

Evolving Resources for Decision Support & Co-Production of Knowledge

Session 2: RISA Annual Meeting 2016

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Outline (or not) (My Background)

- Undergraduate Program
 - Climate Impacts Engineering
- Masters of Engineering in Applied Climate
- Have developed a curriculum
 - Climate-change problem solving
 - Climate-change in planning and design
 - Climate informatics
 - Climate-change practicum

Outline

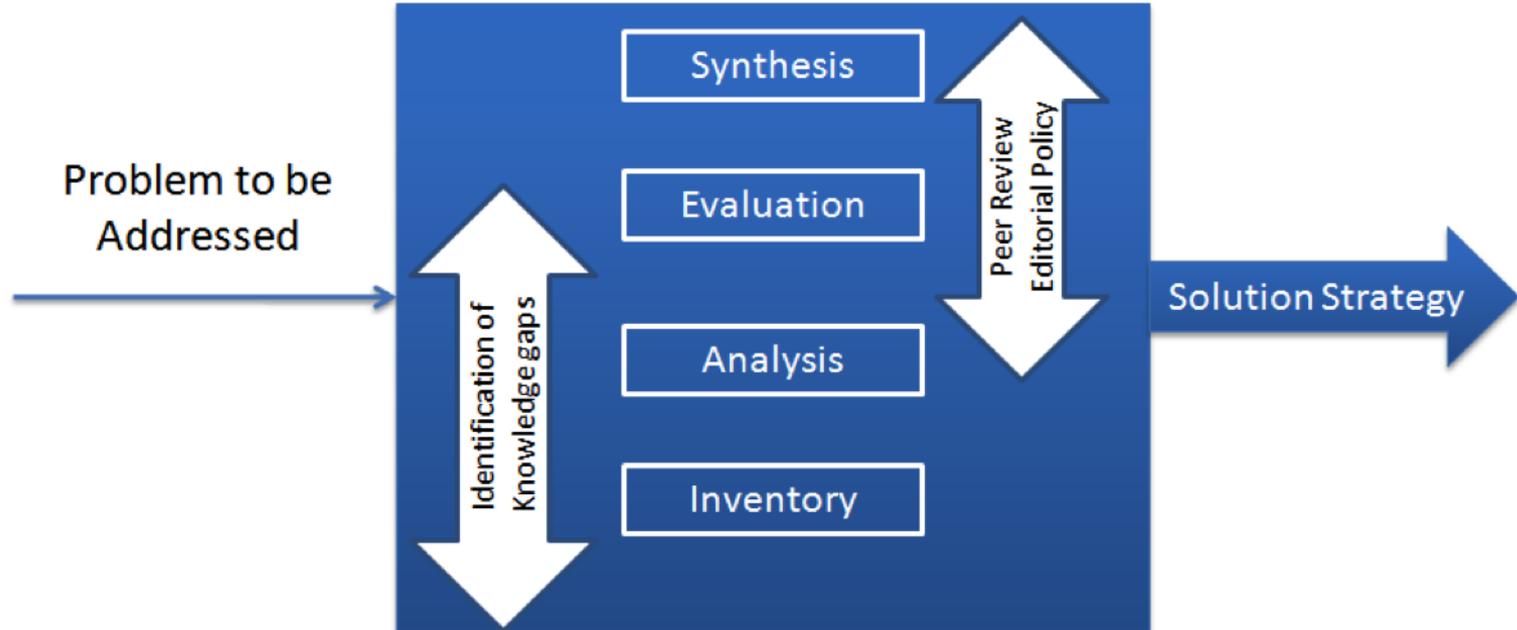
- Assume talking to people more experienced and more expert than myself
- Present some problem solving templates
- Discuss work with National Park Service

GLISA Resources & Products

- [GLISA Web Page resources tab](#)
 - [Narrative Summary of the Great Lakes Region](#)
 - [Great Lakes Climate Divisions](#)
 - [Great Lakes Station Climatologies](#)
 - [National Climate Assessment](#)
 - [Midwest](#) >> [Northeast](#) >> [Great Lakes Synthesis](#)
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 - [Great Lakes Regional Climate Change Maps](#)
 - [Reports from our Projects](#)
- [GLISAcclimate](#)
 - [Climate Information Guide](#)

Structure of Problem Solving (<http://glisacclimate.org/home>)

Common Structure of Problem Solving



Experience from Climate Change Problem

Climate Information Guide

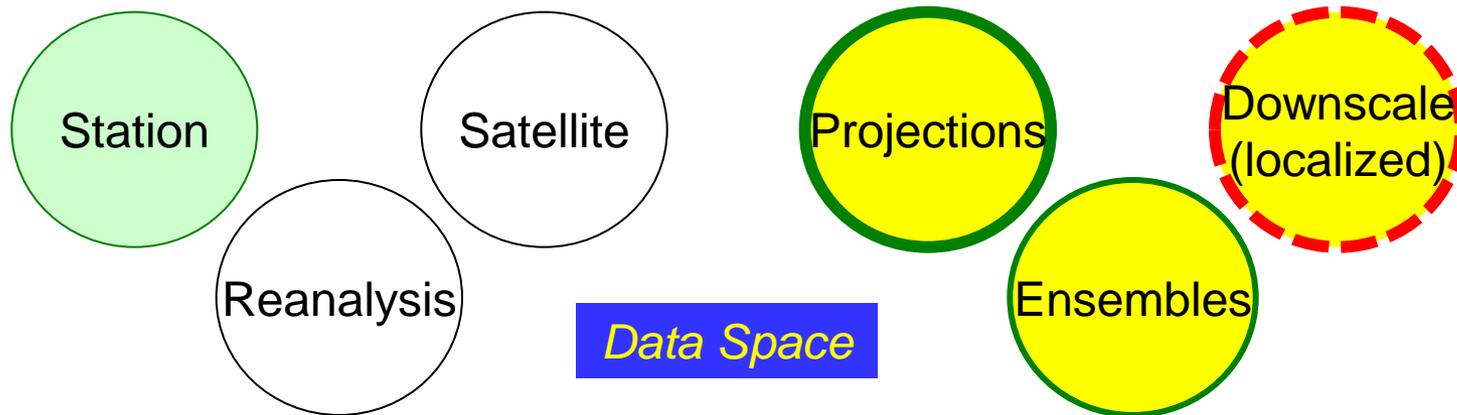
What Has Happened?

