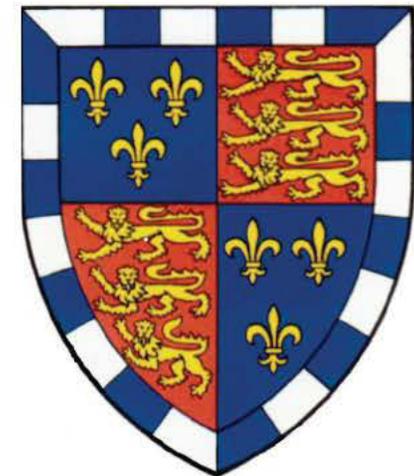
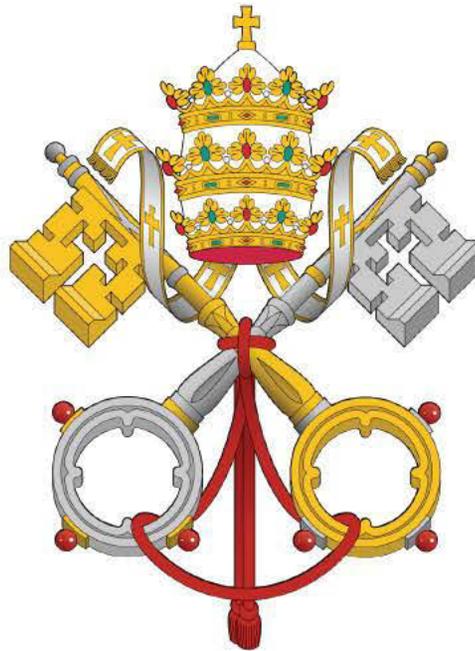
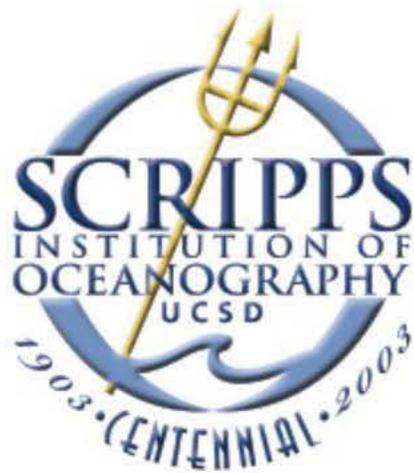


Global Knowledge Action Network

Adaptation to Climate Change

Charles F. Kennel

Scripps Institution of Oceanography, University of California San Diego
Christ's College and Centre for Science and Policy, University of Cambridge



A World New to Human Experience

The past will not be a guide to the future



Intuition and past experience will be decreasingly reliable. Of course, forecasts of the future climate will also be imperfect. But people will have to figure out how to adapt to climate change when they are not entirely sure they know where they are and where they are going.

Adaptive Management

Adaptive management is what you do when you know you have a problem
but you don't know how it will unfold



Assess, Decide, Act
Think Globally, Assess Regionally, Act Locally

Adaptive Management

Assess, Decide, and Act-For A Thousand Years

Be Practical: Do all you can do at any one time

Accommodate political and economic realities

Take progress where you find it, even if it's not everything

Incremental progress is better than none

Be Reasonable: Allow for mistakes

Rethink when circumstances warrant

Give decision makers a second chance to get it right

Be Tolerant: No "one size fits all"

Nations have different economic, political, and technical capacities

Communities take action in different ways and at different rates

Be Timely: Do not delay decisions

Motivate decision makers to decide

Translate new knowledge as it is generated

Be Vigilant: Look out for tipping points

Task assessments to search for precursors

Have "insurance policies" and back-up plans

Be Resolute: Build Enduring Institutions

Global knowledge management and decision support networks

Hierarchy of coordinated governance structures

Assessment Essential to Governance

Past Experience No Longer A Guide To The Future

Assessment

Prepares knowledge for use
by governance



Governance

Makes Decisions
Guides evolution of outcomes

Situational awareness will depend on recent research

Like it or not, decision-makers will have to rely on research assessments to frame the issues they must decide.

No governance without assessment; no reason for assessment without governance

Adaptation Across Scales

Knowledge

Creates Situational Awareness
Articulates options



Action

Implements Decisions
Promotes desired outcomes

Think Globally

Scientific knowledge is managed by an informal club* of advanced nations

Assess Regionally

International experts, regional thought leaders, and local decision makers identify adaptation risks, synthesize pertinent knowledge, and frame decision options

Act Locally

Communities make complex, multi-disciplinary, and regionally distributed decisions. Ostrom** proposes the name “polycentric” for this kind of interrelated decision-making.

*Keohane, R.O. and D. G. Victor, The Regime Complex for Climate Change, *Perspectives on Politics*, v.9, no. 1, March 2011

**Ostrom, E., Beyond Markets and States: Polycentric Governance of Complex Economic Systems, *American Economic Review* 100 (June 2010): 1–33 <http://www.aeaweb.org/articles.php?doi=10.1257/aer.100.3.1>

Knowledge, Governance, Action

	Assess	Decide	Act
Think Globally	<i>Science & Policy</i> IPCC, UNEP, IOC ICSU-Future Earth	<i>Top Down</i> UNFCCC Informal Clubs of Nations World Bank, other NGOs	<i>Global Services</i> Knowledge Sharing Financial support Capacity building Standard setting
Assess Regionally	<i>Specific Impacts</i> Natural systems Human systems Hazards Exposure to risk	<i>Polycentric</i> Consortia Compacts Alliances Information exchange	<i>National Policies</i> Goals, Incentives, Regulations, Technical Services
Act Locally	<i>Strategic choices</i> Vulnerability Capability Feasibility	<i>Bottom Up</i> Trusted local leaders Stakeholders Managers	<i>Adaptation</i> Resilience Disaster preparations Remediation

Kennel, C.F., Climate Change: Think Globally, Assess Regionally, Act Locally, *Issues in Science and Technology*, 25, 46-52, <http://trid.trb.org/results.aspx?q=&serial=%22Issues in Science and Technology%22&issue=%222%22>, Publisher: National Academies, ISSN: 0748-5492, Order URL: <http://worldcat.org/issn/07485492>

Knowledge Action Architecture

Adaptation calls for a consortium of international knowledge management services to support, via assessment, polycentric decision making at regional and local levels

