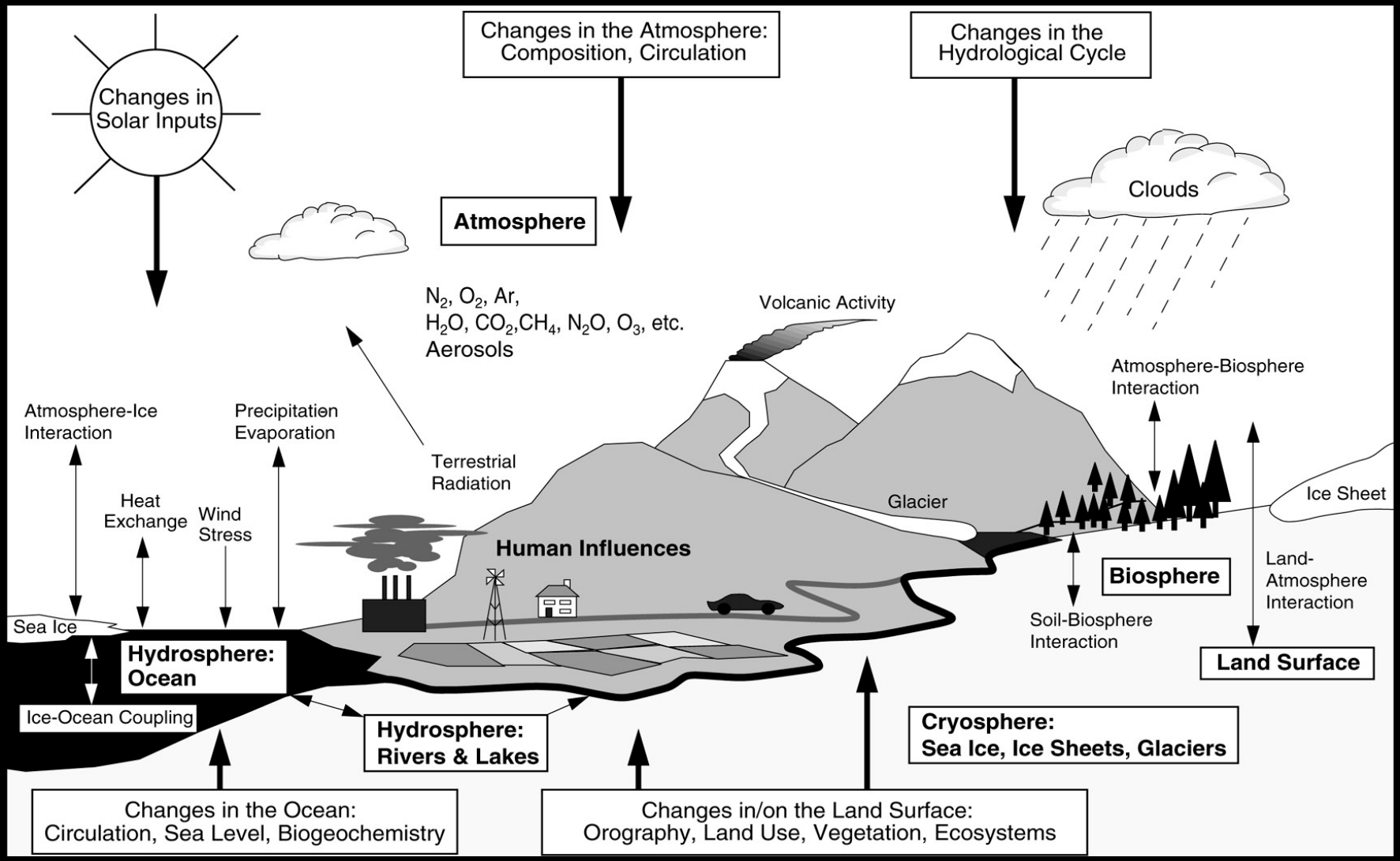
The greenhouse effect is essential – but increasing

With no atmosphere and only the effect of the sun heating the earth, its temperature would be about -18°C. So the greenhouse effect is essential to maintain temperatures high enough for life.

