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Sea Level Rise Scenarios for Coastal Adaptation

Adam Parris
NOAA Climate Program Office

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Physical Scientist / RISA Program Manager
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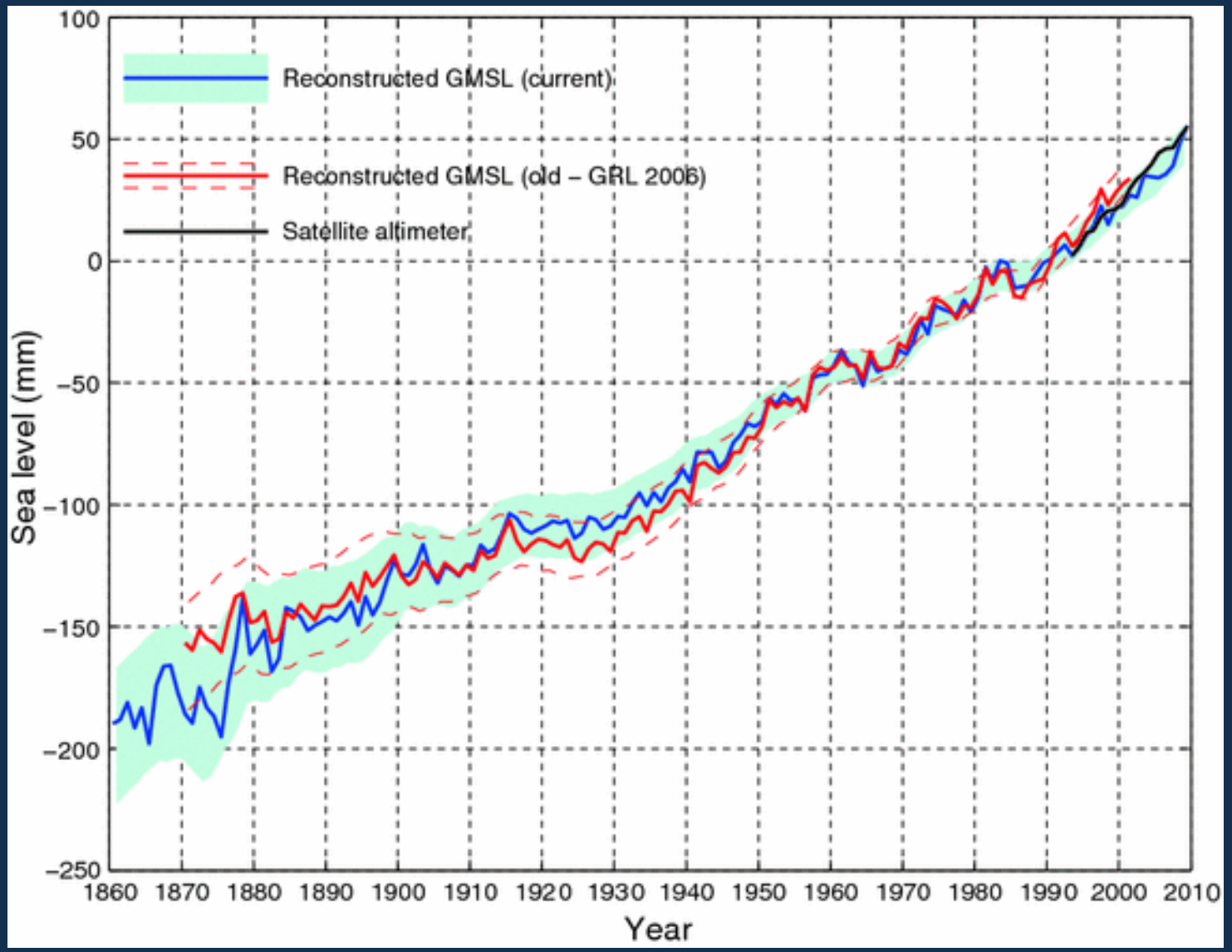
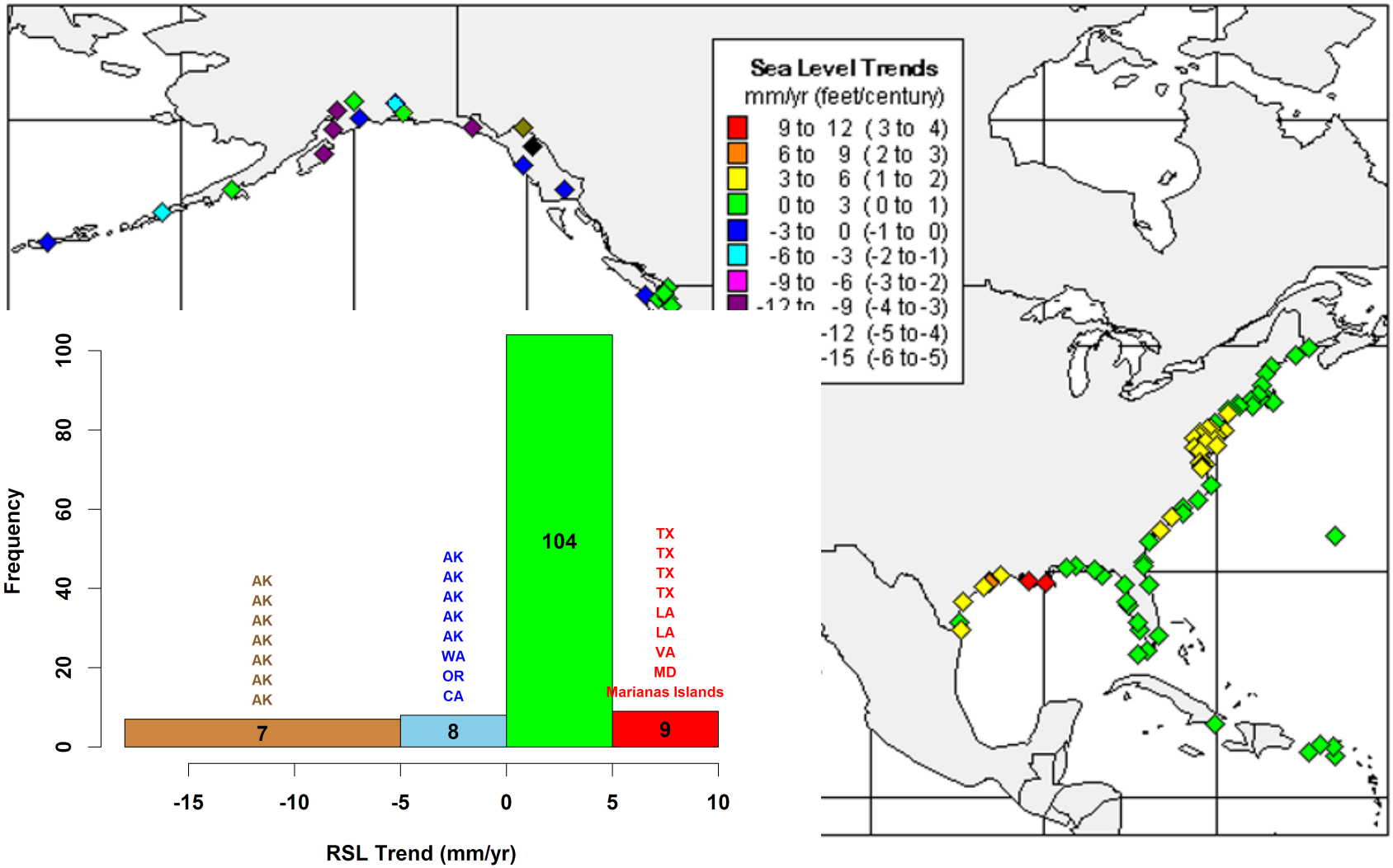
Sea level is rising - globally



