

Tror dere på klimaforandringer og er det sant at de er menneskeskapt?

Underbygger observasjonene klimaforandringer og i hvilken grad og med hvilken usikkerhet kan de skyldes menneskelig aktivitet?

Bo Andersen



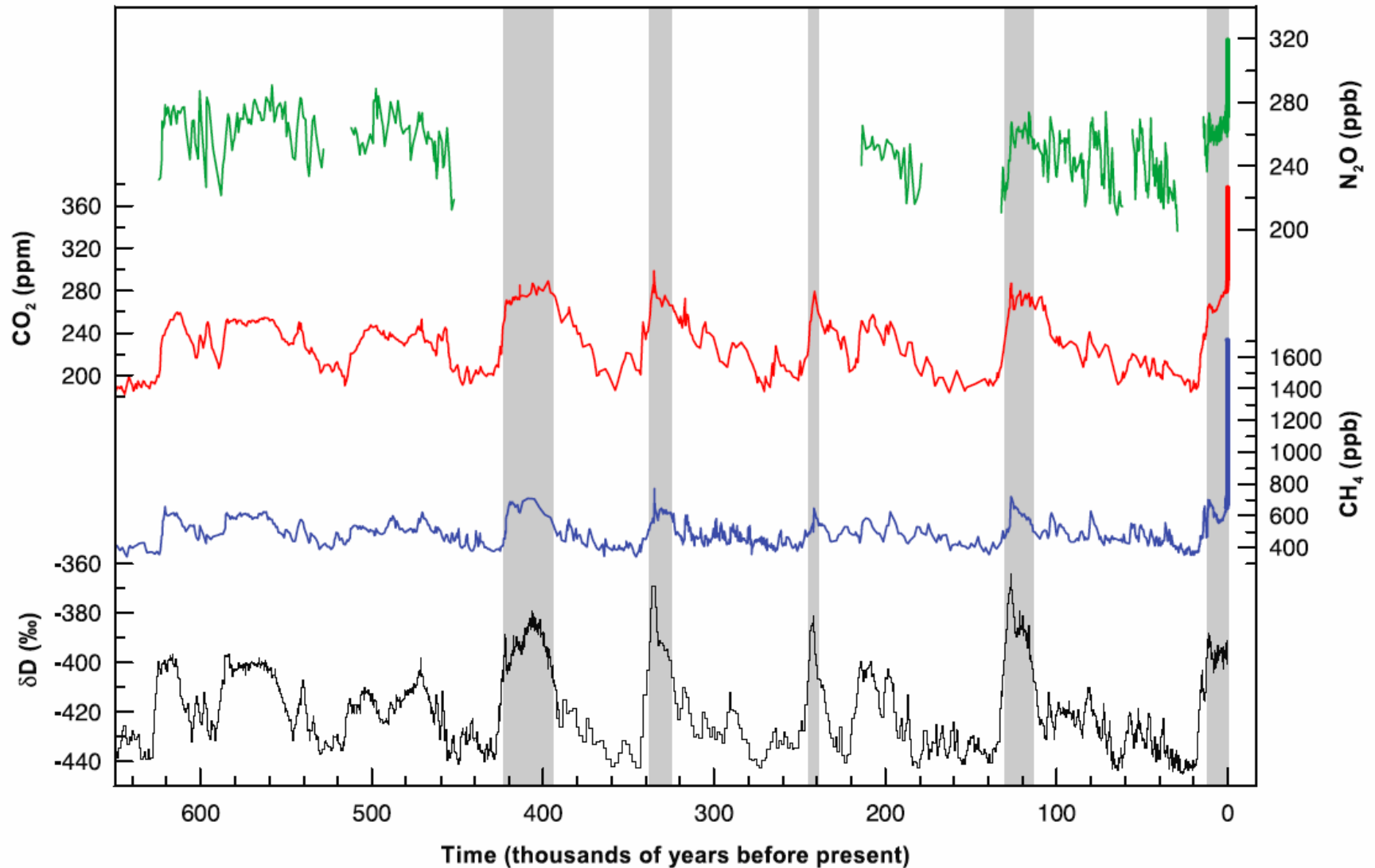
Noen udiskutable forhold rundt klima og forskning

- Sola er drivkraften i klimasystemet, variasjon i innstråling påvirker klimaet.
- Uten drivhuseffekt, intet liv på Jorda.
- Variasjon av gassene som hindrer varmeutstråling fra Jorda påvirker klimaet.
- De fire viktigste drivhusgassene er vanndamp, CO₂, CH₄, N₂O.
- Vanndamp har kortest levetid i atmosfæren og er vanskeligst å modellere den langsiktige effekten av.
- Fra slutten av 1700 tallet har menneskets forbrenning av fossile drivstoffer og arealforandring påvirket atmosfærens sammensetning.
- I forskningsfronten av ethvert felt vil det alltid være motstridende høykvalitets vitenskapelige resultater.
- Forskning er ikke demokratisk, men det innebærer ikke at mindretallet har mer innsikt enn flertallet.



Dette er hva det handler om!

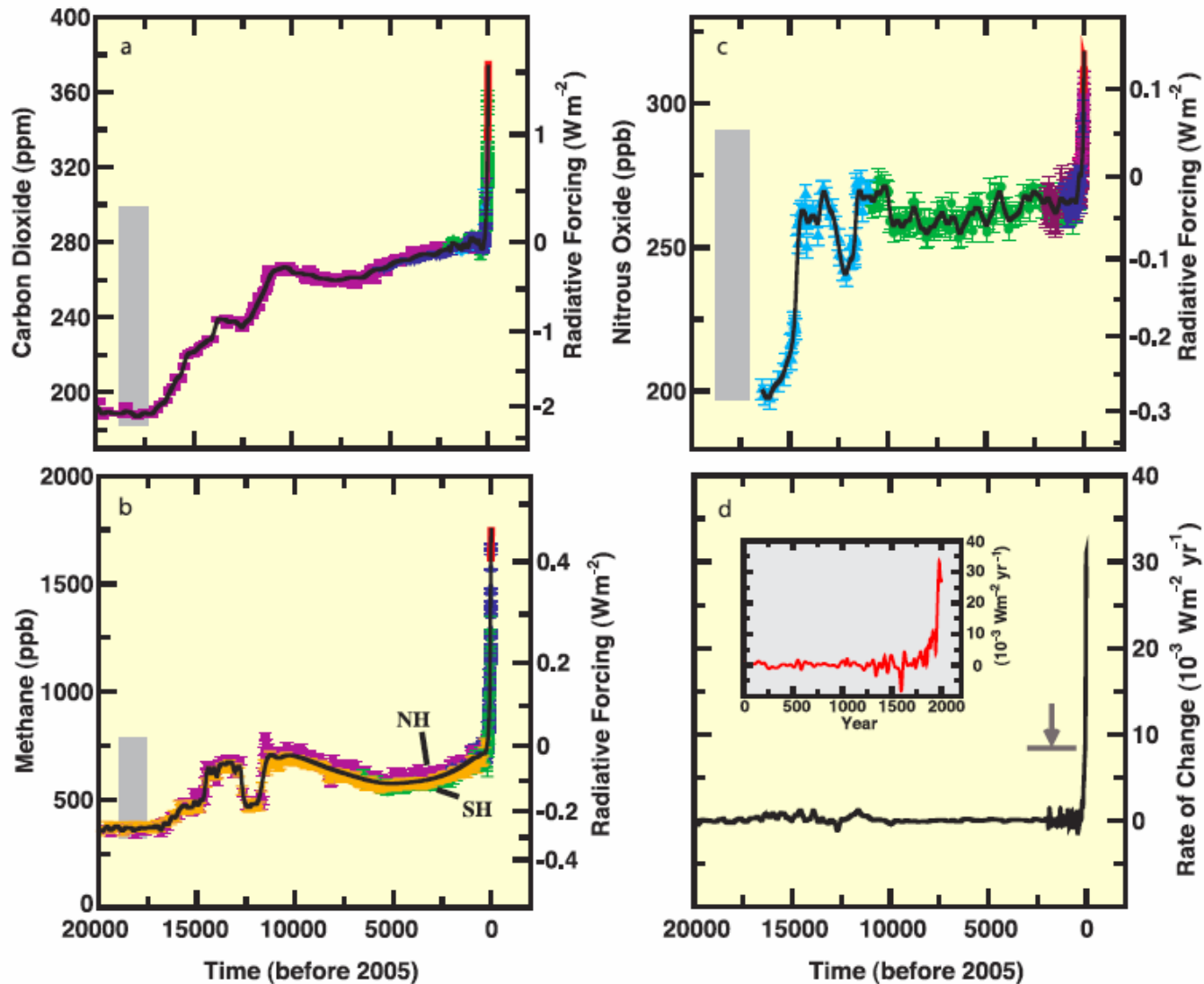
GLACIAL-INTERGLACIAL ICE CORE DATA



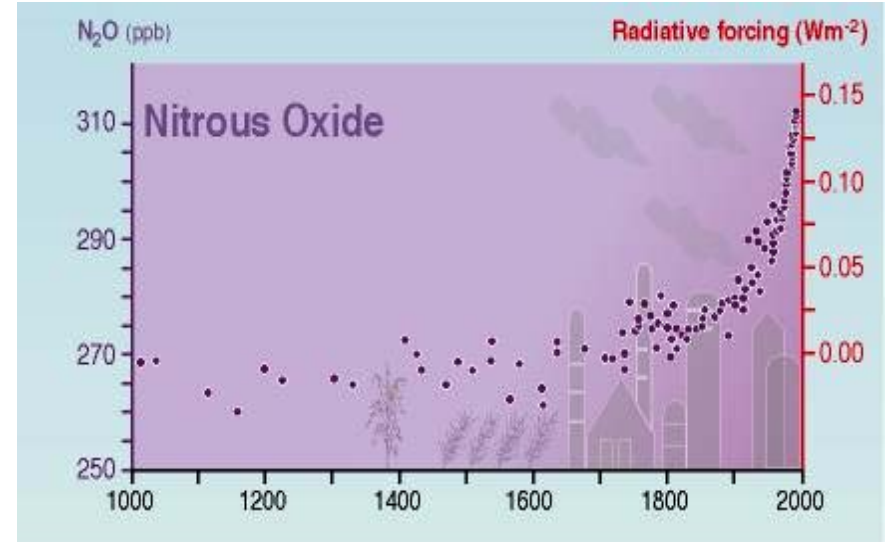
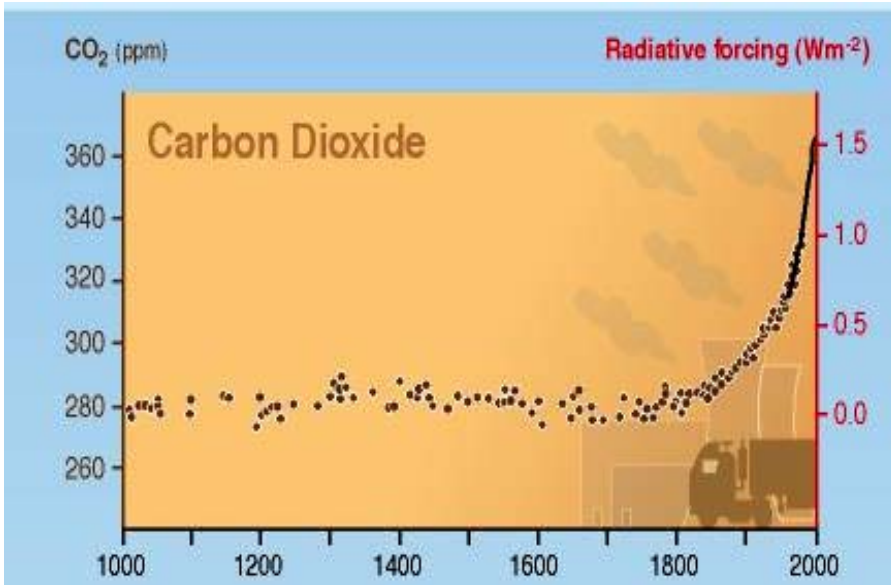


