GLOBALLY-INTERCONNECTED CIVILIZATION
BALANCING NATIONAL AND COMMON INTERESTS

Nation
State
~30%

National Interests

International
Spaces
~70%

Common Interests

PROF. PAUL ARTHUR BERKMAN
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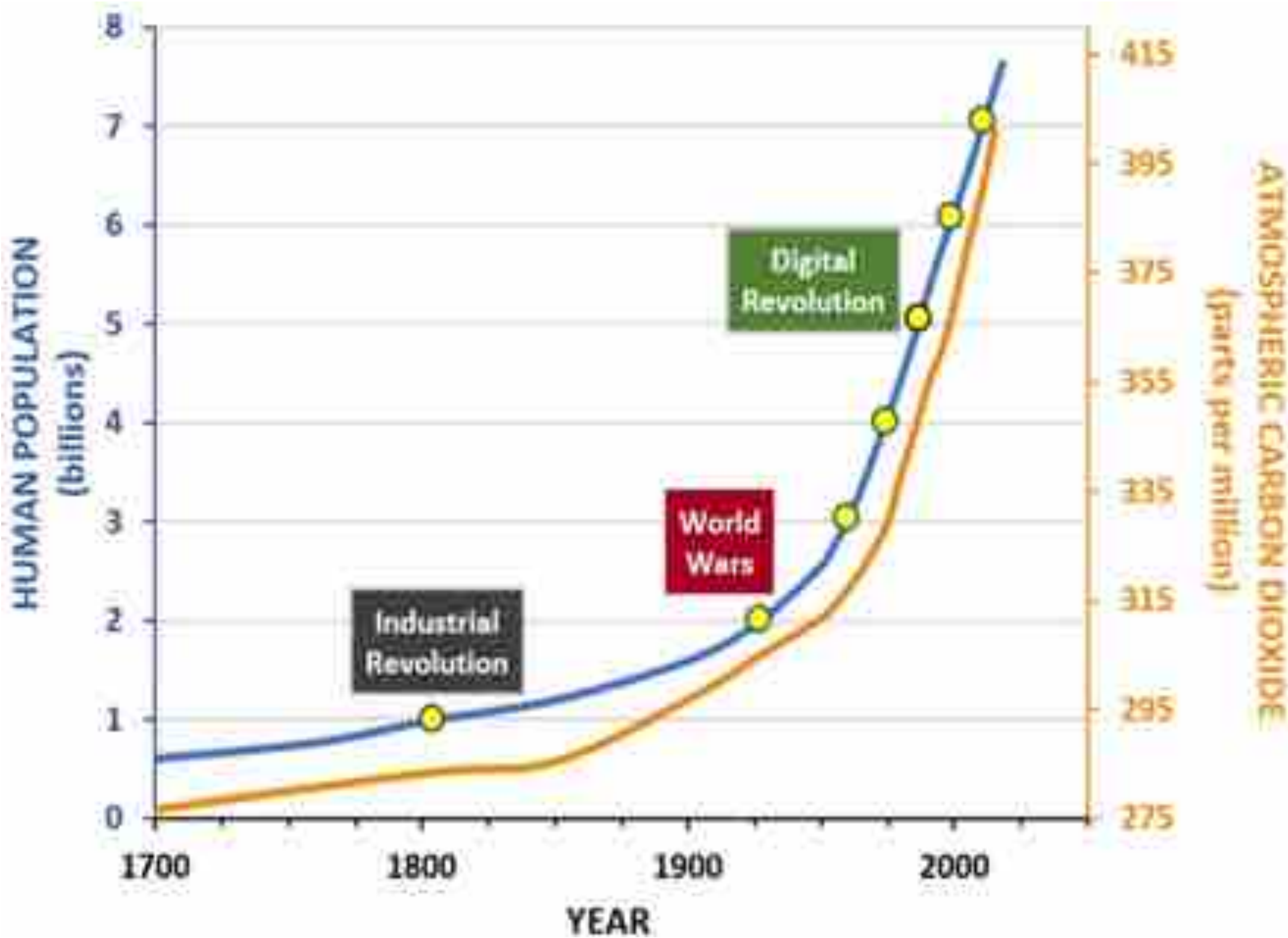
Planetary Symbiosis of Humanity



POLICY FORUM

SCIENCE DIPLOMACY

The Arctic Science Agreement propels science diplomacy

Amid geopolitical tension, science aligns common interests

By Paul Arthur Berkman,[1] Lars Kullerud,[2] Allen Pope,[3] Alexander N. Vylegzhanin,[4] Oran R. Young[5]

Global geopolitics are fueling the renewal of East-West tensions, with deteriorating U.S.-Russia relations in the wake of conflicts in Ukraine and Syria, issues involving cyber-security, and broader concerns about expanding militarization. Against this backdrop, the Agreement on Enhancing International Arctic Scientific Cooperation, signed on 11 May 2017 by foreign ministers of the eight Arctic States, including the U.S. and Russia, as well as Greenland and the Faroe Is-

for marine, terrestrial, and atmospheric research on a pan-Arctic scale.

The agreement aims to improve use of existing infrastructures that were previously unavailable; enable new movement of researchers, students, equipment, and materials; promote sharing of data and metadata in ways that were not previously possible; and encourage holders of traditional and local knowledge to participate in scientific activities across territories (see the map). The science community, working through the organizations representing it in the Arctic Council, including IASC, the University of the Arctic (UArctic), and the International Arctic Social Sciences Association (IASSA),

Science 3 November 2017 • Vol 358 Issue 6363

Science Diplomacy is an international, interdisciplinary and inclusive (holistic) process – involving informed decision-making – to balance national interests and common interests for the benefit of all on Earth across generations.

Globally-Interconnected Civilization

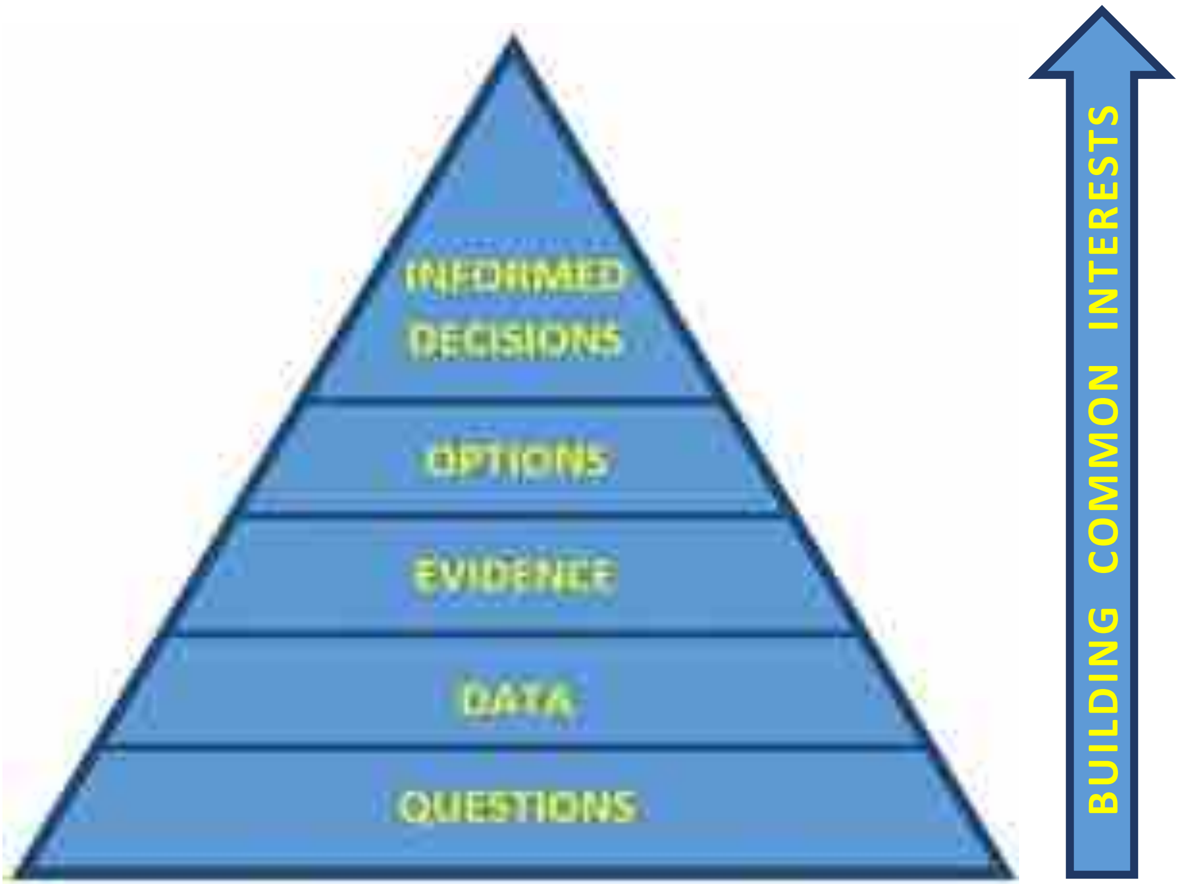
Urgencies exists simultaneously across security time scales (mitigating risks of political, economic, societal and environmental instabilities) and sustainability times scales (balancing societal, economic and environmental elements across generations) that must be addressed by nations and peoples individually and collectively.

THEORY OF INFORMED DECISION-MAKING

Proposition: Informed Decisions Operate Across a 'Continuum of Urgencies'

Global-Local Implementation

Contributing to Informed Decision-Making



SCIENCE is the 'study of change' – symbolized by the Greek letter delta (**Δ**).

Diplomacy – Options (Without Advocacy)

Decision-Support Process

Sustainability

[Stability, Balance and Resilience]

Environmental Protection, Economic Prosperity and Societal Well-being

Urgencies Today and Across Generations

National Interests and Common Interests

Promoting Cooperation and Preventing Conflict

Holistic Integration (Applying – Training – Refining)

TABLE 3: Holistic Dimensions of Science Diplomacy Reflect Categories of Questions with Science as the 'Study of Change' to Address Global-Local Sustainability with Informed Decision-Making (Figs. 1-3)

QUESTION CATEGORY FOR DECISION-MAKING*	HOLISTIC DIMENSIONS TO CONSIDER		
	International	Interdisciplinary	Inclusive
Science as an essential gauge of changes over time and space.			
Science as an instrument for Earth system monitoring and assessment.			
Science as an early warning system.			
Science as a determinant of public policy agendas.			
Science as an element of international legal institutions.			
Science as a source of invention and commercial enterprise.			
Science as an element of continuity in our global society.			
Science as a tool of diplomacy to build common interests among allies and adversaries alike.			

* Decisions involve governance mechanisms and built infrastructure (Table 1, Fig. 1), coupled for sustainability.

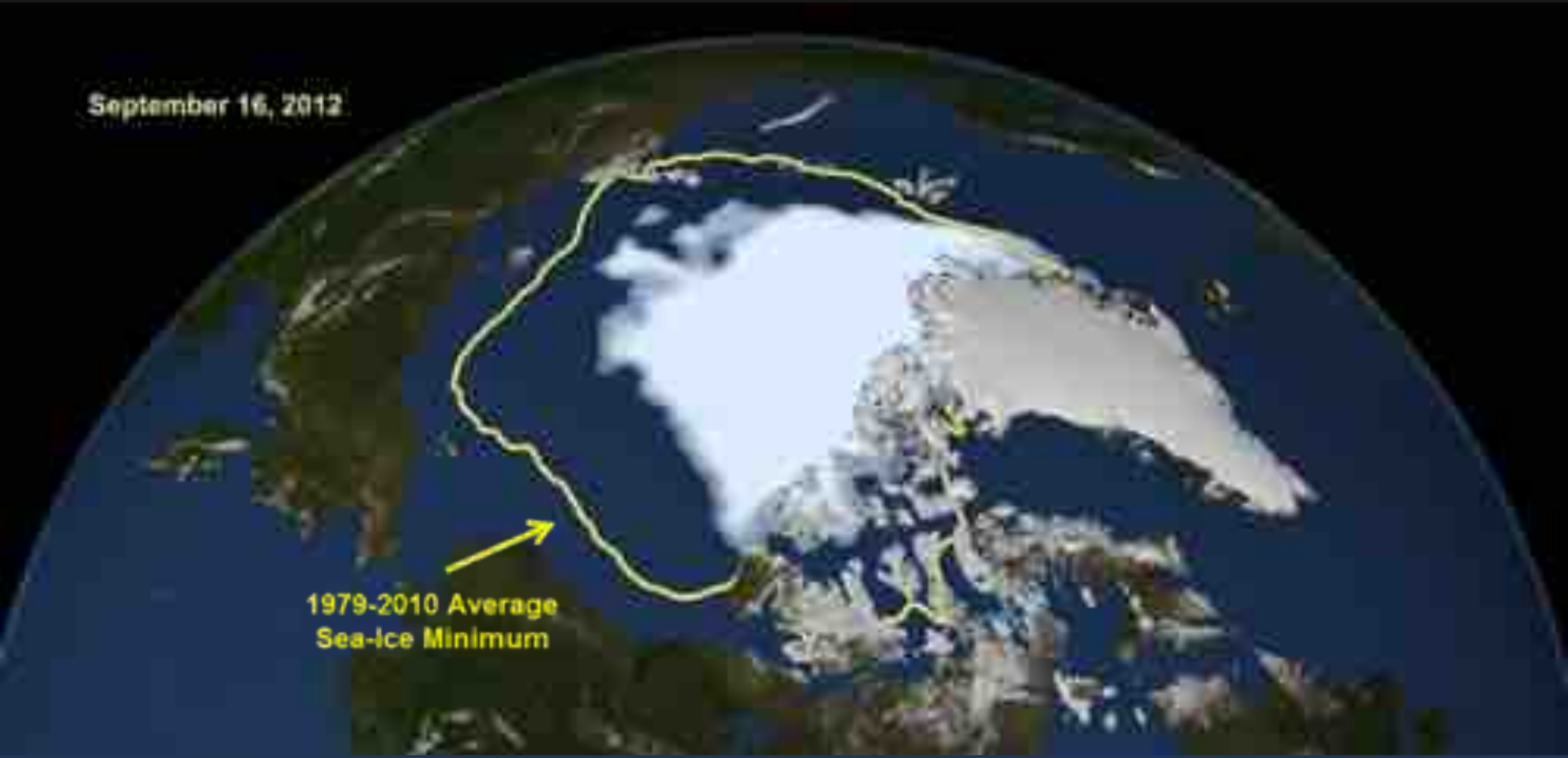
The Arctic Ocean System

HOLISTIC

NATURAL

SOCIAL

Questions: Impacts from Loss of Arctic Sea Ice



SURFACE BOUNDARY OF THE ARCTIC OCEAN HAS CHANGED

Persistent Sea-Ice Cap for Thousands of Years

Now Seasonally Ice-Free Sea (Summer >50% Open Water)

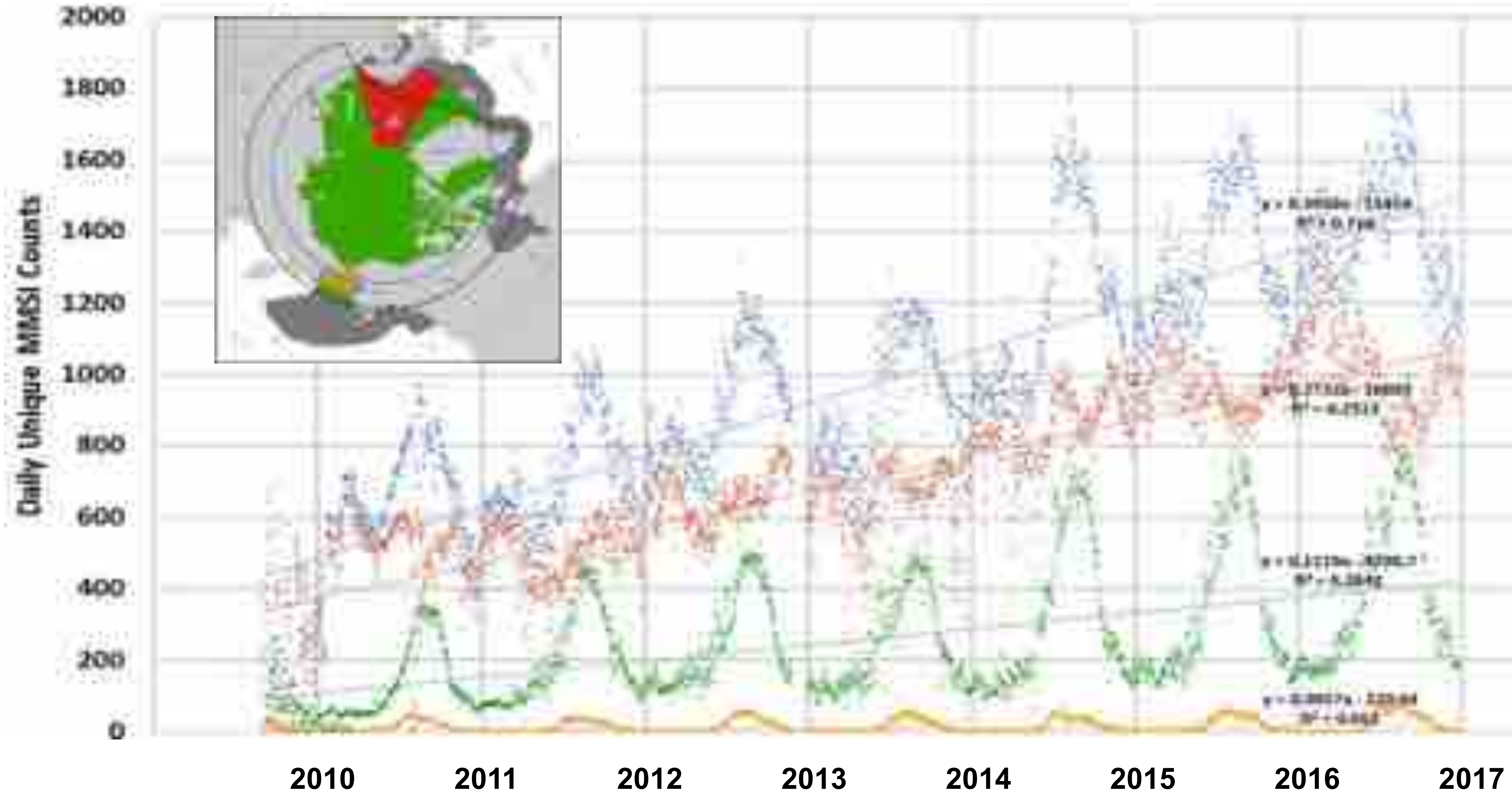
Risks of Instabilities (Economic, Political, Cultural, Environmental)

Data: Oldest Continuous Record of Arctic Marine Shipping

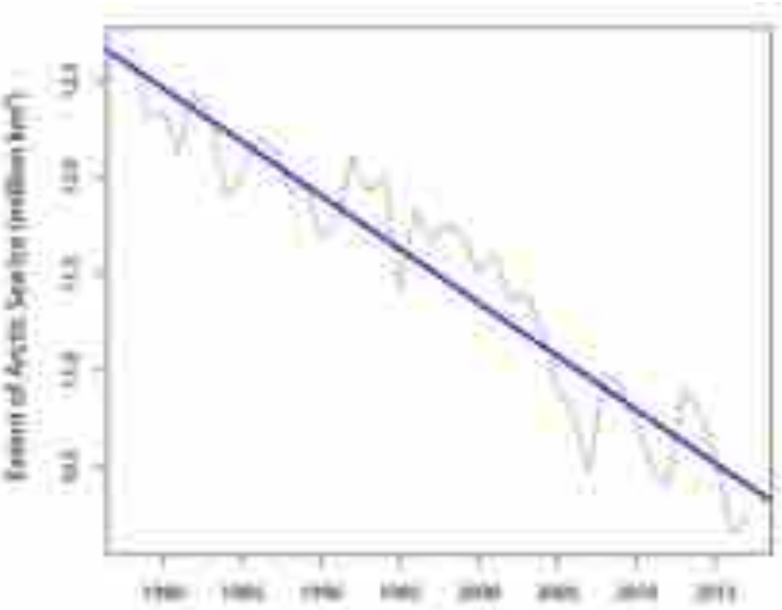
AUTOMATIC IDENTIFICATION SYSTEM (AIS) RECORDS FROM POLAR ORBITING SATELLITES

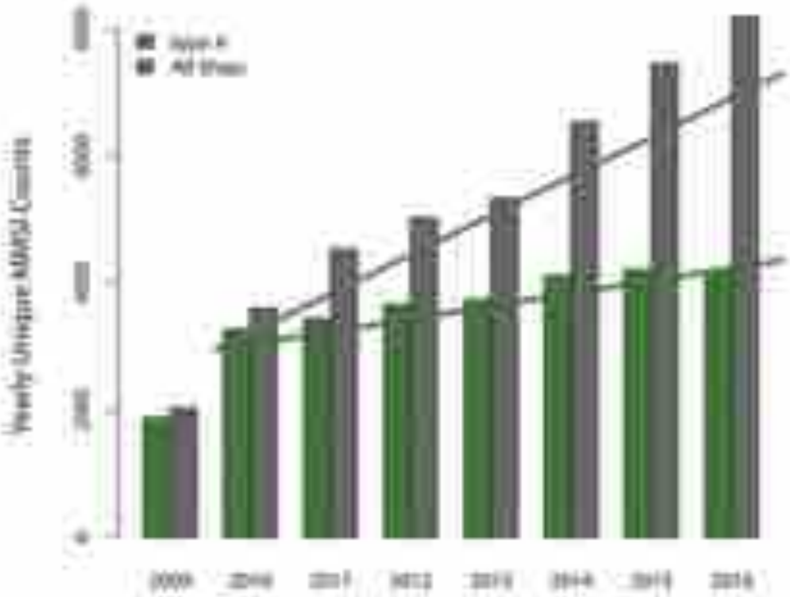
(1 SEPTEMBER 2009 – 31 DECEMBER 2016)

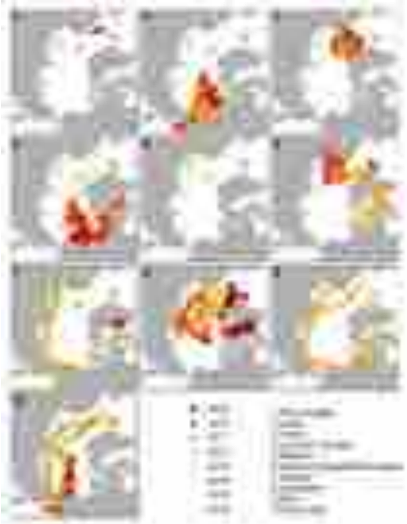
Synoptic – Pan-Arctic – Independent of Jurisdictions

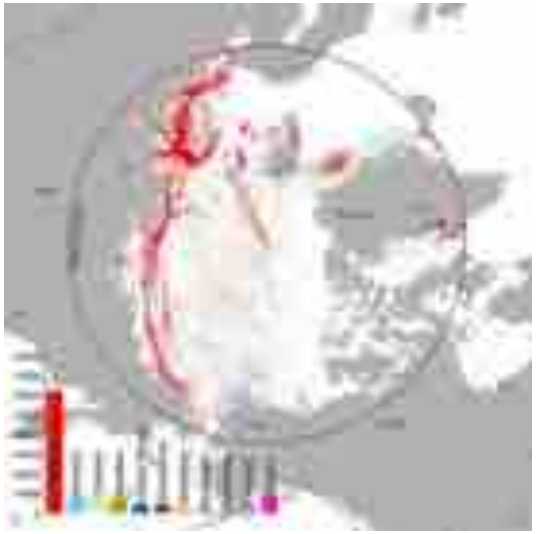


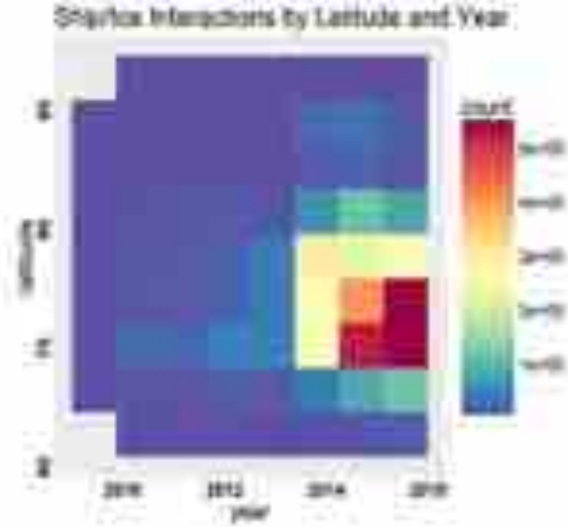
Data: Arctic Marine Shipping and Sea Ice







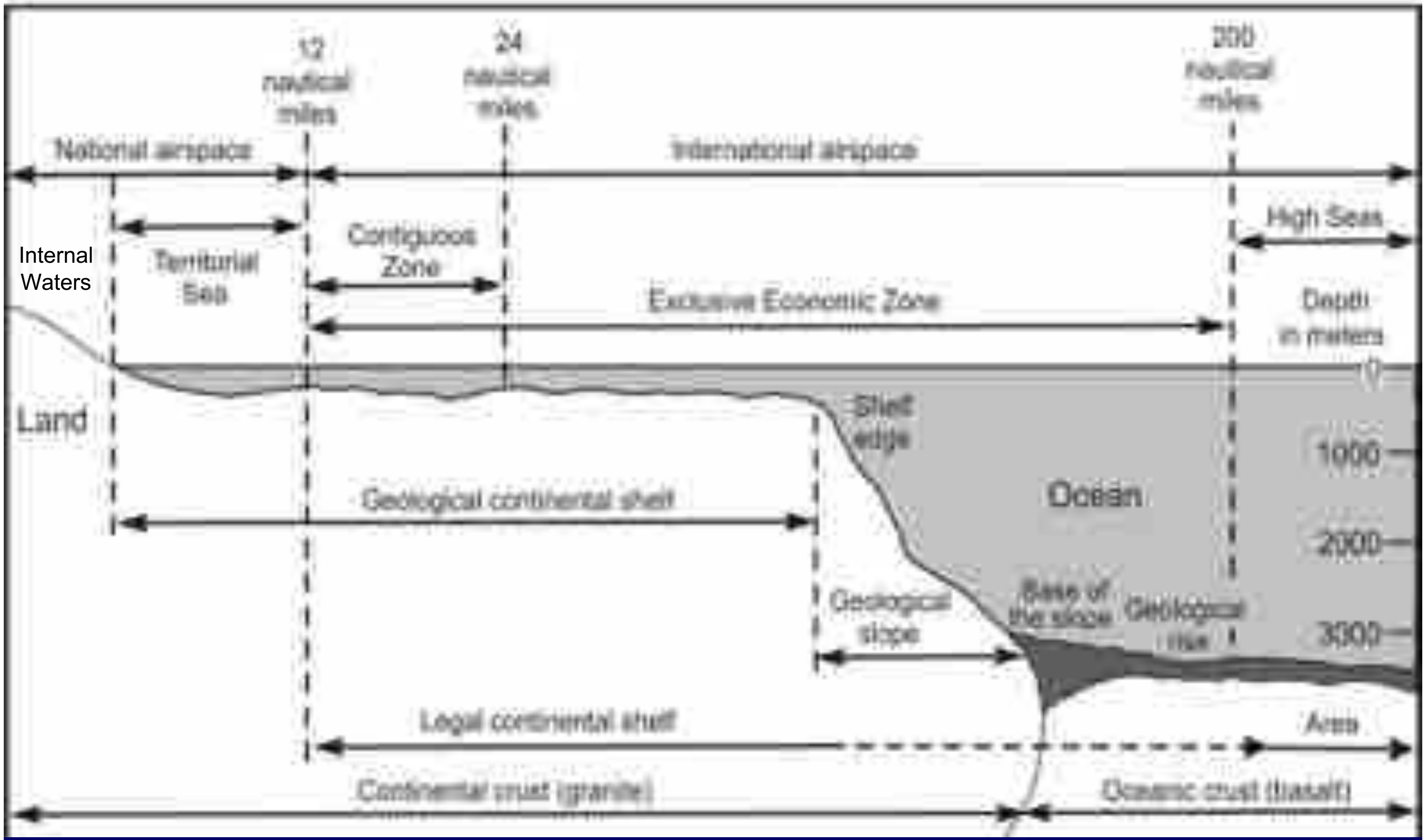




Evidence: Integrating Data with Decision-Making

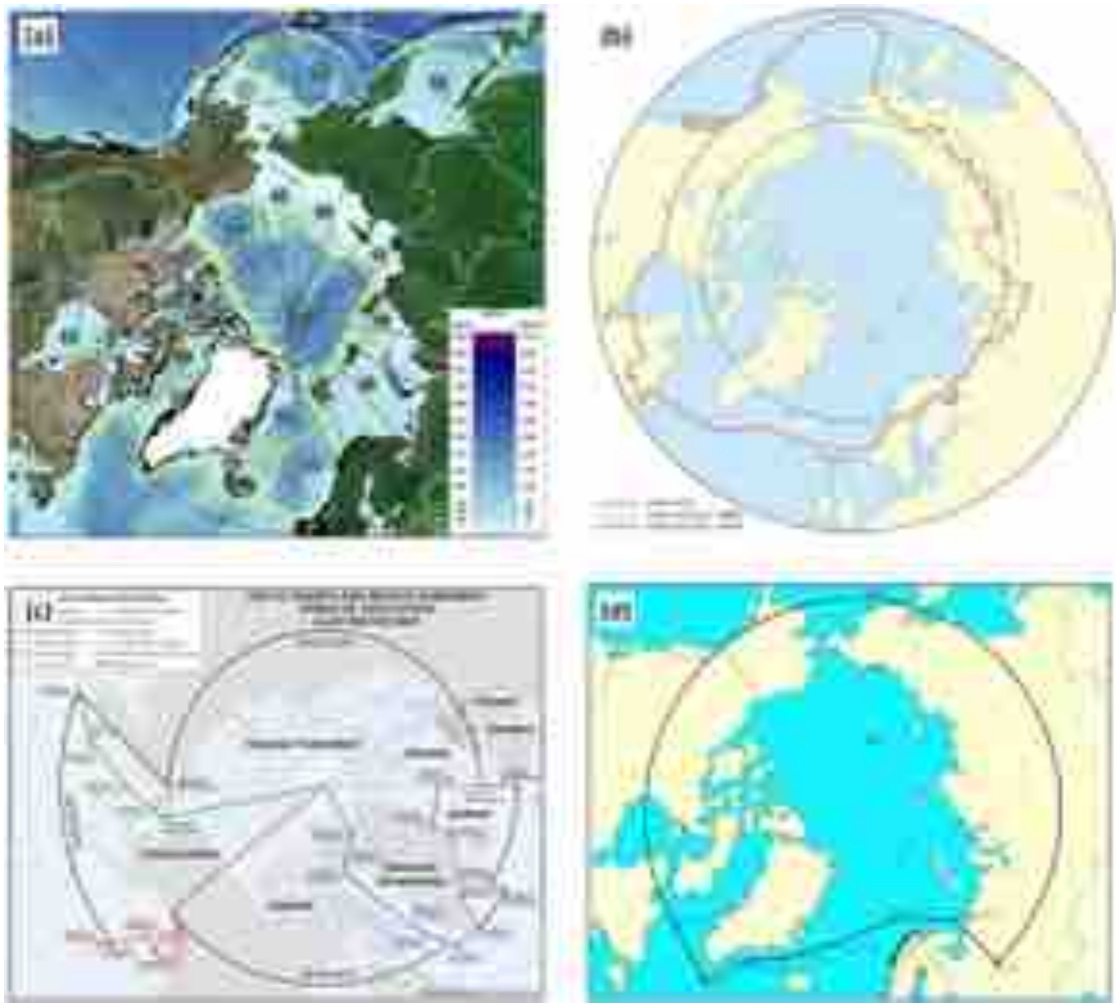
United Nations Convention on the Law of the Sea

Signed: Montego Bay, Jamaica, 10 December 1982
Entered into Force: 16 November 1994
Ratification, Accession or Succession: 155+ Nations

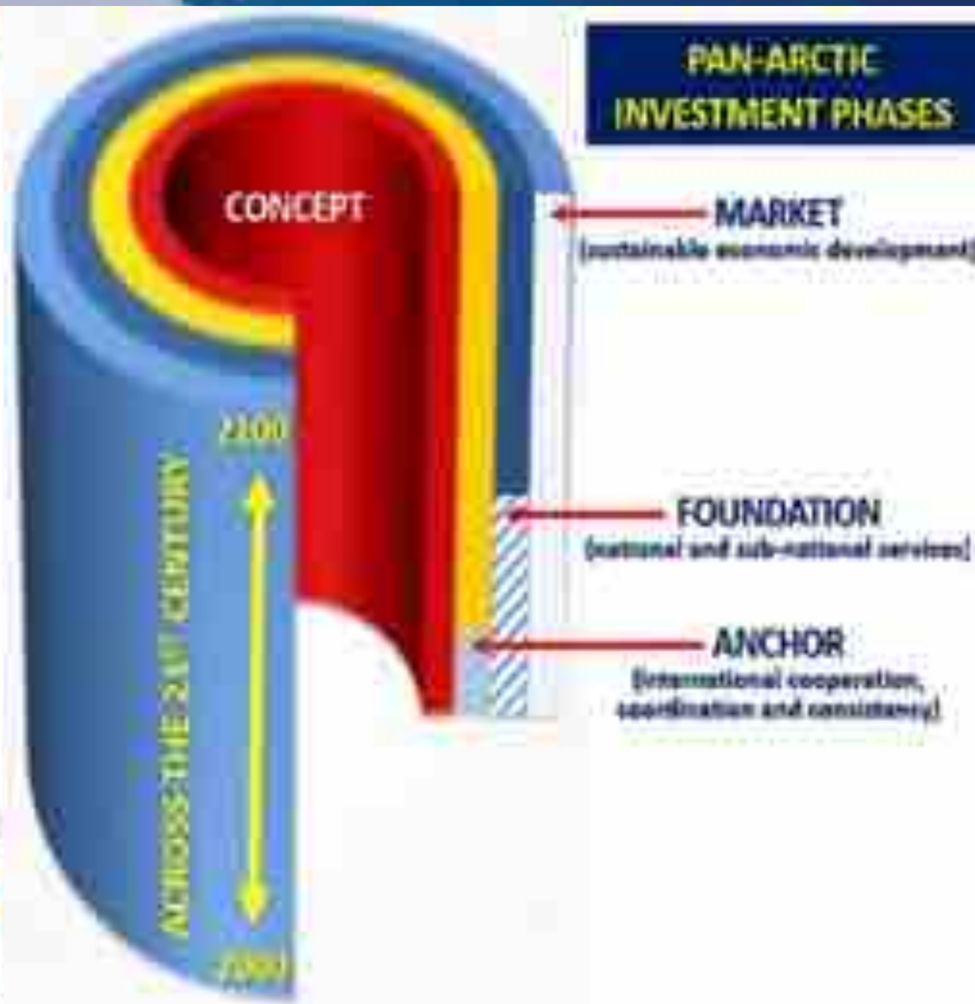


National Interests ⟷ **Common Interests**

Evidence: Understanding Institutional Boundaries



Options: Across a ‘Continuum of Urgencies’




Bloomberg

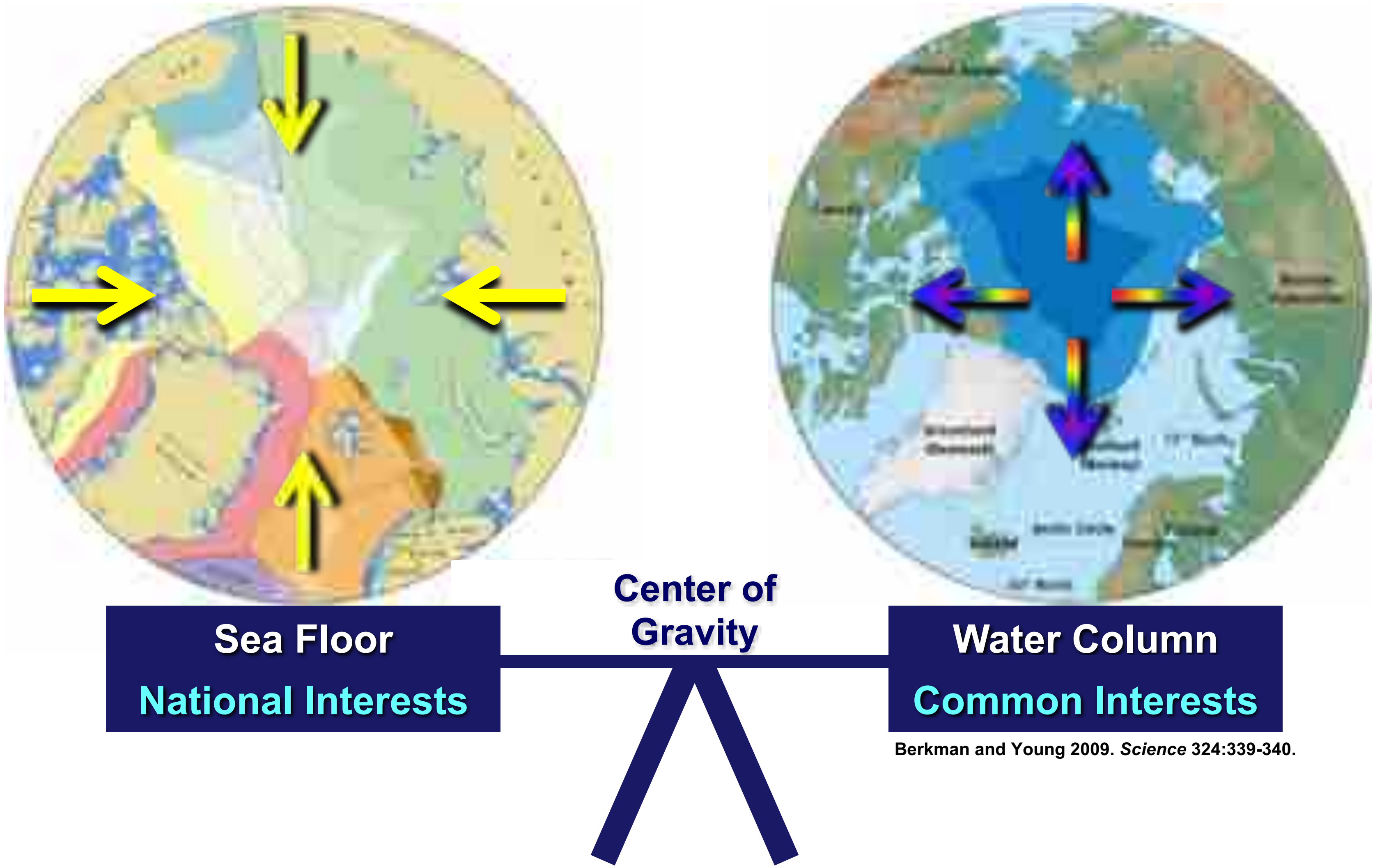
The World Has Discovered a $1 Trillion Ocean


WORLD ECONOMIC FORUM

Arctic Investment Protocol

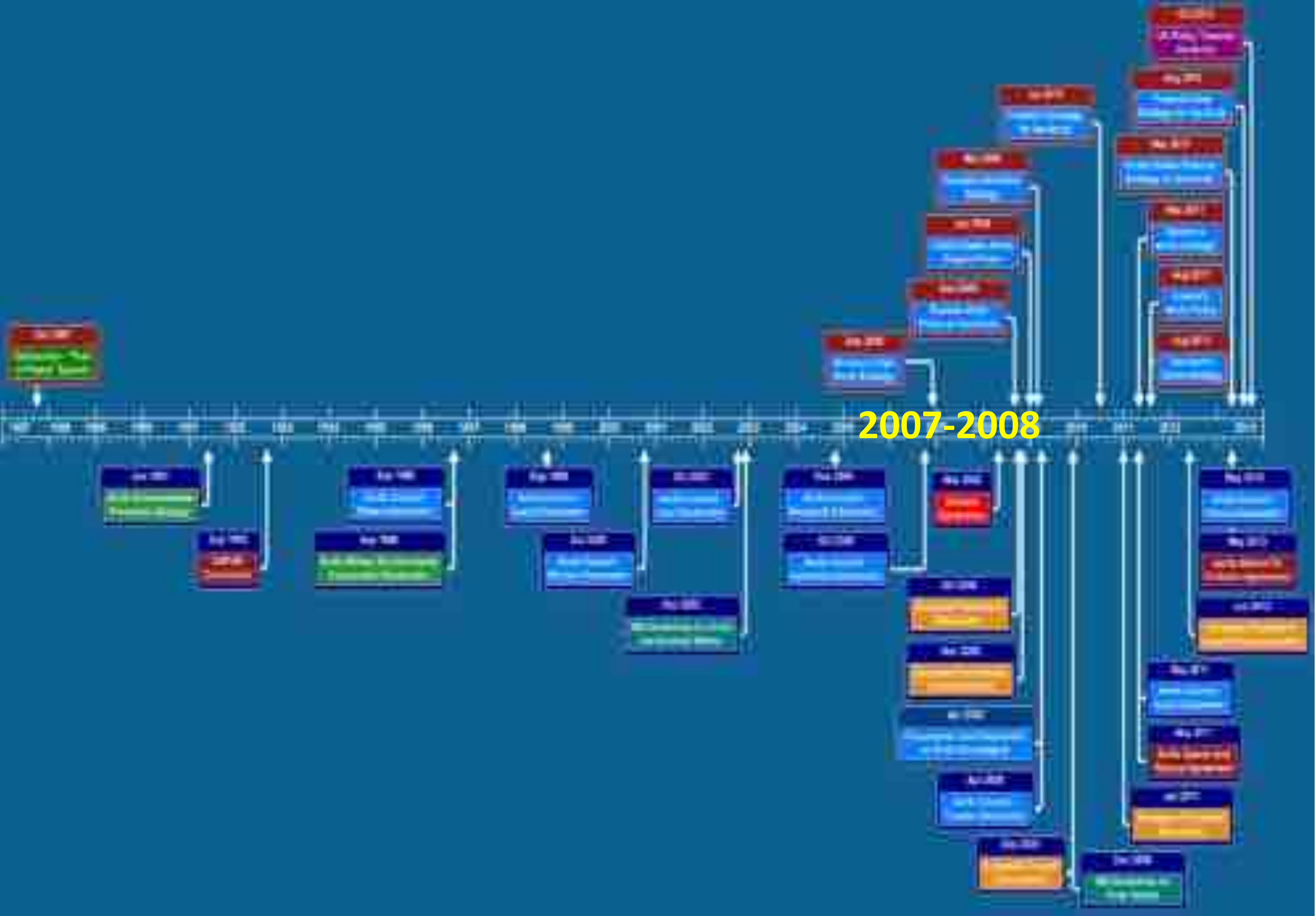
Guidelines for Responsible Investment in the Arctic

Options: Balancing National and Common Interests



Berkman and Young 2009. *Science* 324:339-340.