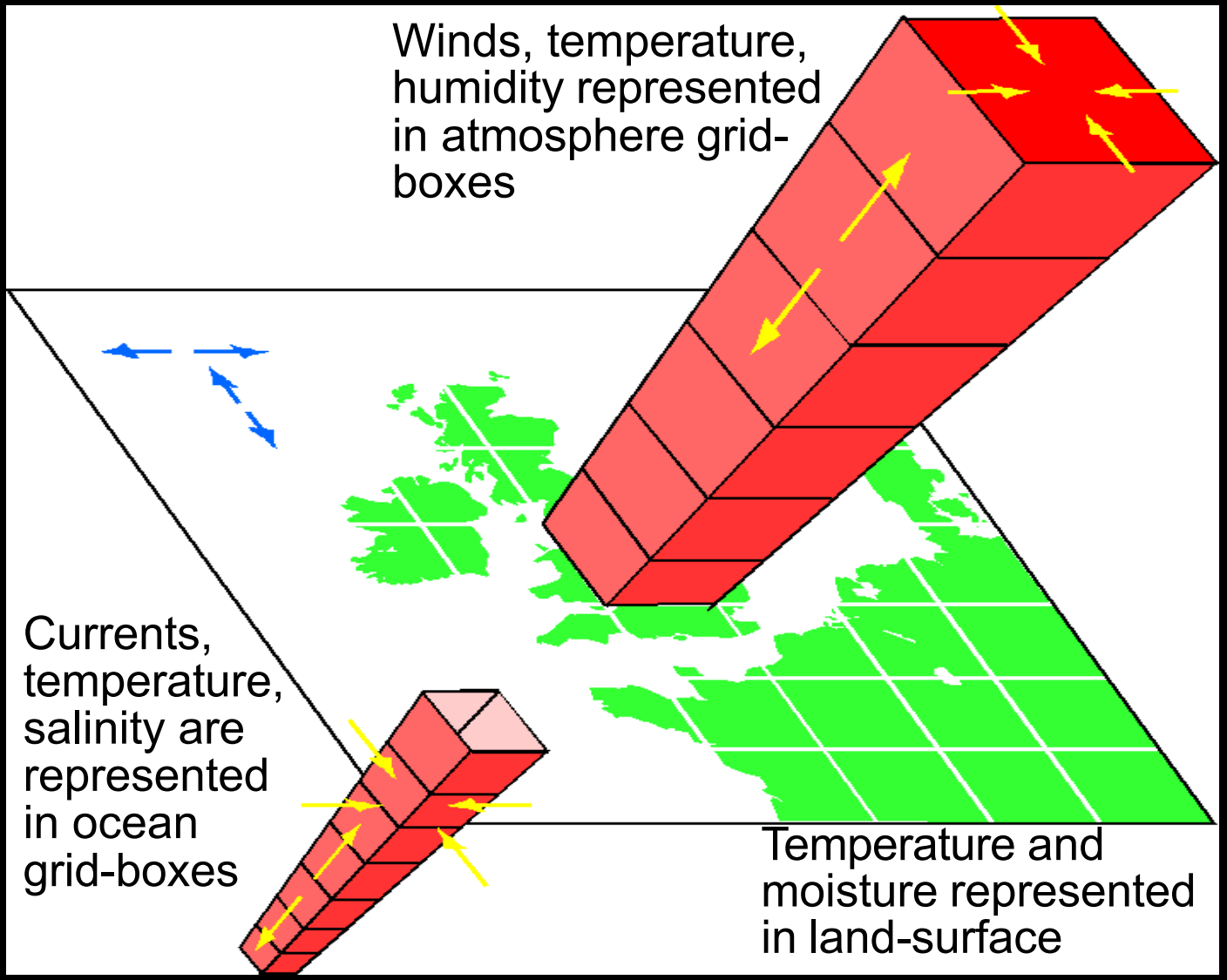
Since people have been using coal, oil and gas for energy (for heating, industry, transport) and have increased agriculture these greenhouse gases and their warming effect have increased significantly



To understand climate change we use models representing all relevant earth system processes

