DRAFT

Faith based Sustainability – The Ethic of Eco-Theology and the Spirit of Natural Capitalism

Ryoichi Yamamoto
Visiting Professor of the International Christian University

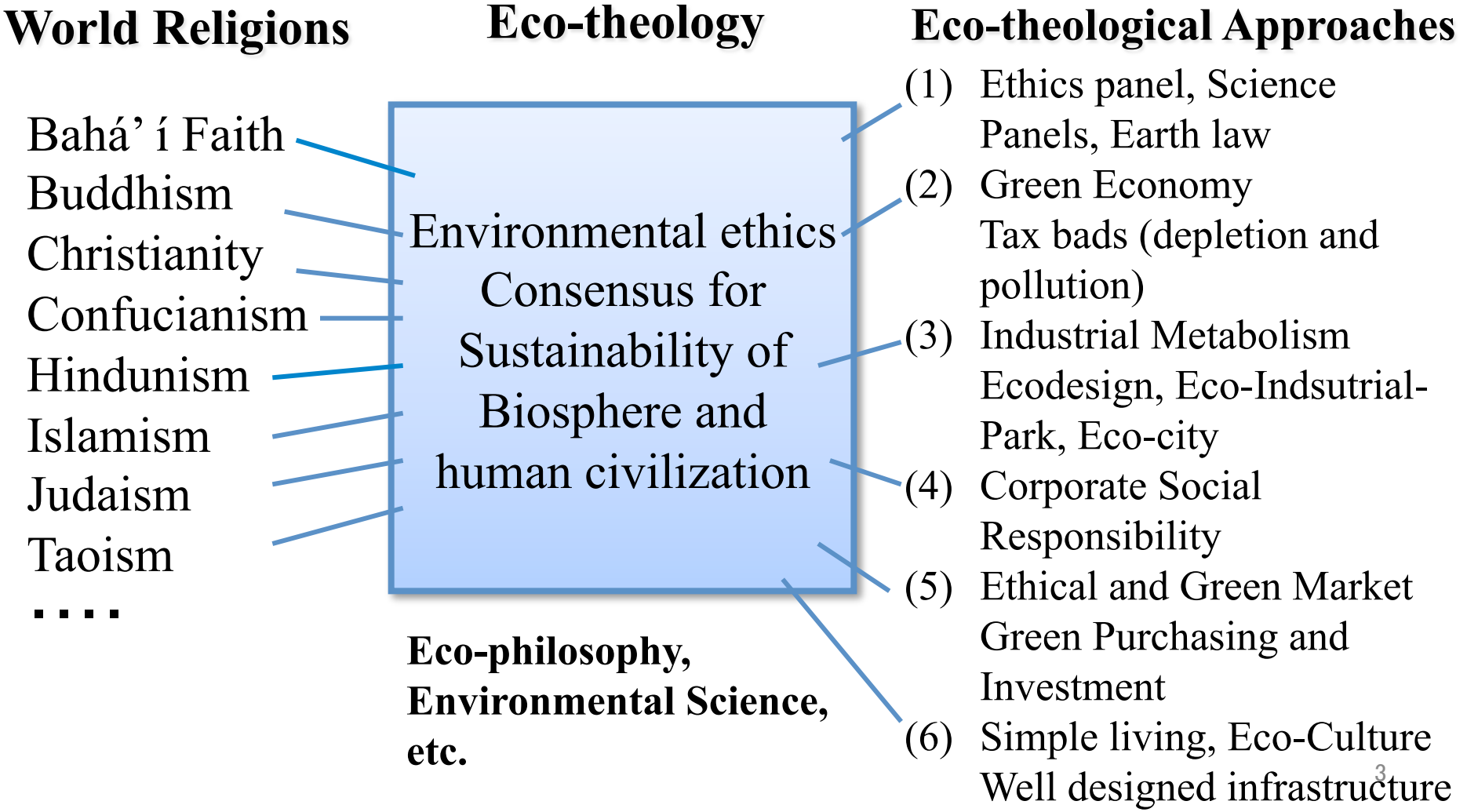
The Purpose of this presentation is to try to show, The ethic of eco-theology can promote natural capitalism and achieve green economy (steady state, low carbon, sound material circulation, flourishing within limits etc.).

Eco-Theology is defined here as the points of religious agreement in environmental ethics.

Ecological Civilization

Summary

The ethic of eco-theology can promote natural capitalism and create a graceful simple-living lifestyle based on the advanced science and technology.



Part 1

What is Sustainable Development ?

Part 1　What is Sustainable Development (SD) ?

1-1. Definition of SD by Bruntland Report
1-2. Early Thoughts on Sustainable Society
Steady State Economy by Herman Daly
The Four System Conditions by Karl-Henrik Robert
1-3. Recent Thoughts on Sustainable Society
Resource Productivity by F. Schmidt-Bleek
Prosperity without Growth by Tim Jackson
1-4. A Call to Integrate Faith, Ecology and the Global Economy
1-5. Humanity has already transgressed at least three Planetary Boundaries
1-6. Recent Status of Global Warming
Dangerous Climate Change
Extreme Weather Events
4ºC Global Warming by 2060
Emission Pathway needed to keep 2ºC target
1-7. Decoupling Status of Metal Consumption from Economic Growth
1-8. Three Different Scenarios for Resource Use Up to 2050
1-9. IEA Strategy for 2ºC/450ppm by 2030
1-10. Full solar Supply of Industrialized Countries – The Example Japan
1-11. We need new MAD Strategies.

Natural science perspective

- planetary boundaries
- risk of tipping points
- very limited global carbon budget in order to keep the 2°C climate target (750 $GtCO_2$ exhausted in 20 years)

Social perspective

- Over 2billion people living on less than $2 a day
- 1.6billion people today without access to electricity
- 900million people without access to transportation
- 1.8million deaths per year due to lack of sanitation, poor hygiene, and unsafe drinking water

Great Transformation :

Comprehensive societal, economic and cultural change is needed

OECD Environmental Outlook to 2050: The Consequences of Inaction

March 2012

By 2050, without new policies,

- A word economy four times larger than today is projected to need 80% more energy in 2050 without new policy action.
- Global energy mix in 2050 will not differ significantly from today, with the share of fossil energy at about 85%, renewables including biofuels just over 10%, and the balance nuclear.
- To feed a growing population with changing dietary preference, agricultural land is projected to expand globally in the next decade to match the increase in food demand, but at a diminishing rate.
- Global greenhouse gas emissions projected to increase by 50%, primary due to a 70% growth in energy-related CO2 emissions.
- Globally, terrestrial biodiversity as measured as mean species abundance is projected to decrease by a further 10% by 2050, with significant losses in Asia, Europe and Southern Africa.
- Globally, mature forest areas are projected to shrink by 13%.
- Freshwater availability will be further strained with 2.3 billion more people than today (in total over 40% of the global population) projected to be living in river basins under severe water stress, especially in North and South Africa, and South and Central Asia. etc.

What is Sustainable Development ?

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs (United Nations World Commission on Environment and Development, 1987).

"Sustainable" coupled with "development" expects continued growth but not such as degrades opportunities for the future. So defined, sustainability could apply to social institutions (colleges, banks, population, culture) as well as environments.

But UNCED intended it to apply to agriculture, forestry, water use, pollution levels, industry, resource extraction, urbanization, national environmental policies and strategies.

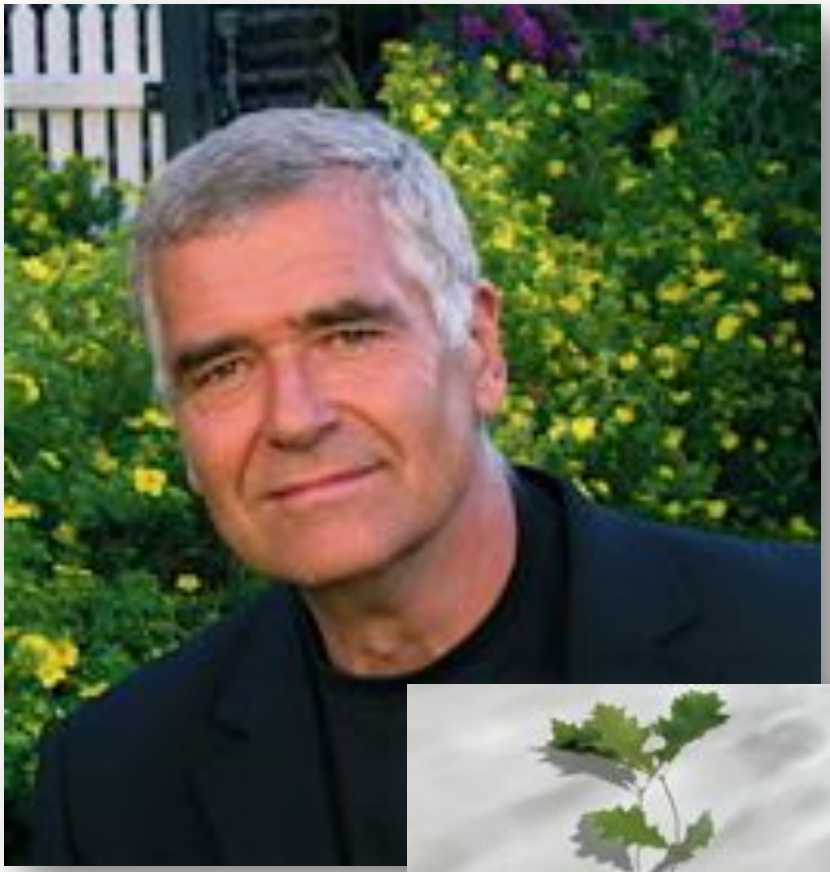
ref. A New Environmental Ethics by Holmes Rolston III

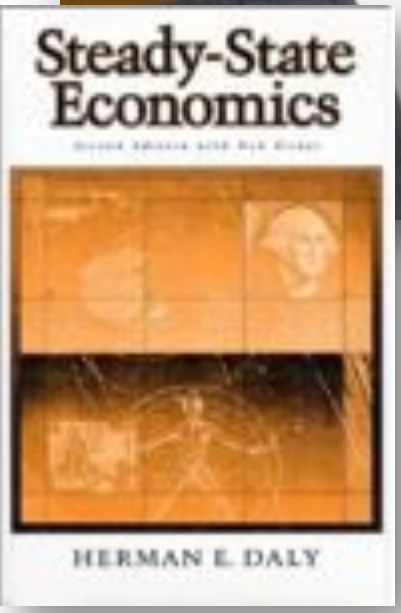
The environment does not exist as a sphere separate from human actions, ambitions, and needs, and attempts to defend it in isolation from human concerns have given the very word "environment" a connotation of naiveté in some political circles. The word "development" has also been narrowed by some into a very limited focus, along the lines of "what poor nations should do to become richer", and thus again is automatically dismissed by many in the international arena as being a concern of specialists, of those involved in questions of "development assistance".

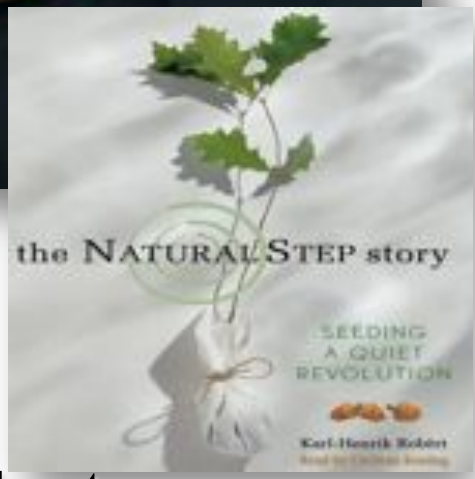
But the "environment" is where we all live; and "development" is what we all do in attempting to improve our lot within that abode. The two are inseparable.

Bruntland Report

Early Thoughts on Sustainable Society







Herman E. Daly
"Steady State Economics"

Karl Henrik-Robert
"The Natural Step"

Rules for a Steady State Economy by Herman Daly

by Sound Byte

(1) Maintain the health of ecosystems and the life-support services they provide.

(2) Extract renewable resources like fish and timber at a rate no faster than they can be regenerated.

(3) Consume non-renewable resources like fossil fuels and minerals at a rate no faster than they can be replaced by the discovery of renewable substitutes.

(4) Deposit wastes in the environment at a rate no faster than they can be safely assimilated.

Benefits of a Steady State Economy

A steady state economy is the only type of economy that is sustainable over the long term. It is an economy that meets peoples needs without undermining the life-support services of the planet.

Sustainability: The Four System Conditions

ref. The Natural Step Story by Karl-Henrik Robert

System Condition 1.

- In the sustainable society, nature is not subject to systematically increasing concentrations of substances extracted from the Earth's crust.

System Condition 2.

- In the sustainable society, nature is not subject to systematically increasing concentrations of substances produced by society.

System Condition 3.

- In the sustainable society, nature is not subject to systematically increasing degradation by physical means.

System Condition 4.

- In the sustainable society, human needs are met worldwide.

Backcasting starts with defining a desirable future and then backwards to identify policies and programs that will connect the future to the present.

Discussions for Economic Growth

- **Economy is a subset of ecology.**
- **Economic wealth is just one of many factors in human happiness.**

We all need to have our basic needs met, but once we have enough, any further wealth is irrelevant.

Growth becomes like an arms race in which the two sides cancel each other's gains.

The quantitative expansion of the economic subsystem increases environmental and social costs faster than production benefits.

- **Growth is unevenly distributed.**
- **There is nowhere left to grow.**

We have lived for 200 years in growth economy.

According to the famous "Limits to Growth" study in 1972, " If the present growth trends in world population, industrialization, pollution, food production, and resource depletion continue unchanged, the limits to growth on this planet will be reached around 2020."

We can not have unlimited economic growth and a stable climate or healthy ecosystems at the same time.

Discussions for Sustainable Economy

- **To slow and eventually begin to reverse material growth** –

that's the throughput of resources, as inputs into the economy and outputs as waste.

- **Factor 10 times of increase in the resource productivity** is needed.
- **Tax bads (depletion and pollution) and, not goods (income, value added)**
- **Changing what we value**

from GDP to ISEW (Index of Sustainable Economic Welfare),
GNH (Gross National Happiness), GPI etc.

- **The rich should reduce their throughput growth** to free up resources and ecological space for use by the poor, while focusing their domestic efforts on developments, that can be freely shared with poor countries.

Thoughts on a Sustainable Society – F. Schmidt-Bleek's Views

- The systemic approach to environmental protection is to curtail the mobilization, extraction, and use of natural resources and increase their productivity throughout the economy.
- Eco-innovation means the creation of novel and competitively priced goods, processes, systems, services, and procedures that can satisfy human needs and bring quality of life to all people with a life-cycle-wide minimal use of natural resources per unit output, and a minimal release of toxic substances.
- Experience has shown that a radically dematerialized western life style is technically feasible without loss of end use satisfaction - up to a factor 10 and more.
- The key driver for economic decision-making is the market price of goods and services. Henceforth the "ecological truth" must be reflected in the price architecture of the market, rewarding the production an use of goods and services with the lowest possible resource intensity (Material-Footstep, MIPS).
- By 2050 the worldwide yearly material consumption per Person should have reached 6-8 Tons. For industrialized countries this implies an average tenfold dematerialization, yielding poorer countries environmental space for their development.

Prof. Dr. Friedrich Schmidt-Bleek
President Factor 10 Institute

Resource Productivity

$$I = P \times \frac{GDP}{P} \times \frac{I}{GDP} \quad (1990)$$

$$1 = 2 \times 5 \times \frac{I}{GDP} \quad (2050)$$

I=Impact

P=Population

$\frac{GDP}{I}$ should be increased Factor 10

by 2050

in order to keep the impact at the 1990 level.

Dematerialization

- Dematerialization refers to the absolute or relative reduction in the quantity of materials required to serve economic functions in society. Dematerialization means doing more with less.
- Dematerialization is Decarbonization (after F. Schmid-Bleek)
- Eco-industrial park (EIP) is an industrial symbiosis network where companies in a region collaborate to use each other's by-products and otherwise share resources. EIP can contribute to " Dematerialization".
- Servicizing refers to selling a service or function rather than a product. Actual ownership of the product remains with the supplier, and customers pay for use and maintenance.
- Producing performance, selling and buying performance, and maintaining performance overtime (after Walter R. Stahel).

Recent thoughts on Sustainable Society

Prosperity without growth ?
12 Steps to a Sustainable Economy

by Tim Jackson

Building a Sustainable Macro-Economy

1.Developing macro-economic capability
2.Investing in public assets and infrastructures
3.Increasing financial and fiscal prudence
4.Reforming macro-economic accounting

Protecting Capabilities for flourishing

5.Sharing the available work and improving the work-life balance
6.Tackling systemic inequality
7.Measuring human and social capital
8.Strengthening human and social capital
9.Reversing the culture of consumerism

Respecting Ecological Limits

10.Imposing clearly defined resource/emissions caps
11.Implementing fiscal reform for sustainability
12.Promoting technology transfer and international ecosystem protection.

A Call to Integrate Faith, Ecology and the Global Economy

November 12, 2009

Endorsed by 74 Religious Organizations and NGOs

As hope-filled people, we stand in awe of Earth's goodness and its capacity to provide abundant life for all God's creation. We recognize our interconnection with Earth-with air, water, land, plants and other creatures. We recognize the dignity of the human person as an individual and as part of a community. We embrace our power and responsibility to create a human economy that fits within Earth's ecological boundaries, more authentically serves human needs and builds community.

