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Towards a Fourth Sustainability Revolution:
Security Policy and Sustainable Peace in the Anthropocene

From Holocene to Anthropocene: Revolutions in Earth History

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1. Goals and Interests: Conflict Avoidance & Peace Creation

- **Why to analyse 4th Sustainability Revolution?**
  - **Climate paradox:** Implementation gap between policy commitments (UNFCCC, KP), declarations (at G-8) and lack of policy implementation
  - **Business as usual** will fail to achieve a 50% (globally) or 80% (OECD countries) reduction of GHG by 2050
- **For which purpose? What is „Erkenntnisinteresse?**
  - To avoid or reduce possible security implications of dangerous (2-4℃) or catastrophic (4-6℃) climate change by 2050 to 2100 , such as possible climate-induced migrations, crises and violent conflicts!
  - Best policy to maintain international peace and security against cliamte related threats are non-military policies (adaptation, mitigation) and implementation of G-8 goals by sustainable development solutions!
  - This requires a different policy perspective & strategy or a **fourth sustainability revolution** or a **new paradigm of sustainability (or a second Copernican type scientific revolution)**

1.1. Goal: Sustainability

- **Term:** sustainability,
  - Latin *sustinere* (*tenere*, to hold; *sus*, up).
  - Main meanings: to “maintain", "support", or "endure”
- **Political concept:**
  - 1987: Brundtland Report
  - 1992: Rio de Janeiro: UNCED
  - 2000: UN-SG: Millennium Report
  - 2002: Johannesburg Summit on SD (UNSSD)
  - 2012: Rio de Janeiro: Rio+20
- **Scientific concept:**
  - Sustainable (Sustainability) Revolution
  - Transition to Sustainable Development
  - Transformation towards Sustainable Development

2. Key Policy Terms: Revolution – Evolution – Transformation

- **Revolution:** lat. *revolvere*, *revolutum*, *revolutio*, turning back, turn or transformation, term in astronomy (Copernicus: *De revolutionibus orbium coelestium* (1543): planets around sun
- **Scientific term: „**a fundamental & permanent structural change of one or sevel systems“, applies to economic, technical, social, political and scientific revolutions.
- **Economic-technical:** fundamental change of organization patterns: agricultural and industrial revolutions (longer process of transformation)
- **Scientific revolution or knowledge revolution:** total break with dominant knowledge (explanations, paradigms, worldview), new scientific knowledge
- **Cultural revolution:** change of cultural value systems
- **Political revolution:** fundamental restructuring of political institutions with an exchange of elites, abrupt change can be violent (1776, 1789, 1848, 1910, 1917, 1919, 1949) or peaceful (1989)
- **Change of prevailing global international political order:** 1648 (West-phalian state); 1815 (Vienna), 1919 (Versailles), 1945 (Yalta, San Francisco) and 1989 (fall of the Berlin Wall: end of the biploar cold war, collapse of SU)

2.1 Policy Terms: Political Revolutions

- **Revolution**: vs. revolt or coups d'etats: limited elite change
- **Type of main actors:** crafts, farmers, citizens, proletariat etc.
- **Evolution of the concept „revolution":** astronomy (1543), political realm: glorious revolution (UK 1688/89): expulsion of King Jacob II, French revolution (1789): turn and the whole process of transformation; Marx/ Engels: fundamental change of the economic basis, Trotzky: permanent revolutions; Fanon, Che Guevara: transformation of developing countries
- **Theories of political revolutions**:
  - **Objective factors:** preconditions: **Did environmental and climatic factors** play a role in the dominant theories in the social, policy & historical sciences?
  - **Subjective factors:** conciousness, revolutionary awareness, action etc.
- **Empirical social science research on revolutions:**
  - **Causes:** ***internal*** (dissatisfaction, modernization processes & impacts, ideologies, political and economic weakness of the state, conflicts among elites, rapid population growth, instable political order or high concentration of political order) vs. ***external*** (wars, dependence on colonial powers)
  - **Stages, patterns:** movements towards progress, local vs. global implications
  - **New revolutions:** in developing countries (grater focus on impact: cists, victims etc.)

2.2 Conceptual History: Revolution

- Koselleck: Revolution as a concept:
  - Political-social concept since 18th century (1789)
    - (short-term) violent upheaval (rebellio, discordia, against despot, tyrant
    - Longer term structural change (political aim, goal)
    - Action-oriented, initiating political action
    - Legal term: directed at a political order
    - Philosophy of history (comprehensive concept)
    - Scientific, technical, industrial (structural similarities)
  - Revolution as a metapher
    - Change and return (Copernicus)
    - World historical necessity

2.3 Key Policy Terms: Evolution

- **Evolution:** lat. *evolutio: gradual* development, change of fundamental structures towards a higher level, further development in a historical context.
- **Cosmology:** development of cosmos in 10-20 billion years **geologic** (minerals, stones etc.), **biologic** (living organisms)
- **Biology:** change of organisms; micro evolution (intra-specific), macro evolution (trans-specific): evolutionary biology: Darwin, from hominids to homo sapiens, also change of world views
- **Philosophy:** **Nietzsche:** permanent return of the same; **Kuhn:** change of paradigms (repeated replacement of basic explanatory patterns or worldviews), Haeckel: evolution as world view
- **Politics & society:** gradual, progressing hidden change vs. active change or transformation
- **Theories of transformation in social sciences**: ***classic*** **theories** (Comte, Spencer) oriented at a philosophy of history, focus on social, economic, political change in stages (often endogenously caused), revival with ***structural functionalism*** (T. Parsons, Eisenstadt) Western theories of modernization, challenged in 1960s, 1970s.

2.4 Key Policy Terms: Transformation

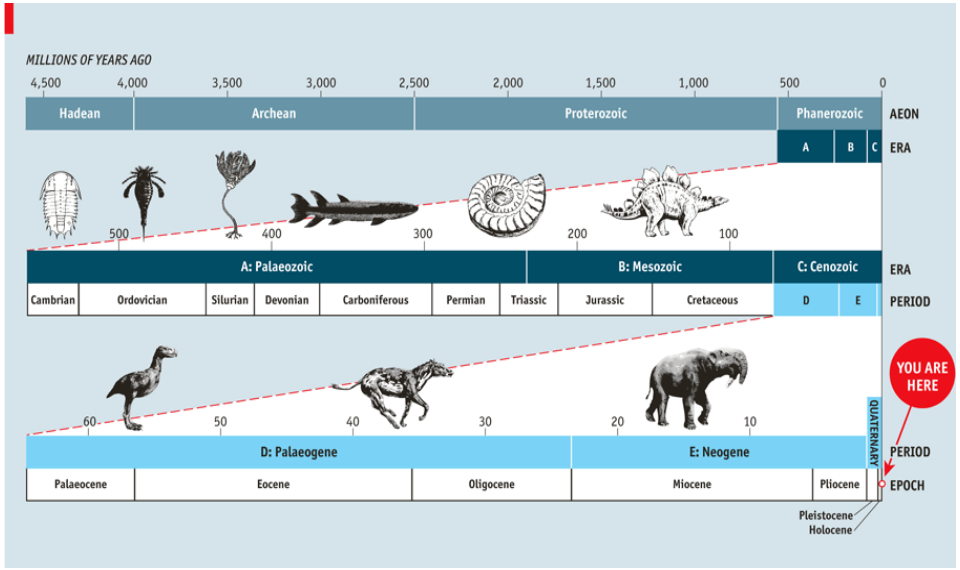
- **Transformation:** *lat. transformare*, change used in many disci-plines, e.g. mathematics, physics, medicine, molecular biology, politics & economy, liguistics (tranformative grammar)
- **Political science:** systems change or systems transformation: fundamental change of the economic or political system either due to a revolutionary or evolutionary change (especially 1990)
- **Transformation societies:** political, social & economic concept explain processes of societal change on the background of fundamental political, economic, social and cultural changes of political institutions, value systems, & economic order & social structure, life styles, can be planned & guided gradually. Development of democracy and of a market economy in East
- **Transformation concept:**
  - **Cybernetic models:** planned transformation ptocesses
  - **Social history: Polanyi:** observed & interpreted: *Great Transformation* (1944)
  - **Transformation of China, India & post-socialist societies and countries (1990s) in several stages:** 1) decline of old system, 2) collapse of old structures, 3) new political and economic orientation, 4) consolidation of new structures, 5) normal phase of a new system

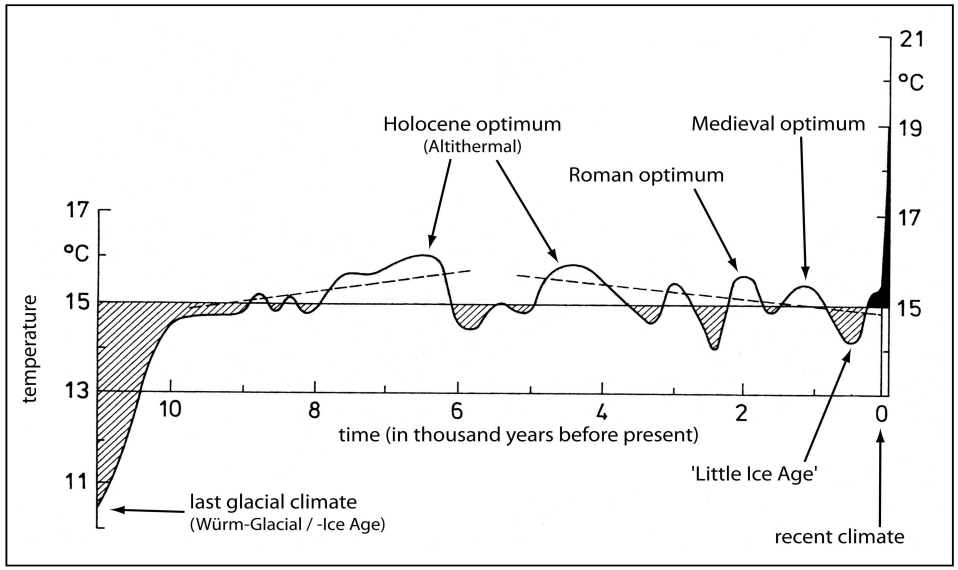
2.5. Transition vs. Transformation

- Transition of Earth System
  - Views of society on: environment, development, knowledge
  - Towards a sustainable use of the earth
- Transformation of Human System
  - Human interventions into Earth System
    - GHG emissions into the Atmosphere
  - Human transformations of the Earth system
    - Global warming
- Goal: Earth Systems Science or Analysis
  - Different concepts in the natural sciences
  - Earth Systems Science Partnership (Amsterdam 2001)
  - Earth Systems analysis for Sustainability
    - Demand side: carrying capacity
    - Supply side: Earth systems resources

3. Changes in Earth History:

Economic, Scientific and Political Revolutions





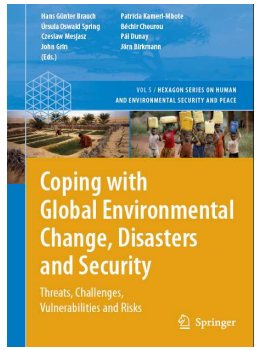
- **Earth: Geologic or earth history and times:**
  - **Earth:** 4.5 billion years
  - **Human beings:** a million years. **Homo sapiens:** 1000s years
- **Last 10.000 years: Holocene** end of glacial period: development of high civilizations
  - **Holocene:** 2nd neolithic rev. ->agricultural rev.
  - **Anthropocene**: industr. (1782) & IT revolutions
- **Fernand Braudels: three times**
  - **Histoire de long durée:** geography
  - **Histoire de conjoncture:** economy
  - **Histoire de événements:** history, politics
- **Political time:** institutions, actors & events

3.1. Holocene

- **End of Cold War:** first peaceful global transition of structure, strategies and policies of international politics since the French Revolution (1789) and the Congress of Vienna (1815) and of the Westphalian sovereignty-based system of nation states,
- Transition from **Holocene** to **'Anthropocene**' is more profound.
- The **Holocene** started with the end of the glacial period about 12,000 years ago what marked the onset of major human progress and the development of high civilizations in the Mediterranean, in China, India and in Mesoamerica.
- In **earth and human history a fundamental change** has occurred since the **Industrial Revolution (1780s)** from the '***Holocene*' to the '*Anthropocene***' due to increasing human interventions, especially through the burning of fossil energy that has resulted in an anthropogenic period of climate change.