What Will Happen?



Characteristics of Successful Use

- Frequent Characteristics of Successful Use of Climate Knowledge and Data
 - Local observation or experience
 - Alignment of projections with regional observations or experience
 - Alignment with known vulnerability
 - Alignment with the narrative of the models



Elements of Evaluation: Data

- Spatial and temporal homogeneity
- Instrument calibration
- Comparison to observations and standards
- Statistical characteristics
 - Statistics common quantitative language across many fields
- Relevant to my application
 - Conform to existing practice in an application field

Elements of Evaluation

- Source of information
- Process for development of knowledge
 - Scientific method
 - Traditional environmental knowledge
 - Simple observation
 - Externality
- Peer reviewed?
- Reproduced?

Engagement: National Park Service

- In 2012 National Park Service's (NPS) Climate Change Response Program contacted GLISA to participate in adaptation planning for Isle Royale National Park
 - Specific focus on management decisions for unique wolf-moose ecosystems
- This process included NPS's structured scenario-planning process
 - Project unique in our experience because NPS knew exactly how they wanted to proceed

NPS Scenario Planning

- Managing for futures that are characterized by
 - Directional change
 - Complex uncertainties
- Consider management options for plausible futures
 - Plausible not probable
- Goals
 - Recognize change
 - Adapt to change
 - Take advantage of change

GLISA in Isle Royale Project

- Isle Royale (2012-2013)
 - Management focus
 - Park's changing forests and wolf & moose populations
 - Wolf and moose ecosystem highly stressed from many factors
 - How does climate change influence stresses?
 - Does climate change introduce new stresses?
 - How does climate and climate change relate to management decisions?
 - » Esp., introduction of wolves and moose by NPS
 - GLISA's role
 - Bi-weekly climate science team meetings
 - Localize observed and projected climate information for the island to support workshop
 - Set of Intermediate Products



Applying Climate Projections

Variable

Identify a climate variable to study
(i.e., temperature, precipitation, etc.)

Region

Identify the geographic region of
interest
(i.e., watershed, city, etc.)

Model
Evaluation

Study how well the weather-scale
processes are represented in the
models

Post-
processing

Describe how any post-processing
influences uncertainty

Synthesize

If the model is not consistent with what
has been observed, that is a major
uncertainty flag

Isle Royale Climate Considerations

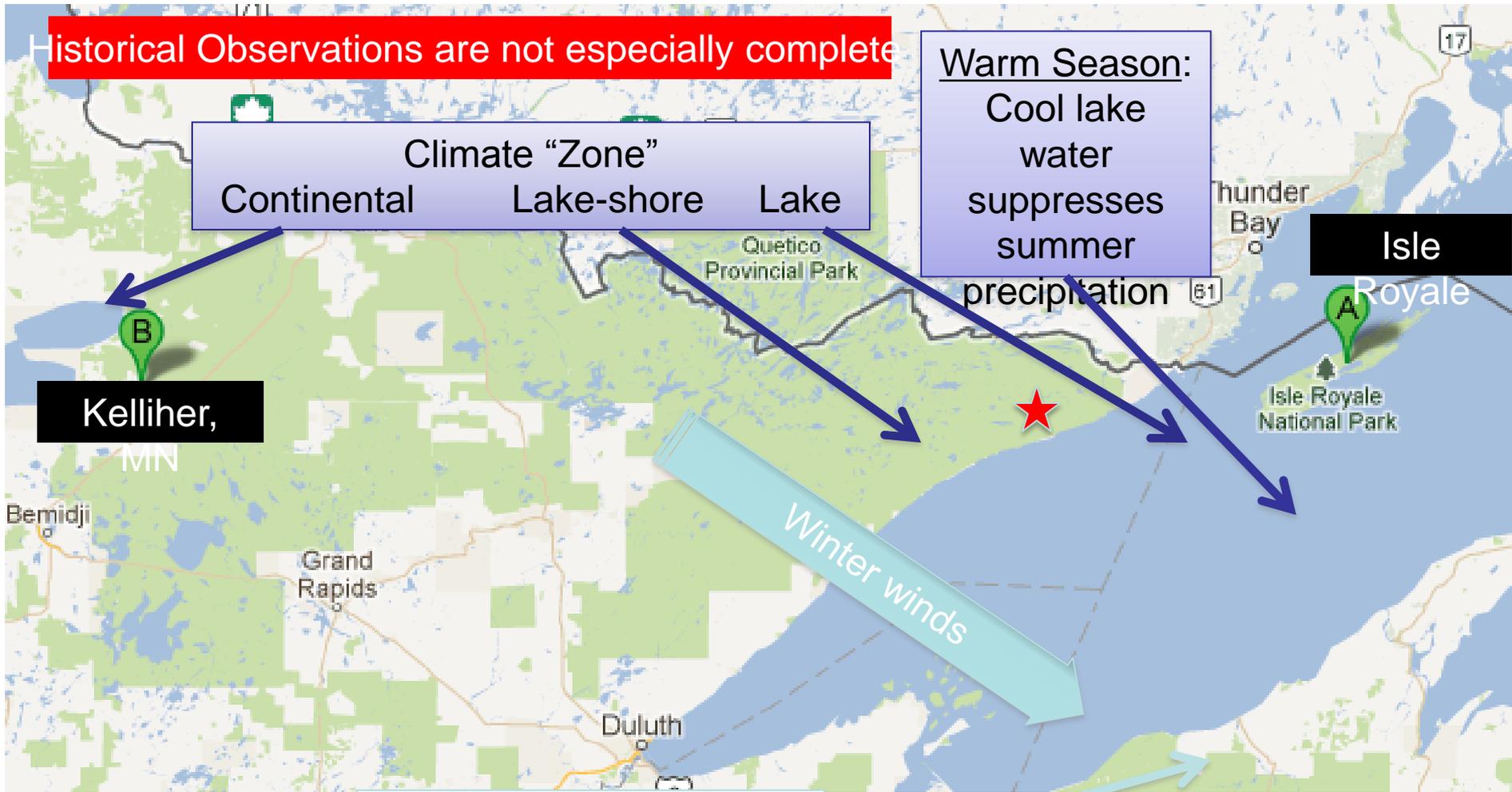
Historical Observations are not especially complete

