



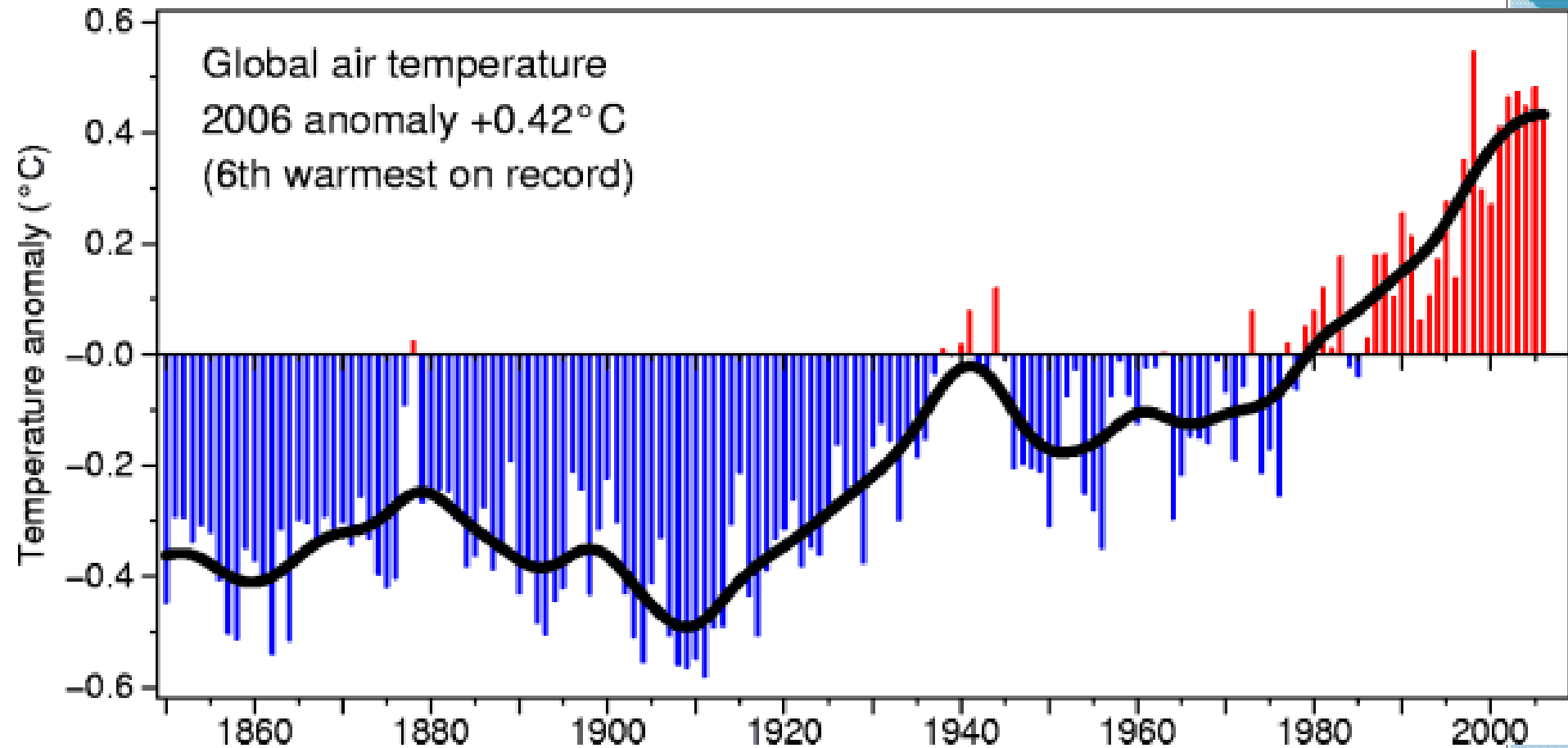
# Hvor alvorlige blir konsekvensene av klimaendringene?

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<http://www.cru.uea.ac.uk/cru/info/warming/>





# IPCC 2007

- For the next two decades a warming of about  $0.2^{\circ}\text{C}$  per decade is projected for a range of SRES emission scenarios.

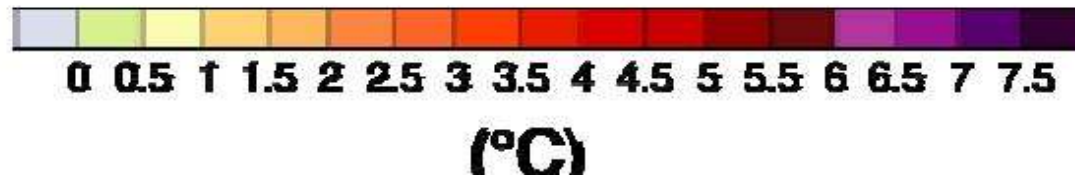
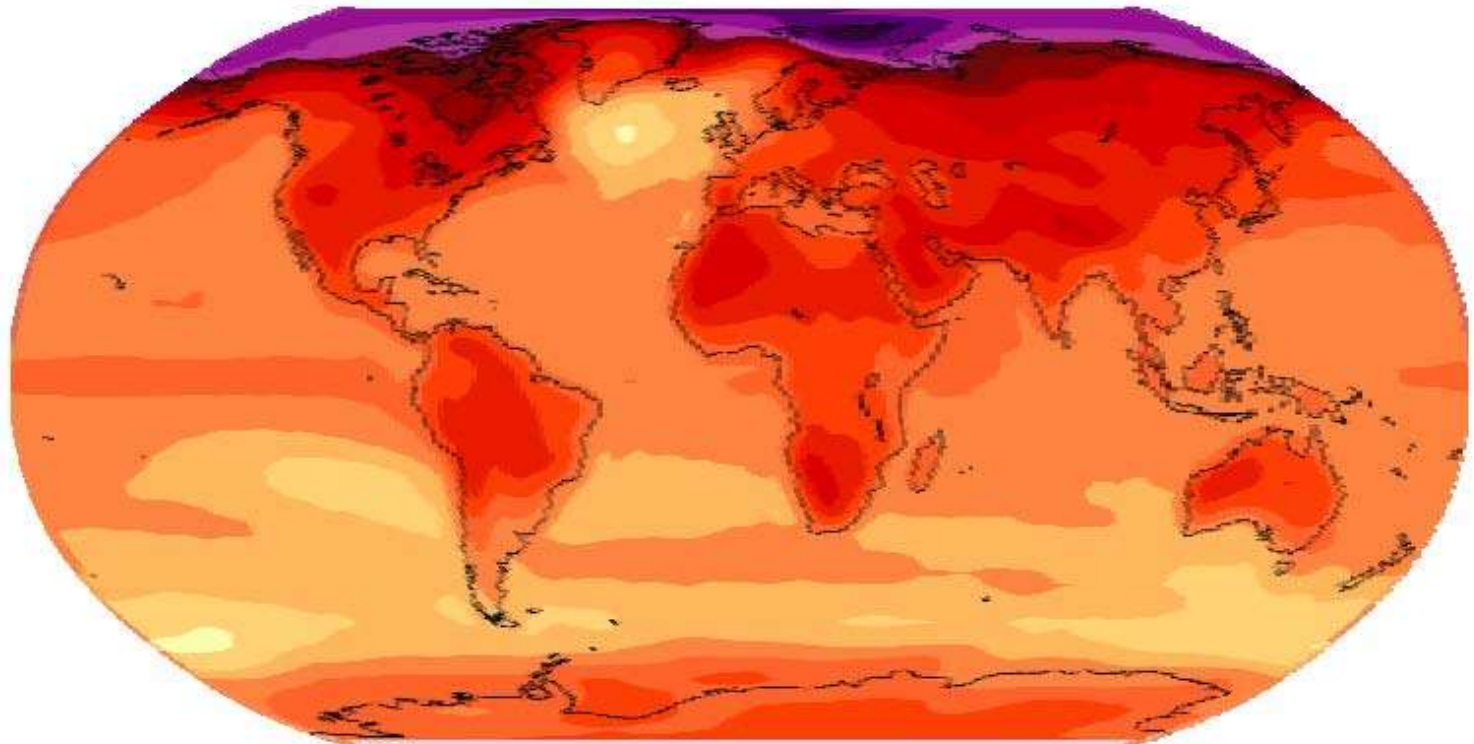
Even if the concentrations of all greenhouse gases and aerosols had been kept constant at year 2000 levels, a further warming of about  $0.1^{\circ}\text{C}$  per decade would be expected.