Data Source: Church & White 2011

Sea level is rising - locally



Data Source: NOAA CO-OPS

Economic, cultural, and ecological assets near sea level

Any amount of SLR will increase coastal flooding

Spencer Platt Getty Images

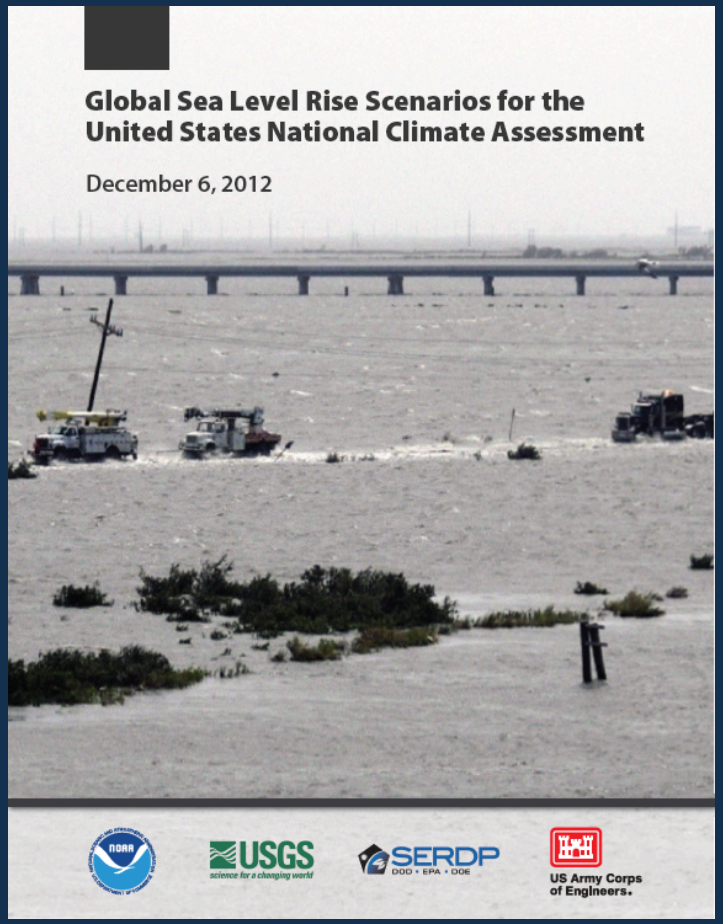
Flooding during high tides

Charleston, SC

Puget Sound, WA

Photo credits: (left) NOAA Coastal Services Center; (right) Ray Garrido, January 6, 2010, reprinted with permission by the Washington Department of Ecology

An interagency effort



Adam Parris, NOAA (Lead)