Informed Decisions: Pan-Arctic Sustainability



For the Benefit of all on Earth Across Generations

Climate Change Impacts in Cities

Robert ("Bob") Bornstein
Dept. of Meteorology
San Jose State University (SJSU)
with input from S. Baklanov (WMO), W. Dabberdt (Vaisala),
G. Ellis (Harvard), M. Ghandehari (NYU), S. Miao (IUM)

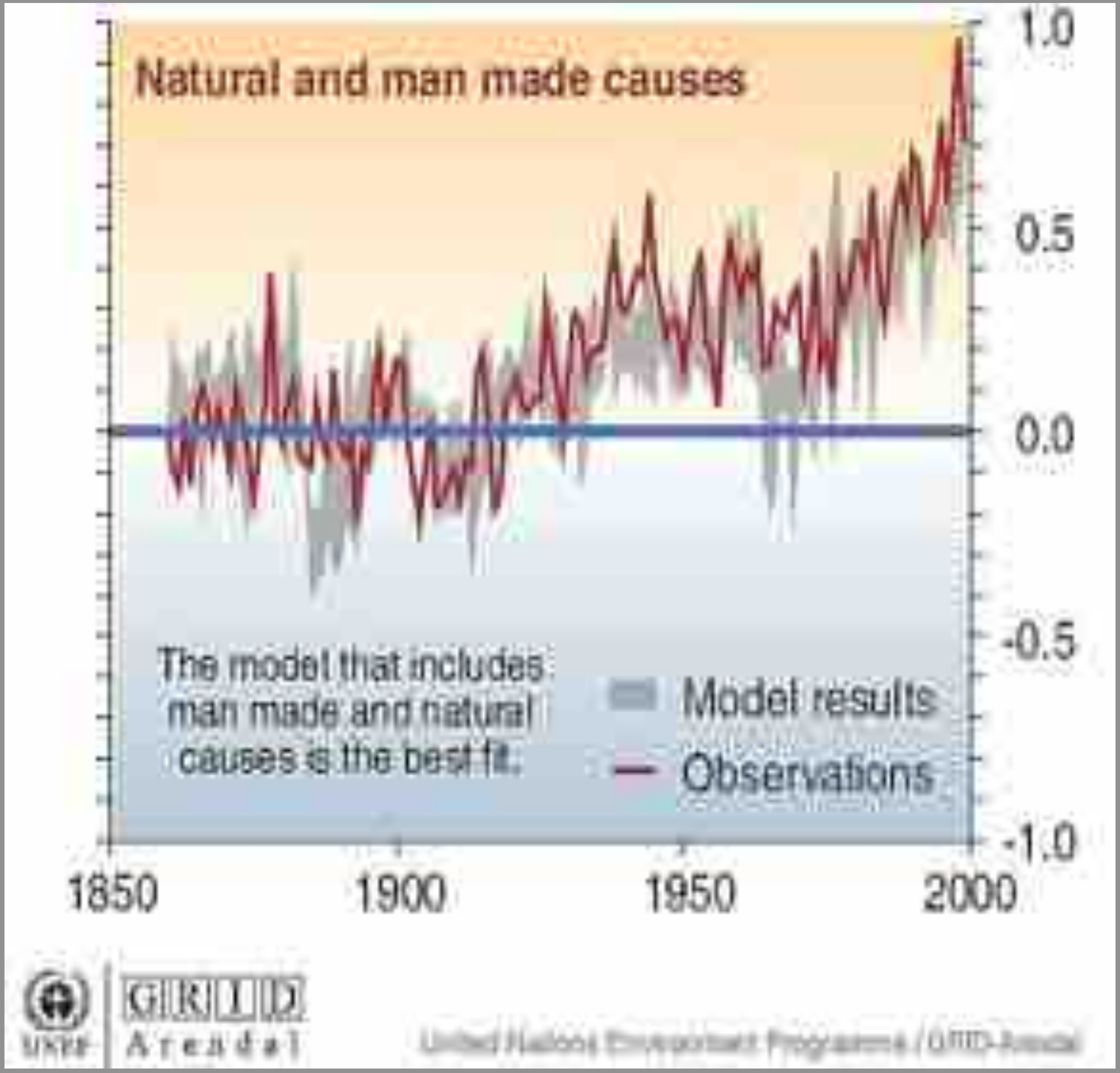
presented at the
2nd Sofia Earth Forum Symposium
Helsinki, Finland
31 October 2018

Outline

- My interests: 50 years of studying polluted urban atmospheres in changing climates in e.g., S. Paulo, Jerusalem, Athens, Mexico City, Beijing, Venice, S. Juan, L A, Atlanta, Houston, NYC

- Global climate-changes
- Urban climates
  - Causes
  - Coastal cities
  - Mega-cities
- Global & urban climate-change interactions
- The future

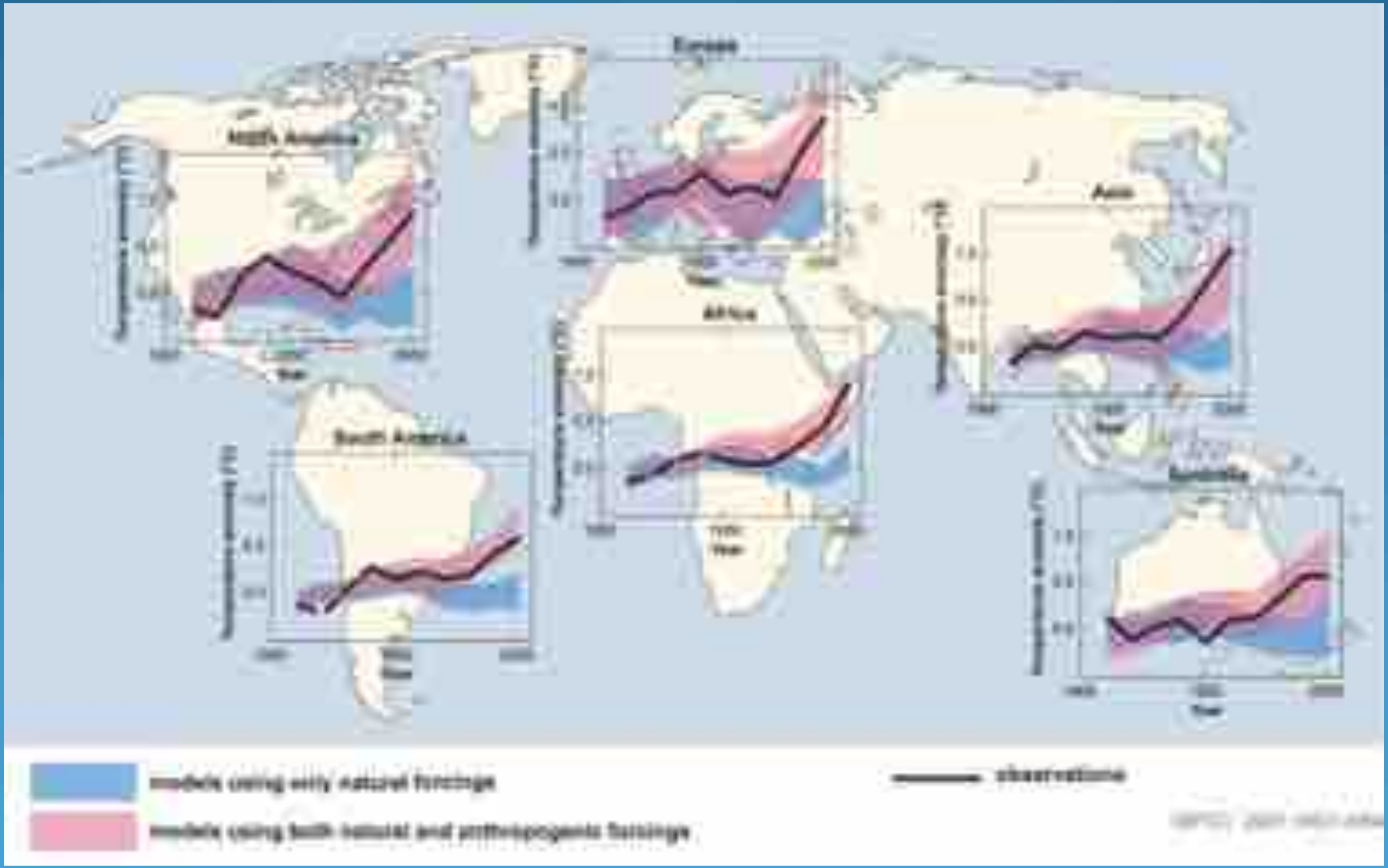
IPCC Modeled (grey) & Observed (red) Average Global-Temperature Trends (^0C): 1850-2000 Note: model results match observations, from W. Dabberdt, Vaisala



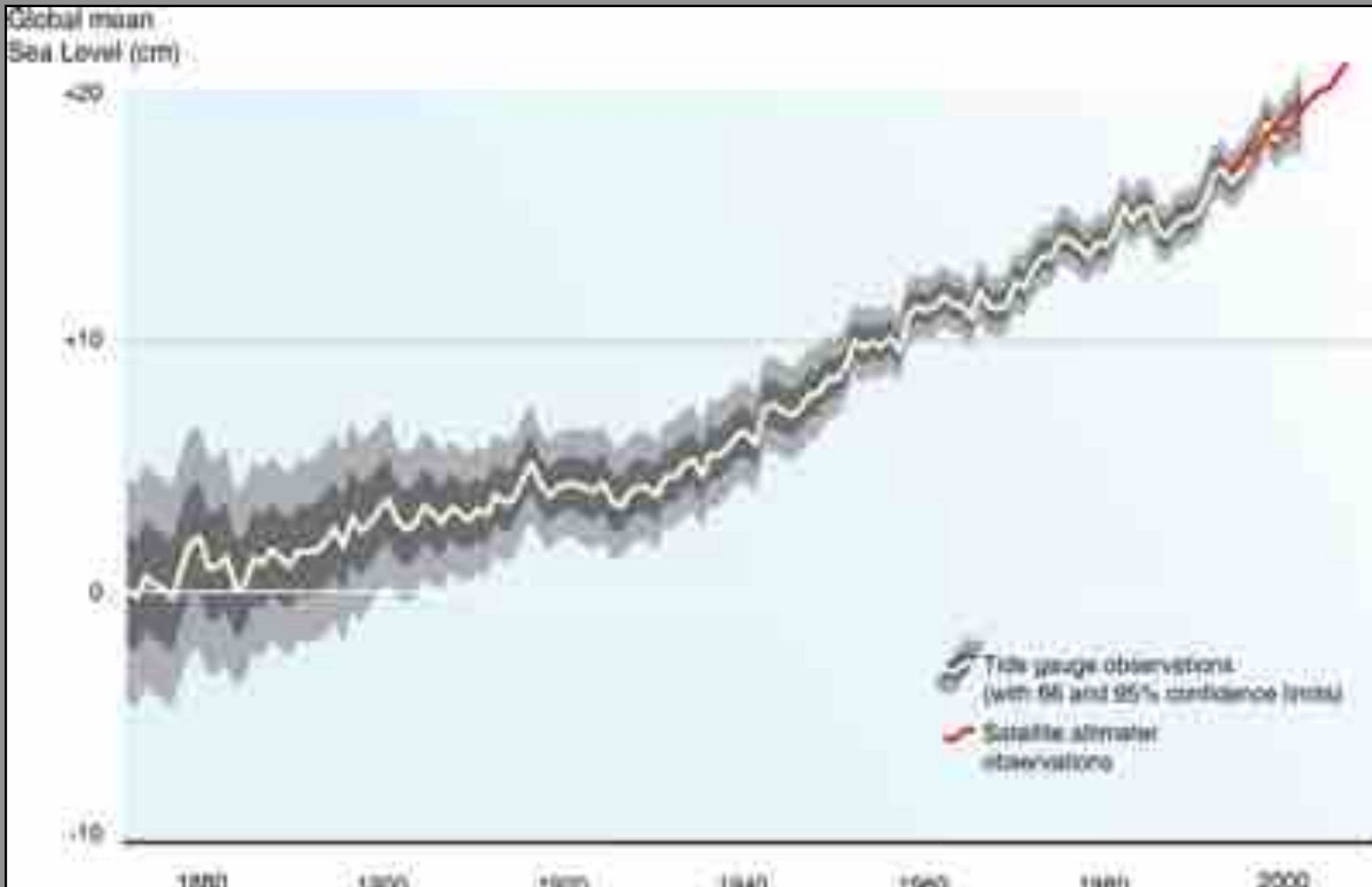
VAISALA

But the temperature-changes (total in pink & natural in blue) are not uniform over globe

Note: IPCC-model results show changes (^0C) due to humans dominate, & again match observations (black lines)



Trends in Observed Global Average Sea Level Rise (cm) 1870-2006 (also not uniform over globe, not shown)



Source: UNEP

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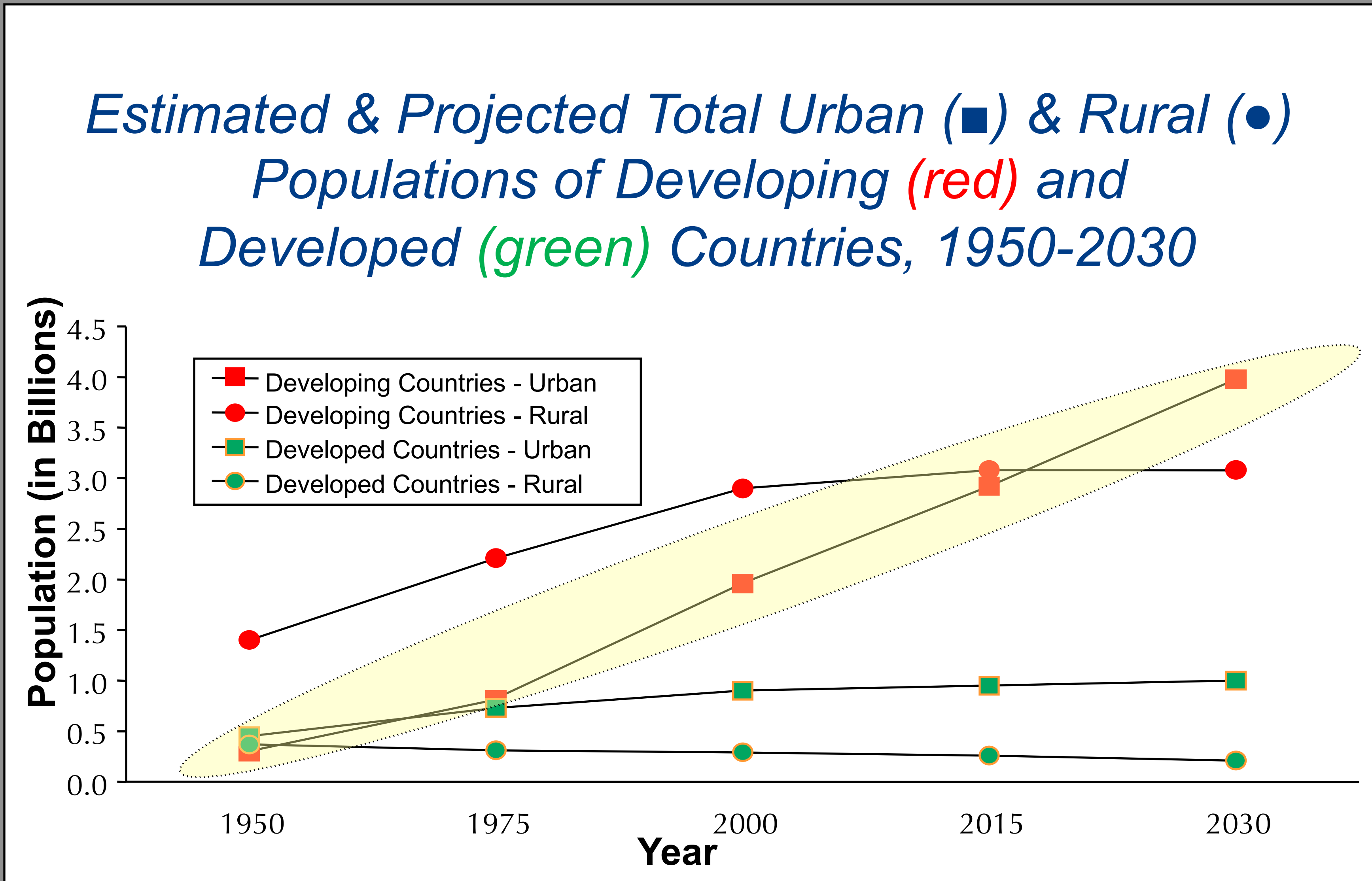
Global populations continue to move to cities



Original source: United Nations (2002)

Adapted from Hinrichsen, Salem and Blackburn (2002)

Producing in 40 years, more (up from 5 to 23) mega-cities (> 10 M) with ever-larger populations (up to 26 M)

City-1975	*Population*
Tokyo	*19.8*
New York	*15.9*
Shanghai	*11.4*
Mexico City	*11.2*
Sao Paulo	*10.0*
	68.3 (5)

City-2000	*Population*
Tokyo	*26.4*
Mexico City	*18.1*
Mumbai	*18.1*
Sao Paulo	*17.8*
Shanghai	*17.0*
New York	*16.6*
Lagos	*13.4*
Los Angeles	*13.1*
Kolkata	*12.9*
Buenos Aires	*12.6*
Dhaka	*12.3*
Karachi	*11.8*
Delhi	*11.7*
Jakarta	*11.0*
Osaka	*11.0*
Metro Manila	*10.9*
Beijing	*10.8*
Rio de Janeiro	*10.6*
Cairo	*10.6*
	266.7 (19)

City-2015	*Population*
Tokyo	*26.4*
Mumbai	*26.1*
Lagos	*23.2*
Dhaka	*21.1*
Sao Paulo	*20.4*
Karachi	*19.2*
Mexico City	*19.2*
Shanghai	*19.1*
New York	*17.4*
Jakarta	*17.3*
Kolkata	*17.3*
Delhi	*16.8*
Metro Manila	*14.8*
Los Angeles	*14.1*
Buenos Aires	*14.1*
Cairo	*13.8*
Istanbul	*12.5*
Beijing	*12.3*
Rio de Janeiro	*11.9*
Osaka	*11.0*
Tianjin	*10.7*
Hyderabad	*10.5*
Bangkok	*10.1*
	379.3 (23)

Source: UN Population Division, March 2000

2015: (most) blue = mostly developing world coastal cities (18)

green = inland cities (only 5)

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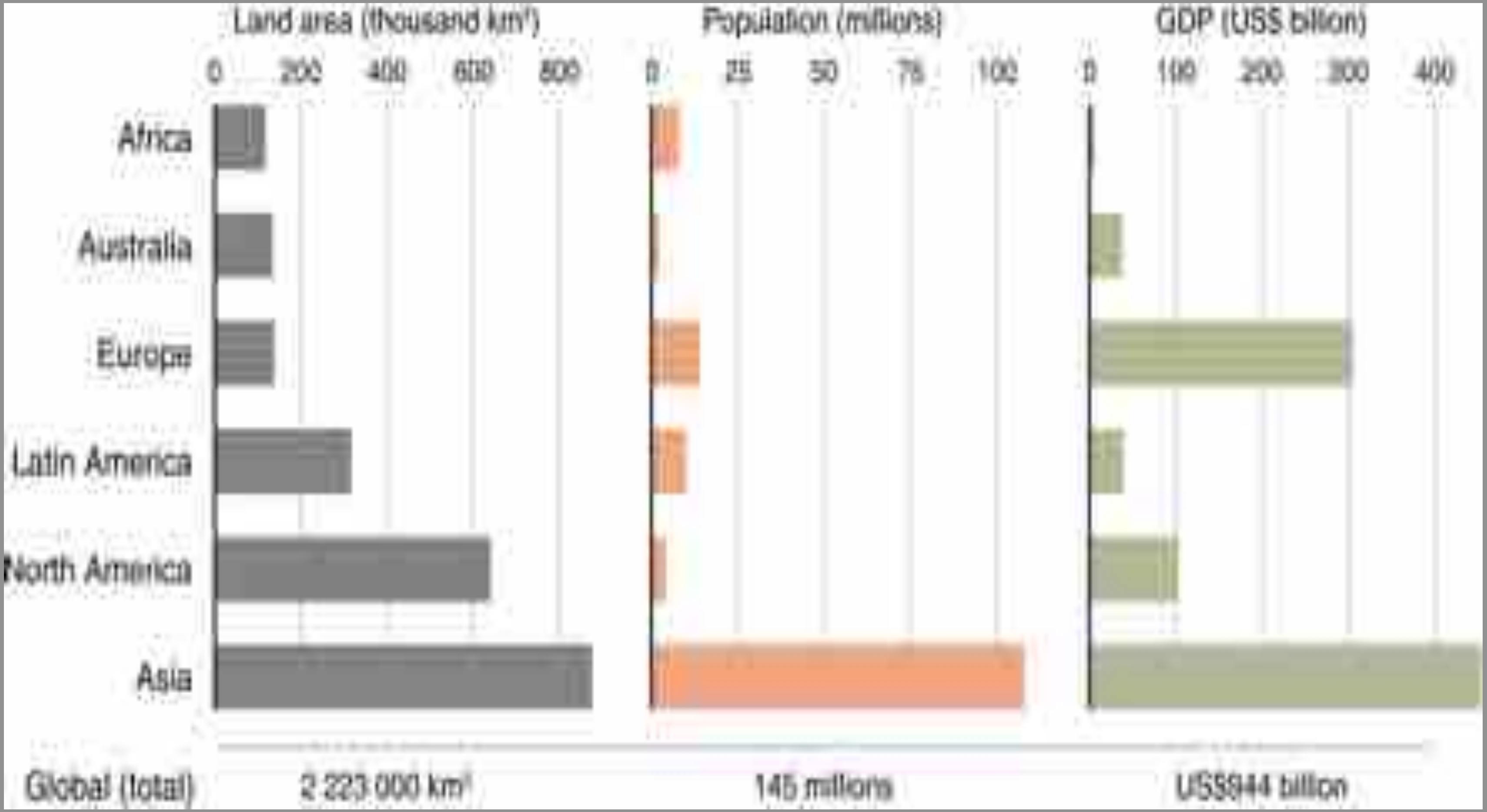
Cities with more than 1 million inhabitants (2006): many are in coastal locations

Note: 200 million people globally live in coastal elevations less than 1 m, while 10% live in at less than 10 m, and are thus at risk of coastal flooding

US coastal vulnerabilities & loses ($B), so far

Global Effects of a Future One-Meter Sea Level Rise (estimates, based on today's situation): Asia will have biggest loses



Source: UNEP

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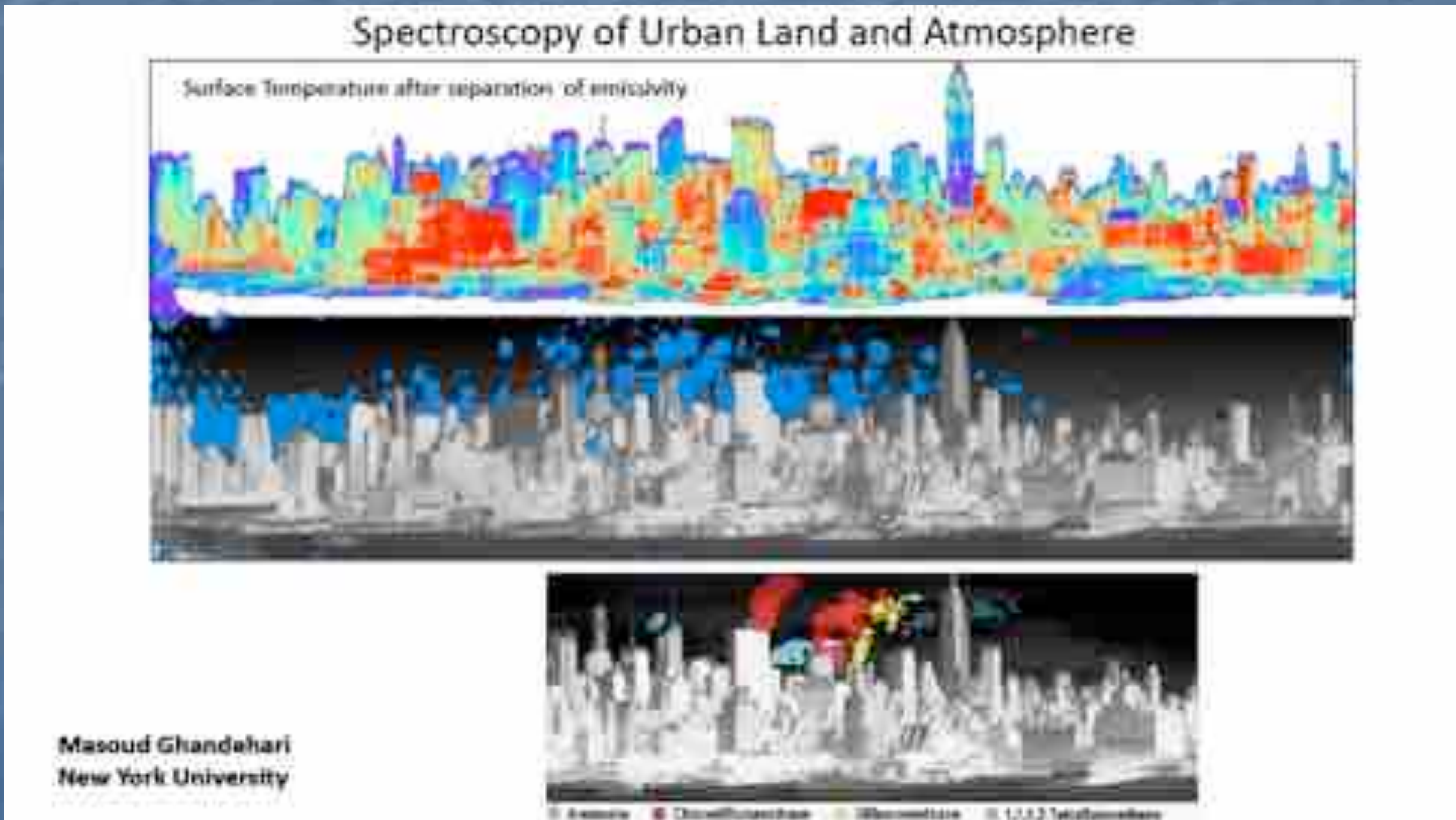
Part 2: Some causes of the unique & complex climates in cities

- Grass & soil become concrete & buildings → altered surface energy- & moisture-balances
- Fossil-fuels → heat & pollution
- Buildings & air pollution which
  - decrease sunlight → cooler cities
  - but trap heat from the earth at night → warmer cities, with urban heat islands (UHIs), which intensify GHG regional-warming

Observed complex NYC-building urban heat islands & pollutant plumes emitted from rooftop-sources (new technique by M. Ghandehari, NYU)

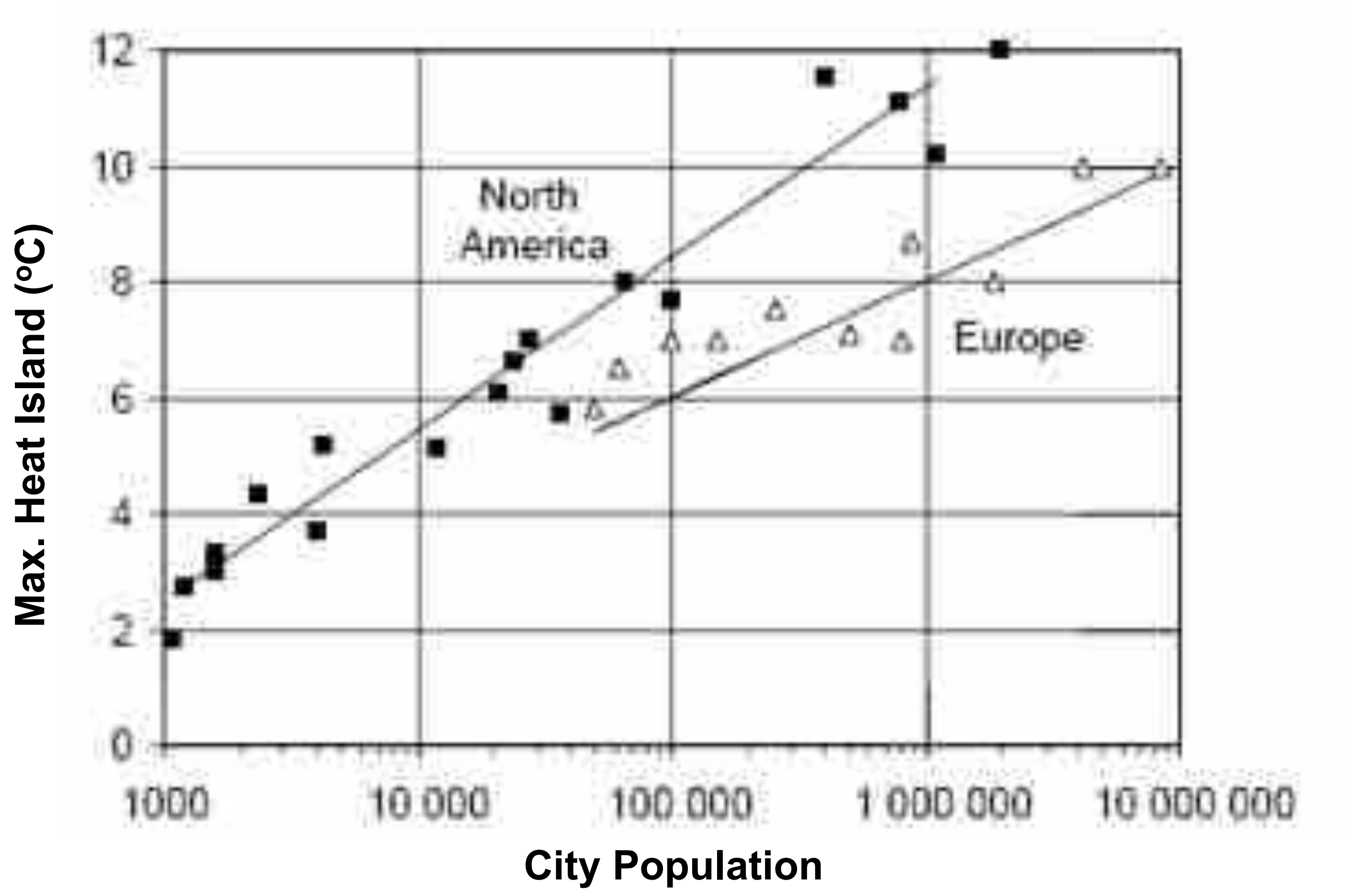


From WMO: Increased Natural & Man-Made Hazards & Risks Exist in Urban Environments

- Poor air quality & peak pollution episodes
- Heat waves (+ UHIs) → human thermal-stress
- Storm flooding & sea-level rise
- Hurricanes, typhoons, & extreme local-winds
- Wild fires, and sand & dust storms

- These exacerbate problems for urban
  - public health
  - energy & water sustainability
- These are also intensified by climate-change

and maximum Urban Heat Island values increase with urban population, i.e., 10^{0}C for cities of 10 million



Source: Oke (1981): *J. Climatol.*, 1, 237-254

thus, recent Heat-Wave mortalities

Event	Year	Location	Approximate Fatalities
Heat wave	1987	Athens	900
Heat wave	1995	Chicago	700
Heat wave	2003	France N. Europe	15 000 30 000

Source: Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond (2007)

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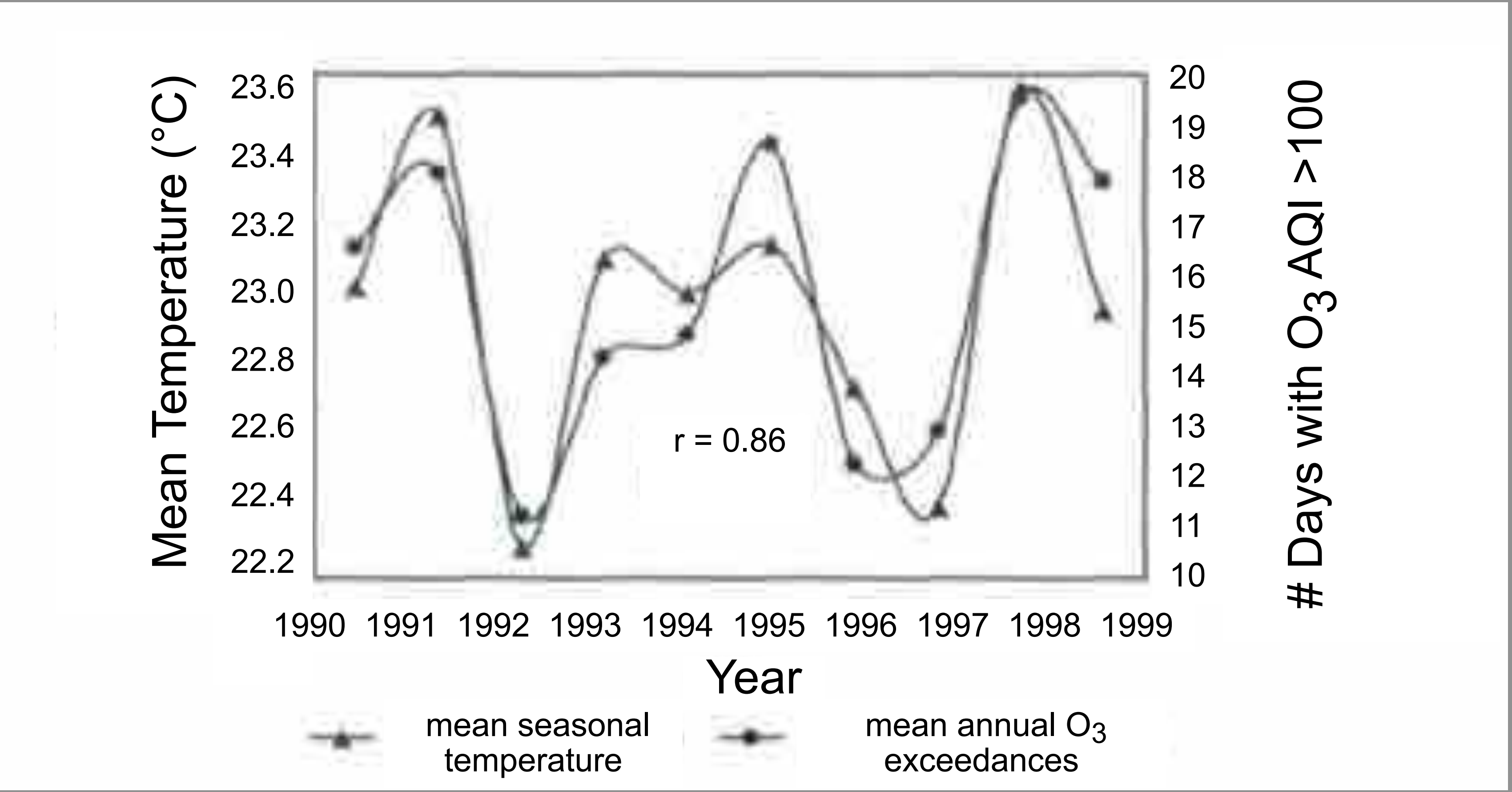
and ozone episodes (AQI > 100) follow average urban temperature (^{0}C), e.g., for a US city just an increase of 1.4^{0}C doubles bad days!



source: NOAA

WMO (2017) Report (it is online):
“Atlas on Children’s Health and the environment”
Note: Most deaths are developing-world cities

livemint

1.7 million children die every year due to polluted environment: WHO

While 570,000 children under five years of age die from respiratory infections such as pneumonia, 361,000 children die due to diarrhoea, says WHO report

Mayank Aggarwal

MORE FROM POLITICS »

Narendra Modi to sound poll bugle at Statue of Unity inauguration today

Environmental Injustice: Variations exist within a city, e.g., babies in Philadelphia (US) zip-codes only 5 miles apart face up to a 20-year difference in life expectancy, not all due to air quality! via G. Ellis

Note: One-in-six people in world live in squatter cities

WMO-IUWECS Program: Translating Research to Improved Urban Environmental-Services (via S. Baklanov, + next two slides)

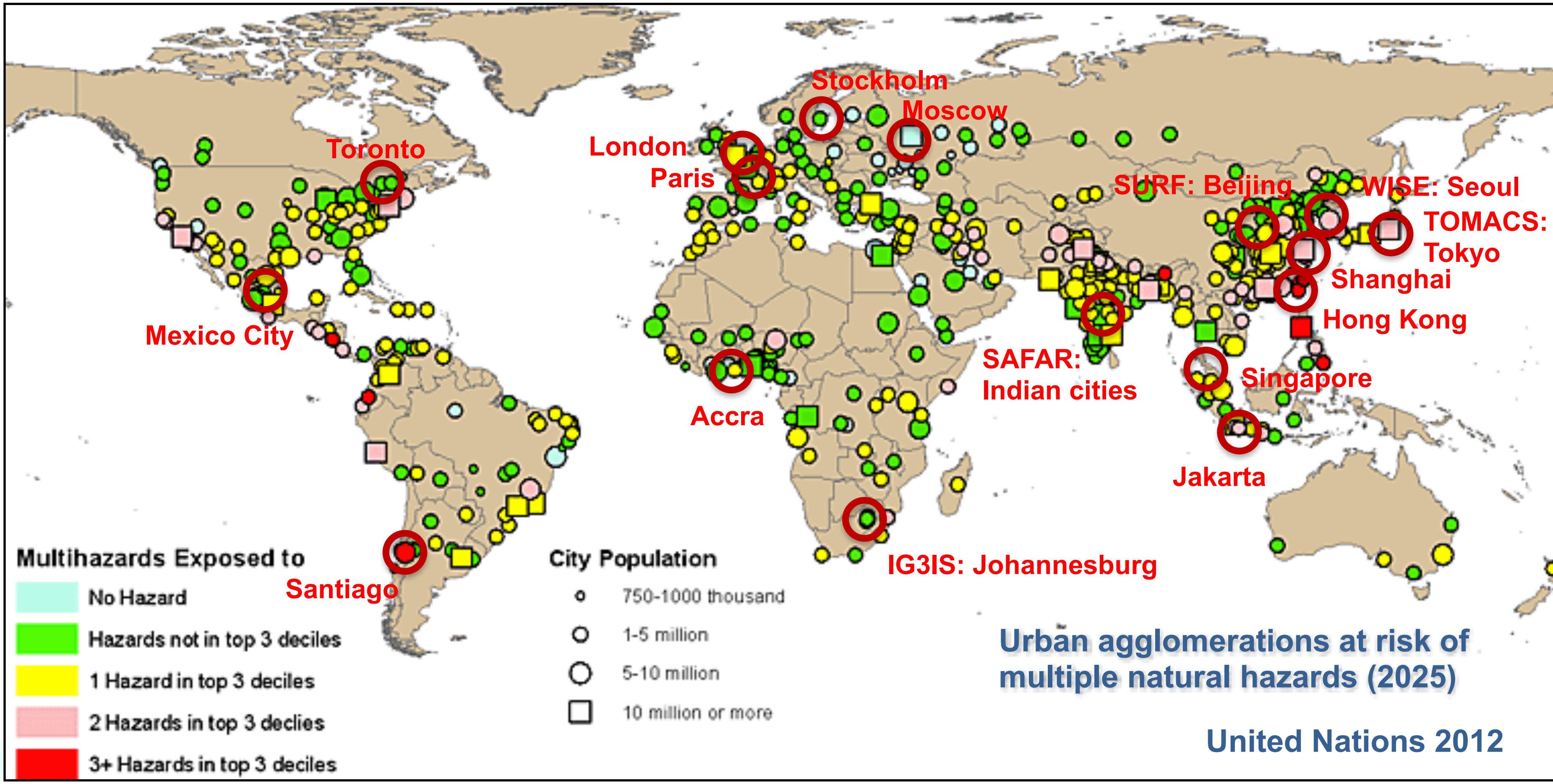
- **Multi-purpose**: forecasting, re-search, planning, mitigation
- **Multi-threat**: severe weather, air quality, floods, climate change, natural hazards
- **Multi-scale:** urban, neighbour-hood, street canyon, building
- **Multi-variable:** weather, chem-icals, hydrological, biometeor-ological, ecological
- **Multi-tool/platform**: ground-based, airborne, satellite
- **Multi-links:** between all as-pects, using big-data & models

Tan et al., 2015

WMO OMM

Better communications of impacts & risks

IUWECS pilot projects & demonstration cities (in red), with the Beijing-SURF project as one I work on



WMO Messages: New cities and countries are welcome.
Bring Integrated Urban Services to your city!

WMO OMM

Summary: Challenges to implementation of IUWECS

- Understanding impacts of cities on: severe weather, climate, water, energy, & natural environments
- Understanding impacts of changing climates: on cities, and on their adaptation & mitigation strategies
- Understanding "critical-limit" climate-change values
- Development of: Integrated Decision Support-Systems
- Multidisciplinary: communication & risk management
- Evaluation of new: integrated-systems & services
- New, targeted, and customized: delivery-platforms

WMO OMM

So, cities are major contributors to global climate change, but can be major combatants against climate change via reducing their GHG emissions!
The Economist (9/15/18) shows Golden Gate Bridge in my home town.

