



# Decision Support Models for Sustainability: Science-Policy Linkages in Urban Settings

*William Solecki*

Transition toward Sustainability after 15 Years:

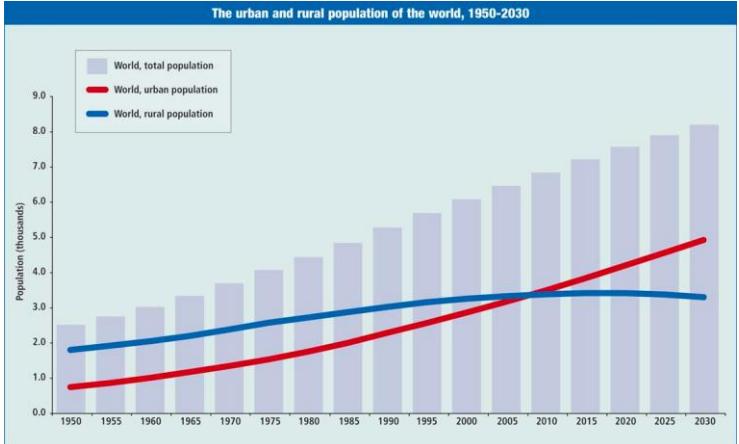
Where Do We Stand in Advancing the Scientific Foundation? A Workshop

January 14-15, 2016

National Academies of Sciences



The urban and rural population of the world, 1950-2030



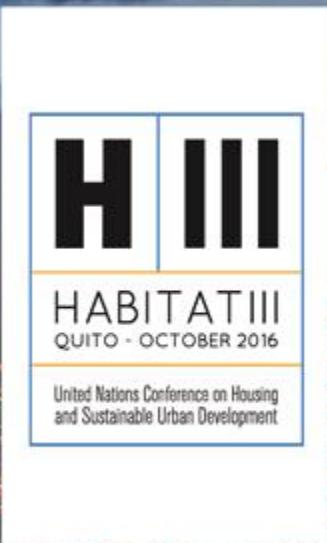
# Context for Science-Policy Linkages – Cities have emerged on the national and international policy agenda



UN World Conference on  
Disaster Risk Reduction  
2015 Sendai Japan

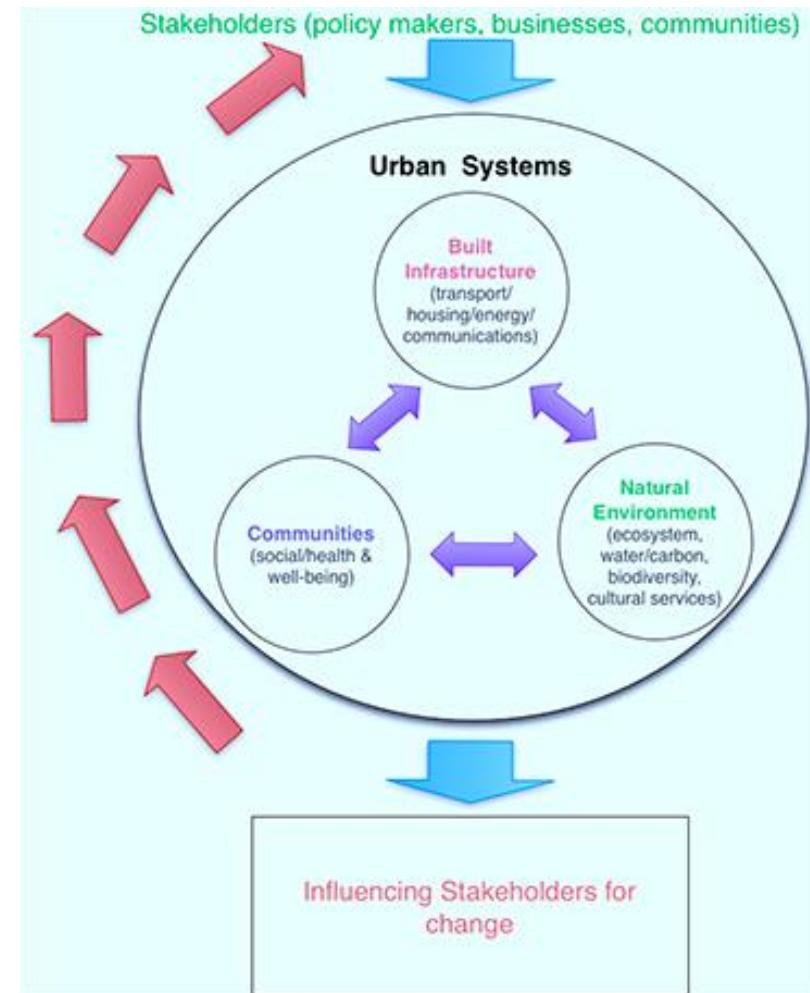


UNITED NATIONS  
SUSTAINABLE  
DEVELOPMENT  
SUMMIT 2015  
25 - 27 SEPTEMBER



# Translating the Science to the Urban: Recent Developments

- Conceptualization and operationalization of urban systems; global teleconnections; urbanization (urban) science
- Uncertainty and likelihood statements – National Climate Assessment, IPCC
- Multiple forms of knowledge – expert, local, empirical, qualitative
- Measurement; micro and macro sensing
- Indicators and monitoring of change
- Community organizations; boundary organizations
- Open and transparent process
- Co-production of knowledge



