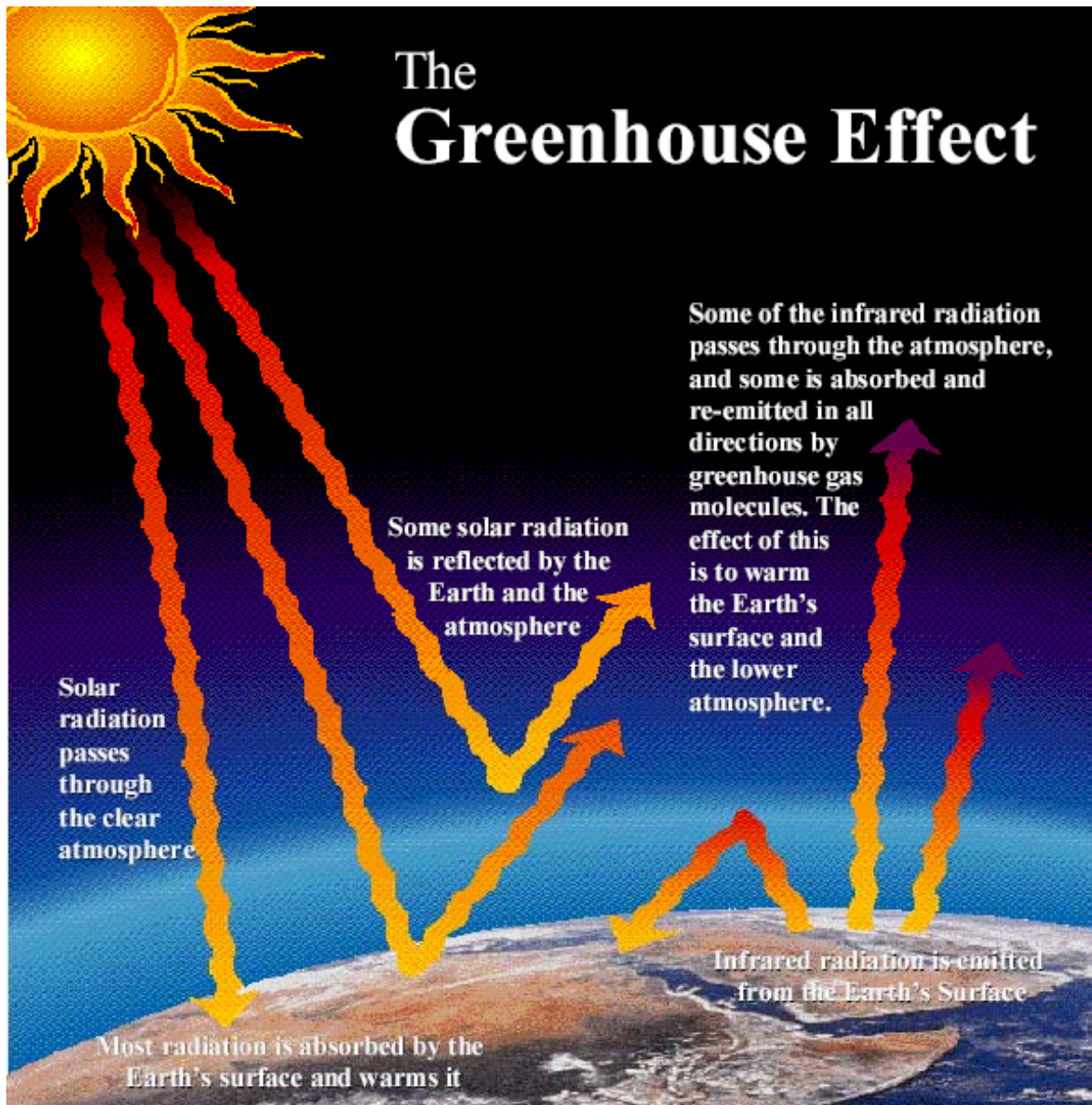


Adaptation Planning Research

Paul Kirshen, Ph.D.
Research Leader, Battelle Memorial Institute
Adjunct Professor, etc, Tufts University

