

Climate Change: What do we know, according to IPCC (WGII)?



Prof. Jean-Pascal van Ypersele

**IPCC Vice-Chair,
(Université catholique de Louvain,
Louvain-la-Neuve, Belgium),**

**www.ipcc.ch & www.climate.be
vanyp@climate.be**

Pre-COP IPCC workshop, Warsaw, 2-10-2008

NB: Unless labeled otherwise, the source of the diagrams and tables shown is the IPCC AR4



⌘ IPCC Working Group II: Impacts, Vulnerability, and adaptation

Jean-Pascal van Ypersele
(vanypers@astr.ucl.ac.be)

Following addressed by WG II:

- Impacts observed so far
- Future scenarios
- Impacts on sectors:
 - Water
 - Ecosystems
 - Agriculture, forestry, fisheries
 - Coasts
 - Settlements and industry
 - Health



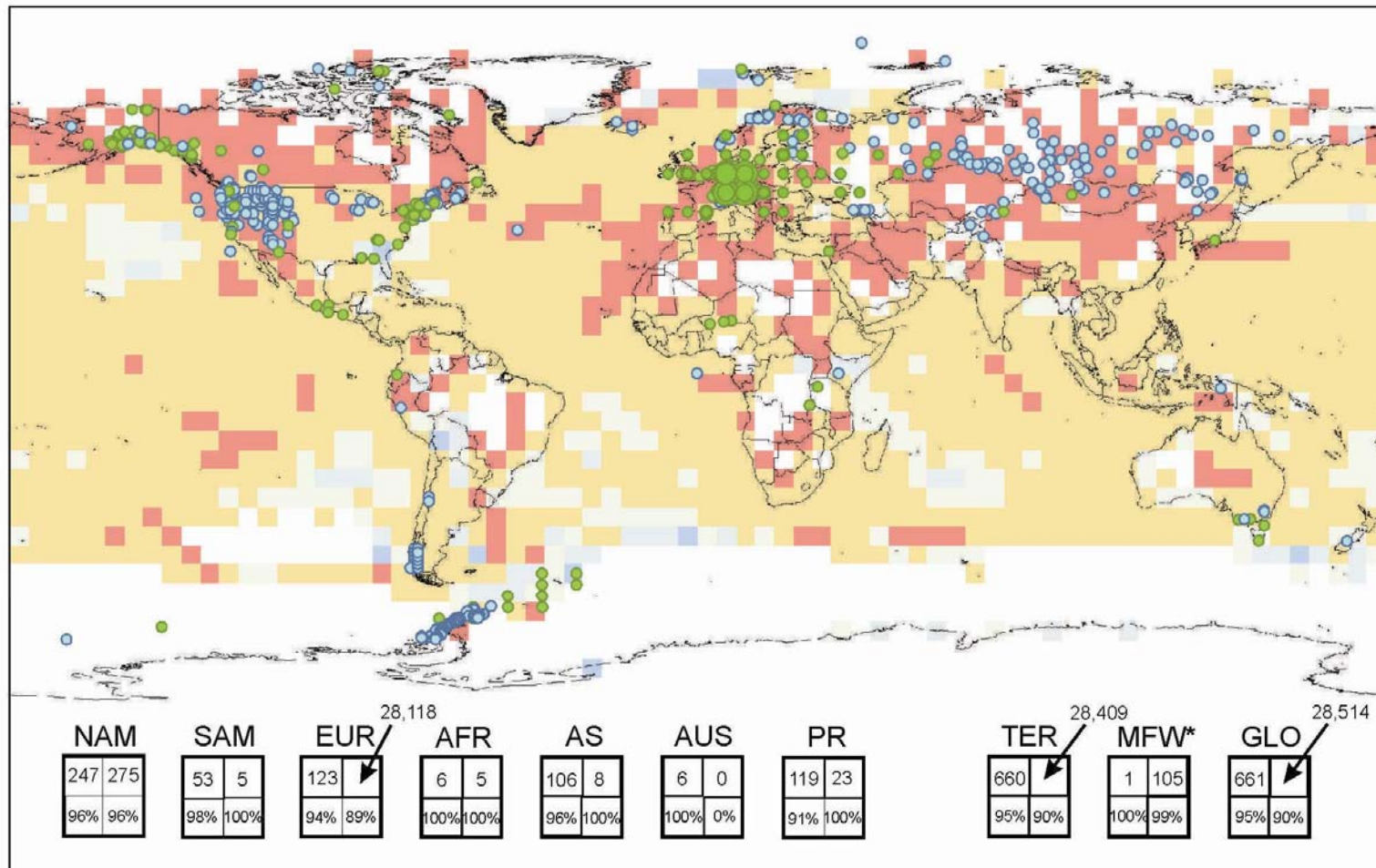
Following addressed (cont.):

- Impacts on regions:
 - Africa, Asia, Australia and New Zealand, Latin America, North America, Polar regions, Small islands, and
 - Europe (including the Alps)

- Adaptation practices
- Adaptation vs. mitigation
- Key vulnerabilities
- Sustainability

