Concepts for Integrating Adaptation

Presented at the

Defense, National Security and Climate Change: Mitigating Risks and Seizing Opportunities in a Rapidly Changing Global Environment, Association of Climate Change Officers

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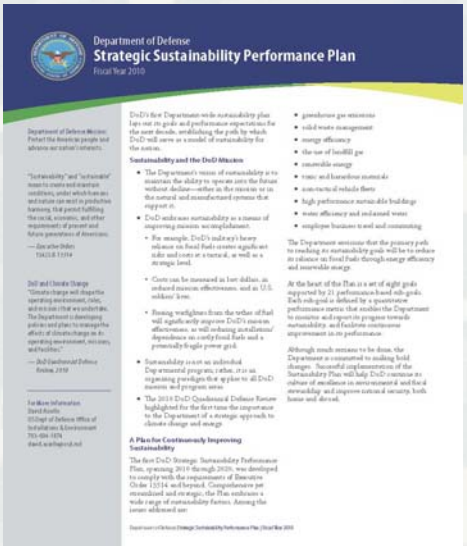
Department of Defense Strategic Sustainability Performance Plan (8/26/10)

- Mandated by EO 13514 (10/09).
- ***One of the four priorities is to maintain readiness in the face of climate change.***
- Addressing Climate Change Risk and Vulnerability: a Three-Phase Approach
  - **Phase 1:** Development of a decision framework
    - *coordinate with other federal entities*
  - **Phase 2**: Climate change impact assessments
    - *develop analytical methodology and tool guidance for conducting assessments*
  - **Phase 3**: Climate change adaptation planning
    - *robust strategies*



New CEQ Implementing Instructions – 4 March 2011

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Climate Concerns for Department of Defense

Vulnerability and Impact Assessment

Adaptation Approaches

Land Use and Carbon Management

DoD Natural Infrastructure & Regional Ecosystem Health

DoD Built Infrastructure & Regional Infrastructure Systems

Defense Missions & Climate Security

Military Operations

Climate Stressors to National/Regional Security

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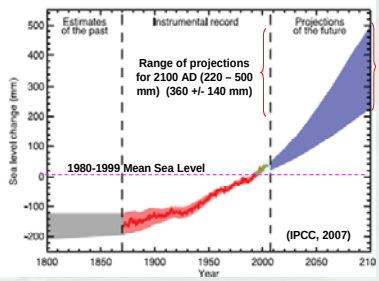
Approaching Climate Change Impact Assessment



Traditional approach is to use IPCC general circulation models projections and scenarios (such as for sea level change, above) to determine extent of potential change and uncertainty of this change, and then identify what might be impacted.

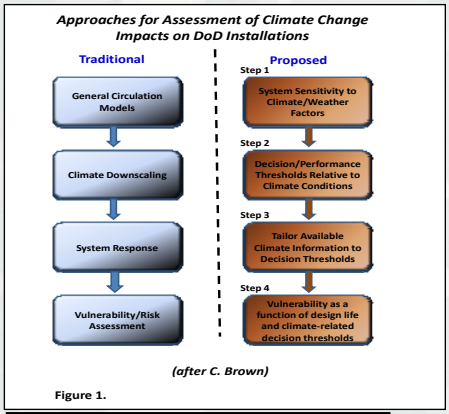


Figure 1.

Alternative is to understand system sensitivities to changing parameters, and then apply best available climate information to relevant decisions about these systems

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Conceptual Approach to Decision Uncertainty

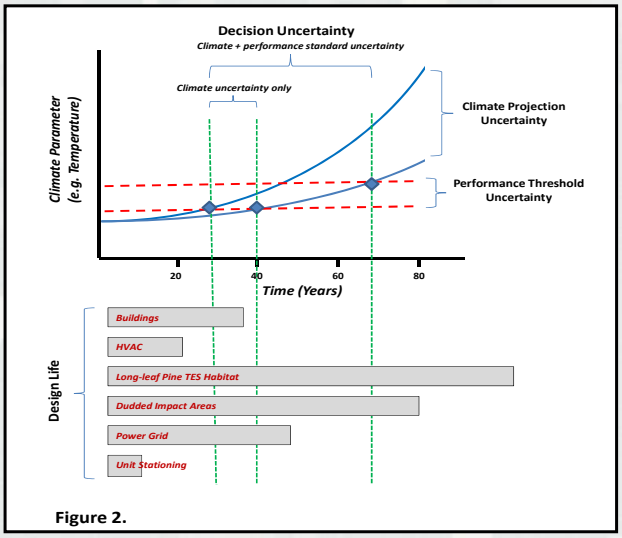

Figure 2.