3.2. Paul C. Crutzen: Foreword Geology of Humankind:

From the Holocene to the Anthropocene

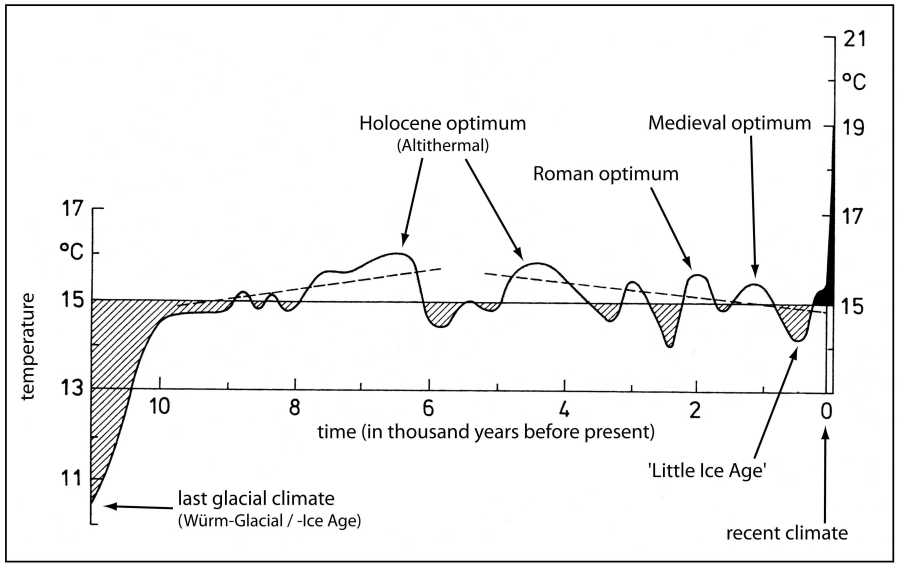


- During 4,5 billion years of Earth history, after a long string of biological processes, only a million years ago, a single species ‘homo sapiens’ evolved, which grew increasingly capable of influencing the geology of our planet.
- **Holocene era** of earth history since end of glacial period (10-12.000 y. BP) high civilizations emerged.
- **Anthropocene:** Since 1780 (J. Watt’s invention of steam engine: burning of coal. oil, gas ➔ GHG increase) humankind increased GHG concentration in the atmosphere from 279 to 393 ppm (6/2011)

3.3. Holocene (very long duration)

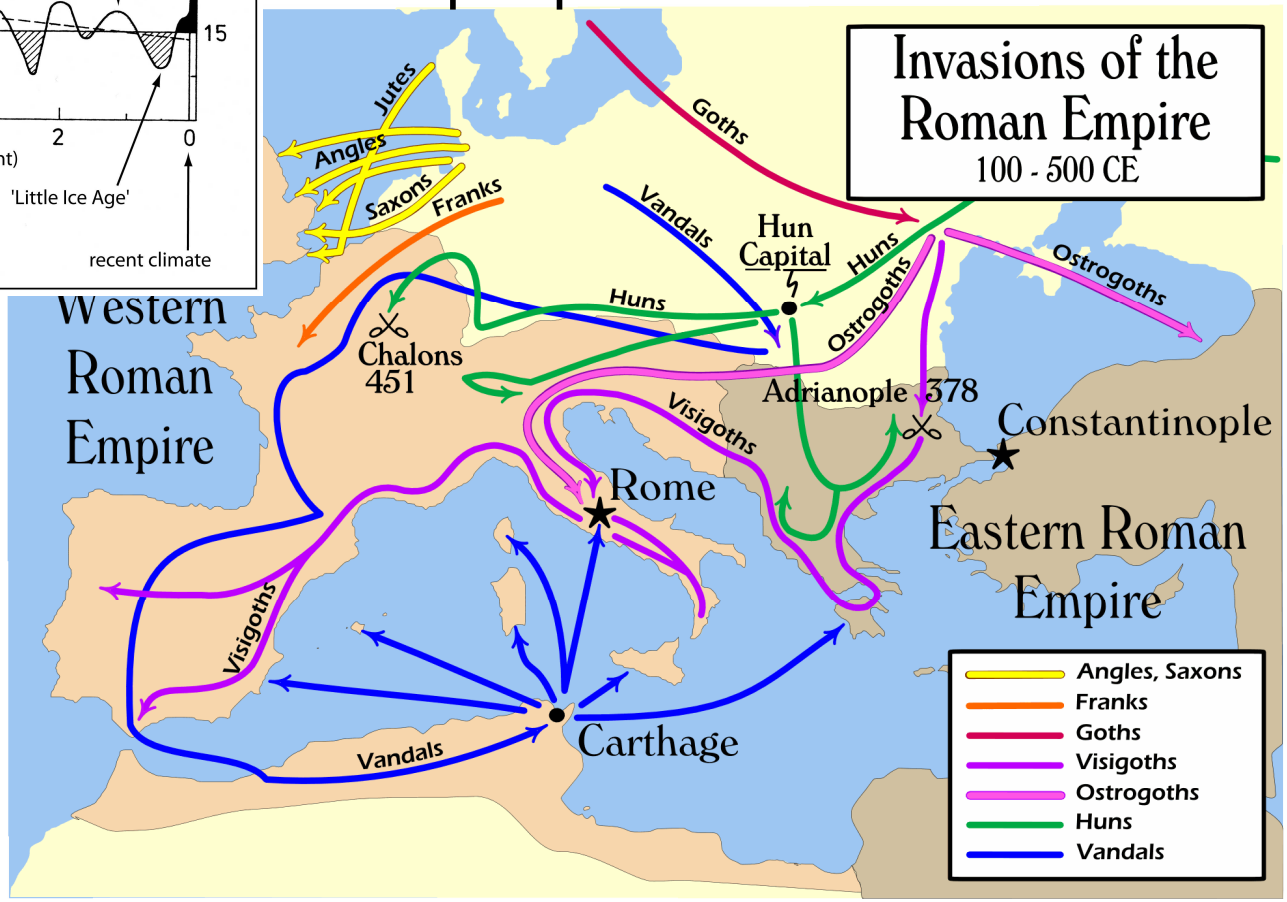
- **'Holocene'** is a period of **geological transition** with a dramatic environmental change with a major sea**-**level rise due to melting of the huge ice sheets that covered large areas in the northern hemisphere.
- Some scientists postulated a 1,500 year cycle throughout with an important contrast in hydrological circulation patterns**.** These **changes in climate** had a major influence on the **development and collapse of high civilizations**.
- The **Roman Empire** coincided with the 'Roman optimum' while its **collapse** occurred during a cooler period when massive people's migration occurred from Central Asia to Europe and from Northern Europe to the Mediterranean.
- The **second climatic downturn ("little ice age")** coincided with bad harvests, famines, pandemics (pest), the Thirty Years War (1618**-**1648).
- The **role of climate for the decline and fall of civilizations** has been disputed between climate determinists and climate sceptics**.**
  - Since 1930's the **anthropogenic model** placed all blame on human malpractice.
  - The **neo-deterministic paradigm** "emphasizes the dynamic interaction between the natural environment … and the human society". Many neo-determinists have argued that during the Holocene cold periods, precipitation changes and long periods of drought triggered massive people's movements.
  - Due to natural climate variability, longer periods of drought and famine resulted in the sudden collapse of several high civilizations (Diamond 2005).

3.4. Impacts of Climate Variability: Holocene (12.000 years b.p. to 1750 AD)



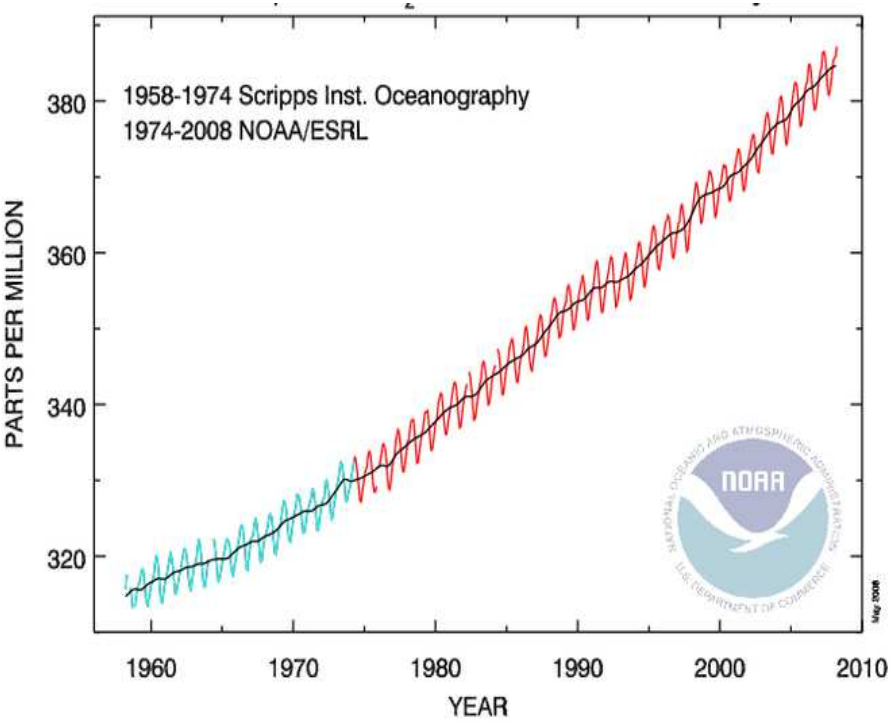
End of Roman Empire: massive people's movements : 1st phase, 300-500 AD, Germanic, Turkish & other peoples.

