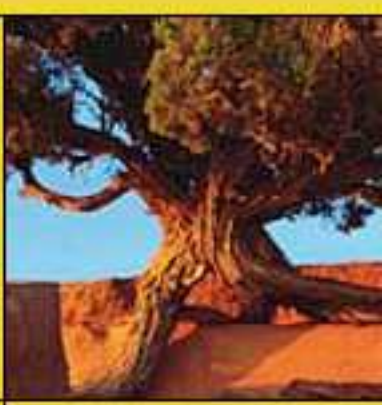
WORKSHOP: NATO Collaborative Linkage Grant
"Combating Desertification with Traditional Knowledge – A Contribution to Euro-Mediterranean Security"
Rome (Italy), 5-6 December, 2006

IPOGEA

Centro Studi Italiano sulle Conoscenze Tradizionali e Locali



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Impact of Global Environmental Change

on National, Environmental and Human Security in the Mediterranean Region by 2020 and 2050

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Copyright & Preliminary Remark

This presentation is partly based on an internal contract study of AFES-PRESS for the Scientific Advisory Committee on Global Environmental Issues of the German Government (WBGU)

AFES-PRESS Study for WBGU, Mosbach, 14. June 2006

The author has been permitted to use material from this background study in this presentation. He expresses only his personal opinions.

The WBGU Report on Global Environmental Change and Security will be published in 2007 and will be accesible at: <http://www.wbgu.de/wbgu_publications_annual.html>

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1. Introduction: AFES-PRESS Study for WBGU

One of several regional studies on links between environmental change & security.

- Under which conditions may environmental change cause security problems, such as revolts, civil wars and transboundary conflicts?
- How can this be prevented and cooperation be enhanced?
- Which regions and societies are especially vulnerable for environmentally induced conflicts?
- Which conclusions may be drawn with regard to vulnerabiliy and the capabiliy for problem solution with regard to the questions analyzed?
- Which conclusions may be drawn with regard to the probability of regíonal destabiiization and/or a possible escalation of conflicts?

Expectations of the study for the WBGU:

- **Study should enable a better understanding of the links between environmental degradation, global change, societal destabilization & and potential escalation to conflicts**.

1.1 Key Questions & Multidisciplinary Approach

It will be distinguíshed between:

- **Six variables or four *factors of vulnerability*** (demographic development and migration; socio-economic disparity and poverty, health and religious-ethnic & cultural factors and public opinion) and
- **Two factors for problem solution (state and public sector, economic – structure).** The significant differences of social and ecologic vulnerability and capabilities for political and economic problem solutions in Southern Europe and North Africa may be summarized as follows:

	Social	Ecologicc	Political	Economic
	Vulnerability		Capabiltiy for problem solution	
	For environmental change & weather-related hazards			
South Europe	low	growing	high	high
North Africa	high	high	low	low

2. Project and Sponsors: Berghof Foundation & NATO Conferences

- 4th Phase of Environmental Security Research:
  - **Research project**: funded by the private Berghof Foundation for Conflict Research in Berlin
  - **Dialogue project:** International conferences with a focus on the Mediterranean sponsored by NATO
    - Canterbury (2001), The Hague (2004), Istanbul (2005)
    - Talks at international conferences: political agenda-setting
  - **Publication project:** volumes in Hexagon series
  - **Teaching project:** Graduate seminars at OSI:
    - See: old bibliographies: WS 2003/4 – WS 2005/2006
    - See: Brauch: Security & Environment in the Mediterranean (Berlin: Springer, 2003).

2.1. Research Context

- **1st Phase of Research on Environmental Security**
  - Westing: Impacts of wars on Environment in Vietnam
  - Ullman, Myers, Matthews: GEC as threats for US national security
- **2nd Phase of Research on Environmental Security**
  - Homer-Dixon, Toronto group: population growth, environmental scarcity as a course of environmental stress that pose security dangers
  - G. Bächler, Zürich/Bern: ENCOP: environmental scarcity and degradation pose security dangers
- **3rd Phase of Research on Environmental Security: No consensus**
  - Collier/Handler: resource abundance as a security danger
- **Goal of 4th Phase of Research on Environmental Security**
  - Oswald 2001; Dalby 2002; Brauch 2003; Dalby/Brauch/Oswald 2007 (2 articles)
  - 3 disciplines: anthropology, geography and political science
  - **Combine national and human security**
    - Change in Earth History: **From Holocene to Anthropocene (Crutzen/Schellnhuber)**
    - Wide concept of **human, gender & environmental security** (Oswald: **HUGE concept)**
    - **Human and Environmental Security and Peace** (Brauch: **HESP Project**)
  - **Hexagon-Series with Springer-Verlag**

2.2. Past: Reconceptualizing Security: Global Mental Mapping

- **Basic Assumption & Guiding Question:**
  - Did global and regional political contextual changes trigger a reconceptualizing of security?
- **What did change?**
  - End of the Cold War: 9 November 1989: Berlin Wall;
  - Events of 11 September 2001;
  - Others: Death of Mao in China, economic crises in Latin America, 1980s, Southeast & East Asia, 1990s.
- **Which were the conceptual innovations?**
  - Theoretical: social constructivism & Beck: risk society
  - Result: Widening, deepening & sectorialization of security

2.3. Future: From Holocene to Anthropocene?

- Crutzen, nobel prize in chemistry; Schellnhuber PIK et al.: **A fundamental change in earth history is under way from the Holocene to the Anthropocene?**
- **What is the cause?** Human behaviour: burning of fossil fuels ➡ greenhouse gases ➡ climate change ➡ hazards (drought, flood & fire) ➡migration ➡conflicts?
- **Stern Review** (30.10.2006): cost of not acting in 21st century: higher than costs of 1st and 2nd world wars!
- **Whose security is at stake**? Of nations? Societies? Human beings or humankind?
- Which are instruments of a proactive security policy?

2.4. Volumes of HEXAGON-Series

1: Brauch – Liotta - Marquina – Rogers - Selim (Eds.): ***Security and Environment in the Mediterranean. Conceptualising Security and Environmental Conflicts*** *(2003).*

2. Shuval - Dweik (Eds.): ***Israel-Palestinian Water Issues – from Conflict to Cooperation*** (2007).

3. Brauch – Grin – Mesjasz – Dunay- Chadha Behera – Chourou - Oswald Spring - Liotta - Kameri-Mbote (Eds.): ***Globalisation and Environmental Challenges: Reconceptualising Security in the 21st Century*** (2007).

4. Brauch - Grin – Mesjasz – Krummenacher - Chadha Behera – Chourou - Oswald Spring - Kameri-Mbote, Patricia (Eds.): ***Facing Global Environmental Change: Environmental, Human, Energy, Food, Health and Water Security Con-cepts*** (2007/2008).

5. Brauch - Oswald Spring - Kameri-Mbote – Mesjasz – Grin – Chourou – Birkmann (Eds.): ***Coping with Global Environmental Change, Disasters and Security – Threats, Challenges, Vulnerabilities and Risks*** (2008).

3. From a narrow national security to a wider environmental and human security concepts

- **Thinking on security changed since 1990:**
  - Contextual change since end of the cold war (1990)
  - Widening, deepening and sectorialisation of security globally
    - UN Sec. General's High Level Panel on Threats (Egypt: A.Moussa)
    - Kofi Annan: In larger Freedom: March 2005
- **Security thinking must adapt to new future challenges**
  - UK: D. King: Climate change more serious threat than terrorism
  - UK: N. Stern: Costs of not acting are higher than WW I & WWII
  - Crutzen/Schellnhuber: Shift from Holocene to Anthropocene
- **This requires a rethinking of security: from the *security dilemma* of states to the *survival dilemma* of people.**

3.1. A Classical Definition in Political Science & in International Relations

- Arnold Wolfers (1962), American of Swiss origin, realist pointed to two sides of the security concept:
  - **"Security, in an objective sense, measures the absence of threats to acquired values, in a subjective sense, the absence of fear that such values will be attacked".**
    - **Objective:** Absence of "threats": interest of policy-makers
    - **Subjective:** Absence of "fears": interest of social scientists,
    - **Intersubjective:** contructivists "Reality is socially constructed"

➢ Security perceptions depend on worldviews or traditions

- ❖ **Hobbessian pessimist:** *power* is the key category (narrow concept)
- ❖ Grotian pragmatist: *cooperation* is vital (wide security concept)
- ❖ **Kantian optimist:** *international law* and *human rights* are crucial.

3.2. Widening of Security Concepts: From National to Environmental and Human Security

4 trends in reconceptualisation of security since 1990:

- **Widening** (dimensions, sectors), **Deepening** (levels, actors)
- **Sectorialisation** (energy,food,health), **Shrinking** (WMD, terrorists)

Dimensions & Levels of a Wide Security Concept

Security dimension⇒ ⇓ Level of interaction	Mili-tary	Political	Economic	Environ-mental ⇓	Societal
Human individual ⇒			Food/ health	Cause & Victim	Food/ health
Societal/Community				↓↑	
National	shrinking		Energy sec.	↓↑	
International & Regional				↓↑	
Global/Planetary ⇒				GEC	

3.3. Environmental & Human Security

Table: Expanded Concepts of Security (© Bjørn Møller, 2003)

Label	Reference object	Value at risk	Source(s) of threat
National security	The State	Territorial integrity	State, substate actors
Societal security	Societal groups	Nation. identity	Nations, migrants
Human security	Individ., humankind	Survival	Nature, state, globaliz.
Environmental sec.	Ecosystem	Sustainability	Humankind

Environmental Security: Referent: Ecosystem; Value at risk is *sustainability*.

- Major challenges: *global environmental change & humankind*,
- Focus: Interactions between ecosystem & humankind,
- Impact of global environmental change on environm. degradation, of increasing demand on environmental scarcity & environmental stress.

Human security: Referent: individuals and humankind.

- Values at risk: survival of human beings and their quality of life.
- Major source of threat: nature (*global environm. change*), globalisation, nation state with its ability to cope with dual challenge.

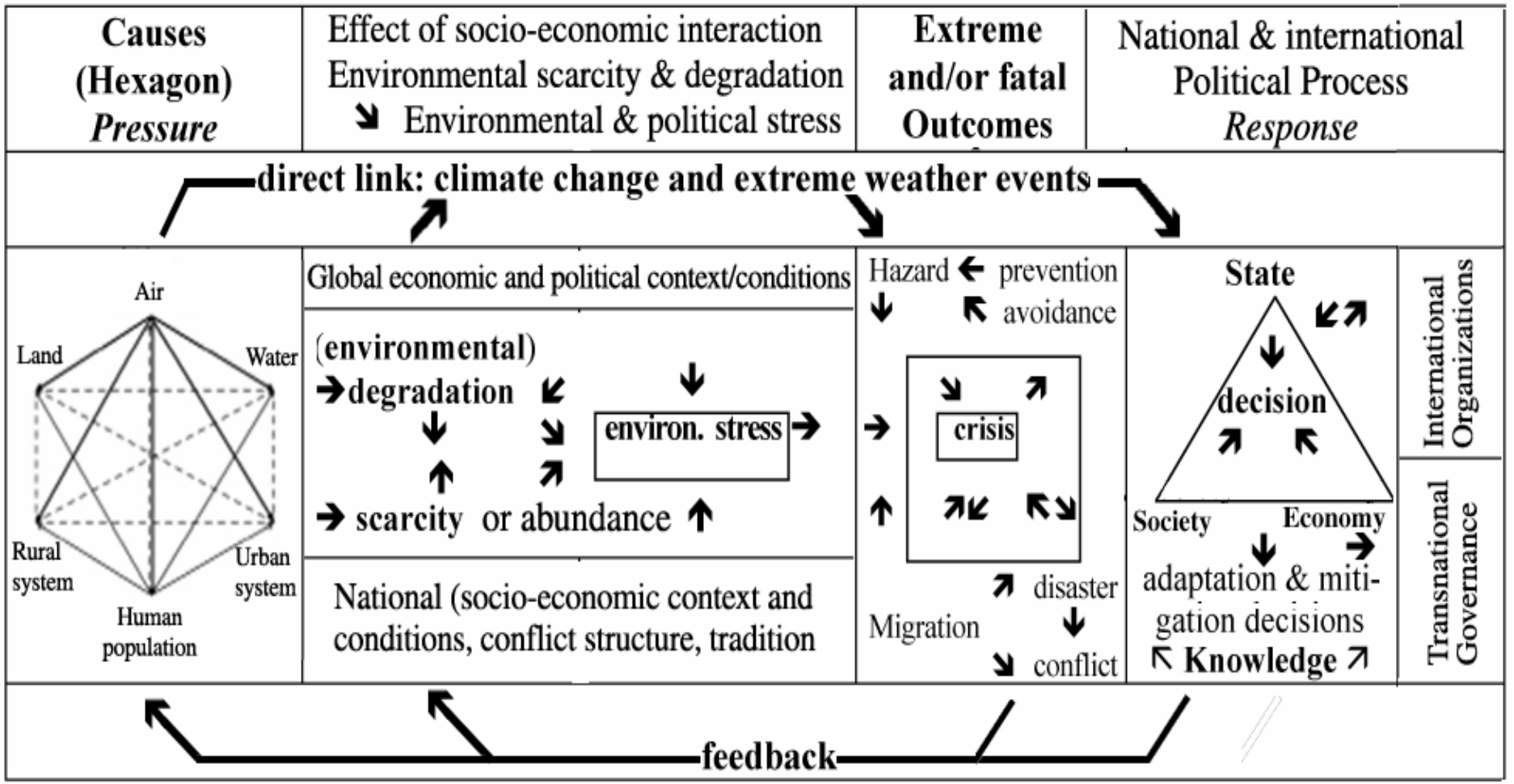
3.4. Four Pillars of Human Security

- **Origin: UNDP Report 1994:** M. ul Haq (Pakistan)
- **Human security**: "safety from the threat of disease, hunger, unemployment, crime, social conflict, ... environmental hazards"
- **Ogata/Sen**: Human Security Now: protection & empowerment
- **Four major pillars of the human security concept.**
  - "**Freedom from fear**" by reducing the probability that hazards may pose a survival dilemma for most affected people of extreme weather events (UNESCO, HSN), **Canadian approach:** Human Security Report
  - "**Freedom from want**" by reducing societal vulnerability through poverty eradication programmes (UNDP 1994; CHS 2003: Ogata/Sen: Human Security Now), **Japanese approach;**
  - "**Freedom to live in dignity**" (**Kofi Annan** in his report: *In Larger Freedom* (March 2005)
  - "**Freedom from hazard impact**" by reducing vulnera-bility & enhancing coping capabilities of societies confronted with natural & human-induced hazards (Bogardi/Brauch 2005; Brauch 2005a, 2005b).

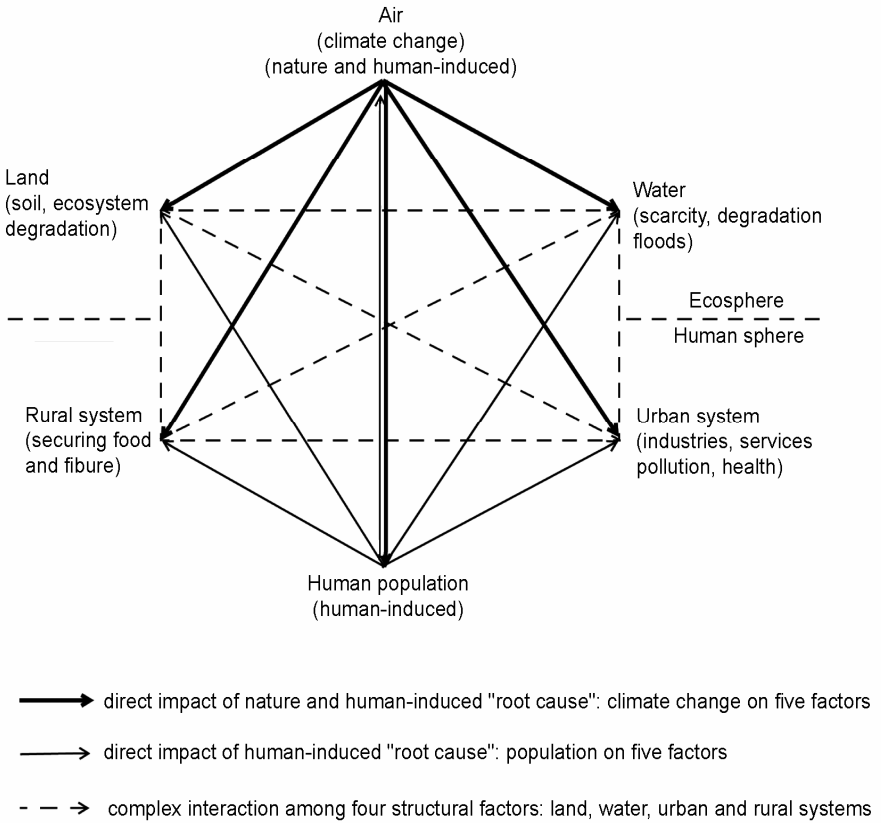
4. PEISOR Model: Global Change, Environmental Stress & Extreme Outcomes

- **The model distinguished 5 stages:**
  - **P: Pressure: Causes of Global Environmental Change (GEC): Survival hexagon**
  - **E: Effect: environmental scarcity, degradation & stress**
  - **I: Impact: Extreme or fatal outcomes: hazards**
  - **SO: Societal Outcomes: disaster, migration, crisis, conflict, state failure etc.**
  - **R: Response by the state, society, the economic sector and by using traditional and modern know-ledge to enhance coping capacity and resilience**

4.1. PEISOR Model: Global Change, Environmental Stress & Extreme Outcomes



4.2. Cause: Pressure of Global Environmental Change: Six Determinants: Survival Hexagon



Ecosphere:

- Air: Climate Change
- Soil: Degradation, Desertification
- Water: degradat./scarcity

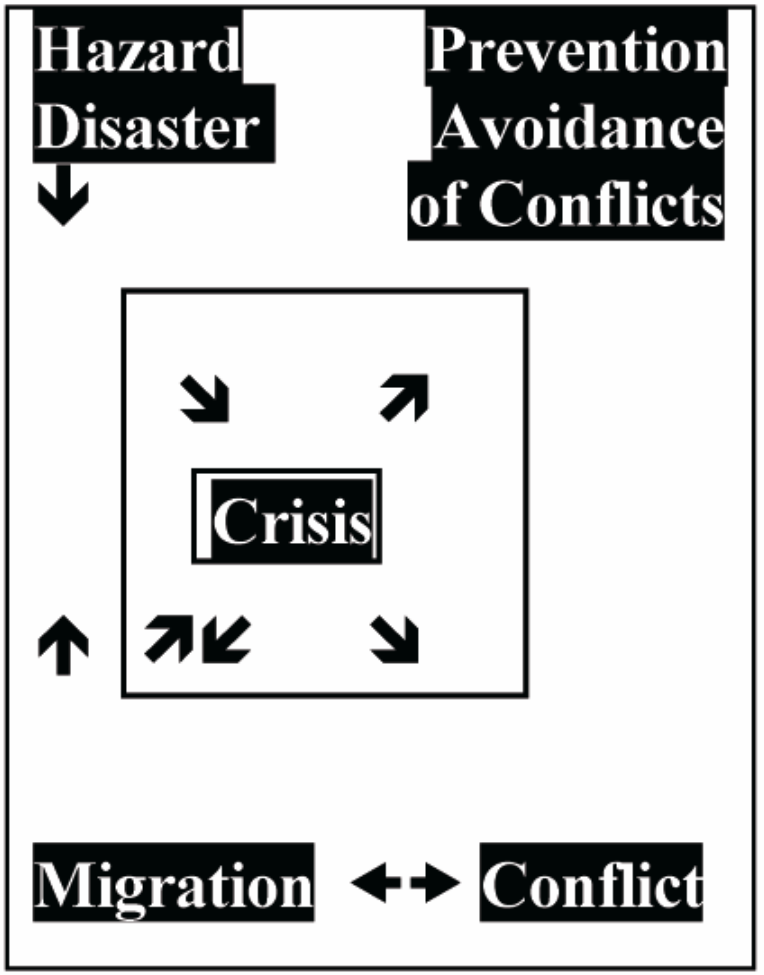
Anthroposphere:

- Population growth/decline
- Rural system: agriculture
- Urban system: pollution etc.

Mode of Interaction

- Linear, Nonlinear
- Exponential
- Chaotic, abrupt

4.3. Impact: Human-Induced Natural Hazards Drought, Famine and Societal Outcomes



Much knowledge on these factors:

- ✓ Drought, migration, crises, conflicts

Lack of knowledge on linkages among fatal outcomes

- ➢ Drought & drought-ind. migration
- ➢ Famine & environm.-ind. migration
- ➢ Conflicts & conflict-induced migration

Lack of knowledge on societal consequences: crises & conflicts

- ➢ Domestic and international crises & conflicts
- ➢ Environmentally or war-induced migration as a cause or consequence of crises and conflicts

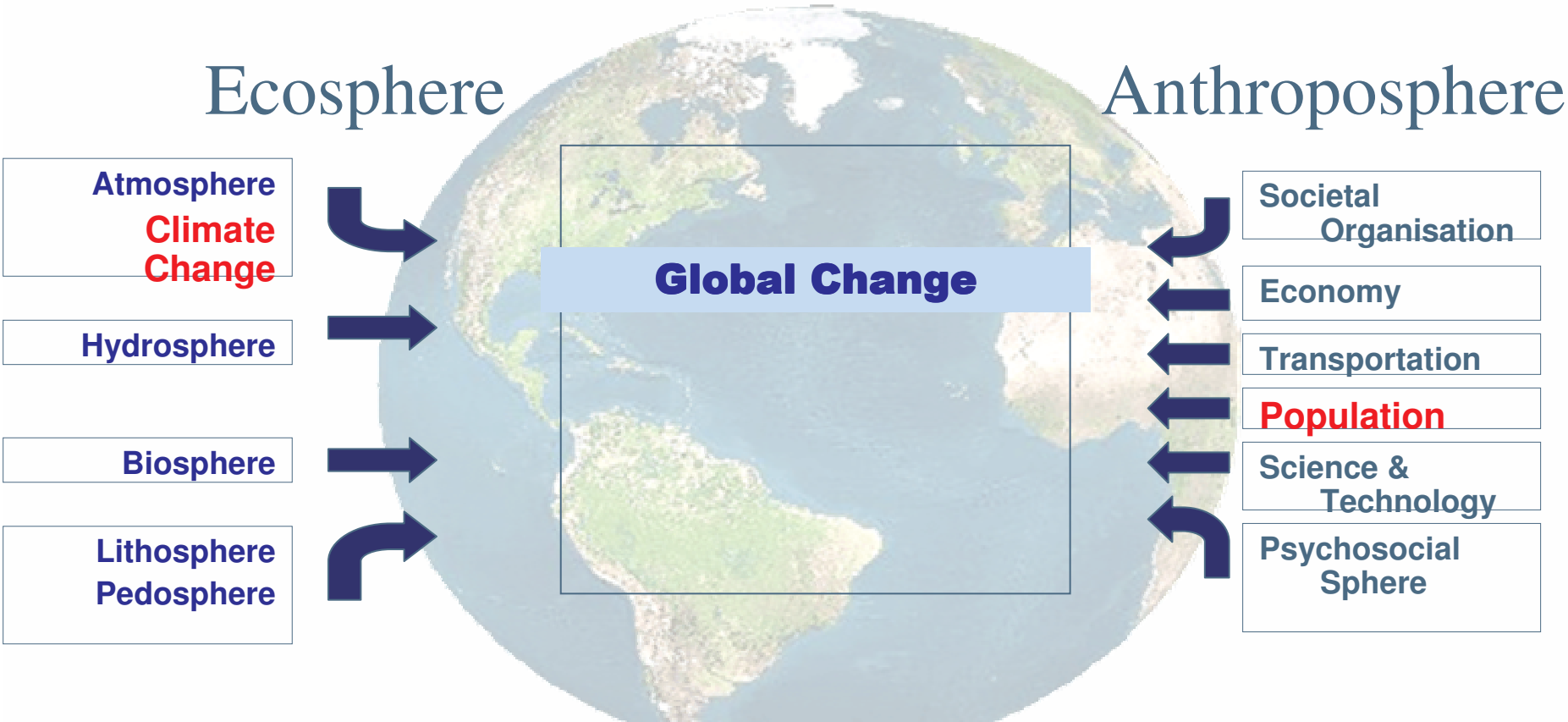
4.4. Societal Outcomes: Knowledge on Linkages of Outcomes

- **What are consequences of climate change, desertification and water scarcity for:**
  - Environmental scarcity
  - Envivironmental degradation
  - Environmental stress?
- **What are indirect Societal Outcomes of:**
  - Human-induced hydro-meteorological natural water-related hazards (Storms, floods, landslides, drought) due to natural variability & increase due to climate change?
  - For migration, societal crises and domestic and international conflicts?
  - What role does social vulnerability of victims play?

5. Global Environmental Change, Climate Change and Desertification

- **Global (environmental) change** (GEC): changes in nature & society that affected humankind and will affect human beings who are both a **cause** of this change and often also a **victim.**
- Cause: Burning of fossil fuels since industrial revolution (1750)
- Increase of concentration of GHG from 275ppm (1750) to 380 ppm (2005)
- Those who caused it those who are most vulnerable are not identical
- GEC affects & combines the **ecosphere & anthroposphere**.
- Human dimension of GEC covers contribution & adaptation of states, societies and human beings to these changes.
- These processes pose questions for social, cultural, economic, ethical, & spiritual issues, for saving & also our responsibility for the environment.
- **Ecosphere**: **atmosphere** (climate syst.), **hydrosphere** (water), **lithosphere** (earth crust, fossil fuels), **pedosphere** (soil), **biosphere**.
- **Anthroposphere:** populations, social organisations, knowledge, culture, economy & transport & other human-related systems.

5.1. Global Environmental Change (GEC): Environment & Security Linkages



GEC poses a threat, challenge, vulnerabilities and risks for human security and survival.

5.2. Global Climate Change: Temperature Increases & Sea Level Rise

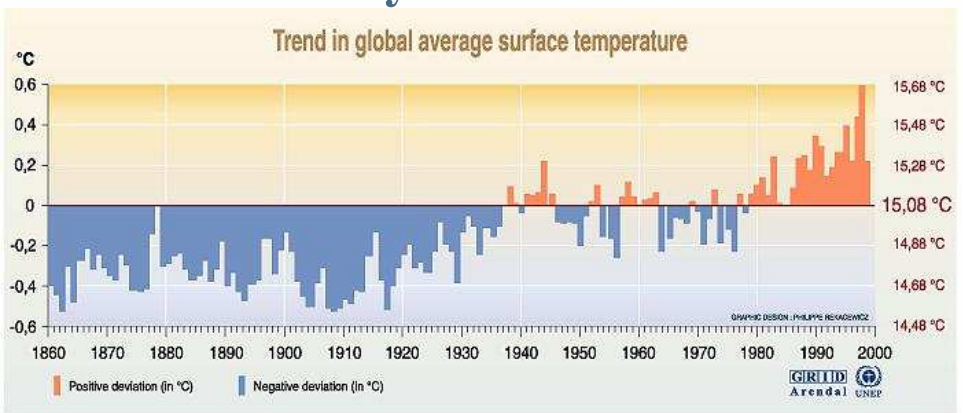
2 Climate Change Impacts: Temperature & Sea level Rise

- Global average temperature rise in 20th century: + 0.6 ℃
- Proj. temperature rise: 1990-2100: +1.4 – 5. 8 ℃

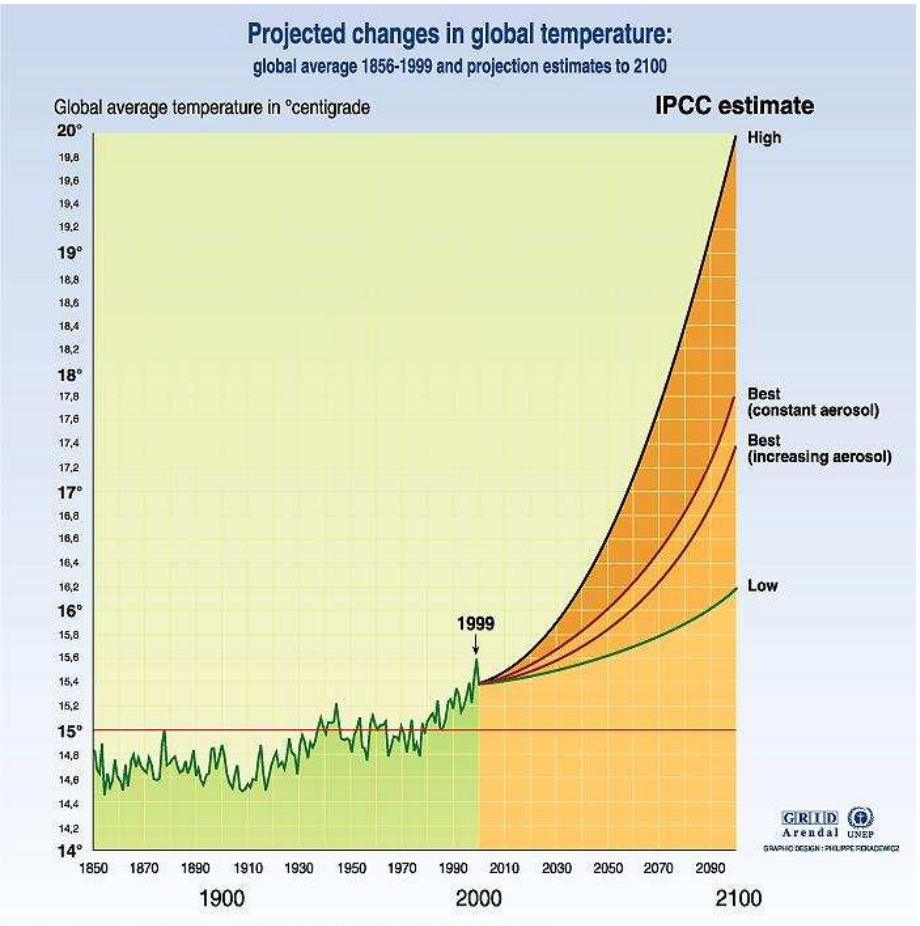
Sources: IPCC 1990, 1995, 2001

Sea level Rise:

- 20th cent.: +0,1-0,2 m
- 21st century: 9-88 cm



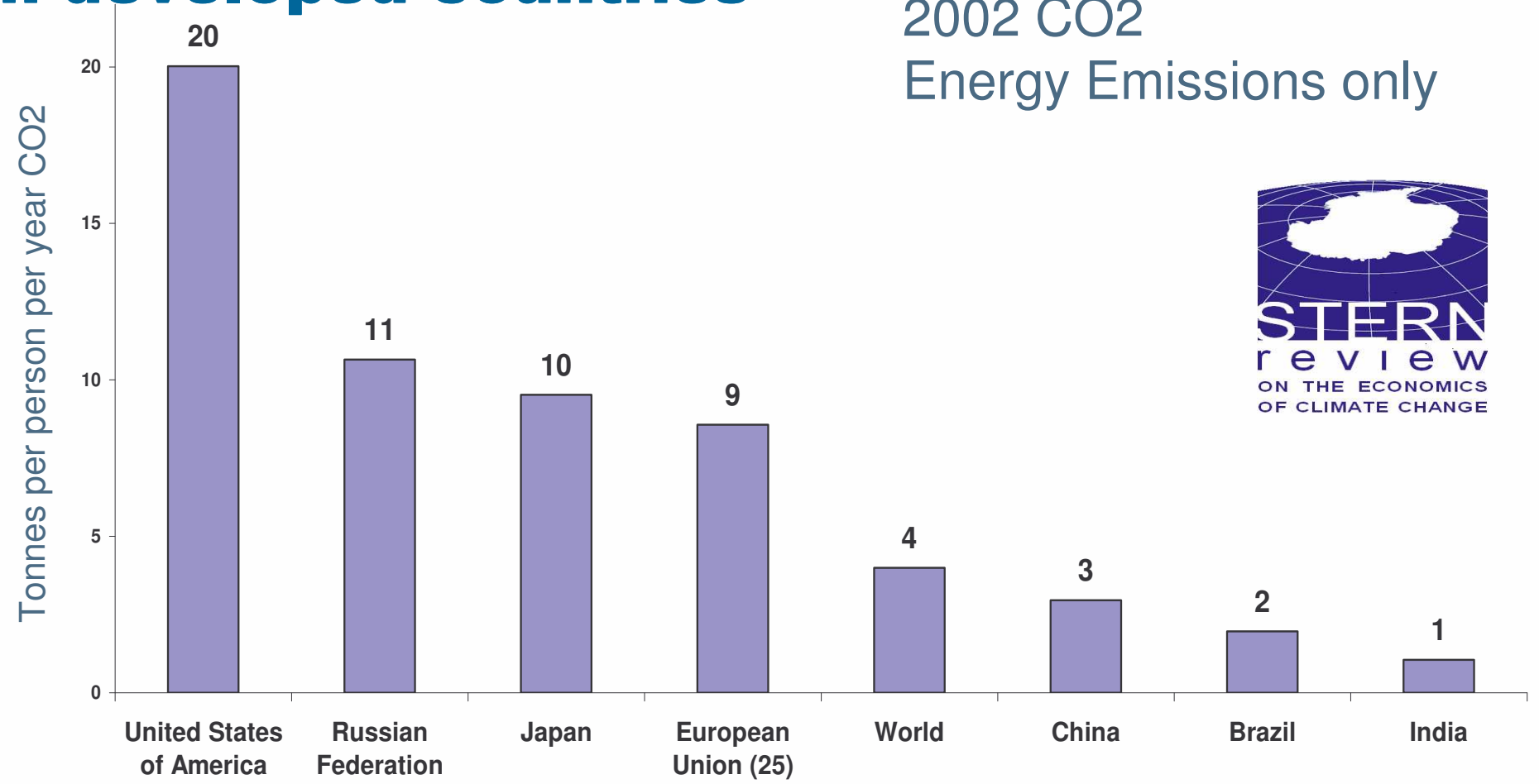
Source: School of environmental sciences, climatic research unit, university of East Anglia, Norwich, United Kingdom, 1999.