We envision:

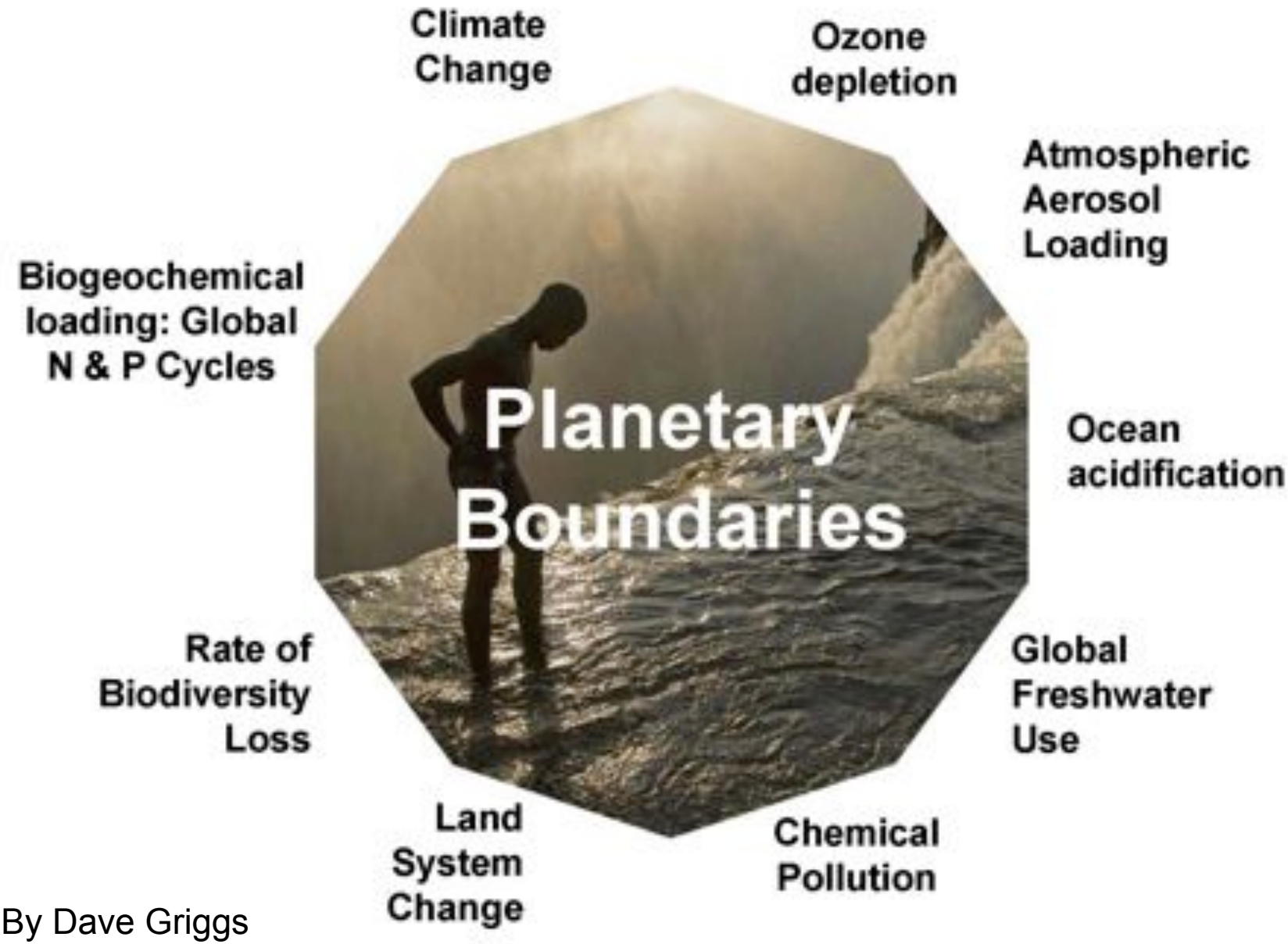
A new economic model that embodies social and ecological values bound by Earth's biophysical limits. etc.

(1)<u>Paradigm shift in mindset and values.</u>

This will entail change from a focus on material goods to holistic well-being; from excess to sufficiency; from exclusion to inclusion; from competition to cooperation……etc.

(2)<u>Public policies for an economy of right relationship,</u> ……

(3)<u>An economy of thriving and resilient communities</u>……..



By Dave Griggs

Monash Sustainability Institute

Rockström et al. 2009

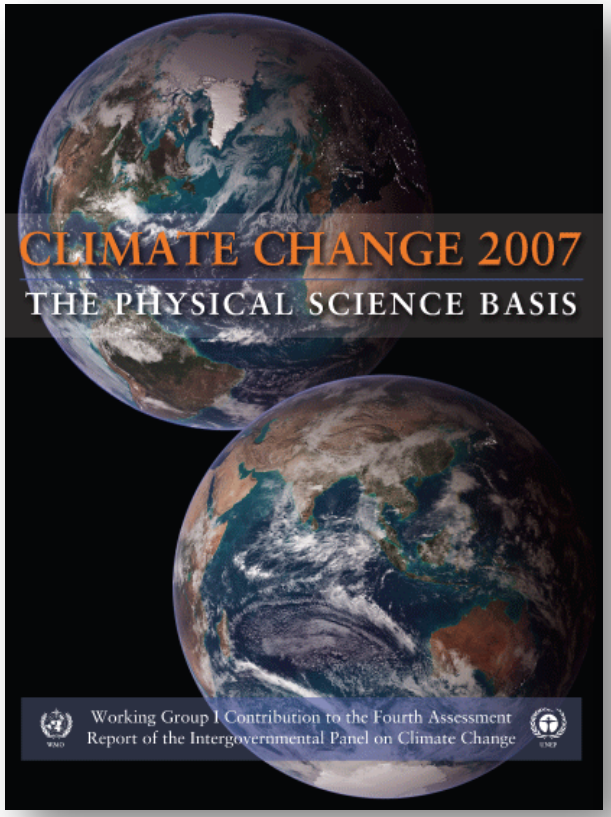
Humanity has already transgressed at least three Planetary Boundaries

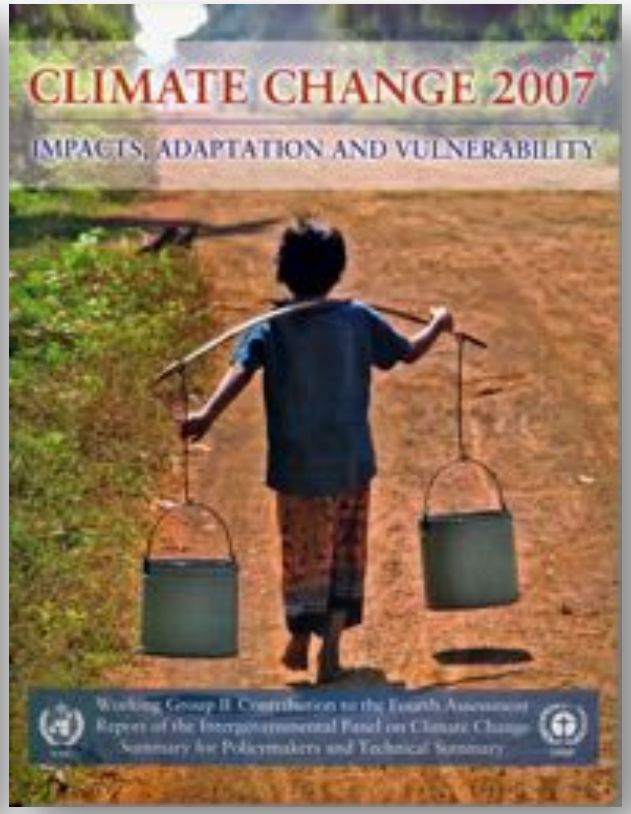
(Climate Change, Biodiversity loss and Biogeo-chemical flow boundary)

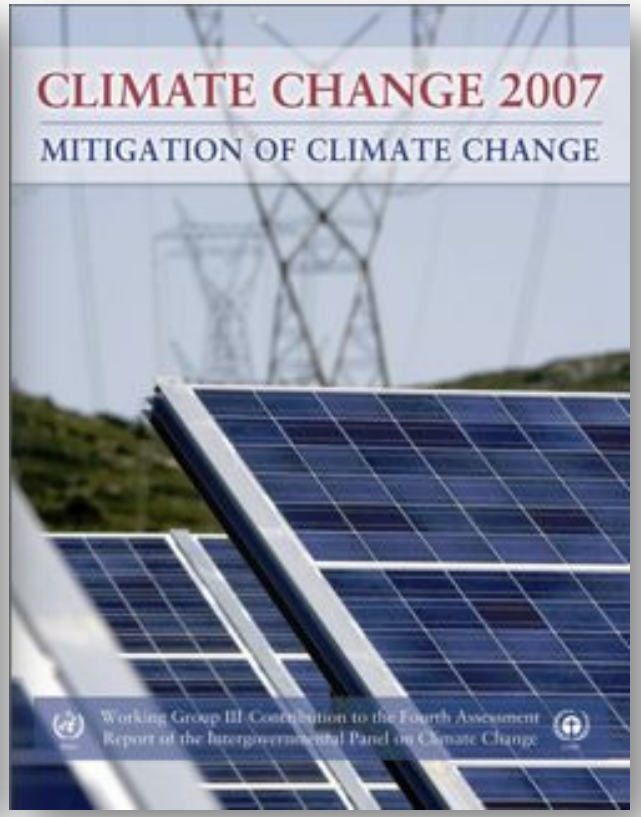
ref. Planetary Boundaries, Johan Rockstroem et al, Ecology and Society 2009

	Earth System Process	Planetary Boundary
1.	Climate Change	Atmospheric CO_2 Concentration, 350ppm (350-550ppm)
2.	Ocean Acidification	Sustain more than 80% of the preindustrial aragonite saturation State of mean surface ocean
3.	Stratospheric ozone depletion	less than 5% reduction from pre-industrial level
4.	Atmospheric aerosol loading	to be determined
5.	Biogeo-chemical flows: Interference with P and N cycles	P < 10 ×(10×-100×) N : Limit industrial and agricultural fixation of N_2 to 35 $MtNyr^{-1}$
6.	Global freshwater use	less than 4,000km^3yr^{-1}
7.	Land system change	less than 15% of global ice – free land surface converted to cropland
8.	Biodiversity loss	less than 10 E/MSy
9.	Chemical Pollution	to be determined

IPCC Fourth Assessment Report: Climate Change 2007 (AR4)







Present Status of Global Warming

Policy Briefs, Nov 2009-No.10

(1)Carbon emissions from fossil combustion and cement production in 2008 were 8.7GtC, 41% higher than in 1990.

(2)For the first time developing countries are now emitting more fossil fuel CO2 emissions (55%) than developed Countries.

(3)Tropical deforestation is responsible for about 1.5 GtC per year, accounting for about 15% of total anthropogenic carbon emissions.

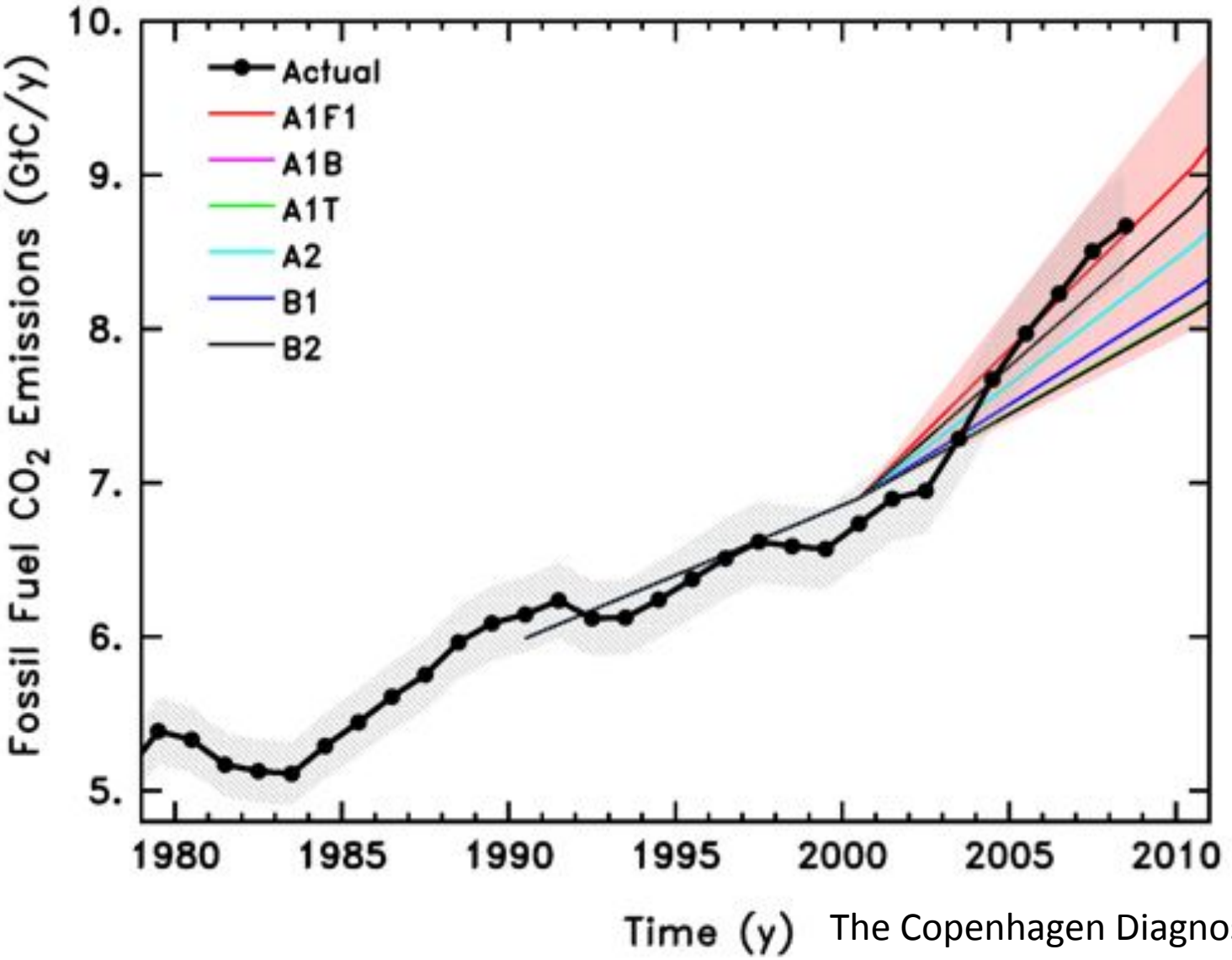
(4)If current trends prevail. global fossils fuel emissions are expected to rise to between 12 and 18 GtC per year by 2050(2 to 3 times the level in 2000)

(5)Air temperature increase from 1850-1899 to 2001-2005 is 0.76℃

(6)Natural CO2 sinks in the ocean and land currently remove an average of 55% of all CO2 emissions from human activities every year.

(7)CO2 concentration in 2008 reaches 385ppm(38% above pre-industrial levels) whish is the highest concentration in at least the last 2million years.

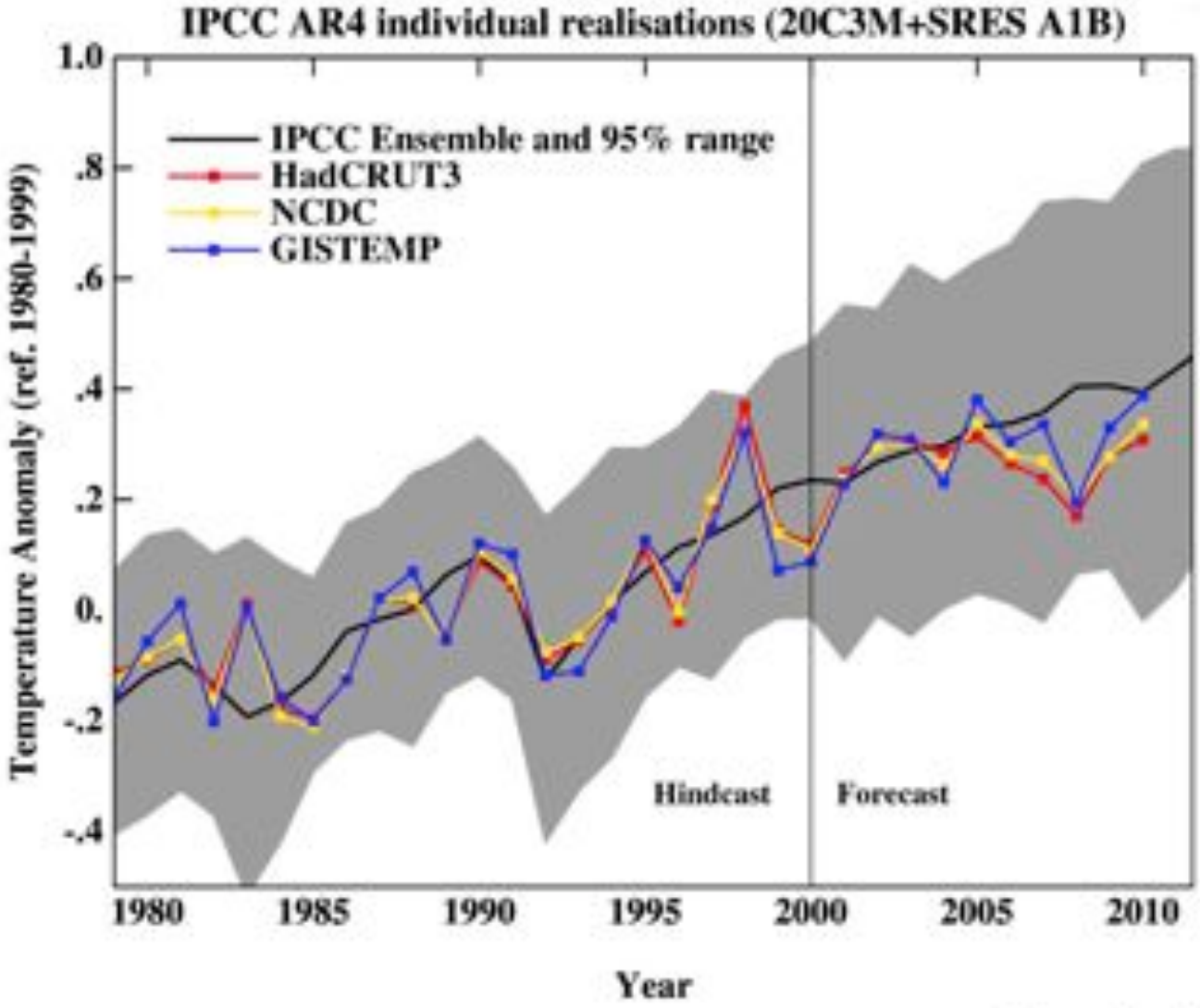
Observed global CO_2 emissions from fossil Fuel burning and cement production