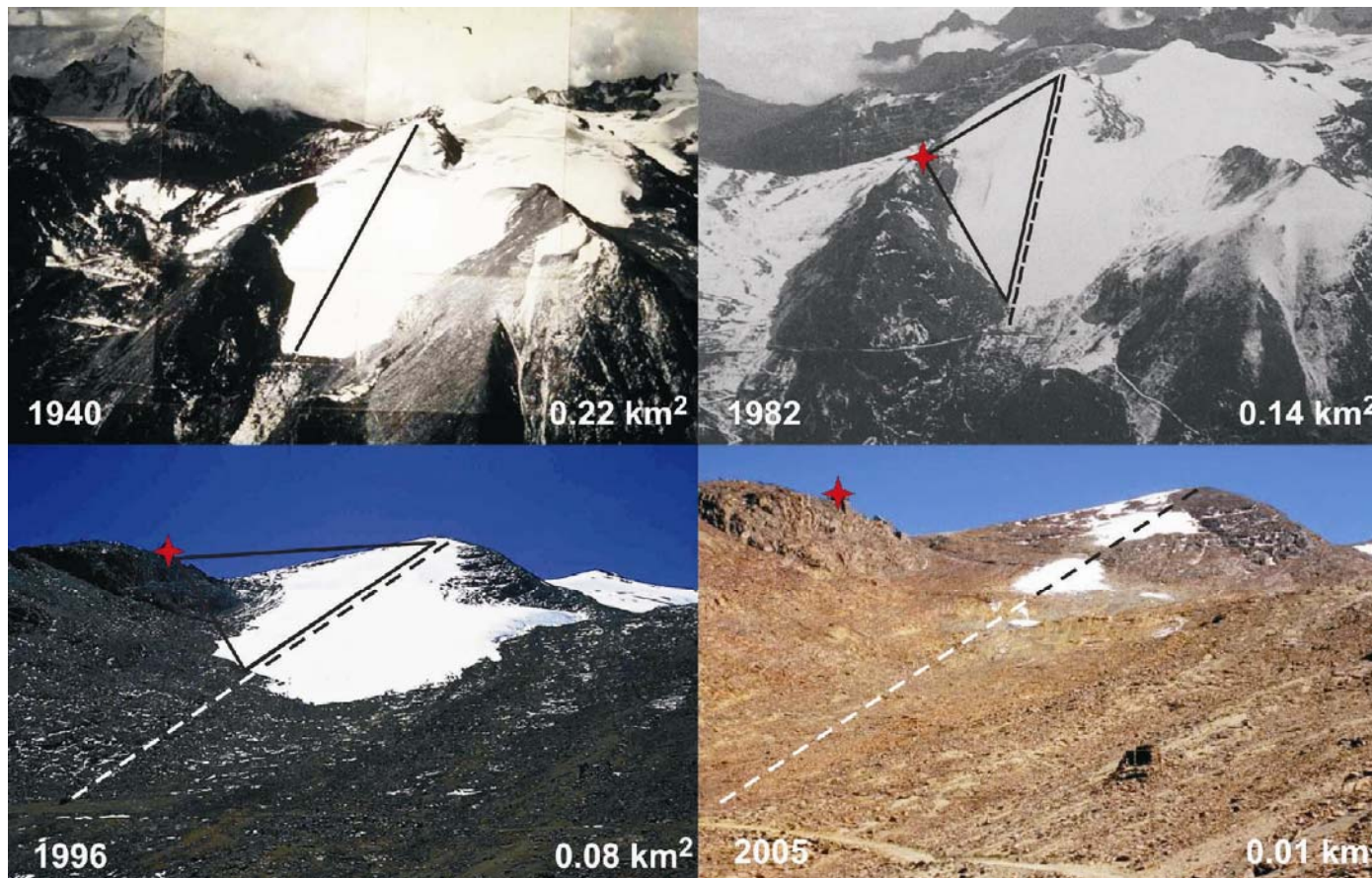


Temperature changes since 1970 and observed changes in physical and biological systems