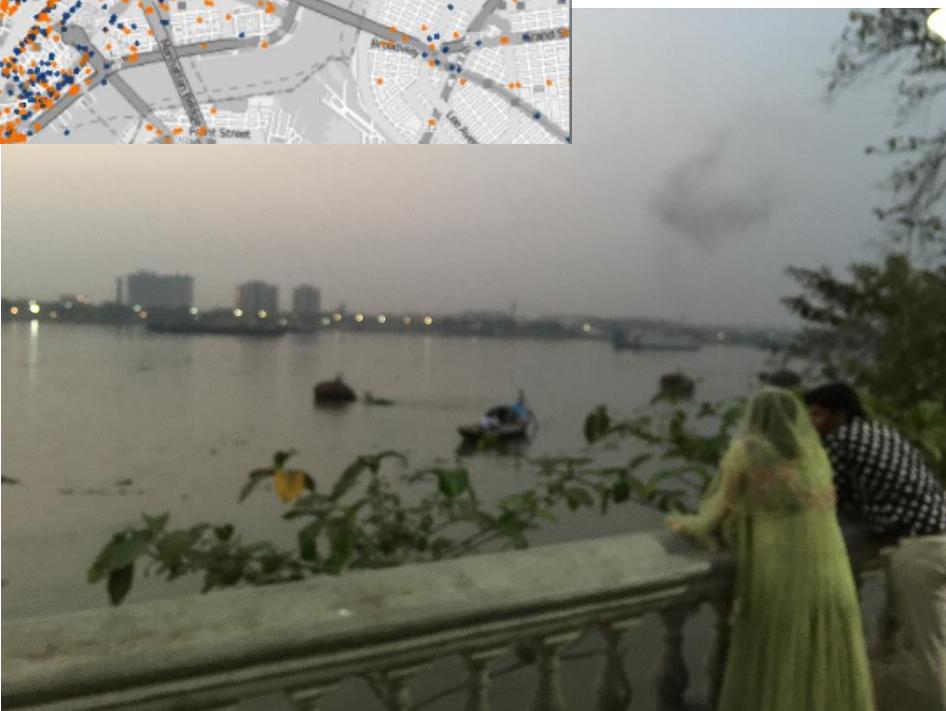
Source: Institute for Transport Studies – Univ. of Leeds

# Computational Models for Urban Decision-Making

- **Models of urban systems still limited**
  - Building on existing engineered – built environmental system model
  - Advances in physical systems
  - Some advances in ecological systems (esp. ecosystem services)
  - Very limited for social systems
  - Limited integrated modeling for the urban realm and scale
- **Challenges**
  - Lack of data key limitation
  - Lack of capacity to operationalize urban system analysis
  - Lack of basic science and expertise
  - Lack of financial resources
  - Lack of trust of products
- **Some exceptions** – some EU countries, China and a few others use integrated modeling for urban spatial planning



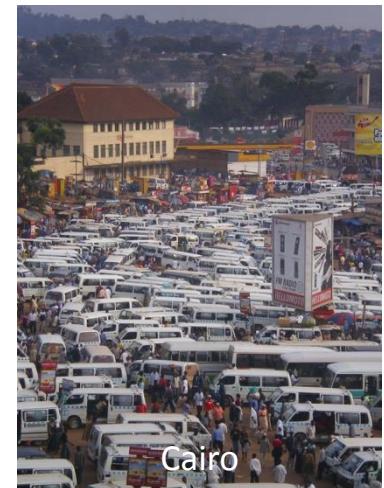
Taxi trips in Manhattan on May 1, 2013 from 8 a.m. to 9 a.m. The blue dots correspond to pickups and the orange ones correspond to drop-offs.



Hooghly River, Kolkata

# City Leaders are at the Right Level of Governance to Take Sustainability Action

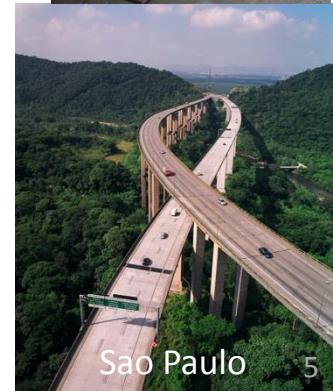
- Understand **systems, risks, exposures, and vulnerabilities**
- Forging links with **local academic and research communities**
- More direct **contact with constituents**
- Involved in **day-to-day management**; more practical
- Able to form **coordination networks** with other cities



