

# Wits scientists debunk climate change myths, impact remains severe

News flash 26<sup>th</sup> February 2014



Earth Stewardship Science Research Institute



# ***Iphakade* and the Art of ClimateCycle Maintenance**

**see : 'Zen and the Art of Motorcycle Maintenance' –**

An Inquiry into Values is a 1974 philosophical novel, the first of Robert M. Pirsig's texts in which he explores his Metaphysics of Quality. The book sold 5 million copies worldwide; and was a cult book when I was at University.

**Teaching and inculcating Iphakade - Earth  
Stewardship Science using concepts of adaption  
and mitigation with 2020 vision**



# Earth Stewardship Science

Borrowed from Xhosa Culture

## Iphakade

‘observe the present and consider the past to ponder the future’

\* ***Earth Stewardship*** — ethical, democratic management of the physical and living systems of our planet:

**Earth as in 'Commons'**

\* ***Science*** is used here in the broadest sense of the word, covering all fields of scientific enquiry: a systematic enterprise that builds and organizes knowledge in the form of testable explanations and predictions across the natural, social, health and engineering sciences; a body of knowledge of the type that can be rationally explained and reliably applied.

\* ***Earth Stewardship Science*** is a new, broad intellectual field in tune with contemporary global perspectives of the world and its complexities. Its consilience approach seeks a deeper understanding of people and planet issues of both local and global significance; and has the potential to make a major impact on the way Africa manages its resources — and how it responds to the many pressures on diversity, environment, and society; and how it relates to poverty and well-being.

# The Earth- is a gigantic recycling machine

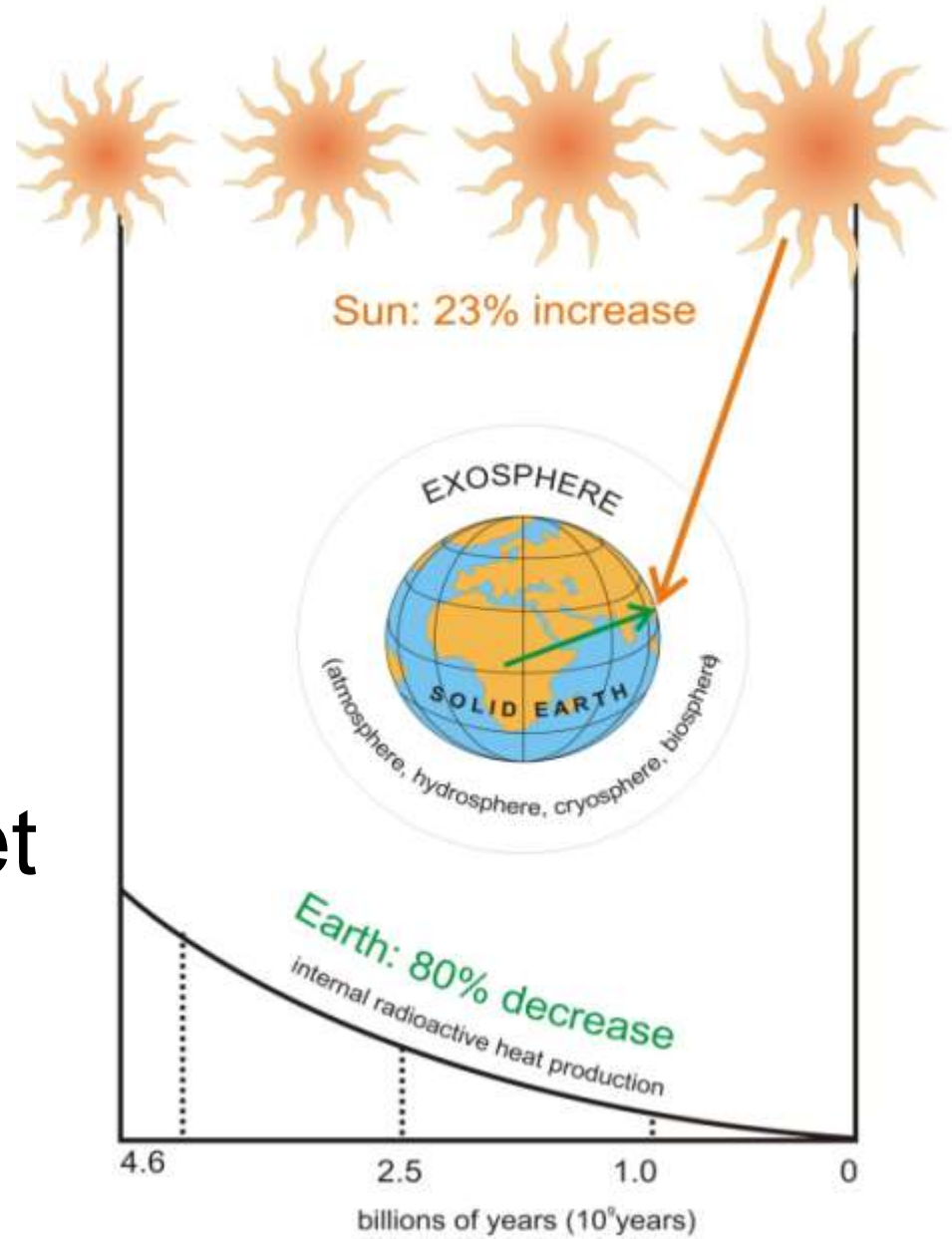


**Missionvale Campus, NMMU, 26 Feb, 2013**

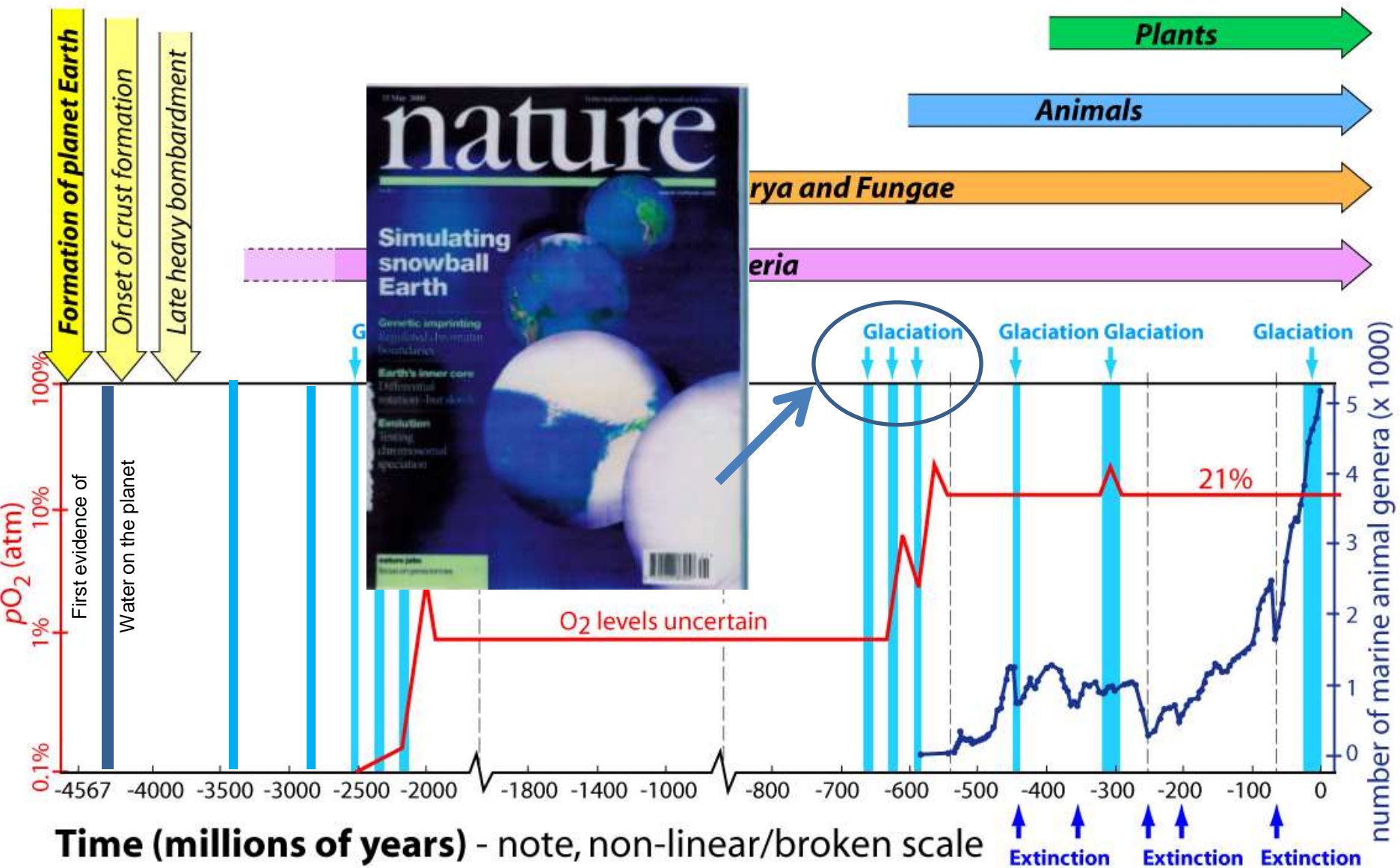
maarten de wit - [www.aeon.org.za](http://www.aeon.org.za)



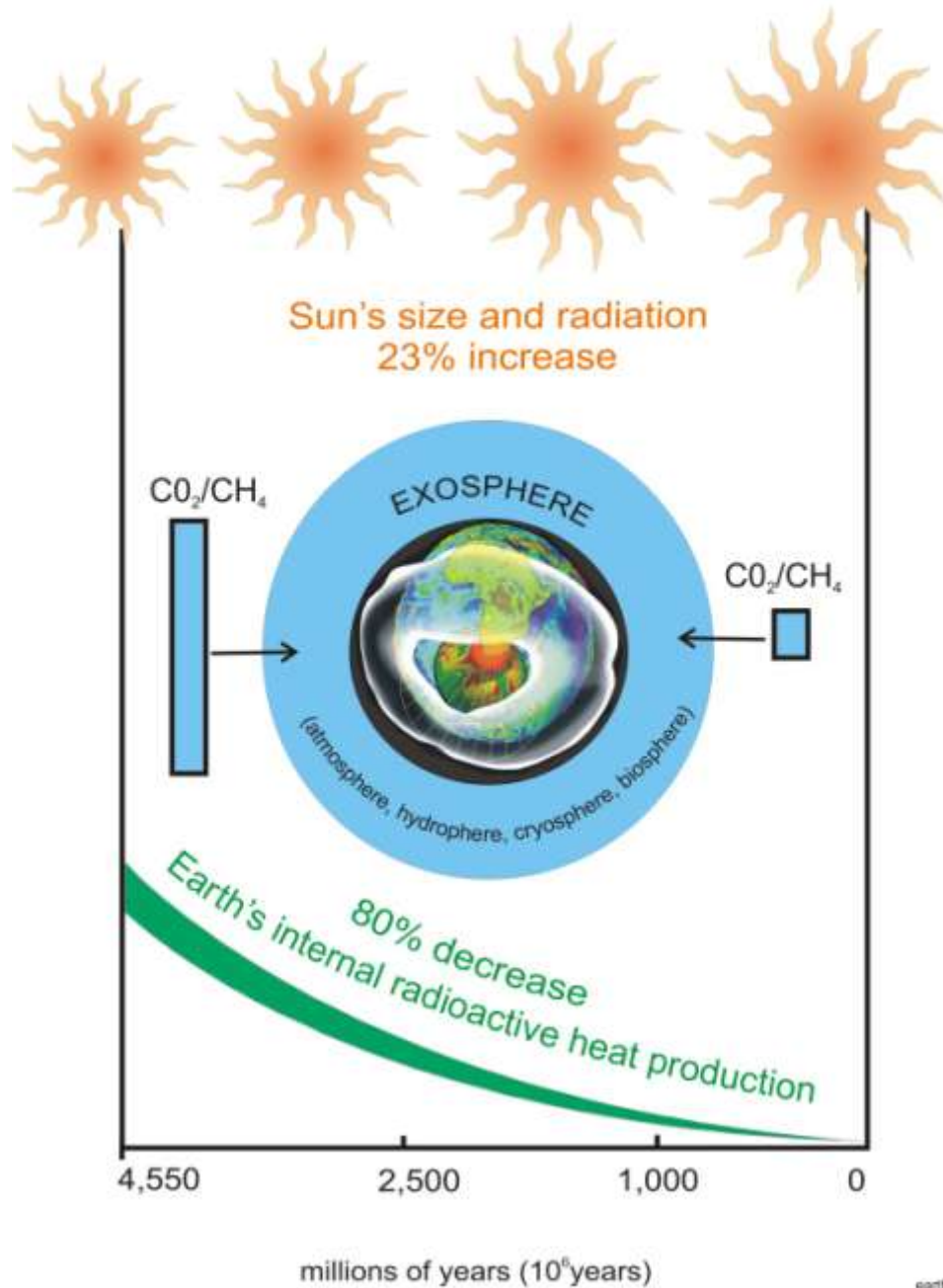
# Energy budget of Sun and Earth



An Evolving planet  
of coevolving  
systems



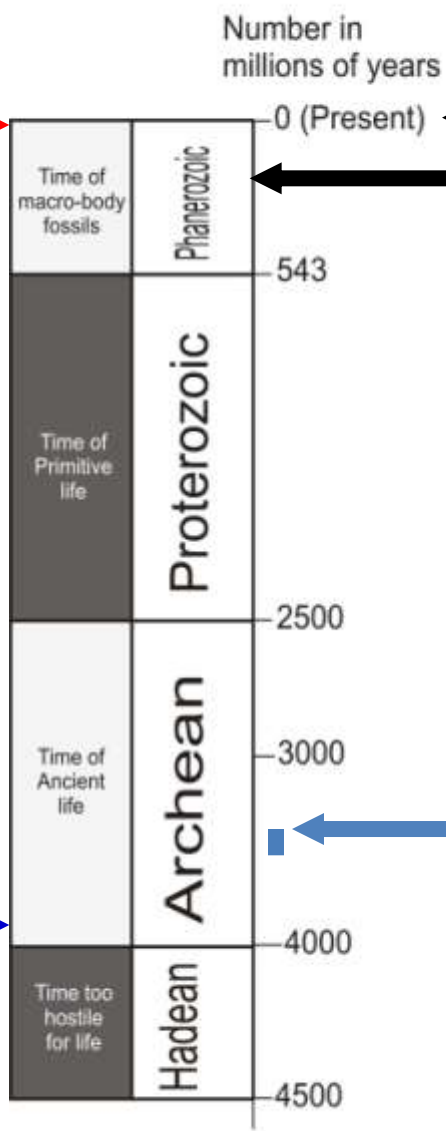
# Energy budget of Sun and Earth



# The Earth has a History with a Deep Time Scale

**Anthropocene**  
**Humans emerge**  
**Sustainable?** →

**Oldest *Homo Sapiens* fossils & symbolic artefacts**  
**Cape Caves: 'Cradle of Culture'**



**Africa emerges as a continent**

**Earth is 4560 million years old**  
**Africa is 120 million years old**  
**Primates: 65 million years ago**  
**Humans: 0.2 million ago**

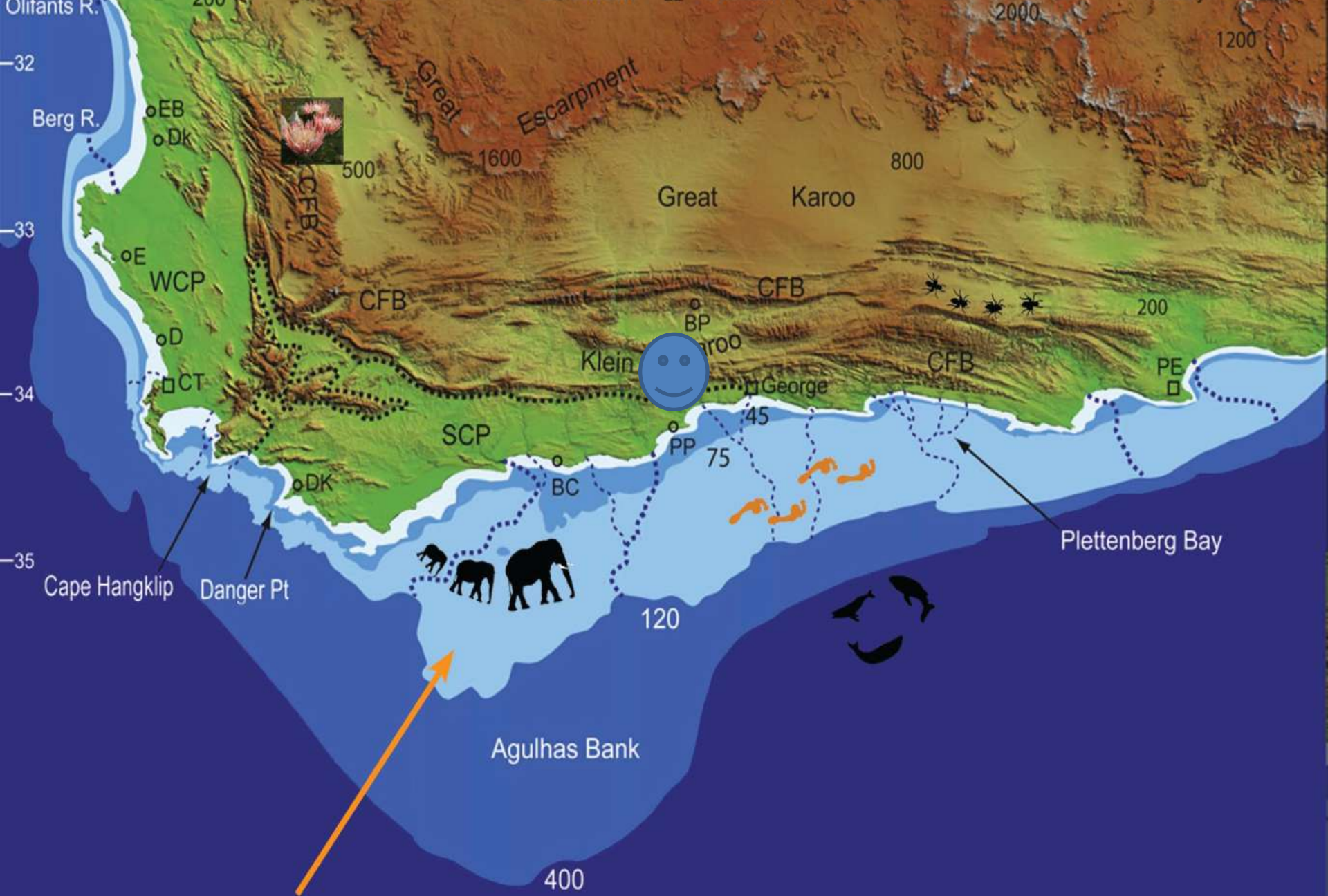
**Oldest fossils of World in Mpumalanga**  
**Makonjwa Mountains: 'Cradle of Life'**

**Sustainable** →  
**Life on Earth**  
**emerges**





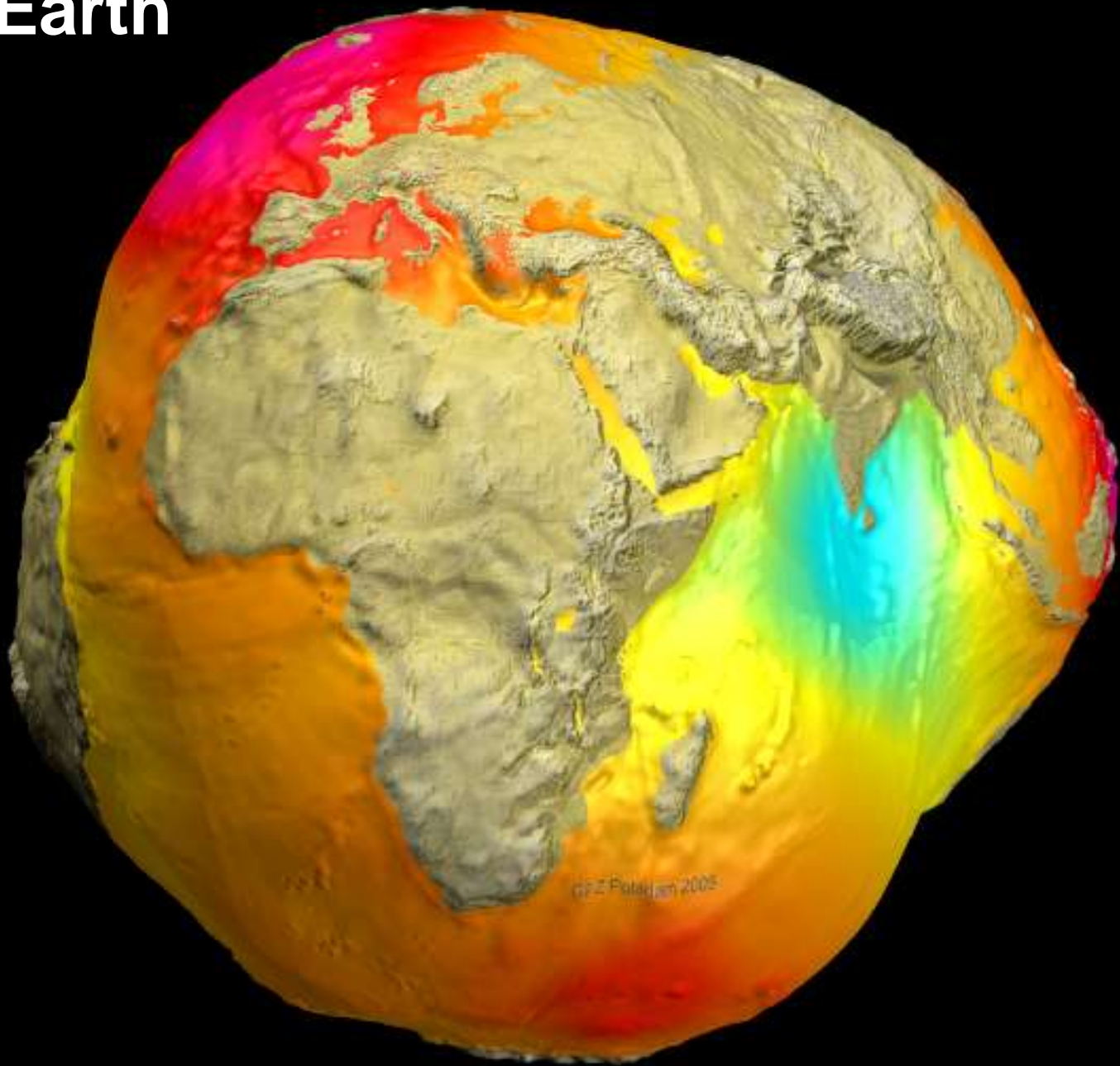




Expanded continental shelf with sea level ca 120 m lower than today;  
 Southern Coastal Plain expanded by ca twice the area of the Kruger National Park

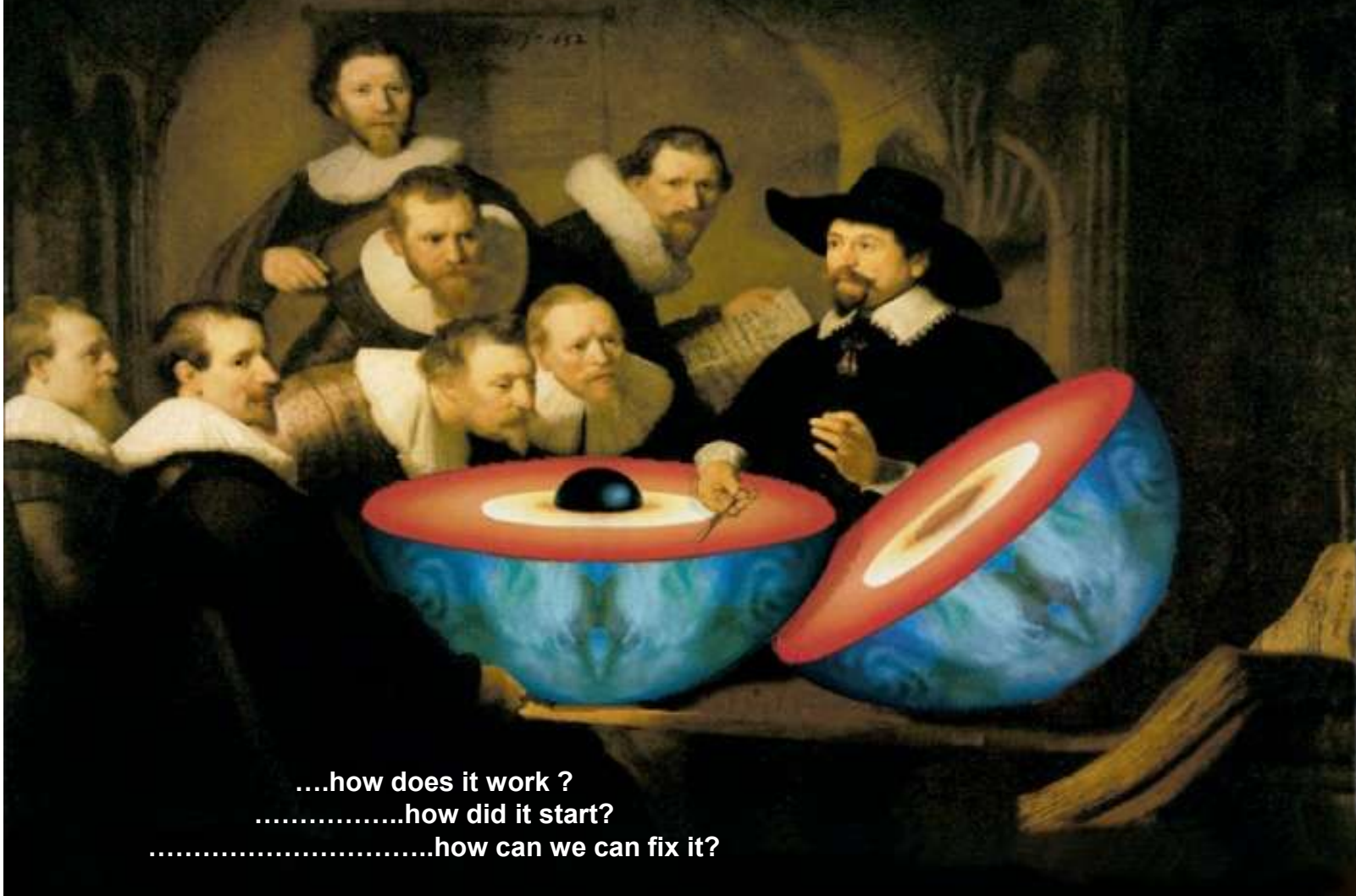
Adapted from Compton (2011)

# Solid Earth



# A Dialogue of Scientists

What's inside.....&

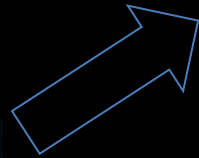


....how does it work ?