- Continued greenhouse gas emissions at or above current rates would cause further warming and induce many changes in the global climate system during the 21<sup>st</sup> century that would *very likely* be larger than those observed during the 20<sup>th</sup> century.



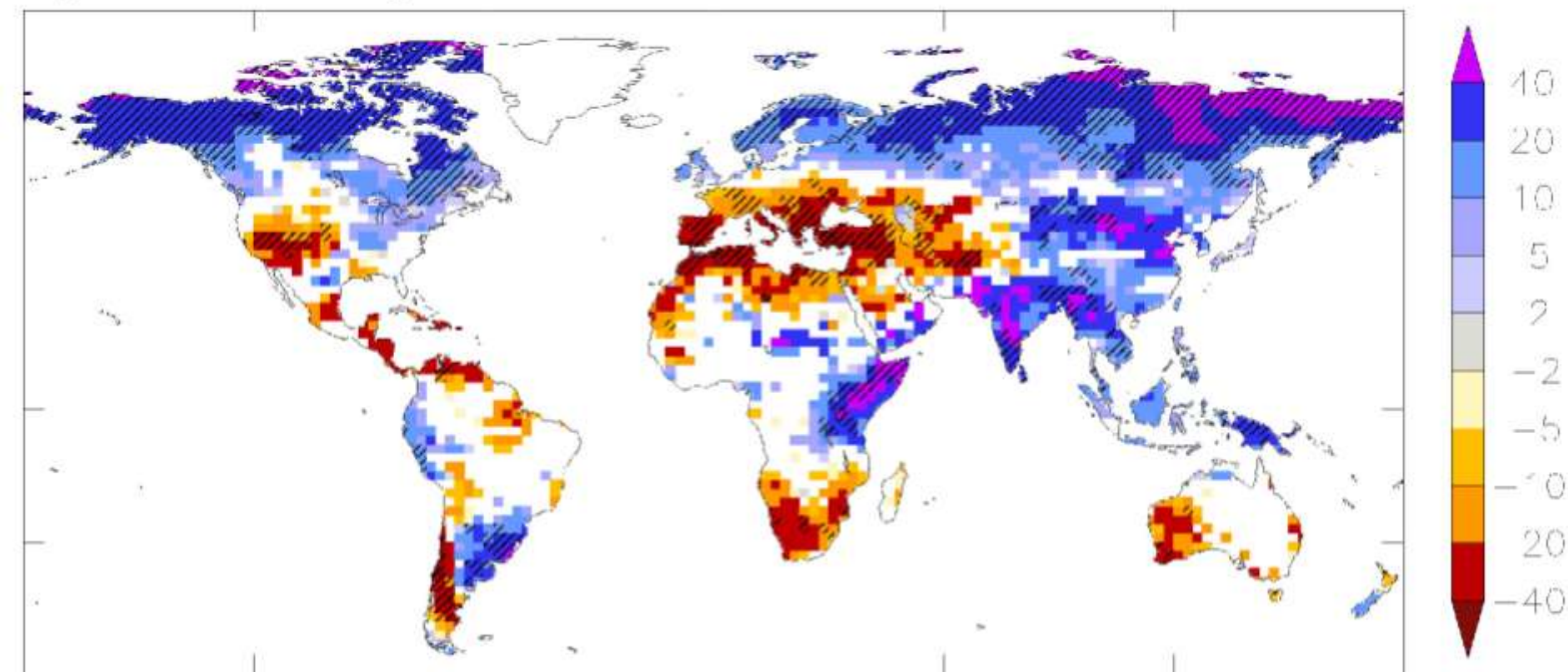


# Geographical pattern of surface warming



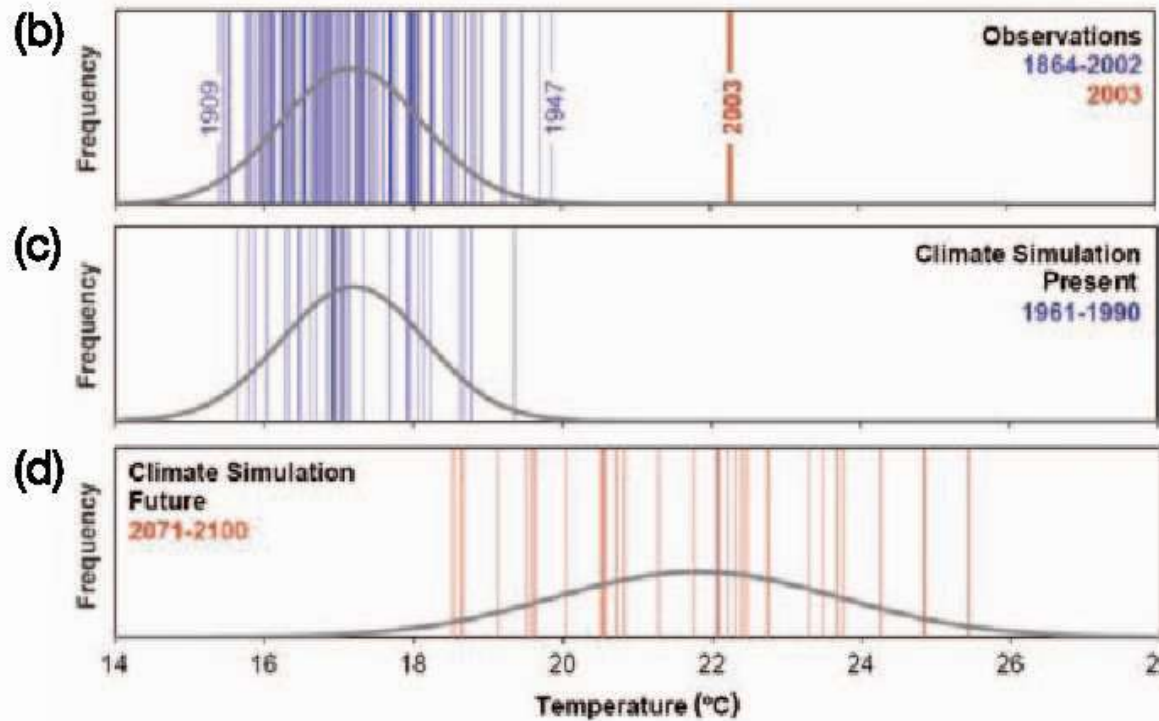
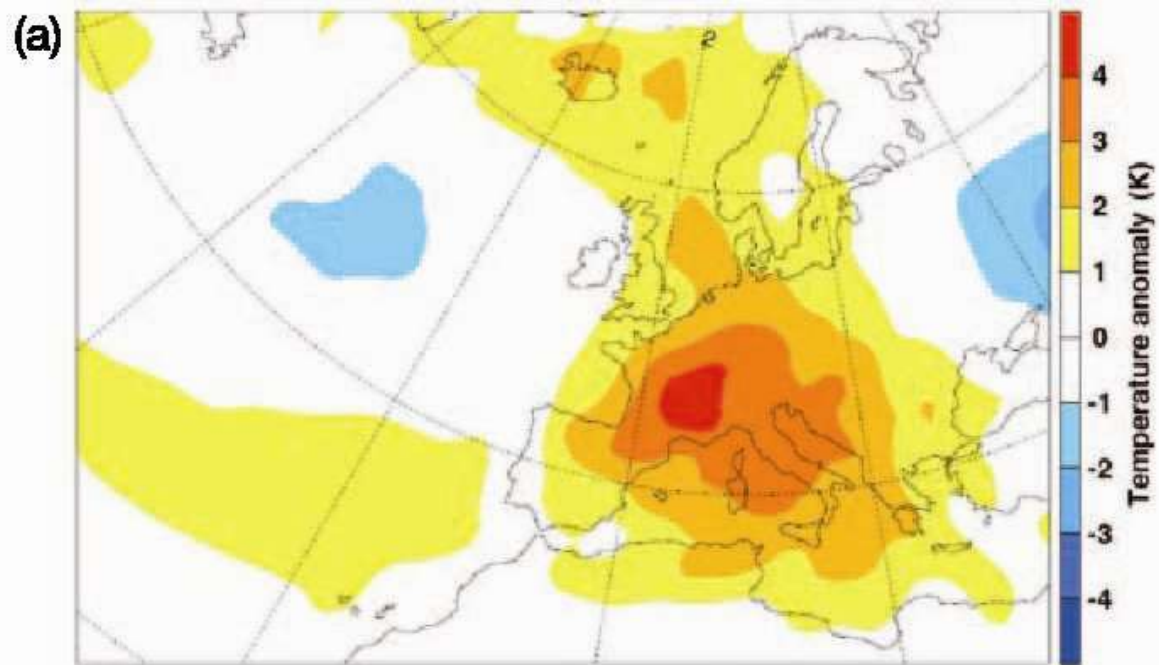
Projected surface temperature changes for the late 21st century (2090-2099). The map shows the multi-AOGCM average projection for the A1B SRES scenario. All temperatures are relative to the period 1980-1999.

## Projected relative changes in runoff



**Figure 3.3.** Relative changes in annual runoff (in %) for the period 2090-2099, relative to 1980-1999. Values are obtained from the median model in the multi-model dataset and are based on the SRES A1B scenario. White areas are where less than 66% of the models agree in the sign of change and stippled areas are where more than 90% models agree in the sign of change. {WGII Figure 3.4, technically adjusted to match the assumptions of Figure SYR 3.2}







## Impacts:

- For the first time, wide ranging impacts of changes in current climate have been documented:
  - retreating glaciers
  - longer growing seasons
  - shift of species ranges
  - and health impacts due to a heat wave of unprecedented magnitude.

**The observed changes described above are consistent with those projected for future climate change.**





## Regional-scale changes include:

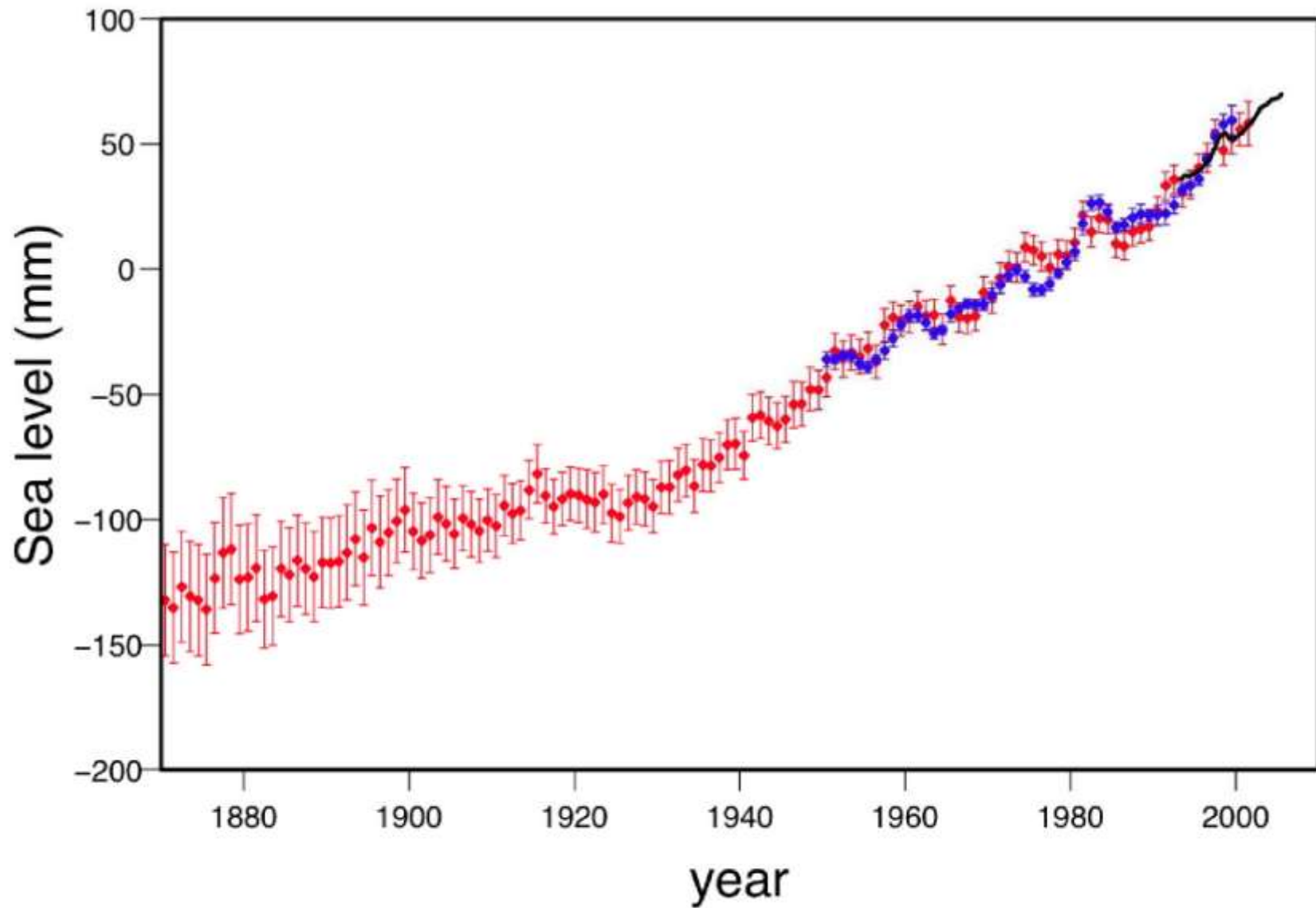
- warming greatest over land and at most high northern latitudes and least over Southern Ocean and parts of the North Atlantic Ocean,
  - continuing recent observed trends in contraction of snow cover area,
  - increases in thaw depth over most permafrost regions,
  - and decrease in sea ice extent;
- *very likely* increase in frequency of hot extremes, heat waves, and heavy precipitation
- *likely* increase in tropical cyclone intensity; less confidence in global decrease of tropical cyclone numbers
- poleward shift of extra-tropical storm tracks with consequent changes in wind, precipitation, and temperature patterns
- *very likely* precipitation increases in high latitudes and *likely* decreases in most subtropical land regions, continuing observed recent trends