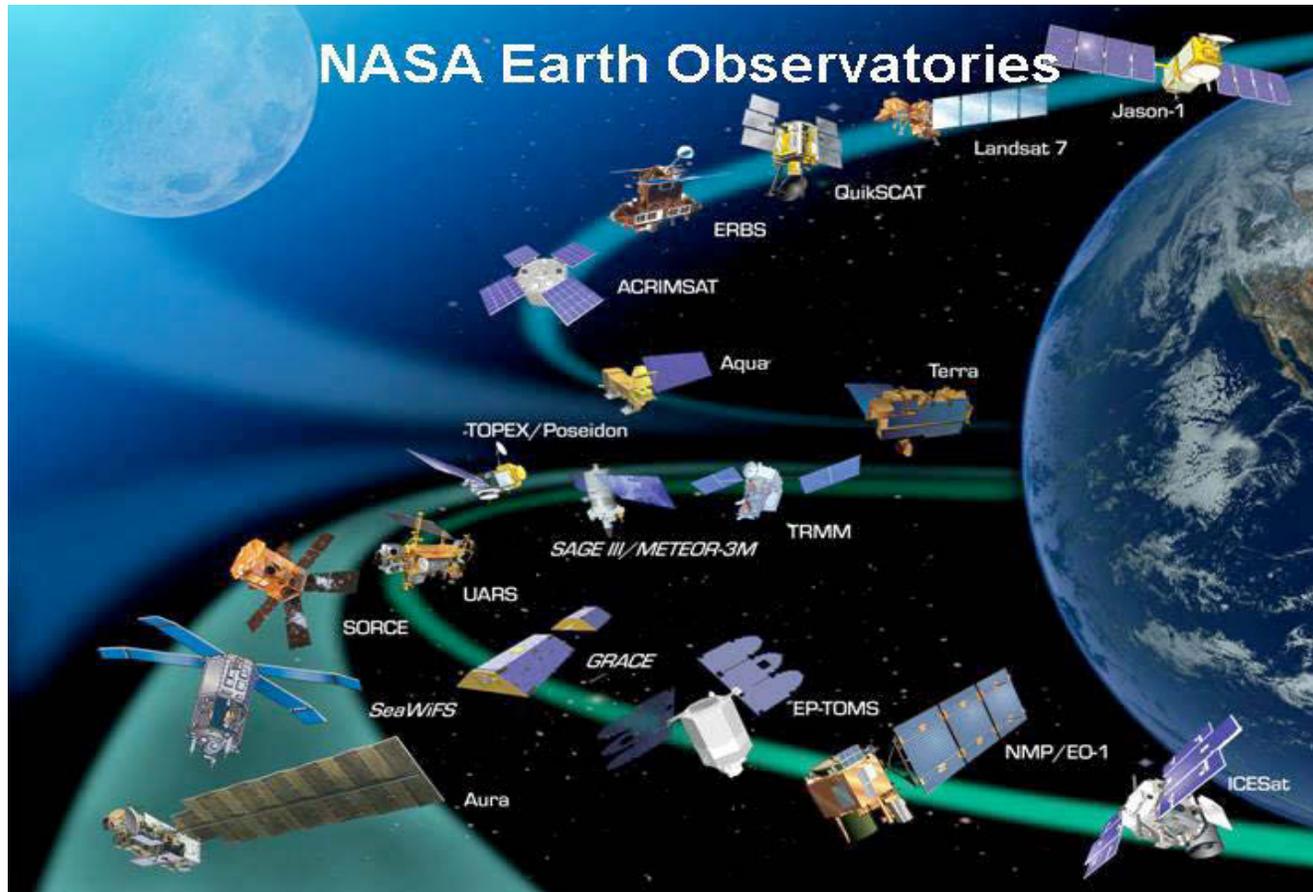


The Task Ahead

A vibrant rainbow arches across a dramatic, cloudy sky at sunset or sunrise. The sky is filled with dark, heavy clouds, with a bright orange and yellow glow from the sun just below the horizon. The rainbow's colors are clearly visible, transitioning from red on the left to violet on the right. The overall mood is one of hope and transition.

Evolve today's Knowledge Management System into tomorrow's Knowledge Action System

Start With What We've Got



Observation and Information Systems

Satellites, *In Situ* Networks, Data Repositories, Models

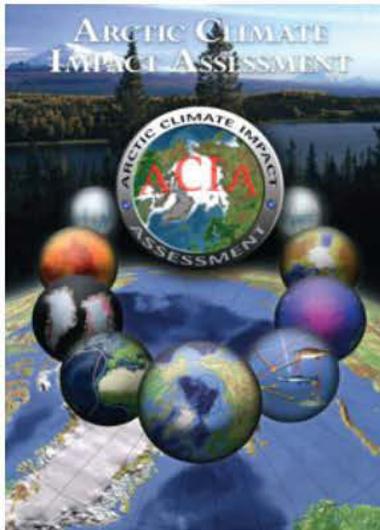
Research Consortia

Global Earth System of Systems, Group on Earth Observations,
Partnership for the Observation of the Global Oceans

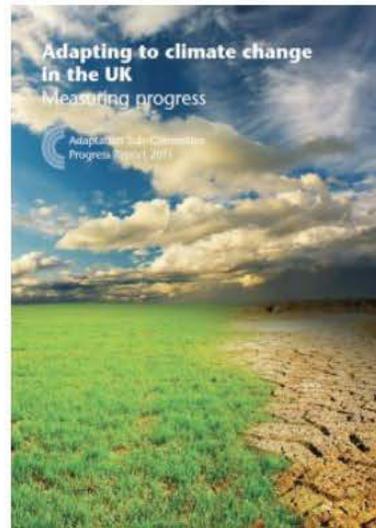
Social Technologies

Assessment, decision support, capacity building

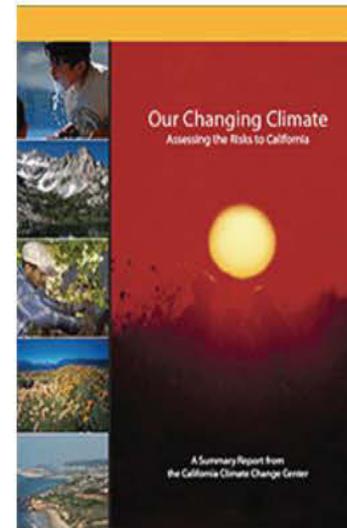
Experience with assessments that reach across scales



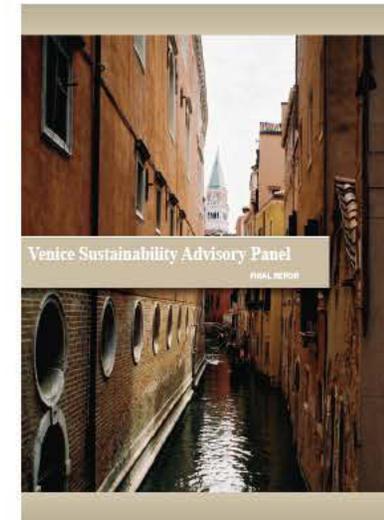
Sub-Global International
Governance Regime



National Governance



Regional Governance



Local Governance

IPCC is not the only assessment regime
Regional assessments that connect to governance
Frameworks for polycentric decision-making