*Figures 1 (previous slide) and 2 from joint University of Massachusetts ERDC proposal related to SERDP SON RCSON12-02

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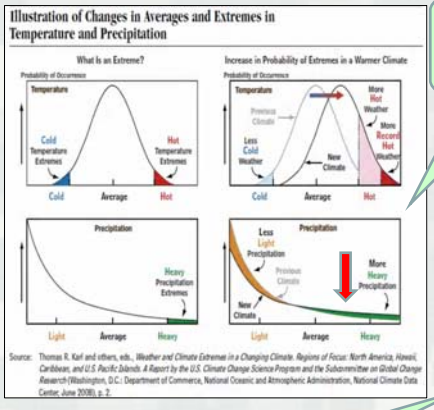
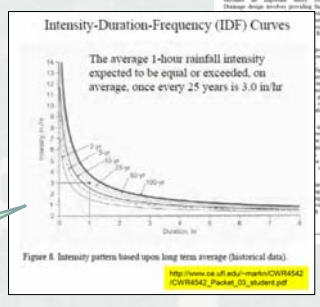
Relating Sensitivity in Design Parameters to Climate Impacts



Climate Change Impacts to Weather Patterns

"Design Manual"



"Historical Data"

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Some Adaptation Considerations

- Budgets are limited today, and will be limited tomorrow – we need good methods that help us understand choices along the time/cost spectrum of changing climatic conditions.
- We are making numerous decisions today about built/natural infrastructure and military operations that are already impacted, or will be impacted, directly or indirectly, by changing climatic conditions. These decisions could become more and more expensive if we delay integrating considerations of these impacts.
- In some cases, the second or third order impacts are the most alarming in terms of costs and disruption for Defense operations, security stressors, and built and/or natural environments.
- A "framework" in needed to align climate impacts and stressors to the "sensitivity" of management, operational and mission decisions to changing climatic conditions – to help focus limited resources
- This framework should inform existing planning and budgeting processes – not generate another process

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Moving Forward

- Develop Framework
- Assess Impacts and Sensitivities
- Integrate into Strategies, Plans and Budgets
- Adapt and Adjust

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Integrating Climate Change Adaptation and Mitigation Strategies for Smart Water Management Decisions

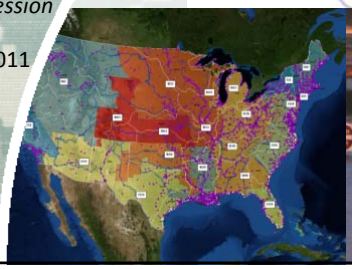
Jeff Arnold, PhD & Kate White, PhD, PE

US Army Corps of Engineers | Institute for Water Resources

ACCO Workshop on Defense, National Security, and Climate Change

Integrating Adaptation Strategies Session

Washington, DC | 31 March 2011



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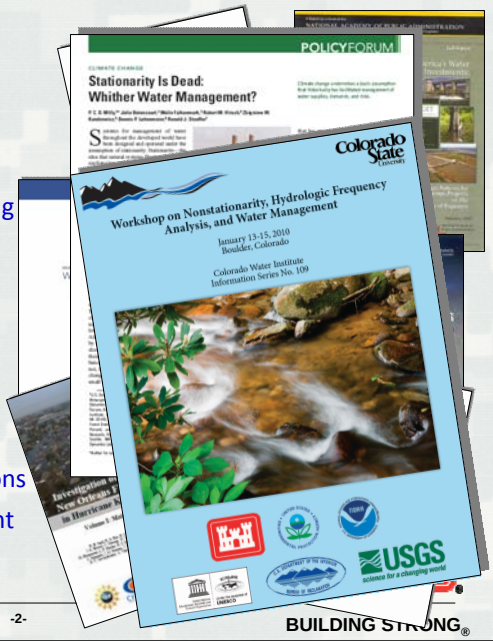
What's Driving Climate Change Work at USACE ?

- ✓ ***Internal & External Reviews –*** IPET / HPDC, ASCE, NRC, others – followed Hurricane Katrina showed that USACE needed to incorporate methods for characterizing *new & changing conditions, both foreseen & surprise*, in its programs & projects
- ✓ ***Hydrologic Stationarity –*** water management & water science agencies work to understand operations for a continually changing environment