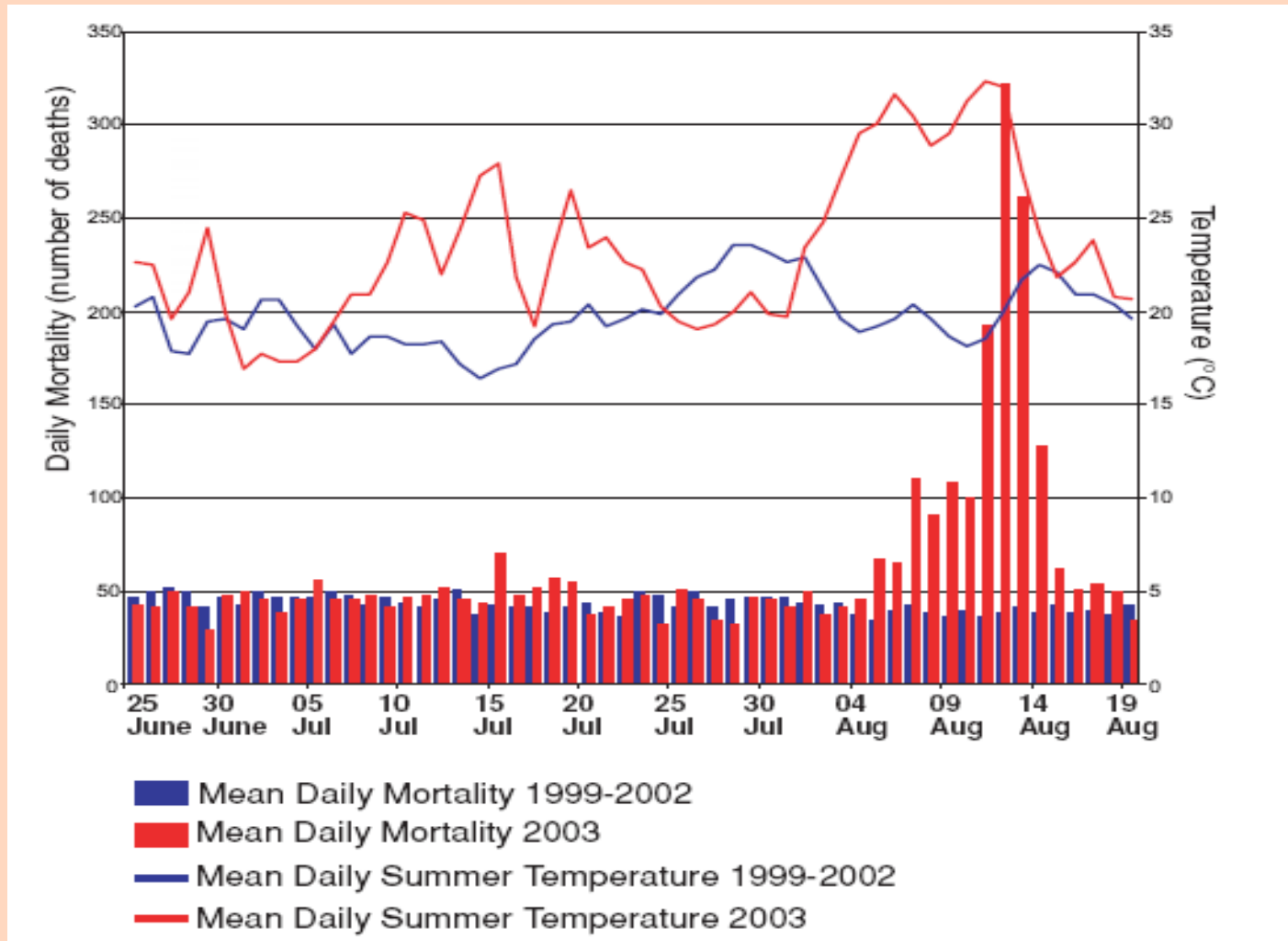


The Chacaltaya glacier and ski-lift, Bolivia

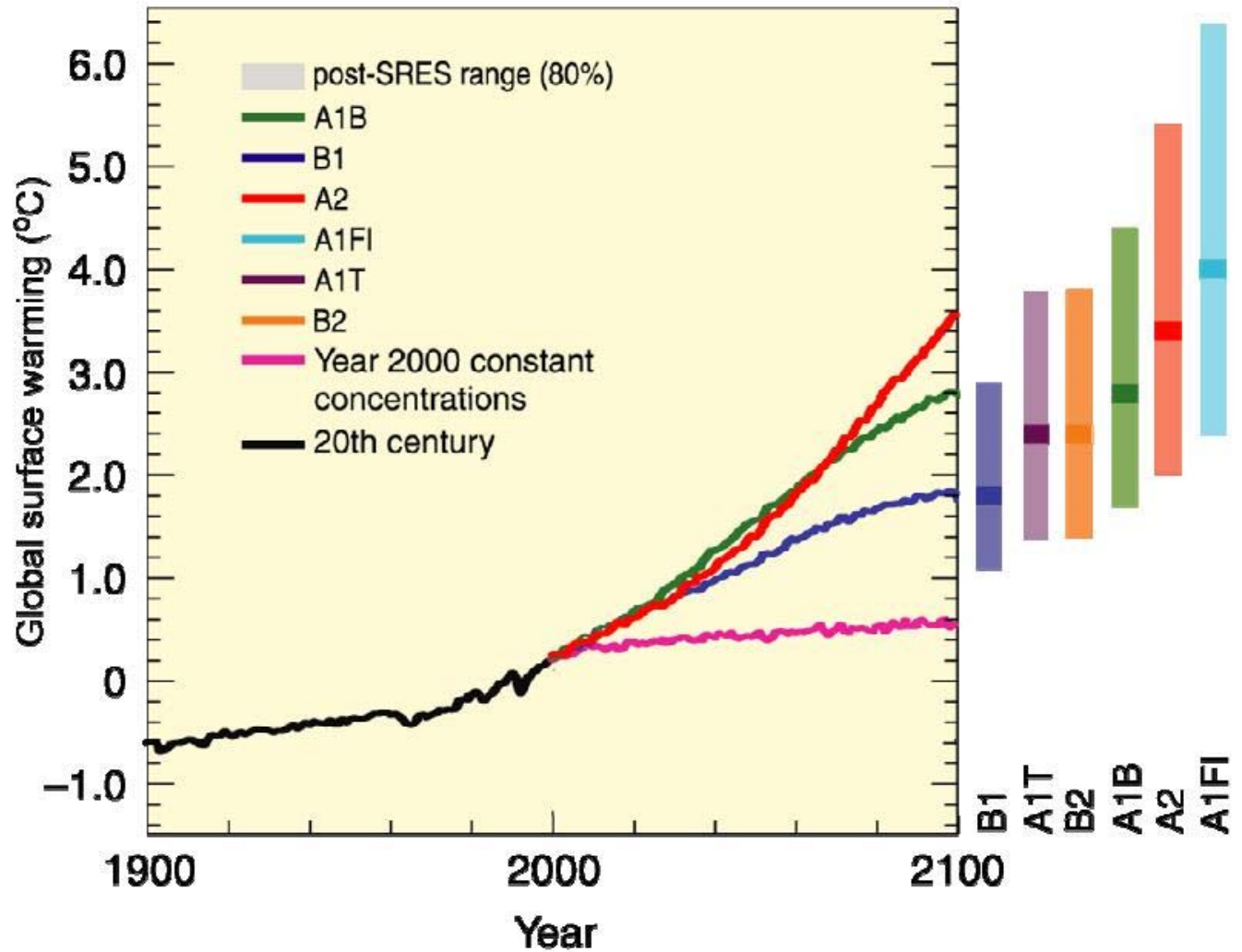
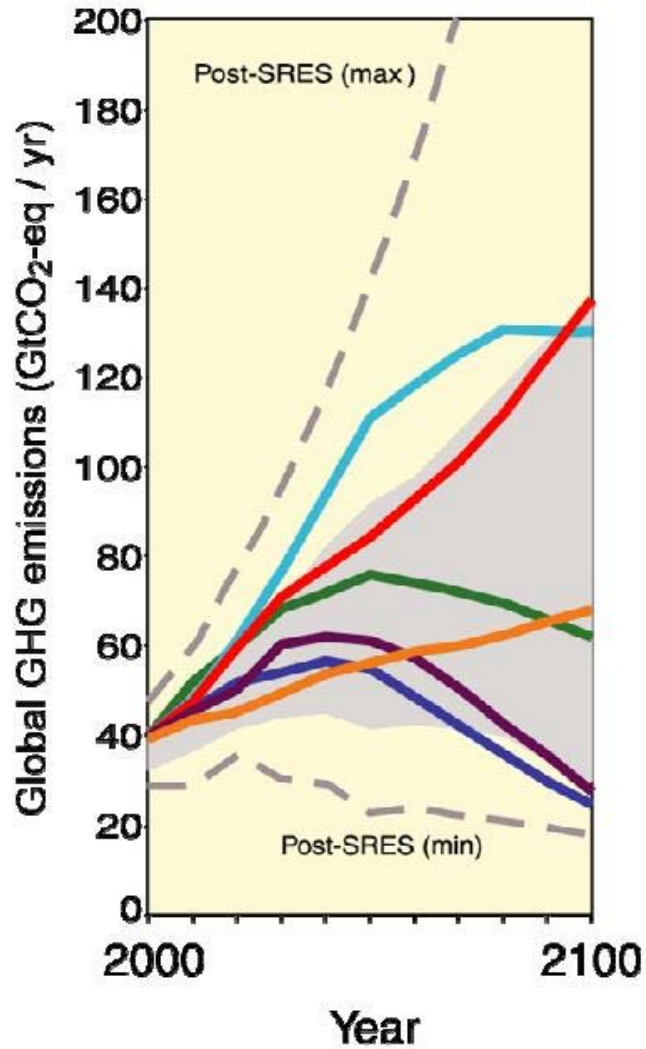
Skiing was no longer possible after 2004



Daily mortality in Paris (summer 2003) (IPCC AR4 Ch 8)