Local government v global warming

Climate Change Impacts in Cities, for the Unborn Children…

Robert ("Bob") Bornstein
Dept. of Meteorology
San Jose State University (SJSU)

with input from S. Baklanov (WMO), W. Dabberdt (Vaisala), G. Ellis (Harvard), M. Ghandehari (NYU), S. Miao (IUM)

Thanks! Questions?

Grand Challenges in Urban Climate and Weather Research

Robert ("Bob") Bornstein
Dept. of Meteorology
San Jose State University (SJSU)
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presented at the

IEAS Induction Ceremony

2nd Sofia Earth Forum Symposium

Helsinki, Finland, 31 October 2018

T

hanks to V. Bondur, M. Kulmala, S. Zilitinkevich

for the great honor to be part of this group

- Long-term PBL obs, e.g., SURF (Beijing), WISE (Seoul), NOAA-CREST (NYC), Helsinki Testbed, PEEX
- Segmented (by wind dir & speed, UHI-magnitude, z) climatological analysis (re urban-atmosphere "battles")
- "Golden" case-studies, i.e., good PBL-data, clear signal
- (Lots of) urban-building data for use in new urbanized models, like uWRF (must know obs & models)
- Aerosol impacts on urban PBL & precip via uWRF-Chem
- 2-way links b/t urban: RANS & CFD/LES/DNS models
- Links b/t science, (Wx & AQ) forecasters, & policy/planners (for ER, energy, water, health, climate-change)

FMI-SJSU interests

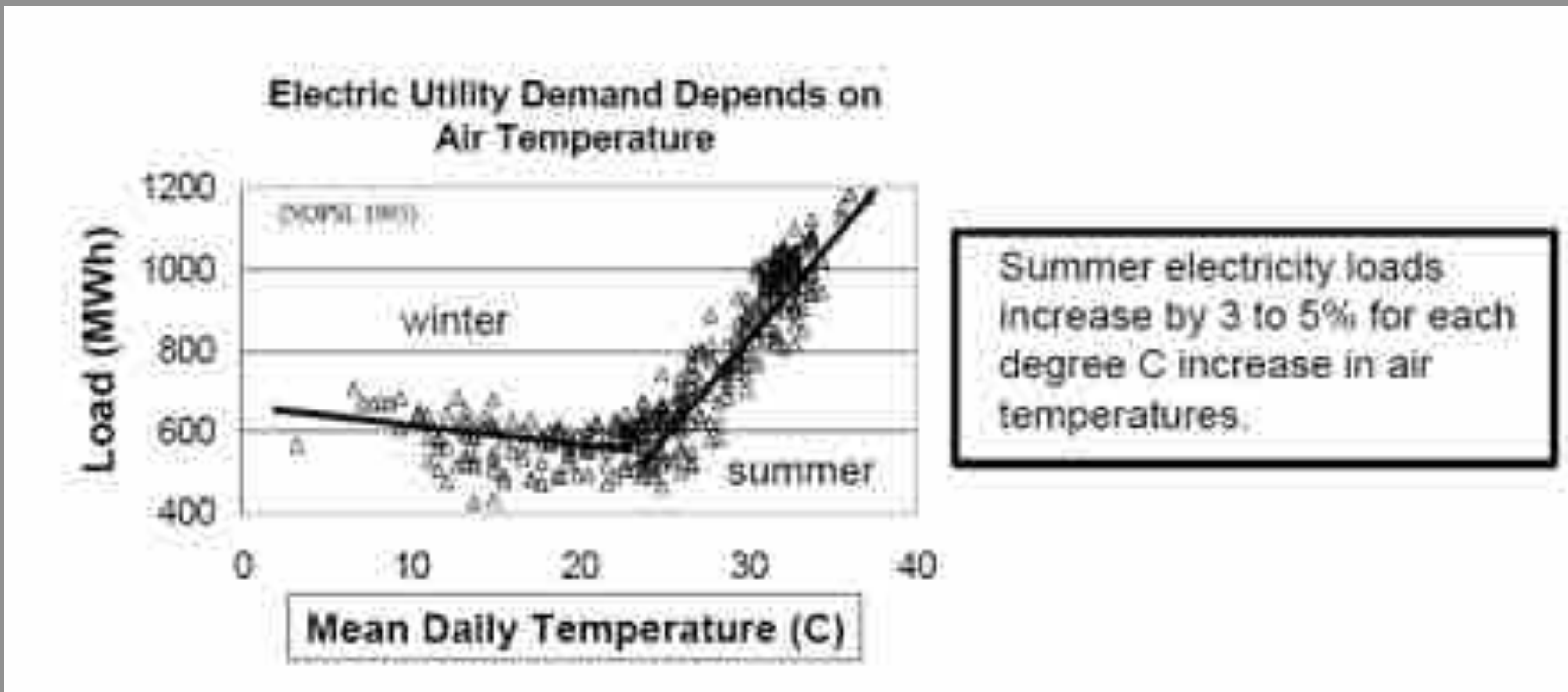
> SJSU, CCNY, NCAR, IUM, NJU, Martilli, U of Trento: urban climate, weather, & χ in a changing climate via PBL obs & (operational & research) uWRF-Chem models

> Helsinki: Dr. Z.-FMI-UofHEL: SBL & PBL q^2-theory

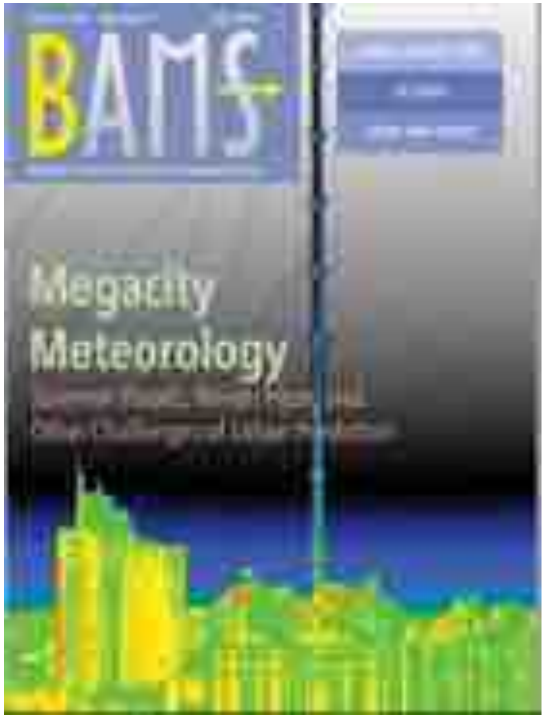
> Overlap: bring Dr. Z's work into mesomet models for

- Diagnostic Eqs: for PBL-depth as f(TKE); stable & unstable SBL $\phi_{m,H}$, $r=K_H/K_M$; & unstable Q_H
- Prognostic PBL Eqs for Θ^2, TPE
- Diagnostic PBL Eqs for 3 independent off-diagonal stress components (no more K_{HOR})
- More realistic building-q^2 (via σ^2_B)
- Two-way linked urban CFD/LES/DNS–RANS models

Urban Energy Demand is Related to Urban Air Temperature
Note: dense cities are energy efficient, not shown



Source: David Sailor,
Portland State Univ. (2007)



Study of Urban-impacts on Rainfall and Fog/haze (SURF) IUM/CMA Project in July *BAMS* by Liang, Miao, Li, B., et al. (2018)

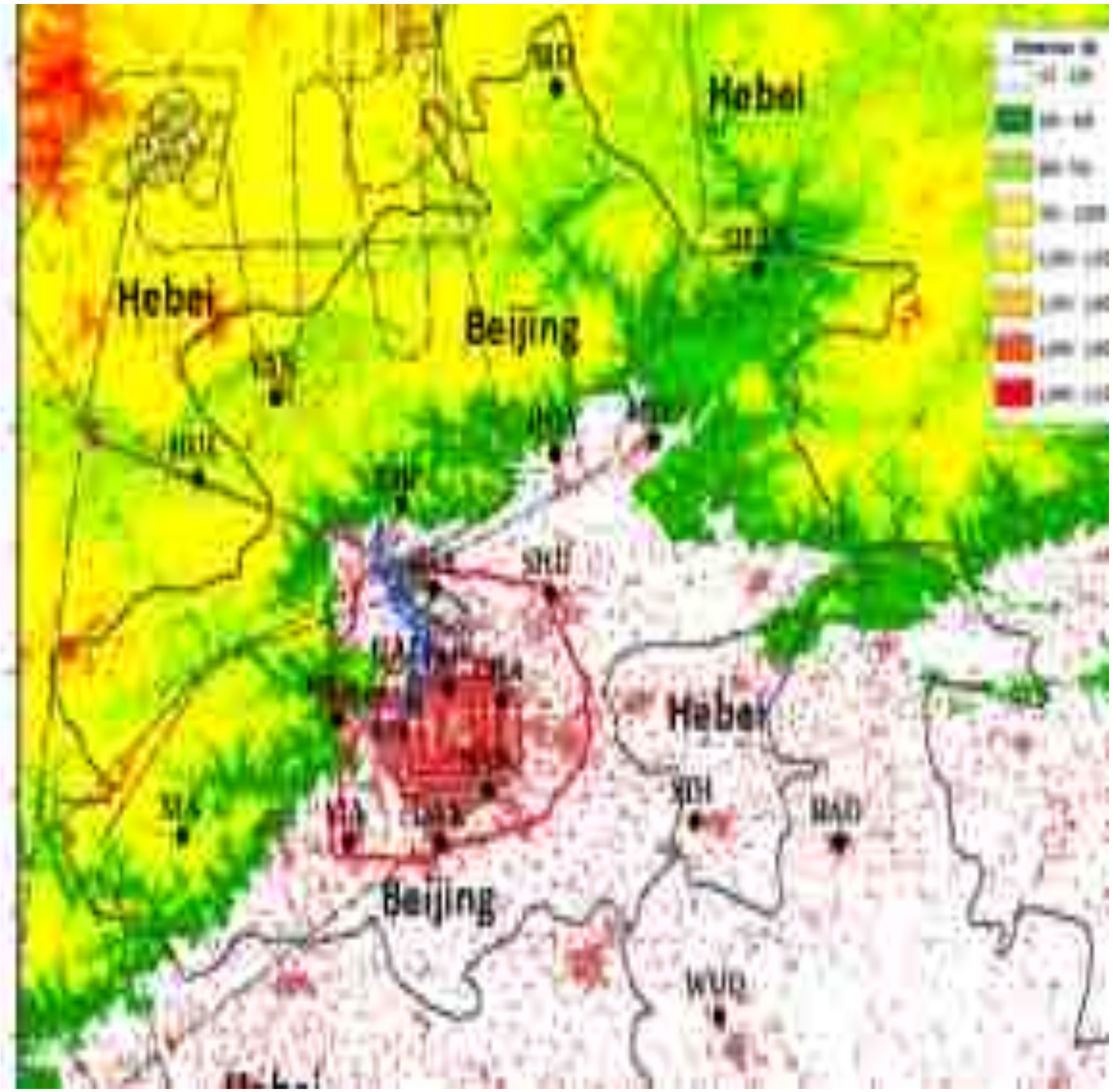
SURF Science Objectives

- Promote cooperative international-research to improve understanding of urban weather-systems via workshops & field studies
- Evaluate & improve high-resolution (~1 km grids) numerical urban chemical & Wx forecast-models
- Enhance urban chemical & Wx forecast-utility for social, economic, & environmental applications, e.g., health, energy, climate change, air quality, urban planning, & emergency-response management
- Specific objectives of Summer TS rainfall & Winter-aerosol field studies: better understand Beijing: urban, terrain, convection & aerosol interactions

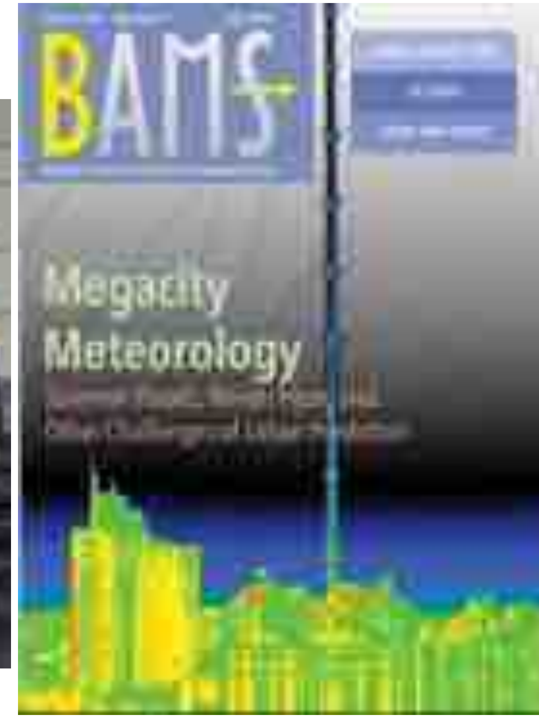
SURF Instruments

(a) 325-m tower at IAP
(b) small balloon radiosonde at IUM
(c) GPS radiosonde at NAN
(d) X-band radar at SHU
(e) ceilometer at LIA
(f) Mini-MPL at DAX
(g) wind profiler at SID
(h) mobile wind profiler at CHA
(i) wind profiler at SHA
(j) wind profiler at YAN
(k) wind profiler at GUC
(l) King Air airplane
(m) Doppler lidar and Mini-MPL at IAP
(n) mobile MPL

Instruments for SURF Summer Experiments



	Total
Wind profilers	14
Radiometers	3
Aerosol Lidars	2
Doppler Lidars	1
Flux towers, including 325 m (BAMS cover) in Beijing	6
Ceilometers	10
Weather radars	4
X-band radars	6
GPS soundings (IOPs only)	4



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SURF Instruments

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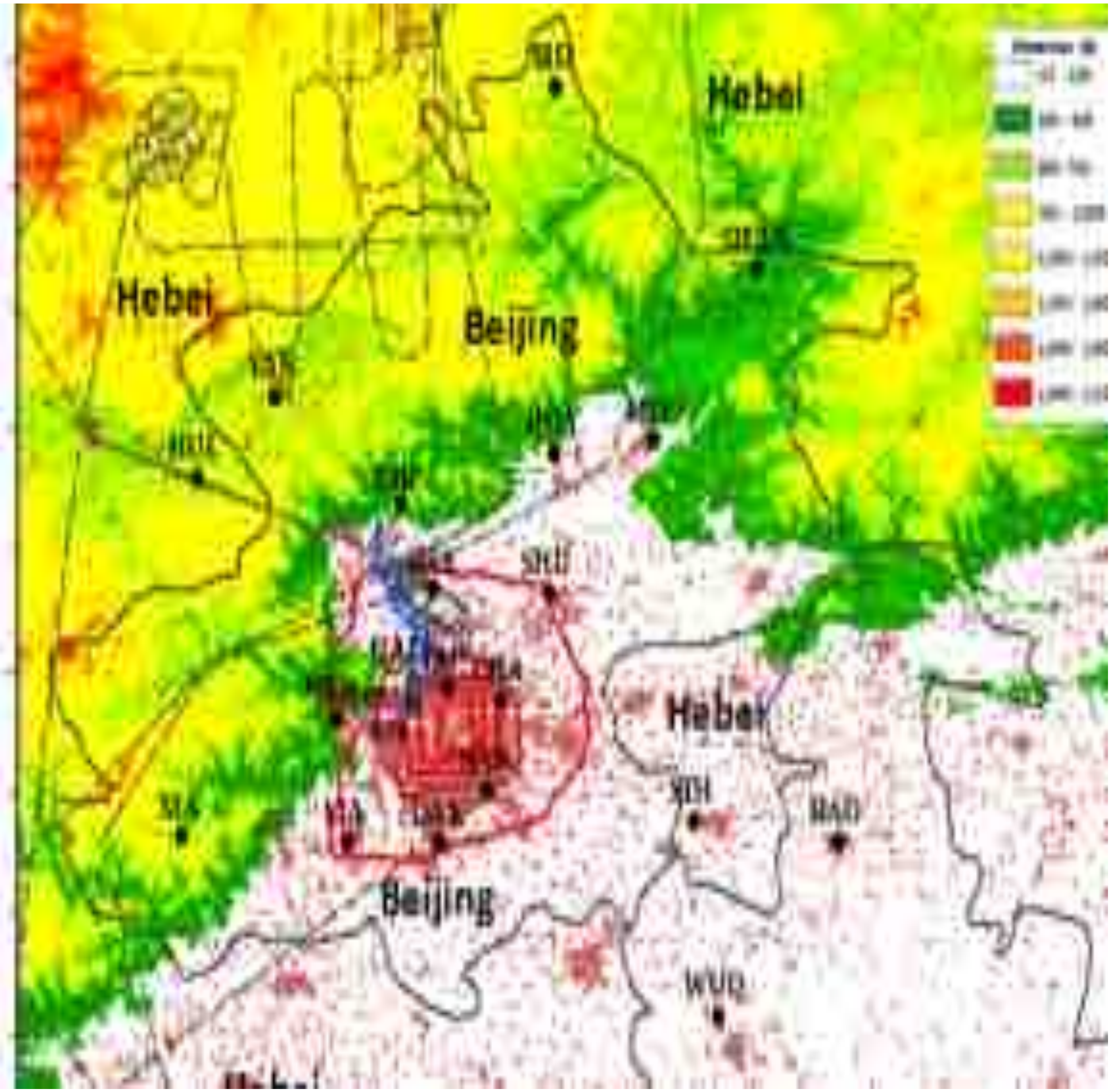

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Non-organic origination of hydrocarbons in the context of Grand Challenges

Prof. Vladimir Kutcherov

KTH Royal Institute of Technology (Stockholm)
Gubkin Russian State University of Oil and Gas (Moscow)

31.10.2018

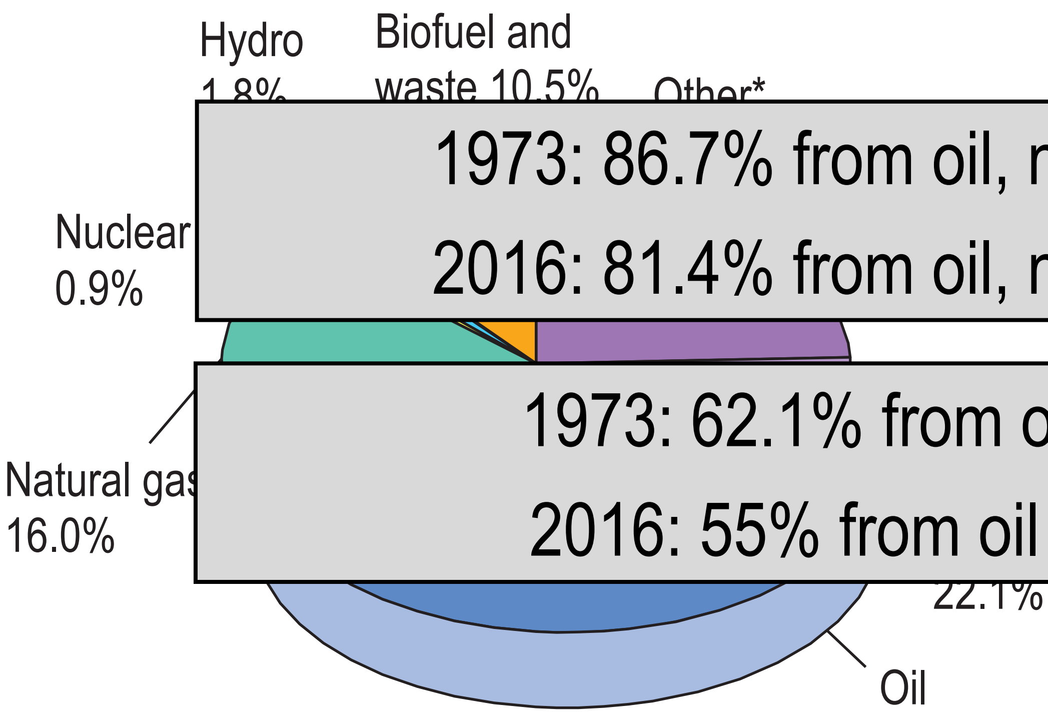
Do we have enough hydrocarbon reserves?

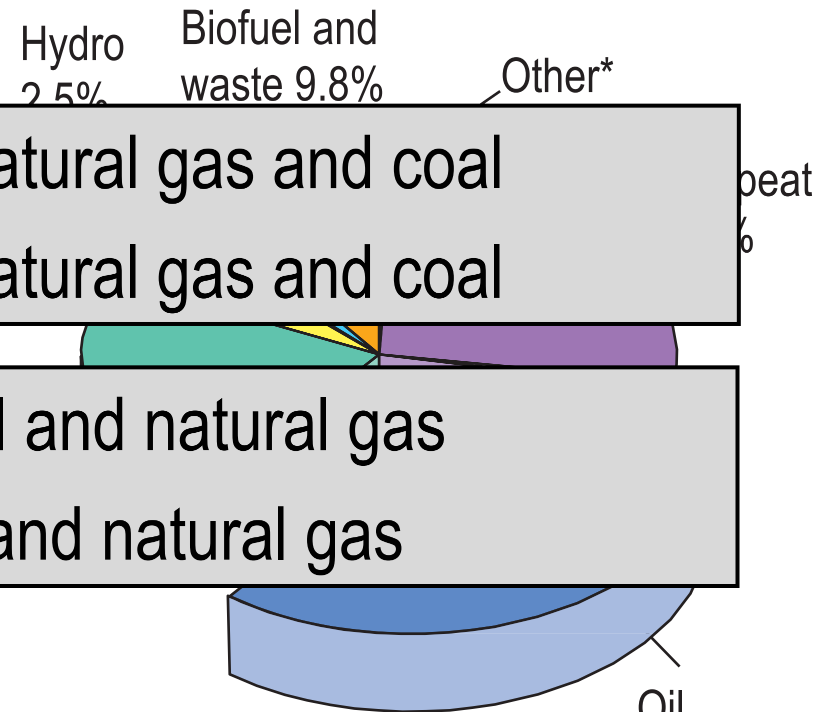
How do we use energy?

What to do?

Global energy balance

1973 | **2016**





1973: 86.7% from oil, natural gas and coal

2016: 81.4% from oil, natural gas and coal

1973: 62.1% from oil and natural gas

2016: 55% from oil and natural gas

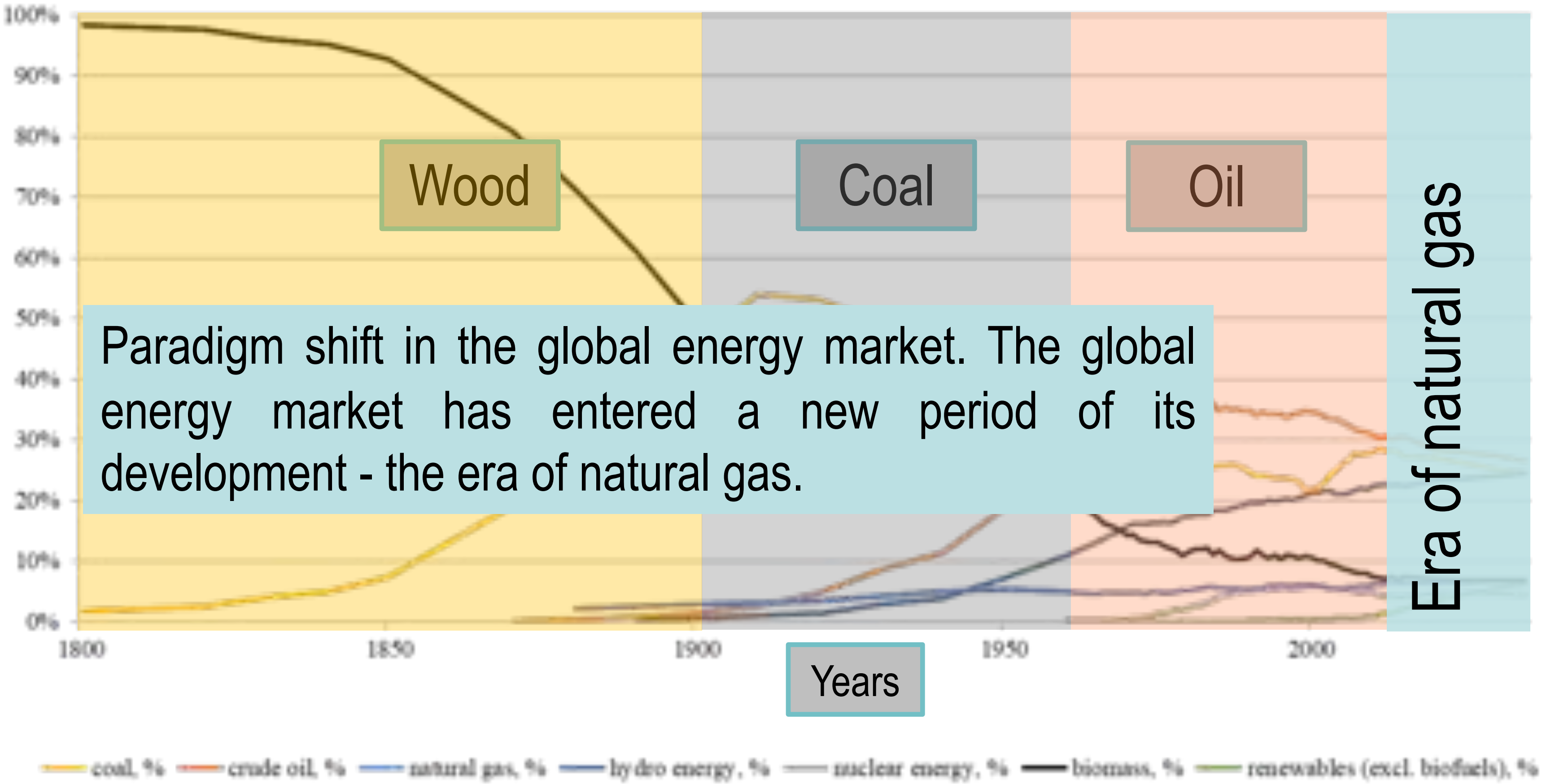
6 101 Mtoe | ***13 761 Mtoe***

**Other includes geothermal, solar, wind, biofuel and waste etc.*

EIA. Key world energy statistics 2018

Periods of transition

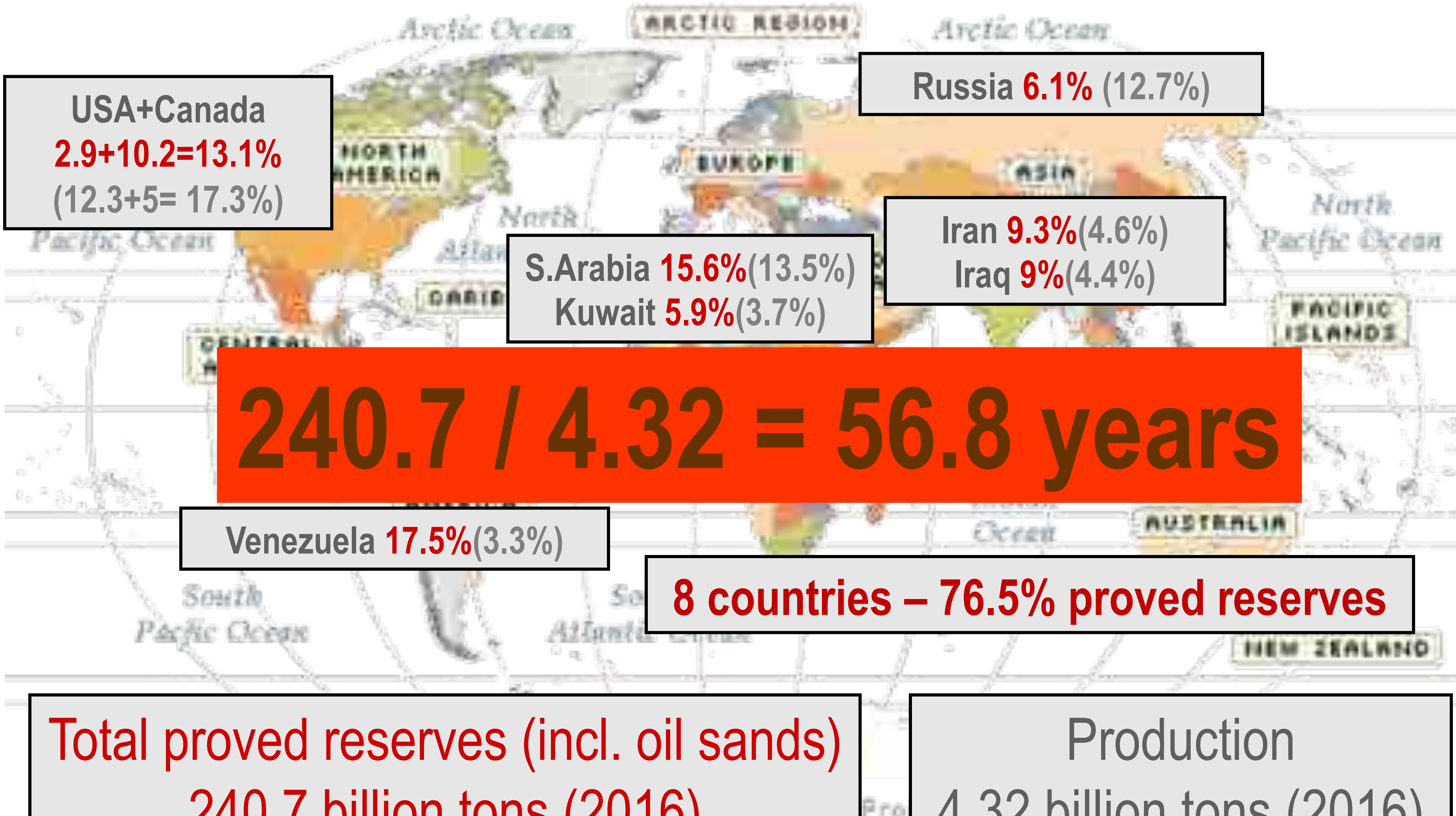
Shares of energy sources



Paradigm shift in the global energy market. The global energy market has entered a new period of its development - the era of natural gas.


Hydrocarbon resources distribution

Oil resources distribution and production



USA+Canada
2.9+10.2=13.1%
(12.3+5= 17.3%)

Russia 6.1% (12.7%)

S.Arabia 15.6%(13.5%)
Kuwait 5.9%(3.7%)

Iran 9.3%(4.6%)
Iraq 9%(4.4%)

240.7 / 4.32 = 56.8 years

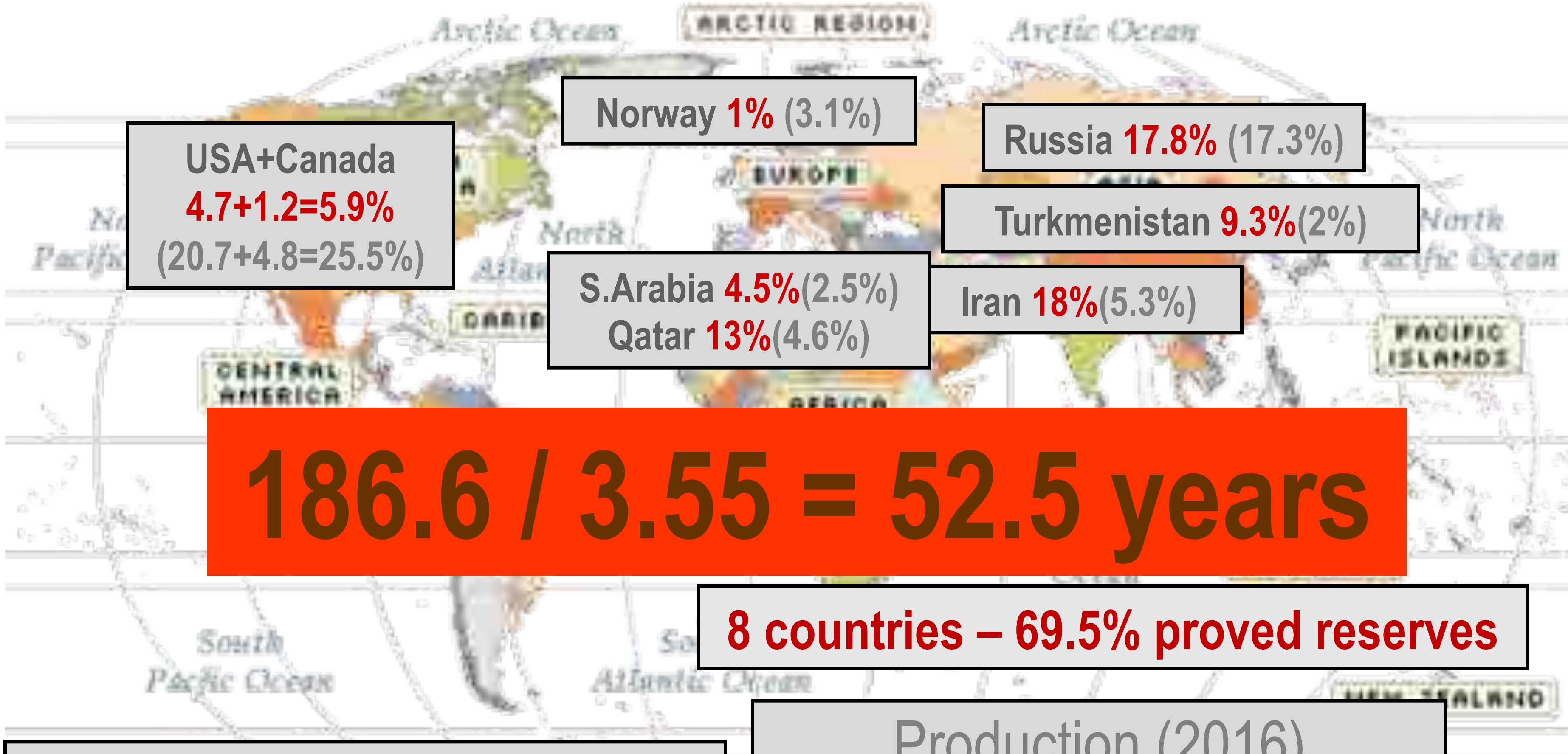
Venezuela 17.5%(3.3%)

8 countries – 76.5% proved reserves

Total proved reserves (incl. oil sands)
240.7 billion tons (2016)

Production
4.32 billion tons (2016)

Natural gas resources distribution and production



Norway 1% (3.1%)

USA+Canada
4.7+1.2=5.9%
(20.7+4.8=25.5%)

Russia 17.8% (17.3%)

Turkmenistan 9.3%(2%)

S.Arabia 4.5%(2.5%)
Qatar 13%(4.6%)

Iran 18%(5.3%)

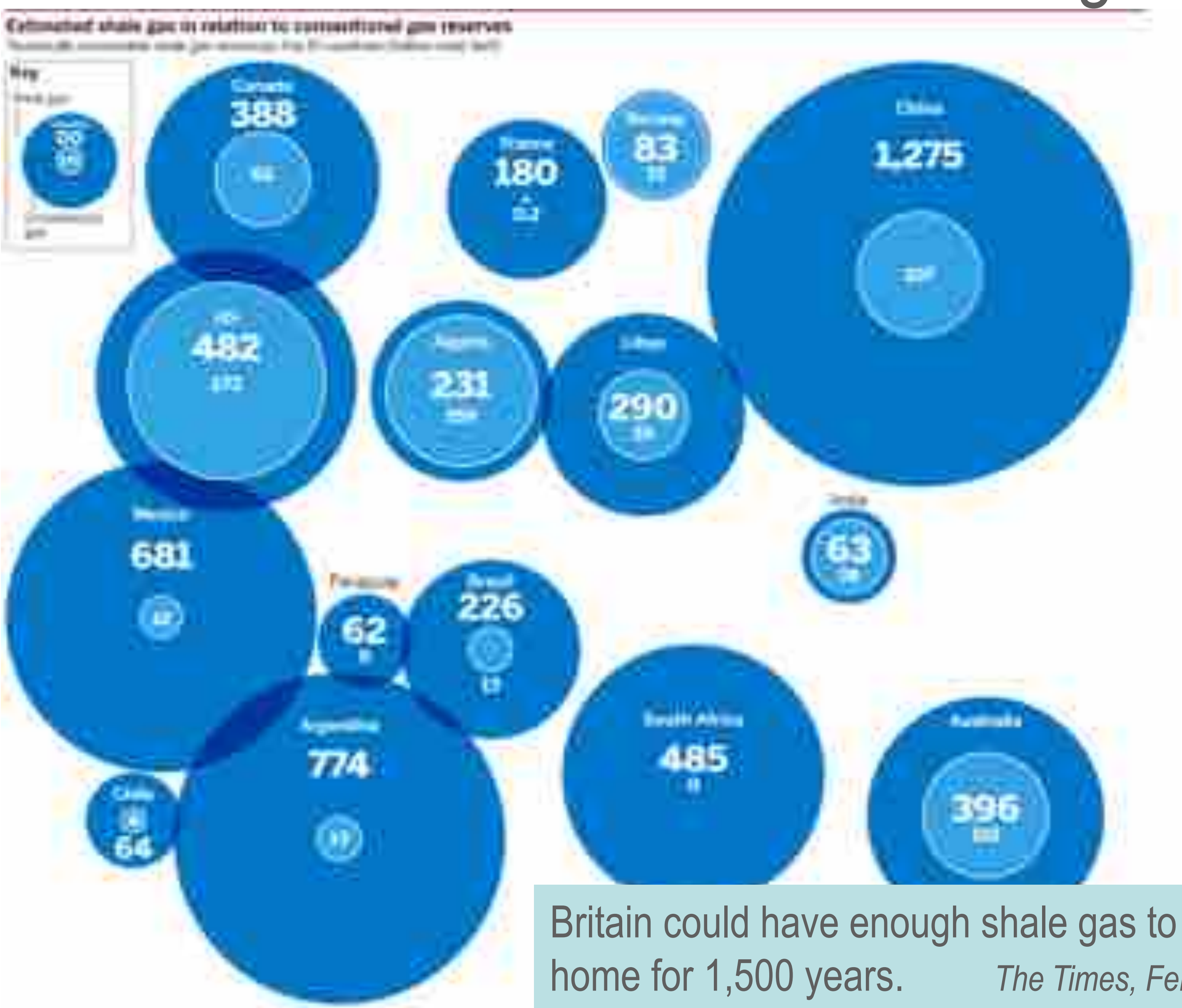
186.6 / 3.55 = 52.5 years

8 countries – 69.5% proved reserves

Total proved reserves (2016)
186.6 trillion cub. m

Production (2016)
3.55 trillion cub. m per year
(3.21 billion toe)

Estimated reserves of shell gas



Britain could have enough shale gas to heat every home for 1,500 years. *The Times, February 9 2013*

Estimated reserves of gas hydrates

10%: 1970 years

Molecules of hydrate-forming gas (CH_4, C_2H_6, etc.) are located inside the water (ice) crystalline cage without any chemical bonding between molecules.