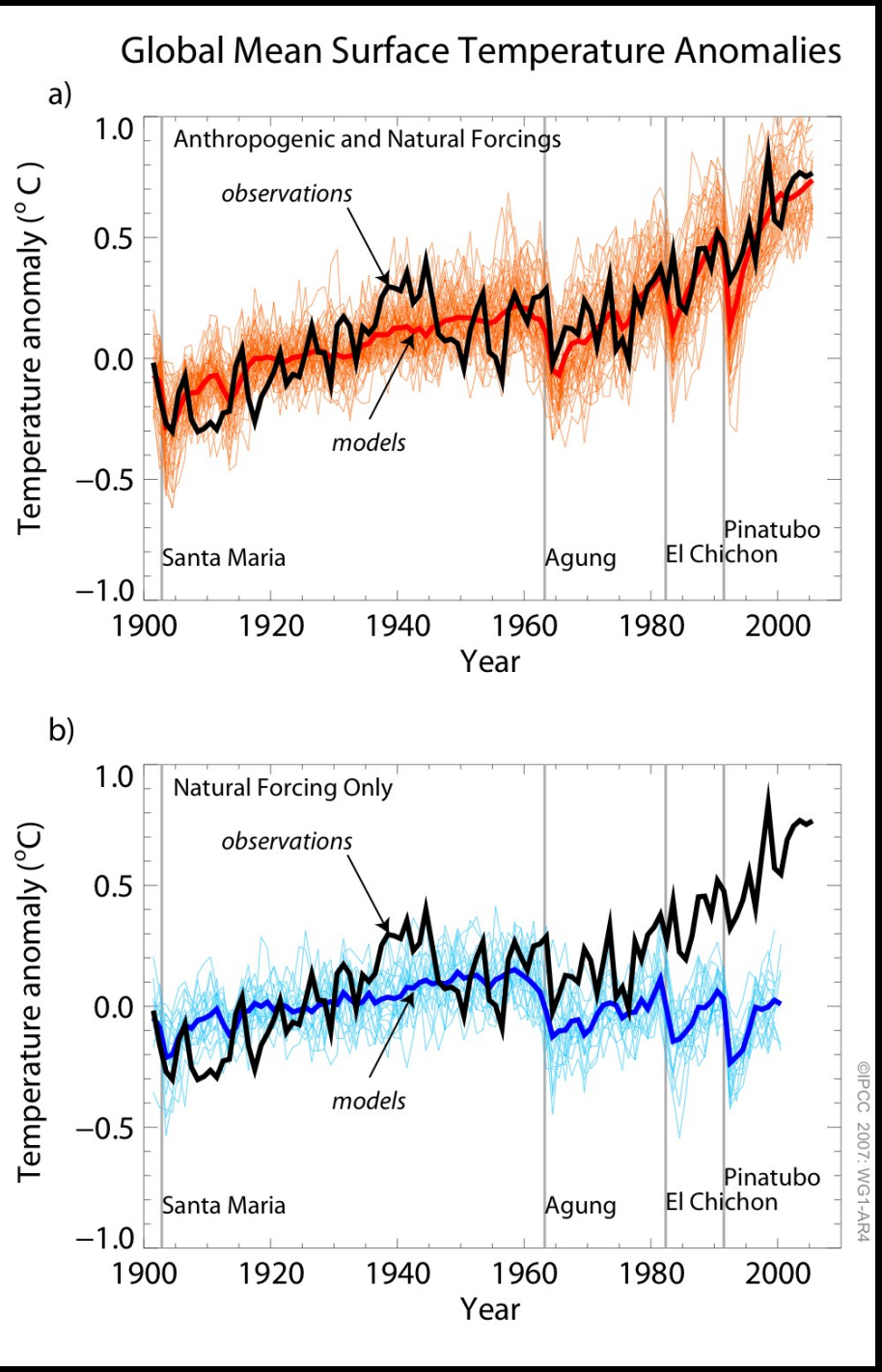


Global climate models represent the climate system on a grid of discrete elements – horizontal resolution~150km



Other processes are represented as smaller-scale interactions averaged over the grid-boxes

Examples are: Radiation, aerosols, clouds, precipitation and