Global Knowledge Action Network

Adaptation to Climate Change

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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
## Knowledge, Governance, Action

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<td>Stakeholders</td>
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<td>Feasibility</td>
<td>Managers</td>
<td>Remediation</td>
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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

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

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
Knowledge Action Social Networks

Communicate motivation to act along with understanding
Forum on Science and Technology in Society, Kyoto, 2009, Special Session on Regional Climate Change

Incubated internationally, empowered regionally, initiated locally

Global, regional, and local participants-a “vertical” structure
Science, technology, and policy experts; regional leaders; local decision makers
Secretariats comprising professional knowledge translators-boundary organizations

Trust engendered by frequent interpersonal interaction

Enlist participation of developing world

Promote capacity-building and intercultural understanding
A peer group for those who do not participate in international peer circles

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
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

<table>
<thead>
<tr>
<th>Term</th>
<th>Likelihood of the Outcome</th>
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<tbody>
<tr>
<td>Virtually certain</td>
<td>99-100% Probability</td>
</tr>
<tr>
<td>Very likely</td>
<td>90-100% Probability</td>
</tr>
<tr>
<td>Likely</td>
<td>66-100% Probability</td>
</tr>
<tr>
<td>About as likely as not</td>
<td>33-66% Probability</td>
</tr>
<tr>
<td>Unlikely</td>
<td>0-33% Probability</td>
</tr>
<tr>
<td>Very unlikely</td>
<td>0-10% probability</td>
</tr>
<tr>
<td>Exceptionally unlikely</td>
<td>0-1% Probability</td>
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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.
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

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Technology Readiness Level

A NASA Example

<table>
<thead>
<tr>
<th>Type of Activity</th>
<th>Technology Readiness</th>
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<tbody>
<tr>
<td>System Test, Launch &amp; Operations</td>
<td>9</td>
</tr>
<tr>
<td>System/Subsystem Development</td>
<td>8</td>
</tr>
<tr>
<td>Technology Demonstrations</td>
<td>7</td>
</tr>
<tr>
<td>Technology Development</td>
<td>6</td>
</tr>
<tr>
<td>Research to Prove Feasibility</td>
<td>5</td>
</tr>
<tr>
<td>Basic Technology Research</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>3</td>
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<td>2</td>
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- 9: Actual system “flight proven” through successful mission operations
- 8: Actual system completed and “flight qualified” through test and demonstration (Ground or Flight)
- 7: System prototype demonstration in space environment
- 6: System/subsystem model or prototype demo in a relevant environment (Ground or Space)
- 5: Component and/or breadboard validation in relevant environment
- 4: Component and/or breadboard validation in laboratory environment
- 3: Analytical and experimental critical function and/or characteristics proof-of concept
- 2: Technology concept and/or application formulated
- 1: Basic principles observed and reported
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

Social Maps
- Citations
- Multi-disciplinarity
- Adoption
- Media Coverage

Ranking
- Reviewers, Citations, Journals, Wikis

Descriptors
- Standard Key Words

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.

- **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
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

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
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.

Inclusion of the Most Vulnerable
The countries least responsible and least able to adapt will suffer the most
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...
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.
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