Does tropical cyclone modification make sense? A Decision-Analytic Assessment

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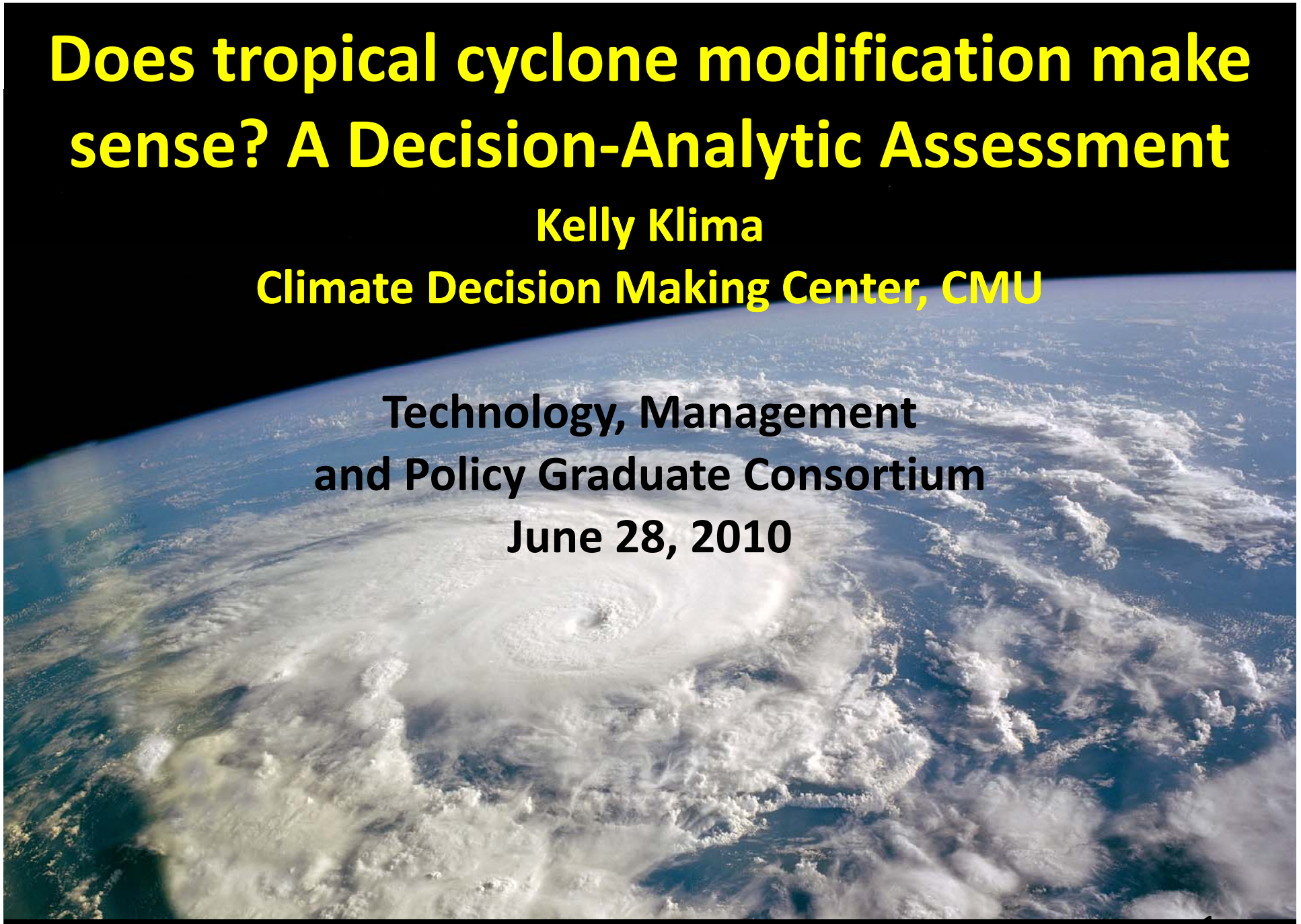

Photo courtesy of NASA: STS047-151-618 Hurricane Bonnie (1992)

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Two general approaches exist for controlling hurricane damage

Hurricane mitigation	Hurricane modification
Currently practiced nationwide	Theorized since 1930s
Involves “hardening” structures against damage	DHS has recently reopened research into the topic
Includes shutters, dams, better roof connections, etc	
Works better for moderate storms	Works better for large storms

How do mitigation and modification compare?