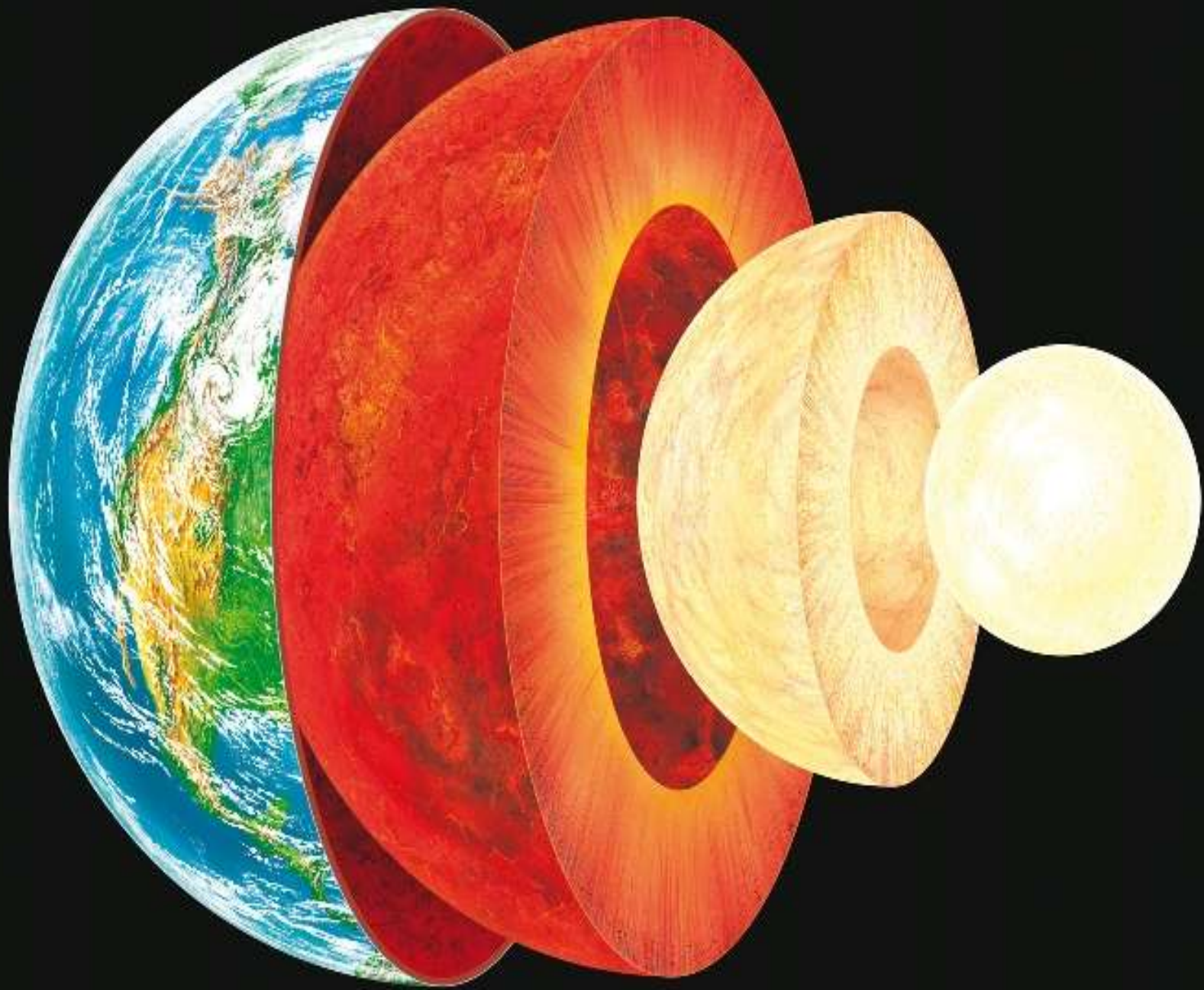
.....how did it start?

.....how can we can fix it?

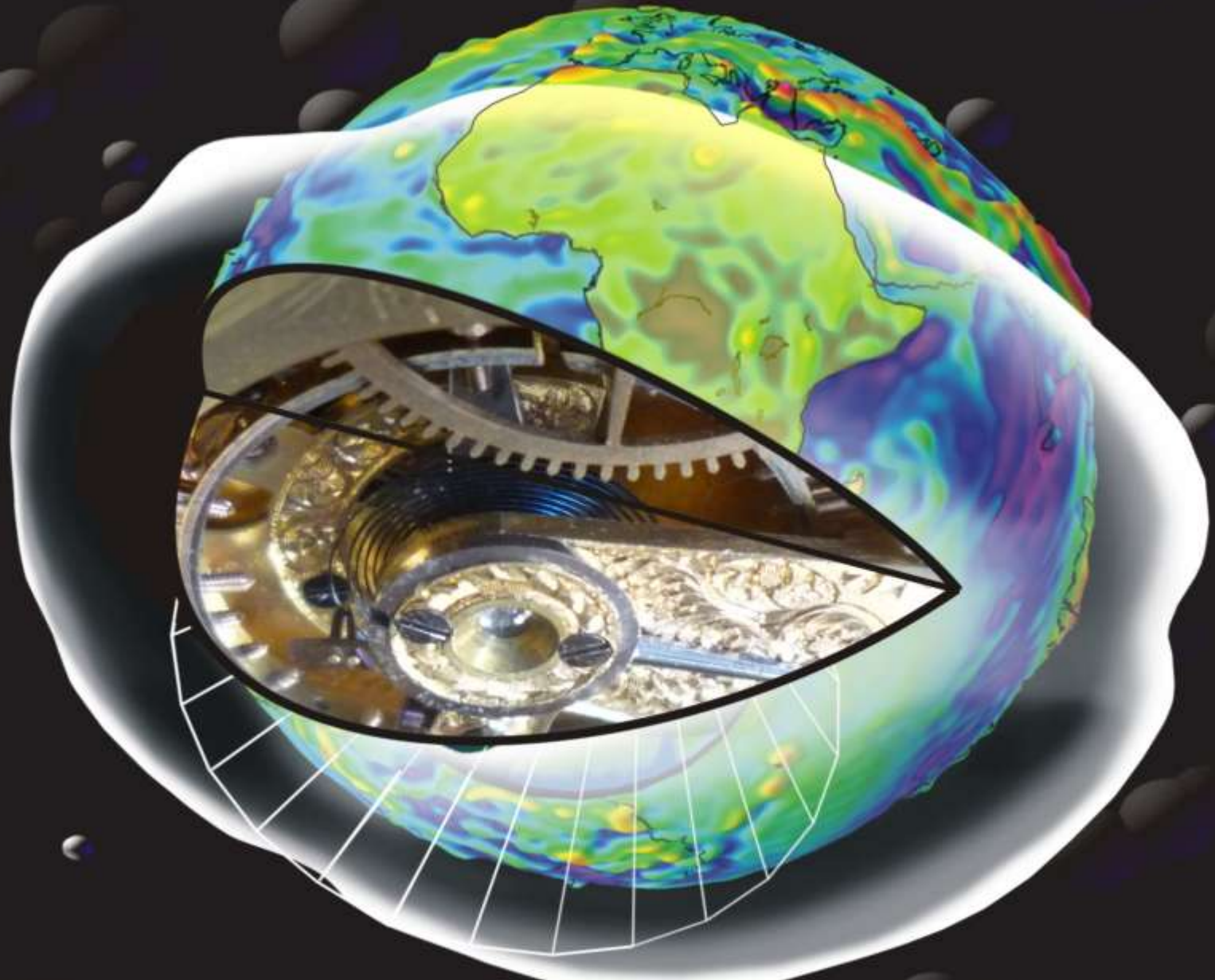
**origins**



**“self-organization”**



Everywhere, everything is on the move





*Destruction.*

Living in the Anthropocene & Facing the Anthropocide

# Dialogue between the HUMAN and NATURAL SCIENCES on a SUSTAINABLE FUTURE



Maarten de Wit, Chair: Earth Stewardship Science  
*Nelson Mandela Metropolitan University*

# Divided Cultures

55 years ago, CP Snow argued that the **failure of science** and the **humanities** to converse was **disastrous for society**:

‘It is the perceived need for intense specialization of any kind in history or physics, in languages or biology that needs to be tackled’.

CP Snow also foresaw **applied science and engineering** as holding the key to a humane future, in terms of a rational understanding of nature but also as the **only force** that could tackle the problems of well-being in developed and developing countries

# 55 years on

- *In almost all countries, a gulf of understanding has opened up by the time students enter university”*  
(CP Snow, 1959)
- *“The real enemy of understanding is not just the ‘two cultures’ but specialization in all disciplines”*  
(M Kemp, 2009)

**Why are we still debating this?**

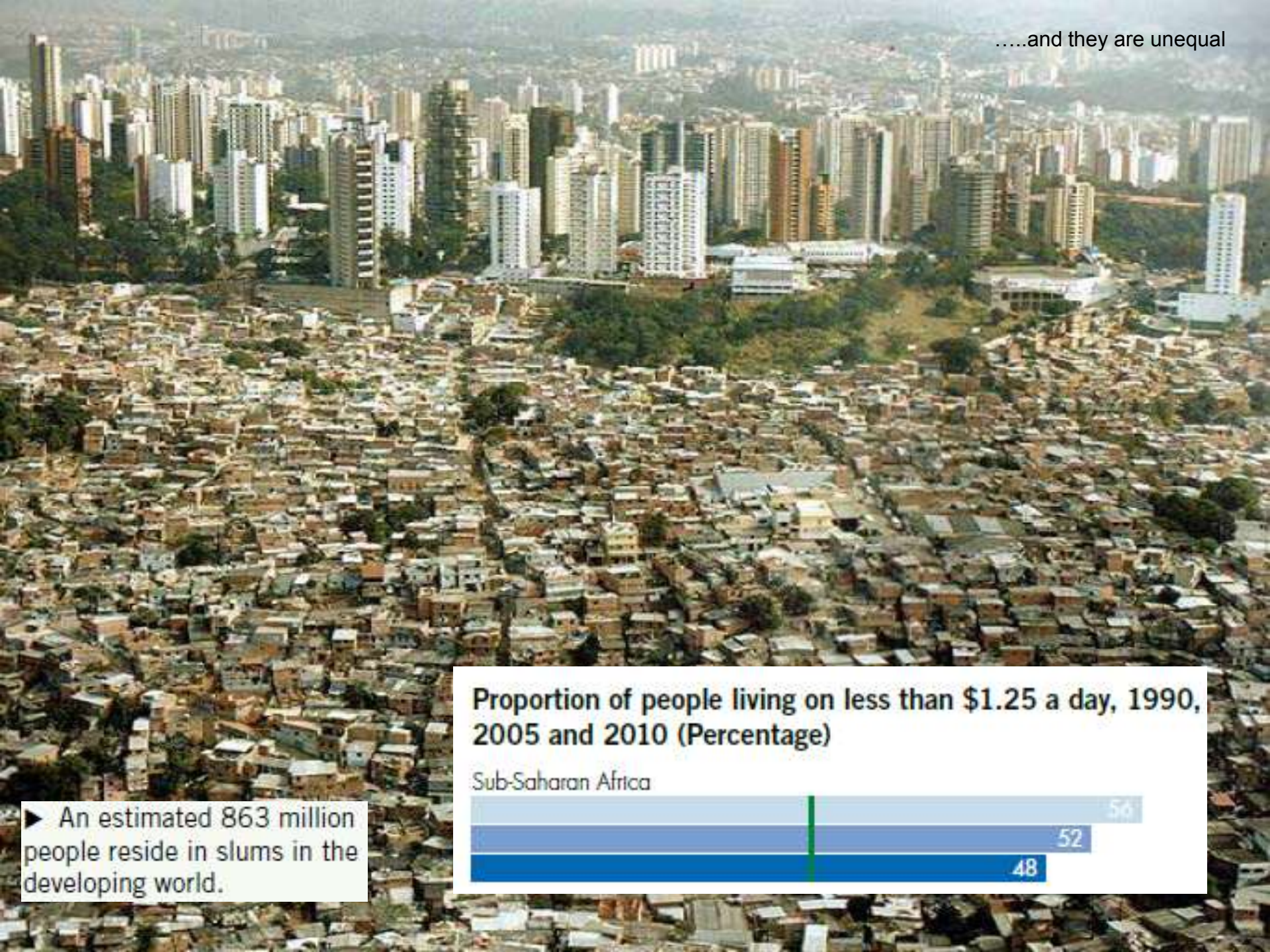
# Colonization of Nature

Since the beginning of the 19th Century, by its own growing activities, Mankind opened a new geological era: **the Anthropocene.**

We are clearly affecting climate and can deliberately do so.



.....and they are unequal

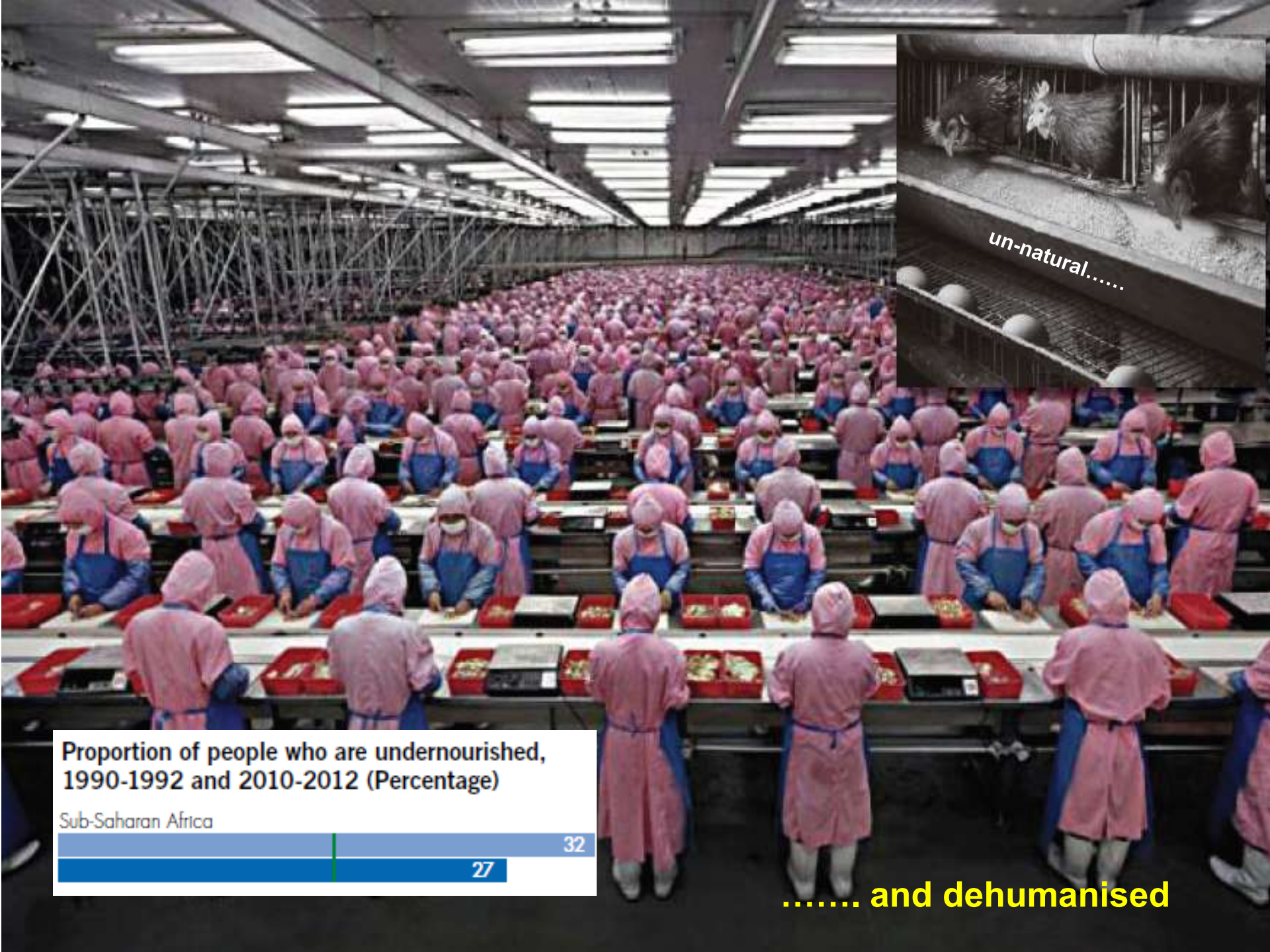


**Proportion of people living on less than \$1.25 a day, 1990, 2005 and 2010 (Percentage)**

Sub-Saharan Africa



► An estimated 863 million people reside in slums in the developing world.



**Proportion of people who are undernourished,  
1990-1992 and 2010-2012 (Percentage)**

Sub-Saharan Africa



**..... and dehumanised**



# What's gone wrong?

*Housing development in Mexico City—yes, it's real.*

# This is not the work of ignorant people...

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It is, rather, largely the result of the work of the "most highly educated" workforce in the history of humankind, people with....

BAs.....

BSs.....

MEs.....

Ph.Ds.....

LLBs.....

MBAs, etc.





**Cartesian science and its emphasis on *parts* instead of *wholes* replaced a spiritual view of a 'whole' universe with that of a fragmented and mechanized one.**

**A collection of objects...**

# Physical Laws of the Universe.....

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Don't apply here...

Only apply here...



“Earth Stewardship Science”  
& new discourse for sustainable living, green activism  
and citizen science in the Anthropocene”



Maarten de Wit, Chair: Earth Stewardship Science  
*Nelson Mandela Metropolitan University*

# Accelerated progress and bolder action are needed in many areas

Environmental sustainability is under severe threat, demanding a new level of global cooperation

The growth in global emissions of carbon dioxide (CO<sub>2</sub>) is accelerating, and emissions today are more than 46 per cent higher than their 1990 level.

Forests continue to be lost at an alarming rate.

Overexploitation of marine fish stocks is resulting in diminished yields.

More of the earth's land and marine areas are under protection, but birds, mammals and other species are heading for extinction at an ever faster rate, with declines in both populations and distribution.

# What have we done?

## Mortgaged the future?

- Explosion of debt
- Next generation less well off?
- Intergenerational debt
- Unaffordable university education and health
- Borne bankrupt
- What will we do for the next ½ century?
- What should we do before 2020?

## **Technical, social and environmental challenges you and your kids will face for the next 50 years:**

- Demand for their new skills will vastly outpace your capacity to teach them.
- Half-lives of your/their skills are shrinking.
- Mass unemployment is endemic.
- Private employers will not take on their labour as an act of charity.
- Their collective purposes will contain competing objectives.
- Your/Their development is linked to an exponential knowledge-curve based on creativity-technology.
- Their communication systems, language and art-forms metamorphose faster than yours.
- Our environments are metastable

# Next generation standards

- Virtually all Africa's (the world's) most urgent problems require collective, integrative action – be it environmental protection, energy needs, infrastructure, water/food security, financial system overhaul, run-away inequality, well-being or basic research.
- Why then do universities continue to separate their students and their research and place them in silos?
- Is continuation along this path the best way to train them to address increasingly complex problems?

# Living in the Anthropocene

We now live in the Anthropocene Era. We are still only beginning to comprehend how much radical re-thinking we will need to understand the forces with which we are shaping and transforming the planet and how to best to manage them. The scale of forces this time is planetary – the time scale a century or more, the stakes are what we might call civilization – and it is all taking place at the headlong speed of self-accelerating human need, greed, technology and environmental turbulence. And it is not the earth, not life, but humans who are in trouble, because whilst we might know what things cost, we mostly have no idea what they are worth.

We need a new holistic approach to stimulate inquisitiveness, self-motivation, creativity, knowledge retention and responsibility of the learner in the school, university and beyond..... HOW?

**Fundamental Requirement:  
understanding the evolving dynamics and complexity of systems**

# STEWARDSHIP of SYSTEMS

- How nature works
- How earth works
- How societies work
- How interactive systems work
- How systems collapse

- How do things emerge?
- How does collaboration emerge
- How does inequality emerge?
- How do things fall apart — *dissipate*?
- How does complexity emerge and collapse?
- What are the risks?

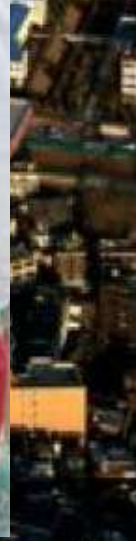
There is no system without evolution

Self organized system  
how do group skills emerge?



# Population... issues are not so simple anymore

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# Interactive Natural and Social Adaptive Systems

The aim of *Earth Stewardship Science* is to search for something fundamental about the interactive dynamics of complex natural and social systems, about how such complex systems emerge and dissipate, and how systems sometimes bounce back, yet at other times take unexpected turns when confronted with internal and external forces?

*Earth Stewardship Science* will explore this in a trans-disciplinary way, using examples taken from our planet, its ecosystems, its organic life, and human cultures, to learn more about interactive processes with their myriads of feedbacks.