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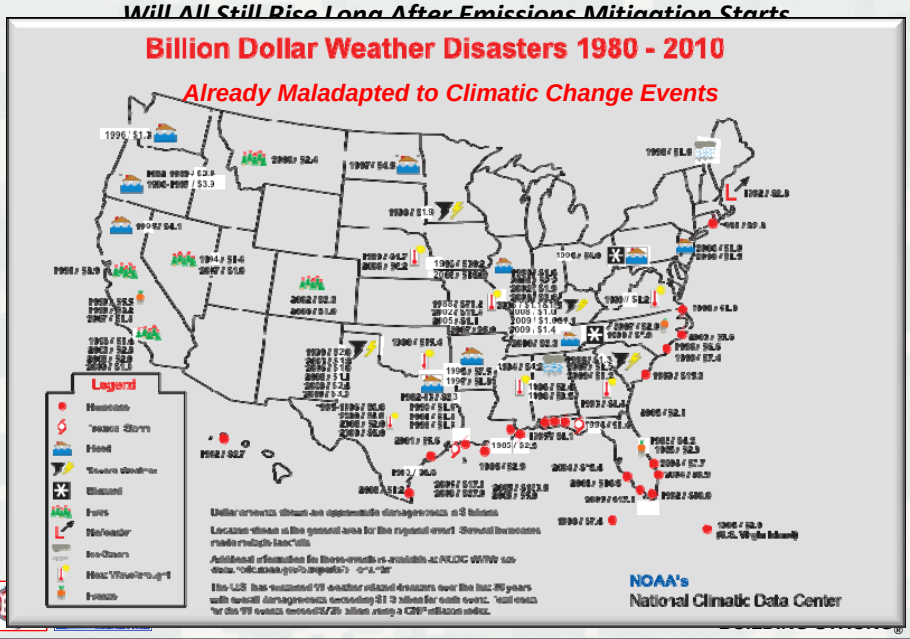
Atmospheric CO2, Temperature, & Sea Level

Will All Still Rise Long After Emissions Mitigation Starts



Sustainability Big and Small

Small : Mitigation & Conservation Measures

Avoid the Unmanageable

- ✓ conserve energy & water, decreasing GHG emissions
- ✓ increase GHG sinks
- ✓ methods, processes, & elements well characterized (*'tame problem'*)
- ✓ inherently quantifiable – inventorying, accounting, reporting, & verifying
- ✓ results closely tied to implementation scales
- ✓ relatively low costs

Big : Adaptation Measures

Manage the Unavoidable

- ✓ ensure robust & resilient mission & operations in an uncertain future
- ✓ problems not well characterized (*'wicked problem'*) & require *actionable science for informed decisions*
- ✓ methods & processes still nascent & not completely quantified / quantifiable
- ✓ cause & effect often separated in space & time
- ✓ long-term monitoring & adjustments required
- ✓ costs run from low to very high