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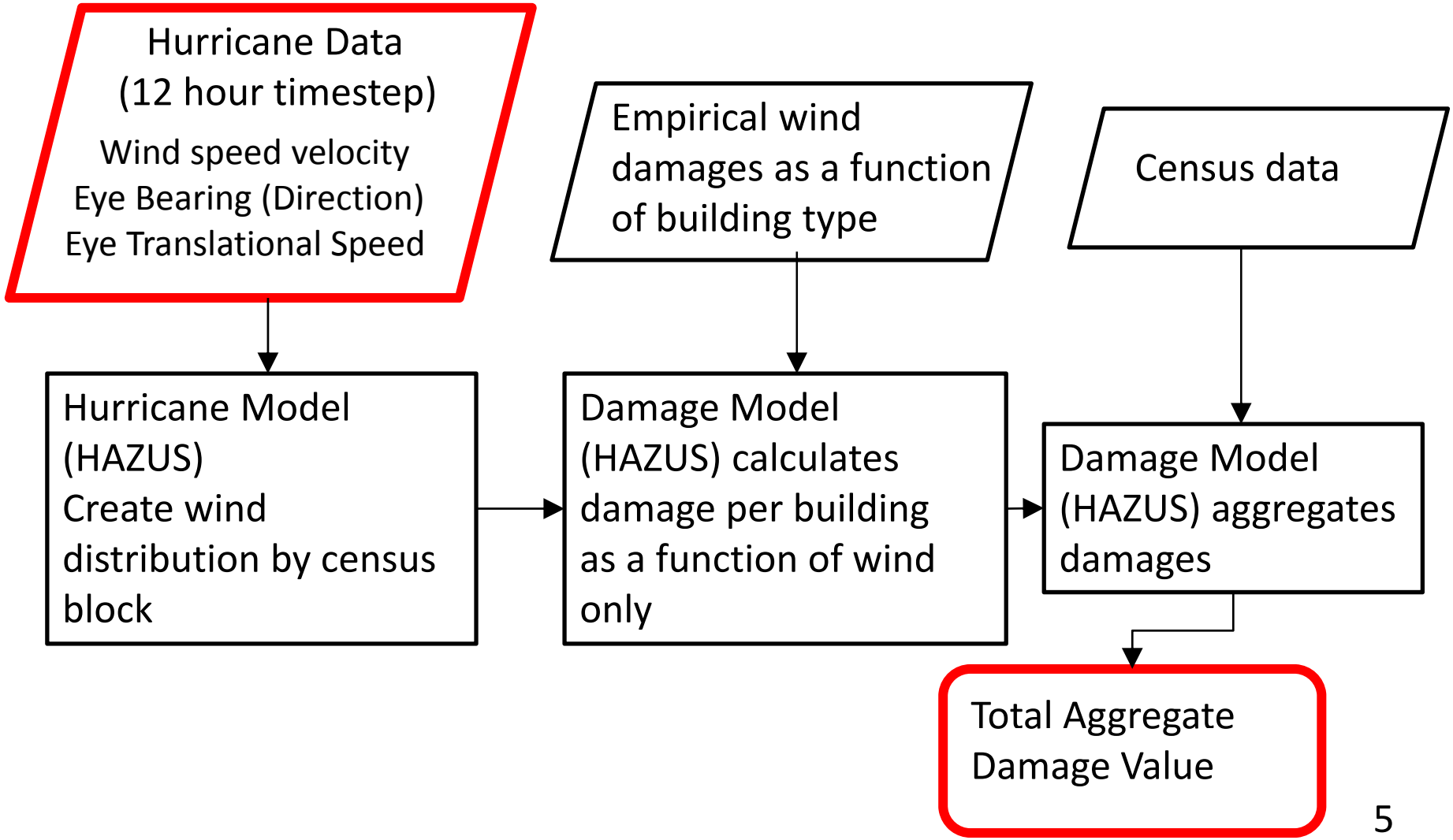
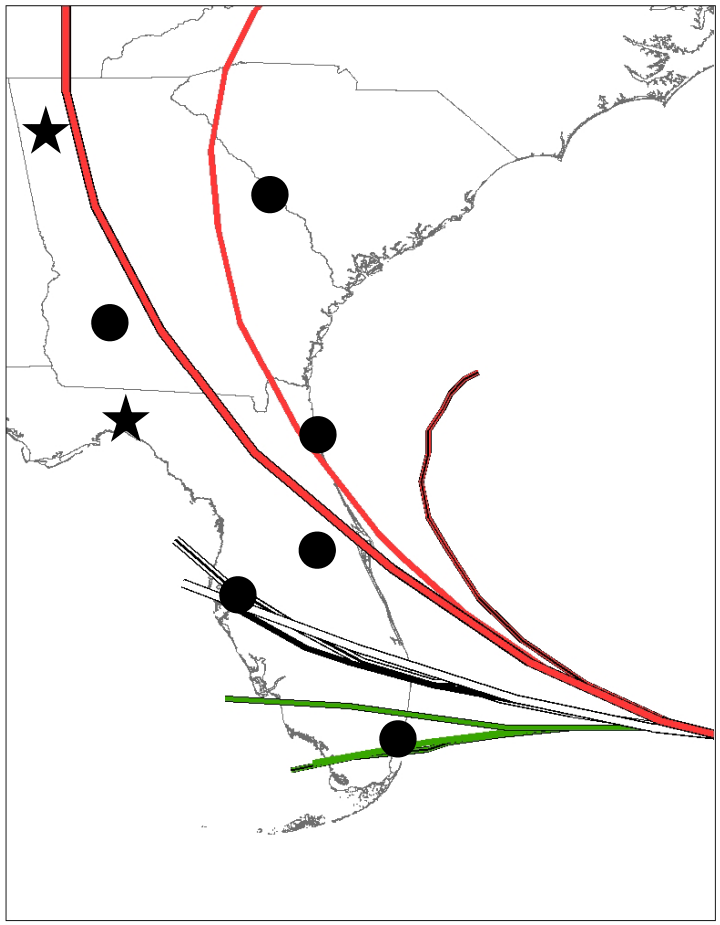
- Suppose that a strategy can be found that, within some bounds of uncertainty, will lead to a change in the strength or the path of a TC.

- How sure would one need to be about the intended and unintended consequences and distributional effects of this intervention before it might make sense to proceed?