Peter Bromirski, Scripps Institution of Oceanography

Virginia Burkett, USGS

Dan Cayan, Scripps Institution of Oceanography & USGS

Mary Culver, NOAA

John Hall, DOD

Radley Horton, Columbia University

Kevin Knuuti, USACE

Richard Moss, University of Maryland, PNNL

Jayantha Obeysekera, South Florida Water Management District

Abby Sallenger, USGS

Jeremy Weiss, University of Arizona

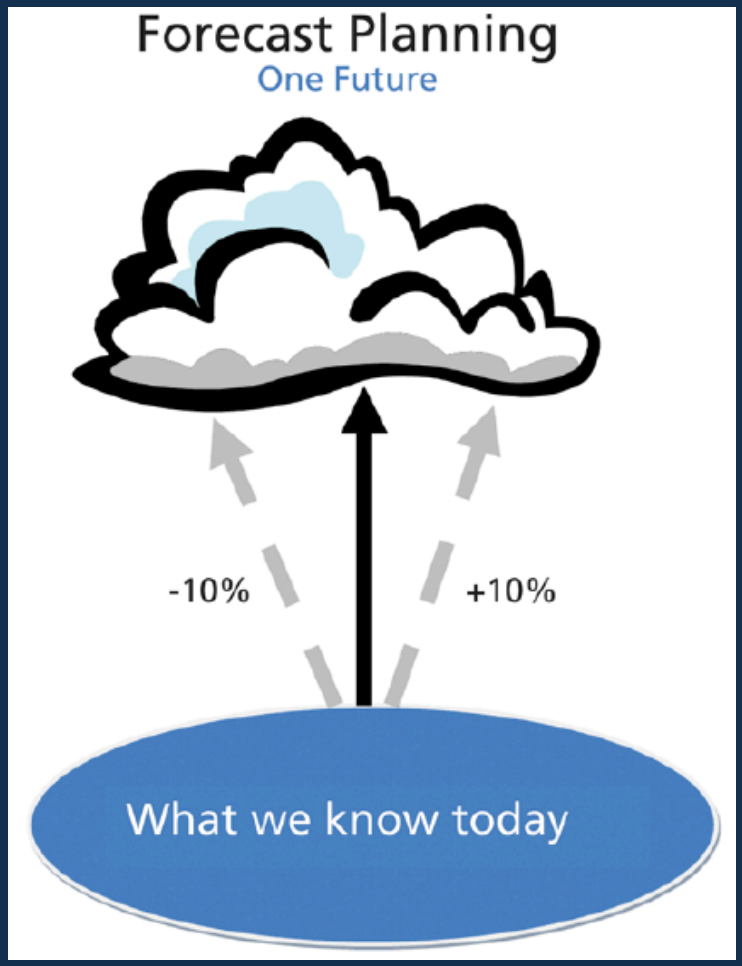
SCENARIOS…

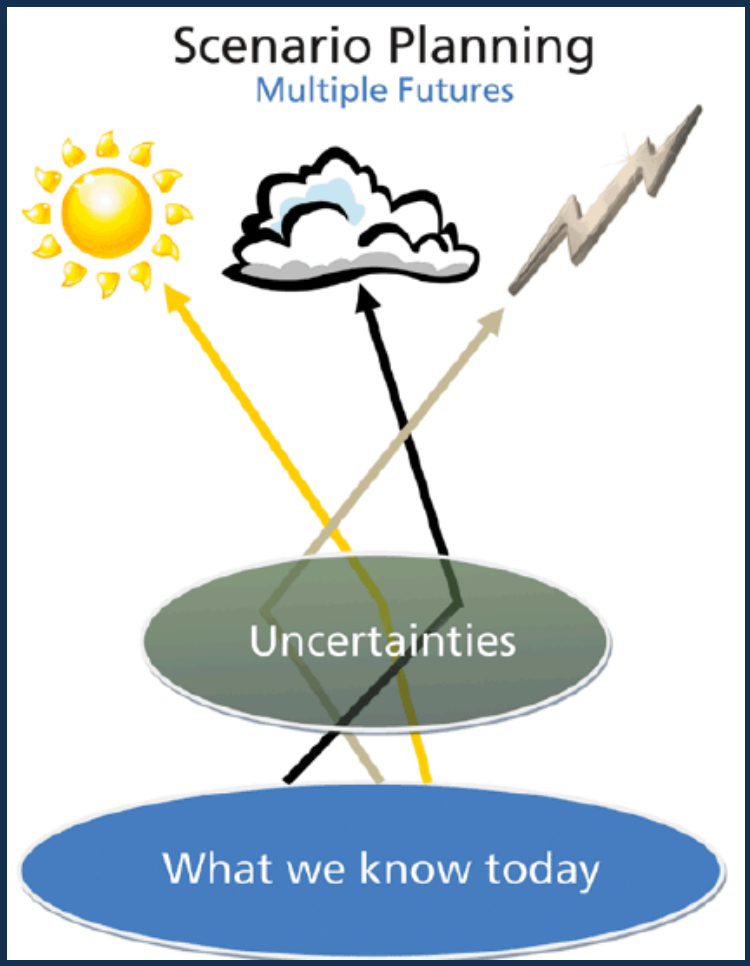
…**ARE** trajectories of environmental change for the purpose of risk and vulnerability assessment to inform the development of robust adaptation options