186.6 / 3.55 = 52.5 years

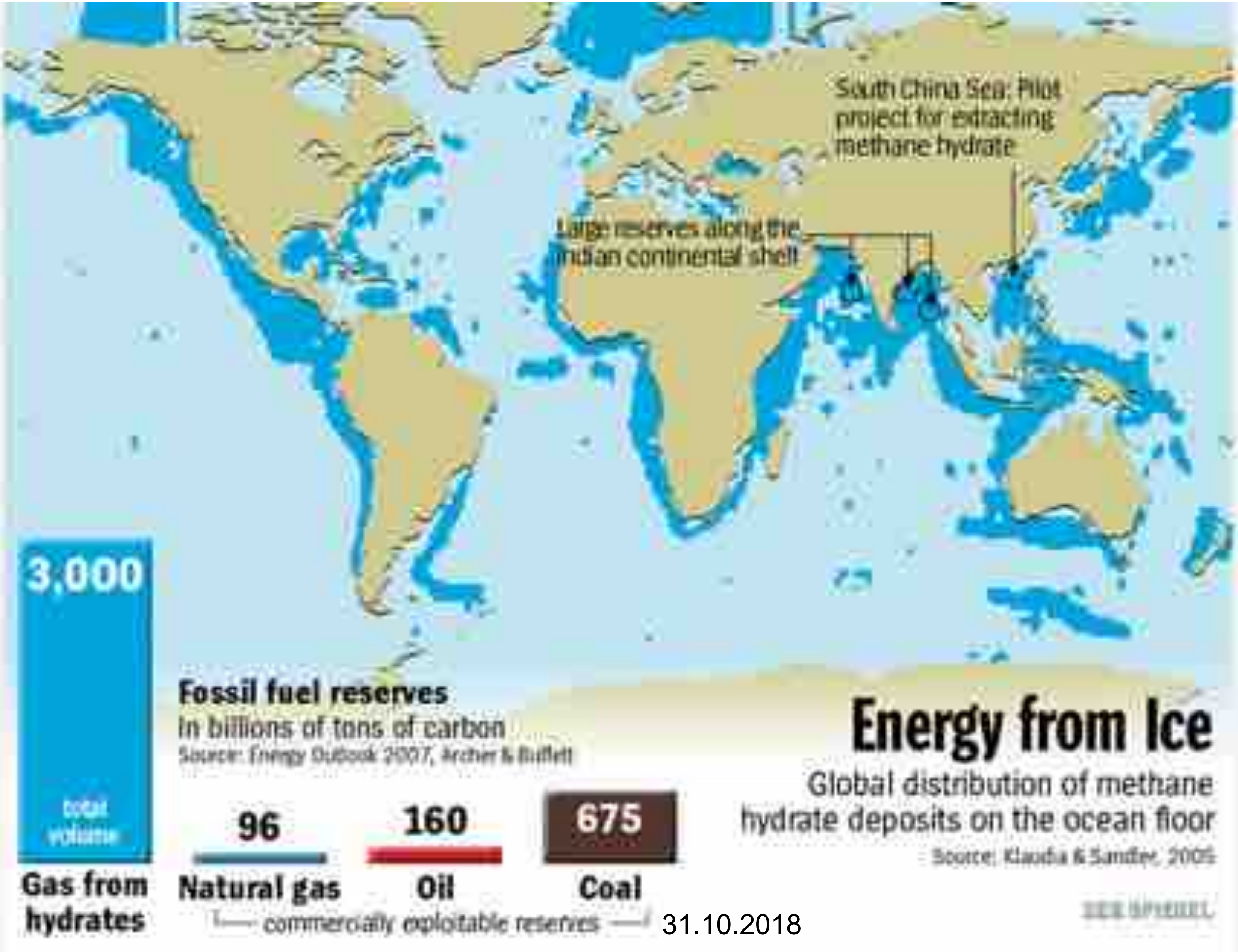
1 m^3 of gas hydrate: 150-180 m^3 of methane

Estimated reserves: 3-140·10^{15} cu m of methane

Natural Gas Europe, 12 February 2013

70·10^{15} / 3.55·10^{12} = 19 700 years

Estimated location of gas hydrate reserves



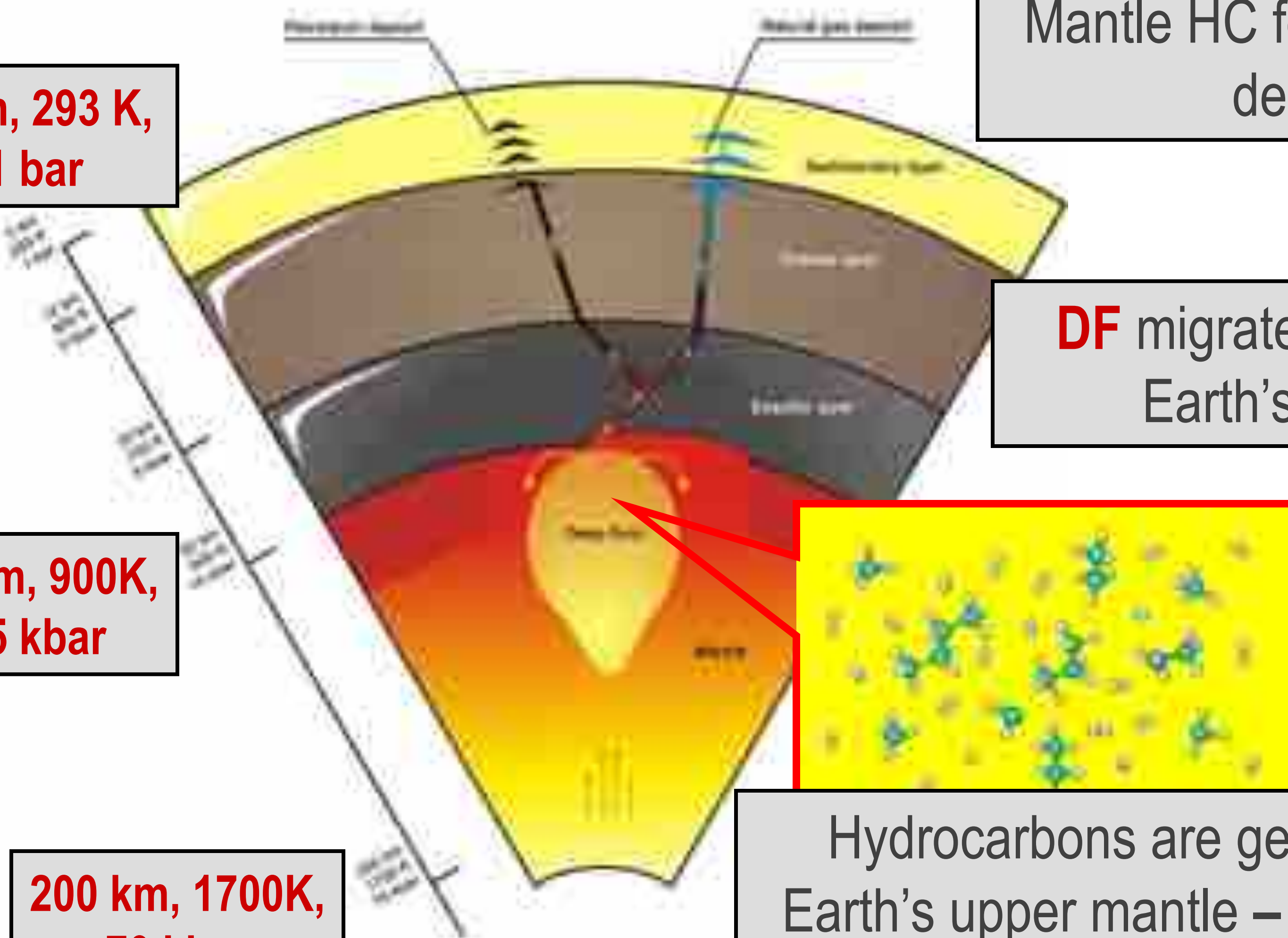
"Every ten or fifteen years since the late 1800's, 'experts' have predicted that oil reserves would last only ten more years. These experts have predicted nine out of the last zero oil-reserve exhaustions."

Quote by C. Maurice and C. Smithson, *Doomsday Mythology: 10,000 Years of Economic Crisis*, Hoover Institution Press, Stanford, 1984.

Abiogenic deep origin of hydrocarbons

31.10.2018

Abiogenic deep origin of hydrocarbons



0 km, 293 K, 1 bar

50 km, 900K, 15 kbar

200 km, 1700K, 70 kbar

Mantle HC form oil and gas deposits

DF migrates into the Earth's crust

Hydrocarbons are generated in the Earth's upper mantle – **deep fluid (DF)**

Could the synthesis of complex hydrocarbon systems out of inorganic systems under mantle conditions be demonstrated *in a laboratory*?

$$CaCO_3 + FeO + H_2O \rightarrow ?$$

High pressure equipment at Gubkin University

$$CaCO_3 + FeO + H_2O \rightarrow ?$$

Experimental results

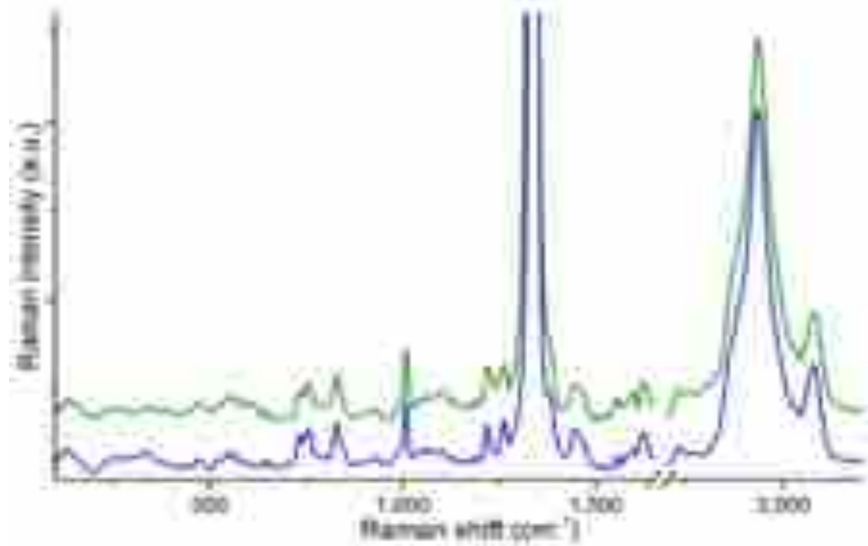
Hydrocarbon	Concentration, m^3 per thousand ton		
	p = 50 kbar T = 1500 K (150 km)	p = 30 kbar t = 1200 K (100 km)	"White Tiger" (Vietnam)
CH_4	130.2	570	124.6
n-C_4H_{10}	4.7	1.9	3.5

The concept of the abiogenic deep origin of hydrocarbons provides the understanding of the presence of enormous, *inexhaustible* resources of hydrocarbons on our planet

$$CaCO_3 + FeO + H_2O \rightarrow Ca(OH)_2 + Fe_3O_4 + C_nH_{2n+2}$$

in distribution characteristic of natural petroleum

New results (2018)



The Raman spectra of the hydrocarbon system at ambient conditions (blue curve) and after 12 hours on the ‘depth of 50 km’ (green curve).

The results of experiments demonstrated that the hydrocarbon system, similar to natural gas condensate, could exist

to a depth of 50 km.

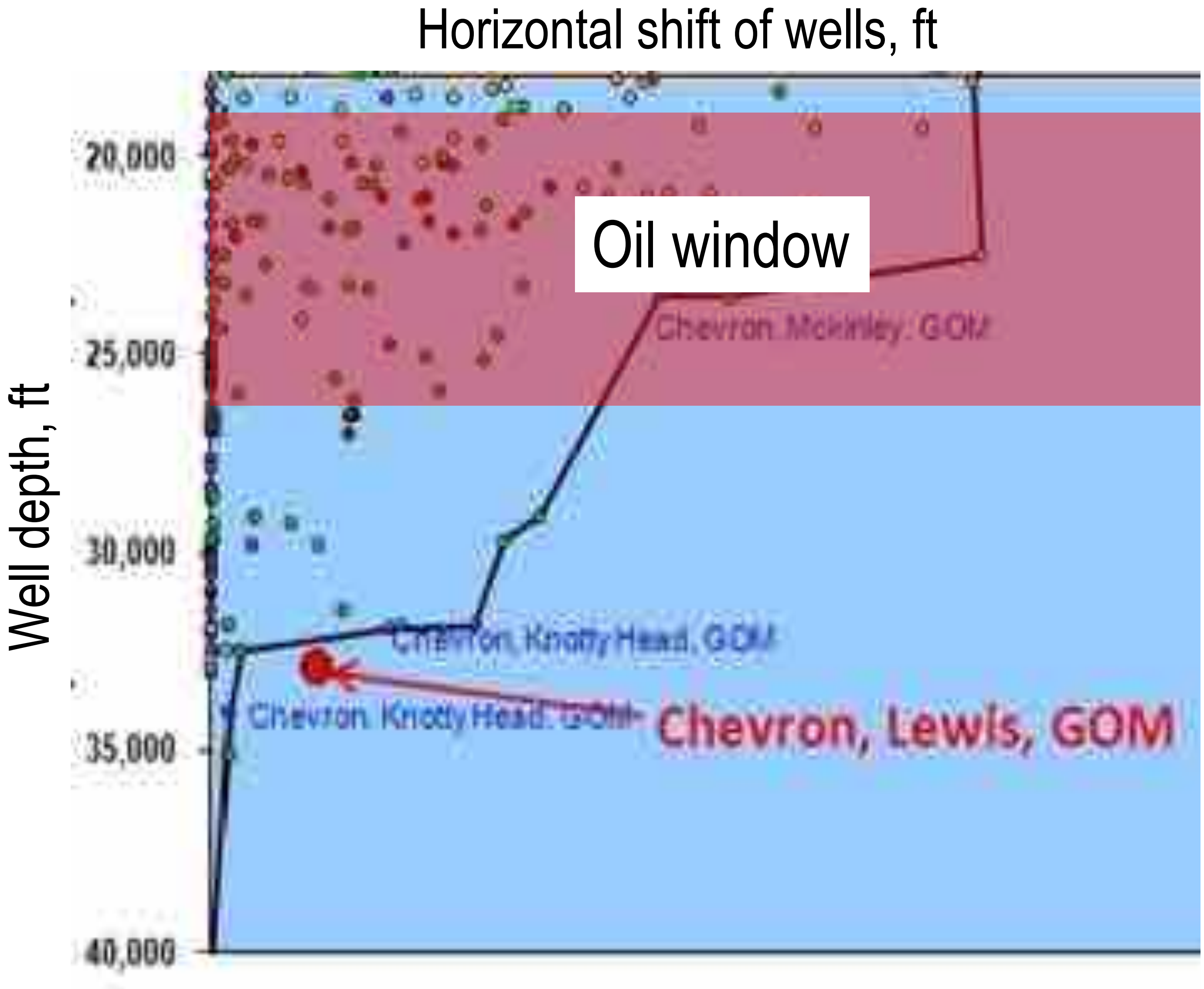
31.10.2018

Titan, Cassini, 2008

Lakes of hydrocarbons in Titan

31.10.2018

Ultra-deep oil and gas deposits



"Neither we, nor our grandchildren, nor their grandchildren will live to see the end of the oil era." -- Karl-Heinz Schult-Bornemann, geologist, 1997

"I don't think anybody has ever doubted that there is an inorganic source of hydrocarbons." -- Michael D. Lewan, geologist, 2002

"Abiogenic gasses are a clear fact. I can make them on the lab bench today." -- Barbara Sherwood Lollar, geochemist, 2005

Do we have enough hydrocarbon reserves?

Yes, we do

- ❑ huge hydrocarbon reserves

>1 000 years

- ❑ developed networks of gas pipelines
- ❑ widely used technologies of natural gas compressing and liquefaction

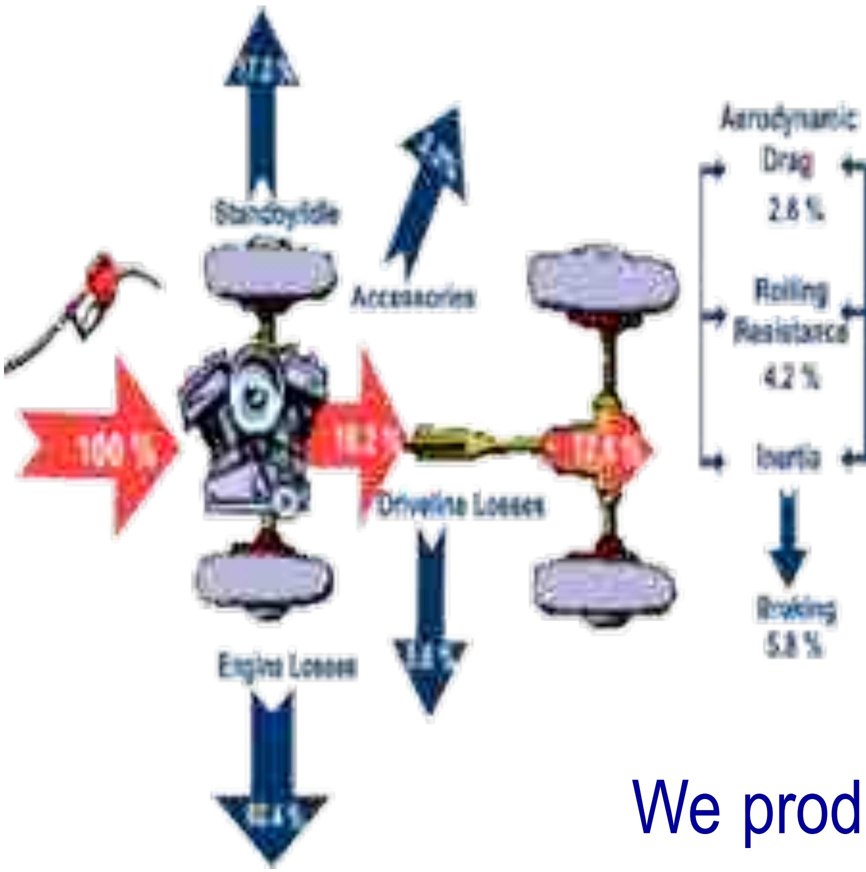
gives us the possibility to deliver this source of energy in any point of the globe comparably cheap

‘Natural gas will play an increasing role as a transition energy source towards a low-carbon world…’

World Energy Council (2013)

How do we use energy?

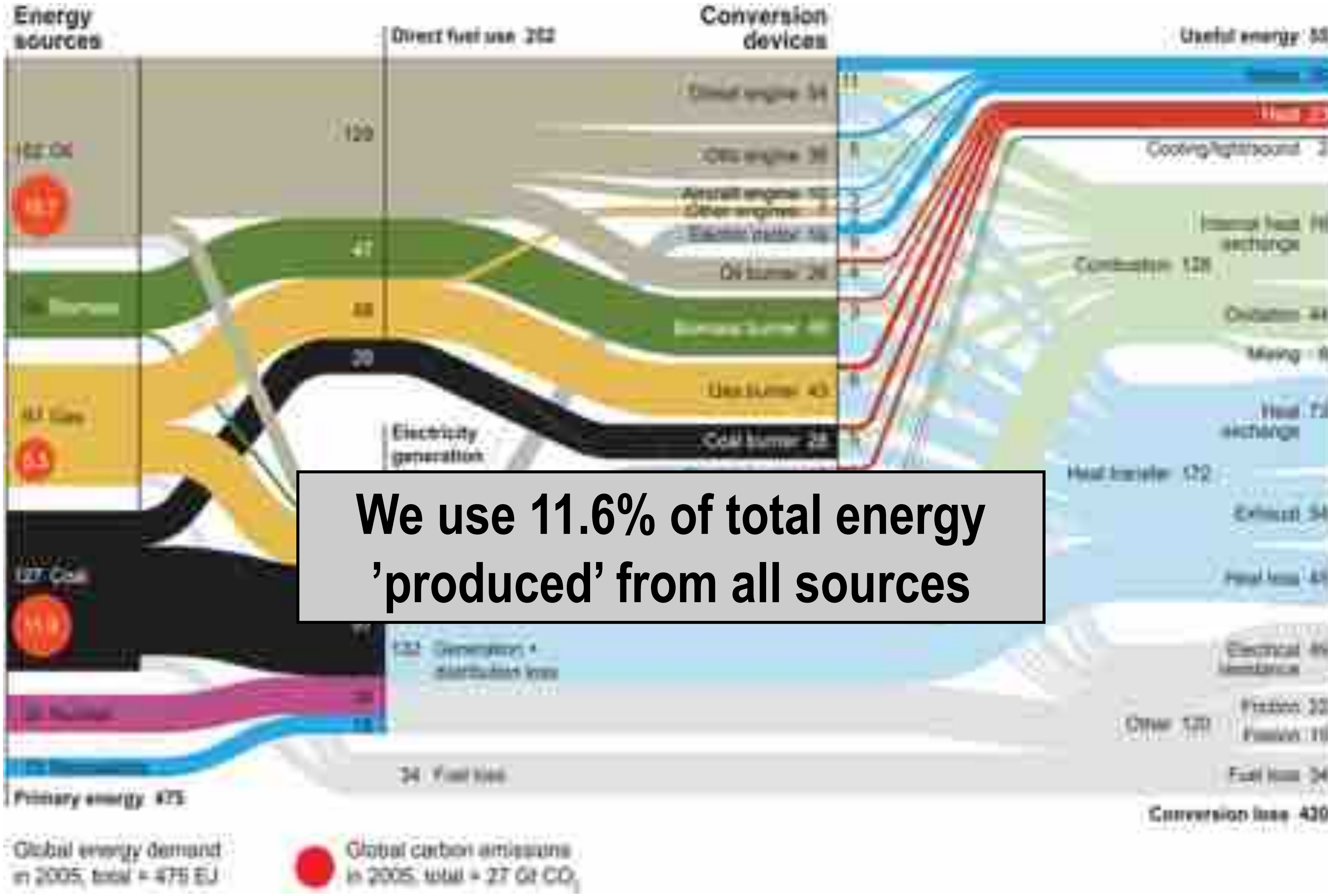
Energy losses per vehicle



Only about 15 percent of the energy from the fuel you put in your tank is used to power your car down the road.

We produce:	$4 \cdot 10^9$ t of oil
We burn 2/3 in vehicles:	$2.67 \cdot 10^9$ t
We throw out to the wind:	**$2.27 \cdot 10^9$ (57%)**

Production and useful energy



We use 11.6% of total energy ’produced’ from all sources

What to do?

What is the main argument of opponents of natural gas use?

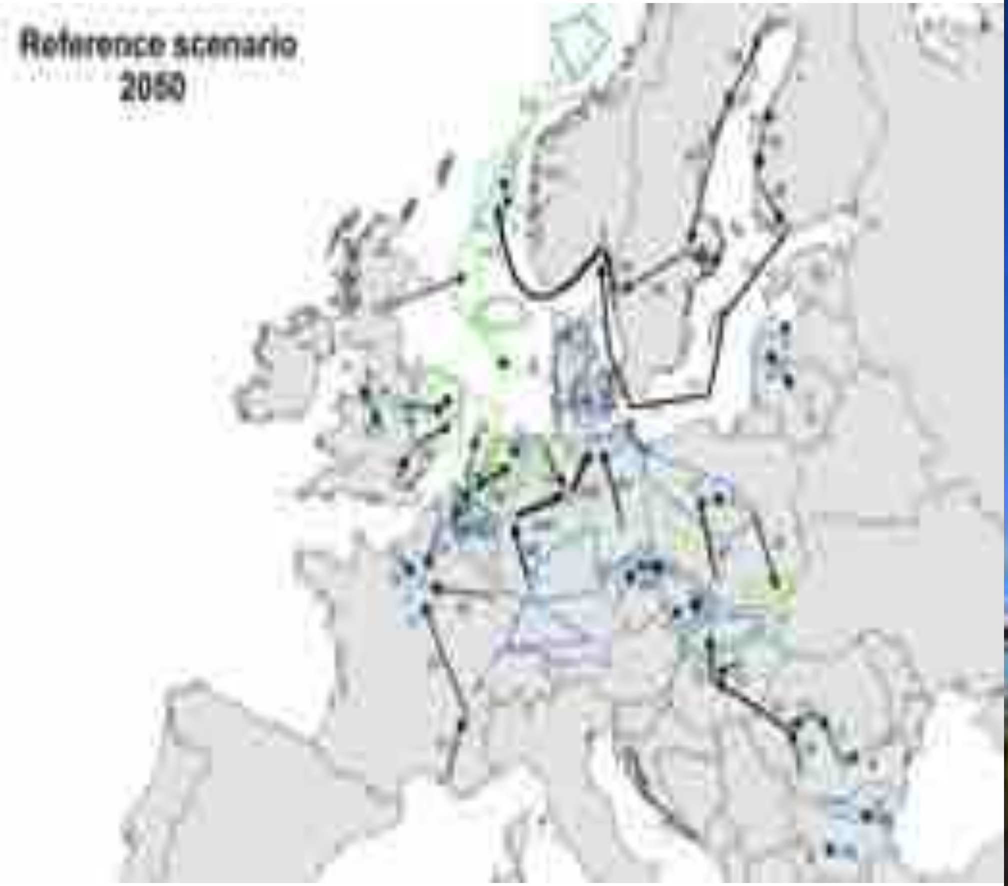
CO_2 emission: 1 kg of methane produces during combustion 2.75 kg of CO_2 which should be utilized

CO_2 emission is bad.

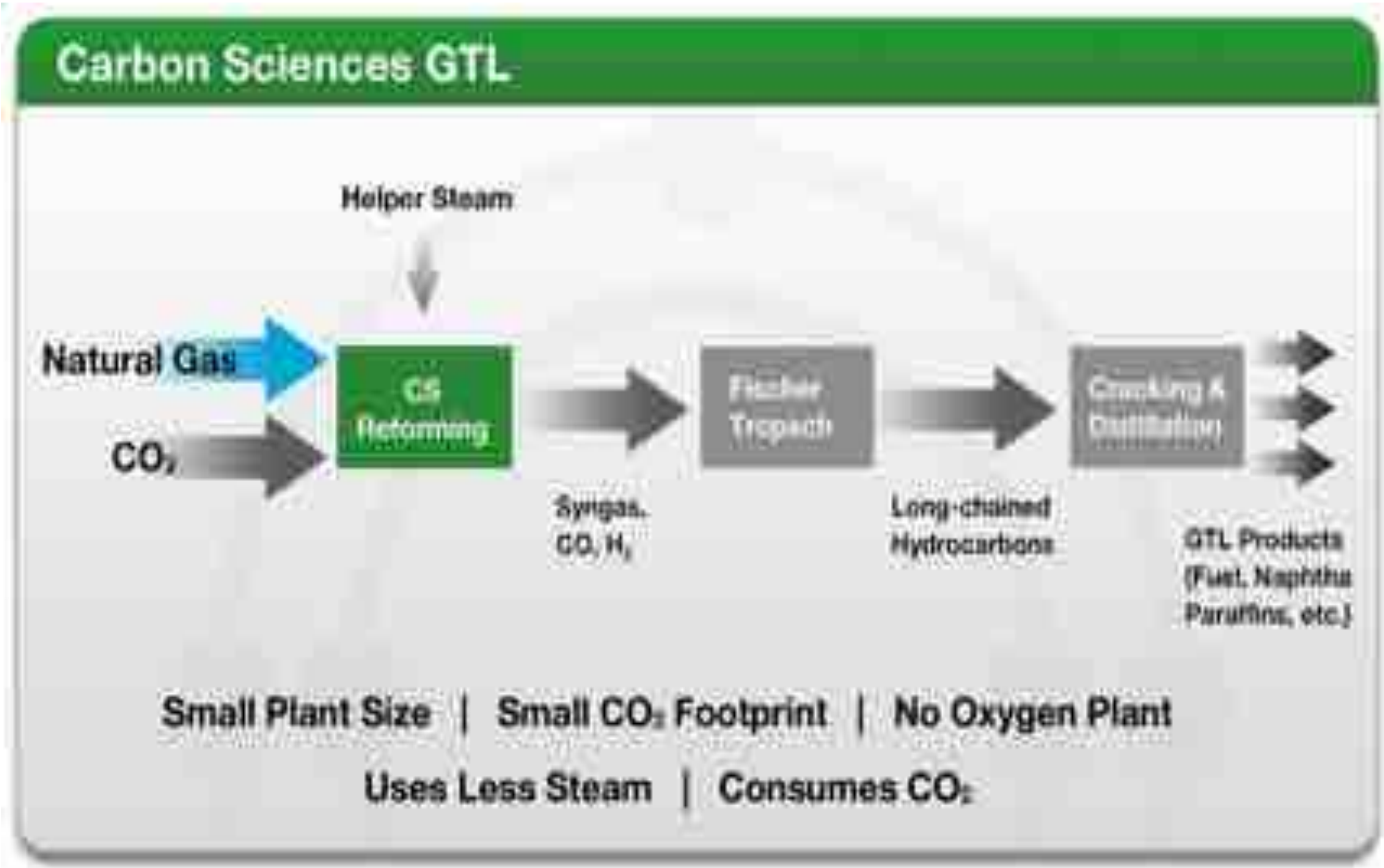
"Carbon Capture and Storage (CCS) is an essential component of a portfolio of technologies and measures to reduce global emissions and help avoid the most serious impacts of climate change…"

from the International Energy Agency/Carbon Sequestration Leadership Forum
"Report to the G8 Summit", June 2010

CCS pipeline system in Europe 2050

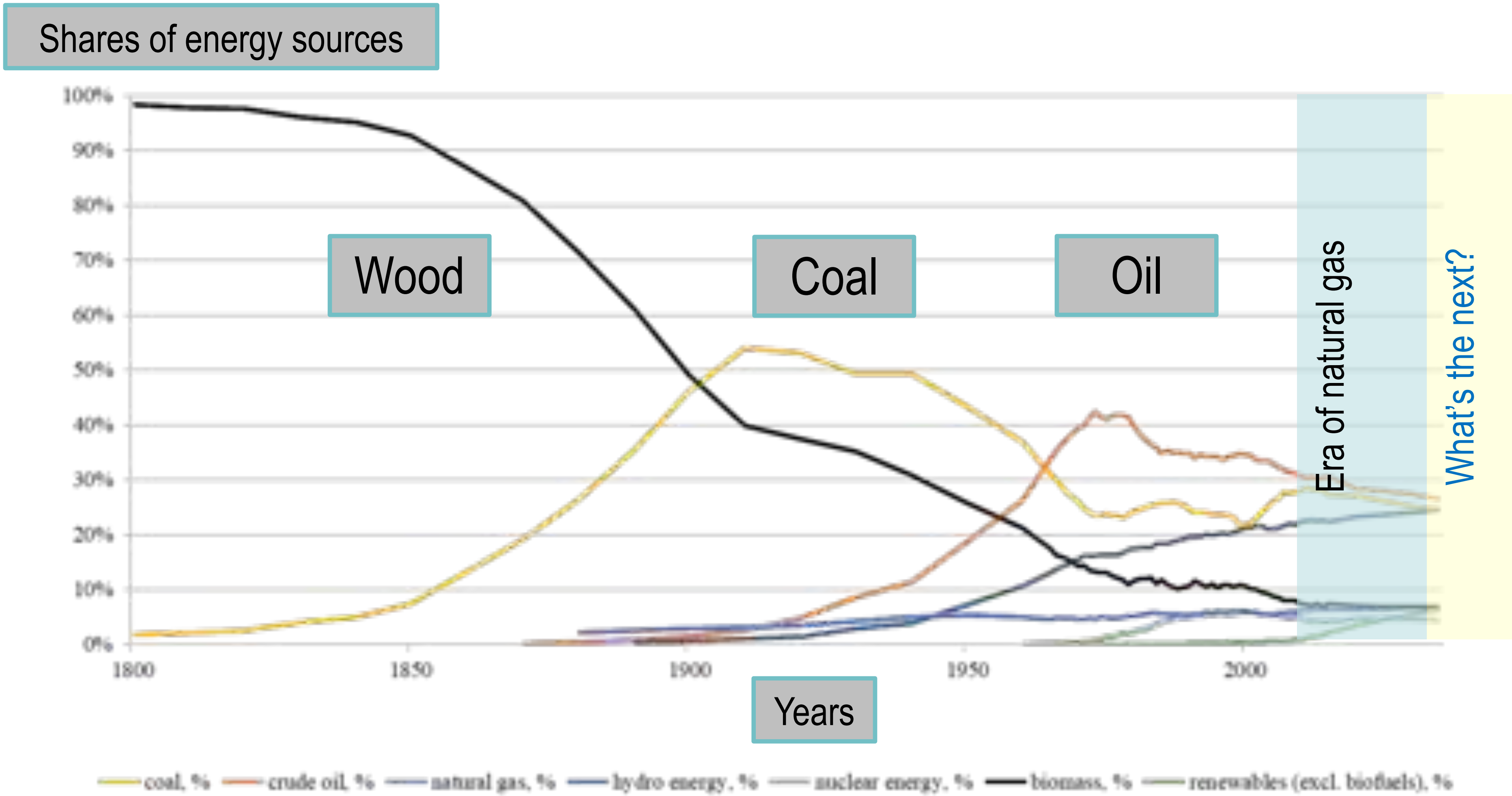


CO_2 → fuel



Carbon Sciences GTL
Helper Steam
Natural Gas
CO2
CS Reforming
Fischer Tropsch
Cracking & Distillation
Syngas, CO, H2
Long-chained Hydrocarbons
GTL Products (Fuel, Naphtha Paraffins, etc.)
Small Plant Size | Small CO2 Footprint | No Oxygen Plant
Uses Less Steam | Consumes CO2

Periods of transition

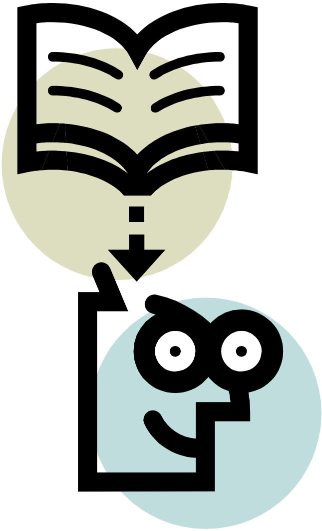


31.10.2018

Now this is not the end.
It is not even the beginning of the end.
But it is, perhaps, the end of the beginning.

Sir Winston Churchil
speech in November 1942

Thank you for attention



Vladimir.Kutcherov@energy.kth.se

CONTRIBUTION TO Solving GRAND CHALLENGES

Climate change

Volcanoes

Energy

Biodiversity loss

Epidemic diseases

Chemicalisation

Demography / Population

Earthquakes

Air quality

Fresh water

Ocean acidification

Deforestation

Food supplies

DISCIPLINES

Natural Sciences

Social Sciences

Medicine

Technology

IEAS

Sofia Earth Forum

Science Diplomacy

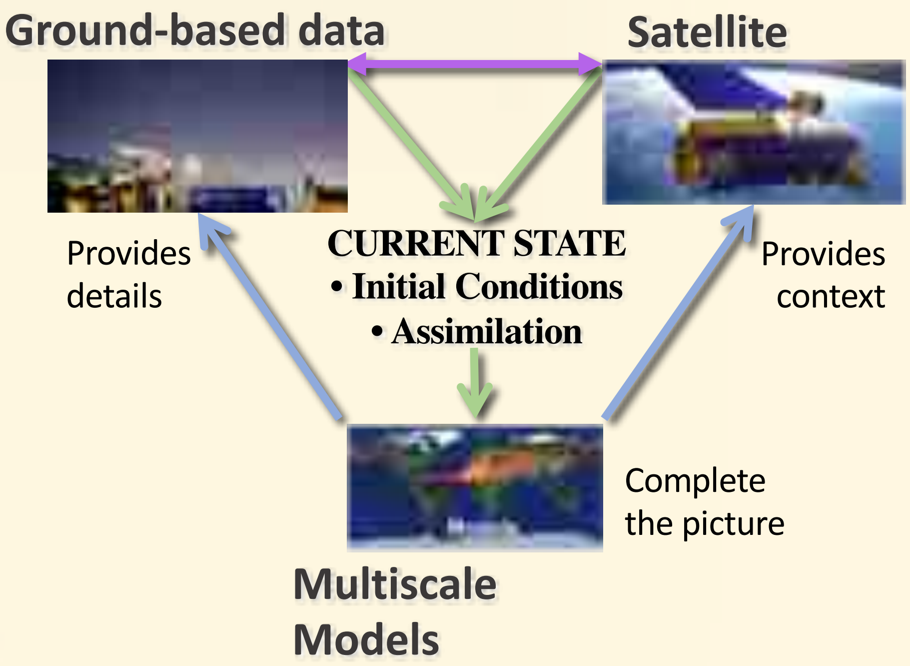
From ideas
To implementation

MULTIDIMENSIONAL, MULTIDISCIPLINARY, MULTISCALE APPROACH TO ANSWER GRAND CHALLENGES

Clear and ambitious vision / from deep understanding to practical solutions

Empirical measurements and modelling / from observations to new theories

From research to innovations / economic growth and human wellbeing




COMMENT

An enclosure for measuring gas exchange between plants and the atmosphere at a station in Finland.

Build a global Earth observatory

Markku Kulmala calls for continuous, comprehensive monitoring of interactions between the planet's surface and atmosphere.

Nature Comment (2018), Nature 553, 21–23


COMMENT

Steps to the digital Silk Road

Nature Comment (2018), Nature 554, 25-27

Sharing big data from satellite imagery and other Earth observations

Global SMEAR and Digital Belt & Road - DBAR

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Institute for Atmospheric and Earth System Research
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Academician, Professor **Guo Huadong**
Chair of DBAR
The Institute of Remote Sensing and Digital Earth
Chinese Academy of Sciences
guohd@radi.ac.cn

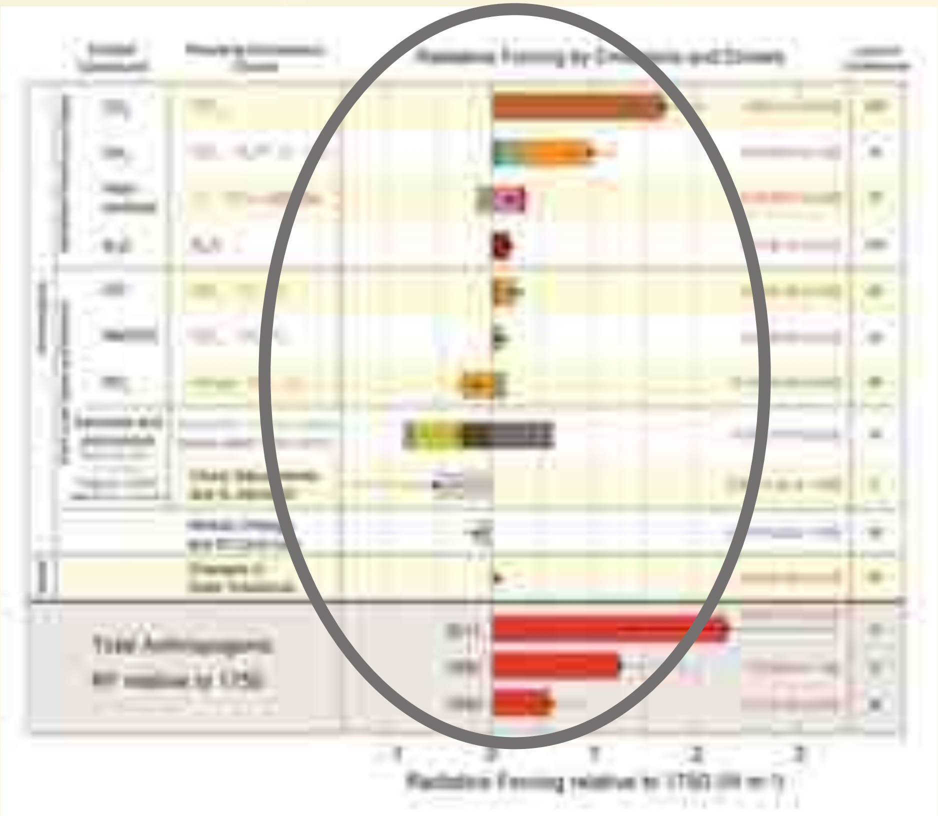
INTEGRATED APPROACH:
THE GLOBAL EARTH OBSERVATORY / GLOBAL SMEAR

Current observations (see IPCC 2013) are fragmented:

1) Greenhouse gases
2) Aerosols
3) Air quality
4) Ecosystems
5) Climate
6) …

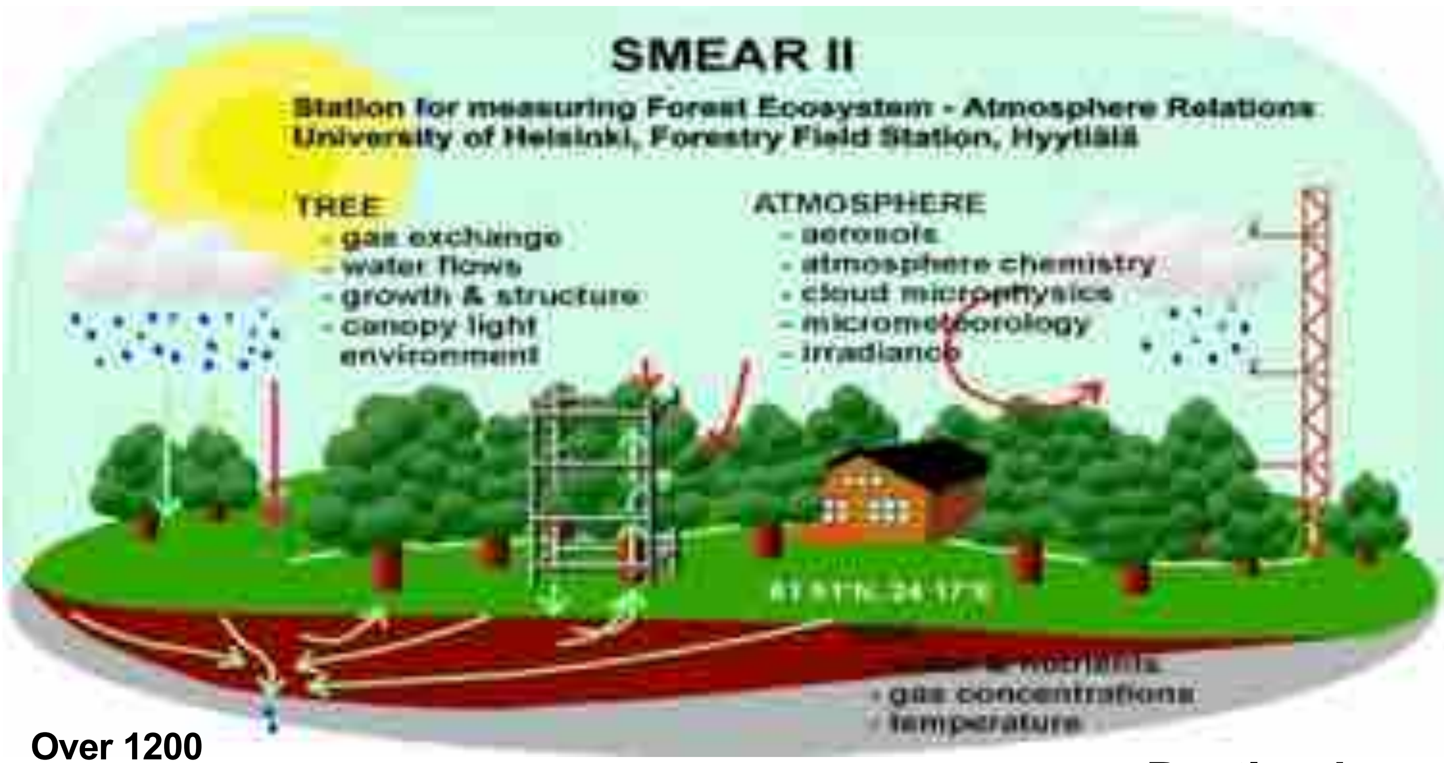
Future aspiration: **Integrated approach**

- **To understand feedbacks**
- **To reduce uncertainties**
- **To mitigate and adapt effectively**



SMEAR II-station (boreal forest, country side)

