

Impacts du réchauffement global sur les écosystèmes et les sociétés humaines



Pr Jean-Pascal van Ypersele

UCL-ASTR

(Université catholique de Louvain, Institut d'astronomie et de géophysique G. Lemaître)

Toile: www.climate.be

E-mail: vanyp@climate.be

Chaire Francqui, cours n°5, ULB, 20-3-2008

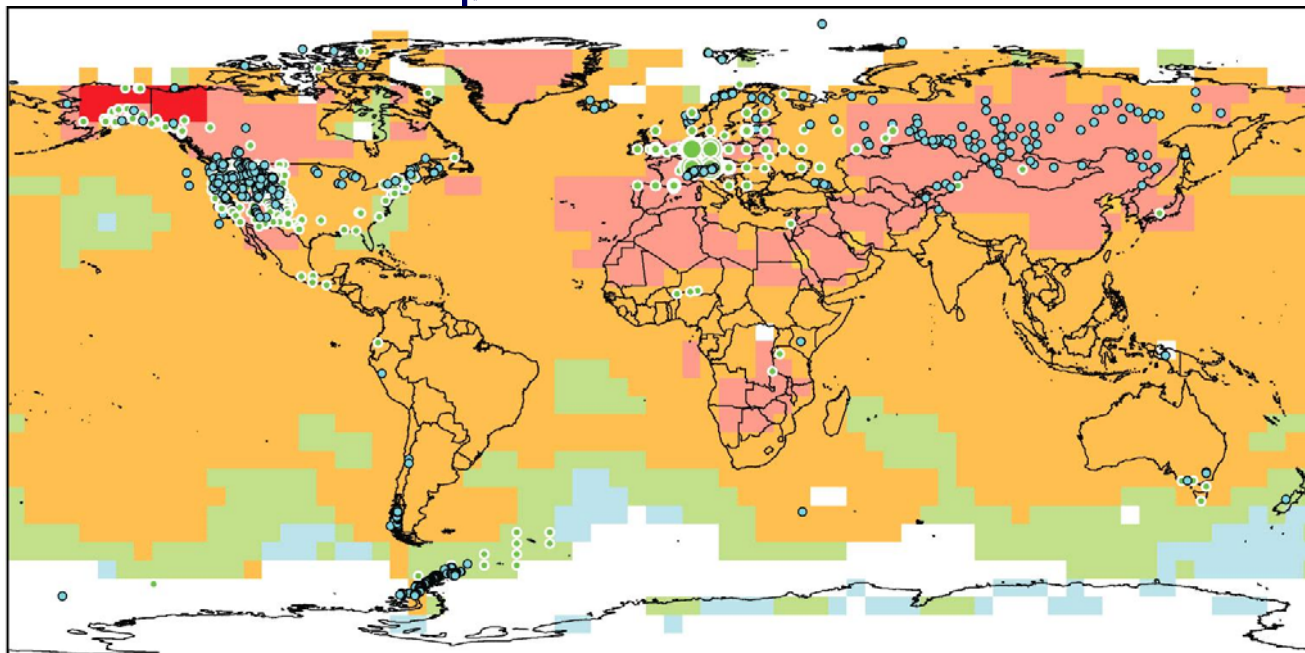
Evénements extrêmes (Source: IPCC WG1 AR4)

Phénomène et tendance	Probabilité qu'il y ait eu une tendance à la fin du 20 ^e S	Influence humaine sur ces tendances (probabilité)	Probabilité que la tendance se poursuive au 21 ^e siècle pour les scénarios SRES
Journées et nuits froides plus chaudes et moins nombreuses sur la plupart des régions	très probable (> 90%)	probable (> 66%)	virtuellement certain (> 99%)
Journées chaudes plus chaudes et plus fréquentes sur la plupart des régions	très probable	probable (nuits)	virtuellement certain
Vagues de chaleur plus fréquentes sur la plupart des régions	probable (> 66%)	plus probable que non (> 50%)	très probable
Evénements de fortes précipitations sur la plupart des régions	probable	plus probable que non	très probable
Accroissement de l'étendue affectée par des sécheresses	probable dans beaucoup de régions depuis 1970	plus probable que non	probable
Accroissement de l'activité des cyclones tropicaux intenses	probable dans beaucoup de régions depuis 1970	plus probable que non	probable
Accroissement de la fréquence des niveaux de la mer extrêmes (hors tsunamis)	probable	plus probable que non	probable

Impacts observés jusqu'à présent

- **De nombreux** systèmes naturels, sur tous les continents and certains océans sont **affectés** par les **changements climatiques régionaux** (réchauffement)
- Le **réchauffement** dû aux **activités humaines** a **probablement** eu un **impact perceptible** sur de **nombreux systèmes physiques et biologiques** au **niveau global**

Figure TS.1. Changes in physical and biological systems and surface temperature 1970-2004

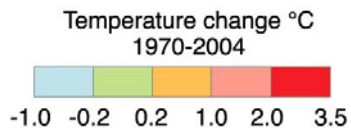


NAM		LA		EUR		AFR		AS		ANZ		PR*		TER		MFW**		GLO	
355	455	53	5	119	28,115	5	2	106	8	6	0	120	24	764	28,586	1	85	765	28,671
94%	92%	98%	100%	94%	89%	100%	100%	96%	100%	100%	-	91%	100%	94%	90%	100%	99%	94%	90%

Observed data series

- Physical systems (snow, ice and frozen ground; hydrology; coastal processes)
- Biological systems (terrestrial, marine, and freshwater)

Europe ***	
○	1-30
○	31-100
○	101-800
○	801-1,200
○	1,201-7,500



Physical Biological

Physical	Biological
Number of significant observed changes	Number of significant observed changes
Percentage of significant changes consistent with warming	Percentage of significant changes consistent with warming

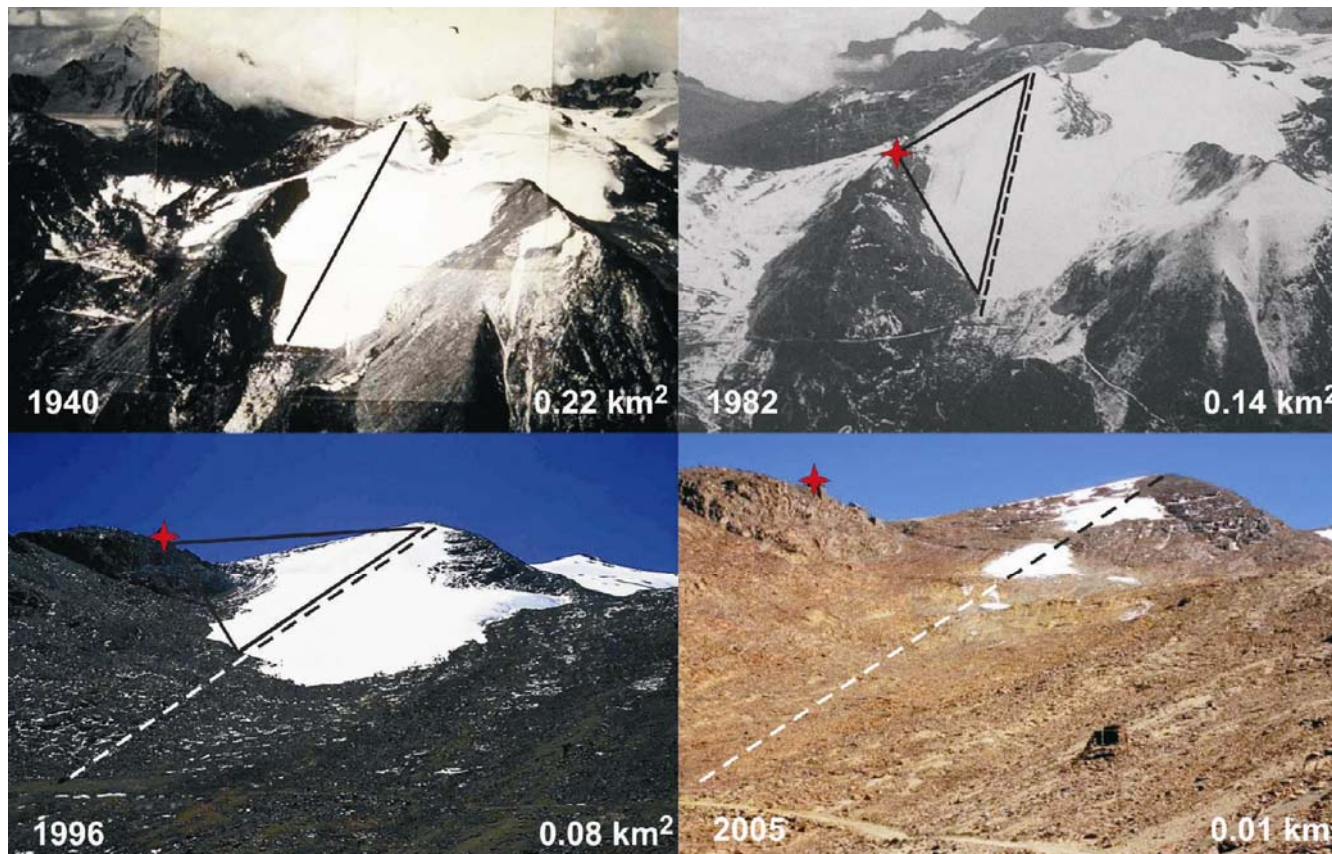
* Polar regions include also observed changes in marine and freshwater biological systems.