Source : Temperatures 1856 - 1999: Climatic Research Unit, University at East Anglia, Norwich UK. Projections: IPCC report 95.

5.3. Current emissions per capita are higher in developed countries

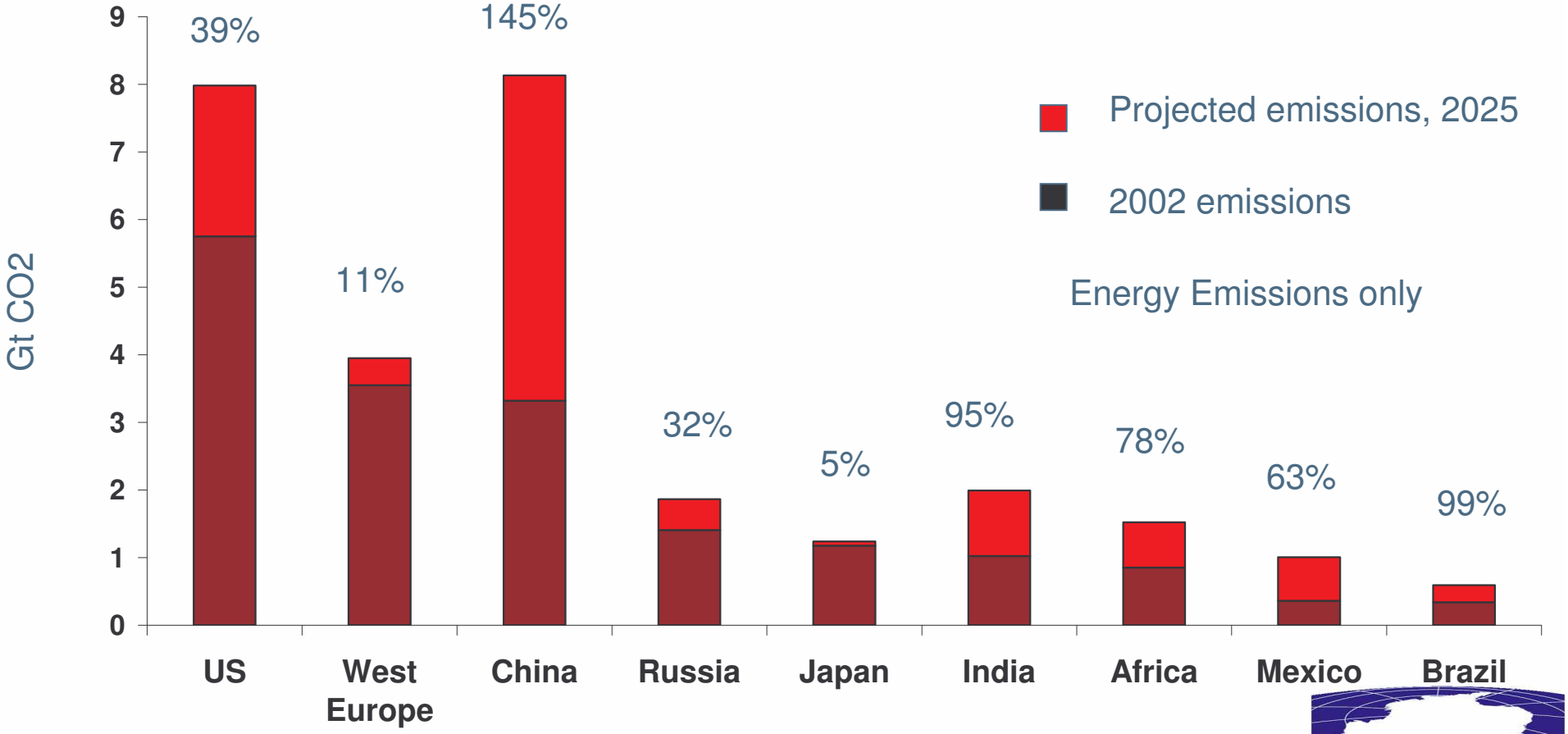
2002 CO2
Energy Emissions only



STERN review
ON THE ECONOMICS OF CLIMATE CHANGE

Source: World Resources Institute, CAIT

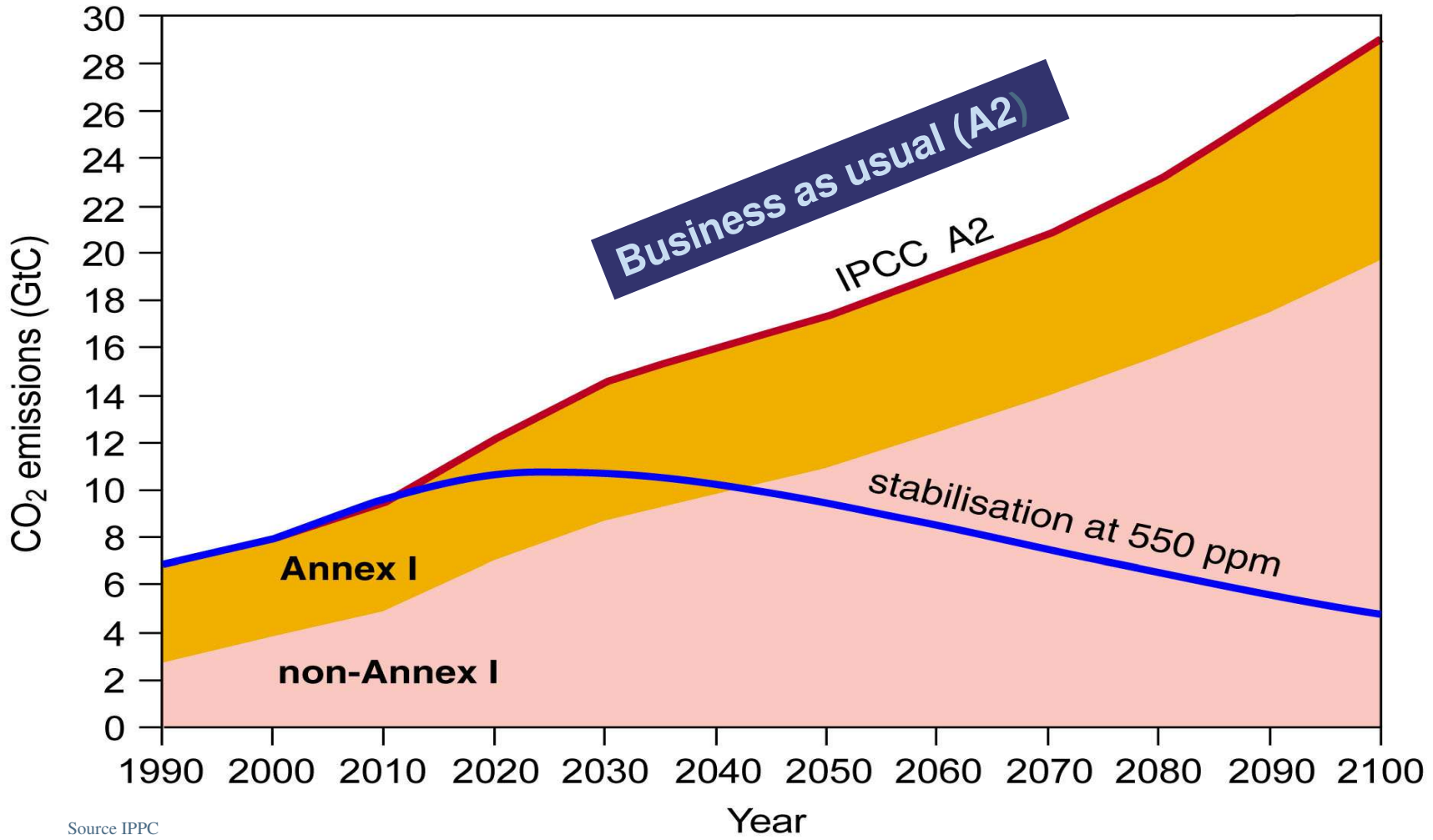
5.4. Larger developing countries account for much of the forecast rise in emissions



Source: World Resources Institute, CAIT Energy Information Administration Reference Scenario, Energy emissions only

STERN review
ON THE ECONOMICS OF CLIMATE CHANGE

5.5. Stabilisation below 550 ppm, emissions must fall & developing countries must be part of the solution

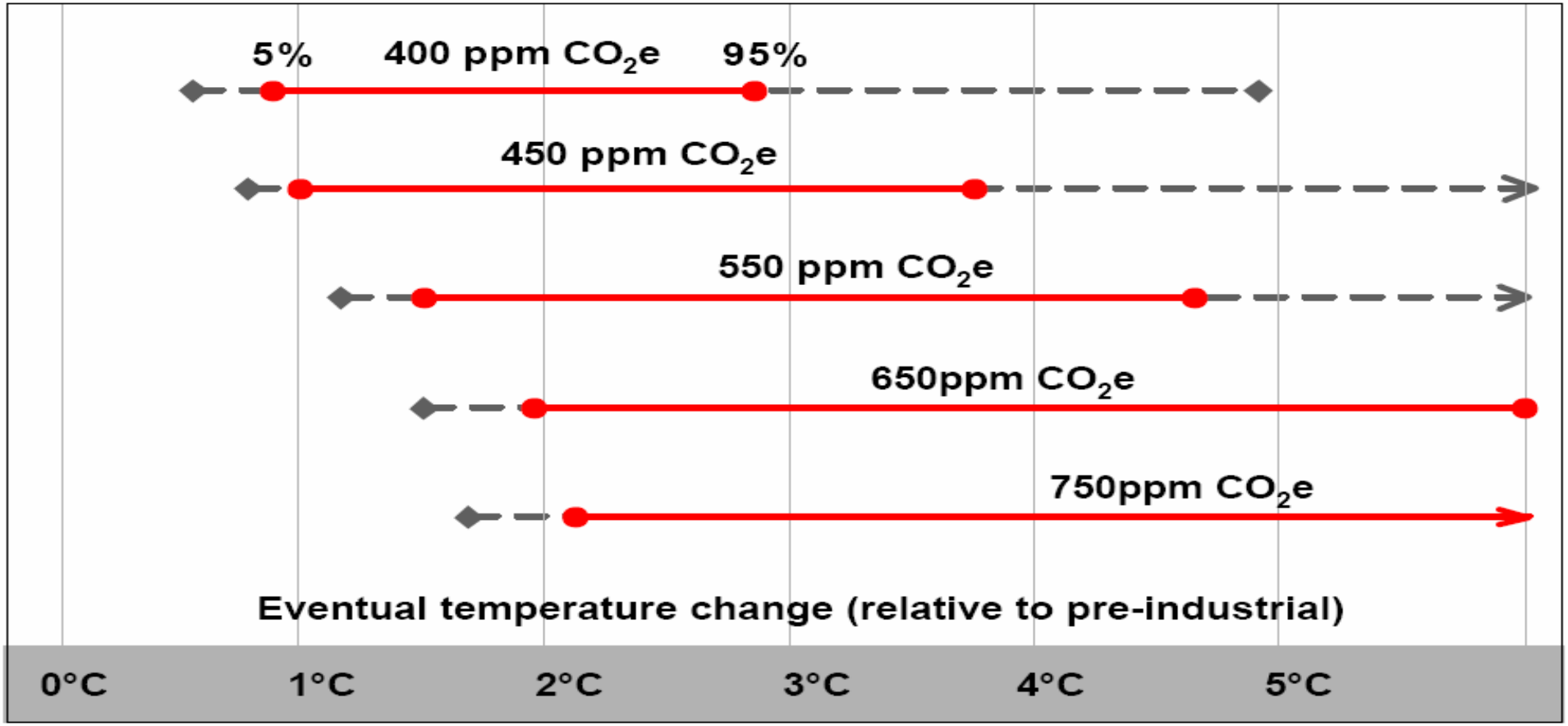


Source IPPC

5.6. Stern Report (UK), 30 Oct. 2006

STERN review
ON THE ECONOMICS OF CLIMATE CHANGE

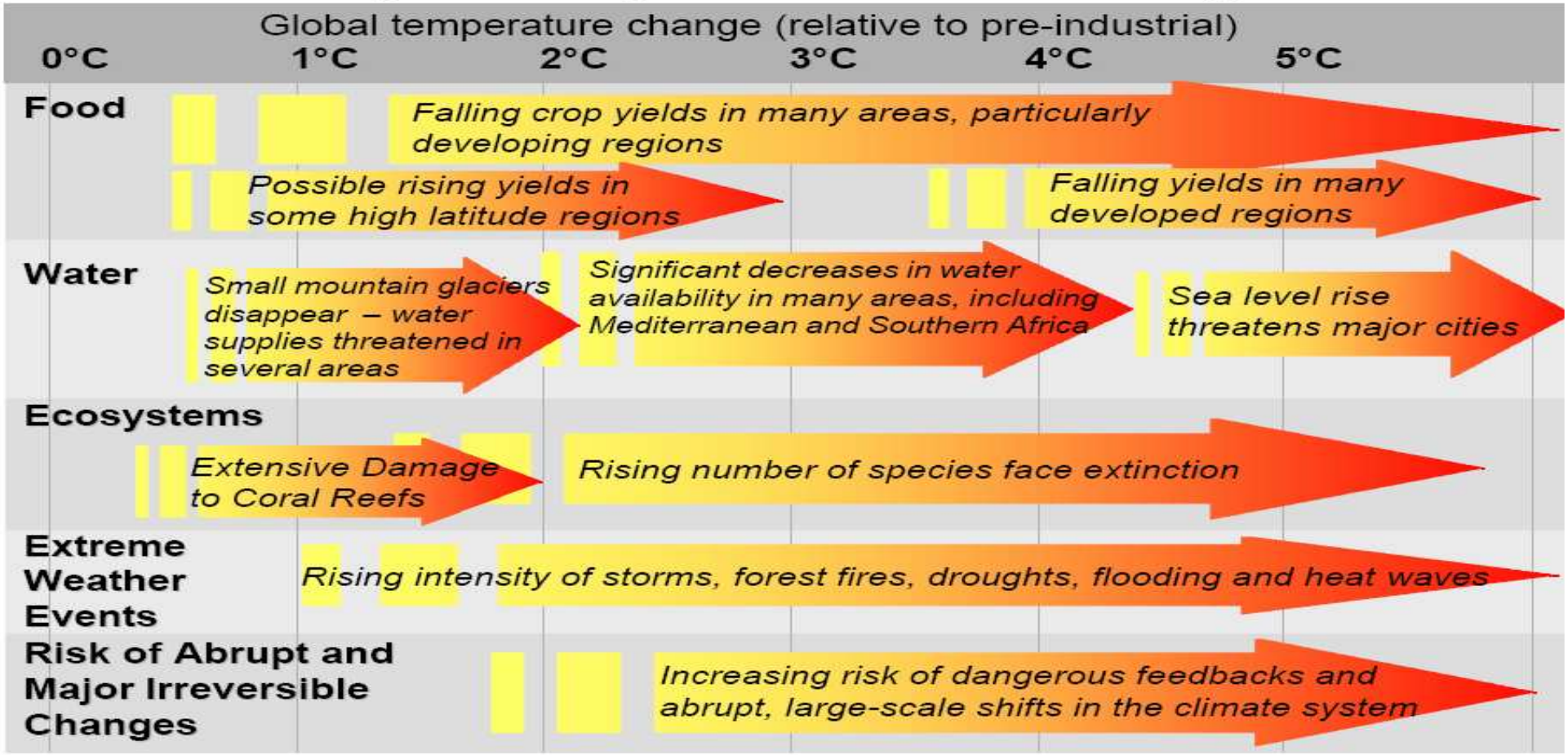
Stabilisation and Commitment to Warming



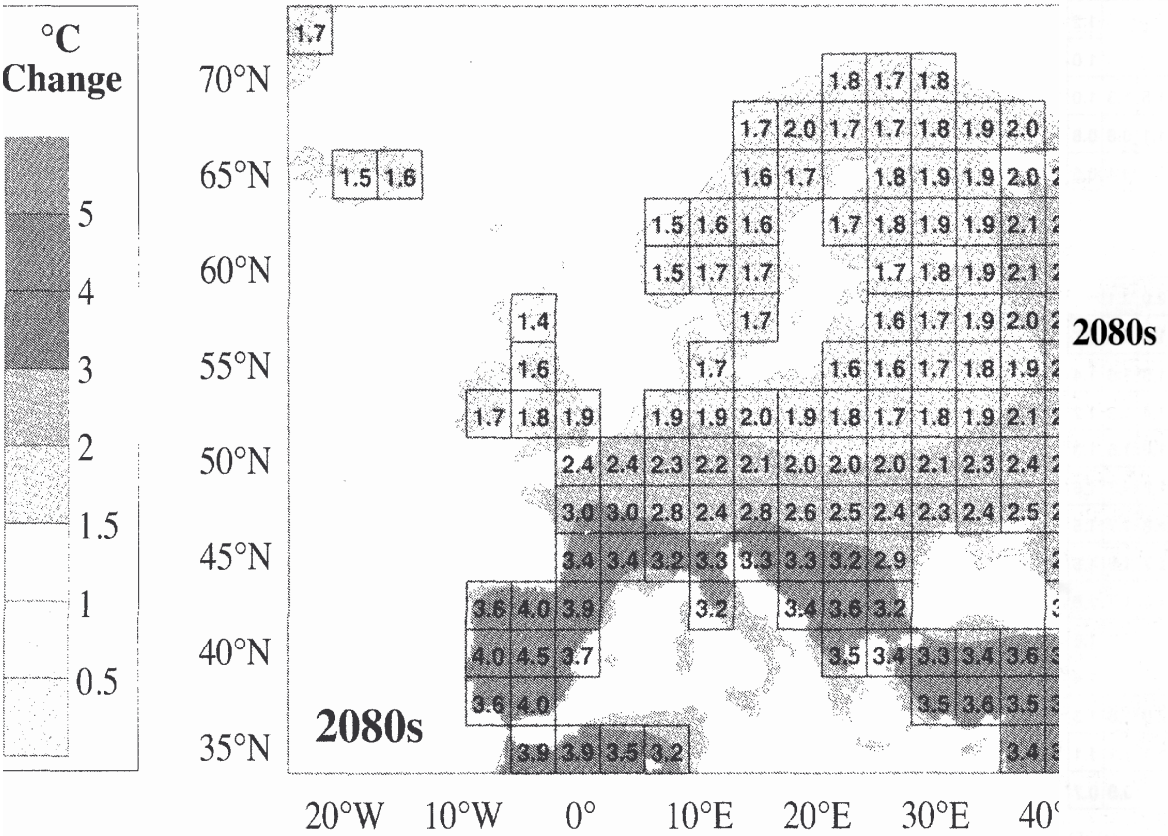
5.7. N. Stern Report, Oct. 2006

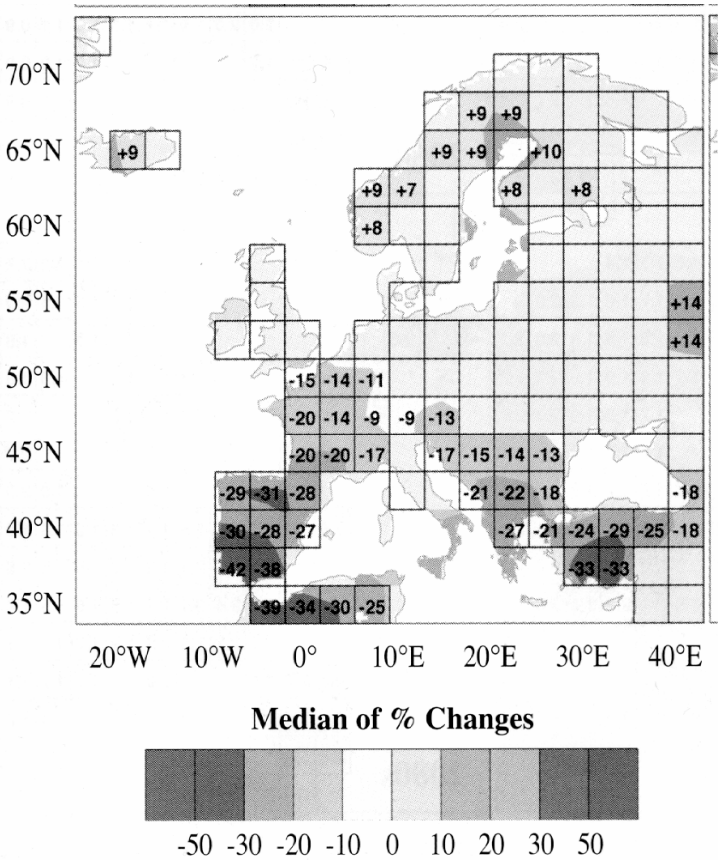
STERN review ON THE ECONOMICS OF CLIMATE CHANGE

Projected Impacts of Climate Change



5.8. Climate Change in the Mediterranean





↑ Mean Temperature Change for Summer in 2080s (WG II, p. 651)

Mean Precipitation Change for Summer in 2080s (WG II, p. 652) ↑

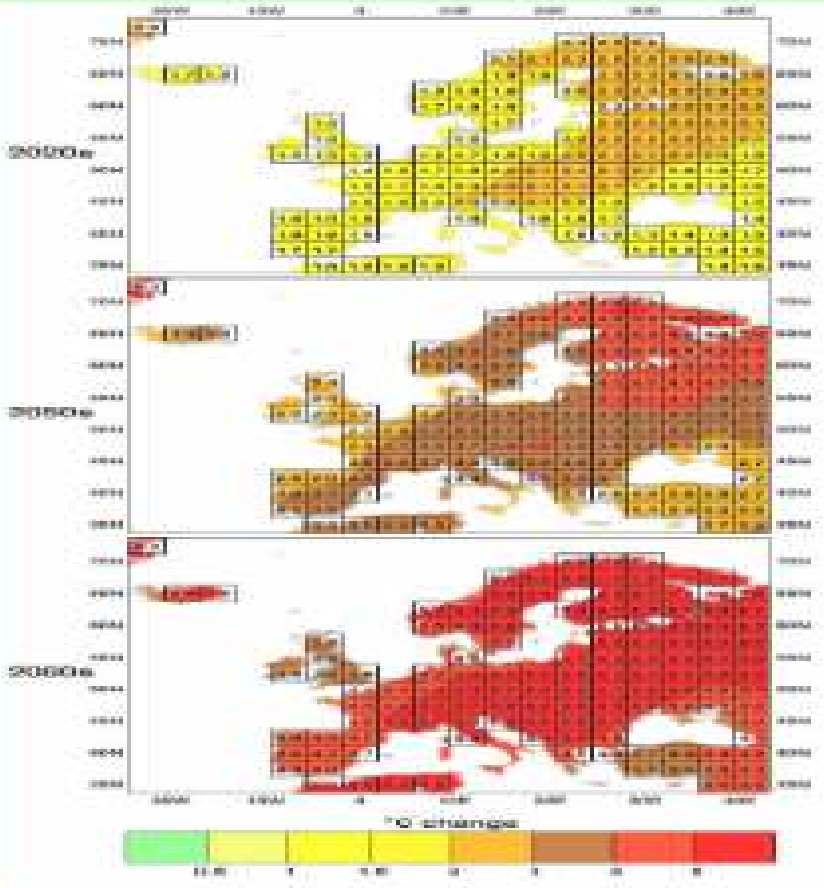
Source: IPCC: Climate Change 2001, WG II: Impacts (p. 651-652)

No specific climate change models for South. & East. Mediterranean

5.9. Projected Changes for Winter Temperatures & Summer Precipitation in Europe (2020/2050/2080)

Winter Temperatures

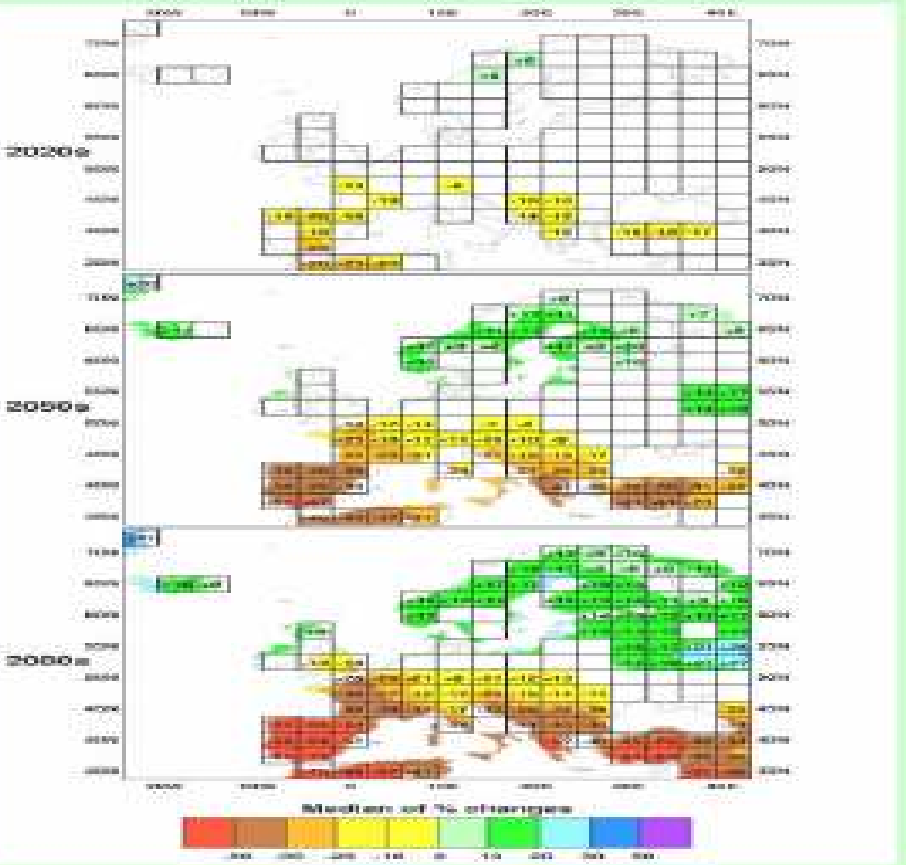
A2



Summer Precipitation

(only significant changes shown)