Climate "Zone"
Continental Lake-shore Lake

Warm Season:
Cool lake water suppresses summer precipitation

Cool Season: Lake water increases rain and snow on the downwind side

Ice vs Water in Winter Matters !



Four scenarios

- Least change (baseline for all)
- Summer drought, wind, fire
 - For example, increased summer dry and large wind events (derechos)
- Warmer than Duluth (extreme heat)
 - For example, much higher temperatures, longer growing season, less snow, warmer lake
- Isle Savanna
 - For example changes in Arctic Oscillation / North Atlantic Oscillation (variability, esp., spring heat and dry)

Resource	Least Change	Summer Drought, Wind, and Fire	Warmer than Duluth	Isle Savanna
<p>Wolf</p> 				
<p>Moose</p> 		 then 		
<p>Boreal Forest</p> 				
<p>Temperate Forest</p> 				
<p>Savanna</p> 	NA*	NA	NA	

*NA: Not Applicable/Not Considered

Products: Isle Royale

- Report: [Using Climate Change Scenarios to Explore Mangement at Isle Royale National Park](#)
 - Restoration to past not possible
 - Perpetuation of present unlikely
 - Make best possible future
- Presentation on Arctic Oscillation at NPS national webinar: ([link](#))

Apostle Islands

- Nuances on the Isle Royale Approach
 - Tried to do the climate scenarios in advance
 - Integrated climate variables → lake levels, lake ice
 - Set of management problems
 - Infrastructure, design and deck height of docks on Lake Superior
 - Staffing, particularly in winter and shoulder seasons
 - Natural ranges: plant and animal species range changes, invasions, and altered disturbance regimes (Karner blue butterfly, endangered species)

Products: Apostle Islands

- [Climate Change Scenario Planning Workshop Summary](#): Apostle Islands National Lakeshore, April 23-24 2015
- Seasonal Lake Ice Prediction Project

Conclusions?

- What has happened?
 - Is it consistent with projections
 - Are there known vulnerabilities
- Role of weather (processes)
 - How we feel climate
 - How well represented in models
- Plausible futures

Rood: Maybe Usable New Book

- Demystifying Climate Models: A Users Guide to Earth System Models (Gettelman and Rood) (should be free open access)
 - <http://www.springer.com/us/book/9783662489574>
- Climate-Change Blogger for Wunderground.com
 - <http://www.wunderground.com/blog/>
- Rood's [Class MediaWiki Site](http://climateknowledge.org/classes/index.php/Climate%20Change%20The%20Move%20to%20Action)
 - [http://climateknowledge.org/classes/index.php/Climate Change: The Move to Action](http://climateknowledge.org/classes/index.php/Climate%20Change%20The%20Move%20to%20Action)
- A tumblr site to help me remember
 - <http://openclimate.tumblr.com/>

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Isle Royale

- Scenario Planning Workshop
 - Brought together experts (i.e., forestry, climate, large mammal, park staff/scientists)
 - Lessons Learned
 - Local experts have knowledge that can expedite problem solving (i.e., ice)
 - Climate impact specialists are necessary for translating climate information to on-the-ground impacts (i.e., forests)

Aspects of GLISA Role

- Represent “climate” as part of an iterative planning process which includes experts from many fields.
- NPS has substantial knowledge of climate, climate change and impacts. GLISA is
 - Supplementing
 - Tailoring
 - Linking weather to climate

Climate Impacts / Applied Climate

- Undergraduate Program in Climate Impacts Engineering
- Masters of Engineering in Applied Climate
 - Fifth year for our Undergraduates
 - 1.5 – 2 years for external applicants

Curriculum

- Configure classes to support climate and climate change
- Identify courses across University to provide breadth
- Create new classes for degree

New Classes

- Climate Change: An Inter-Disciplinary Approach to Problem Solving (Cross listed in SNRE)
- Climate Change in Planning and Design (Uncertainty and Non-stationarity in Context)
- Climate Change Informatics (with School of Information)

New Classes

- Climate Change Practicum (undergraduate, 1 semester)
 - Internships
- Climate Change Practicum (graduate, 2 semesters)
 - Internships

Students working with GLISA, Graham Sustainability Institute, Water Center, +
– looking for more

Rood: Blog & Book

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- Demystifying Climate Models: A Users Guide to Earth System Models (Gettelman and Rood) (should be free open access)
 - <http://www.springer.com/us/book/9783662489574>