Cairo



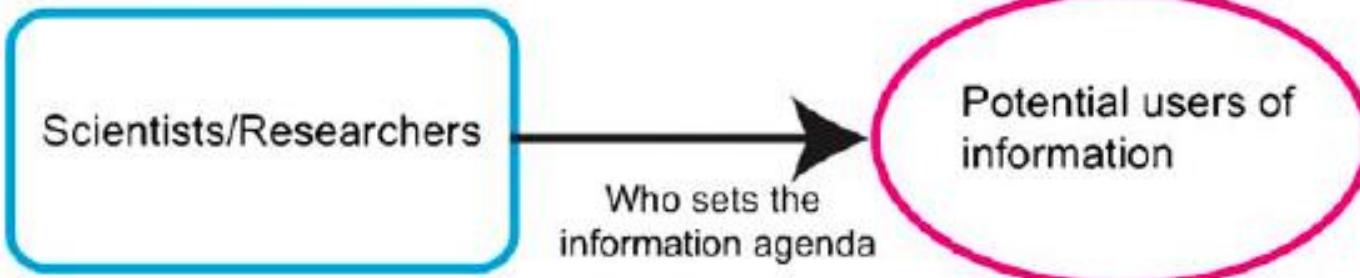
Phnom Penh



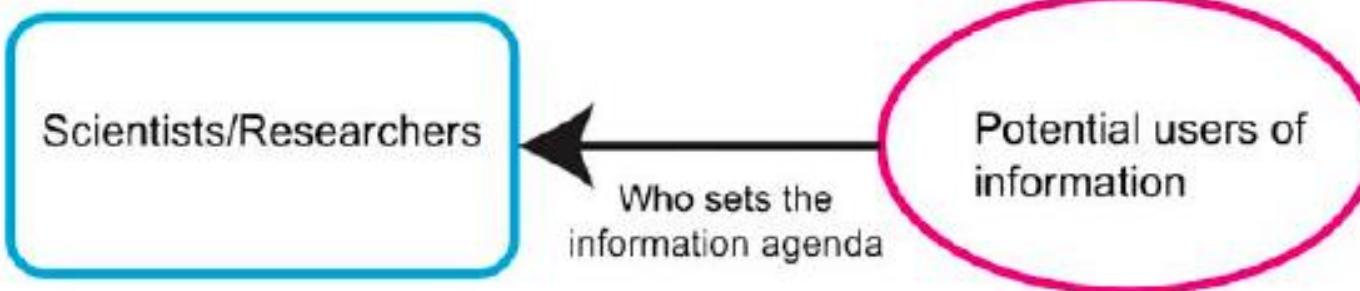
Sao Paulo

# Types of Science-Policy Linkages

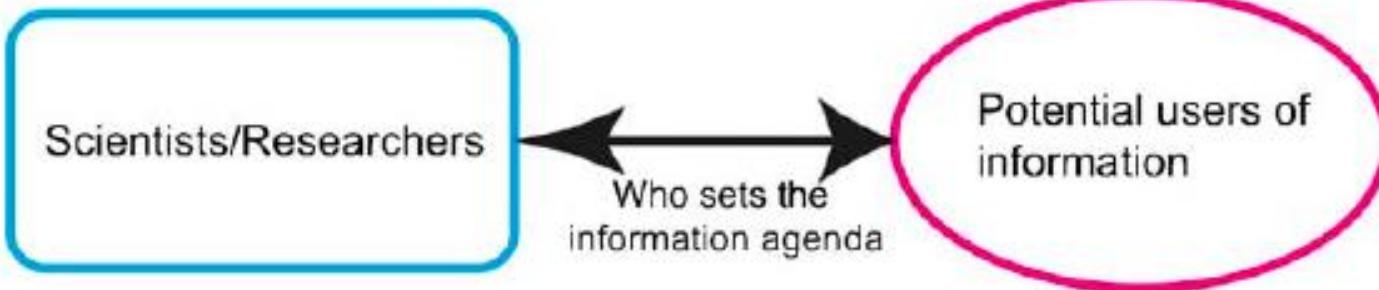
A



B



C



# Co-Production of Knowledge

“the collaborative process of bringing a plurality of knowledge sources and types together to address a defined problem and build an integrated or systems-oriented understanding of that problem” Armitage et al. 2011

## Key Phases of Co-Production

- Joint problem-framing
- Integration in knowledge production and joint knowledge dissemination
- Collaborative experimenting and learning

## Key Issues

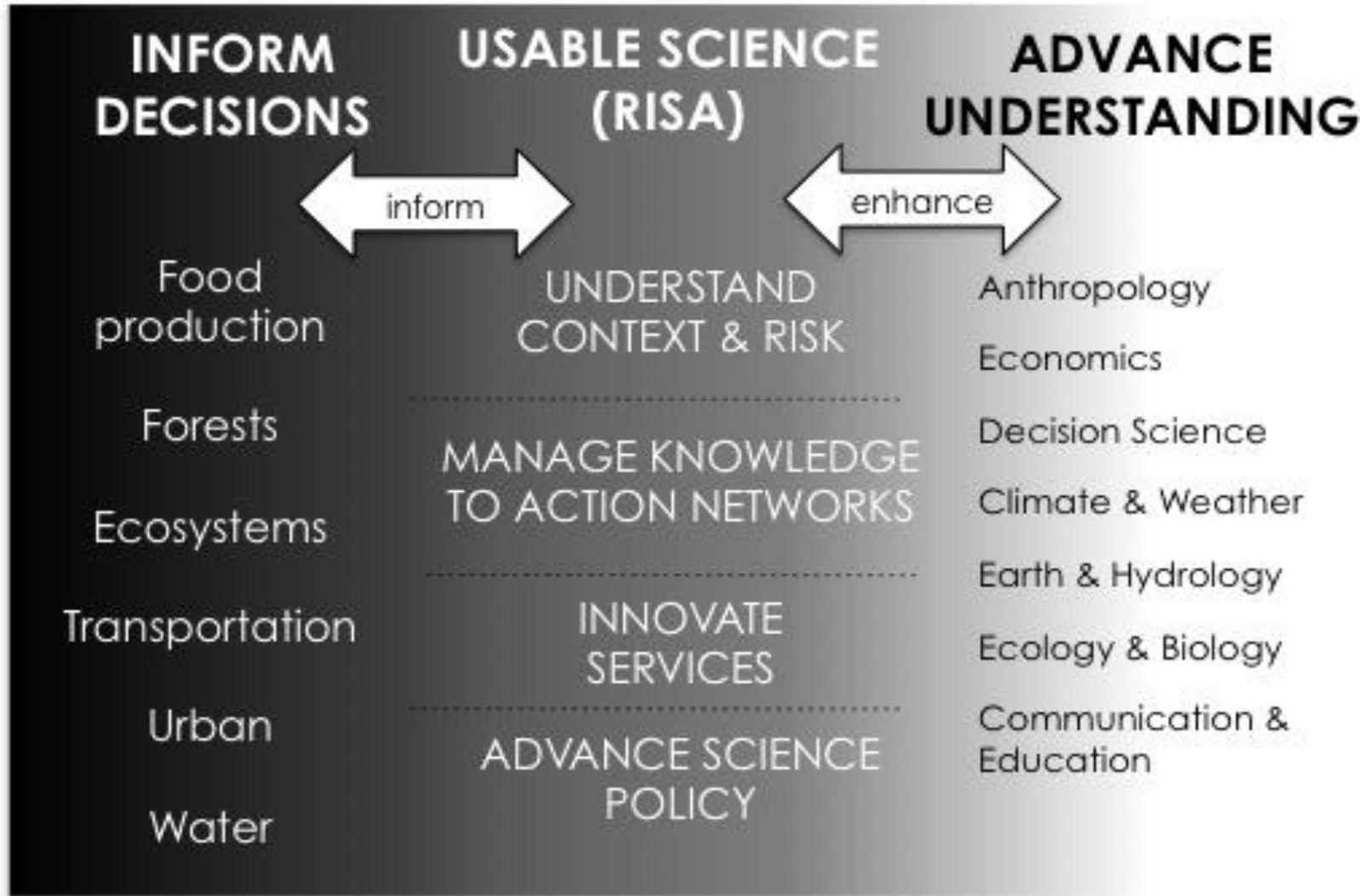
- Participants - Who is at the table? Who is not?
- Position – expertise and power?
- Incentives – benefits and costs to participants and other stakeholders
- Arrangements and approach – experiments, sensing, relationships across groups and participants, sustaining process
- Outcomes – measurement, indicators, value