** Marine and freshwater includes observed changes at sites and large areas in oceans, small islands and continents. Locations of large-area marine changes are not shown on the map.

*** Circles in Europe represent 1 to 7,500 data series.

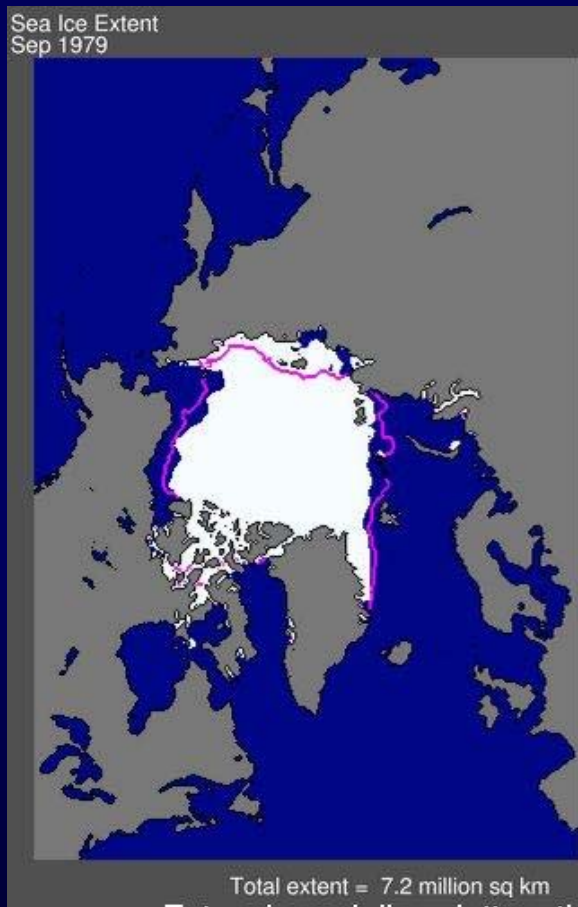
The Chacaltaya glacier and ski-lift, Bolivia

Skiing was no longer possible after 2004

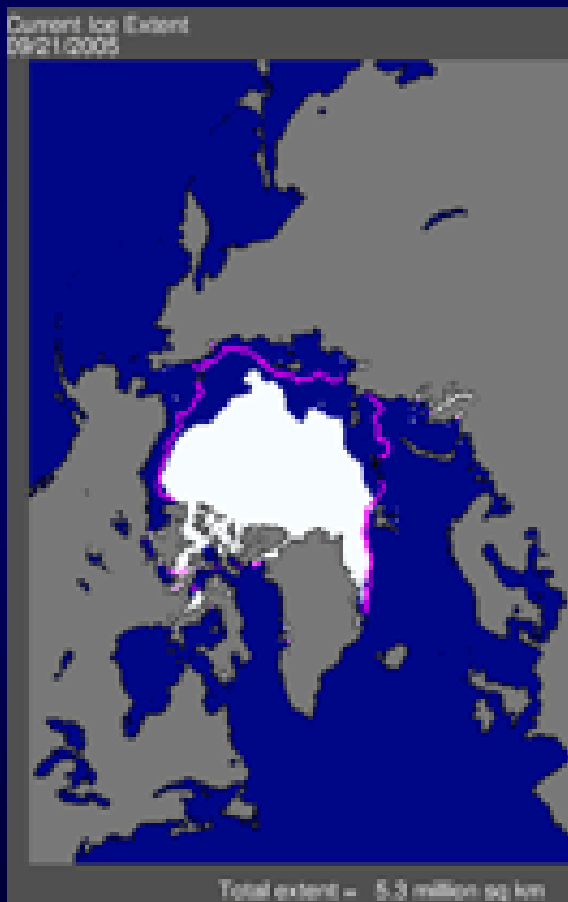


Extension of the Arctic ice cap

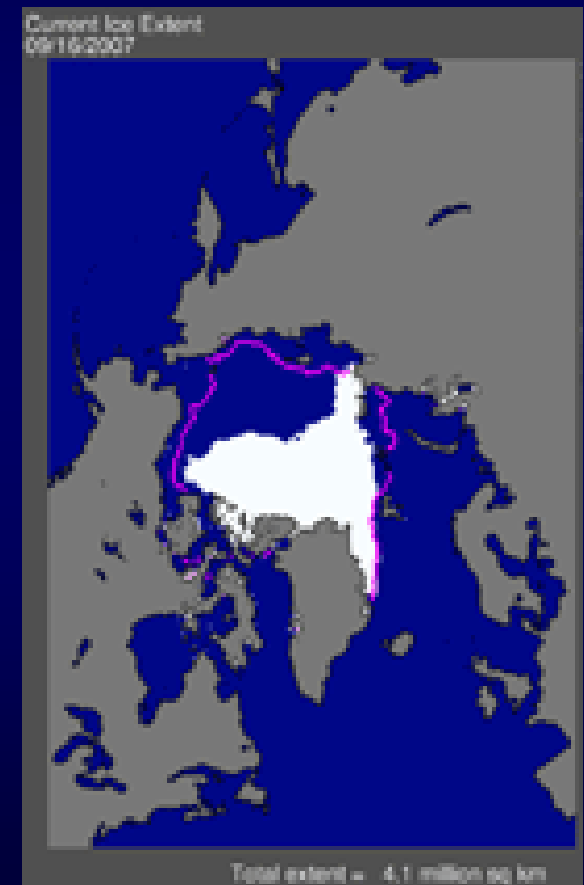
September 1979



September 2005



September 2007



The pink line indicates the average ice cap extension since 1979

GIEC GT-II (Impacts) (2)

2001 (426 auteurs, 440 relecteurs)

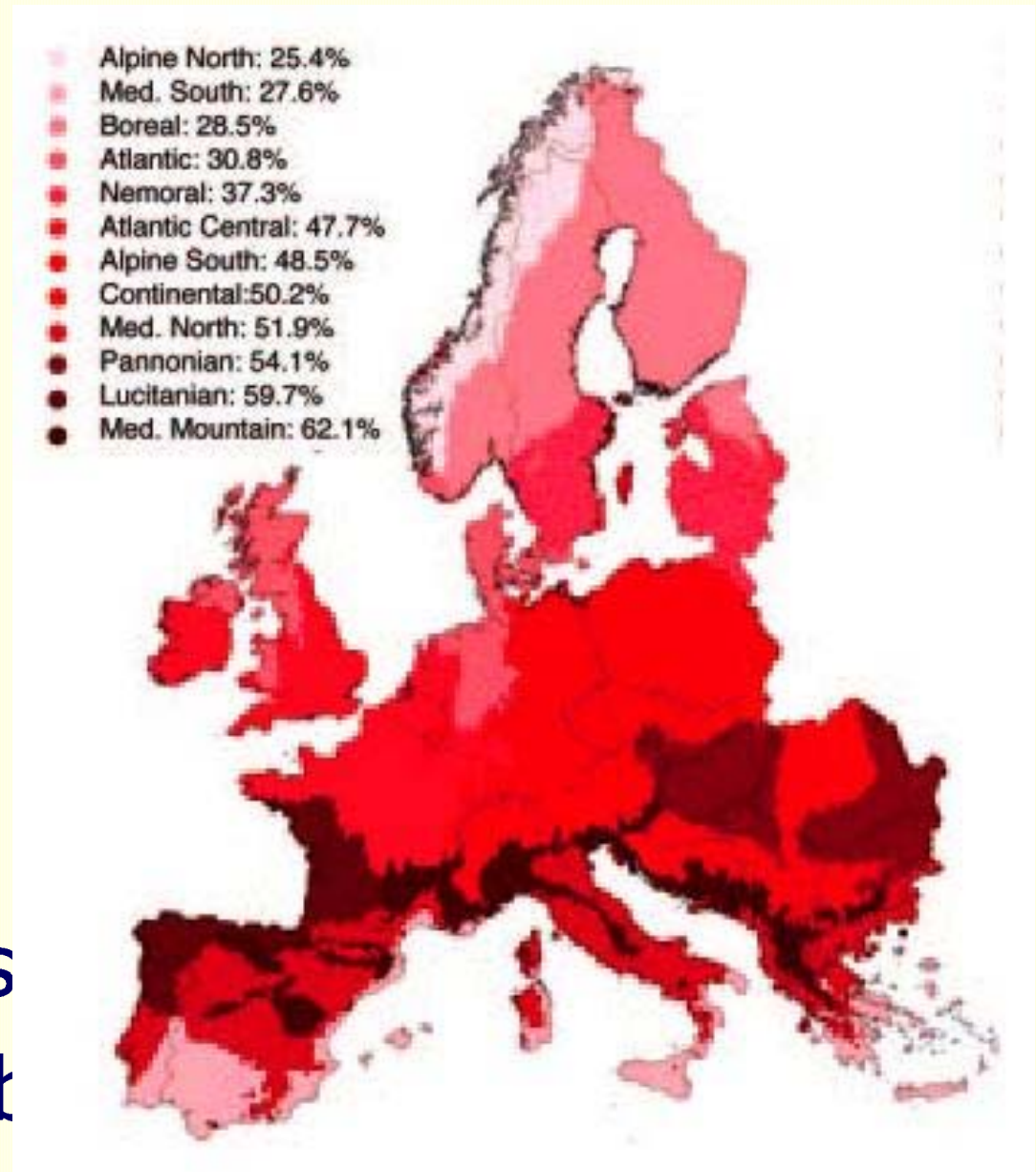


z Certains!
systèmes!
naturels!
pourraient!
subir des!
dommages!
importants et!
irréversibles:

- z glaciers
- z récifs coralliens et atolls
- z palétuviers
- z forêts boréales & tropicales
- z écosystèmes polaires & alpins
- z zones de prairies humides
- z pâturages naturels résiduels

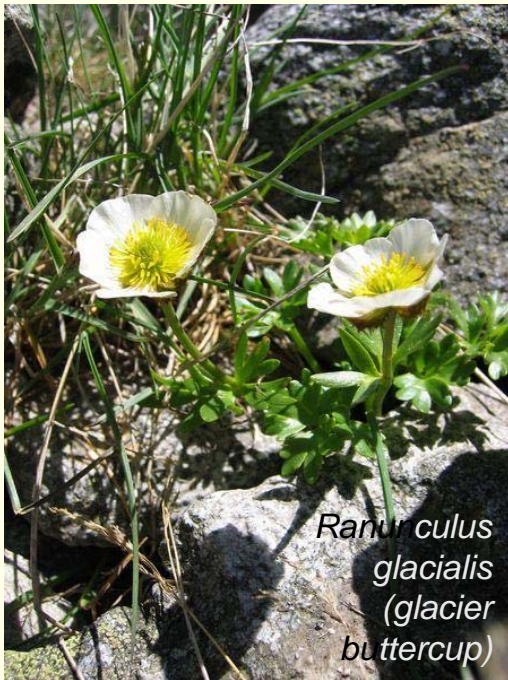
Species in ! Europe

- 12,500 plants
- 123 reptiles
- 62 amphibians
- 514 birds
- 187 mammals
- 358 freshwater fish
- >200,000 invertebrates



Species at risk in the Alps and other European mountains

One study estimated up to 60%!
of Alpine plants at risk

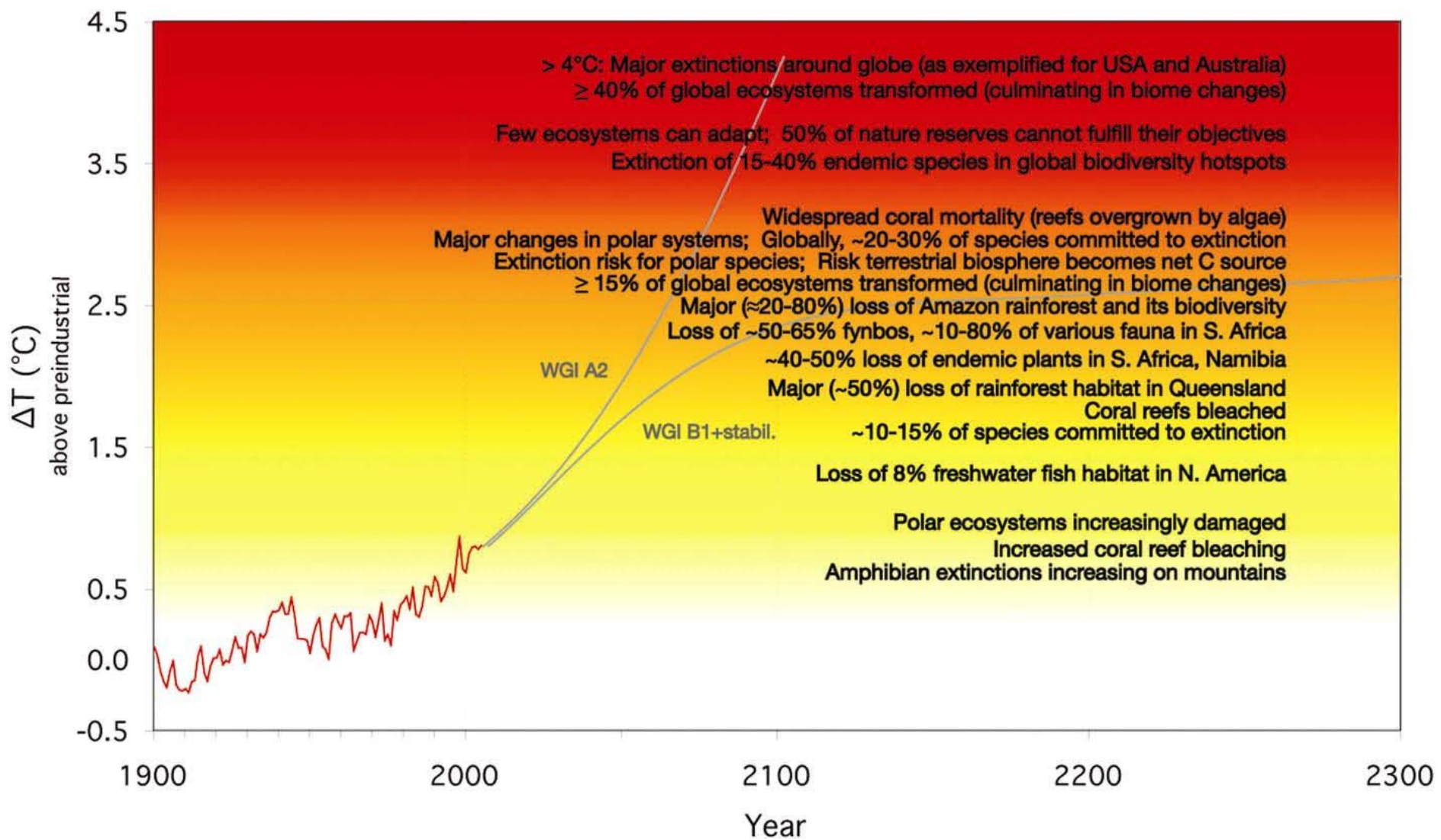


Alectoris graeca (Rock partridge)

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.



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



**GIEC AR4 GT2 (2007):
20% - 30% des espèces
végétales et animales
sont soumises à risque
accru d'extinction si**

**ΔT 1.5°C - 2.5°C (au -
dessus de la température
de 1990)**

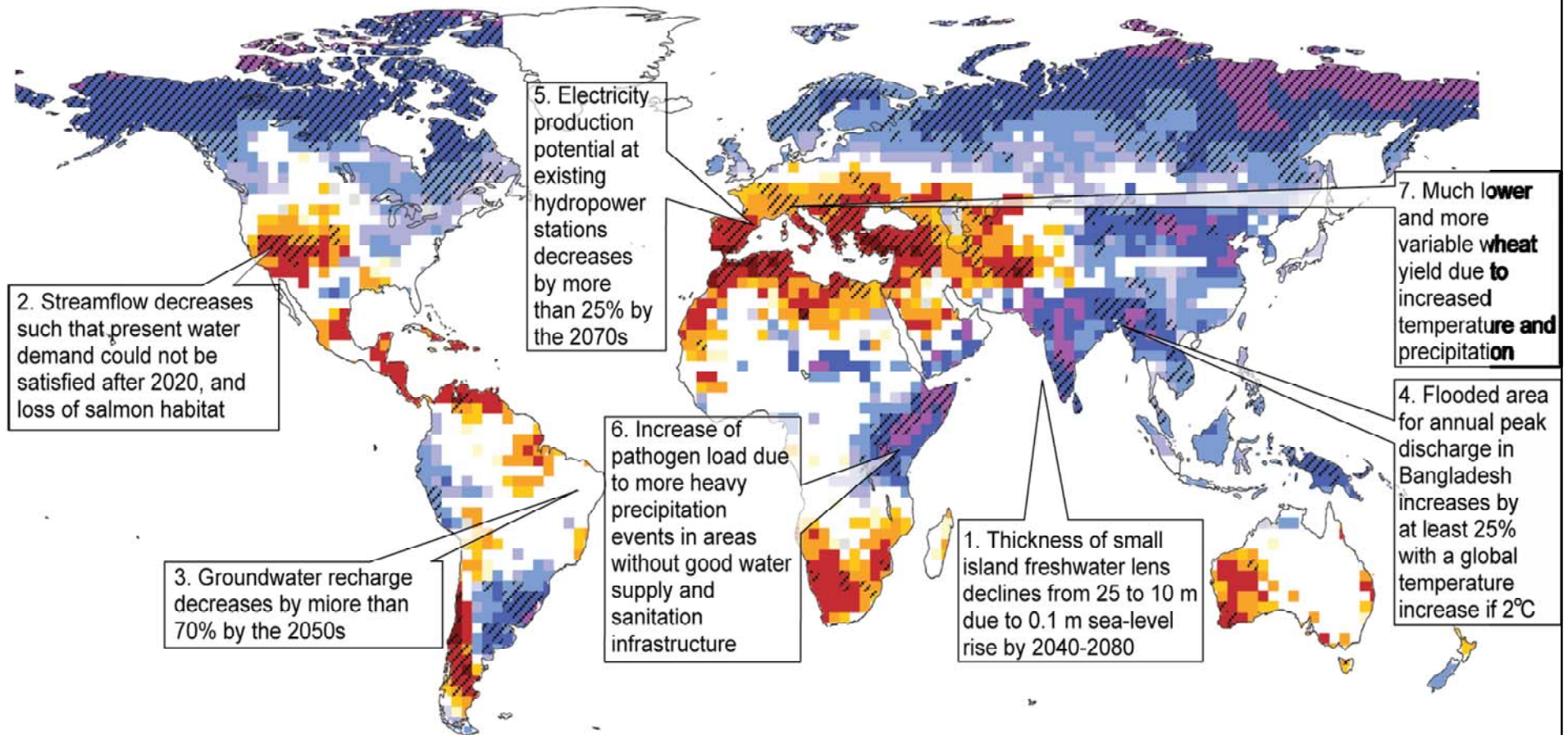
GIEC GT-II (Impacts) ⁽³⁾

2001 (426 auteurs, 440 relecteurs)