evaporation, convection, land/sea-surface and atmosphere interactions



When we run the climate models for the recent past they simulate the observed warming …

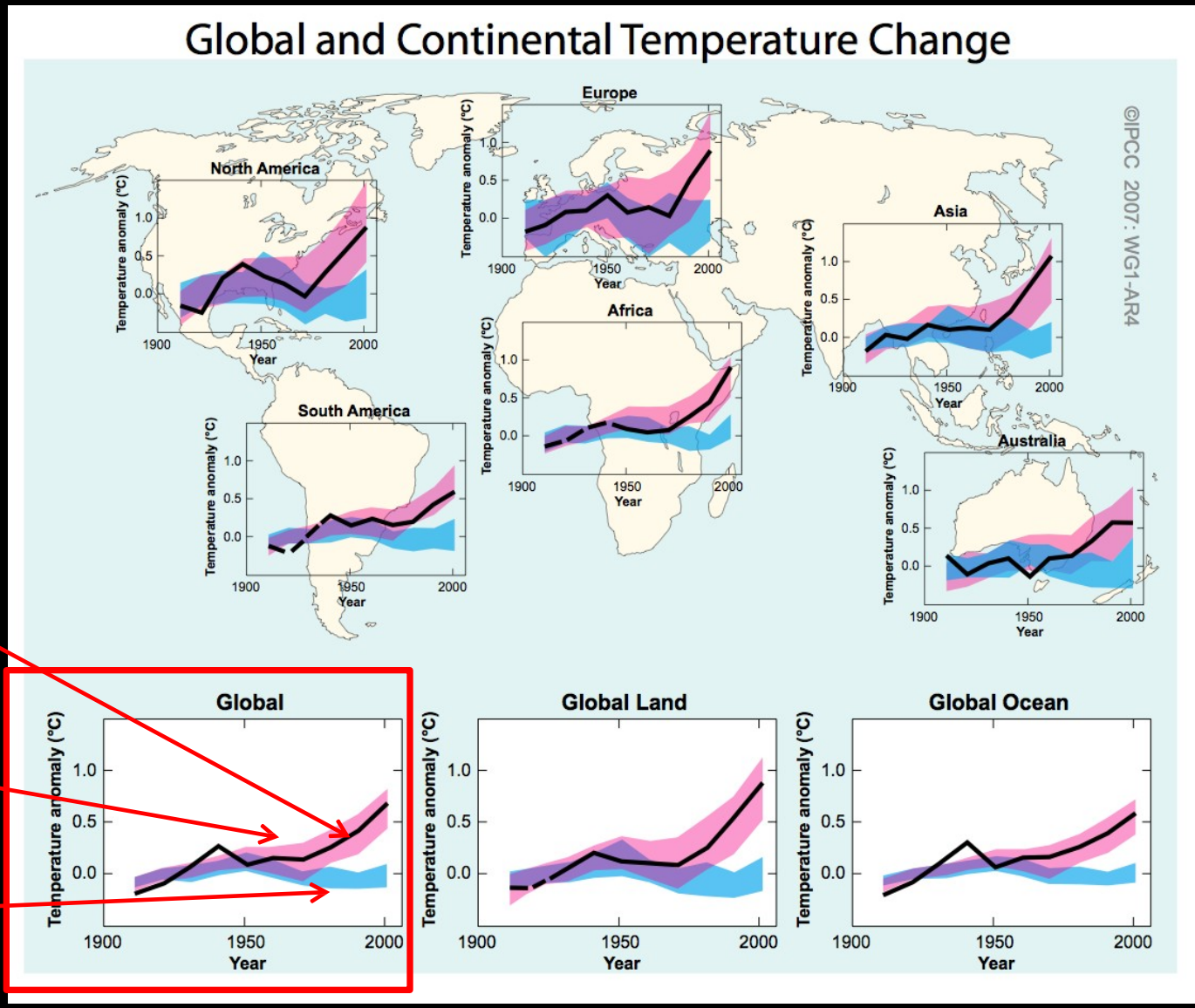
if they include observed changes in greenhouse gases, aerosols and natural factors (volcanoes, solar output