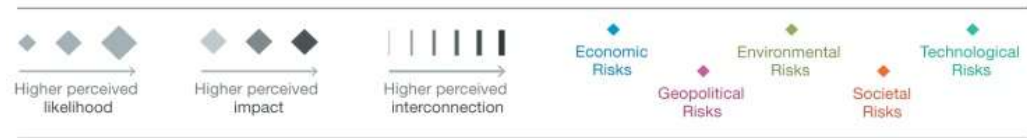
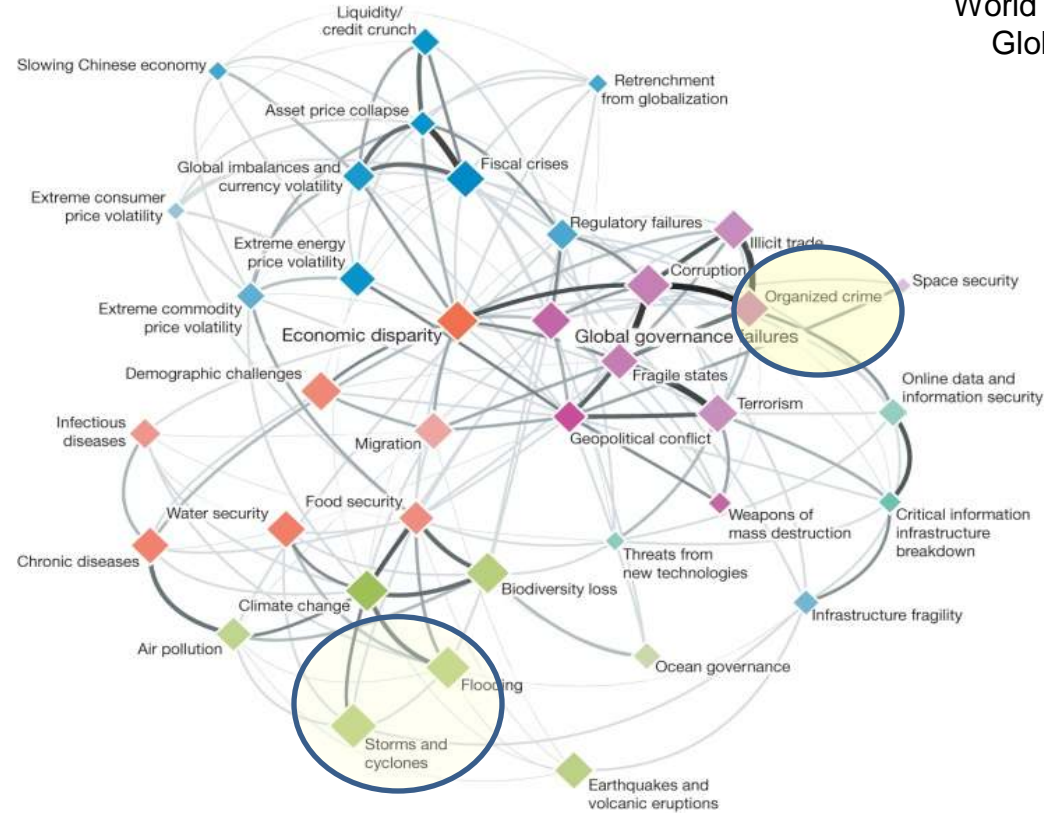
New learning and teaching  
tools

Networks,  
communications



# Risks Interconnection Map 2011 illustrating systemic interdependencies in the hyper-connected world we are living in.

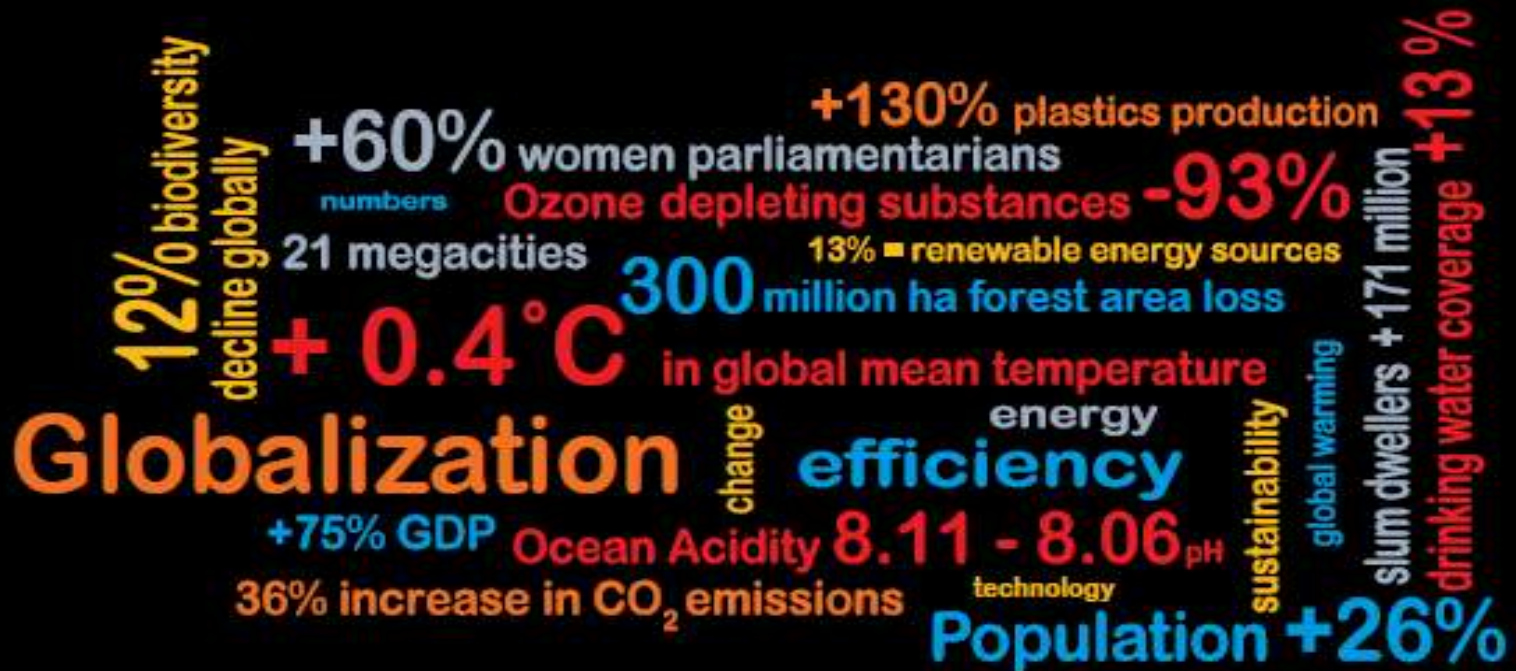
World Economic Forum  
Global Risks 2011



D Helbing *Nature* **497**, 51-59 (2013)  
doi:10.1038/nature12047

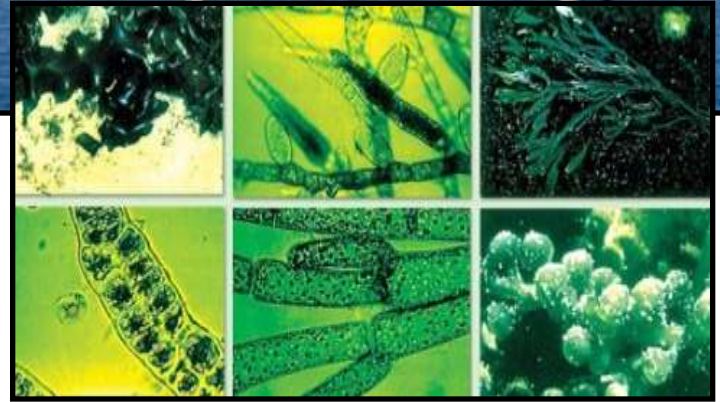
# KEEPING TRACK

of our **evolving** environment

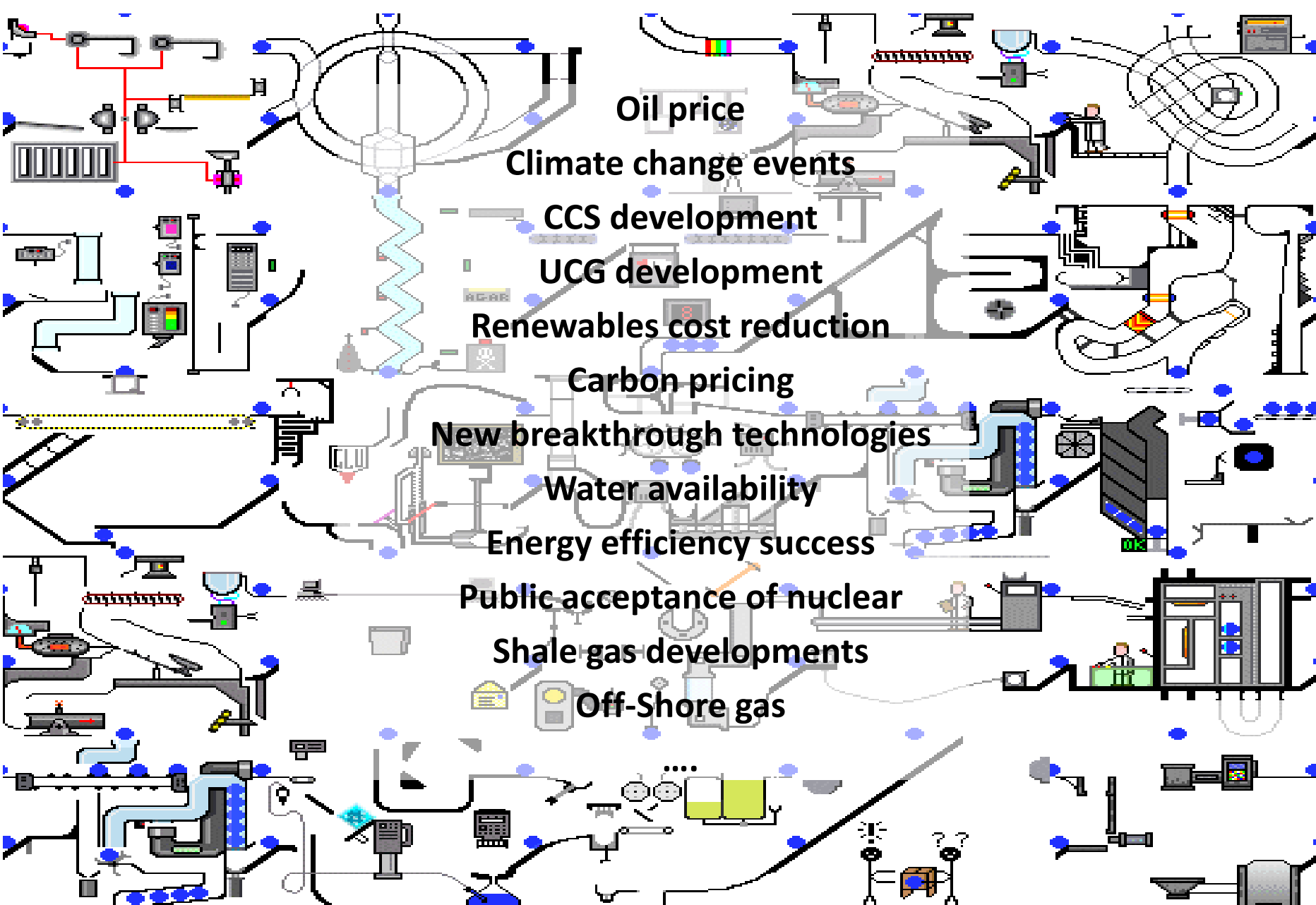


From Rio to Rio+20 (1992-2012)

# Where will our energy come from?

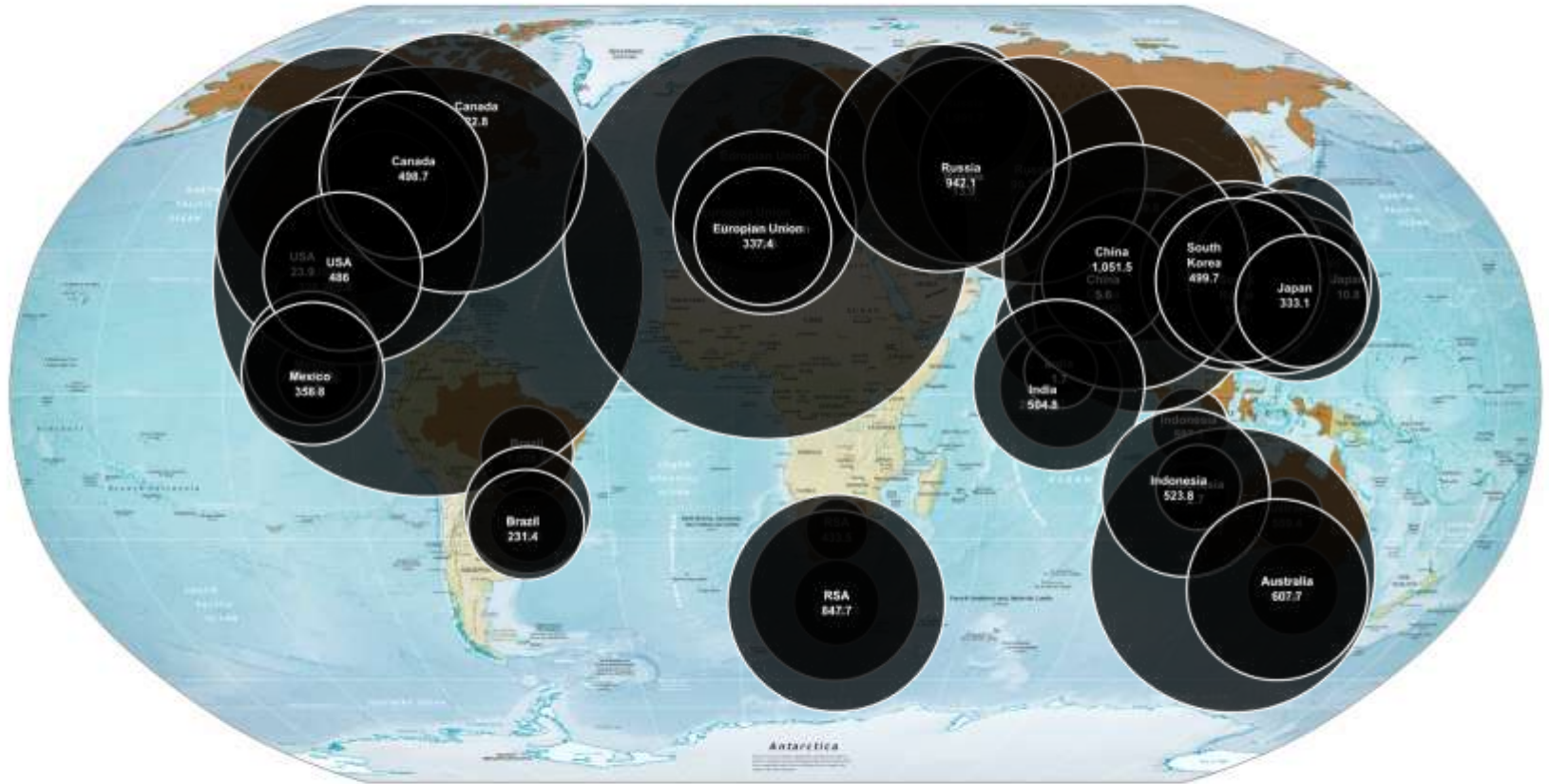


# How will this all work out ?



# CO<sub>2</sub> Emissions (tons per million dollars)

(tons per million international dollars)




**CO<sub>2</sub> Emissions**

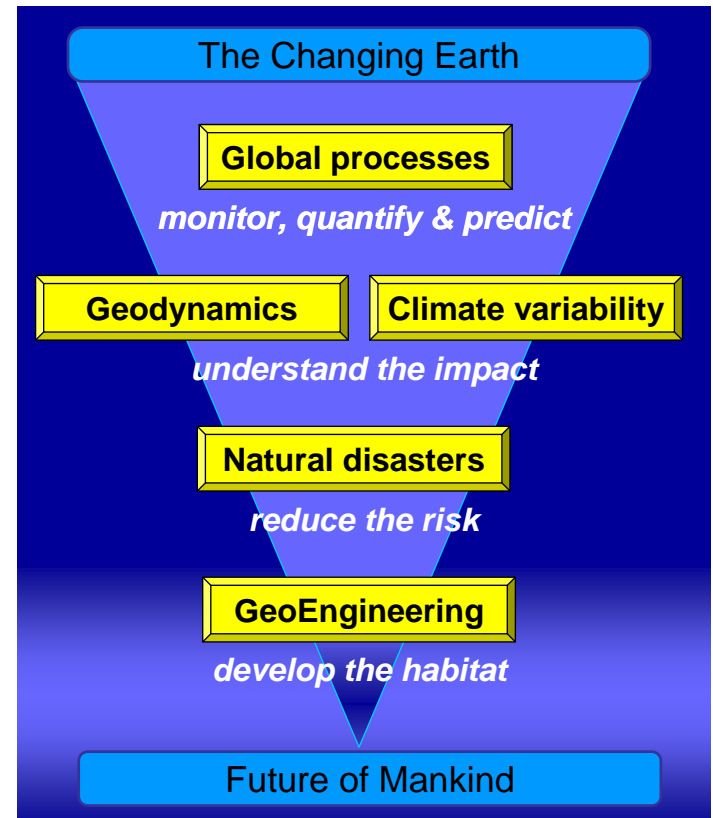
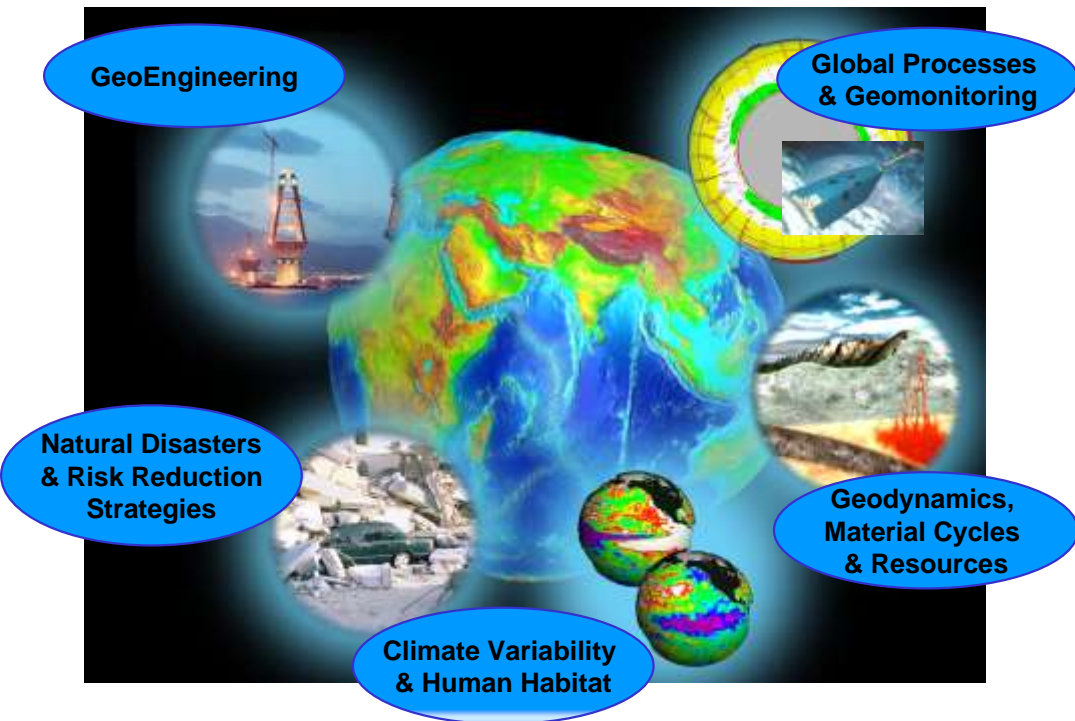

**Denotes major international economies**

# Globally networked risks and how to respond

Today's strongly connected, global networks have produced highly interdependent systems that we do not understand and cannot control well. These systems are vulnerable to failure at all scales, posing serious threats to society, even when external shocks are absent. As the complexity and interaction strengths in our networked world increase, wo/man-made systems can become unstable, creating uncontrollable situations even when decision-makers are well-skilled, have all data and technology at their disposal, and do their best. To make these systems manageable, a fundamental redesign is needed.

**A 'Global Systems Science' or 'Earth Stewardship Science'**, might create the required knowledge and paradigm shift in thinking, collaboration and evolving dialogue.

# „How to manage a habitable planet“



***Living systems and the changing Earth***

THE INEVITABLE

# EXECUTIVE SUMMARY:

Crutzen Somewhat Simplified

Seitz Somewhat Simplified

MICROBUBBLES INJECTED  
INTO HYDROSPHERE

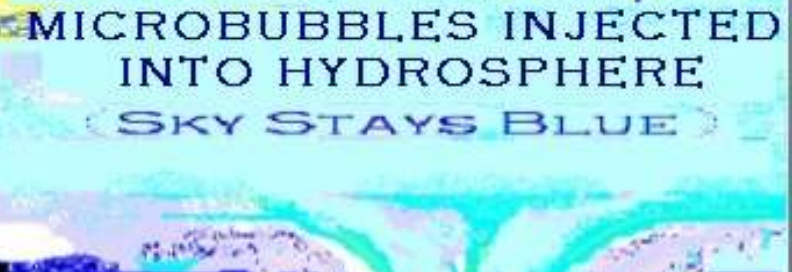
(SKY STAYS BLUE)



AEROSOLS INJECTED  
INTO STRATOSPHERE

(SEA STAYS DARK)