De siste årene

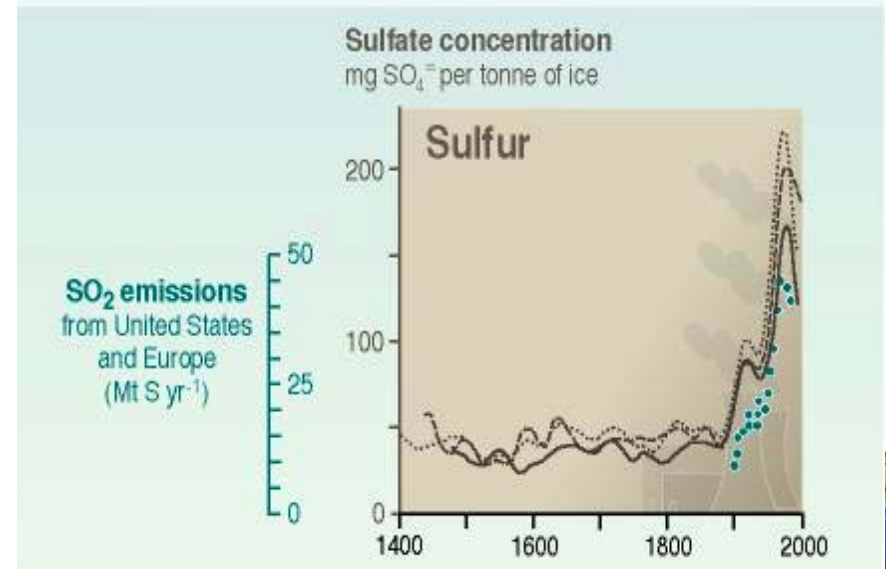
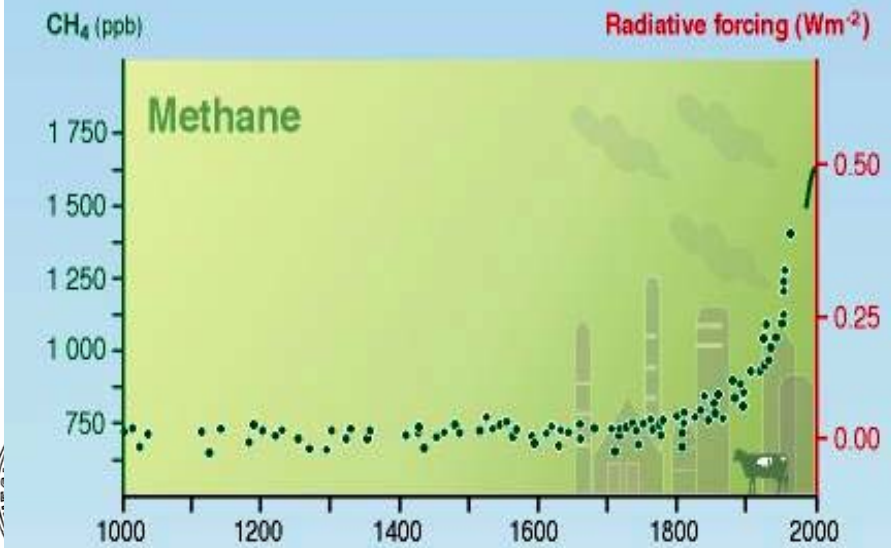
CHANGES IN GREENHOUSE GASES FROM ICE CORE AND MODERN DATA



Human activities have changed the composition of the atmosphere since the pre-industrial era



Sulfate aerosols deposited in Greenland ice





This is the "greenhouse" problem

Humans are perturbing the carbon cycle

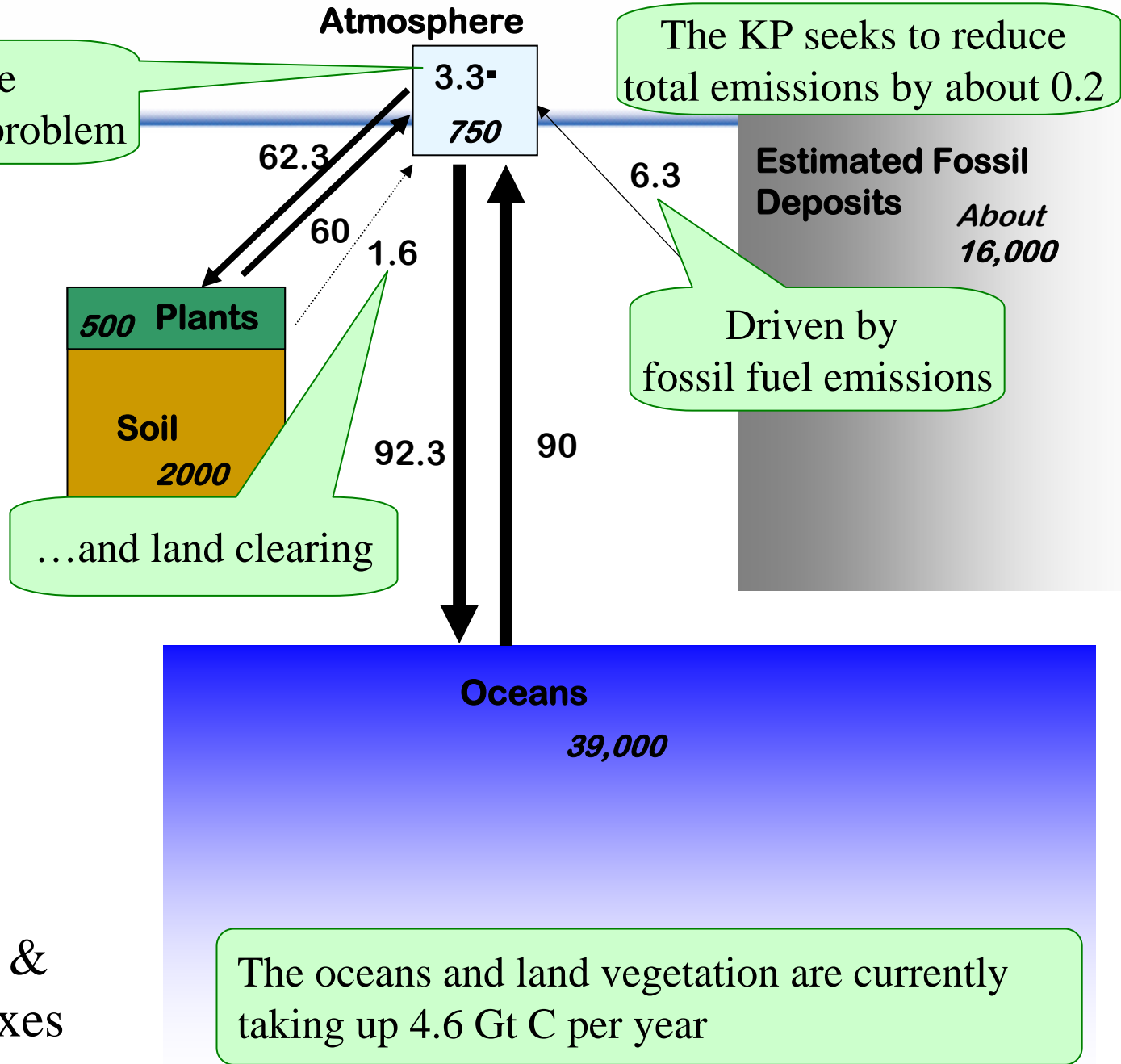
...and land clearing

The KP seeks to reduce total emissions by about 0.2

Driven by fossil fuel emissions

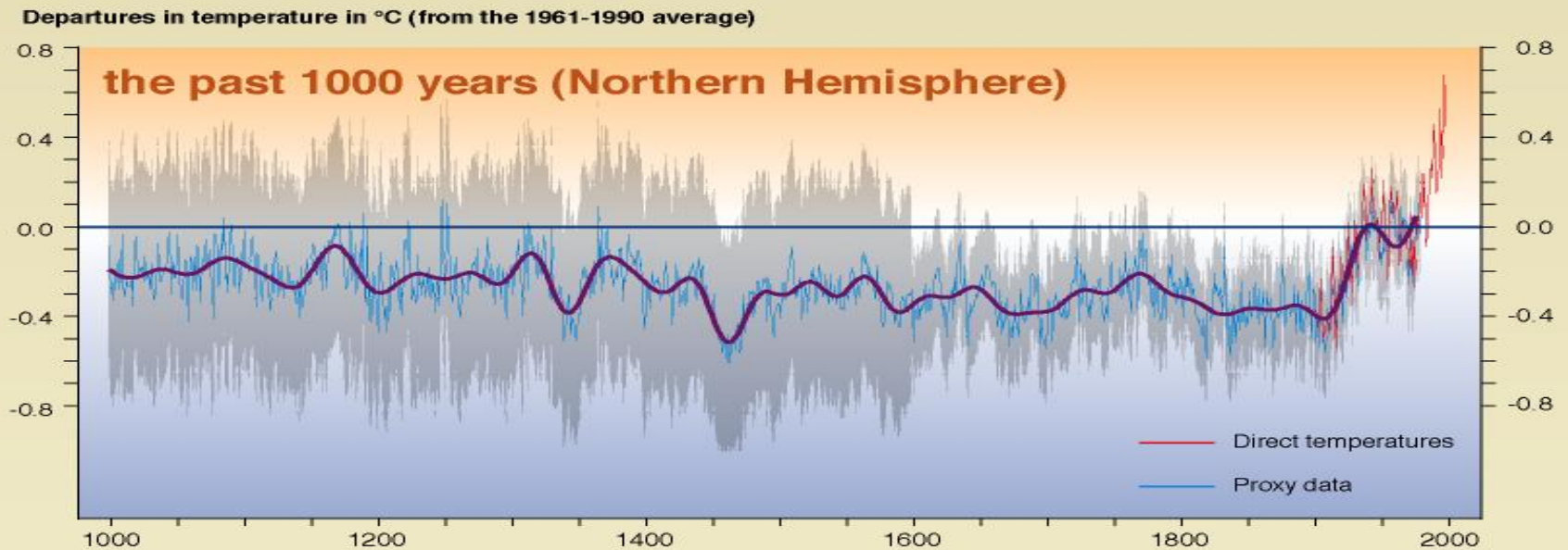
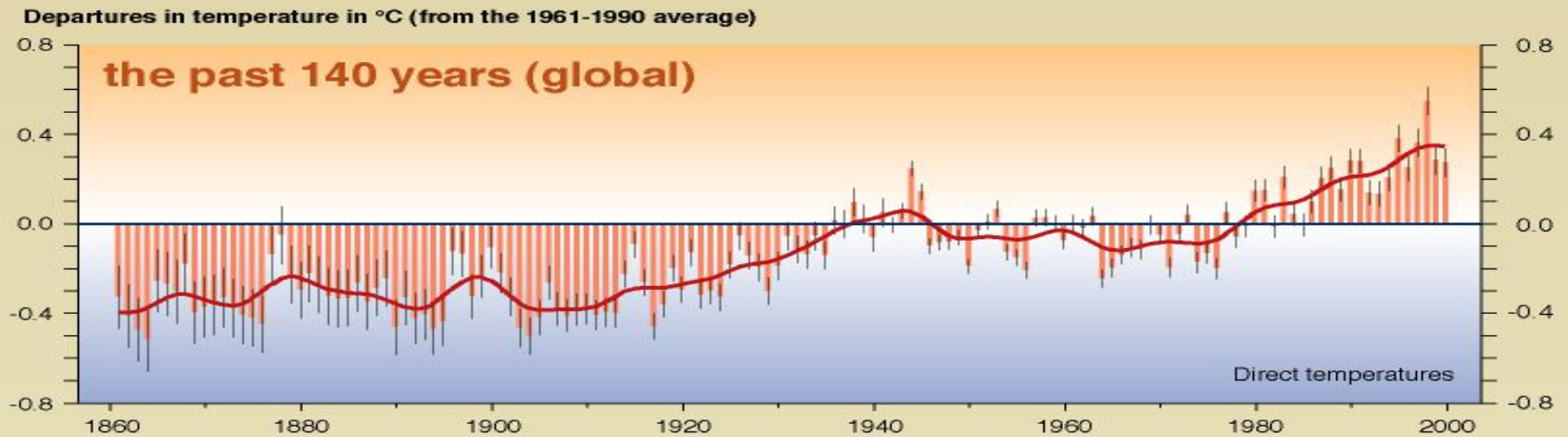
The oceans and land vegetation are currently taking up 4.6 Gt C per year