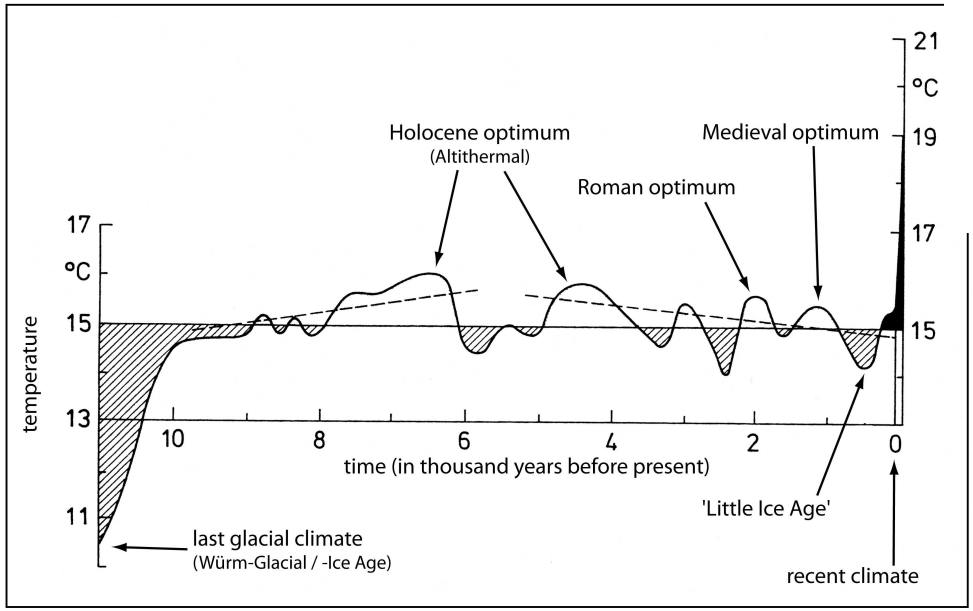
During **Holocene** era both **climate pessima** (cold periods) and **changes in precipitation patterns** and long periods **of drought** were major triggers for **several phases of massive people's movements**:



3.5. There is a consensus that climate change is largely anthropogenic

IPCC in Assessment Reports (1990, 1995, 2001, 2007): since industrial revolution climate change has been anthropogenic





GHG in the atmosphere

1750: 279 ppm, 6/2011: 393 ppm

1/3: 1750-1958: 279 to 315 ppm

2/3: 1958-2011: 315 to 393 ppm

3.6. Anthropocene (long duration)

- **Since late 19th century scientists** referred to the **human intervention into nature and the earth system** that were facilitated by major population growth due to technological and medical advances and the availability of cheap fossil energy sources.
- **Crutzen** (2006) pointed to **chemical impacts of human activities** during the Anthropocene resulting in increasing **air pollution, acidification of precipitation, major changes in land-use**.
- “Still growing impacts of human activities on earth and atmosphere” make it “appropriate to emphasize the central role of [hu]mankind in geology and ecology by using the term ‘Anthropocene’ for the current ecological epoch”.
- Crutzen (2006: 17) argues that as **humankind** “will remain a major geological force for many millennia” it is necessary “to develop a world-wide accepted strategy leading to **sustainability of ecosystems against human induced stresses”** what will be “one of the greatest tasks of [hu]mankind, requiring intensive research efforts and wise application of the knowledge”.
- This **fundamental change in earth and human history** and the **societal and political impacts** of this more severe global change than the end of the Cold War is gradually being understood by policy-makers and international relations and security specialists who have launched a process of securitization of the causes, effects, impacts and societal outcomes of global environmental change.

4. **Focus on interactions between nature & human systems**

- **3 Phases of Addressing GEC & Climate Change**
  - **As a research question; "*Scientization":*** social construction of science: IPCC: knowledge assessment and transfer to policy makers
  - **As a political task: "*Politicization*":** From knowledge to action: agenda setting, conventions, regimes, UNFCCC, Kyoto Protocol (1997); Bali (2007) > Copenhagen (2009)
  - **As a security challenge:** "*Securitization*": existential threat requires extraordinary policy response
- **Climate change new theme since early 1970s**
- **New: Interactions of natural & political system**
- **Objective danger vs. subjective concern:**
  - **Natural variability: millions of years**
  - **Anthropogenic climate change: since 1782 (1950s)**

4.1. Scientization: Climate change as a scientific problem

- ***Anthropogenic Climate Change as* a research question**: from hypothesis to scientific mainstream
  - **Tyndall (1860s): Projection of greenhouse gases in atmosphere**
  - **Svante Arrhenius** (1896) Theory: Linkage between burning of hydrocarbons and increase of greenhouse gases in at.
  - **Since 1971** scientific climate conferences
  - **1979: 1st** world climate conference,
  - **1988:** Initiation: climate research & assessment
    - World Climate Research programme was formed
    - IPCC was established by UN General Assembly
  - **1992:** UN Framework Convention on Climate Change
  - **2009: 3rd** world climate conference

4.2. Politicization: Climate Change as a Political Problem

- ***Environment: Stockholm 1972: Start of environment as a polit. issue***
  - ***UNEP was set up in Nairobi***
  - ***Rich countries problems (?) debate on additionality***
- ***1992: Rio de Janeiro: UN Conference on Environment and Development in***
  - ***UNFCC: United Nations Framework convention on Climate Change***
  - ***UN CBD: United Nations Convention on Biological Diversity***
  - ***Mandate for UNCCD: UN Convention to Combat Desertification***
- ***As political task*** (1988-2009):
  - 1988: US Reagan Administration: climate change on G-7 Agenda
  - UN-GA Mandate for IPCC & negotiations for UNFCCC (1992) that was signed at Earth summit in Rio de Janeiro
  - Berliner Mandate (COP 1) for negotiation of the Kyoto Protocol (1997)
  - Kyoto Protocol of 1997 was only partly implemented
  - COP 15 (December 2009) in Copenhagen: post 2012 CC regime

- ***2000: Millennium Development Goals***
- ***2002: Johannesburg: UNSSD: UN Summit on Sustainable Development***
- ***2012: Rio +20 (goals up to 2032)***

4.3. Securitization: Climate change as a security danger

Securitization: declaring something as an issue of utmost importance that requires extraordinary measures

Who is the securitizing actor?

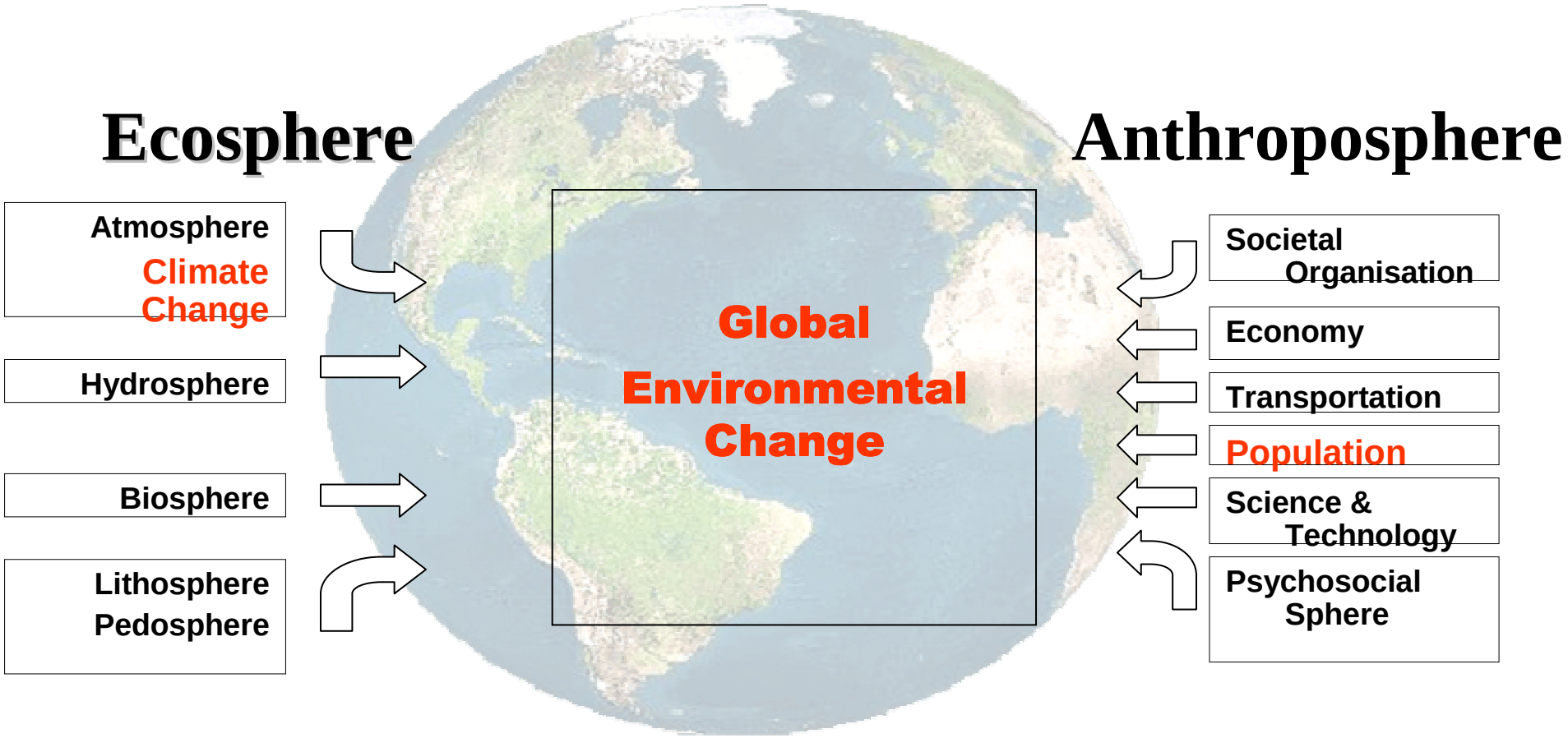
- **scientific study? media? government (policy maker)**
- **audience: we must be convinced**

Scientific debate started in 1989 (Brown, Gleick), 2000

2007 became a turning point

- ***Intergovernmental Panel on Climate Change*** **(IPCC)** released its *Fourth Assessment Report* (AR4) in 2007: 4 reports
- April 2007: UN Security Council: UK: Foreign Minister Beckett
- WBGU-Report: June 2007: German dual presidency: G-7 and of the EU
- EU-Council, Solana and commission tasked to study this issue
- October-Dec. 2007, Nobel Peace prize to IPCCC (Pachauri), Al Gore
- 2008: EU Paper and European Security Strategy
- June 2009. UN General Assembly: Pacific Small Island Developing States
- September 2009: Report of Sec. Gen. Ban-Ki Moon
- **Nov./Dec. 2009: COP 15: Copenhagen: CC was securitized (issue of utmost importance) but no extraordinary measures were taken (less than 1% for transfers compared with bailout costs for global banking crisis)**
- July 2011: second UN-SC debate (German presidency) reporting mechanisms

4.4 Global Environmental Change (GEC)



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

4.5. Four GEC Scientific Programmes

- **International Geosphere-Biosphere Programme** (IGBP). research pro-gramme that studies Global Change
- **Goals:** • Analyze interactive physical, chemical and biological processes that define Earth System dynamics
  • changes occurring in these dynamics
  • role of human activities on changes

- **DIVERSITAS:** integrates biodiversi-ty science for human well-being:
- By linking biology, ecology & social sciences, it produces socially relevant new knowledge to support sustainable use of biodiversity