but not if they only include natural factors

Using global models with observed human-related and natural factors is key to this understanding

Understanding and attributing regional climate change

Anthropogenic warming is discernible on all inhabited continents

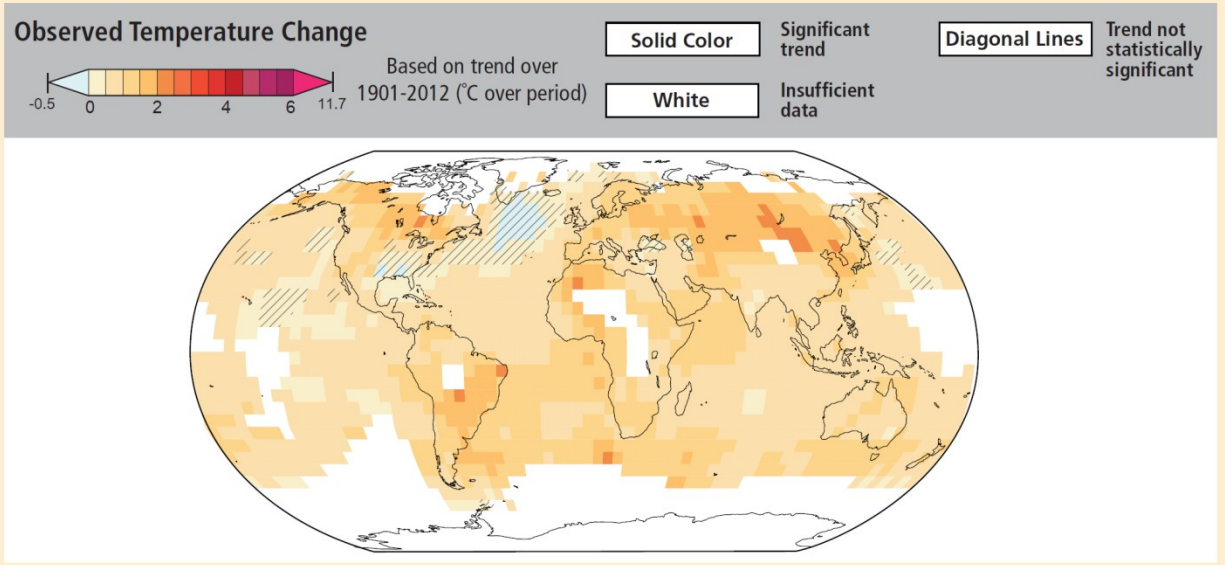


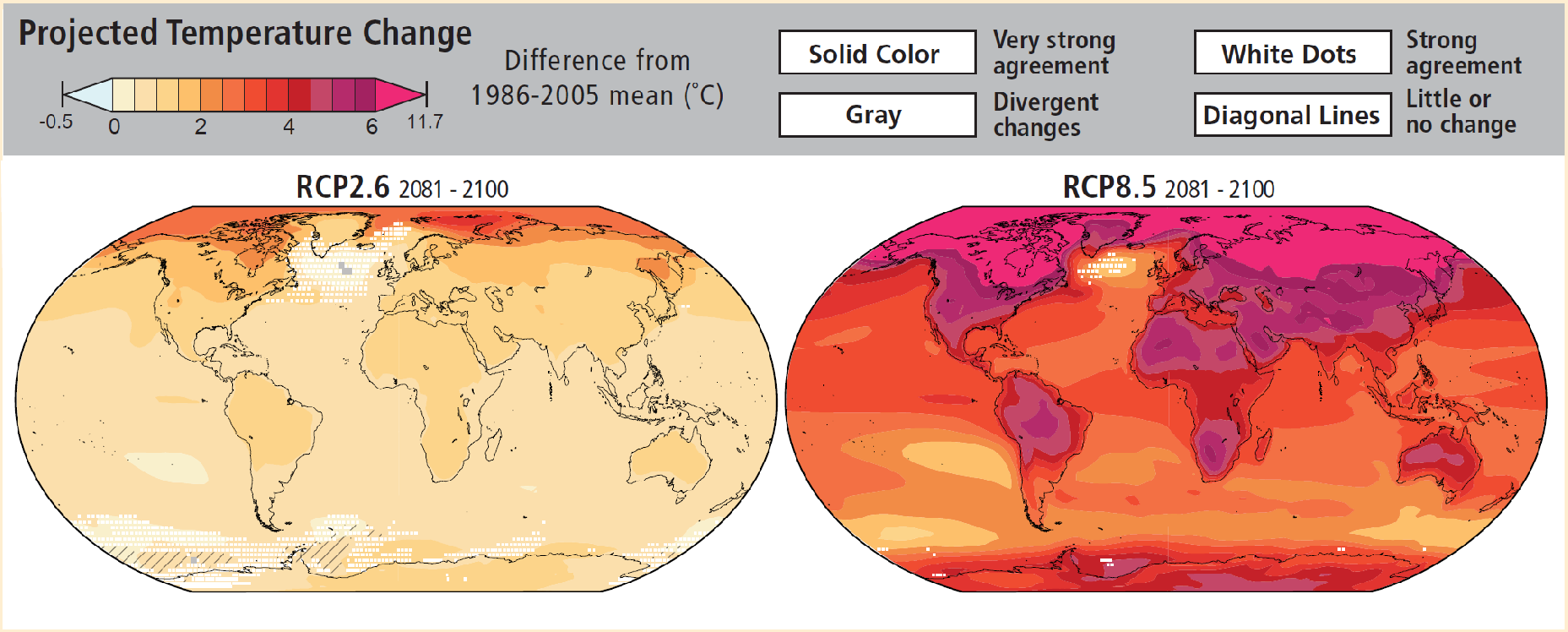
Observed (black line)

Expected for all forcings (red band)

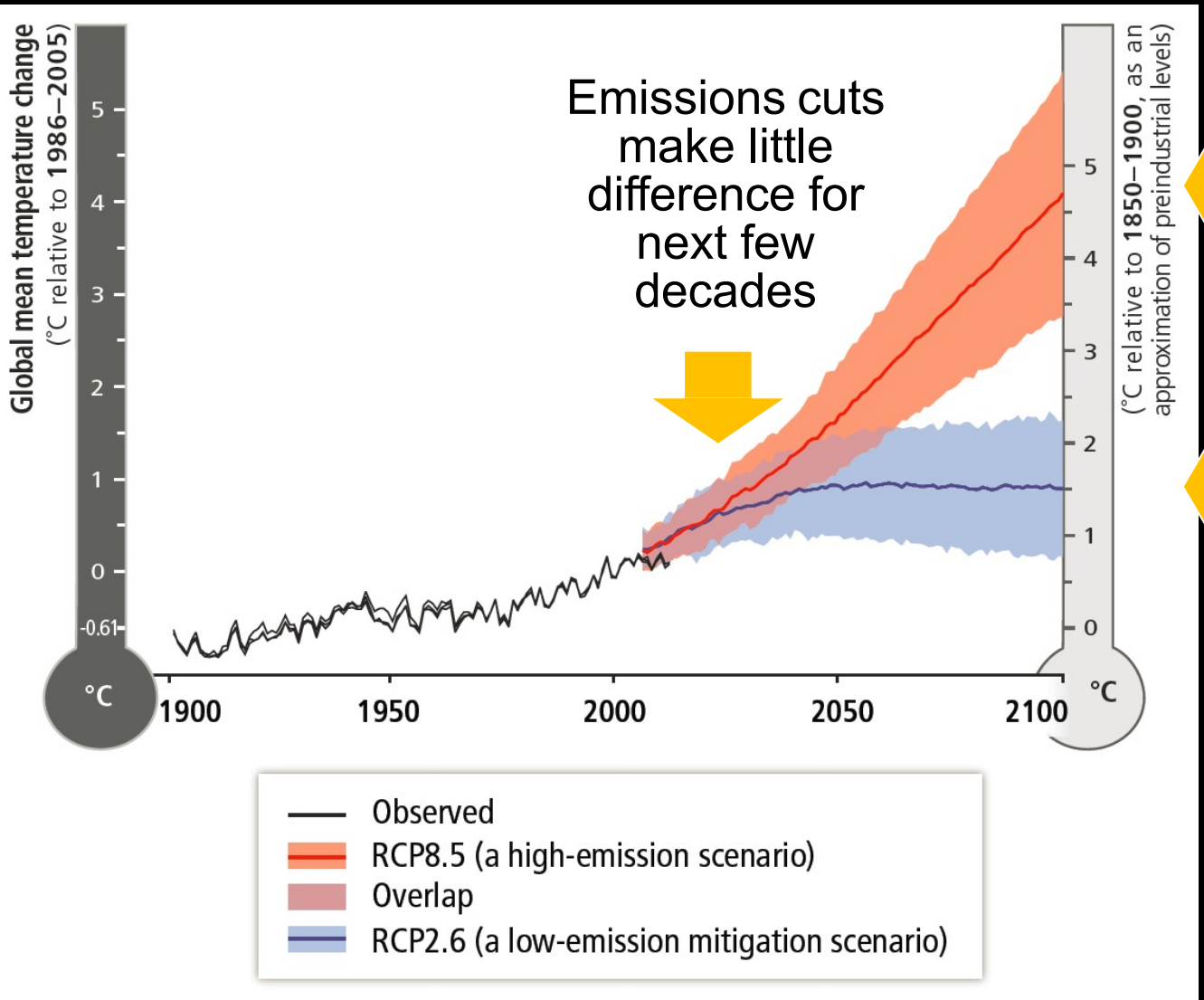
Natural forcing only (blue band)