Units
Gt C for stores &
Gt C y⁻¹ for fluxes



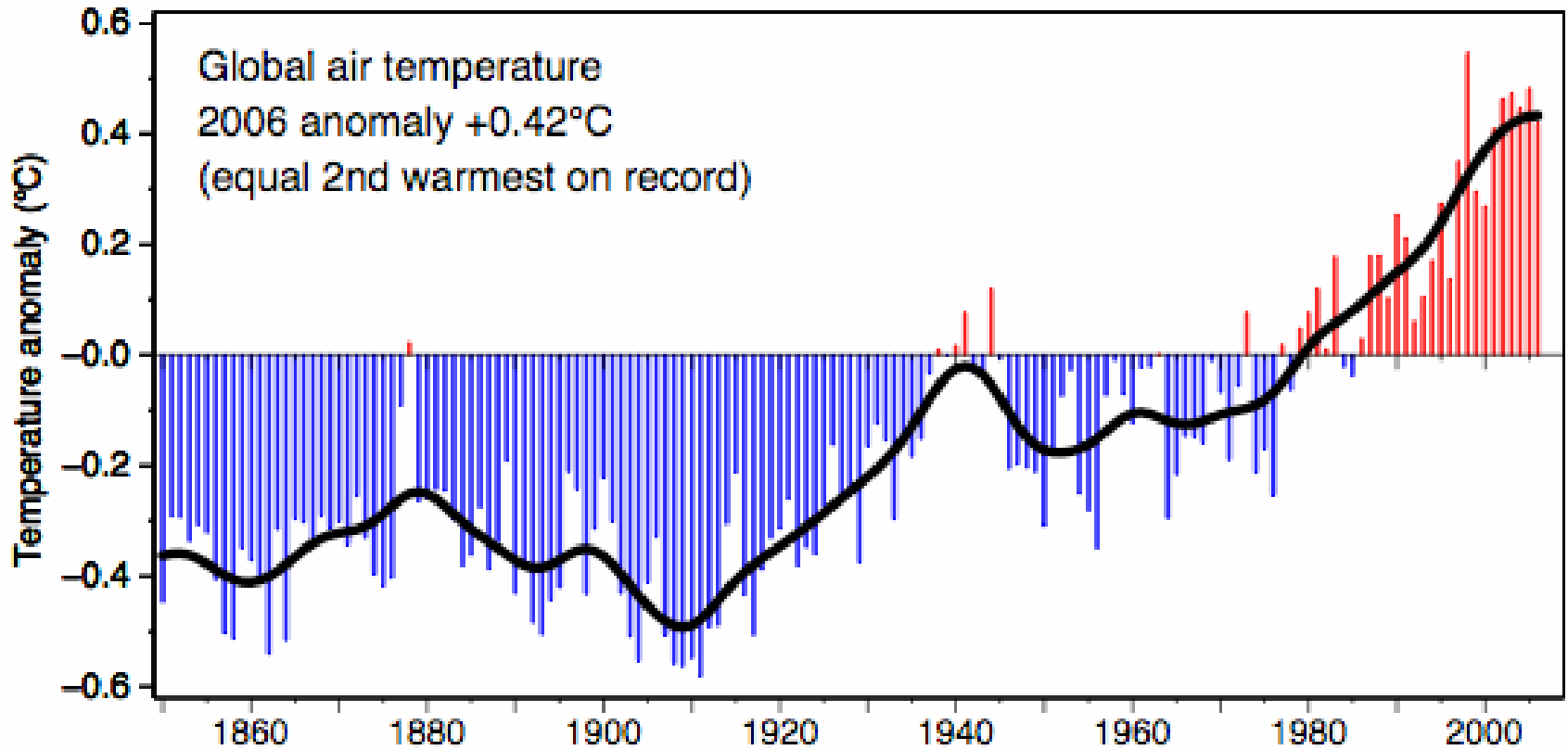
Global mean surface temperatures have increased

Variations of the Earth's surface temperature for...





Med 2006

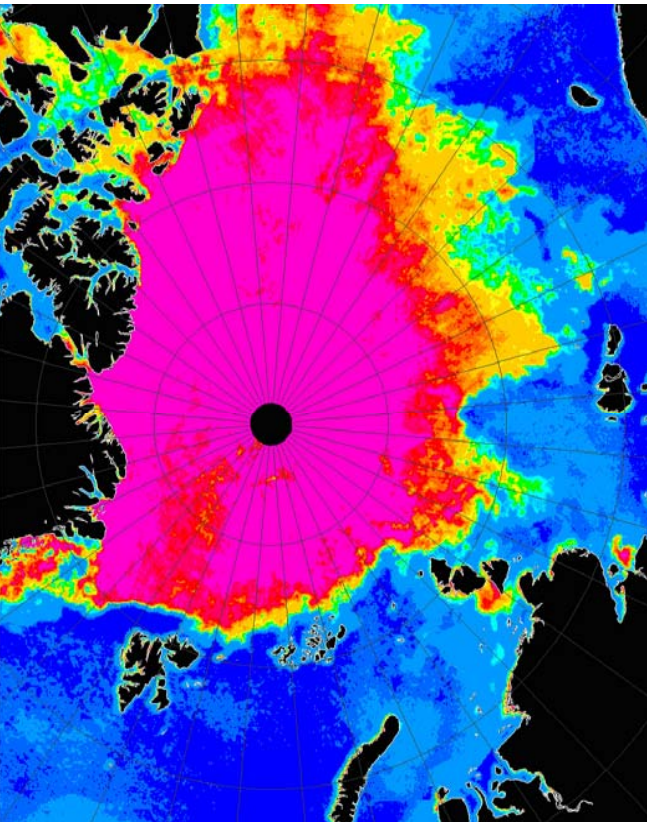




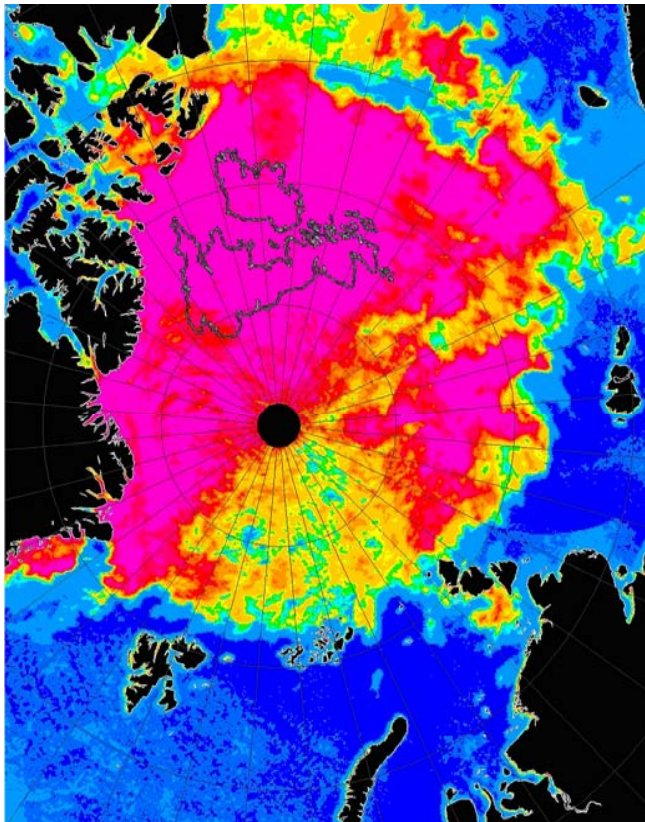
QuickTime™ and a
YUV420 codec decompressor
are needed to see this picture.