SKY GETS LIGHTER



WATER GETS BRIGHTER

Plan B

# Geo-Engineer Climate Change Inject sulfate aerosols into the atmosphere

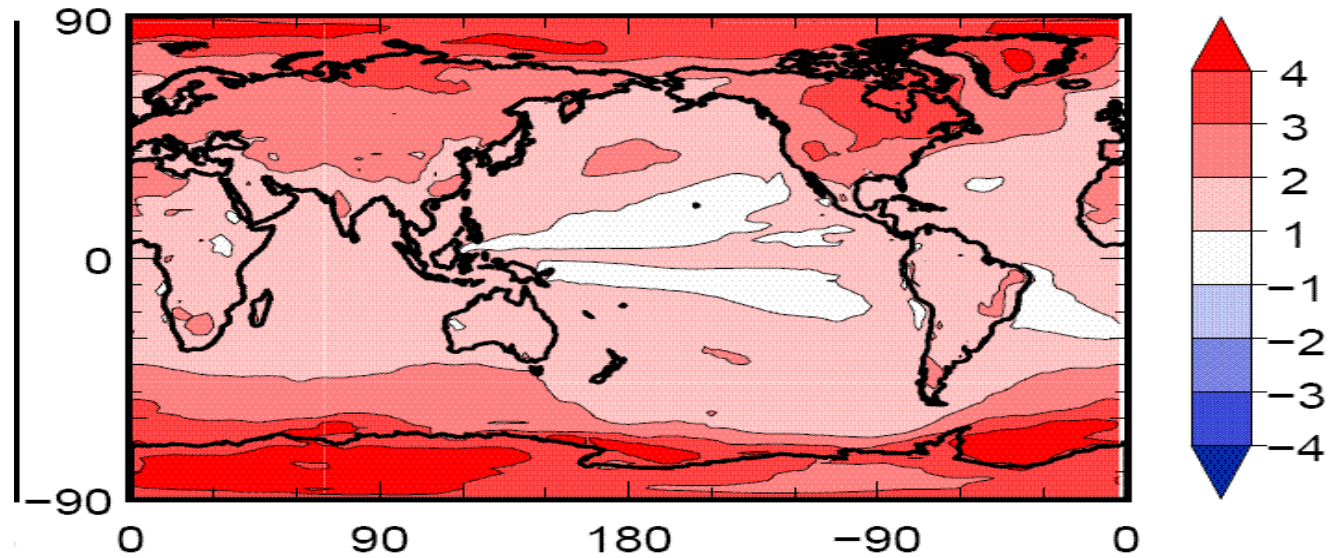


more geo-mimicry

**Paul Crutzen**

# Annual Average Surface Temperature

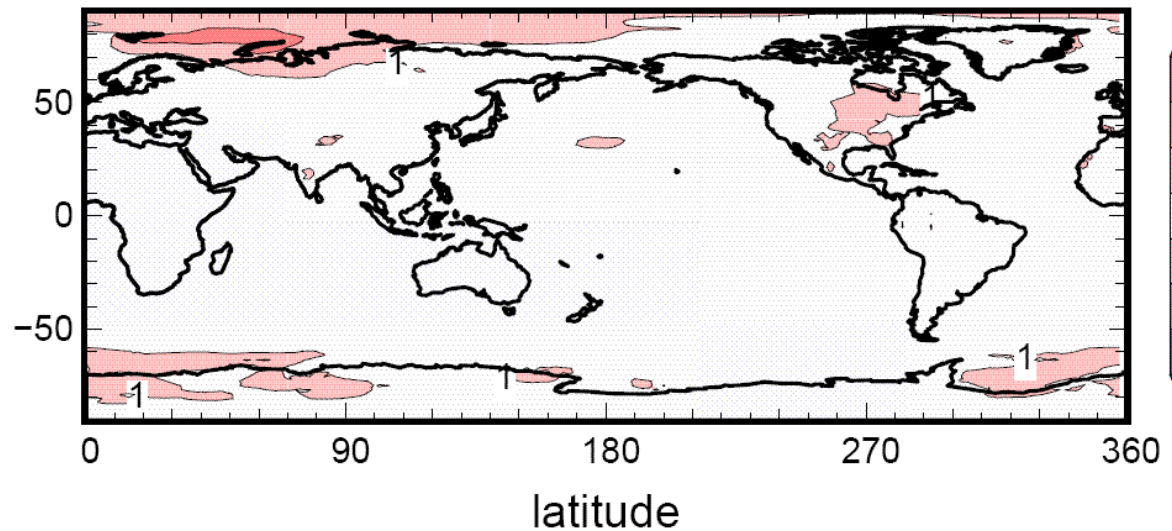
2xCO<sub>2</sub> -  
Control



A giant airconditioner

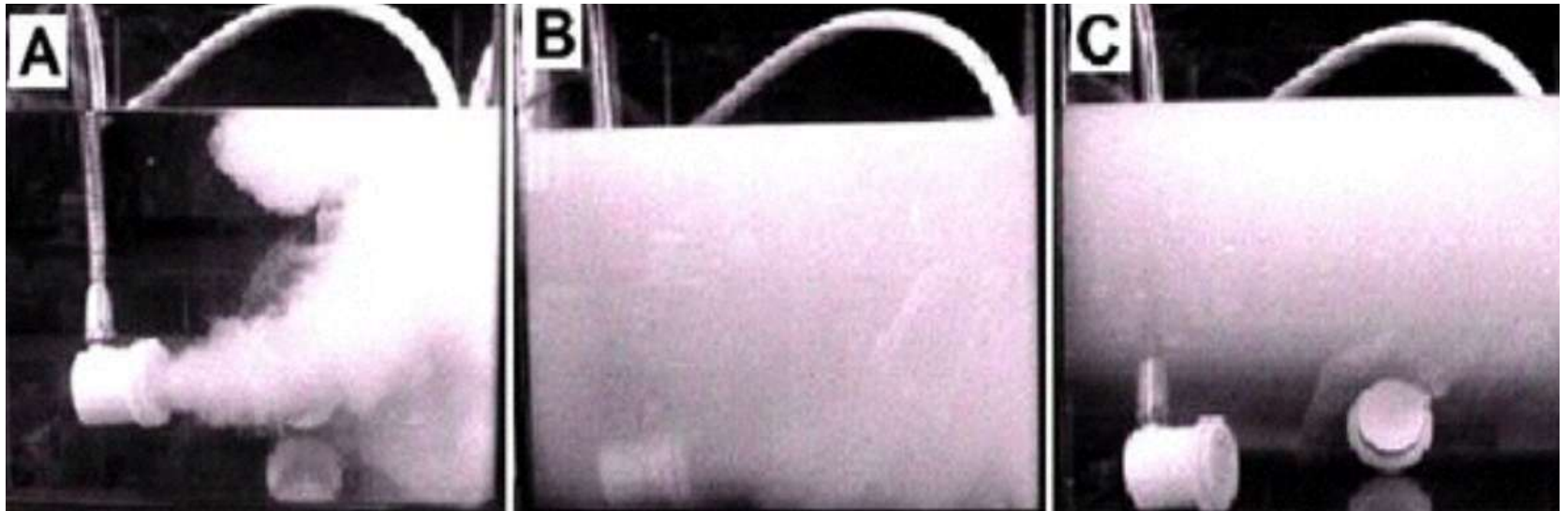
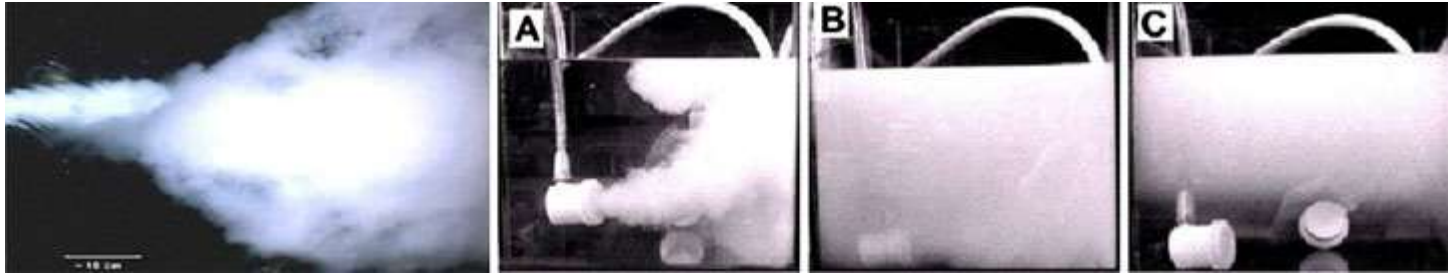
abs diff  
level stats: min -0.65 max 2.5 avg 0.35

Geo-  
SO<sub>4</sub>/2xCO<sub>2</sub> -  
Control



# Making clouds underwater

WATER SUPERSATURATED WITH COMPRESSED AIR  
BEING RELEASED THROUGH A VORTEX NOZZLE



START

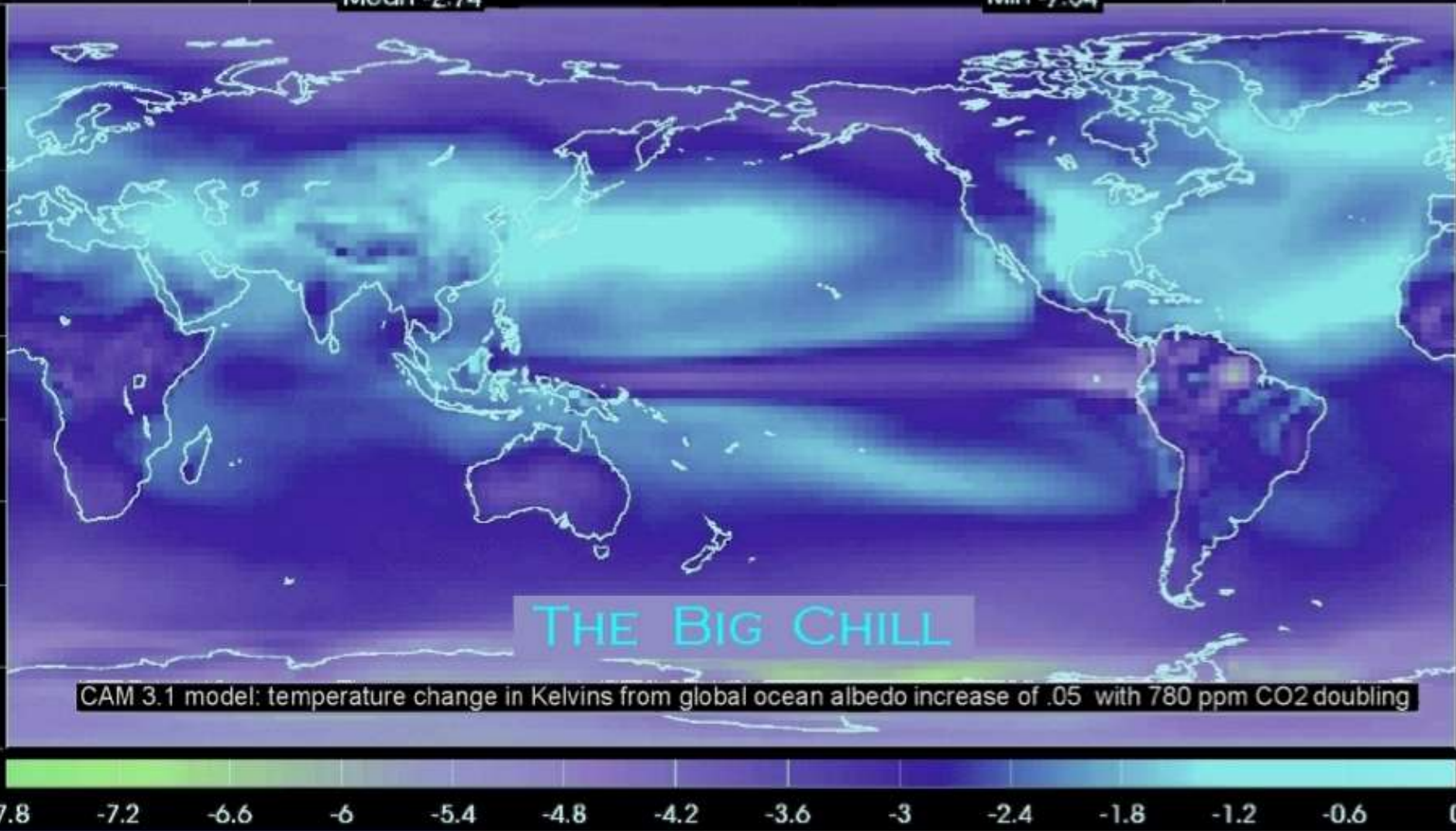
STOP

2 MINUTES LATER

**Local can add up to global: GCM runs based on hydrosol physics show a 5% ocean albedo rise more than offsets warming from doubled CO2**

Mean -2.74

Min -7.54



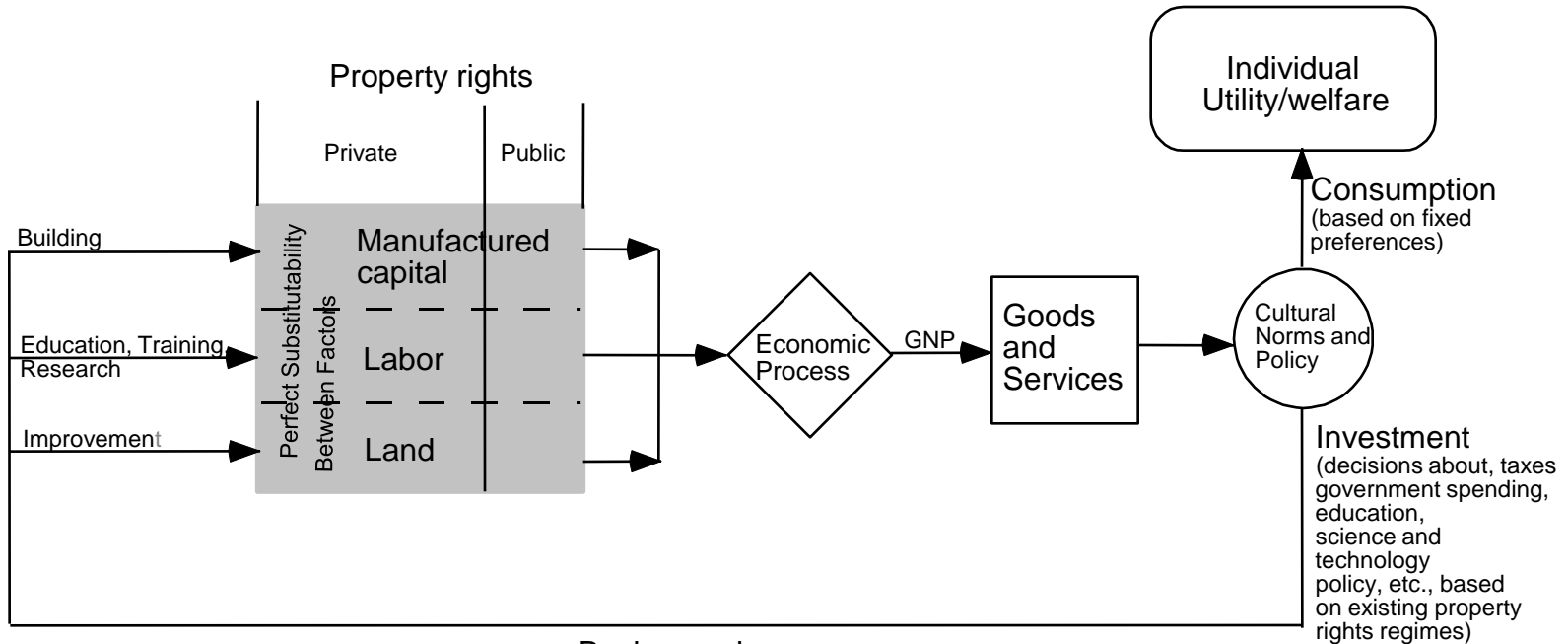
# Risk, systemic risk and hyper-risk

Globalization and technological revolutions are changing our planet. Today we have a worldwide exchange of people, goods, money, information, and ideas, which has produced many new opportunities, services and benefits for humanity. At the same time, however, the underlying networks have created pathways along which dangerous and damaging events can spread rapidly and globally. This has increased systemic risks.

**The related societal costs are huge.**

# "Empty World" Model of the Economy

Based on a simplistic view of capital and narrow definition of GDP



Basic premises:

More is always better

The economy can grow forever

Private property is always best

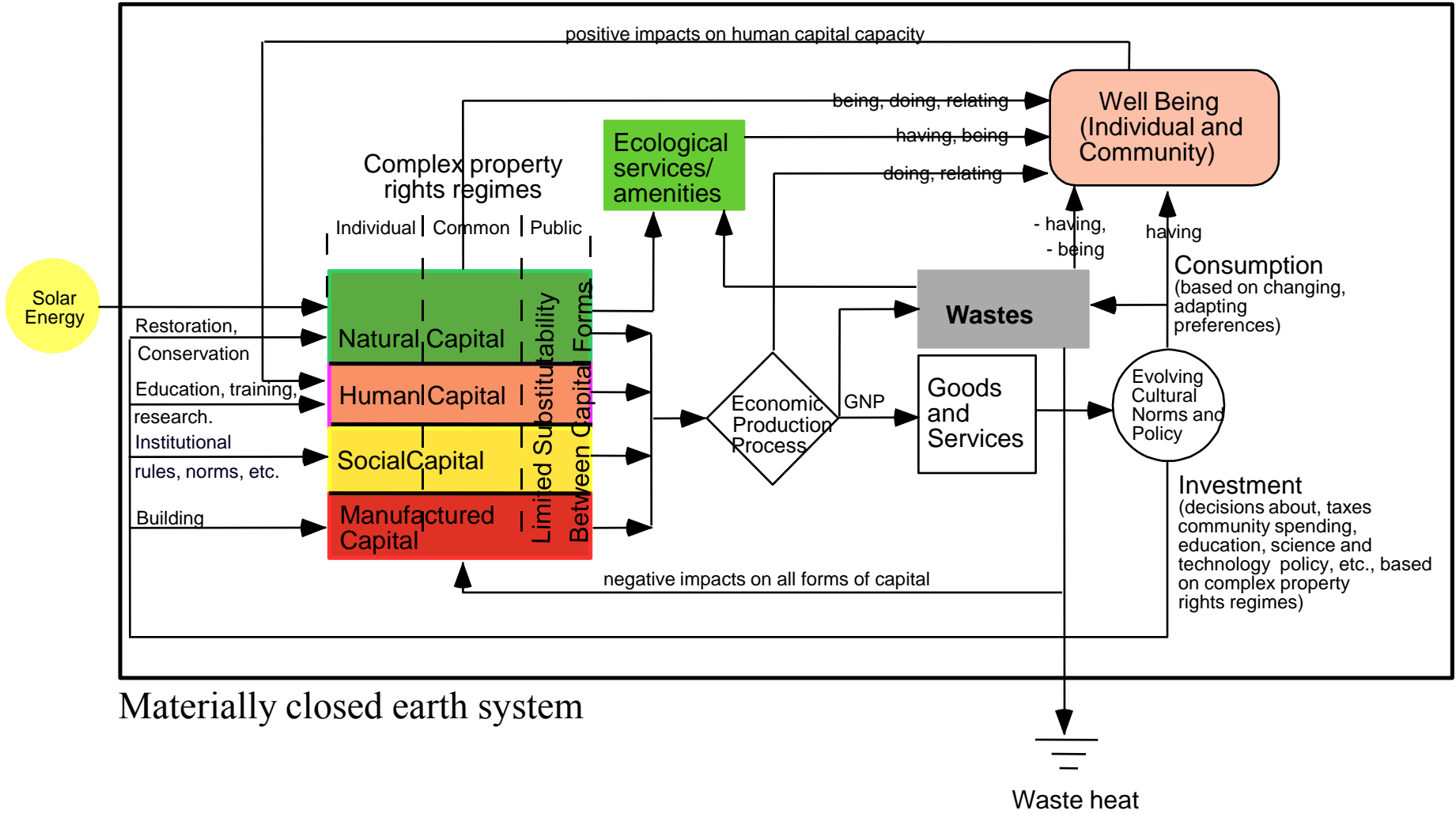
**This has been tried and should now be discarded**



# Ecological Economics and the War on Externalities

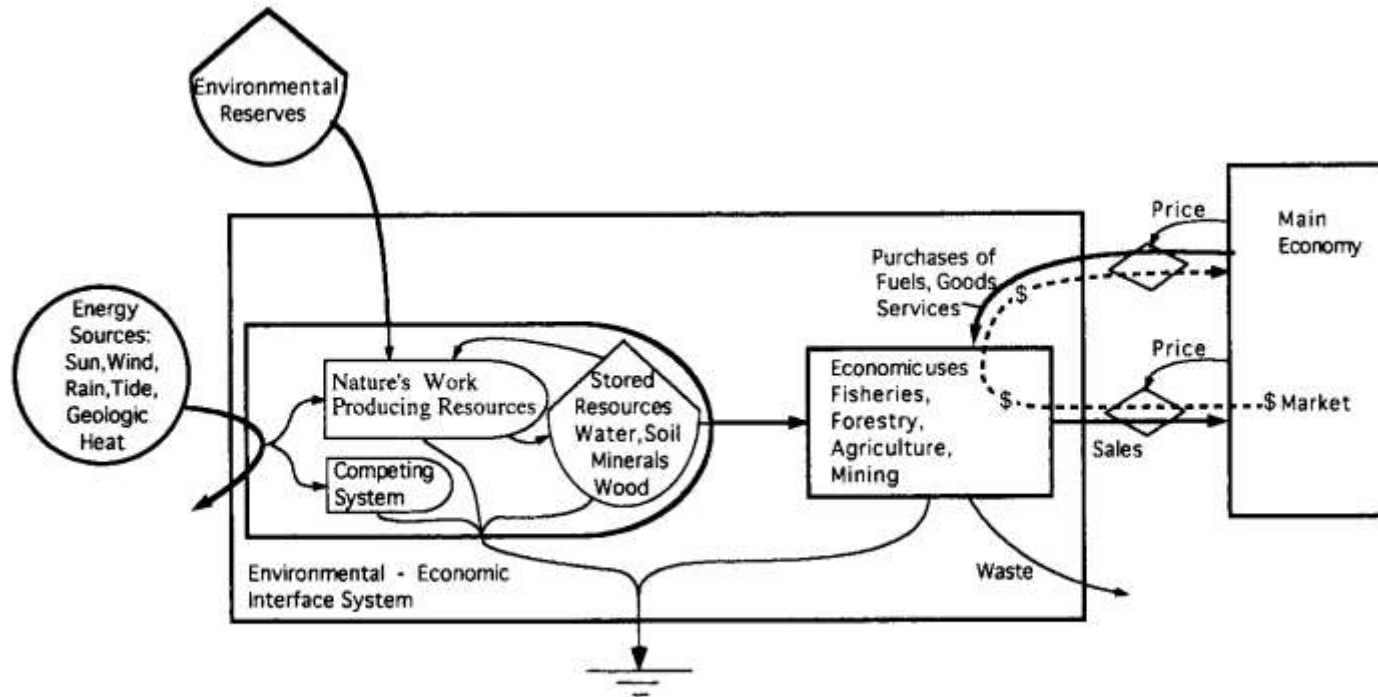
Inculcating the value of nature into our economy and commerce:

**EARTH IS A GOODS AND SERVICES PROVIDER, BUT NOT A BOTTOMLESS PIT OF FREEBEEES**



# concepts and definitions ...

## Environmental - Economic Interface System





Can we learn  
to mimic  
nature?



# Earth Stewardship Science

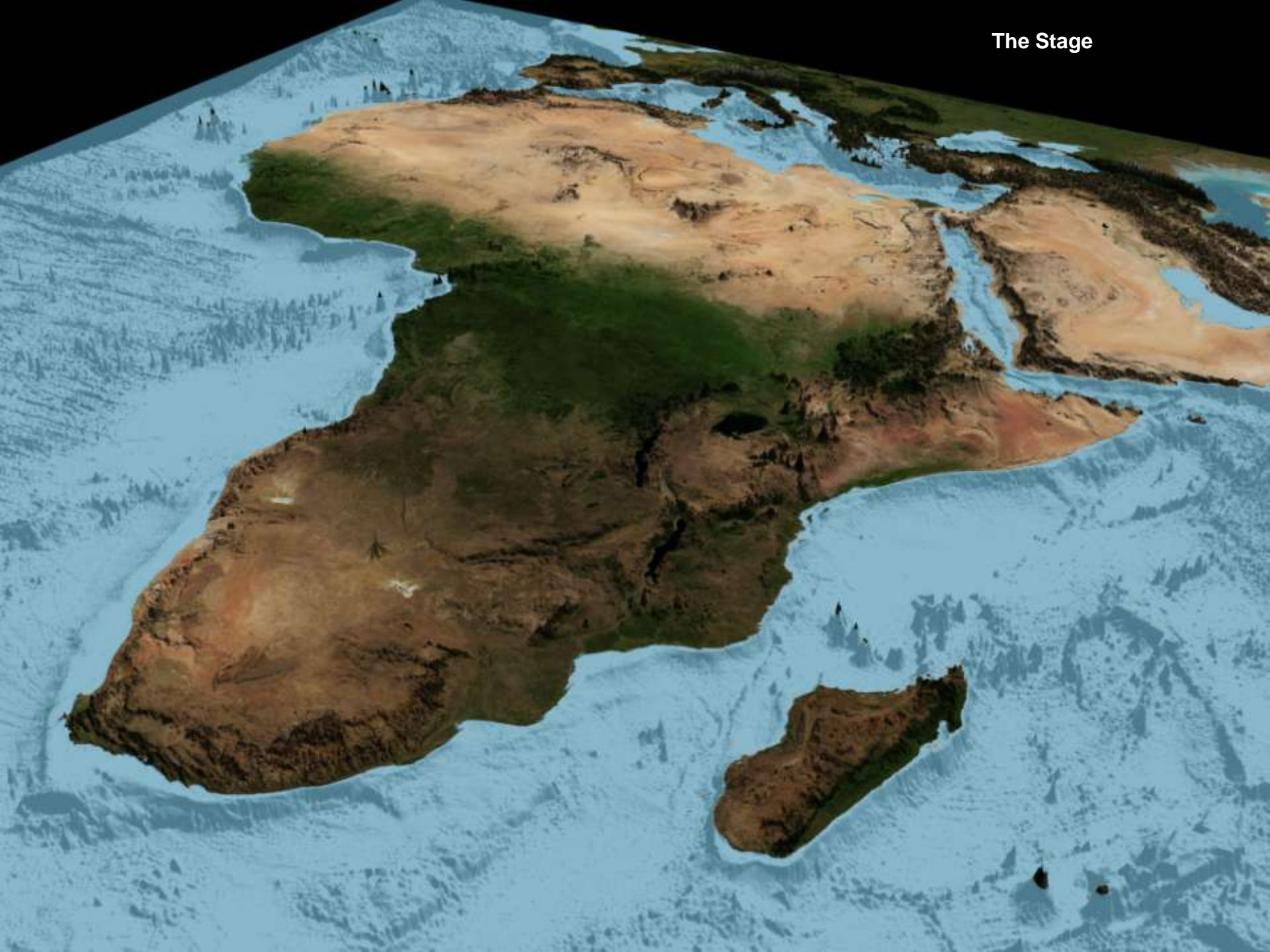
with everyone a stakeholder



## The stark facts



- Stewardship: living in the anthropocene
- Systems: how they emerge, work and dissipate
- Learning about the past to plan for the future
- Interdisciplinary thinking and implementation
- Resources and Values
- Stewardship and Culture in Africa



# The True Size of Africa

A small contribution in the fight against rampant *Immappancy*, by Kai Krause

Graphic layout for visualization only ( some countries are cut and rotated )  
But the conclusions are very accurate: refer to table below for exact data

COUNTRY	AREA x 1000 km <sup>2</sup>
China	9.597
USA	9.629
India	3.287
Mexico	1.964
Peru	1.285
France	633
Spain	506
Papua New Guinea	462
Sweden	441
Japan	378
Germany	357
Norway	324
Italy	301
New Zealand	270
United Kingdom	243
Nepal	147
Bangladesh	144
Greece	132
<b>TOTAL</b>	<b>30.102</b>
<b>AFRICA</b>	<b>30.221</b>



In addition to the well known social issues of *illiteracy* and *innumercy*, there also should be such a concept as "*immappancy*", meaning *insufficient geographical knowledge*.