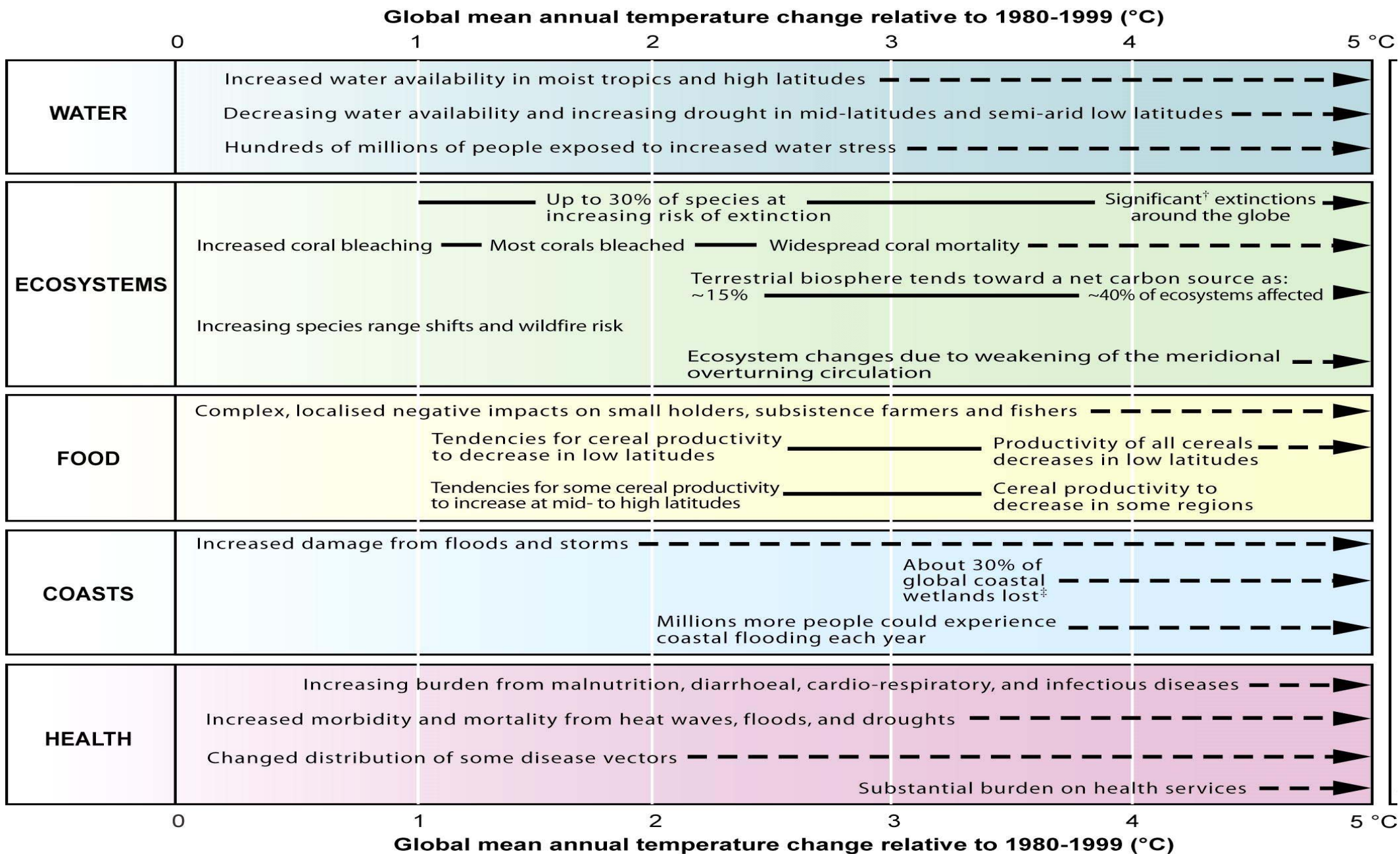
Climate projections without mitigation



NB: écart par rapport à la moyenne 1980-1999

Figure SPM.2. Key impacts as a function of increasing global average temperature change

(Impacts will vary by extent of adaptation, rate of temperature change, and socio-economic pathway)

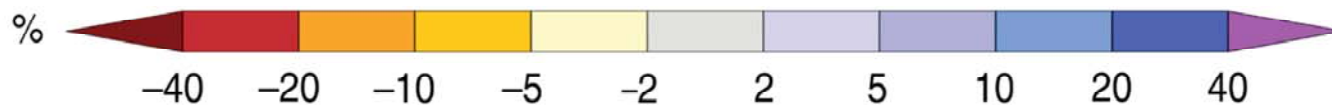
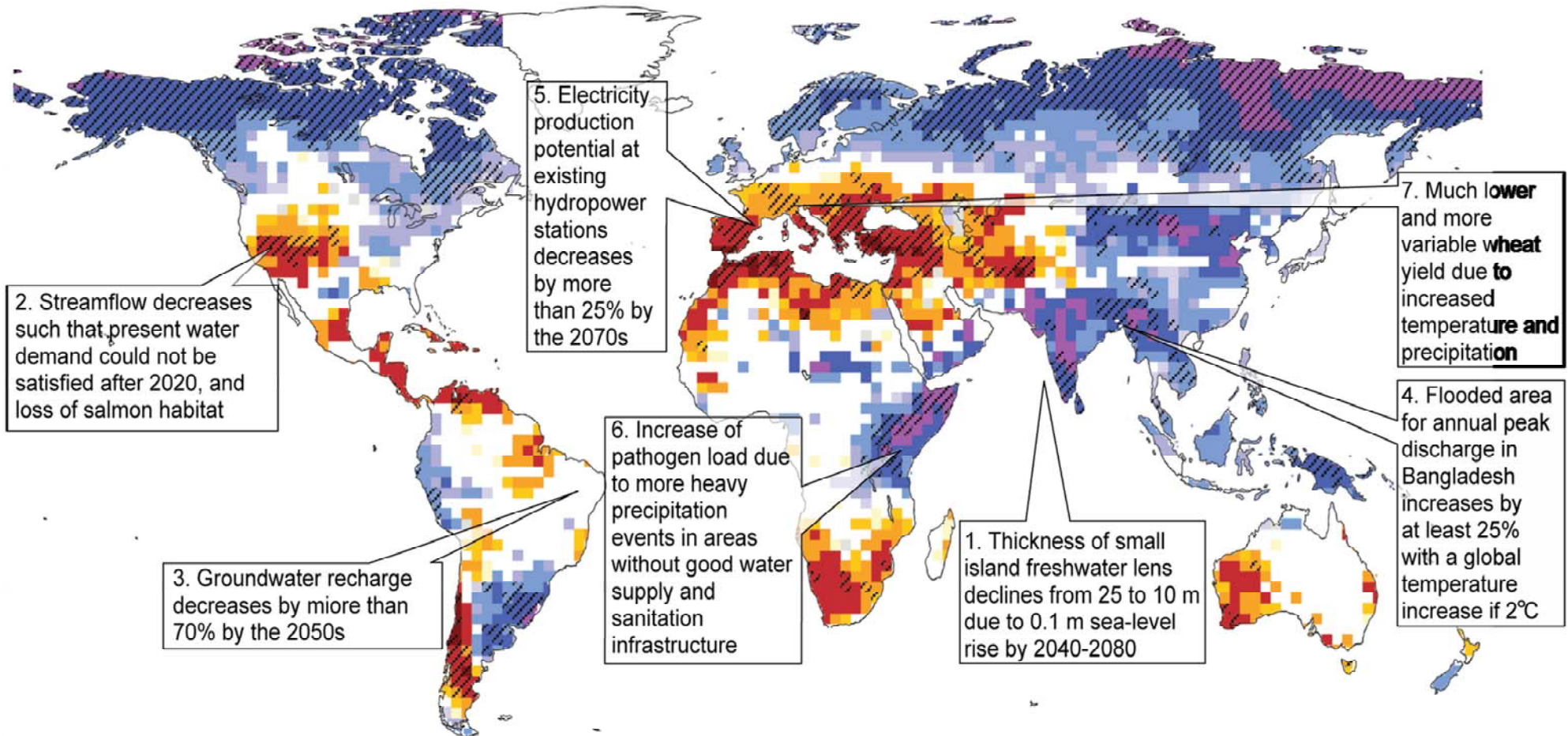


[†] Significant is defined here as more than 40%.