What Assessments Do

Four basic knowledge management processes



Assembly & Synthesis



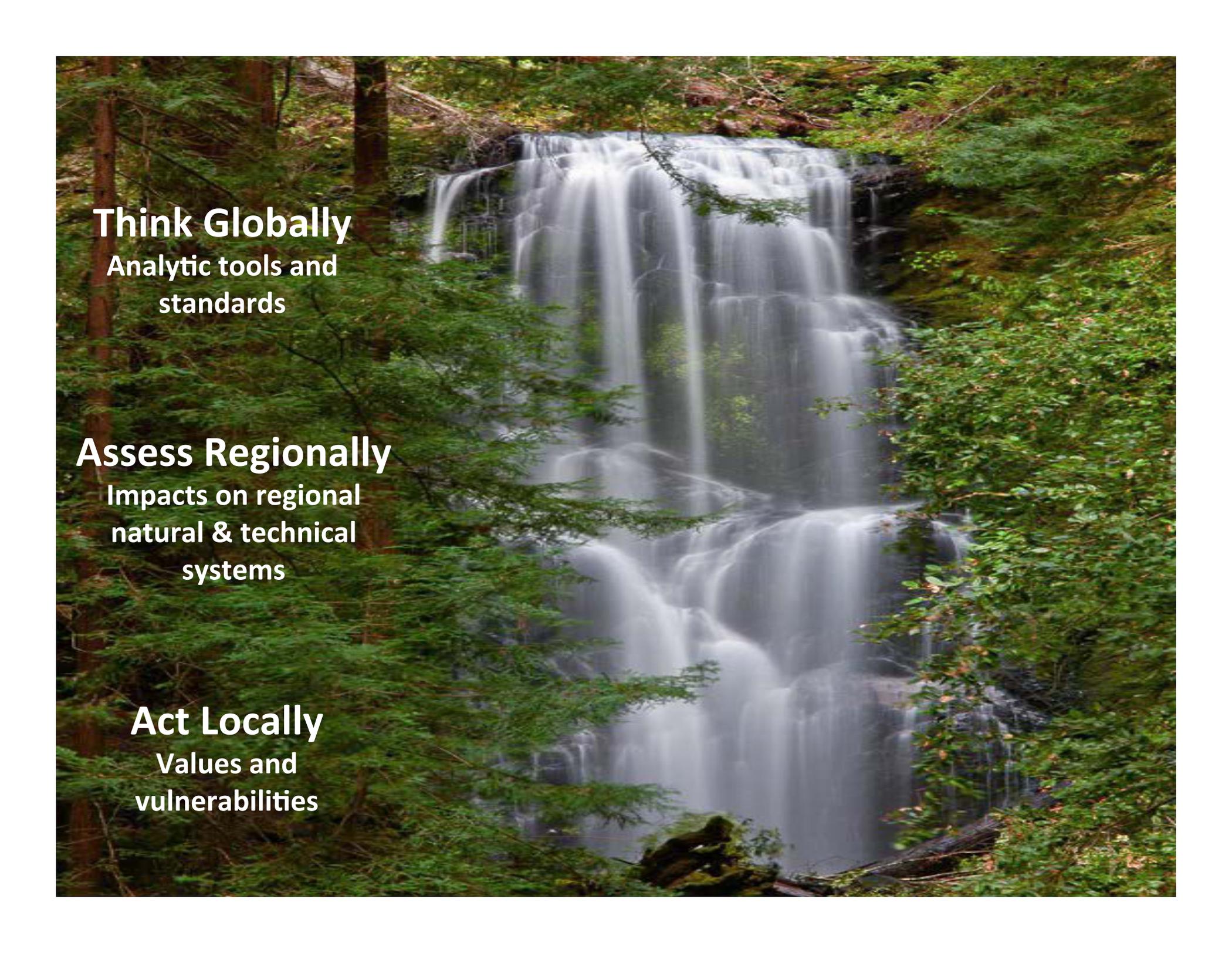
Certification



Delivery



Translation



Think Globally

Analytic tools and
standards

Assess Regionally

Impacts on regional
natural & technical
systems

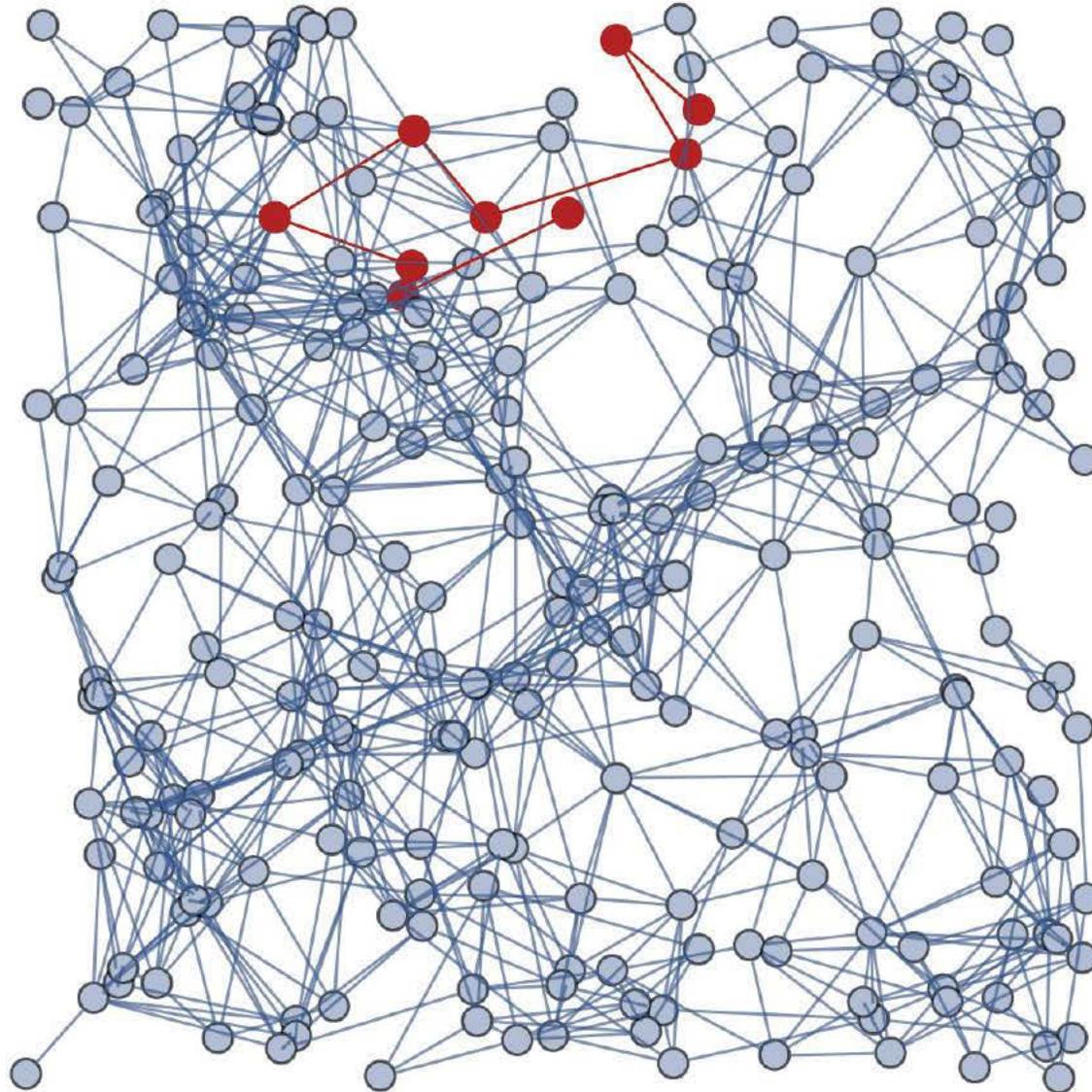
Act Locally

Values and
vulnerabilities

Knowledge Assembly & Synthesis

We think of it as purposeful and sequential

It actually diffuses from multiple sources and requires networking



Knowledge Certification

**IPCC's Most Important Value Added Product
Deploys the Authority of Science**

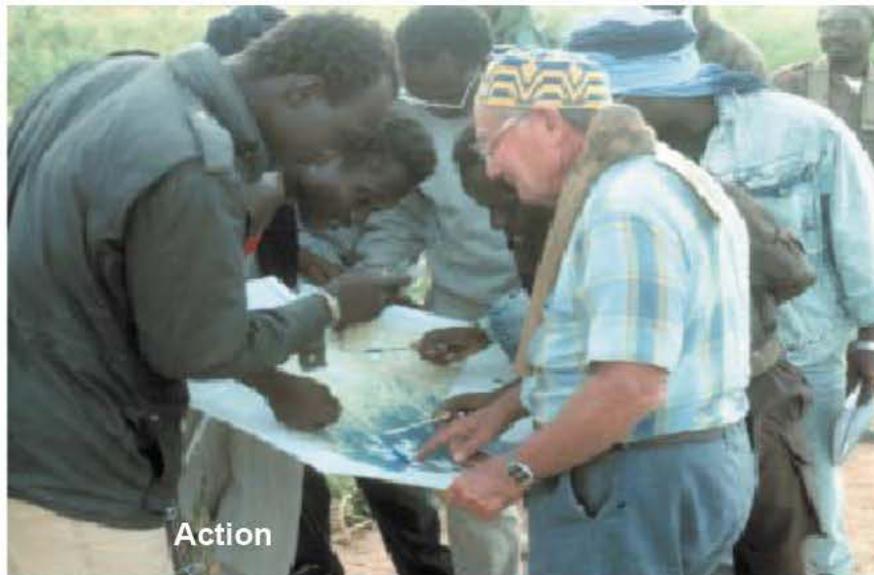
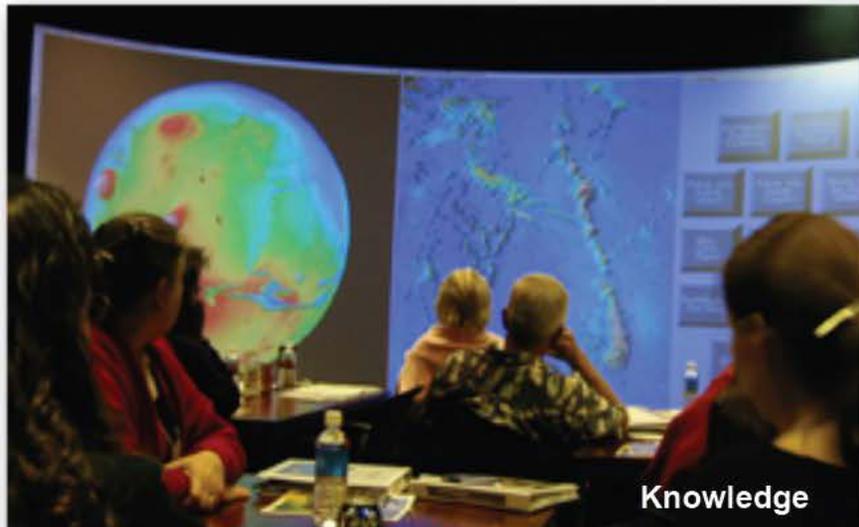


