SPACE FOR HUMAN AND ENVIRONMENTAL SECURITY

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Space for Human and Environmental Security in the Americas:
Space Policy, Long-term Sustainability and Cyber-health

Ciudad de Máxico, 24 Abril, 2012

Outline

-Drivers of unsustainability

-Planetary boundaries

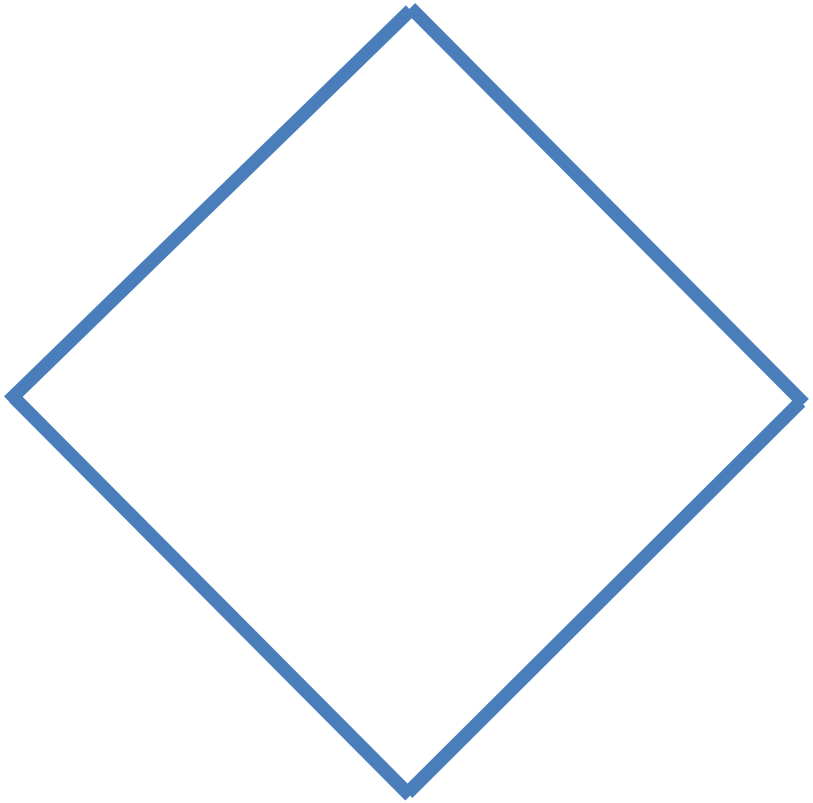
-Natural resources scarcity

-Long-term sustainability of outer space activities is essential for long-term sustainable development on Earth

The Square of Unsustainability

Inequalities of Development, Poverty, Hunger, Health and Wellbeing Deficiencies

Food Insecurity, Biodiversity Loss, Water Scarcity and Scarcity of Other Natural Resources



Unsustainability of the Energy Systems

Climate Change

ENERGY SUSTAINABILITY

- Access to energy sources

- Price and competitiveness

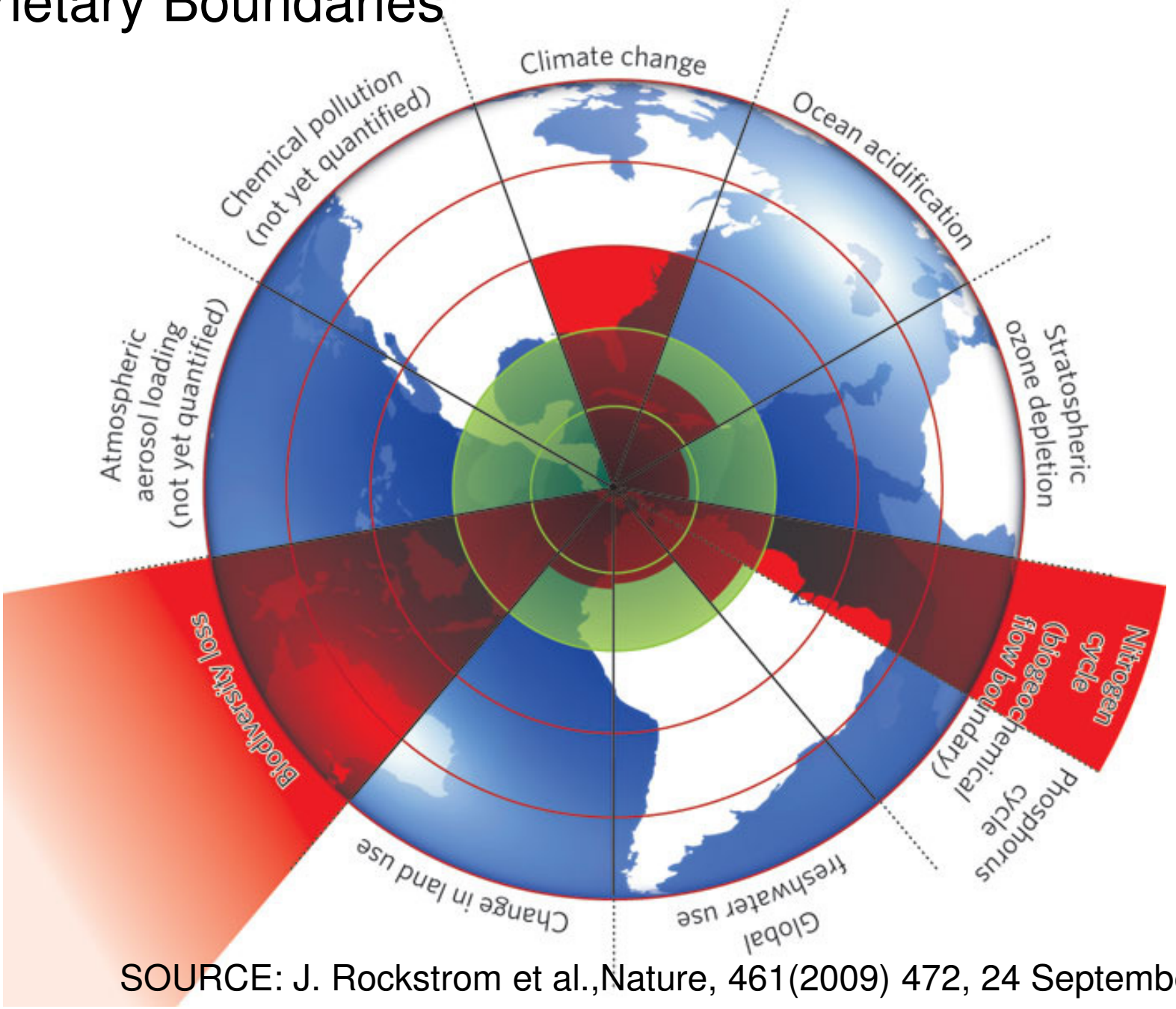
- Environmental compatibility.

Approximately 80% of the world energy primary sources are fossil fuels – This strong dependence implies a strong connection between energy and climate change

- All 4 drivers of unsustainability are strongly interconnected and interdependent

- To reach sustainable development the 4 drivers should be simultaneously addressed

Planetary Boundaries



SOURCE: J. Rockstrom et al.,Nature, 461(2009) 472, 24 September

GMO Commodity Index: The Great Paradigm Shift

SOURCE GMO LLC

Note: The GMO commodity index is an index comprised of the following 33 commodities, equally weighted at initiation: aluminum, coal, coconut oil, coffee, copper, corn, cotton, diammonium phosphate, flaxseed, gold, iron ore, jute, lard, lead, natural gas, nickel, oil, palladium, palm oil, pepper, platinum, plywood, rubber, silver, sorghum, soybeans, sugar, tin, tobacco, uranium, wheat, wool, zinc.