- z Les systèmes humains qui sont sensibles aux changements climatiques incluent principalement:
 - z ressources en eau
 - z agriculture (spécialement sécurité alimentaire) et foresterie
 - z zones côtières et systèmes marins (pêcheries)
 - z établissements humains
 - z énergie et industrie
 - z assurances, services financiers
 - z santé humaine

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). NB: Hatched=90% of models agree on sign of change; White=less than 66% models agree.

More heavy precipitation and more droughts....



More heavy precipitation and more droughts....



More heavy precipitation and more droughts....

- Warmer world implies more evaporation - more water goes to the atmosphere where water is available on the ground (e.g., oceans). The atmosphere therefore will contain more water vapor available to rain out. And most places receive the majority of their moisture in heavy rain events, which draw moisture from a big area.
- Warmer world implies more evaporation - but soils will dry out as a result. So dry regions will get drier unless storm tracks shift in a lucky way. And for some, they are expected to shift in an unlucky way.
- At mid to low latitudes - wet get wetter, dry get drier

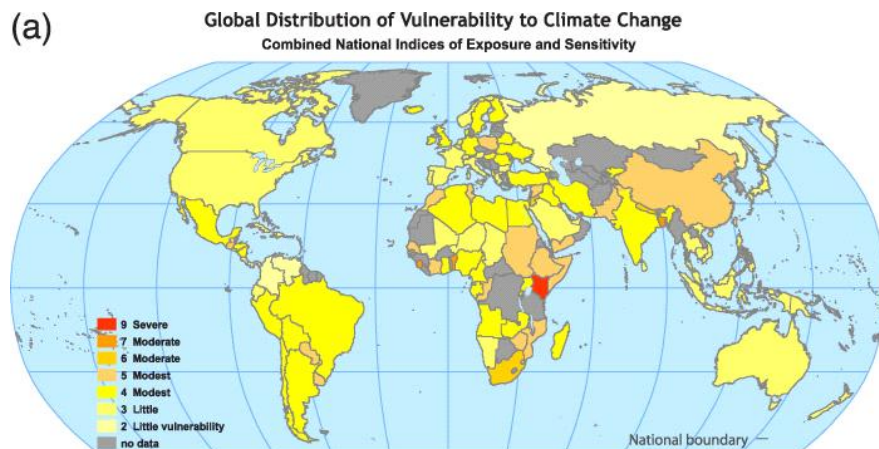
Régions les plus affectées par les effets des CC

- L'Arctique
- L'Afrique subsaharienne
- Petites îles
- Grands deltas

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

- The poor
- Young children
- The elderly

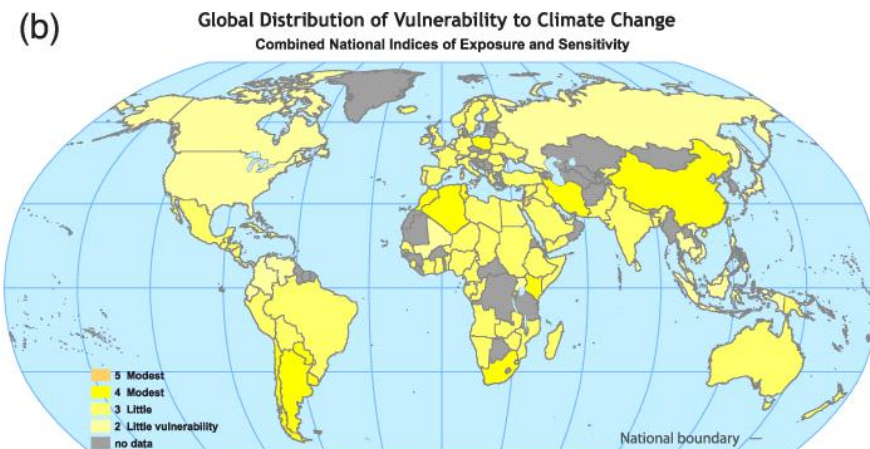
Figure TS.19. Geographical distribution of vulnerability in 2050



Scenario A2 Year 2050 with Climate Sensitivity Equal to 5.5 Degrees C
Annual Mean Temperature with Aggregate Impacts Calibration

<http://ciesin.columbia.edu/data/climate/>

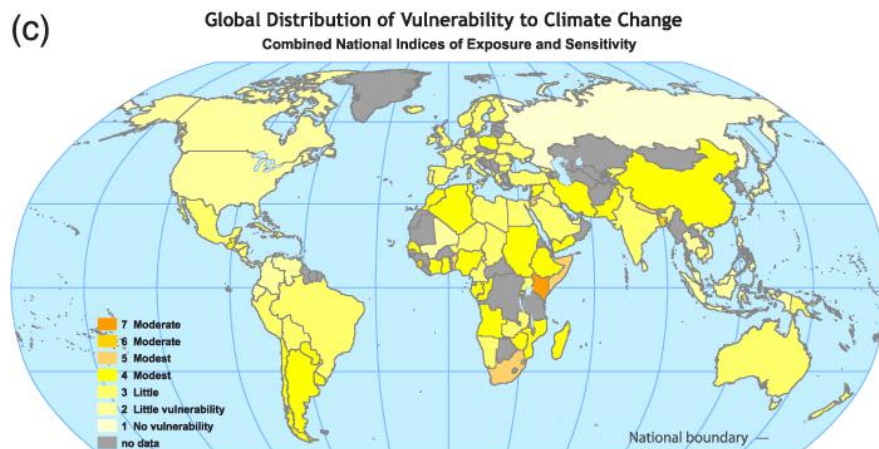
©2006 Wesleyan University and Columbia University



Scenario A2 Year 2050 with Climate Sensitivity Equal to 5.5 Degrees C
Annual Mean Temperature with Aggregate Impacts Calibration and Enhanced Adaptive Capacity

<http://ciesin.columbia.edu/data/climate/>

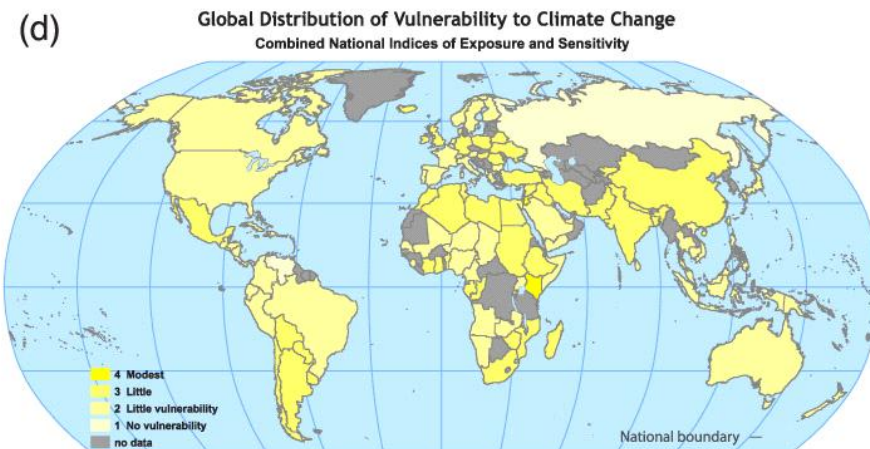
©2006 Wesleyan University and Columbia University



Scenario A2-550 in Year 2050 with Climate Sensitivity Equal to 5.5 Degrees C
Annual Mean Temperature with Aggregate Impacts Calibration

<http://ciesin.columbia.edu/data/climate/>

©2006 Wesleyan University and Columbia University



Scenario A2-550 in Year 2050 with Climate Sensitivity Equal to 5.5 Degrees C
Annual Mean Temperature with Aggregate Impacts Calibration and Enhanced Adaptive Capacity