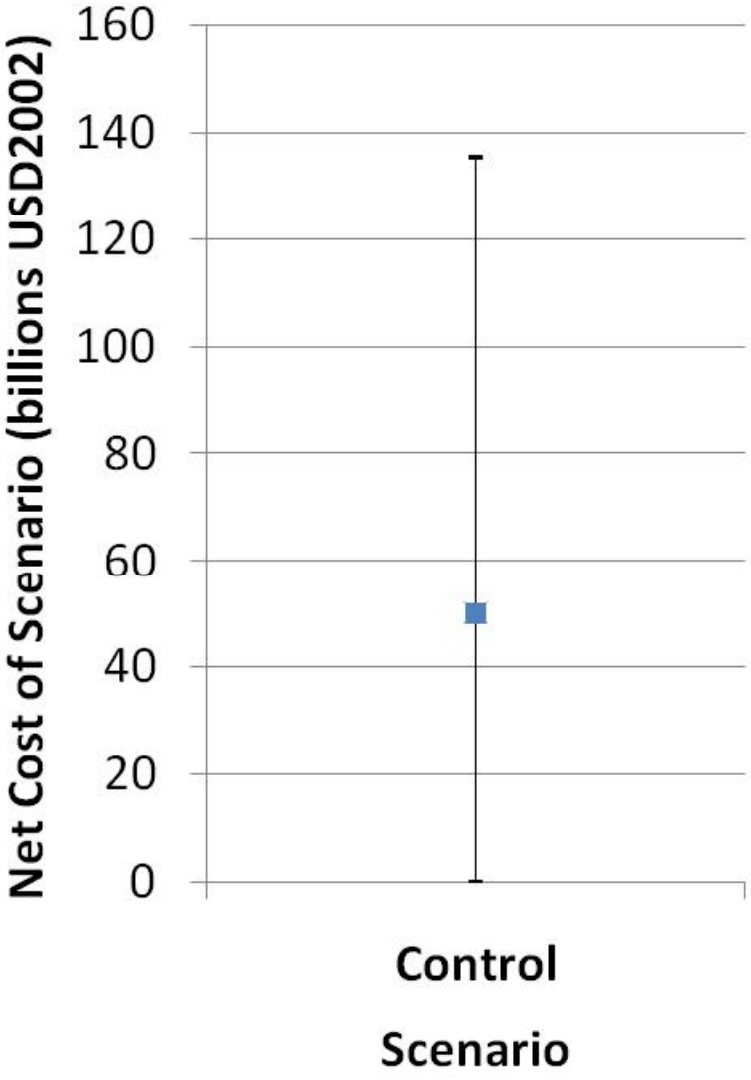
We use a model that assesses total aggregate damages



We examine strong storms that come ashore in the Greater Miami area



National Hurricane Center historical hurricane tracks (1953-2007)



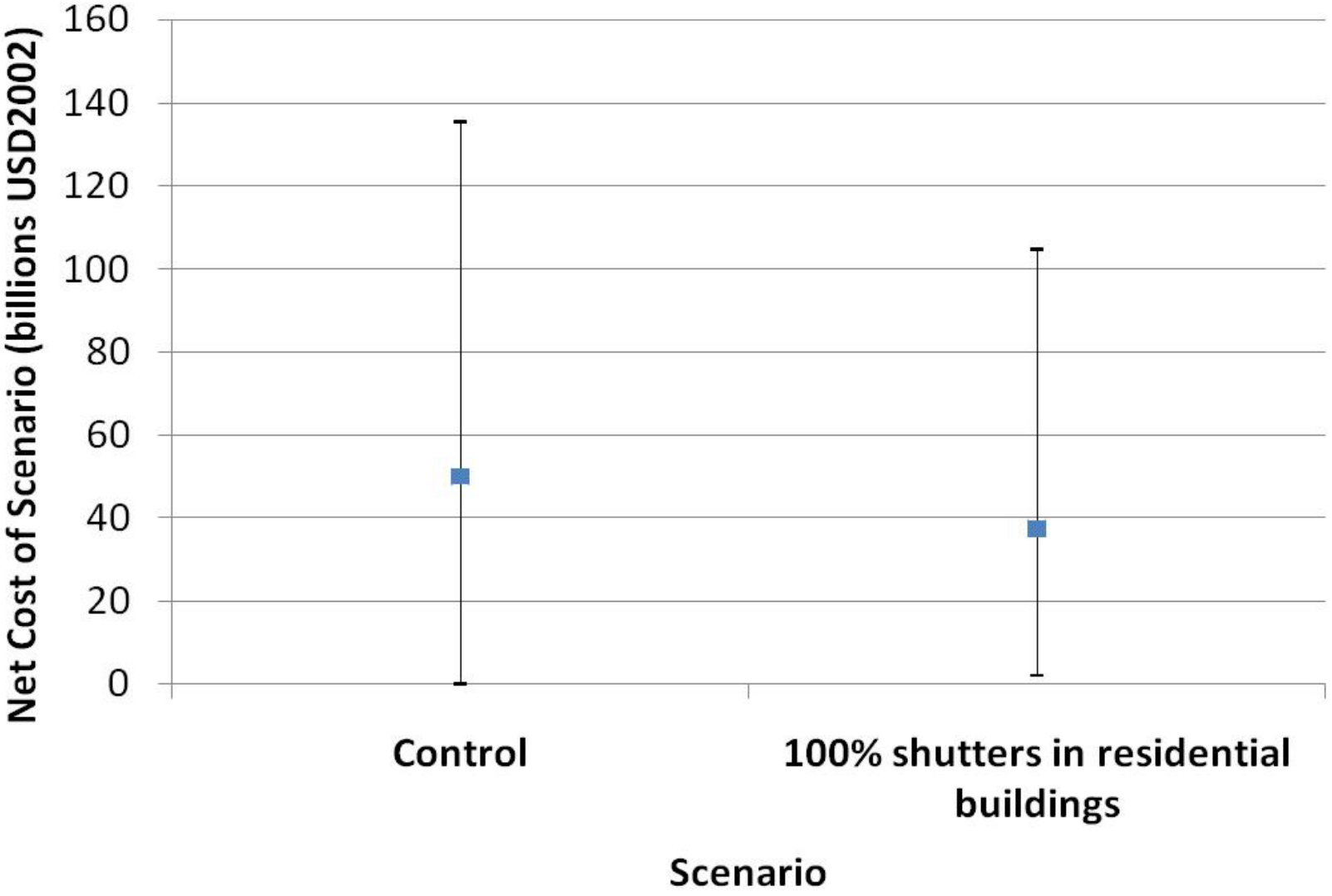
A commonly suggested mitigation technique is home shutters