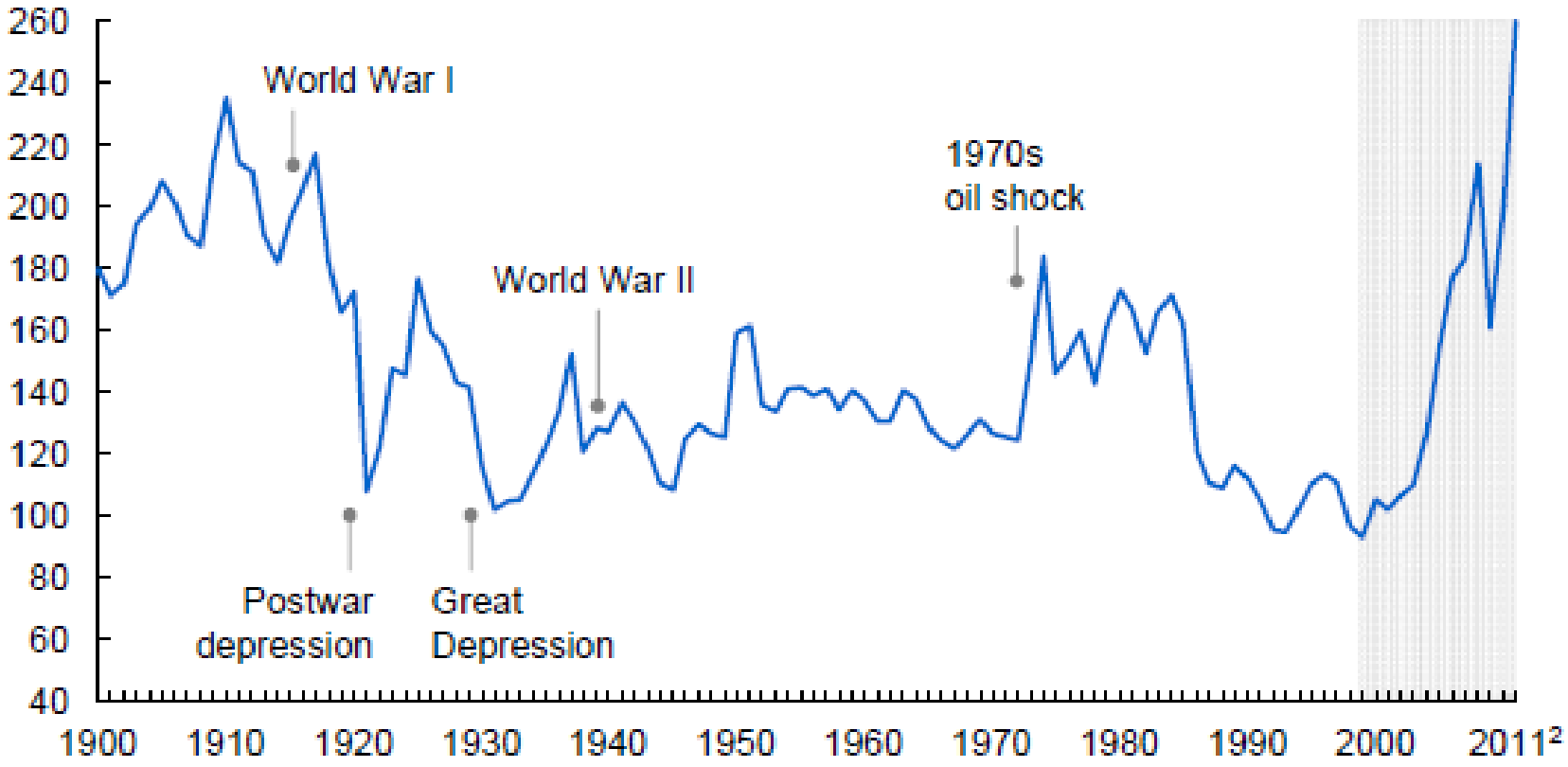
Source: GMO As of 2/28/11

SOURCE: World Bank, IMF, FAO, OECD, McKinsey

Exhibit E1

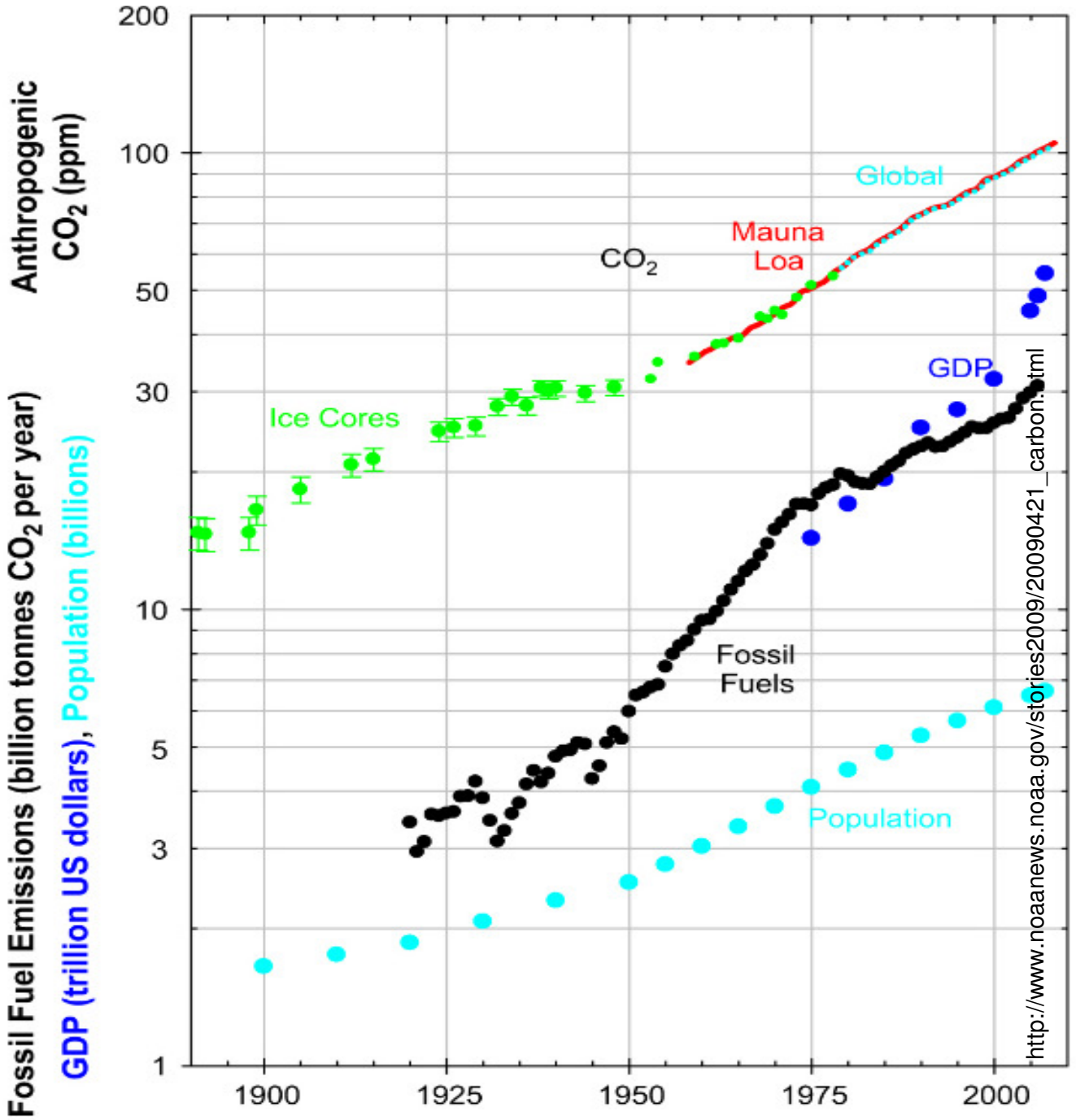
Commodity prices have increased sharply since 2000, erasing all the declines of the 20th century

MGI Commodity Price Index (years 1999–2001 = 100)[1]



1 See the methodology appendix for details of the MGI Commodity Price Index.
2 2011 prices are based on average of the first eight months of 2011.
SOURCE: Grilli and Yang; Stephan Pfaffenzeller; World Bank; International Monetary Fund (IMF); Organisation for Economic Co-operation and Development (OECD); UN Food and Agriculture Organization (FAO); UN Comtrade; McKinsey analysis

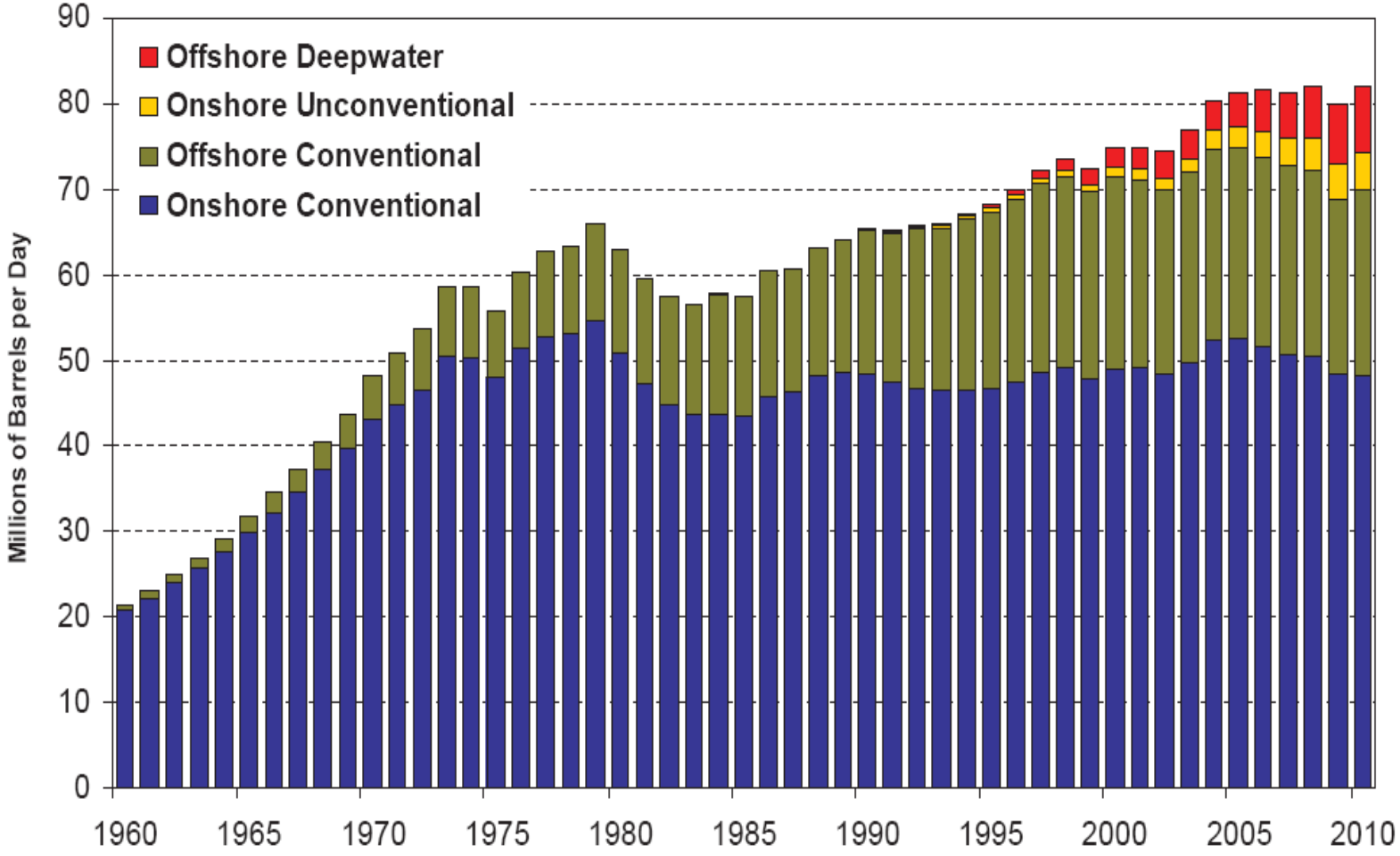
Anthropogenic atmospheric carbon dioxide, fossil fuel emissions, world gross domestic product (GDP), and world population for the past century. Carbon dioxide data from Antarctic ice cores (green points), Mauna Loa Observatory (red curve), and the global network (blue dots).



SOURCE: NOOA, April 2009

Fonte: NOOA, April 2009

Global Oil Production – Onshore and Offshore, Conventional and Unconventional



Source: Energyfiles, Energy Information Administration, BP Statistical Review of World Energy, Wood Mackenzie As of 12/31/10

Sustainable space utilization supporting sustainable development on Earth

1 - Main sustainable development issues, including early warning and disaster management issues, that can be supported by outer space activities

2 - Technical capacity-building and international cooperation to ensure that all countries benefit from space applications and have access to space data that improves human development and contributes to sustainable development on Earth

3 - Equitable access to the limited resources of outer space and to the benefits of outer space activities for human development and sustainable development

One day without civilian satellites would bring chaos

For longer periods of time it would bring the collapse of our civilization, as we know it

Consequences:

No GPS
No cellphones
No internet access through satellites
No land, air and maritime traffic control
No financial markets
Severe impairment of most weather forecast services
etc

Examples of Earth observation applications for sustainable development

- Tele-health
-Tele-education
-Institutional and public awareness of space applications for sustainable development

-Sustainable agricultural management and development
-Crop system analysis
-Integrated agricultural drought assessment and management
-Assessment of land productivity, land degradation and soil carbon dynamics

-Monitoring water resources
-Water resource development plans

-Urban and rural planning

-Sustainable development of forests
- Monitoring and analysis of biodiversity changes

-Mineral and mining exploration

-Monitoring the Earth system
-Monitoring climate change and its impacts, including climate system tipping points
-Monitoring carbon stocks and greenhouse gas emissions

-Development of a green economy

-Management of energy smart grids

Examples of Earth observation applications for disaster management and humanitarian relief

-Management of disasters related with geophysical, meteorological, hydrological and climate events
-Vulnerability and risk analyses
-Rapidly mapping and assessing local emergency situations
-Reconstruction activities

Examples related to the equitable access to the limited resources of outer space

-Access to the geostationary orbit
-Access to the radio frequencies in which satellites operate