[‡] Based on average rate of sea level rise of 4.2 mm/year from

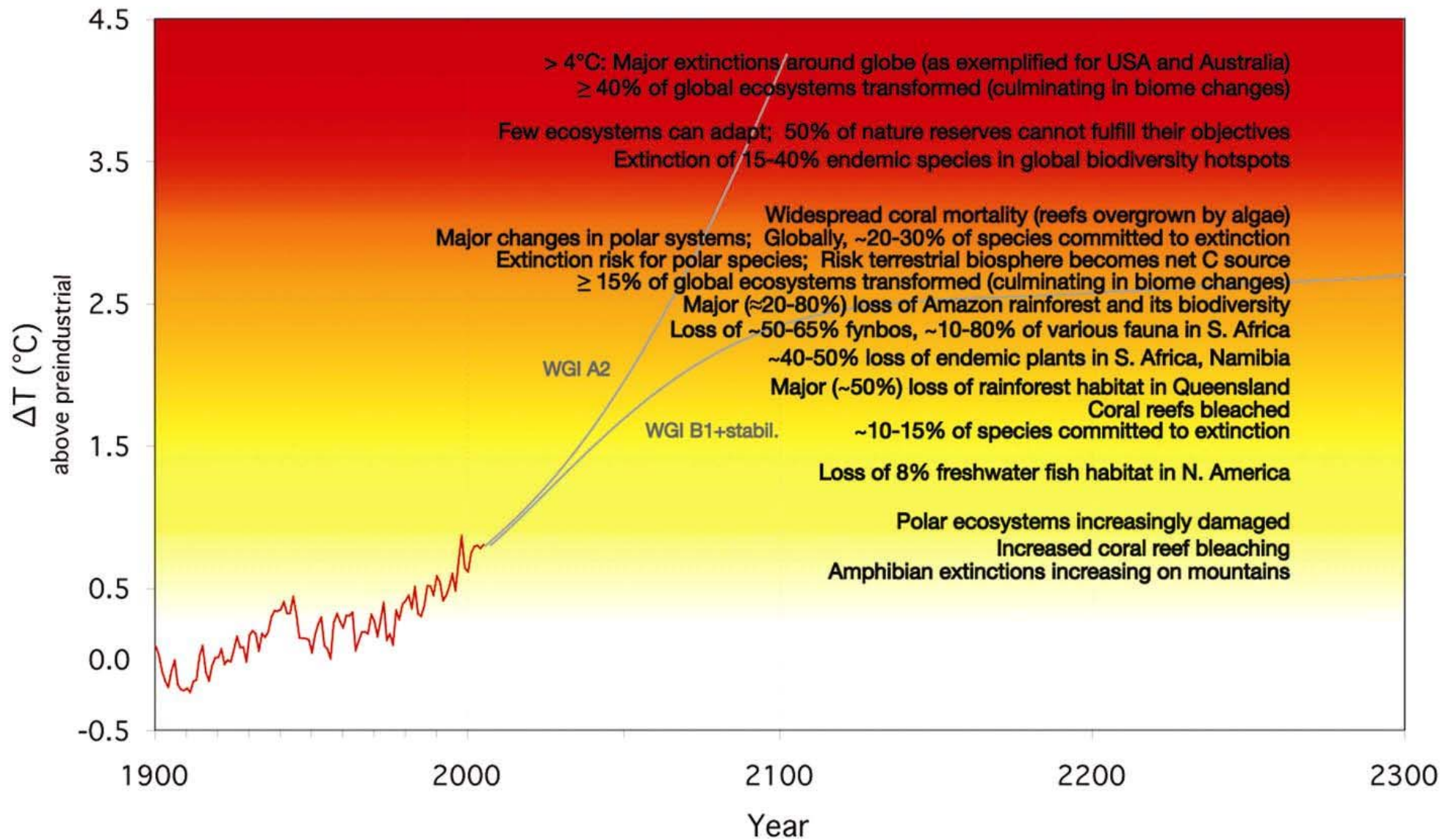
Phenomenon ^a and direction of trend	Likelihood of future trends based on projections for 21st century using SRES scenarios	Examples of major projected impacts by sector			
		Agriculture, forestry and ecosystems [4.4, 5.4]	Water resources [3.4]	Human health [8.2]	Industry, settlements and society [7.4]
Heavy precipitation events: frequency increases over most areas	Very likely	Damage to crops; soil erosion, inability to cultivate land due to waterlogging of soils	Adverse effects on quality of surface and groundwater; contamination of water supply; water scarcity may be relieved	Increased risk of deaths, injuries and infectious, respiratory and skin diseases	Disruption of settlements, commerce, transport and societies due to flooding; pressures on urban and rural infrastructures; loss of property
Area affected by drought increases	Likely	Land degradation, lower yields/crop damage and failure; increased livestock deaths; increased risk of wildfire	More widespread water stress	Increased risk of food and water shortage; increased risk of malnutrition; increased risk of water- and food-borne diseases	Water shortages for settlements, industry and societies; reduced hydropower generation potentials; potential for population migration
Intense tropical cyclone activity increases	Likely	Damage to crops; windthrow (uprooting) of trees; damage to coral reefs	Power outages causing disruption of public water supply	Increased risk of deaths, injuries, water- and food-borne diseases; post-traumatic stress disorders	Disruption by flood and high winds; withdrawal of risk coverage in vulnerable areas by private insurers; potential for population migrations; loss of property

Water at the end of the 21st century for SRES A1B



TP Figure 3.4: Ensemble mean change of annual runoff, in percent, between present (1980-1999) and 2090-2099 for the SRES A1B emissions scenario (based on Milly et al., 2005).

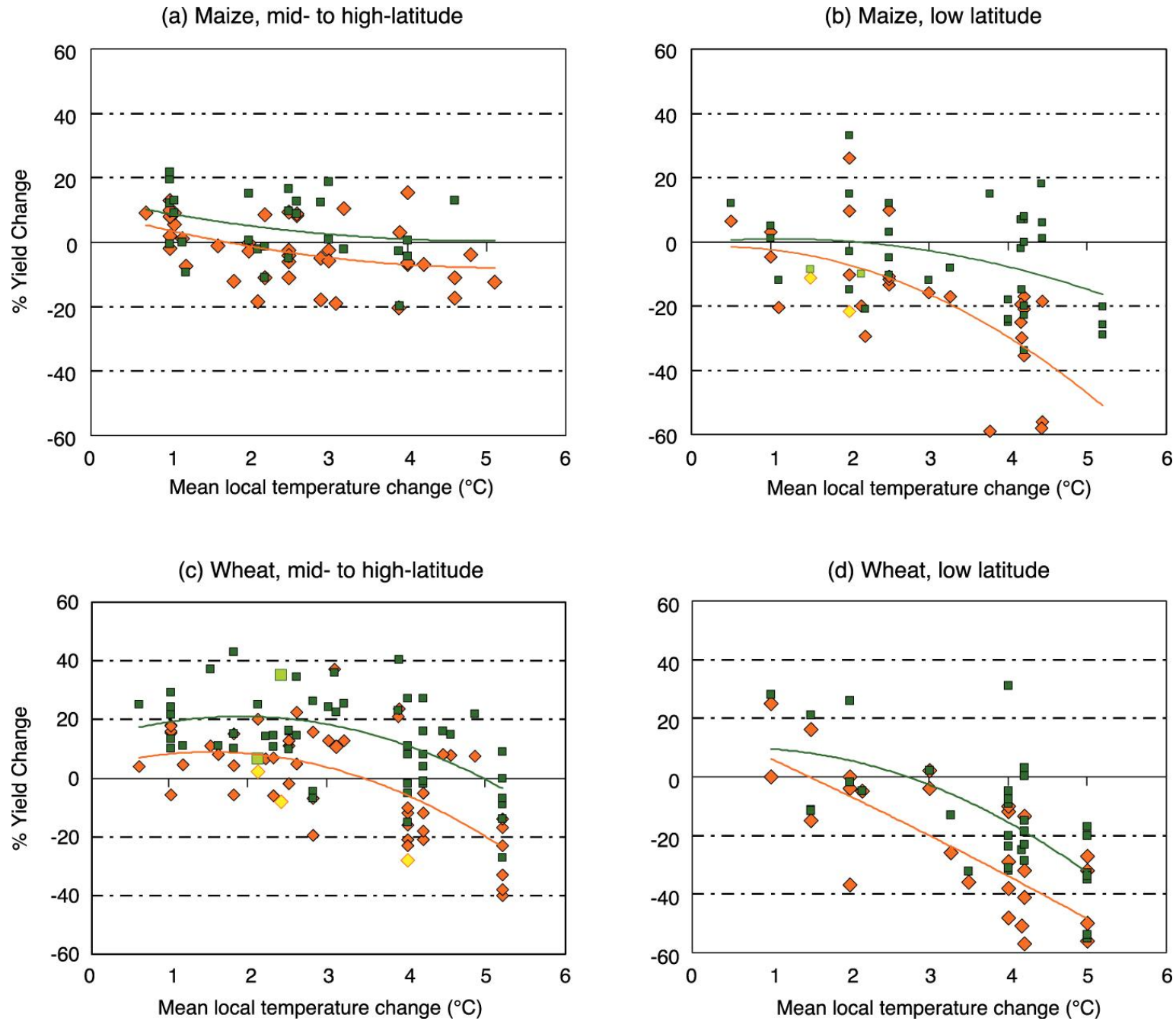
Figure TS.6. Projected risks due to critical climate change impacts on ecosystems