A2



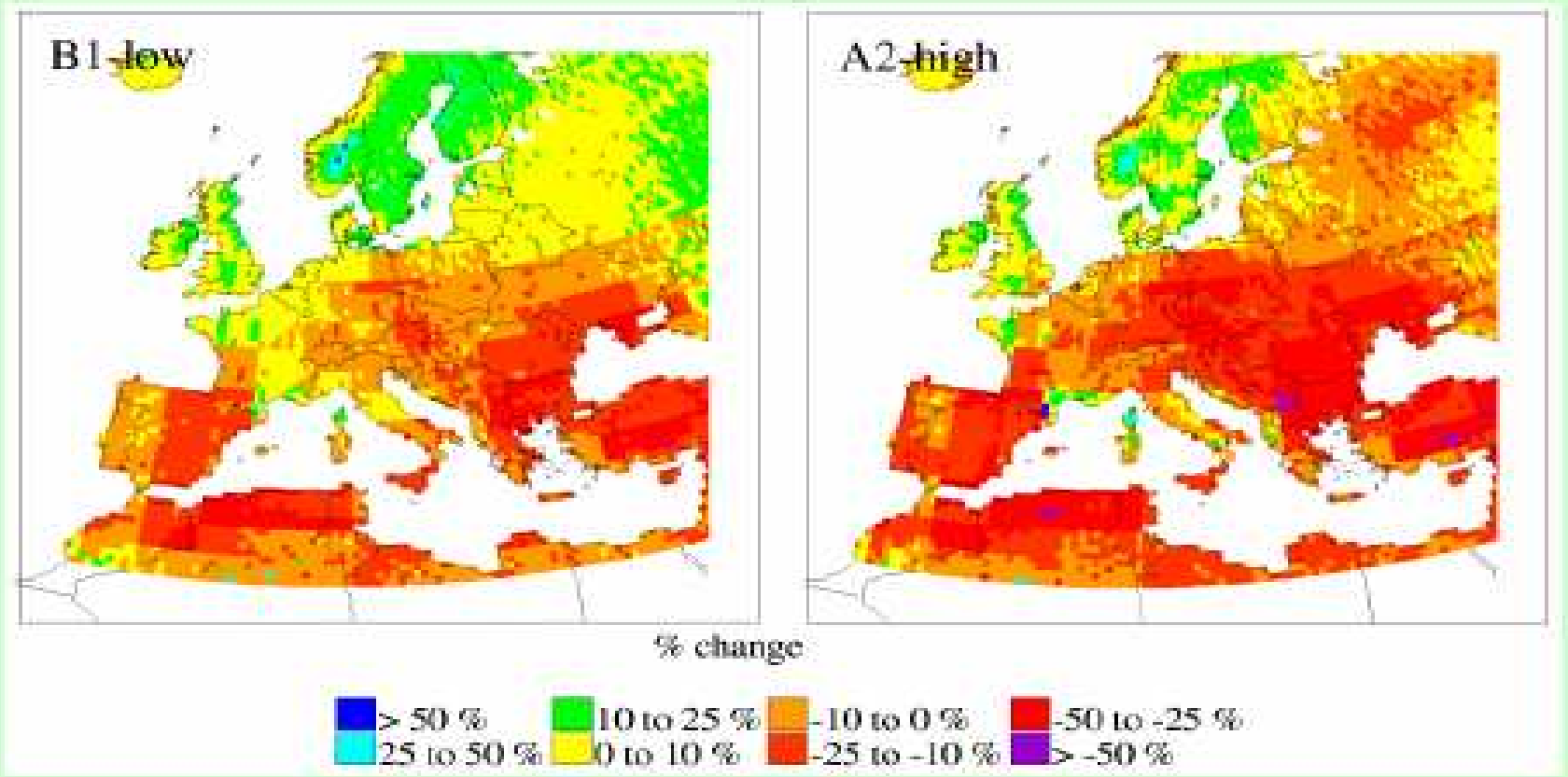
5.10. Water Availability in Europe, 2050‘s

© M. Parry, Meeting of EU Agriculture/ Environment Ministers, 11.9.2005, London

WATER AVAILABILITY, 2050s

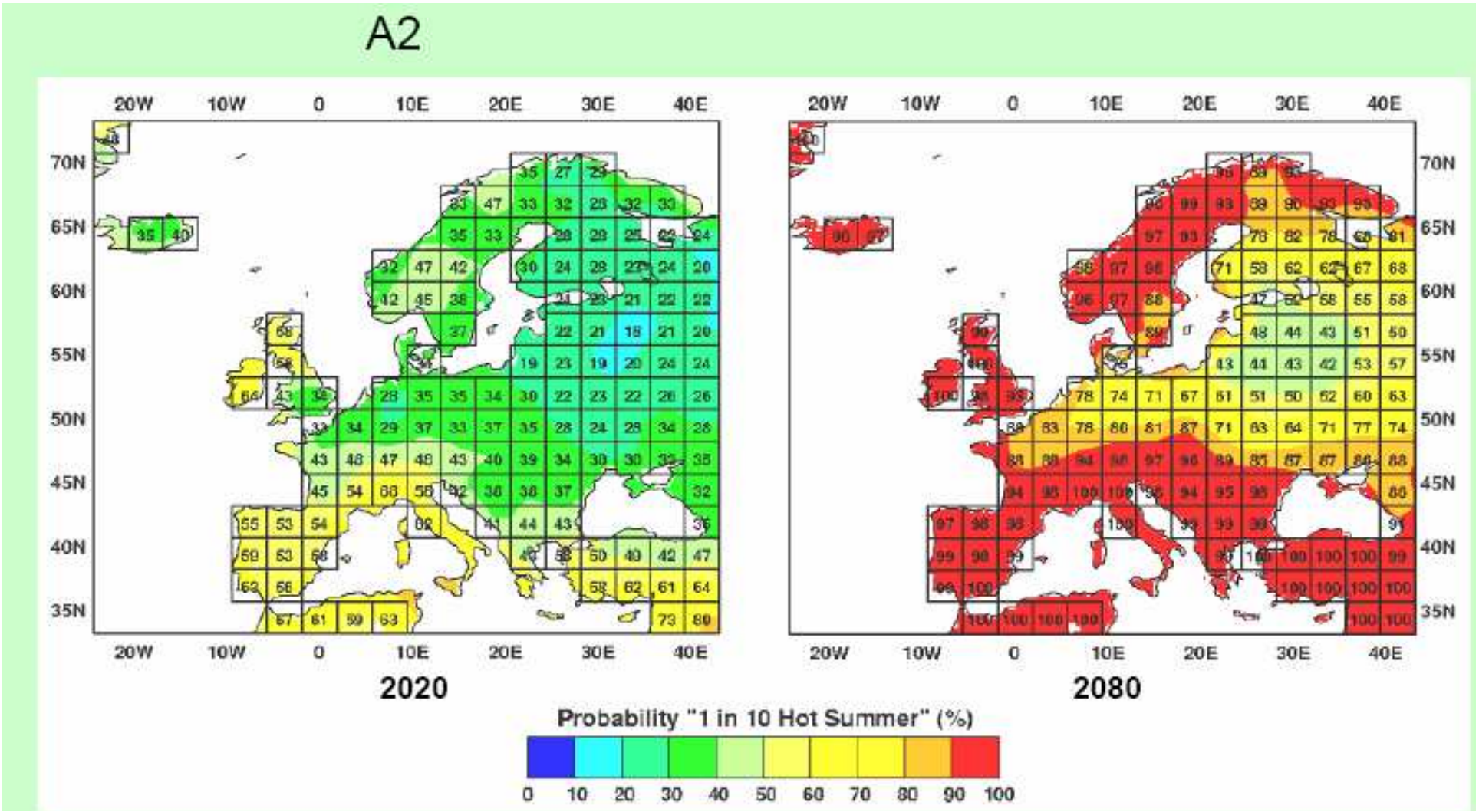
(CHANGE IN ANNUAL RUNOFF)

Acacia Project

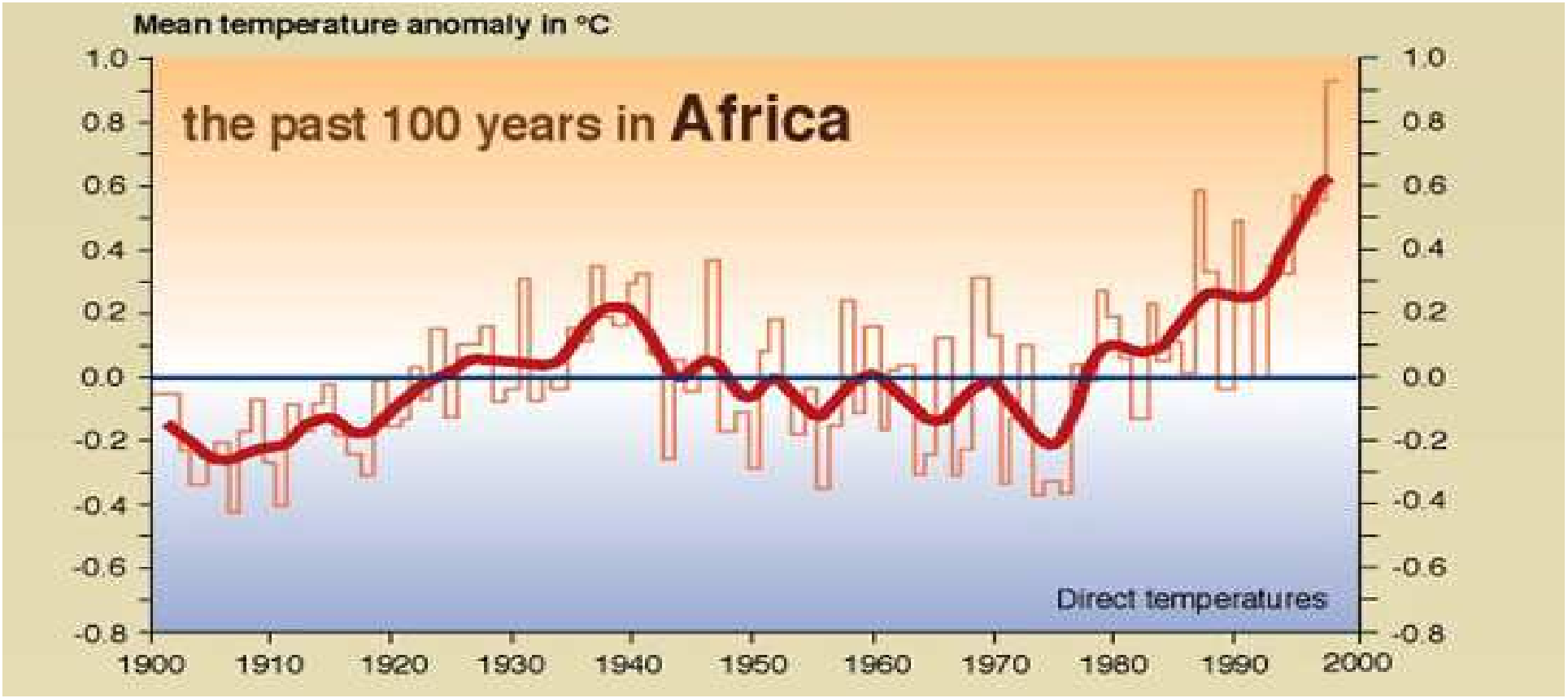


5.11. Probability of 1 in 10 Hot Summers (%) by 2020/2080

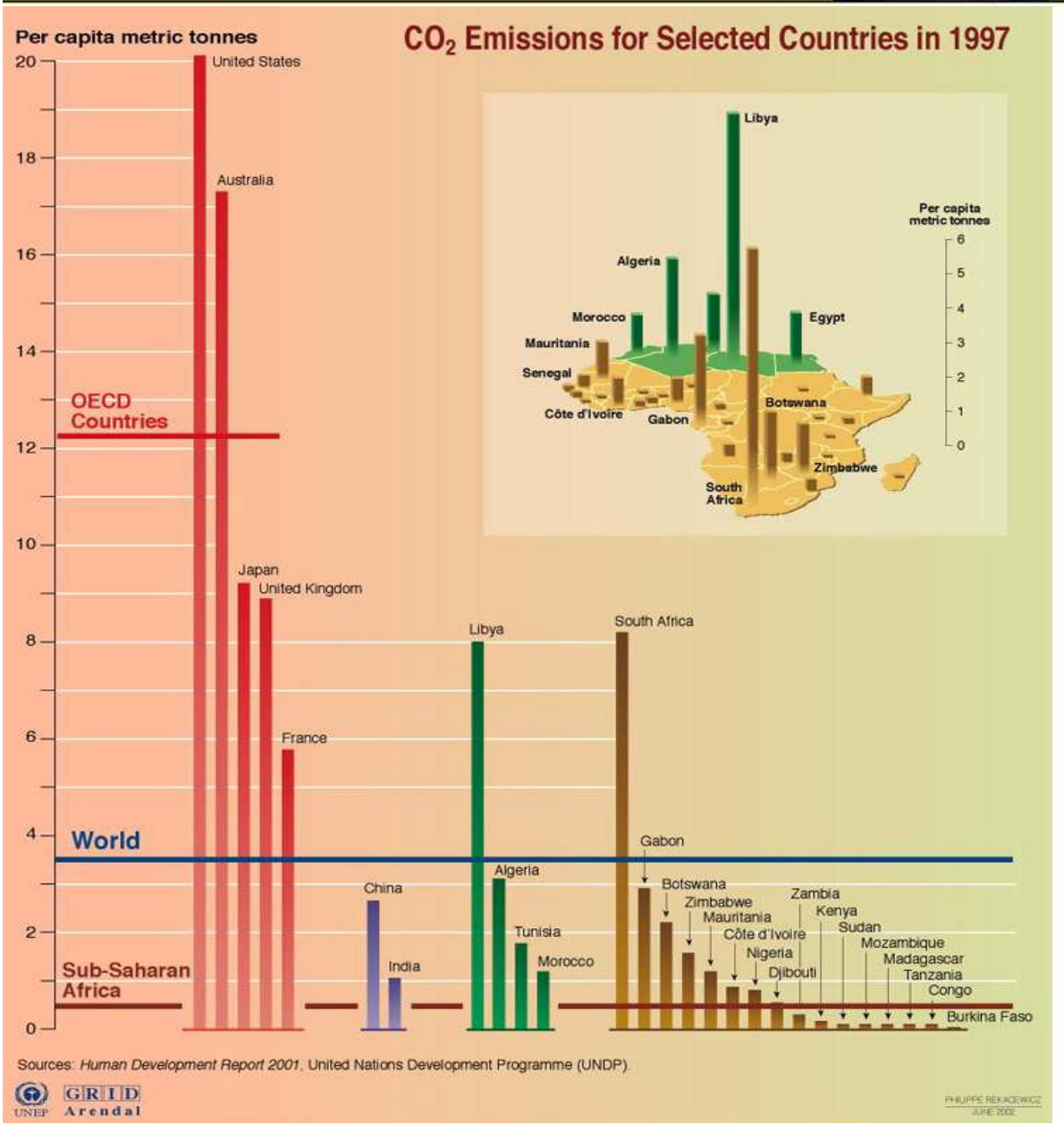
© M. Parry, Meeting of EU Agriculture/ Environment Ministers, 11.9.2005, London



5.12. Climate Change in Africa: Temperature Rise



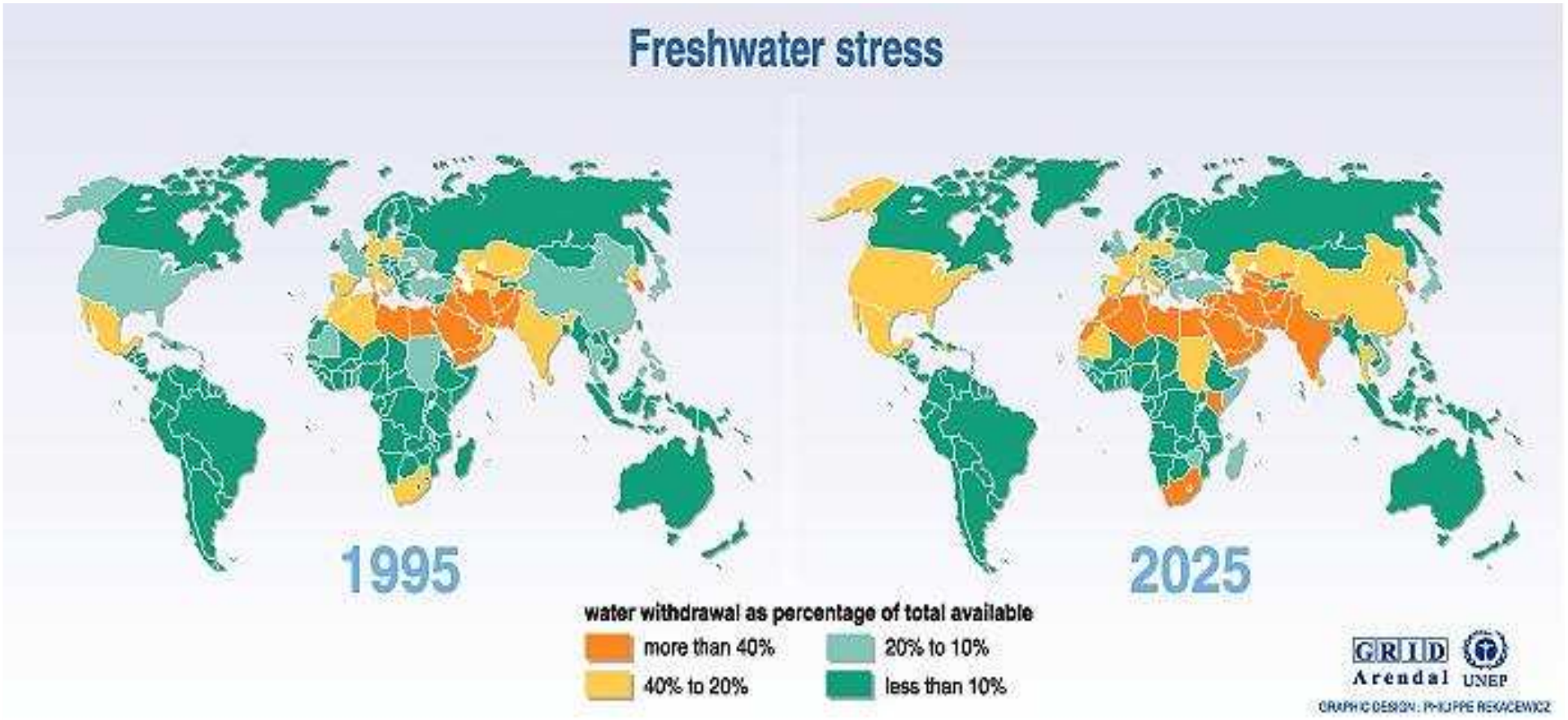
Africa has been warming in the 20th century at 0.05℃ per decade. By 2000, the 5 warmest years in Africa occurred since 1988, 1988 & 1995 being the two warmest years. (Source: UNEP-GRID)



5.13. Limited Emissions & high impact

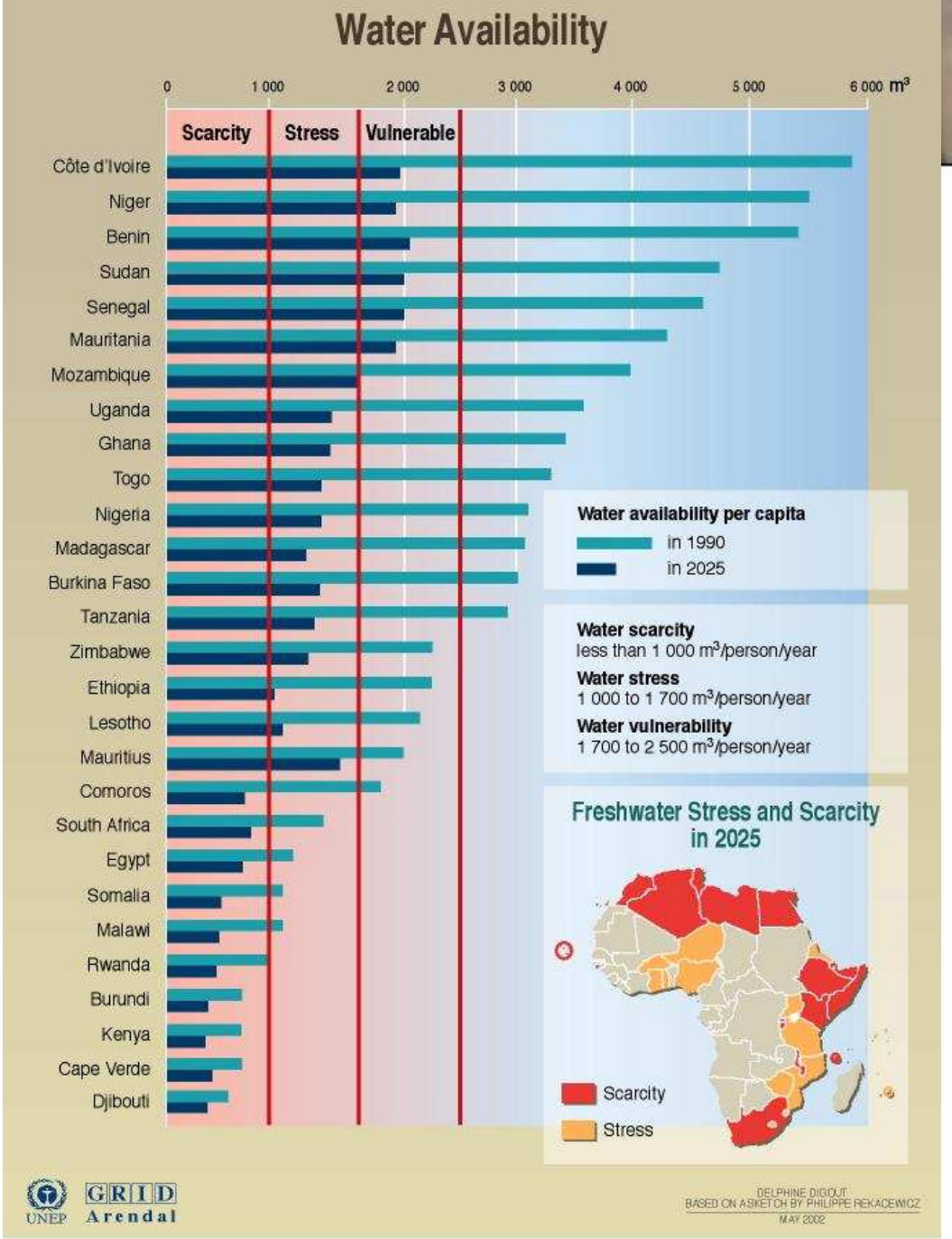
- Africa is very vulnerable to climate change given its low capacity to respond and adapt.
- Africa's contribution through greenhouse gas emissions is insignificant.
- Greenhouse gas emissions per capita in Africa are low
- Europe emit 50-100 times, U.S. 100-200 times more.
- Africa Regional Workshop in Accra, 21.-23.9.2006:
- CC affects Sustainable Development;
- CC jeopardizes MDG 1 (poverty & hunger eradication), 6 (AIDS), 7 (environm. sutain.)

5.14. Freshwater stress, 1995 and 2025



Source: Global environment outlook 2000 (GEO), UNEP, Earthscan, London, 1999.

North Africa was already seriously affected by fresh water stress in 1995 and this stress will intensify by 2025 affecting also Sudan, Kenya and Mauritania.



Source: United Nations Economic Commission for Africa (UNECA), Addis Ababa ; Global Environment Outlook 2000 (GEO), UNEP, Earthscan, London, 1999.

5.15. Impact of Climate Change on Precipitation

- By 2000, 300 million Africans risk living in a water-scarce environment. - By 2025, the number of countries experiencing water stress will rise to 18 affecting 600 million people

- Population growth & climate chan- ge cause economically significant constraints in parts of Africa.

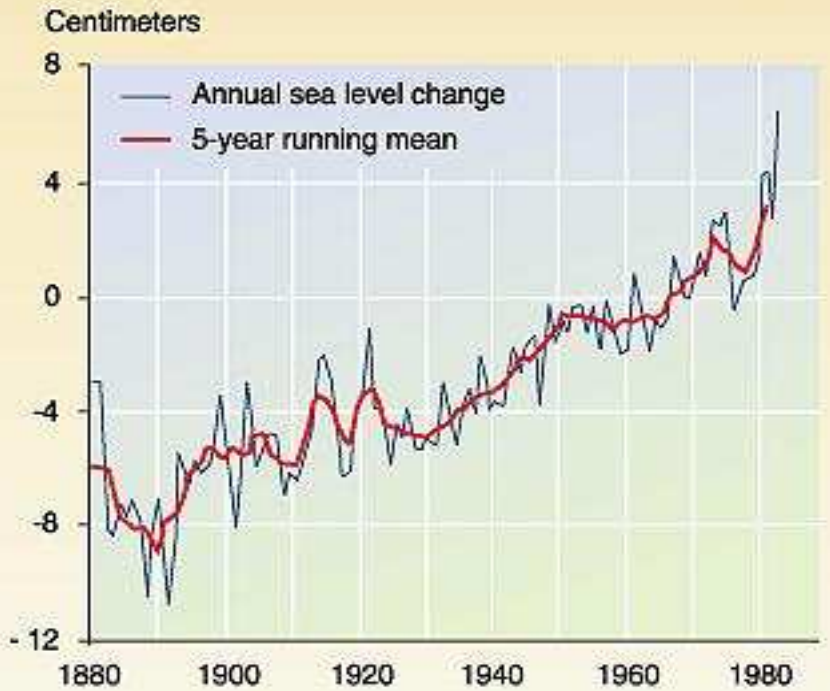
- Water scarcity, increasing population, degradation of shared fresh-water ecosystems, & competing de- mands for water have potential to create bilateral& multilateral conflicts

5.16. Sea Level Rise: 1860-2100

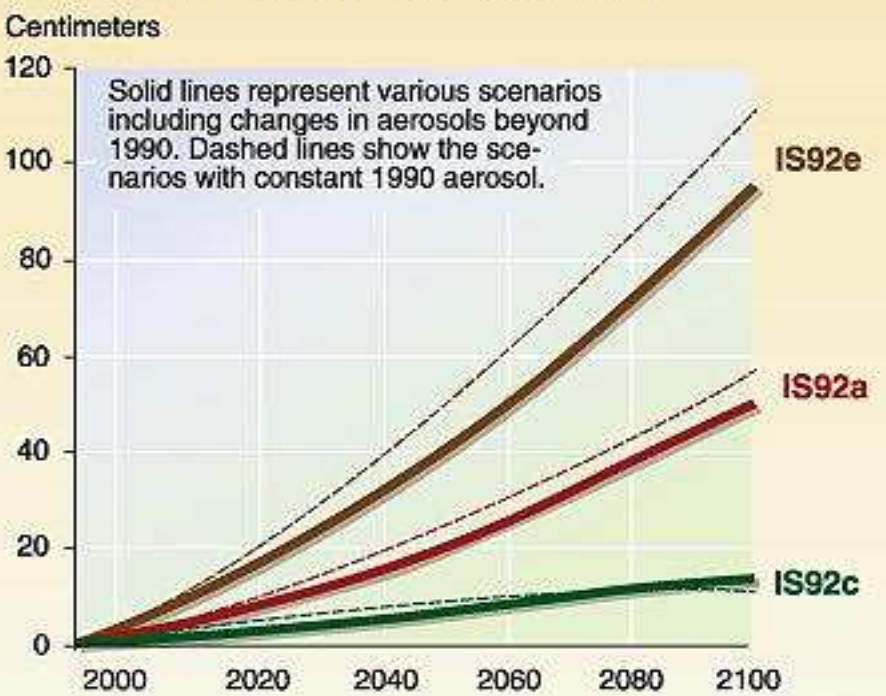
IPCC, TAR, WG 2 (2001): Sea level rise 1860-2000: 0.1 – 0.2 m; sea level rise: 1990-2100: + 0.09 - 0,88 m

Sea level rise due to global warming

Sea level rise over the last century



Sea level rise scenarios for 2100

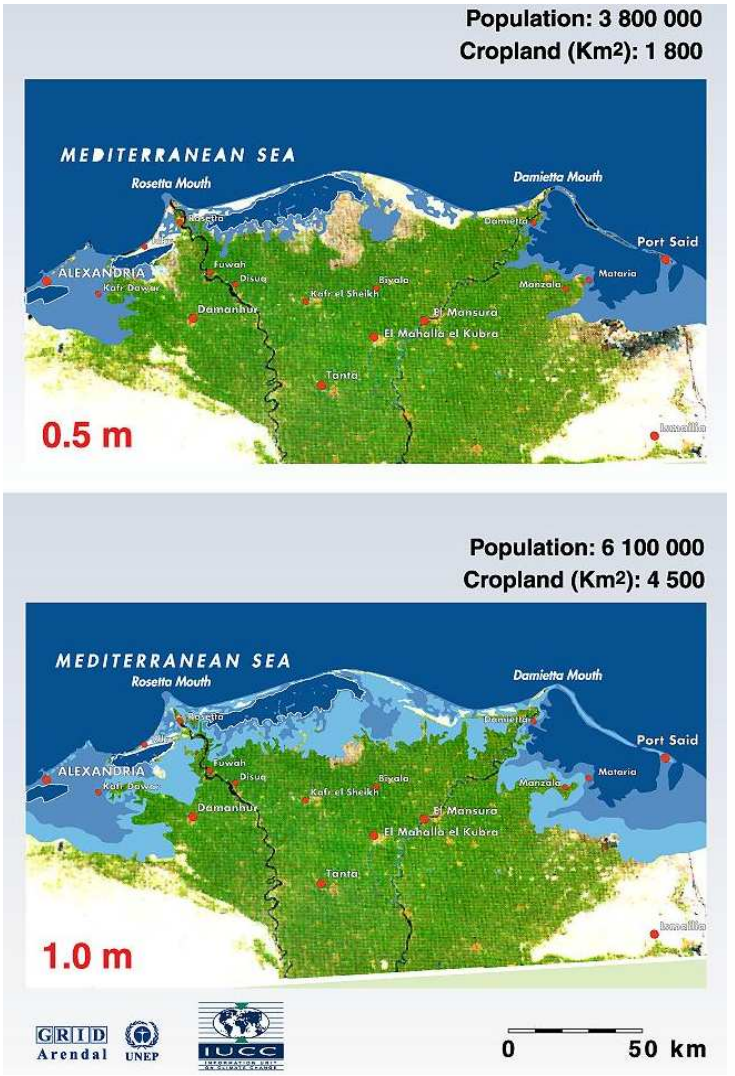


GRID Arendal UNEP

GRAPHIC DESIGN : PHILIPPE REKACEWICZ

Source: Climate change 1995, The science of climate change, contribution of working group 1 to the second assessment report of the intergovernmental panel on climate change, UNEP and WMO, Cambridge university press, 1995; Sea level rise over the last century, adapted from Gornitz and Lebedeff, 1987.

5.17. Climate Change Impacts for Nile Delta



Global Climate Change:

Sea level rise: IPCC, TAR, WG 2 (2001)

- 1860-2000: 0.1 – 0.2 m;
- 1990-2100: 0.09-0,88 m

Climate Change Impacts: Egypt:

- Nil Delta: 50cm, 2 mio. pers., 214.000 jobs
- Temperature Cairo 2000-2060: + 4°C
- Self-sufficiency rate (SSR) for cereals: 1990-2060: decline from 60 to 10%
- Projected yield decline for wheat due to climate change: 2000 - 2050: -18%.