## Nearly all European regions:

- are anticipated to be negatively affected by some future impacts of climate change and these will pose challenges to many economic sectors.
  - Climate change is expected to magnify regional differences in Europe's natural resources and assets.
  - Negative impacts will include increased risk of inland flash floods, and more frequent coastal flooding and increased erosion (due to storminess and sea-level rise).
  - The great majority of organisms and ecosystems will have difficulties adapting to climate change.
  - Mountainous areas will face glacier retreat, reduced snow cover and winter tourism, and extensive species losses.



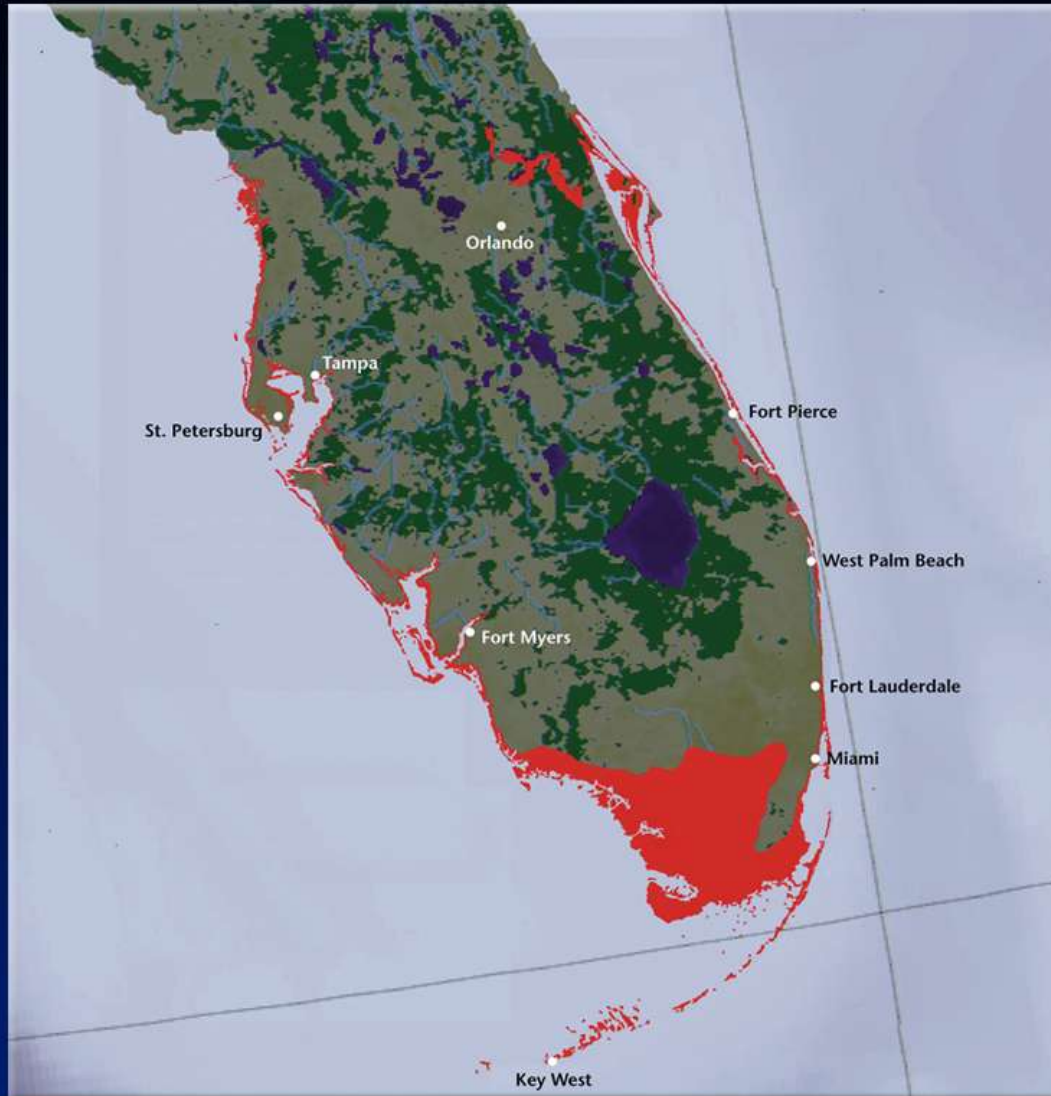


**Figure TS-18.** Annual averages of the global mean sea level based on reconstructed sea level fields since 1870 (red), tide gauge measurements since 1950 (blue), and satellite altimetry since 1992 (black). Units are in mm relative to the average for 1961–1990. Error bars are 90% confidence intervals. {Figure 5.13}



# IMPACTS OF A WARMING ARCTIC

Areas in Florida Subject to Inundation  
with 100 Centimeter Sea Level Rise

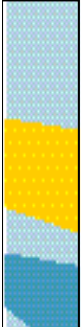




# Male, Maldives



Photo: Bruce Richmond, USGS



**Figure TS.8.** Relative vulnerability of coastal deltas as indicated by estimates of the population potentially displaced by current sea-level trends to 2050 (extreme >1 million; high 1 million to 50,000; medium 50,000 to 5,000) [B6.3]. Climate change would exacerbate these impacts.