<http://ciesin.columbia.edu/data/climate/>

©2006 Wesleyan University and Columbia University

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

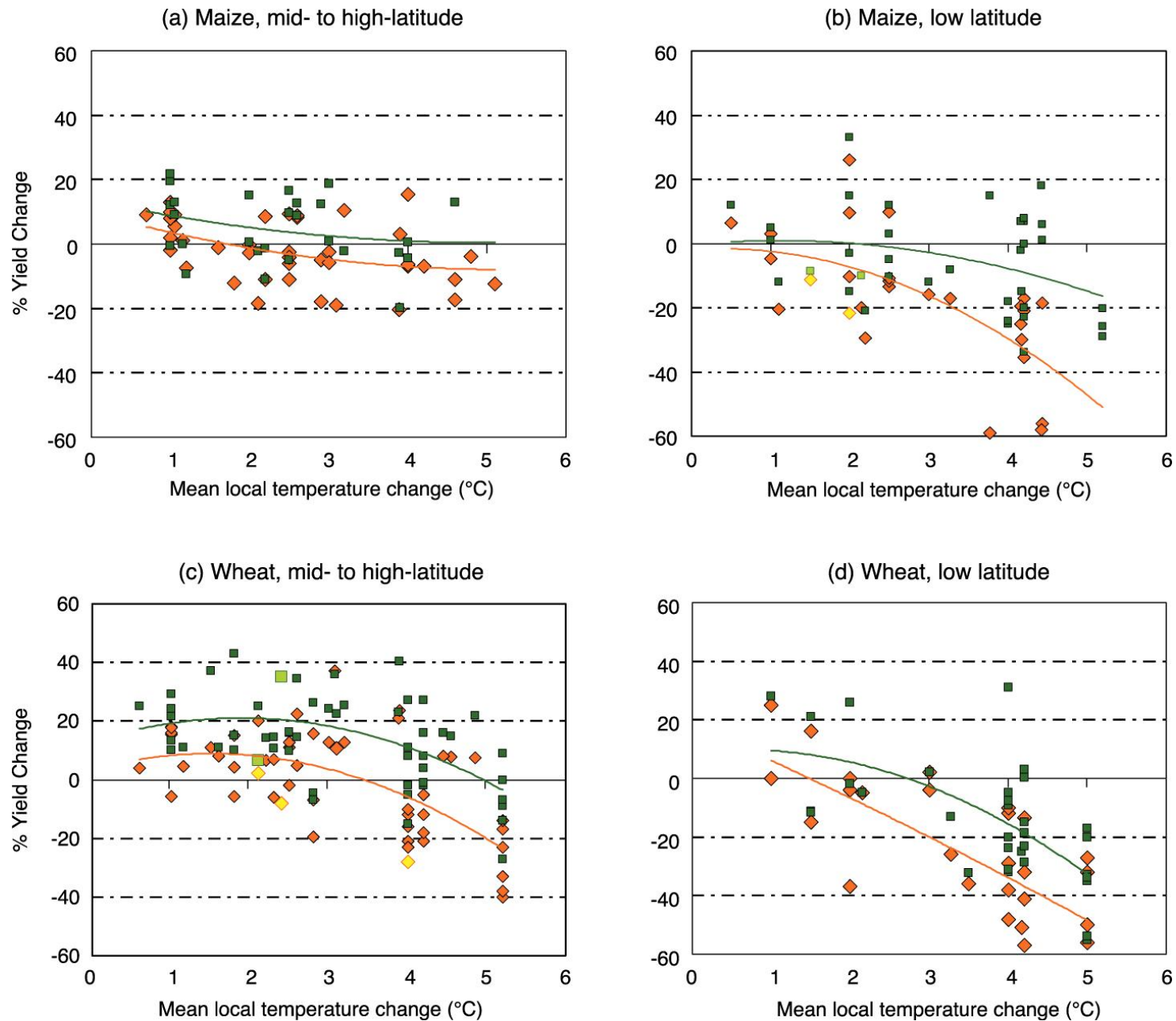
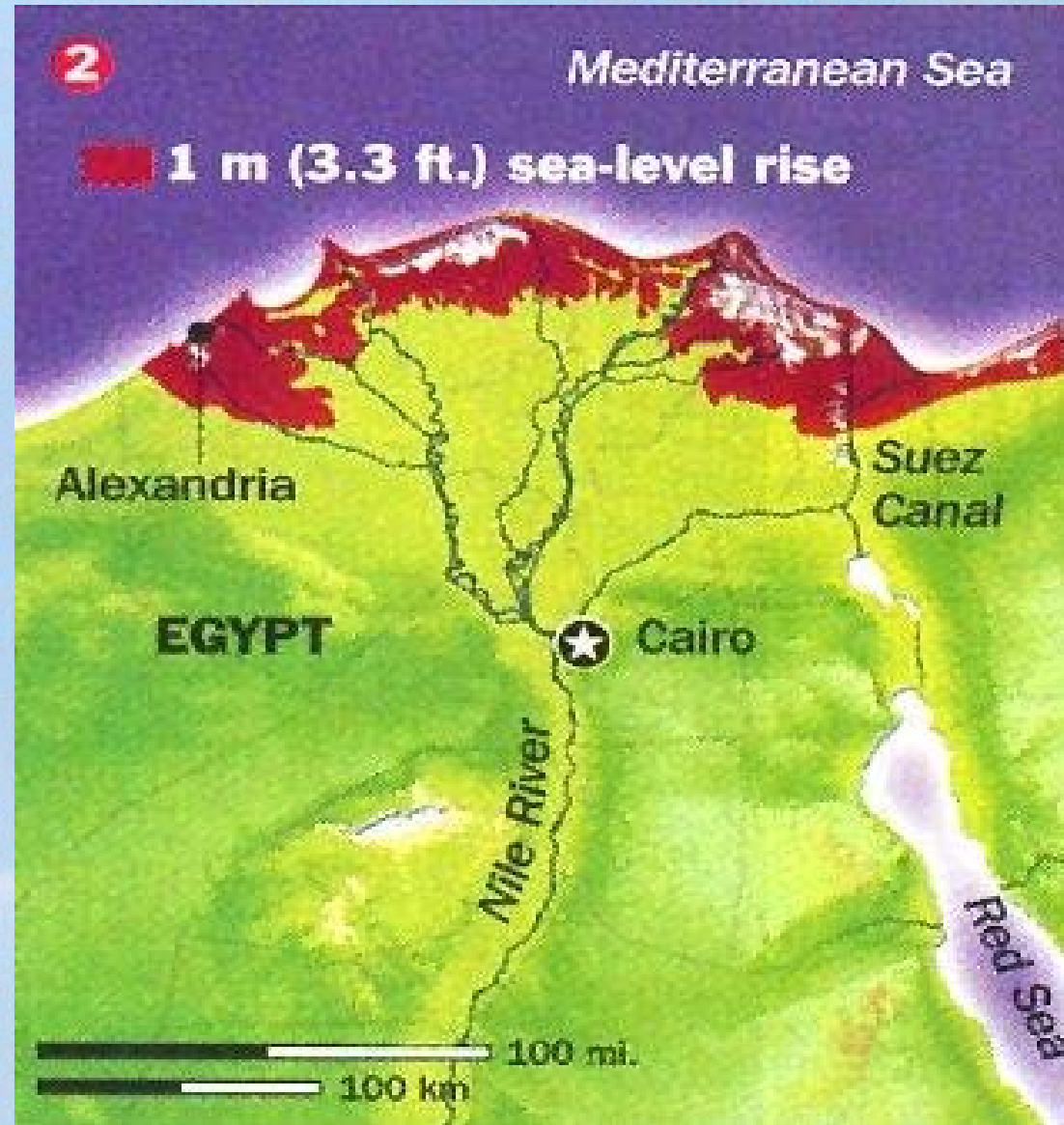


Figure TS.8. Relative vulnerability of coastal deltas



10 millions d'habitants = autant de réfugiés?



(Time 2001)