Continuous, comprehensive observations



Over 1200 different variables

Lakes

Forest

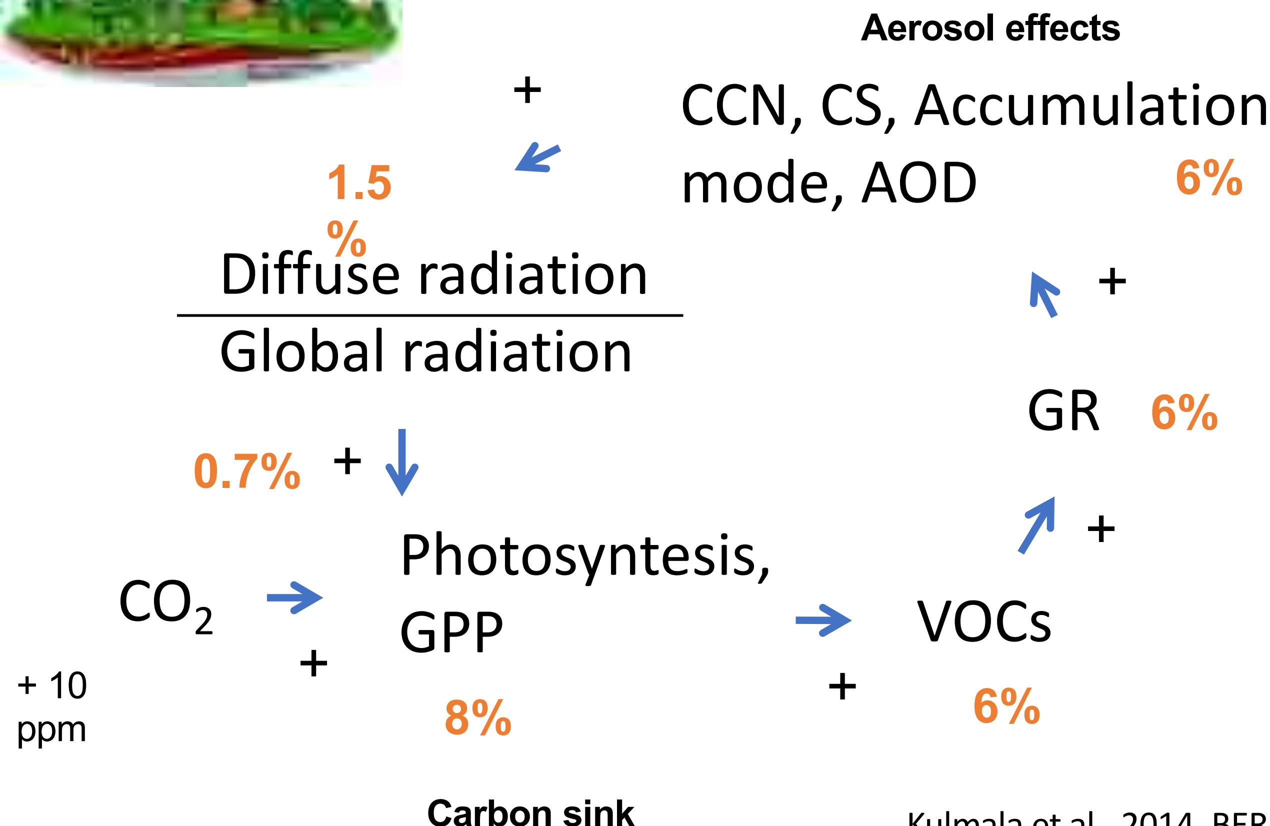
Peatlands

Urban

Site for ICOS, ACTRIS, INGOS, EXPEER, ANAEE, LTEER, LifeWatch, WMO, EMEP, CARBOEUROPE, NITROEUROPE, EUCAARI, PEGASOS

SMEAR II Hyytiälä

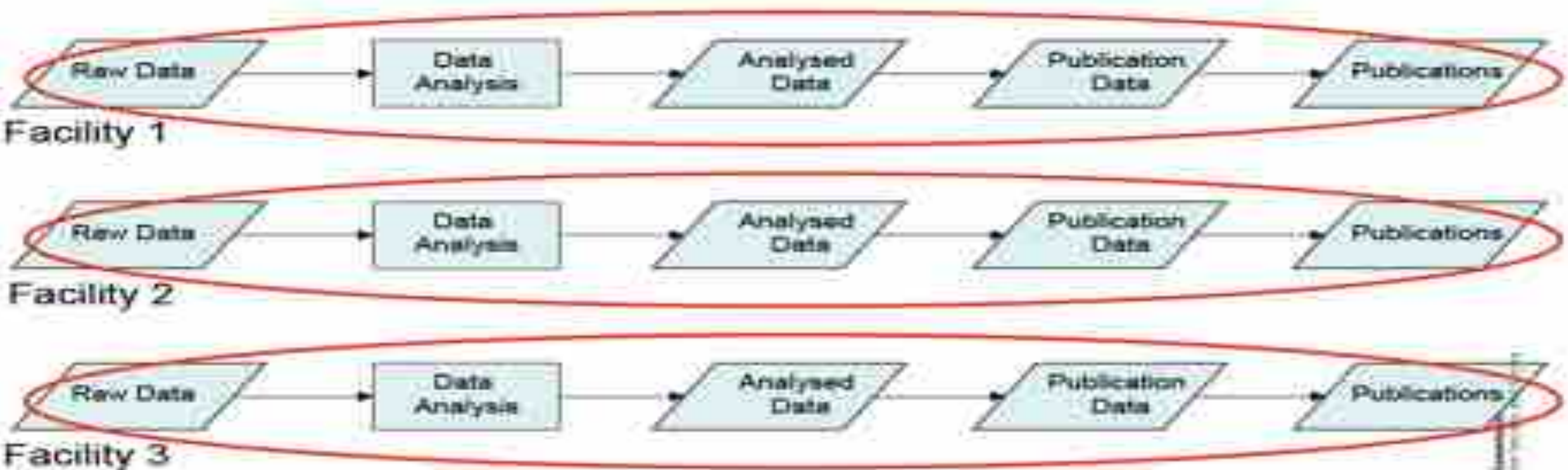
SMEAR II: 1996-2009



Kulmala et al., 2014, BER

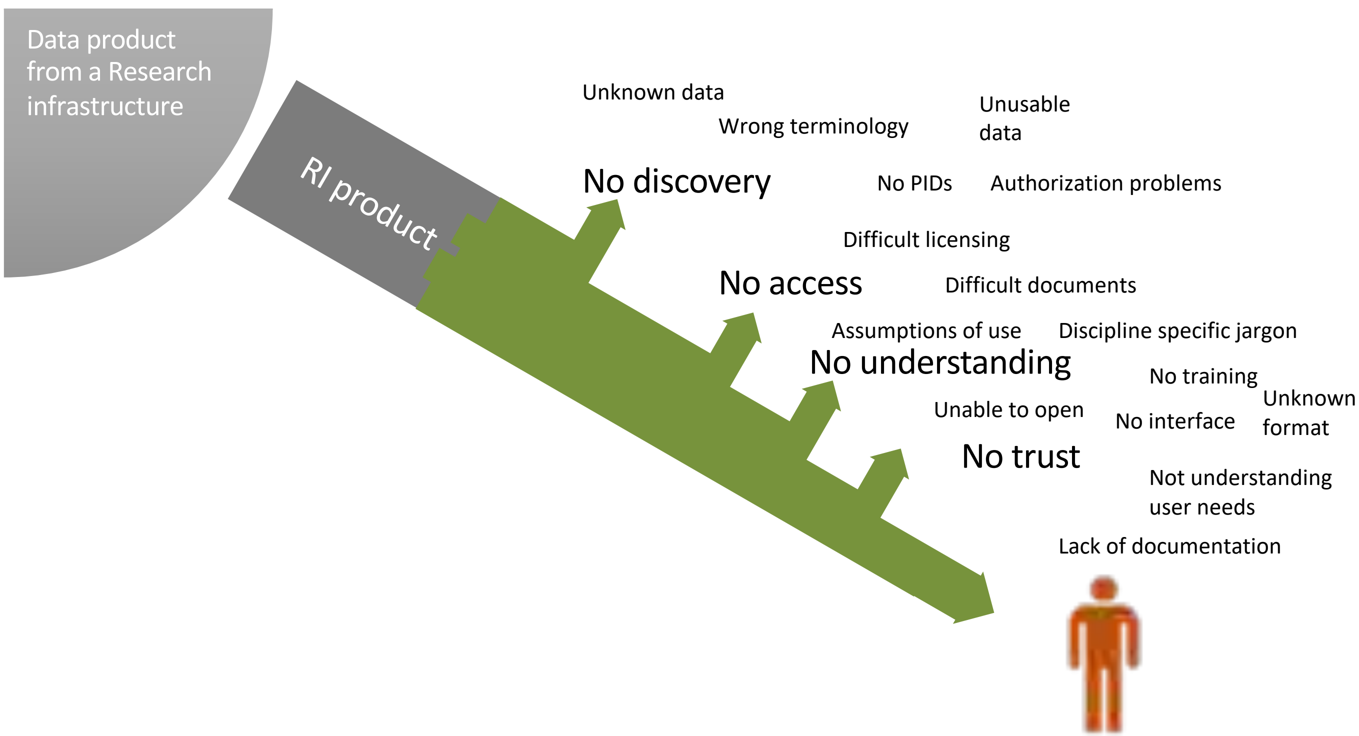
Current view

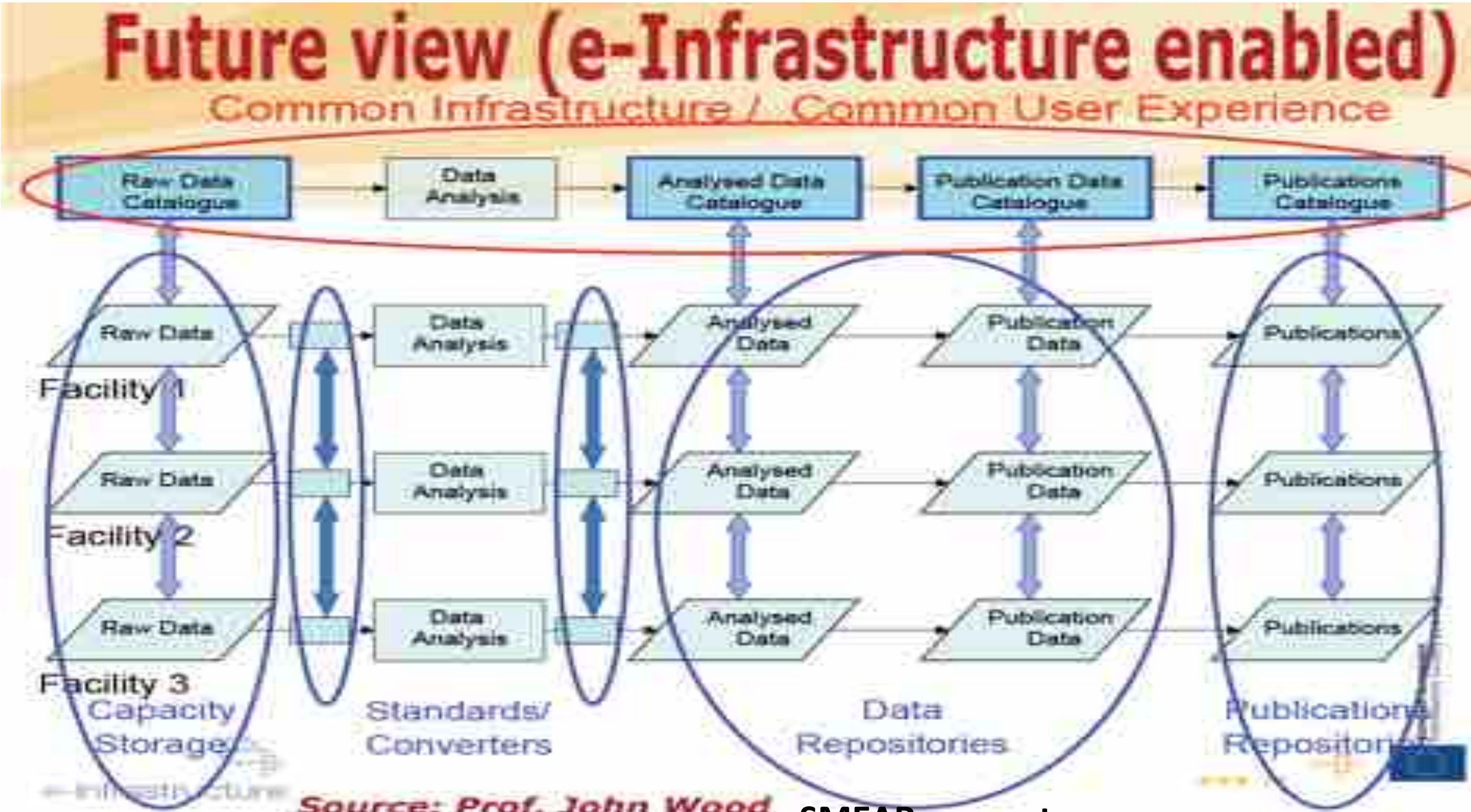
Distinct Infrastructures / Distinct User Experiences



Source: Prof. John Wood

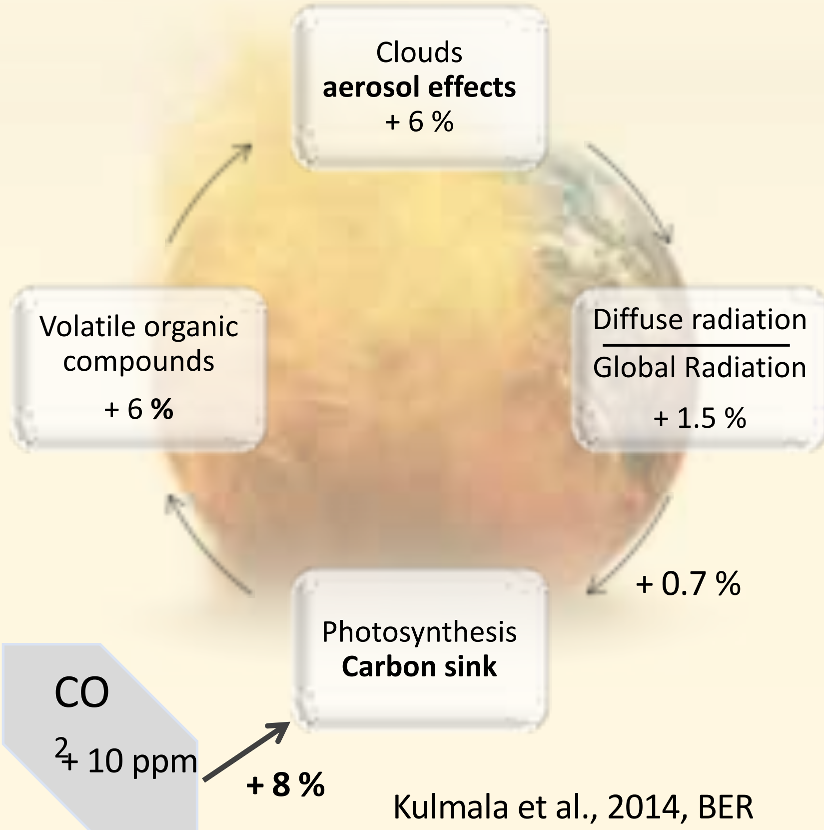
Barriers of information



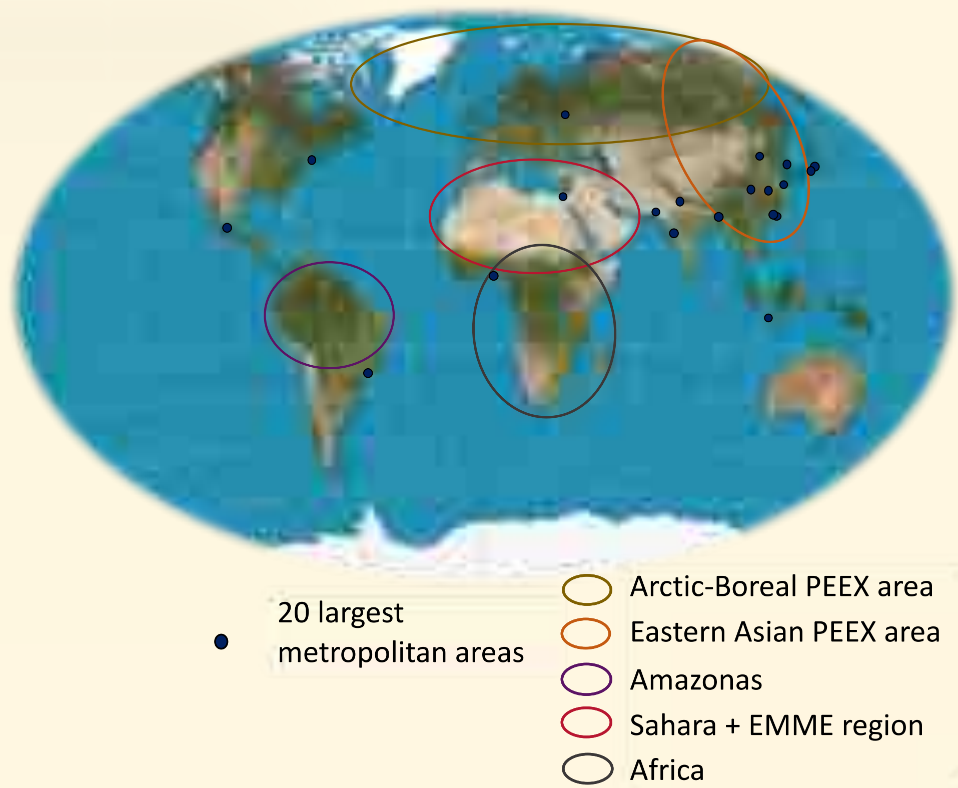


SMEAR concept

THE POTENTIAL OF SMEAR CONCEPT:
GLOBAL COMPREHENSIVE FEEDBACK ANALYSIS

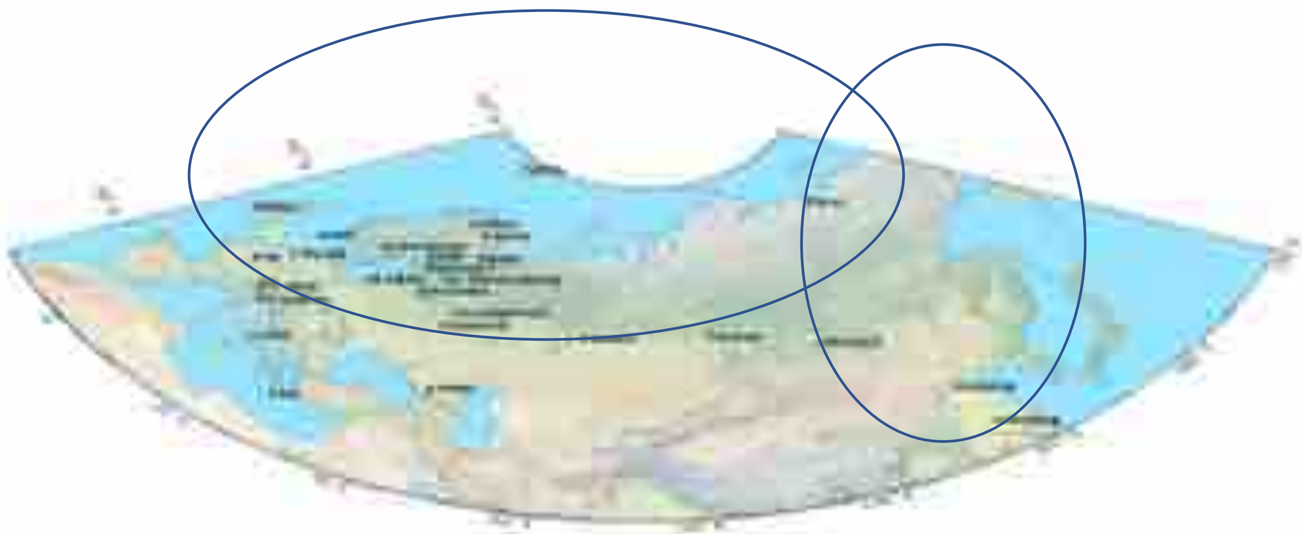


Kulmala et al., 2014, BER



PEEX (Pan Eurasian Experiment)
2013 - 2033 (-2100)
www.atm.helsinki/peex

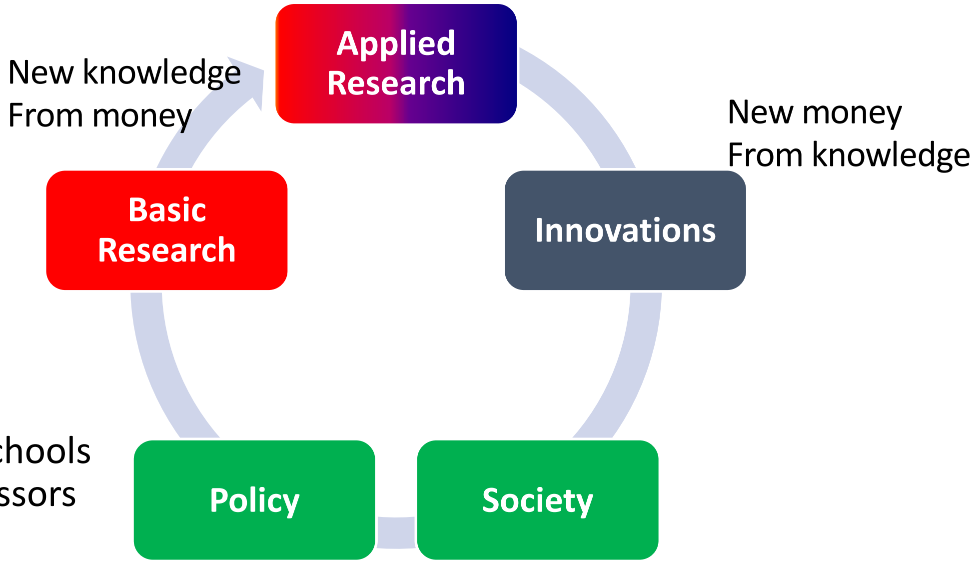
PEEX region



Station network, Marine, Airborne, remote sensing, multiscale modelling, Supradisciplinary

PEEX

- PEEX and DBAR
- INFRASTRUCTRURES
  - SMEAR / SORPES
  - In GLOBAL SMEAR
- RESEARCH
  - High level research
  - Nature/Science
  - PEEX Connections
- Capacity Building
  - Knowledge transfer
  - Joint courses, summer/winter schools
  - Joint Students/Post docs / Professors
- Innovations
  - Business – research connections
  - SMEAR/SORPES as test bed



GRAND CHALLENGES - IMPOSSIBLE TO ADDRESS WITHOUT A MULTIDISCIPLINARY RI CONCEPT

Vision: 1000 SMEAR (Station for Measuring Earth surface - Atmosphere Relations) stations

- 10 Billion euros investments (+ education of 5000 technicians, 5000 scientists)
- Integrated concept: ICOS, ACTRIS, AnaEE/eLTER
- WMO/GAW and GEO in collaboration
- USA: NEON 2.2 Billion USD
- Russia, Estonia, Chile, Kenya, RSA, Saudi-Arabia, …
  - New stations
- CHINA: New network of 20–25 stations
  - CCTV (China Central TV) document from SMEAR II: Potentially 1.2 Billion audience

Number	1990	2018	2026	2035
SMEAR stations	1	9	95	900


An enclosure for measuring gas exchange between plants and the atmosphere at a station in Finland.

Build a global Earth observatory

Markku Kulmala calls for continuous, comprehensive monitoring of interactions between the planet's surface and atmosphere.

Climate change. Water and food security. Urban air pollution. These environmental grand challenges are all linked, yet each is studied separately.

Interactions between Earth's surface and

The result is a cacophony of information that yields little insight. It is like trying to forecast weather in November with spotty measurements of rain, wind, temperature or pressure from June.

Nature Comment, January 2018

Policymakers: test policies and their impacts

Companies: develop environmental services

POLICY DIALOGUE / SCIENCE DIPLOMACY

Contribution to an executive dialogue relevant particularly to societies living under changing Arctic and in Silk Road environments

Provision of policy-relevant options for climate change mitigation and adaptation as well as air quality

Direct dialogue with Russian Geographical Society and CAS

INAR-FS leads intiatives / platforms:

- Pan-Eurasian Experiment (PEEX)
- Global SMEAR / Global Observatory
- International Eurasian Academy of Sciences, European Center

HIGH GLOBAL IMPACT: SOLVING AIR QUALITY PROBLEM

- Polluted air is responsible for 2.5 million deaths annually in China and 6.4 million globally
  - Also many local environmental problems (e.g. clean water, food production, forest dieback, biodiversity loss…)
- GDP in China 20 000 Billion USD (2017)
  - 4–8 % reduced due to air pollution (estimation by Chinese Government)
- Our work could contribute 1–2% of that by promoting Finnish companies to get into market more efficiently
  - Ca 10–20 billion USD per year and ca 100 000 new jobs
- Co-design with companies, e.g.
  - Vaisala: weather radars (0.5 Billion USD), air quality division
  - Neste: reducing diesel emissions, improving processes, early warning systems
  - Nokia / China Mobile: citizen science

COMMENT

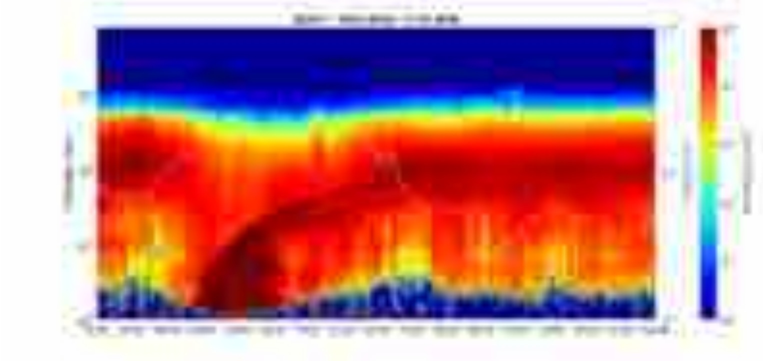
China's choking cocktail

Nature Comment, October 2015

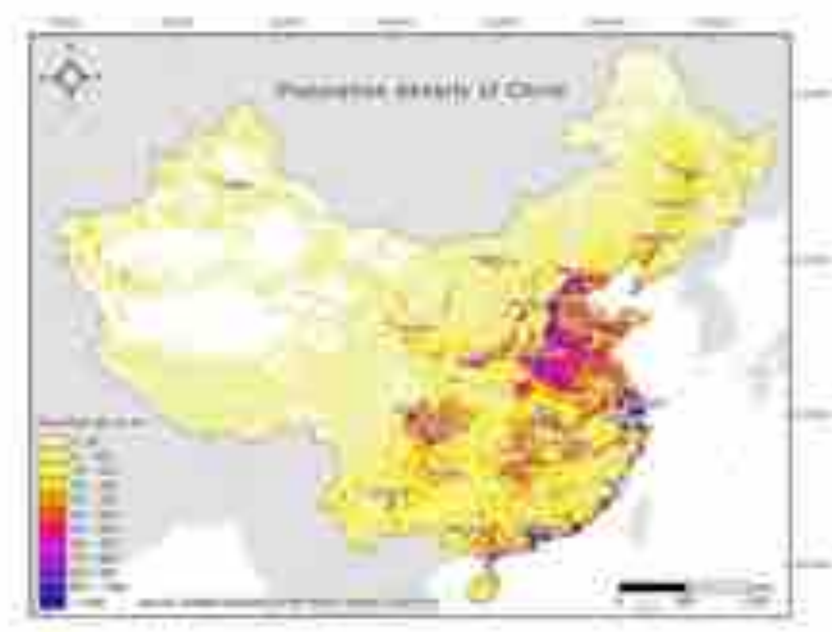
Research Questions

What are the sources of Beijing's Haze?

Does NPF contribute to Haze?:



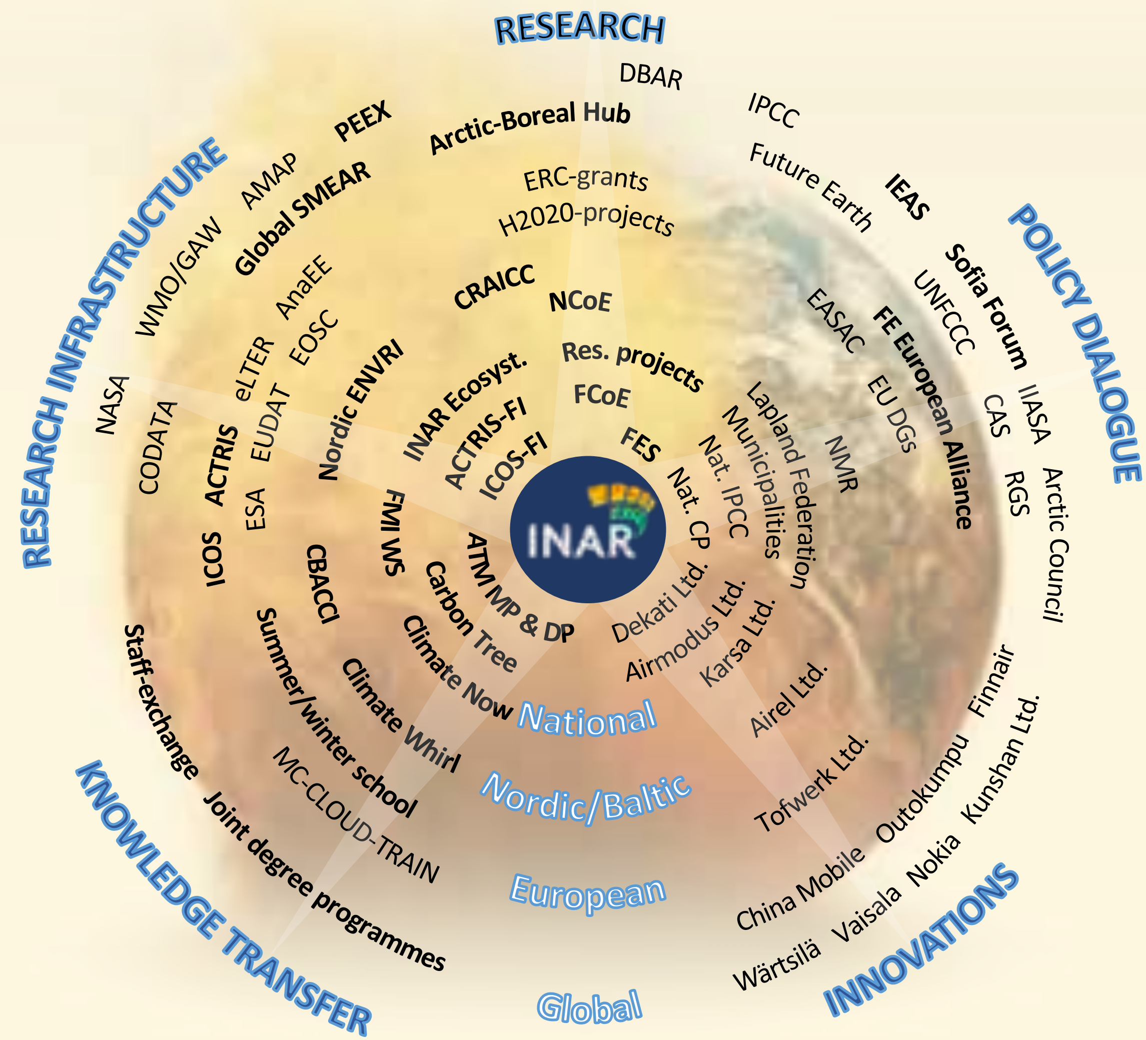
Population density vs air pollution vs needed observations. Ca 3 M km^2

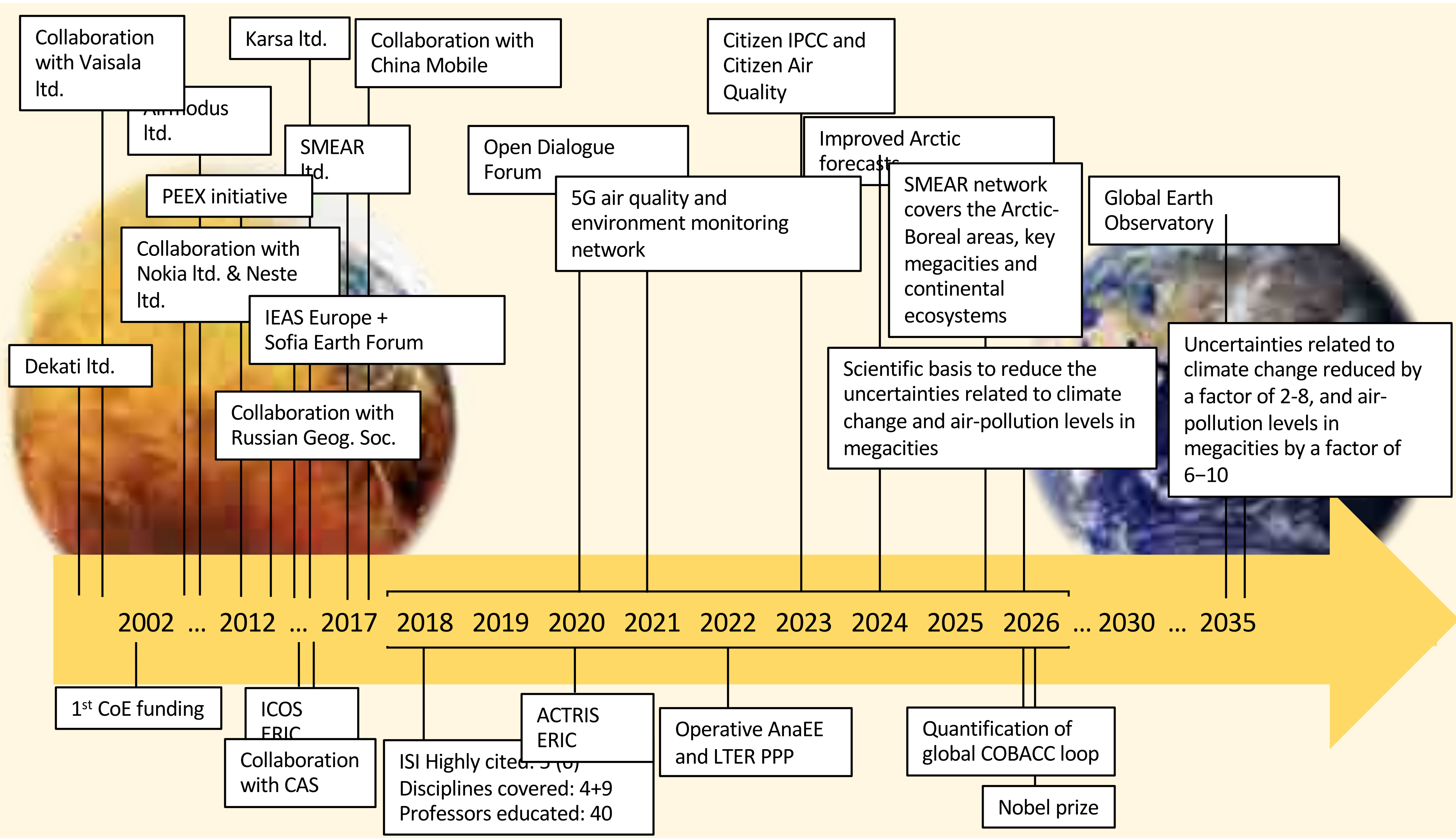


10% of global population
lives inside red area

ADDED VALUE

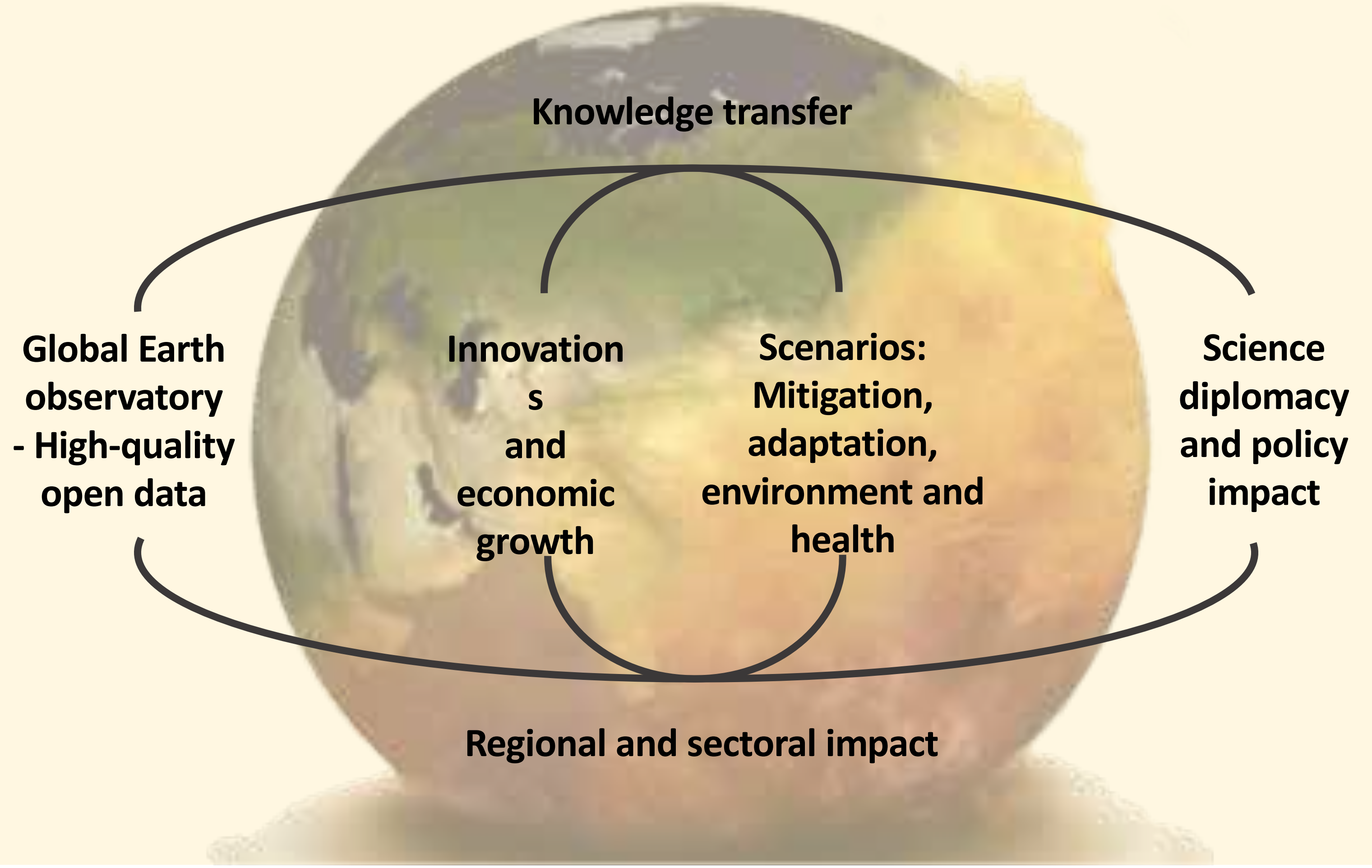
- From deep understanding to practical solutions, innovations and economic growth
- INAR-FS is the core to orchestrate national and international Armada
- ”Finland’s Max Planck”
- INAR-FS penetrates across boundaries





Collaboration with Vaisala ltd.
Airmodus ltd.
Karsa ltd.
Collaboration with China Mobile
SMEAR ltd.
PEEX initiative
Collaboration with Nokia ltd. & Neste ltd.
IEAS Europe + Sofia Earth Forum
Dekati ltd.
Collaboration with Russian Geog. Soc.
Open Dialogue Forum
5G air quality and environment monitoring network
Citizen IPCC and Citizen Air Quality
Improved Arctic forecasts
SMEAR network covers the Arctic-Boreal areas, key megacities and continental ecosystems
Global Earth Observatory
Scientific basis to reduce the uncertainties related to climate change and air-pollution levels in megacities
Uncertainties related to climate change reduced by a factor of 2-8, and air-pollution levels in megacities by a factor of 6–10
2002 ... 2012 ... 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 ... 2030 ... 2035
1st CoE funding
ICOS ERIC
Collaboration with CAS
ISI Highly cited: 5 (6)
Disciplines covered: 4+9
Professors educated: 40
ACTRIS ERIC
Operative AnaEE and LTER PPP
Quantification of global COBACC loop
Nobel prize

GLOBAL IMPACT / INTEGRATED SYNTHESIS

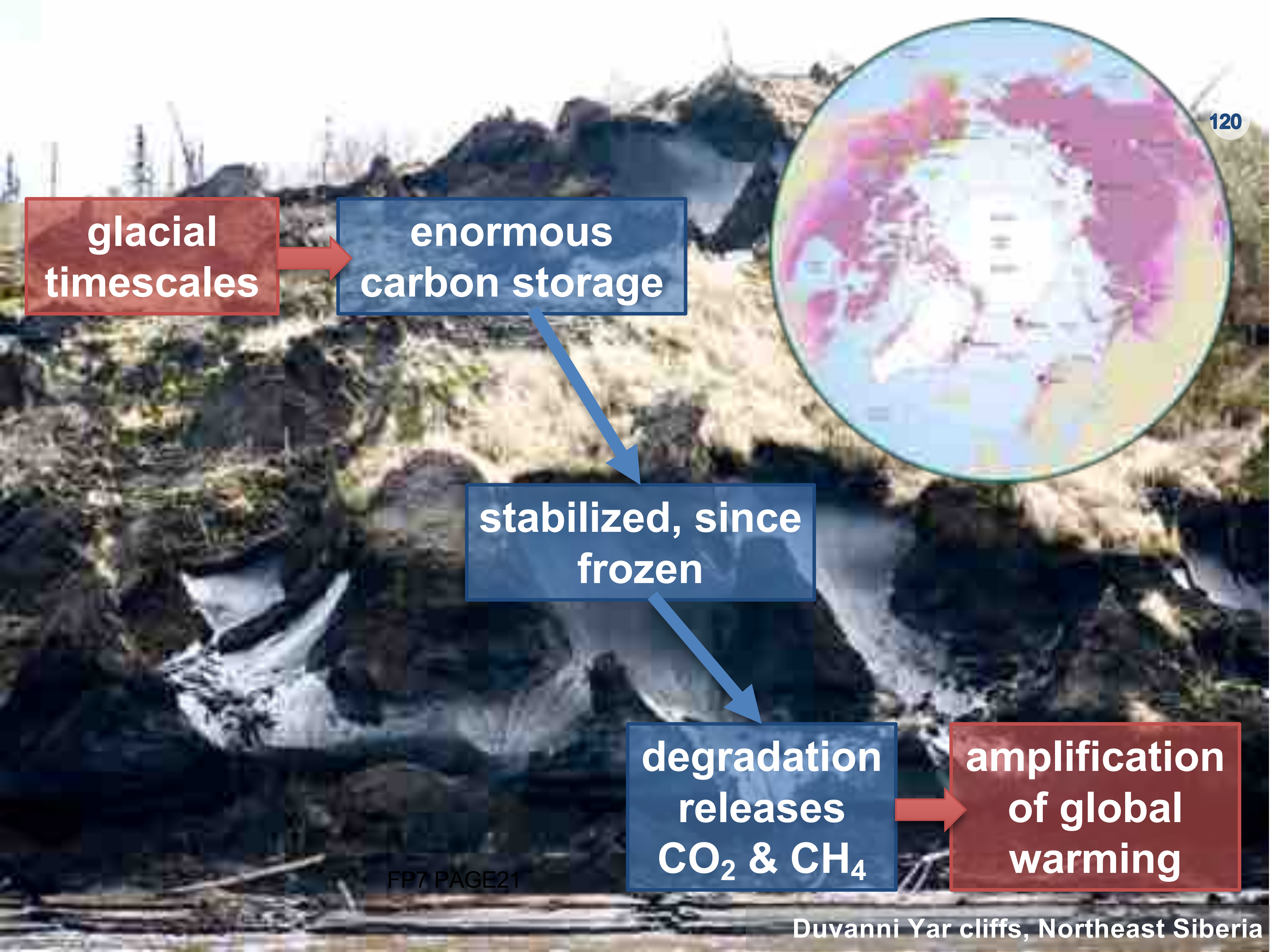


How to set up and maintain an observing system for permafrost degradation?