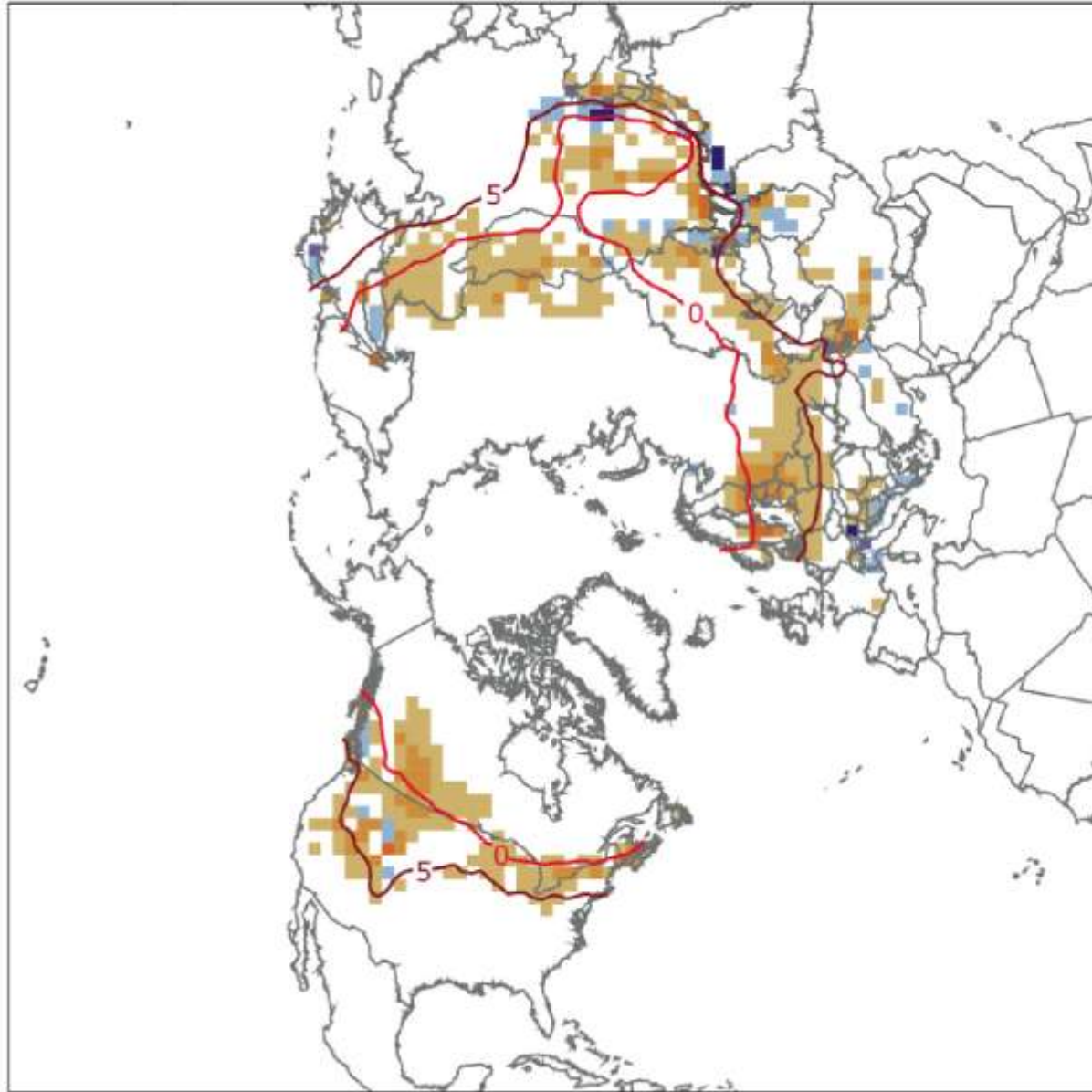


# In the Polar Regions

- the main projected biophysical effects are reductions in thickness and extent of glaciers and ice sheets, and changes in natural ecosystems with detrimental effects on many organisms including migratory birds, mammals and higher predators.
- In the Arctic, additional impacts include reductions in the extent of sea ice and permafrost, increased coastal erosion, and an increase in the depth of permafrost seasonal thawing.
- For human communities in the Arctic, impacts, particularly those resulting from changing snow and ice conditions, are projected to be mixed.
  - Detrimental impacts would include those on infrastructure and traditional indigenous ways of life.
  - Beneficial impacts would include reduced heating costs and more navigable northern sea routes.
- In both polar regions, specific ecosystems and habitats are projected to be vulnerable, as climatic barriers to species invasions are lowered.
- Arctic human communities are already adapting to climate change, but both external and internal stressors challenge their adaptive capacities.



# March and April Snow Departure (1988 through 2004) - (1967 through 1987)



Legend for color-coded ranges:

- 36 - -26
- 25 - -16
- 15 - -6
- 5 - 5
- 6 - 15
- 16 - 25
- 26 - 38



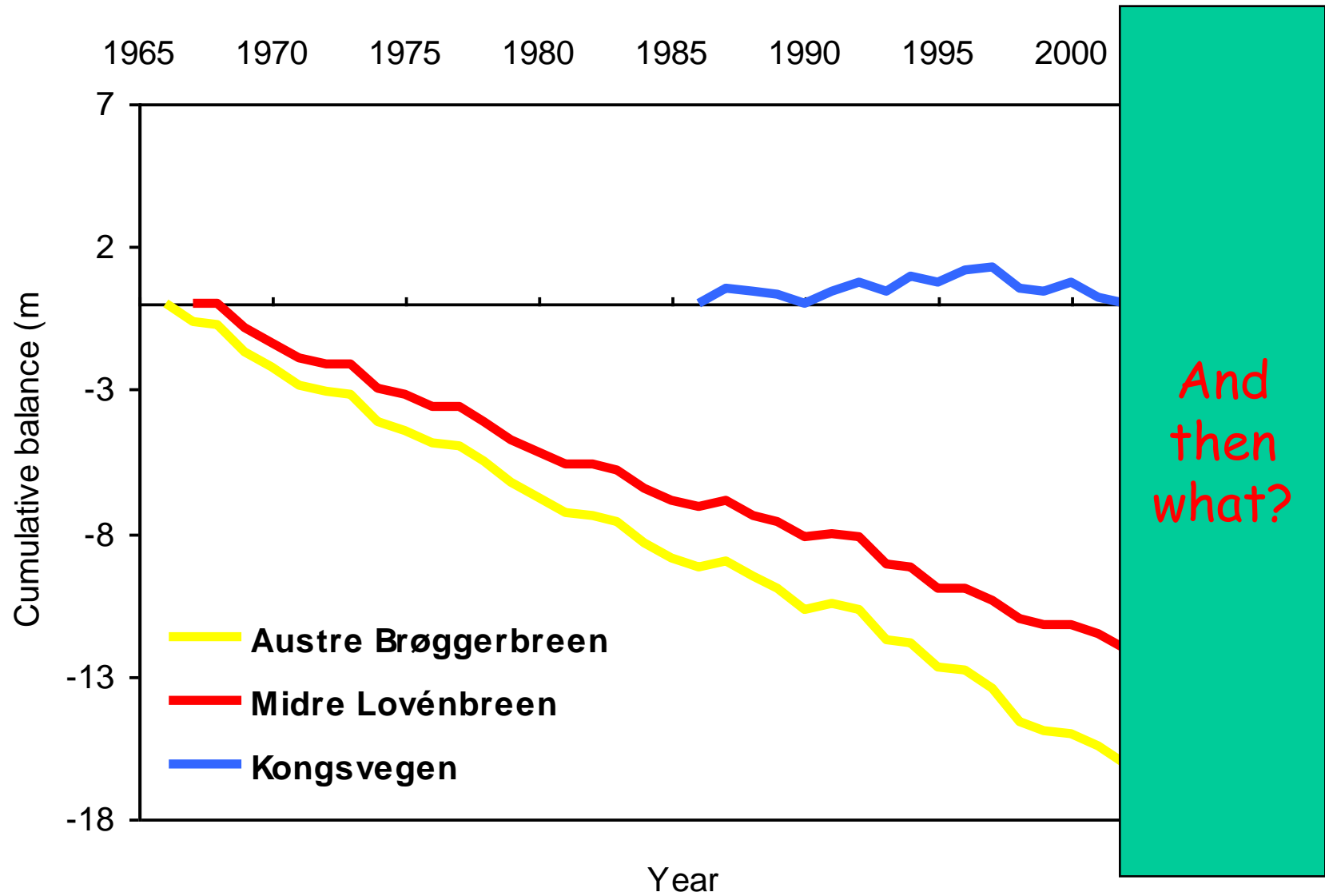
**Midtre  
Lovénbreen**

Frontposition 2002

Frontposition 1990

Frontposition around 1920

**Glacier changes**





# IMPACTS OF A WARMING ARCTIC

**Many coastal communities are facing increasing exposure to storms, reduced sea ice, and rising sea levels**



*The village of Shishmaref, located on an island just off the coast of Alaska and inhabited for 4000 years, is now facing the reality of moving.*