Ting er på gang

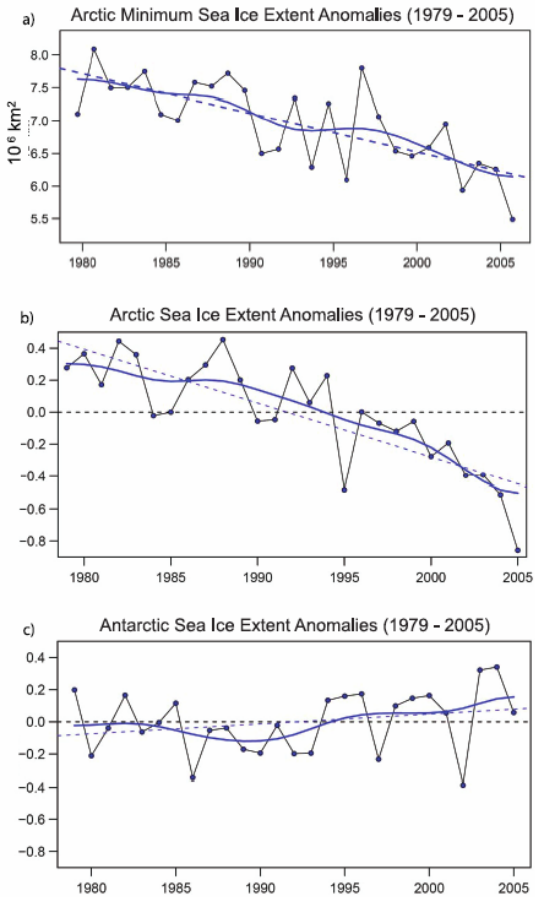


2005



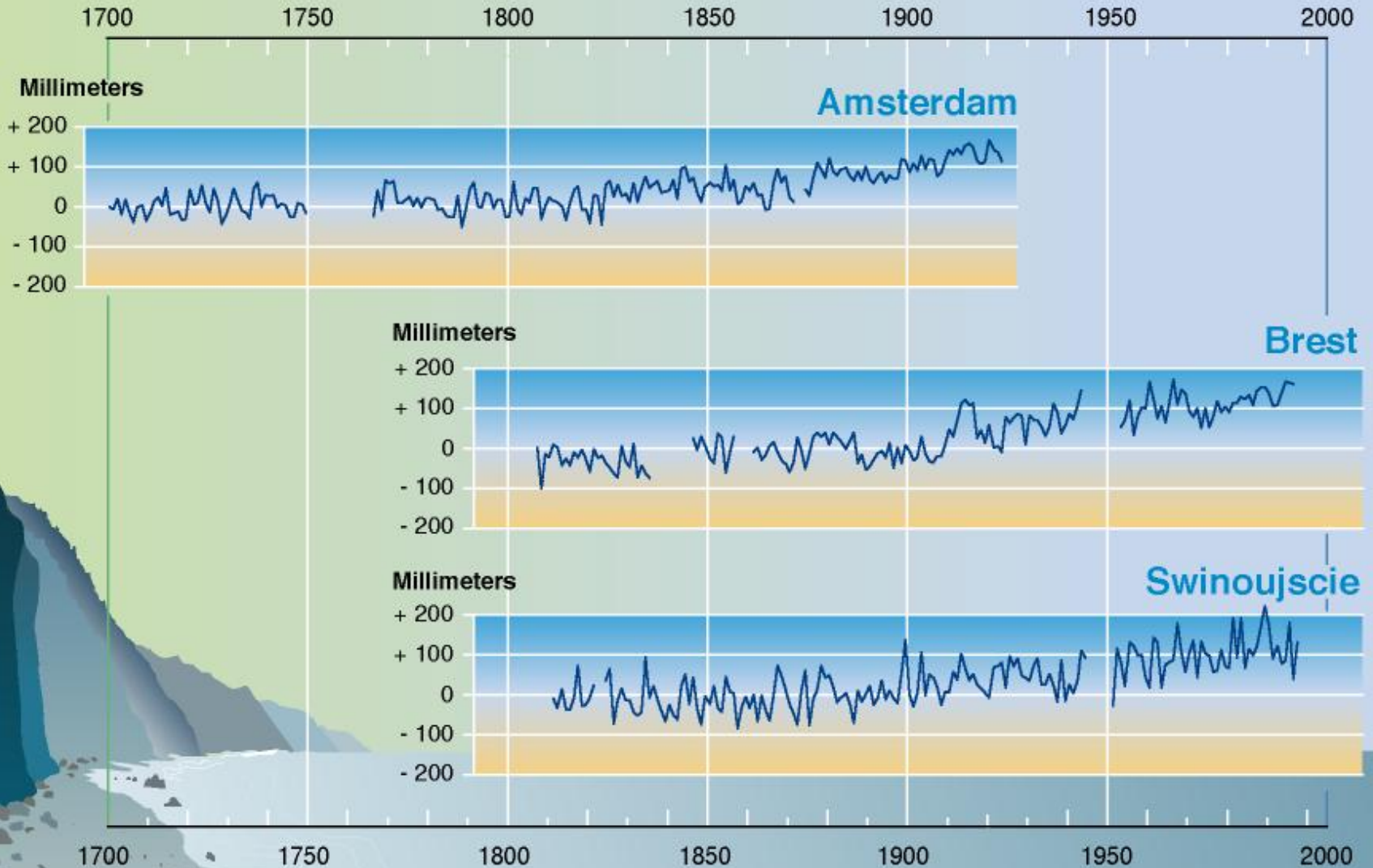
2006

CHANGES IN SEA ICE EXTENT



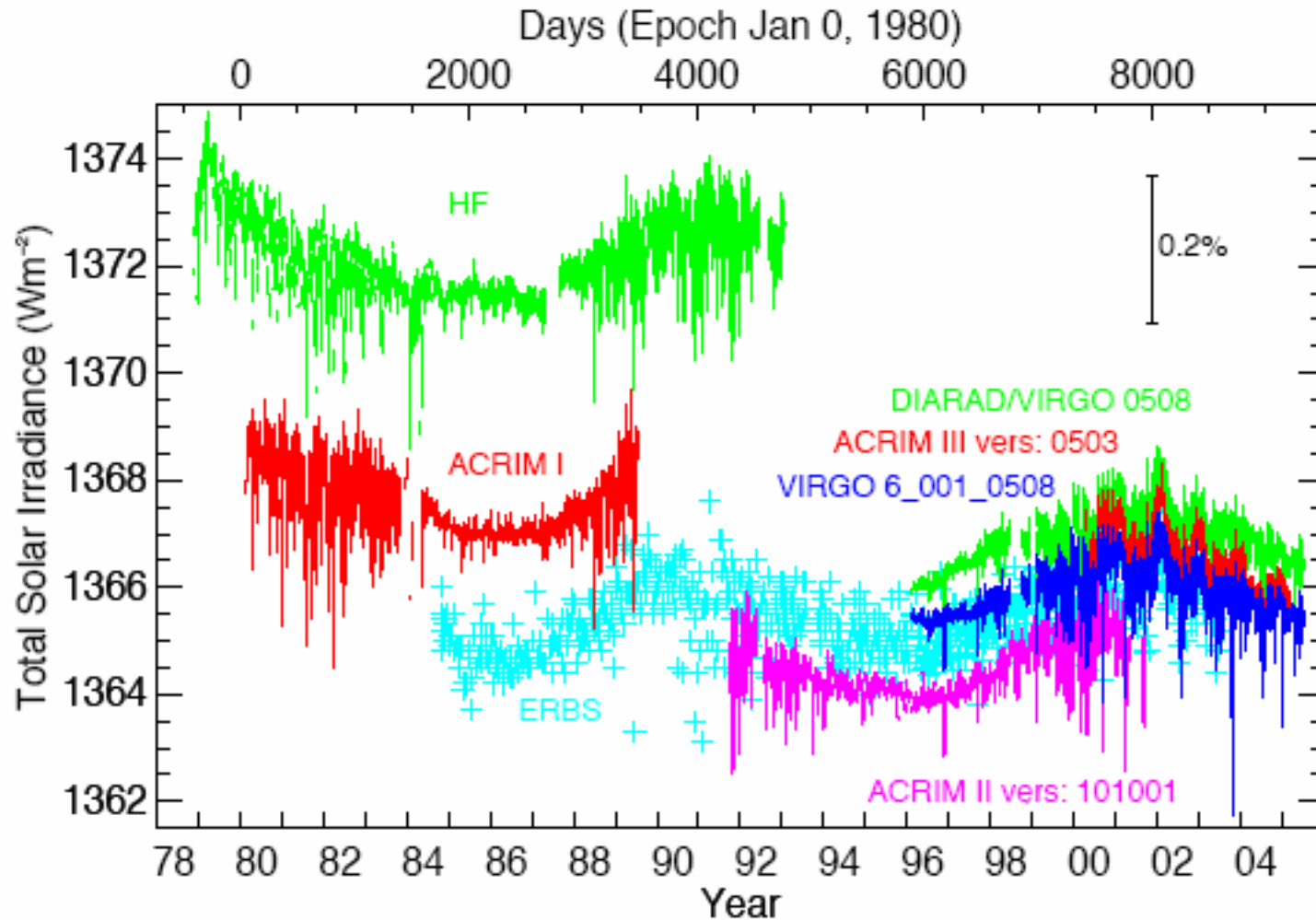
Sea Levels have risen

Relative sea level over the last 300 years



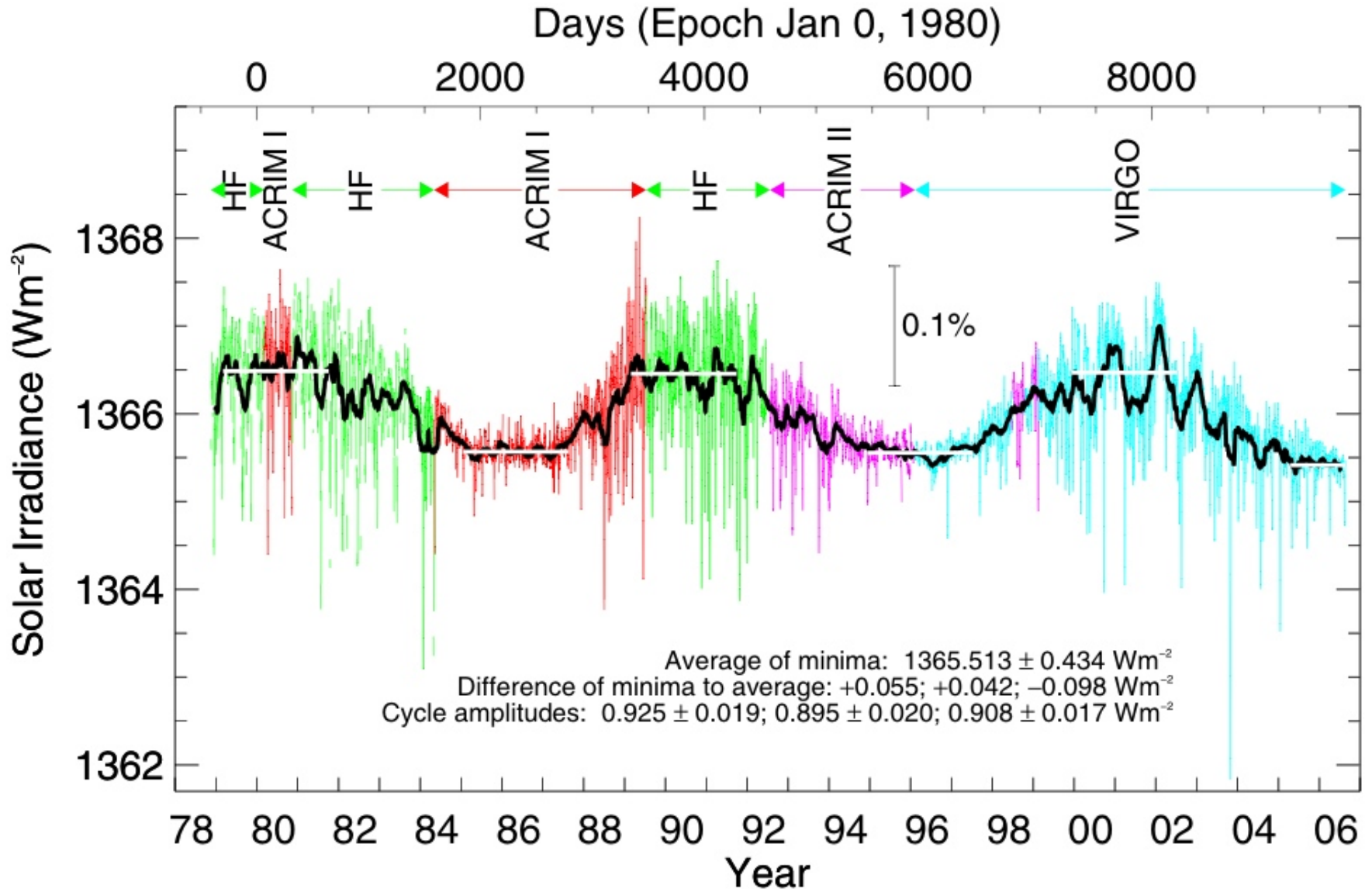


Absolutte målinger?



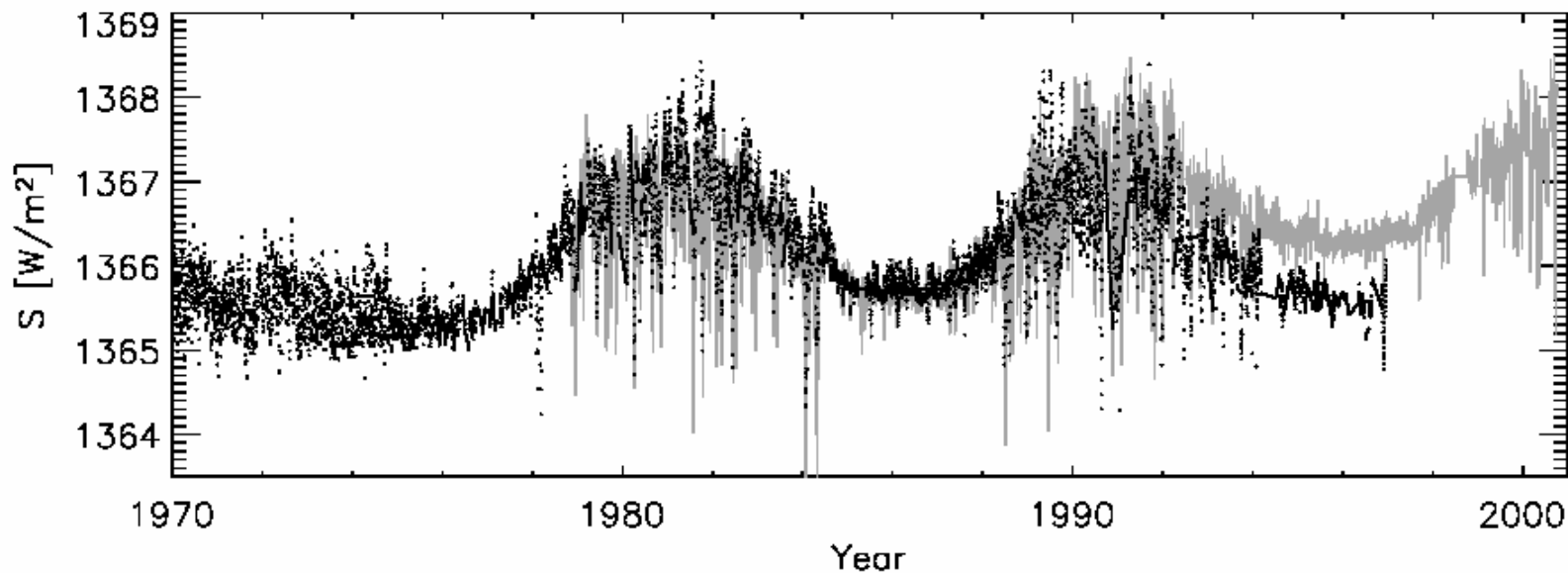
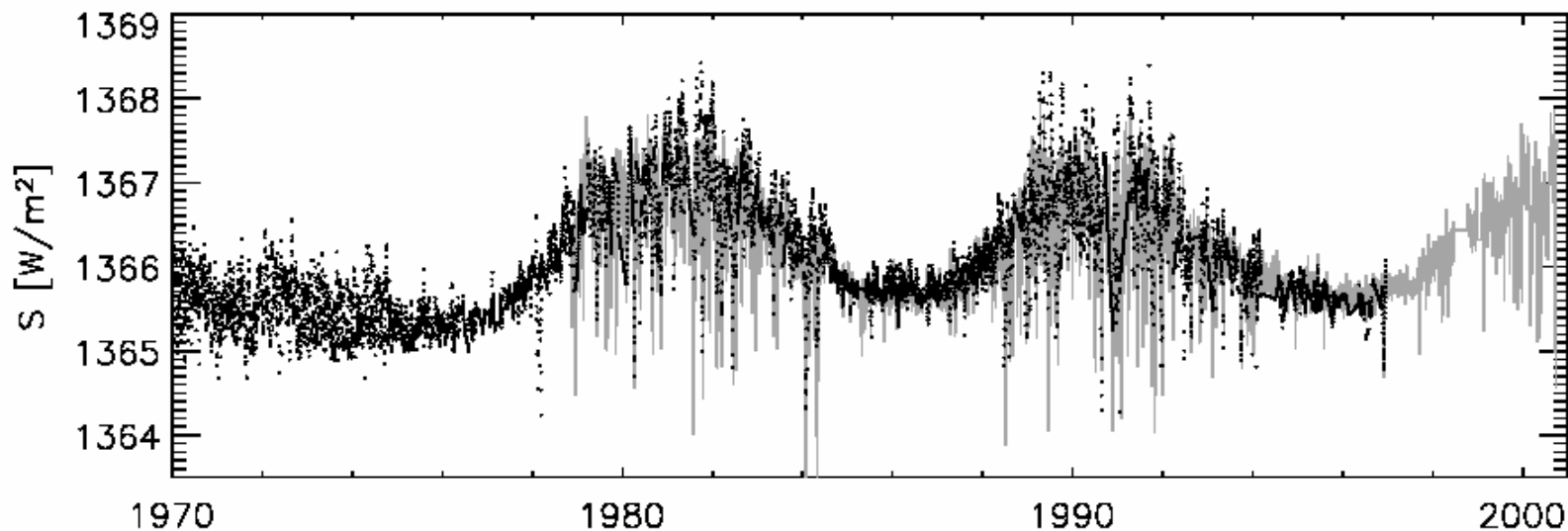