**Extensive Literature
Review**

**Informal Ranking of
Reviewers**

**Exhaustive Small
Group Discussion**

**Consensus of
Experts Present**



Knowledge Translation

Explain and Motivate

Not Enough to be Correct

If you can't make yourself understood,
they won't listen

If you neglect social justice and economic
development, they will neglect you

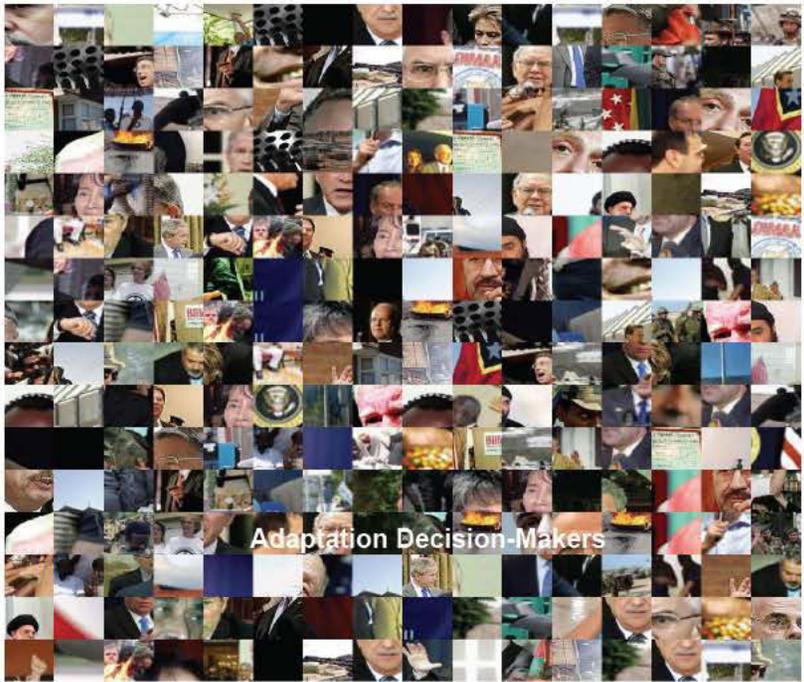
If you are culturally insensitive,
they won't respond

Trust Motivates Action

Personal contact is the precursor to trust.

Decision makers should participate
in assessments.

Trusted local leaders will carry out
adaptation strategies



Knowledge Delivery

Connect Efficiently to
Governance

Deliver the right knowledge to the
right people at the right time

Deliver it when they need it and
where they need it

Deliver it in forms they can use

Keep on delivering it

What Knowledge Action Networks Do

STS, Special Session on Regional Climate Change, Kyoto, 2010



Global Science, Technology, and Policy
Communities



Regional Knowledge leaders



Local Decision Makers

Understand local impacts of regional climate change

Characterize risks to the things local communities care about

Leverage existing resources and programs

Interrelate decisions at the global, regional, and local levels

Build capacity

Translate scientific knowledge into locally usable forms

Communicate the need for adaptation action in culturally appropriate terms

Develop technical systems for local use

Relay local knowledge to the regional, national, and international levels

Support local leaders as they implement adaptation actions

Looming Technical Problems

The world will need to invest in modernizing
its assessment system



*Capacity... Complexity... Coordination...
Timeliness... Sustainability... Certification*

The Capacity Problem

Specialized decision support will be needed for dozens of industrial sectors, hundreds of ecologically distinct regions, and thousands of culturally unique communities



How can the relatively small science, technology & policy community develop the capacity to serve millions of decision-makers in thousands of communities with different cultural, economic, and environmental characteristics?

The Complexity Problem

Adaptation Knowledge Cascade

Large-Scale Weather and Ocean Patterns

Large atmospheric systems-equator to pole heat transport, polar vortex, atmospheric rivers,...

Ocean circulation-El Nino/La Nina, Pacific Decadal Oscillation, Gulf Stream...

Regional patterns- temperature, wind, rainfall, relative sea level rise...

Extreme events-heat waves, cold snaps, storms, droughts, floods,...

Regional Geophysical Systems

Cryosphere-Sea ice, Greenland, Antarctic, mountain glaciers and snows, permafrost...

Mountains and Watersheds-river networks, aquifers, deltas, sediment transport...

Deserts-dust transport,...

Regional Ecosystems

Biodiversity: species distributions and abundances...

Biomes- chaparral, grassland, savannah, forest, tundra, marshlands, coastal zones...

Habitats-invasive species, fragmentation,..

Regional Technical Systems

Managed Ecosystems-Agriculture, forestry, fisheries...

Managed Water and Air Supplies-Irrigation, pollution,..

Managed Extreme Events-Disaster response and civil infrastructure...

Managed Human Services-Electricity production and transmission,...

Humans

Health-Malaria, cholera, respiratory diseases, ...

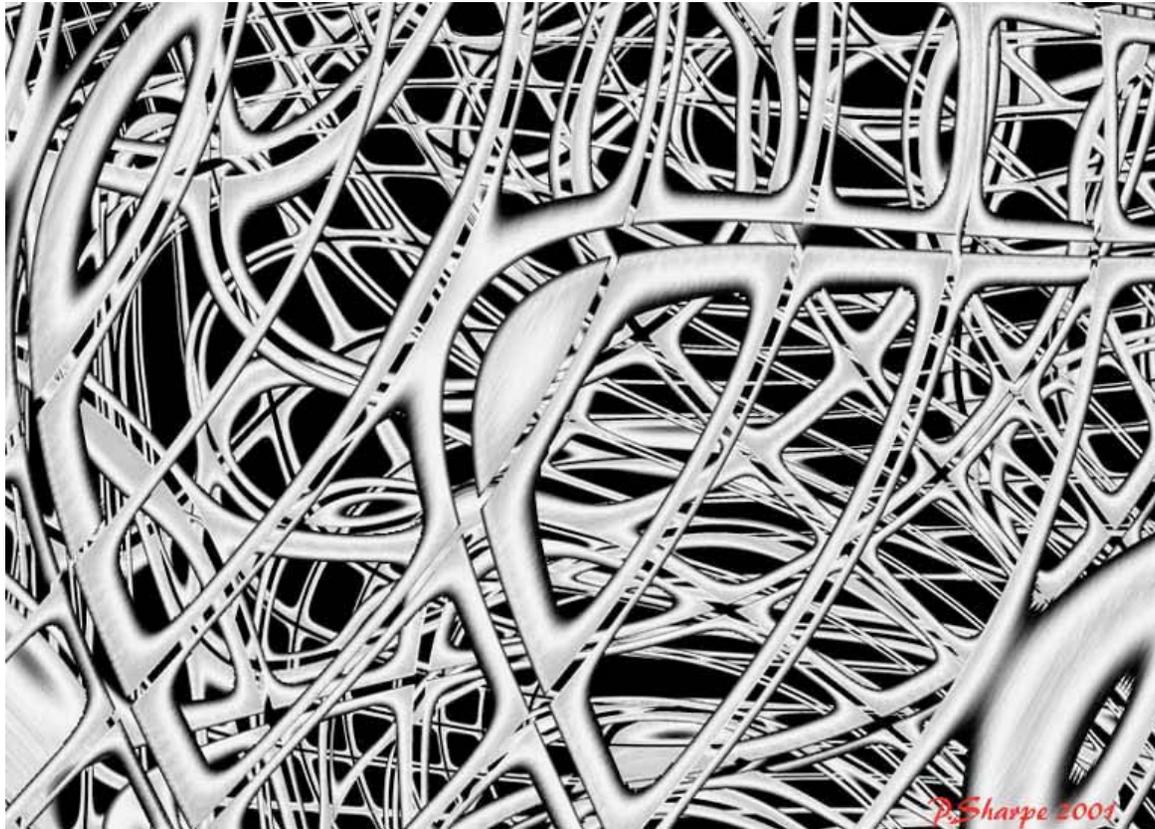
Security-Food, water, and energy, environmental conflict and migration