# Co-Design and Co-Production of Knowledge



# Examples of Science-Policy Linkages – Models in Practice

# NOAA – Regional Integrated Systems



# New York City Adaptation Process

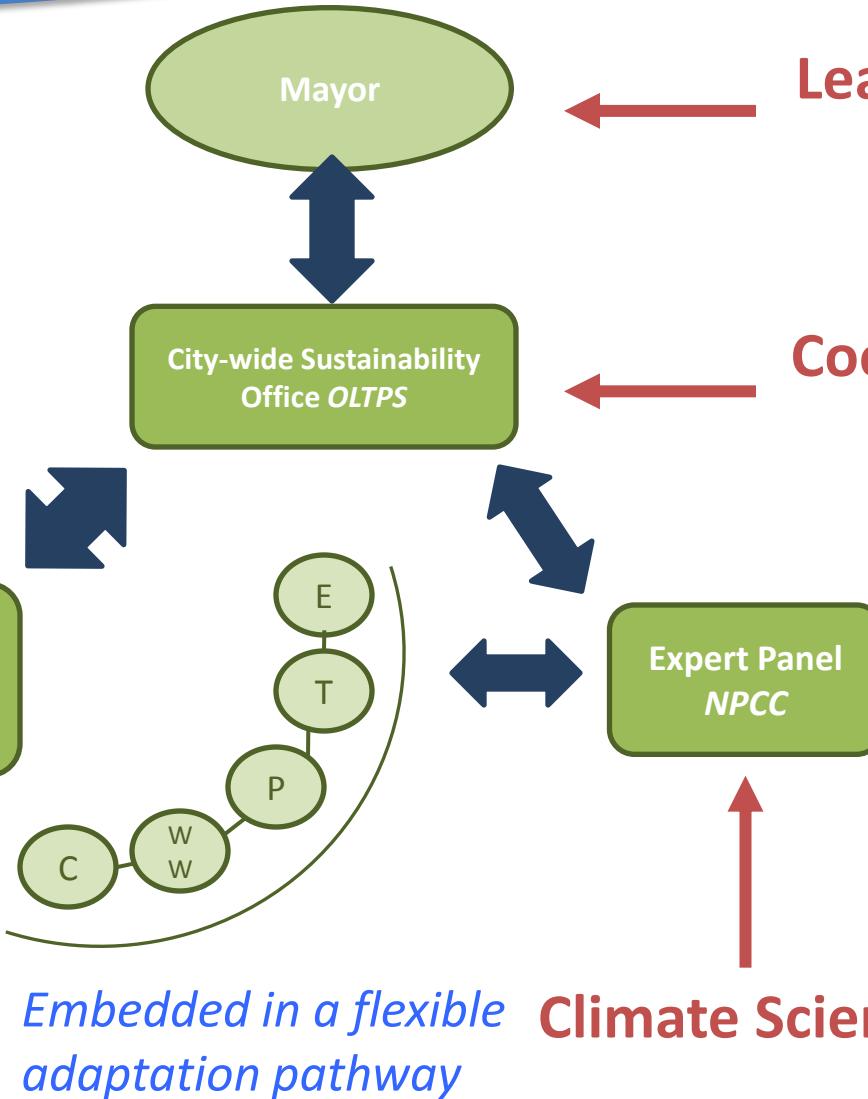
## Implementation

- City Agencies
  - Regional Authorities
  - Private Stakeholders



Integration across  
Sector-specific Working Groups

- Energy (E) - Transportation (T)
- Policy (P) - Water & Waste (WW)
- Communications (C)



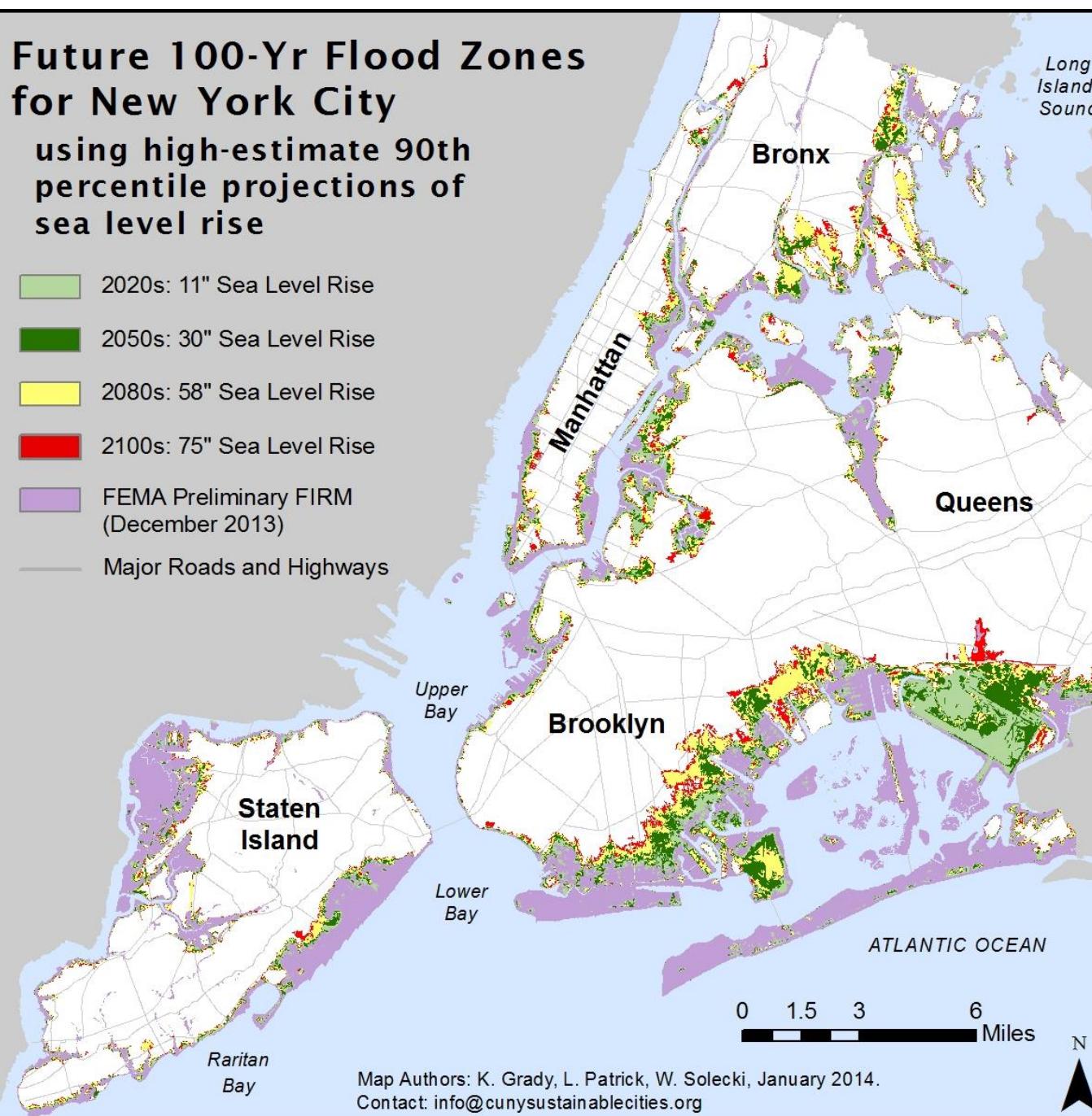
University scholars and private sector experts