Some Projects

- Lake Levels (Sustained Assessment)
 - Water Center
 - GLISA
 - NOAA
 - National Park Service
- Freezing Rain Climatology (NCEI)
- Flood vulnerability in Detroit neighborhoods
- Wolf-Moose Ecosystems Isle Royale
- Freeze-Thaw Cycles in New York
- Coupling Lake with Land Observations (GLOS)
- Great Lakes “Ensemble”
 - Localizing climate-model projections to account for important lake-weather processes
- Tribal Fisheries and Lake Levels (Marsik, Water Center)
- Prediction of Apostle Island Ice Caves (NPS)
- Global tides and climate change (Arbic)
- Precipitation trends in Aspen, CO (AGCI)

Resources and Recommended Reading

- [Cash et al: 2002: Knowledge Systems](#)
- [Usable Science? Tang and Dessai \(2012\)](#)
- Hines, Hungerford, Tomera, [Responsible Environmental Behavior](#), 1987
- Rood: [Solving the Problems of Climate Change and Sustainability](#), Michigan Journal of Sustainability, 2, 2014.

Knowledge System, Science Focused

Science &
Research

Applications

Dilling & Lemos, 2011

- Information brokers
- Collaborative group processes
- Embedded capacity
- Boundary Organizations
- Knowledge Networks

Cash et al: 2002

- Boundary Management
- Dual Accountability
- Boundary Objects

Cash et al: 2002

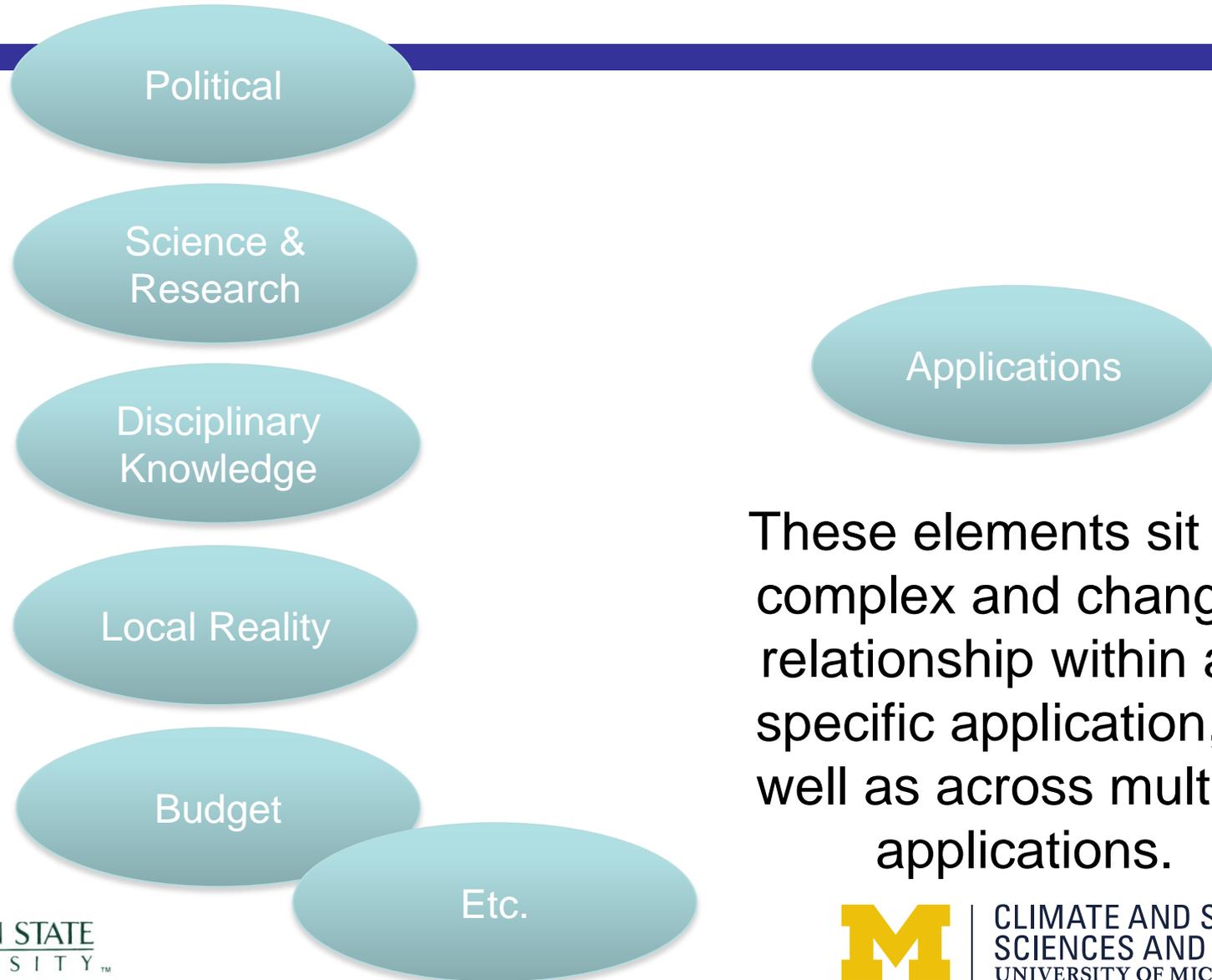
- **Legitimacy**
- **Credibility**
- **Salience**