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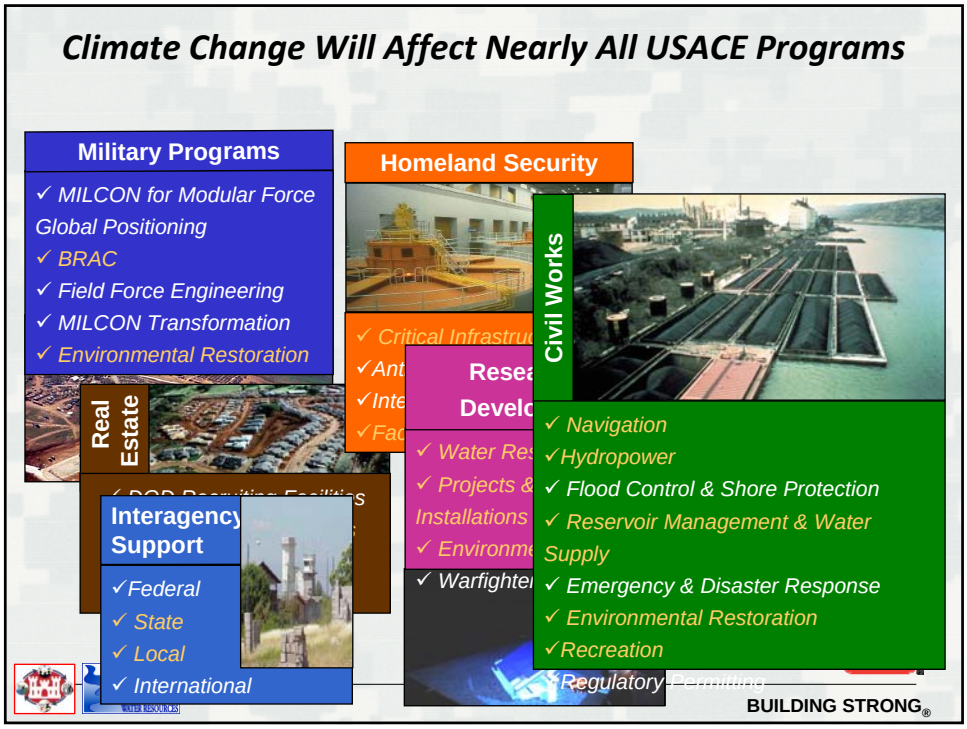
Climate Change Will Affect Nearly All USACE Programs
Military Programs
✓ MILCON for Modular Force
Global Positioning
✓ BRAC
✓ Field Force Engineering
✓ MILCON Transformation
✓ Environmental Restoration
Homeland Security
Civil Works
Real Estate
Interagency Support
✓Federal
✓ State
✓ Local
✓ International
✓ Navigation
✓Hydropower
✓ Flood Control & Shore Protection
✓ Reservoir Management & Water Supply
✓ Emergency & Disaster Response
✓ Environmental Restoration
✓Recreation
Regulatory
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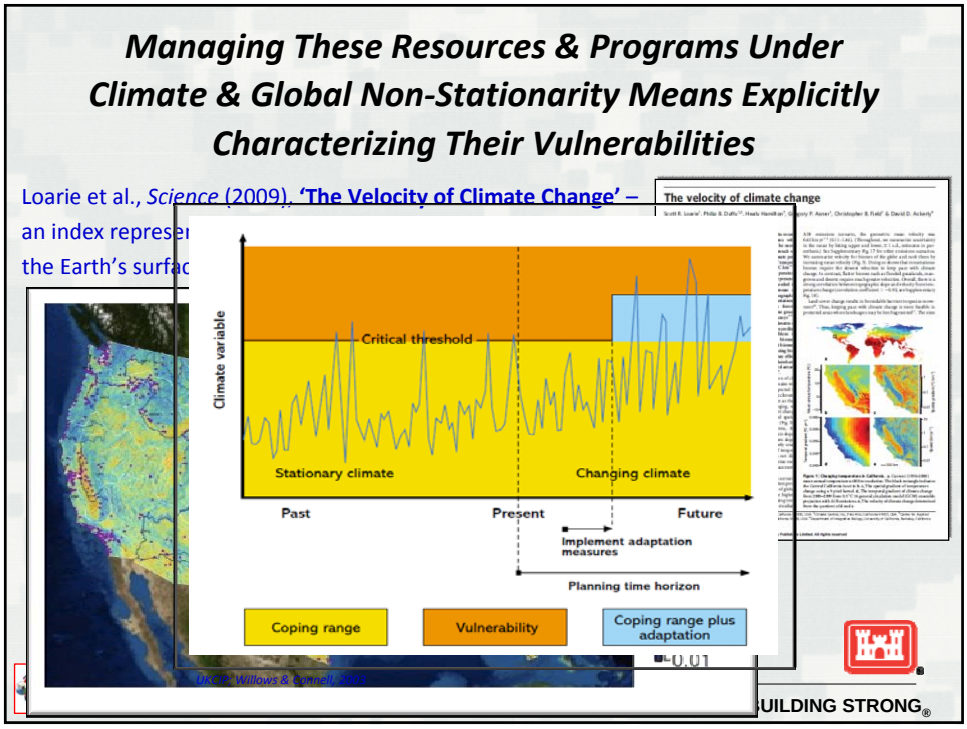
Managing These Resources & Programs Under Climate & Global Non-Stationarity Means Explicitly Characterizing Their Vulnerabilities
Loarie et al., Science (2009), 'The Velocity of Climate Change' –
an index represe
the Earth's surfa
The velocity of climate change
Climate variable
Critical threshold
Stationary climate
Changing climate
Past
Present
Future
Implement adaptation measures
Planning time horizon
Coping range
Vulnerability
Coping range plus adaptation
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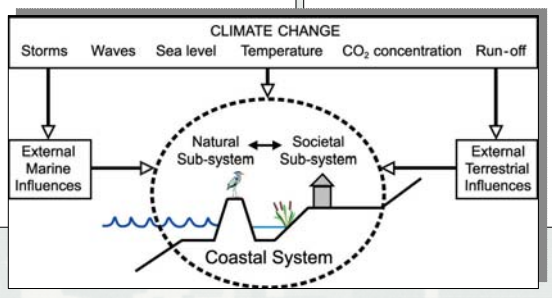
Integrated Indicator for Adaptation & Mitigation

eGRID Regional Coverage of CO2e Emissions Intensities from Electric MWH Produced Against USACE Project Locations

Specific Example: Sea-Level Change

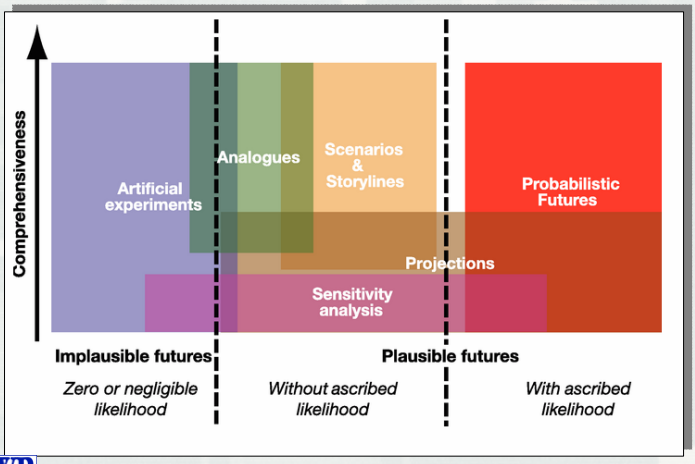
Local	Global
• Land surface processes such as subsidence, resource extraction, glacial rebound • Can estimate future conditions and uncertainties	• Global processes that depend on complex systems interactions • Uncertainties are large • Difficult to bound temporally



IPCC 2007 AR4 WG2 Figure 6.1.