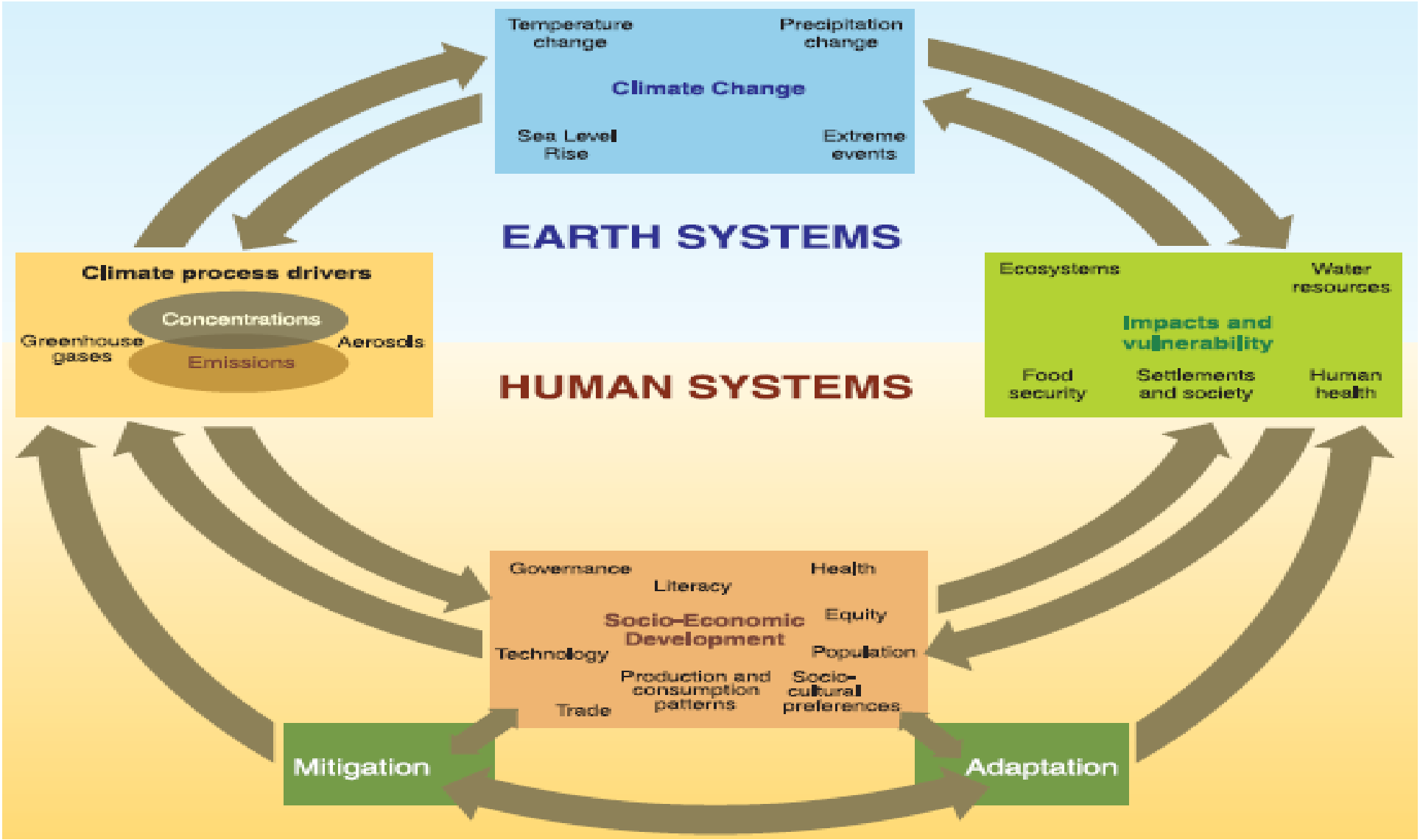
- **International Human Dimensions Programme (IHDP):** international, interdisciplinary science organization: promoting, & coordinating research, capacity building & networking. Social science perspec-tive on global change and works at the interface between science and practice

- **World Climate Research Programme** draws on climate-related systems, faci-lities & intellectual capabilities of 185 countries to advance understanding of processes that determine our climate.
- Two key objectives of **WCRP** are:
  - to determine predictability of climate;
  - to determine effect of human activities on climate.

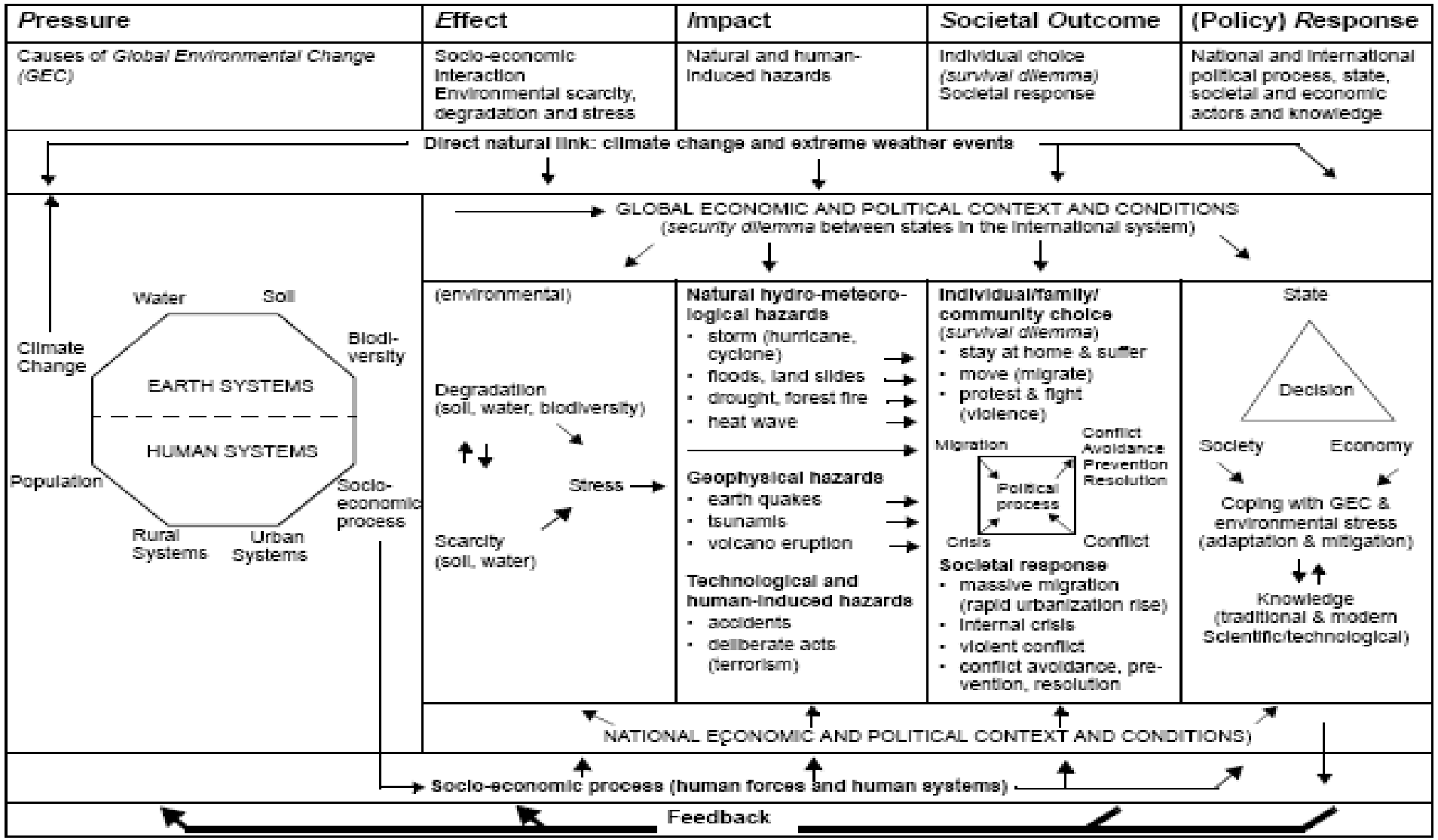
4.6. Earth System Science Partnership (ESSP)

- **2001: Amsterdam Declaration on Global Change: IGBP, IHDP, DIVERSITAS, WCRP formed Earth System Science Partnership.**
- **ESSP: partnership for integrated study of the Earth System, changes, & implications for global/regional sustainability.**
  - **Global environmental changes are both accelerating & moving the earth system into a state with no analogue in previous history.**
  - **The Earth System is the unified set of physical, chemical, biological & social components, processes and interactions that together determine the state and dynamics of Planet Earth, including its biodata & human occupants.**
  - **Earth System Science: study of Earth System, with an emphasis on observing, understanding and predicting global environmental changes involving interactions between land, atmosphere, water, ice, biosphere, societies, technologies and economies.**

4.7. IPCC: AR4, 2007 (Synthesis Report)



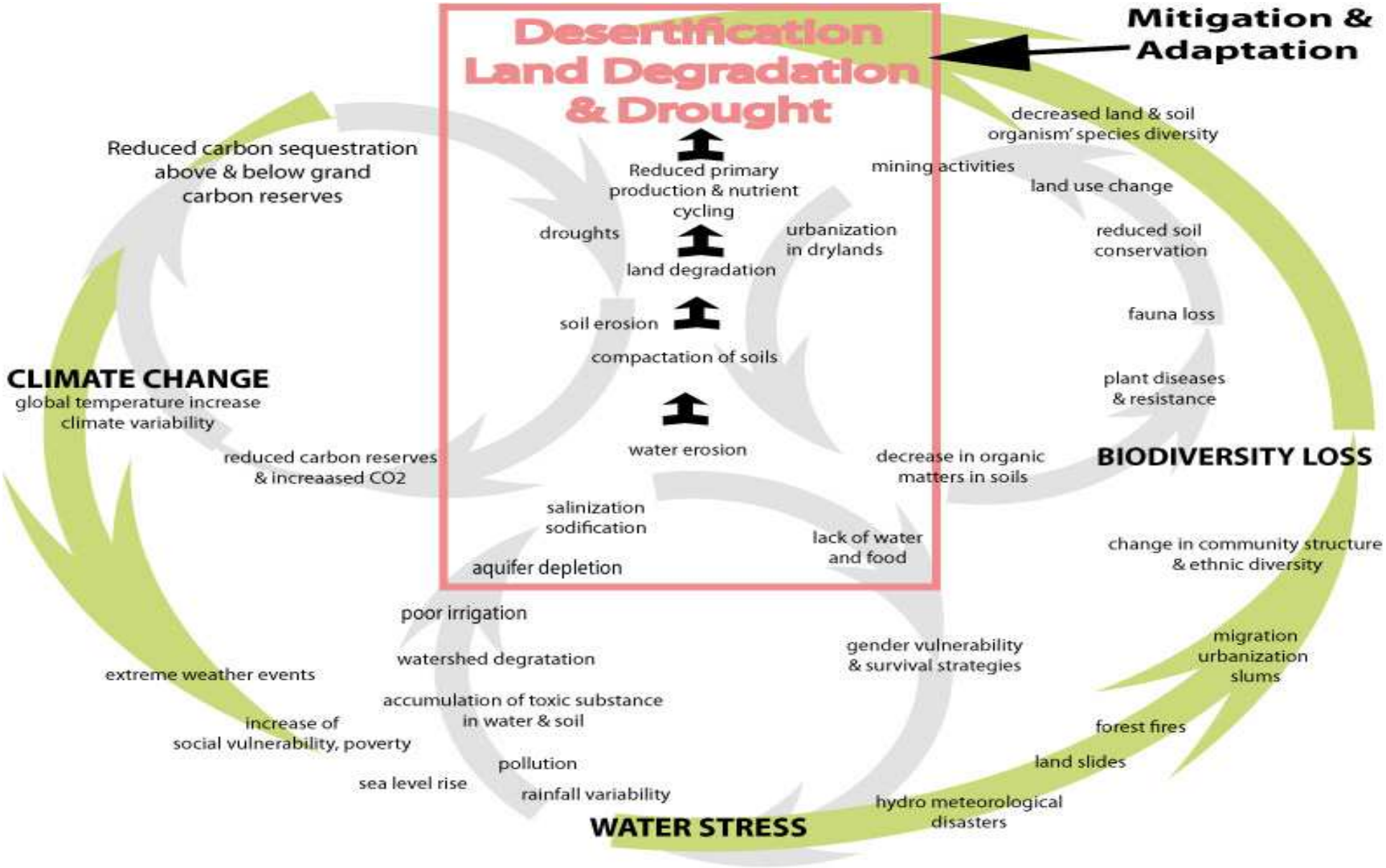
4.8. Global Environmental Change & Impacts: PEISOR Model