Credibility, Legitimacy, Salience

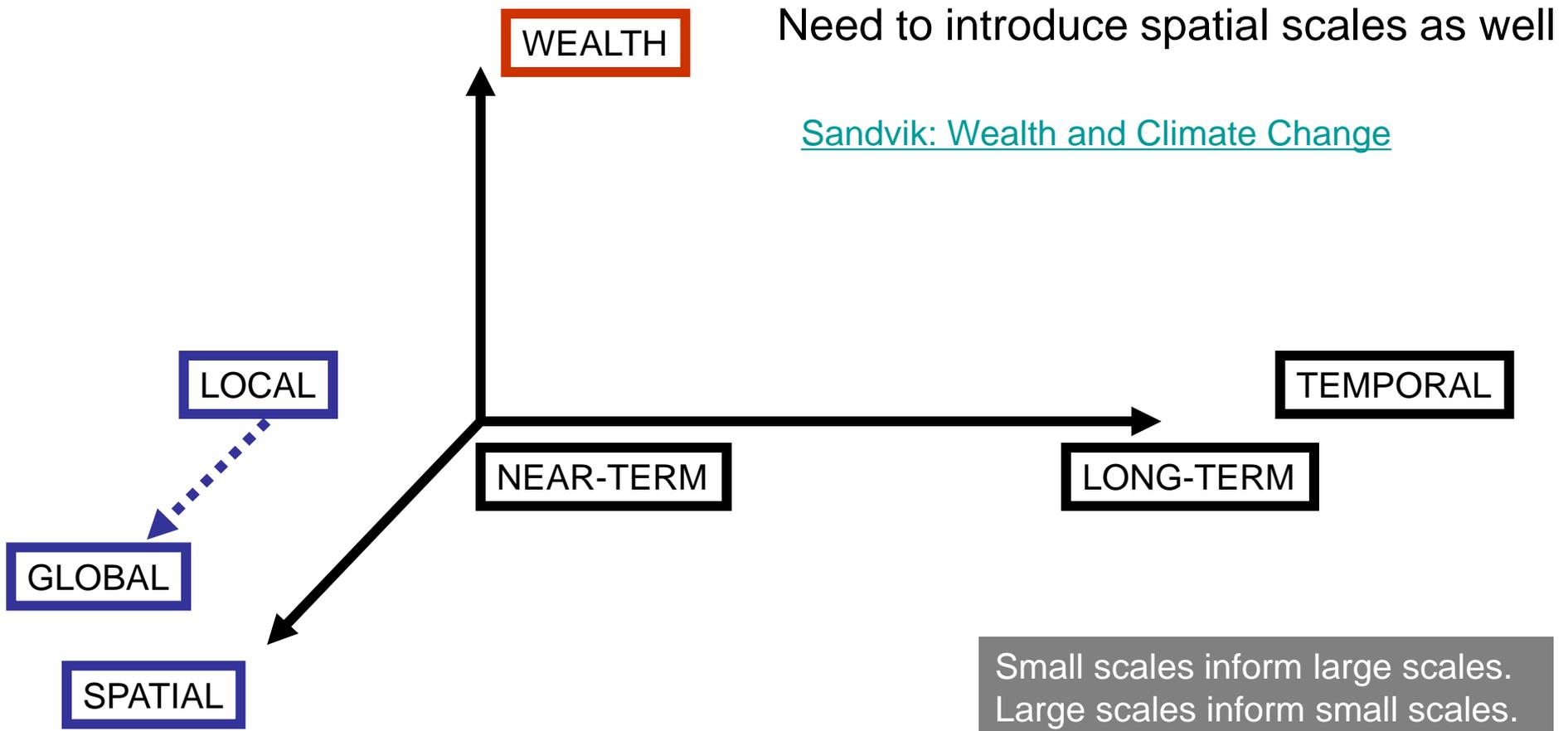
- Credibility is an attribute of scientific adequacy.
- Legitimacy is an attribute of objectivity, fairness, and a lack of political bias.
- Salience requires that information be relevant to the problem to be addressed.

Heuristic Knowledge System



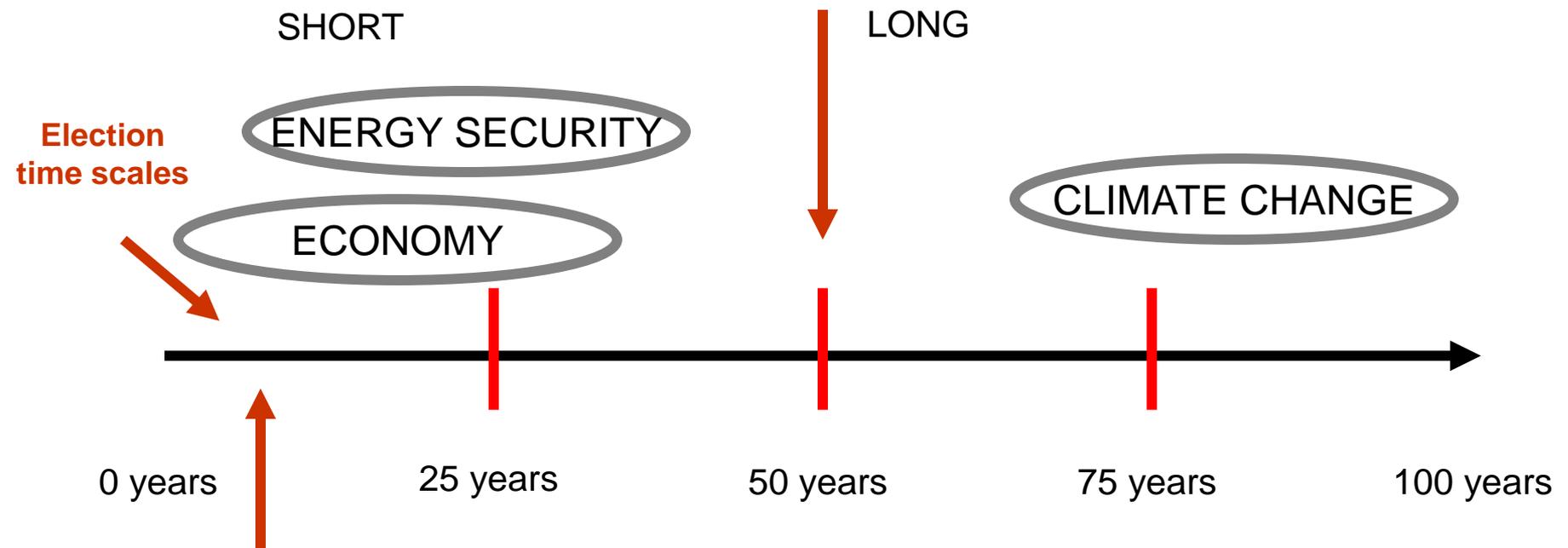
These elements sit in a complex and changing relationship within any specific application, as well as across multiple applications.