6. Climate Change & Food Security

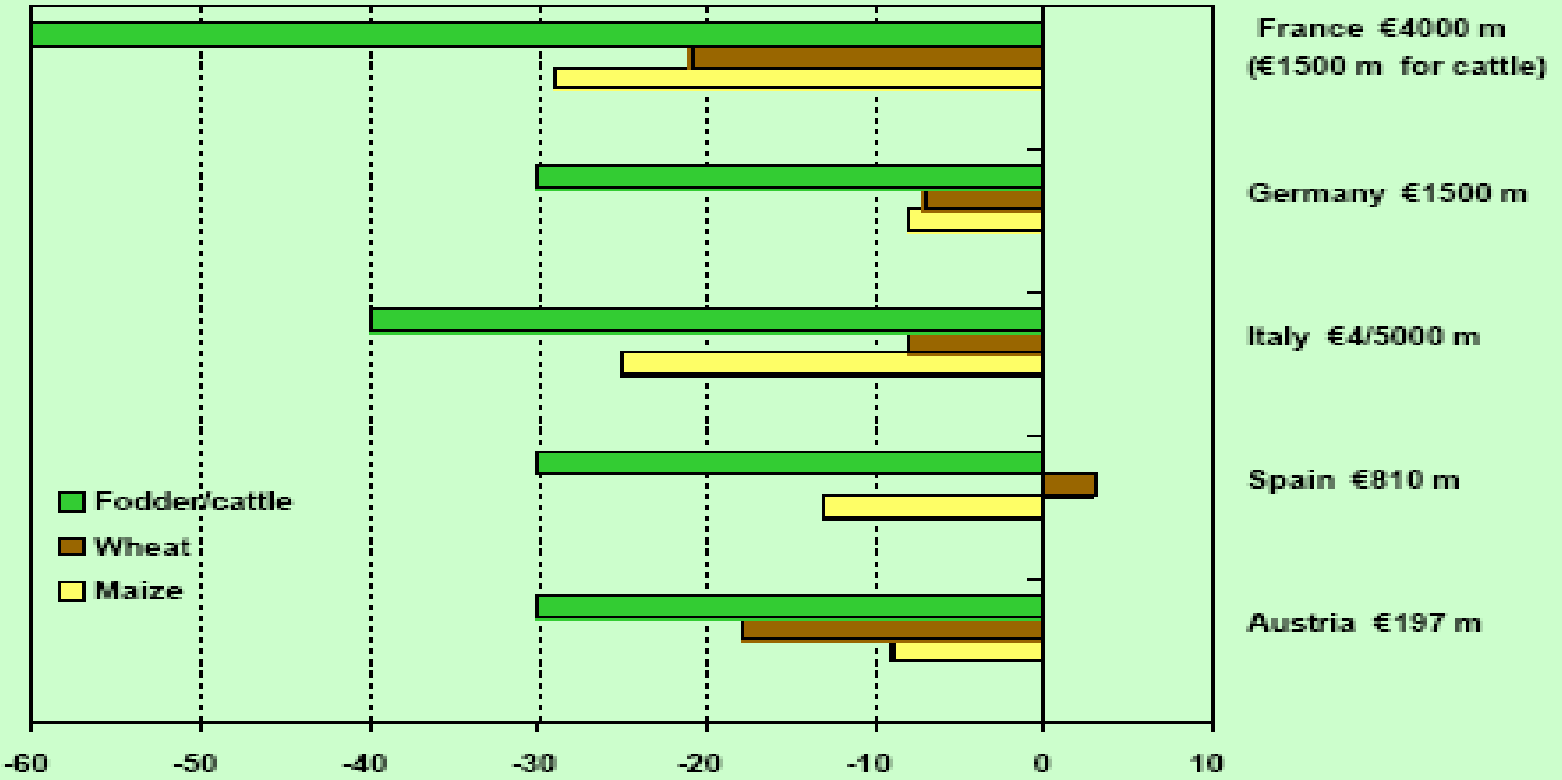
- Climate change affects food security:
  - Impacts on precipitation levels (declines/increases)
  - Impact on desertification (may become irreversible)
  - Heat waves (may become more intensive and may occur more often
  - Impact on crops, water needs, crop yields
  - Extreme weater events (drought, forest fires, flash floods occur more often
  - Need for adaptation and mitigation measures
  - Need to analyse and assess these challenges
  - Shift from short term perspective of politicians to a longer-term integrtd perspective of scientists
  - Adaptation of farming to new conditions: close interaction of indigineous knowledge with scientific knowledge
  - This requires a mutual learning process

6.1. Effects of 2003 summer heat wave on agricultural yield in five EU countries

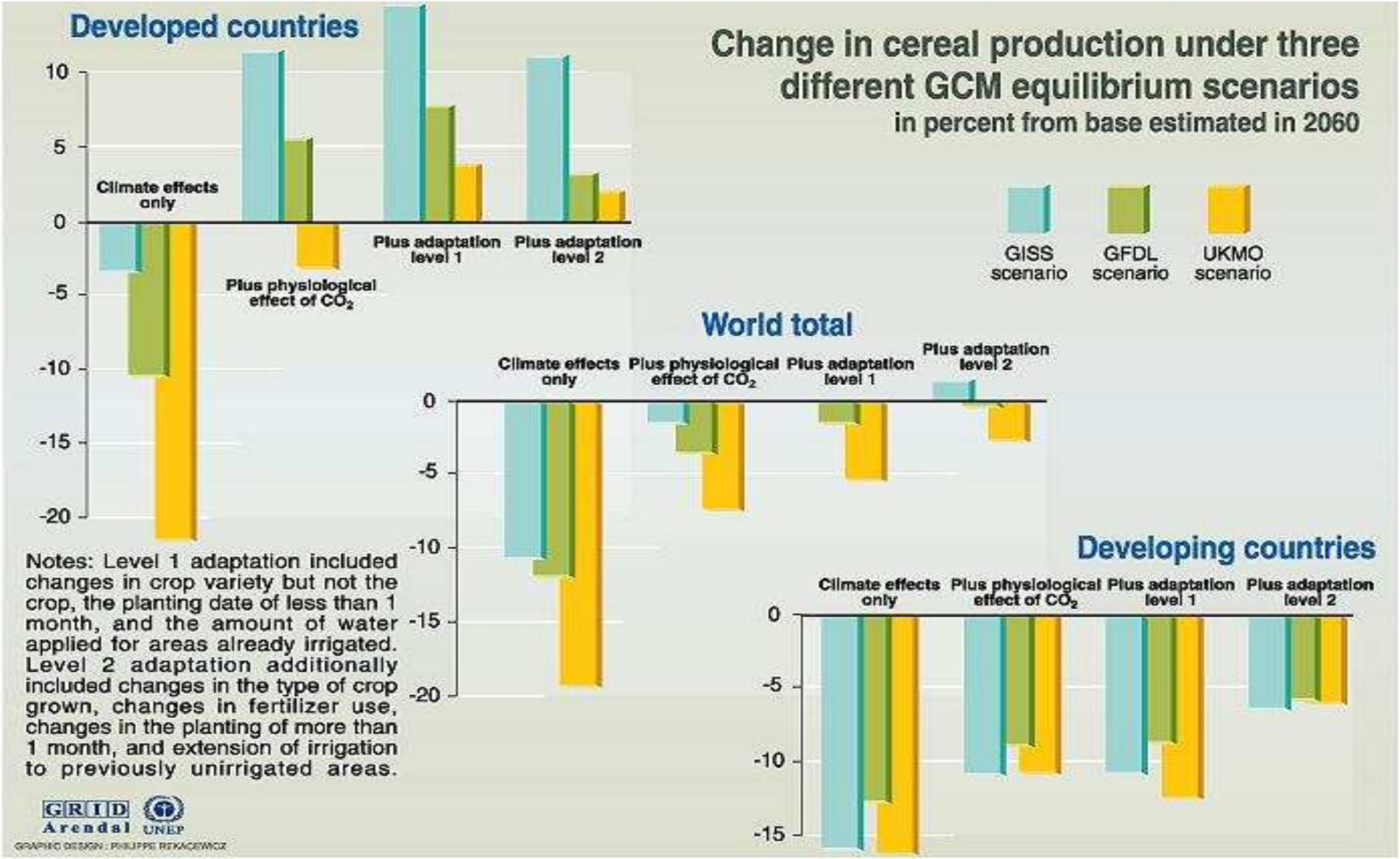
© M. Parry, Meeting of EU Agriculture/ Environment Ministers, 11.9.2005, London

COPA

Effects of 2003 summer heat wave on EU agriculture



6.2. Climate Change Impacts on Agriculture



Source: Climate change 1995, Impacts, adaptations and mitigation of climate change: scientific-technical analyses, contribution of working group 2 to the second assessment report of the intergovernmental panel on climate change, UNEP and WMO, Cambridge press university, 1996.

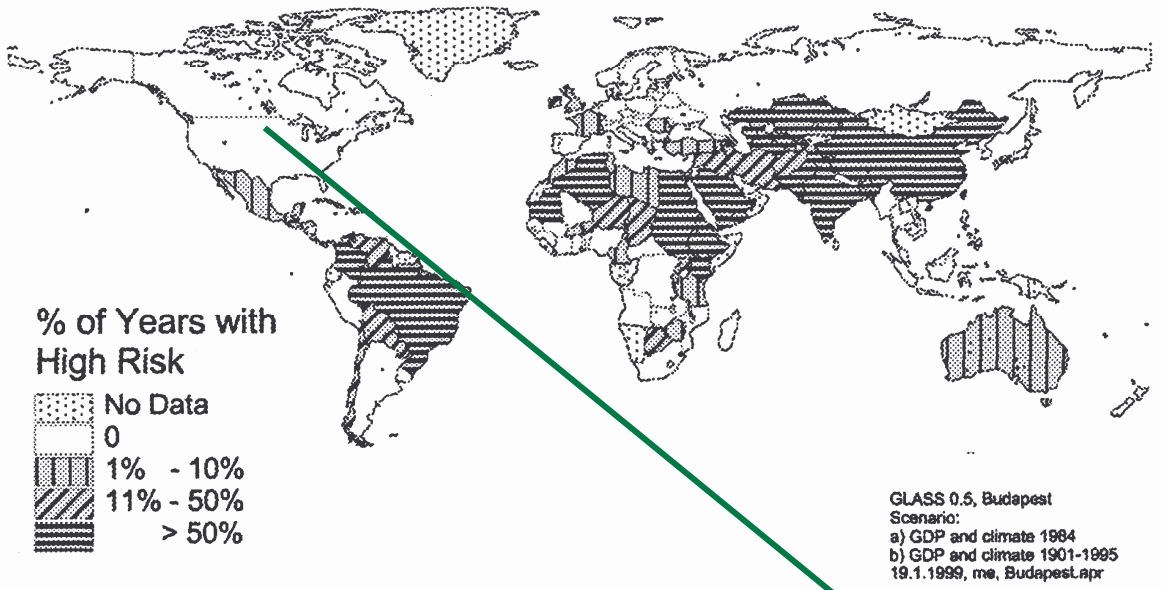


Figure 4. High Potential for Food Crisis 1901-1995.

← High Potential for Food Crisis (1901-1995) Alcamo/Endejan 2002: 143

6.3. Food Crises

High Potential for Food Crisis (2001-2050) with GDP and Climate Change →

Alcamo/Endejan 2002-143

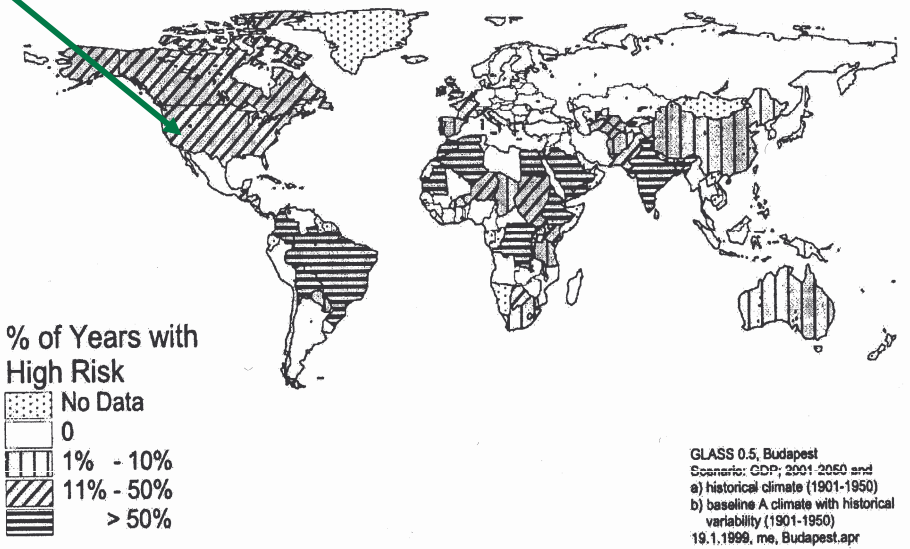
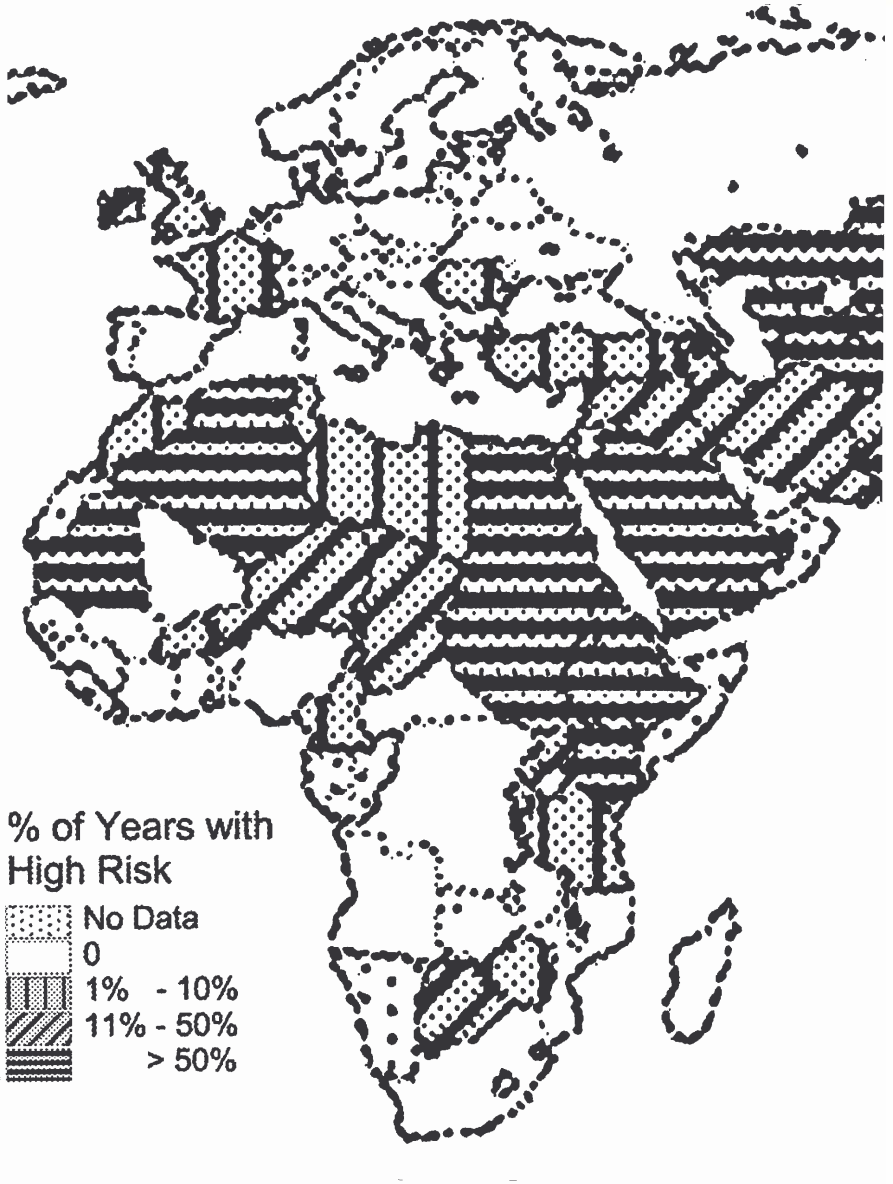


Figure 6. High Potential for Food Crisis 2001-2050 – with GDP Increase and Climate Change.

6.4. High Potential for Food Crisis 1990-2050



← Food Crisis: 1900-1995

Source:Alcamo/Endejan (2002)

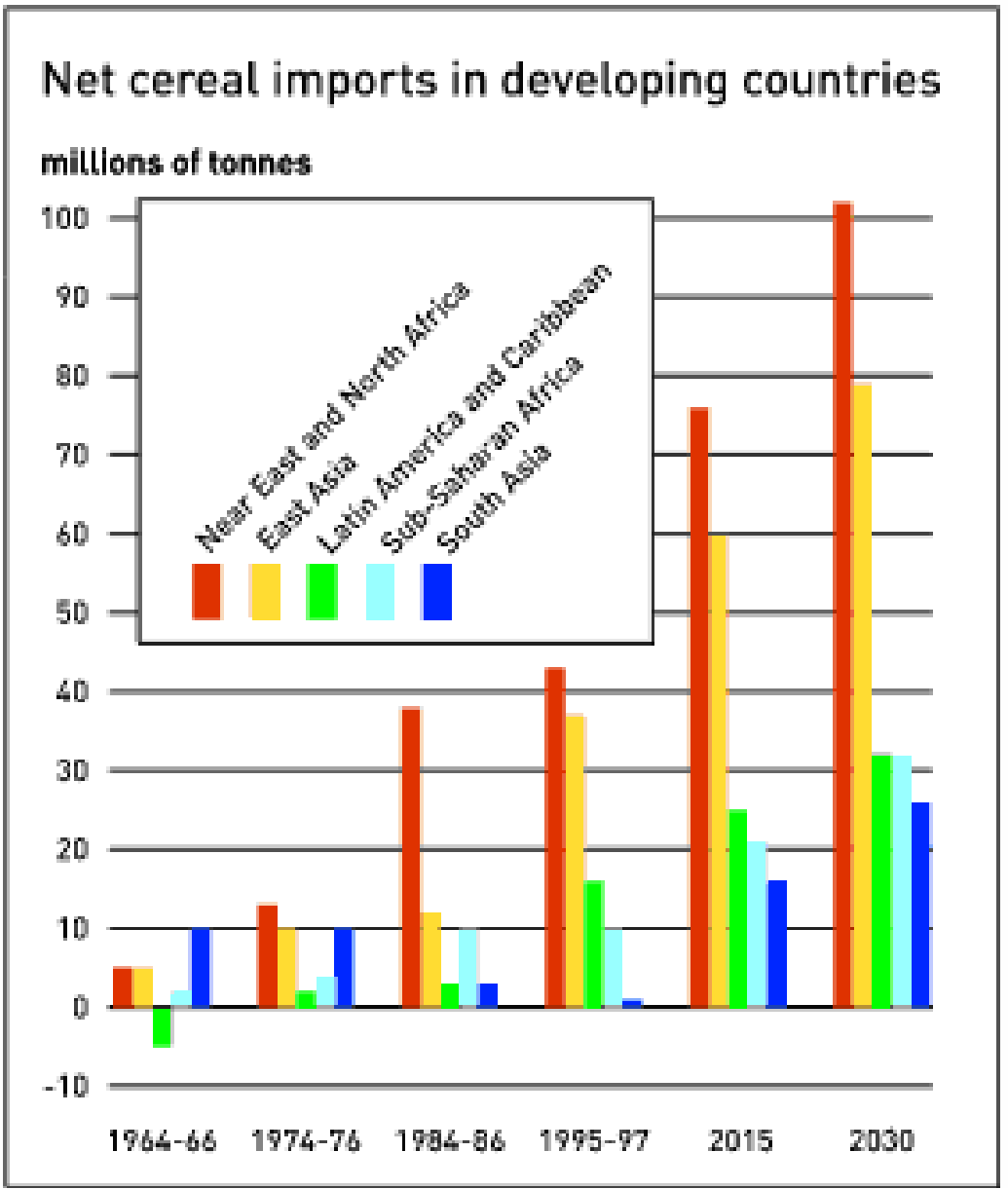
High Potential for Food Crisis 2001-2050 with GDP Increase & Climate Change ↓

6.5. Food Security in the MENA Region

Table: Cereal balance for the MENA, all cereals (1964-2030).

19	Demand				Pro-duc-tion	Net tra-de	Self-suf-fic. rate %	Growth rates, % p.a			
	Per caput (kg)		Total (mio.tons)					Time 19.../20..	Dem and	Pro-duc-tion	Po-pula tion
	food	All uses	food	All uses							
64/66	174	292	28	47	40	- 5	86	67-97	3.6	2.4	2.7
74/76	190	307	40	64	55	- 13	85	77-97	3.1	2.7	2.7
84/86	203	365	56	100	65	-38	65	87-97	2.1	2.0	2.4
95/97	208	357	75	129	84	-43	65	’95- 15	2.0	1.4	1.9
2015	209	359	108	186	110	-85	56	‘15- 30	1.5	1.2	1.4
2030	205	367	130	232	131	-116	54	‘95-‘30	1.8	1.3	1.7

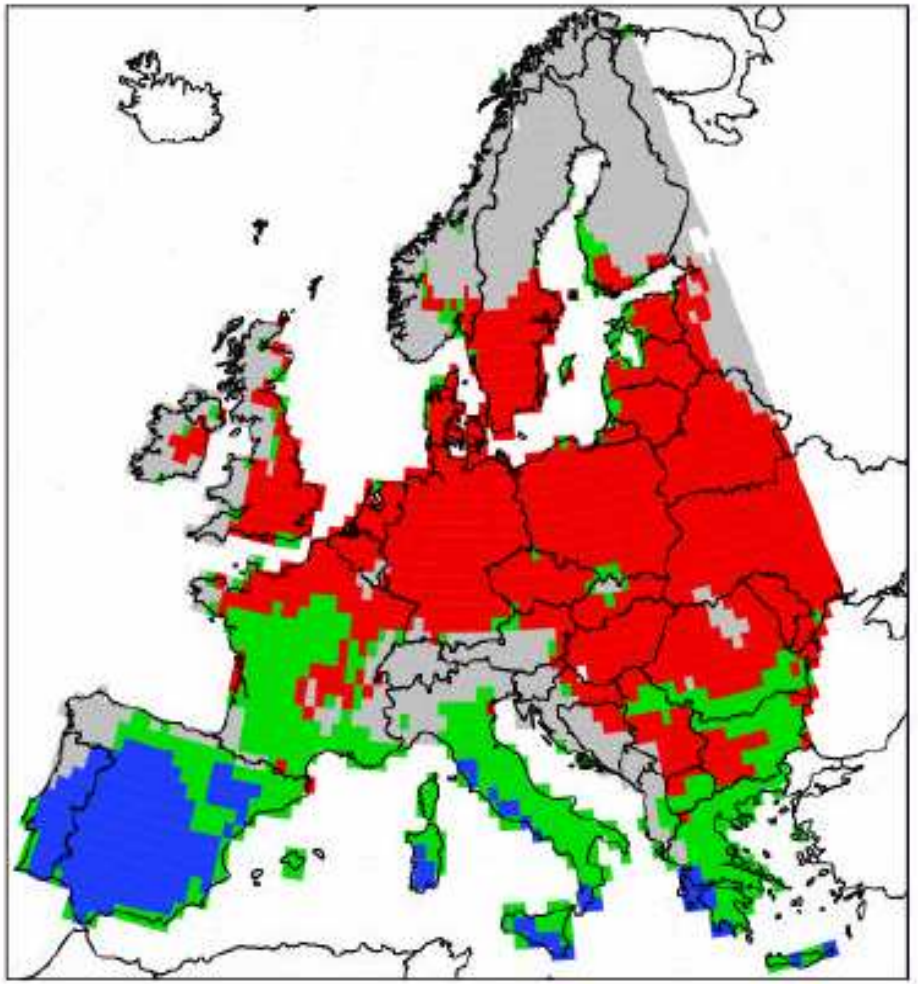
6.6. FAO (2000) Increase in Cereal Imports



- **FAO: 4 March 2003, Rome**
  World's population will be better fed by 2030**, but hundreds of millions of people in developing countries will remain chronically hungry**.
- Parts of South Asia may be in a difficult position and **much of sub-Saharan Africa** will not be significantly better off than at present in the absence of concerted action by all concerned.
- Number of hungry people is expected to decline from 800 million today to 440 million in 2030.
- **The target of the World Food Summit (1996) to reduce the number of hungry by half by 2015, will not be met by 2030.**

6.7. Yields of Wheat by 2080

(M. Parry, IPCC, London, 2005)