Martin Heimann
Max-Planck-Institute for Biogeochemistry, Jena, Germany
INAR/Physics, University of Helsinki, Finland

martin.heimann@bgc-jena.mpg.de

Duvanni Yar cliffs, Northeast Siberia


glacial timescales
enormous carbon storage
stabilized, since frozen
degradation releases CO_2 & CH_4
amplification of global warming
FP7 PAGE21
Duvanni Yar cliffs, Northeast Siberia

Changing face of the Arctic

sinking surfaces

thermo-karst

wildfires

Arctic greening

net sink for carbon → net source for carbon?

7,000 underground gas bubbles poised to 'explode' in Arctic

By The Siberian Times reporter

20 March 2017

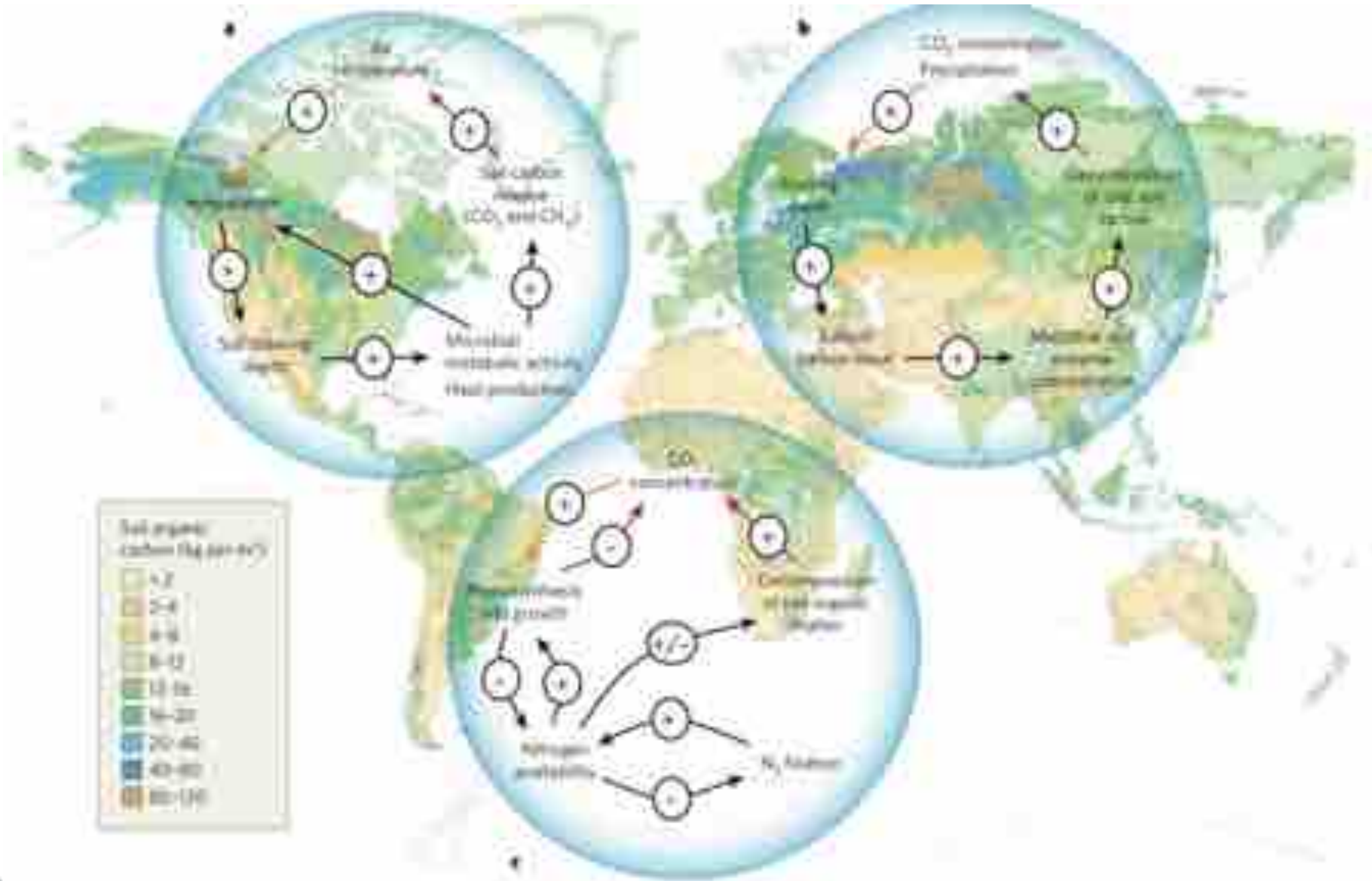
Mysterious “Pingos” in Siberian Arctic tundra

Permafrost methane "bomb"?

An aerial photograph of the Batagaika crater in Siberia.

http://news.nationalgeographic.com

Major biogeochemical-climate feedbacks



Heimann and Reichstein, 2008

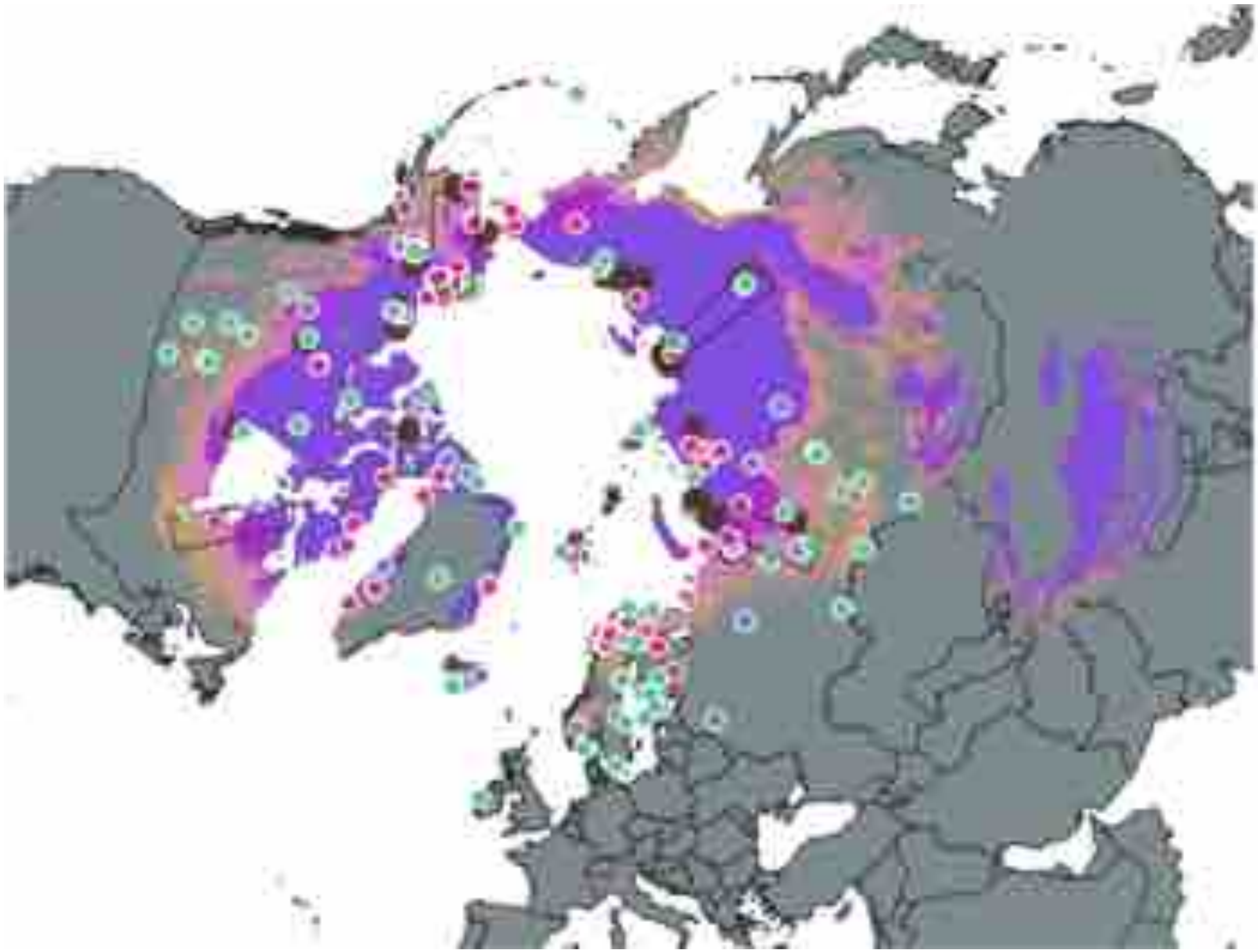
Arctic GHG research and monitoring - rationale

- Arctic: a climate and biogeochemical "hot spot":
  - Enhanced warming
  - Sea ice retreat
  - Permafrost thawing
  - Forest migration into tundra region
  - Wetlands: wetting or drying?
  - Methane emissions from shallow sub-sea permafrost
- Potential for significant climate-biogeochemical feedbacks (+/-) on global cycles of carbon (CO_2) and methane (CH_4)
- Increasing anthropogenic impacts – shipping, oil and gas exploration, mining
- Need observing system for detection and quantification of changes

station network with in situ biogeochemical observations (a.o. CO_2 and CH_4)

- Continuous
- Continuous (ICOS)
- Continuous (NIES)
- Continuous (Env Canada)
- Campaign/flask sampling (NOAA/ESRL)
- 2018

Key Arctic ecosystem research sites



Implementation sketch

- Atmosphere Watch type secondary level GHG monitoring network
- FLUXNET type network
- Soil monitoring sites network (e.g. CALM, GTN-P)
- Hydrology

- Remote sensing - key parameters:
  - Cryosphere processes:
    - Surface freeze-thaw extent and timing
    - Snow cover and depth
  - Vegetation cover change (a.o. "Arctic greening")
  - Disturbances (a.o. fire)
  - Changes in microtopography, thermokarst formation (inSAR?)

Thank you

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Sofia Earth Forum 2018

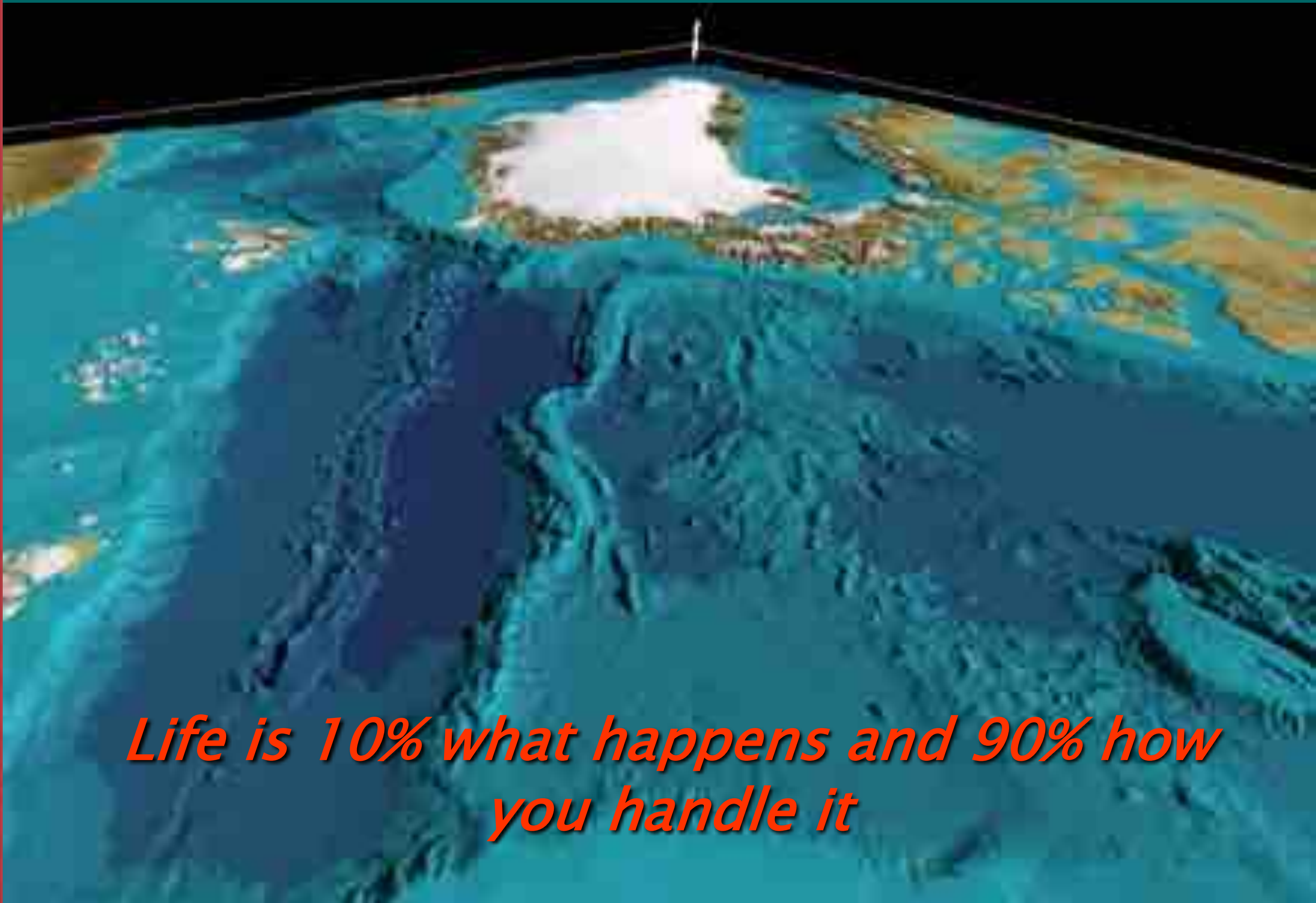
GLEE and SERENDIPIDY

Raudfjorden, Svalbard

GLEE (not Gee) ---- Fun, joviality, mirth, hilarity. Musical composition for three or four voices (as at dinner. yesterday !)

SERENDIPITY --- an aptitude for making desirable discoveries by accident; something positive that happens unexpectedly

Serendipidity and Life!



Life is 10% what happens and 90% how you handle it


From the origin of the Arctic
to EUROPROBE (1990´s)
and the Orogens of Europe

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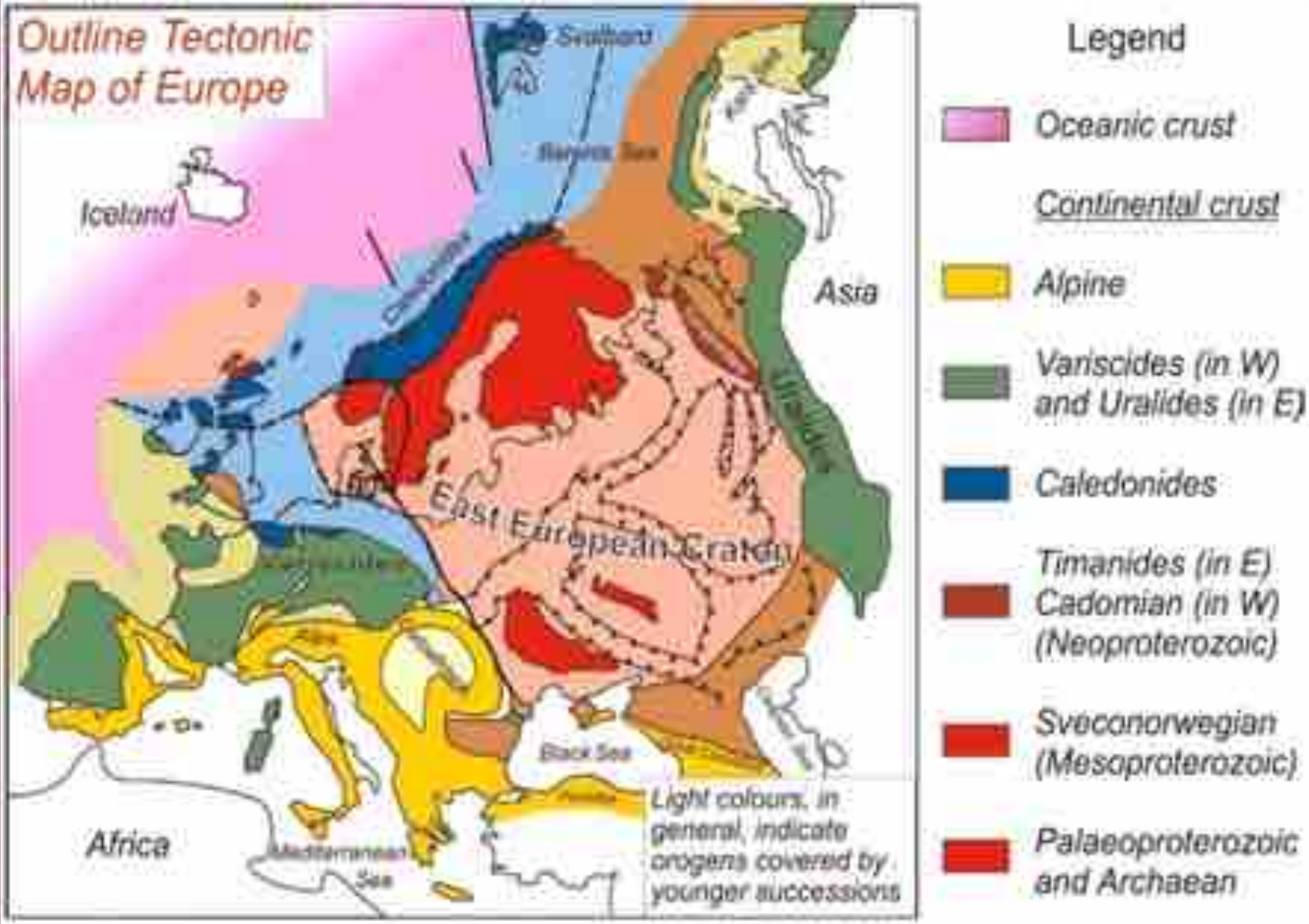

From: GEE, D. G. & STEPHENSON, R. A. (eds) 2006. *European Lithosphere Dynamics*. Geological Society, London, Memoirs, **32**, 1–9. 0435-4052/06/$15.00

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Inspiration from European Geotraverse (EGT) and Canada's Lithoprobe

Ten major Integrated Geological Geohysical Geochemical Projects from the Urals to Iberia and Arctic to the Med.

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And towards the end of EUROPROBE

The European Union of Geosciences (EUG) and the European Geophysicl Society (EGS) merged into the

European Union of Geosciences (EGU)

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Himalayas -- India-Asia collision zone

The Present is the key to the Past (and vice-versa)

Karakoram Mountains

***Science** is about*

Hypotheses, Theories

*and **Paradigms***

(not truth)

For “verification”,
lithosphere geoscientists
need to drill.

Importance of IODP and ICDP

And a final reflection

A True Scientist

accepts no authorities;
for him/her, ***scepticism***
is the highest of duties, and
blind faith the one unpardonable sin.

En sann vetenskapsman erkänner inga auktoriteter, ty för honom är skepticism den högsta av dygder och blind tilltro en oförlåtlig synd.

Thomas Huxley

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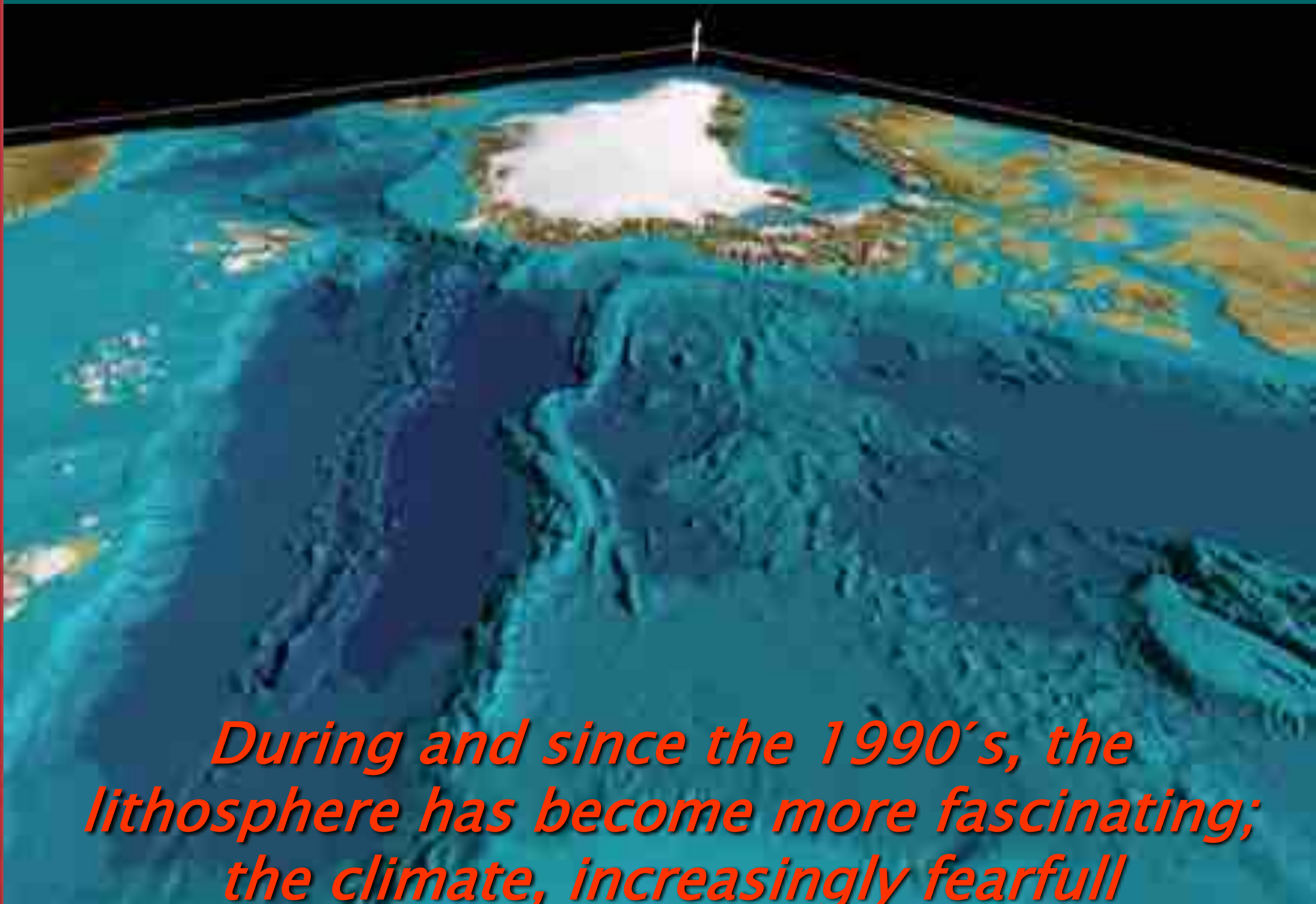
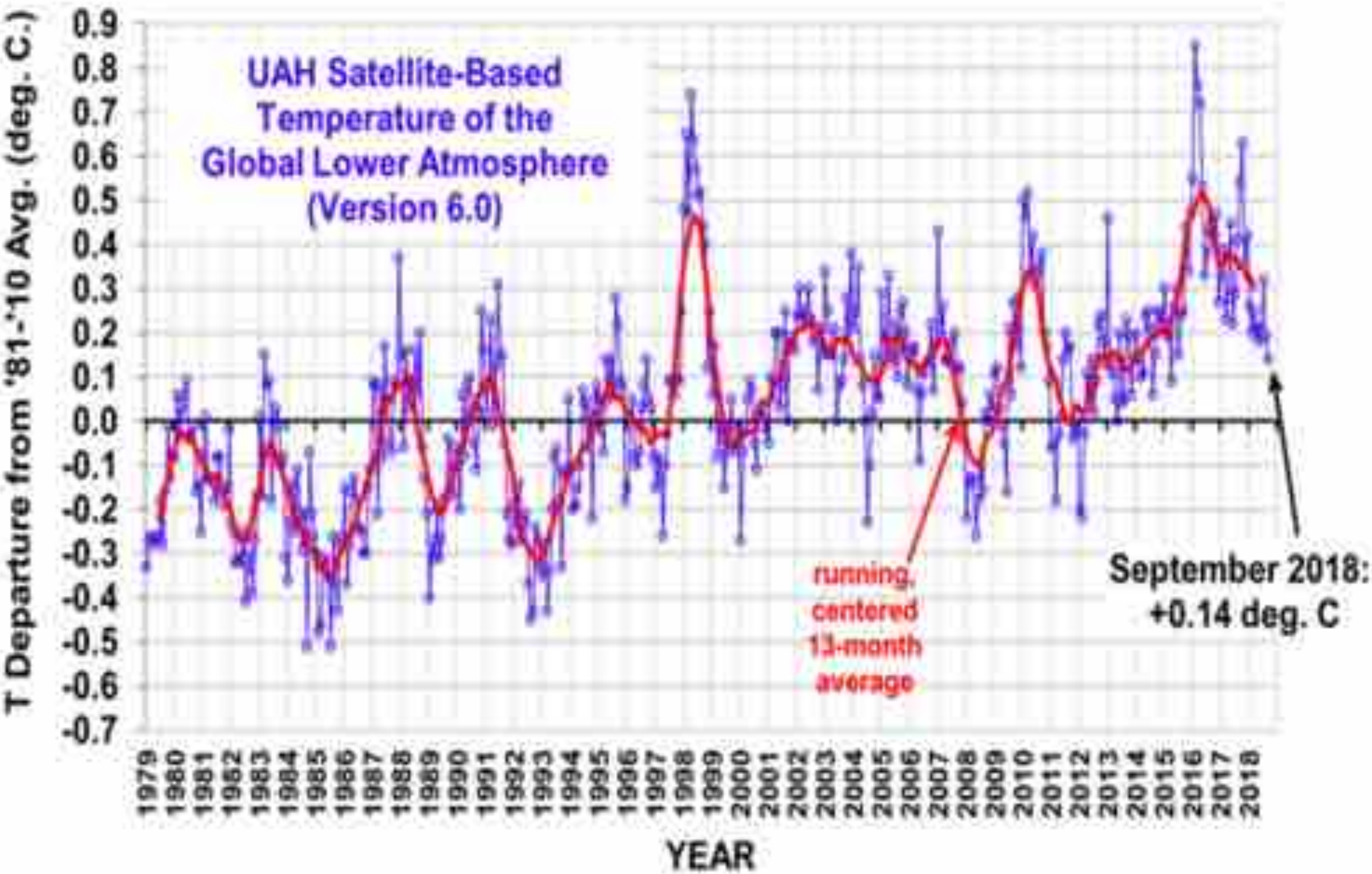
Science in the Lithosphere and the Atmosp

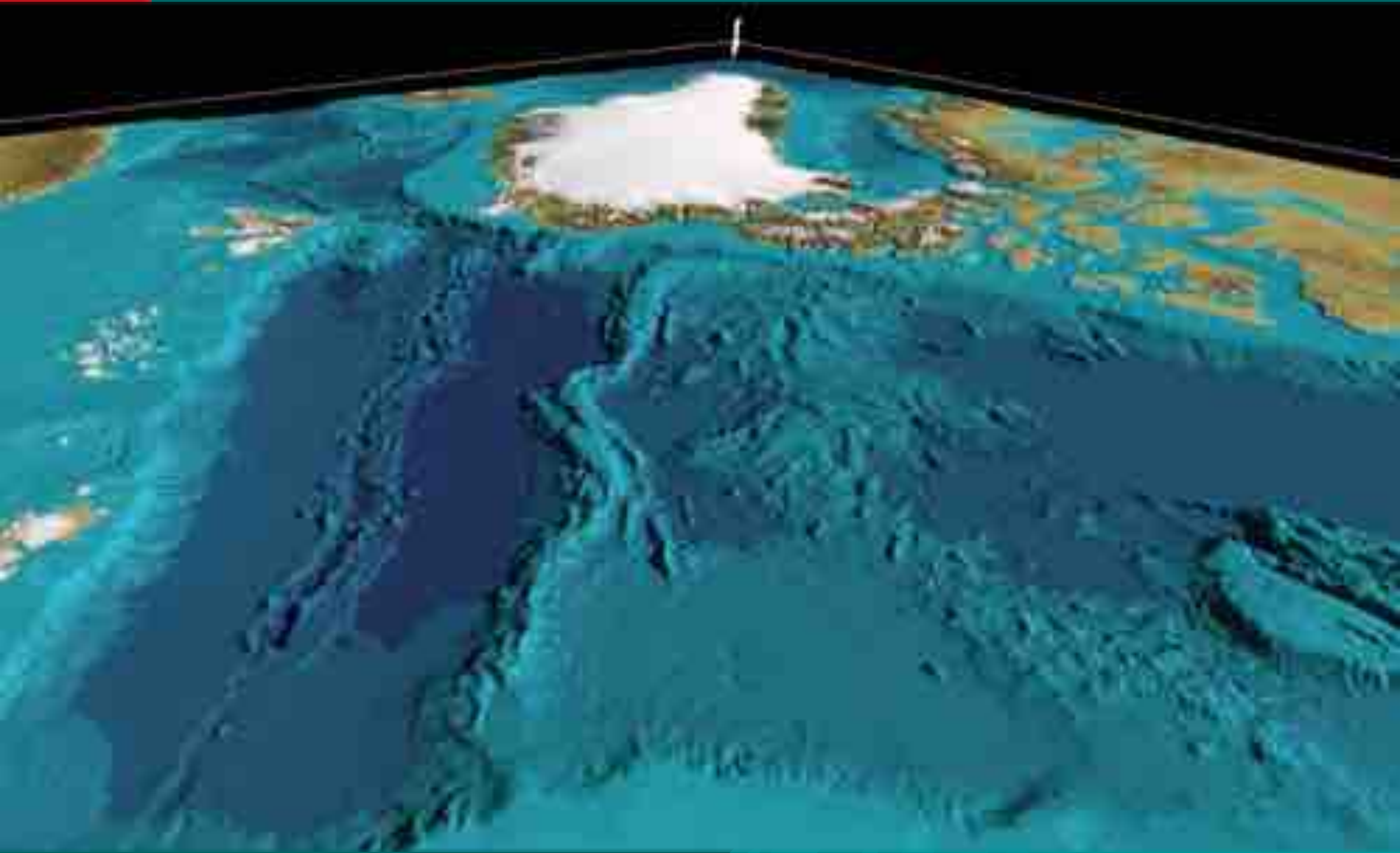


During and since the 1990´s, the lithosphere has become more fascinating; the climate, increasingly fearfull

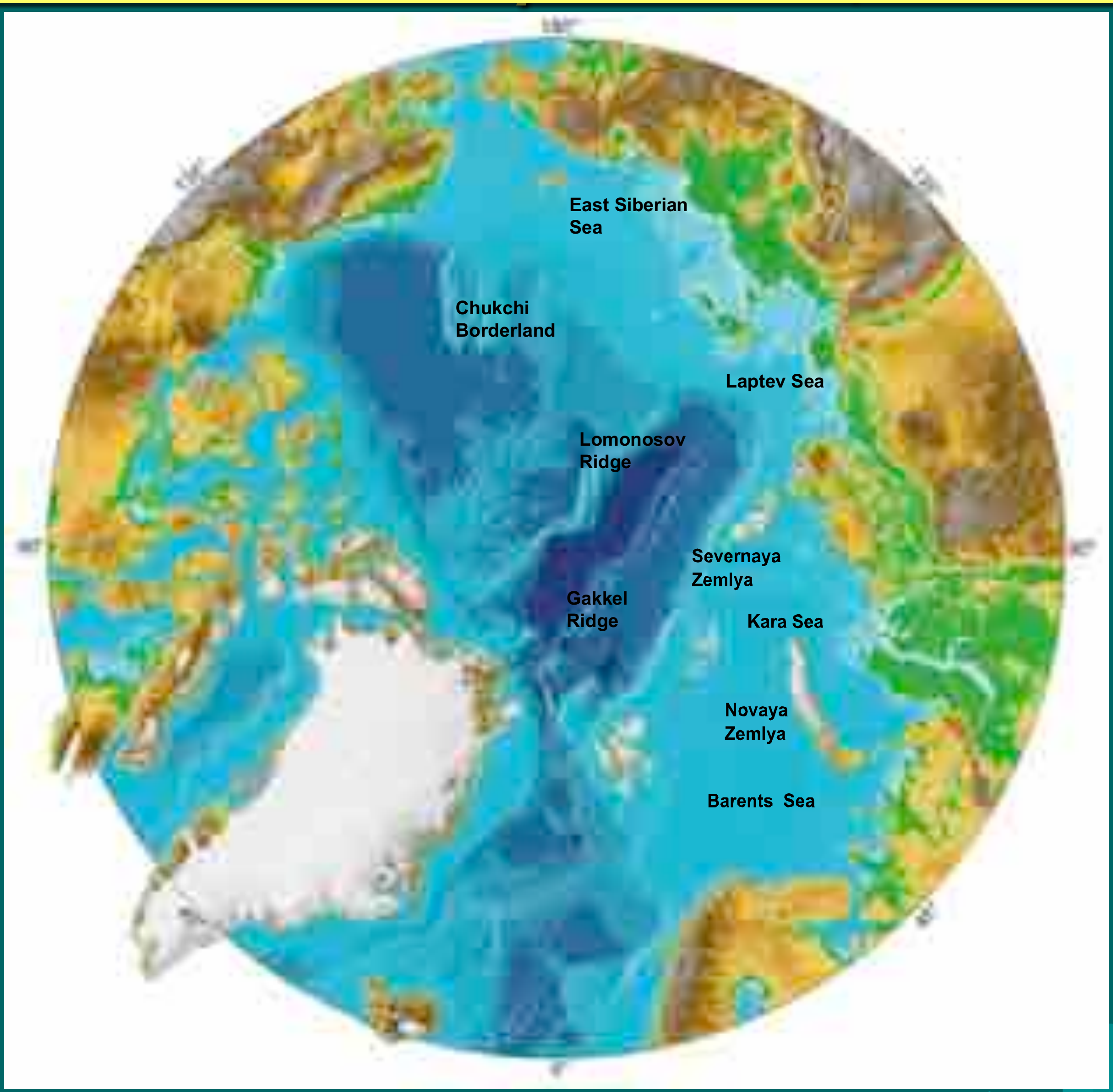
The Fear of Climate Warming



Thanks for your attention!

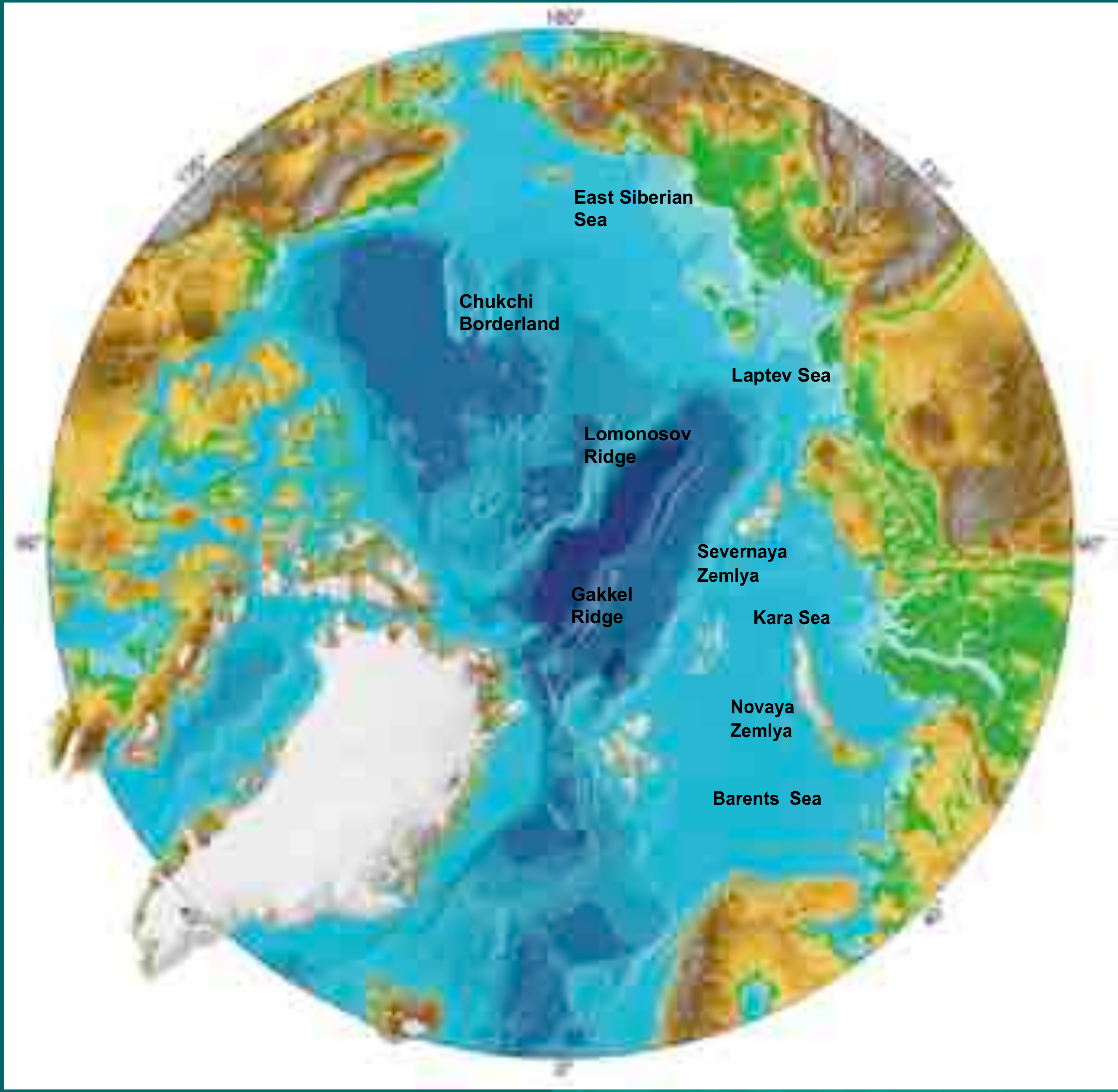


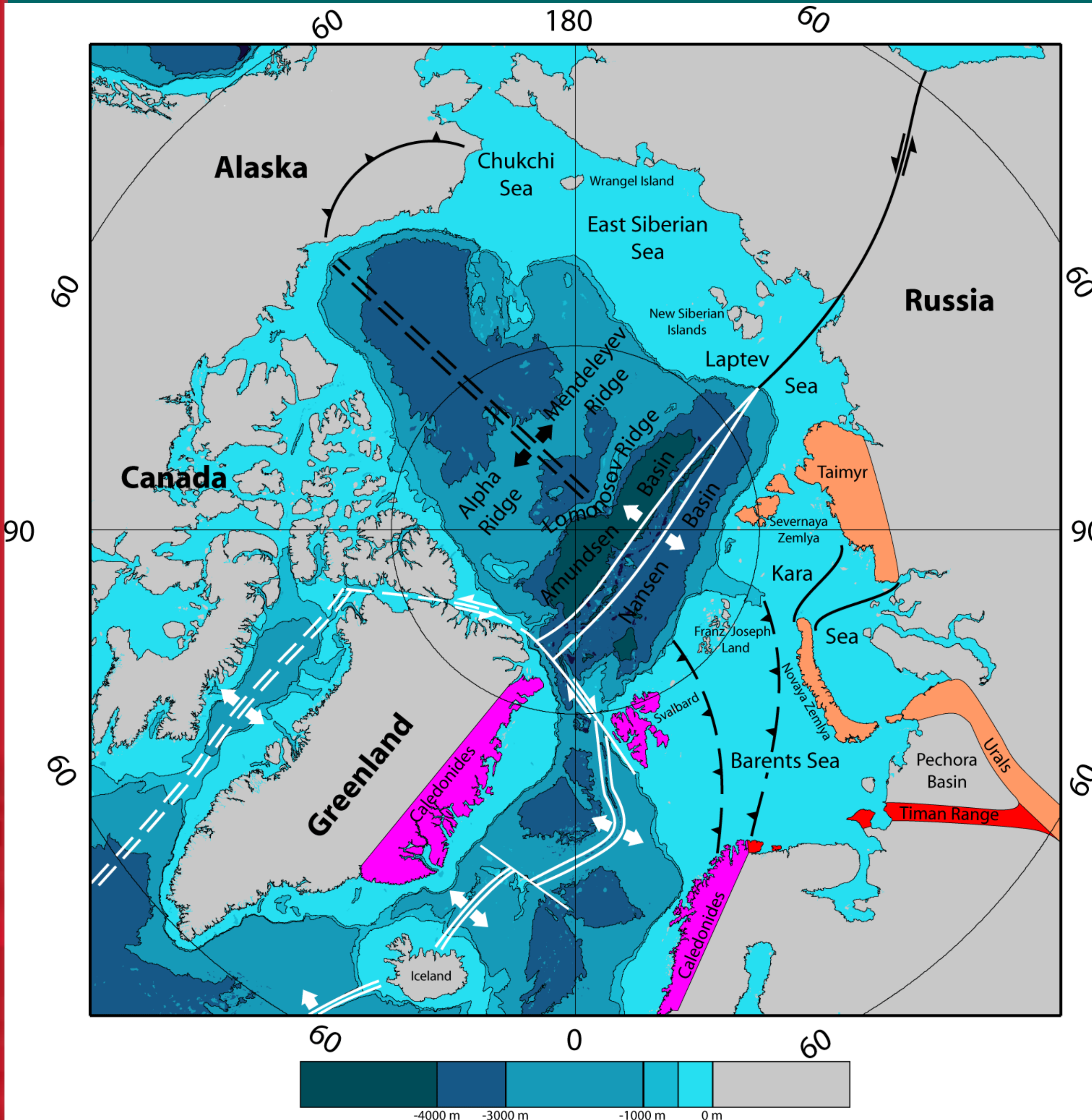
The Holocene Optimum (5000 BC)



A nice free, ice-free Arctic

The origin of the Arctic

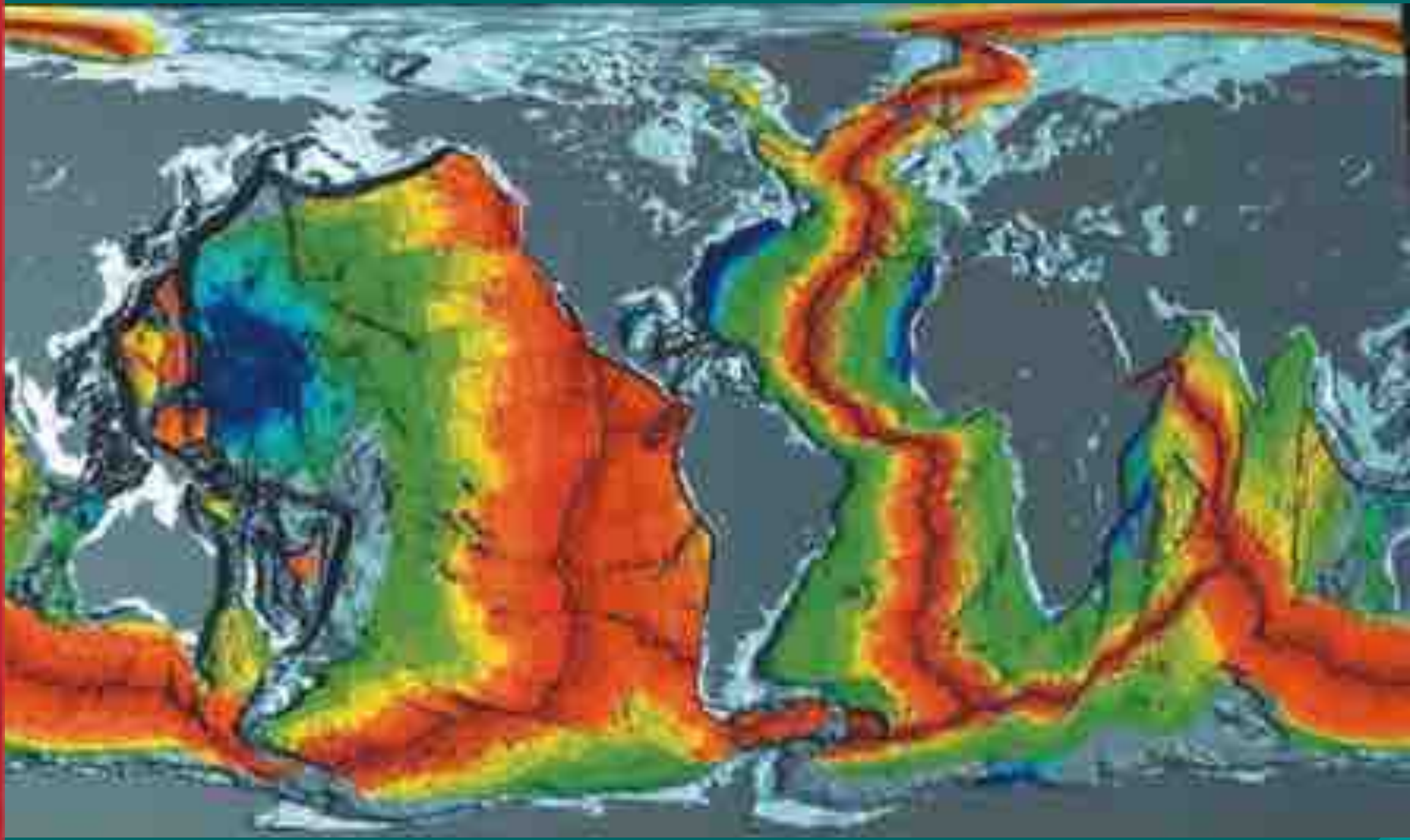




Tectonic setting of the Arctic showing the inferred opening of the Amerasia Basin in the Mesozoic, and the Eurasia Basin and North Atlantic in the Cenozoic.