The climate change context





Projections of future temperature change with high and low emissions

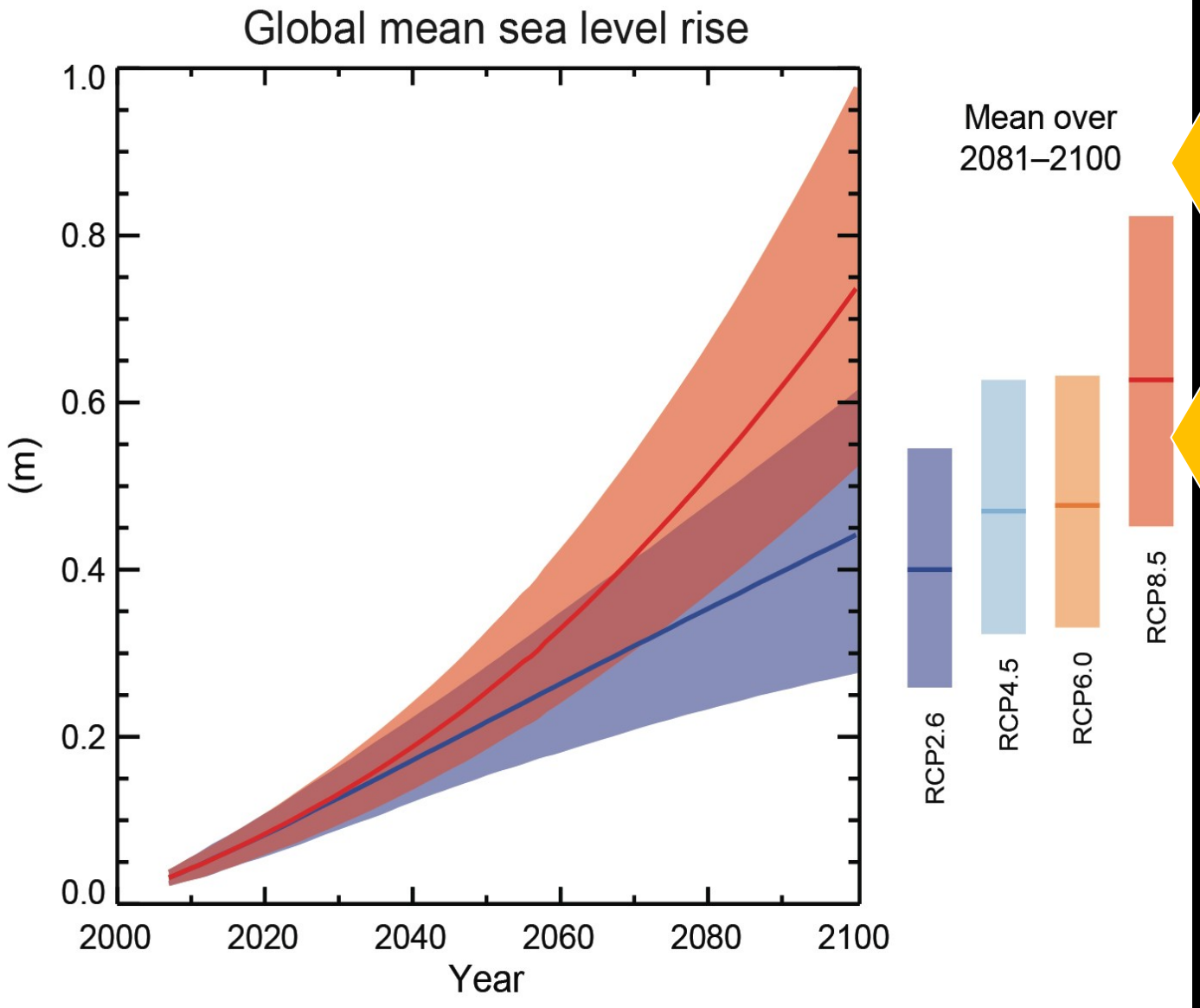


Ongoing increases in global greenhouse gas emissions

If global emissions peak within next few years then decline

Projections from multiple global climate models assessed in IPCC AR5 using low and high greenhouse gas Concentrations Pathways (RCPs)

Sea-levels will continue to rise

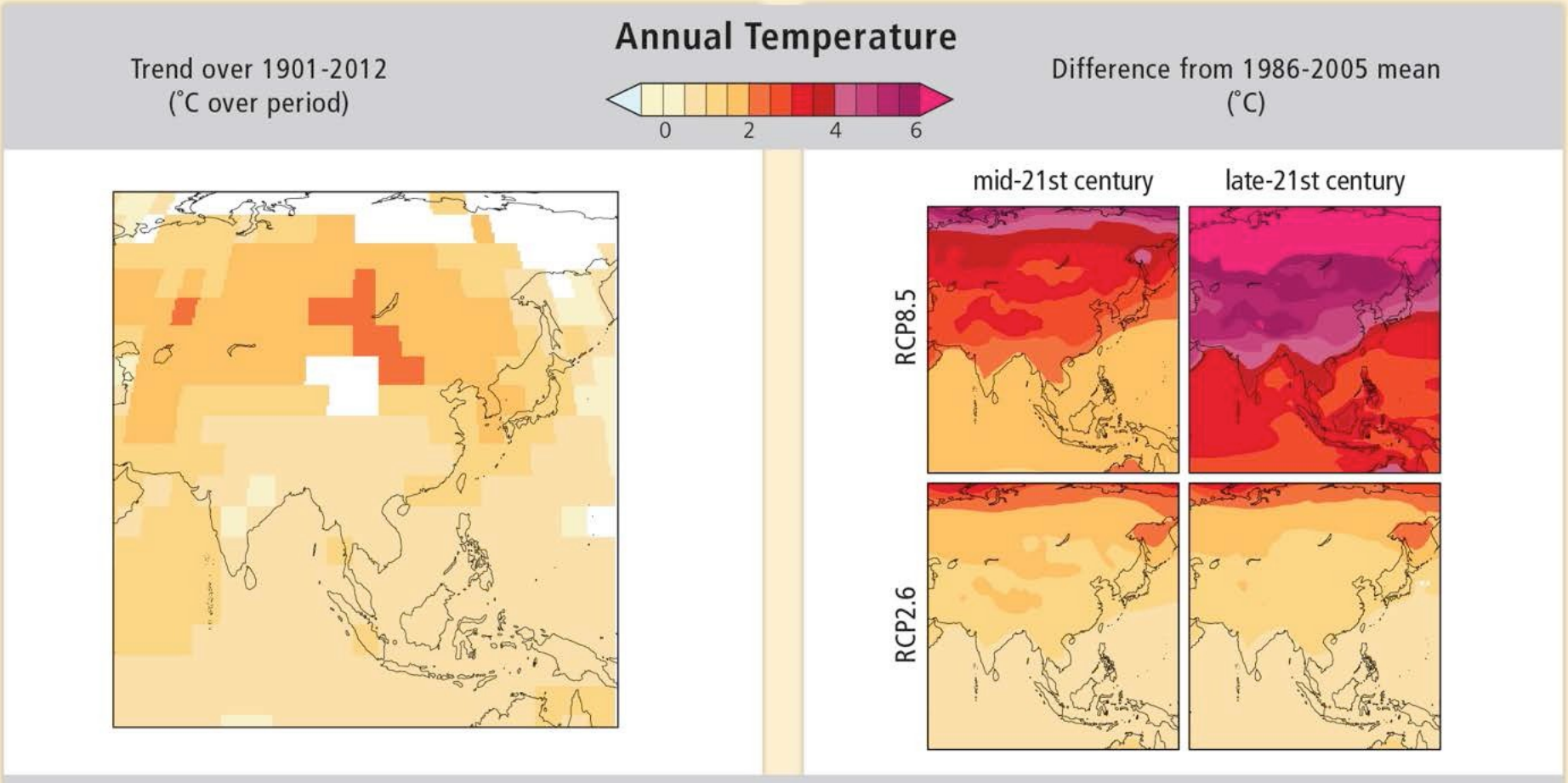


With large increases in global greenhouse gas emissions sea-levels will continue to rise exponentially