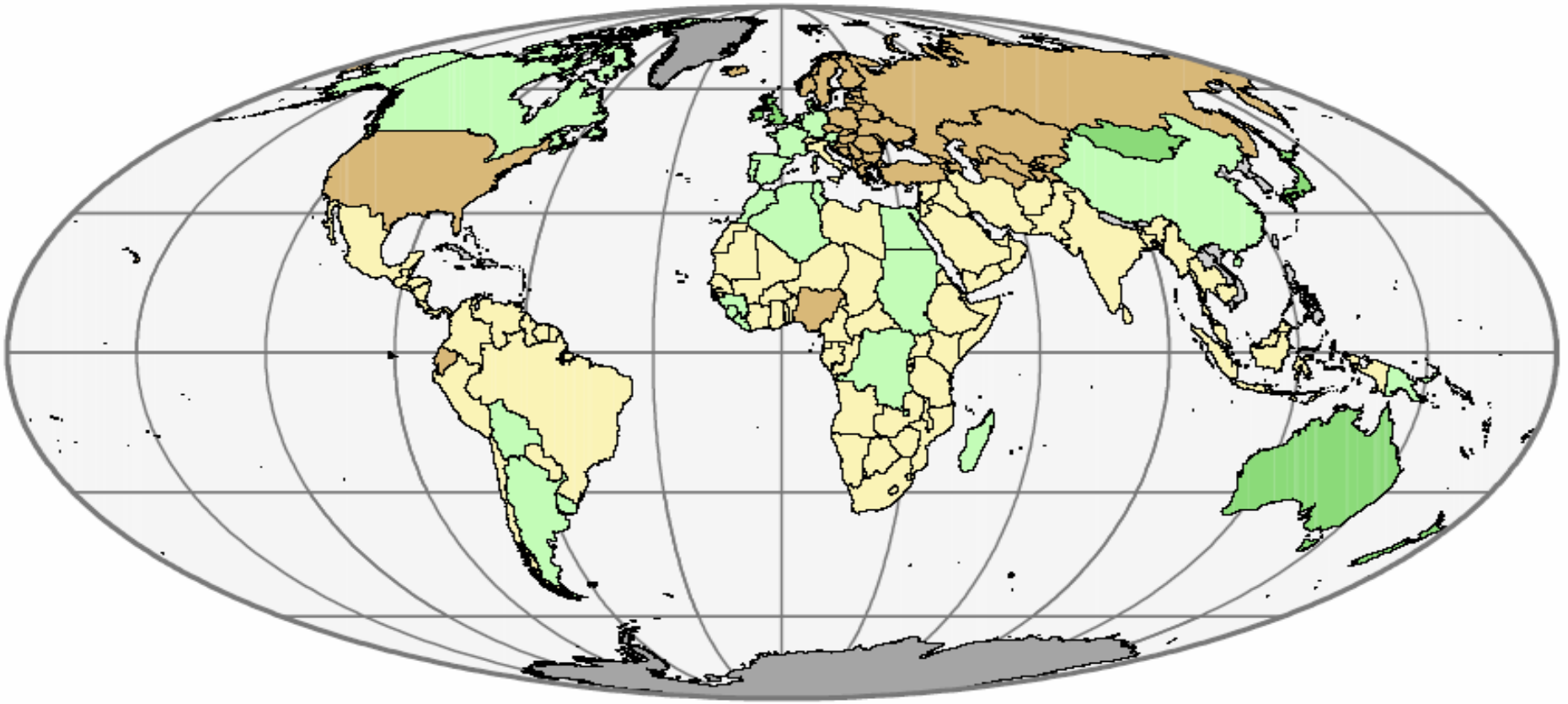


Reduced yield in all models

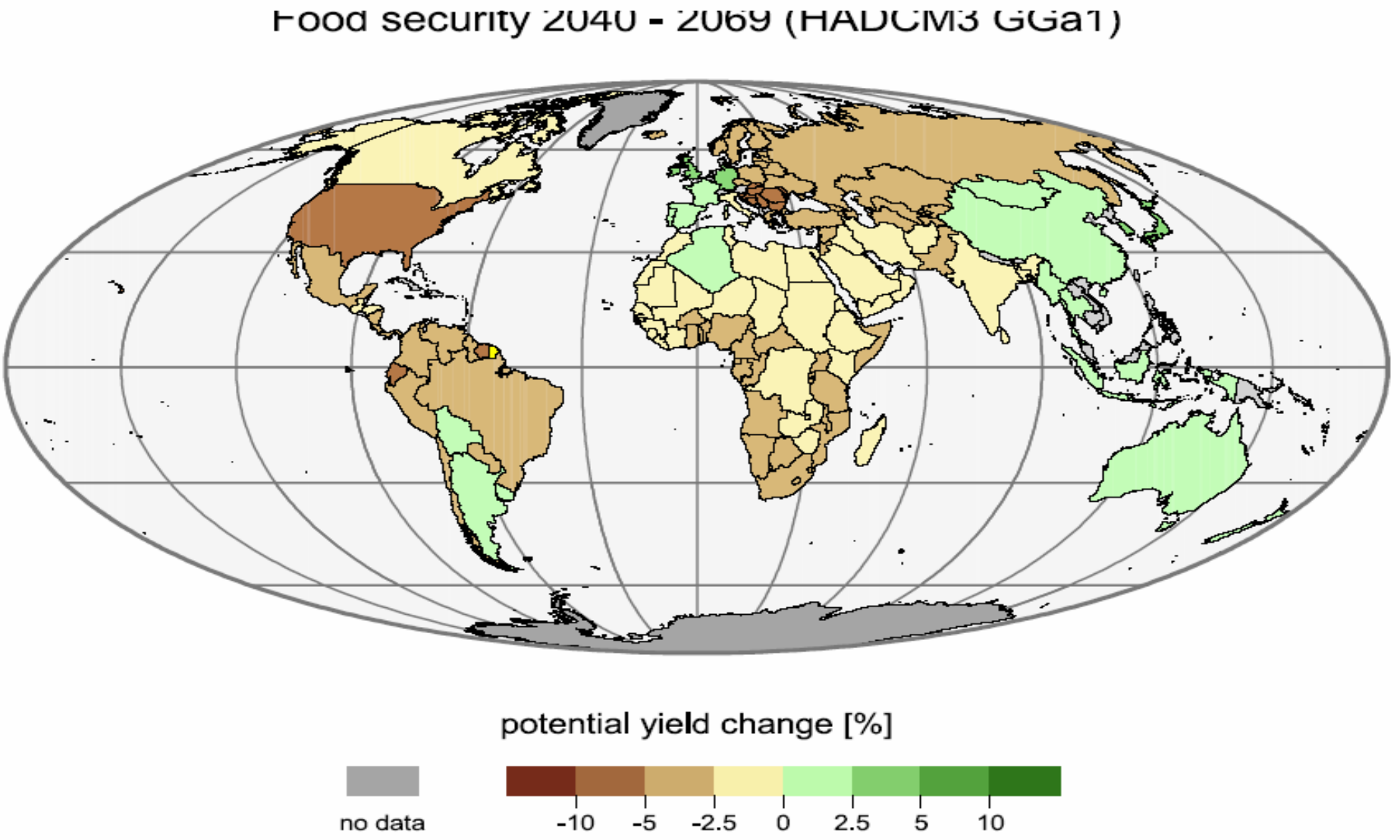
Increased yield in all models

Models do not agree

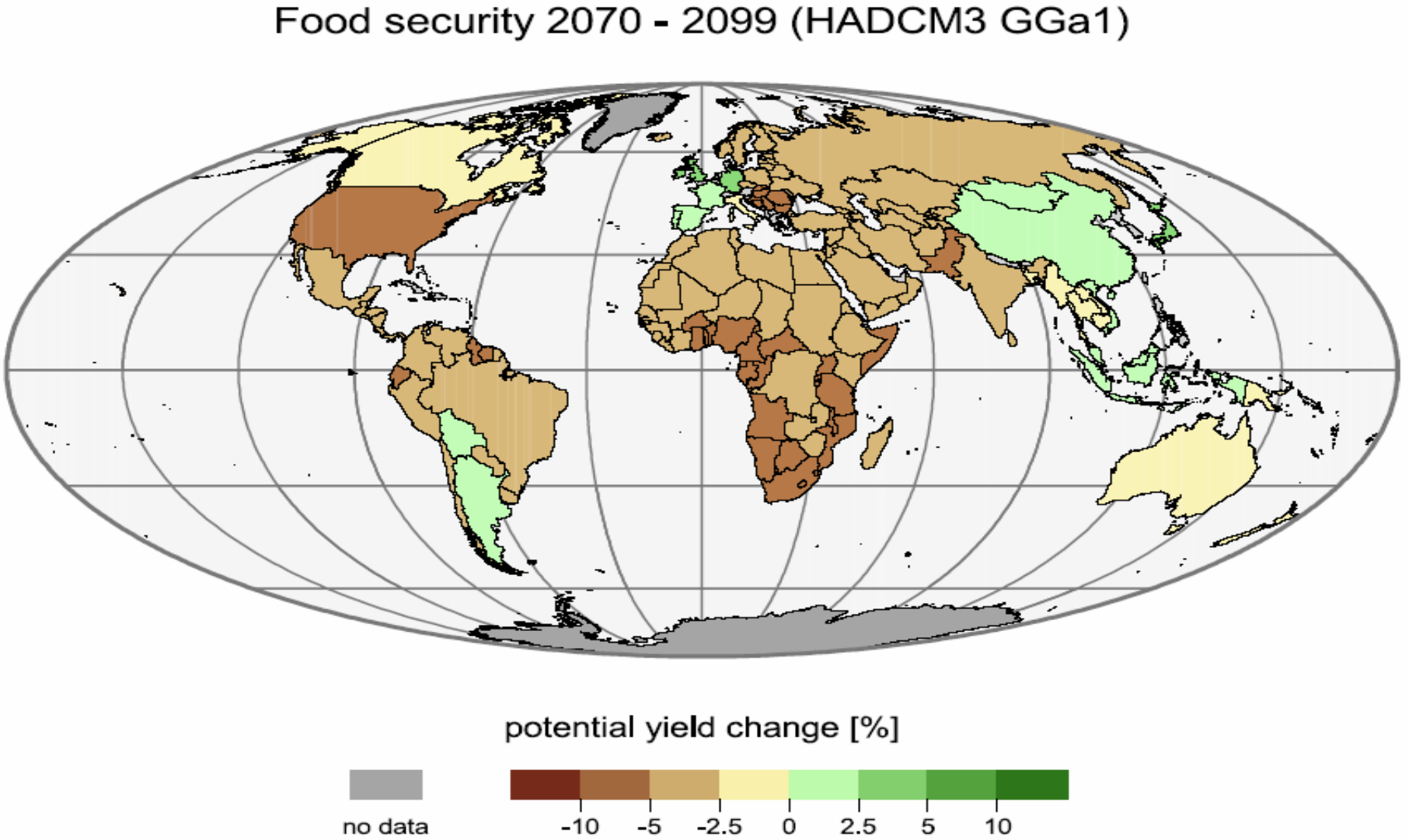
6.8. Food Security by 2020: Changes in Crop Yield



6.9. Food Security by 2050: Changes in Crop Yield



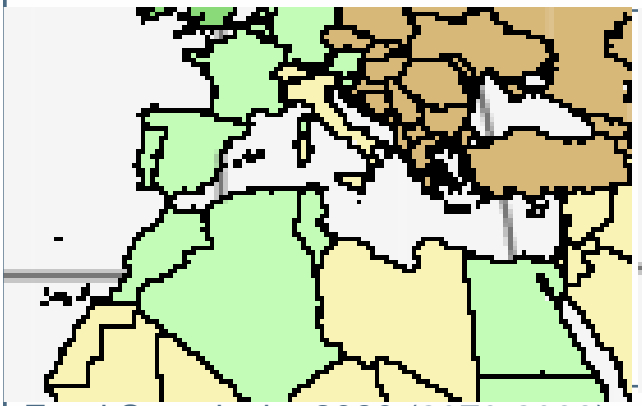
6.10. Food Security by 2080: Changes in Crop Yield



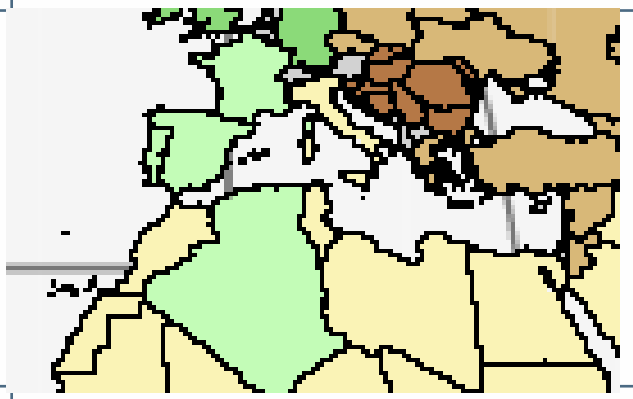
6.11. Climate Change & Food Security in Mediterranean

Changes in Agricultural Crop Yields by 2020, 2050, 2080

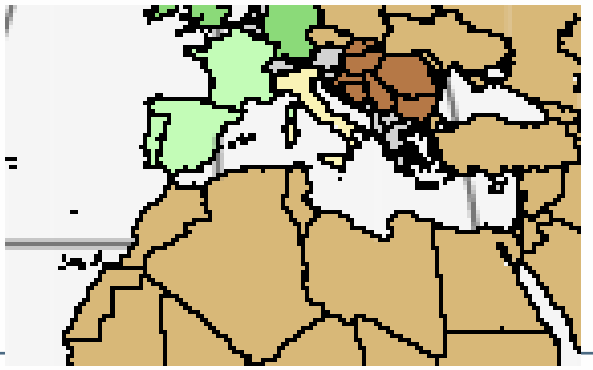
Food Security by **2020** (2010-2039) (HADCM3 GGa1)



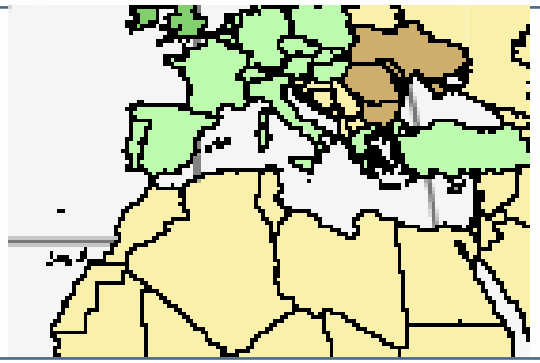
Food Security by **2050** (2040-2069) (HADCM3 GGa1)



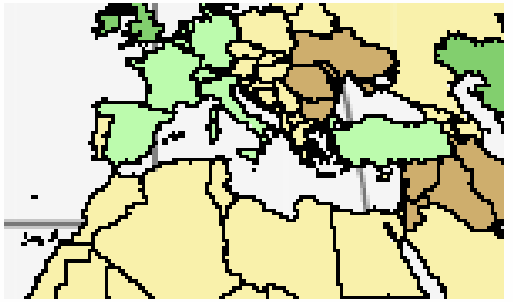
Food Security by **2080** (2070-2099) (HADCM3 GGa1)



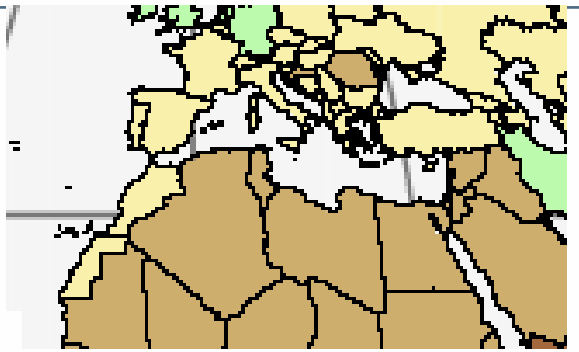
Food Security by **2080** (2070-2099) (HADCM2), CO2 Stabilisation at 550ppmv



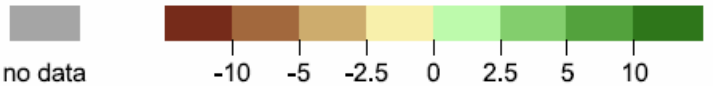
Food Security by **2080:** (2070-2099) (HADCM2), CO2 Stabilisation at 750ppmv



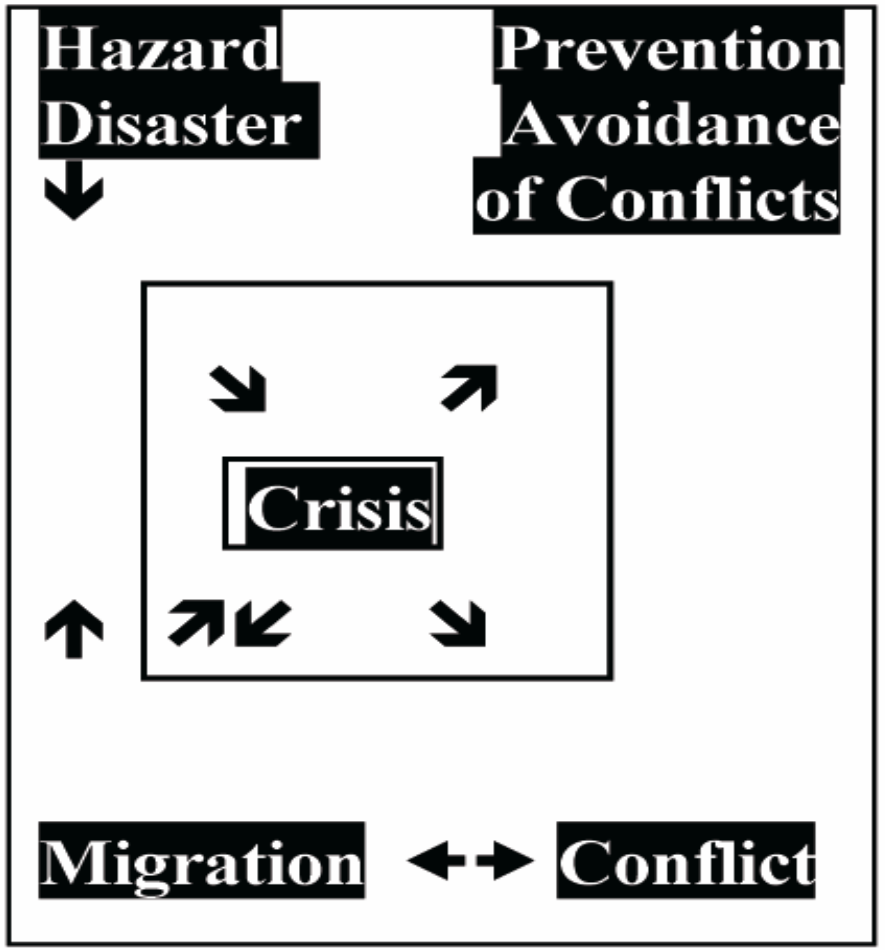
Food Security by **2080** (2070-2099) (HADCM2 IS92a), CO2 (unmitigated



potential yield change [%]



7. Environmental Stress & Impact: Hazards and Migration

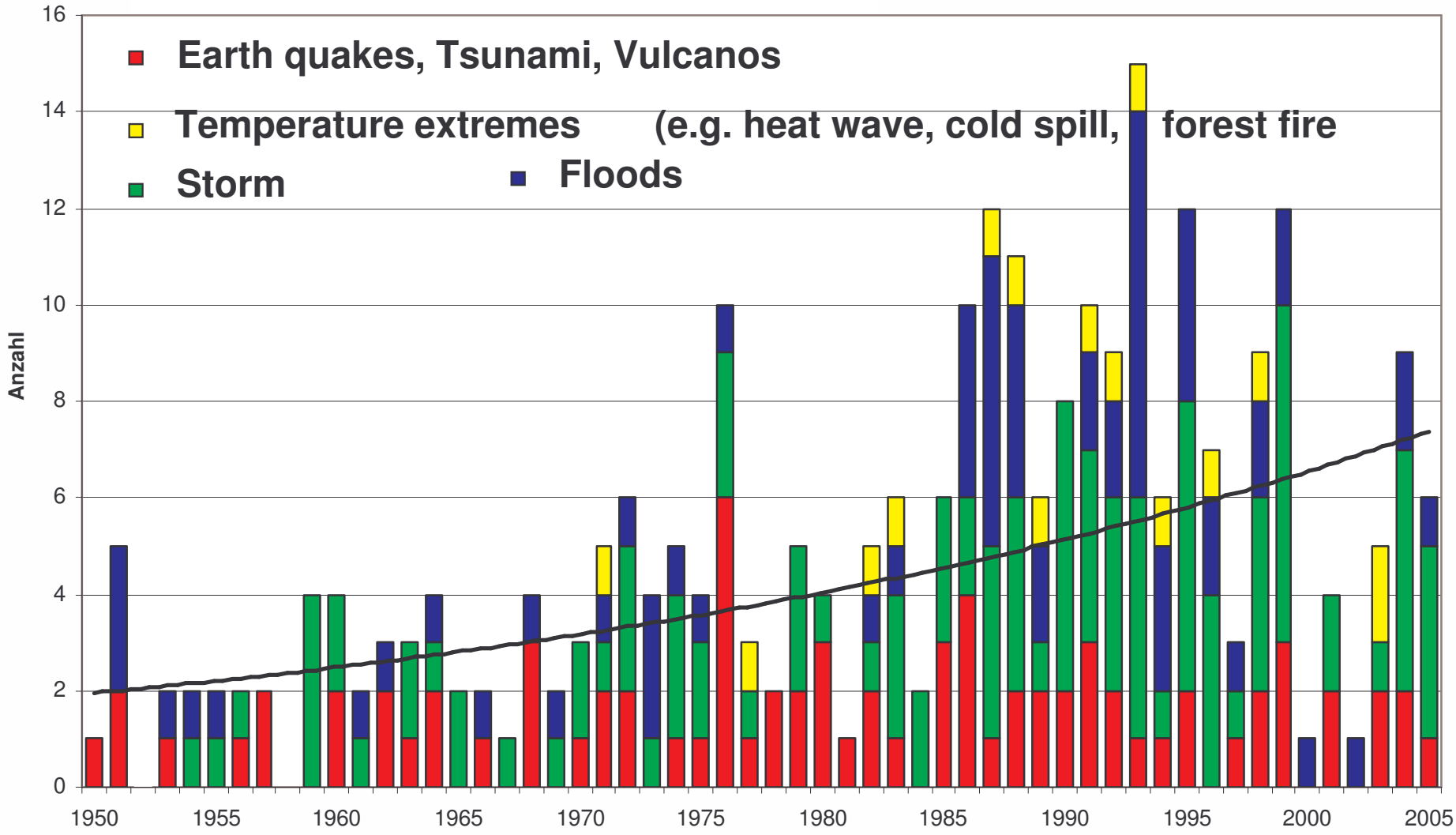


- IPCC TAR (2001): high probability
- Direct link between climate change and hydro-meteorological hazards:
  - Drought, forest fires
  - Storms, flash floods
  - Land slides
- Evidence by MunichRe & CRED, EMDAT, Louvain
- This has affected & will affect the region in 21st century.

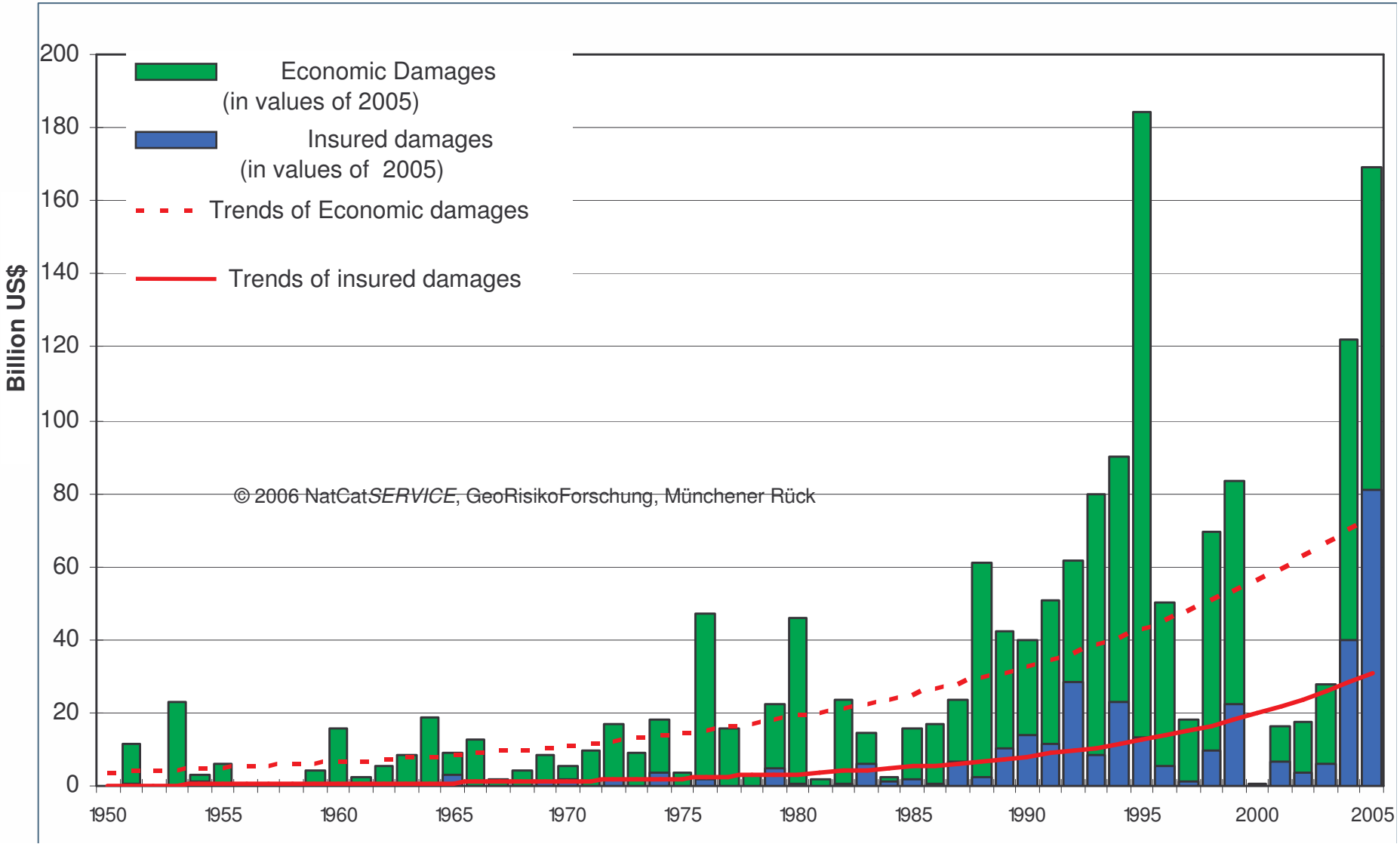
7.1. Extreme Weather Events in the 20th & 21st Century (IPCC, TAR 2001, WG II)

Confidence in observed changes (latter half of the 20th century)	Changes in Phenomenon	Confidence in projected changes (during the 21st century)
Likely[7]	**Higher maximum temperatures and more hot days over nearly all land areas**	Very likely[7]
Very likely[7]	**Higher minimum temperatures, fewer cold days and frost days over nearly all land areas**	Very likely[7]
Very likely[7]	**Reduced diurnal temperature range over most land areas**	Very likely[7]
Likely[7], over many areas	**Increase of heat index[12] over land areas**	Very likely[7], over most areas
Likely[7], over many Northern Hemisphere mid- to high latitude land areas	**More intense precipitation events[b]**	Very likely[7], over many areas
Likely[7], in a few areas	**Increased summer continental drying and associated risk of drought**	Likely[7], over most mid-latitude continental interiors. (Lack of consistent projections in other areas)
Not observed in the few analyses available	**Increase in tropical cyclone peak wind intensities[c]**	Likely[7], over some areas
Insufficient data for assessment	**Increase in tropical cyclone mean and peak precipitation intensities[c]**	Likely[7], over some areas