- Social, biological, and physical scientists
- Legal and insurance experts
- Risk management professionals

# Future 100-Yr Flood Zones for New York City

using high-estimate 90th  
percentile projections of  
sea level rise

- 2020s: 11" Sea Level Rise
- 2050s: 30" Sea Level Rise
- 2080s: 58" Sea Level Rise
- 2100s: 75" Sea Level Rise
- FEMA Preliminary FIRM  
(December 2013)
- Major Roads and Highways

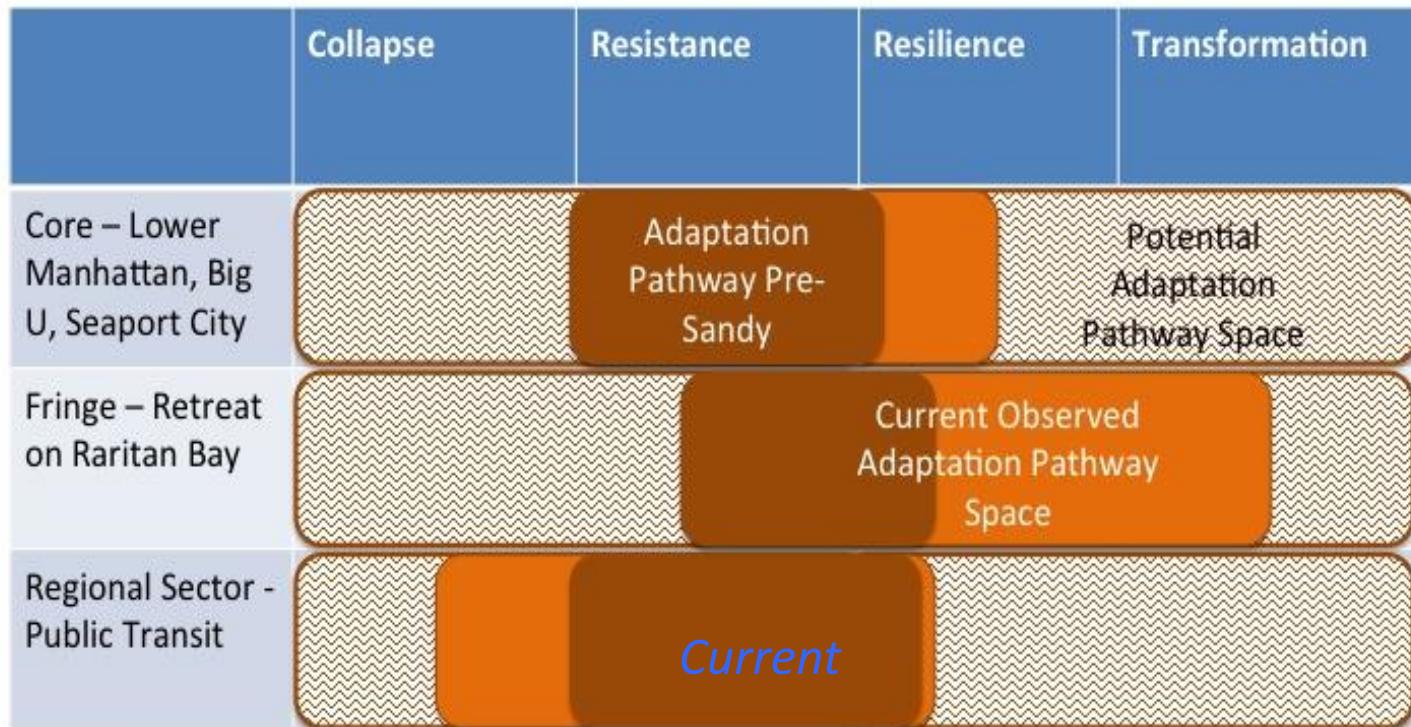


A co-generated  
product from  
the CCATF, NYC,  
and NPCC

Source: New York City Panel on Climate Change (2015)

# Transformation and Resilience of the Urban Coast (TRUC) Project – funded by Belmont Forum

## New York City Case Examples and Adaptation Pathways Observed and Potential\* Analysis Space



\*Observed empirical adaptation pathways can be derived from the case study data; understanding of potential adaptation pathways will be derived from the modeling, scenario work, and face-to-face discussions with local stakeholders