Even if global emissions peak within next few years then decline sea levels will continue to rise (for centuries)

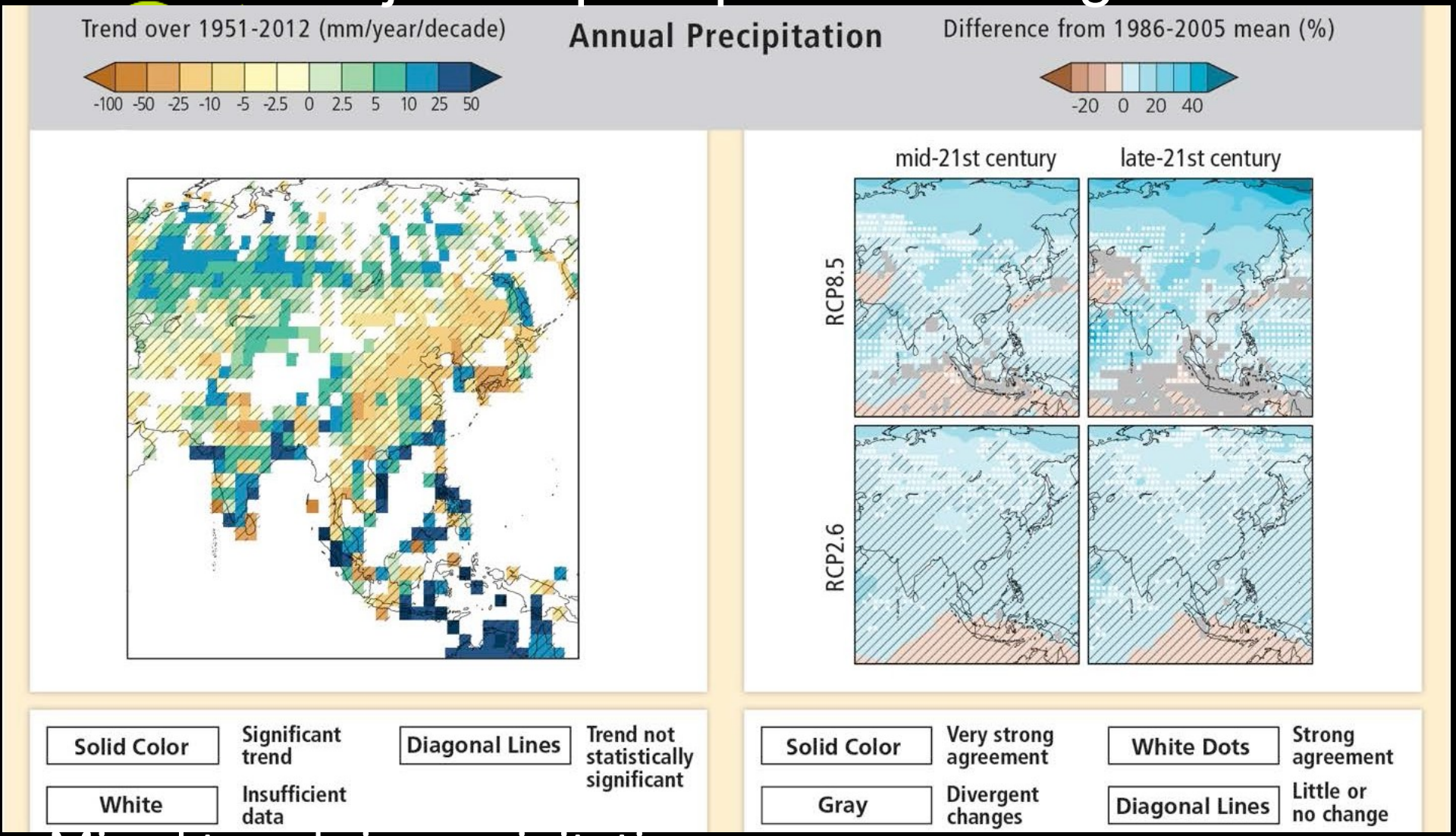
Projections from multiple global climate models assessed in the IPCC AR5 using four Representative greenhouse gas Concentrations Pathways (RCPs)

Projected temperature changes in Asia



- Clear warming trends everywhere we have good data
- Significantly more warming in the future but much less with aggressive mitigation

Projected precipitation changes in Asia



- Mixed trends in precipitation
- General tendency for increases in average precipitation
- Areas of uncertainty in some tropical/central Asian regions

Conclusions

- The greenhouse effect is strengthening as human activity increases greenhouse gases in the atmosphere
- Using observations and climate models demonstrates human influence has caused most observed warming and the models can be used to predict future changes
- The world will continue to warm, and more than has been observed to date even with aggressive mitigation
- Sea-levels will continue to rise and precipitation will change in many regions

Today and tomorrow's climate is not as it used to be