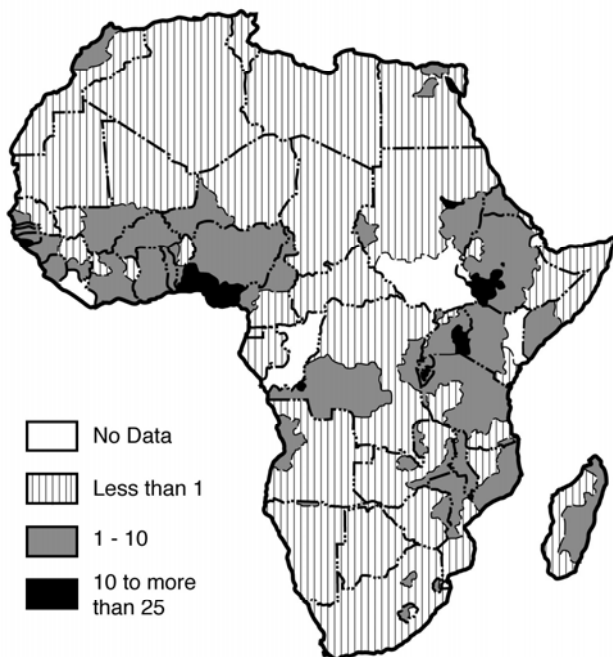
**20% - 30% of plants
and animals species
likely at “increased
risk of extinction”**

**if ΔT 1.5°C - 2.5°C
(above 1990 temperature)**

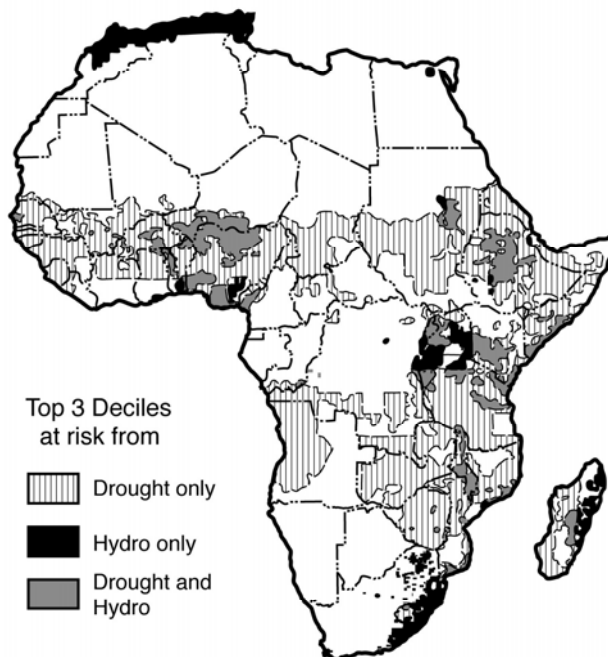
Figure TS.7. Sensitivity of cereal yield to climate change



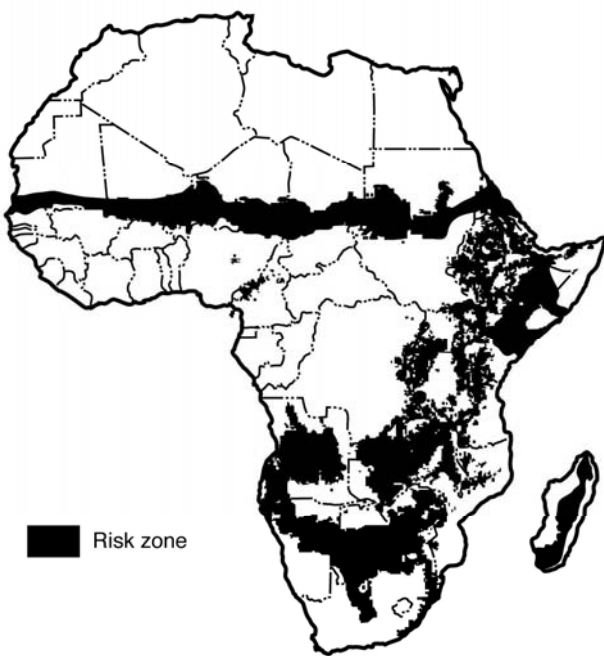
a) Underweight Children per square kilometre



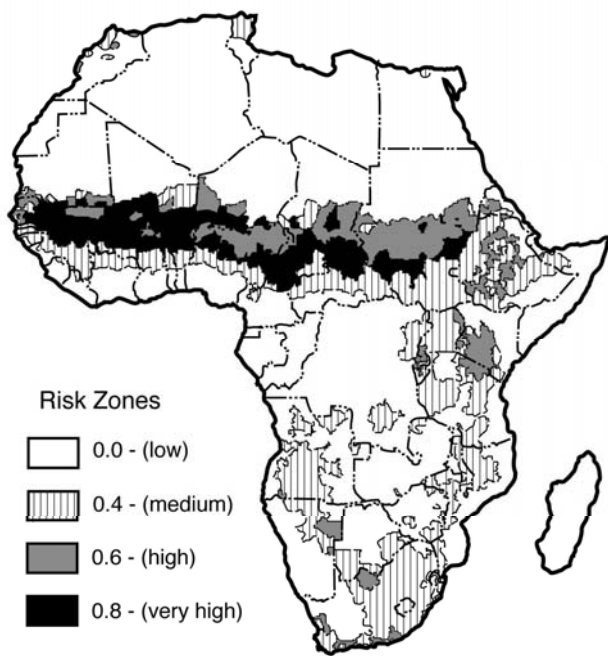
b) High Mortality Risk



c) Epidemic Malaria



d) Epidemic Meningitis



Vulnerability to climate change can be made worse by the presence of other stresses:

Multiple stresses in Africa (Ch 9)

Developing countries are the most vulnerable to climate change (from IPCC TAR)

- ⌘ **Impacts are worse** - already more flood and drought prone and a large share of the economy is in climate sensitive sectors
- ⌘ **Lower capacity to adapt** because of a lack of financial, institutional and technological capacity and access to knowledge
- ⌘ **Climate change is likely to impact disproportionately upon the poorest countries and the poorest persons within countries,** exacerbating inequities in health status and access to adequate food, clean water and other resources.
- ⌘ **Net market sector effects are expected to be negative in most developing countries**

Regions most affected

- The Arctic
- Sub-Saharan Africa
- Small islands
- Large megadeltas

In all regions, there are some areas and communities which are particularly vulnerable