Bare fra rommet



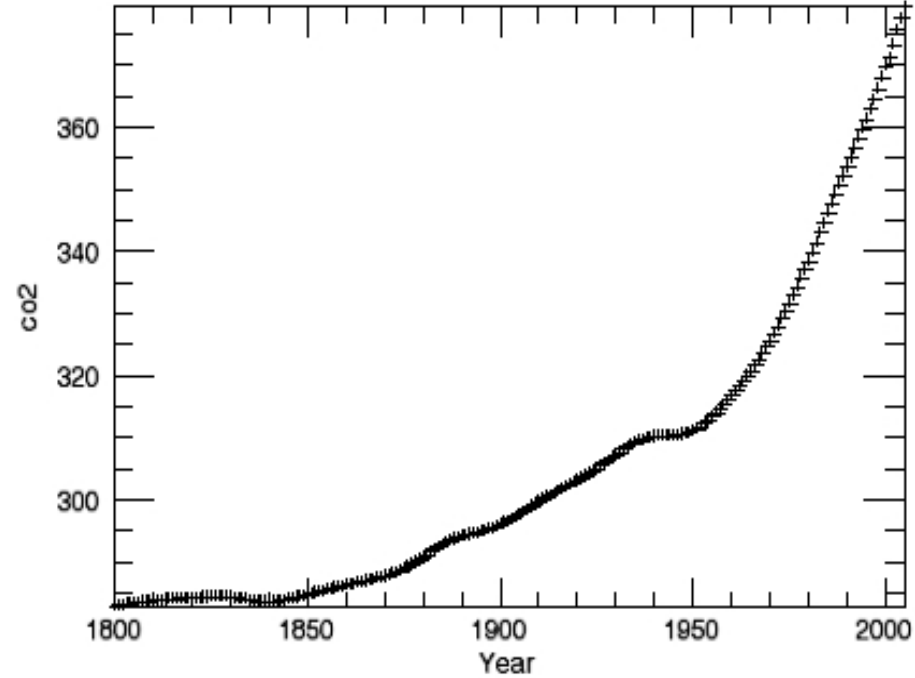
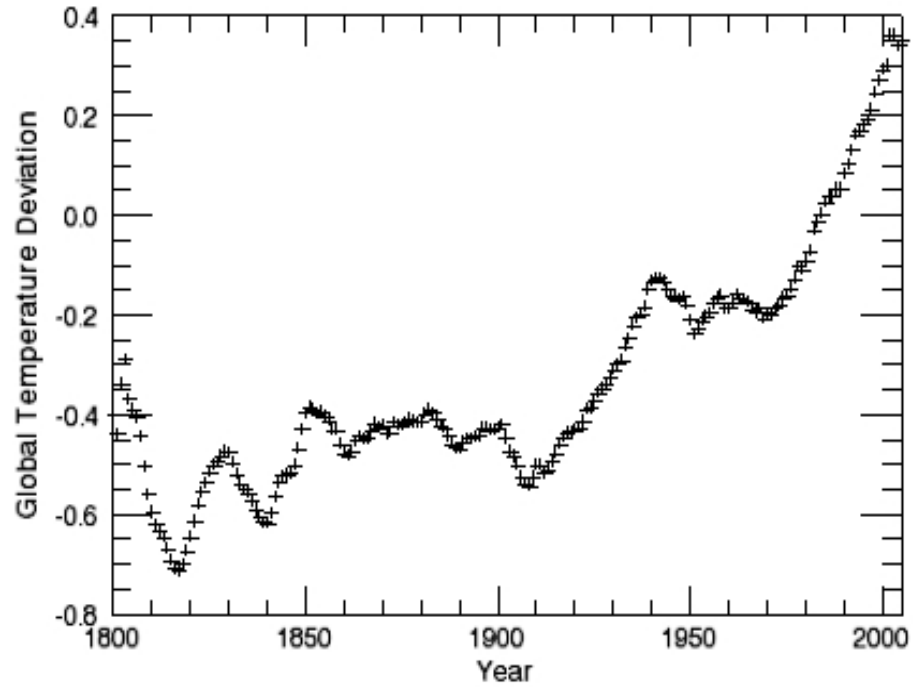


Hvor er våre resultater “bedre”?





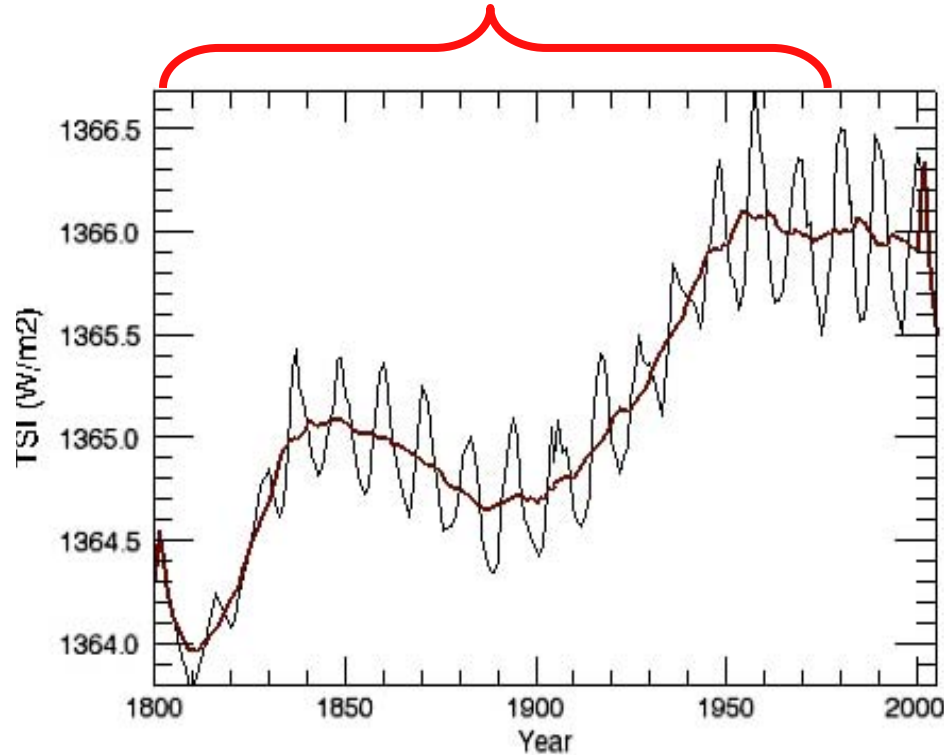
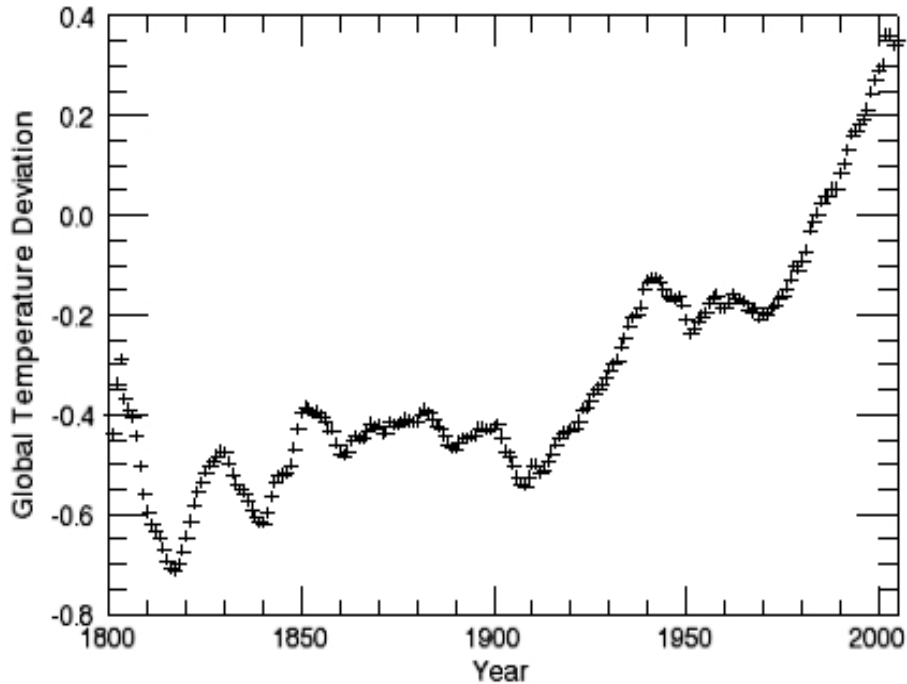
Kjente målinger





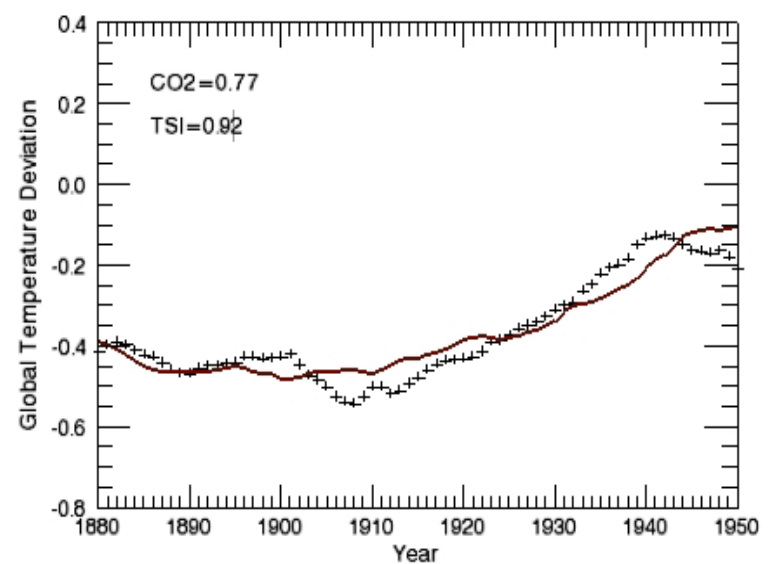
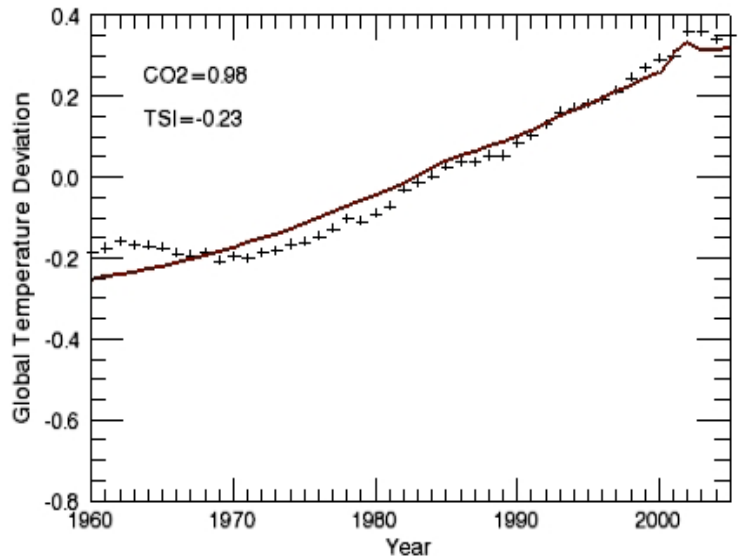
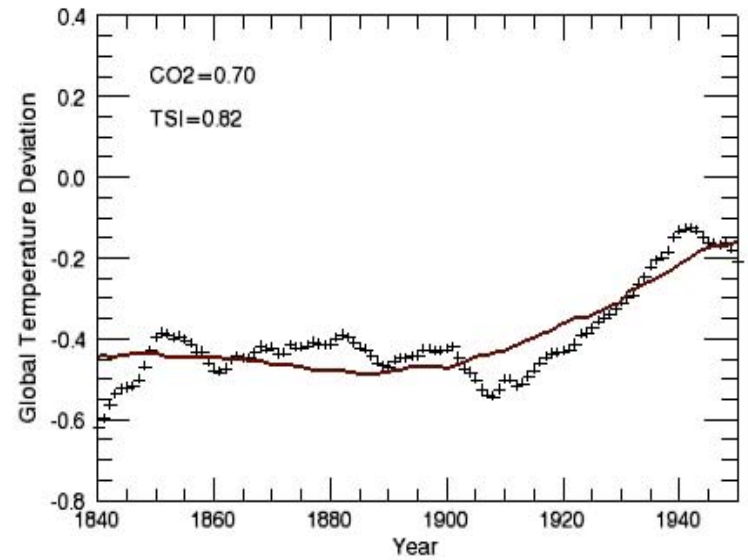
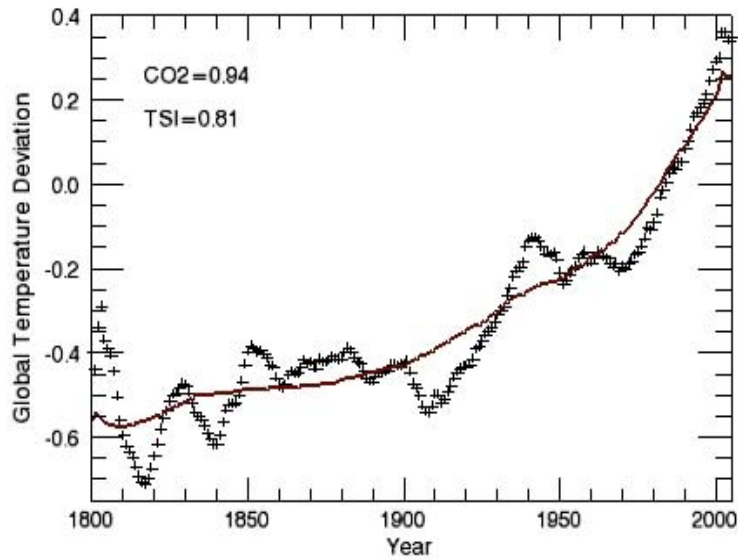
Mest modeller og indirekte målinger