Figure courtesy of Hurricane Proof

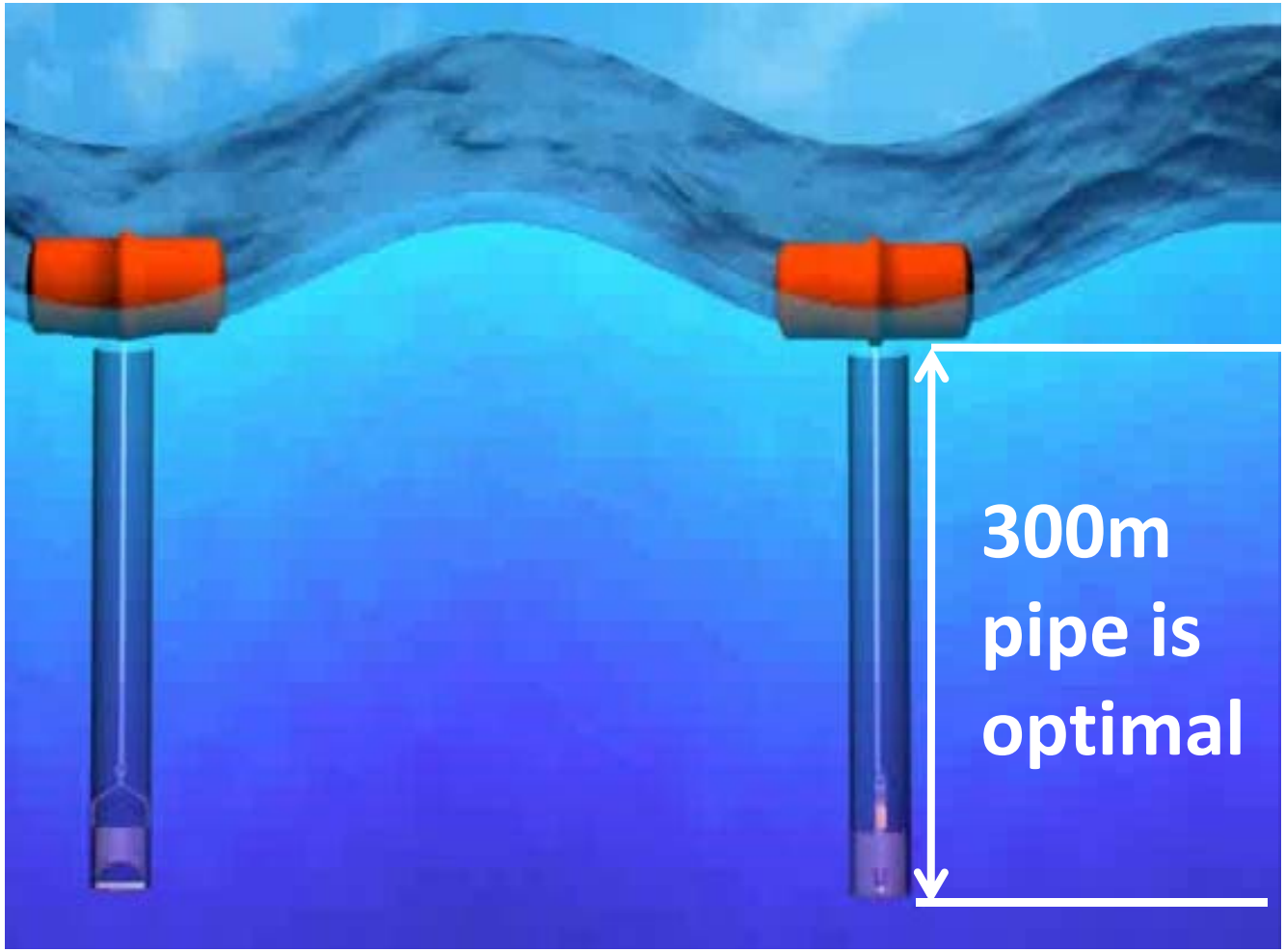
Annualized cost to shutter all houses (30yrs, 5% discount rate)