The Copenhagen Diagnosis, 2009

Observed warming falls within range of projections

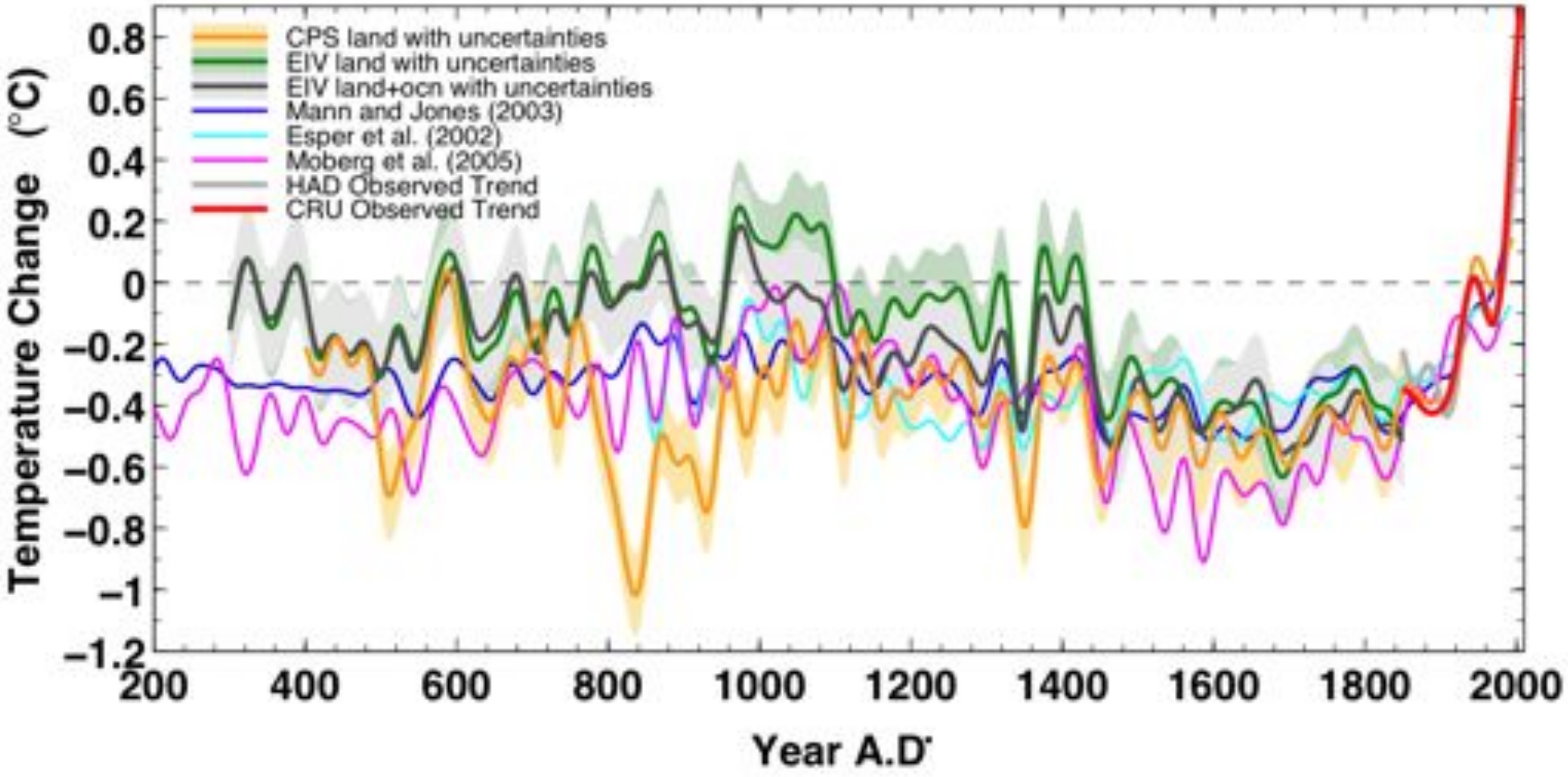
by Prof. H. J. Schellnhu



Realclimate 201

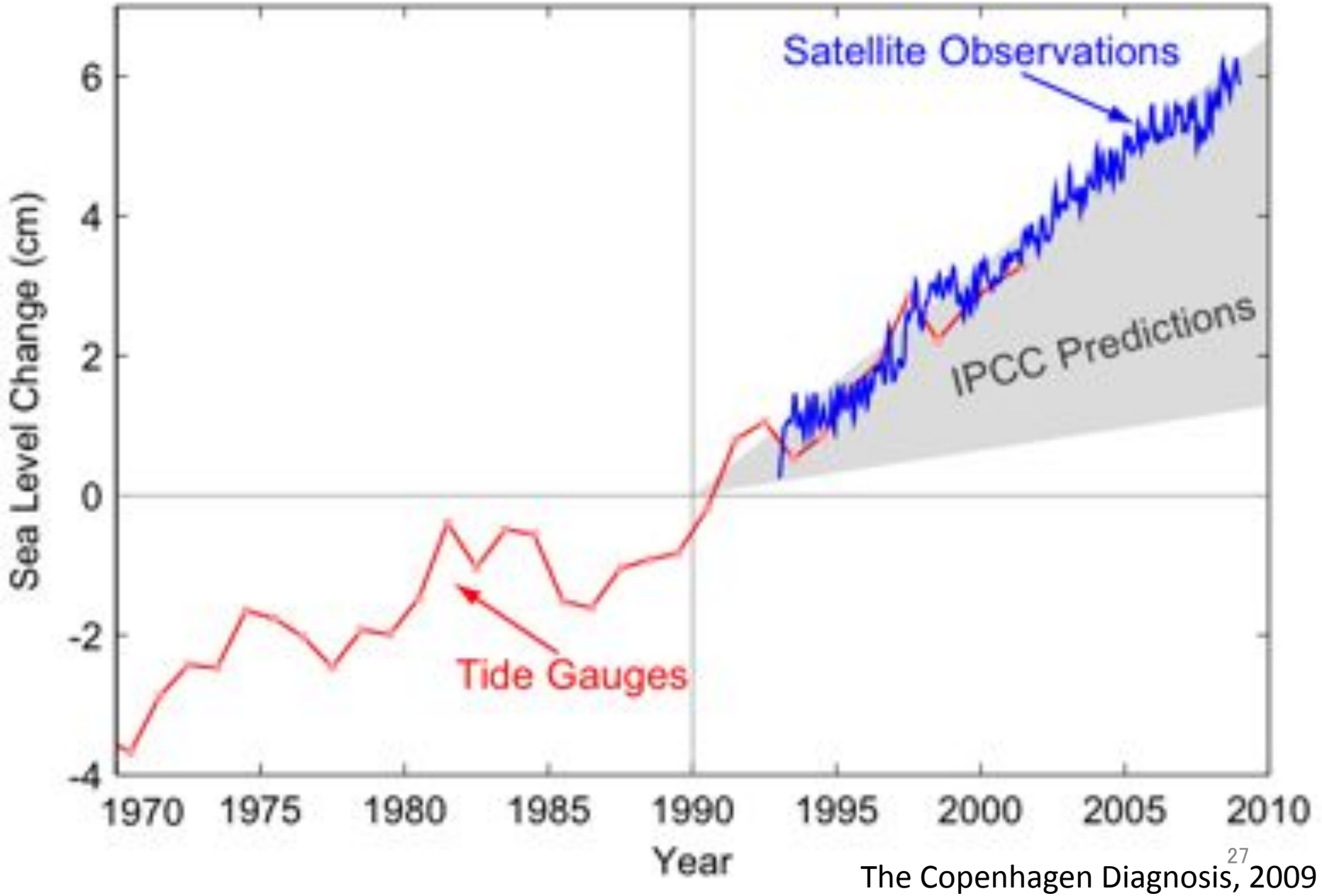
but see also Kaufmann et al. 201

Comparison of various Northern Hemisphere temperature reconstruction



The Copenhagen Diagnosis, 2009

Sea level change



The Copenhagen Diagnosis, 2009

Melting of Mountain Glaciers

Courtesy of the Royal Geographical Society

Courtesy of Glacier Works

Dangerous Climate Change

Reasons for concern (IPCC AR3, AR4)

(1) Risk to unique and threatened systems
coral reefs, tropical mountain glaciers, endangered species etc.

(2) Risk of extreme weather events
heat waves, floods, droughts, wildfires, hurricanes

(3) Disparities of impacts and vulnerabilities
disproportionate harm to developing countries and the poor in developed countries

(4) Aggregate damages
net global market damages

(5) Risks of large-scale discontinuities
rapid sea-level rise, ocean acidification etc.

Hansen et al (2007) conclude
"identification of 'dangerous' effects is partly subjective, but we find evidence that added global warming of more than 1ºC above the level in 2000 has effect that may be highly disruptive."

Extream Weather Events
Jun 06 2011

The Year of Living Dangerously

2010 Extreme Weather Cost Lives, Health, Economy

Daniel J. Weiss, Valeri Vasquez, and Ben Kaldunski April 2011 American Progress Org.

"Scientists predict that temperatures over most of the United States are very likely to increase by more than the global average this century.

And given the evidence, legislators from states that are particularly vulnerable to extreme weather events would do well to work toward reducing the carbon dioxide pollution driving these drastic climate changes.

But climate science deniers persist in Congress.

Last month, the Republican majority in the House blocked the EPA from limiting GHG emissions in a 249 to 177 vote."

Extreme weather in 2010

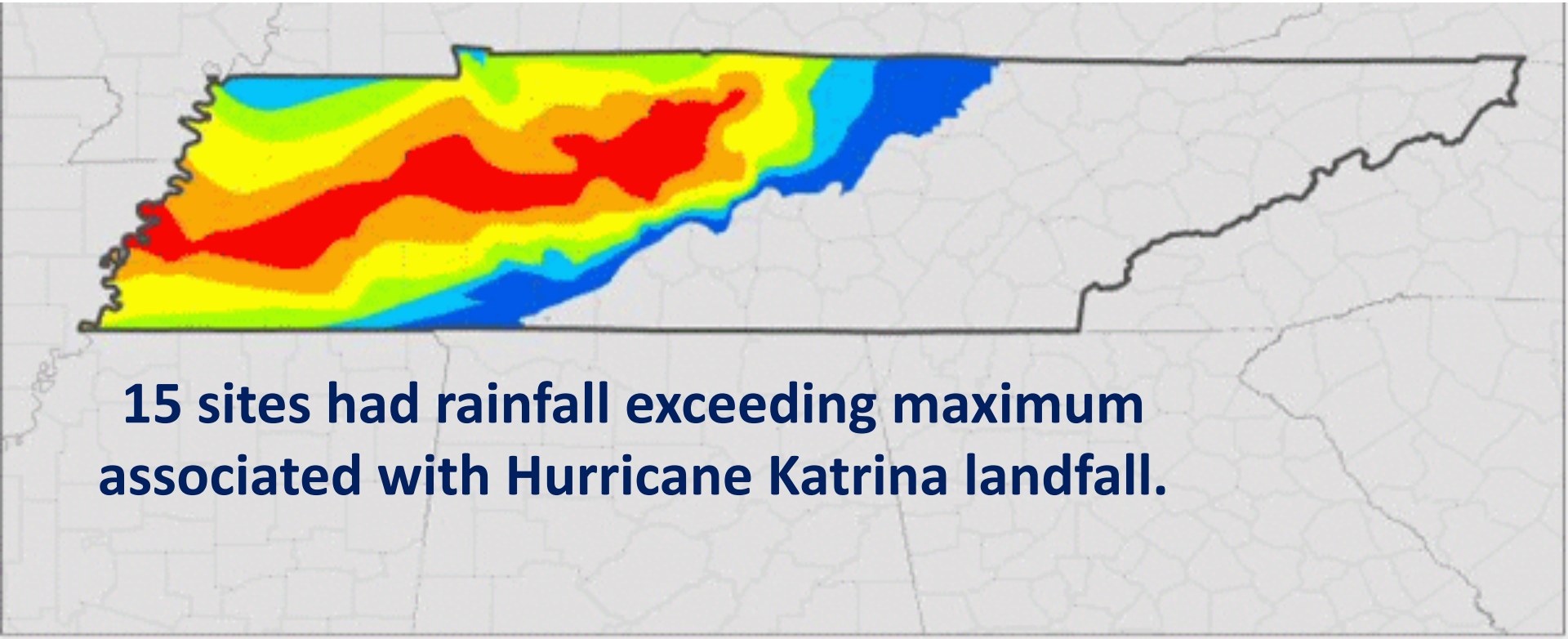
- **The record heat wave and wildfires in Russia**
- **Monsoonal flooding in Pakistan**
- **Rain – induced landslides in China**
- **Calving of a large iceberg from the Greenland ice sheet**
- **Droughts and wildfires in Australia**
- **A record number of high temperature days in the eastern USA (NASA reports hottest January - Jury 2010 on record)**

World Meteorological Organization stated…

"while a longer time range is required to establish whether an individual event is attributable to climate change, **the sequence of current events matches IPCC predictions**".

Stunning NOAA map of Tennessee's 1000-year deluge

May 1-2, 2010



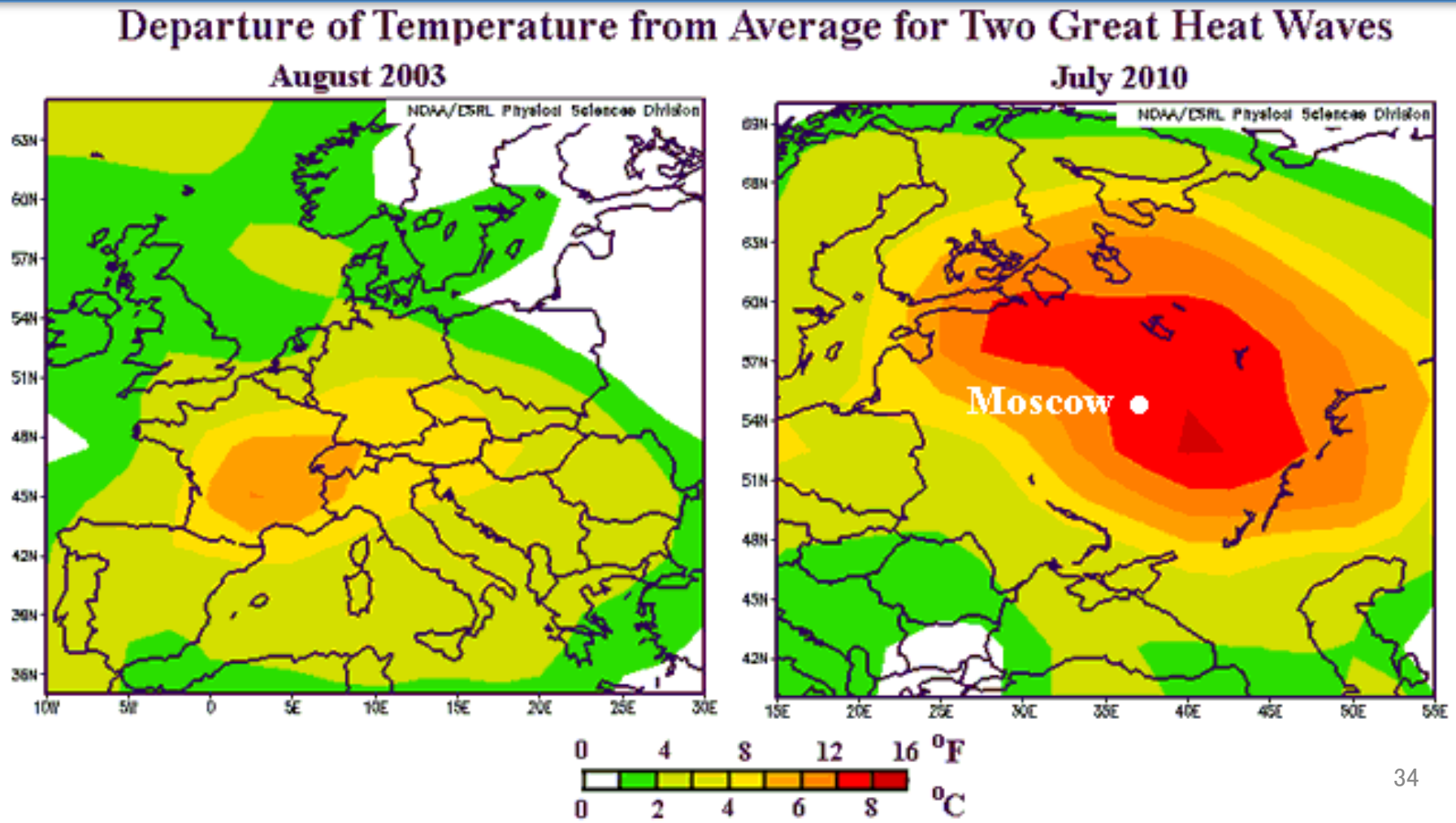
15 sites had rainfall exceeding maximum associated with Hurricane Katrina landfall.