Universe of Futures

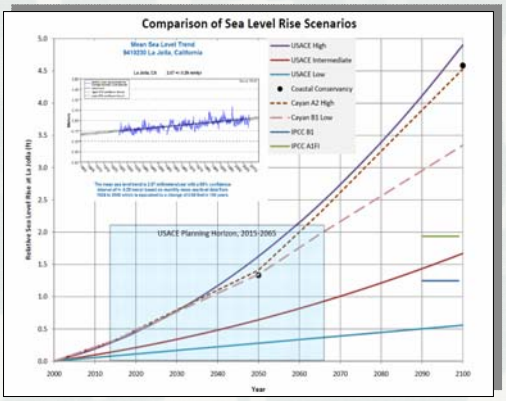
Select based on decision, consequences, potential for unintended consequences



95 Carter et al (2007) BUILDING STRONG®

EC 1165-2-211 Incorporating Sea Level Change Considerations in Civil Works Programs

- **Three estimates of future SLC must be calculated for all Civil Works Projects within the extent of estimated tidal influence:**
  - **Extrapolated trend**
  - **Modified NRC Curve 1**
  - **Modified NRC Curve III**
- **These curves are scenarios based on different assumptions about processes and causes without specific attributions of likelihood**
- **As a result, the scenarios used in the EC represent multiple plausible futures**