Based on *Jackson and Gunnarson 1990*

Plate tectonics paradigm



Based on four categories of independent evidence:

1. Shape of the continents
2. Geology of the continents
3. Ocean floor structure, composition and age
4. Plate boundaries, movement and velocity measurements

Following the Caledonian Mountain Belt into the High Arctic

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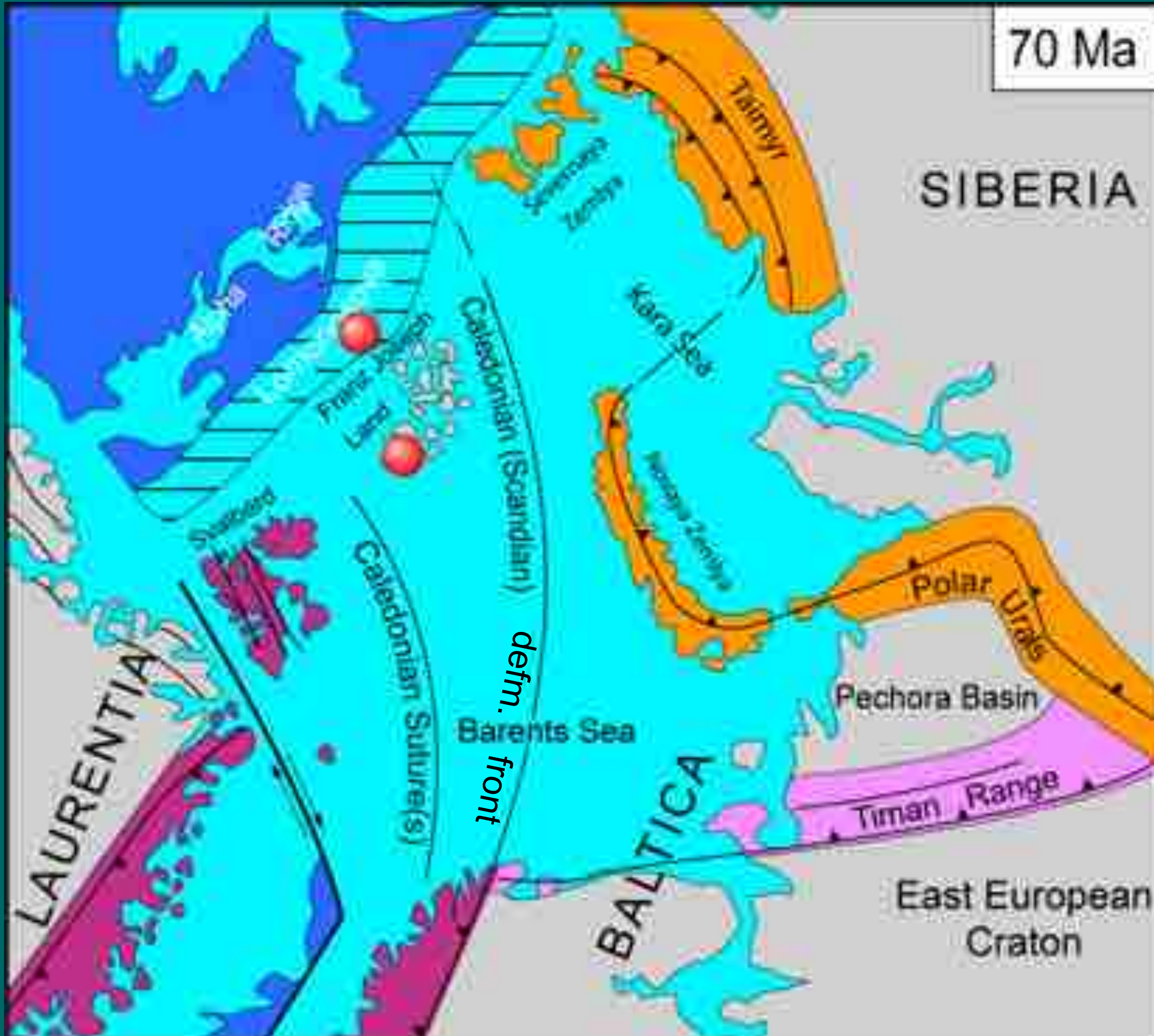
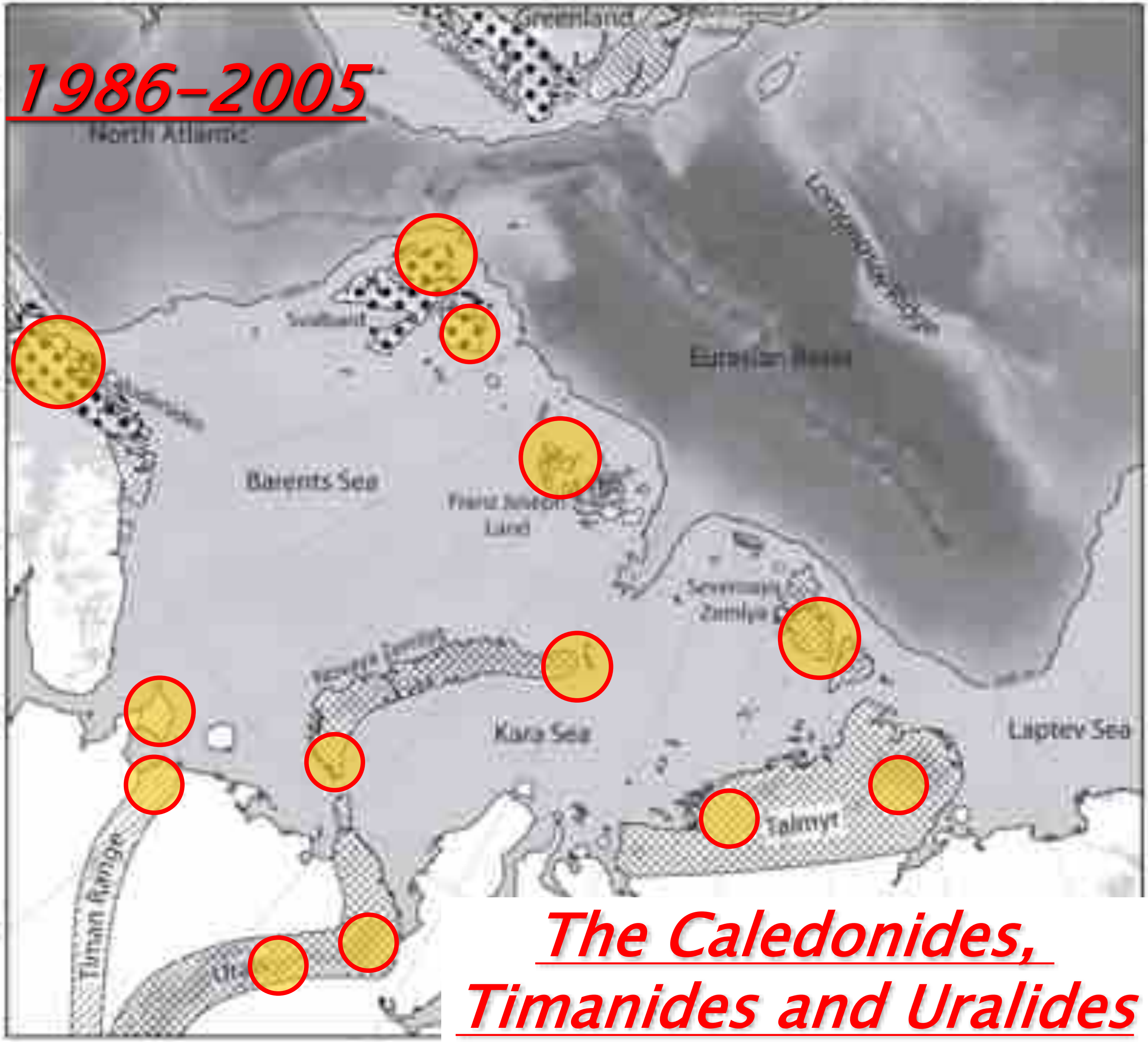
Lomonosov & Franz Josef Land Drillholes

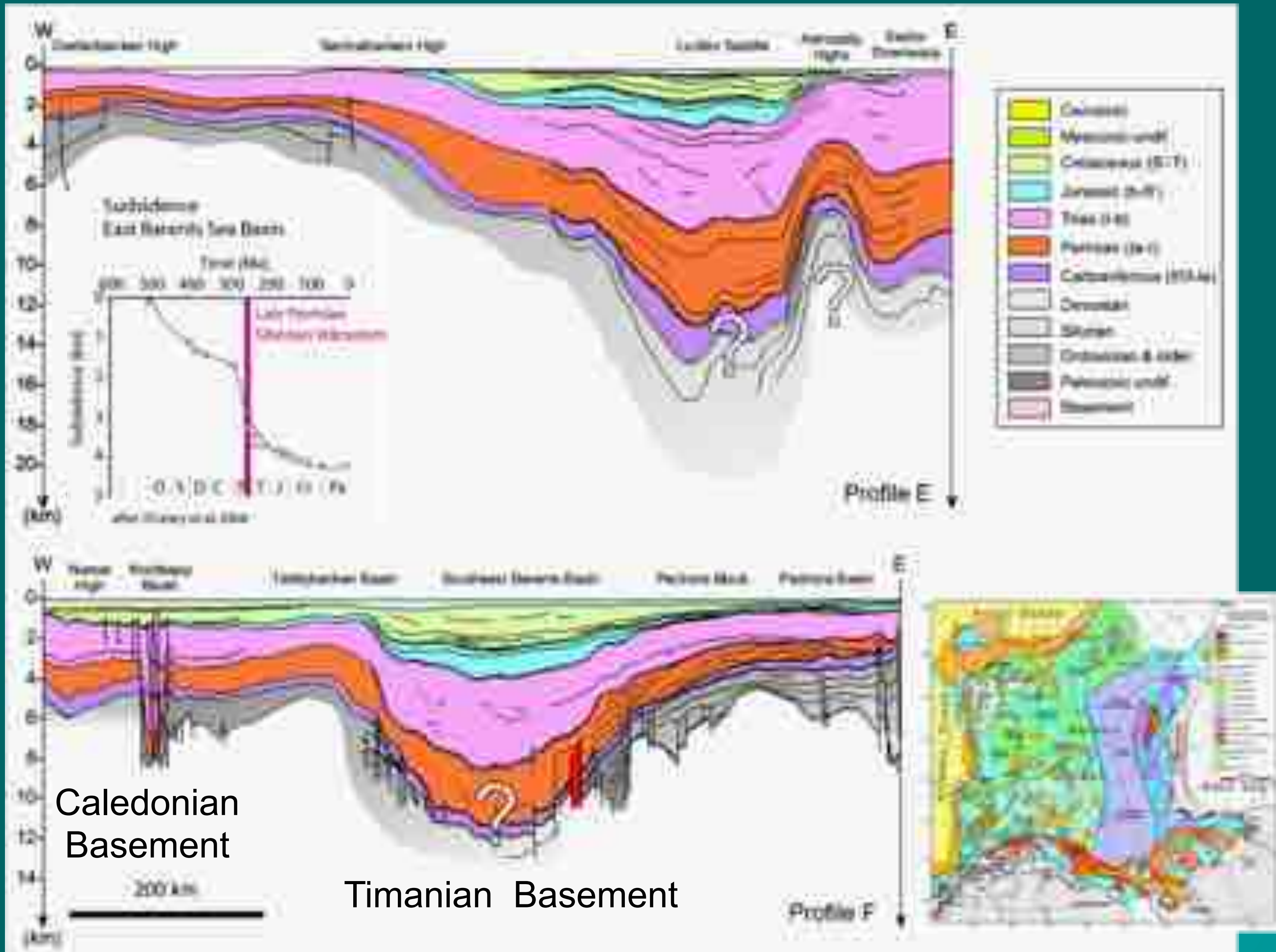




The Caledonides, Timanides and Uralides

Eastern Barents Sea Basin

Faleide et al., 2007



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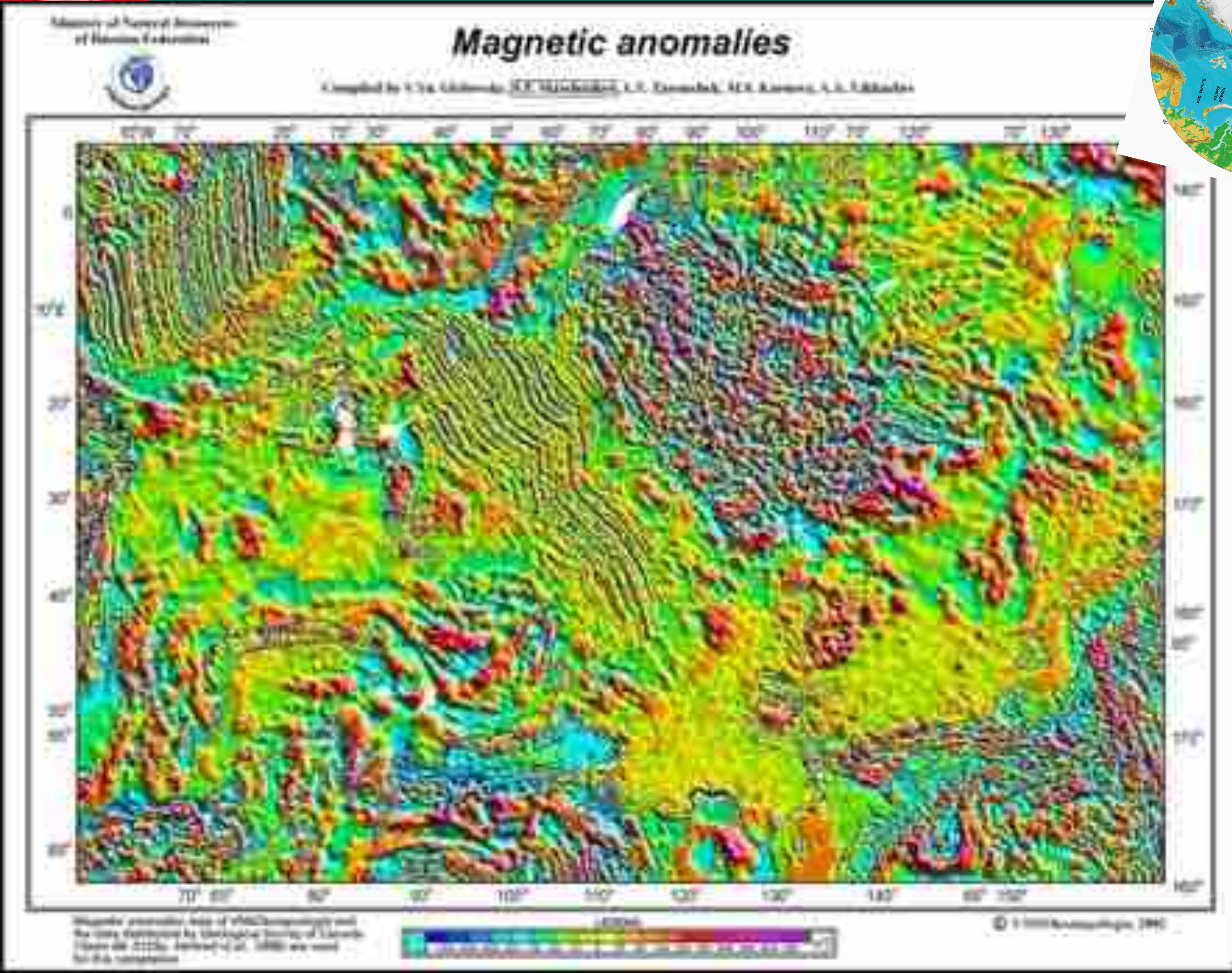
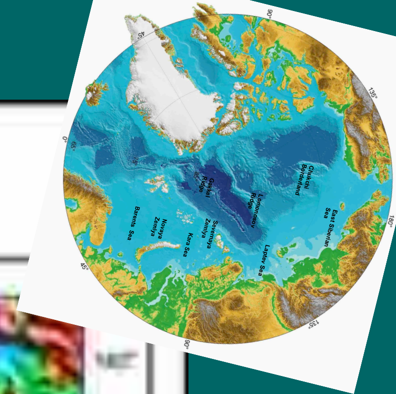
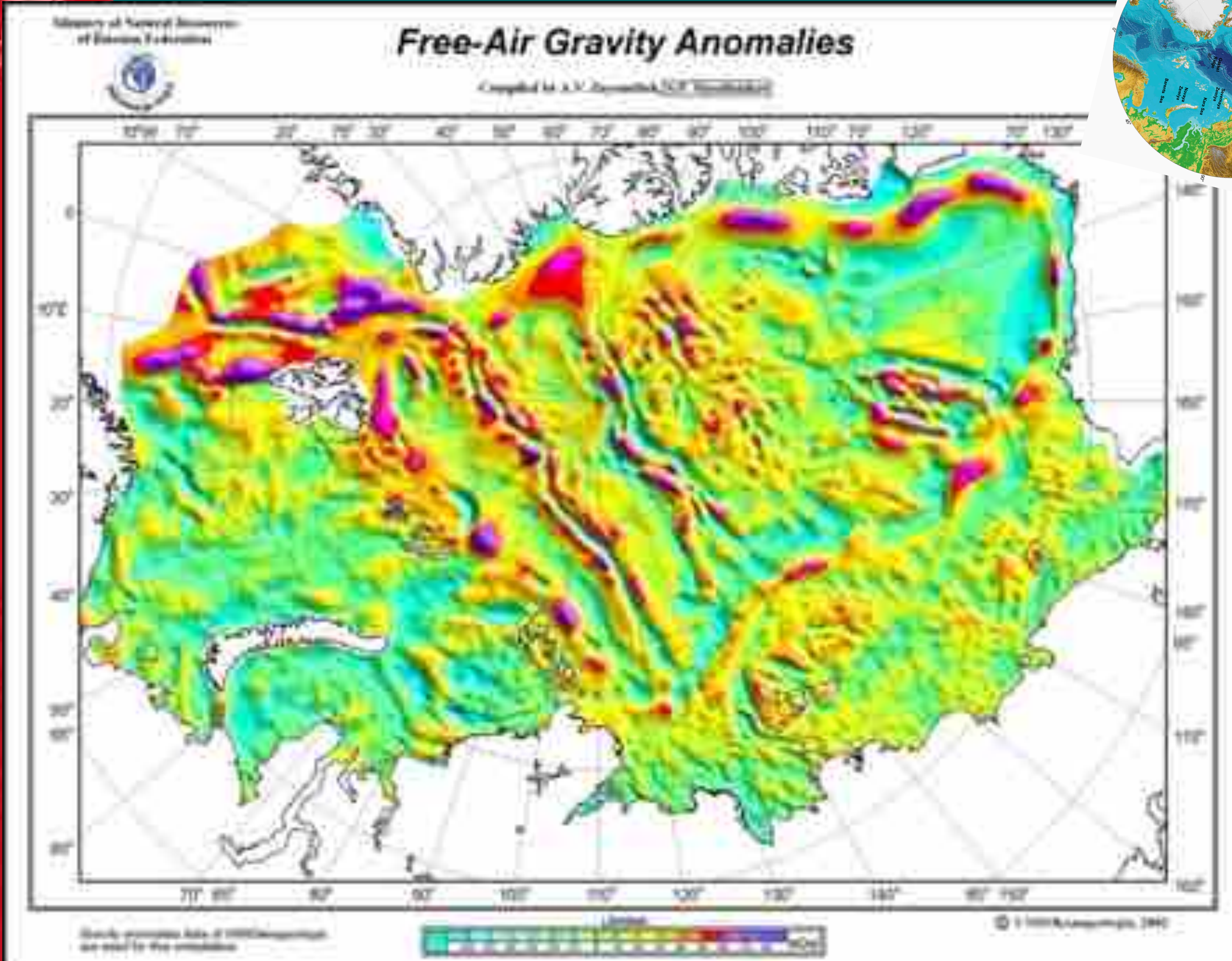
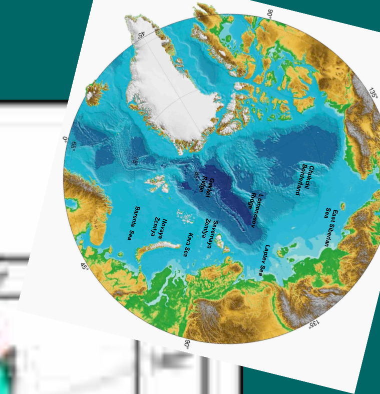

Magnetic anomalies




Free-Air Gravity Anomalies



Who will own the Arctic?

Pan-Eurasian Experiment PEEX

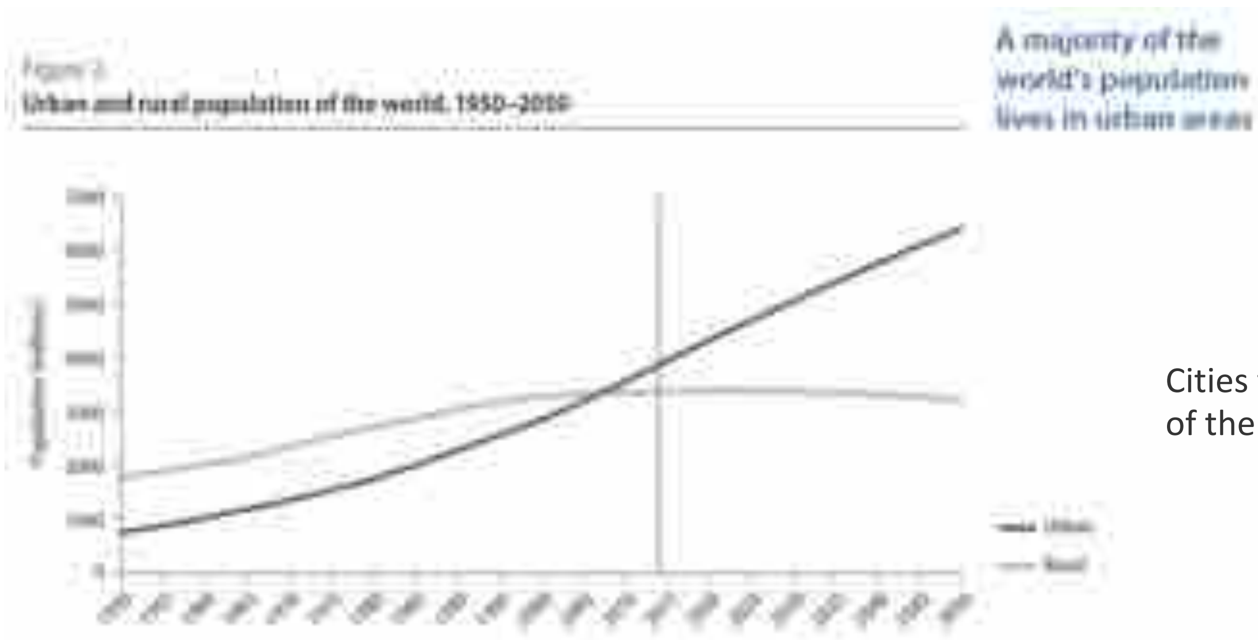
Focus: Sustainable Cities

- Climate, air quality and megacities interactions: gaps in knowledge, research needs.
- Urban hazards: pollution episodes, storm surge, flooding, heat waves, public health.
- Global climate change affects megacities’ climate, environment and comfort.
- Growing urbanization requires integrated urban weather, environment and climate monitoring systems (IUWECS).
- New generation of multi-scale models and seamless integrated urban services are needed.
- Seamless approach from Research to Services
- Pilot Projects for Eurasian cities
- Northern Urbanization specifics: research focus for PEEX

WMO OMM GAW WWRP

abaklanov@wmo.int

Urbanization: we have crossed a historic landmark



United Nations, Department of Economic and Social Affairs, Population Division (2014). World Urbanization Prospects: The 2014 Revision, Highlights (ST/ESA/SER.A/352).

The Global Context

Cities today occupy approximately only 2% of the total land, however:

70%
Economy (GDP)

over 60%
Global Energy Consumption

70%
Greenhouse Gas Emissions

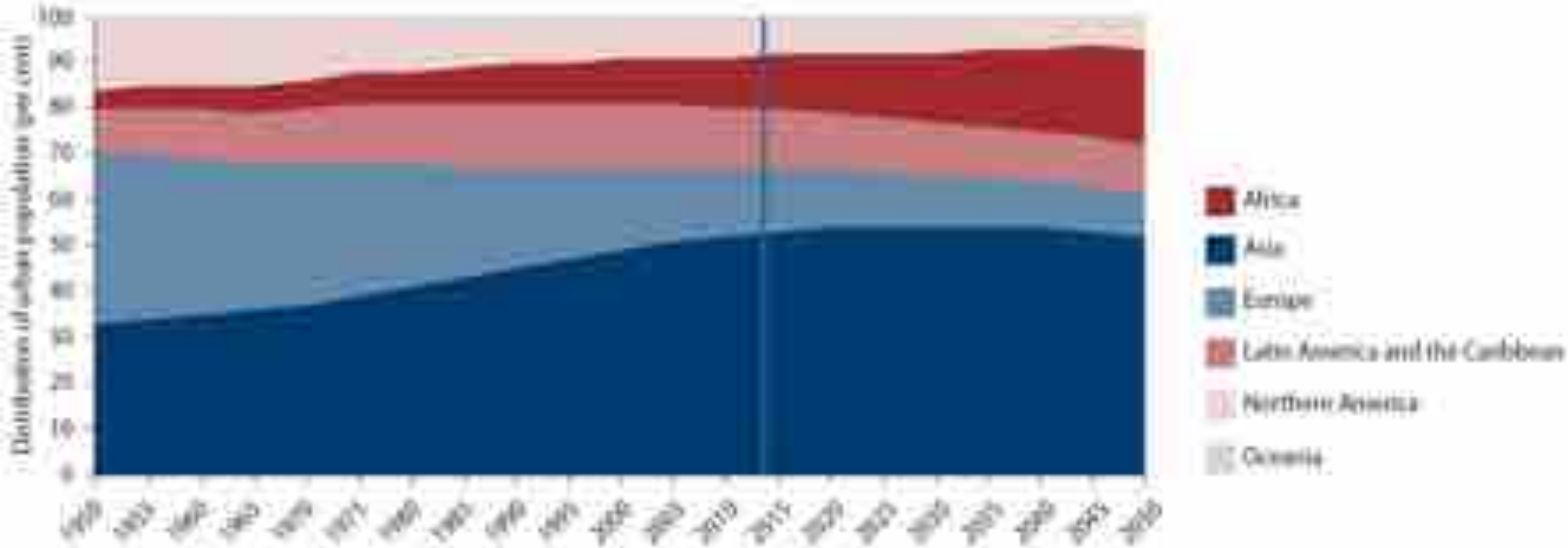
70%
Global Waste

XXI century – a century of urbanization

Percentage urban and location of urban agglomerations with at least 500,000 inhabitants, 2014

Global urban population growth is propelled by the growth of cities of all sizes

Asia will continue to host nearly one half of the world's urban population



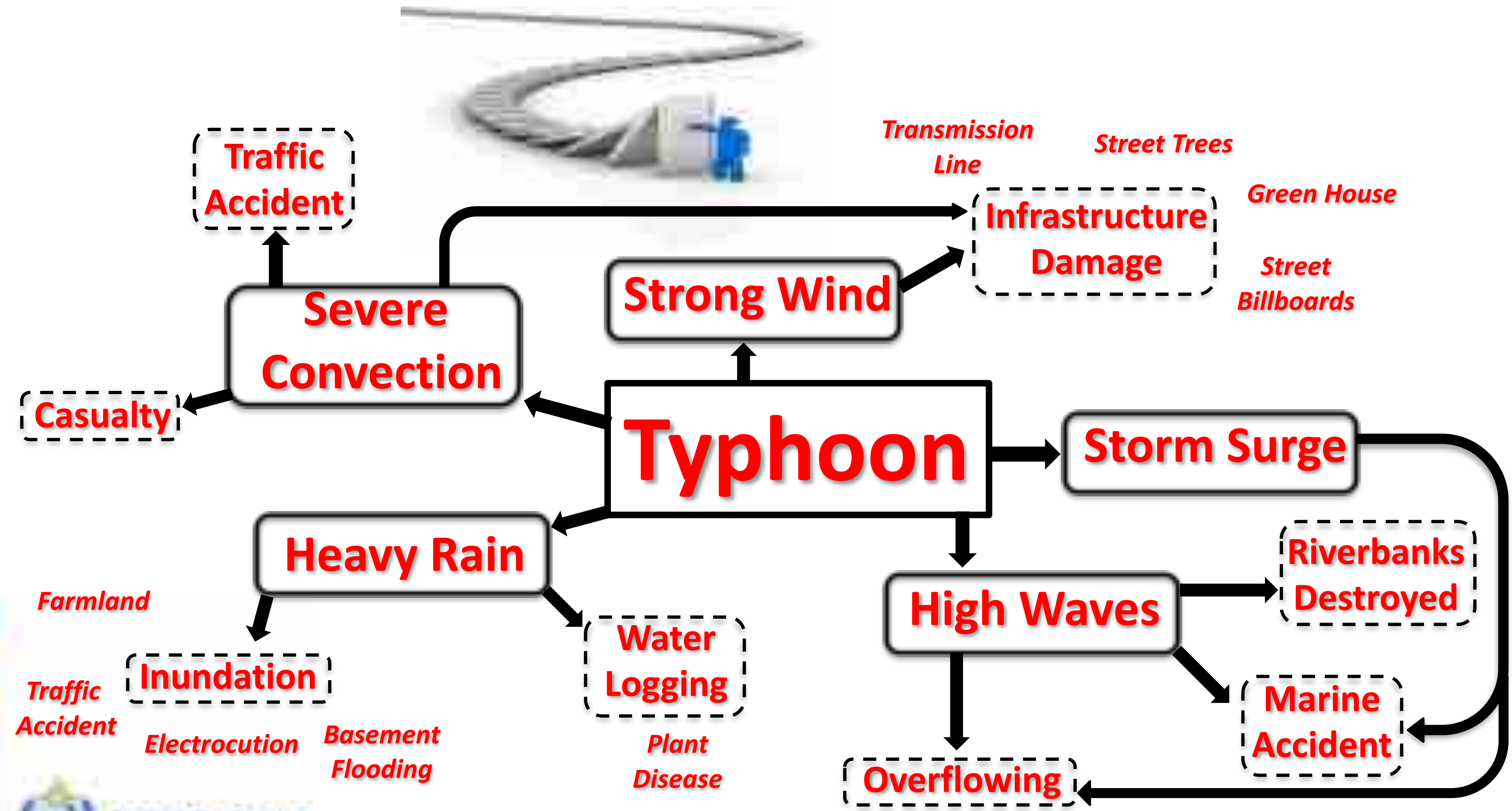
Statement of the Problem

- 90% of disasters for urban areas are of hydro-meteorological nature
  - increased with climate change
- 70% of GHG emissions generated by cities
- Strong feedback
  - Two phases should not be considered separately
- Critical need to consider the problem in a complex manner with interactions of climate change and disaster risk reduction for urban areas

WMO OMM

Domino effect: a single extreme event can lead to new hazards and a broad breakdown of a city's infrastructure:

Example of Hazard Domino Effect (Typhoon)



WMO OMM

Solution: Integrated Urban Services

Urban activities are a priority and specific cross-cutting element within the WMO strategy

Goal: Science-based Integrated Urban Weather, Water, Environment and Climate Services (IUWECS)

- Multi-Hazard Early Warning Systems
- Integrated urban GHG information System (IG3IS - urban)
- Climate services
- Focus on impact based forecast and risk based warnings

WMO OMM

WMO for UN New Urban Agenda

The 17th World Meteorological Congress (2015)
Resolution 68: Establishing WMO Cross-cutting Urban Focus and elaboration of **Guidelines for Integrated urban services**

Welcome to contribute!

Focus of the Guide to IUWECS:

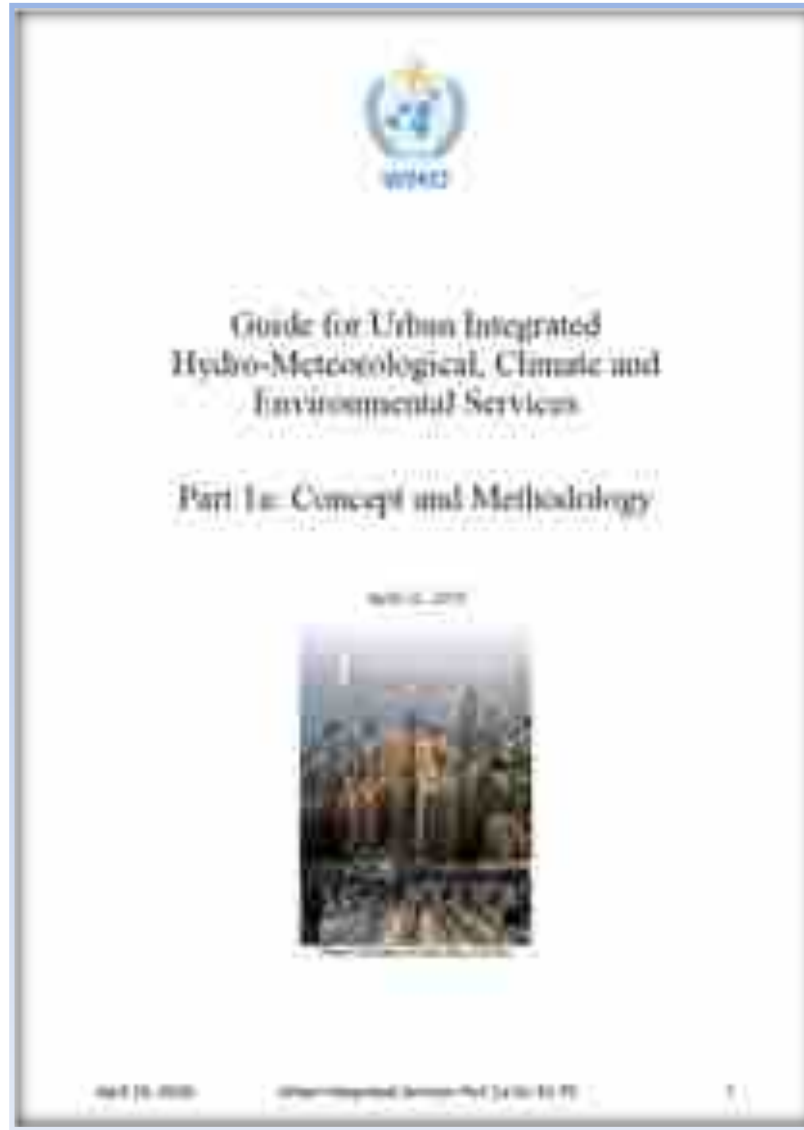
Part 1: Concept and Methodology

Part 2: Good practices of demonstration cities

Part 3: Guidelines for practical realization and delivery

To document and share the ***best available practices*** that will allow Members to ***improve the resilience of urban areas to a great variety of natural and other hazards***

(e.g. extreme weather, flooding, diminished air quality, transport security, urban and coastal inundation, large scale air-borne high-impact hazards such as: hurricanes, typhoons, smoke from large fires, sand and dust storms, volcanic ash, nuclear and industrial /chemical accidents /releases, etc.)