Tennessee Extreme Event of May 1-2, 2010
Average Recurrence Intervals (ARI) for 48-Hour Duration

Created by Hydrometeorological Design Studies Center
Office of Hydrologic Development
National Weather Service
National Oceanic and Atmospheric Administration

ARI (years)
- < 10
- 10 - 50
- 50 - 100
- 100 - 200
- 200 - 500
- 500 - 1,000
- > 1,000

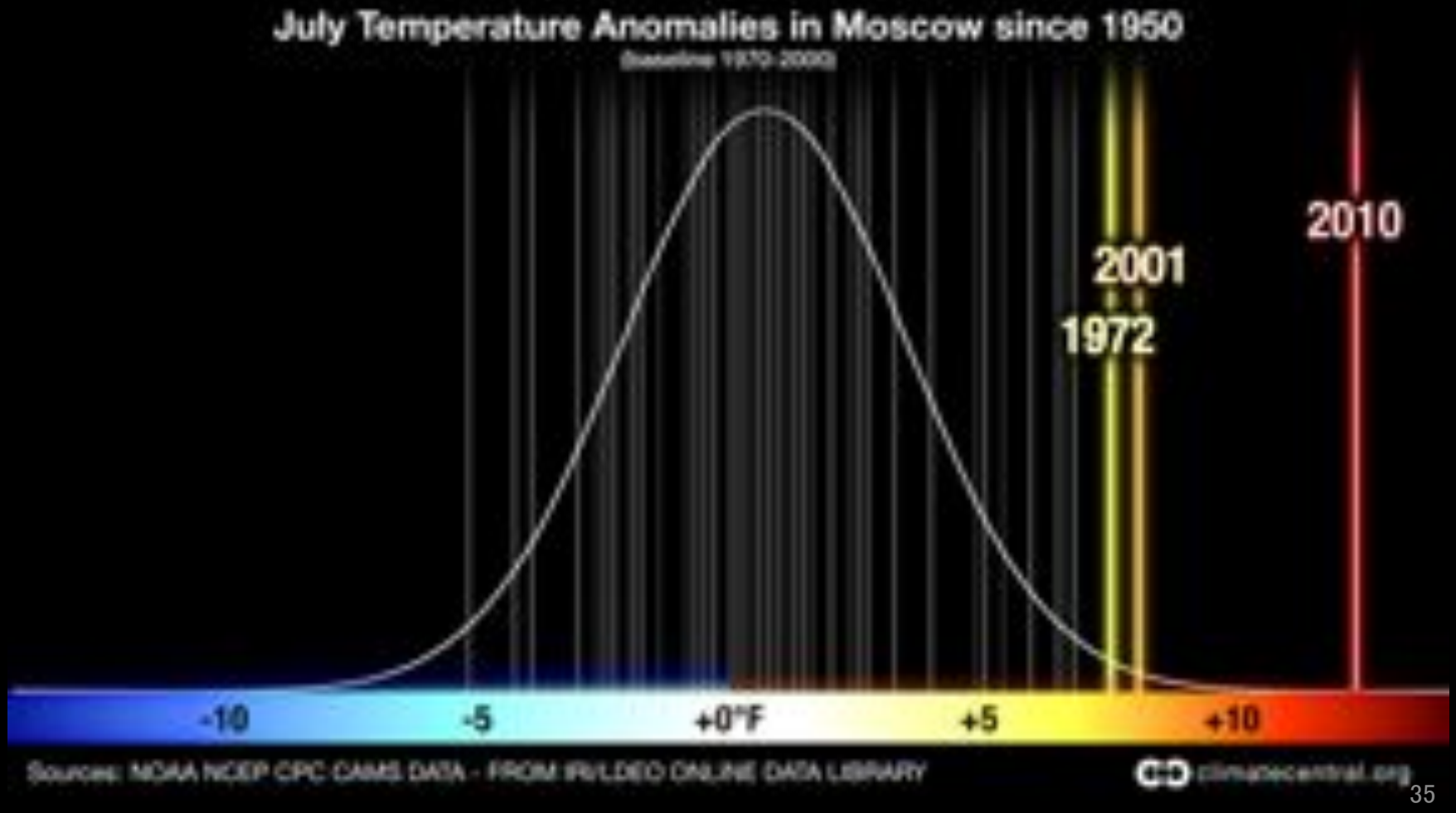
Russian Meteorological Center: "There was nothing similar to this on the territory of Russia during the last one thousand years in regard to the heat."



Russia's 2010 July Heat Record

Study Finds 80% of Chance Russia's 2010 July Heat Record Would Not Have Occurred Without Climate Warming.

Probability of July average temperature anomalies in Moscow, Russia since 1950. The image shows that the average temperature in Moscow for July 2010 was significantly hotter than in any year since 1950.



Huge iceberg breaks off Greenland glacier

Ice Island Calves off Petermann Glacier

Image acquired July 28, 2010.

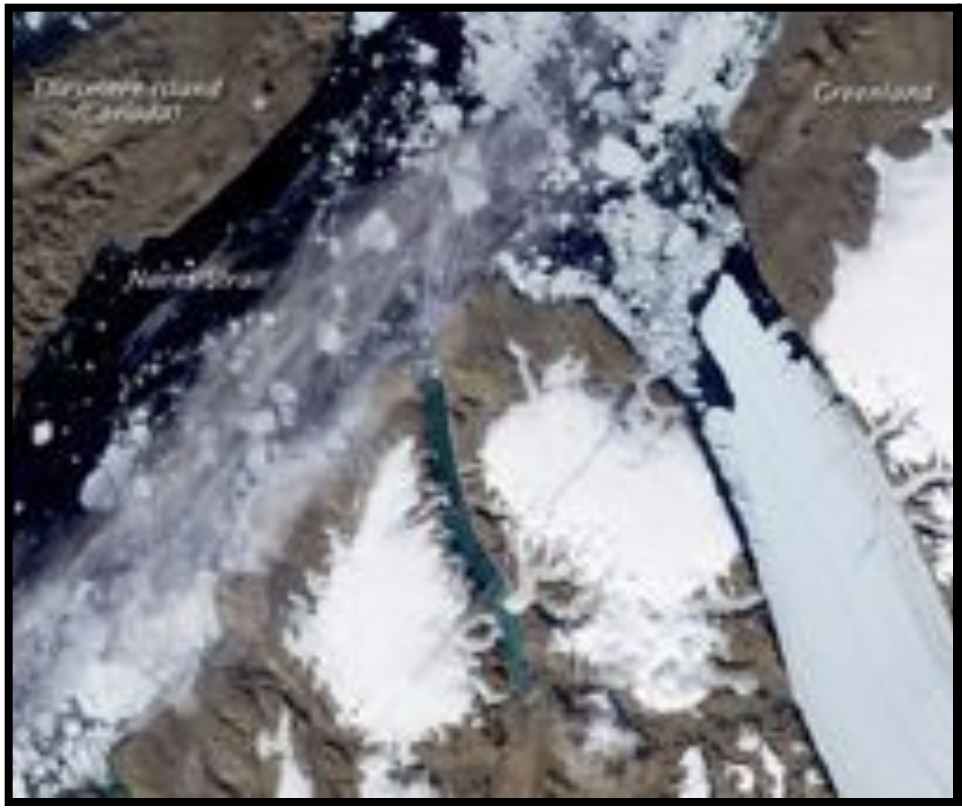
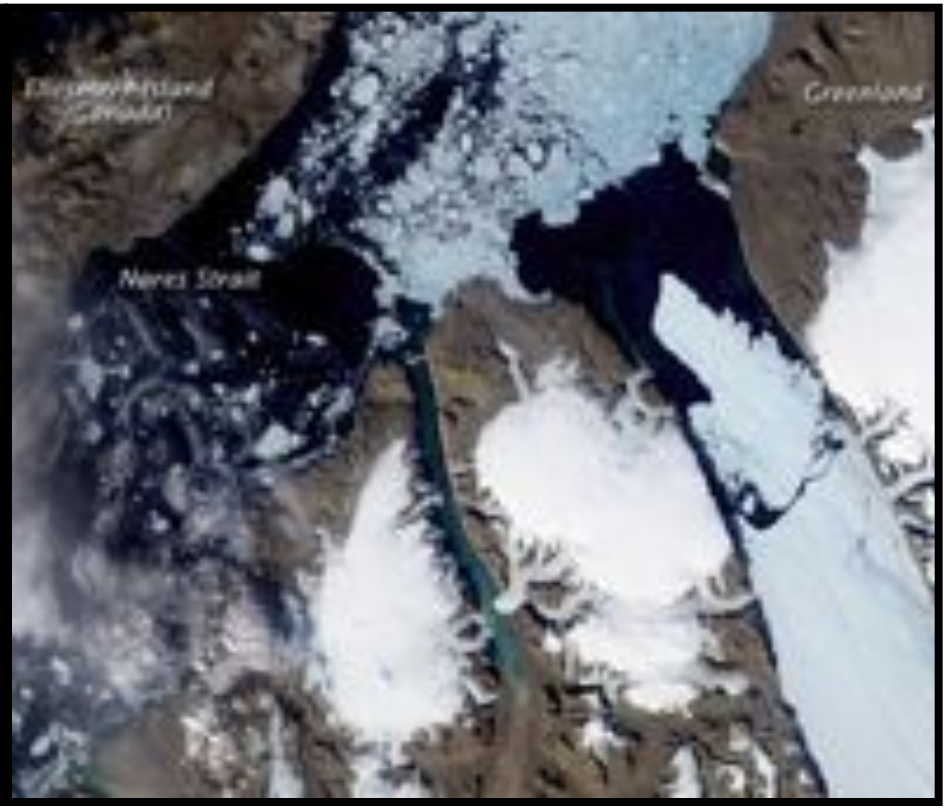
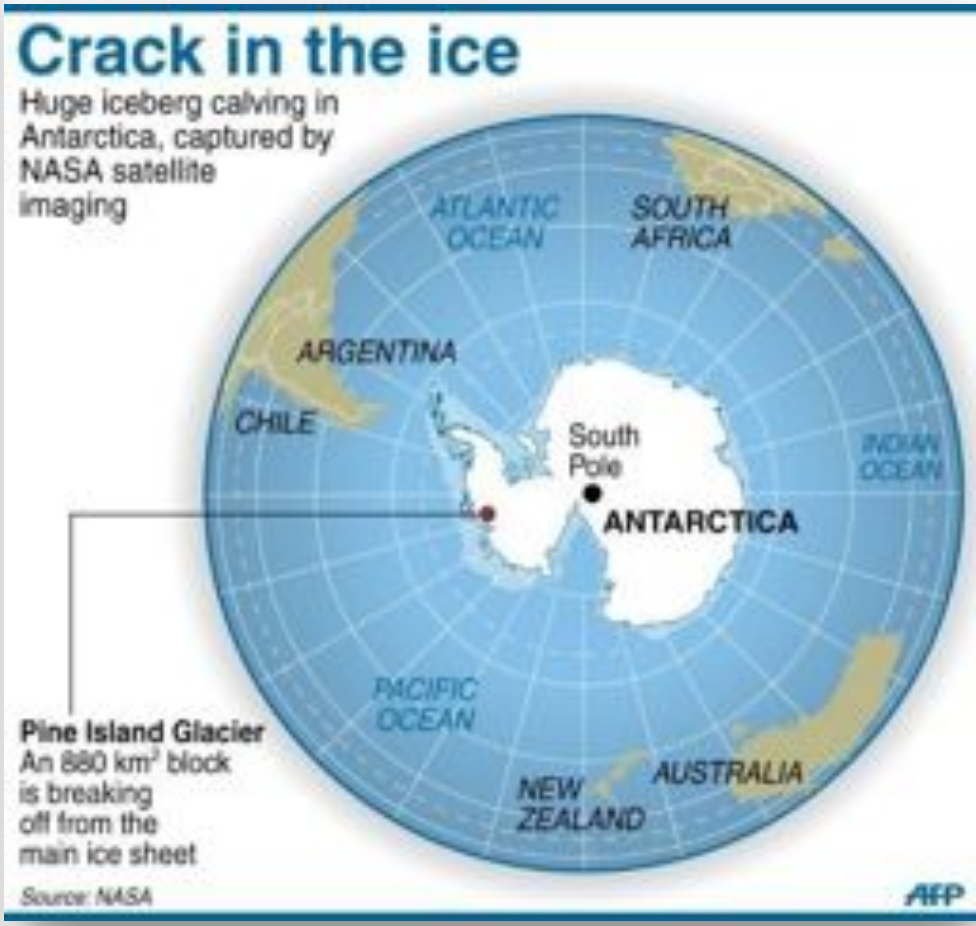


Image acquired Aug. 5, 2010.



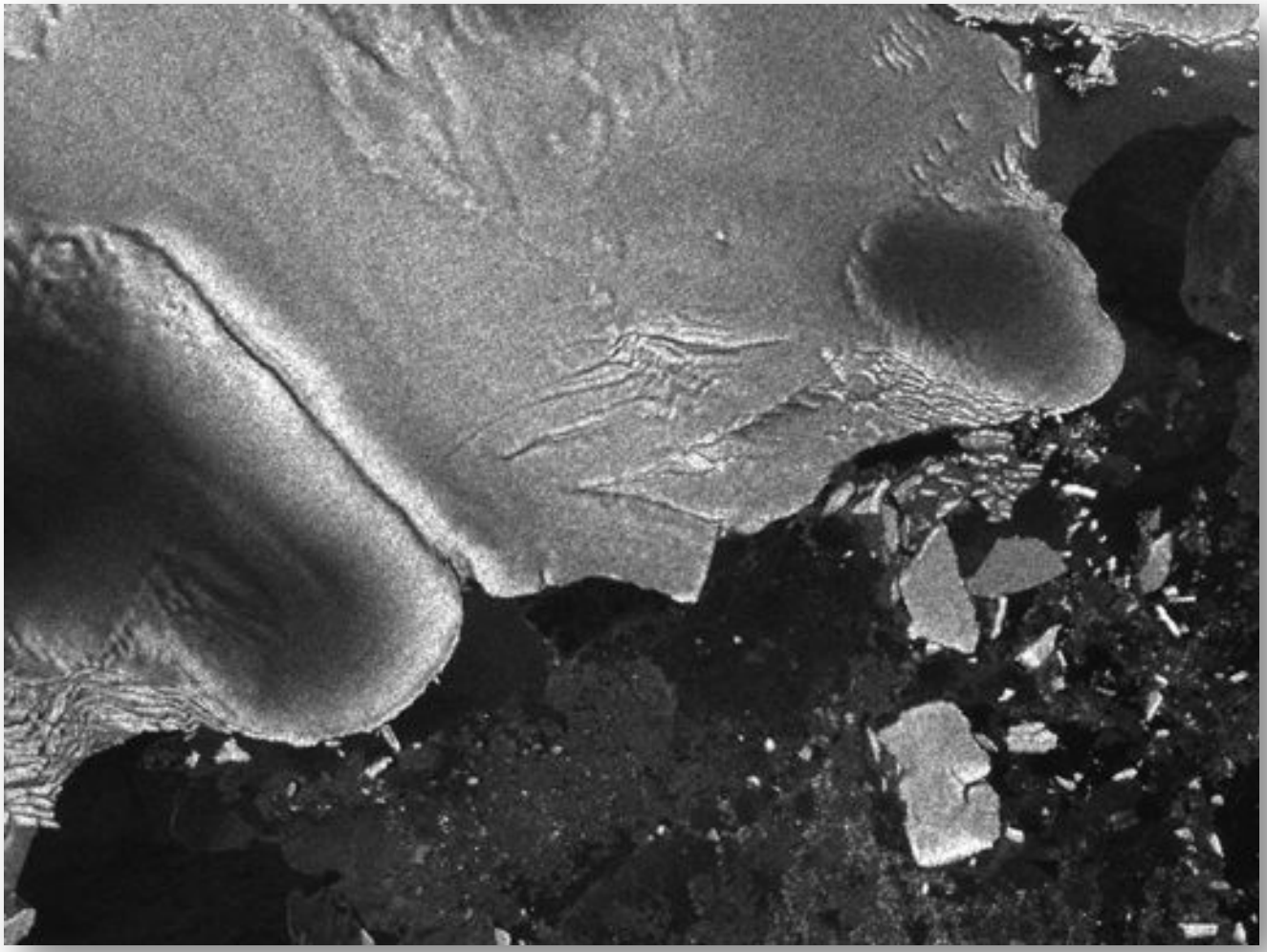
Source: NASA

Crack in Pine Island Glacier



February, 2012

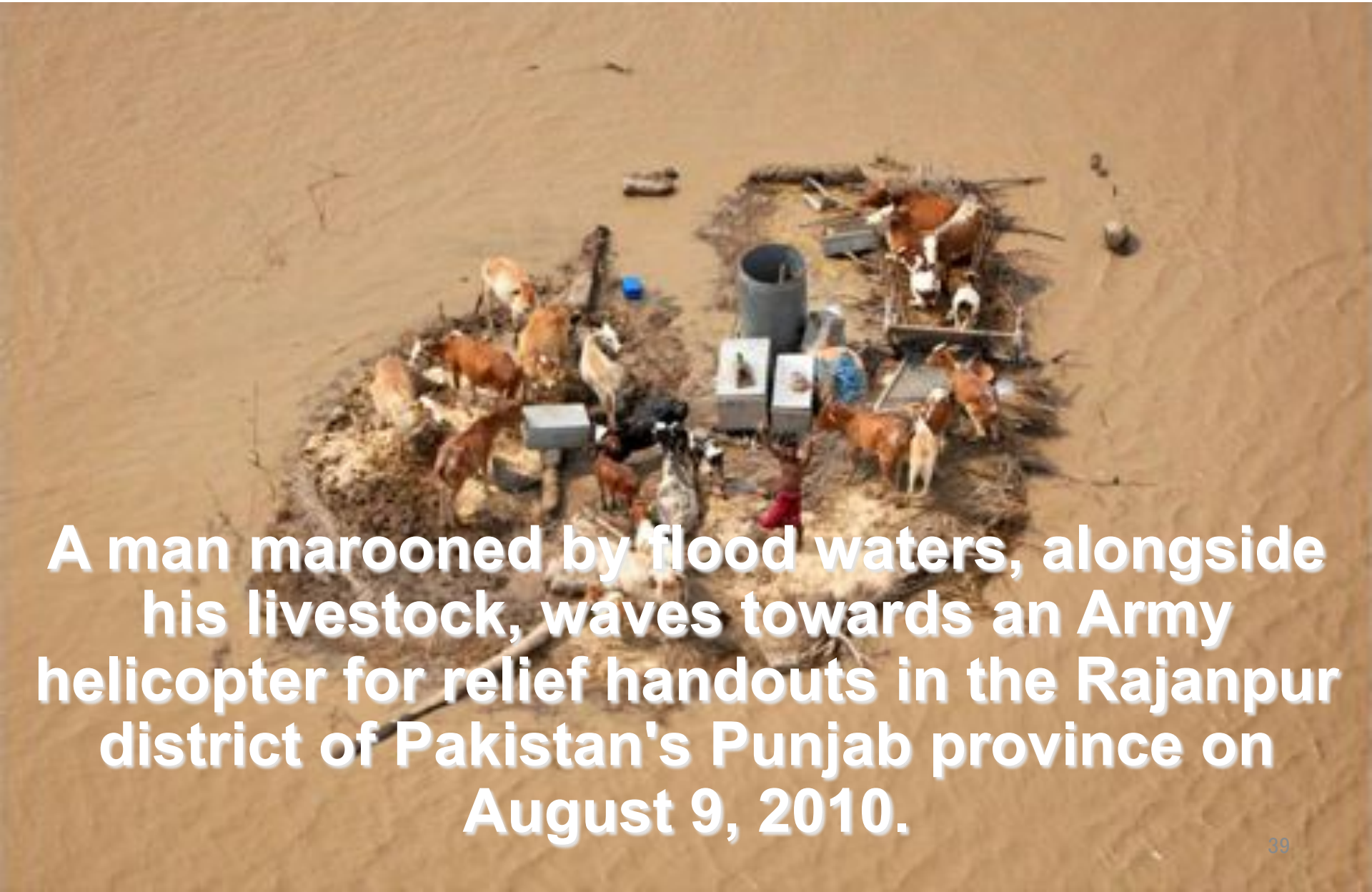
March 2011 Japan Tsunami broke off icebergs in Antarctica



NASA observes – for the first time – the power of an earthquake and tsunami to break off large icebergs a hemisphere away.