Florida = $1.4-1.8B
Georgia = $0.7-0.9B

For a large storm, shutters may decrease net total costs



The modification technique closest to implementation is wind-wave pumps



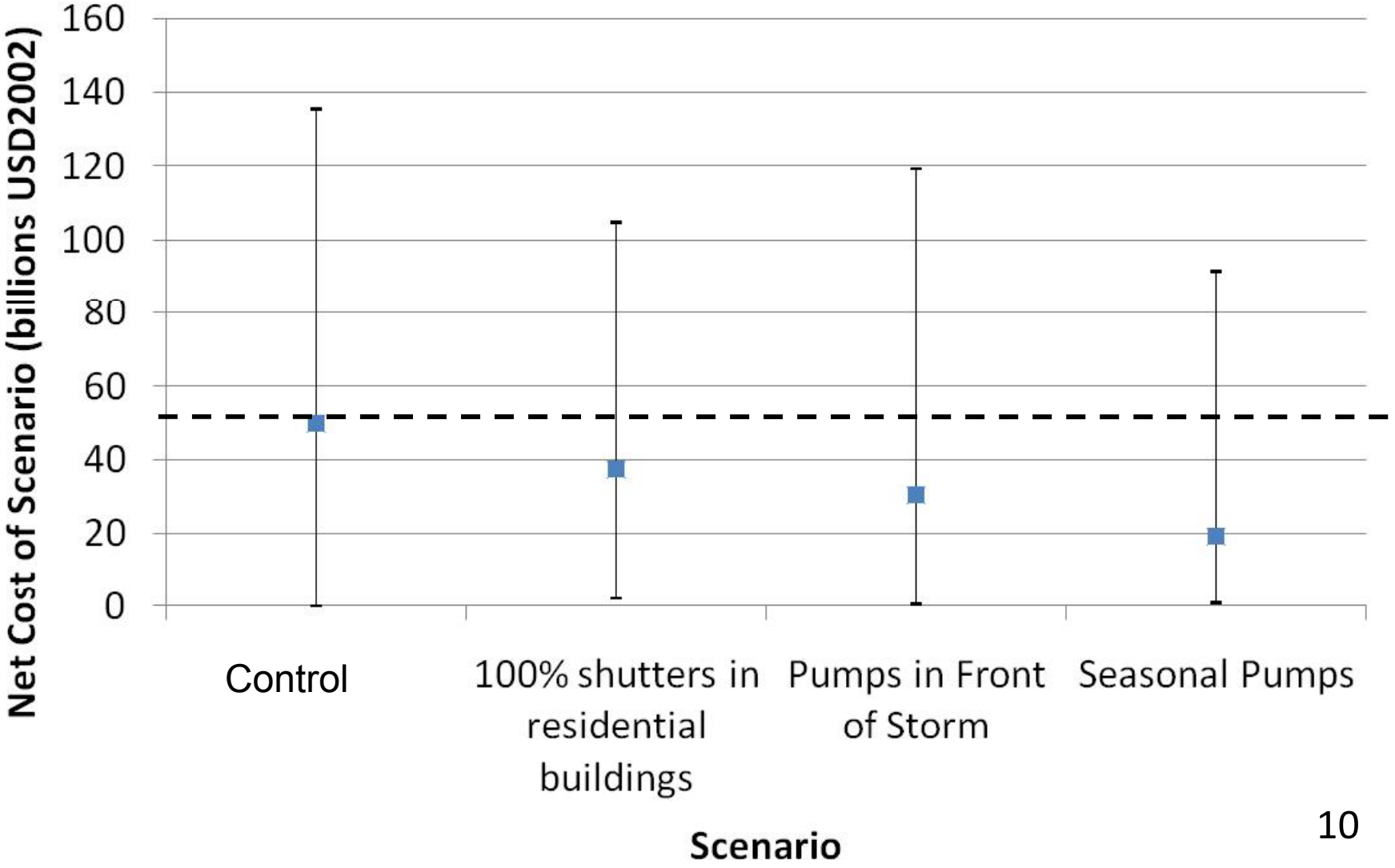
Deployment Cost

Seasonal
= $0.9-1.5B

Per TC
= $0.4-0.7B

Figure courtesy of Philip Kithil, Atmocean

We find modification may be more competitive than mitigation



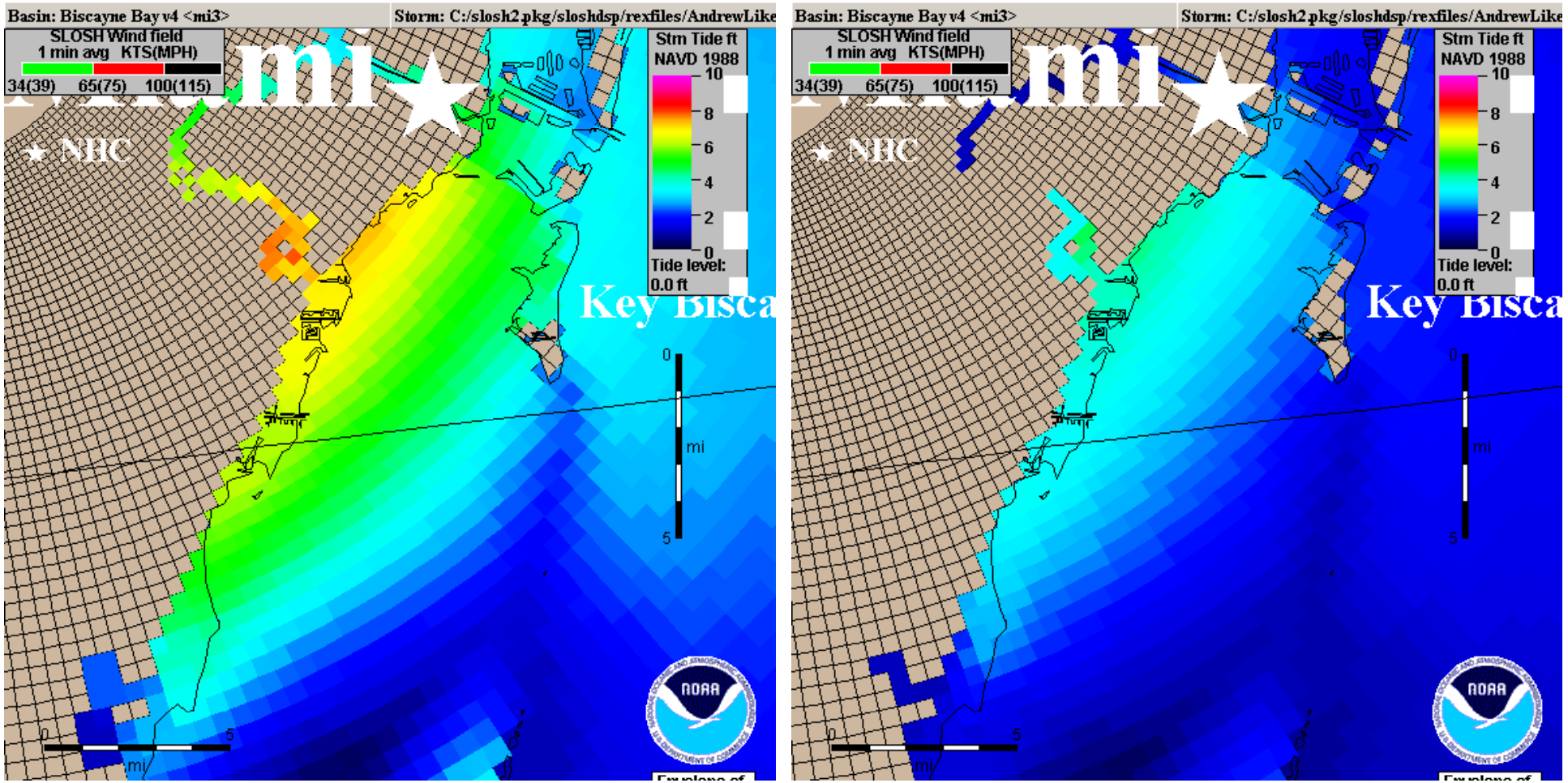
Benefit-cost analysis alone does not capture the complexity of this decision

- Mitigation and modification may be done in parallel
- Other issues include uncertainty, liability/ethics, risk tolerance, political/budgetary/time restraints
- Next steps seek to address complexities
  - Storm surge damages
  - Public perceptions of hurricanes
  - Other modification technique: Steering