kirshenp@battelle.org

Paul.kirshen@tufts.edu



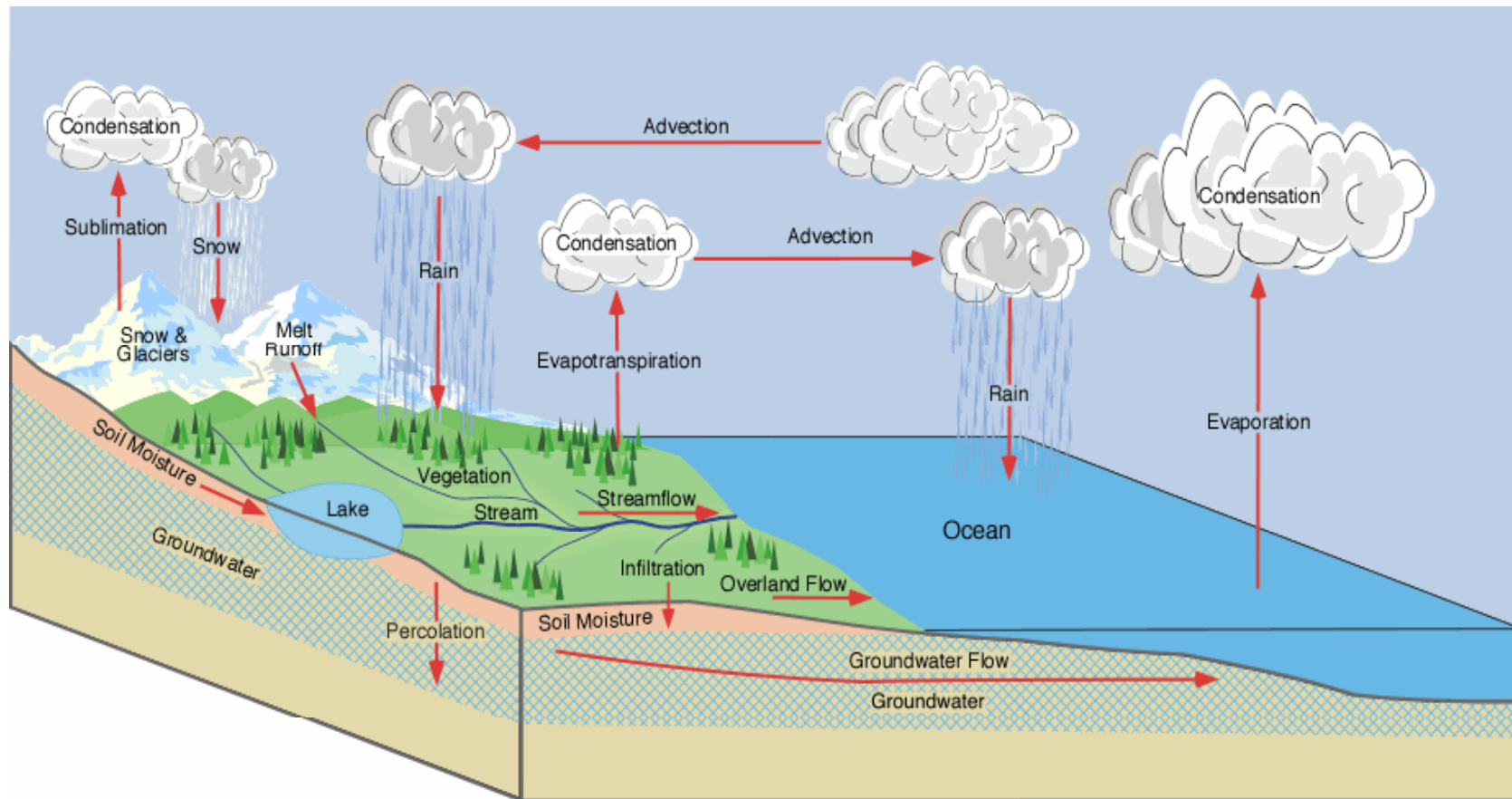
Impacts
Global
Temperature
and other
Climate
Elements