Source: boston.com

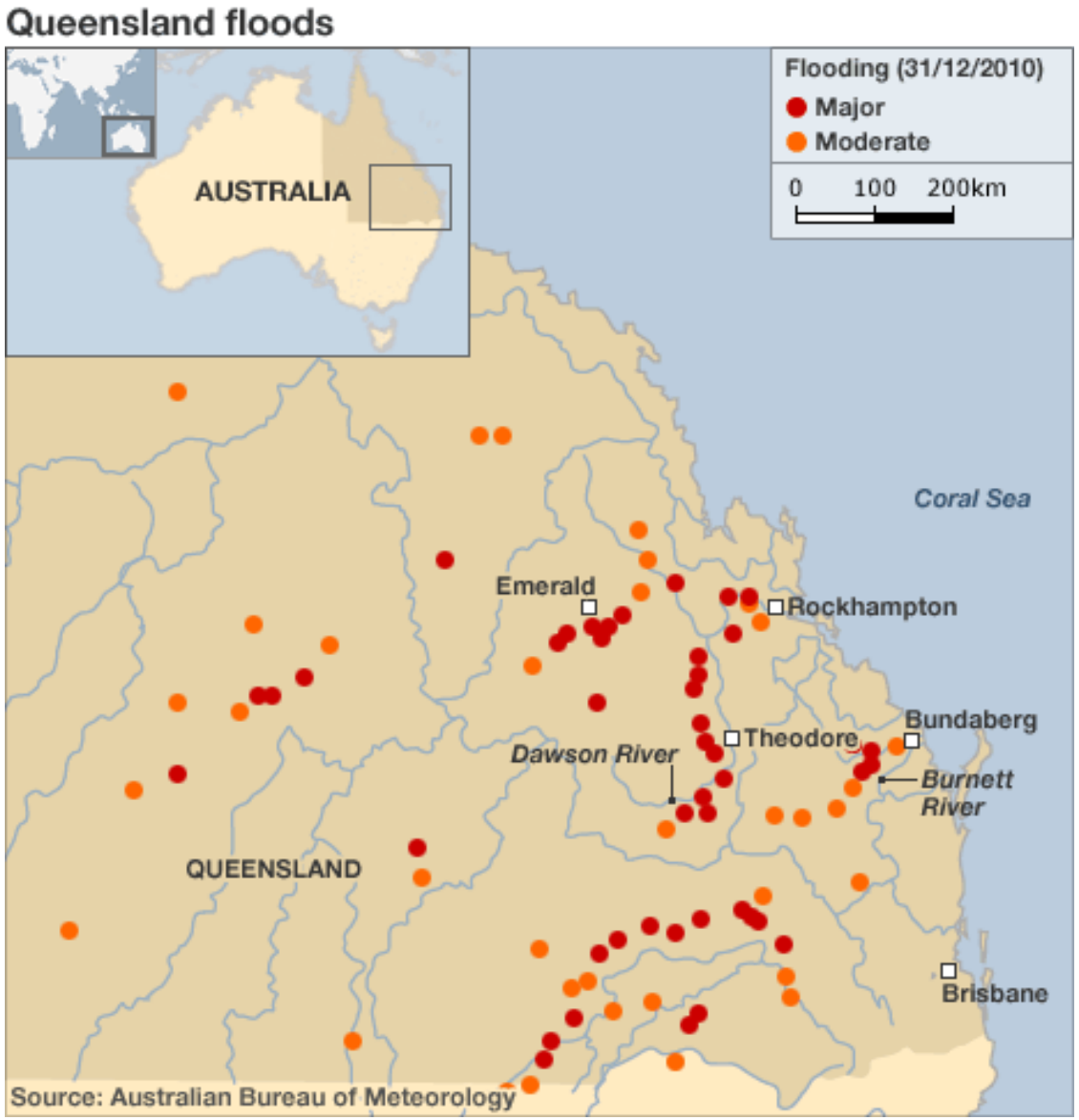
Pakistan Floods



A man marooned by flood waters, alongside his livestock, waves towards an Army helicopter for relief handouts in the Rajanpur district of Pakistan's Punjab province on August 9, 2010.

Australia‘s Queensland faces ’biblical‘ flood

BBC News, 1 January 2011



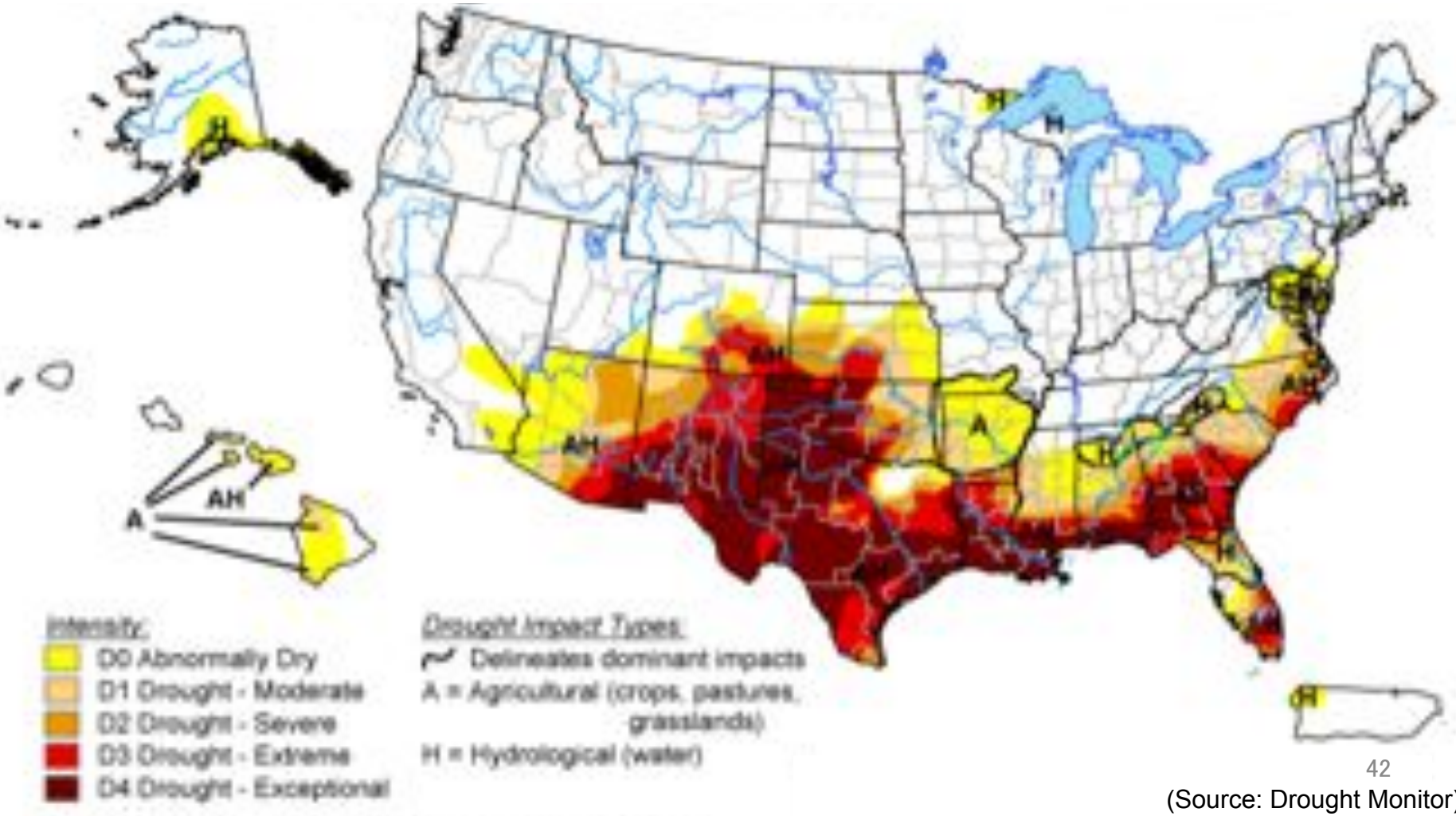
A senior official has described the flooding in Queensland, Australia, as a disaster of "biblical proportions".

Rockhampton, where 77,000 people for impact, amid warnings of 30ft (9m) floodwaters. More than 20 other towns have already been left cut off or flooded across an area larger than France and Germany.
At least six river systems across Queensland have broken their banks. The floods have affected about 200,000 people, and many have been evacuated.
There are concerns that damage could cost billions of Australian dollars to repair.
“In many ways, it is a disaster of biblical proportions,” State Treasurer Andrew Fraser told journalists in the flood-hit town of Bundaberg.

U.S Drought Monitor

(July 5, 2011)

Maps are released each Thursday at 8:30 a.m. Eastern Time.



(Source: Drought Monitor)

Texas Drought Has Hit Critical Stage And May Worsen

http://tamunews.tamu.edu/2011/04/07/

The drought situation in Texas has reached the critical stage, says a Texas A&M University atmospheric scientist who also serves as climatologist for Texas, and the U.S. Drought Monitor has designated parts of central and eastern Texas as under “exceptional drought” in its latest assessment.

Climate Variability and Climate Change: The New Climate Dice

10 November 2011

J. Hansen, M. Sato. R. Ruedy

Abstract. The "climate dice" describing the chance of an unusually warm or cool season, relative to the climatology of 1951-1980, have progressively become more "loaded" during the past 30 years, coincident with increased global warming. The most dramatic and important change of the climate dice is the appearance of a new category of extreme climate outliers. These extremes were practically absent in the period of climatology, covering much less than 1% of Earth's surface. Now summertime extremely hot outliers, more than three standard deviations (σ) warmer than climatology, typically cover about 10% of the land area. Thus there is no need to equivocate about the summer heat waves in Texas in 2011 and Moscow in 2010, which exceeded 3σ – **it is nearly certain that they would not have occurred in the absence of global warming. If global warming is not slowed from its current pace, by mid-century 3σ events will be the new norm and 5σ events will be common.**

After Praying for Rain, Texas Governor Rick Perry Prays for the EPA to Stop Environmental Regulations. THINKPROGRESS

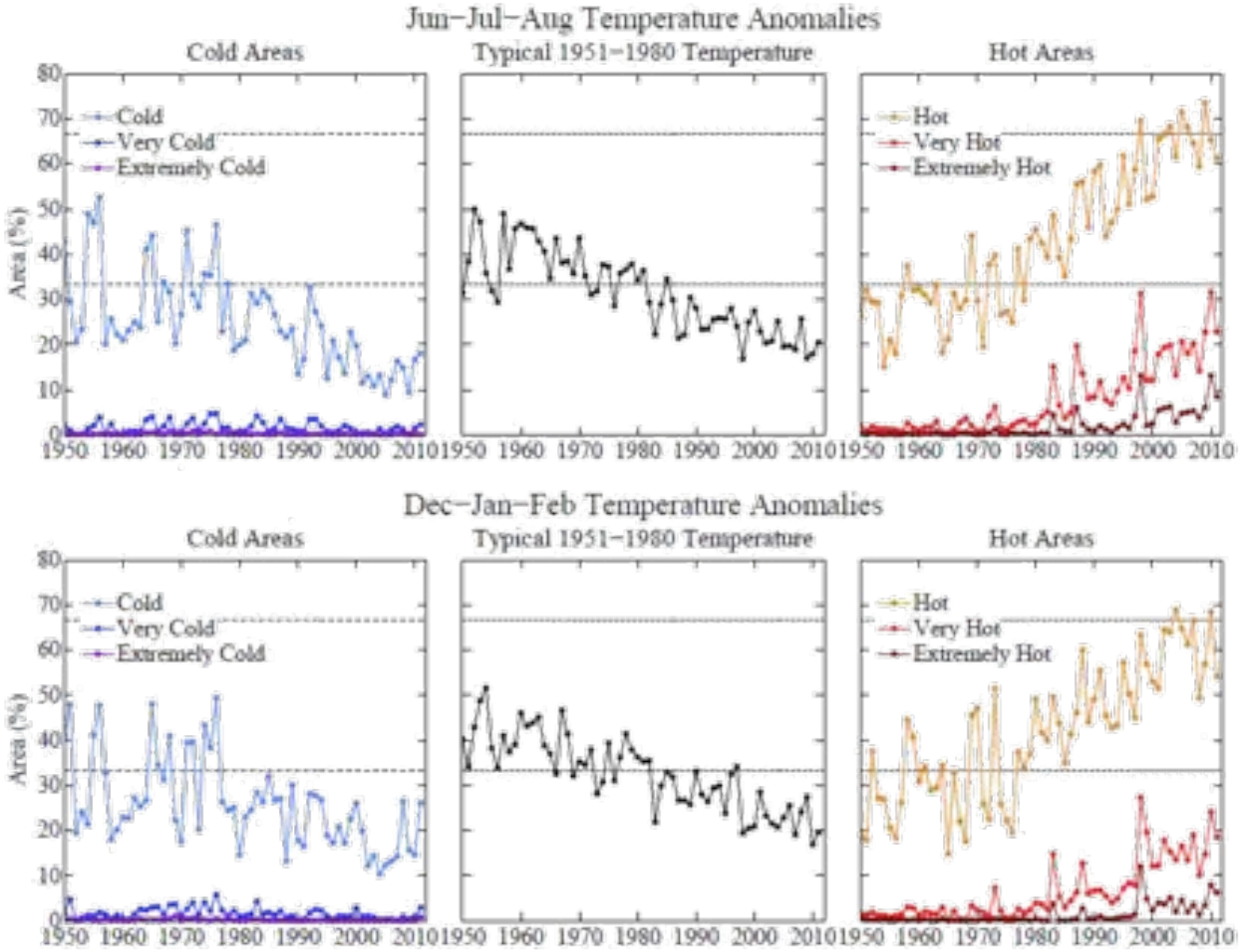
"I, Rick Perry, Governor of Texas, under the authority vested in me by the Constitution and Statutes of the State of Texas, do hereby proclaim the three-day period from Friday, April 22,2011, to Sunday, April 24,2011, as Days of Prayer for Rain in the State of Texas. I urge Texans of all faiths and traditions to offer prayers on those days for the healing of our land, the rebuilding of our communities and the restoration of our normal way of life."

Science cannot disprove the possibility of divine intervention. However, there is a relevant saying that "Heaven helps those who help themselves."

Science does show that business-as-usual fossil fuel emissions will cause atmospheric CO_2 to continue to increase rapidly. The increasing greenhouse gases will cause the rapid global warming of the past three decades to continue, and this warming will cause the climate dice to become more and more loaded with greater and greater extreme events. The probability that this conclusion is wrong is about as close to zero as one can get.

J. Hansen, M. Sato, R. Ruedy
NASA, USA

Area of the world covered by temperature anomalies in categories defined as hot (>0.43σ), very hot (>2σ), and extremely hot (3σ), with analogous divisions for cold anomalies



Source: Climate Progress

Severe weather continues in central US

The Joplin twister, which killed more than 120 people, is the eighth deadliest storm on record in the United States dating back to 1840. This year's tornado season has produced approximately 1,000 twisters and has taken the lives of more than 300 people.

Debbie Surlin salvages items from her parent's home in Joplin, Mo. Wednesday, May 25, 2011. The home's residents Beverly and Roy Winans rode out the EF-5 tornado by hiding under a bed in the home. The tornado tore through much of the city Sunday, damaging a hospital and hundreds of homes and businesses and killing at least 123 people. (Charlie Riedel/Associated Press)

Massive sand storm hits Phoenix ARIZONA, July 5th 2011

A monstrous dust storm roared through Phoenix, Arizona on Tuesday night, delaying flights and causing power outages for thousands of people.
The AP reports that the massive dust cloud, also known as a "haboob," was around 5,000 feet when it arrived in Phoenix, but radar data reveals that it reached heights anywhere from 8,000 to 10,000 feet high prior. The storm appeared to be around 50 miles wide in some areas, KSAZ-TV reported.

Thailand flood reaches Bangkok

This aerial picture shows an under-construction temple surrounded by floodwaters outside the ancient Thai capital of Ayutthaya, north of Bangkok on October 11, 2011. (Christophe Archambault/ AFP/Getty Images)

People push their belongings through floodwaters during an evacuation from a flooded market in Bangkok October 24, 2011. (Sukree Sukplang/Reuters)

From Cairo to the Cape, climate change begins to take hold of Africa

The world's poorest communities have begun to experience extreme weather outside the natural variability of African climate. Without a rapid reduction in emissions, the continent faces calamitous temperature rises within this century

China's Drought of the Century

http://www.theepochtimes.com/n2/china-news/

An ongoing drought in central and eastern China not seen in 50 or 100 years has dried up many rivers. Downstream provinces near the Three Gorges Dam have been scourged, the Yangtze River is withering, and China's largest freshwater lake is nearly dry, pushing the ecological system in a large area to the brink of calamity.

Human activities are also being badly impacted. Drinking and irrigation water is in short supply, rice crops are dying, and cargo vessels are stranded.

And the threat of extinction to one wildlife species highlights all those troubles.

Premier urges all-out efforts for drought relief

Chinese Premier Wen Jiabao looks at lake-turned grassland as the result of lingering drought in Yongxiu county of East China's Jiangxi province June 5, 2011. [Photo/Xinhua]

Key Messages of the IPCC Special Report on Extreme Events

November 2011

(1) Even without taking climate change into account, disaster risk will continue to increase in many countries as more vulnerable people and assets are exposed to weather extremes.