A survey with random American schoolkids let them guess the population and land area of their country. Not entirely unexpected, but still rather unsettling, the majority chose "*1-2 billion*" and "*largest in the world*", respectively.

Even with Asian and European college students, geographical estimates were often off by factors of 2-3. This is partly due to the highly distorted nature of the predominantly used mapping projections (such as *Mercator*).

A particularly extreme example is the worldwide misjudgement of the true size of *Africa*. This single image tries to embody the massive scale, which is larger than the *USA*, *China*, *India*, *Japan* and *all of Europe*..... combined!

## Top 100 Countries

Area in square kilometers, Percentage of World Total  
Sources: Britannica, Wikipedia, Almanac 2010

	AREA km <sup>2</sup>	%	
1	Russia	17.098.242	11,50
2	Canada	9.984.670	6,70
3	China	9.596.961	6,40
4	United States	9.629.091	6,40
5	Brazil	8.514.877	5,70
6	Australia	7.692.024	5,20
7	India	3.287.263	2,30
8	Argentina	2.780.400	2,00
9	Kazakhstan	2.724.900	1,80
10	Sudan	2.505.813	1,70
11	Algeria	2.381.741	1,60
12	Congo	2.344.858	1,60
13	Grenland	2.166.086	1,50
14	Saudi Arabia	2.149.890	1,40
15	Mexico	1.964.375	1,30
16	Indonesia	1.860.360	1,30
17	Libya	1.759.540	1,20
18	Iran	1.628.750	1,10
19	Mongolia	1.564.100	1,10
20	Peru	1.285.216	0,88
21	Chad	1.284.000	0,88
22	Niger	1.267.000	0,85
23	Angola	1.246.700	0,85
24	Mali	1.240.192	0,83
25	South Africa	1.221.037	0,82
26	Colombia	1.141.748	0,76
27	Ethiopia	1.104.300	0,74
28	Bolivia	1.098.581	0,74
29	Mauritania	1.025.520	0,69
30	Egypt	1.002.000	0,67
31	Tanzania	945.087	0,63
32	Nigeria	923.788	0,62
33	Venezuela	912.590	0,61
34	Namibia	824.116	0,55
35	Mozambique	801.590	0,54
36	Pakistan	796.095	0,53
37	Turkey	783.562	0,53
38	Chile	756.102	0,51
39	Zambia	752.212	0,51
40	Myanmar	676.578	0,45
41	Afghanistan	652.090	0,44
42	Somalia	637.657	0,43
43	France	632.834	0,43
44	C. African Rep	622.984	0,42
45	Ukraine	603.500	0,41
46	Madagascar	587.941	0,39
47	Botswana	582.000	0,39
48	Kenya	580.367	0,39
49	Yemen	527.968	0,35
50	Thailand	513.120	0,34
51	Spain	505.992	0,34
52	Turkmenistan	498.100	0,33
53	Cameroon	475.442	0,32
54	Papua New Guinea	462.840	0,31
55	Uzbekistan	447.400	0,30
56	Morocco	446.550	0,30
57	Sweden	441.370	0,30
58	Iraq	438.317	0,29
59	Paraguay	406.752	0,27
60	Zimbabwe	390.757	0,26
61	Japan	377.930	0,25
62	Germany	357.114	0,24
63	Rep o.s. Congo	342.000	0,23
64	Finland	338.419	0,23
65	Vietnam	331.212	0,22
66	Malaysia	330.803	0,22
67	Norway	323.802	0,22
68	Côte d'Ivoire	322.463	0,22
69	Poland	312.685	0,21
70	Oman	309.500	0,21
71	Italy	301.336	0,20
72	Philippines	300.000	0,20
73	Burkina Faso	274.222	0,18
74	New Zealand	270.467	0,18
75	Gabon	267.668	0,18
76	Western Sahara	266.000	0,18
77	Ecuador	256.369	0,20
78	Guinea	245.857	0,17
79	United Kingdom	242.800	0,16
80	Uganda	241.038	0,16
81	Ghana	238.539	0,16
82	Romania	238.391	0,16
83	Laos	238.800	0,16
84	Guyana	214.969	0,14
85	Bahrain	207.800	0,14
86	Kyrgyzstan	199.951	0,13
87	Senegal	196.722	0,13
88	Syria	185.180	0,12
89	Cambodia	181.035	0,12
90	Uruguay	176.215	0,12
91	Suriname	163.820	0,11
92	Tunisia	163.610	0,11
93	Nepal	147.181	0,10
94	Bangladesh	143.998	0,10
95	Tajikistan	143.100	0,10
96	Greece	131.957	0,09
97	Nicaragua	130.373	0,09
98	North Korea	120.538	0,08
99	Malawi	118.484	0,08
100	Eritrea	117.600	0,08
<b>TOP 100 TOTAL</b>	<b>132.632.524</b>	<b>89,34</b>	



United States



Europe



India



Japan



China

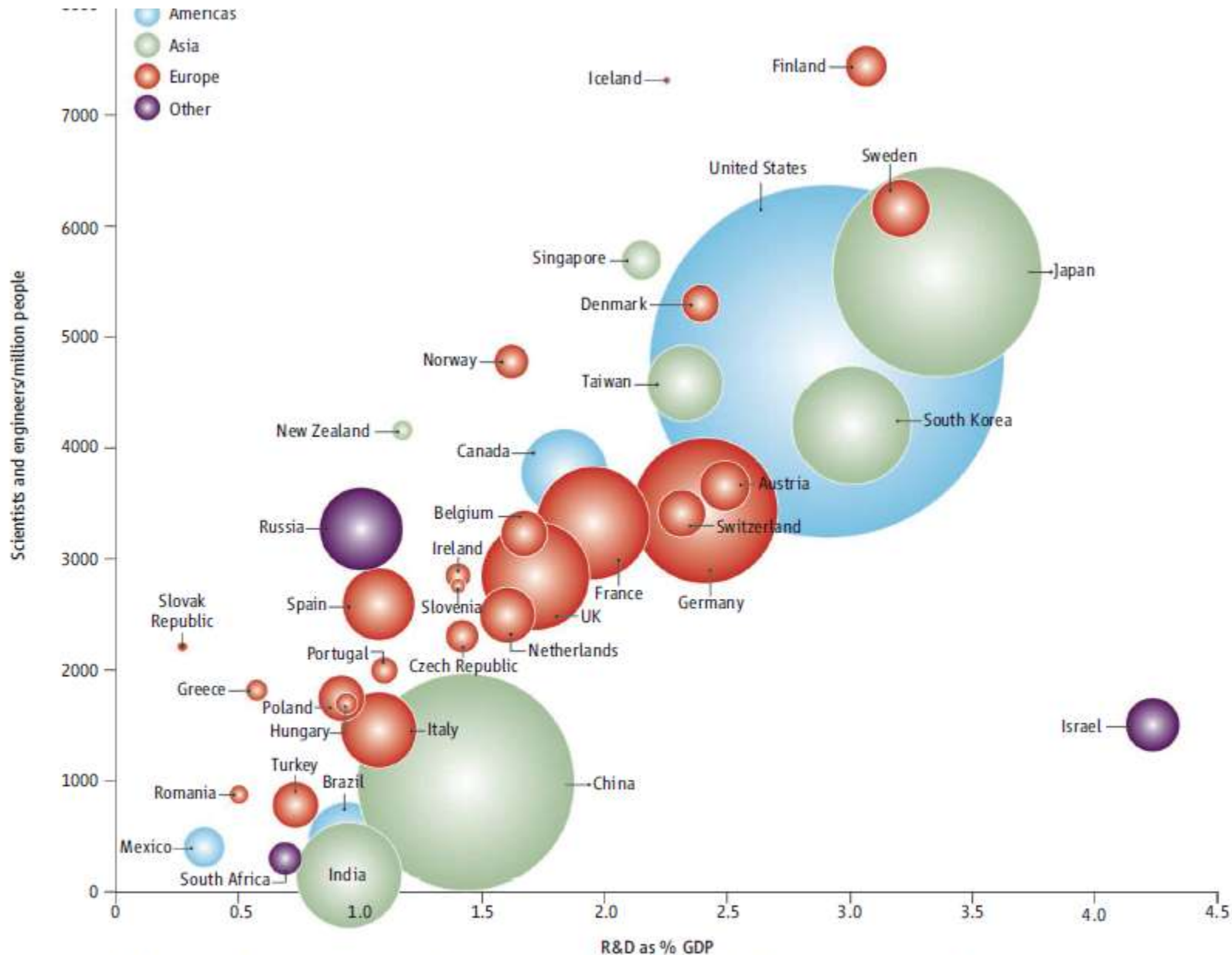
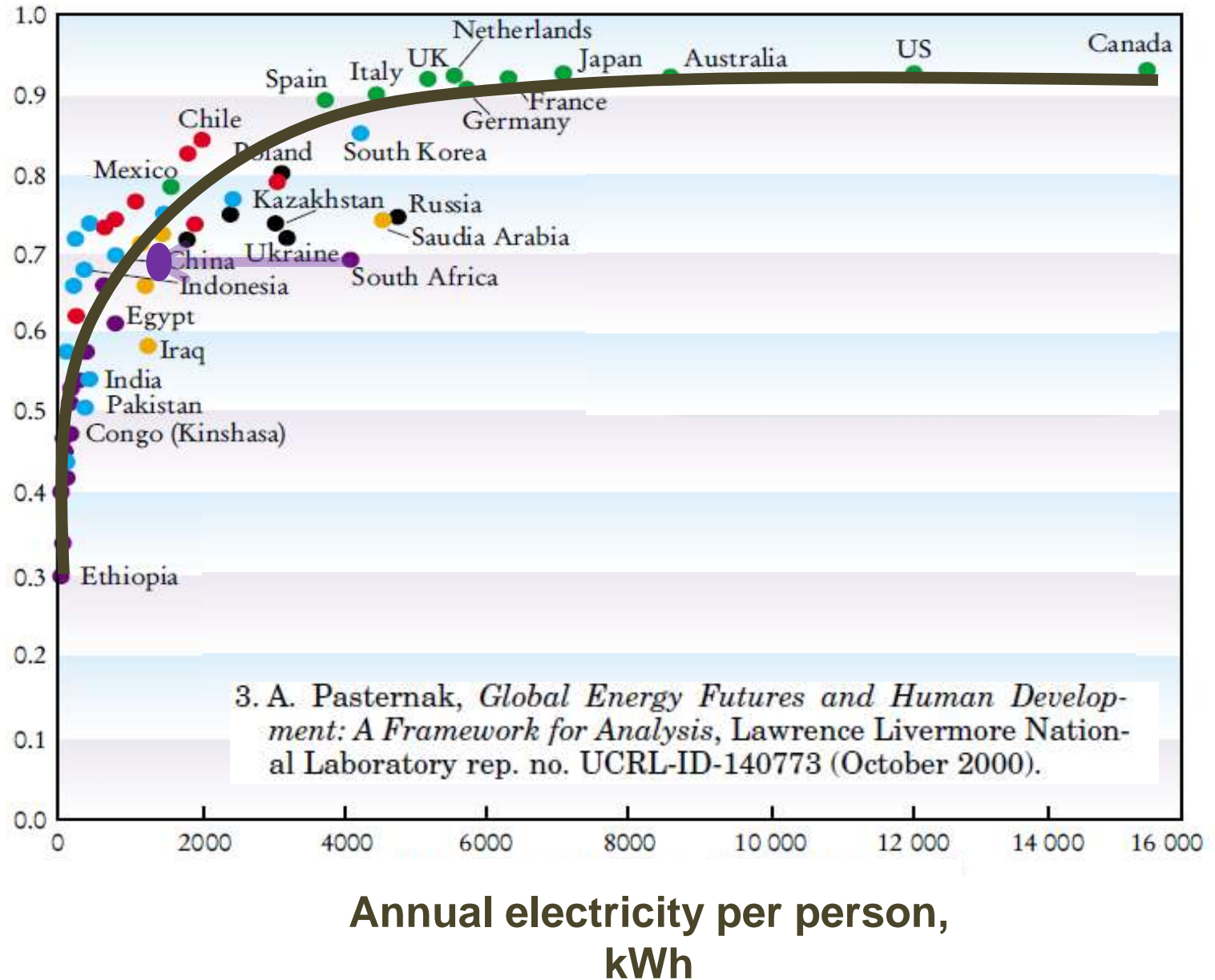


Fig. 4. World of R&D in 2010. Size of circle reflects the relative amount of annual R&D spending by the country noted. [Reproduced by permission of *R&D Magazine* (28)]

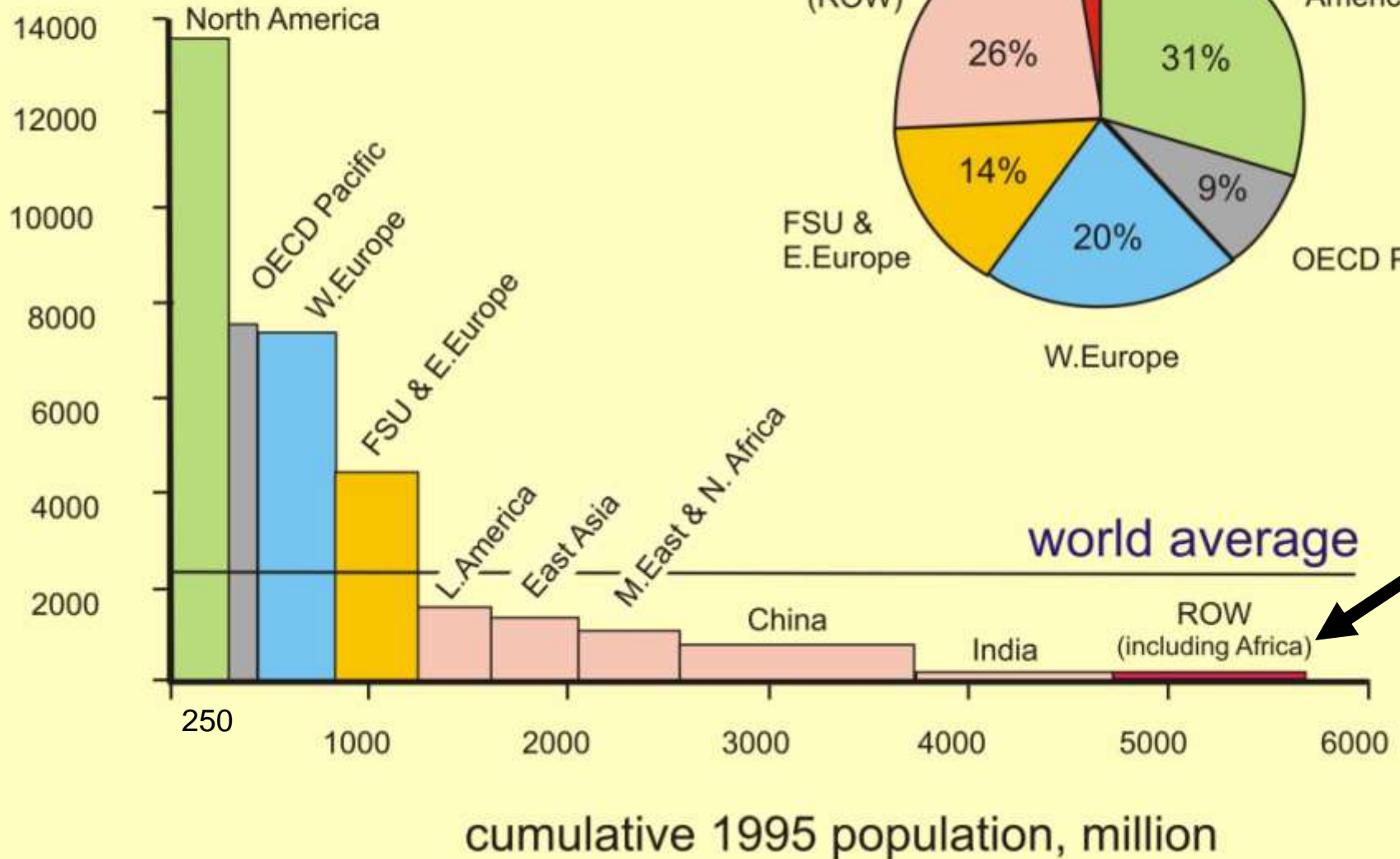
# Human development index and electricity consumption

↑  
Human development index

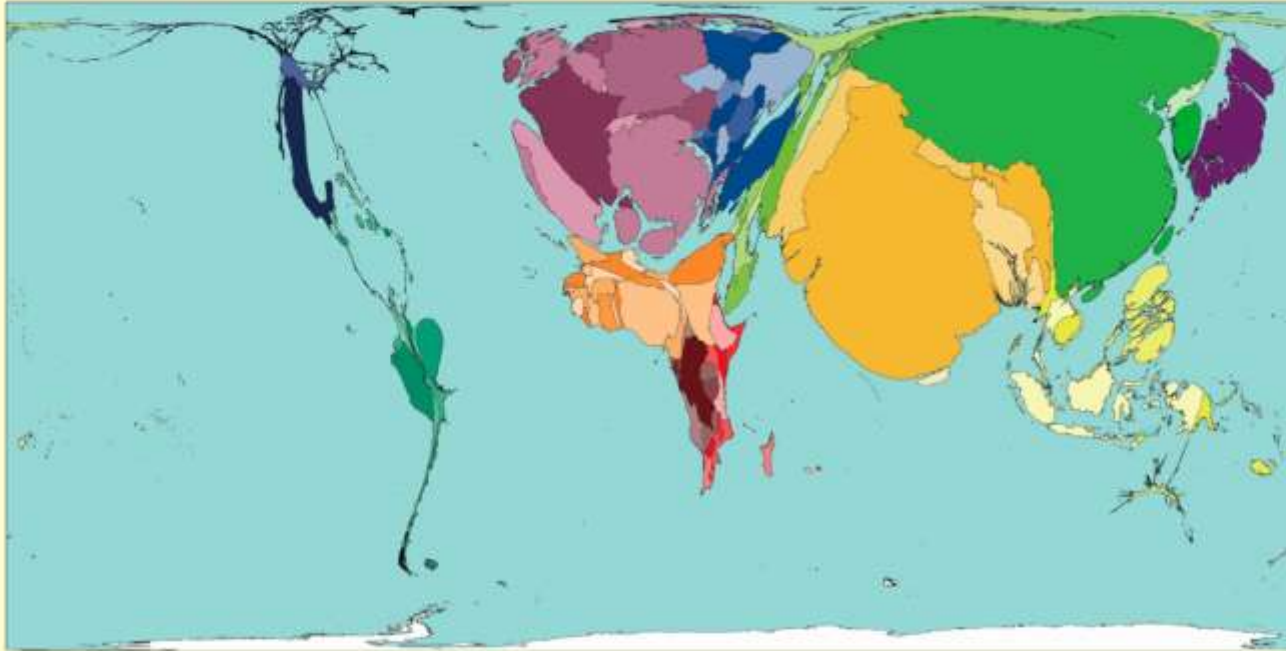


# World Electricity Demand by Regions

Per Capita Electricity Demand, kWh (1995)



# Wealth Year 1500



In the year 1500 European territories were some of the wealthiest on earth, when measured by the Gross Domestic Product (GDP) per person.

The regions with the largest total GDPs were Eastern Asia and Southern Asia. These were also the most populous regions at that time.

The regions with the lowest GDP in 1500 were Central Africa and Southeastern Africa. These regions also had the lowest GDP per person. In 2002 these regions enjoyed an even smaller proportion of the world total GDP expressed in purchasing power parity dollars than they did in 1500.

Territory size shows the proportion of worldwide Gross Domestic Product equalised in US\$ in purchasing power parity that was produced there in 1500.



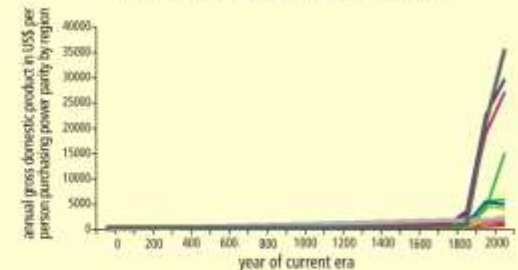
Land area

## TOP TEN AND OTHER NOTABLE RATES OF WEALTH PER PERSON IN YEAR 1500

Rank	Territory	Value	Rank	Territory	Value
1	Italy	1100	11	Norway	640
2	Belgium	875	12	Switzerland	632
3	Netherlands	761	21	Portugal	606
4	Denmark	738	23	China	600
5	France	727	53	India	550
6	United Kingdom	714	60	Ireland	526
7	Austria	707	61	Japan	500
8	Sweden	695	65	Iraq	499
9	Germany	688	86	Turkey	496
10	Spain	661	106	Egypt	475

US\$ of Gross Domestic Product in purchasing power parity per person in 1500\*

## TIMELINE OF WORLD WEALTH

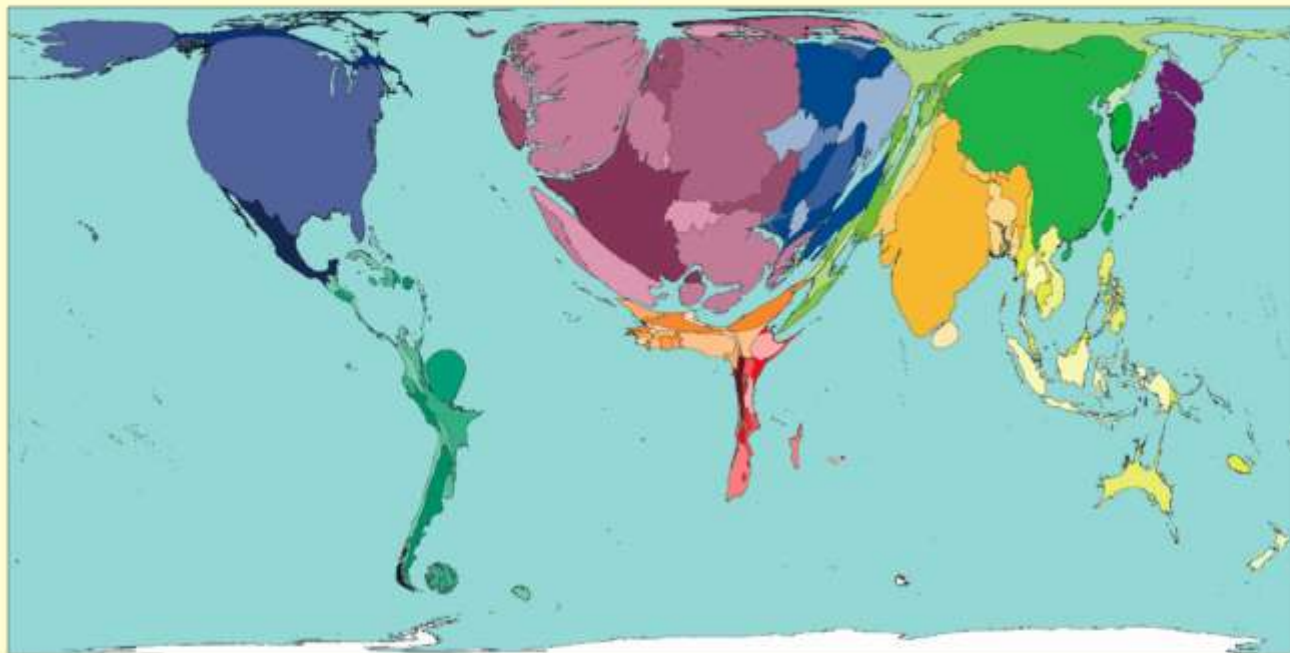


- Technical notes**
- Data are from Angus Maddison's 2003 The World Economy.
  - Gross Domestic Product is measured in Purchasing Power Parity (PPP) US\$, thus PPP US\$1 has the same purchasing power in every territory. This PPP is in 1990 prices.
  - See website for further information.

*“Slaves captured in raids and war grew in importance as a commodity ... Kola nuts ... were also important, as were the dyestuff of northern Nigeria. All these goods were highly prized in and around the Mediterranean basin.”*

Richard Effland, 2003

# Wealth Year 1900



By the 1900s Western Europe had experienced an industrial revolution. Workers who may previously have performed all stages of a production process in their own homes were now in mechanised factories with a greater division of labour. This increased efficiency and therefore output.

In the period between 1500 to 1900 the world average of Gross Domestic Product per person had doubled. The world population had also risen over this period, thus the rise in total Gross Domestic Product was even greater than the per person increases. In 1900 the world total was US\$2 trillion when expressed in 1990 purchasing power parity.