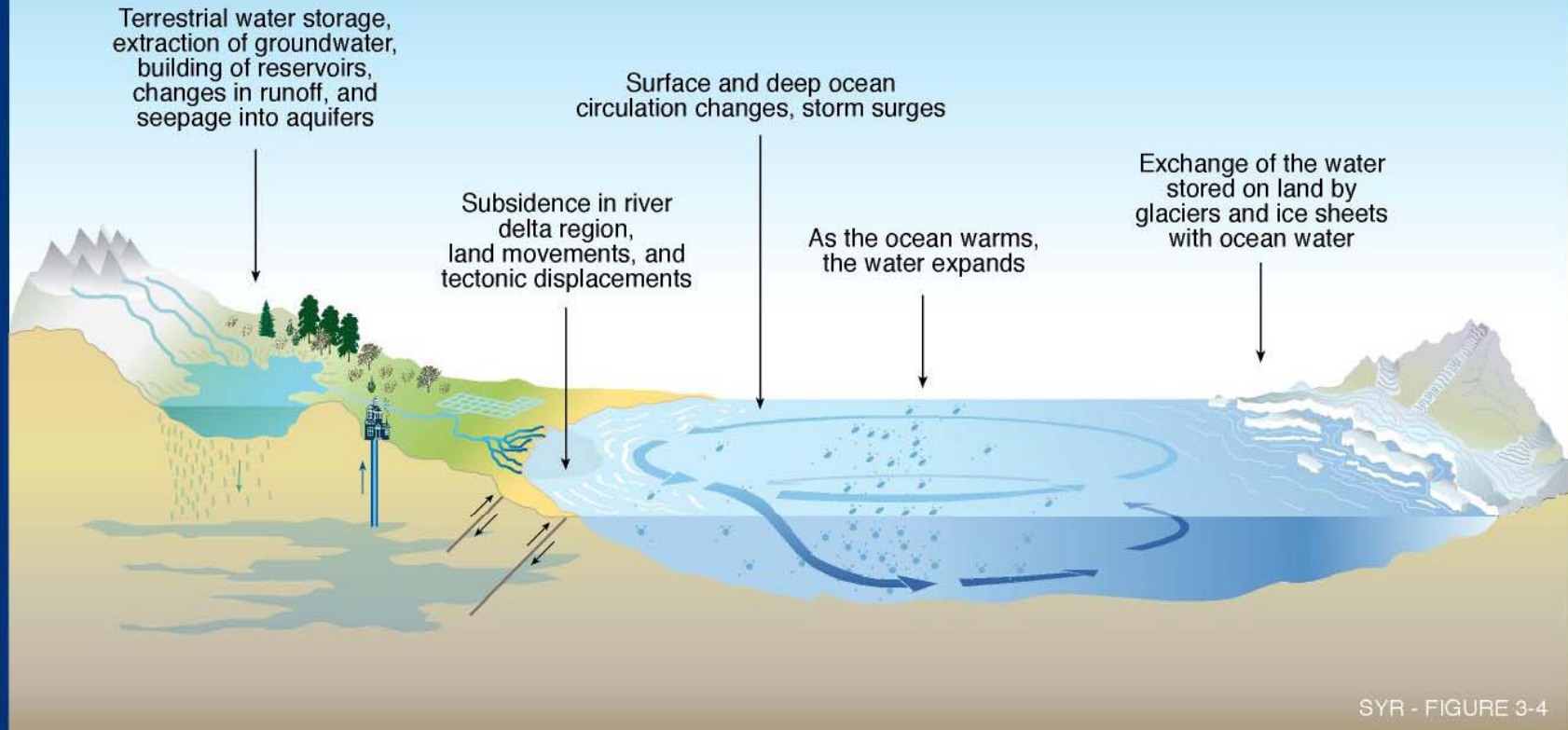
Climate Change Impacts

- Sea Level Rise & Storm Intensity
- Ocean Acidification
- Hydrology
- Water Quality and Ecosystems
- Public Health
- Land Cover
- Infrastructure
- Economic Activities
- Social Conditions (eg equity, migration)
- More

Impacts on Various Natural Cycles; Example of Hydrologic Cycle



What causes the sea level to change?