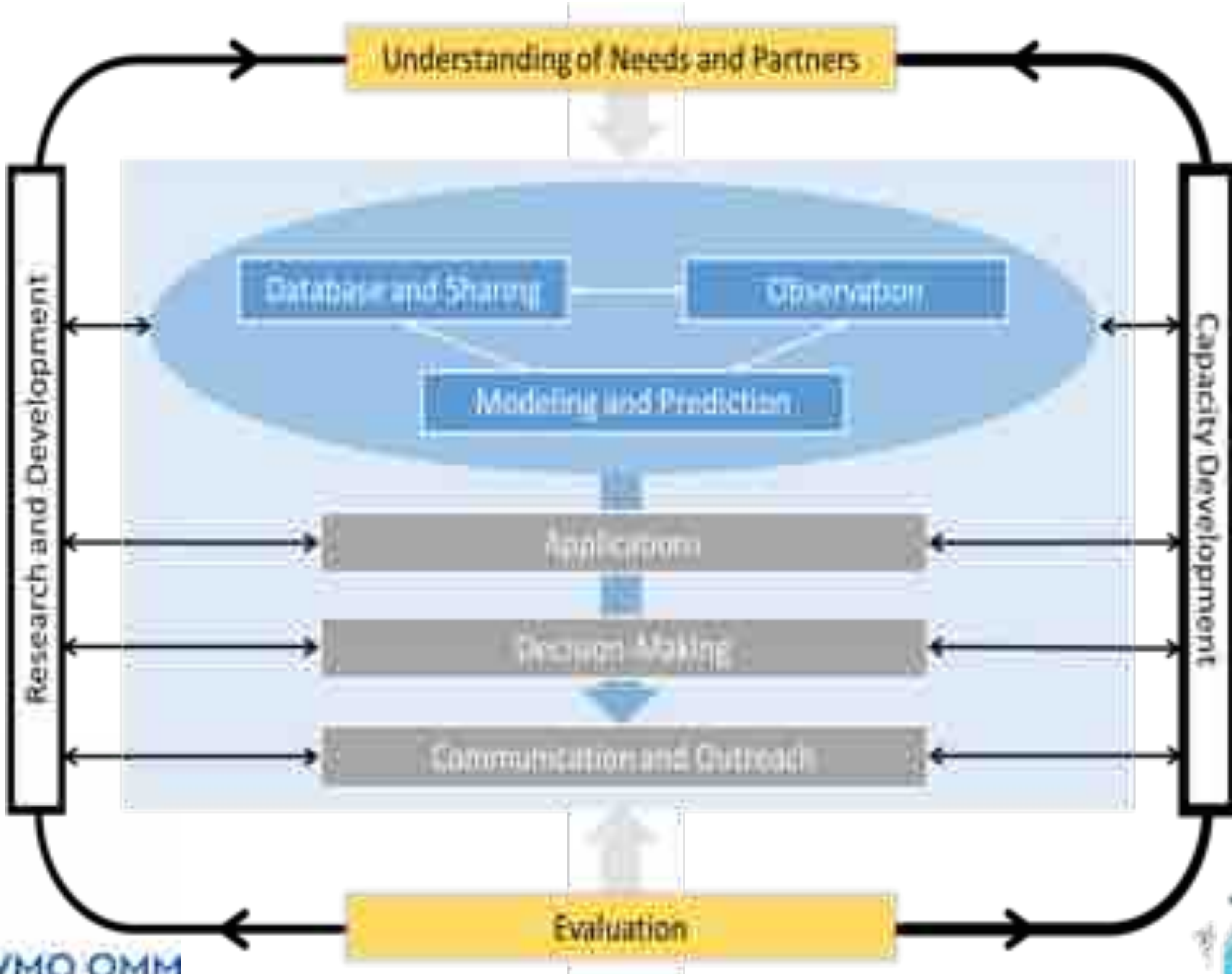
Guide for Urban Integrated Hydro-Meteorological, Climate and Environmental Services

Part 1a: Concept and Methodology

Available on:
http://www.wmo.int/pages/prog/arep/gaw/documents/UrbanIntegratedServicesPart1aConceptandMethodologyEC-70.pdf

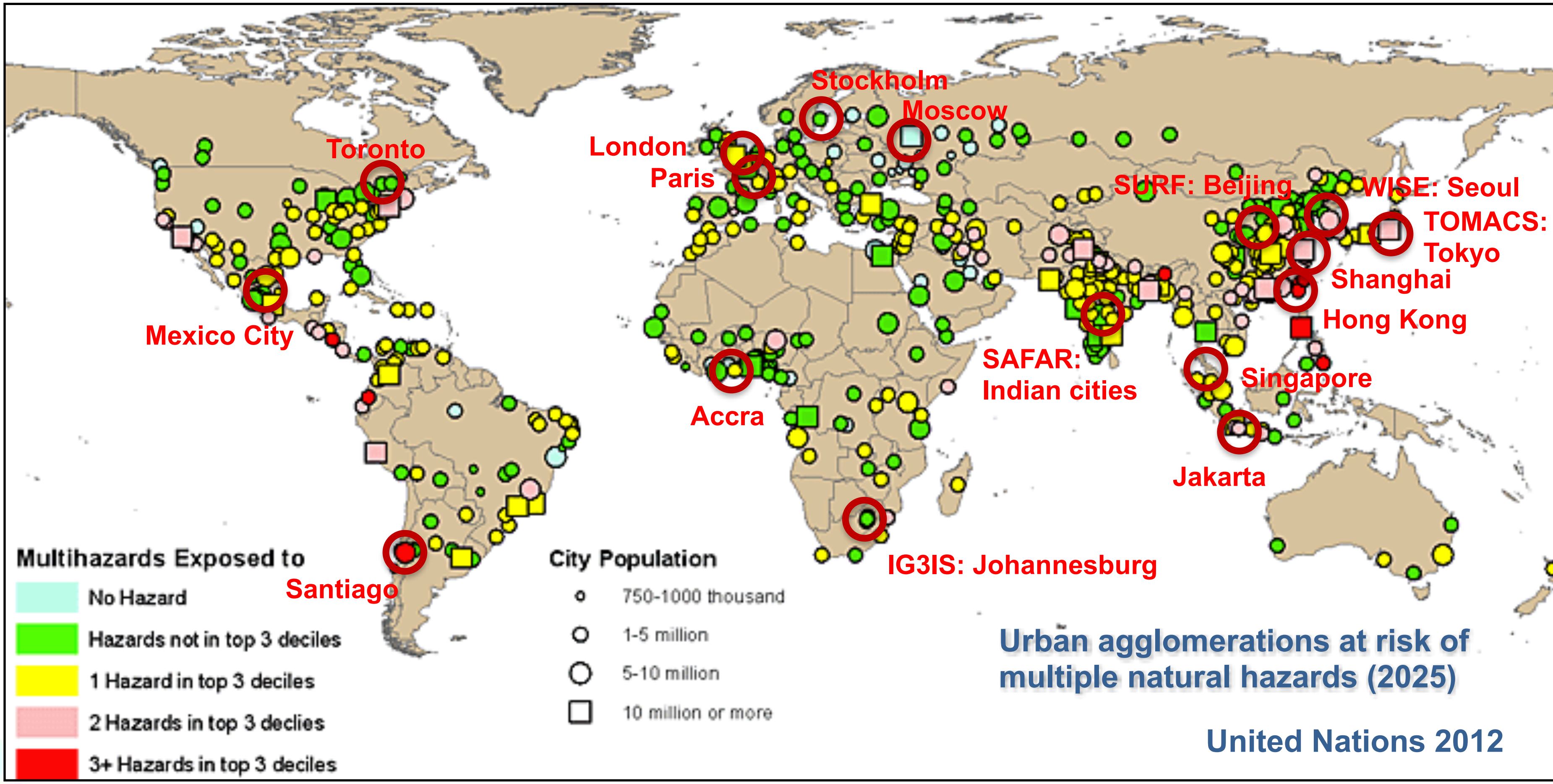
WMO OMM

Components of the development an Integrated Urban Weather, Environment and Climate Service (IUWECS)



WMO OMM

WMO pilot projects and demonstration cities



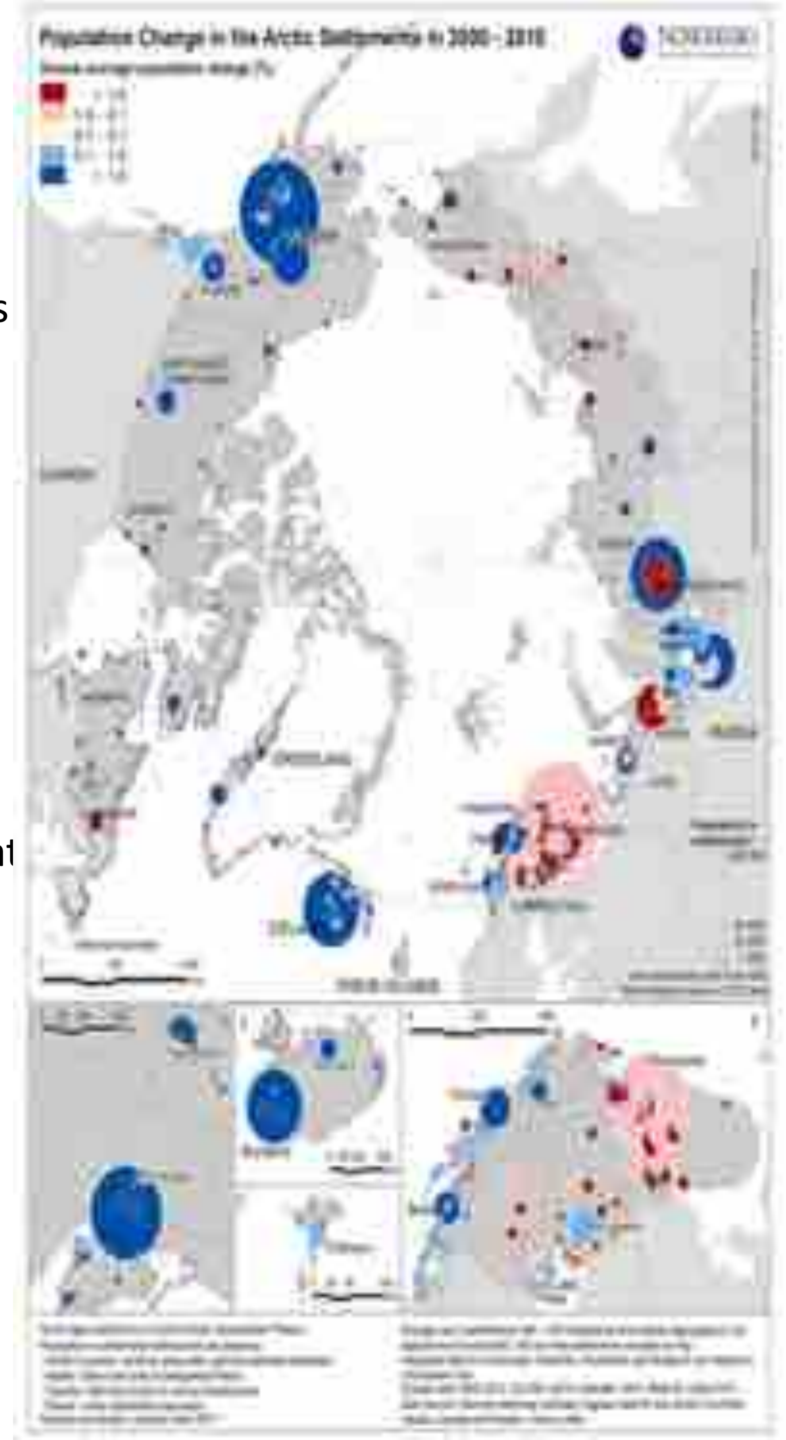
New cities and countries are welcome to join the team.
Start realising Integrated Urban Service for your city!

WMO OMM

Northern Urbanization

Arctic and Northern PEEX region is characterized:

- Much **lower population density** and not fast growing
- Highly urbanized with ≈ **90%** of population living in cities
- **Small size cities** are dominating, but not less problems
- About **100** urban settlements with > 5000 inhabitants
- Much **higher vulnerability** and lower sustainability
- **Cold climate is a dominant environmental factor**
- Urban nexus includes:
  - Snow – impact on management and planning
  - Frozen soil & permafrost – infrastructure stability
  - Frozen surface water – water supply and sewage
  - Dormant vegetation – reduced ecosystem services
  - Stagnant atmosphere – air pollution and urban heat island
  - Low temperatures – health issues and working routines -
  - **high energy consumption**
- **Migration is a dominant societal factor** in the region
  - More than 60% of urban population are 1st generation migrants
  - High skills but little sense-of-place
  - External, unsustainable development agenda



Northern Urbanization

- PEEX WG: Northern Urbanization: Environmental challenges and their impact on urban societies (focus on UHI and AQ studies)
- WMO Integrated Urban Weather, Water, Environment and Climate Services & Multi-Hazard Early Warning Systems
- Demonstration and Focus Cities: Examples for Arctic region
- PACES task for Arctic cities AQ and sustainable development

City	Reference
Apatity	Konstantinov et al. (2015a,b)
Barrow	Klene et al. (2013)
	Hinkel & Nelson (2007)
Fairbanks	Magee et al. (1999)
Nadym	Esau and Miles (2016)
Norilsk	Varentsov et al. (2014)
	Telyatnikov et al. (2014)

Esau et al., 2017

WMO for Integrated Urban Services

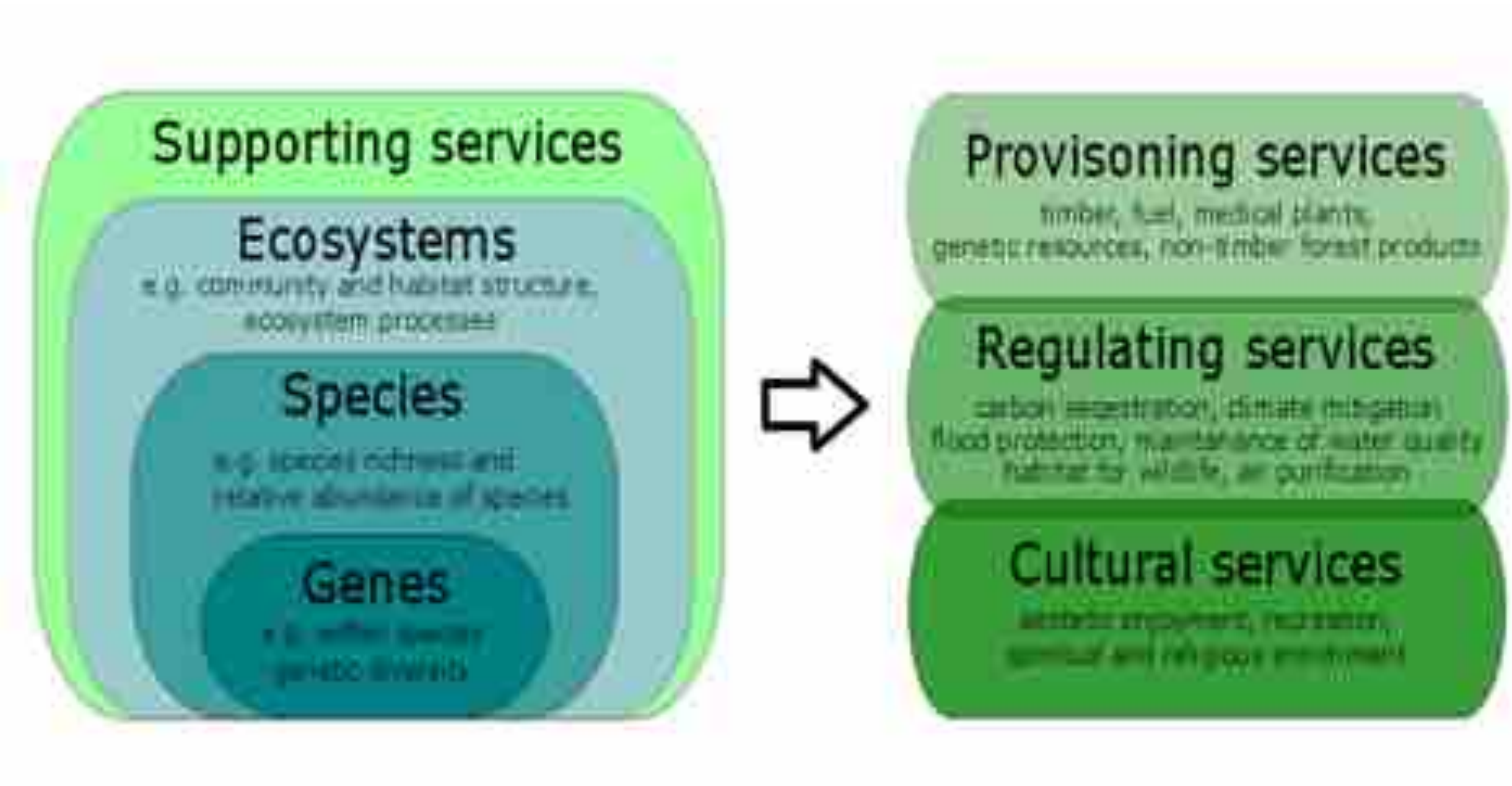
Methodology Part of Urban Guide is vailable on:

http://www.wmo.int/pages/prog/arep/gaw/documents/UrbanIntegratedServicesPart1aConceptandMethodologyEC-70.pdf

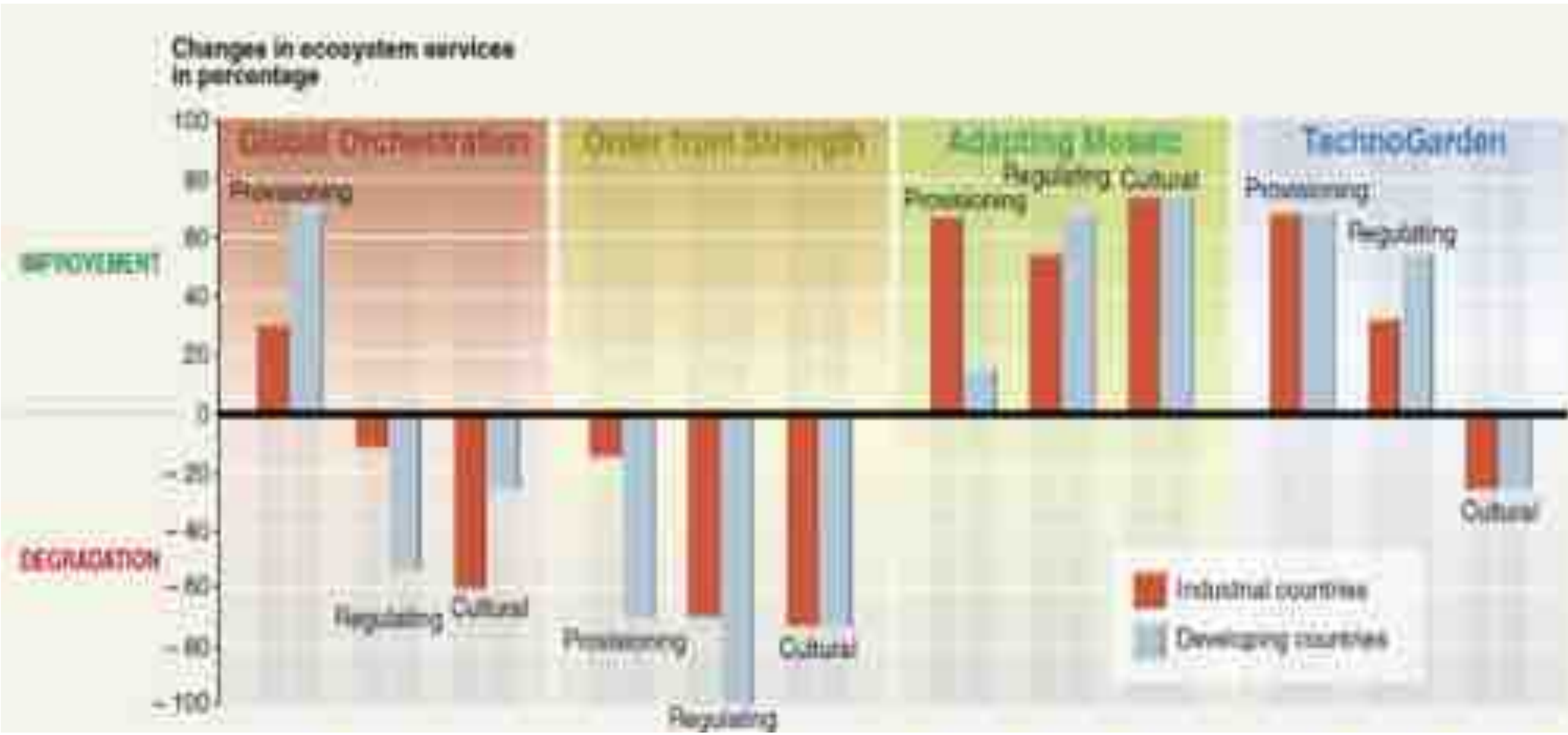
Current challenges in ecosystem and climate change research

Sofia Earth Forum, Nov 2018

Ecosystems provide crucial services for humans



Changes in ecosystem services with 4 scenarios for ecosystems and human well-being



Millennium Ecosystem Assessment 2015

Climate services: sinks and storages for carbon

1.1 Pg C y^{-1}

+

7.8 Pg C y^{-1}

4.0 Pg C y^{-1}

Atmosphere

44%

2.6 Pg C y^{-1}

Terrestrial ecosystems

30%

2.3 Pg C y^{-1}

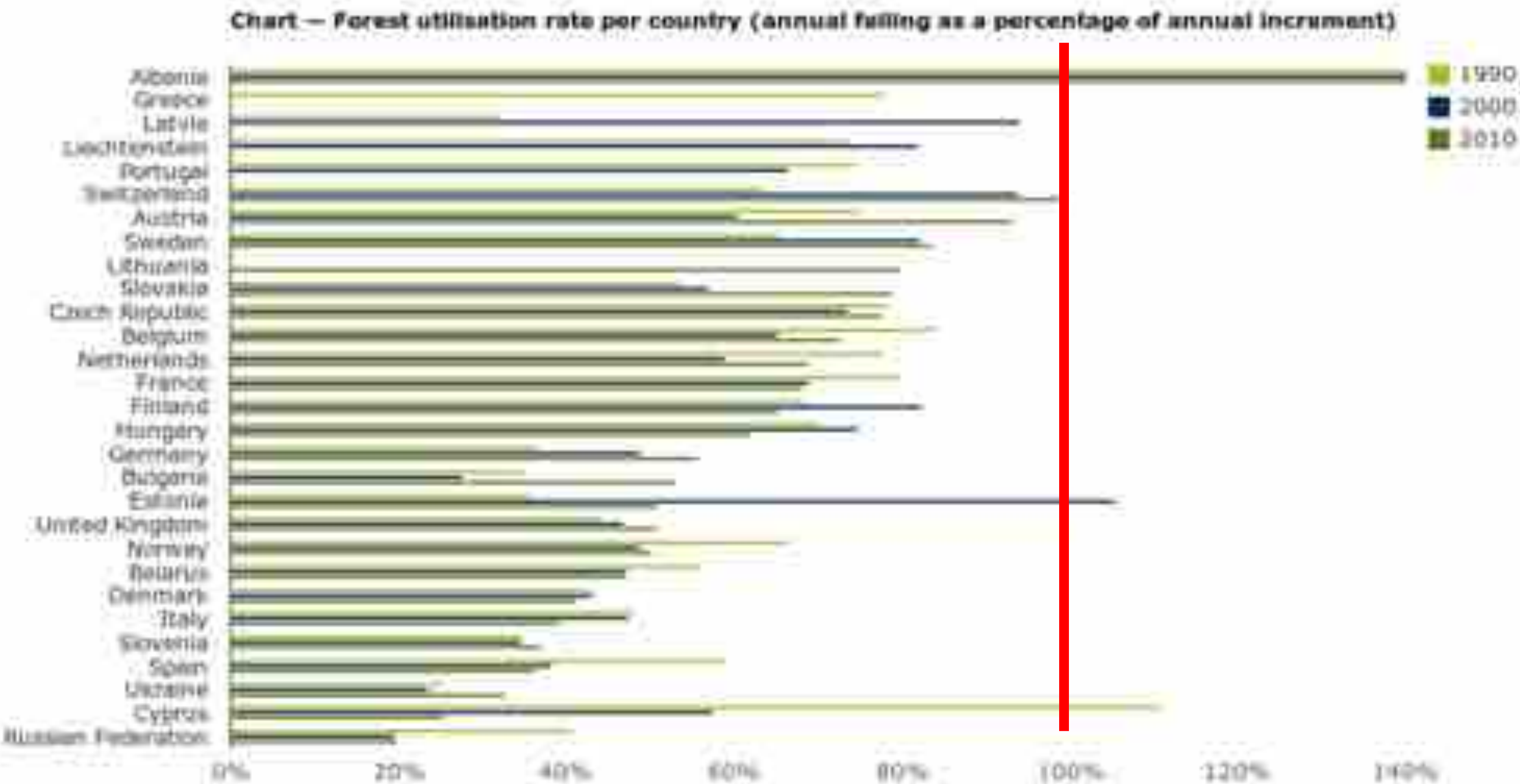
Oceans

26%

Pg = 10^{15} g = 10^{9} tn

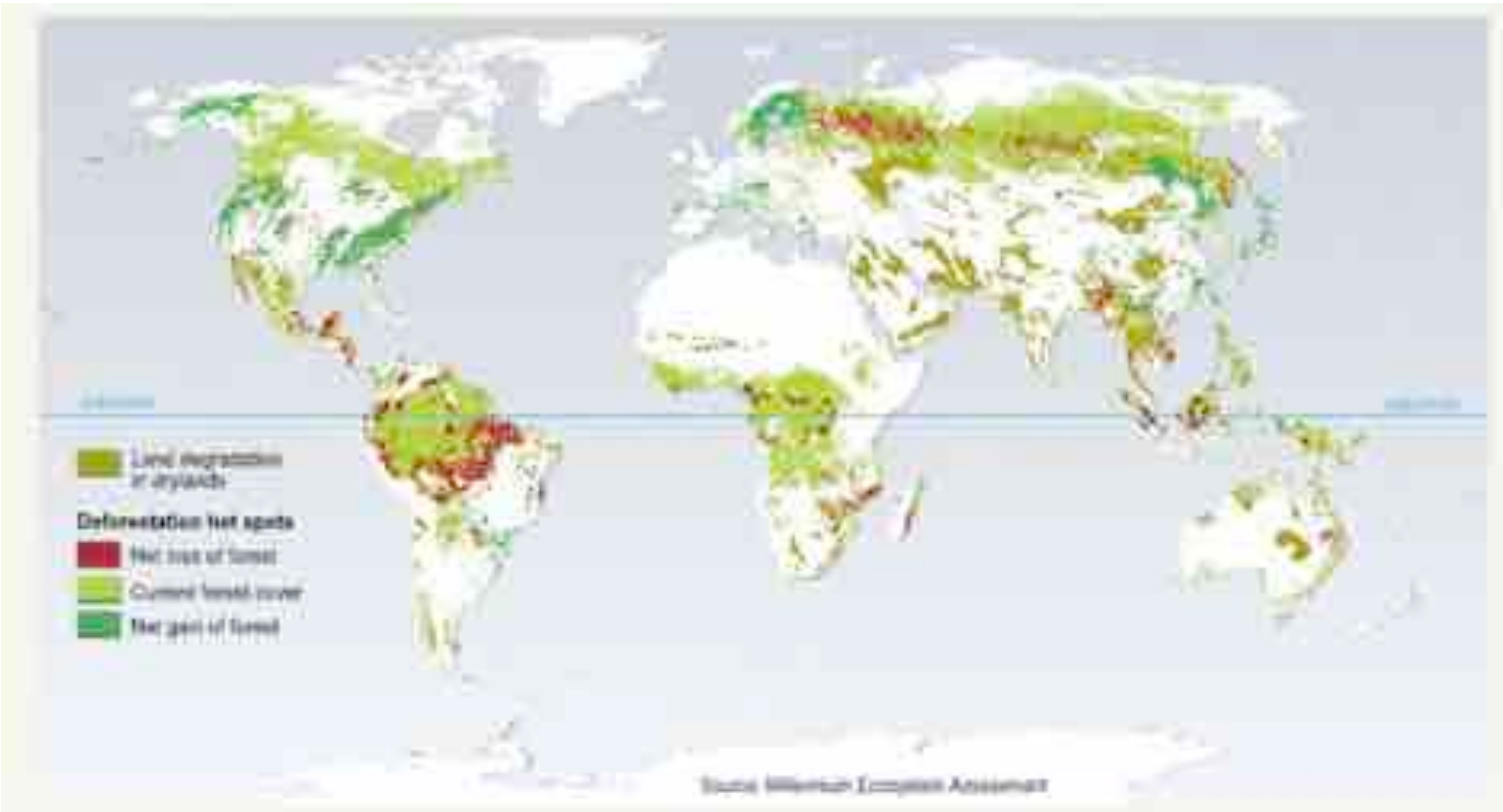
Sources: CDIAC NOAA-ESRL; Houghton et al, 2012; Giglio et al 2013; Le Quéré et al 2015; Global Carbon Budget 2015

Is the forest carbon stock sustained?

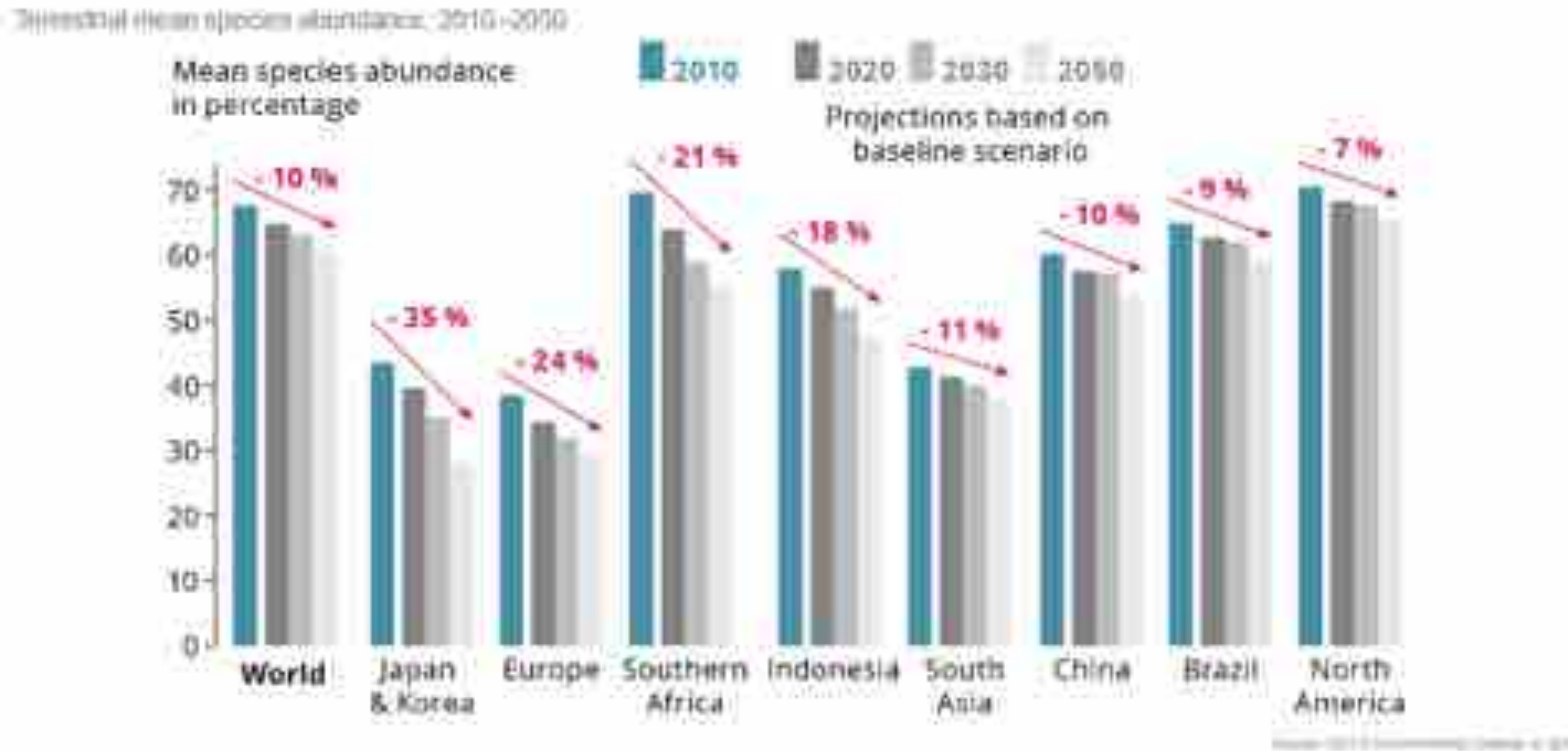


FELLINGS, % FROM ANNUAL INCREMENT

Changes in land cover between 1980-2000



Biodiversity challenge



The economic value of pollinators

Globally 216–529 Billion € /year

Ecosystem climate and biodiversity services are dynamic and depend on management of ecosystems

- Forest **carbon sink has been increasing in last decades,** but in the future rbon sinks and storage to ecosystems need to be even increased

- **Climate change already affects negatively** the ecosystems: their resilience should be ensured to maintain the carbon sink
  - Drought, storms, pests, diseases
  - Adaptive, active management tools (continuous cover forestry, multiple species stands, rotation times, genetic diversity)

- Economically **and** ecologically viable alternative management options are not sufficiently understood or implied in international forest and agricultural policies

- **Tradeoffs** between intensive use (e.g. bioenergy) & other ecosystem services (climate, biodiversity, recreation)

SOFIA EARTH FORUM 2018

2nd SOFIA EARTH FORUM ON GRAND CHALLENGES, SOLUTIONS AND LEGITIMACY

Time: 31 October - 1 November 2018
Venue: Cultural Centre Sofia ([illegible] 35, FI-00085 Helsinki, Finland)

Wednesday 31 October

08.30 Opening word: Finnish Orthodox Church Metropolitan [illegible]

08.45 Aims of the Forum, Academician Markku Kulmala

SESSION: BRIDGING THE WORLD THROUGH SCIENCE AND SOFT POWER, Chair Sergej Zilitinkevich

08.50 The Arctic Science Agreement propels science diplomacy, Paul Arthur Berkman, Director, Science Diplomacy Center, Professor of Practice in Science Diplomacy, Fletcher School of Law and Diplomacy, Tufts University, USA, KEYNOTE

10.20 Climate change impacts in urban areas, Robert Bornstein, San Jose University, USA

10.40 Non-organic origination of oil in the context of Grand Challenges, Vladimir [illegible], Royal Tech. University, Sweden / Gubkin Oil and Gas University, Russia

11.00 Group Photo

11.15 Lunch

SESSION: CHANGING WORLD - PERSPECTIVES, Chair Alexander Frolov

12.30 Bishop Feognost of [illegible], Russian Orthodox Church, KEYNOTE

13.00 On the role of science diplomacy, global initiatives, IEAS-Europe, Markku Kulmala, University of Helsinki, Finland, KEYNOTE

13.30 New horizons for the ecological thinking: integral ecology and new humanism, [illegible], Institute of Philosophy, Russian Academy of Sciences, Russia

SESSION: INITIATIVES, BODIES RELEVANT TO SOFIA FORUM PROCESS ADDRESSING COMMON PROBLEMS AND TO BUILD CONSTRUCTIVE INTERNATIONAL PARTNERSHIPS, Chair Tuukka Petäjä

Session contributes to IEAS - Europe activities

14.00 International Eurasian Academy of Sciences (IEAS), Valery Bondur, Institute for Scientific Research of Aerospace Monitoring "AEROCOSMOS", Russia KEYNOTE (translation: [illegible])

14.30 Coffee break

SESSION: PRESENTATION OF INTERNATIONAL EURASIAN ACADEMY OF SCIENCES (IEAS)

Delivery of diplomas to new members of IEAS by the President, Acad. of RAS, Professor Valery Bondur

with

- [illegible], Max-Planck-Institute for [illegible], Germany
- [illegible], [illegible] Institute, Finland
- [illegible], [illegible] University, Sweden
- [illegible], INAR, Finland
- Robert Bornstein, San Jose University, USA
- Alexander Baklanov, World Meteorological Organization (WMO), Switzerland
- Alexander Frolov, NRC "Kurchatov Institute", Russia [illegible]
- [illegible], INAR, Finland [illegible]

SESSION: PROBLEMS, INITIATIVES & BODIES RELEVANT TO THE SOFIA FORUM PROCESS – TOWARDS CONSTRUCTIVE INTERNATIONAL PARTNERSHIPS, Chairs Jaana Bäck and Hanna K. Lappalainen

14.45 Discussion on the Sofia Earth Forum priorities and synergies with other initiatives

- PEEX, [illegible]
- Arctic Science Forum
- [illegible] - [illegible] initiative
- UN - IPCC, UNESCO
- other relevant initiatives

17.00 Dinner at Cultural Center Sofia

THURSDAY 1 November

SESSION: Sofia Earth Forum, IEAS-Europe next steps, Chair Hanna Lappalainen

09.15 Summing up, further activities, publications, Sergej Zilitinkevich, FMI, Finland

SESSION: CHANGING WORLD – PERSPECTIVES, chair Markku Kulmala

09.40 UN Sustainable Development Goals and Environment Predictions, Alexander Baklanov, WMO, Switzerland

10.00 Science-Policy Dialogue: Climate Change Perspective, [illegible], University of Helsinki, Finland

10.20 Archbishop of the Evangelical Lutheran Church of Finland [illegible], KEYNOTE

10.50 Closing remarks by Markku Kulmala and Sergej Zilitinkevich

11.00 Lunch

Sofia Earth Forum

- initiated by Academician Markku Kulmala and Metropolitan Ambrosius, Diocese of Helsinki, Orthodox Church of Finland
- aims at joint understanding over different boundaries and at finding practical solutions on the Grand Challenges, especially in the Northern context
- science diplomacy
- 1st Sofia Earth Forum on Grand Challenges, Solutions and Legitimacy
  - event format
    - based on invitation
    - presentation and discussion
- organized by IEAS-Europe & PEEX
  - at the Culture Centre Sofia, Helsinki, Finland, 20-22 June 2016

1st Sofia Earth Forum in June 2016 speakers

Metropolitan Ambrosius, Diocese of Helsinki, Orthodox Church of Finland

Archbishop Jakov of Narjan-Mar and Mezen, Russia

Bishop Kari Mäkinen, the Archbishop of Finland, Finland

Prof. Salomon Kroonenberg, Delft Univ. of Technology, The Netherlands

Prof. Sergej Zilitinkevich, Finnish Meteorological Institute, Finland

Prof. Wolfgang Lutz, IIASA, Austria

Mr. Paavo Lipponen, former Prime Minister of Finland, Finland

Tarmo Soomere, President, Estonian Academy of Sciences, Estonia

Prof. Nikolay S. Muskhelishvili, University of Humanities, Moscow, Russia

Dr. Olga Solomina, Director, Inst. Geography, RAS, Russia

Prof. Kari Raivio, Chancellor emeritus, University of Helsinki, Finland

Mr. Aleksi Härkönen, Finland Arctic Ambassador, Finland

1st Sofia Earth Forum topics discussed

- theology and science - perspectives on responsibility
- challenge for ethics - moral traditions and the universal perspective
- science policy based approach towards solving Grand Challenges
- Grand Challenges - Nordic dimension & Land-atmosphere feedbacks
- International Arctic collaboration – policy frameworks
- education – the next generation of multi-disciplinary young scientists
- towards mutual understanding & on the communication in culture
- what does it mean when we say that something is unprecedented - a long-term perspective on environmental problems
- technology perspective & novel use of energy resources
- climate and humankind: interactions over the past millennium
- science policy / diplomacy based approach towards solving Grand Challenges
- dialogue between Science and Theology
- misuse of science for political purposes

International Eurasian Academy of Sciences
The International Eurasian Academy of Sciences (IEAS) has been established in 1994 on the initiative of several eminent scientists of Europe and Asia. The IEAS is a public body bringing together scientists and scholars of culture, art and religion for solving environmental and social challenges shared by the Eurasian countries.

Mission
The IEAS mission consists in fostering the efforts of scientific communities to address global problems induced by the urbanization and to develop transition paths to sustainable development in the socioeconomic and moral spheres of public life through consolidating the potential of scientists and scholars.

Priorities and goals
The IEAS priorities:
providing science-based evaluations of the international, governmental and public programmes and projects;
conducting scientific research, facilitating practical application of its results, and elaborating recommendations for dealing with specific problems faced of different regions.

INAR

THE ASSEMBLY

The highest IEAS governing body

PRESIDIUM

Governs IEAS during the period between Assemblies

PRESIDENT

VALERY BONDUR

Academician of IEAS
Academician of RAS
Vice President of RAS
Professor
Russian Federation, Moscow

VICE-PRESIDENTS

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Professor
Moscow, Russian Federation

JIANG ZHENCHUA

President of China Scientific Centre of IEAS
Academician of IEAS
Academician of CAS
Professor
Beijing, China

MARKKU KULMALA

Director of IEAS European Centre
Academician of FAS
Professor
Helsinki, Finland

SCIENTIFIC SECRETARY

SHAKHRAMANYAN MIKHAIL

Academician of IEAS
Professor
Moscow, Russian Federation

IEAS

IEAS European Centre

Academicians of IEAS-Europe

Professor **Markku Kulmala**, Finland
Professor **Sergej Zilitinkevich,** Finland
Professor **Alexandr Alexsandrov**, Bulgaria
Professor **Meinrat O. Andreae**, Germany
Professor **Almut Arneth**, Germany
Professor **Steven Arnold**, UK
Professor **Irina M. Artemieva**, Denmark
Professor **Aleksandr Baklanov**, Switzerland
Professor **Jerzy Bartminski**, Poland
Professor **Ekaterina Batchvarova**, Bulgaria
Professor **Robert D. Bornstein**, USA
Professor **François Bouillé,** France
Professor **Ivan Nikolov Chernozemski**, Bulgaria
Professor **Dr. Ilia Dimitrov Christov**, Bulgaria
Professor. **George Djolov**, South Africa
PhD Dr. **Kostas Eleftheriadis**, Greece
Professor **Tov Elperin**, Israel
Associate Professor **Nikolai Erchak**, Poland
Professor **Igor Esau**, Norway
Professor **Ernst Fasan**, France
Professor **Harindra Joseph S. Fernando**, USA
Professor **Manfred M. Fischer**, Austria
Professor **Andreas Frank**, Austria
Professor **David G. Gee**, Sweden
Professor **Petar Getsov**, Bulgaria
Professor **Michael Ghil**, USA
Professor **Yehuda Gradus**, Israel
Professor **Hans-Christen Hansson**, Sweden
Professor **Martin Heimann**, Germany
Dr. **Frank Hoffmann**, Germany
Professor **Albert A. M. Holtslag**, Netherlands
Professor **Juha A. Janhunen**, Finland
Professor **Veli-Matti Kerminen**, Finland
Professor **Markku Kivinen**, Finland
Professor **Nathan Kleeorin**, Israel
Associate Professor **Milan Konechny**, Czechia
Professor **Salomon B. Kroonenberg**, Netherlands
Professor **Ari Laaksonen**, Finland
Professor **Paolo Laj**, France
Dr. **Hanna Lappalainen**, Finland
Professor **Søren Ejling Larsen,** Denmark
Professor **Jean-Laurent Mallet**, France
Professor **Ian Masser**, Belgium
Professor **Fedor Mesinger**, Serbia
Professor **Arto Mustajoki**, Finland
Professor Dr. **Werner E. G. Müller**, Germany
Professor Dr. **Ferjan Ormeling**, Netherlands
Professor **Tuukka Petäjä**, Finland
Professor **Didier Raoult**, France
Professor **Yigal Ronen**, Israel
Professor **Igor Rogachevskii**, Israel
Professor **Bengt Rystedt**, Sweden
Professor **Alexandr Sadovski**, Bulgaria
Professor **Vasil S. Sgurev**, Bulgaria
Professor **Gad Shani**, Israel
Professor **Henrik Skov**, Denmark
Andreas Sofocleous, Cyprus
Sofoklis Sofokli, Cyprus
Professor **Anatoly Shvidenko**, Austria
Professor **Petteri Taalas**, Finland
Professor **Ilya Usoskin**, Finland
Professor **Yola Verhasselt**, Belgium
Professor **Timo Vesala**, Finland
Professor **Yrjo Viisanen**, Finland
Professor **Bas van de Wiel,** Netherlands