7.2. Major Natural Hazards (1950 – 2005)

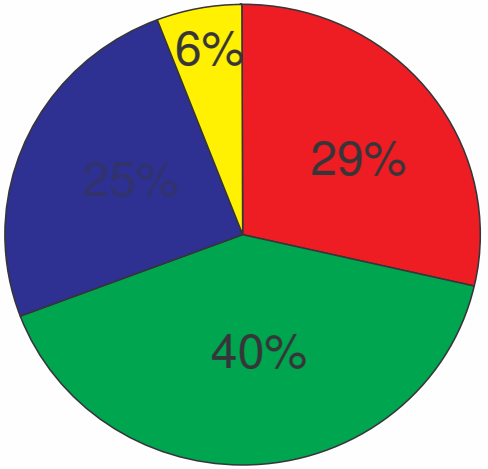


7.3. Major Natural Hazards (1950-2005), Economic & Insured Losses



7.4. Major Natural Hazards (1950-2005)

267 Events



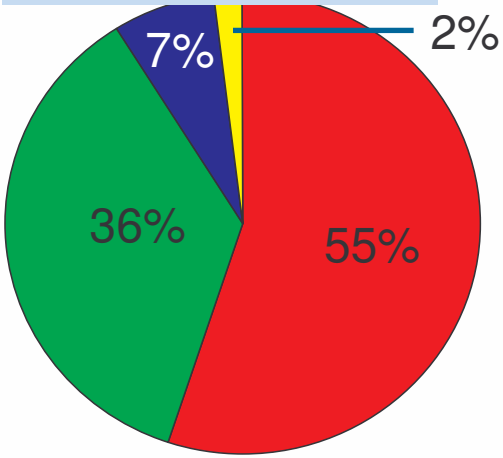
Geological events

- Earthquake/Tsunami, Volcano

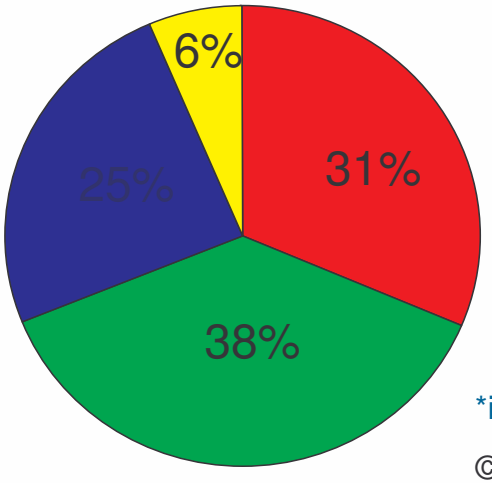
Weather-related events

- Storm
- Floods
- Extreme temperatures

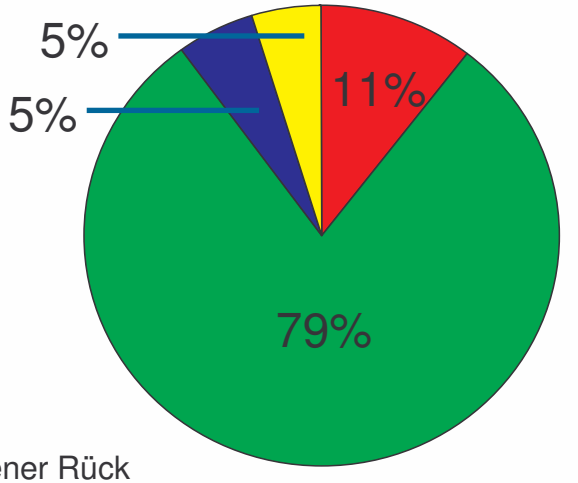
1,75 Million dead



Economic damage: 1.400 billion US$

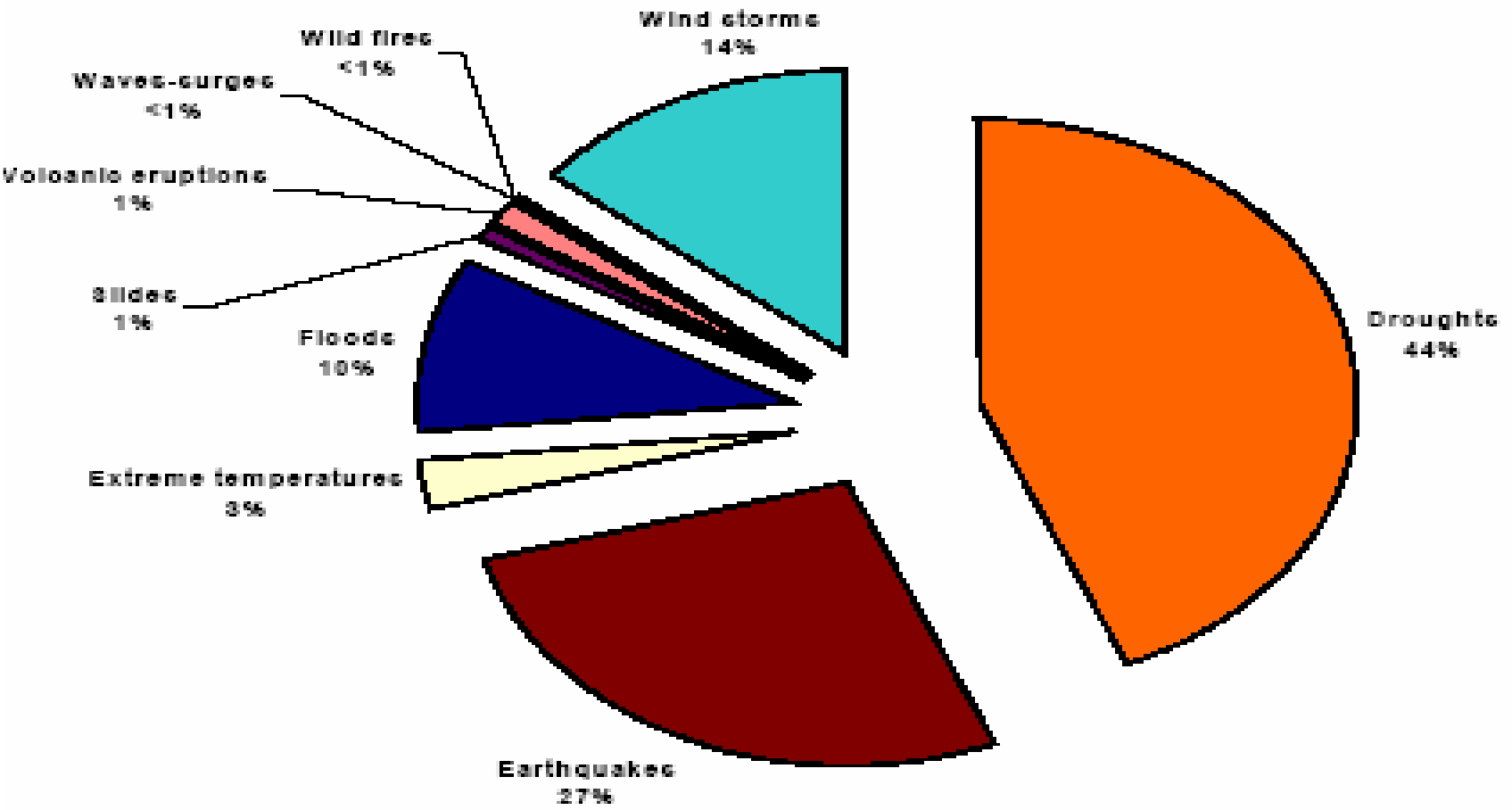


Insured damage: 340 billion US$



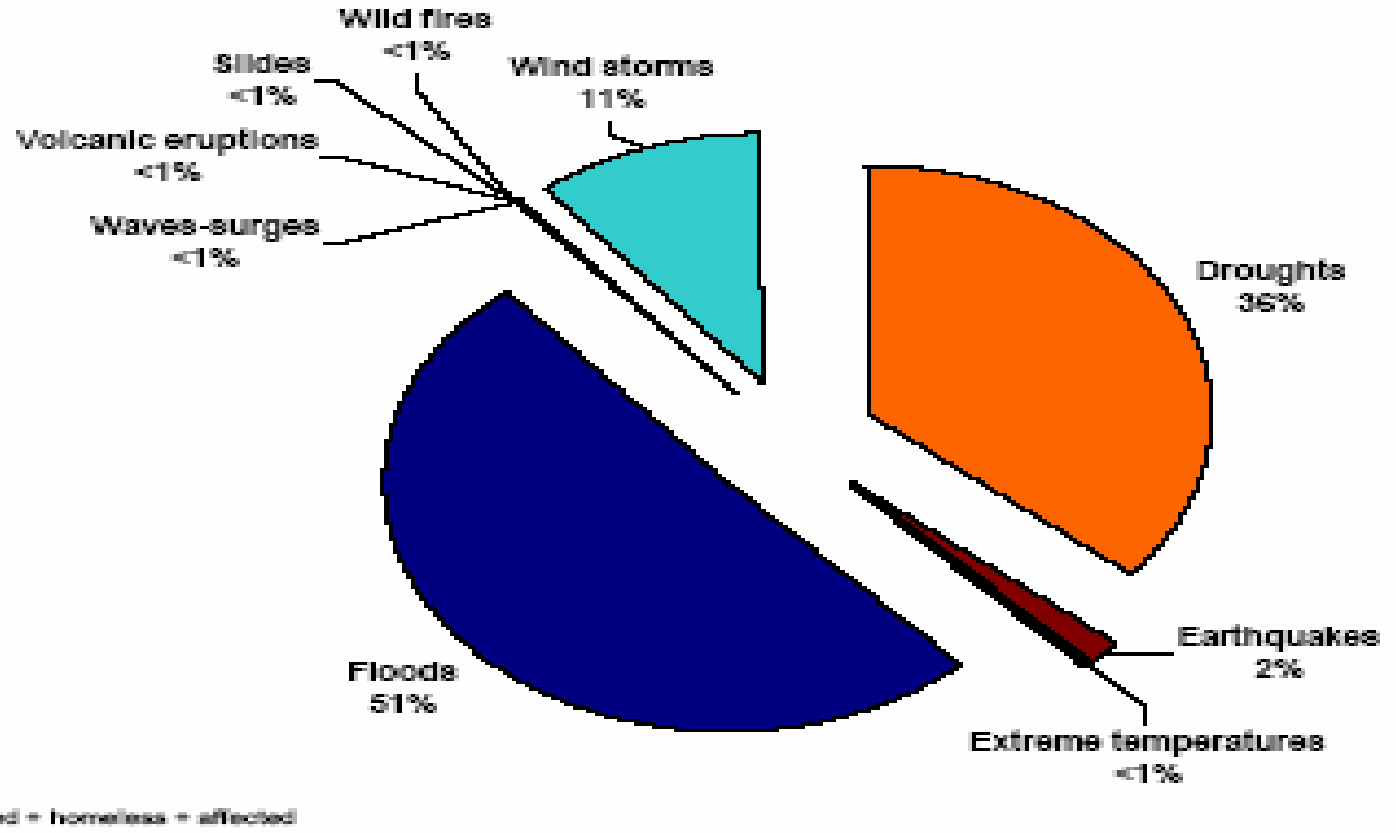
*in Werten von 2005

7.5. Reported Death of Natural Hazards globally (1974-2003): 2.066.273 persons



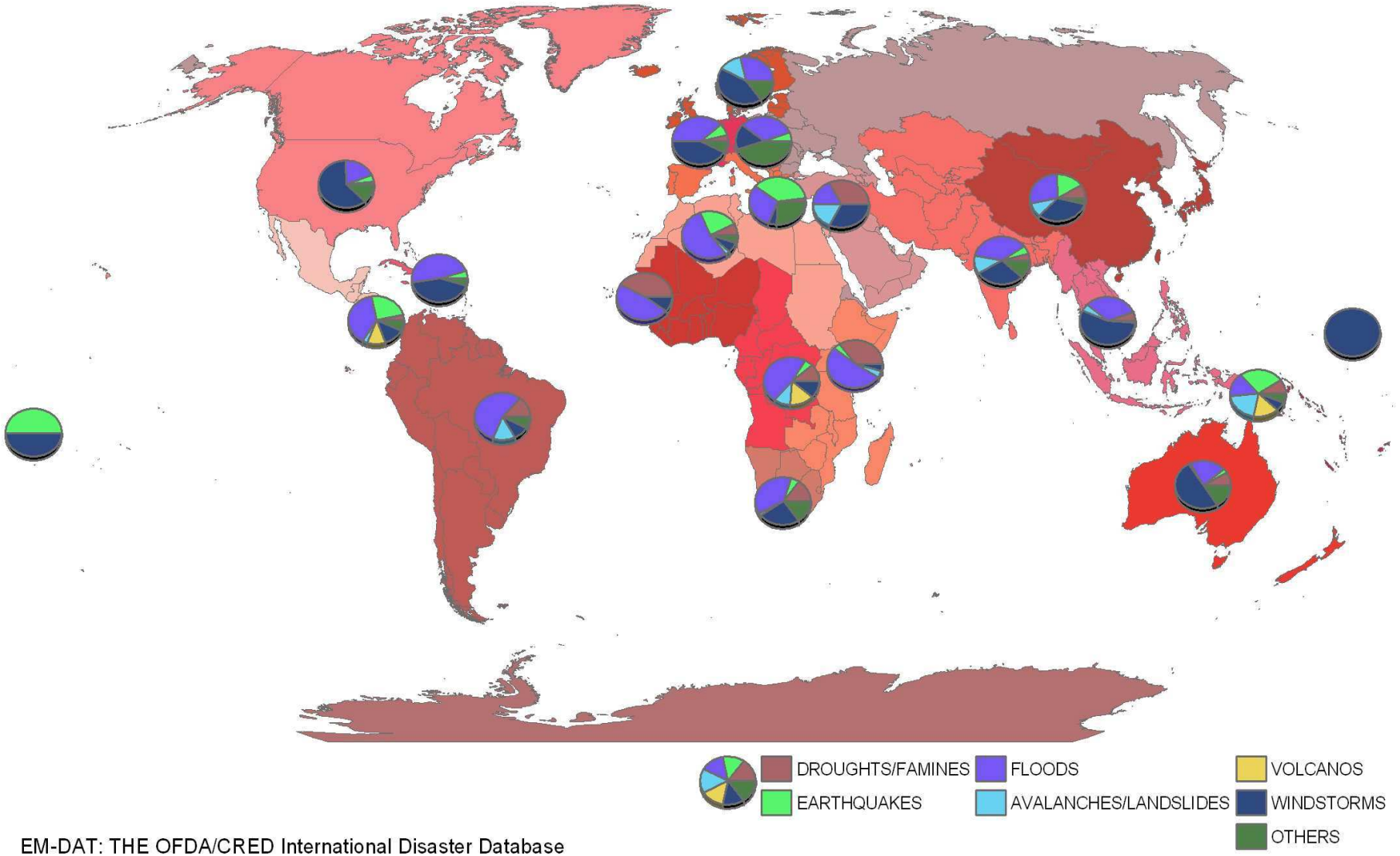
Source: © Hoyois und Guha-Sapir (2004)

7.6. Affected Persons of Natural Hazards Globally (1974-2003): 5 076 494 541 Persons



Source: © Hoyois und Guha-Sapir (2004)

Disaster Type Proportions by United Nations Sub-Regions: 1974-2003



EM-DAT: THE OFDA/CRED International Disaster Database
www.em-dat.net - Université Catholique de Louvain - Brussels - Belgium

7.8. Trend Analysis: Natural Hazards in the Mediterranean Region

People reported killed & affected by natural disasters, 1975 – 2001

	Total		Earthquake		Flood		Storm	
	E	Killed	E	Killed	E	Killed	E	Killed
S.Europe	249	8,889	33	6,007	71	837	60	469
Balkans	50	562	11	187	12	108	0	0
W. Asia	95	27,613	23	26,087	24	505	8	70
N. Africa	82	6,606	10	3,452	38	2,924	6	69
Total	485	43,729	79	35,735	145	4,374	76	608

Source: CRED database: how representative are reported events?

Role of Earthquakes more important than global trends (Munich Re)

Fatalities of Earthquakes: ca. 50% in 1999 in Izmit (Turkey)

Floods: More events & damages in S.Europe, more fatalities in N.A.

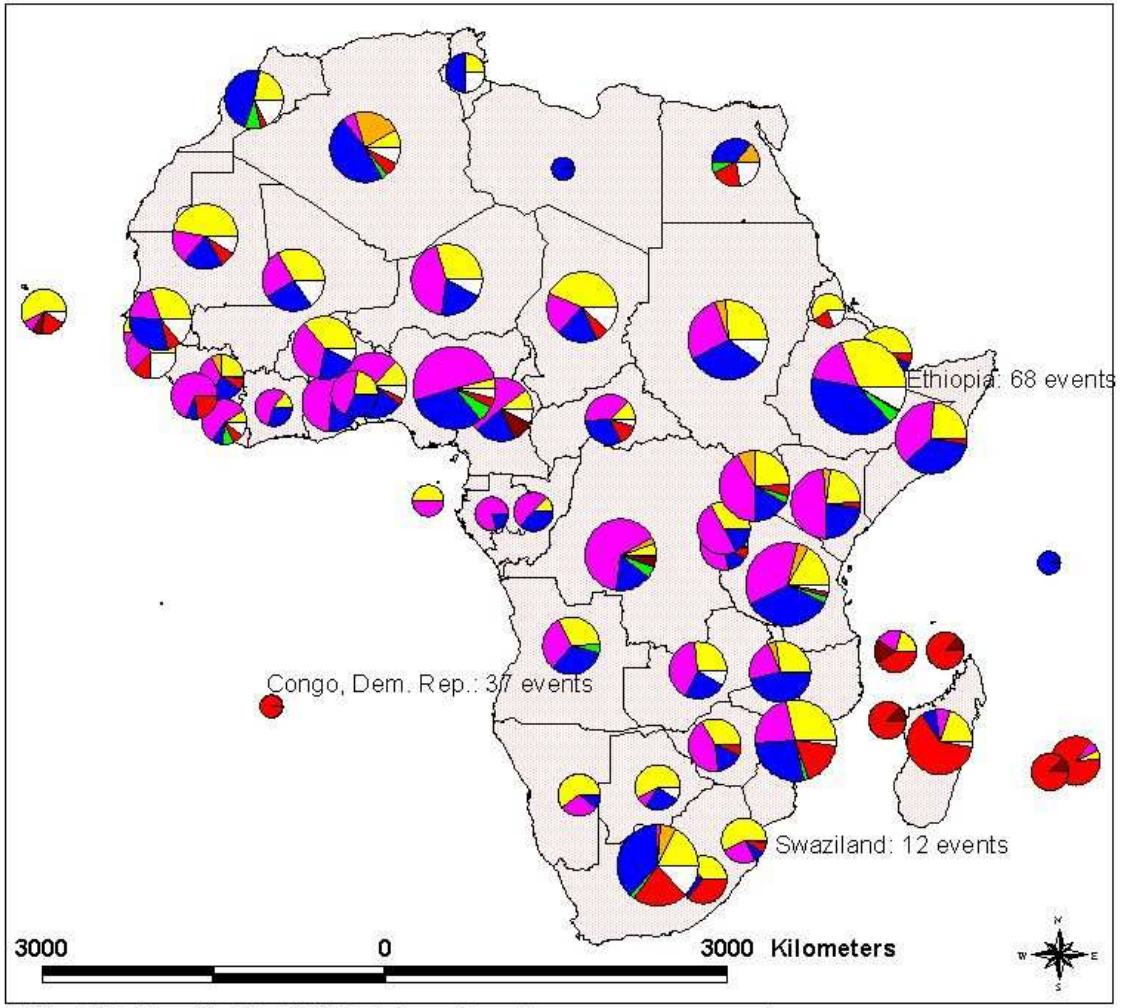
7.9. Floods in the Med. Region, 1975-2001

country	Date (m/19)	Event	Area affected	death	Econ. loss million ($)	Econ loss ins.
France	**10/88**	**Flash flood**	**Nimes**	**11**	**1,600**	
	11/99	Flash flood	Pyrenees	31	500	400
Greece	11/77	Flood	Athens	25	30	
	1/97	Flood	Athens	9	160	
Italy	**11/94**	**Flash flood**	**Piedmont**	**64**	**9,300**	
	10/00	**Floods, Islide**	**I,CH, F**	**38**	**8,500**	**420**
Spain	8/83	Flood	Burgos	40	950	
	11/87	**Flood ld.slide**	**Valencia**	**16**	**1,000**	
Turkey	**5/98**	**Floods**	**North, S.**	**27**	**2,000**	
Egypt	**11/94**	**flood**	**Durunka**	**589**	**140**	
Algeria	**11/01**	**Flash flood**	**Algeria**	**750**	**300**	

7.10. Types of natural hazards in Africa (1975-2001)

- This survey of EM-DAT, CRED, Univ. Louvain (Belgium) illustrates the vulnerability of the region to drought but also to flash floods

Distribution of natural disasters, by country and type of phenomena, in Africa (1975-2001)

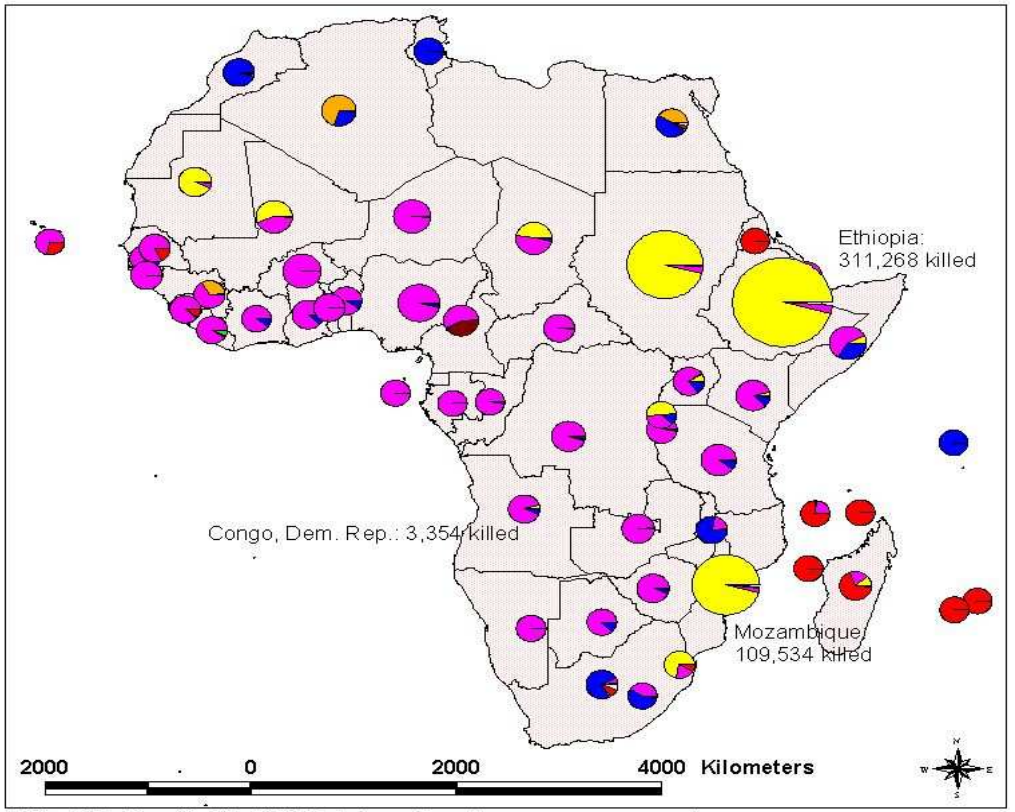


EM-DAT: The OFDA/CRED International Disaster Database
(http://www.cred.be ; email: cred@epid.ucl.ac.be)

LEGEND
- Volcano
- Earthquake
- Drought/Famine
- Epidemic
- Avalanche/Landslide
- Flood
- Wind Storm
- Other

7.11. Fatalities & Affected People of Natural Hazards in Africa (1975-2001)

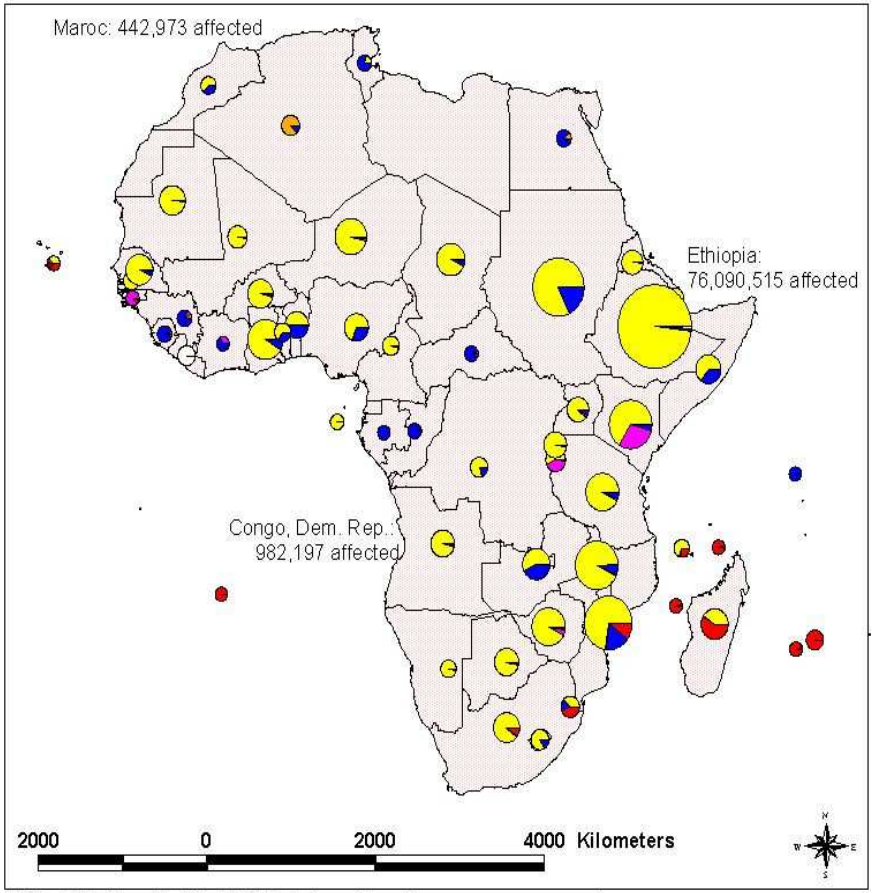
Distribution of natural disasters fatalities, by country and type of phenomena, in Africa (1975-2001)



EM-DAT: The OFDA/CRED International Disaster Database
(http://www.cred.be ; email: cred@epid.ucl.ac.be)

LEGEND
- Volcano
- Earthquake
- Drought/Famine
- Epidemic
- Avalanche/Landslide
- Flood
- Wind Storm
- Other

Distribution of people affected by natural disasters, by country and type of phenomena, in Africa (1975-2001)



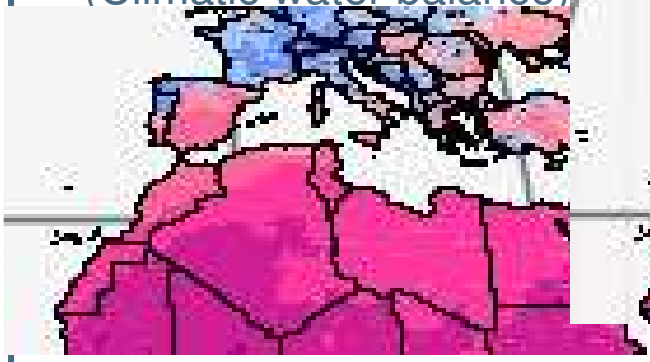
EM-DAT: The OFDA/CRED International Disaster Database
(http://www.cred.be ; email: cred@epid.ucl.ac.be)

LEGEND
- Volcano
- Earthquake
- Drought/Famine
- Epidemic
- Avalanche/Landslide
- Flood
- Wind Storm
- Other

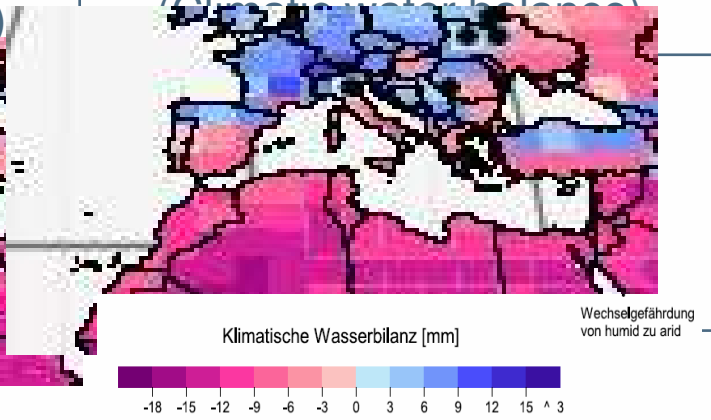
7.12. Potential Dangers of Drought

Source: AFES-PRESS for WBGU, 2006, slides by PIK for WBGU

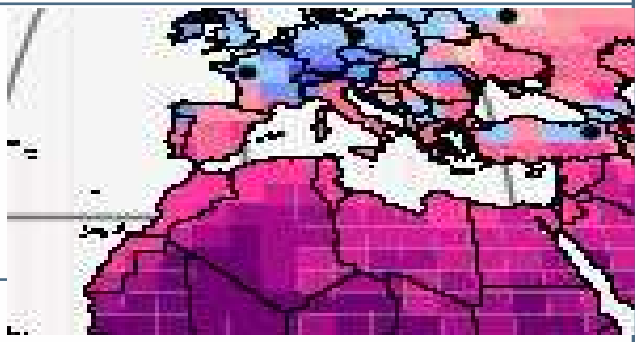
For 1975-2004
(Climatic water balance)



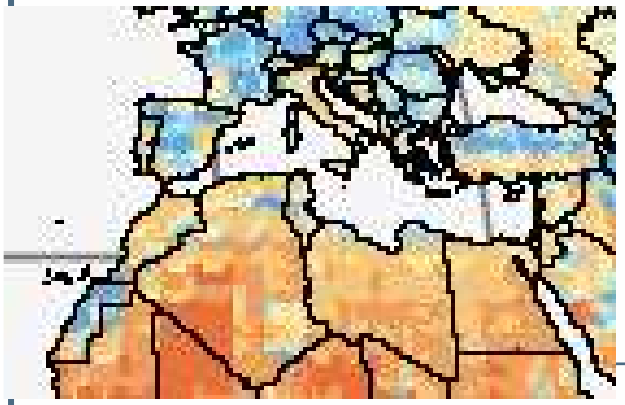
For 2050 (2040-2069)
(Climatic water balance)



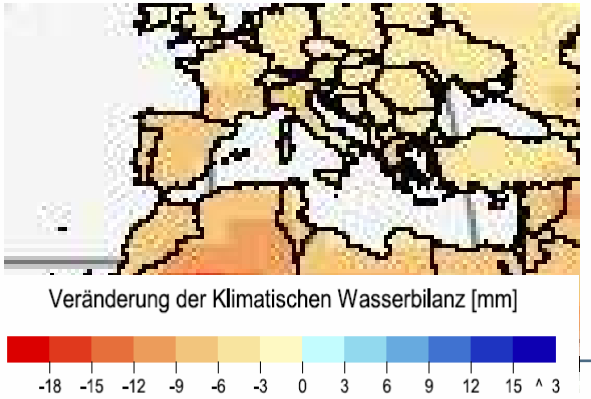
For 2080 (2070-2099)
(Climatic water balance)



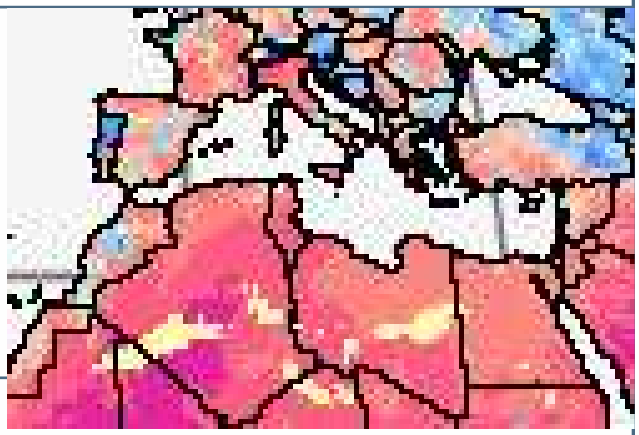
Difference 2040/2069-1975/2004,
change of climatic water balance.



Difference 2070/ 2099-2040/69,
change of climatic water balance.



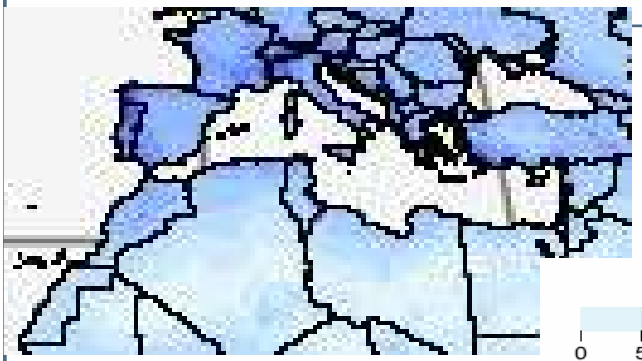
Trends of climatic water balance.
1975-2004



7.13. Potential for Flash Floods

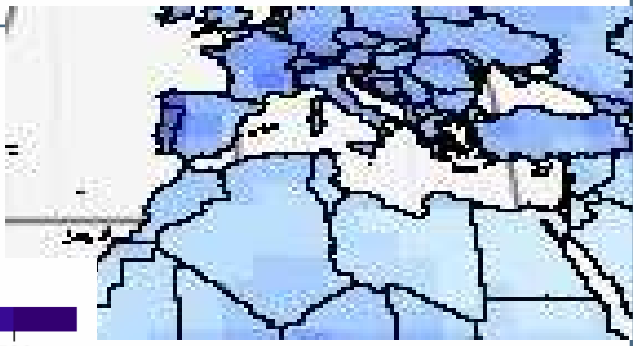
Source: AFES-PRESS for WBGU, 2006, slides by PIK for WBGU

Potential danger of flash floods by country, 1975-2004



Potential danger of flash floods by 2050 (2040-2069)

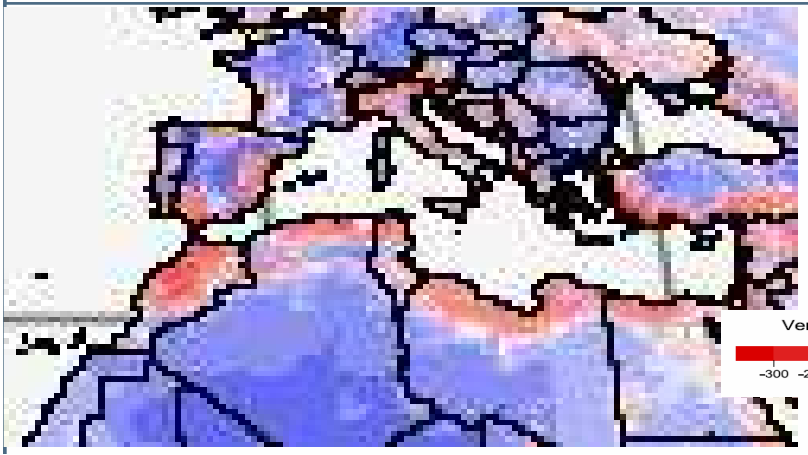
Potential danger of flash floods by 2080 (2070-2099)



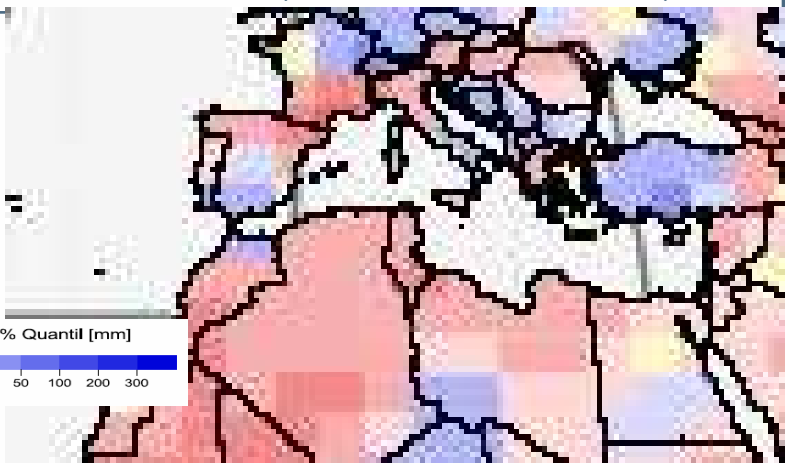
Mittel der Werte über dem 95% Quantil [mm]

0 5 20 50 100 150 200 250 300 350 400 450 500

Potential danger of flash floods by country Difference 1990-2050 (2040-2069 -1975/2004)



Potential danger of flash floods by country Difference 2050-2080 (2070/2099 -2040/2069)



Veränderung der Mittelwerte über dem 95% Quantil [mm]

-300 -200 -100 -50 -20 -5 -1 1 5 20 50 100 200 300

7.15. Conclusions on Projected Fatal Outcomes in the Mediterranean

- IPCC (2001): Climate change has already contributed to an increase in extreme weather events in 29th century and will increase further in 21st century.
- Due to high societal vulnerability in North Africa the number of victims to floods was higher while the economic loss was lower than in Southern Europe.
- Soil erosion, droughts, forest fires and heat waves as well as flash floods have cumulative negative effects and will increase the number of victims and economic losses.
- The ageing of the North (declining population) and the high population growth in the South will have different impacts on the Mediterranean landscapes.
- The migration pressure in the MENA will intensify.
- These trends will affect the environmental security dimension and will impact on human, societal and regional security!