Why Adaptation ?

Reduce Vulnerability

“Vulnerability is the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity.” (IPCC 2007)

Forms of Adaptation

“Adaptation Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory, autonomous and planned adaptation:

Anticipatory adaptation – Adaptation that takes place before impacts of climate change are observed. Also referred to as **proactive** adaptation.

Autonomous adaptation – Adaptation that does not constitute a conscious response to climatic stimuli but is triggered by ecological changes in natural systems and by market or welfare changes in human systems. Also referred to as **spontaneous** adaptation.

Planned adaptation – Adaptation that is the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state.” (IPCC, 2007)

General Proactive Adaptation Responses

- Do Nothing
- Accommodate
- Protect
- Retreat

Approach to Adaptation Planning

- **Robust Strategies** that function well no matter what the climate and other uncertainties
- Includes **no-regrets** and **co-benefits** actions
- Develop two basic types of actions
- **“Here and Now”** for new projects and presently threatened areas – like Deer Island WWTP
- **“Prepare and Monitor”** actions where construction does not take place now – but options are preserved and actions taken when a trigger point is reached from the monitoring system

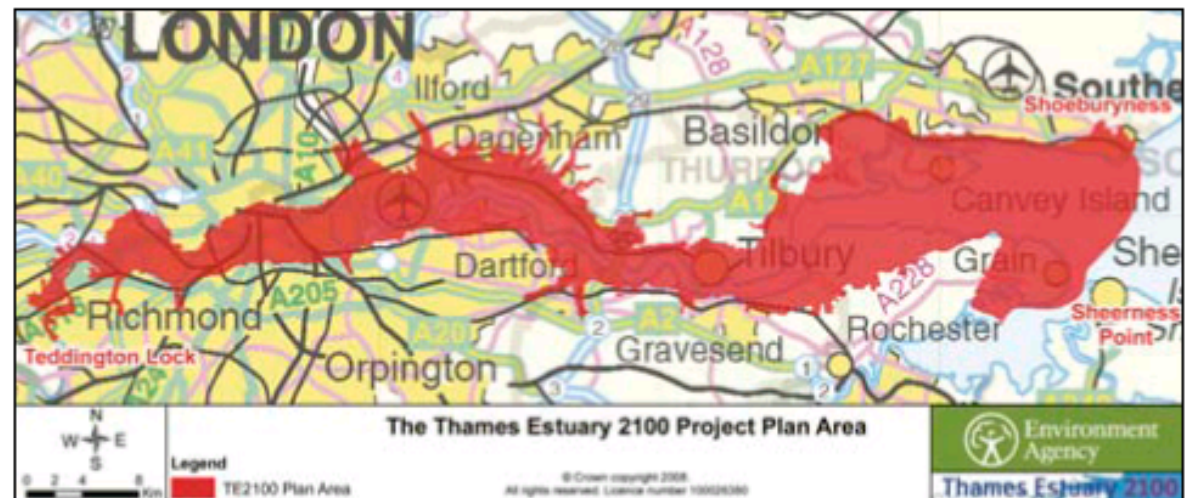
Example of Effective Adaptation Strategy

(adjustable and flexible, involved stakeholders, uses multiple approaches, staged over time, updated as needed, forestalls large investments until really needed but preserves the options and has decision trigger points based upon the amount of climate change and other indicators – biophysical as well as socio-economic).

Thames Estuary 2100




The Thames Estuary 2100 project was established by the Environment Agency in 2002 with the aim of developing a strategic flood risk management plan for London and the Thames estuary through to the end of the century. The key driver for the project was to consider how tidal flood risk was likely to change in response to future changes in climate and people and property in the floodplain. Additional to this there was an understanding that many of the existing flood walls, embankments and barriers were getting older and would need to be raised or replaced to manage rising water levels. It was time to plan for the future and make recommendations on what actions were needed to adapt to a changing estuary.