Economics-Industries, trade, investment

Welfare-Socio-Economic Development

The Coordination Problem

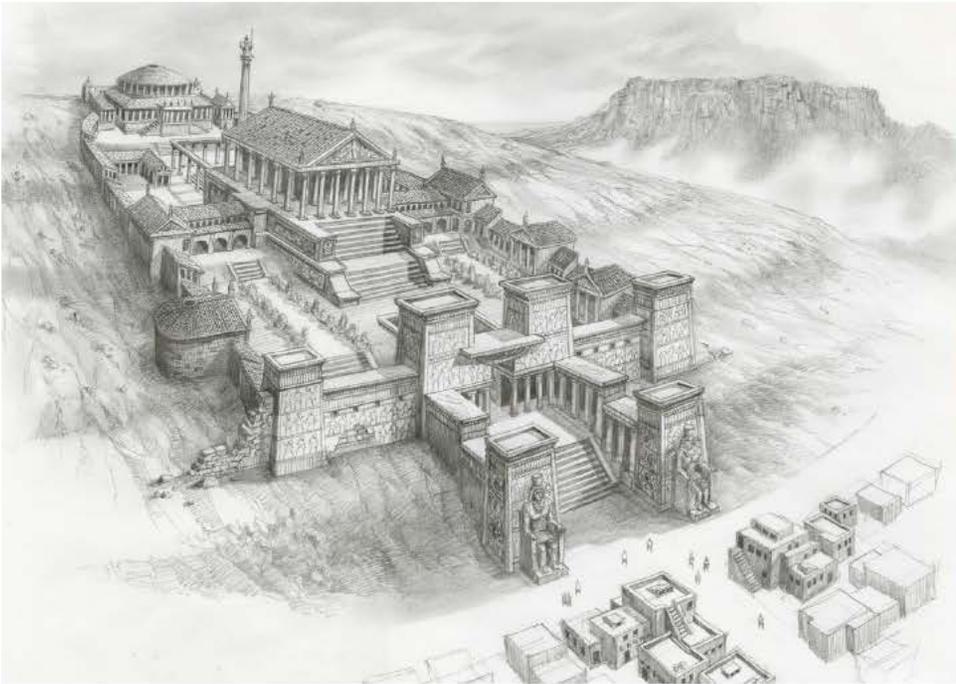
Regional and Sectoral Polycentric Governance



Adaptation is not suited to a centralized, top down, command-and-control management style. No central actor-leader, committee, government agency- can conceive of all the tasks ahead and how they interrelate.

The Sustainability Problem

Keep knowledge in active use for 1000 years



Ancient Library of Alexandria, 300 BCE-400CE



Modern Library of Alexandria, 2002 CE-

Enduring Meta-Institutional Framework
Resilience to Disasters, Disruptions, Political Change
Obsolescence Strategy



The Timeliness Problem

- Rate of climate change will double in the next twenty years (AR5, 2013)
- Arctic climate changes at twice the global rate; 2004 Arctic Assessment out of date by 2011; 2007 IPCC could not keep up with ice melt rate
- Significant changes now likely to occur in the seven years between IPCC reports
- Communities at risk cannot wait for knowledge to cascade from global to regional to local

***Assessment should become an “always on”
knowledge management service***

Web-Based Assessment



Turn assessment from a periodically appearing document into an always-on knowledge management service that communities, industries, and individuals everywhere can access at any time.

Hunting for Decision-Ready Knowledge in the Information Jungle



Quality Assurance

The key enabler



**Local leaders find themselves faced with decisions they cannot delay.
They will not wait for knowledge to trickle down to them.
Can they find knowledge they can trust on their own?**

Knowledge Certification

IPCC's Most Important Value Added Product

Term	Likelihood of the Outcome
Virtually certain	99-100% Probability
Very likely	90-100% Probability
Likely	66-100% Probability
About as likely as not	33-66% Probability
Unlikely	0-33% Probability
Very unlikely	0-10% probability
Exceptionally unlikely	0-1% Probability

An IPCC assessment is a characterization of a state of knowledge that is transmitted to decision makers for their use. IPCC derives its judgments of knowledge reliability from the trained intuitions of small groups of qualified experts who have contributed to the published literature on a given topic. This group is required to make extraordinarily complete surveys of the peer-reviewed literature. Its judgments are arrived at after exhaustive person to person discussion and reflect the consensus views of those present.

IPCC Characterizes the Research Literature

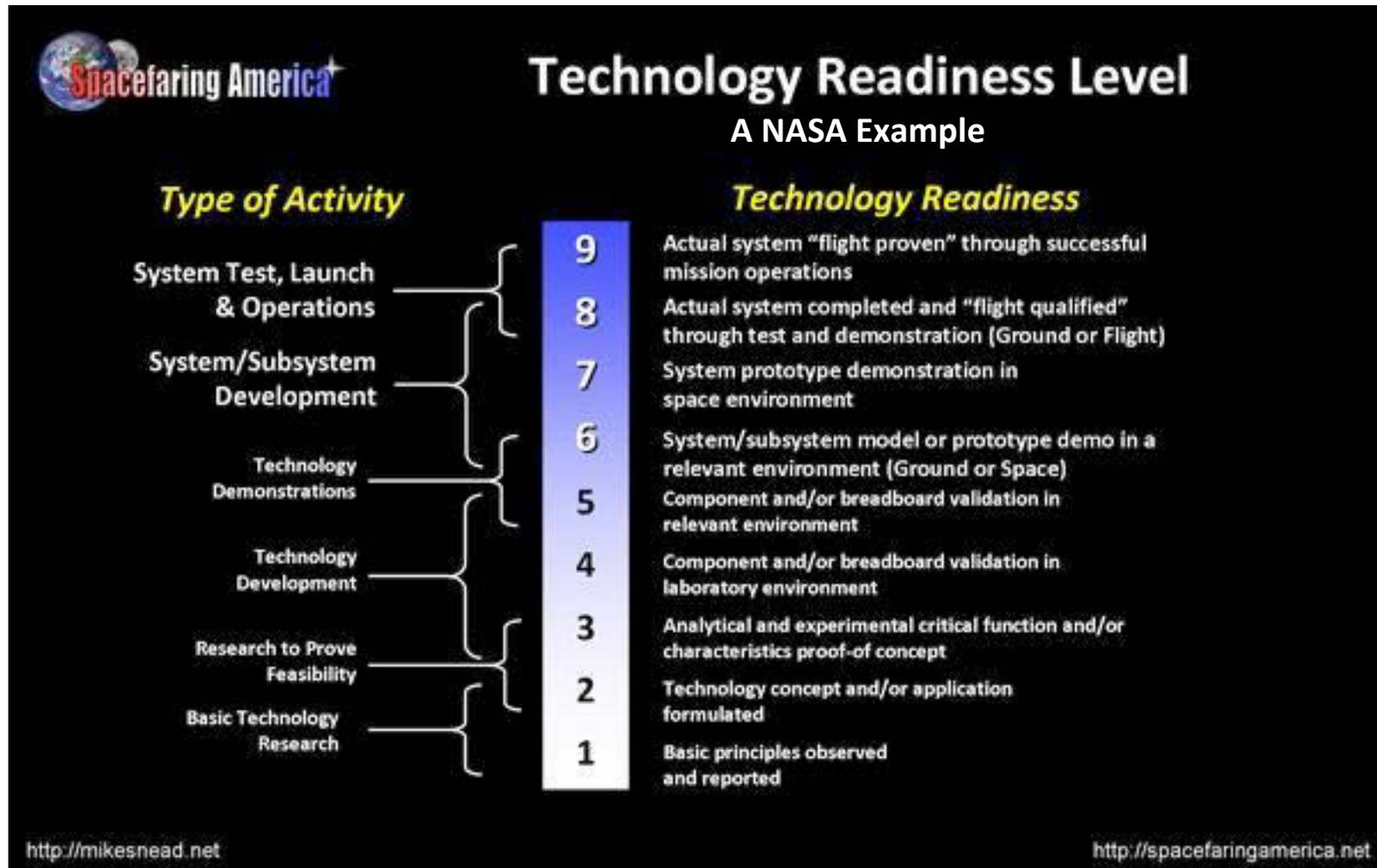
It does not rate the experience with the uses of the knowledge it certifies.

It does not evaluate its uses in the secondary and tertiary assessments in the knowledge cascade.

It is not equipped to follow how that knowledge is deployed and used in practical situations

Decision Readiness

Assurance of research knowledge reliability is what IPCC does
Decision readiness evaluates deployment of that knowledge



The Certification Problem

Put Knowledge To Work Soon After It Appears



There is an urgent need to invent social and internet-based processes to characterize how ready new research is for practical use by non-experts.

Bibliometric Indices

Peer Review, Research Impact, General Acceptance, Decision Readiness



ISI Web of
KNOWLEDGE™
Transforming Research

Social Maps

Citations

Multi-disciplinarity

Adoption

Media Coverage

Ranking
Reviewers, Citations,
Journals, Wikis

Descriptors
Standard Key Words



Oreskes, N., Beyond the Ivory Tower, The scientific consensus on climate change, *Science*, 306, 1686, 2004

Annotated Search

A globally distributed library of libraries

Multidisciplinary journal appearing daily with a vast table of contents



Every entry provided with living annotation by a global network of qualified reviewers

Knowledge syntheses appear as soon as subject matter is mature enough

Levels of decision readiness characterized

Challenge to the International Community

The world cannot wait for a perfect top-down framework.

Take the first steps now.