- The poor
- Young children
- The elderly



WMO



UNEP

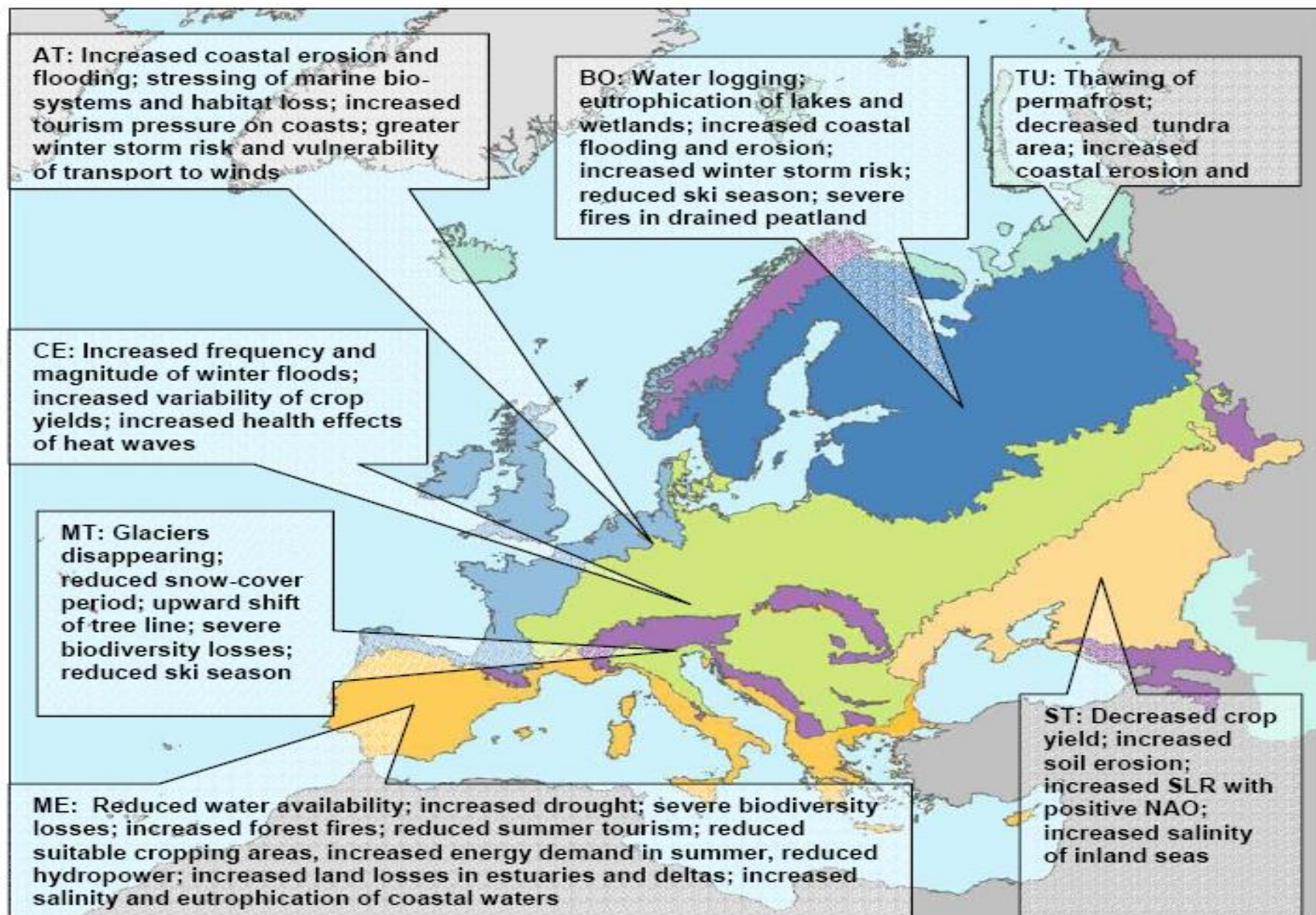


Figure 12.3: Key vulnerabilities of European systems and sectors to climate change during the 21st century for the main biogeographic regions of Europe (EEA 2004a): TU (Tundra, pale turquoise); BO (Boreal, dark blue); AT (Atlantic, light blue); CE (Central, green [includes the Pannonian Region]); MT (Mountains, purple); ME (Mediterranean, orange [includes the Black Sea region]); ST (Steppe, cream); SLR (sea-level raise); NAO (North Atlantic Oscillation).

Excerpts from IPCC AR4 WG2 (Chapter Europe)

- **For the first time, wide ranging impacts of changes in current climate have been documented in Europe**
 - retreat of glaciers, lengthening of growing season, shift of species, heat wave in 2003, ...
- **Climate-related hazards will mostly increase, although changes will vary geographically**
 - More winter floods in maritime regions, snowmelt-related floods in Central and E. Europe, flash floods throughout Europe.
 - Coastal flooding related to increasing storminess and sea level rise is likely to threaten up to 2.5 million additional people annually.
 - Some impacts may be positive, as in reduced risk of extreme cold events. However, on balance, health risks are very likely to increase.



WMO



UNEP

Excerpts from IPCC AR4 WG2 (Chapter Europe)

- **Climate change is likely to magnify regional differences of Europe's natural resources and assets.**
- **Water stress will increase over Central and S. Europe, as well as the number of people living in river basins under high water stress.**

Excerpts from IPCC AR4 WG2 (Chapter Europe)

- **It is anticipated that Europe's natural (eco)systems and biodiversity will be substantially affected by climate change. The great majority of organisms and ecosystems are likely to have difficulty in adapting to climate change.**
 - **A large percentage of the European flora is likely to become vulnerable, endangered, or committed to extinction by the end of this century.**
 - **Options for adaptation are likely to be limited for many organisms and ecosystems.**
 - **Low-lying, geologically-subsiding coasts are likely to be unable to adapt to sea-level rise.**
 - **New sites for conservation may be needed.**

Terrestrial Ecosystems in Europe

- **Greatest impacts on**
 - **arctic regions**
 - **moisture-limited ecosystems of southern and eastern Europe**
 - **mediterranean**

Excerpts from IPCC AR4 WG2 (Chapter Europe)

- **Climate change is estimated to pose challenges to many European economic sectors and alter the distribution of economic activity.**
 - **Agriculture will have to cope with increasing water demand for irrigation in S. Europe.**
 - **Peak electricity demand is likely to shift in some locations from winter to summer.**
 - **Winter tourism in mountain regions is anticipated to face reduced snow cover.**

Excerpts from IPCC AR4 WG2 (Chapter Europe)

- **Adaptation to climate change is likely to benefit from experiences gained in reactions to extreme climate events, by specifically implementing proactive climate change risk management adaptation plans.**
- **Although the effectiveness and feasibility of adaptation measures are expected to vary greatly, only a few governments and institutions have systematically and critically examined a portfolio of measures.**

Key Vulnerabilities

What if the Gulf Stream is affected?

- Based on current model simulations, it is *very likely* that the **meridional overturning circulation (MOC) of the Atlantic Ocean** will slow down during the 21st century.
 - **longer term changes not assessed with confidence**
- **Temperatures in the Atlantic** region are projected to **increase** despite such changes due to the much larger warming associated with projected increases of greenhouse gases.