Over the past six years we have undertaken a



The Plan

Chapter 5: The Thames Estuary 2100 Plan

Three time horizons – three themes for flood risk management		
 First 25 years	The first 25 years from 2010 to 2034 “Maintaining confidence and planning together”	<ul style="list-style-type: none">• Continuing maintenance, operation and essential improvements.• Safeguarding the spaces for future flood management.• TE2100 will have a real influence in the preparation of, and updating of regional and local strategic and spatial plans.
 Middle 35 years	The middle 35 years from 2035 to 2069 “Renewal and reshaping the riverside”	<ul style="list-style-type: none">• Many of the existing walls, embankments and smaller barriers will need raising and major refurbishment or replacement in this period.• These major projects provide an opportunity to reshape our riverside environment through working with spatial planners, designers, environmental groups and those who live and work in the Estuary area.• Towards the end of this period, a decision will be made on the century option to be adopted.
 Up to 2100	To the end of the century from 2070 “Preparing for, and moving into the 22nd century”	<ul style="list-style-type: none">• From 2070 (based on government’s current climate change guidance) a major change will be needed and one of our “end of the century” options will be implemented.• This is a long time in the future but your views are important as they will set the basis from which future changes in attitudes are measured.

Trigger Points

Table 5.2. Ten indicators for change – and why they are important to TE2100

1	Mean Sea Level	The level to which protection may be required twice a day every day. Mean sea level is the level which determines the number of times per year that a barrier must be closed. This also has a major impact on the area of intertidal habitat in the Estuary.
2	Peak surge tide level	The extreme (but rare) tidal flood levels which will have to be managed. Peak surge tide level also determines the crest level of the defences including the Thames and other barriers.
3	Peak river (fluvial) flood flows	The combined tidal/fluvial flood risk at pressure points in West London and where tributaries meet the estuary.
4	Condition of flood defence structures	How to optimise the repair and renewal of defences for investment programmes getting best value for money whilst ensuring public safety. To ensure that the flood defence system will function as required. Identification of the improvements needed to ensure the integrity of the system.
5	Frequency of closure and reliability of the Thames/ other barriers	How much useful life remains for these important structures, and how efficient they are.
6	Developed area and value/ type of development	People and property at risk. Key social and economic information for flood risk management planning.
7	Extent of erosion/deposition	How stable the morphology of the estuary is and how this affects the ecology of the estuary and the defences.
8	Intertidal habitat area including mudflat and saltmarsh	The health and stability of the intertidal habitat zone, and whether we are complying with EU habitats regulations.
9	Land use planning and development activities	A measure of how well flood risk (i.e. safer floodplains) and opportunities for sustainability (e.g. the creation of green corridors) are being factored into development. Also predicts future needs for society and economics.
10	Public/institutional attitudes to flood risk	Public (hence political) appetite for risk and institutional preparedness to manage risk and to plan for/respond to emergencies.

Flexibility

There is no way of knowing exactly what London and the Thames Estuary will look like so far in the future. The choice of “end of the century” option will be made around 2050 during a future review of the TE2100 Plan and will be based on the conditions prevailing at the time of the review.

TE2100 – Fit for Purpose over its 100 year life?

We recommend that the TE2100 Plan is reviewed against the 10 indicators for change every 10 years as a minimum – or more frequently if major change is occurs in one or more of the indicators being monitored.

If one or more of the indicators change significantly, this will trigger a movement of the bars on Table 5.3 showing the interventions. This could be likened to the channel volume sliders on a sound mixing desk, the final “mix” being the optimum decisions at each stage throughout the life of the TE2100 Plan.

There are many different ways in which we could respond to changes identified each time the TE2100 Plan is reviewed and updated. Table 5.4 shows the ways in which the TE2100 Plan is adaptable to change.