Random A

Incubate knowledge action networks

Seed funding and core secretariat support

Communications and common tools

Federate knowledge services

International diplomatic, technical initiatives

Strengthen GEO

Connect knowledge management and decision support infrastructures

Annotated search engines

Boundary organization services

Promulgate standards for decision readiness and federation

Convene conferences, workshops

Propose certification processes



Interoperability

Internet Protocols enabled the spread of the internet around the world by enabling millions of small initiatives.

Could knowledge management protocols transform how the world adapts to climate change?

Knowledge Management Protocols

A High Leverage Investment

Taxonomy Standards

- Labelling of subjects
- Data formats and data quality characterization
- Meta-languages

Repository Standards

- What should be preserved, and for how long
- Redundancy and security
- Technological evolution strategy
- Incentives to contribute

Accessibility Standards

- Intellectual property and security
- Price and public release
- Configuration management and traceability

Annotation Standards

- Characterization of decision readiness
- Descriptors, labels, notation

Global Adaptation

*An Emergent Property of Distributed Local Actions
Made possible by interconnectivity*

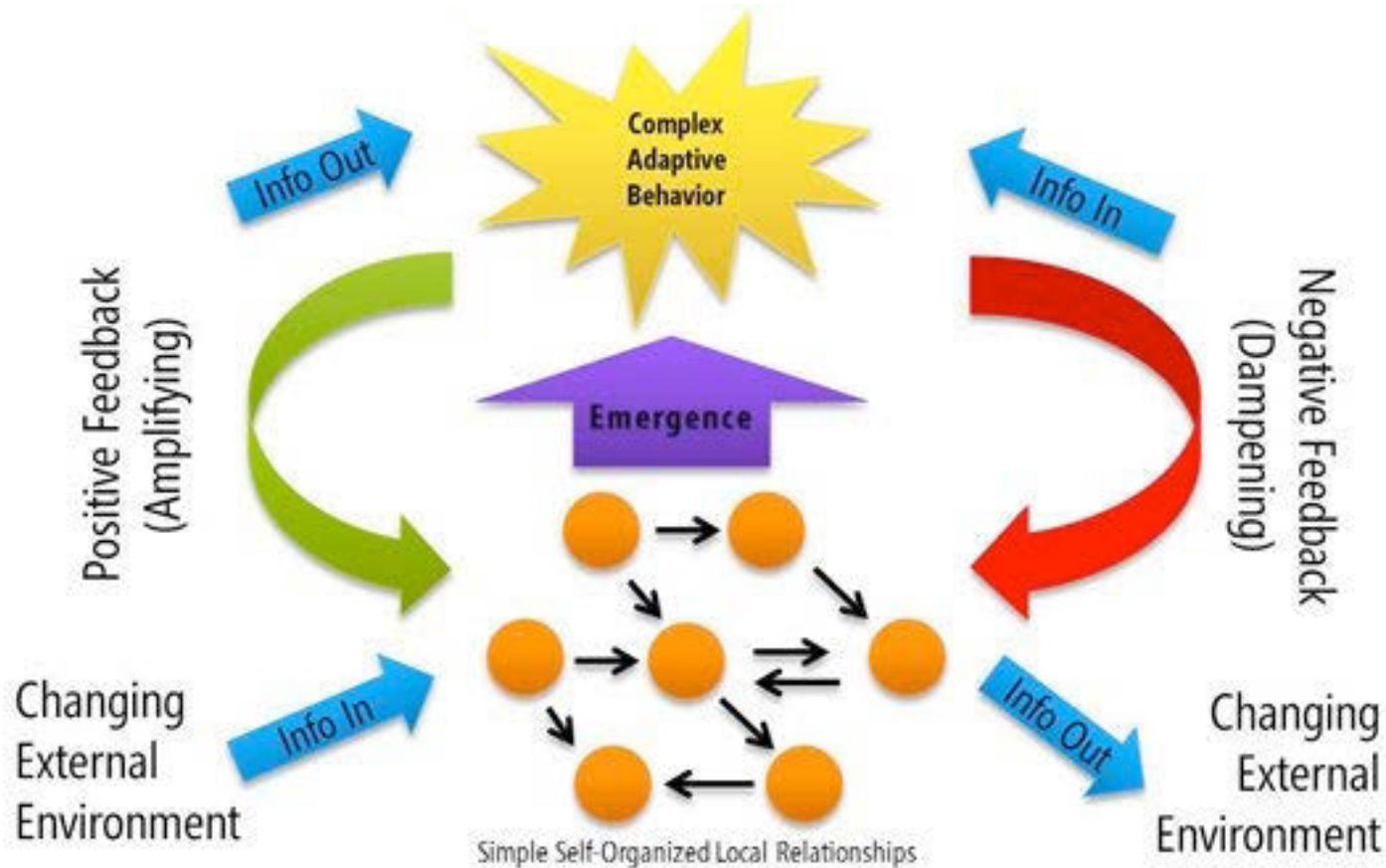


Figure adapted from Wikipedia; Complex Adaptive System by Alan Hakimi, The New World of Emergent Architecture and Complex Adaptive Systems, MSDN Blogs, Zen and the Art of Enterprise Architecture

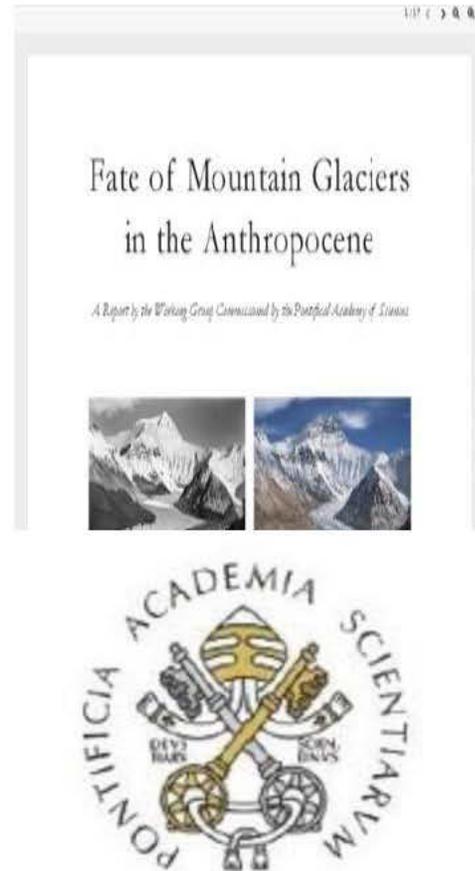
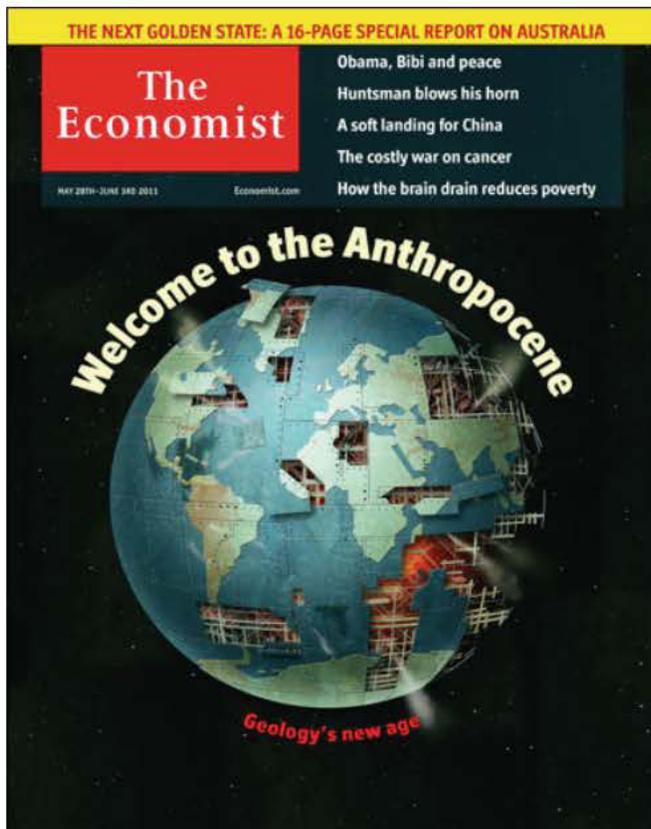


Sustainable Humanity Sustainable Nature Our Responsibility

Pontifical Academy of Sciences
Pontifical Academy of Social Sciences



The Anthropocene



The Anthropocene:
A New Epoch of Geological Time?