…**ARE NOT** predictions or projections of what will happen

…**ARE NOT** formed under the assumption of reducing uncertainty

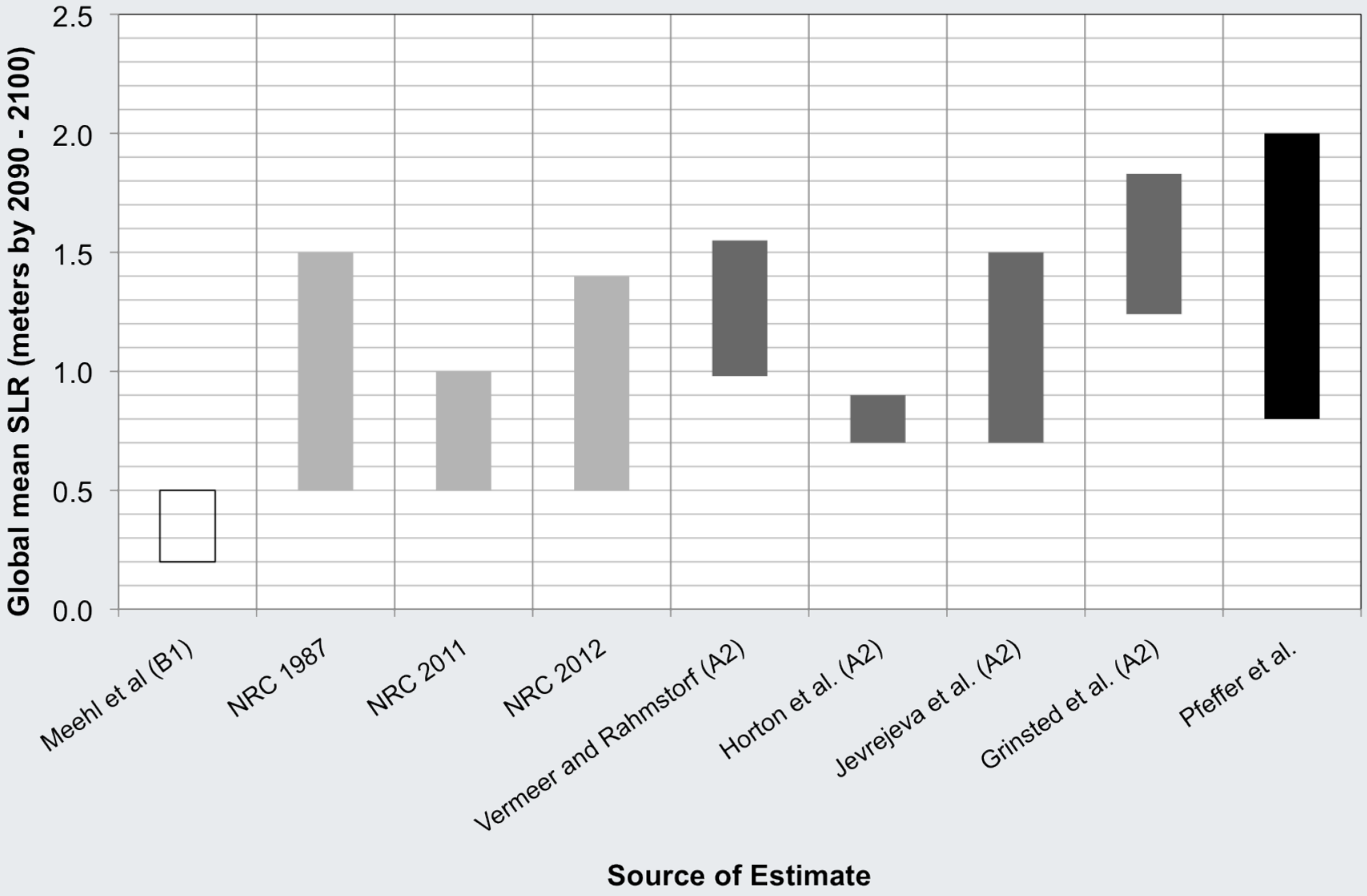
Why Scenario Planning?