Table 5.4. How the TE2100 Plan is adaptable

<p>Changes to the timing of new intervention: If rates of change increase, interventions will be brought forward. If the rates of change are slower, then these interventions will be delayed.</p>
<p>Ability to change between options: If the rate of change of a critical factor is significantly different from the expected rate of change, it may be necessary to switch to an alternative option which can cope more efficiently with these new conditions.</p>
<p>Adaptation of engineering responses: Structures should be designed so that they can be adapted to changing circumstances. For example, providing foundations for new defences that can take higher future flood water loadings, or designing barriers and other control structures that can be modified in the future. The initial cost will be higher than responses that do not allow for subsequent adaptation, but this can result in significant savings over the whole life of the structure.</p>
<p>Safeguarding land for future options: Each flood risk management option will require land for new defences, enlarged defences, new barriers, new areas of habitat creation, and in some cases flood storage. Land allocations through the spatial planning system must be guided and informed by the requirements of the TE2100 options to ensure they remain possible.</p>
<p>Adaptation to new infrastructure: New infrastructure on the Thames estuary could have a major impact on flood risk management arrangements. For example, ports such as the proposed London Gateway Port at Shellhaven will require free access for navigation. Also, new transport links could provide the opportunity to combine a new crossing of the estuary with a new barrier. This could be brought forward in the TE2100 Plan if this is justified by the synergies and funding from different groups.</p>

Example of Water Supply, Amman, Jordan



Strategy

“Based upon these results, a robust dynamic strategy would be to continue utilization of conventional sources until about 2060 and beginning a program of city-wide onsite greywater recycling now, and reuse of water reclaimed from the CWWTP within the next 25 years. It would be economical to tolerate a small amount of shortages. Plans for programs of water import from the Disi Aquifer and desalinated Red Sea should be formalized, but reserved for the next generation.

As noted earlier, future infrastructure decisions should be re-evaluated a short time before construction would begin, using the most up-to-date water supply and water use data, and the most current projections for future climate and demographic change scenarios. This model analysis should also be re-run to provide any adjustments in the strategy. The adaptive decision making process would require the use of a monitoring system to keep track of local climate changes and update scenarios for the future, as well as stakeholders’ preferences for the various supply options and tolerance for shortages.

Flexible construction techniques should be used that allow the replacement of water from conventional sources with water from other sources, and the blending of fresh water sources with desalinated ocean water and treated wastewater. The model results, particularly the ranges shown in Figure 10 for latter stages, suggest that the principles of adaptive management will be especially pertinent to water resources planning in the GAA in the next 50-75 years. Of course, all that needs to be decided now is what water sources to use, and what capacity to begin expanding (including demand management as a form of capacity expansion), in the present. Following the framework of adaptation planning, future decisions will wait for updated information, and decreased ranges of uncertainty.”

Ray et al (2010)

Some PHK Research Areas

Adaptation Planning Process

Adaptation Benefits and Costs

Adaptation and EJ

Adaptation and Institutions

CLIMATE CHANGE

Stationarity Is Dead: Whither Water Management?

P. C. D. Milly,^{1*} Julio Betancourt,² Malin Falkenmark,³ Robert M. Hirsch,⁴ Zbigniew W. Kundzewicz,⁵ Dennis P. Lettenmaier,⁶ Ronald J. Stouffer⁷

Science 319 2/08

New planning paradigm requires
Risk-Based Design and Robust
Decision Making

Robust and Other Decision Making Techniques

Case Studies in Urban Drainage in MA and CO

SLR and Coastal Flooding

Outcomes of adaptation planning ?

How to obtain ?