Reducing Climate Complexity



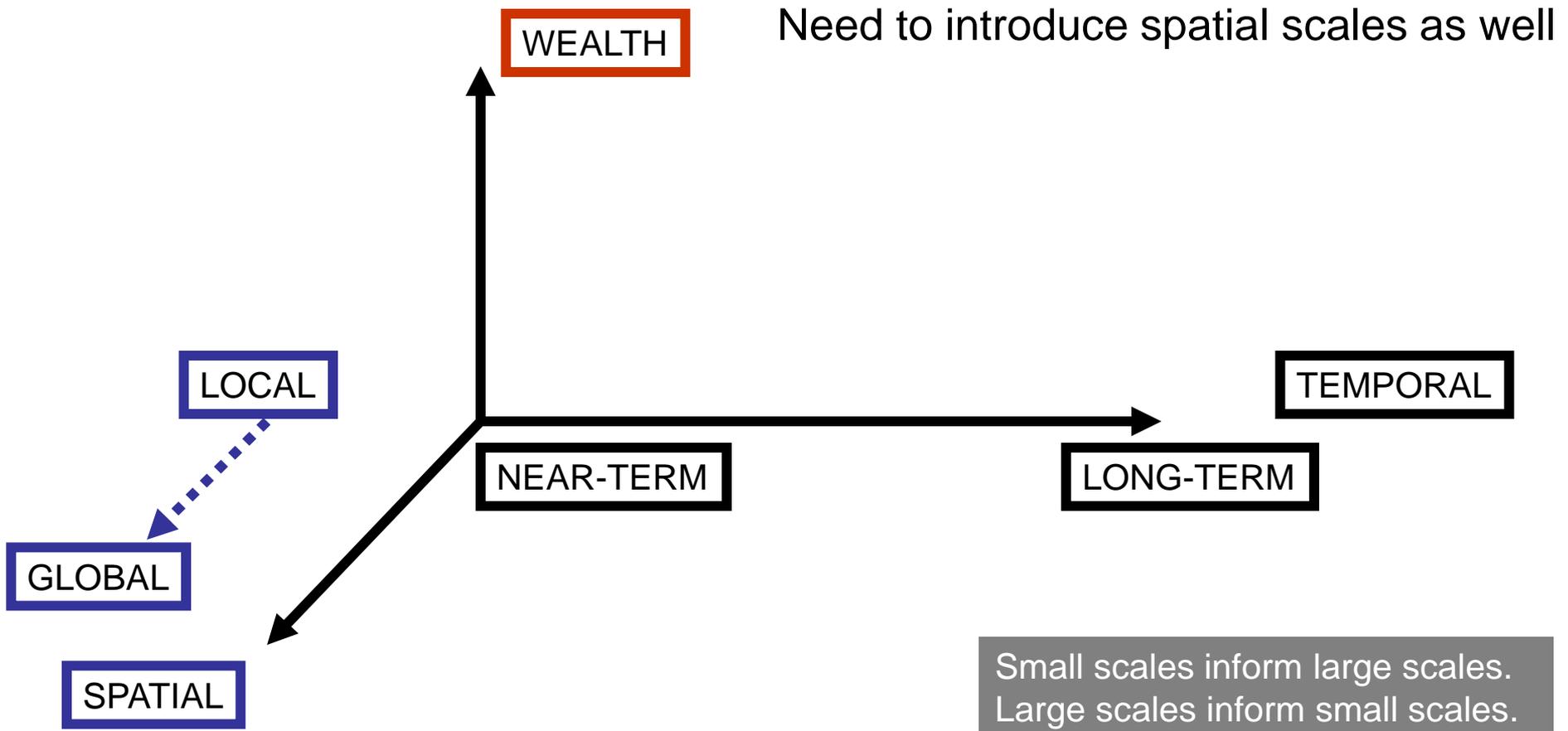
What is short-term and long-term?

Pose that time scales for addressing climate change as a society are best defined by human dimensions. Length of infrastructure investment, accumulation of wealth over a lifetime, ...