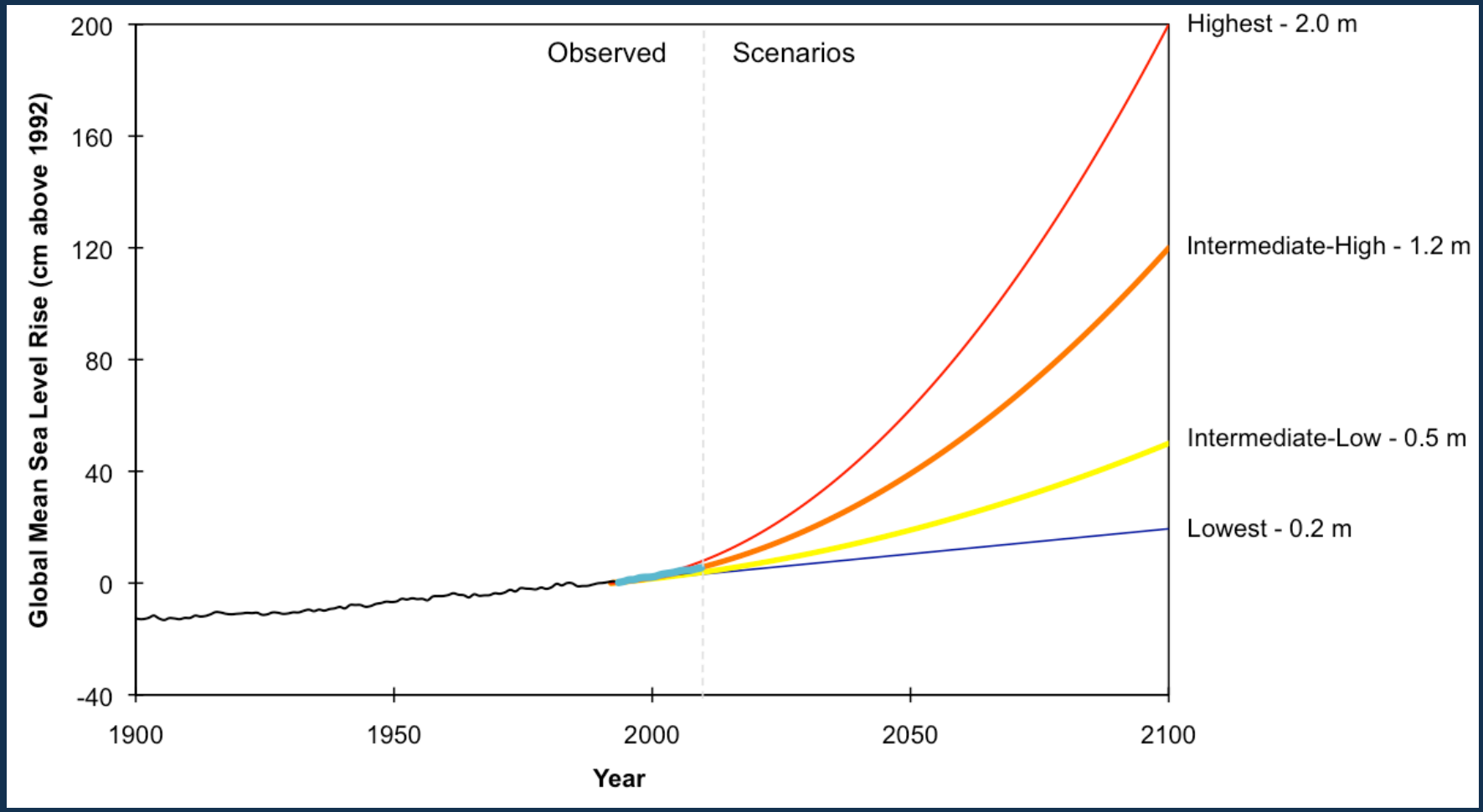


Source: Global Business Network Weeks et al 2011

Just give me a number – please!



Global sea level rise scenarios

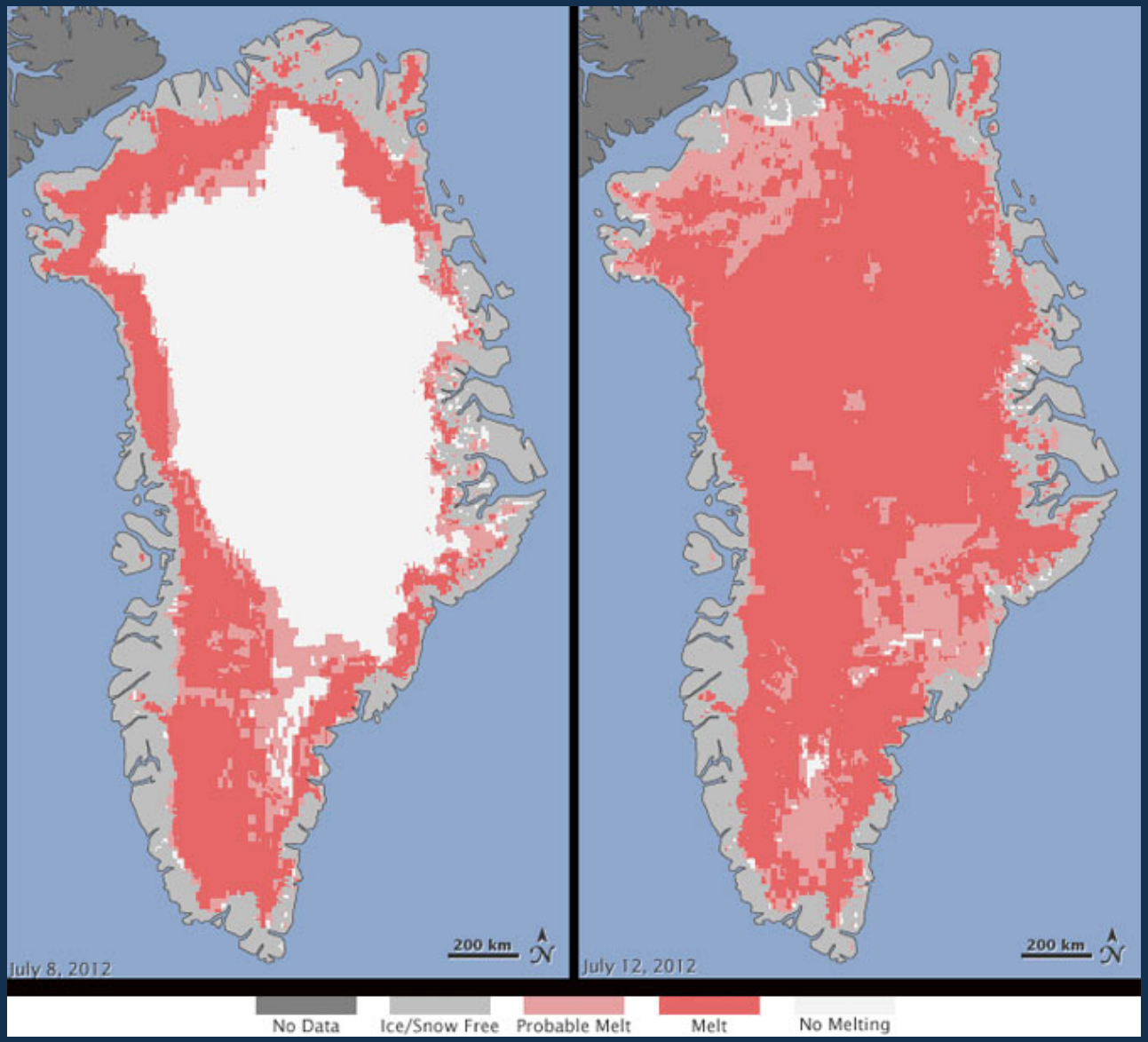


Risk-based framing

We have very high confidence (>9 in 10 chance) that global mean sea level will rise at least 0.2 meters (8 inches) and no more than 2.0 meters (6.6 feet) by 2100.