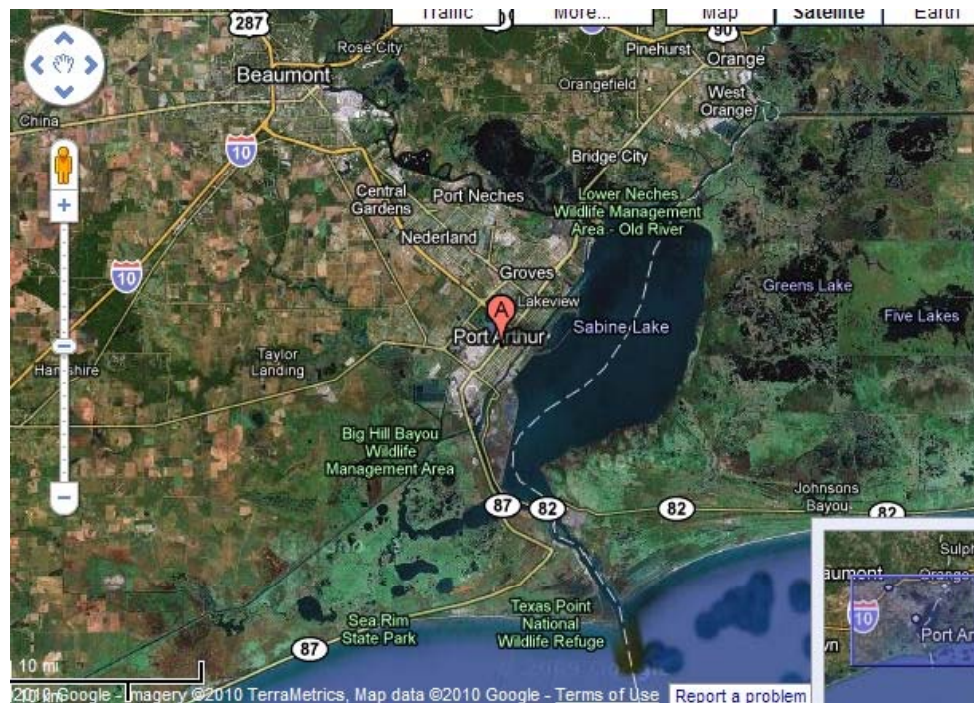
Assembly Square
Site Plan

October 30, 2006



Adaptation Benefits and Costs

Joint Adaptation Planning of Built and Natural Environments (role of ecosystem services)



Adaptation and EJ

“a lack of adaptive capacity in poorer communities and developing countries is often the most important factor that creates hotspots of human vulnerability “(IPCC-WG2, 2007)

Research in Metro Boston and Chesapeake Bay

How does cultural knowledge of EJ communities and planners influence adaptation planning ?

Can co-learning between them improve the process ?

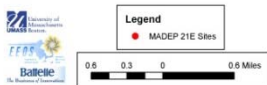
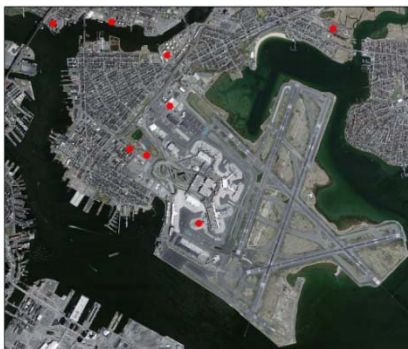
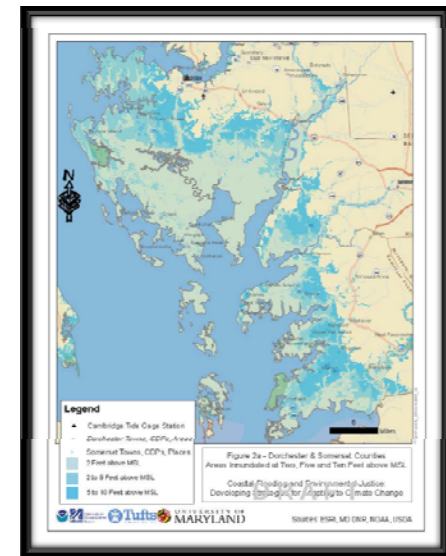


Figure X3
East Boston Area
Source: MassGIS, MADOT
September 2010



Adaptation and Institutions

Are today's laws and institutions,
established under a stationary
climate, adequate for the climate
change management ?

Thank you

kirshenp@battelle.org

Paul.kirshen@tufts.edu