Early Warning and Disaster Management

-GEOPHYSICAL EVENTS

Earthquakes, tsunamis, volcanic eruptions

Climate Related Events

-METEOROLOGICAL EVENTS

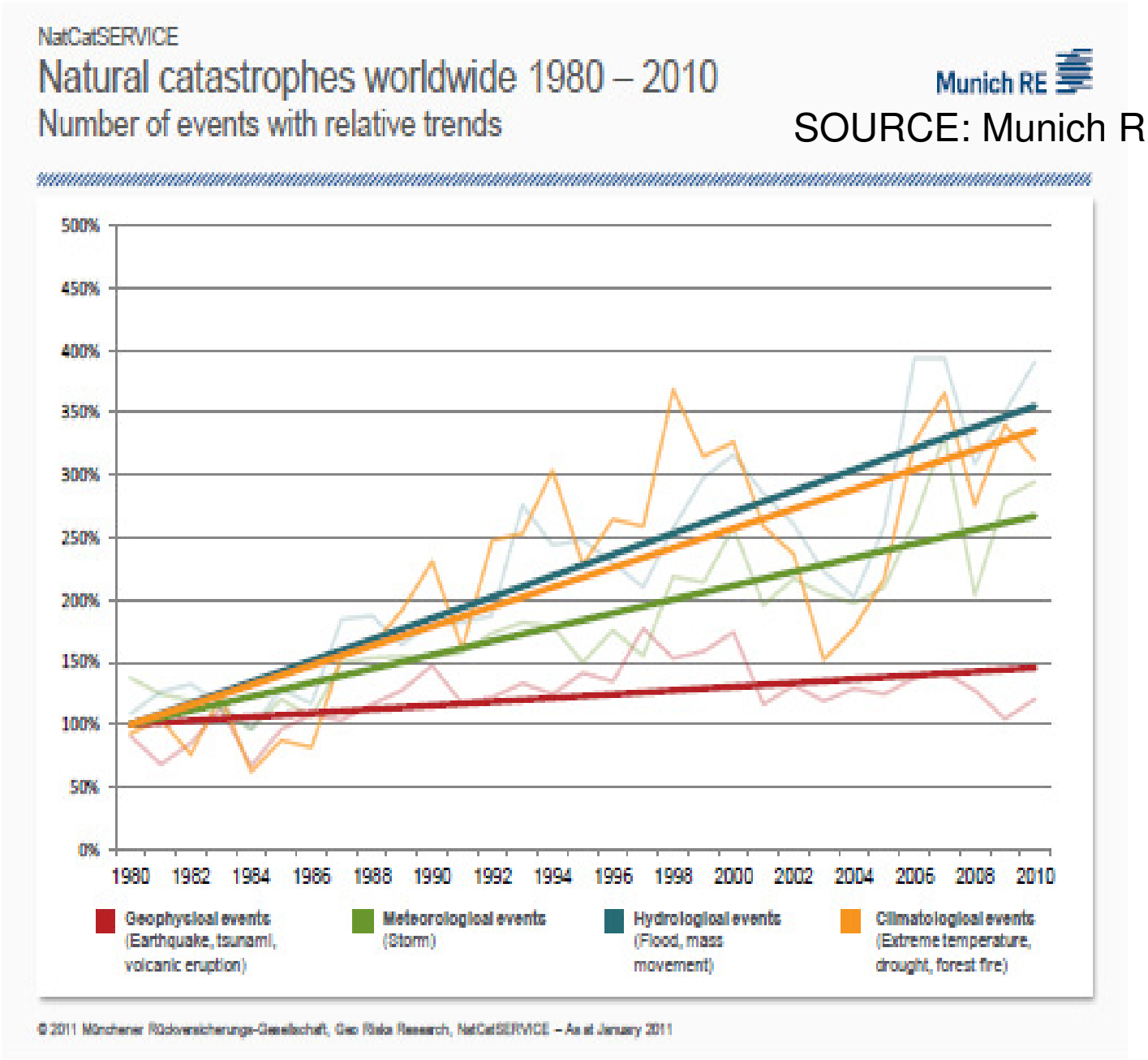
Tropical cyclones and storms

-HYDROLOGICAL EVENTS

Floods, mass movements

-CLIMATOLOGICAL EVENTS

Extreme temperatures, heat waves, droughts, forest fires



SOURCE: Munich RE, 2011

Fig. 1: Relative trends of loss relevant natural extreme events of the different perils

SOME OF THE SATELLITES THAT ARE CURRENTLY BEING USED FOR CLIMATE CHANGE

Poles & Ice

Aura, Cryosat / Siral, Envisat / SAR, Radarsat 2

Sea Level & Water Resources

SMOS, GOCE, JASON / Poseidon, Envisat / Meris

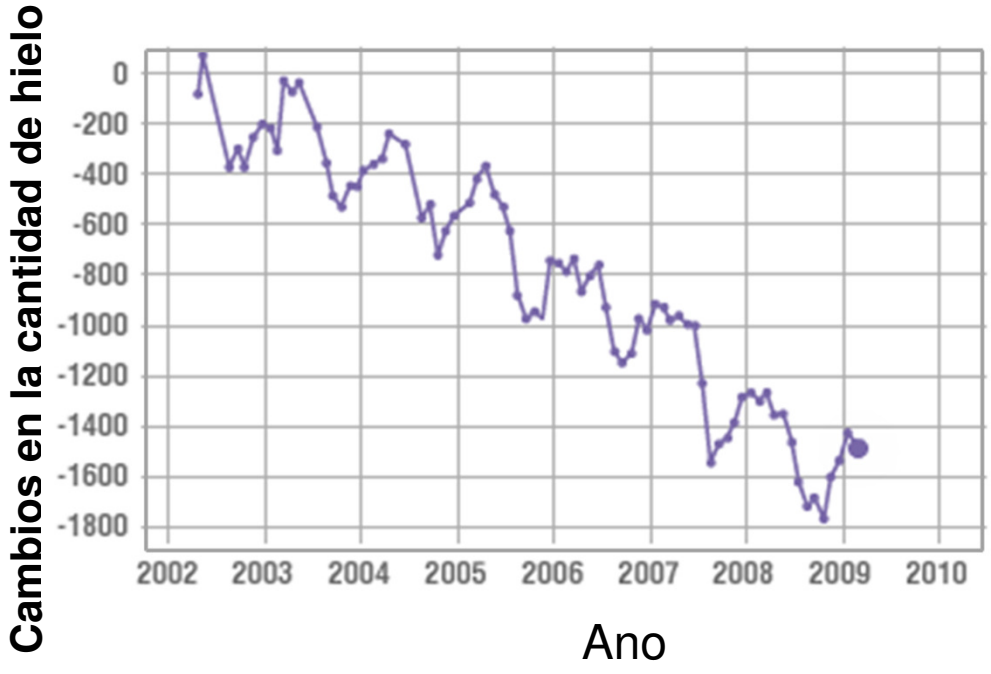
Forests and Natural Resources

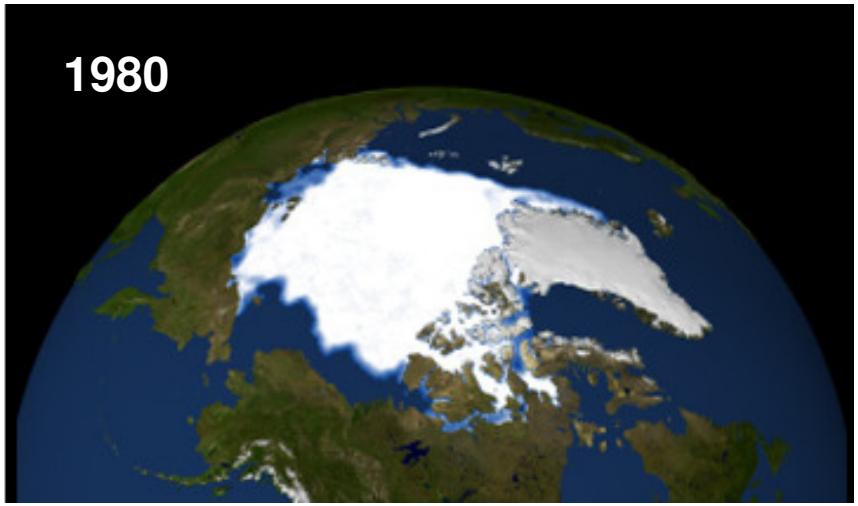
COSMO-SkyMed, ERS, Sentinel 1, Sentinel 3, Vegetation