(2) Evidence suggests that climate change has changed the magnitude and frequency of some extreme weather and climate events in some regions already.

(3) Climate change will have significant impacts on the severity and magnitude of climate extremes in the future.
As climate change becomes more dramatic, its effect on a range of climate extremes will become increasingly important and will play a more significant role in disaster impacts.

(4) Climate extremes are essentially becoming more unpredictable.

(5) Any delay in greenhouse gas mitigation is likely to lead to more severe and frequent climate extremes in the future.

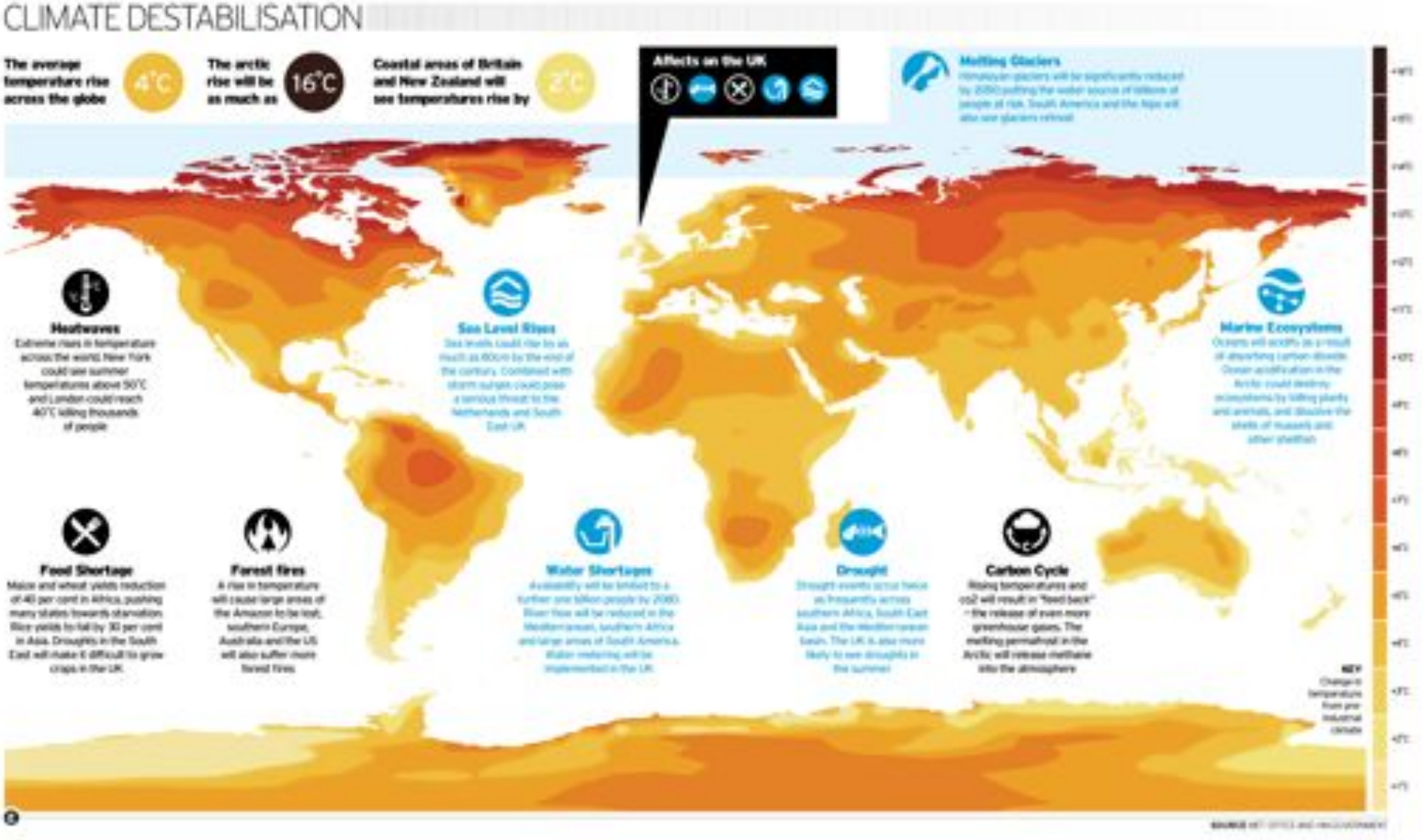
4ºC Global Warming: Regional patterns and timing

by Richard Betts et al, Met Office, Hadley Centre, UK

- **Current CO2 emissions are near (but not above) upper end of IPCC**
- **4ºC global warming (relative to pre-industrial) is possible by the 2090s, especially under high emissions scenario**
- **Many areas could warm by 10ºC or more**
- **The Arctic could warm by 15ºC or more**
- **Annual precipitation could decrease by 20% or more in many areas**
- **Carbon cycle feed backs expected to accelerate warming**
- **Plausible worst case: 4ºC by 2060**

4°C World

"Day After Tomorrow" map



4°C World

Tyndall Center, UK

Kevin Anderson

Less than 10% of the world population can only survive in the 4CWorld

Potsdam Climate Impact institute, Germany

Joachim Schellnhuber

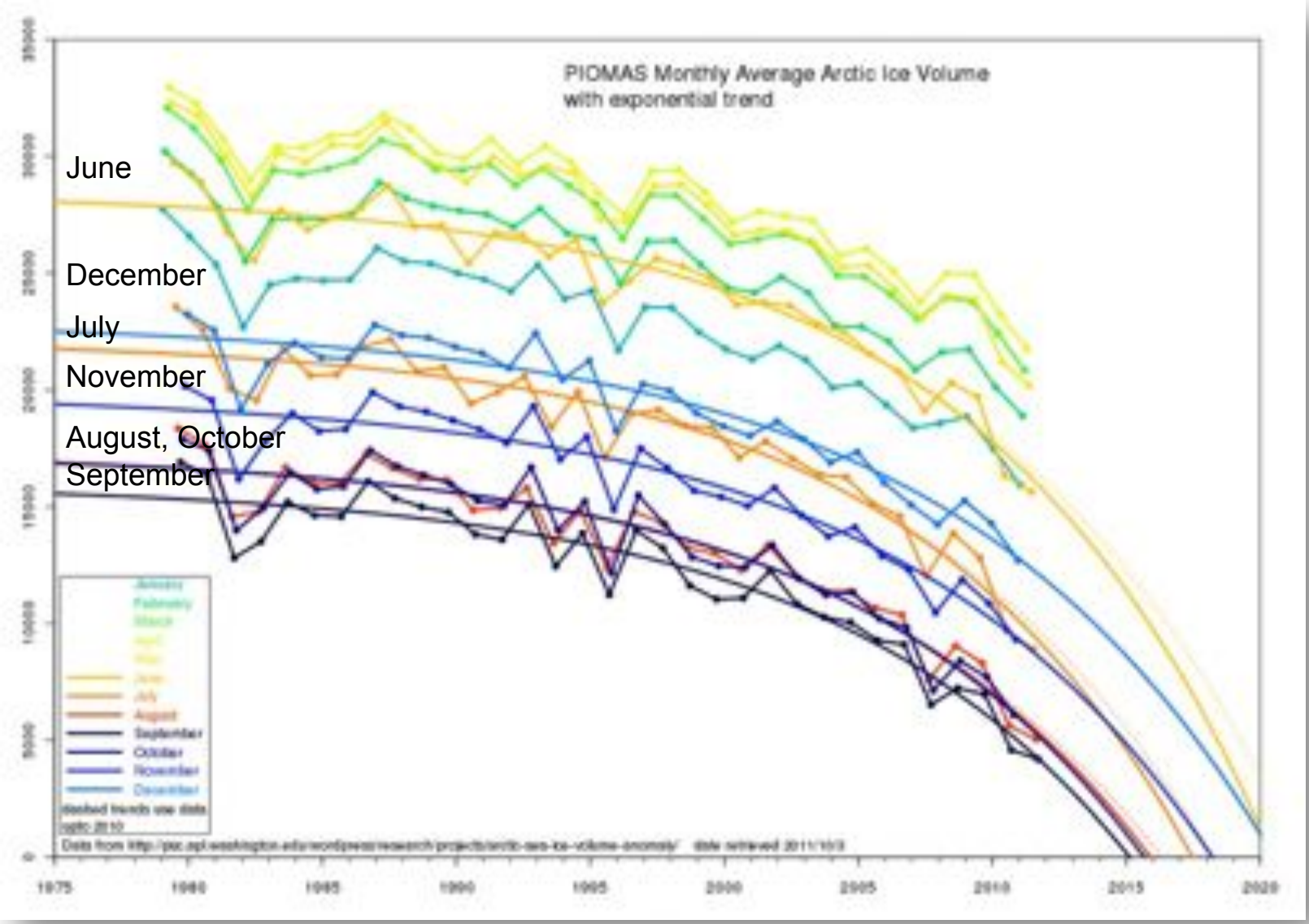
Carrying Capacity of the World population in the 4C World is less than 1 billion

NASA Goddard institute, USA

James E. Hansen

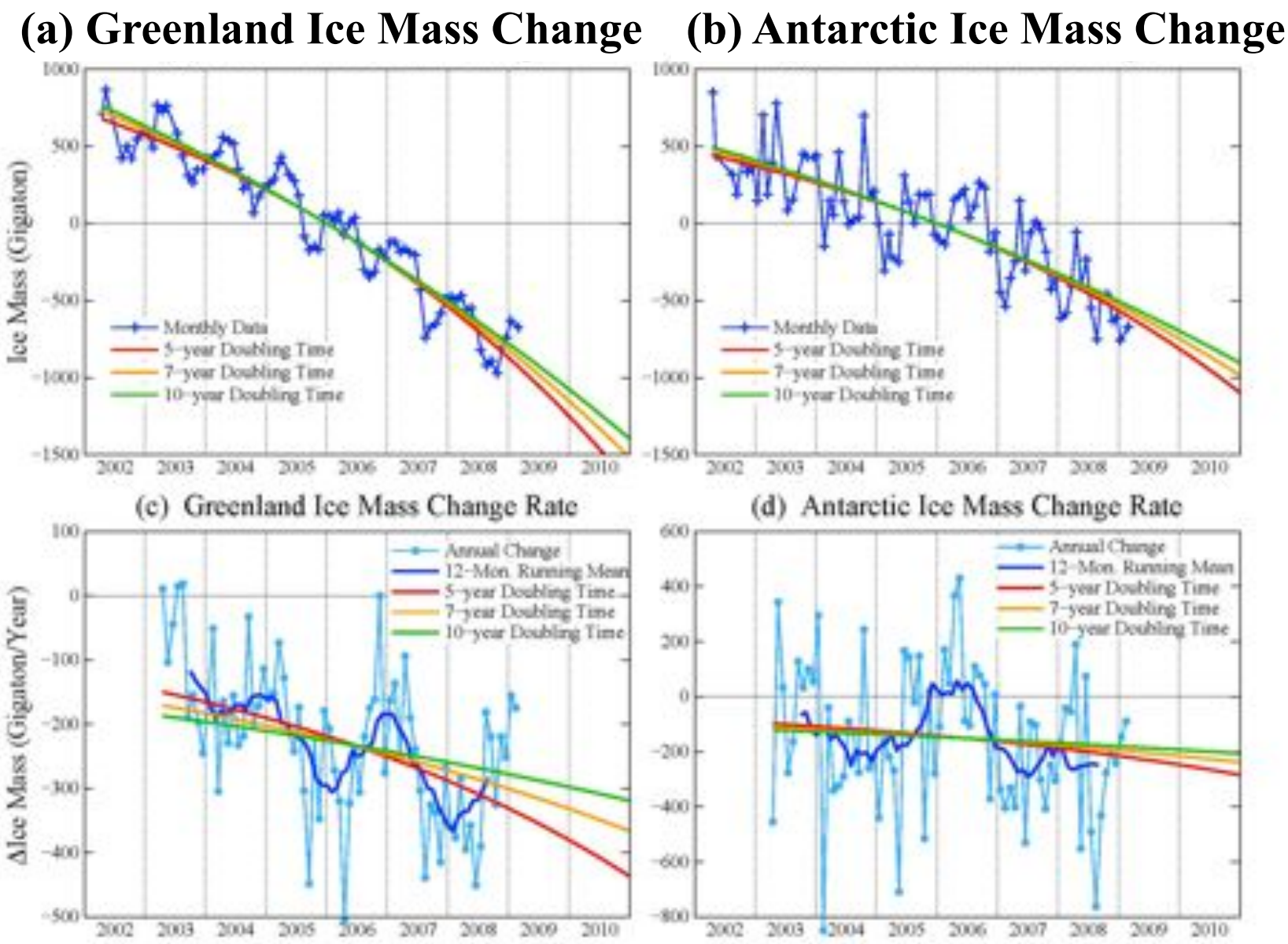
2C Climate target is prescription for disaster or guaranteed disaster

PIOMAS Trend Shows That All The Arctic Sea Ice Will Be Gone In Four Years, 2015.
Winters look ice free by about 2030 or 2040.



Ice-free Arctic Sea in Summer may be within a decade.

Rapid Ice-Mass Loss

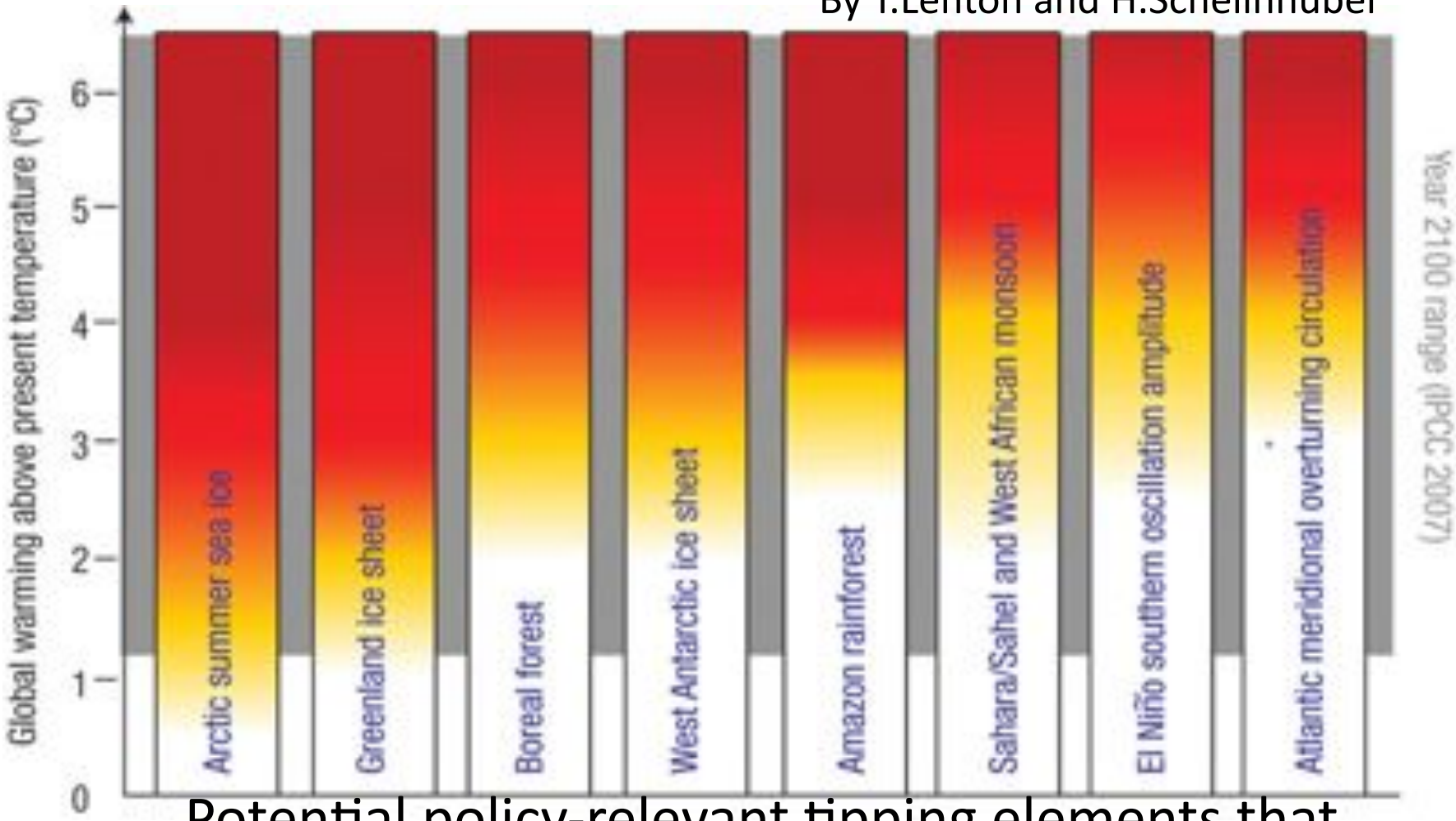


Tipping Elements and the time expected for them to undergo major transition has been by Lenton et al

Melting of Arctic sea-ice	(approx 10 years)
Decay of the Greenland ice sheet	(more than 300 years)
Collapse of the West Antarctic ice sheet	(more than 300 years)
Collapse of the Atlantic thermohaline circulation	(approx 10 years)
Increase in the El Nino Southern Oscillation	(approx 10 years)
Collapse of the Indian summer monsoon	(approx 10 years)
Greening of the Sahara/Sahel and disruption of the West African monsoon	(approx 10 years)
Dieback of he Amazon rainforest	(approx 50 years)
Dieback of the Boreal Forest	(approx 50 years)

Passing Tipping Points

By T.Lenton and H.Schellnhuber



Potential policy-relevant tipping elements that could be triggered by global warming this century, with shading indicating their uncertain thresholds

2009,July

L'Aquila Summit, Italy, G8 and MEF

「2℃ target」 was recognized clearly by political leaders.

G8 L'Aquila Declaration 2009

"We recognise the broad scientific view that the increase in global average temperature above pre industrial level ought not to exceeds 2ºC.

Because this global challenge can only be met by a global response, we reiterate our willingness to share with all countries the goal of achieving at least a 50% reduction of global emissions by 2050, recognising that this implies that global emissions need to peak as soon as possible and decline there after.