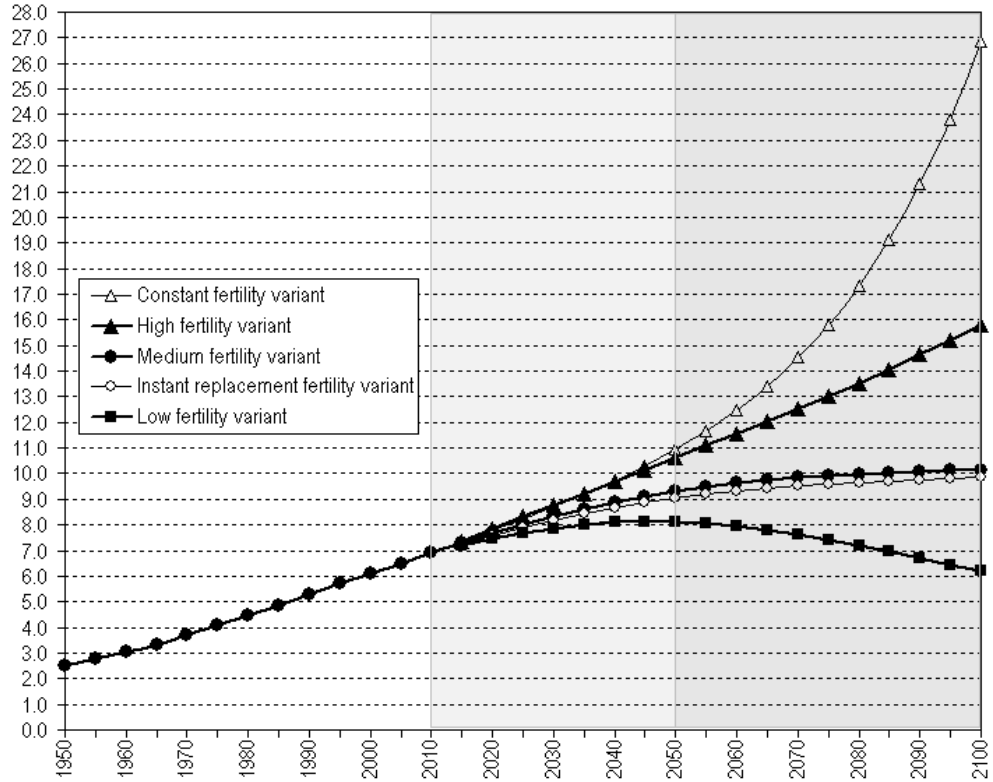
4.9. Mega trends of the Earth System & of Global Economy and Society

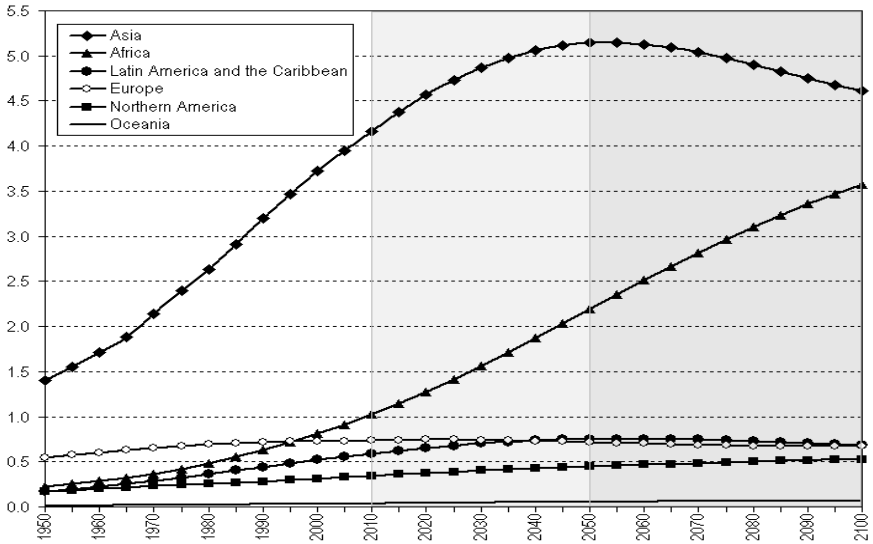
- **PEISOR Model: Octagon of eight key fctors:**
  - **Environmental quartet:** soil, water, biodiversity & climate change
  - **Societal quartet:** population, rural, urban systems, socio-economic processes
- **WBGU Report (2011): A Social Contract for Sustainability** (http://www.wbgu.de/en/flagship-reports/fr-2011-a-social-contract/)
- **Mega trends of the Earth system:**
  - **Climate change** & physical, societal impacts
  - **Soi**l degradation & desertification
  - **Water** scarcity & degradation
  - Raw materials, nutrients and pollutants
- **Mega trends of global economy & society:**
  - Economic development
  - **Global energy trends: demand and production**
  - **Population change and urbanization**
  - System of rule: democratization
  - Increasing competition on landuse: food, energy, forests etc.

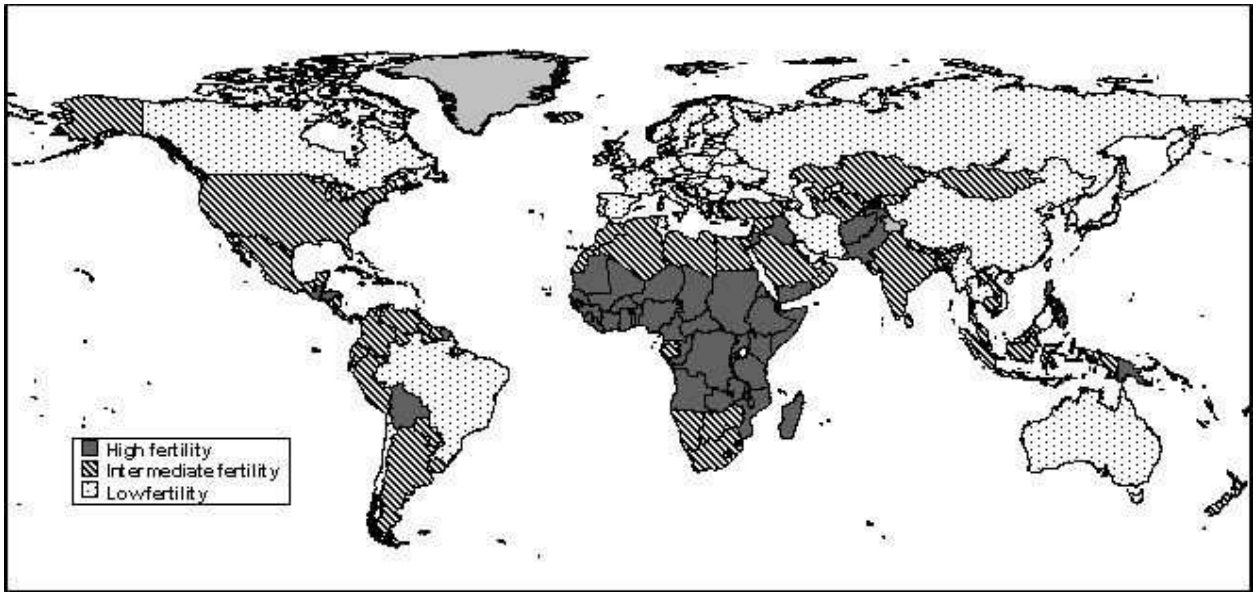
4.10. Interaction within the Earth System: Environmental Quartet



4.11. Population Projection (2010)





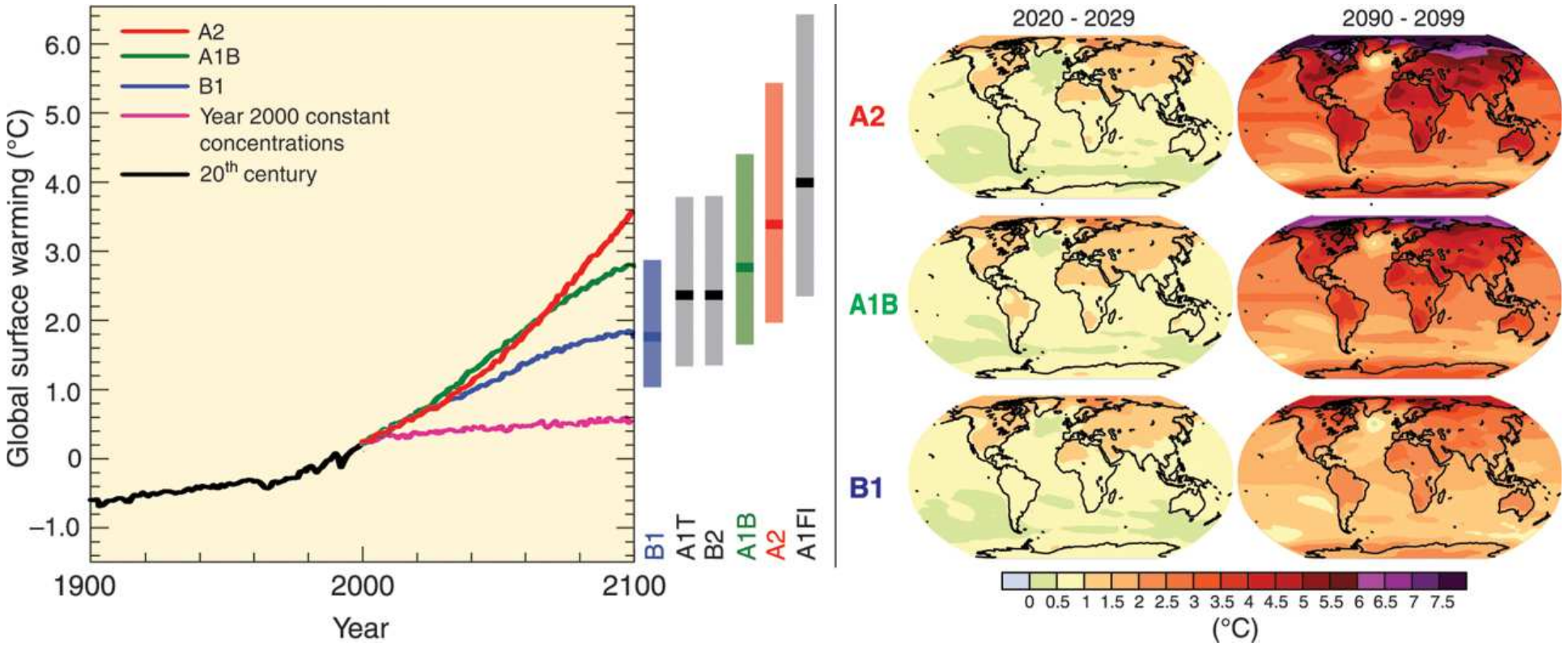


- Med. projection:

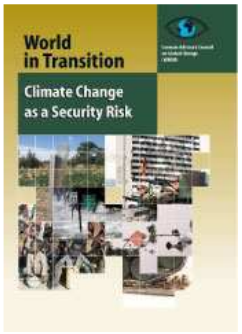
2050: 9 b, 2100: 10 b

- Asia & Africa highest increase
- Highest fertility rate in environmental hotspots

4.12. Anthropogenic Climate Change in the Anthropocene (1900-2100)

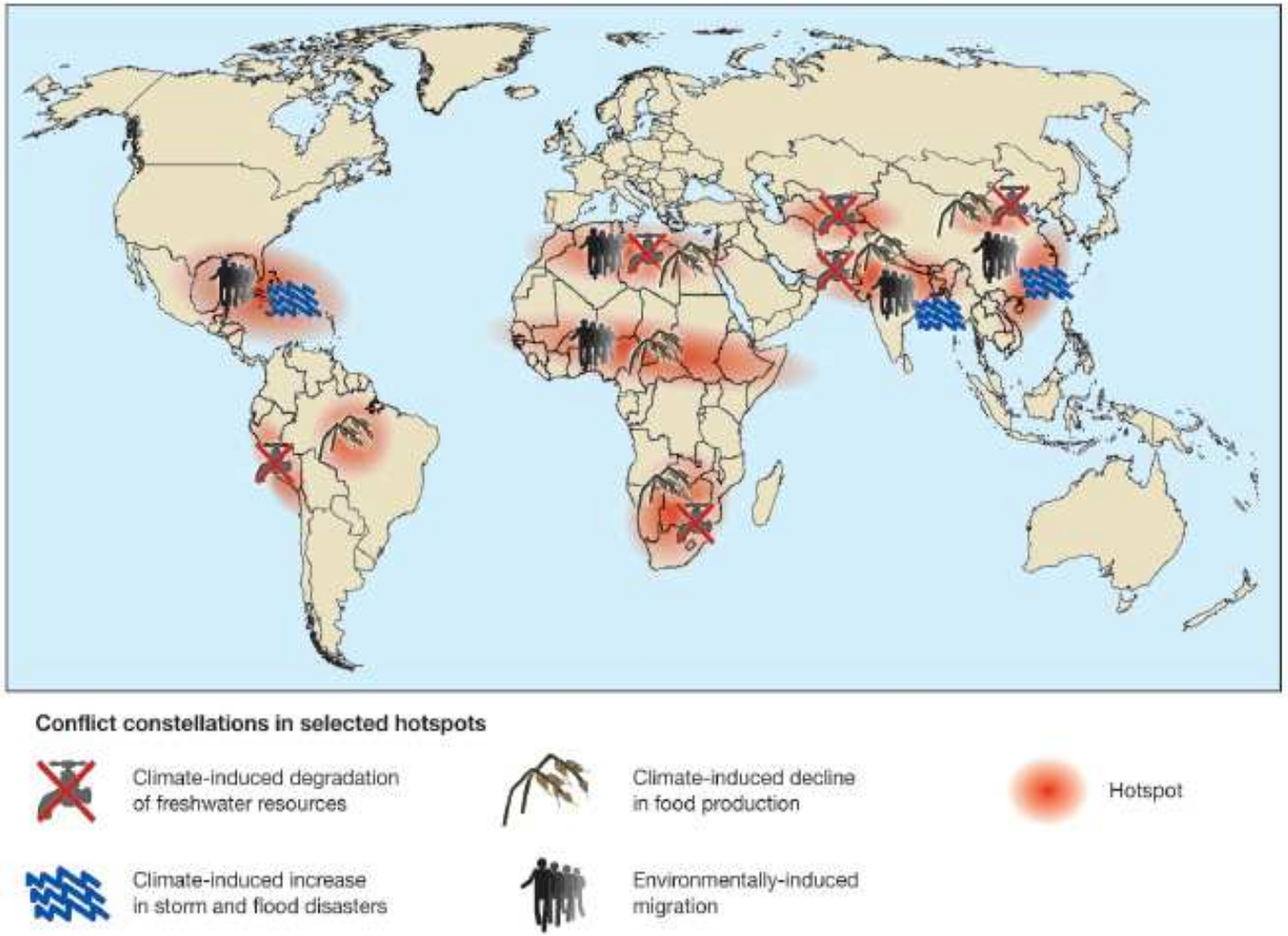


- **Three Regimes for Temperature Increase**
  - +2℃: **certain**: EU Stablization goal (**decision in Copenhagen COP 15)**
  - +4℃: **probable, without immediate Stabilizartion Measures**
  - +6℃: **possible** (business as usual) **(catastrophe scenario)**



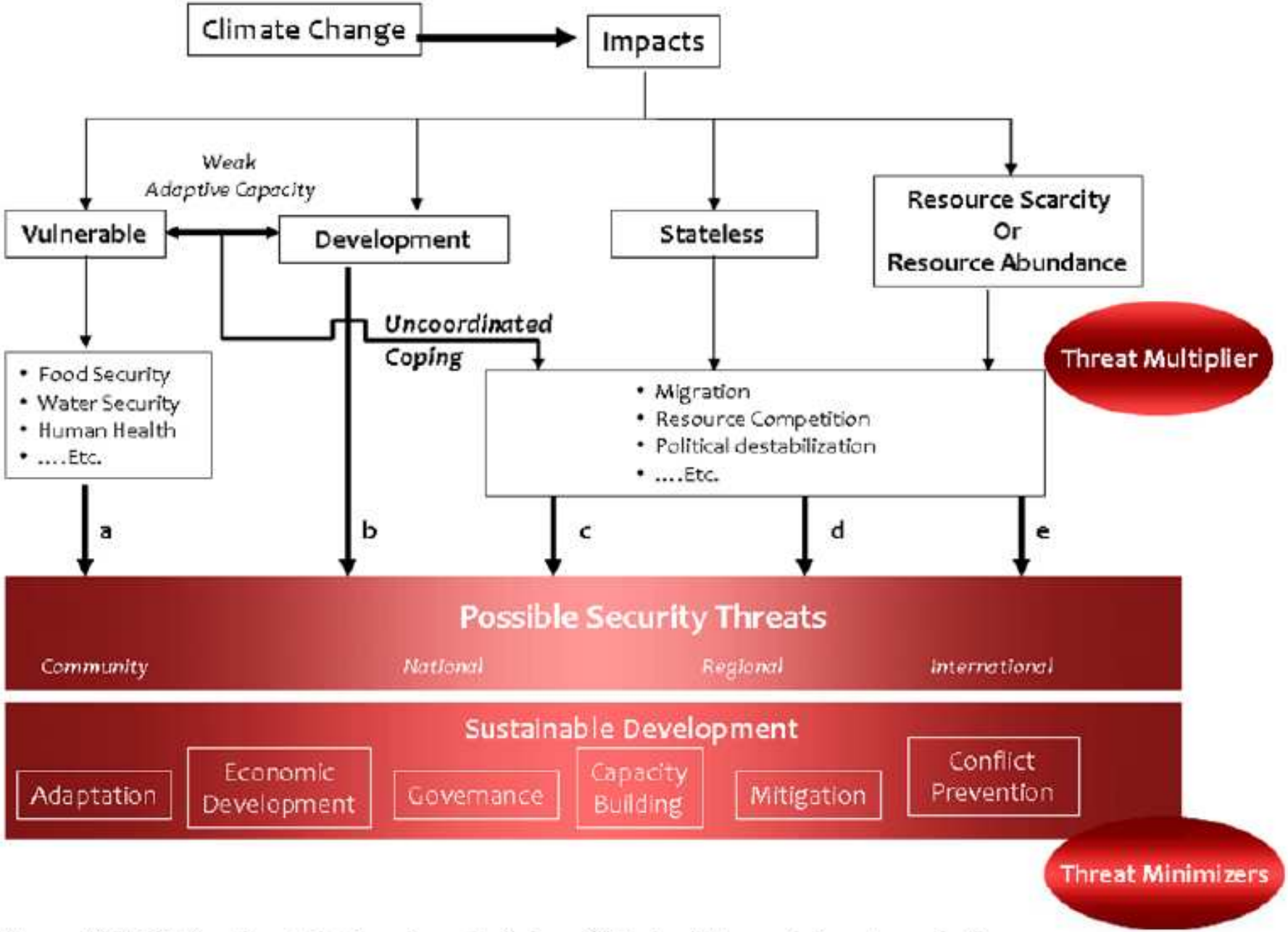
4.13 WBGU Study: Climate Hotspots: Four Conflict Scenarios

Figure 4.7: Regional hotspots and security risks associated with climate change. **Source**: WBGU (2008: 4). Reprinted with permission.



- **Mediterranean**
  - Water
  - Food product.
  - **Migration**
- **South, Central and East Asia**
  - –Water
  - Food product.
  - **Migration**
  - cyclone
- **Latin America & Caribbean**
  Wasser
  - Water
  - Food product.
  - **Migration**
  - hurricanes

Threat multipliers and threat minimizers: the five channels



Source: United Nations Secretariat, based on submissions of Member States and relevant organizations.