Bangladesh and sea level rise

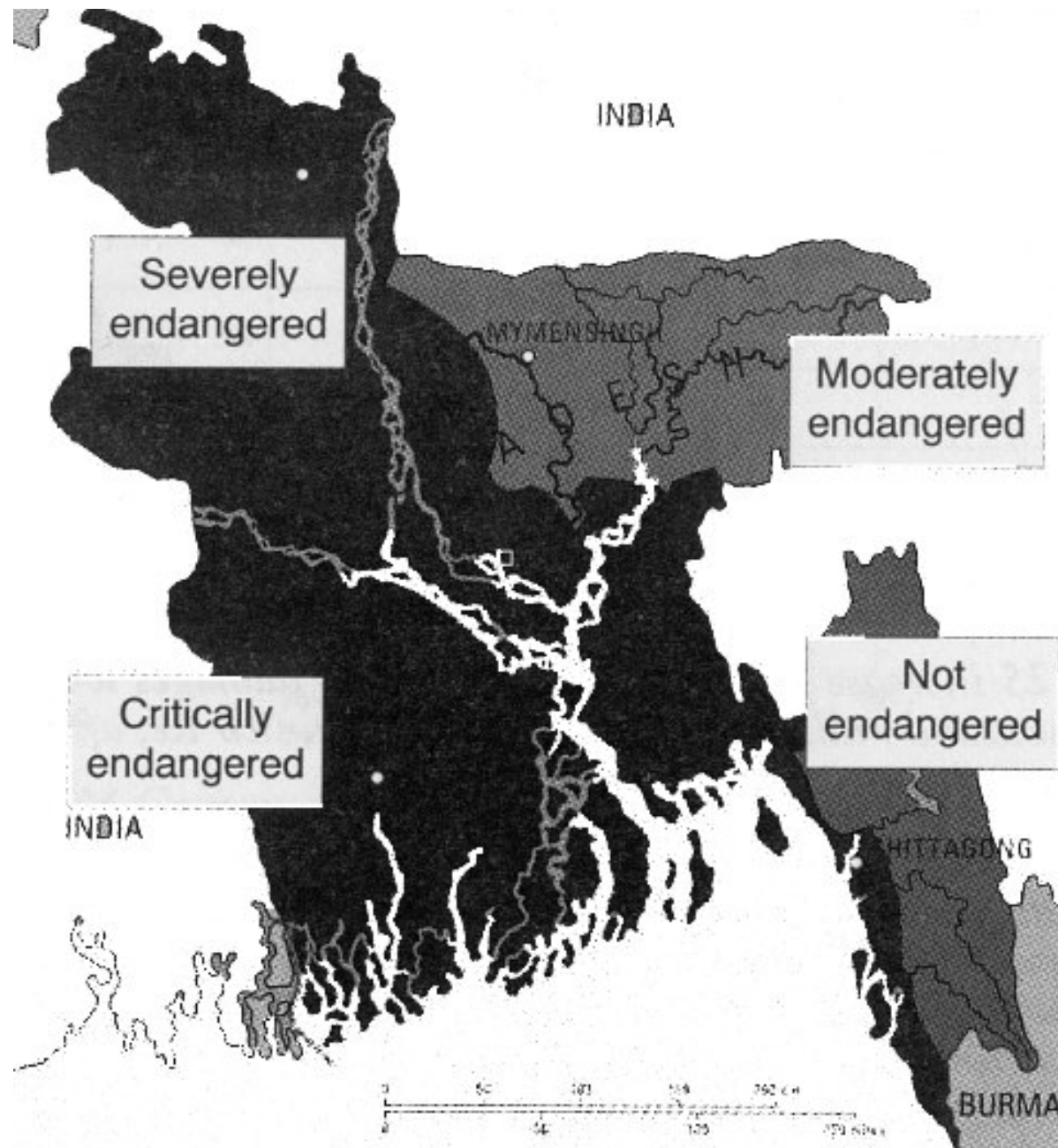
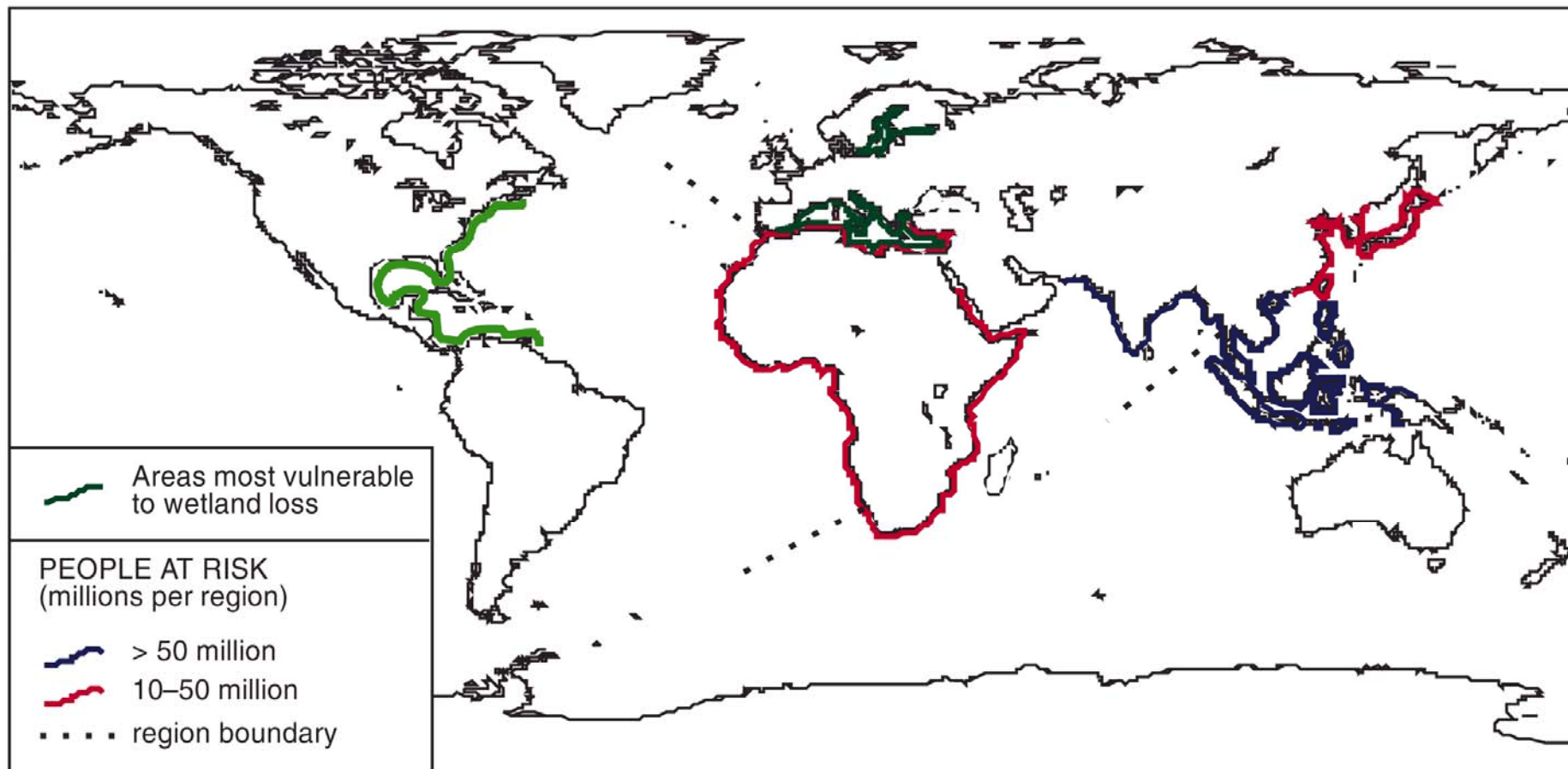


Figure 18: Tens of millions of people are projected to be at risk of being displaced by sea level rise

Assuming 1990s Level of Flood Protection

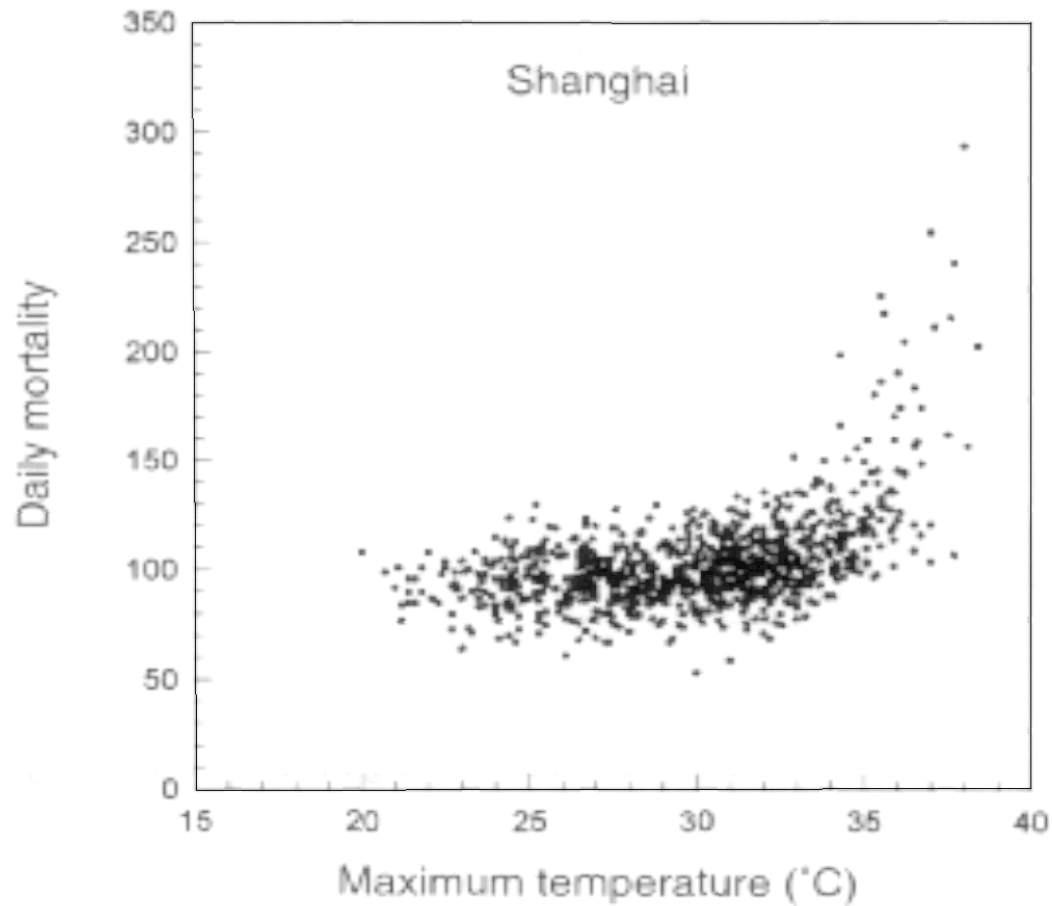


Source: R. Nicholls, Middlesex University in the U.K. Meteorological Office. 1997. *Climate Change and Its Impacts: A Global Perspective*.