Wednesday 11th May

The concept of the Anthropocene represents one of the most democratic and bottom-up organising principles that Earth science has ever seen. The term is already embedded in the language of scientists, socio-economists, politicians, and the media. If we are to understand the significance and scale of contemporary global change, in all its forms, we need to know it, to see it, against the backdrop of the Earth's full story. And we need to see it from as many perspectives, from as many realms, as possible.

This conference will bring together the range of disciplines and realms to discuss, to debate the evidence for the Anthropocene.

SPEAKERS

Paul Crutzen
Andrew Revkin
Dennis Dimick
Will Steffen
Davor Vidas
James Syvitski
Dorothy Merritts
Erle Ellis
Toby Tyrrell

COSVENORS

Michael Ellis
British Geological Survey
Jan Zalasiewicz
University of Leicester
Mark Williams
British Geological Survey
& University of Leicester
Alan Haywood
University of Leeds

CONFERENCE THEMES

LIFE AND ITS DIVERSITY
HUMANS AND GEOLOGY
SOCIO-ECONOMIC ISSUES

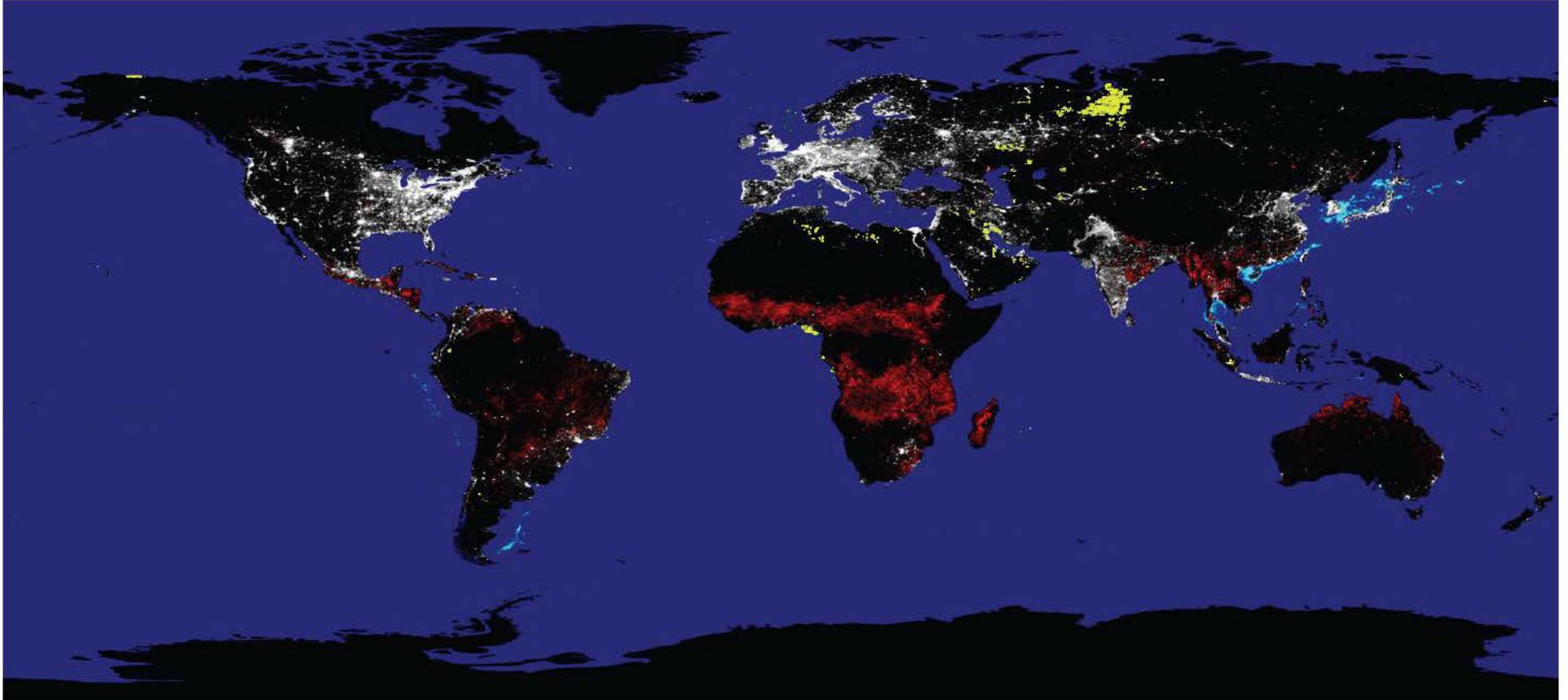
For further information please contact Lelia Tiele:
The Geological Society, Burlington House, Piccadilly, London, W1J 0BG
Tel: 020 7432 0988 Email: lelia.tiele@geosoc.org.uk
Web: www.geosoc.org.uk/anthropocenecent

P. Crutzen and E. Stoermer, *Global Change Newsletter*, 41, 1, pp. 17-18, 2000

P. Crutzen, Anthropocene Man, *Nature*, 467, S10, October 14, 2010

Our civilization faces an entirely new circumstance

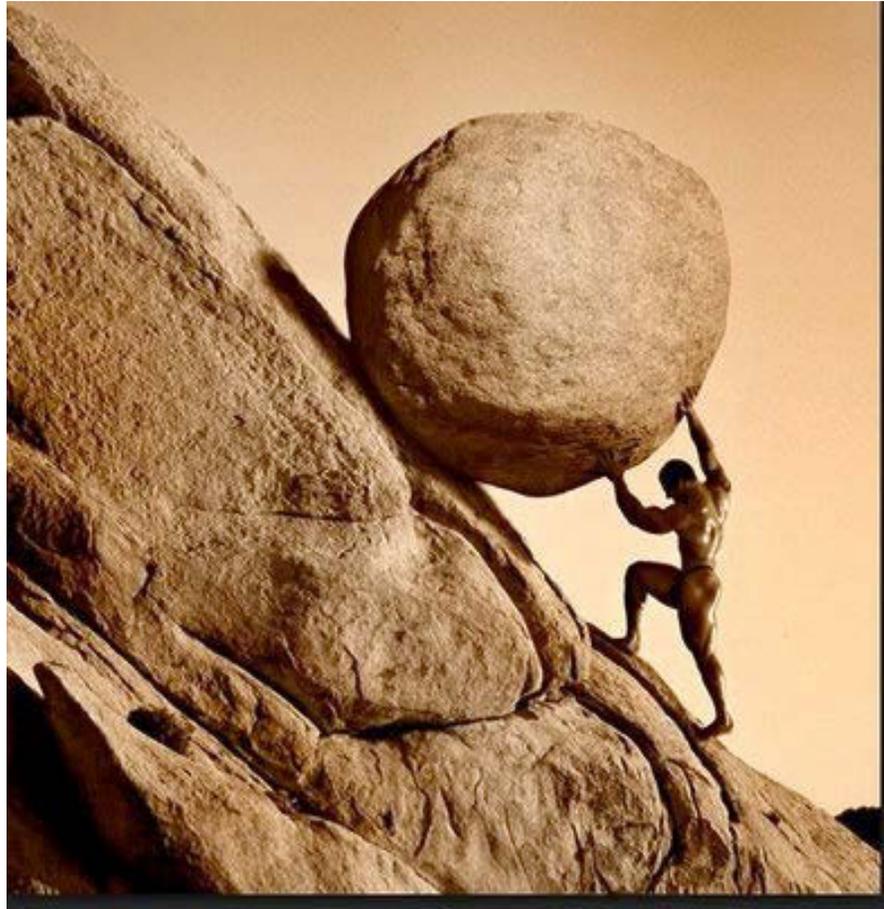
The human environmental impact became global in the last 50 years



Global warming, world-wide biodiversity collapse, habitat fragmentation, long droughts, ozone depletion, global air pollution, deforestation, desertification, retreating glaciers, disappearing polar ice, sea level rise...

“...the greatest threat facing humanity”

U.N. Secretary General Ban Ki-Moon



“The journey of a thousand years begins with small steps”

With thanks to Lao Tzu



“I am tired of writing obituaries for fish...”