Secular part uncertain



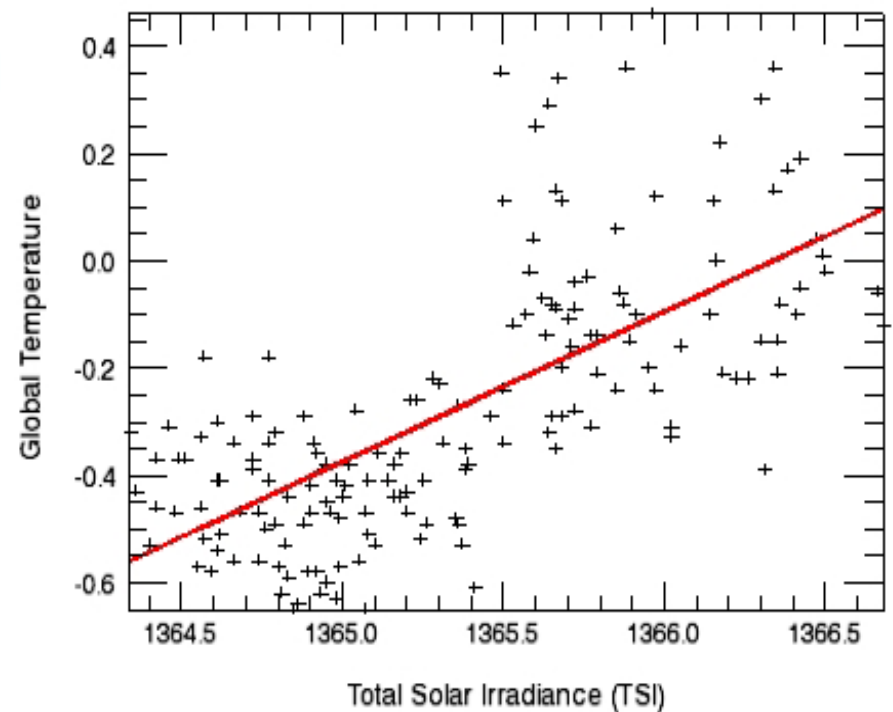
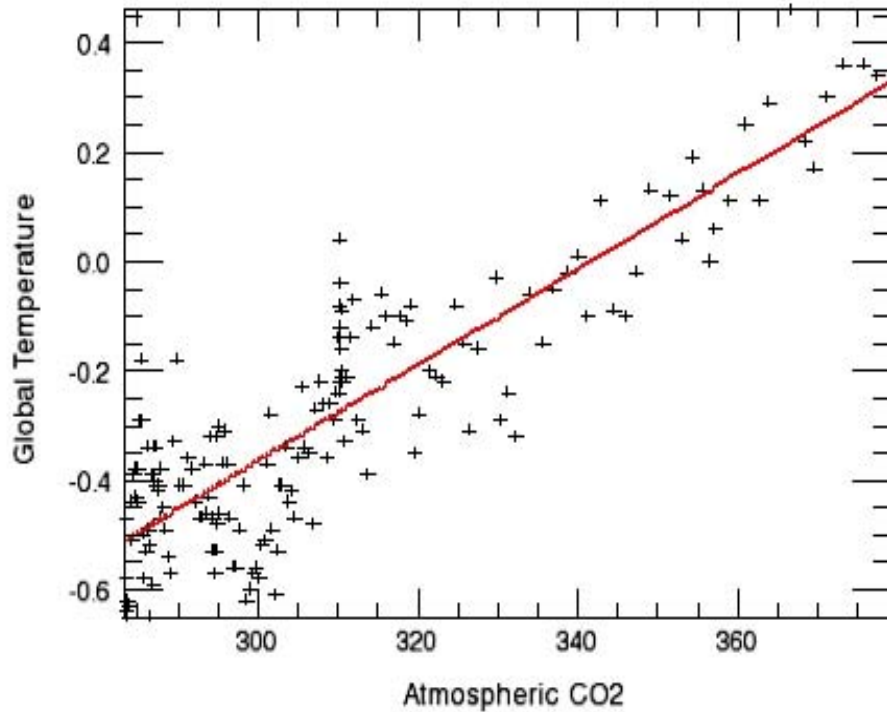


Korrelasjoner



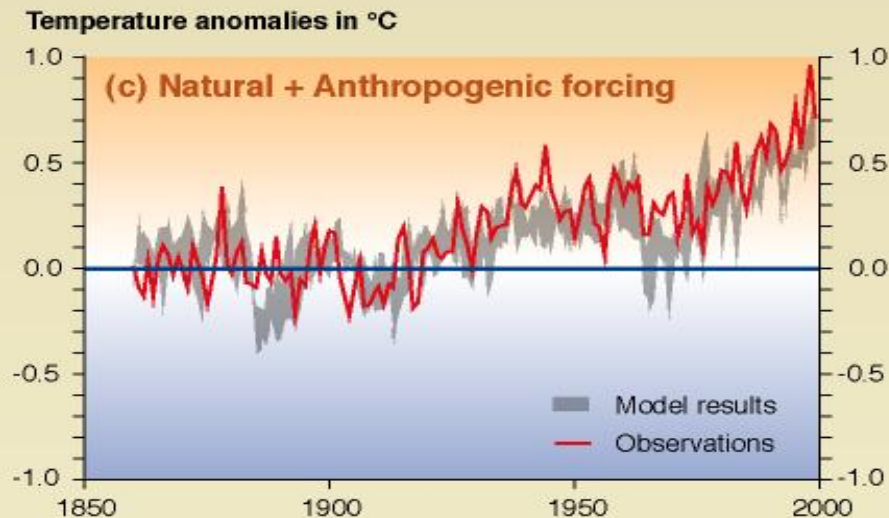
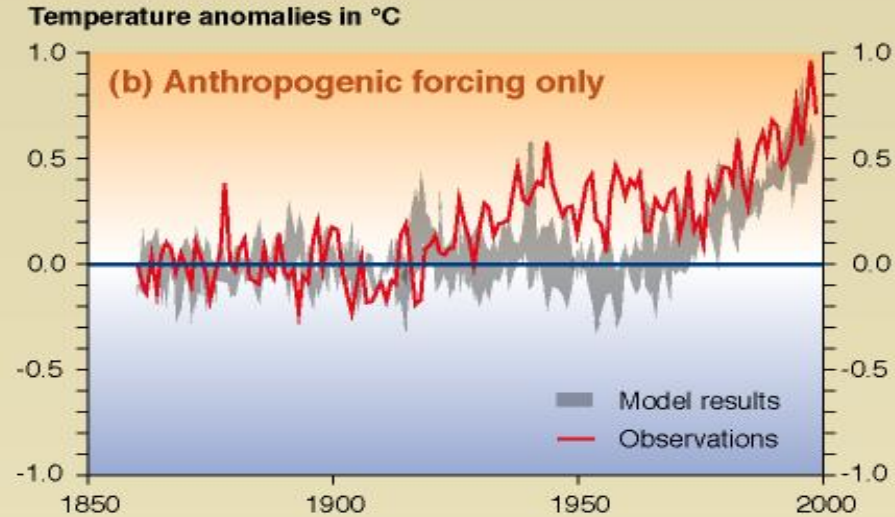
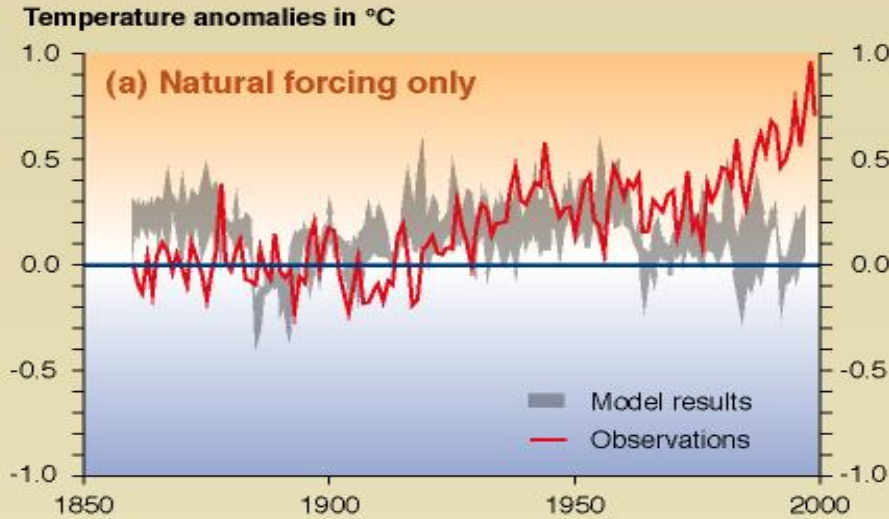


En annen måte å se det på



Most of the observed warming in the past 50 years is attributable to human activities

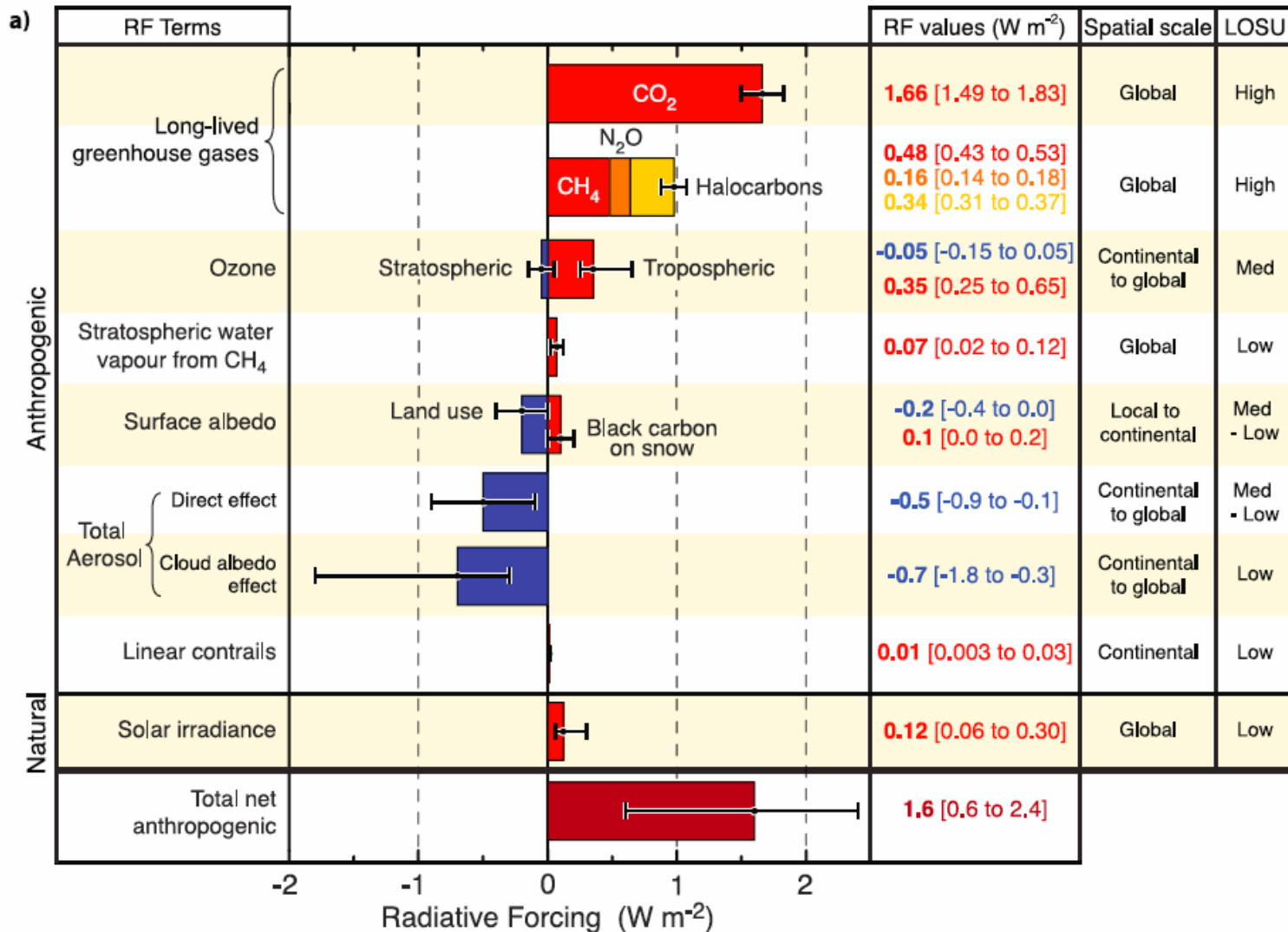
Comparison between model and observations of the temperature rise since 1860