Figure TS.9. Direction and magnitude of change of selected health impacts of climate change

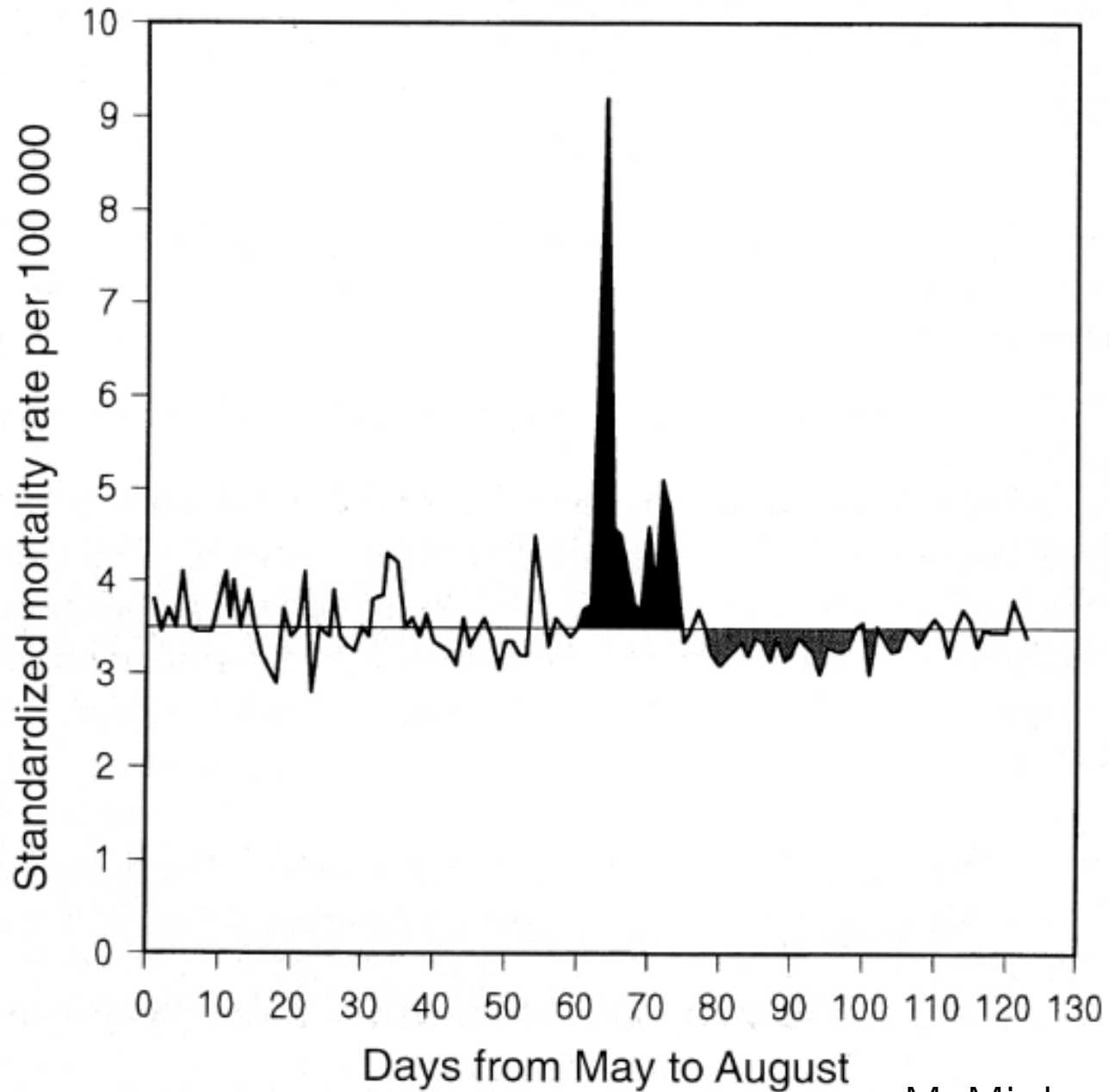
	Negative impact	Positive impact
Very high confidence		
Malaria: contraction and expansion, changes in transmission season	←	→
High confidence		
Increase in malnutrition	←	
Increase in the number of people suffering from deaths, disease and injuries from extreme weather events	←	
Increase in the frequency of cardio-respiratory diseases from changes in air quality	←	
Change in the range of infectious disease vectors	←	→
Reduction of cold-related deaths		→
Medium confidence		
Increase in the burden of diarrhoeal diseases	←	

Relationship between maximum temperature and mortality in Shanghai, China, 1980-89

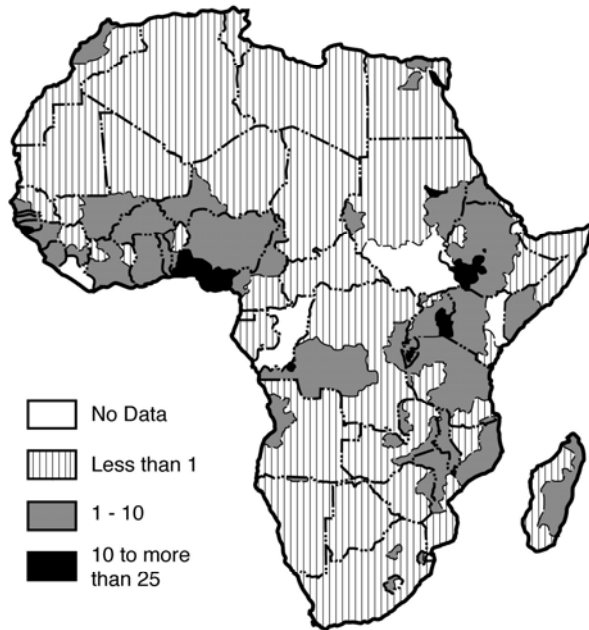


Jean-Pascal van Ypersele
(vanypers@astr.ucl.ac.be)

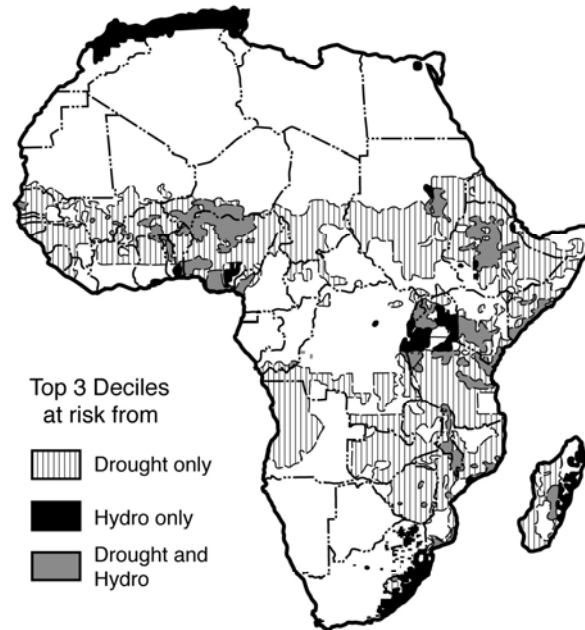
Daily summer mortality during a New York heat wave in 1996



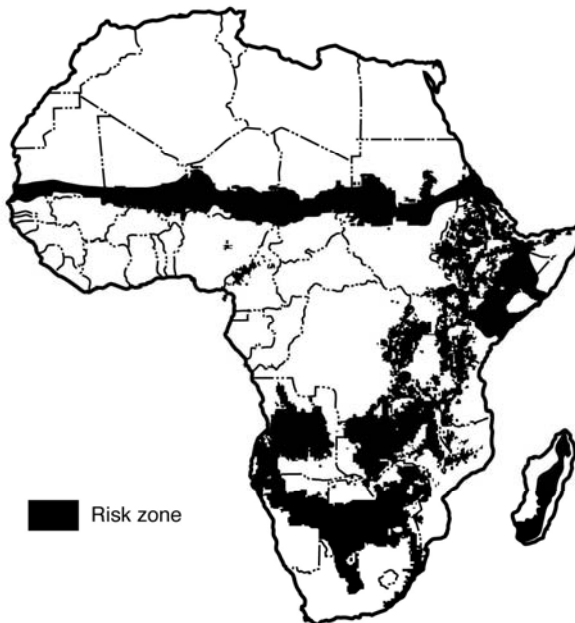
a) Underweight Children per square kilometre