Territory size shows the proportion of worldwide Gross Domestic Product measured in US\$ equalised for purchasing power parity that was produced there in 1900.



Land area

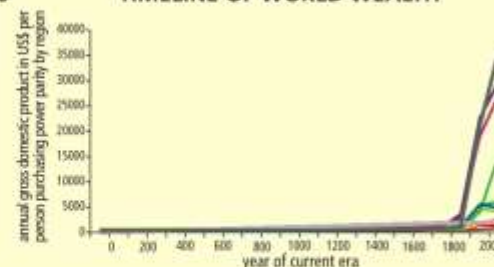
- Technical notes**
- Data are from Angus Maddison's 2003 The World Economy.
  - Gross Domestic Product is measured in Purchasing Power Parity (PPP) US\$, thus PPP US\$1 has the same purchasing power in every territory. This PPP is in 1990 prices.
  - See website for further information.

## TOP TEN WEALTHIEST AND OTHER NOTABLE RATES OF WEALTH PER PERSON IN YEAR 1900

Rank	Territory	Value	Rank	Territory	Value
1	United Kingdom	4492	141	Myanmar	685
2	New Zealand	4298	142	Albania	685
3	United States	4091	143	Brazil	678
4	Australia	4013	165	Bangladesh	607
5	Switzerland	3833	169	India	599
6	Belgium	3731	170	Somalia	557
7	Netherlands	3424	188	Mongolia	553
8	Denmark	3017	189	China	545
9	Germany	2985	190	Nepal	539
10	Canada	2911	193	Dem Republic Congo	483

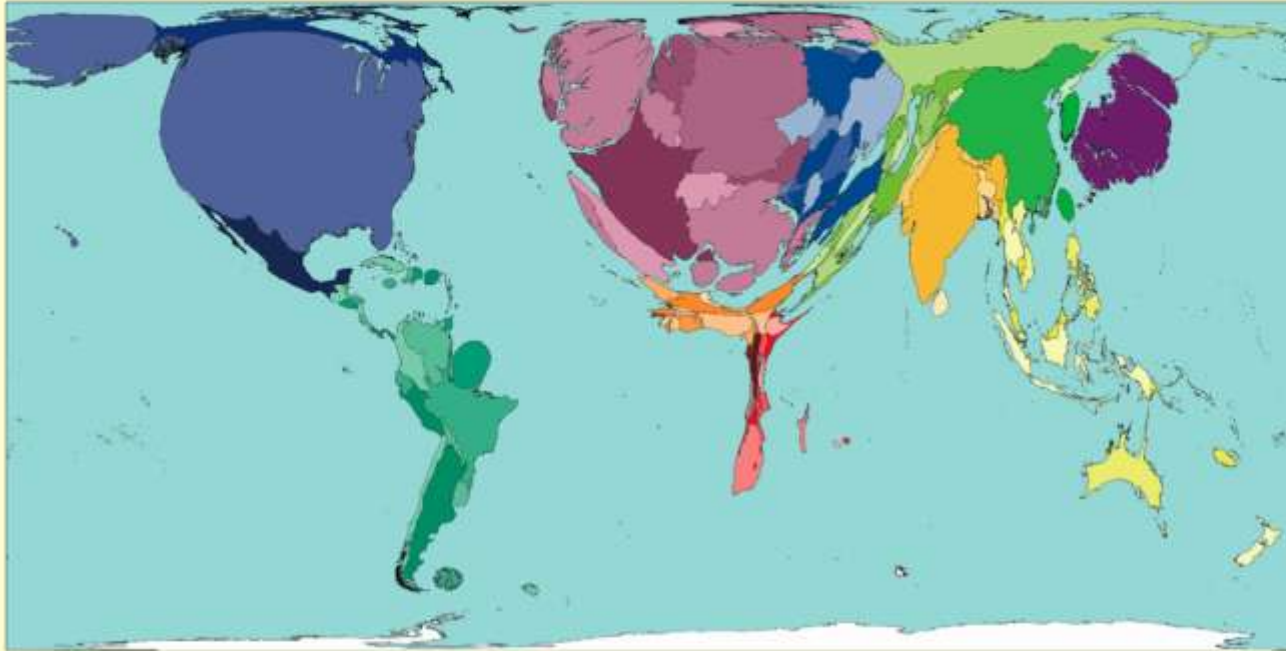
US\$ of Gross Domestic Product in purchasing power parity per person in 1900\*

## TIMELINE OF WORLD WEALTH



*“The industrial revolution ... enormously increased the capacity of some groups, mostly Europeans at first, to produce goods and services. It greatly altered the distribution of wealth and poverty around the world ...”* National Centre for History, 2006

# Wealth Year 1960



In 1960 most of the world's wealth was recorded as being produced in North America and Western Europe. Wealth distribution maintained a similar pattern to that in 1900, except that the proportion of world wealth found in Asian territories generally decreased, whilst it tended to increase in South American territories.

The highest levels of Gross Domestic Product per person in 1960 were in the small Middle Eastern territories of Qatar, Kuwait and the United Arab Emirates. The territories with the lowest Gross Domestic Product per person were mainly in Northern Africa and Southeastern Africa.

Territory size shows the proportion of worldwide Gross Domestic Product measured in US\$ equalised for purchasing power parity that was produced there in 1960.



Land area

## MOST AND LEAST WEALTHY TERRITORIES IN 1960

Rank	Territory	Value	Rank	Territory	Value
1	Qatar	33104	191	Mali	535
2	Kuwait	28813	192	Cape Verde	508
3	United Arab Emirates	22433	193	Guinea-Bissau	501
4	Switzerland	12457	194	United Republic of Tanzania	459
5	United States	11328	195	Lesotho	458
6	France	9785	196	Burundi	444
7	Venezuela	9646	197	Ethiopia	439
8	New Zealand	9465	198	Botswana	403
9	Denmark	8812	199	Malawi	394
10	Australia	8791	200	Guinea	392

US\$ of Gross Domestic Product in purchasing power parity per person in 1960\*

## TIMELINE OF WORLD WEALTH

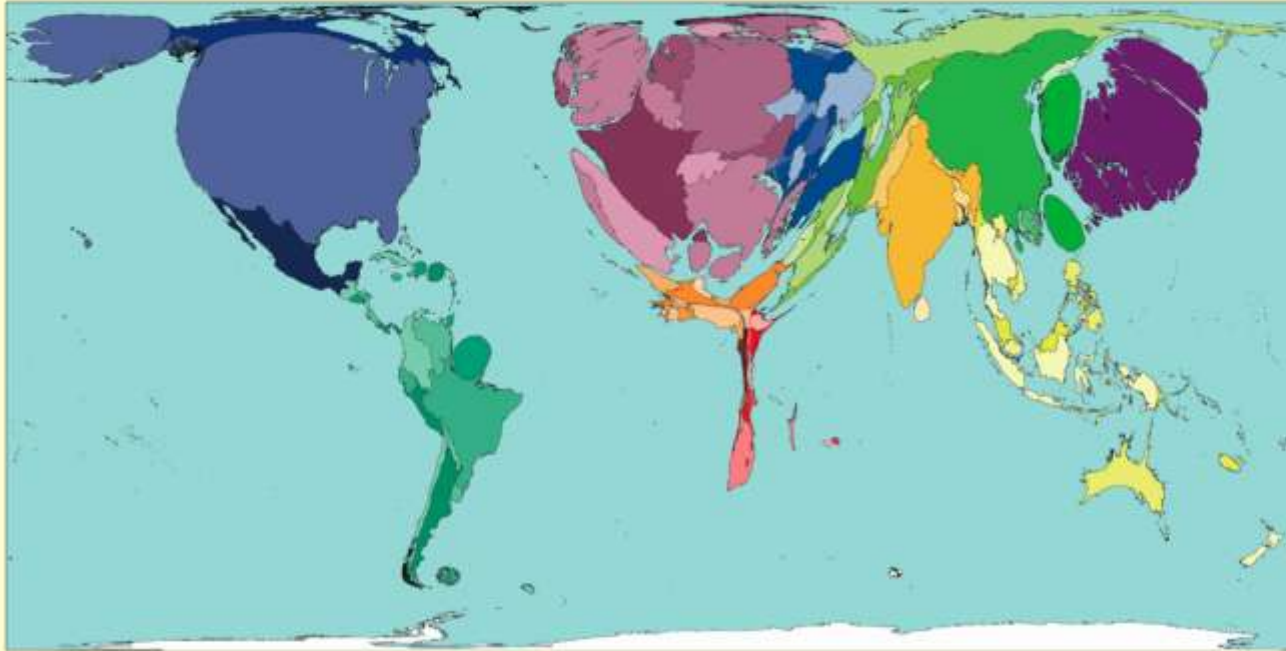


- Technical notes**
- Data are from Angus Maddison's 2003 The World Economy.
  - Gross Domestic Product is measured in Purchasing Power Parity (PPP) US\$, thus PPP US\$1 has the same purchasing power in every territory. This PPP is in 1990 prices.
  - See website for further information.

*"The first Asian economic miracle was Japan's after World War II, rooted in the changes of the Meiji restoration ... The Asian Tigers ... began to emerge from 1960 onward ..."*

Luis Alberto Moreno, 2006

# Wealth Year 1990



In 1990 the region with the lowest wealth or Gross Domestic Product (GDP) was Central Africa. The GDP of Central Africa was 0.8% of the GDP of the richest region, North America. If just 1% of the North America's GDP had been redistributed to Central Africa the region's GDP would have more than doubled.

Wealth per person had doubled since 1960, and the world GDP rose from PPP US\$8 trillion to US\$27 trillion over these thirty years. This vast increase in wealth was distributed in a broadly similar pattern to 30 years before. One change is the growth of Japan, China, the Republic of Korea and Taiwan.

Territory size shows the proportion of worldwide Gross Domestic Product measured in US\$ equalised for purchasing power parity that was produced there in 1990.



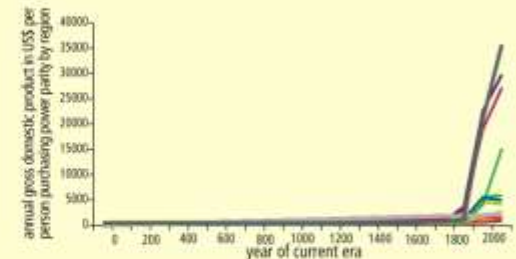
Land area

## MOST AND LEAST WEALTHY TERRITORIES IN 1990

Rank	Territory	Value	Rank	Territory	Value
1	United States	23201	191	Bangladesh	640
2	France	22603	192	Afghanistan	601
3	Switzerland	21482	193	Uganda	592
4	Canada	18872	194	Ethiopia	581
5	Japan	18789	195	Niger	562
6	Greenland	18662	196	Malawi	558
7	Norway	18466	197	United Republic of Tanzania	540
8	Denmark	18452	198	Guinea	526
9	Sweden	17695	199	Dem Republic Congo	525
10	Hong Kong (China)	17541	200	Chad	421

US\$ of Gross Domestic Product in purchasing power parity per person in 1990\*

## TIMELINE OF WORLD WEALTH

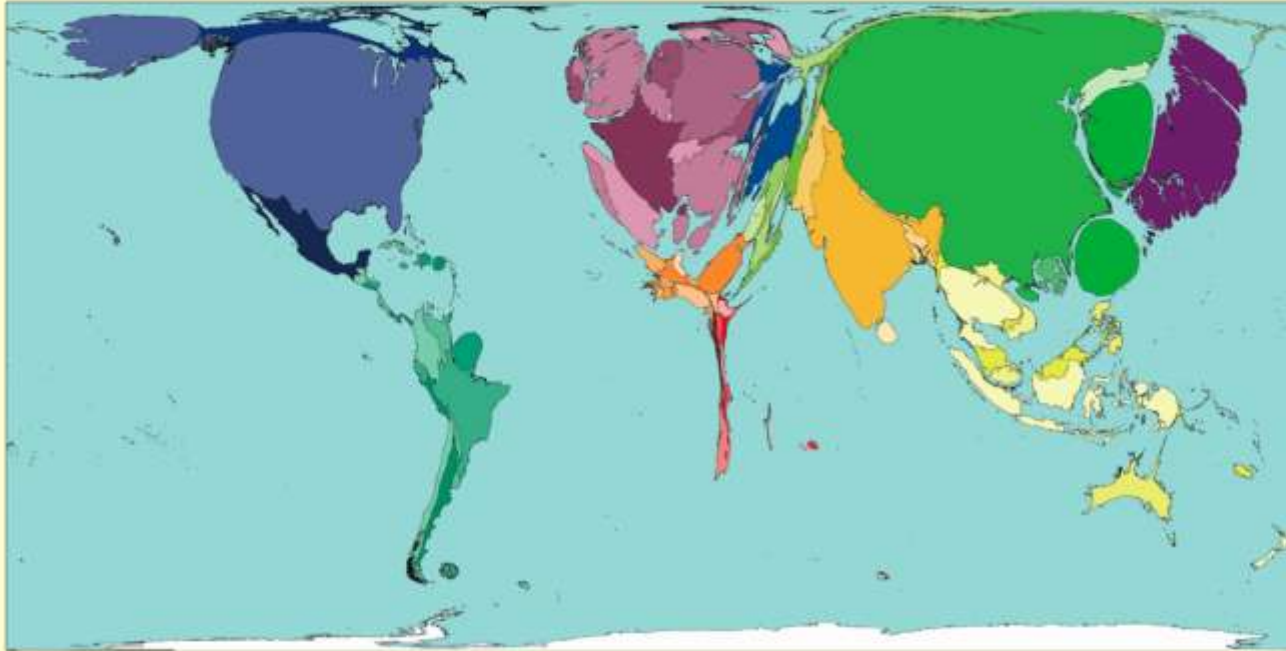


**Technical notes**  
 • Data are from Angus Maddison's 2003 The World Economy.  
 • Gross Domestic Product is measured in Purchasing Power Parity (PPP) US\$, thus PPP US\$1 has the same purchasing power in every territory. This PPP is in 1990 prices.  
 • See website for further information.

*"As of 1990 ... the Korean stock market was equal in size to all the emerging markets of East Asia combined."*

Andrew Horvat, 2005

# Wealth Year 2015



The projected wealth of China in 2015 could mean it producing 27% of all the wealth in the world, if the economic trends established between 1975 and 2002 continue for another 13 years. In year 1 of the current era China produced 26% of the wealth in the world, but very slowly declined to generating only 5% of the world total in 1960.

Whilst China is predicted to recover its former position within the world economy, this time instead of the Americas having a very small percentage of world wealth, as in year 1, now it is African territories that are predicted to remain small on the international financial stage. Eastern European territories are also predicted to have decreasing proportions of world wealth.

Territory size shows the proportion of worldwide Gross Domestic Product measured in US\$ equalised for purchasing power parity to be produced there in 2015.



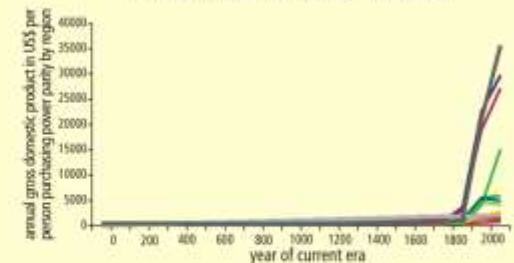
Land area

## TERRITORIES PREDICTED TO BE THE MOST AND LEAST WEALTHY BY 2015

Rank	Territory	Value	Rank	Territory	Value
1	Taiwan	64519	191	Comoros	533
2	Hong Kong (China)	51470	192	Dem Republic Congo	525
3	Singapore	48645	193	Chad	493
4	Malta	42407	194	Central African Republic	485
5	Luxembourg	38526	195	Zambia	480
6	Republic of Korea	38249	196	Djibouti	446
7	United States	38063	197	Sierra Leone	443
8	Norway	36830	198	Afghanistan	423
9	Japan	35694	199	Tajikistan	361
10	Ireland	34677	200	Niger	348

US\$ of Gross Domestic Product in purchasing power parity per person in 1990\*

## TIMELINE OF WORLD WEALTH



- Technical notes**
- Data are from Angus Maddison's 2003 The World Economy and the United Nations Population Division's 2002 World Population Estimates.
  - Gross Domestic Product is measured in Purchasing Power Parity (PPP) US\$, thus PPP US\$1 has the same purchasing power in every territory. This PPP is in 1990 prices.
  - See website for further information.

*“Asia’s rise is the economic event of our age. Should it proceed as it has over the last few decades, it will bring the two centuries of global domination by Europe and, subsequently, its giant North American offshoot to an end.”*

Martin Wolf, 2003

*A Growth Ethic...*

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"There are no great limits to growth because there are no limits of human intelligence, imagination, and wonder."

*(Ronald Reagan 40th president of US)*

"Growth for the sake of growth is the ideology of the cancer cell."

Edward Abbey



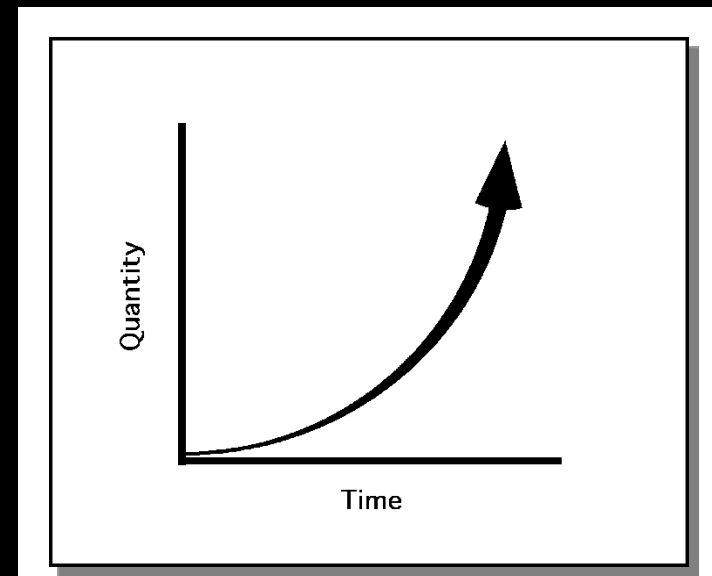
# Exponential Growth...

The failure to understand the concept of exponential growth by those "in charge" may be the single biggest problem we face...

*Doubling Time = 70/n years*

<u>Growth rate</u>	<u>D time</u>
3%	24 yrs
5%	14 yrs
7%	10 yrs
10%	7 yrs

CO2 emissions rising 10 per cent from 1990 to 2000 and 33 per cent from 2000 to 2010.



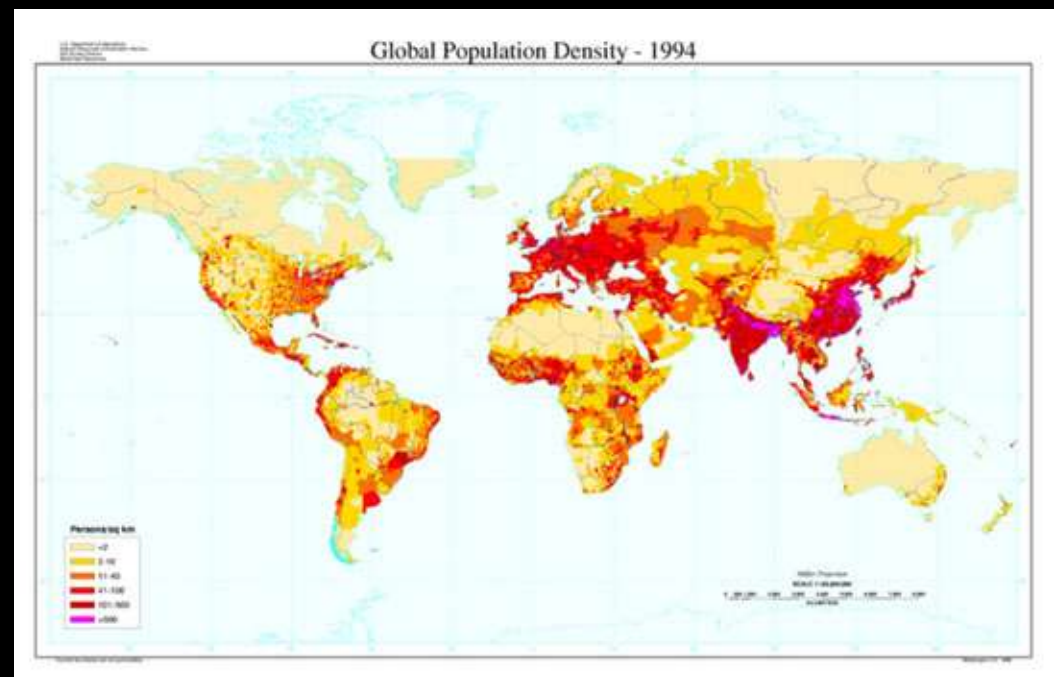
# Global Population... Migration and urbanization

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Brain drain, globalization, coastal and city crowding, xenophobia and discrimination, dying rural towns...

The number of people uprooted by conflict or persecution is at its highest level in 18 years

Developing regions carry the heaviest burden in hosting uprooted populations. By the end of 2012, developing countries hosted 8.5 million refugees, accounting for 81 per cent of the refugee population falling under the aegis of the UNHCR. In 2012, least developed countries provided asylum to 2.5 million of those refugees.







Store



**Earth Stewardship**

**001**

# Earth Stewardship Science must be challenging

- Why are you at university; what do you want & why do you want it?
- Does your communication and conversation at university need recasting?
- Can you learn to live an ethical life without reference to post-mortem rewards or punishment?
- What do social democracy/eco-socialism and the local/global Commons mean to you?
- If something is profoundly wrong with the way you live – What is to be done?

The return of people to the streets, on this epic scale, is a powerful step forward.

**The green movement: YOU can do it too**



Egypt today: a revolutionary pursuit of social justice and an end to state violence against citizens.