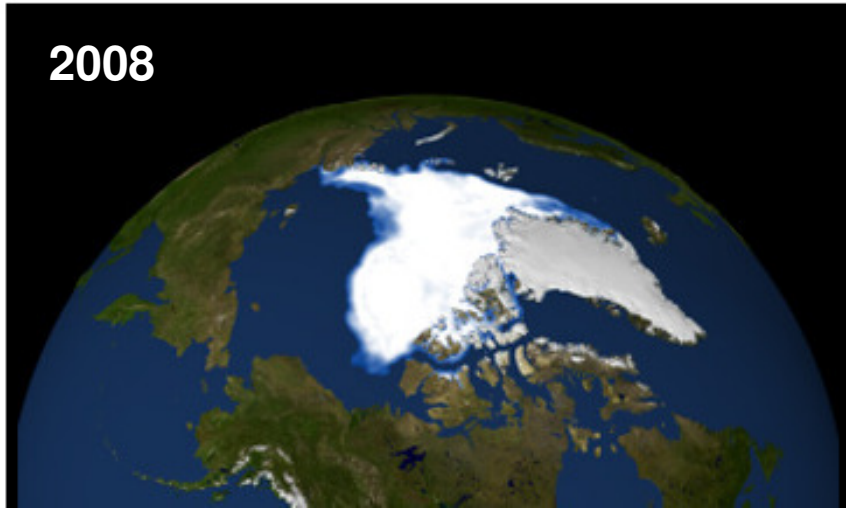
Meteorology, Atmosphere

IASI, Meteosat, MSG

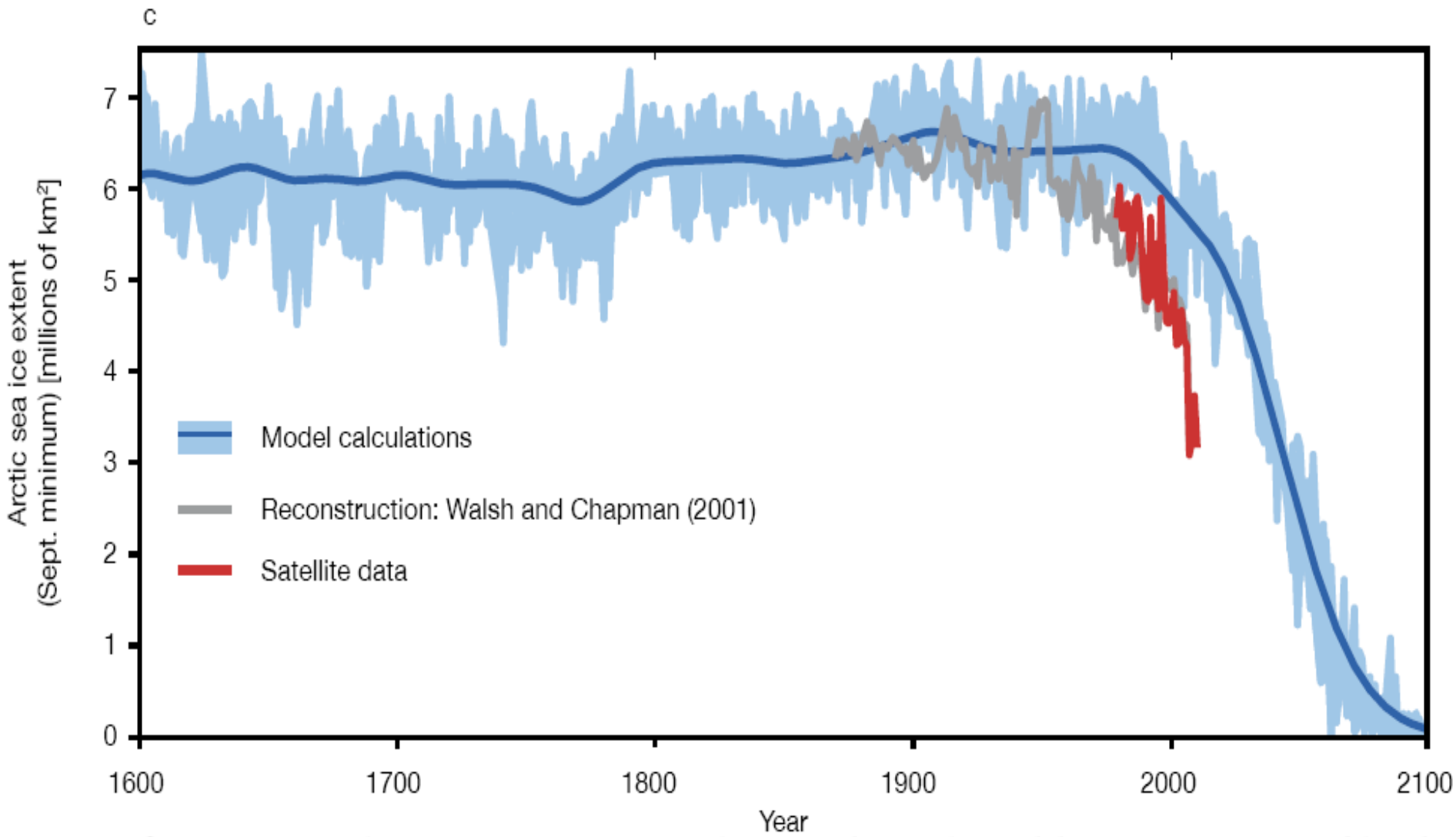
Arctic Sea Ice Area





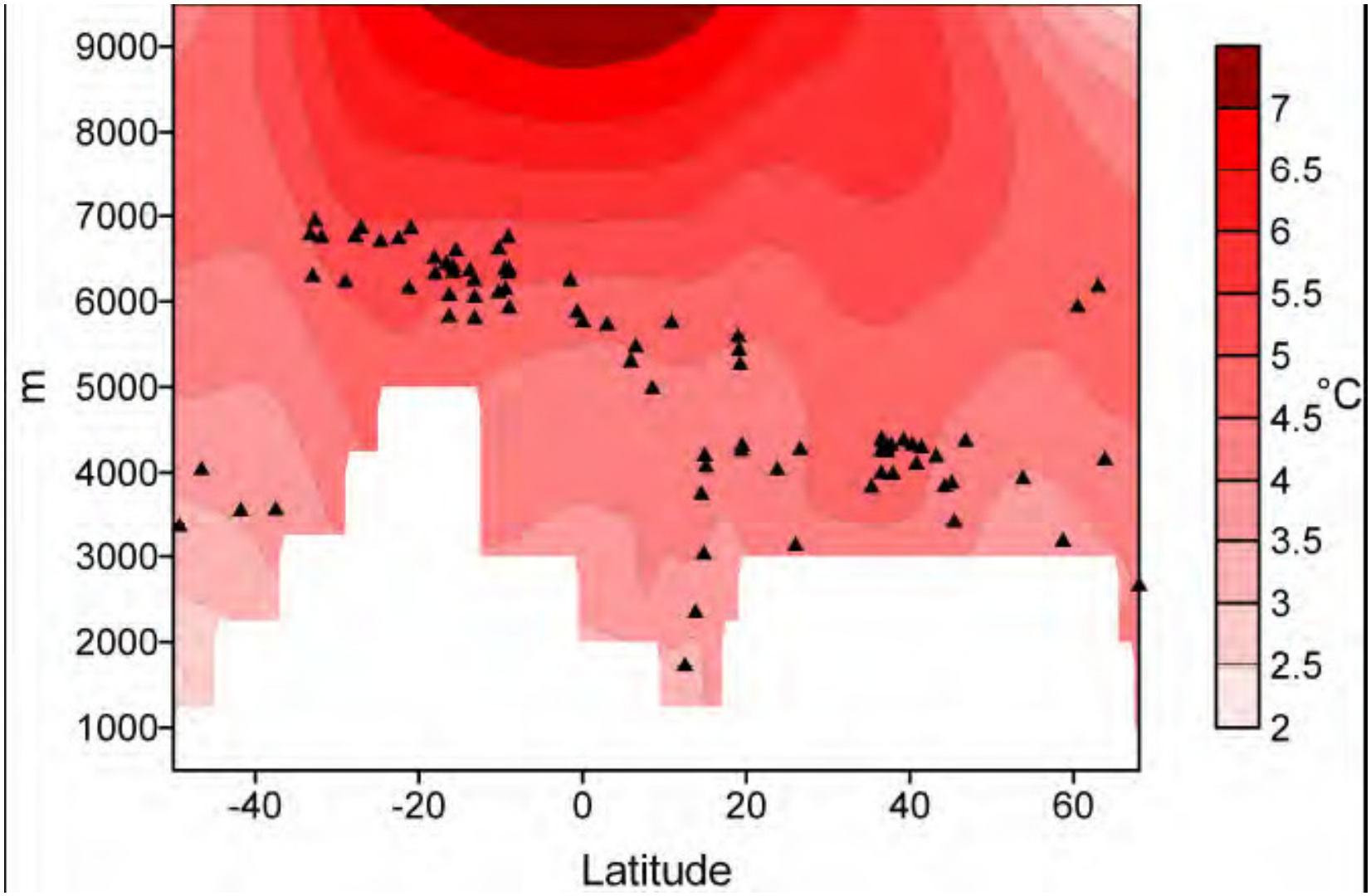


SOURCE: NASA -University of California Irvine. 2010.



c) Extent of Arctic sea ice at the summer minimum (September), according to observed data, reconstruction (Walsh and Chapman, 2001) and a series of model calculations by the Max Planck Institute for Meteorology, Hamburg (based on Jungclaus et al., 2010).

Source: based on WBGU, 2009, amended

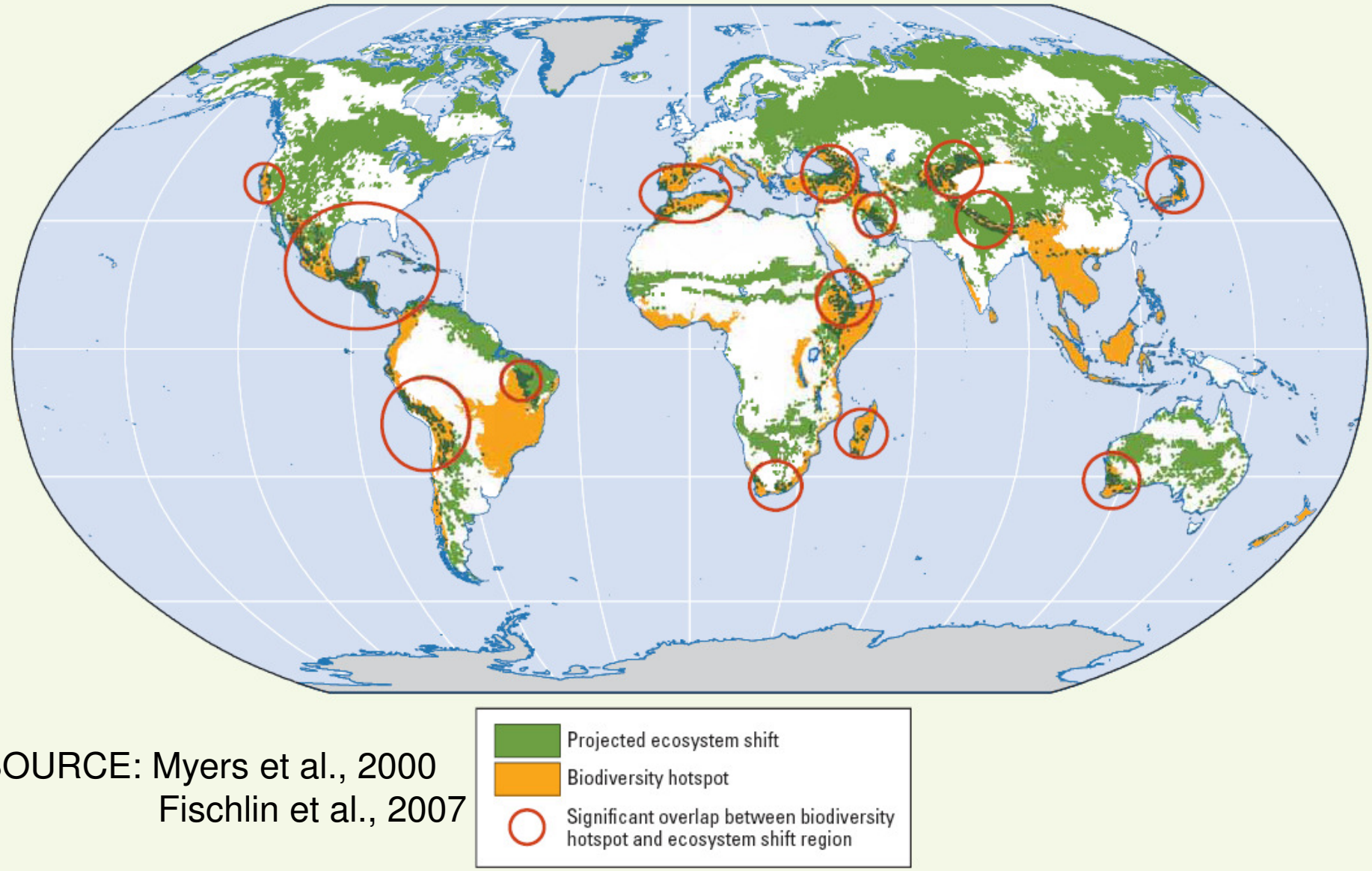


Source: Bradley et al. 2006.

Figure 2. Projected changes in temperature for the American Cordillera from Alaska to Southern Chile between 1990–1999 to 2090–2099

Deforestation in Amazonia, seen from satellite. The roads in the forest follow a typical "fishbone" pattern SOURCE, NASA, 20 September 2006

Map FB.1 While many of the projected ecosystem changes are in boreal or desert areas that are not biodiversity hotspots, there are still substantial areas of overlap and concern



SOURCE: Myers et al., 2000
Fischlin et al., 2007

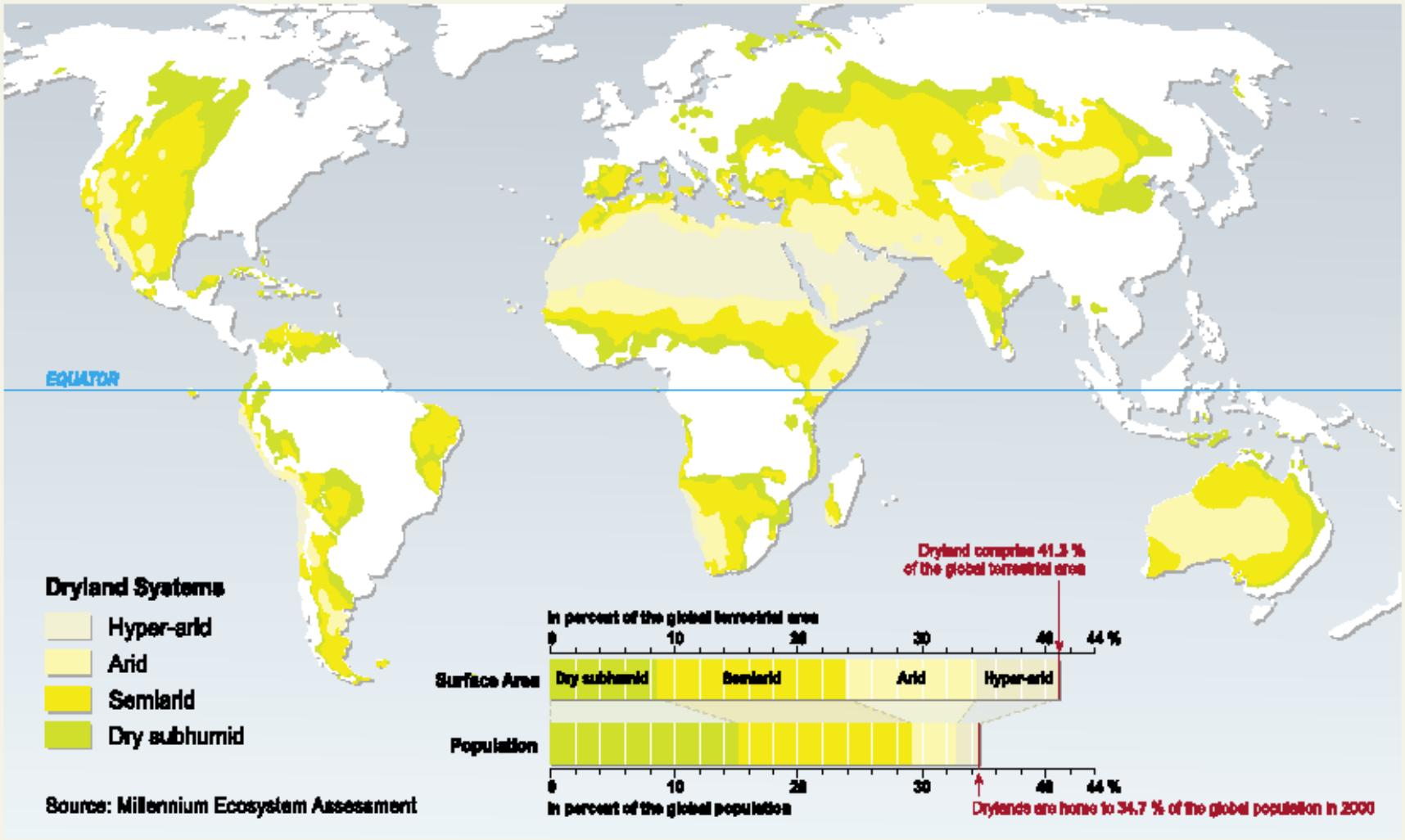
Source: WDR team based on Myers and others (2000) and Fischlin and others (2007).