# Science and Resilience Institute @ Jamaica Bay

## Knowledge cultures as a nested system (Brown 2001)

### Culture and content

#### INDIVIDUAL KNOWLEDGE

Own lived experience, lifestyle choices, learning style, identity

**Content: reflections, learning**

### Key



### Nested knowledges

#### LOCAL KNOWLEDGE

Shared lived experience of individuals, families, businesses, communities

**Content: stories, events, histories**



#### SPECIALISED KNOWLEDGE

Environment and Health Sciences, Engineering, Law, Philosophy, etc

**Content: case studies, experiments**



#### ORGANISATIONAL KNOWLEDGE

Organisational governance, policy, strategies

**Content: agendas, alliances, plans**



#### HOLISTIC KNOWLEDGE

Core of the matter, vision of the future a common purpose

**Content: symbol, vision, ideal**



# Science & Resilience Institute at Jamaica Bay

A Global-to-Local Partnership for Resilience

## RESILIENCE THEORY

*Boundary  
Organization  
Science – Policy  
Linkage Baked In*

### PARTNERS

City of New York National Parks Service

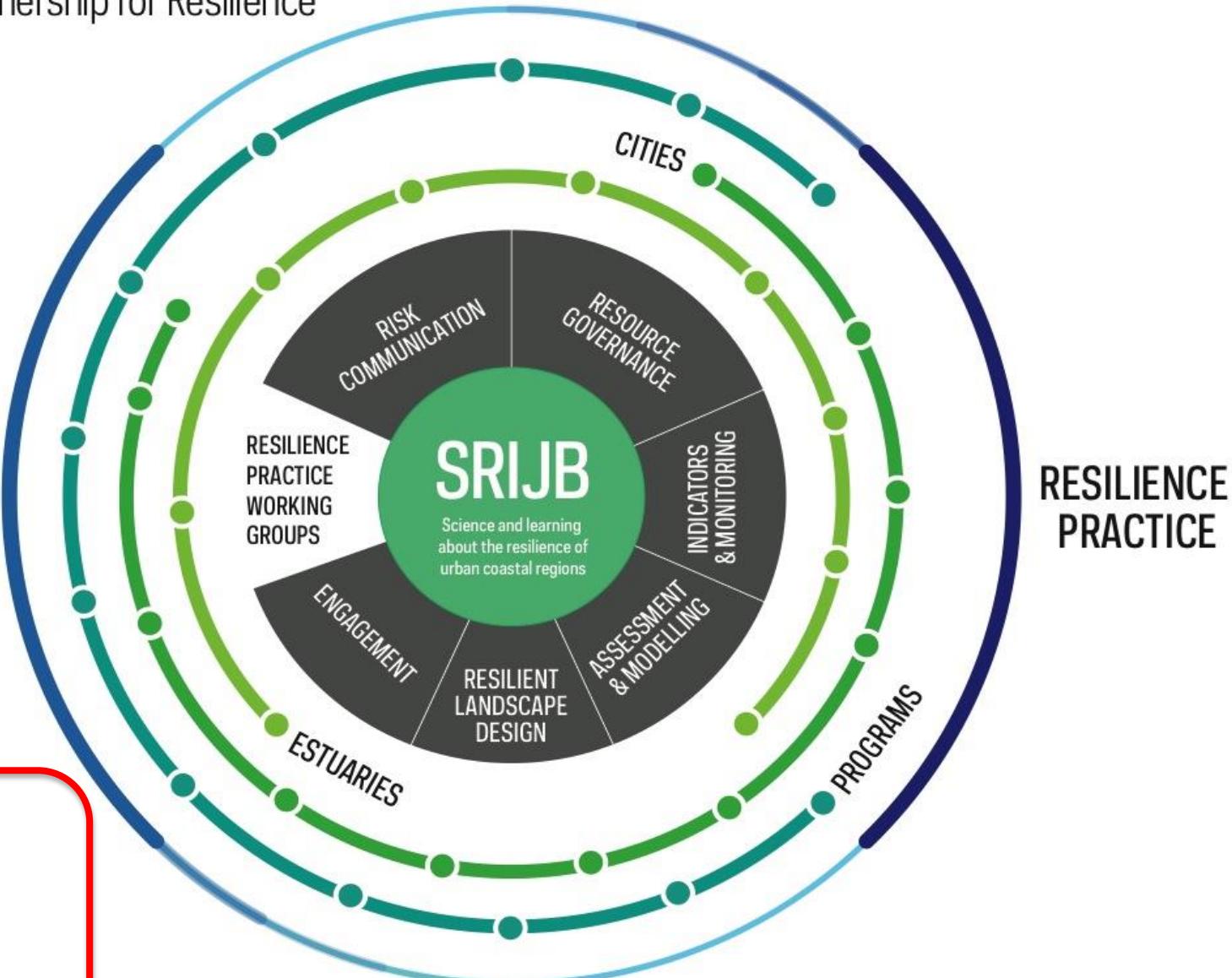
City University of New York Columbia University

Cornell University Rutgers University

NASA Goddard Institute for Space Studies

New York Sea Grant Stevens Institute of Technology

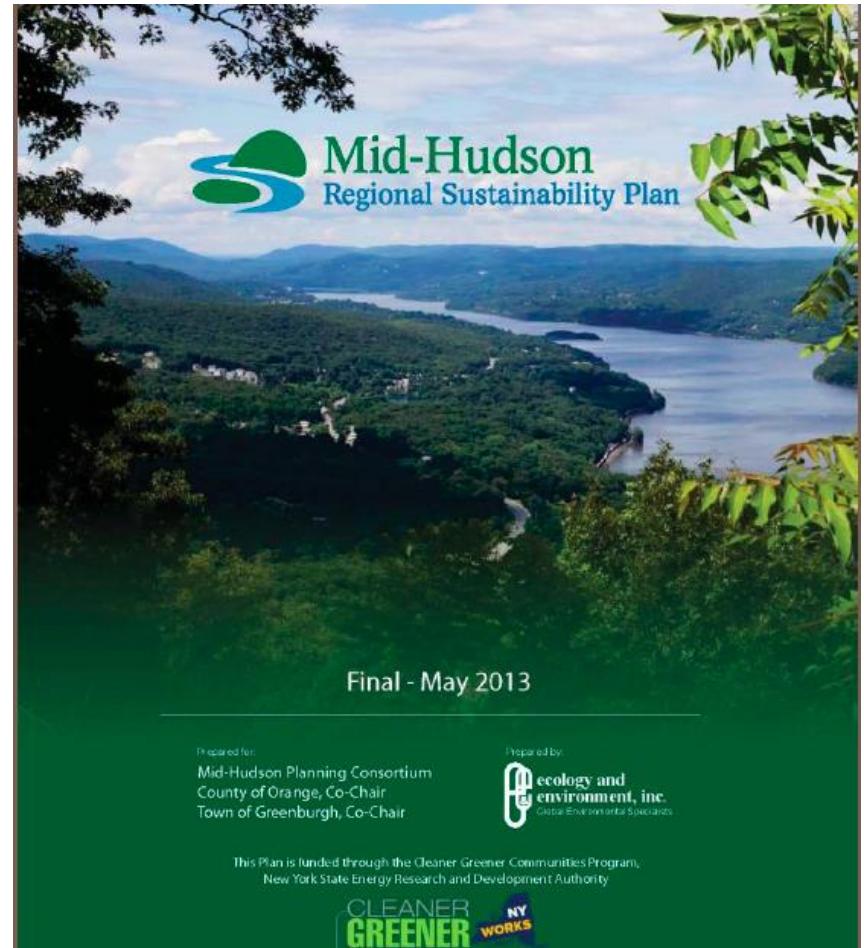
Stony Brook University (SUNY) Wildlife Conservation Society