# Earth Stewardship Science

**Increased**  
heritage and  
scientific proof  
of genomics

**Enlivened** arts  
and social  
traditions

**Enhanced** flow  
of knowledge,  
health,  
science and  
ideas

**Fostered**  
science and  
scientists  
across Africa

**Sustained**  
academic  
networks

**New product**  
innovation  
and  
derivation

## Iphakade

‘observe the present and consider the past to ponder the future’

# Earth Stewardship Science



**If ALL Africans are stakeholders -  
Something sustainable will emerge**

## Aim

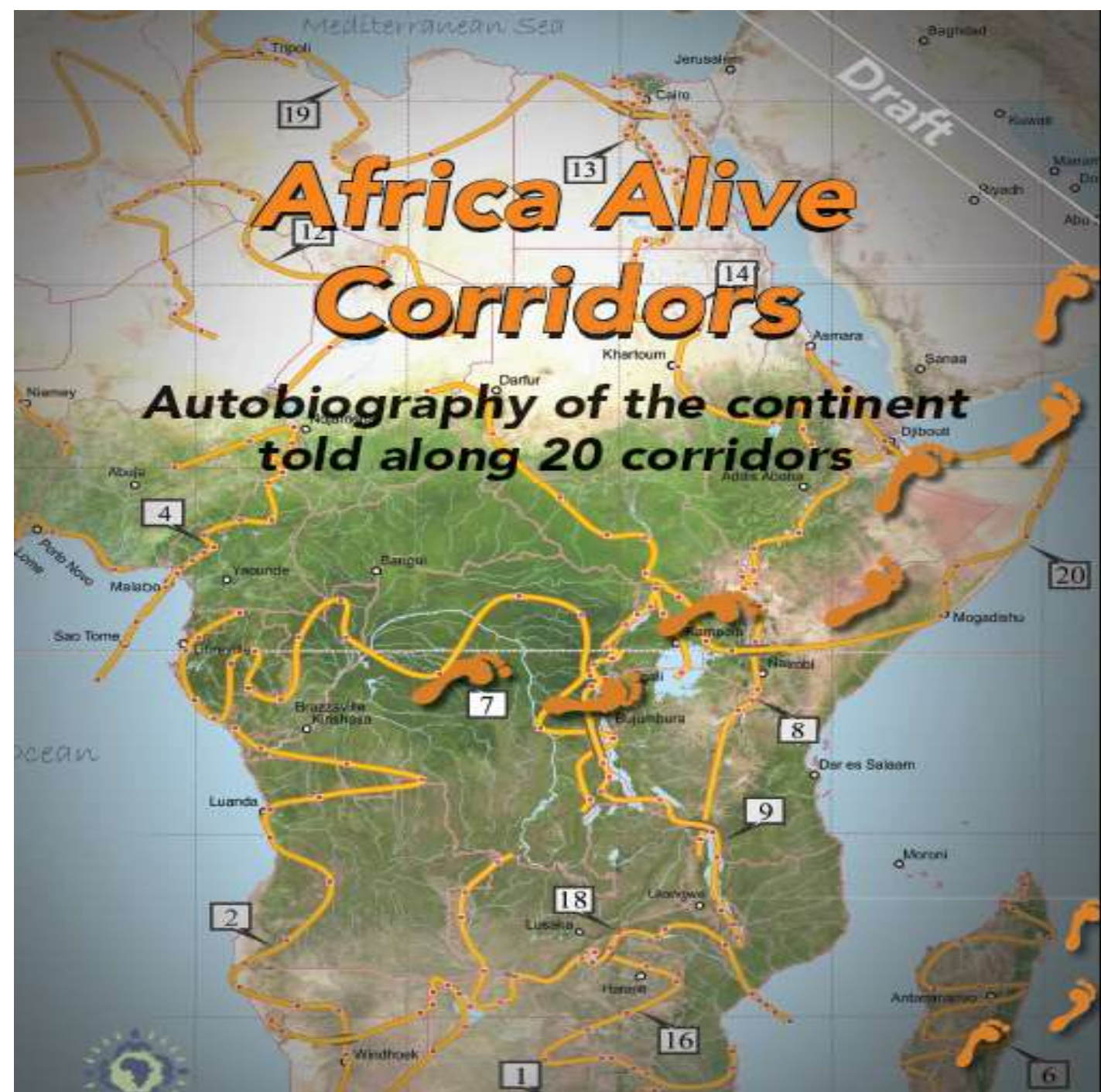
critical thinking and teaching outside the box

to induce and catalyse the emergence of a new trans-disciplinary science – called Earth Stewardship Science – that will integrate research on, and teaching in, our understanding of the dynamic resilience of our Earth-Life-Social System and help us to better define our life support systems within which we will mitigate, adapt, and manage the global commons in the Anthropocene under the isiXhosa motto *'Iphakade'*:

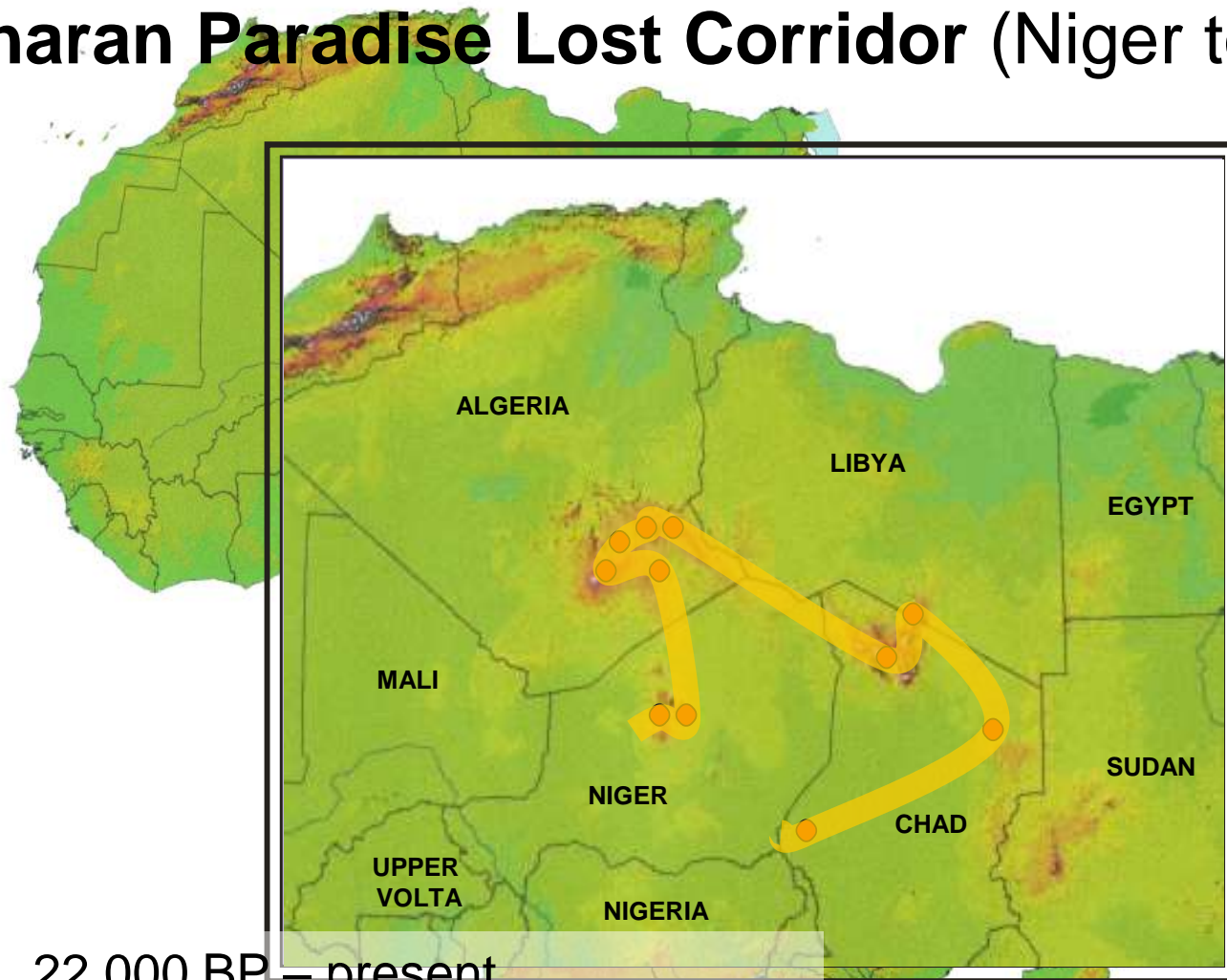
*“Observe the present and consider the past to ponder the future”.*

# Africa Alive Corridors

Autobiography of the continent  
told along 20 corridors



## 12. Saharan Paradise Lost Corridor (Niger to Chad)

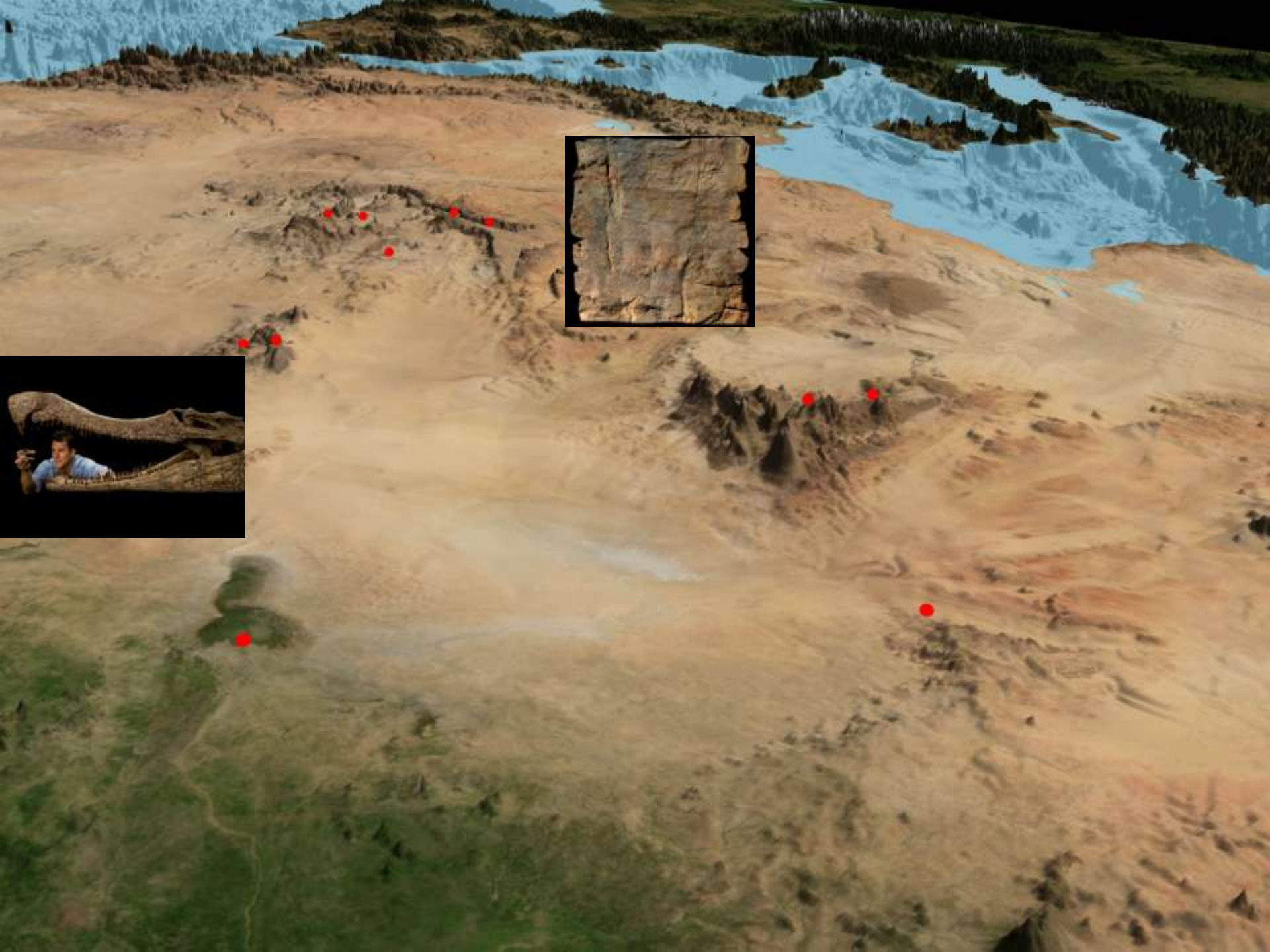


22,000 BP – present

*'The rock-art gallery traces desertification'*

- **Rock art** & fossils: from forest to desert
- The Sahara in global context (**climate change**)

• ***Sahelanthropus***, the earliest known hominid

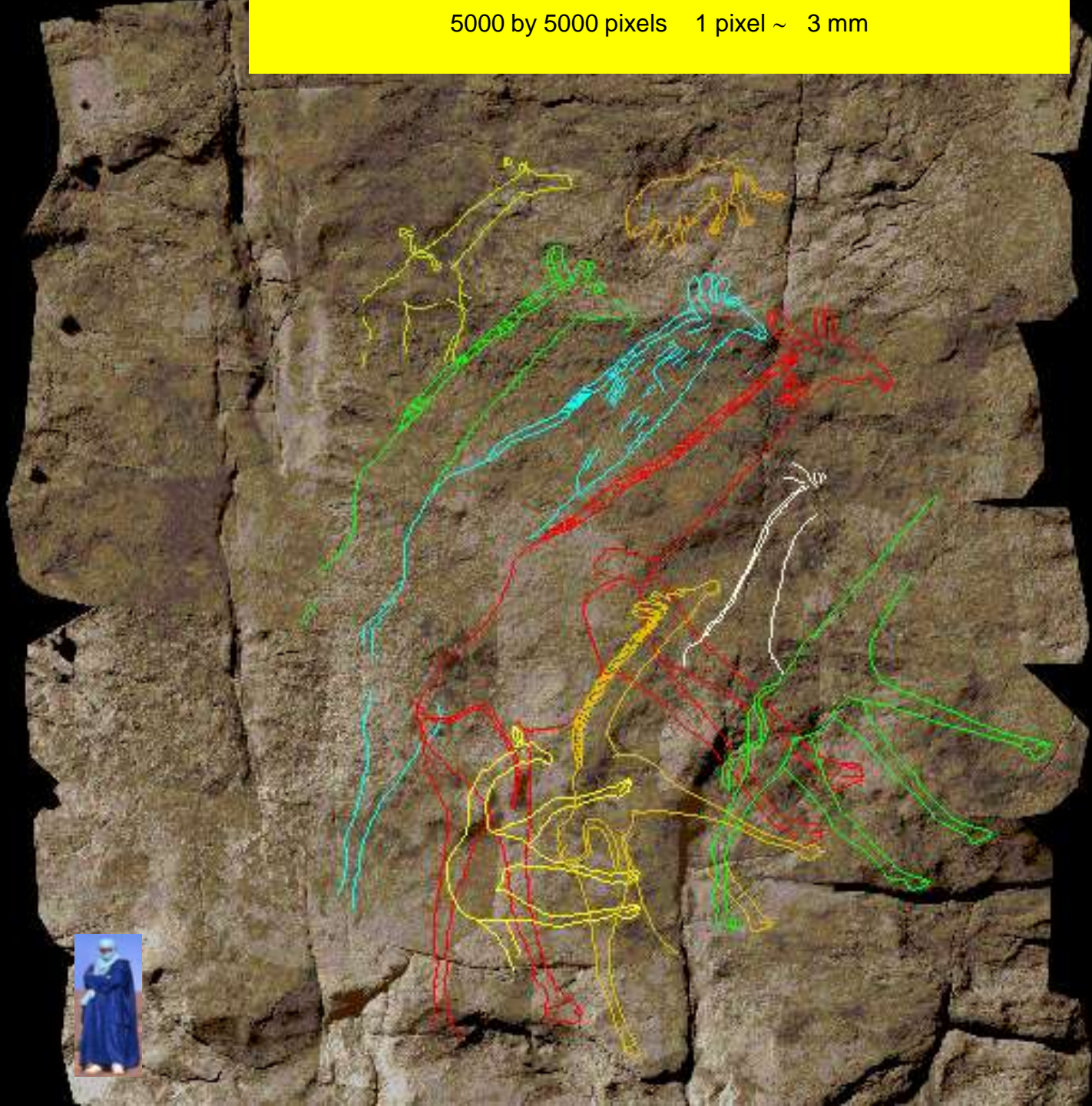




Rock Cliff,  
Niger



5000 by 5000 pixels 1 pixel ~ 3 mm



# A warning from other species

Oldest evidence of Human activity:  
7 million years old  
hominin fossils (Chad)

## First Cultural evidence for severe climate change:

7000 years ago the Sahara was a lush place to live, then changed very rapidly

Line drawings in GIS format



## Corridor 12

'Saharan Paradise Lost' (Niger, Algeria, Libya, Chad): 20,000 BP to present; one of the greatest rock art galleries on Earth traces the desertification of the Sahara from a savannah paradise to the most extensive desert—a clear tale of global warming.

# Revive the art of story telling through ArtScience

“A people are as healthy and confident as the stories they tell themselves. Sick storytellers can make nations sick. Without stories we would go mad. Life would lose it’s moorings or orientation... Stories can conquer fear, you know. They can make the heart larger.”

Ben Okri – *The Famished Road*



# The Entire IPCC Report in 19 Illustrated Haiku

A work of art that doubles as powerful talking points and a visual guide

Reports released by the **Intergovernmental Panel on Climate Change (IPCC)** can be daunting, even for science and policy insiders. The full Physical Science Assessment, the first instalment of the [Fifth Assessment Report](#) (pdf), released in manuscript form earlier this year, is over 2,000 pages long.

And even the [Summary for Policymakers](#), rather optimistically referred to as a “brochure,” is a dense 27 pages.

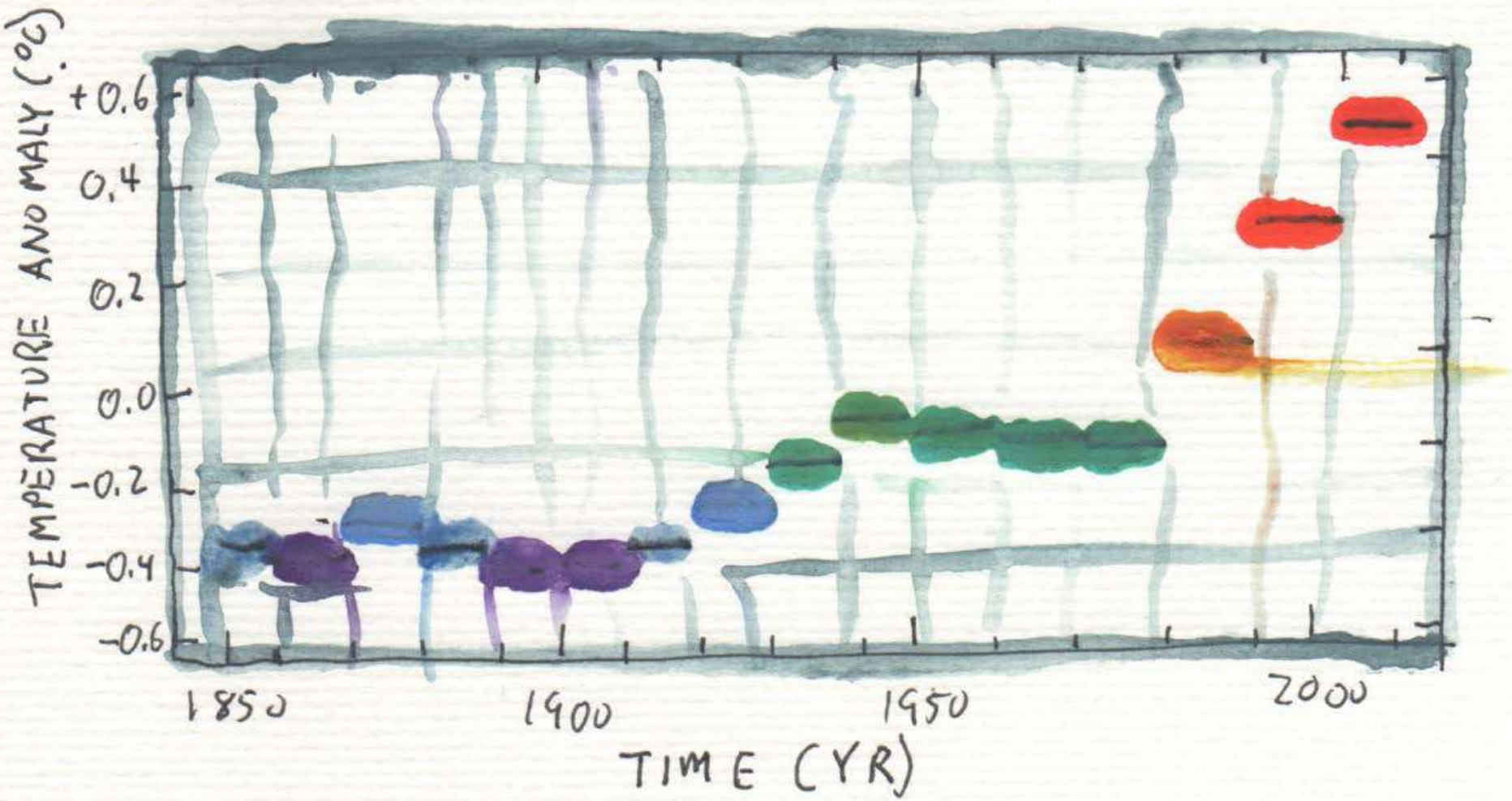
What if we could communicate the essence of this important information in plain language and pictures? Well, that’s just what one Northwest oceanographer Greg Johnson has done. He’s distilled the entire report into 19 illustrated haiku.

The result is stunning, sobering, and brilliant. It’s poetry. It’s a work of art. But it doubles as clear, concise, powerful talking points and a compelling visual guide.



CLIMATE  
CHANGE  
SCIENCE  
2013:  
HAIKU

Gregory  
C.  
Johnson



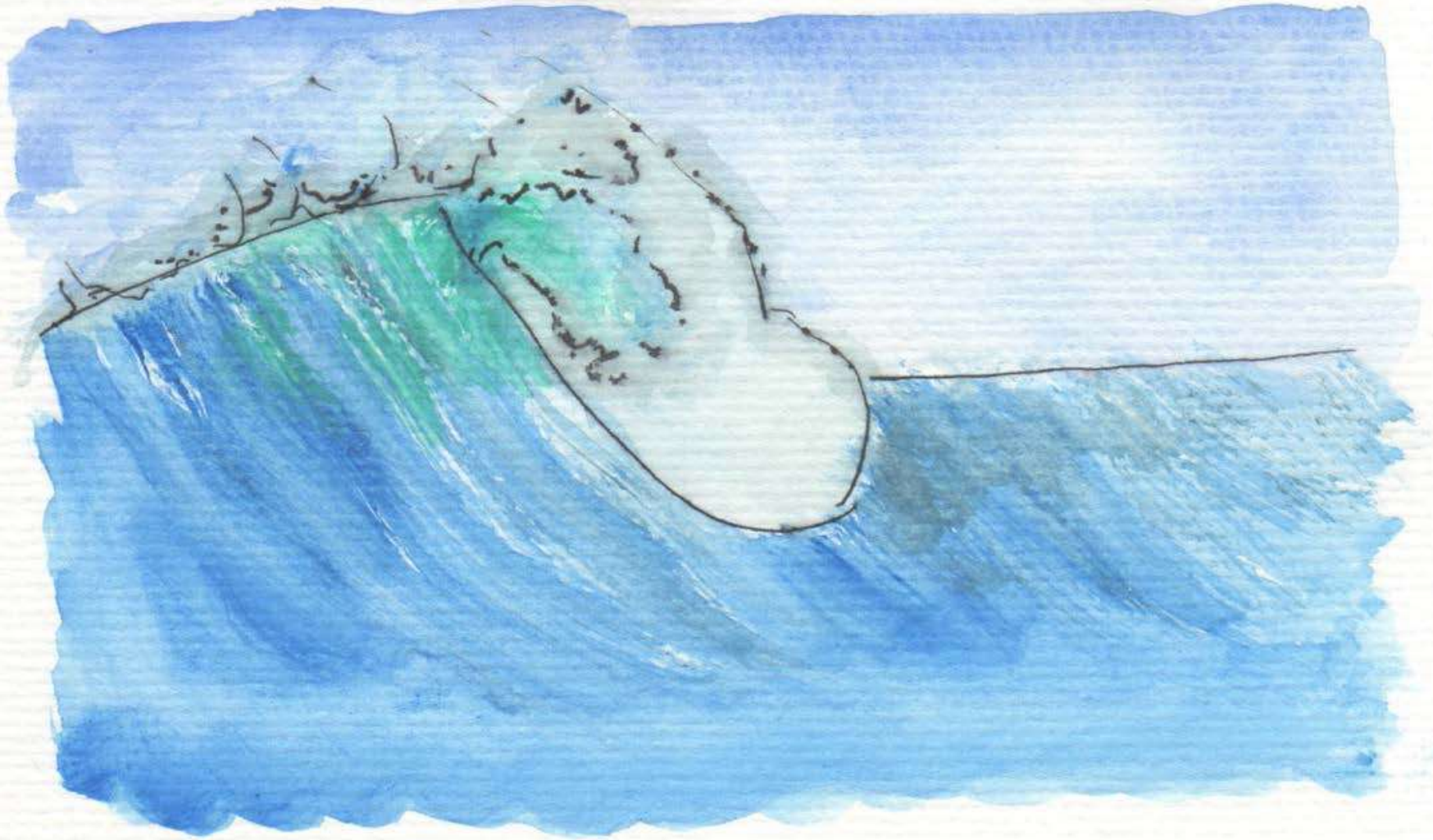
Big, fast carbon surge:  
Ice melts, oceans heat and rise.  
Air warms by decades.