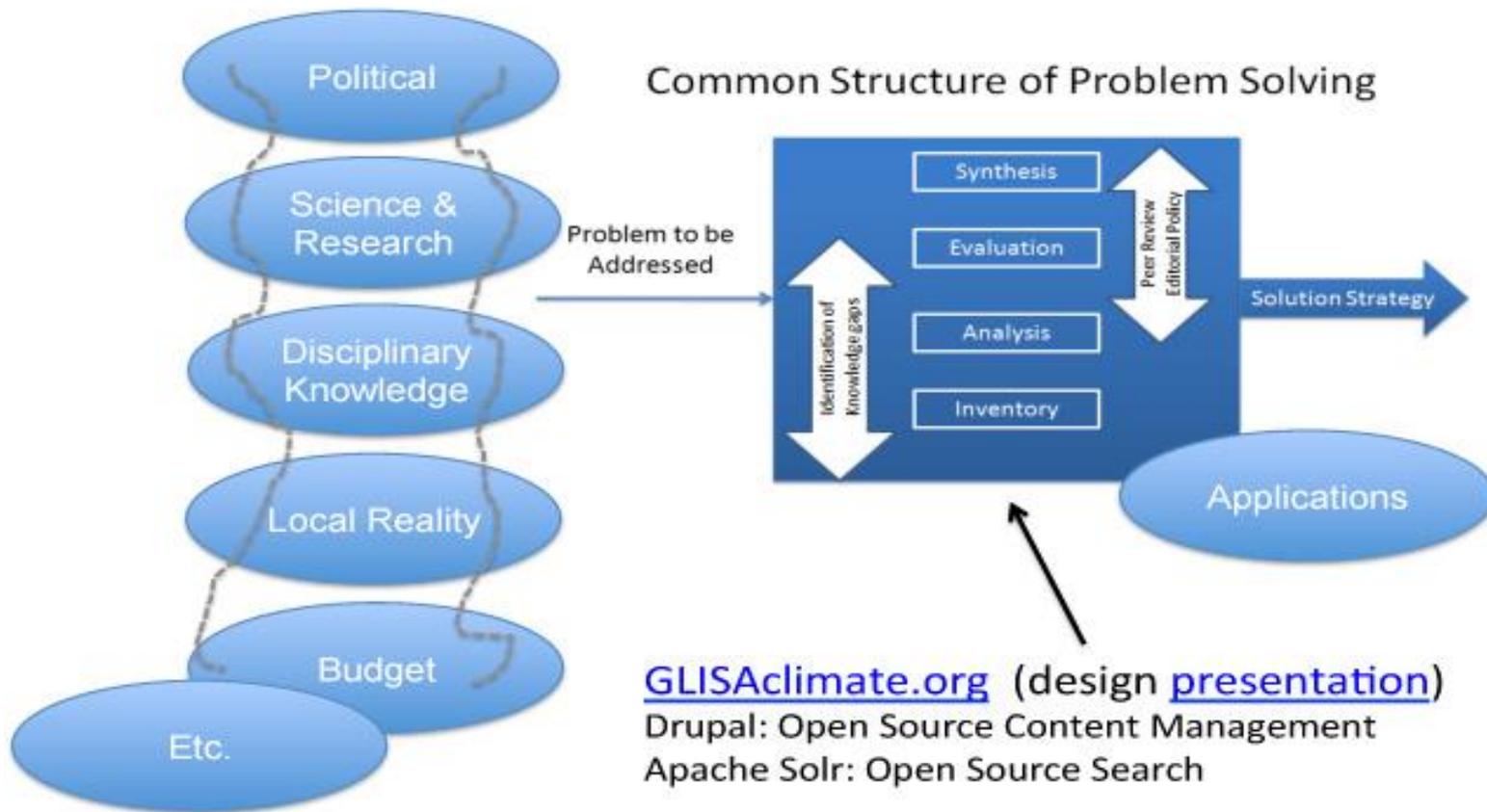
There are short-term issues important to climate change.