Note: The figure shows the overlap between biodiversity hotspots (Conservation International and Myers and others 2000) and the projected changes in terrestrial ecosystems by 2100 relative to the year 2000, as presented by the Intergovernmental Panel on Climate Change in Fischlin and others (2007), figure 4.3 (a), p. 238. The changes should be taken as only indicative of the range of possible ecosystem changes and include gains or losses of forest cover, grassland, shrub- and woodland, herbaceous cover, and desert amelioration.

PRESENT-DAY DRYLANDS AND THEIR CATEGORIES

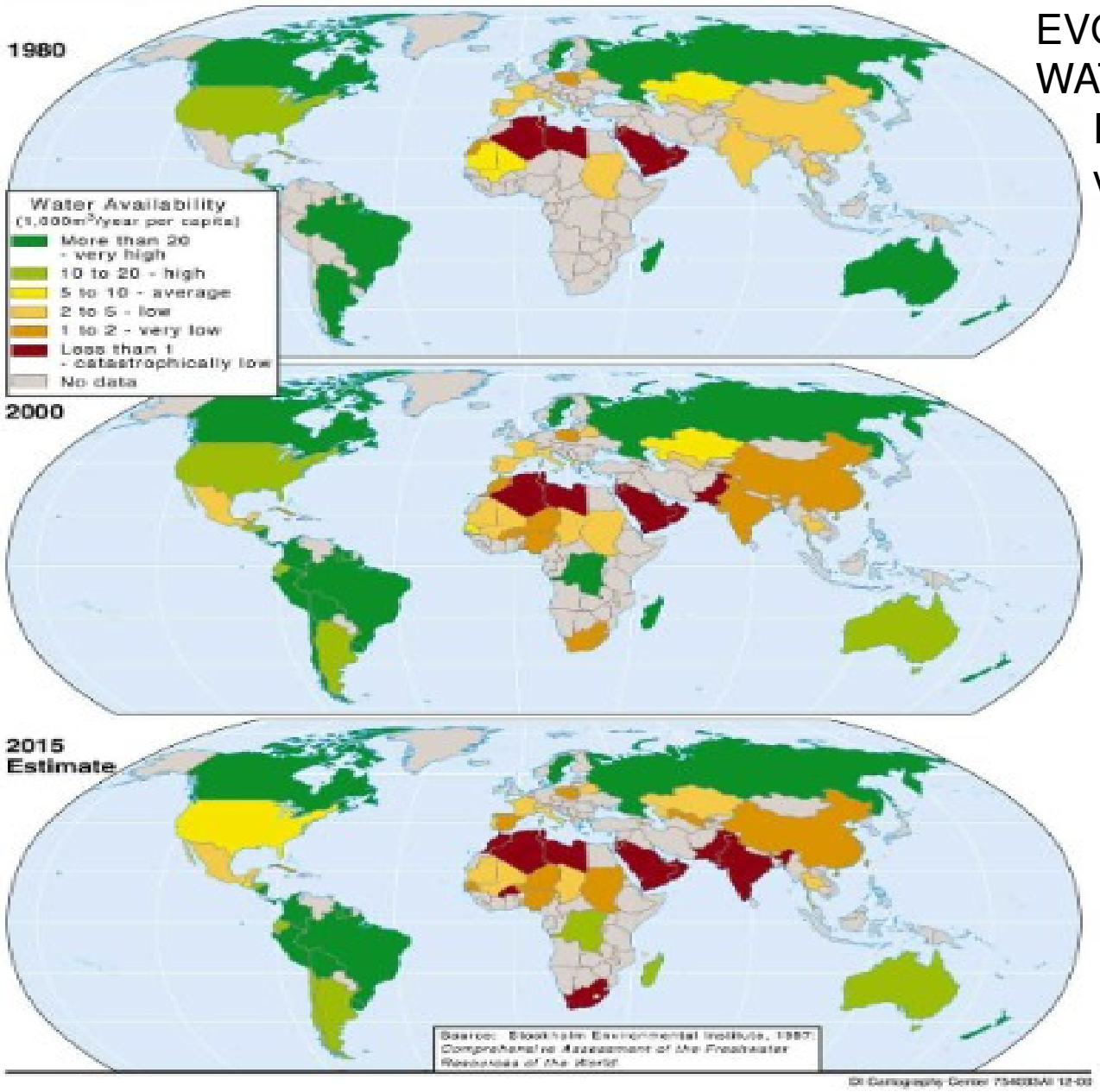
SOURCE: UNEP

Drylands include all terrestrial regions where the production of crops, forage, wood and other ecosystem services are limited by water. Formally, the definition encompasses all lands where the climate is classified as dry subhumid, semiarid, arid or hyper-arid. This classification is based on Aridity Index values†.



† The long-term mean of the ratio of an area's mean annual precipitation to its mean annual potential evapotranspiration is the Aridity Index (AI).

Notes: The map is based on data from UNEP Geo Data Portal (http://geodata.grid.unep.ch/). Global area based on Digital Chart of the World data (147,573,196.6 square km); Data presented in the graph are from the MA core database for the year 2000.

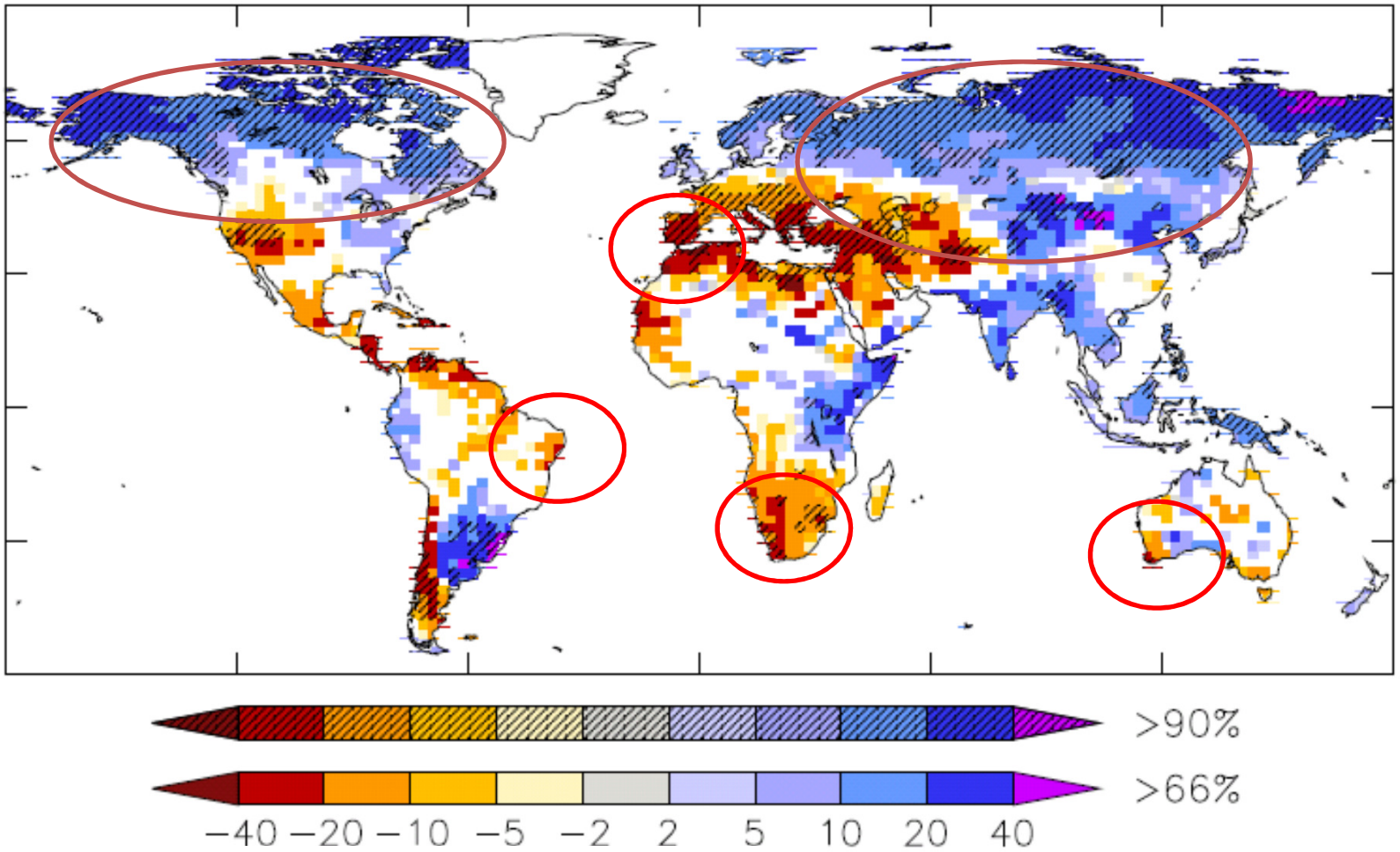


EVOLUTION OF WATER AVAILABILITY, From very high to very low

SOURCE: Stockholm Environmental Institute, 1997

National Intelligence Council, *Global Trends 2015*, Dec. 2000, p. 29 citing original source as Stockholm Environmental Institute, *1997: Comprehensive Assessment of the Freshwater Resources of the World*