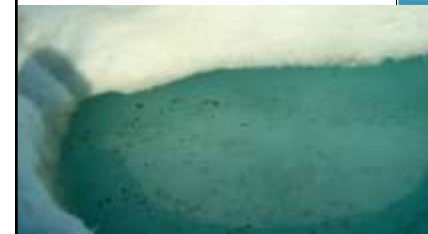
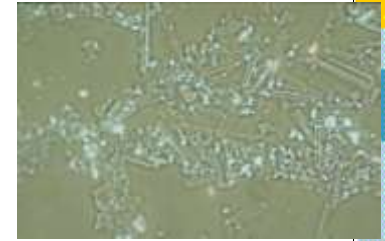
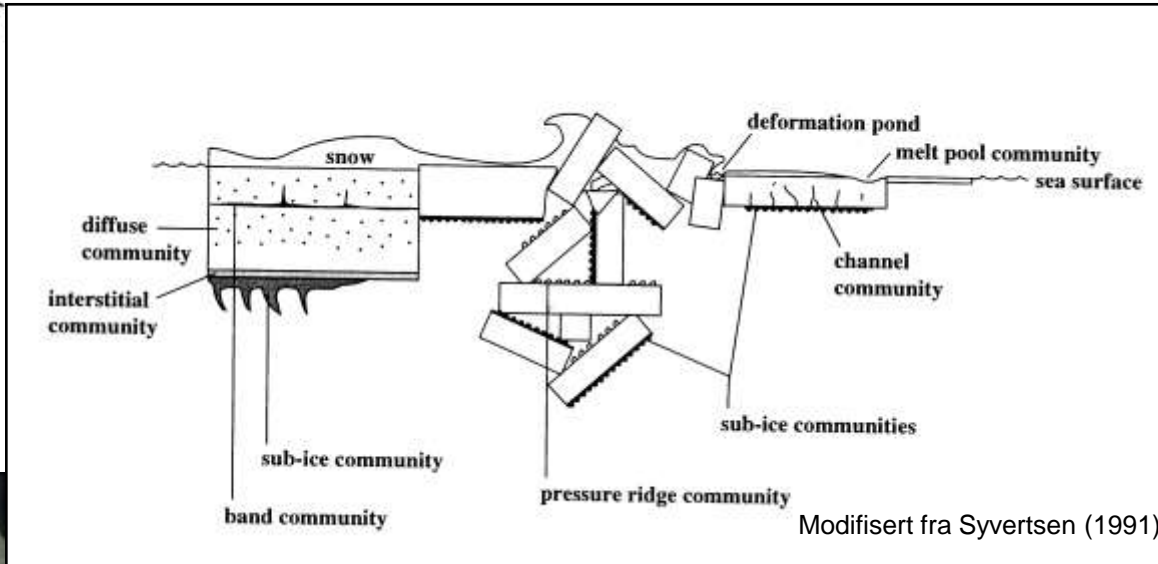