5. Levels of Revolutions: Overview since end of glacial time

- **Earth history:** Holocene: Impact of end of glacial period (ice age: 10-12.000 years ago),
- **Human history:** **Neolithic revolution** (1936, Vere Gordon Childe): transition from collectors & hunters (old stone age) to productive processes of resident cultures (young stone age) in Near East (fervent crescent): impact of climatic change: warmer & wetter climate: higher evaporation & precipitation levels
- **Economic-technical:** fundamental change of organization patterns: **agricultural revolutions** (long transformation process)
  - **Technical adaptation**: use of wild cereals (residence, food reserves), use of dry areas, domestication of animals (since 9000 years b.p.) **-> increase in carrying capacity and population growth.**
  - **Centres: Near East** (grain, 9000 years BC), **Southeast Asia** (rice, 8000 years BC), **Mesoamerica** (Maize, 3500 years BC)
  - **Fundamental change in world view:** mythologies & religious beliefs

5.1. From Holocene to Anthropocene

Holocene: 2nd neolithic revolution, slow gradual transition

- ***From hunters & collectors to resident farmers***
- ***Neolithic and Agricultural Revolution:*** 7,000-10,000 years ago: human settlements in the Holocene
- ***Gradual*** development of resident communities, towns, cities, small states, systems of rule [start of polities (institutions, norms), politics (processes)]
- **Change of ownership**: private property, patriarchy

Anthropocene: (1782, 1950s): three socio-economic revolutions [productive & consumptive patterns, ways of life]

- ***Industrial:*** 1782: industrialization, urbanization with massive use of fossil energy (beyond Malthusian projections), major population increase (medicine, European emigration)
- ***Technological-Communicative:*** 1950s: Globalization: oil & gas: transportation, 1980s: computers, internet, uncontrolled financial flows (end of the Westphalian state, control of territory) (Cold War [1947-1989] and post cold war era [1990-present]) GEC in the Anthropocene
- ***Future (?) Sustainability Revolution:*** 2020-2050: Decarbonization, Dematerialization from a human, gender and environmental (HUGE) security perspecive

5.2. Major Socio-Economic Revolutions: Neolithic and Agricultural Revolution

- **Klaus Schmidt** (Darmstadt. WBG, 2009: 128ff, Weltgeschichte 1): **Climate change and not scarcity of resources** were causes of change: people had to respond with new survival strategies, start in Near East (present Turkey, Syria, Iraq),
- Development of first administrative structures, emergence of towns (4_{th} millennium BC), Egypt since 3500 BC
- **Early high civilizations:** Egypt, Mesopotamia, Indus valley, Hethiter, Crete, Mycene, Cyprus, China, Mesoamerica)
- **Neolithic revolution:** from collectors to farmers;
- **Societal impacts:** emergence of villages, towns;
- **Political impacts:** emergence of city states (rulers, wars),
- **Long Transformation:** 10.000-5.000 years BC (WBGU, 2011, Box 3.1: summary Neolithic revolution, expert study by Sieferle)

5.3. Industrial Revolution

- **Complex process of economic & societal transformation:** started in UK, spread to France, Germany, Italy, Russia): transformation of the energy system (energy sources)
- **Before:** biomass and human labour; **later**: Coal, oil, gas (steam engine, railway, automobile, electricity), fertilizers (yield rise), e.g. Haber-Bosch
- **UK:** united state, internal peace, centralized politics, natural resources, sophisticated crafts, protection of property (patents), scientific elite, investment in new ideas & technologies
- **Germany:** take off after 1870: science & technology (expansion
- **United States:** after 1865 (civil war): huge potential: land, resources, manpower, internal market (expansion)
- **Russia and Japan** were latecomers & competitors in Far East
- **Political preconditions:** innovative actors, investments, joint world view, institutionalized co-operation: science, economic system, state (Polanyi (1944), Osterhammel (2009), Sieferle (2010) et al.)

5.4. Communication & IT revolutions: Globalization: new actors & processes

- **Second cause of change for security concept & policy:** new technology, new processes, new actors & new security threats
- **New technologies**: constraints for SU & China: political control
  - Communication systems: telephone, radio, TV: spreading of information: both propaganda (state control) but also awareness raising
  - Computers (information technology), internet: information beyond control
  - Financial flows: beyond national control
- **New processes:** Penetration of national sovereignty, awareness, element for democratization?
- **New actors:** Non-state actors and processes (beyond national and international control, accountability)
- **New security threats:**
  - individ. Terrorism & organized crimes
  - Financial flows, products, speculation (virtual economy), financial crises

5.5. PEISOR: Policy Response

Actors: State, Society, Economic Sector, Knowledge

- **Key actors for development and implementation of a new transformation towards sustainability are:**
  - **States:** initiate, fund and implement strategies, policies & measures for a fourth sustainability revolution
  - **Society** (parties, interest & pressure groups, NGOs, lobbyists): public awareness, discourse, social movements for sustainability transformation
  - **Economic sector & business community:** develops and offers technical and economic solutions
  - **Knowledge** (generation & education): source for innovation

6. Scientific revolutions: paradigm or fundamental changes in worldviews

- ***Thomas Kuhn*** challenged the prevailing view of progress in "normal science." in: ***The Structure of Scientific Revolutions (1962)*** argueing that **conceptual continuity** were interrupted by periods of **revolutionary science** or **paradigmatic shifts** that change the rules of the game and asks new questions of old data, & moves beyond puzzle-solving of normal science.
- **Copernican Revolution** in its beginning, did not offer more accurate predictions of celestial events, such as planetary positions, than the Ptolemaic system, but instead appealed to some practitioners based on a promise of better, simpler, solutions that might be developed at some point in the future.
- **Core concepts** of an **ascendant revolution: "paradigms**" & his insistence that a **paradigm shift** **was a mélange of sociology, enthusiasm and scientific promise** caused an uproar. For some commentators it introduced a realistic humanism into the core of science while for others the nobility of science was tarnished by Kuhn's introduction of an **irrational element into the heart of its greatest achievements**.
- **Crisis:** precondition: for new theories and how scientists respond to them.
- **Scientific transition to a new scientific paradigm:** scientific revolution
- **Revolutions as changes of world views:**

6.1. Changes in Worldviews

- **Copernican Revolution paradigm shift from the**
  - **Ptolemaic model of the heavens, which postulated the Earth at the center of the galaxy, towards the**
  - **heliocentric model with the Sun at the center of our Solar System. It was one of the starting points of the Scientific Revolution of the 16th century.**
- **Challengers: Copernicus (1543), Brahe (1577), Kepler (), Galilei (1610), Bruno (burnt), Newton (1677): *Philosophiae Naturalis Principia Mathema-tica***
- **Thomas Kuhn:** Copernican Revo-lution (1957), Structure of Scientific Revolutions (1962). Postscript (1969)

6.2. Critiques: Eurocentric perspective?

- **Kuhn's SSR was criticized by history and philosophy of science**, e.g. in 1965, at a special symposium by Popper, Feyerabend, Lakatos, Toulmin and Watkins
- Stephen Toulmin (1972) argued that **revisions in science take place much more frequently, and are less dramatic**.
- **Kuhn would need to delineate** what is perhaps an implausibly sharp distinction between **paradigmatic and non-paradigmatic science**.
- **Arun Bala in *The Dialogue of Civilizations in the Birth of Modern Science* (Palgrave Macmillan, 2006)** claimed that SSR is a Eurocentric work charging that ignores the significant impact of Arabic and Chinese science when he writes:
  - Every civilization of which we have records has possessed a technology, an art, a religion, a political system, laws and so on. In many cases those facets of civilizations have been as developed as our own. But only the civilizations that descend from Hellenic Greece have possessed more than the most rudimentary science. The bulk of scientific knowledge is a product of Europe in the last four centuries. No other place and time has supported the very special communities from which scientific productivity comes (Kuhn, *1962: 167-168*).
- **Bala argues** that **Kuhn's postmodern epistemological paradigm** obstructs recognition of non-Western influences on modern science. Bala argues that this leads **Kuhn to treat different cultural scientific traditions as separate intellectual universes** isolated from each other. Instead, Bala argues, we would have a different multicultural picture of science by including the contributions from Arabic, Chinese, ancient Egyptian and Indian traditions of philosophy, mathematics, astronomy and physics that went into shaping the birth of modern science.
- **Source:** Wikipedia on Kuhn's Structure of Scientific Revolutions

6.3. Knowlede Revolution

Source: Uwe Jochum: „Wissensrevolution“ (2010)

- **3 Expansions of knowledge:**
  - **External: geography**
    - Horizontal expansion: Geographic knowledge (1492)
    - Vertical expansion: down (seas) up (mountains)
  - **Internal: e.g. natural sciences (biology)**
  - **Retrospective (history)**
- **New institutions of systematic knowledge creation**
  - Universities, technical universities, academies (applied for military, agriculture, industry, administration)
- **New means/infrastructure** of knowledge distribution
  - Books and libraries (university, national), loans, media
- Systematization of knowledge: Encyclopedias

6.4. Clark/Crutzen/Schellnhuber (2004): 2nd Copernican Revolution for Sustainability

- **Alternative vision** refers to the need for a "**new paradigm for global sustainability"** (Clark/Crutzen/Schellnhuber 2004), for a "transition to [a] much more sustainable global society" (Raskin/Banuri/Gallopin et al. 2002), aimed at **peace, freedom, material well-being and environmental health.**
  - Changes in **technology and management systems** (geoengineering) alone will not be sufficient,
  - but "significant **changes in governance, institutions and value systems**" are needed,
  - resulting in a **fourth major transformation after** "the stone age, early civilization and the modern era".
- Alternative strategies should be "**more integrated**, more **long-term in outlook**, more attuned to natural dynamics of the Earth System and more visionary" (Steffen et al. 2004: 291–293).
- These many changes suggested above by natural scientists require a '**Fourth green, sustainable or sustainability revolution**' (goal: decarbonization of energy & production syst.)

7. Modern Global, Regional & National Political Revolutions

- **Political revolution:** fundamental restructuring of political institutions with an exchange of elites, abrupt change can be violent
- **With a global impact: change of international order**
  - **American Revolution (1776):** Decolonization & republic system of rule
  - **French Revolution** (1789): liberty, fraternity, egality: **Vienna Congress (1815)**
  - **Soviet Revolution** (1917) -> **Versailles (1919)**
  - **Chinese Revolution** (1949)
  - **Peaceful revolution (1989);** End of Cold War and bipolar world
- **With a regional impact:**
  - **Revolutions** and counter revolutions in Europe (1848)
  - **Arab spring** (revolutions): 2011
- **With a national impact:**
  - **Glorious revolution** in UK (1688/1689)
  - **Mexican revolution** (1910-1919)
  - **German revolution** (1918)
  - **Chinese Cultural revolution** (1960s, 1970s)

7.1. Linkage between natural (climatic) factors, technical, scientific and political revolutions?

- **Climatic factors war crucial in neolithic & agricultural revolutions in the Holocene**
- **Most theories on political revolutions did not analyse environmental and climatic (variability) factors.**
- **Most historical & political science studies on global, regional, national revolutions did not address possible environmental and global triggers (**climate change not asocially constructed field or theme until 1980s, 1990s),
- **Extreme weather events and the French Revolution (1789)**
  - **Widespread famine and malnutrition** among most dissatisfied groups of French population in months immediately before Revolution were presumably the single igniting factor.
  - Since the Laki volcanic eruption in Iceland 1784-1785 summers had been cool in Europe and harvest poor. In France, several weather extremes seem to have been most serious. **1785 produced the coldest March recorded in much of Europe**, and extended what was already an **outstandingly severe winter**. This was followed by a **year of drought**, with only 67 per cent of expected annual precipitation falling in Paris (Lamb 1995).
  - This resulted in a **forage crisis** on the French farms, and many **cattle** had to be slaughtered. French peasants ate bread made of rye or oats, and only the upper classes could afford wheaten bread. Even so the **dearth produced by the failing harvest** meant that about 55 per cent of the poorer classes' earnings went on bread alone.
  - To make things even worse, in **1789 the price for bread was increased from 8 to 14 sous. This caused widespread dissatisfaction**, to put it mildly.
  - <http://www.climate4you.com/ClimateAndHistory%201700-1799.htm#List of contents>