Nested scales are important for science and for decision making

# Sustainability Orange (County) – Suburban/Exurban New York State

- Several \$400k project to translate indicators into measurements
- Well developed measures complete with specific instructions
  - Sustainability Indicators
  - Objectives
  - Initiatives for Implementation
  - Implication Strategies
  - Range of empirical measures
  - Methods for deriving empirical measures
  - Specific protocol for defining measure by Orange County planning staff
- The process becomes so elongated that the co-production process becomes splintered.

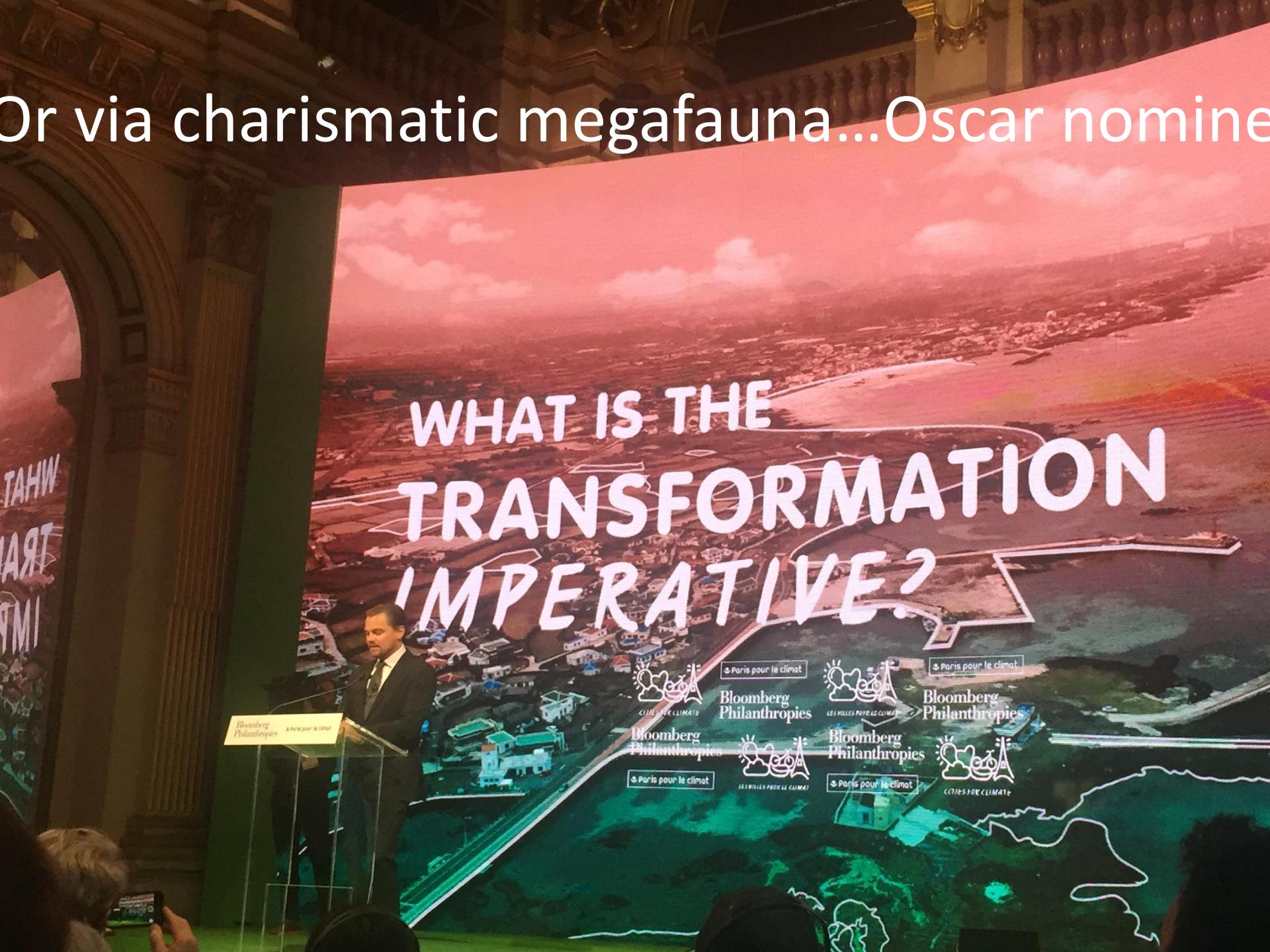


# City Networks (C40 and Iclei) at COP21 – Paris Dec. 2015



Another model: Science without Scientists – Peer to peer learning

Or via charismatic megafauna...Oscar nomine



# Concluding Thoughts

- Significant movement to the development of policy relevant (not necessarily policy prescriptive) research
- Movement from supply side to demand driven research – on time research; away from “over the wall” research
- Collaborative – co-generation knowledge current edge
- Challenges for process - power relations still dominate, legal constraints – who has authority to act and what are the economic benefits and costs of action, time intensive – stakeholder fatigue, many still feel excluded
- Challenges for science community – loss of the cutting edge – loss of outside the box thinking, loss of gray science for black and white, getting too close to power