*Similar Issues at Banks Island*

Ice is a habitat for large



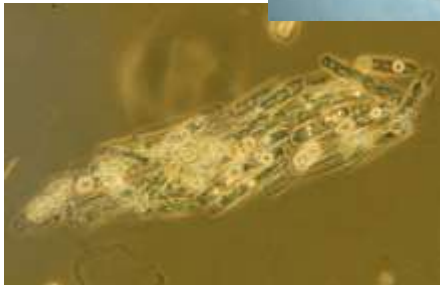
# And ice is a habitat for small



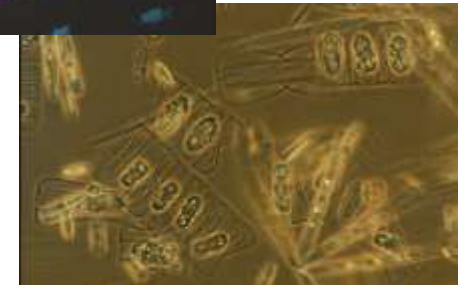
Melt pond communities



Channel communities



Under ice communities





# IMPACTS OF A WARMING ARCTIC

## Possible Changes in Fish Distribution

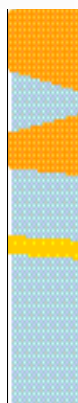
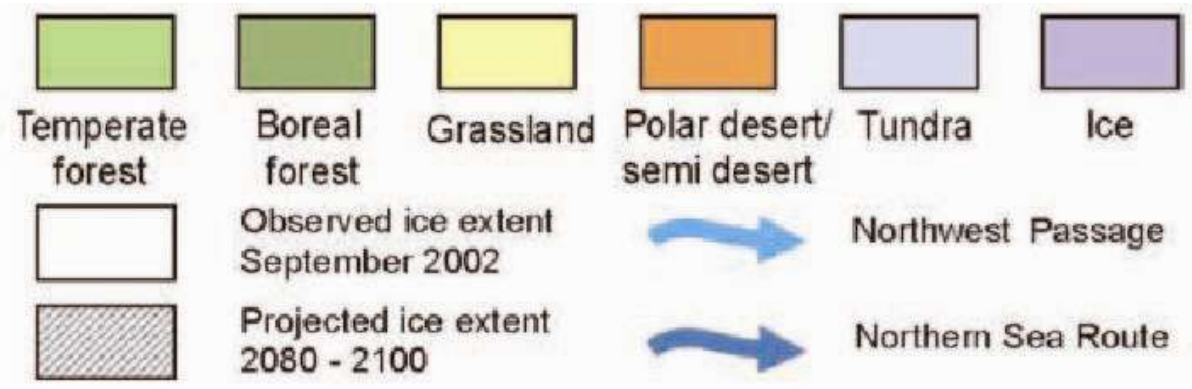
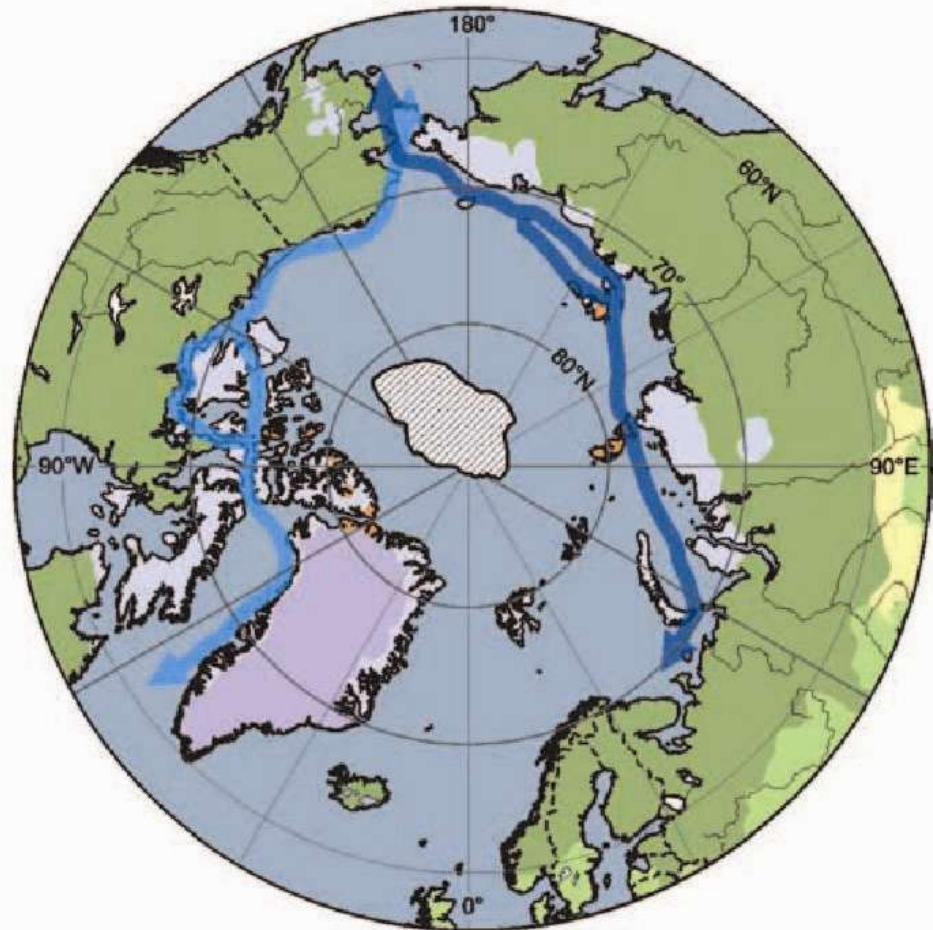
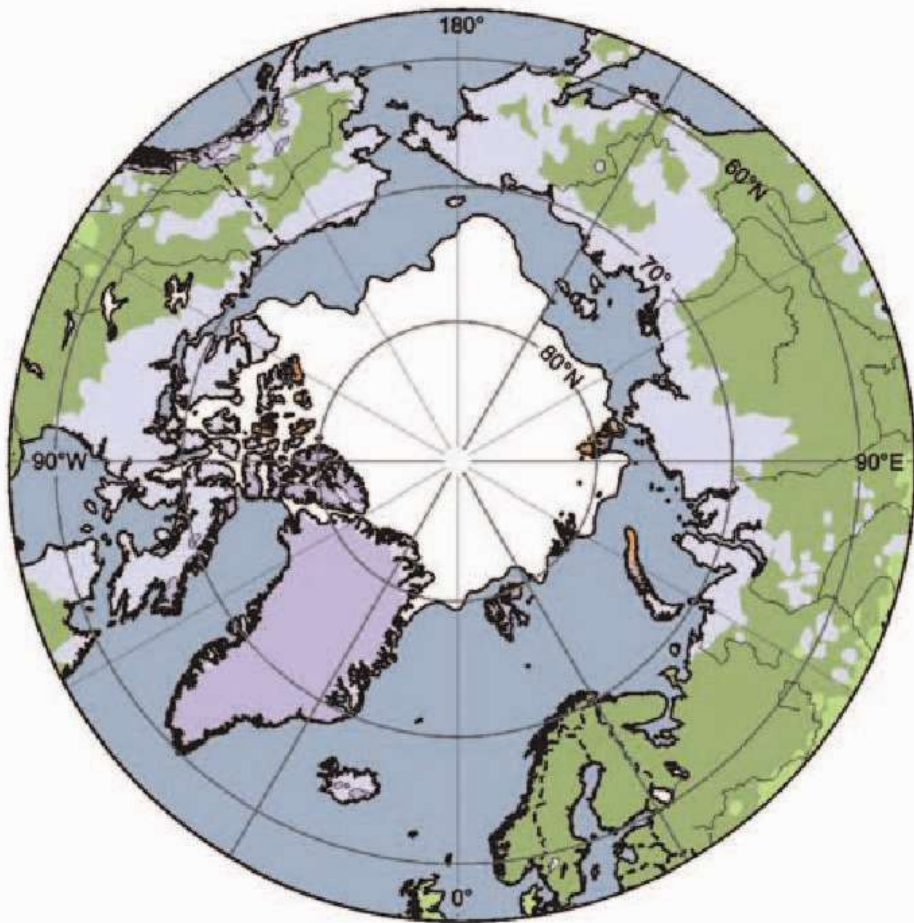


These shifts are governed by (1) changes in oceanic temperatures, (2) salinity, (3) nutrients, (4) changing patterns in North Atlantic Deep Water formation, and (5) interspecies interactions.

Climate driven changes in marine ecosystems.