Nancy Knowlton, Smithsonian

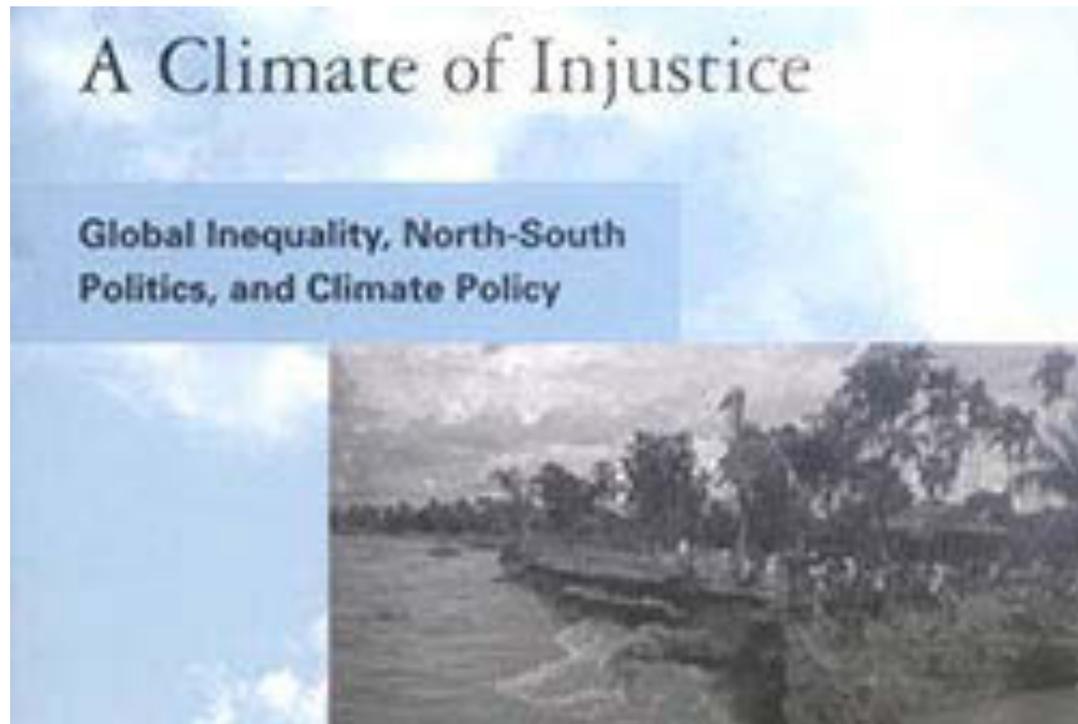


“We have no right to be pessimistic...”

Jeffrey Sachs, Columbia Earth Institute, UN Climate Change Advisor

Inclusion of the Most Vulnerable

The countries least responsible and least able to adapt will suffer the most



There are assertions of blame and responsibility but few approaches that appeal to the interests of both developed and developing countries. However, there is a potential mutuality of interest in a global knowledge action network for disaster management and adaptation. It encourages developing nations to initiate their own assessments. Their communities get a chance to become centers of innovation for adaptation through networking. Though there will be an asymmetry in scale and nature of investment, both developed and developing countries can see benefit in investing. It won't solve everything but it could help.

A healthier, safer, more just, more prosperous, and sustainable world is within reach, but...

The massive fossil fuel use at the heart of the global energy system deeply disrupts the Earth's climate and acidifies the world's oceans. The warming and associated extreme weather will reach unprecedented levels in our children's life times and 40% of the world's poor, who have a minimal role in generating global pollution, are likely to suffer the most.

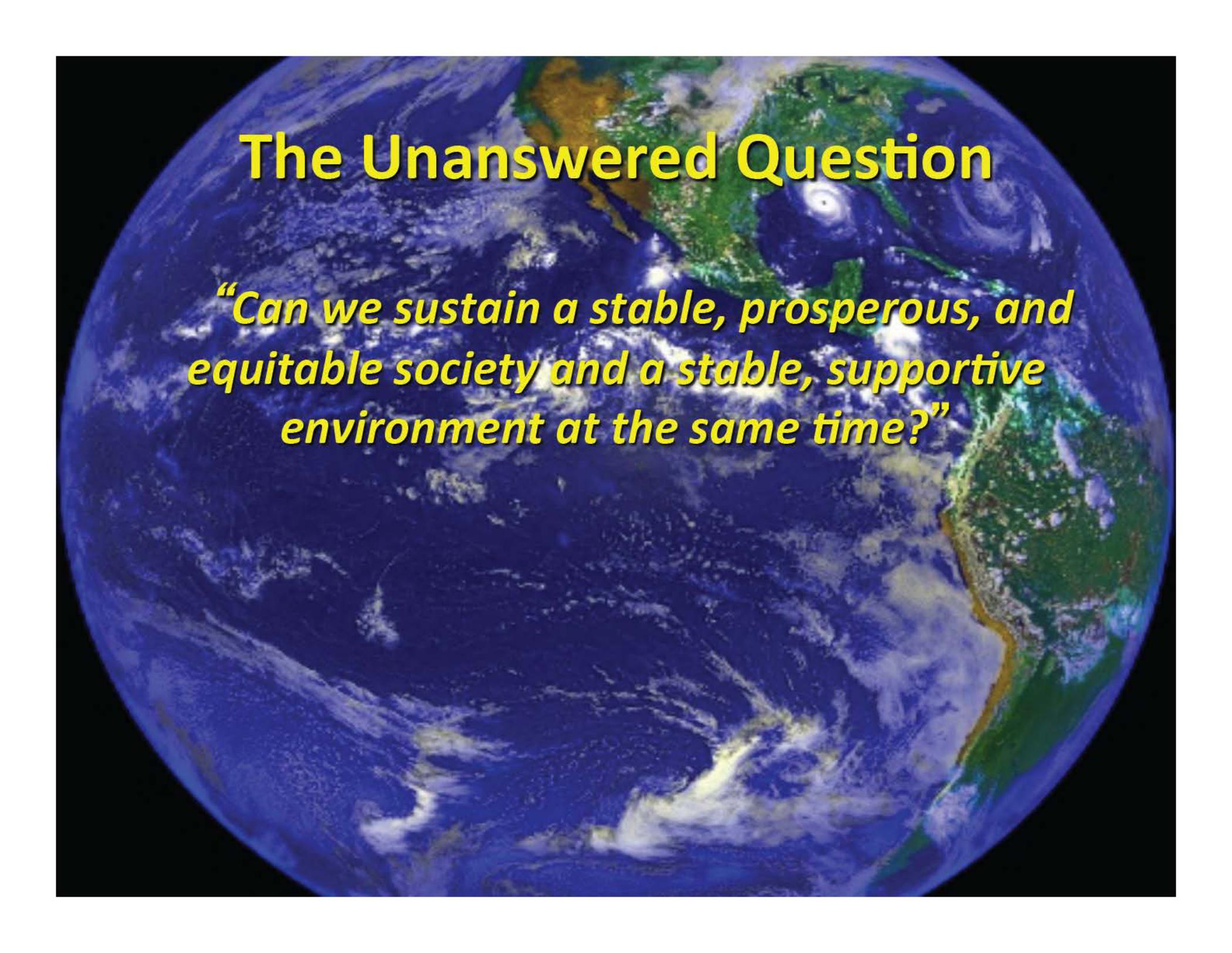
Industrial-scale agricultural practices are transforming landscapes around the world, disrupting ecosystems and threatening the diversity and survival of species on a planetary scale. Yet even with the unprecedented scale and intensity of land use, food insecurity still stalks the planet...

Intertwined crises of poverty, exclusion, and the environment

Humanity's relationship with nature is riddled with unaccounted for consequences... Socio-environmental processes are not self-correcting. .

Our economies, our democracies, our societies and our cultures pay a high price for the growing gap between the rich and the poor within and between nations.... Market forces alone, bereft of ethics and collective action, cannot solve the intertwined crises of poverty, exclusion, and the environment.

Unfair social structures... have become obstacles....The main obstacles to achieving sustainability and human inclusion are inequality, unfairness, corruption and human trafficking.

A satellite view of Earth showing the Americas and the Pacific Ocean. A large hurricane is visible over the Caribbean Sea. The text is overlaid on the image.

The Unanswered Question

“Can we sustain a stable, prosperous, and equitable society and a stable, supportive environment at the same time?”

The greatest challenge lies in the sphere of human values

“It says much that even some of the most accomplished scientists at this meeting articulated that progress on climate, energy, equity, education and conservation of living resources will be driven by values and faith more than data and predictive models.

In a discussion over dinner, Walter Munk, at 96 one of great oceanographers of modern times, spoke not of gigatons of carbon or megawatts of electricity:

‘This requires a miracle of love and unselfishness’ he said.”

Andrew Revkin, New York Times