*Landscape with the Fall of Icarus –*  
P. Bruegel the Elder

# Thank you

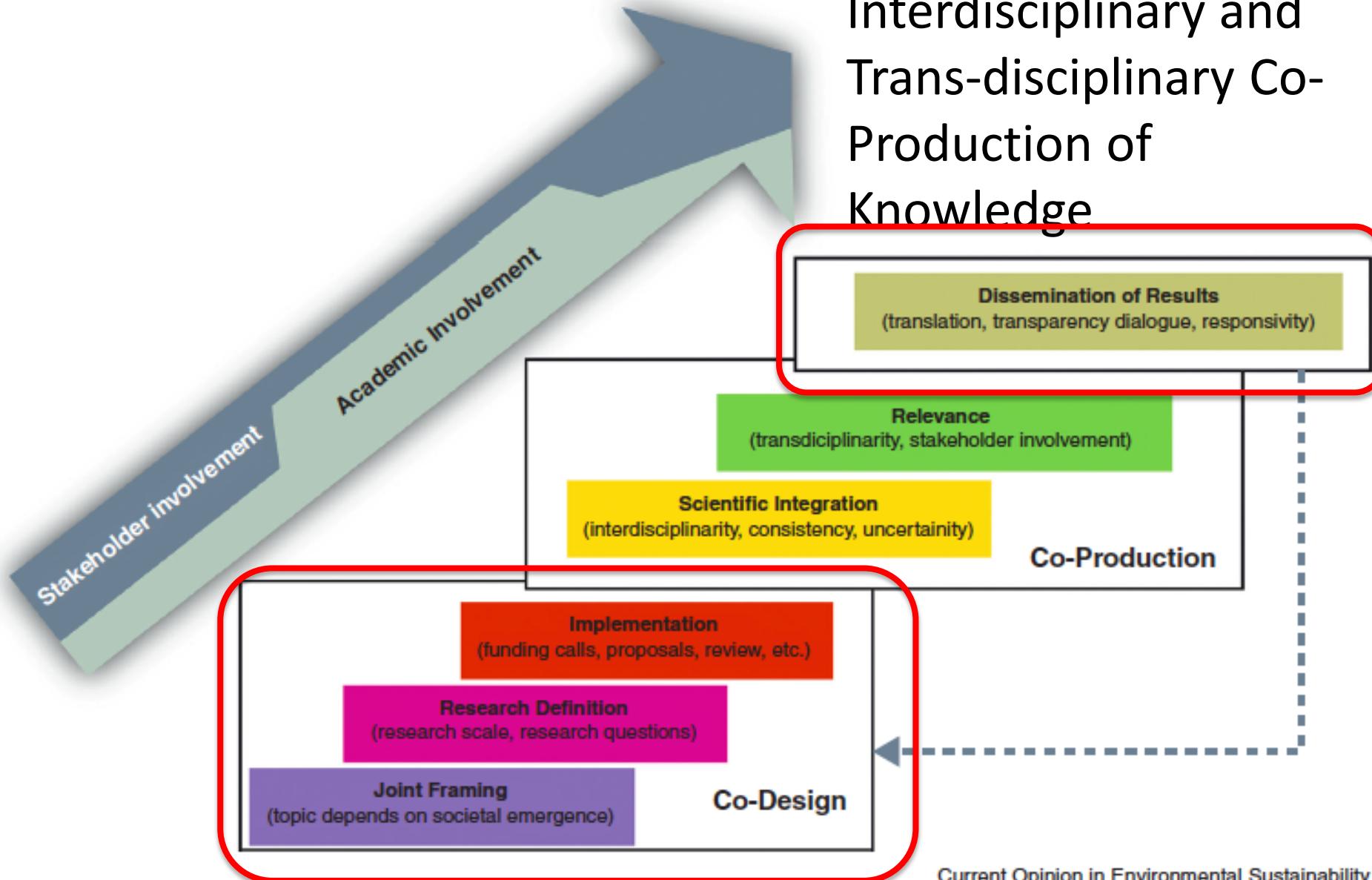
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# Framework for Interdisciplinary and Trans-disciplinary Co- Production of Knowledge



# Approaches to Collaboration Categorized by the Mode(s) of Engagement

Approach to deliberate coproduction	Mode(s)	Type of question	Role of research team	Resources required
Action research	Collegial	<ul style="list-style-type: none"> <li>• Stakeholder defined</li> <li>• Effecting change for stakeholder</li> <li>• Social/environmental justice focus</li> </ul>	<ul style="list-style-type: none"> <li>• Facilitators, teachers, technical guidance</li> <li>• Support the research of the stakeholder community</li> </ul>	<ul style="list-style-type: none"> <li>• Sufficient time to spend in stakeholder community</li> <li>• Financial (or other) support for stakeholder participants</li> </ul>
Transdisciplinarity	Collegial	<ul style="list-style-type: none"> <li>• Technical question that also has complex political or social impacts</li> </ul>	<ul style="list-style-type: none"> <li>• Equal partners with stakeholders</li> <li>• Facilitators of the process</li> </ul>	<ul style="list-style-type: none"> <li>• Sufficient time to spend on participatory activities</li> </ul>
Rapid assessment process	Consultative Collaborative	<ul style="list-style-type: none"> <li>• Understanding how stakeholders frame an issue; what terms and knowledge systems they use to understand the issue</li> </ul>	<ul style="list-style-type: none"> <li>• Ethnographers—learning about stakeholders' context</li> <li>• Proposing solutions to address issue of concern.</li> </ul>	<ul style="list-style-type: none"> <li>• Social science research training</li> <li>• Travel funds to go to stakeholder community/organization</li> </ul>
Participatory integrated assessment	Consultative Collaborative Collegial	<ul style="list-style-type: none"> <li>• Scenario planning</li> <li>• Development of integrated models</li> </ul>	<ul style="list-style-type: none"> <li>• Facilitators of participatory processes</li> <li>• Provide technical input</li> </ul>	<ul style="list-style-type: none"> <li>• Sufficient time to spend on participatory activities</li> <li>• Sufficient funds to engage in participatory activities</li> </ul>
Boundary organizations	Consultative Collaborative Collegial	<ul style="list-style-type: none"> <li>• Any of the above</li> </ul>	<ul style="list-style-type: none"> <li>• Purveyors of salient, credible, legitimate science</li> </ul>	<ul style="list-style-type: none"> <li>• Sufficient time to spend on participatory activities</li> <li>• Sufficient funds support boundary organization work</li> </ul>