7.2 Linkage between climatic factors and Arab Revolutions in 2011?

- **Did climate change impacts in one part of the world trigger the Arab revolutions that have taken place since January 2011?**
- *International Institute for Strategic Studies* (IISS) postulated that natural hydro-meteo-rological or climatalogical hazards, e.g. heat waves and forest fires in summer 2010 in **Russia, Ukraine, and Kazakhstan, and floods in Canada and Australia** resulting in a major **decline in food supply** & rapidly growing **food prices**, created one of several major incentives for the rapid spread of public protests throughout the Arab world.
  - Record food prices have been just one ingredient in the unrest in the Arab world. … Structural shifts have led to a tightening of the international food-supply system, magnifying the effect of disruptive events such as weather-related crop failures in 2010. … The cost of wheat has been climbing since summer 2010, when drought and bushfires laid waste to crops in Russia, Ukraine and Kazakhstan, all leading exporters; the prices of sugar, maize (corn), soybeans and vegetable oils have also been rising.
- **The IISS strategic comment of March 2011 further argued**
  - There are many reasons to link the Arab uprisings to food-price inflation. With little arable land and scarce water supplies, the … [MENA] region imports more food per capita than any other, accounting for 25–50% of national consumption. By tonnage it is the world's largest cereal-importing area, and it is a major customer for Russian grain. Huge population growth and changing diets have contributed to the region's growing food insecurity. … Experts in Tunisia and Egypt have described food prices as an 'aggravating factor' in the recent turmoil, rather than the principal cause. … In Egypt, families spend an average 40% of their income on food, overall food-price inflation has been at 20%, and the price of some individual commodities, such as tomatoes, has shot up tenfold. … Russia, the world's fourth-largest wheat exporter accounting for roughly 14% of the global wheat trade, responded by imposing an export ban on wheat, barley and rye from August. … Russia's largest customer, Egypt, received only 1.6 m tonnes from Moscow in the last six months of 2010, compared to 2.8 m tonnes in the same 2009 period. Ukraine, another major supplier, stopped overseas grain sales. ...
- This thesis of a link between hydro-meteorological hazards resulting in a declining food supply in a part of the world and rising food prices in highly dependent food-importing countries: public unrest, bread riots, eruption into rapidly-spreading revolutions,

8. Strategies for Transition towards Sustainability (WBGU 2011)

5. Transformation Governance

5.2 Political Instruments for Managing the Transformation

5.3 Transformation Impediments and Barriers

5.4. A New Statehood within the Multilevel System

6 Agents of Transformation: How Innovations Can Spread (Faster)

6.1 From Awareness to Action? – From Action to Awareness!

6.2 Concept of Change Agents: Definition, Typology, Roles

6.3 Where & how Change Agents are already Shaping the Transformation Today

6.4 Conclusion: Promote and Multiply Change Agents to Achieve a Rapid Transformation

8. Strategies for Transition towards Sustainability (WBGU 2011)

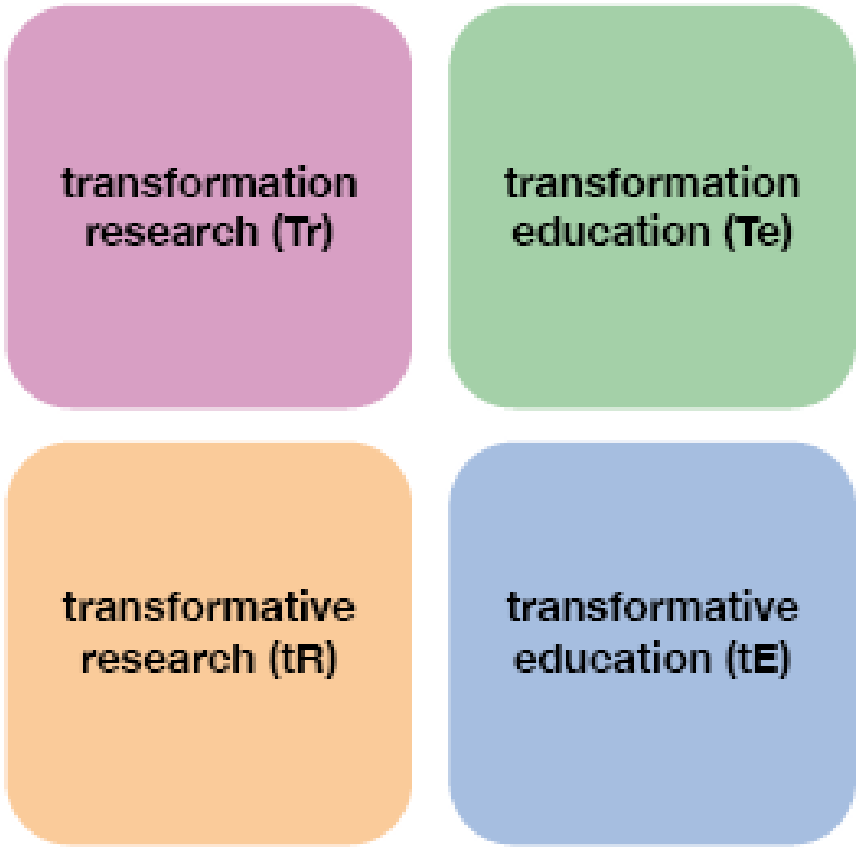
- The WBGU views this worldwide remodelling of economy and society towards sustainability as a ‘Great Transformation’.
- Production, consumption patterns and lifestyles in all of the three key transformation fields must be changed in such a way that global greenhouse gas emissions are reduced to an absolute minimum over the coming decades, and low-carbon societies can develop.
- The extent of the transformation ahead of us can barely be overestimated. In terms of profound impact, it is comparable to the two fundamental transformations in the world’s history: the Neolithic Revolution, i.e. the invention and spreading of farming and animal husbandry, and the Industrial Revolution, which Karl Polanyi (1944) called the ‘Great Transformation’, meaning the transition from agricultural to industrialised society.

9 Emerging Research Agendas

Strategy for Sustainable Transition Requires Changes in the Scientific System of Knowledge Production

- **Edward O. Wilson (1998)** noted a growing *consilience* (interlocking of causal explanations across disciplines) in which the "interfaces between disciplines become as important as the disciplines themselves" that would "touch the borders of the social sciences and humanities."
- **Clark, Crutzen and Schellnhuber (2004)** called for a 'second Copernican Revolution in earth systems science' & a 'new paradigm of sustainability' and new 'Contract for a Planetary Stewardship'
- **Grin, Rotmans and Schot (2010)** reviewed "Transitions to Sustainable Development: New Directions in the Study of Long Term Transformative Change"
- **Huff (2011)** discussed past "Intellectual Curiosity and the Scientific Revolution" in Western and Non-western Cultures (Confucianism, Hinduism and Islam)
- **Brauch, Dalby and Oswald Spring (2011)** suggested a new 'Political Geo-ecology for the Anthropocene" by bringing politics and security into Earth Systems Science and its key results into the social sciences
- **WBGU (2011)** proposed a new "Social Contract for a Global Transformation"

9.1. WBGU (2011): Knowledge Society in the Transformation Process: Recommendations for Research and Education



Transformation Research

– The WBGU proposes a new scientific ‘transformation research’, which addresses the future challenge of transformation realisation. This discipline explores transitory processes in order to come to conclusions on the factors and causal relations of transformation processes.

Transformative Research

– The WBGU uses the expression transformative research (tR) to describe research that actively advances the transformation. Transformative research supports transformation processes with specific innovations in the relevant sectors.

9.2. WBGU (2011): Research Proposals

- Science and research should dedicate themselves even more to the low-carbon transformation within the context of sustainability.
- Research should focus more on transformation-relevant issues and subjects and the new field of transformation research.
- It should increasingly meet a number of structural demands, such as, for example, a systemic, long-term, cross- and transdisciplinary direction.
- It should develop technological and social low-carbon innovations, evaluate these, and assess the required conditions for their global diffusion.
- This also includes the development, evaluation, and public discussion of strategies and policy options. Accordingly, research programmes should reflect these demands.

9.3 WBGU (2011): Research Proposals (2)

- The WBGU calls for a new, **‘transformation research’, on transformation processes & social preconditions** within the scope of planetary boundaries. WBGU proposes a joint societal research & discussion process.
- **Additional R&D funding is required** & should be consolidated at EU and international level.
- The WBGU suggests direct public spending in the industrialised countries on R&D in the **energy field tenfold**, largely through reallocation.
- The current funds for the BMBF **sustainability research**, particularly the framework programme ‘**Research for Sustainable Development’, and ‘Socio- Ecological Research’ (SÖF**) should be significantly increased, and SÖF’s global perspectives should be considerably extended.
- **Interdisciplinary research** should be supported by concrete measures. This requires changing existing incentive systems, & introducing new ones.
- In the **8th EU Framework Programme for Research**, the German federal government should lobby for a stronger focus on the transformation; environment and energy research should be given particular weight.
- Internationally, **Germany and the EU should forge stronger research alliances with research centres in emerging economies**. Germany should step up the promotion and support of education, science and research capacities in the less developed countries.

9.4. New Social Contract for a "Global Transformation"

A New Social Contract

- **Transformation into a sustainable society requires a modern framework for nine billion people for living with each other, and with nature: a new Social Contract with responsible global citizen and among generations.**
- **Science plays an essential role for a profound transition not caused by imminent necessity, but by precaution and insight with a special agreement between science and society.**
- **A new culture of democratic participation to ensure the protection of future-oriented interests. A low-carbon transformation can only be successful if it is a common goal, pursued simultaneously in many of the world's regions.**
- **It encompasses new ways of shaping global political decision-making and cooperation beyond the nation state.**

10. Political Urgency and Research Agenda: Towards a Fourth Sustainability Revolution

Glooming Prospects for Post-Kyoto Regime: Paralysis

- Prospects for Post-Kyoto climate regime at COP 17 in Durban are low
- At present it becomes increasingly unlikely to realize the 2°C world
- Probability of ‘dangerous climate change’ increases dramatically
- This increases the probability that thresholds in the climate system may be crossed, that tipping points may be unleashed, triggering cascading processes as: ‘Arabellion’ and ‘Fukushima nuclear disaster’

Business-as-usual paradigm prevails in politics & media

- In light of global financial crisis, the sense of urgency for proactive climate action has declined since 2009 prior to Copenhagen (COP 15)
- The US government is paralyzed due to ideological confrontation within the US Congress and between the Senate & the House
- Lack of urgency among BASIC countries to accept commitments.

10.1. Implications for the Social Sciences

- The challenge of research on the societal impacts of global environmental change in the Anthropocene requires an understanding of the **observed and projected changes** within the **earth system** and its **physical and societal impacts for the human systems, i.a. an analysis of earth systems sciences.**
- This requires increased funding for multi-, inter- and transdisciplinary research to address the '**consilience**' of the sustainability paradigm.
- Research on sustainability transition may not be limited to a research agenda of the priorities, pathways & strategies towards sustainability
- For **sociology and political science** it requires to address 'cascading processes' in the 'world risk society' stimulated by the ‚principle of *precaution through prevention*' (Ulrich Beck, 2011).
- For international relations, security and peace research this requires conceptual research on the conditions and possibilities of a sustainable peace as a global political framework for a sustainable transition.

10.2. Implications for International Relations

- **Is transformation research - suggested by WBGU - relevant for IR and specifically for security & peace research?**
- Previous WBGU report: Security Risk Climate Change (2007): impact on securitization of CC in EU (2008), UN (2007, 2009, 2011) in the contact of international security (goal conflict prevention), but in the US primarily in the context of national security (as new tasks for the adaptation of the US military)
- 2 types of policy response: concepts matter
  - Reactive policies. Discourse on national security
  - Proactive polices: discourse on international, human, environmental security
- Goal: link transition towards sustainability with goal of a sustainable peace requiring a proactive peace policy to address potential climate-induced causes of conflicts and wars.
- **Task of value-oriented or normative conceptual and policy-relevant peace and security research.**