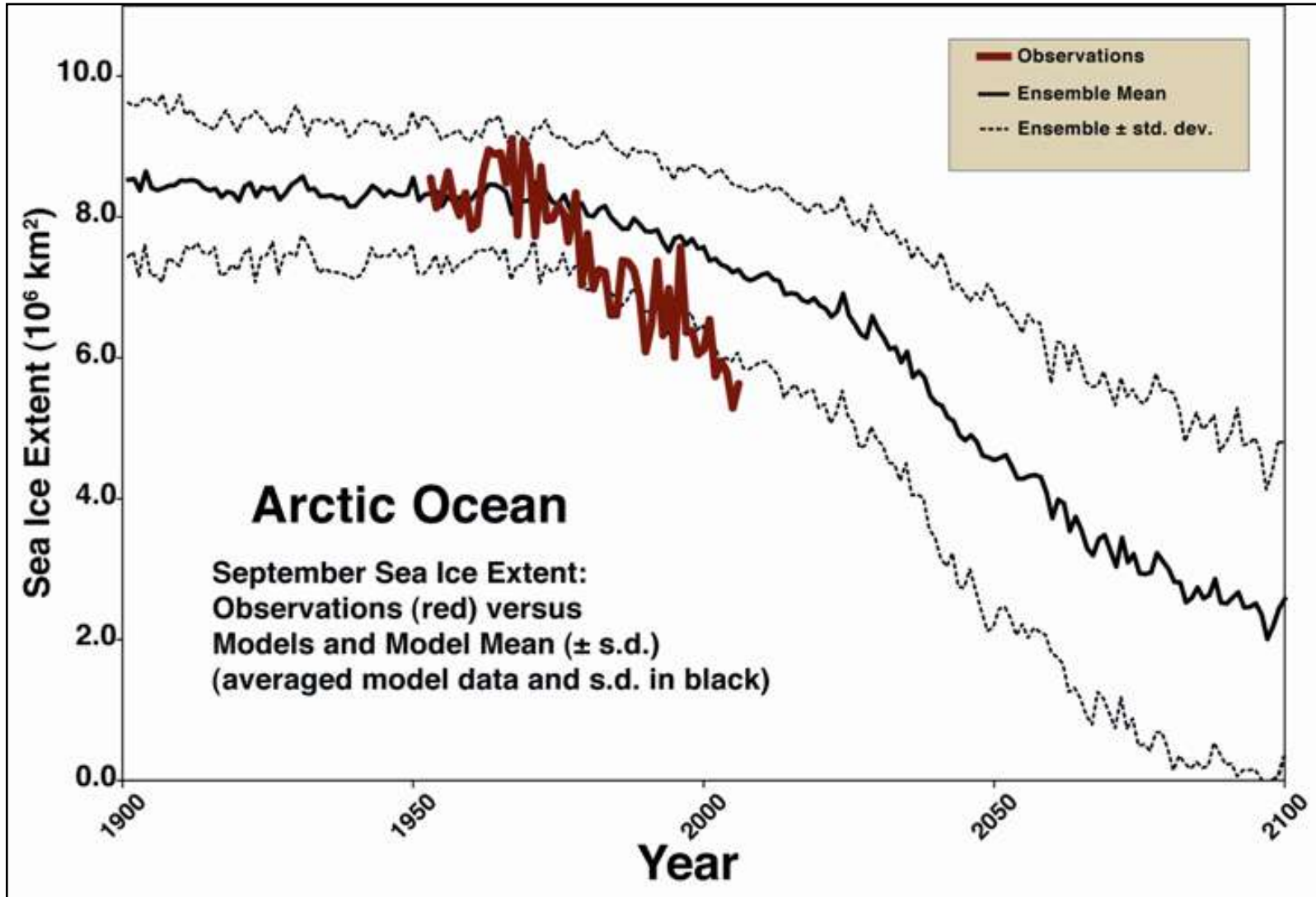
### Current Arctic Conditions

### Projected Arctic Conditions





# Models and Observations





## The long-term perspective

- **Determining what constitutes “dangerous anthropogenic interference with the climate system” in relation to Article 2 of the UNFCCC involves value judgements.**
- **Science can support informed decisions on this issue, including by providing criteria for judging which vulnerabilities might be labelled “key”.**

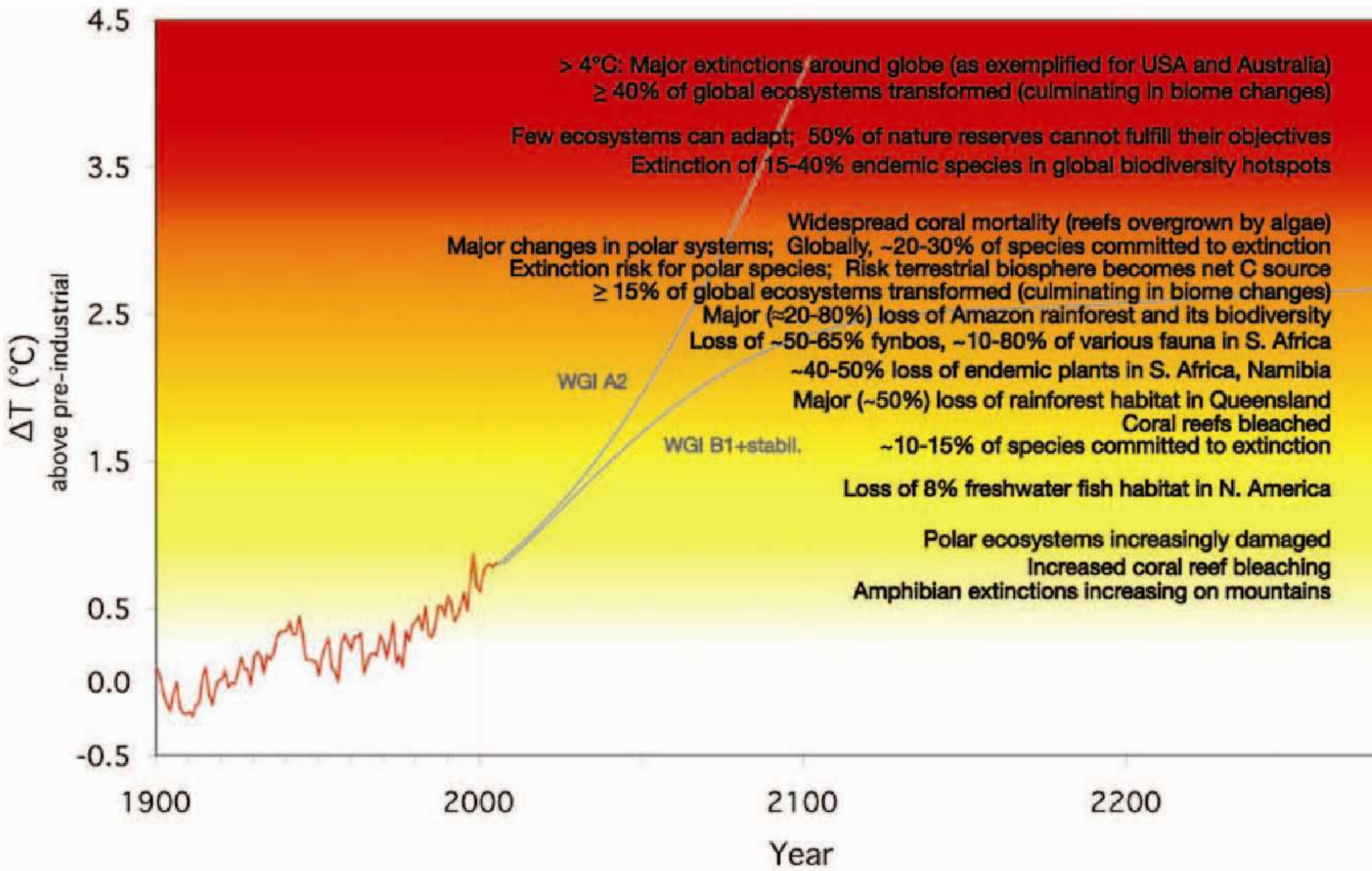




# The five "reasons for concern"

- Risks to unique and threatened systems.
  - Approximately 20-30% of plant and animal species assessed so far are likely to be at increased risk of extinction if increases in global average temperature exceed 1.5-2.5 °C over 1980-1999 levels.
- Risks of extreme weather events.
  - Droughts, heat waves, and floods
- Distribution of impacts and vulnerabilities.
  - Poor and elderly.
  - Dry areas and megadeltas
- Aggregate impacts
  - Benefits peak at lower magnitude of warming
- Risks of large-scale singularities
  - Sea-level
  - Greenland, Antarctica ice sheets







## Particularly vulnerable regions

- **Africa**, because of low adaptive capacity and projected climate change impacts
- **small islands**, where there is high exposure of population and infrastructure to projected climate change impacts
- **Asian and African mega deltas**, due to large populations and high exposure to sea level rise, storm surges and river flooding.
- **the Arctic**, because of the impacts of high rates of projected warming on natural systems and human communities





# Climate and energy sources

- Climate independent
  - Fossil fuels
  - Nuclear power
- Climate dependent
  - Wind
  - Hydro
  - Solar
  - Bio-fuels





*Thanks for your attention!*

*Tack för visat intresse!*