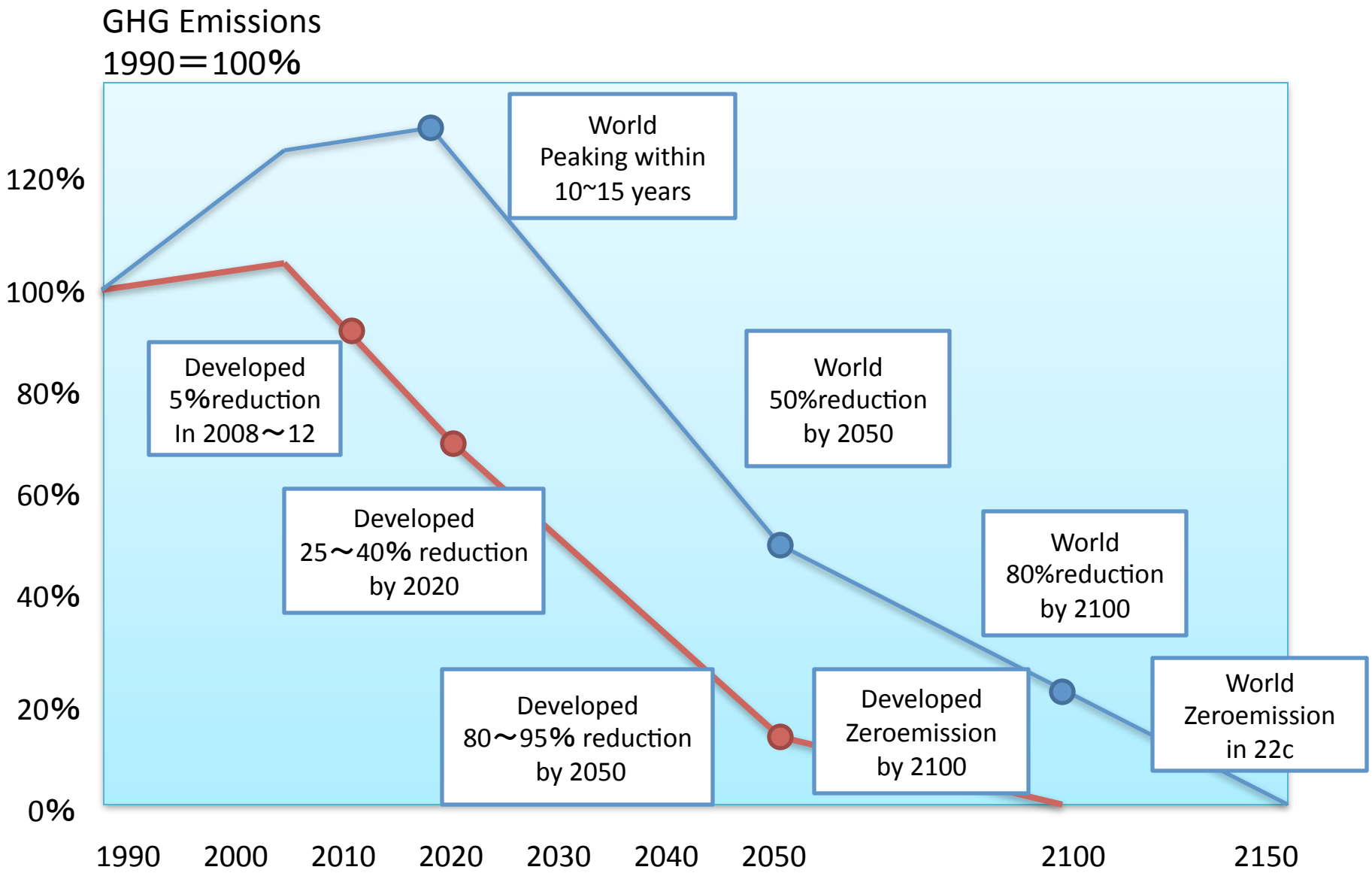
As part of this, we also support a goal of developed countries reducing emissions of green house gases in aggregate by 80% or more by 2050 compared to 1990 or more recent years"

September 7,2009

Japan's
Ex Prime minister,
Mr. Yukio HATOYAMA
declared

25% reduction of Green House Gas Emission by 2020

Zero-carbon Economy is our final Goal.



Emission Pathway needed to keep 2℃ target

Proposed CO_2 Emission's Reduction Rate by 2050 is 50% Compared with the 1990 level

CO_2 emission in 2010		33.5 billion tons
〃	1990	22.0 billion tons

Then, 33.5 billion tons ⇒ 11 billion tons

Almost 1/3 of the present value

Cumulative Allowable CO_2 Emissions (2010-2050) to keep the 2℃ target with the probability 67% is 750 billion ton

- Per capita budget of emission = 750 billion ton/6.8 billion = 110 ton
- Budget lifetime estimated by assuming the per capita CO_2 emission at 2008 for each country

Country	Years
China	**24**
USA	**6**
India	**88**
Germany	**10**
Japan	**11**
Russia	**9**

ref. WBGU(2009)

Irreversible climate change due to carbon dioxide emissions

Susan Solomon, Gian-Kasper Plattner, Reto Knutti and Pierre Friedlingstein
PNAS (2009)

The severity of damaging human-induced climate change depends not only on the magnitude of the change but also on the potential for irreversibility. This paper shows that the climate change that takes place due to increases in carbon dioxide concentrations **is largely irreversible for 1,000 years after emission stop.**
Following cessation of emissions, removal of atmospheric carbon dioxide decreases radiative forcing, but is largely compensated by slower loss of heat to the ocean, so that **atmospheric temperatures do not drop significantly for at least 1,000 years.**

World headed for irreversible climate change in five years, IEA warns. 2011

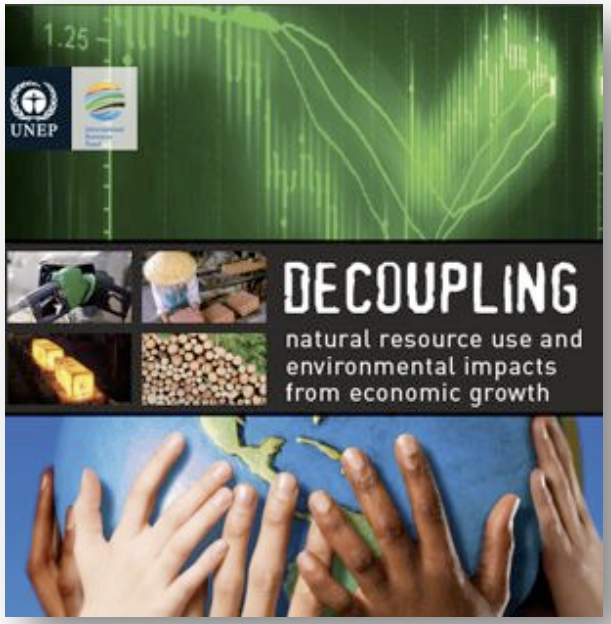
If fossil fuel infrastructure is not rapidly changed, the world will 'loss for ever' the chance to avoid dangerous climate change

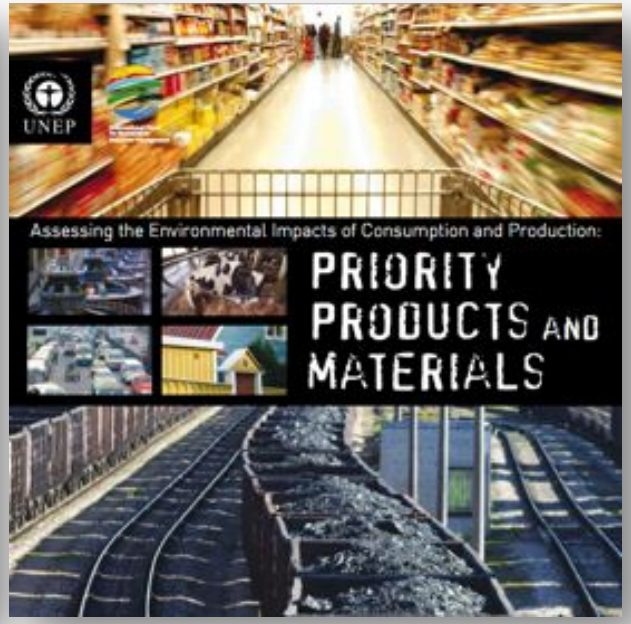
by Fiona Harvey, environment correspondent, gurdian, UK

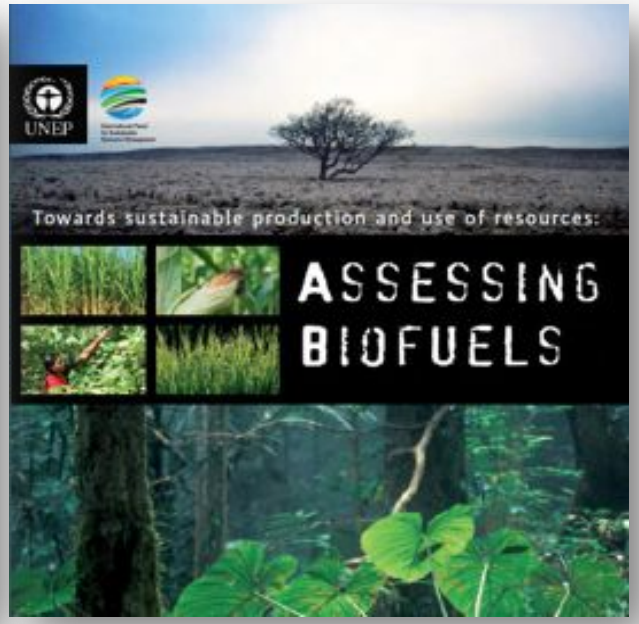
If the world is to stay below 2ºC of warming, which scientists regard as the limit of safety, then emissions must be held to no more than 450ppm of carbon dioxide in the atmosphere; **the level is currently 390ppm.** But the world's existing infrastructure is already producing 80% of that "carbon budget", according to the IEA's analysis.
This gives an ever-narrowing gap in which to reform the global economy on to a low-carbon footing.
By 2017, there will be no room for manoeuvre at all.

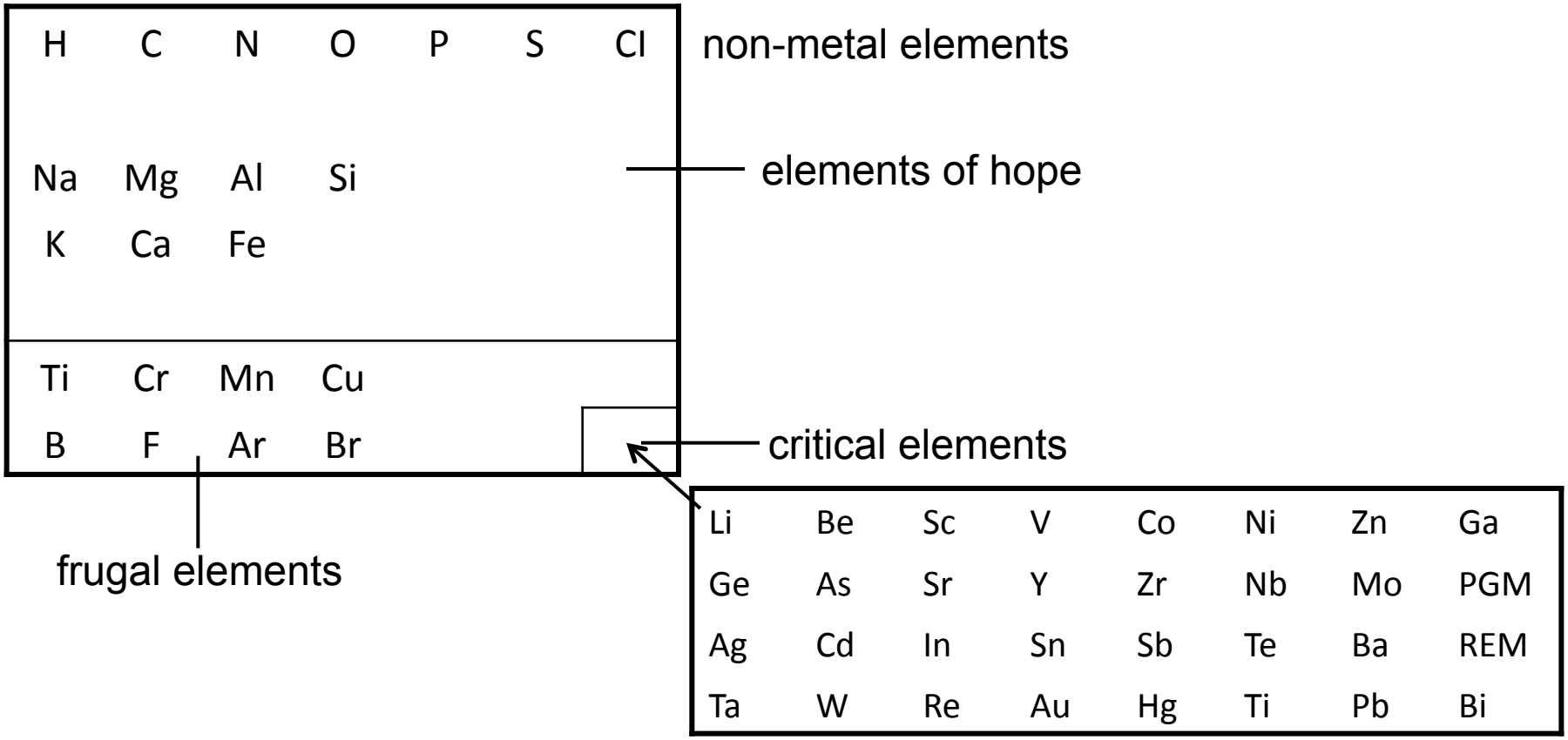
IEA＝International Energy Agency

International Resource Panel Publications









Metal mineral Scarcity:
A call for managed austerity and the elements of hope by A.M. Diederen

The elements of hope

a group of abundantly available elements for sustainable substitution

The frugal elements

Less abundant but still plentiful elements. These elements should only be applied in mass for applications in which their unique properties are essential.

The critical elements

These elements should be saved for the most essential and critical applications.

Decoupling Status of Metal Consumption from Economic Growth

Kohmei Halada, Masanori Shimada and Kiyoshi Ijima
National Institute of materials Science, Tsukuba, JAPAN

World will need a few times more metallic resources at 2050 than present.

Forecasting of the consumption of metals at 2050

Fe, Mo, W, Co, Pt, Pd Present resources will be exhausted completely

Ni, Mn, Li, In, Ga The consumption will increase more than doubling

Cu, Pb, Zn, Au, Ag, Sn The consumption will exceed even its resource base

$$\frac{\text{Annual production}}{\text{Concentration in the Earth's Crust}} = \text{Index of the extent of depletion}$$

$$\text{Total Material Requirement for 1kg Production (ton)} = \text{Index of the environmental burden for metal production}$$

Ecological Rucksack

How to estimate the extent of depletion and the environmental burden for metal production

Peak Metal ?

by Dr. Kohmei HALADA (NIMS, Japan)

	Ratio of (annual production / Concentration in the crust) to Fe, where the ratio for Fe is set to 100	Total Material Requirement for 1 kg production (ton)	Increase of annual production (2009/1999) (%)
Fe	100	0.008	165
Co	15	0.61	219
Ni	116	0.26	125
Al	1	0.05	163
Cu	1,851	0.36	125
Zn	959	0.04	131
Au	12,392	1100	101
Pb	6,855	0.03	128
Hg	337	2	56
Cd	991	530	118
Pt	375	530	118
Ir	4	400	40
Rh	34	2300	85
Sb	9,861	0.06	136

Three different scenarios for resource use up to 2050

Scenario 1 Business-as-usual (BAU)

BAU scenario assumes that developing countries adopt growth and development strategies aimed at 'catching up' with the resource consumption patterns of industrialized countries, this will result in the tripling of global annual resource extraction and consumption by 2050.

Specifically, this means more than doubling biomass use, while almost quadrupling fossil fuel use and tripling the annual use of metals (ores) and construction minerals.

Scenario 2 Moderate contraction and convergence

Assumes substantial structural change in the dominant industrial production and consumption patterns. This scenario would require substantial economic structural change and massive investments in innovations for resource decoupling.

Scenario 3 Tough contraction and convergence

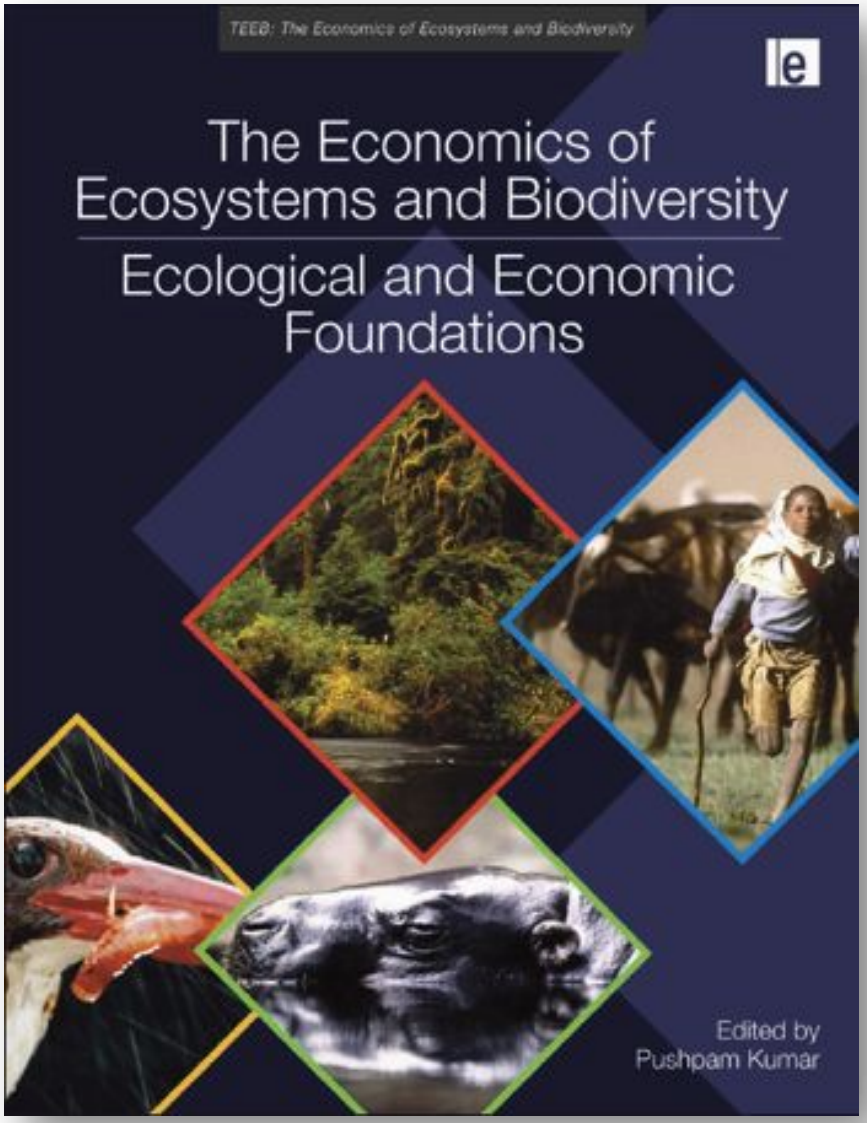
This scenario does not raise global resource consumption above the 2000 levels, and can hardly be addressed as a possible strategic goal by politicians.