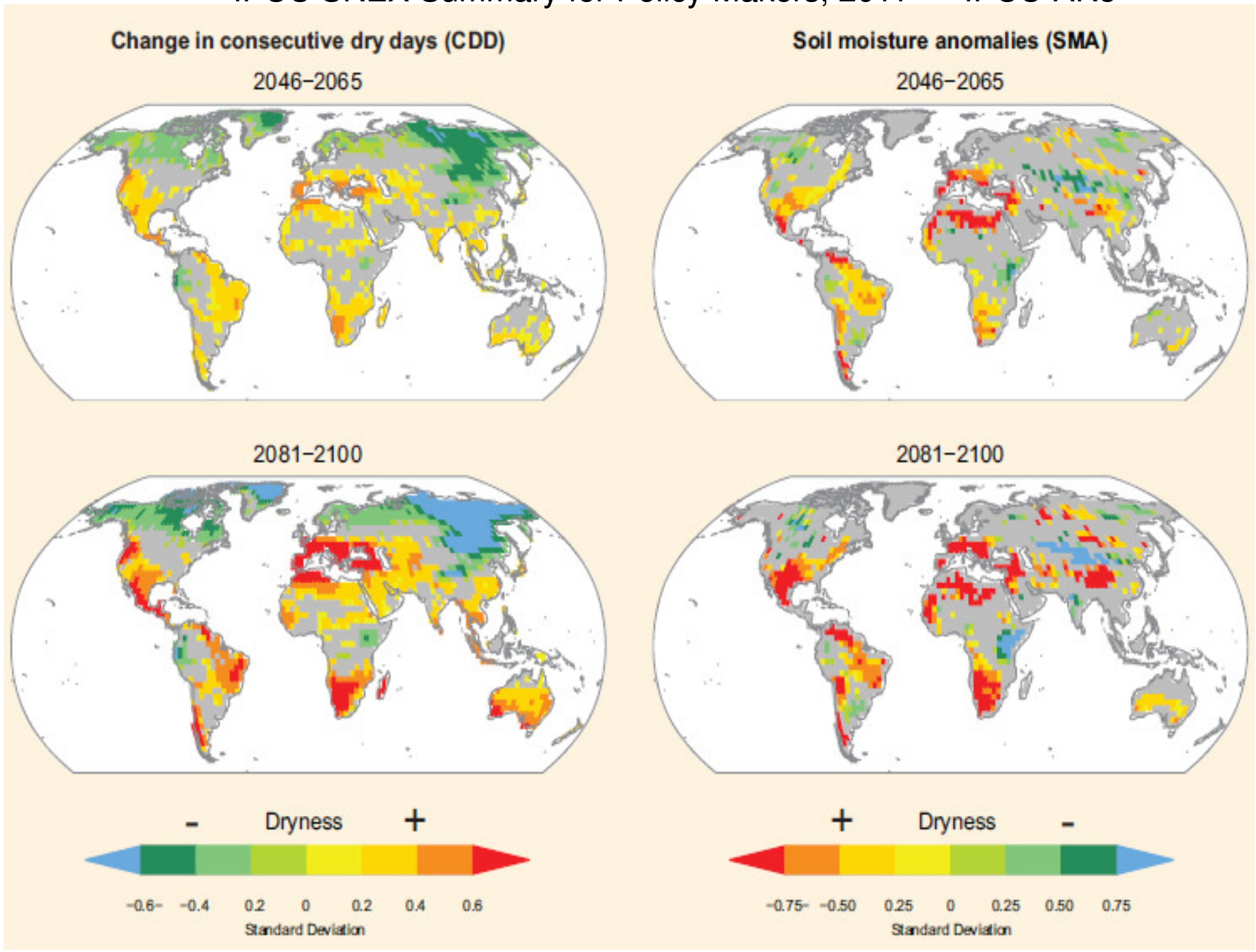
Expected change in annual runoff - 2060



Multimodel mean changes in annual runoff by 2060, in percent, indicating also degree of agreement between the 12 models used Scenario A1B, i.e. very rapid economic growth, convergence among regions and technological change in energy systems. Illustration from Milly et al 2005.

SOURCE: Milly et al., 2005

IPCC SREX Summary for Policy Makers, 2011 IPCC-AR5



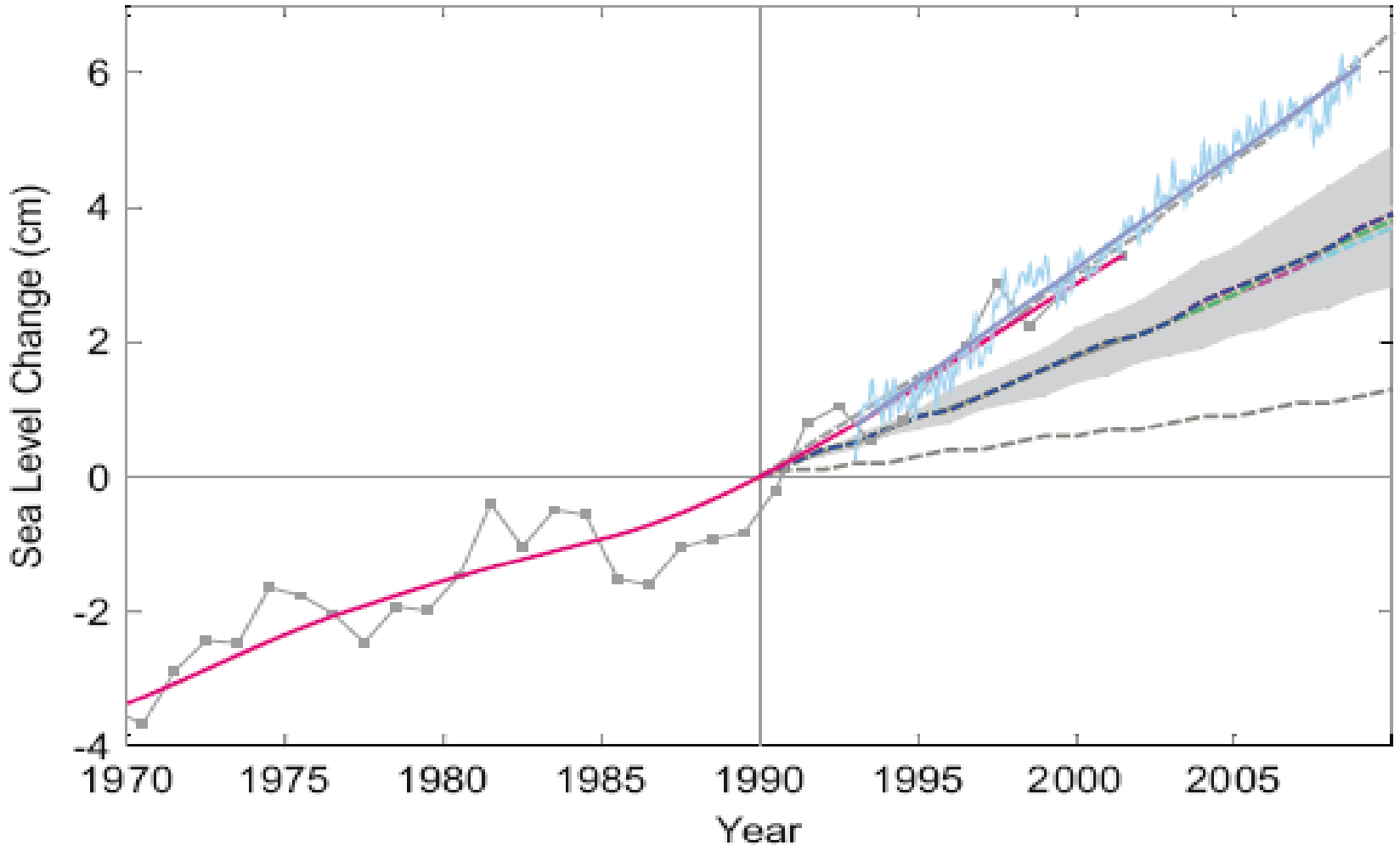


Figure 1

Change in sea level from 1970 to 2008, relative to the sea level at 1990. The solid lines are based on observations smoothed to remove the effects of interannual variability (light lines connect data points). Data in most recent years are obtained via satellite based sensors. The envelope of IPCC projections is shown for comparison; this includes the broken lines as individual projections and the shading as the uncertainty around the projections[3].

SOURCE: OECD, 2010

Table 1.2-1

Concentration of cities in coastal zones. For various population figures, the proportion of cities along the coast is shown. Major cities are particularly often located in coastal regions.

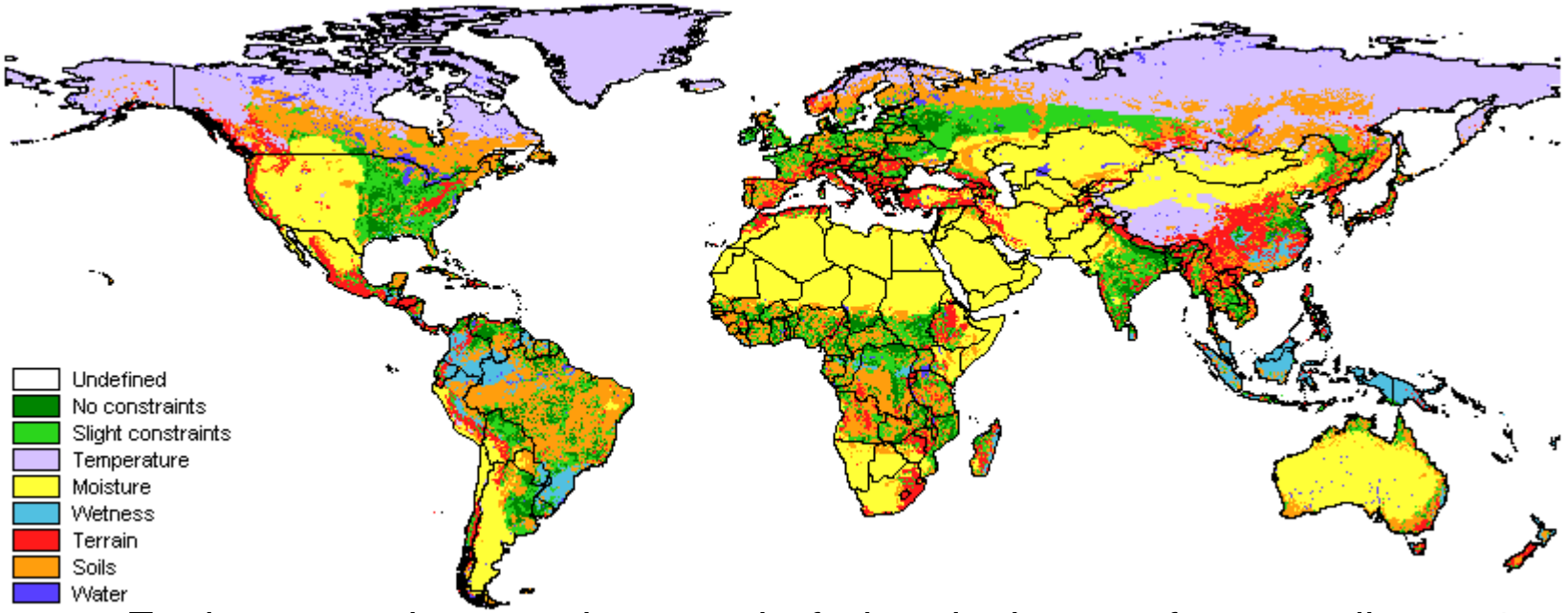
Source: OECD, 2010d

CONCENTRATION OF CITIES IN COASTAL ZONES

	Population figure				
Region	**<100,000 [%]**	**100,000–500,000 [%]**	**500,000–1 million [%]**	**1–5 million [%]**	**>5 million [%]**
Africa	9	23	39	50	40
Asia	12	24	37	45	70
Europe	17	22	37	41	58
Latin America	11	25	43	38	50
Australia and New Zealand	44	77	100	100	–
North America	9	19	29	25	80
Small island states	51	61	67	100	–
World	13	24	38	44	65