7.16. Increase in Human Disasters and Conflicts Impacting on the Mediterranean

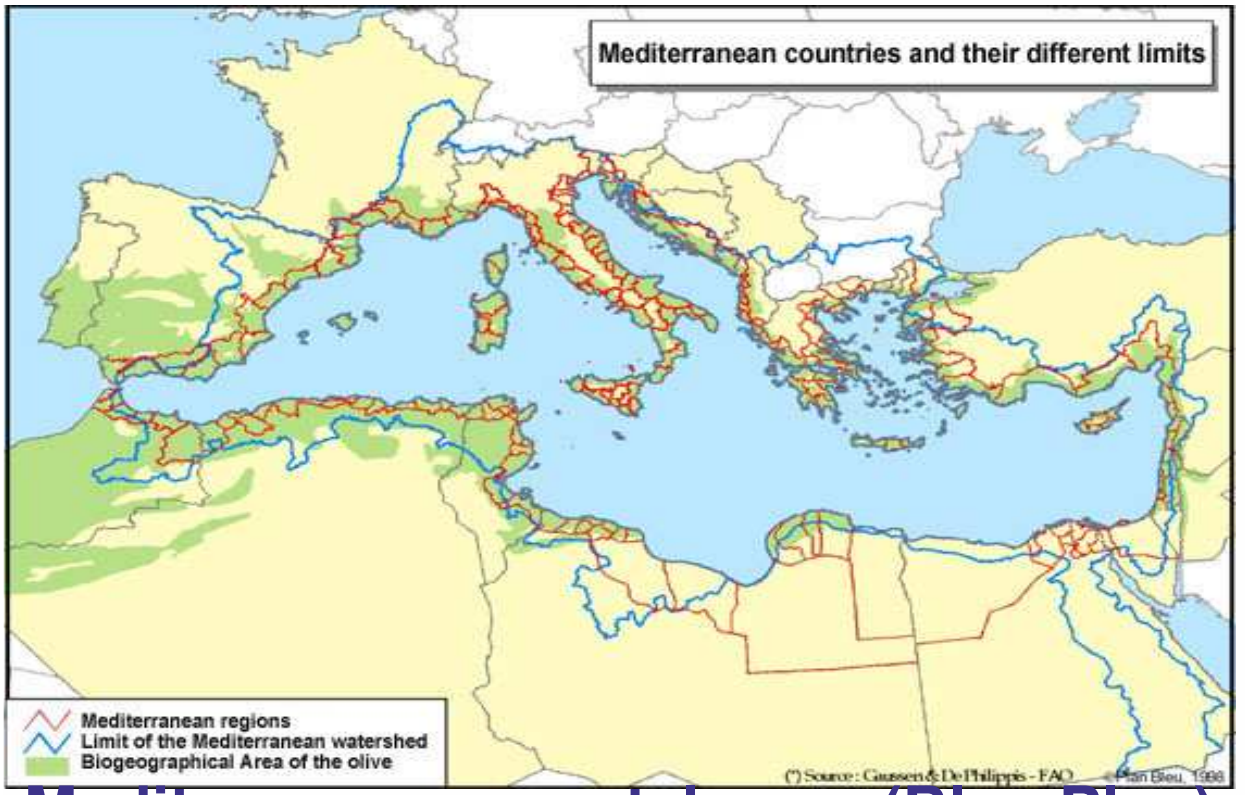
- **Will these fatal outcomes of global environmental change (GEC) and climate change(CC) lead to conflicts?**

Hypotheses

- Thesis 1: Population growth, urbanisation & persistent high poverty will increase the societal vulnerability to hazards and disasters.
- Thesis 2: Extreme weather events will „very likely“ lead to an increase in hydro-meteorological hazards (droughts, flash floods and storms).
- Thesis 3: Environmental stress and hazards may trigger distress migration and low level conflict potentials within societies and among states.

8.Regional Context:

Southern Europe and North Africa



Mediterranean coastal zone (Blue Plan)

vulnerable to rapid onset hazards: **drought & forest fires, storms, flash floods, mudflows**;

vulnerable to slow onset hazards: **sea-level rise and temperature increase (climate change)**

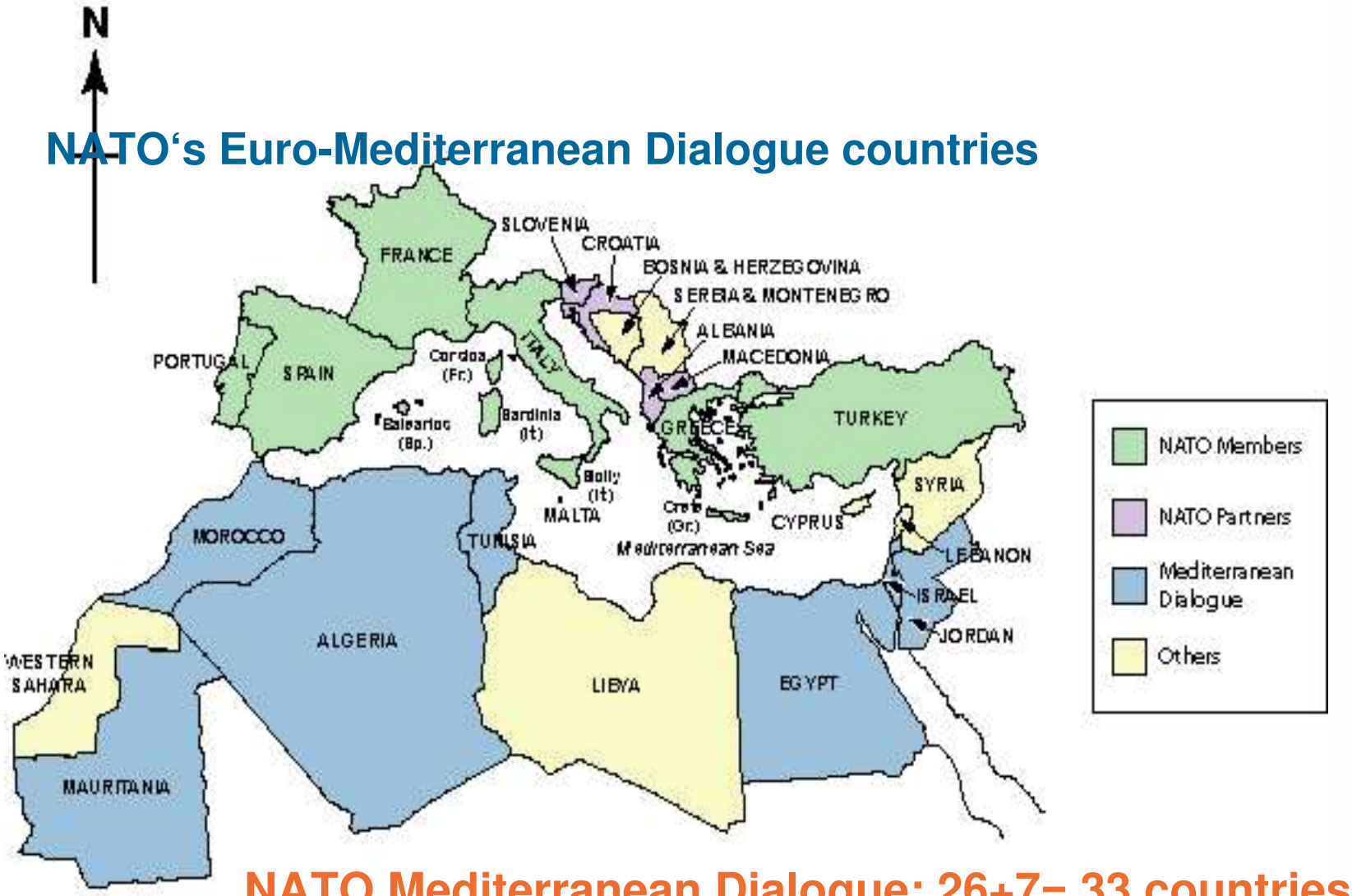
- **Geoecological commonalities**
  - **Climate change** (extreme weather events: hazards)
  - **Soil erosion & desertification**
  - **Water: precipitat.** (scarcity, degradation, drought, forest fire)
- **Socio-economic differences**
  - **Population growth**
  - **Urbanisation**
  - **Food needs**

Difference:

- **Social vulnerability**
- **Coping capacity**

8.1. Political Space:

NATO‘s Mediterranean Dialogue



NATO Mediterranean Dialogue: 26+7= 33 countries

8.2. Euro-Mediterranean Partnership (EMP)

- Euro-Mediter. Partnership (EMP) or Barcelona process: 1 May 2004: 25+10 (35 countries)
- Libya is an observer
- EU-programme SMAP

2 meetings of Environm. Ministers

- Nov. 1997: Helsinki
- July 2002: Athens

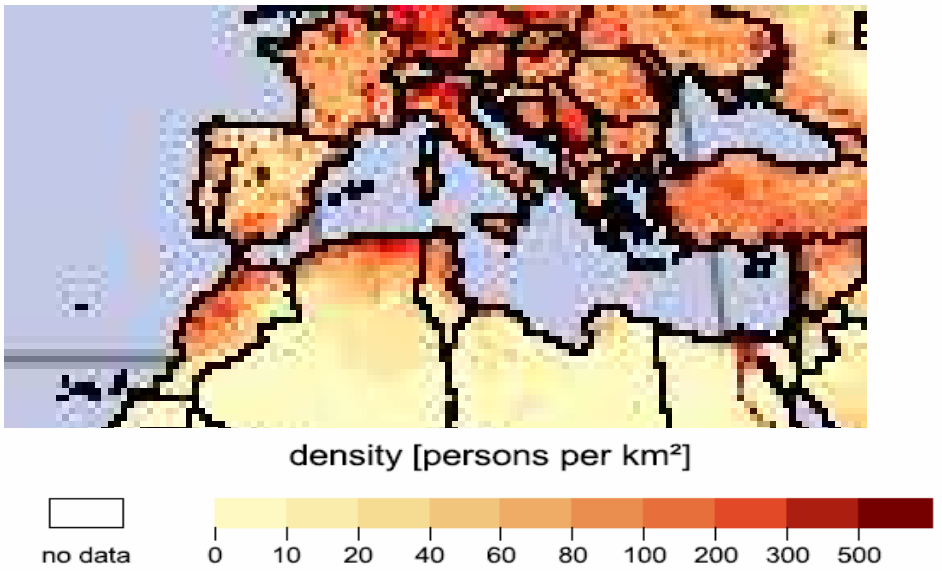
June 2003, Council of Thessaloniki, EU Green Diplomacy (Network)

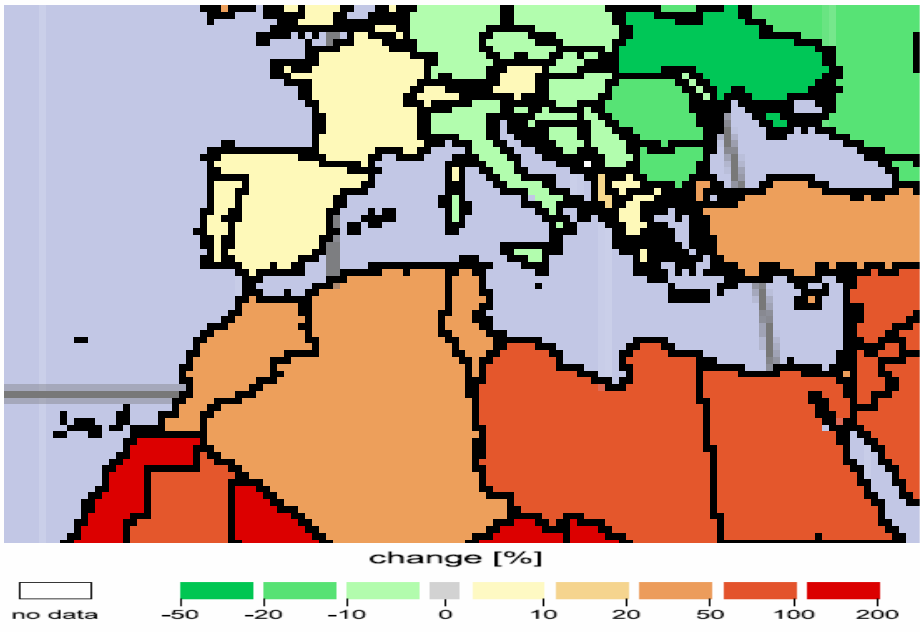
Nov. 2005: 10 years of the Barcelona Prozess

8.3. North Africa

- 5 countries: E, L, T, A, M
- Dramatic population growth
  - 1950: 42 mio.; 2000: 142 mio.
  - 2020: 193 mio. 2050: 244 mio.
- Rapid urbanization (in %)
  - 1950: 25; 2000: 48; 2030: 63
- High population density in cities: increase:2005 to 2025

High population density in cities in 2005





8.4. Population Growth: South & Central Europe

UN Population Projection (Rev. /2000 & 2004), mio.

Quelle: UN Populations Division: World Population Prospects. 2004 Rev.

	2000 R 1 2000	2000 R.2 2004	2050 R 1 2000	2050 R.2 2004	1950-2050 R.1	1950-2050 R.2	2000-2050 R.1	2000-2050 R.2
France	59,24	59,28	61,83	63,12	20,00	17,45	2,59	3,84
Greece	10,61	10,98	8,98	10,74	1.42	3,18	-1,63	-0,23
Italy	57,53	57.53	42,96	50,91	-4,14	3,81	-14,57	-6,80
Portugal	10,02	10,23	9,01	10,72	60	2,32	-1,01	0,50
Spain	39,91	40,7	31,28	42,54	3,27	14.53	-8.63	1,82
S. Europe	177,3		154,1	178,0	+21,2	41,28	-23,24	-0,88

8.5. Population Growth: North Africa

Table: UN Population Projection (Rev. 2000), mio.

Source: UN Populations Division: World Population Prospects. 2000 Rev.

	1850	1900	1950	2000	2025	2050	1950-2050	2000-2050
Algeria	3.0	5.0	8.75	30.29	42.74	51.18	42.43	20.89
Morocco	3.0	5.0	8.95	29.88	42.00	50.36	41.41	20.48
Tunisia	1.0	1.5	3.53	9.46	12.34	14.08	10.55	4.62
Libya	0.6	0.8	1.039	5.29	7.97	9.97	8.94	4.68
Egypt	5.5	10.0	21.83	67.88	94.78	113.84	92.01	45.96
N. Africa	13.1	22.3	44.10	142.8	199.83	239.43	195.33	96.63
East. Med.	12.45	16.05	29.25	89.50	141.43	173.88	144.53	84.28
MENA	25.55	38.35	73.35	232.30	342.73	413.20	339.86	180.90
S. Europe	83.0	103.5	132.9	177.3	172.5	154.1	+21.2	-23.24

8.6. Population Growth: Eastern Mediterranean

Table: UN Population Projection (Rev. 2000), mio.

Source: UN Populations Division: World Population Prospects. 2000 Rev.

	1850	1900	1950	2000	2025	2050	1950-2050	2000-2050
Jordan	0.25	0.3	1.24	4.91	7.19	11.71	10.47	6.80
Israel			1.26	6.04	8.49	10.07	8.81	4.03
OPT	0.35	0.5	1.01	3.19	7.15	11.82	10.82	8.63
Lebanon	0.35	0.5	1.44	3.50	4.58	5.02	3.58	1.52
Syria	1.5	1.75	3.50	16.19	27.41	36.35	32.85	20.16
Turkey	10.0	13.0	20.81	55.67	86.61	98,82	78.01	43.15
East. Med.	12.45	16.05	29.25	89.50	141.43	173.88	144.53	84.28
S. Europe	83.0	103.5	132.9	177.3	172.5	154.1	+21.2	-23.24

8.7. Migrationstrends im MMR

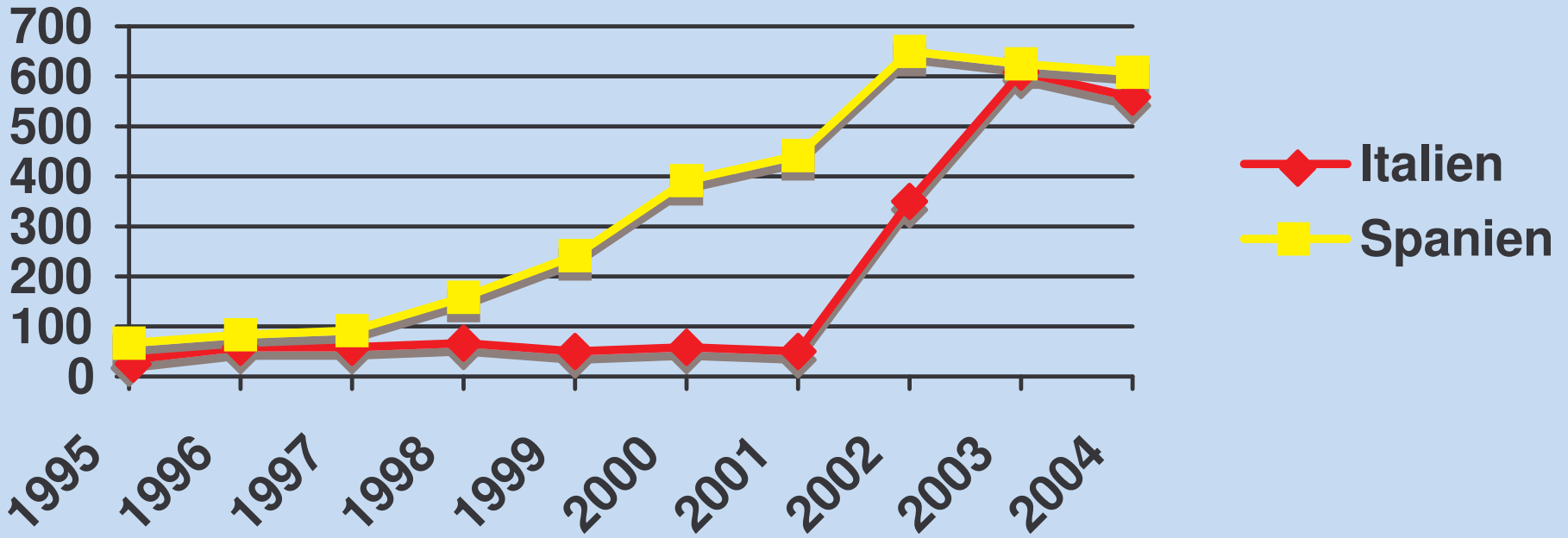
Table: Net migration rates in the Med. (Zlotnik, 2003:599)

Region	*1950-60*	*1960-70*	*1970-80*	*1980-90*	*1990-2000*
	Net number of migrants per year (thousands)				
Mediterran.	-2,765	-4,097	-2,127	-839	369
NW Mediter.	-1,521	-761	1,079	337	2,124
NE Mediter.	-823	-1,162	-71	-162	-888
East. Medit.	576	-406	-1,295	-506	921
South. Medit.	-997	-1,769	-1,840	-508	-1,788
	Net migration rate				
Mediterran.	-1.1	-1.4	-0.6	-0.2	0.1
NW Mediter.	-1.2	-0.5	0.7	0.2	1.3
NE Mediter.	-2.4	-3.1	-0.2	-0.4	-2.0
East. Medit.	1.7	-0.9	-2.3	-0.7	1.0
South. Medit.	-2.0	-2.8	-2.3	-0.5	-1.4

8.8. Migration to Spain in 1000

	1975	1980	1985	1990	1995	2000	2005
Estimated number of inter-national migrants at mid-year	299,95	240.91	405,87	765,59	1 009,0	1 628,3	4 790,07
Estimated number of refugees at mid-year	17,0	23,750	9,600	8,490	5,607	6,851	5,507
Population at mid-year (1000)	35 596	37 542	38 474	39 303	39 921	40 717	43 064
International migrants as a percentage of the population	0.8	0.6	1.1	1.9	2.5	4.0	11.1
Refugees as a percentage of international migrants	5.7	9.9	2.4	1.1	0.6	0.4	0.1
	1970-1975	1975-1980	1980-1985	1985-1990	1990-1995	1995-2000	2000-2005
Growth rate of the migrant stock (percentage)	-4.4	-4.4	10.4	12.7	5.5	9.6	21.6

8.9. Migration Saldo in Italy and Spain (1995-2004 (in 1.000). Source: I.Siegel (2006)



9. Environmental Change & Conflict in N. Africa

- For states in **North Africa (2005-2020)** it is unlikely that **GEC** (climate change, soil erosion, water scarcity) and **their impacts** (declining agricultural yields, extreme weather events) will lead to a „**Security Dilemma**“ or **wars** among the states of North Africa and those in Southern Europe.
- **Climate change, desertification & water scarcity cannot be contained with military means.**
- However, the **societal impacts of GEC** my pose a **survival dilemma** for **affected people** and force them to leave their homes and livelihoods to the cities or to other countries.

9.1. Scenarios on the Environmental Dimension of Human Security

- **Between 2000-2050 the population in North Africa will grow by 100 mio. persons** and nearly all of them **will live in the big cities**, many in informal housing, and many without jobs and perspective of the future.
- This poses **major challenges for societal, environmental and human security in all 5 countries**.
- **Reserves of oil and gas will be exhausted in many OAPEC countries,** alternatives to the oil rent as a major source of national inclome are needed.
- With **population growth**, **chaotic urbanization** the need for water and food will grow but simultaneously due to climate change and desertification crop yields may drop as will the self-sufficiency in food production and the depen-dence on virutal water will rise.
- **Internal conflicts on access to „blue“ drinking water will grow between the urban centres and the rural areas where „green“ water for irrigation may drop.**

9.2. Environmental & Distress Migration Will Rise Significantly until 2020 & 2050

- **Scenario 1:** During **drought** periods water and food will be **scarce, food prices may rise & survival in the rural areas may become more difficult**.
- **Scenario 2:** On this **survival dilemma** for parts of the rural population many young men react by moving to the urban centes (**urbanization**) and if affordable overseas.
- **Scenario 3:** As in the past (1970s-90s) **mass** and **food protests** may challenge the governments
- **Scenario 4: Migration**: besides economic reasons, societal and **environmental causes** may become key **triggers**.
- **Scenario 5:** The **countries of North Africa** have already become the goal of **transmigrants** from sub-Sahara Africa, ma-ny of them try to get to Europe or North America. This has in some cases resulted in violent conflicts with the police & hosts.

9.3. Conflict & Cooperation Potentials in the Nile Basin

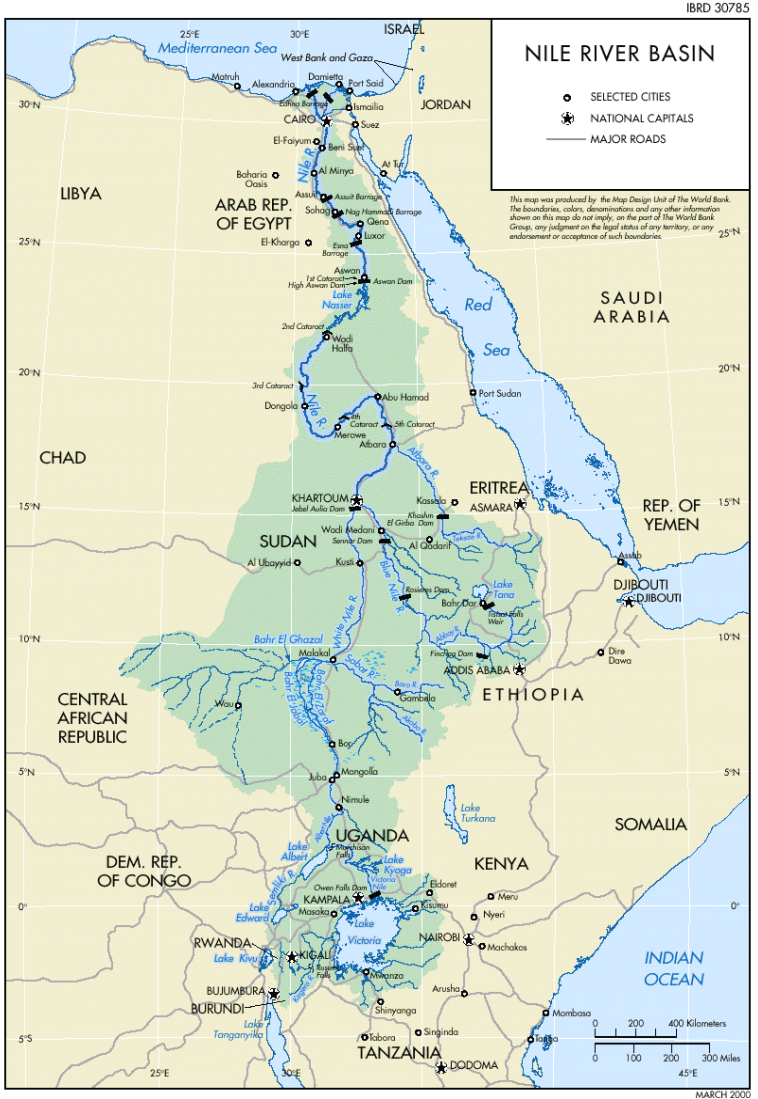
- **Scenario 6:** European counter measures to contain immigration may enhance the protest potential in emigrating countries.
- **Scenario 7:** Diaspora scenario: the uprooted youth who is not integrated in their host countries have contributed to internal insecurity and violence in some recipient countries (e.g. France)
- **Scenario 8:** Combating desertification and greening the military: Military forces is a major resource for combating desertification. Disaster preparedness and response may become a new mission for miltary forces in many affected countries.
- **Scenario 9:** Peaceful solution mechanisms for internal conflicts over water and land-use are needed.
- **Scenario 10:** The Nile Basin has been affected by drought, famine and was a victim of many violent internal conflicts.

9.4. Most Likely: Migration and Conflicts in the Nile River Basin

- **GEC:** Climate change, desertification and water stress will affect: countries of North Africa, Sahel, Horn and in Nile Basin and have negative imapcts on precipitation and food yields.
- **Migration pressure is to rise:** the transmigration pressure from countries of Sub-sahara Africa to North Africa & Europe will rise. This requires a joint migration policy & regime.
- Sadat, Boutros-Ghali, Serageldin warned: **Next war will be fought about water.** Cooperative policy measures should reduce the probability of this prophecy to become reality.
- **Nile Basin Initiative:** should be extended from joint management to joint research and knowledge creation.

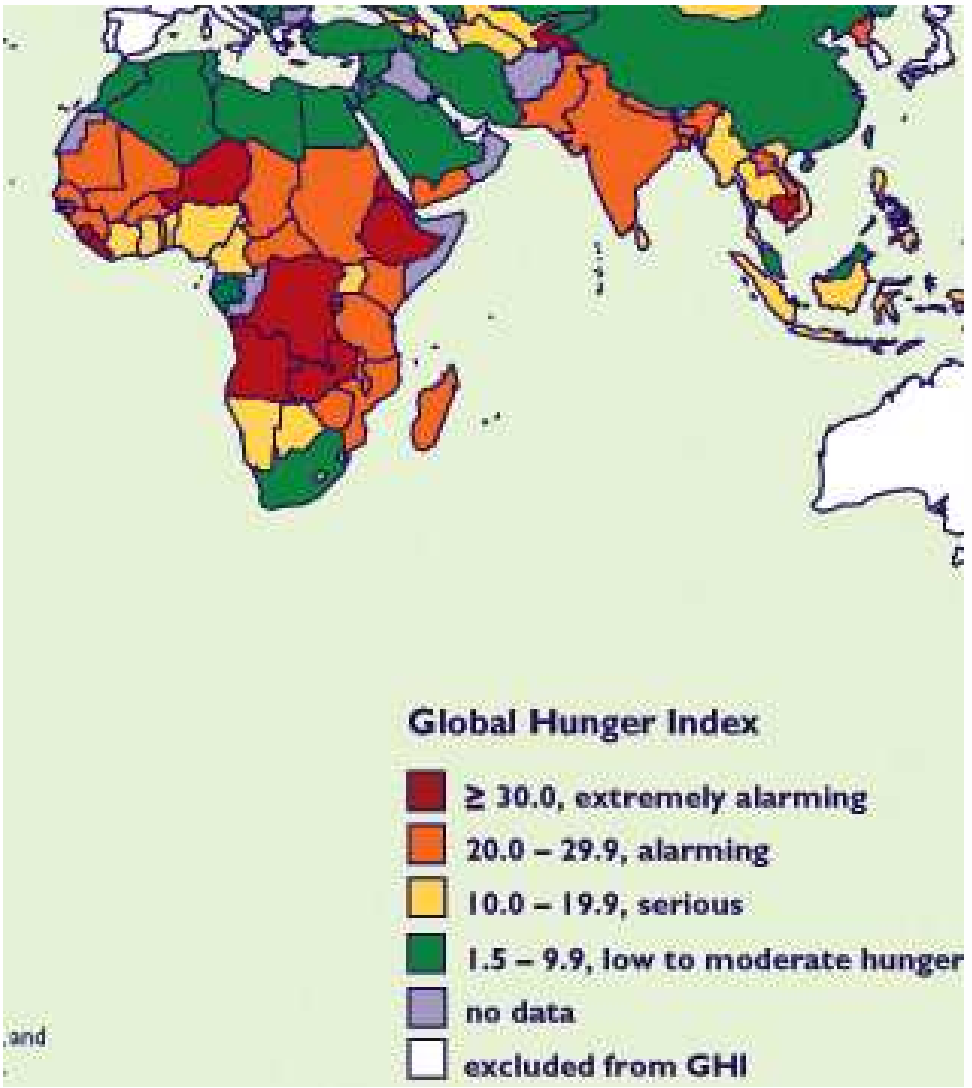
9.5. Nile Basin countries:

population growth 1950 -2050



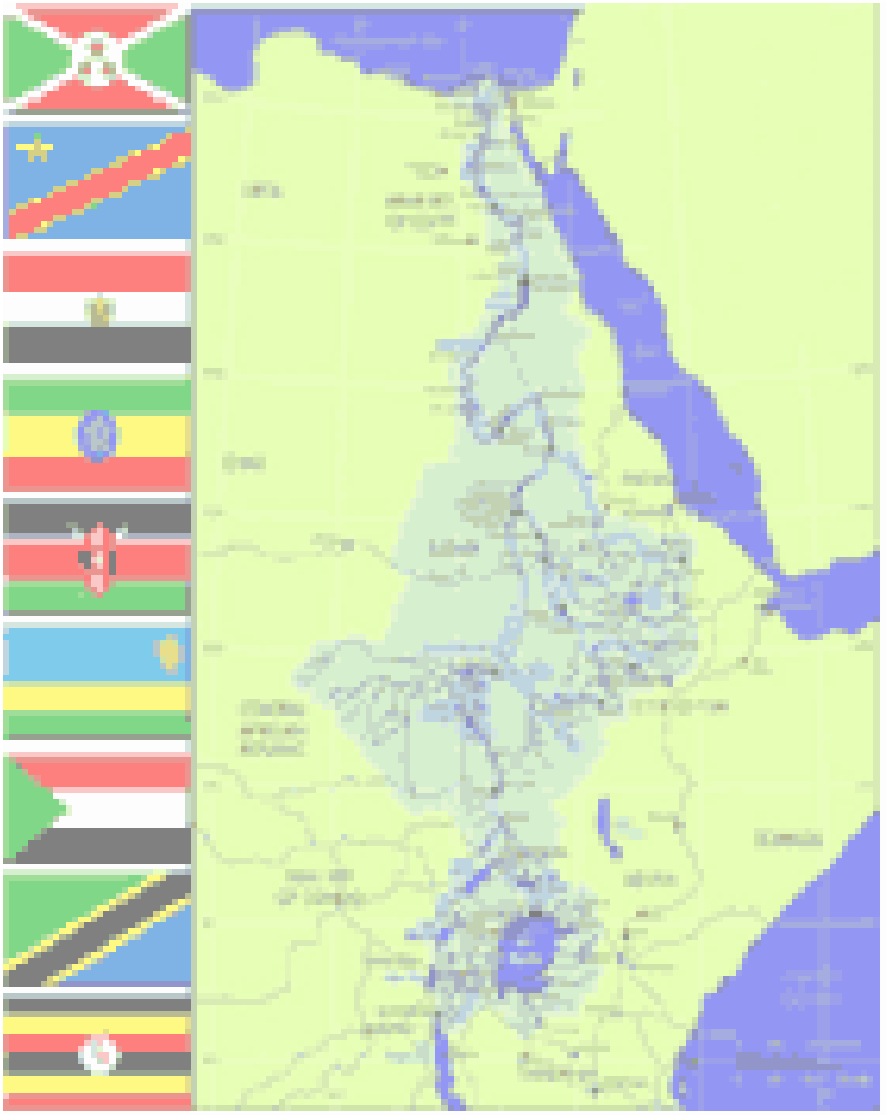
NB countr.	1950	2000	2025	2050	2005-2050
Burundi	2,5	6,4	13,9	22,9	15,1
D.R.Congo	12,2	51,0	108,0	183,2	122,4
Egypt	21,8	67,9	101,1	125,9	51,9
Eritrea	1,1	3,7	7,2	10,2	5,5
Ethiopia	18,4	62,9	118,4	170,2	92,8
Kenya	6,3	30,7	49,4	64,8	31,0
Rwanda	2,1	7,6	12,9	17,4	8,7
Sudan	9,2	31,1	61,3	84,2	44,0
Tanzania	7,9	35,1	52,6	71,4	34,9
Uganda	5,2	23,3	55,8	130,9	104,0
Total	86,7	280,8	580,6	881,1	510,3

9.6. IFRI: Global Hunger Index: Oct. 2006



- **Global Hunger Index** of Inter-nat. Food Policy Research Institute
- **Of 12 countries** with highest hunger levels, **nine** were affected by **civil wars or violent conflicts**.
- **The 10 worst cases are all in Sub-Saharan Africa**.
- Among **most affected** are countries in Nile Basin (**Eritrea, Ethiopia**), in Sahel (**Niger**)
- In all other countries: **alarming**.
- **Situation may get worse:**
  - **demand increase** and
  - **supply decline** due to impects of **Global environmental change**.