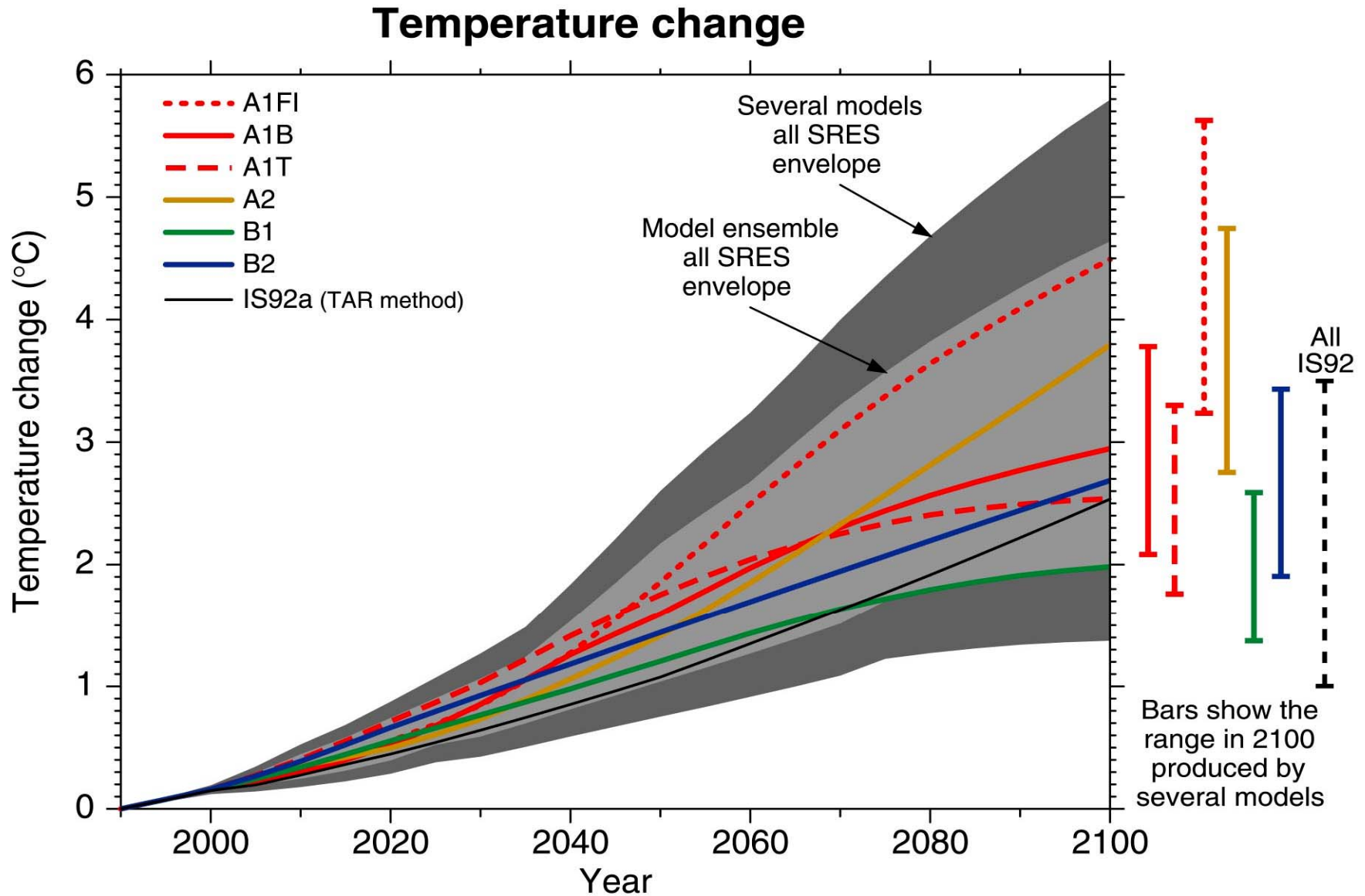


Beste estimer på effekt nå

GLOBAL MEAN RADIATIVE FORCINGS

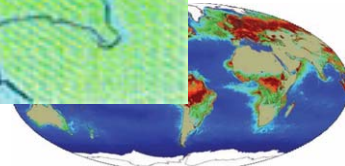
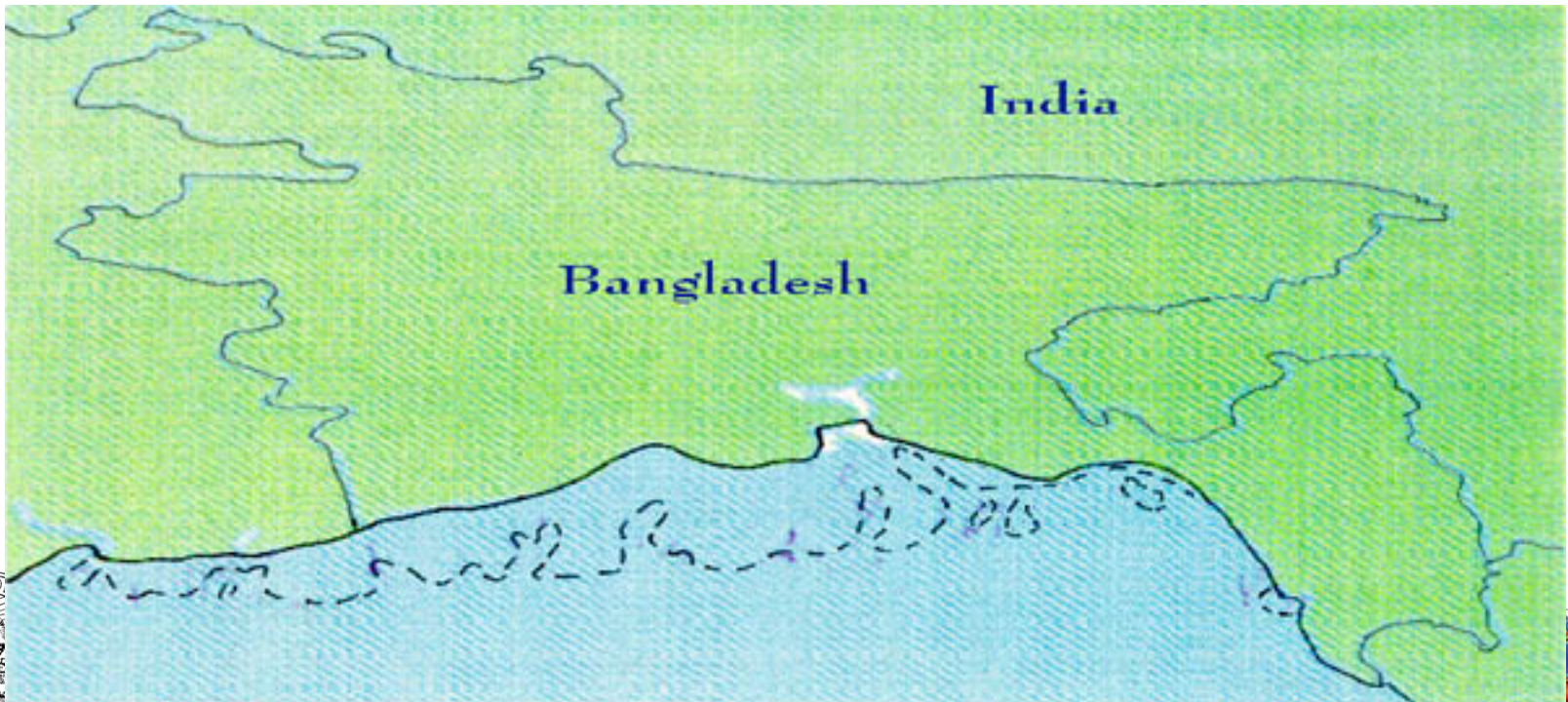


Global mean surface temperature is projected to increase during the 21st century



Increased risk of floods, potentially displacing tens of millions of people, due to sea level rise and heavy rainfall events, especially in Small Island States and low-lying deltaic areas.

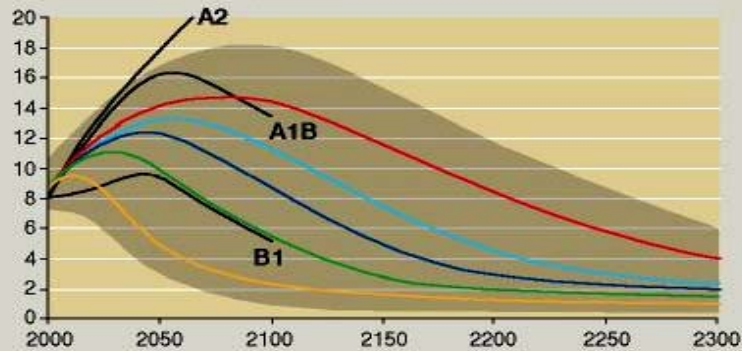
Bangladesh is projected to lose about 17% of its land area with a sea level rise of one meter - very difficult to adapt due to lack of adaptive capacity



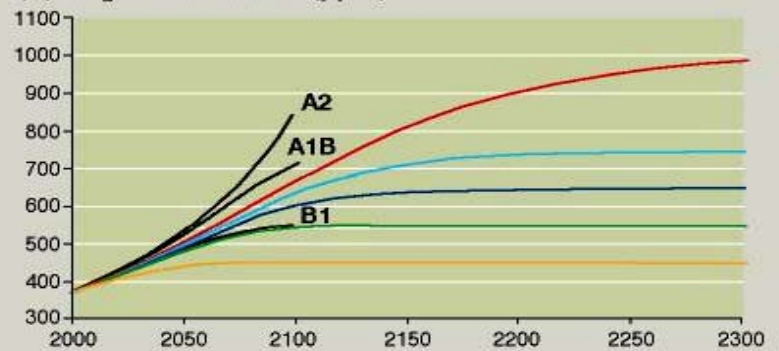
Stabilization of the atmospheric concentration of carbon dioxide will require significant emissions reductions

Emissions, concentrations, and temperature changes corresponding to different stabilization targets for CO₂ concentrations

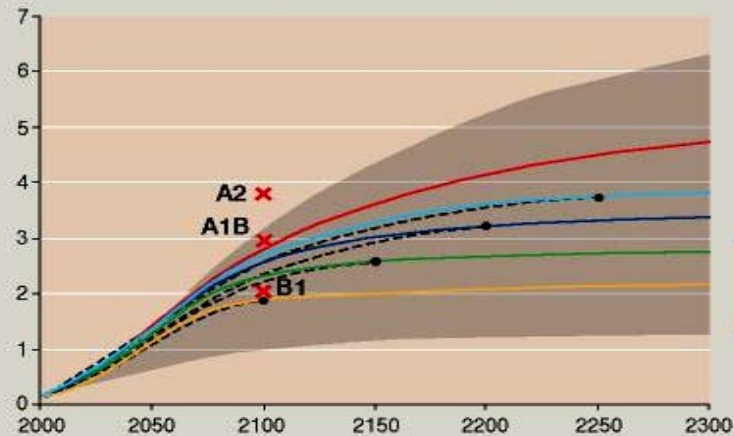
(a) CO₂ emissions (Gt C)



(b) CO₂ concentration (ppm)



(c) Global mean temperature change (°C)