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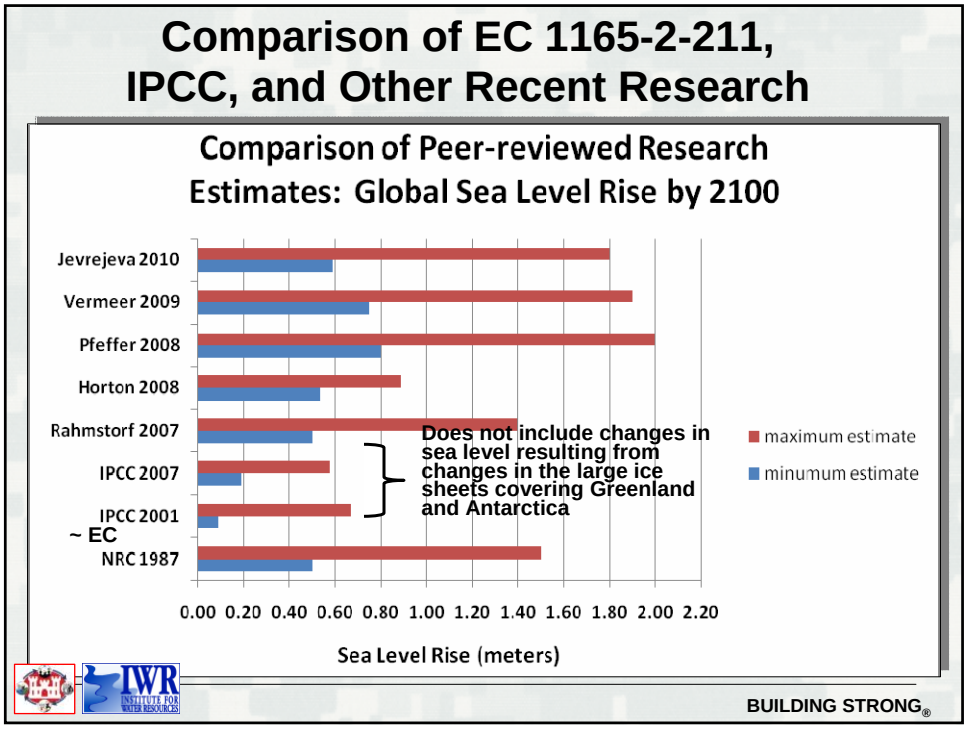
Comparison of EC 1165-2-211, IPCC, and Other Recent Research
Comparison of Peer-reviewed Research Estimates: Global Sea Level Rise by 2100
Jevrejeva 2010
Vermeer 2009
Pfeffer 2008
Horton 2008
Rahmstorf 2007
IPCC 2007
IPCC 2001
~ EC
NRC 1987
Does not include changes in sea level resulting from changes in the large ice sheets covering Greenland and Antarctica
maximum estimate
minumum estimate
0.00 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.20
Sea Level Rise (meters)
IWR
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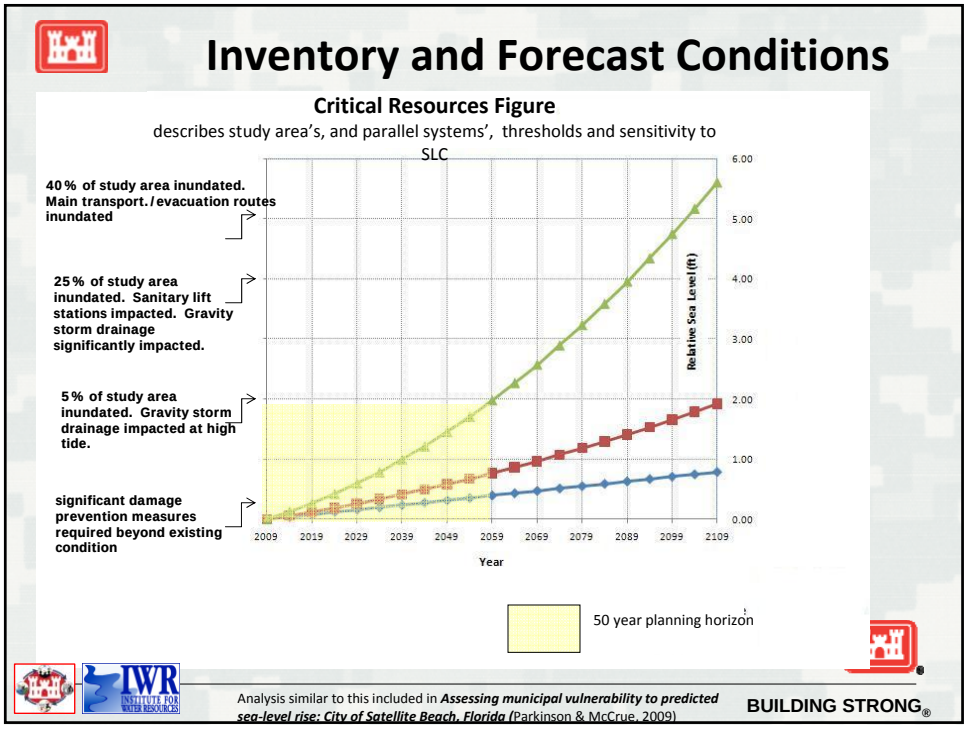
Inventory and Forecast Conditions
Critical Resources Figure
describes study area's, and parallel systems', thresholds and sensitivity to SLC