Reducing Climate Complexity



Common Structure Problem Solving

Knowledge System Utilizing a Common Structure of Problem Solving



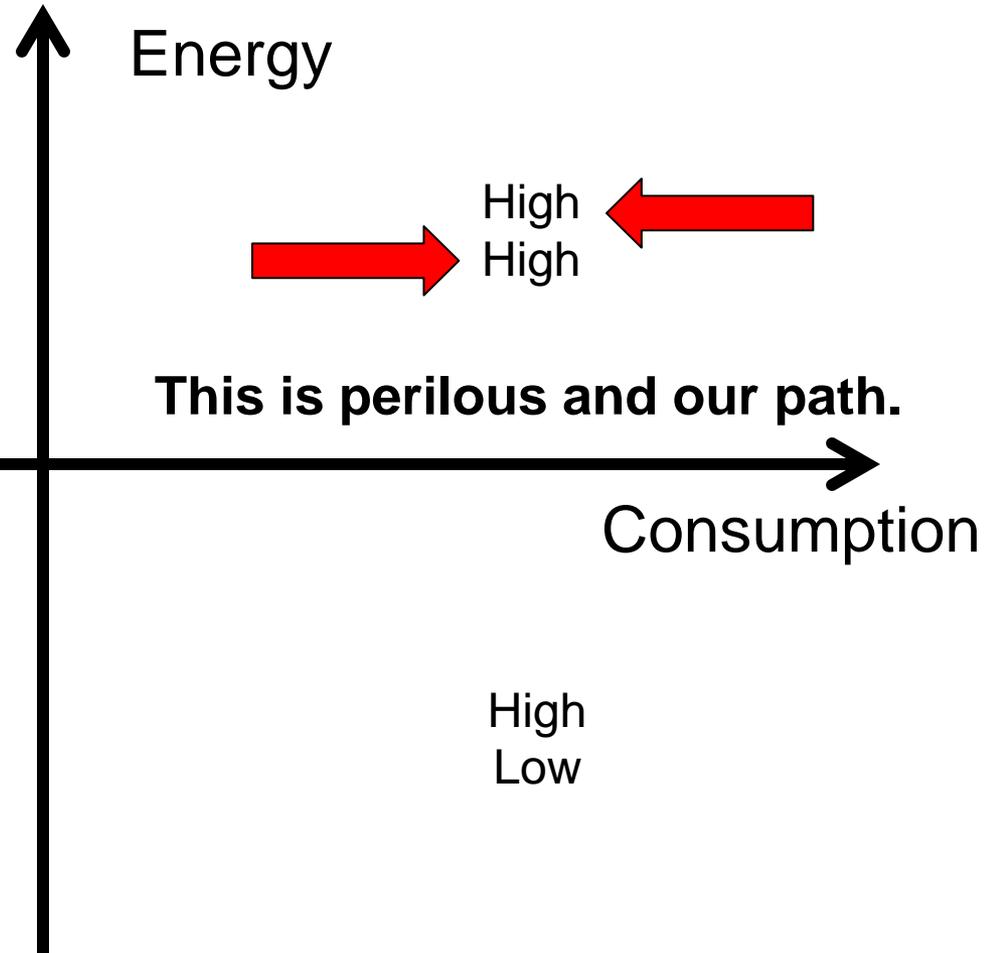
Skill Set

- **Analysis**
 - Determination of knowledge that is important to the application
 - Distinguish between facts and inferences
 - Identify advocacy
- **Evaluation / Judgment**
 - What is the quality of the knowledge?
- **Synthesis**
 - How do pieces fit together?

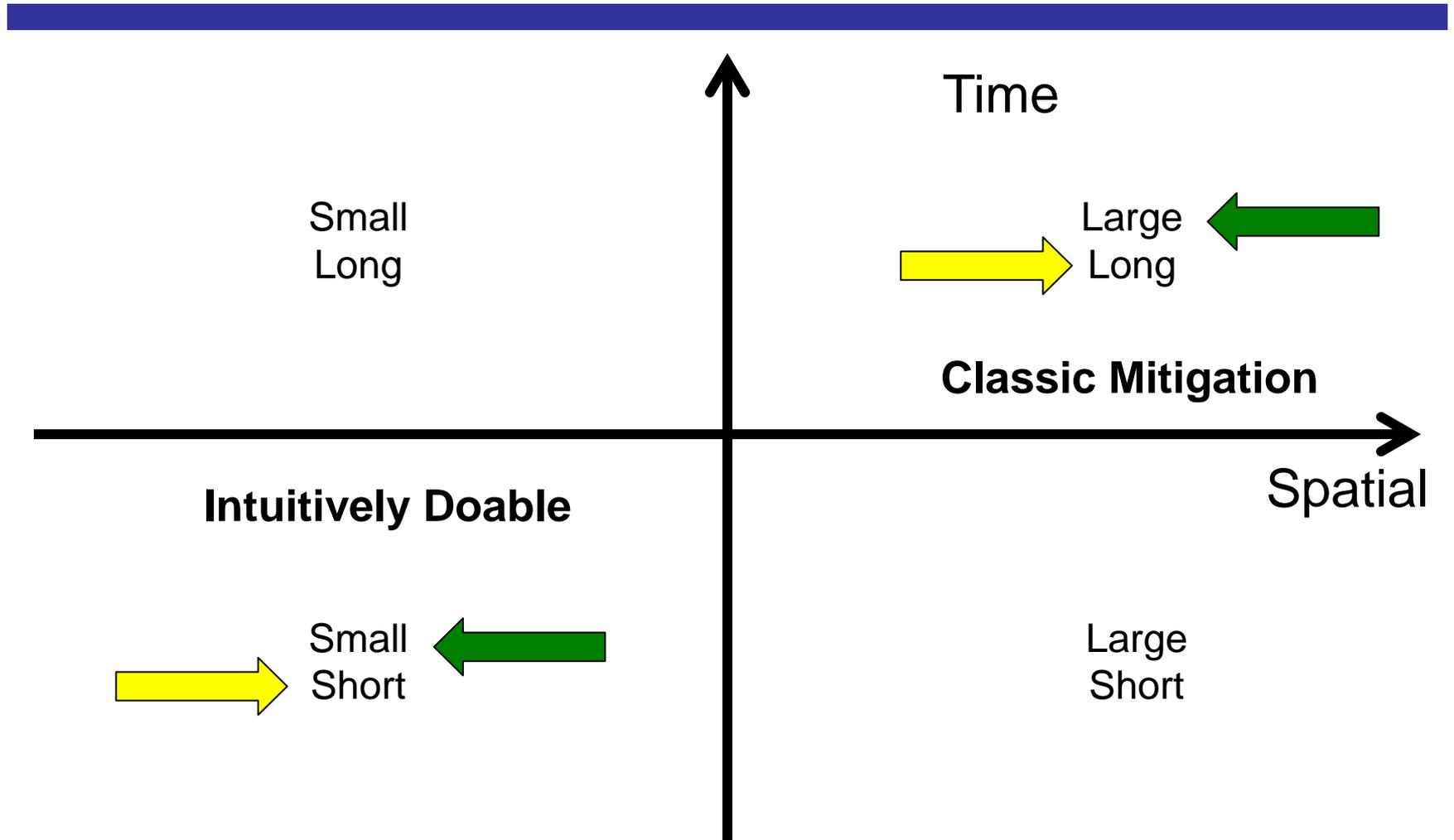
Some approaches to analysis

- There are attributes of analysis and evaluation that are shared
 - Evaluation is intrinsic in the analysis process
 - Evaluation becomes more rigorous as the problem advances through its iterative steps

Energy and Consumption



Space and Time



How do we organize problem solving?



Knowledge at the Loading Dock

- Information, data knowledge at the loading dock (“made available”) is necessary, but it is not sufficient to assure usability and use.

Motivator: Environmental Behavior

- Hines, Hungerford, Tomera, [Responsible Environmental Behavior](#), 1987.
 - We need to correct “[t]he erroneous assumption...that skills evolve naturally from knowledge”
 - What to do and the skills to do it
- Rood: [Solving the Problems of Climate Change and Sustainability](#), Michigan Journal of Sustainability, 2, 2014.