9.6. Nile Basin Initiative (NBI)



- **NBI:** transitional **institutional mechanism**, an **agreed vision**; basin framework, & a process to facilitate substantial investment in the Nile basin to **realize regional socio-economic development**.
- Establishment: beginning of the **process of confidence building** and realizing mutual benefits through shared projects.
- **Shared Vision Program (SVP)** creating environment for sustainable development
- **Subsidiary Action Programs (SAPs)**.

9.7. Widening the Scope of the Nile Basin Initiative & Nile Transboundary Environment Action Project

- NBI & NTEAP does not address:
  - Challenges posed by Global Environmental Change
    - Climate Change & desertification
    - Basic and applied research
- NBI should consider to add on to its action plan:
  - Linkages of integrated water management with:
    - Enhanced Weather Monitoring (systematic observation)
    - Regional Impact and vulnerability assessments
    - Adaptation planning and implementation
    - Assistance in the preparation of National Action Plans:
      - Responding to Climate Change
      - Combatting desertification
  - Training Course of DRC in late 2006 in Egypt crucial

10. Policy Responses: Millenium Ecosystem Assessment Reactive vs. Proactive Strategies

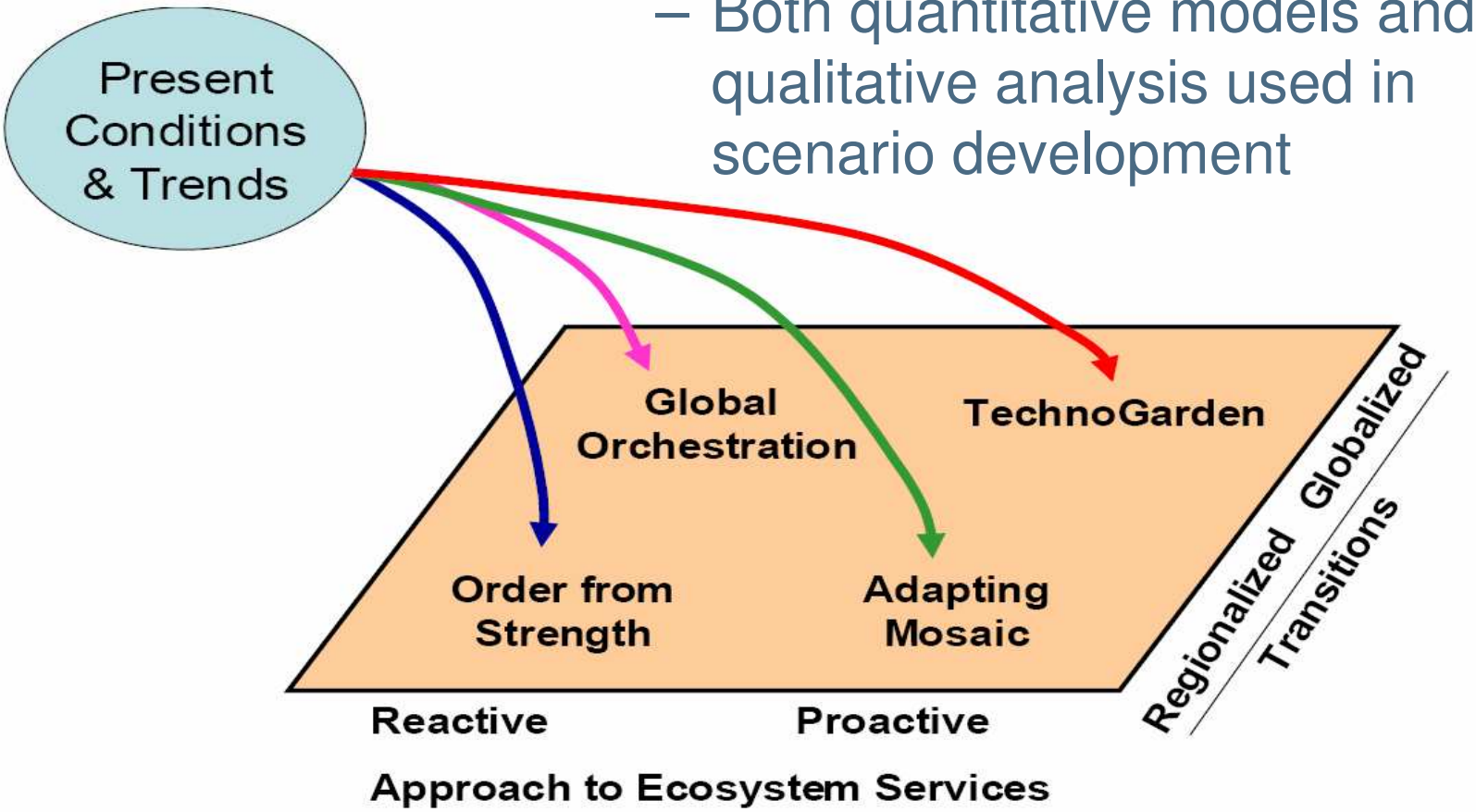
- **Over the past 50 years, humans have changed ecosystems more rapidly & extensively than in any comparable period of time in human history, largely to meet rapidly growing demands for food, fresh water, timber, fiber & fuel**
- The changes that have been made to ecosystems have contributed to **substantial net gains in human well-being** and **economic development**, but these gains have been achieved at growing costs in the form of the **degradation** of many ecosystem services, **increased risks of nonlinear changes**, and the **exacerbation of poverty** for some groups of people.
- **The degradation of ecosystem services could grow significantly worse during the first half of this century and is a barrier to achieving the Millennium Development Goals**
- **The challenge of reversing the degradation of ecosystems while meeting increasing demands for their services can be partially met under some scenarios that the MA has considered but these involve significant changes in policies, institutions and practices, that are not currently under way.**

10.1. Vulnerability and Problem Solution in Southern Europe & North Africa

- Shift from the Security Dilemma of states to a Survival Dilemma of people:
  - To stay at home – often without prospects for employment and perspective for the own family (often women, children, old people)
  - To leave the rural areas for the cities (urbanization)
  - Potential for mobilzation of protests
  - To emigrate abroad & send remittances for family
  - This survival dilemma will become more intense due to the effects of global environmental change.

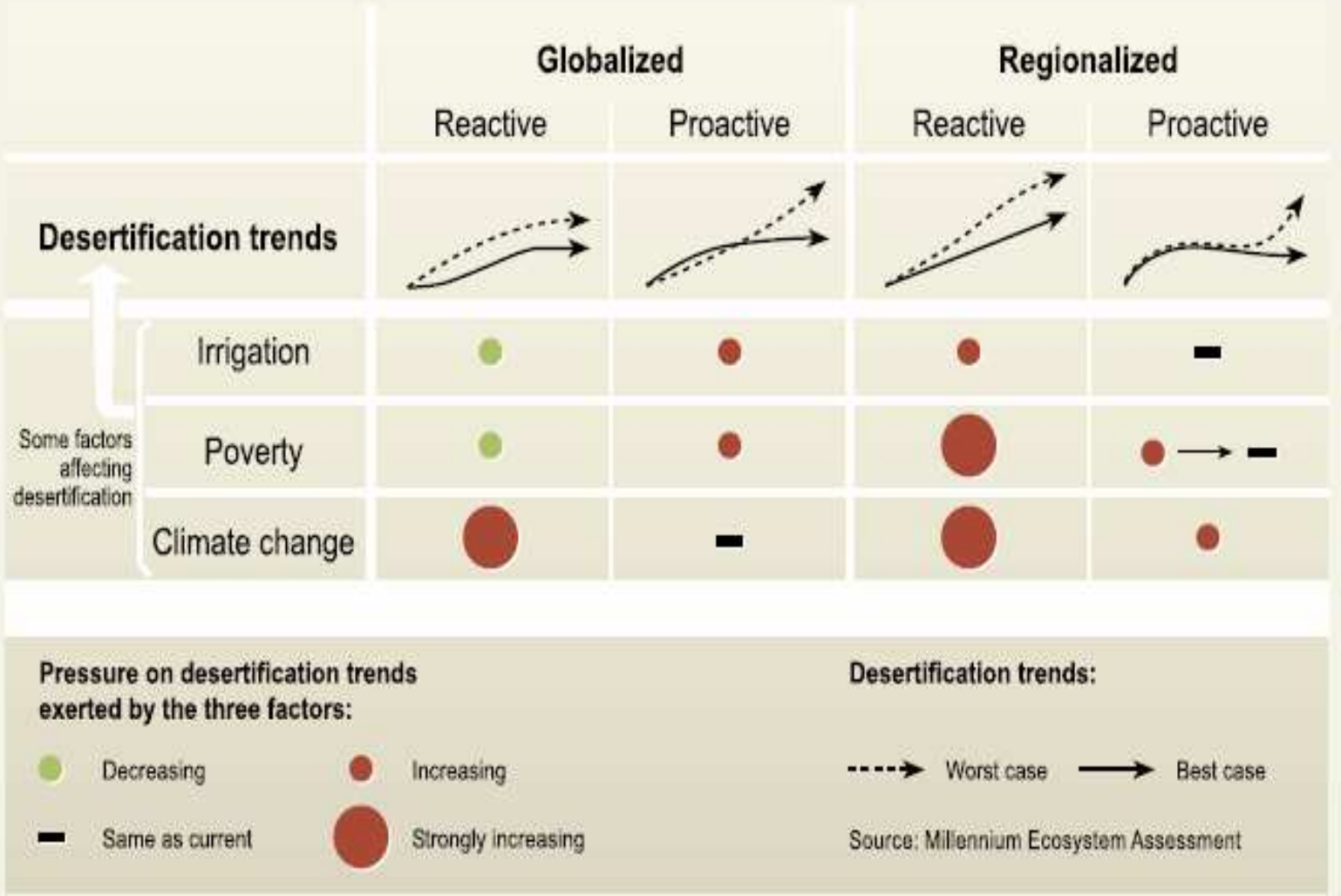
10.2. MA Scenarios

- **Not predictions – scenarios are plausible futures**
- Both quantitative models and qualitative analysis used in scenario development

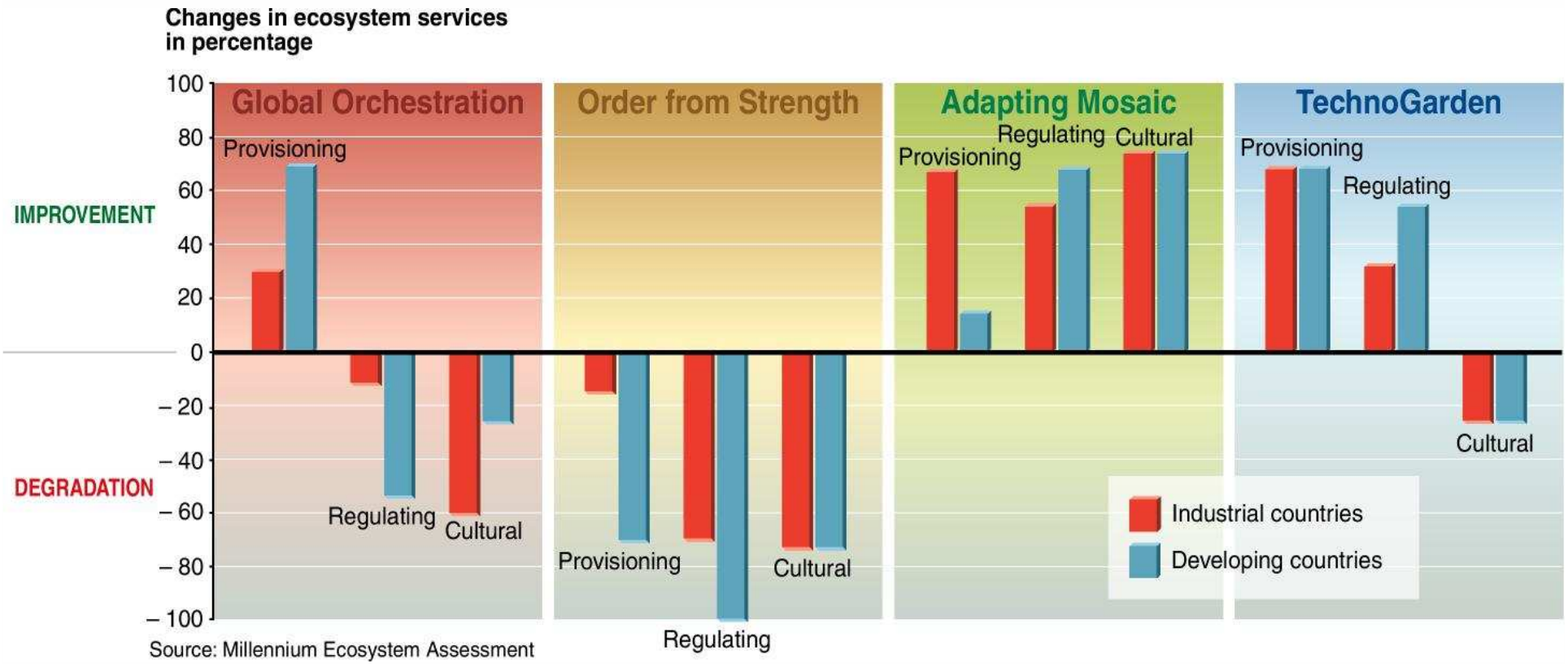


10.3. MEA-Scenarios

Rates of change in the extent of desertified areas in the drylands: Solid lines indicate the best case; dashed lines indicate the worst case for desertification in each of the MA scenarios.



10.4. Improvements in Services possible by 2050



- Three of the four scenarios show that significant changes in policy can partially mitigate the negative consequences of growing pressures on ecosystems, although the changes required are large and not currently under way

10.5. Examples of changes in policies and practices that yield positive outcomes

- Global Orchestration
  - **Major investments in public goods (e.g., education, infrastructure) and poverty reduction**
  - Trade barriers and distorting subsidies eliminated
- **Adapting Mosaic (Regional)**
  - **Widespread use of active adaptive management**
  - **Investment in education** (countries spend 13% of GDP on education, compared to 3.5% today)
- **TechnoGarden (Global)**
  - **Significant investment in development of technolo-gies to increase efficiency of use** of ecosystem services
  - Widespread use of 'payments for ecosystem services' and development of market mechanisms

10.6. Technological Responses

- *Development and diffusion of technologies designed to increase the efficiency of resource use or reduce the impacts of drivers such as climate change and nutrient loading are essential*
- **Promising Responses**
  - **Promotion of technologies that enable increased crop yields without harmful impacts related to water, nutrient, and pesticide use**
  - Restoration of ecosystem services
  - **Promotion of technologies to increase energy efficiency and reduce greenhouse gas emissions**
  - **Promotion of renewable energy sources**

10.7. Responses: Knowledge Creation

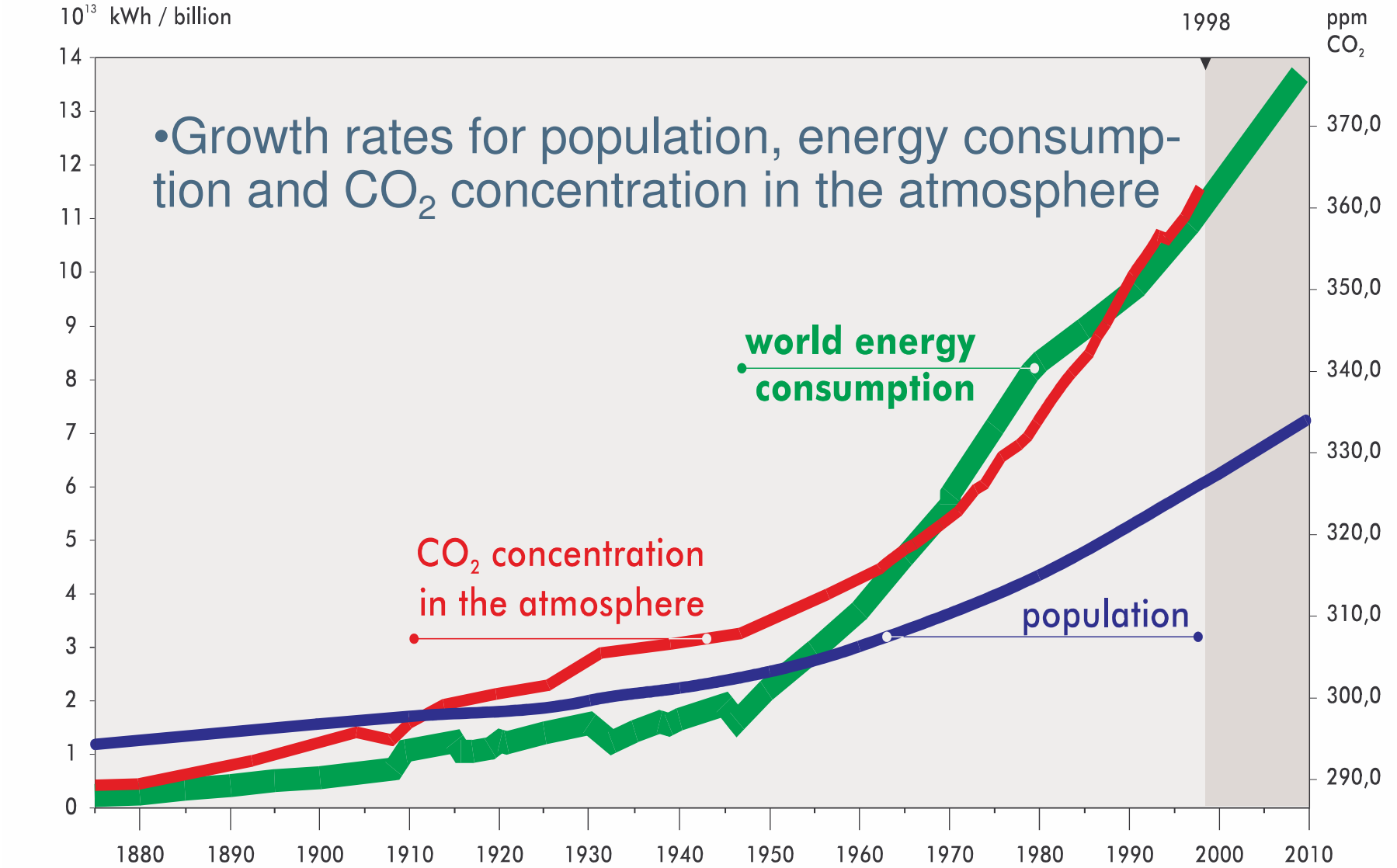
- ***Effective management of ecosystems is constrained both by the lack of knowledge and information about ecosystems and by the failure to use adequately the information that does exist***
- **Promising Responses**
  - **Incorporation of nonmarket values of ecosystems in resource management decisions**
  - Use of all relevant forms of knowledge and information in assessments and decision-making, including traditional and practitioners' knowledge
  - **Enhancement of human and institutional capacity for assessing consequences of ecosystem change for human well-being & acting on such assessments**

10.8. Need for Global Proactive Strategies & Proposals

Developing the TechnoGarden by Technology Sharing

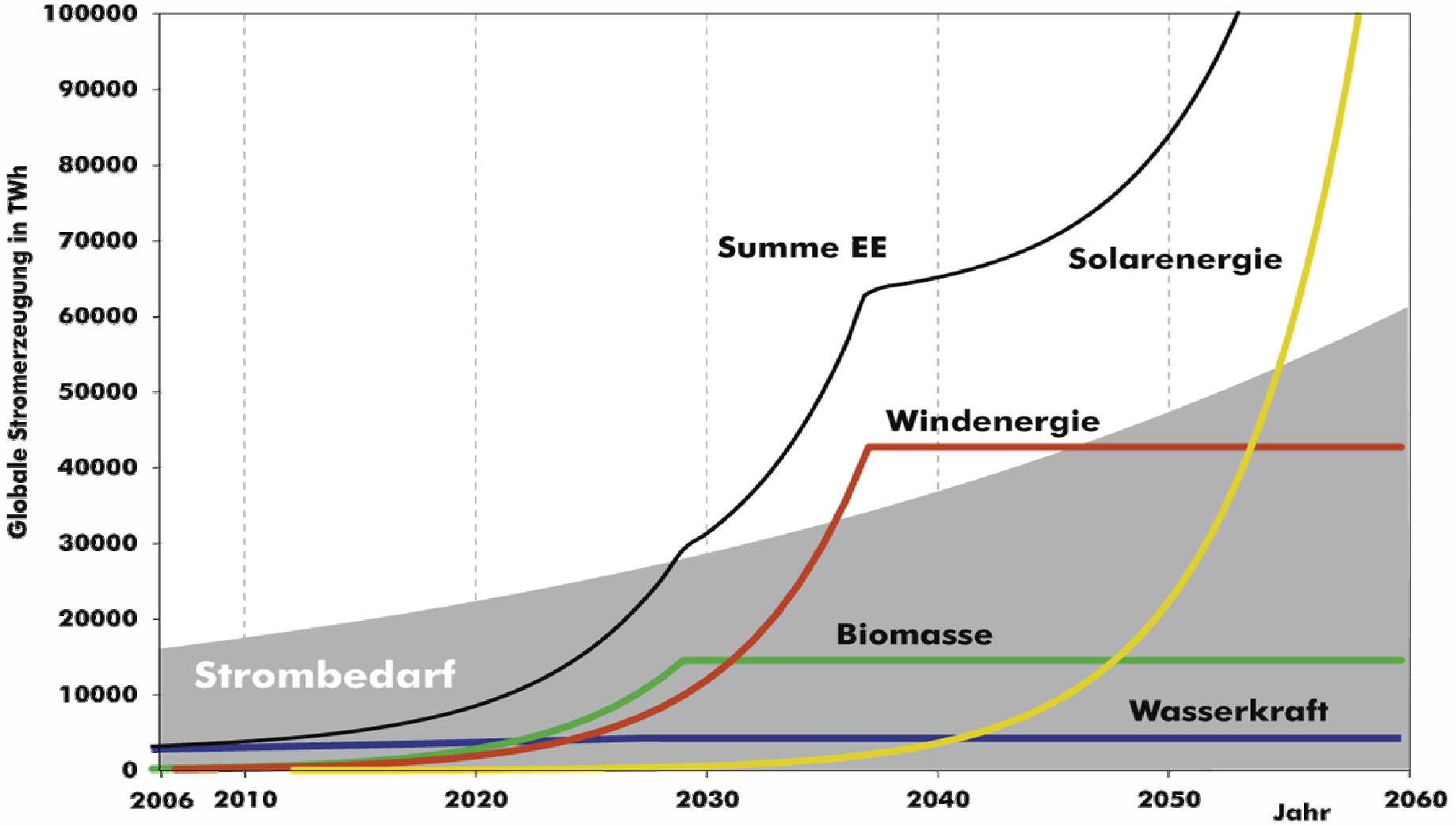
- Two Centres of Excellence for **Advanced Research, Technology Development and Training on Renewable Energy**
  - **Masreq in Cairo** (feasibility study, Nov. 2006):
    - project development bilateral: Egyptian-German scientific co-operation
    - project realization interregional: Euro-Mediterranean Barcelona Process
    - project funding
    - hosts: Egyptian-German Technical University in Cairo
  - Maghreb **in Tunis** (Italy & Tunisia: **MEDREP: Mediterranean Renewable Energy Programme** (s. 2004)

10.9. Current Global Energy Situation & Future Trends (Source: J. Schmid, ISET; Kassel)



10.10.Scenario: Renewable Energy Sources

Source: Prof. Dr. J. Schmid



10.11. Use of Renewable Energy for Agriculture and Energy Generation

- Small-scale applications: water pumping: from diesel to solar generators
- Water desalination: fom gas/oil to renewables (solar/wind):
  - Reverse osmosis (image 1)
  - or solar destillation (image 2)
  - Solar thermal (source) & reverse osmosis
  - Solar destillation

10.12. Solar Thermal Technologies

- **Concentrating Solar Power Technologies:**
  - ❖ „use solar radiation to achieve high temperatures and to generate steam or air with high energy density, which can then be used for electricity generation and other purposes“. (Trieb et. al. 2002)

❖ **alternatives: a) Fresnel concentrators, b) parabolic trough (400-600 °C), c) solar tower concept with surrounding heliostat field (1200 °C, up to 50 MW), d) solar dish (for small applications up to 50 kW).**

❖ **Economic lifetime: at least 25 years; energy payback time of a solar plant: ca. 0.5 years (Trieb et. al. 2002)**



10.13. Solar Thermal Technologies:
Parabolic Trough & Solar Dish

10.14. Solar Thermal Electricity Activities

- Luz built 9 solar stations in Mojave desert in 1984, ca. 354 MW (30 to 80 MW each), price: 12 c/kWh, new: 10-5C/kWh
- Only commerc. installation
- CIEMAT (Spain) & DLR (Germany) at PSA Almeria developed technology
- Spain: in planning stage, first two sides in Sevilla & Granada are under construction
- GEF: projects in Mexico, Morocco, Egypt, India
- (Egypt: call for tender started

10.15. Desalination: Technologies & Use

- **Combined solar power & desalination plants with proven technol.**
  a) steam turbine co-generation system and
  b) thermal seawater desalination.
- **Trieb/Nitsch/Kronshage/Schillings et. al. (2002):**
  "a **200-MW plant** of this type with 7.500 full load operating hours/yr under condi-tions of Dubai would deliver approximately **1.5 bn. kWh/yr of electricity** and 60 million m3 of freshwater at approximately **4.3 €-cents/kWh and 1.30 €/m3 of water**, **water for 50.000 and electrictiy for 250.000 people, costs: 800 M€.**
- **Middle East Desalinat. Research Centre, Muscat, Oman: 20 experts, budget US$ 1,000,000, desalination R& D in these areas:**
  a) thermal processes, b) membrane processes, c) **desalination & renew-able energy system integration, d) hybrid desalination processes**, e) non-traditional or alternative desalination processes, f) common technical processes, g) environmental Issues, h) capacity building, i) data banks & ref. material

10.16. Middle East Desalination Research Center in Oman

- **Middle East Desalination Research Cent.(MEDRC), Muscat, Oman developed a MENA Univers. & Research Institution Outreach Program:**

  - Al-Azhar University
  - Ben-Gurion University of the Negev
  - Jordan University of Science and Technology
  - Hashemite University
  - Hydraulic Research Institute
  - King Abdulaziz City for Science and Technology
  - King Fahd University of Petroleum and Minerals
  - Kuwait University
  - Kuwait Institute for Scientific Research
  - Royal Scientific Society
  - Sultan Qaboos University
  - The University of Qatar
  - University of Sfax
  - Technion-Israel Institute of Technology
  - University IBN Tofail
  - Water and Environment Research and Study Center (WERSC)

10.17. Functional Regional Cooperation: Solar Desalination for Egypt & Gaza

- Step 1: Bilateral cooperation between Egypt & PNA on fossil & renewable desalination
- Assessment of water needs & technological and economic feasibility study
- Goal: Research & development in Sinai on solar thermal desalination infrastructure for Sinai and Gaza
- CDM: as a tool for attracting foreign invest-ments in the framework of the Kyoto mecha-nisms (Egypt signed the Kyoto Protocol)
- Pilot Project: Capacity Building: Euro-Mediterranean R & D Facility for hybrid desalination with gas and solar thermal energy
- GEF and international donor community, incl. Arab Development Funds: Pilot projects
- Goal: Establishment of a major desalination plant in Sinai at the Egyptian border to Rafah.
- Contribute to Water & Health Security in Gaza

10.18. Regional Adaptation: Eating Cactus Exploiting Indigineous Knowledge Mexican-Egyptian food experiment

- **Cactus:** An unused source of food in many deserts that has been used as a source of food in Mexico by indigineous people

Collecting cactus leaves in Northern Sinai

Observing the preparation as a vegetable, salad, soup & cake by Prof. Oswald, former environment minister of Morelos, Mexico

Tasting of the cactus vegetable by Prof. Dr. Ismail Abdel Galil, President of the DRC, Cairo, Egypt

Thank you

for inviting me and giving me an opportunity to share with you these very preliminary and emerging conceptual ideas.

Thank you

for your attention and patience.

Send your comments to:

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