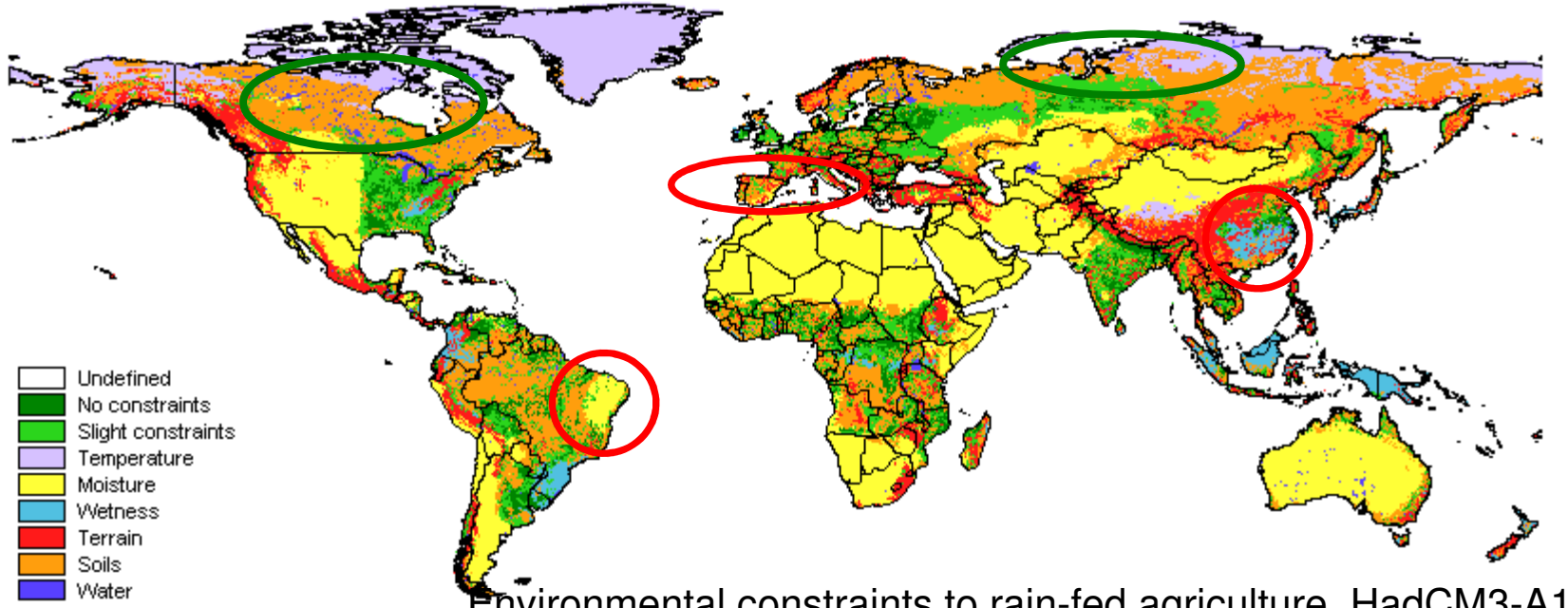
SOURCE: IIASA

IMPACTS OF CLIMATE CHANGE ON RAIN-FED AGRICULTURE



3.7

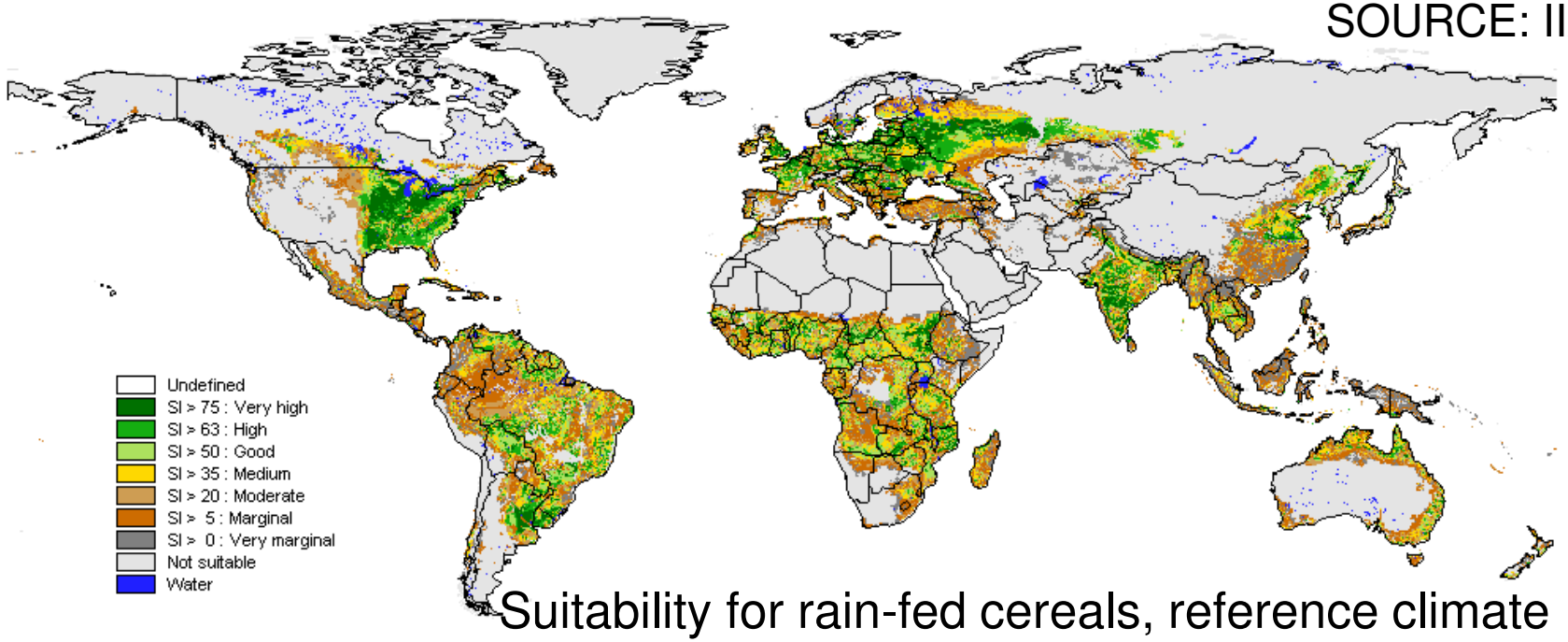
Environmental constraints to rain-fed agriculture, reference climate 1961-90



3.8

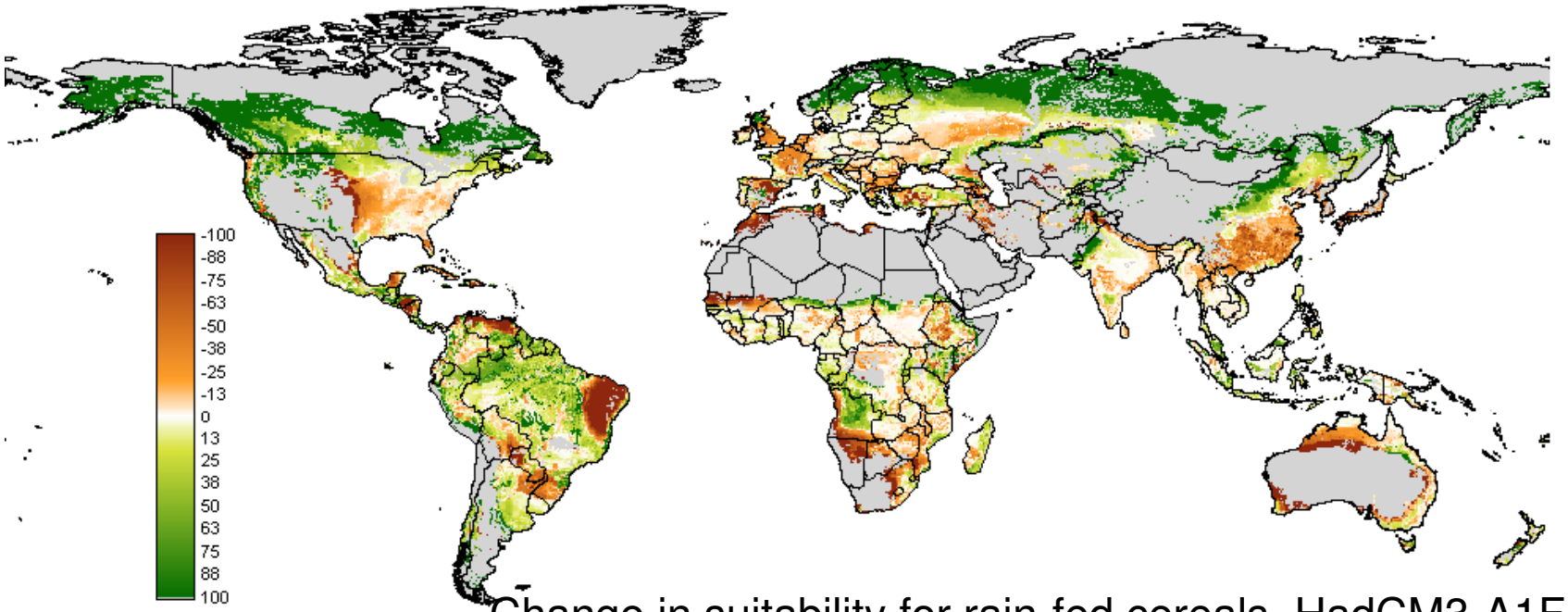
Environmental constraints to rain-fed agriculture, HadCM3-A1FI 2080s

SOURCE: IIASA



3.12a

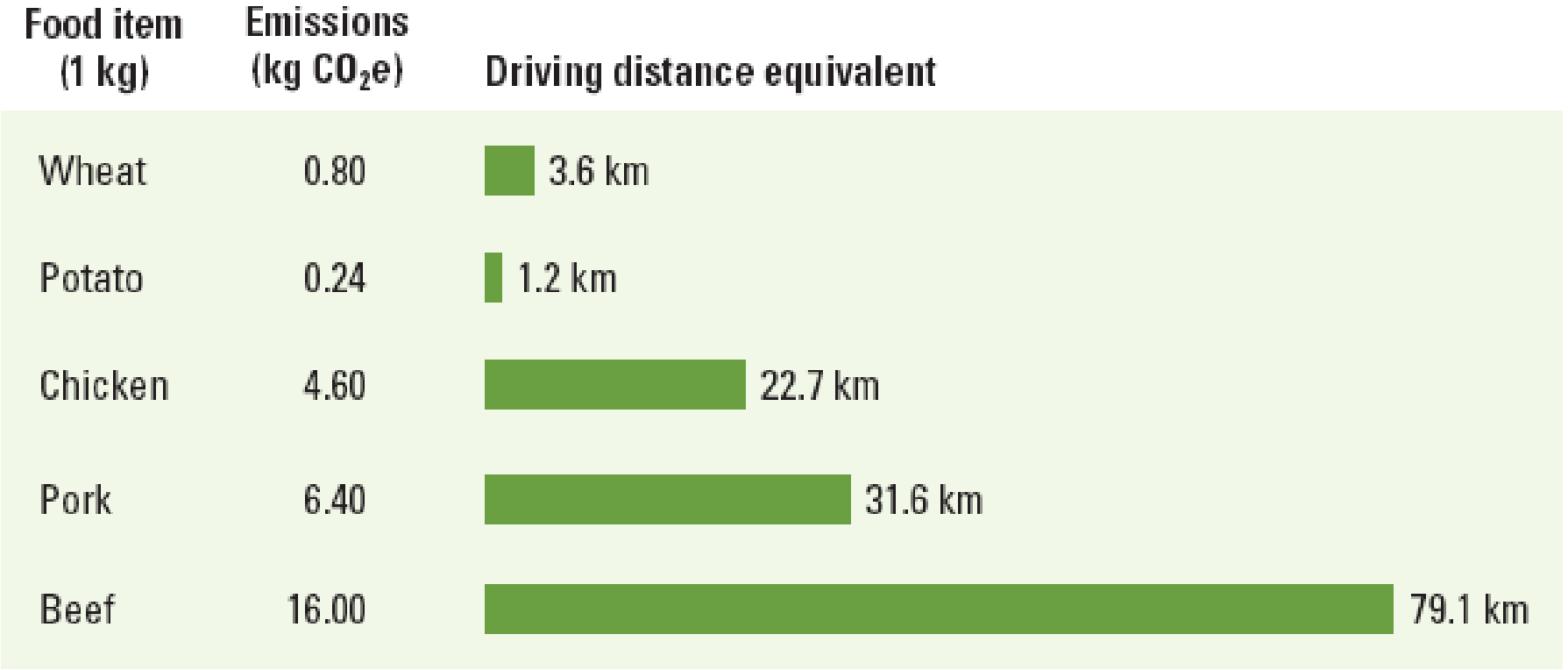
Suitability for rain-fed cereals, reference climate 1961-90



3.12b

Change in suitability for rain-fed cereals, HadCM3-A1FI, 2080s

Figure 3.4 Intensive beef production is a heavy producer of greenhouse gas emissions



Source: Williams, Audsley, and Sandars 2006.