40% of study area inundated. Main transport./evacuation routes inundated
25% of study area inundated. Sanitary lift stations impacted. Gravity storm drainage significantly impacted.
5% of study area inundated. Gravity storm drainage impacted at high tide.
significant damage prevention measures required beyond existing condition
Relative Sea Level (ft)
6.00
5.00
4.00
3.00
2.00
1.00
0.00
2009 2019 2029 2039 2049 2059 2069 2079 2089 2099 2109
Year
50 year planning horizon
IWR
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Analysis similar to this included in Assessing municipal vulnerability to predicted sea-level rise: City of Satellite Beach, Florida (Parkinson & McCrue, 2009)
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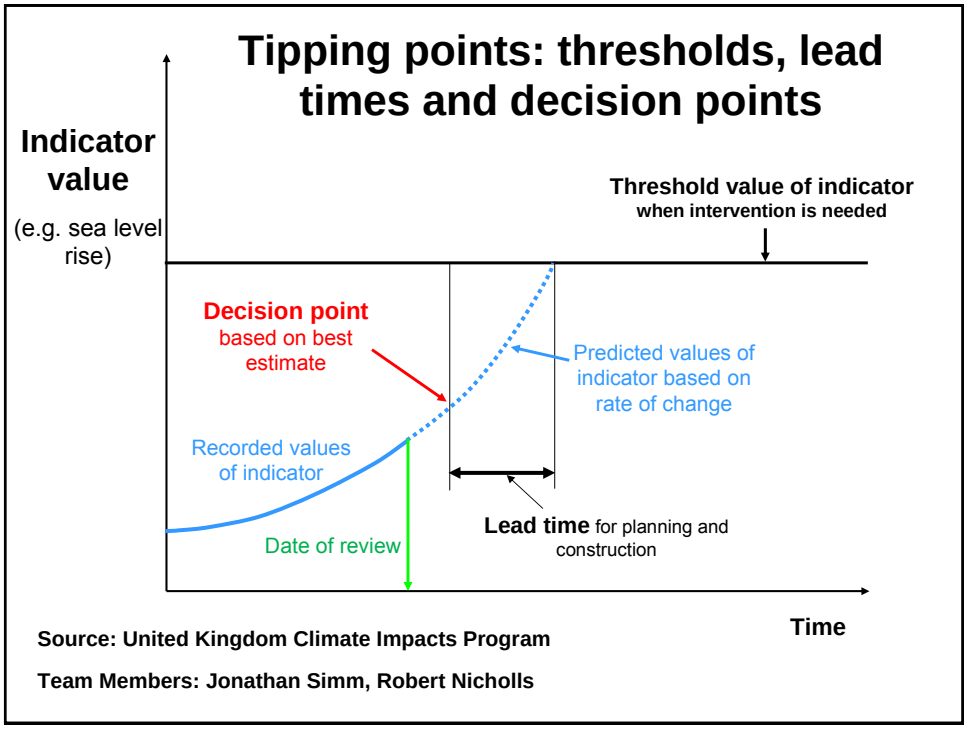
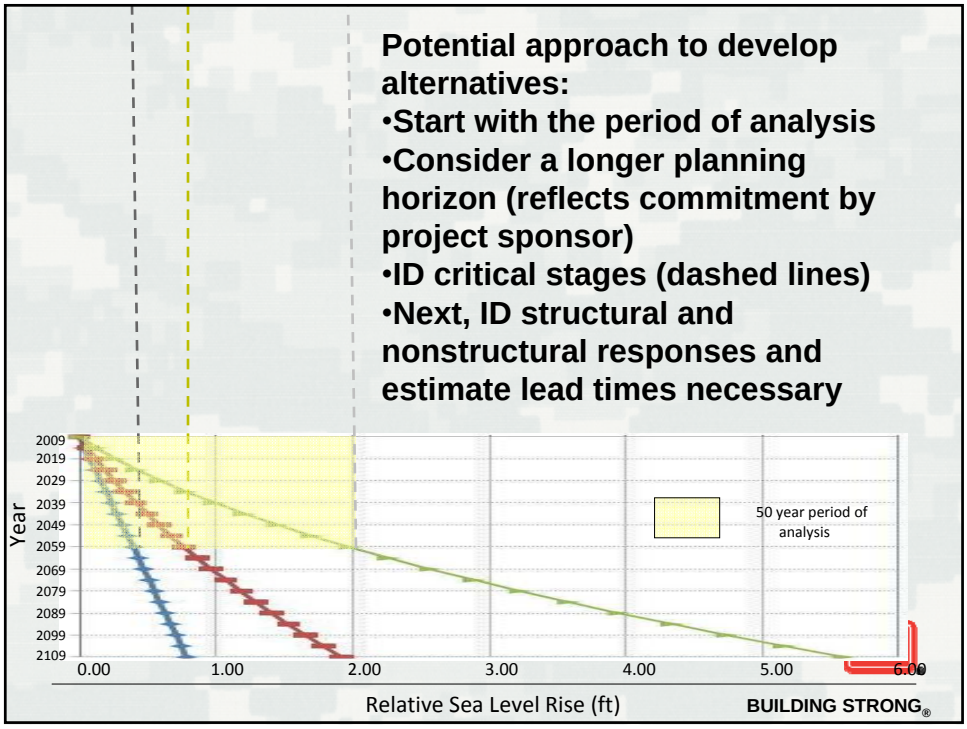