Table; Metabolic scales and rates, overview of scenario analysis

ref. IRP Report

		Baseline	Scenario 1: Business as usual	Scenario 2: Moderate contraction and convergence	Scenario 3: Tough contraction and convergence
Year		2000	2050	2050	2050
World population (Billions)		6.0	8.9	8.9	8.9
World Metabolic rate (Tons/capita/year)		8	16	8	5.5
World metabolic scale (Billion tons/year)		49	141	70	49
Metabolic rate	Industrialized High density	13	13	6.5	5
	Industrialized Low density	24	24	12	8
	Developing High density	5	13	6.5	5
	Developing Low density	9	24	12	8

The Economics of Ecosystems and Biodiversity (TEEB)



To save the millions of biospecies,

(1) the surface temperature increase should be suppressed less than 1.5℃.

and

(2)the warming rate should be suppressed less than 0.05℃/decade.

Actually, the warming rate is now 0.48℃/decade in the arctic region.

IEA Strategy for 2℃/450ppm by 2030

ref. World Energy Outlook(2007)

Necessary Reduction of GHG

(1)Energy Saving (40%) 2%/year

(2)Carbon Capture and Storage (21%) establish 460 CCS

(3)Nuclear Power Plant (16%) Construct 235 plants

(4)Renewable Energy (19%)

Hydro	increase factor	2
Biomass	〃	10
Wind	〃	20
Geothermal	〃	4
solar	〃	130

(5)Biofuel etc

Collapse of the myth of Nuclear Safety

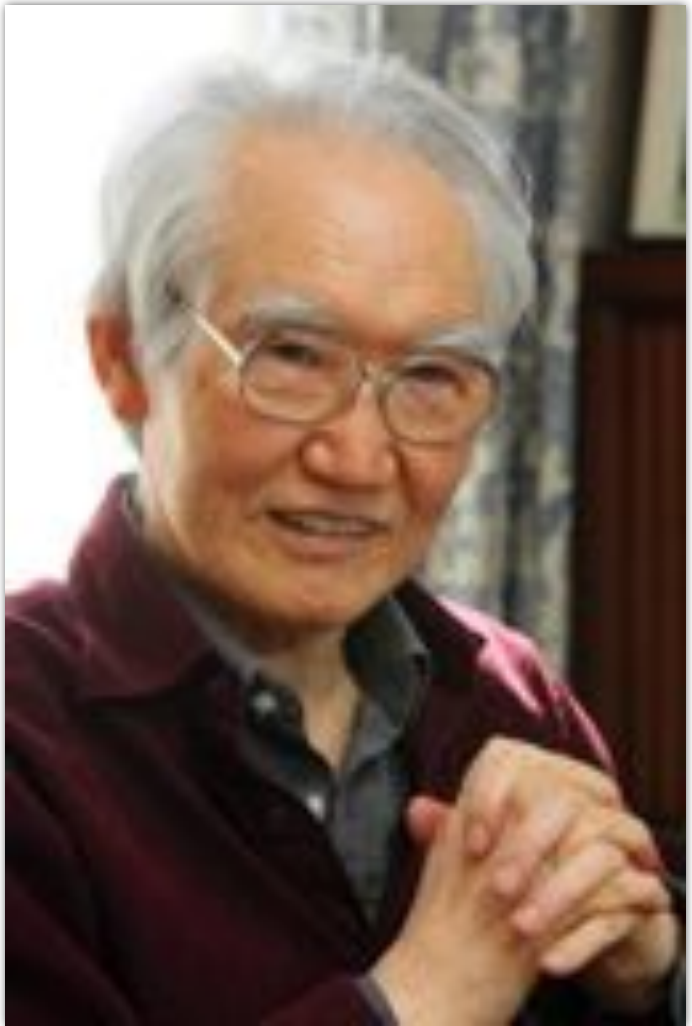
A place of refuge of Fukushima prefectural

Fukushima Daiichi Nuclear Power Station

They temporarily returned to home putting on protective clothing.

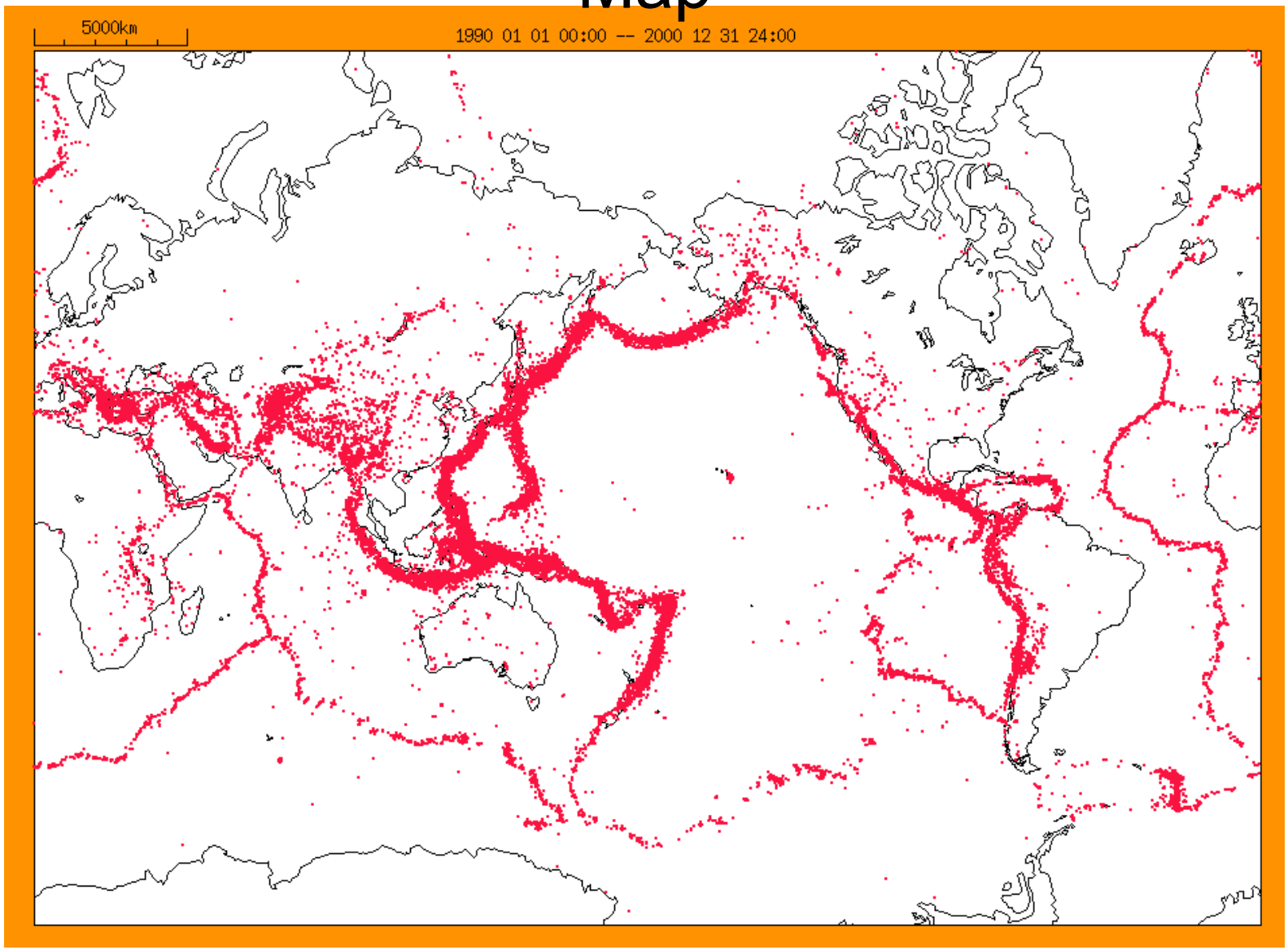
Complex Disaster of Earthquake Disaster and Severe Accident of Nuclear Power Plant was predicted

Prof. Kiyoo MOGI
Professor Emeritus of
the University of Tokyo



Prof. Katsuhiko ISHIBASHI
Professor Emeritus of
the Kobe University

Distribution of Earthquakes in the World Map



Ref: the Meteorological Agency of Japan

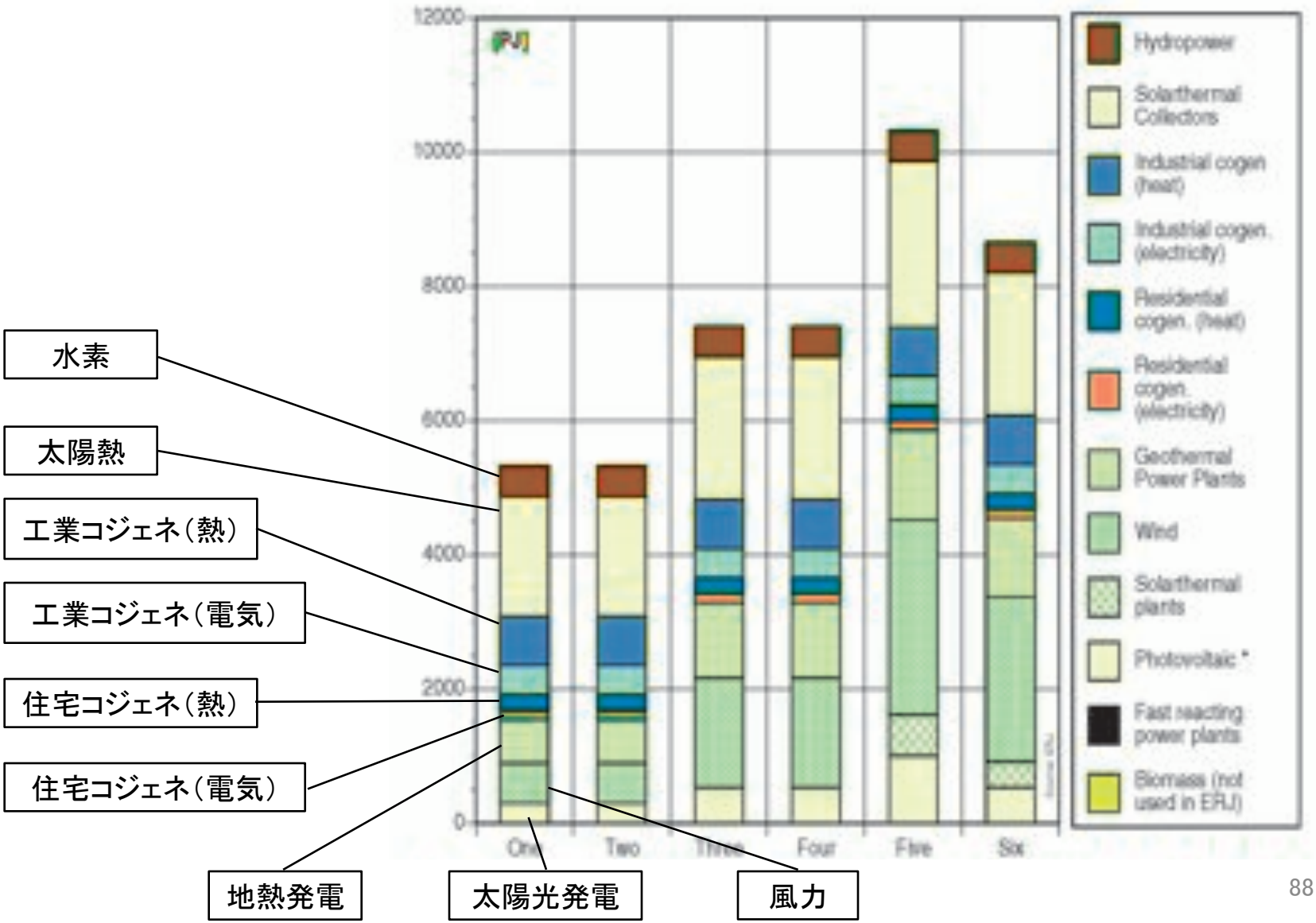
Full Solar Supply of Industrialized Countries – The Example Japan

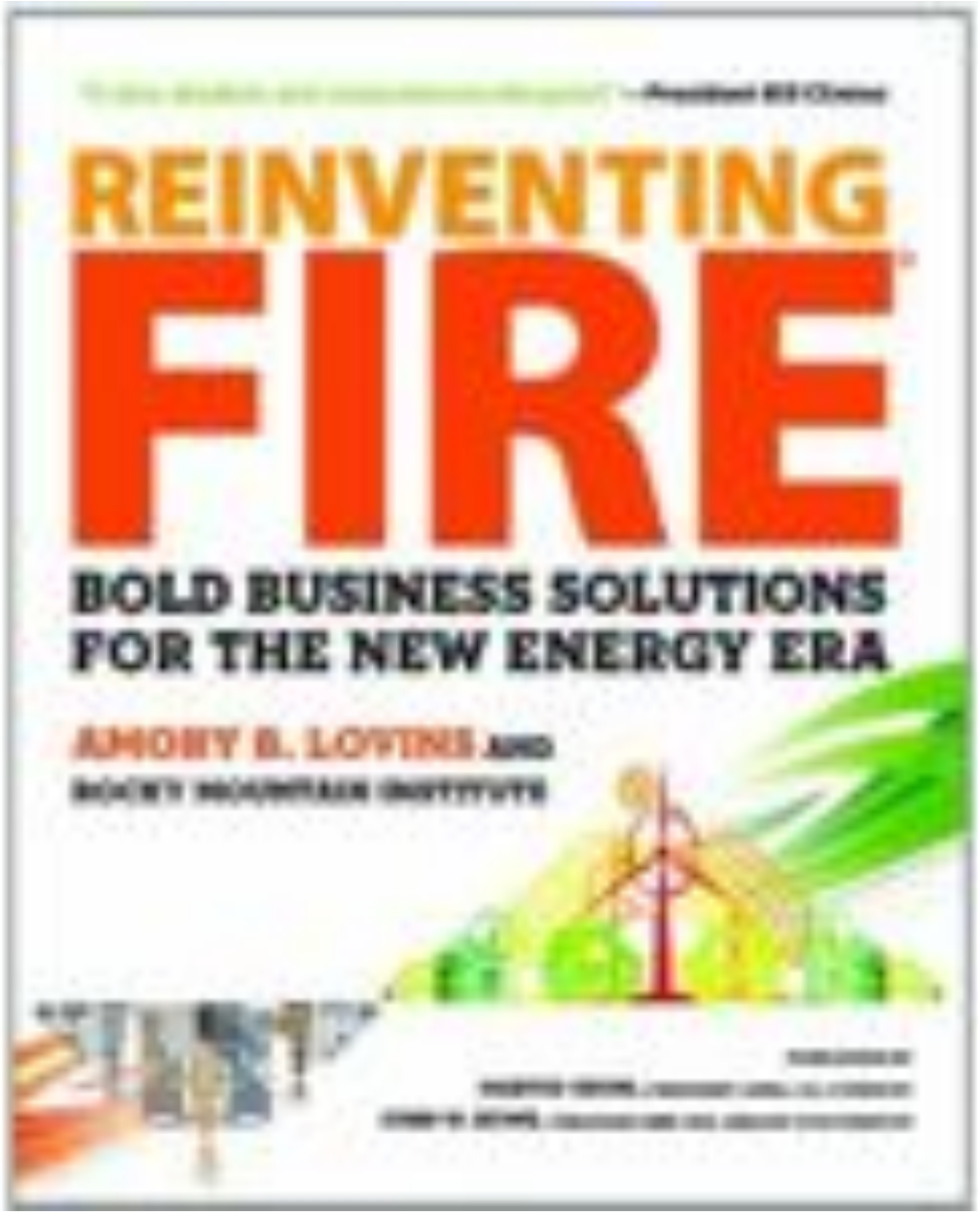
by Harry Lehman (www. Energyrichjapan.info)

Using baseline data from 1999, "the Energy Rich Japan" report shows how a combination of the best energy efficiency technologies available today, and a massive investment in renewable energy, could ultimately provide Japan with 100% of its energy needs from renewables – including transportation fuels – without expensive and environmentally damaging imported fossil and nuclear fuels. Rather than seeking energy security through its hugely expensive and polluting nuclear program, for example, Japan could instead build its own renewable energy industry. As an energy – hungry and supposedly "resource-poor" country, Japan could make this transition to clean, renewable energy without any sacrifice in living standards or industrial capacity.

Six scenarios of how this might happen are outlined in the report, all of which can provide 100% renewable energy for Japan.

Full Solar Supply of Industrialized Countries – The Example Japan by Dr. Harry Lehman





ソフトエネルギーパスの著者

エイモリー・ロビンス博士の新しい著書

アメリカは2050年までに
脱石油、脱石炭、脱原子力
達成可能、80%CO_2削減、
5兆ドルの経済利益が結論

We need new MAD strategies!

Old MAD =	・Mutual Assured Destruction for Nuclear Missiles
New MADs	・Mutual Assured Dematerialization for Reduction of Resource consumption ・Mutual Assured Decarbonization for Reduction of Carbon-Dioxide Emissions

The Mitigation, Adaptation and Development
(H. J. Schellnhuber)