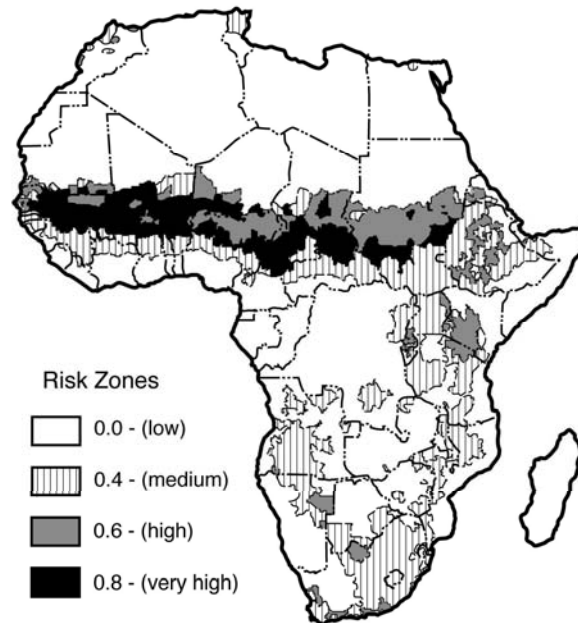
b) High Mortality Risk



c) Epidemic Malaria



d) Epidemic Meningitis



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

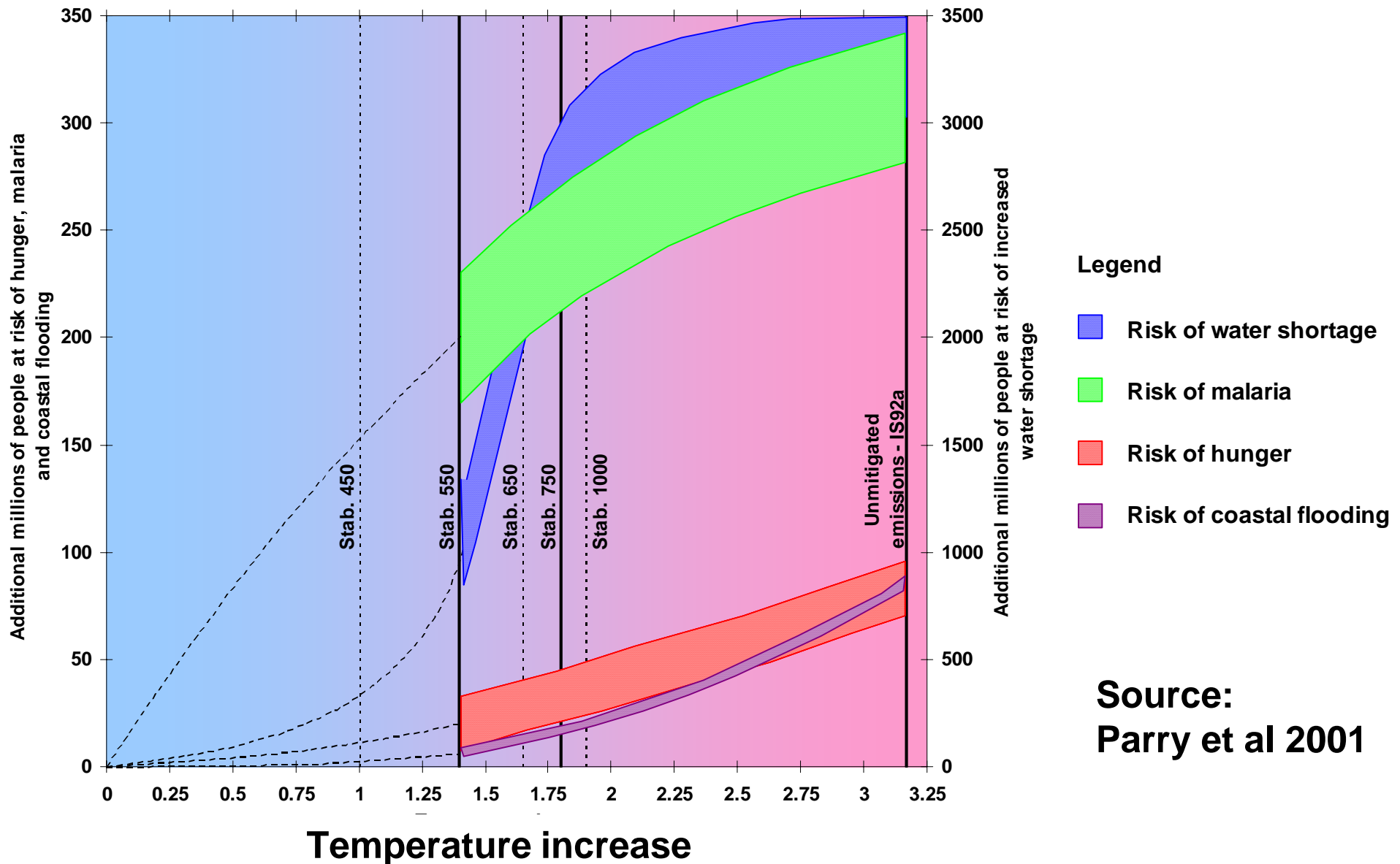
Multiple stresses!
in Africa (Ch 9)

Developing countries are the most vulnerable to climate change

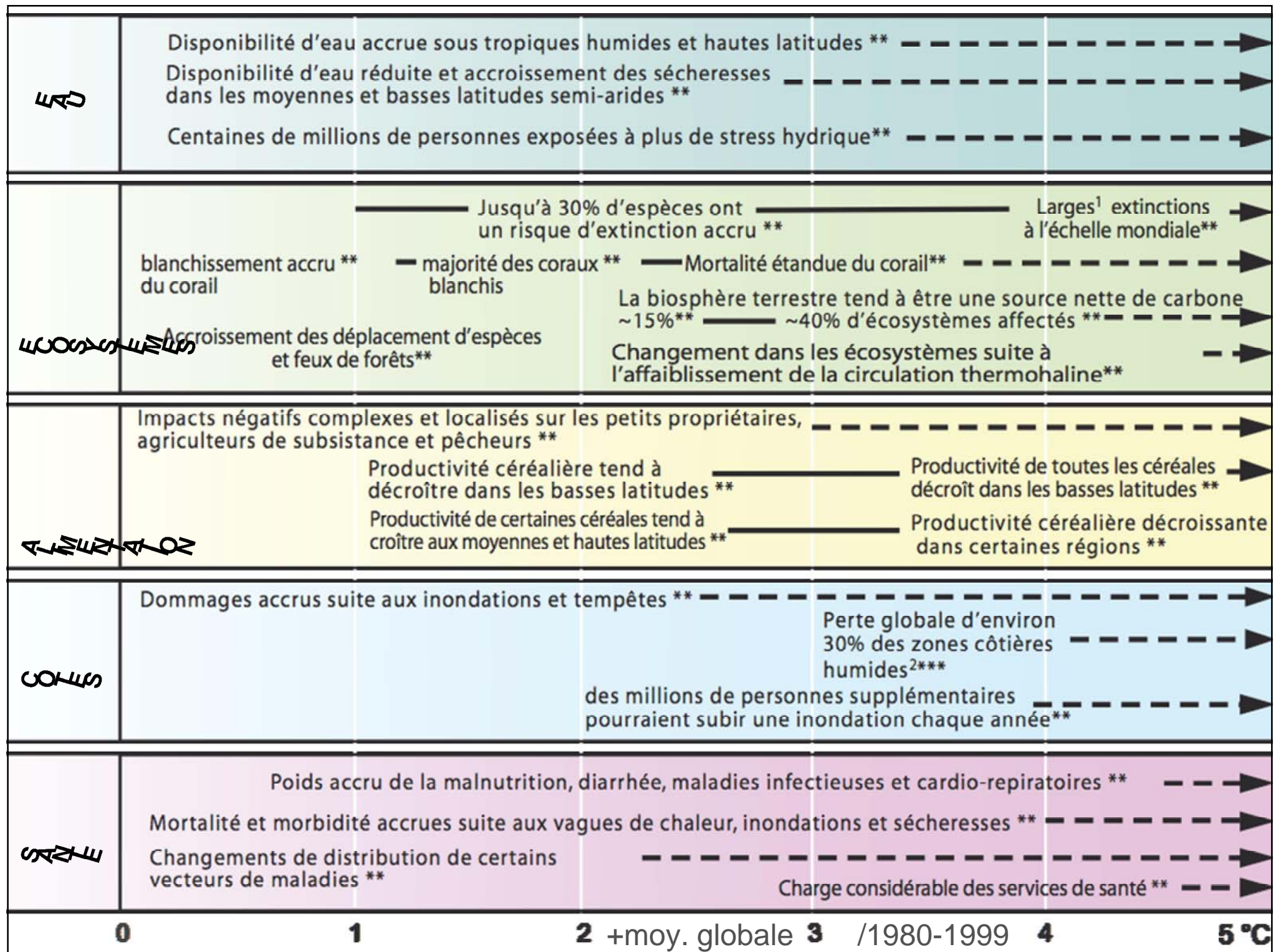
- z **Impacts are worse** - already more flood and drought prone and a large share of the economy is in climate sensitive sectors
- z **Lower capacity to adapt** because of a lack of financial, institutional and technological capacity and access to knowledge
- z **Climate change is likely to impact disproportionately 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.
- z **Net market sector effects are expected to be negative in most developing countries**

(Based on IPCC AR3 (2001))

MILLIONS AT RISK by the 2080s



Source:
Parry et al 2001



Pour en savoir plus...



- z www.climate.be : ASTR-UCL
- z www.ipcc.ch : IPCC ou GIEC
- z www.unfccc.int : Convention & Protocole
- z www.cfdd.be : Conseil fédéral
développement durable
- z www.climat.be : campagne climat du Gvt
- z jcm.chooseclimate.org : modèle interactif du
Dr B. Matthews, UCL-ASTR
- z www.realclimate.org : réponse aux sceptiques