Tipping points: thresholds, lead times and decision points
Indicator value
(e.g. sea level rise)
Threshold value of indicator
when intervention is needed
Decision point
based on best estimate
Predicted values of indicator based on rate of change
Recorded values of indicator
Lead time for planning and construction
Date of review
Time
Source: United Kingdom Climate Impacts Program
Team Members: Jonathan Simm, Robert Nicholls


Potential approach to develop alternatives:
•Start with the period of analysis
•Consider a longer planning horizon (reflects commitment by project sponsor)
•ID critical stages (dashed lines)
•Next, ID structural and nonstructural responses and estimate lead times necessary
Year
2009
2019
2029
2039
2049
2059
2069
2079
2089
2099
2109
50 year period of analysis
0.00
1.00
2.00
3.00
4.00
5.00
6.00
Relative Sea Level Rise (ft)
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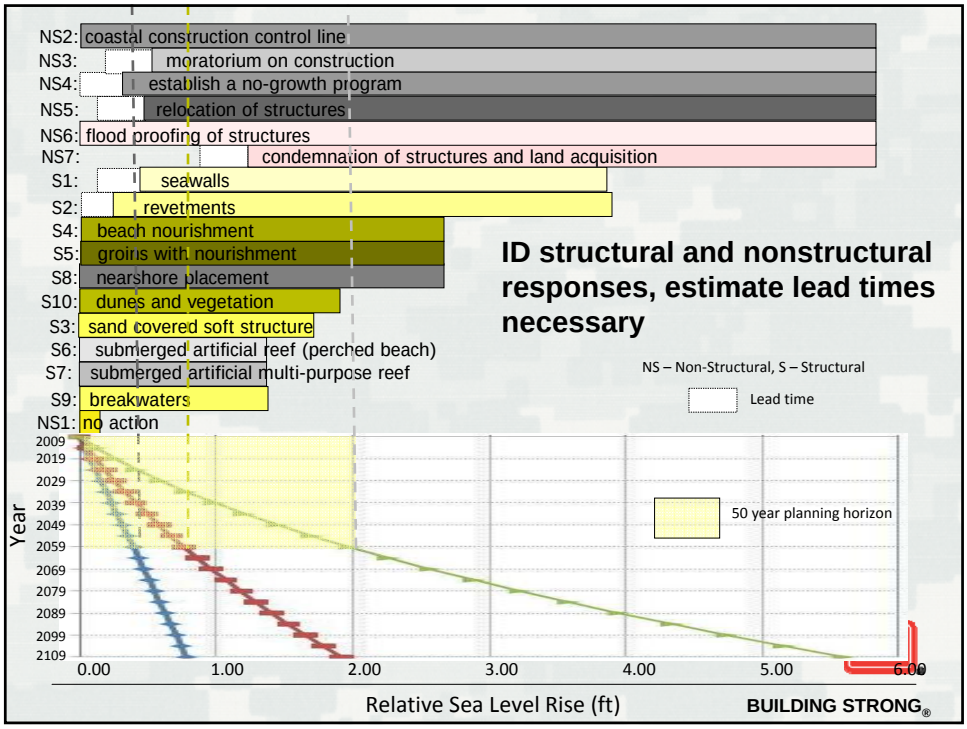
NS2: coastal construction control line
NS3: moratorium on construction
NS4: establish a no-growth program
NS5: relocation of structures
NS6: flood proofing of structures
NS7: condemnation of structures and land acquisition
S1: seawalls
S2: revetments
S4: beach nourishment
S5: groins with nourishment
S8: nearshore placement
S10: dunes and vegetation
S3: sand covered soft structure
S6: submerged artificial reef (perched beach)
S7: submerged artificial multi-purpose reef
S9: breakwaters
NS1: no action
ID structural and nonstructural responses, estimate lead times necessary
NS – Non-Structural, S – Structural
Lead time
50 year planning horizon
Year
2009
2019
2029
2039
2049
2059
2069
2079
2089
2099
2109
0.00
1.00
2.00
3.00
4.00
5.00
6.00
Relative Sea Level Rise (ft)
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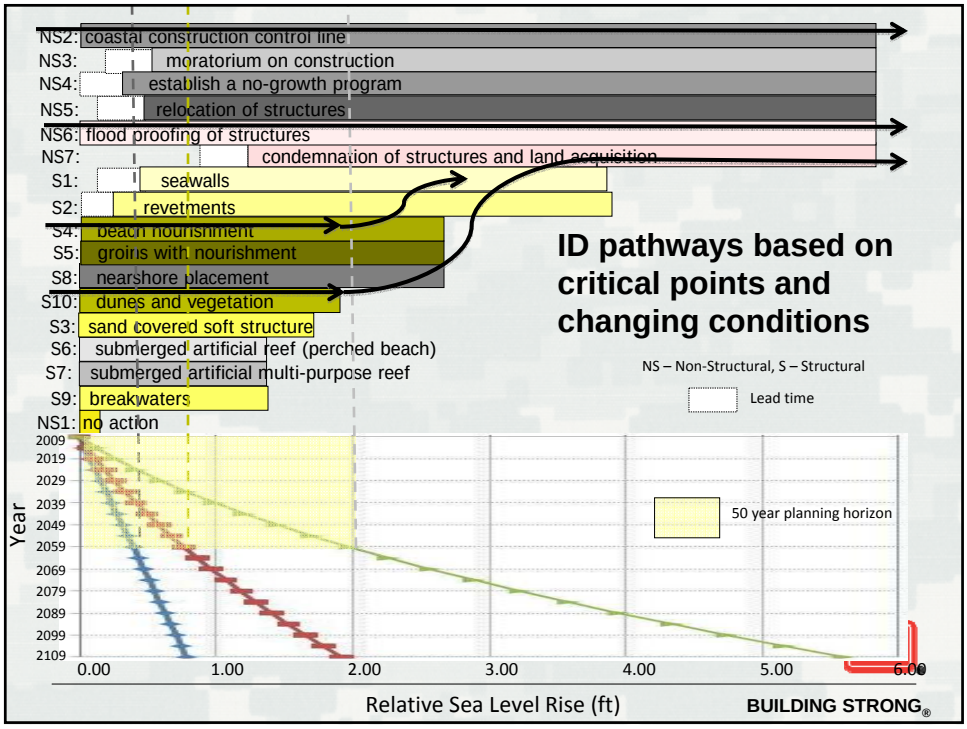
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ID pathways based on critical points and changing conditions
NS – Non-Structural, S – Structural
Lead time
50 year planning horizon
Year
2009
2019
2029
2039
2049
2059
2069
2079
2089
2099
2109
0.00
1.00
2.00
3.00
4.00
5.00
6.00
Relative Sea Level Rise (ft)
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Summary

- Begin with the decisions
  - Encourage thorough exploration of future conditions through appropriate selections from "universe of futures"
  - ID performance thresholds
  - Consider all alternatives
- Integrate adaptation and mitigation
- Comfort level is increased when DoD and USACE independently arrive at similar approaches

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