Confidence Level	Possible Contributing Factors
Very High	Strong evidence (established theory, multiple sources, consistent results, well documented and accepted methods, etc), high consensus
High	Moderate evidence (several sources, some consistency, methods vary and/or documentation limited, etc.), medium consensus
Medium	Suggestive evidence (a few sources, limited consistency, models incomplete, methods emerging, etc.), competing schools of thought
Low	Inconclusive evidence (limited sources, extrapolations, inconsistent findings, poor documentation and/or methods not tested, etc.), disagreement or lack of opinions among experts

Greatest source of uncertainty?



Source: NASA

A decision analogy

Tomorrow there is a chance of rain, but what do you have planned for tomorrow?

Why such a large scenario range?

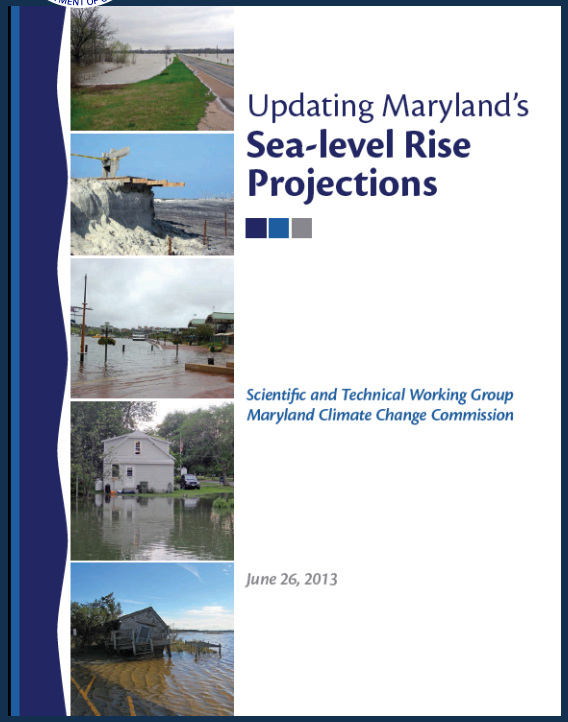
Higher risk tolerance:

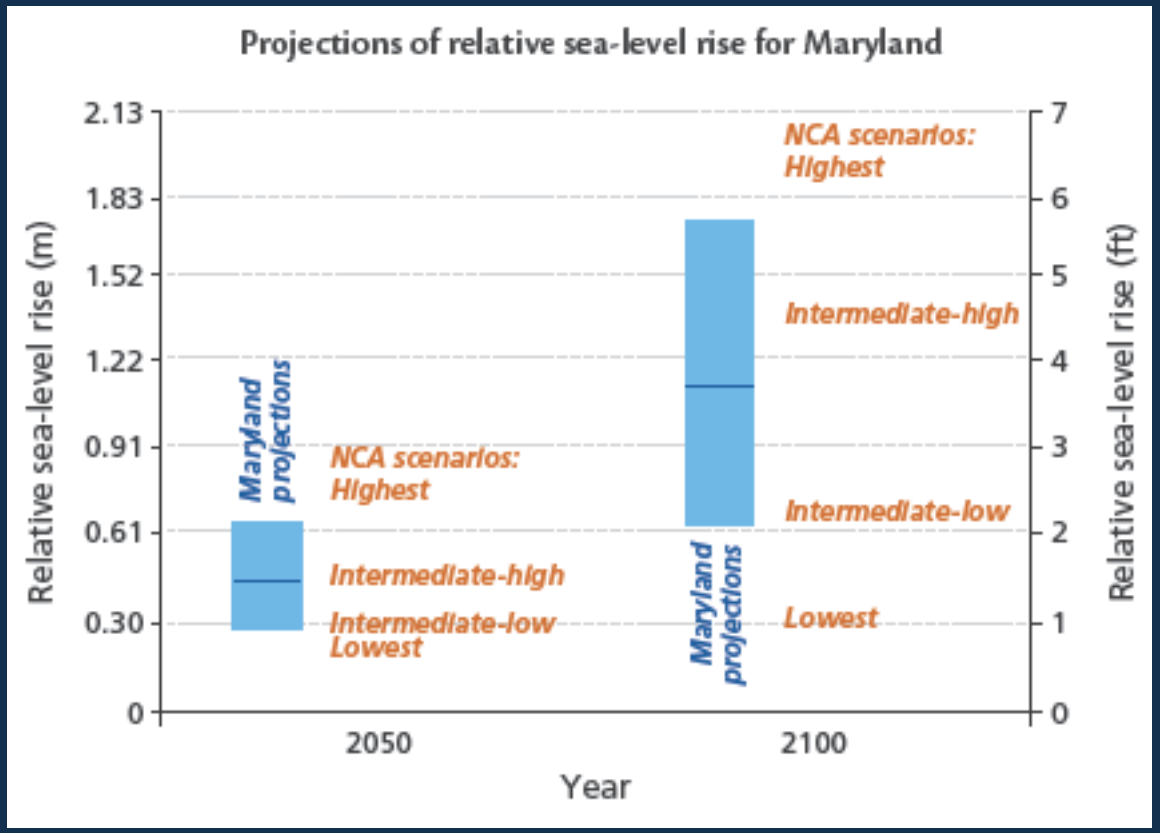
- Greater flexibility to accommodate flooding
- Lower consequence
- Ability to change in near term

Lower risk tolerance:

- Little flexibility to accommodate flooding
- Higher consequence
- Inability to change in near term

Adaptive risk management thru planning





Boesch, D.F., L.P. Atkinson, W.C. Boicourt, J.D. Boon, D.R. Cahoon, R.A. Dalrymple, T. Ezer, B.P. Horton, Z.P. Johnson, R.E. Kopp, M. Li, R.H. Moss, A. Parris, C.K. Sommerfield. 2013. Updating Maryland's Sea-level Rise Projections. Special Report of the Scientific and Technical Working Group to the Maryland Climate Change Commission, 22 pp. University of Maryland Center for Environmental Science, Cambridge, MD.