Note: The figure shows CO_2 equivalent emissions in kilograms resulting from the production (in an industrial country) of 1 kilogram of a specific product. The car and road image conveys the number of kilometers one must drive in a gasoline-powered car averaging 11.5 kilometers a liter to produce the given amount of CO_2e emissions. For example, producing 1 kilogram of beef and driving 79.1 kilometers both result in 16 kilograms of emissions.

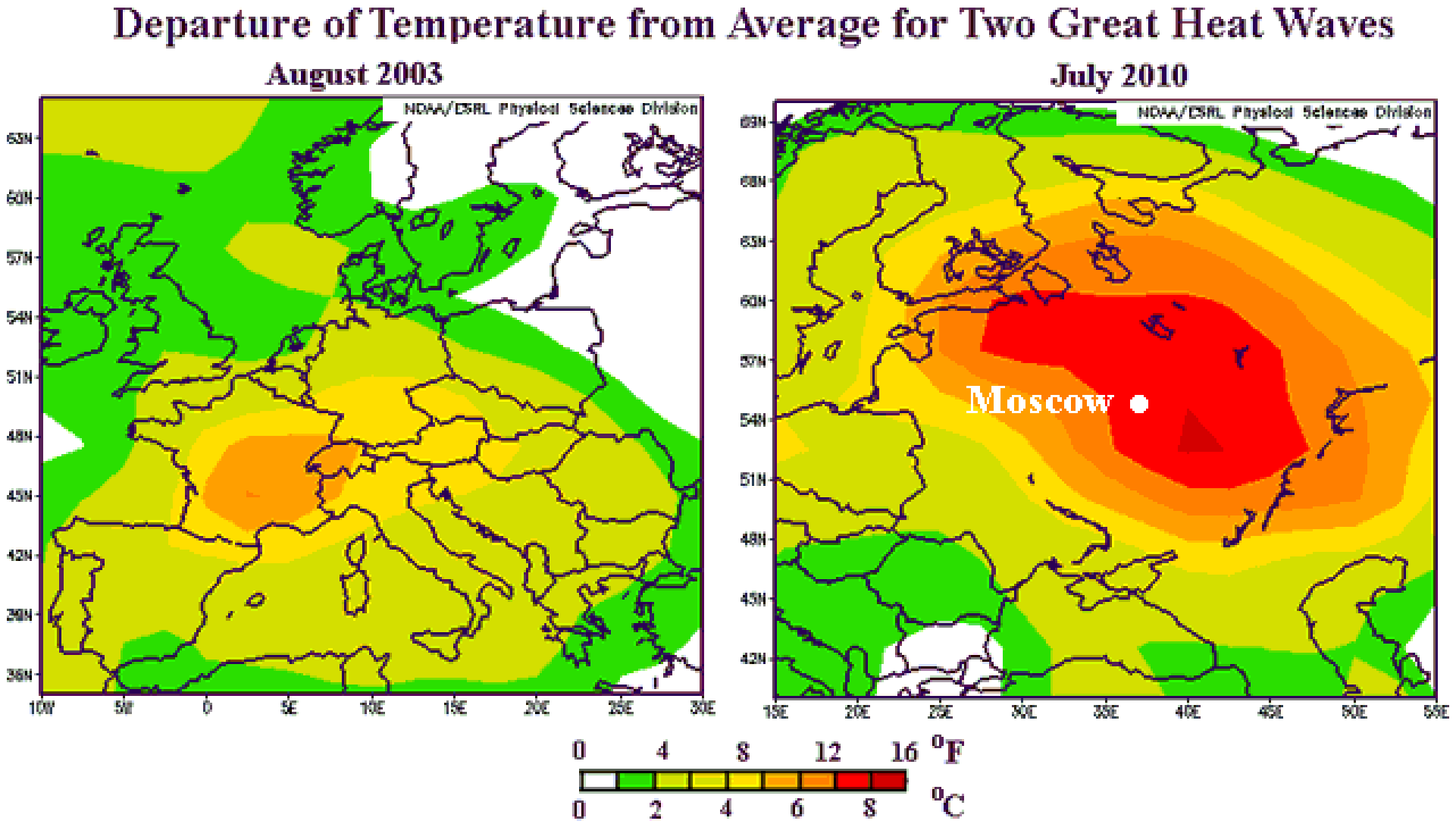
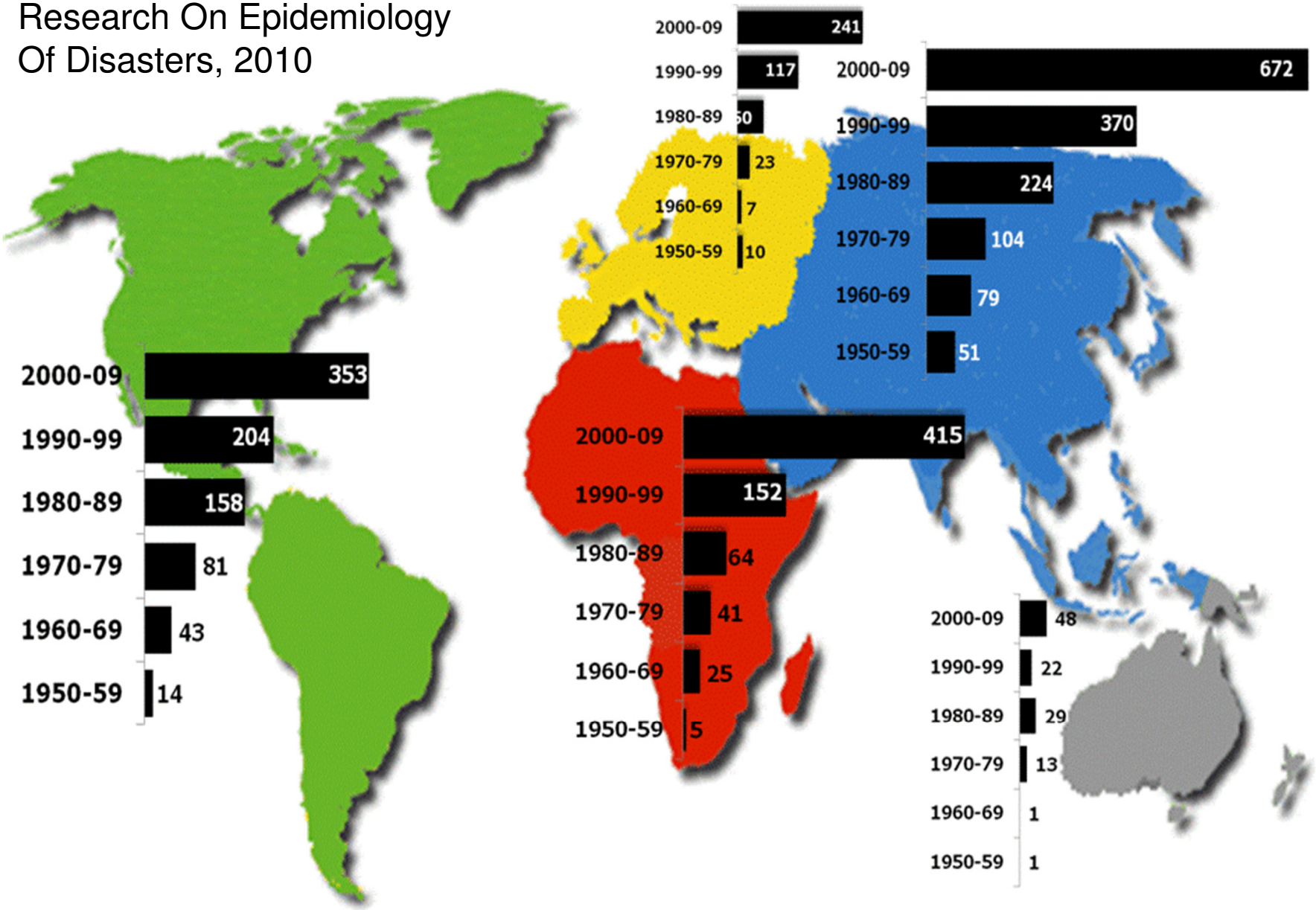


Figure 1. A comparison of August temperatures, the peak of the great European heat wave of 2003 (left) with July temperatures from the Great Russian Heat Wave of 2010 (right) reveals that this year's heat wave is more intense and covers a wider area of Europe.

SOURCE: NOAA – ESRL, Physical Sciences Division

Floods 1950-2009

SOURCE: Center for Research On Epidemiology Of Disasters, 2010



Fuente: The international disaster data base. Center for Research on Epidemiology of Disasters. 2010.

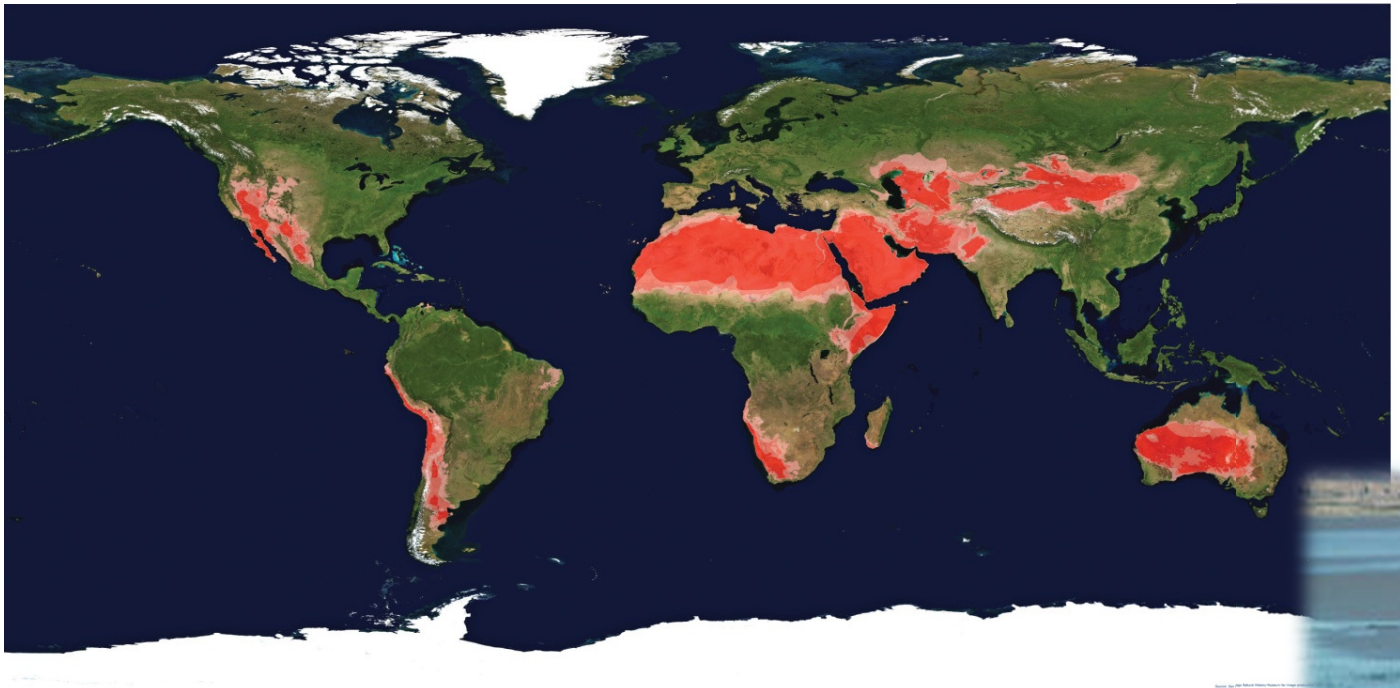
Droughts

About 400,000,000 people live under extreme drought conditions

Land considered "very dry" at global level:

15% em 1970

38% em2010



Conclusion

Long-term sustainability of outer space activities is essential for long-term global sustainable development on Earth

Thank you for your attention