HISTORY, EARTH



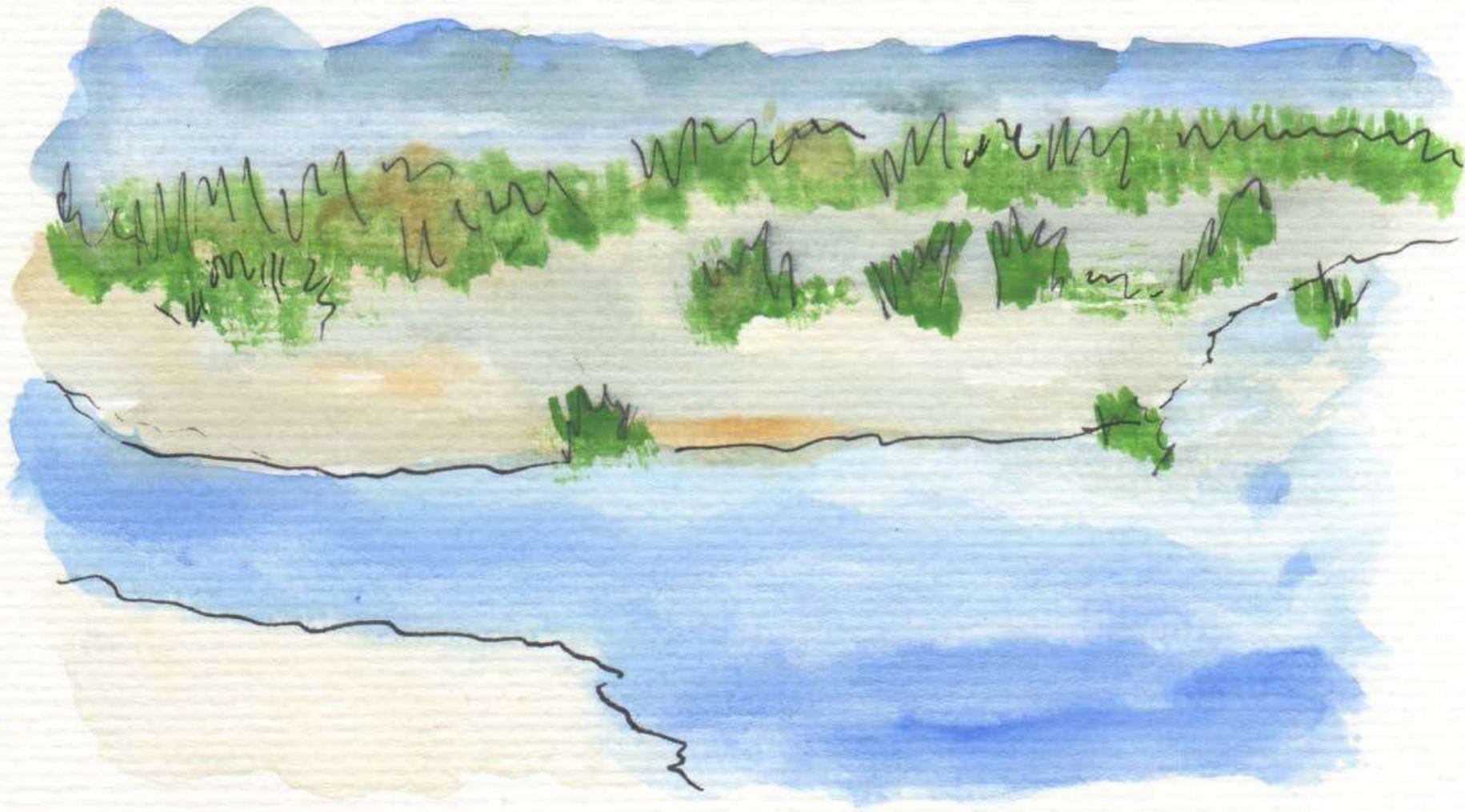
HISTORY, AIR

Carbon increases:  
Air warms through century past.  
More heavy rains fall.



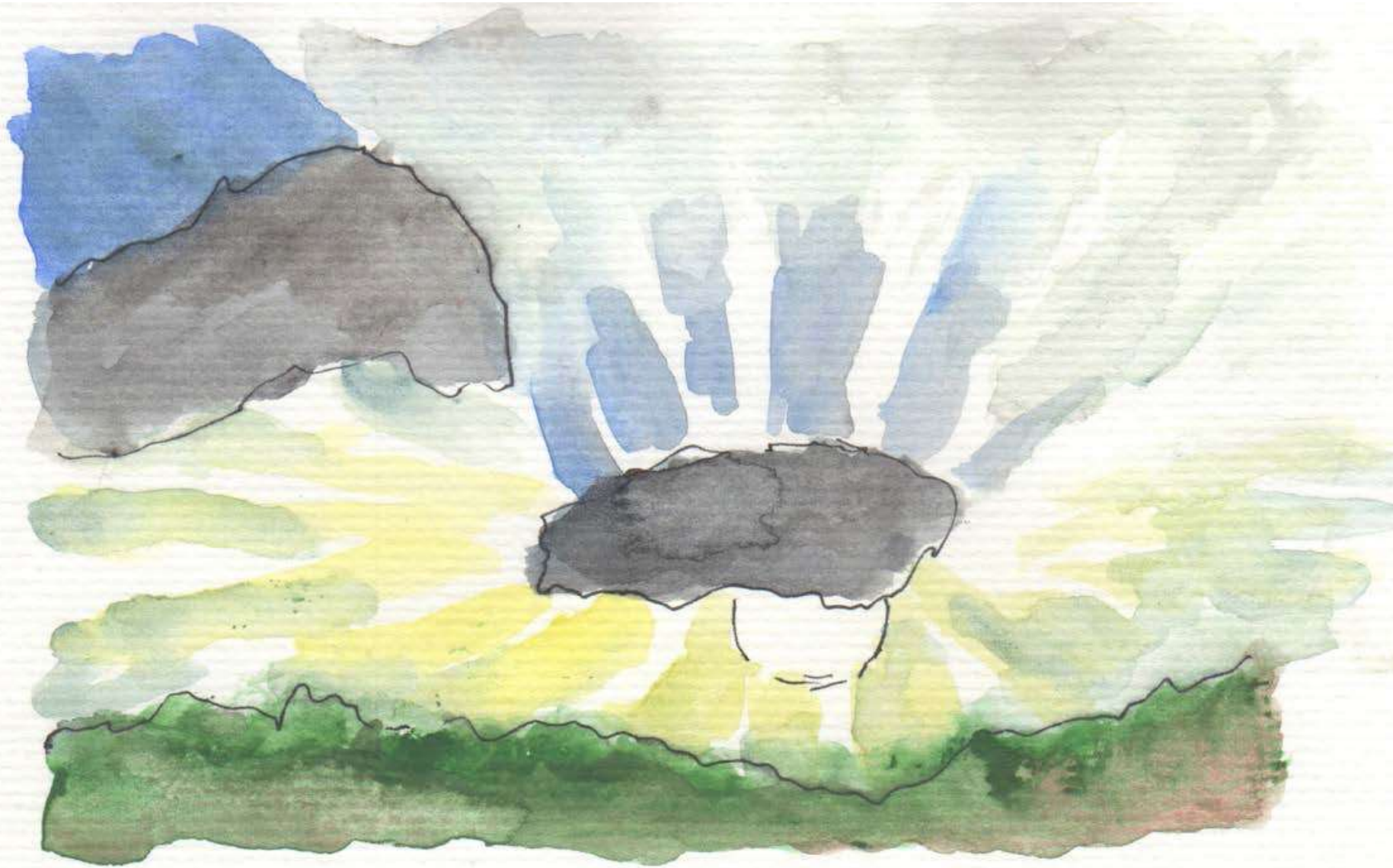
Abyss warms, coasts flood.  
Air moistens – salt patterns shift.  
Carbon sours oceans.

HISTORY, WATER



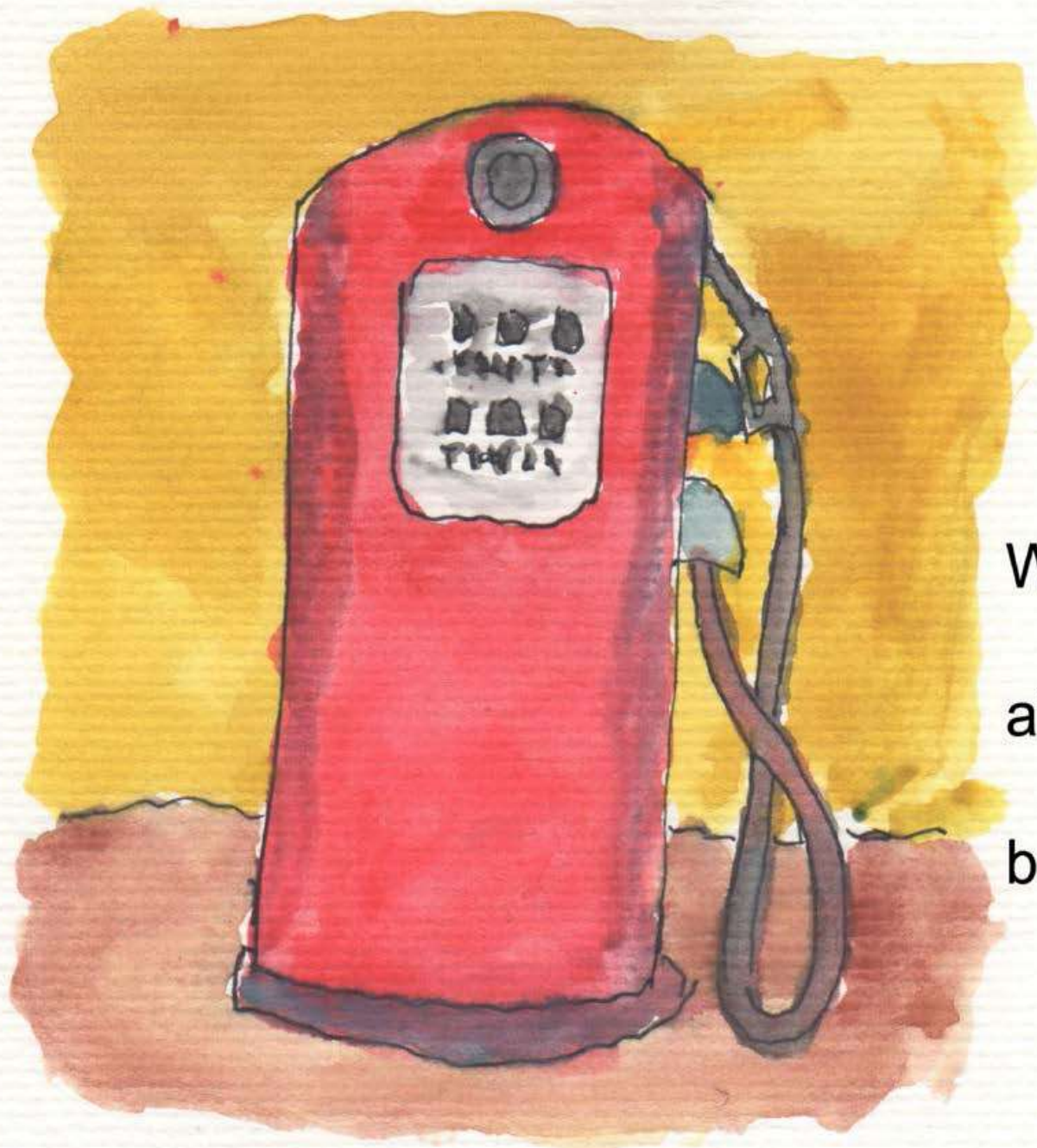
Seas rise as they warm.  
Rates quicken last century.  
Melting ice joins in.

WATER MEETS EARTH



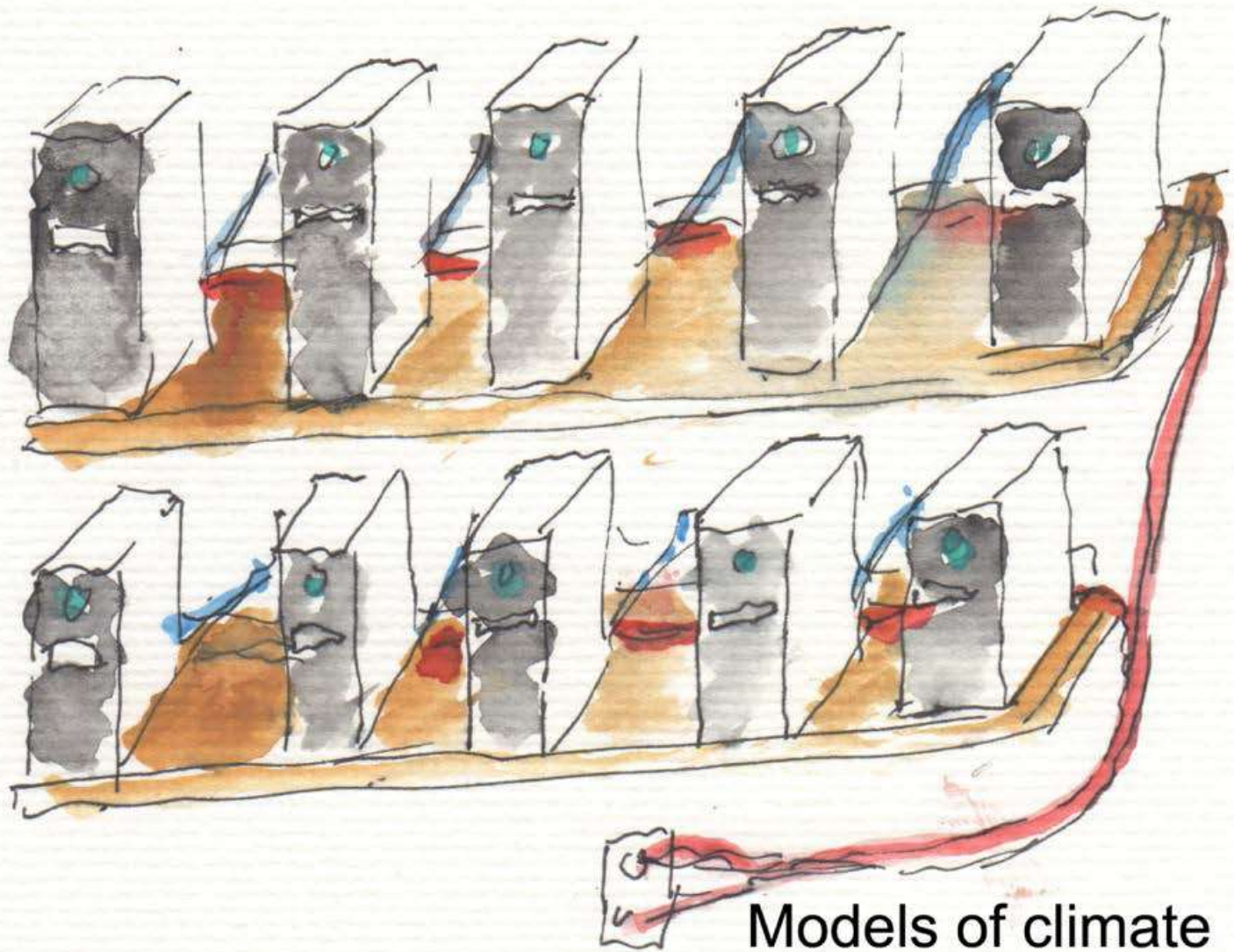
CO<sub>2</sub>, methane  
warm despite sun-spots, dust, soot,  
clouds, and volcanoes.

CHANGE DRIVERS



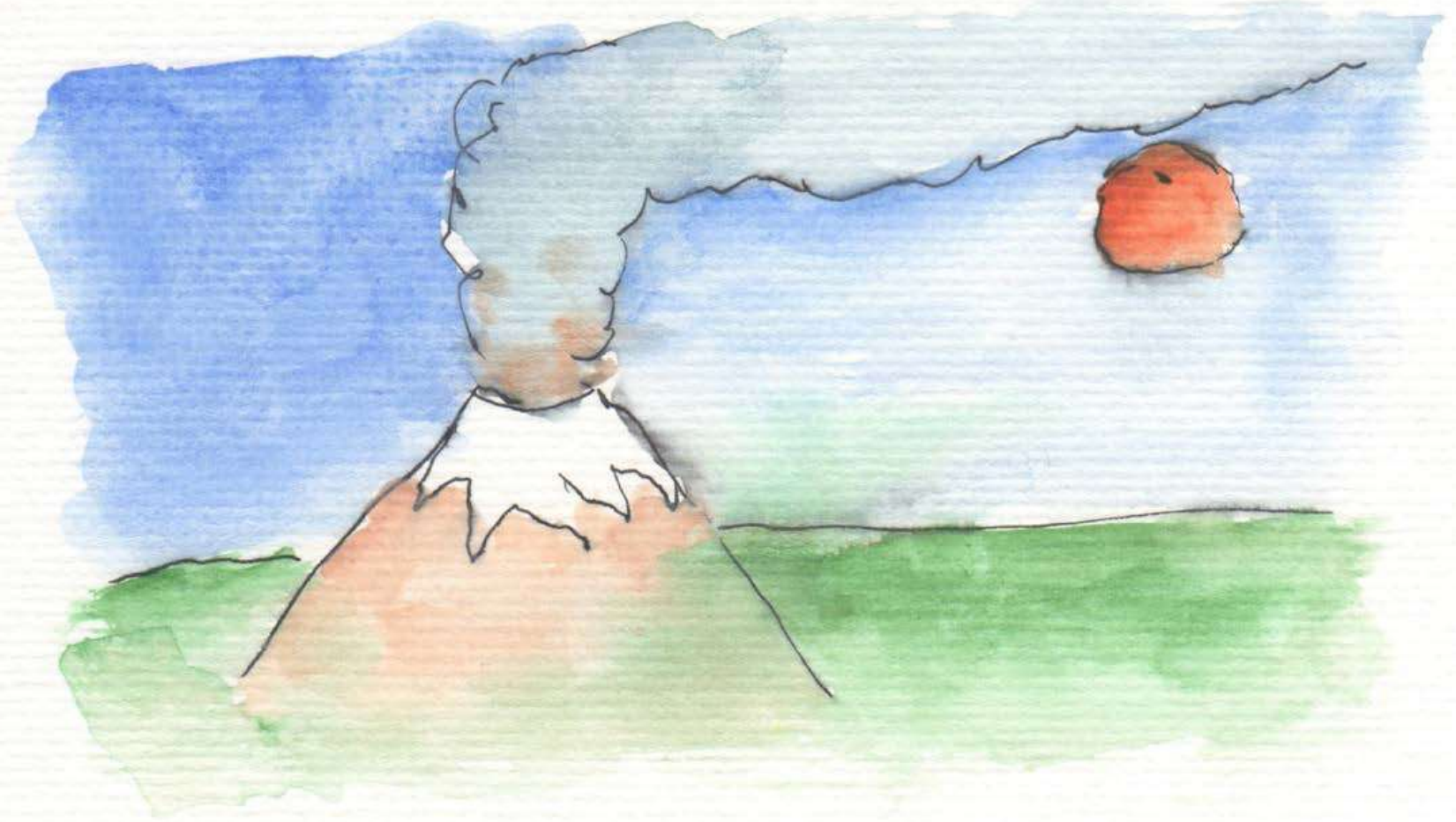
We burn  
more carbon  
air warms  
for decades –  
but seas . . .  
for millennia.

RESPONSE



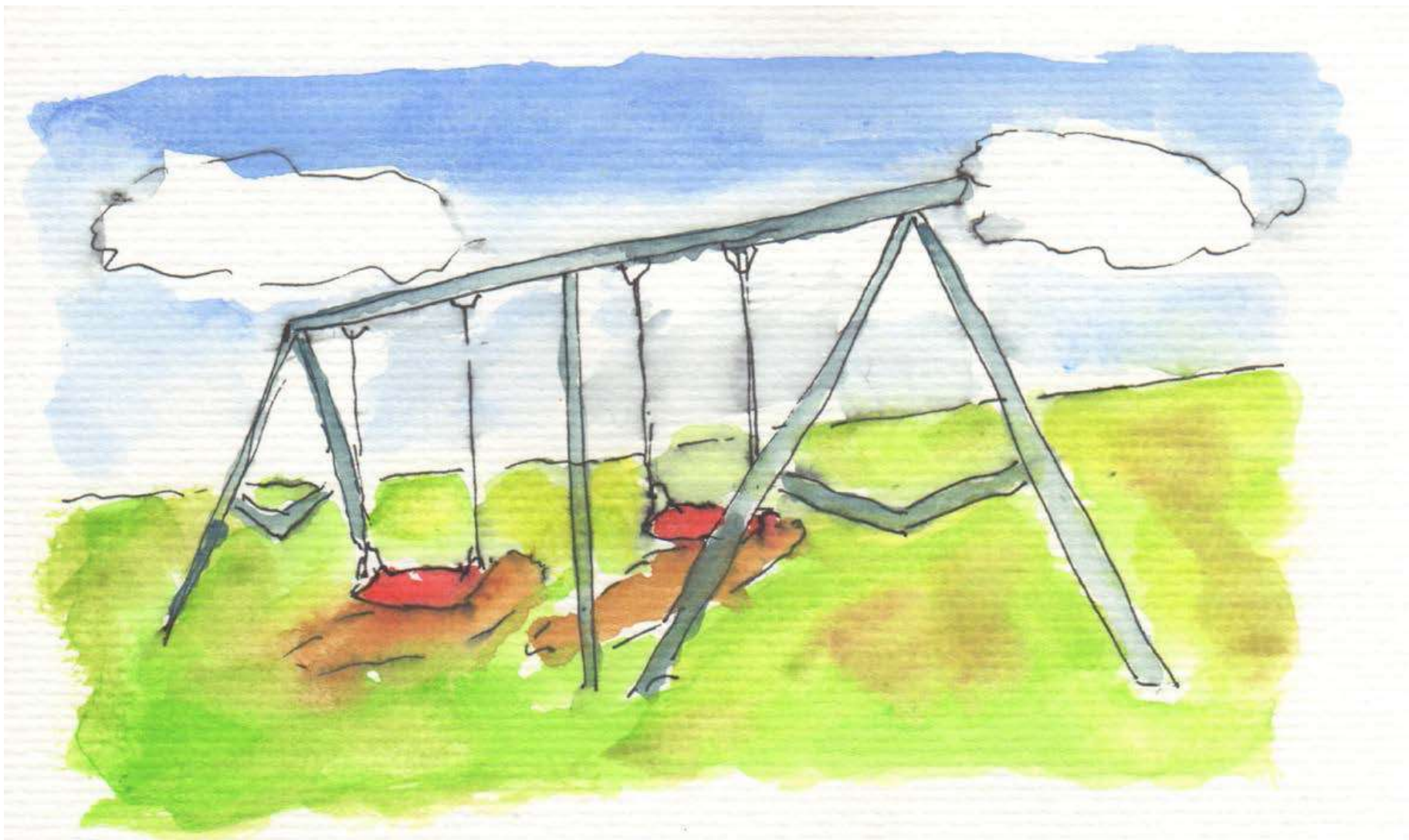
Models of climate  
improve with time and details . . .  
capture big patterns.

MODELS



Recent air warming  
slowed by volcanoes and sun?  
Seas sequester heat.

A PAUSE



THE FUTURE

Forty years from now  
children will live in a world  
shaped by our choices.

**we must ensure that these kids become  
“stakeholders of Africa”**



# *The Berlin Wall 2.0*



# Earth Stewardship needs Disruptive Innovation

6 habits of mind that characterize disruptive innovators:

- Associating
- Questioning
- Observing
- Networking
- Experimenting
- Multi-tasking

Innovation —Can it be learned?  
*Innovators excel at connecting seemingly unconnected things*  
Creative associations come from broadening your experiences

**The best innovators are T-Shaped : they need to have depth in one area and breath in lots**

**The taste for questions is linked to a talent for observation**  
**Why aren't things done differently?**

Language and SMS  
Physics for Poets/DNA for the Arts  
The complexity of sound/music  
The economics of nature  
The business of waste  
The ethics of living  
Ill-being and environmental decay  
The communication revolution & mobile learning  
The networking society  
Experiments and self-assembly

# Some questions

- How do societies fail or survive?
- Where do we come from; how did everything begin?
- **How resilient is Earth to impacts of human activities?**
- What are the boundaries of a safe operating space for humanity?
- Does social stability depend on natural resources?
- What can we learn from the past?
- Is intergenerational equity attainable/desirable?
- **How might democracy evolve in a system that also votes for other species?**
- Can technology provide sustainable solutions for an ailing planet?
- **How can we distil reliable scientific information out of social noise?**
- Is something profoundly wrong with the way we live today?
- **How do we know where the end begins?**

# What counts for the new university student?

- Engagement through an enabling and efficient support system
- **Ethics and values; are there limits?**
- Knowledge about truth-value of statements, what counts as knowledge and how it can be validated (epistemic cognition )
- Understand accuracy, precision and uncertainty in observations, measurements, projections, models, risks
- **Not what you cover, but what you uncover and discover**
- **Questions never thought to ask or respond to before**
- Knowing about knowing (metacognition)
- Emergence of infectious curiosity and discovery
- Engaging sense of wonder and responsibility
- Transcending cultural and intellectual boundaries: **ArtScience**
- **Discovering alternatives to the way people live globally**
- A rich language for thinking and cultivating disposition of inquiry
- Learning about learning (deep transformational approach to learning)
- Sharing the joy of learning and the language of learning
- Grasping the essence of **Consilience** - the unity of knowledge

# Listen to the voices of experience

- **You** must draw on a much broader range of knowledge and stakeholders
- Simply generating and communicating scientific knowledge is not sufficient to combat biodiversity loss
- If people are seen as major contributors to climate evolution and loss of biodiversity then people behaviour and attitude must be a major part of the solutions — **in the language of the social sciences.**