Build regional/local scenarios

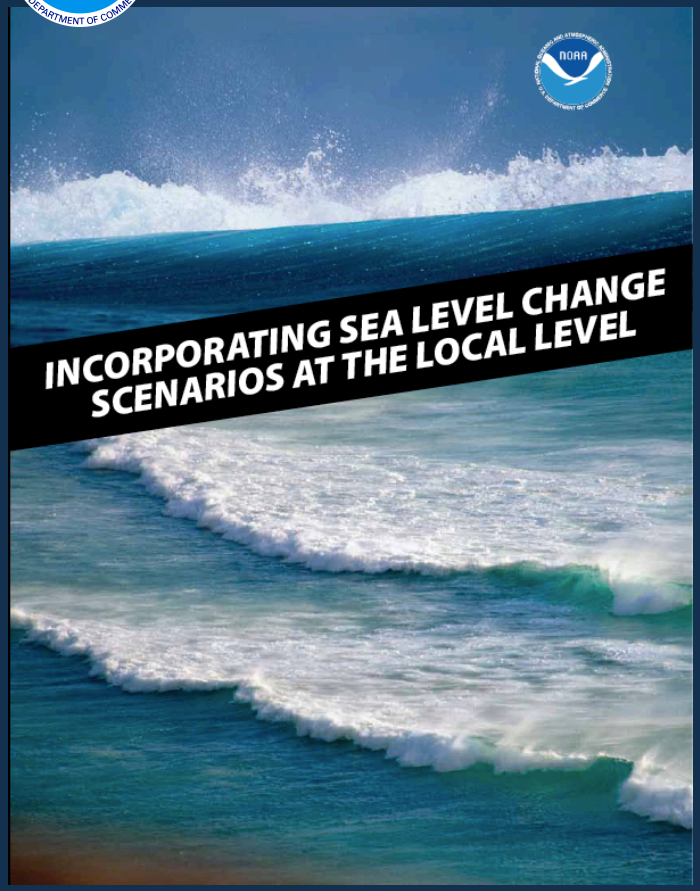


Table 1. Components of Sea Level Change

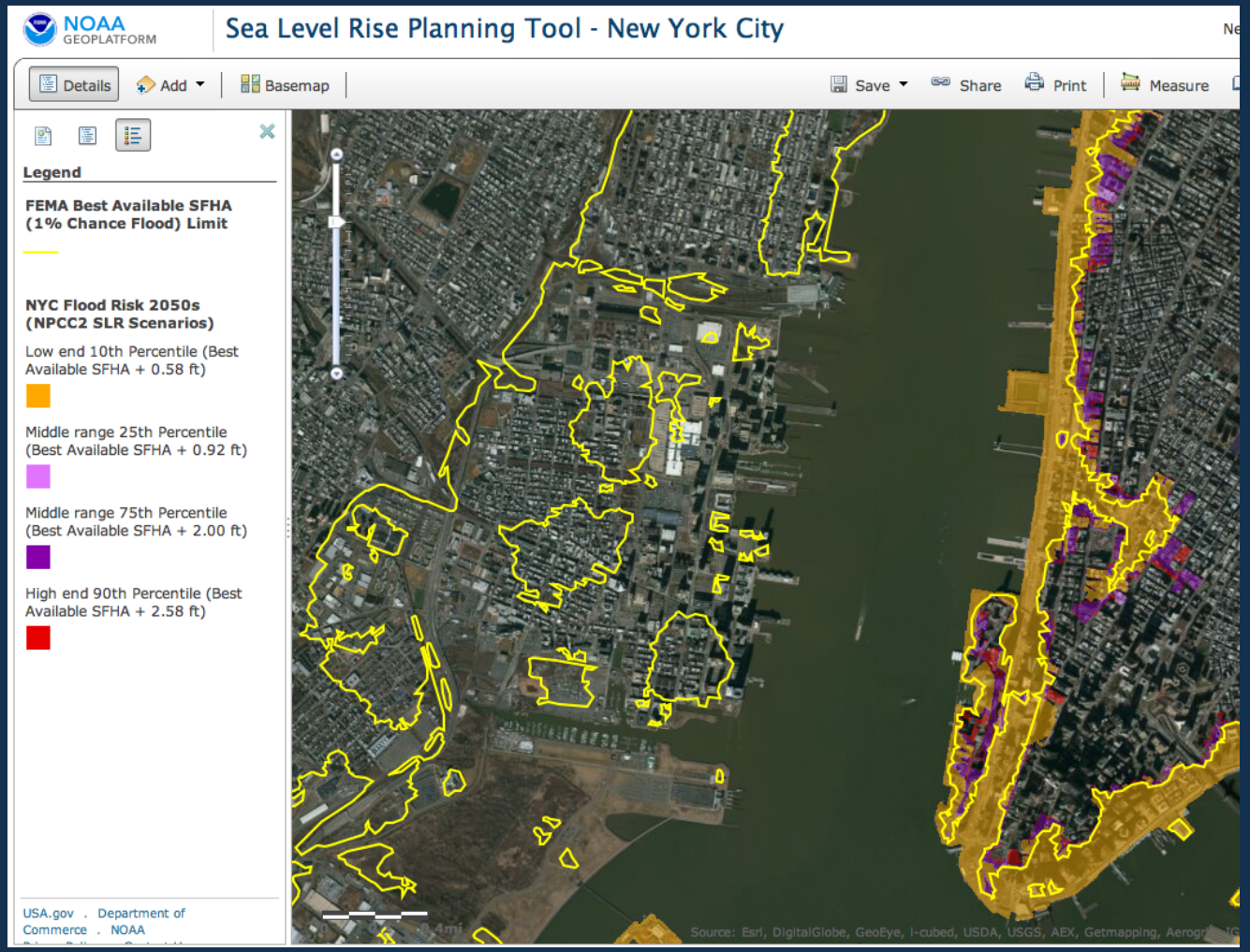
Component	Quantity	Source	Where to locate the Information	Certainty
Component I: Historical Local Relative Sea Level Trends	+10.0 to -15.0 millimeters (mm) per year	Measured	NOAA tide gage records	Highly Certain
Component II: Localized Vertical Land Changes (Subsidence, Isostatic Rebound)	-8.0 (subsidence) to +20.0 (uplift) mm per year	Modeled/Measured	NGS, State Advisor, USGS published subsidence/rebound rates, CO-OPS estimates from tide gage records	
Component III: 20th Century Historical Global Sea Level Change	+1.7 to 1.8 mm per year	Measured	Historical global tide gage analyses and global isostatic adjustment models	
Component IV: Global Sea Level Change since 1993	+3.1 to 3.3 mm per year	Measured	Series of satellite altimeter missions since 1993 and global tide gage records	
Component V: Future Climate Change Scenarios	Acceleration constant 2 centimeters (cm) per decade increasing by 3 cm per decade each decade	Modeled	IPCC 2007, various research papers since IPCC	
Component VI: Regional Tidal Elevation Surface	Uncertainty of modeled surfaces area-dependent: 16 cm to 45 cm 95% CI	Modeled	VDATUM	Less Certain