Storm Surge: Initial runs show altering storm intensity alters storm surge

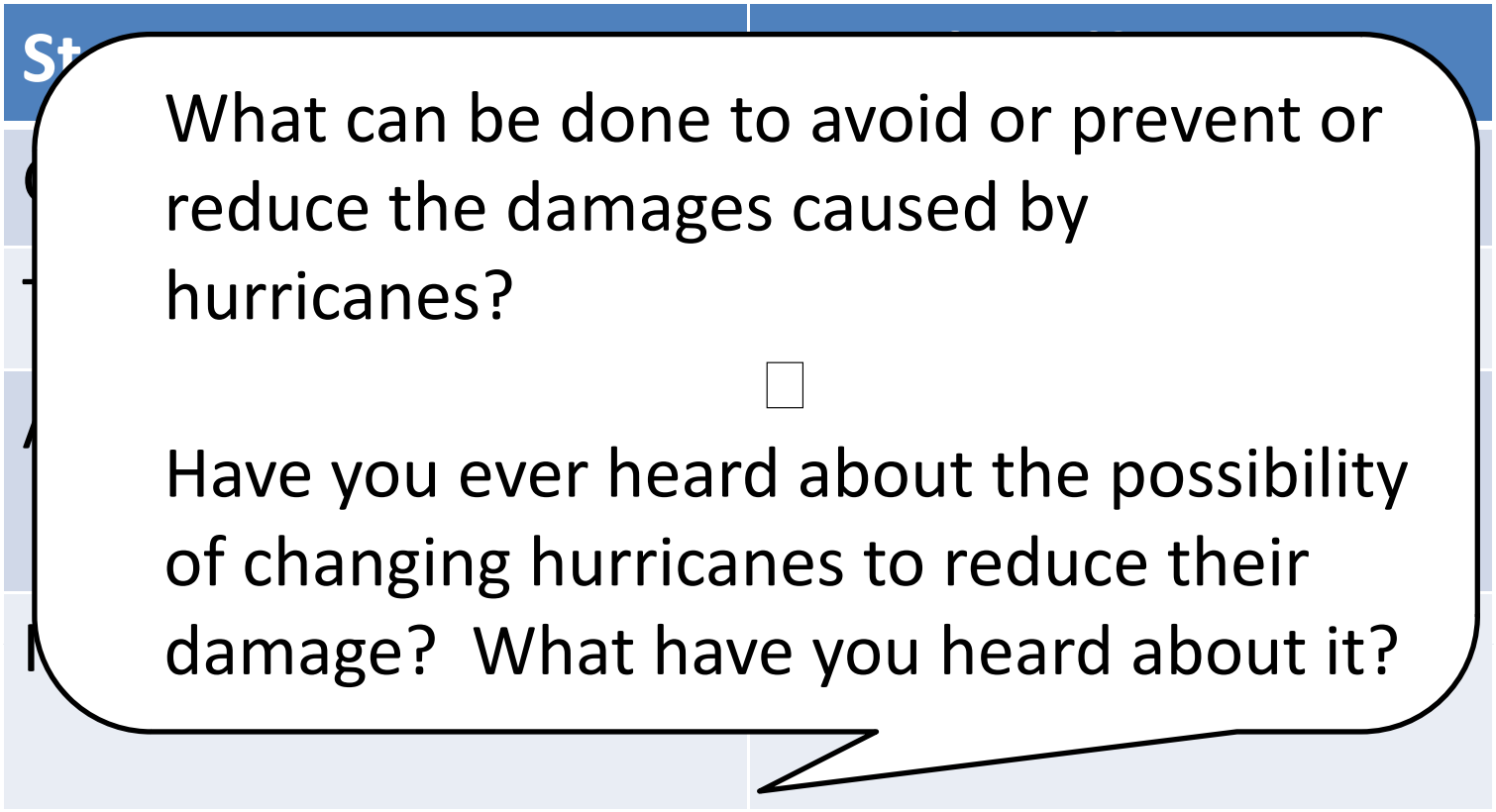
Control

1.5 deg SST decrease

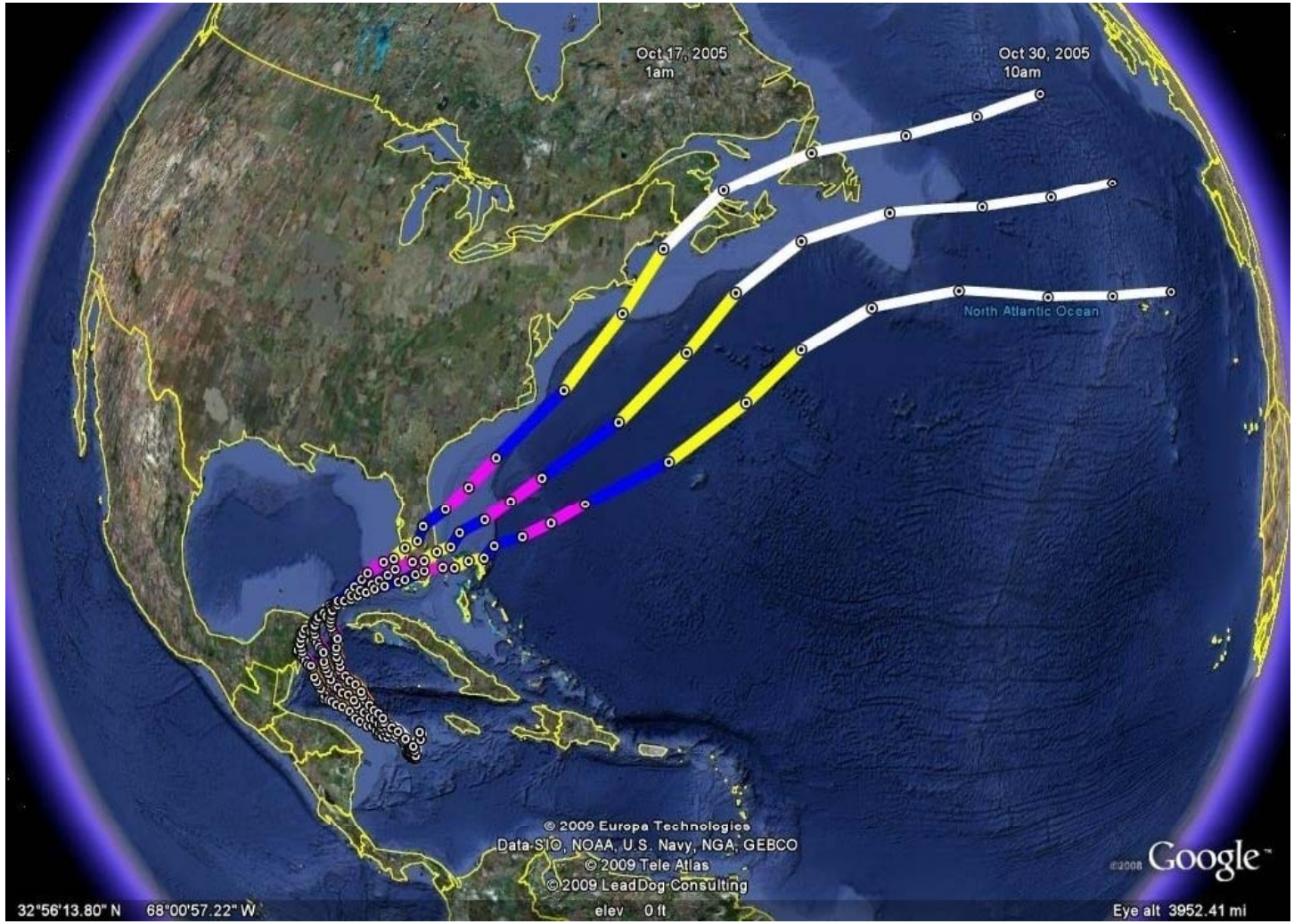


Figures courtesy of National Hurricane Center

Public perceptions of hurricanes: An initial interview has been conducted



Steering: A 10º rotation in bearing can greatly shift the hurricane track



10º C or CC rotation

Technique and costs unclear

Photo generated from Google Earth & Wilma 2005

Acknowledgments

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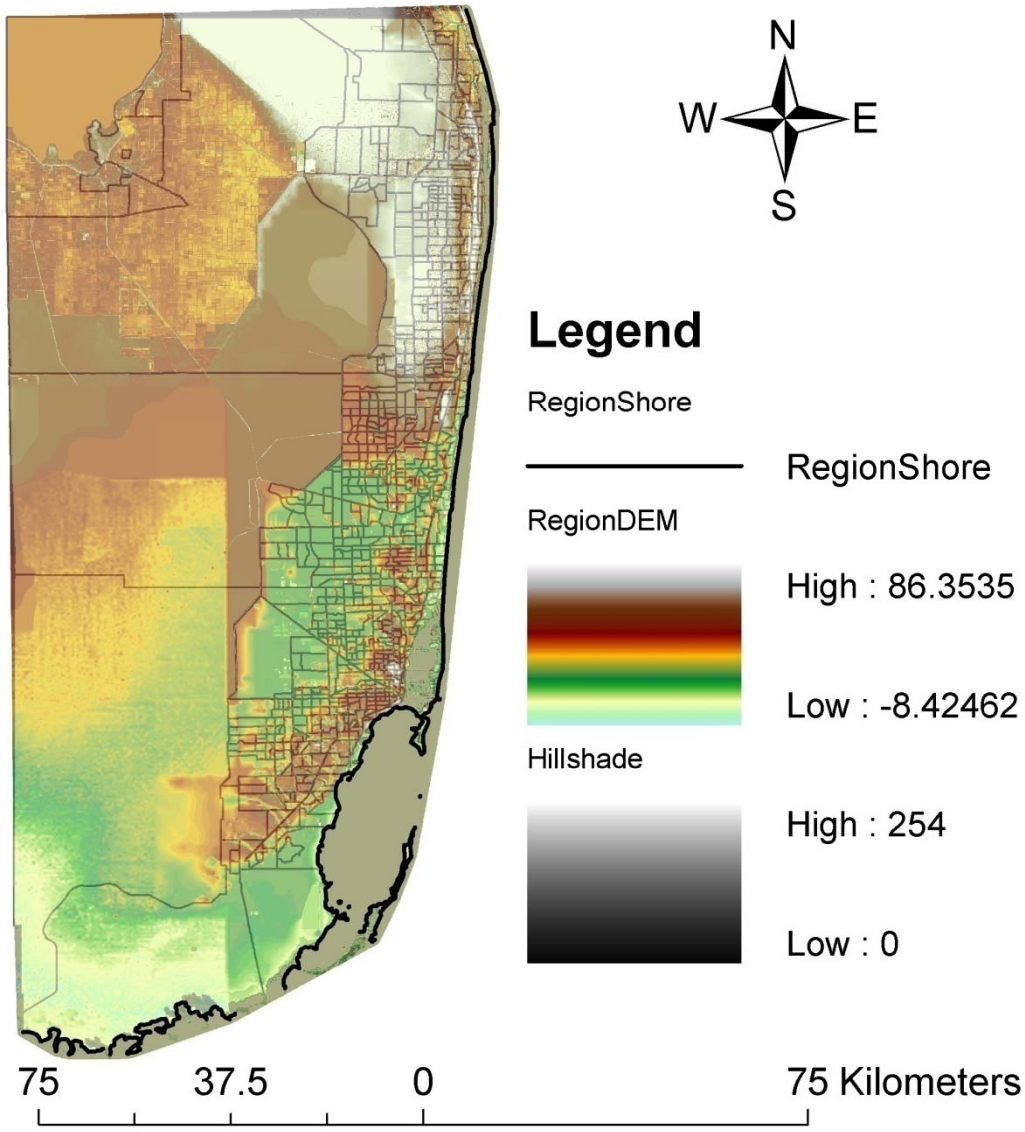
I am learning how to implement SLOSH output in HAZUS's flood damage model



How do results change when storm surge damages are included?

- Specifically,
  - What are the storm surge damages?
  - How are wind and storm surge damages combined?
  - Including storm surge, how do techniques compare?
- Plan
  - Consider model (e.g. talks with RMS)
  - Use SLOSH input in HAZUS to obtain flood damages
  - Use historical and experimental data to inform combination of wind and storm surge damages
  - If cannot obtain damage model, use indicator

What are public perceptions of hurricane damages?

- Specifically,
  - What do people believe about damages?
  - How does the public evaluate hurricane modification compared to its alternatives?
  - What, if any, are the ethical and liability implications of hurricane modification?
- Plan
  - Construct and conduct interview to help frame questions for a wider audience
  - Construct and administer survey

How might a steering modification compare?

- Specifically
  - When/how would it be implemented?
  - How certain would it need to be?
  - What about issues of equity?
- Plan
  - Use input from committee and Kevin Sharp's thesis to clarify problem and approach
  - Conduct net BC analysis informed by survey results
  - Find value of information associated with reducing uncertainty