Ice sheet melting

- Melting of the Greenland ice sheet
 - Total melting would cause 7 m SLR contribution
- Melting of the West Antarctic Ice Sheet
 - Total melting would cause 5 m SLR contribution
- Warming of 1 – 4°C over present-day temperatures would lead to partial melting over centuries to millennia

**With 1 metre sea-level rise: 63000 ha below sea-level in Belgium (likely in 22nd century, not impossible in 21st century)
(NB: flooded area depends on protection)**



Source: N. Dendoncker (Dépt de Géographie, UCL), J.P. van Ypersele et P. Marbaix (Dépt de Physique, UCL) (www.climate.be/impact)

With 8 metre sea-level rise: 3700 km² below sea-level in Belgium
(very possible in year 3000)
(NB: flooded area depends on protection)



Source: N. Dendoncker (Dépt de Géographie, UCL), J.P. van Ypersele et P. Marbaix (Dépt de Physique, UCL) (www.climate.be/impact)

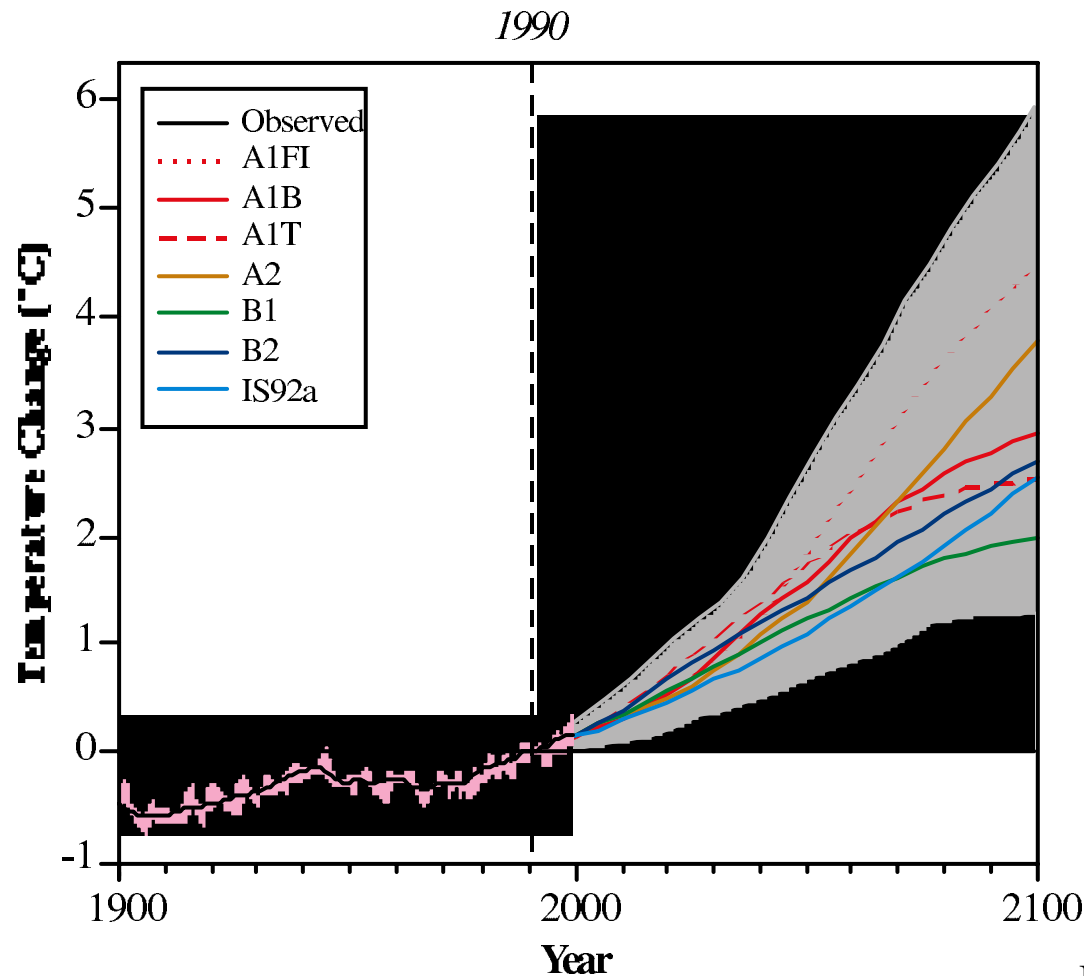
**Adaptation will be
necessary to address
unavoidable impacts**

Adaptation / Mitigation

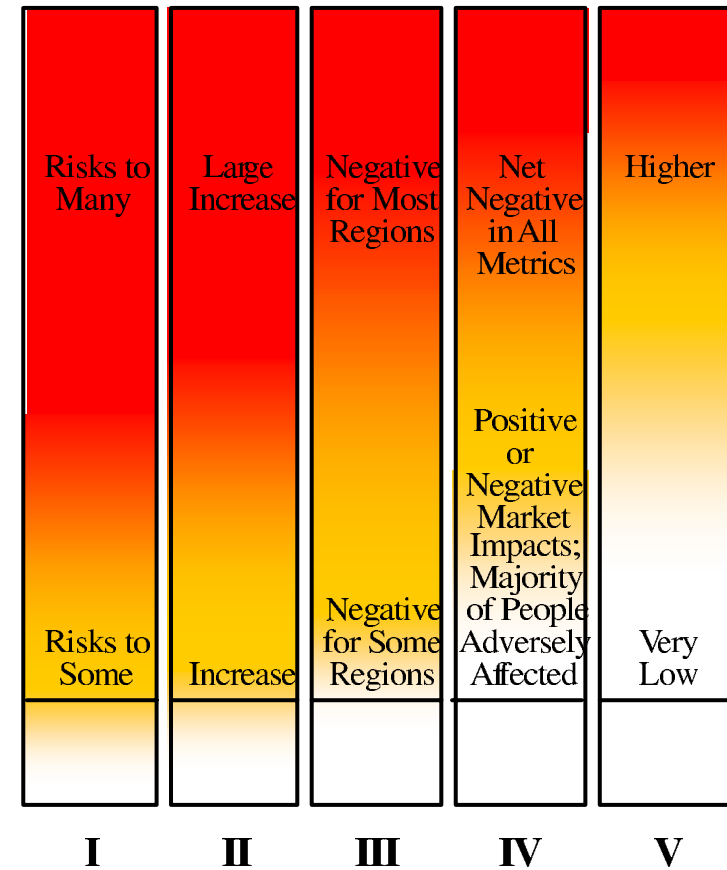
(not verbatim)

- Some adaptation is occurring now, faces limitations and barriers
- Other stresses can exacerbate vulnerability
- Vulnerability depends also on development paths
- Sustainable development can reduce vulnerability
- Mitigation can reduce, delay or avoid impacts

Reasons for Concern



Reasons for Concern



- I Risks to unique and threatened systems
- II Risks from extreme climate events
- III Distribution of Impacts
- IV Aggregate Impacts
- V Risks from large-scale discontinuities

Source: IPCC TAR WG2 (2001)

John Holdren, President of the American Association for the Advancement of Science

- ⌘ ***'We basically have three choices – mitigation, adaptation, and suffering.'***
- ⌘ ***We're going to do some of each. The question is what the mix is going to be.***
- ⌘ ***The more mitigation we do, the less adaptation will be required, and the less suffering there will be.'***

Useful links:



⌘ www.ipcc.ch : IPCC

⌘ www.unfccc.int : Climate Convention

⌘ www.climate.be/JCM: interactive climate model

⌘ www.climate.be/vanyp : my slides and other documents