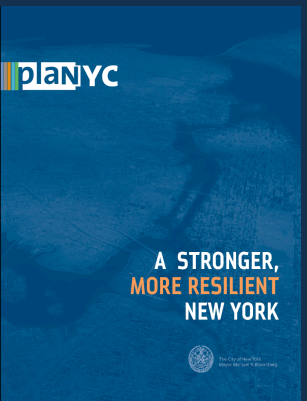
CI – Confidence Interval
CO-OPS – Center for Operational Oceanographic Products and Services
IPCC – Intergovernmental Panel on Climate Change
NGS – National Geodetic Survey
NOAA – National Oceanic and Atmospheric Administration
State Advisor – State National Geodetic Survey Advisor
USGS – United States Geological Survey
VDATUM – NOAA Vertical Datum Transformation Tool

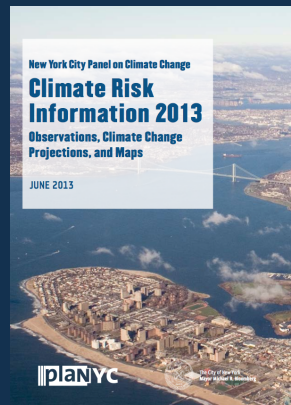
NOS SLR tech report http://www.csc.noaa.gov/publications/slc_tech.pdf

Incorporating Sea Level Change Scenarios at the Local Level - http://www.csc.noaa.gov/digitalcoast/publications/slcscenarios

Visualization of future flood risk







Usable science supports choices, actions

The SLR Tool for Sandy Recovery was **used** for:

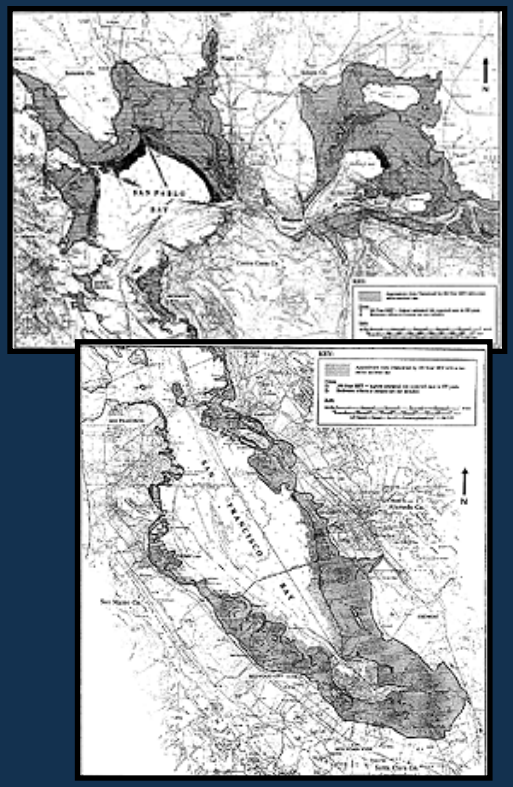
- 16 local laws in 2013
- Natural Hazard Mitigation Plan
- Multi-purpose levee in Lower Manhattan
- Beach replenishment and dune construction
- Restored wetlands and a tidal barrier in Coney Island Creek
- ConEd rate case

Limiting factors from local/regional view

- Additional analysis on flood recurrence required
- Rates of Vertical Land Movement (VLM)
- Shoreline change

Don't wait for perfect information

Pacific Institute, 1988



BCDC, 2007

USGS, 2009

Resilience is a social process