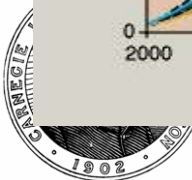


WRE profiles

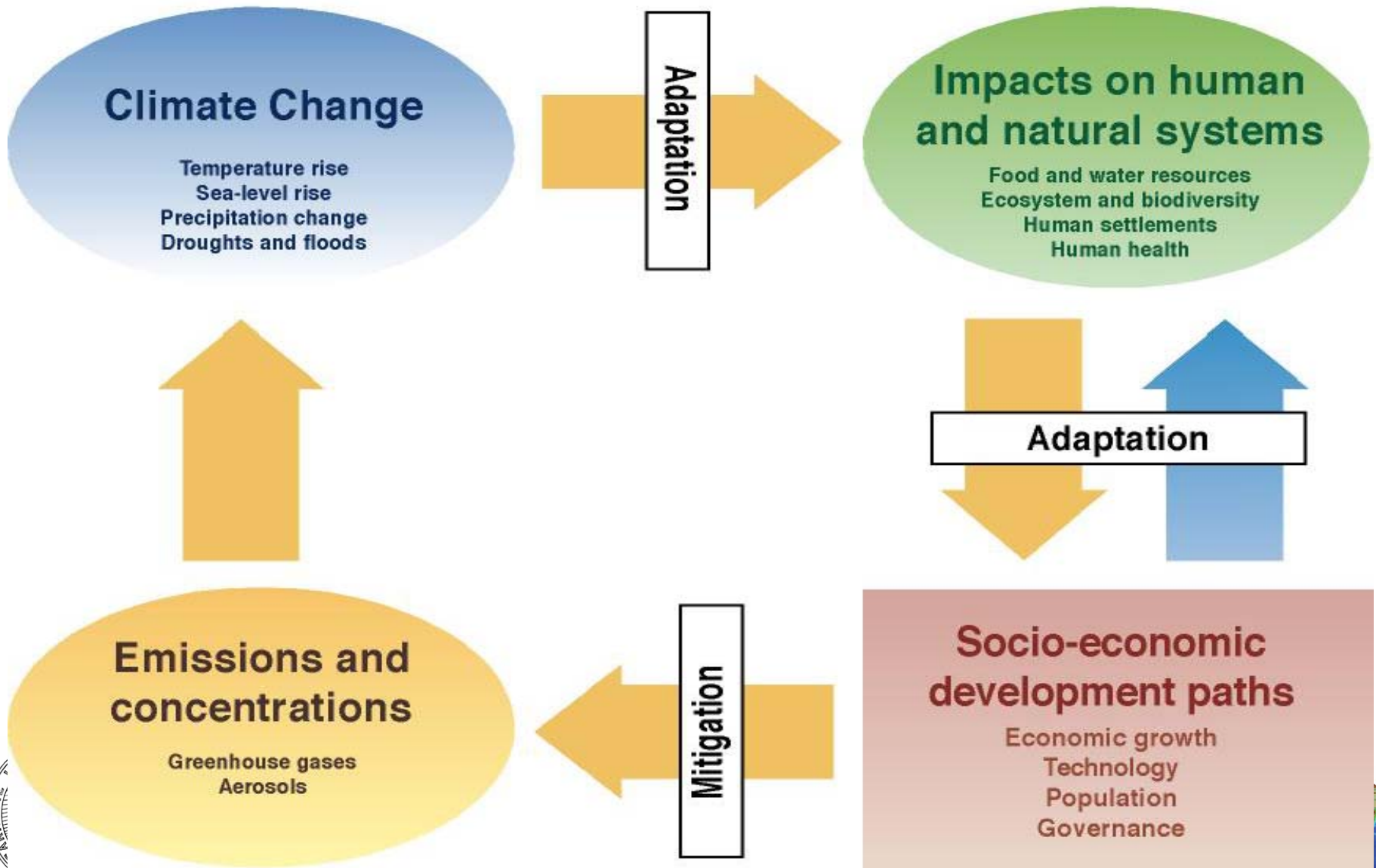
- WRE 1000
- WRE 750
- WRE 650
- WRE 550
- WRE 450

S profiles

- S profiles
- SRES scenarios

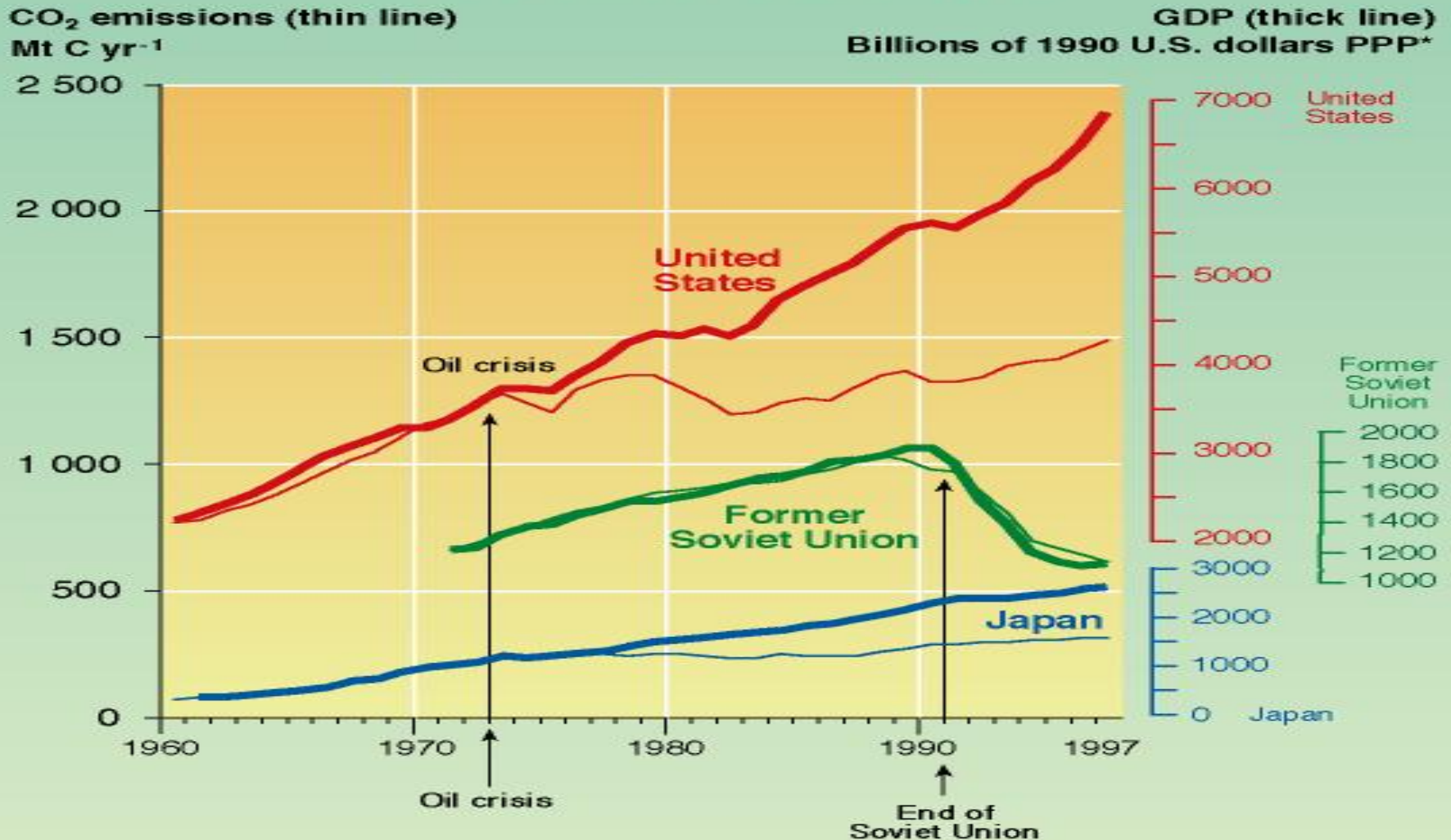


Climate Change - An integrated framework



Den enkle sammenhengen mellom BNP og CO₂ utslipp kan brytes

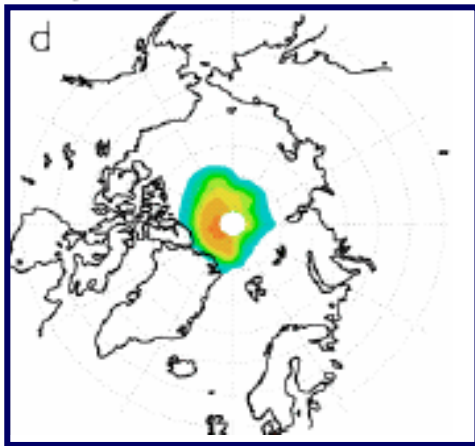
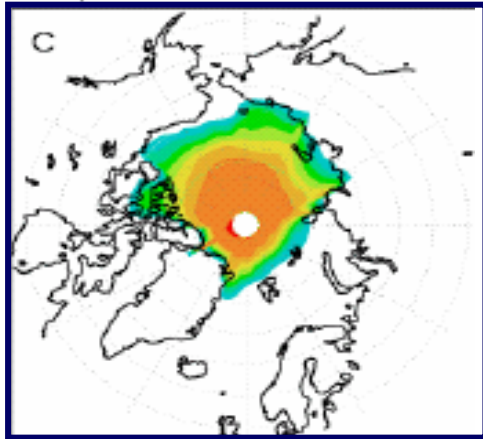
Comparison between GDP and CO₂ emissions for selected countries



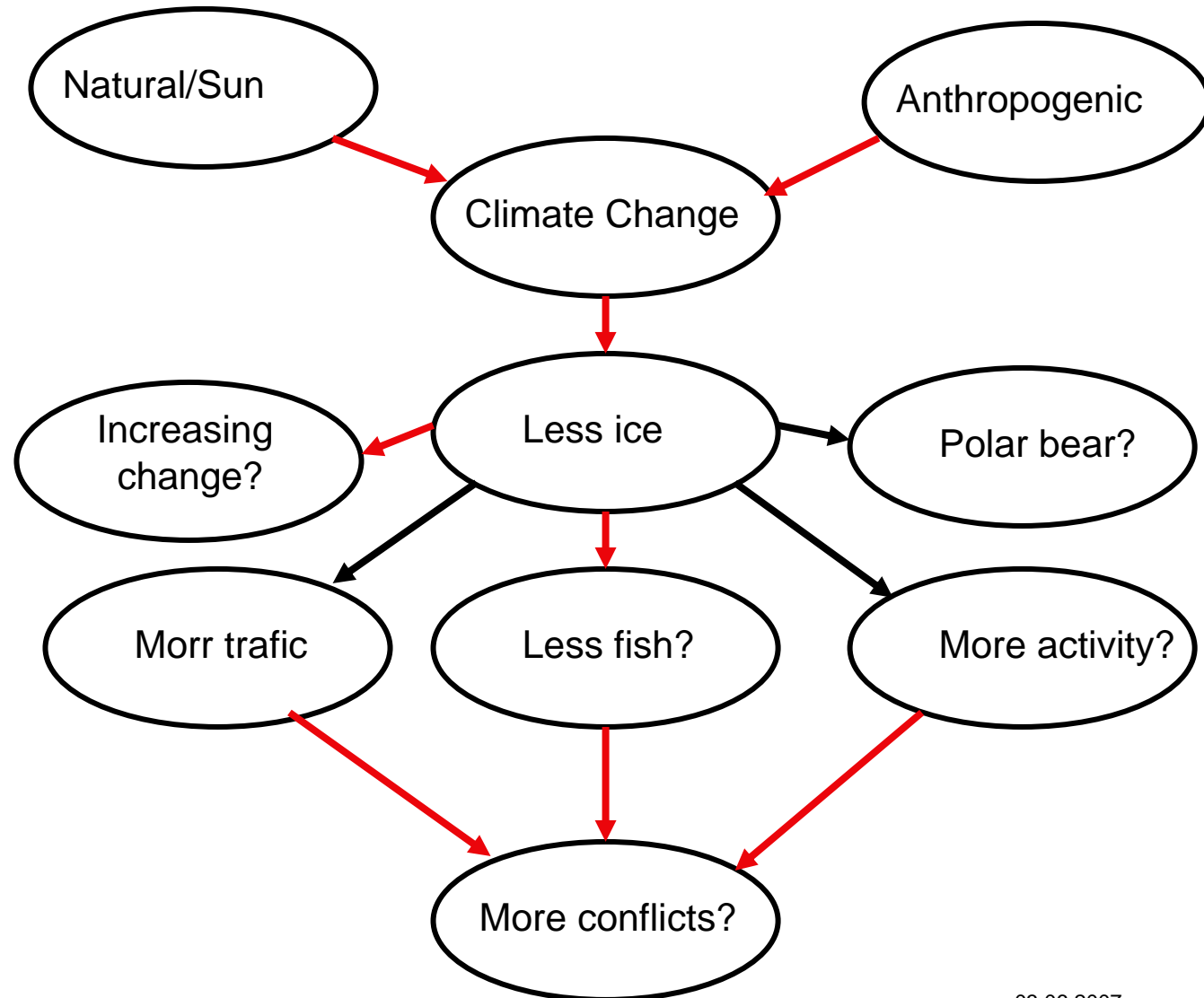
*PPP: Power Purchase Parity



From basic science to geopolitics



Modelling NERSC





Hva kan NAROM gjøre?

- Bidra til mindre bruk av ordene tro og sannhet.
- Få flere til å skjønne at $5\text{km}/6500\text{km} \approx 0,008$ er et lite tall.
- Supplere skolen med informasjon om globale endringer observerbare fra rommet, jordobservasjon.
- Lage enkle eksperimenter som viser drivhuseffekten av noen gasser.



Ettertanke

**Rom er ikke den eneste løsningen på
noen av spørsmålene vi diskuterer,
men**

**få eller ingen viktige spørsmål (i nord)
kan besvares tilfredstillende uten
bruk av rom.**



Informasjon, rom og politikk

