Synthesizing GHG Stabilization with Impacts and Adaptation

Gary Yohe

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Workshop on GHG Stabilization Scenarios

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Outline of Remarks

- Reflections from the TAR
- Perspectives on a risk-based approach to synthesis
- Risk and robustness – distributions versus not-implausible futures
- Implementation uncertainty and the proximity of the target
- Incorporating the results of mitigation into adaptation analyses, and visa-versa

A Perspective from the TAR

- Climate related damages that can be avoided by mitigation are the benefits of that mitigation

- Credible calculations of the benefits of mitigation must therefore recognize the potential that adaptation (autonomous and planned) could reduce damages and therefore the benefits of mitigation.

Support for that Approach

The environmental economics literature – optimal intervention assumes efficient evasive activity

The finance literature – calculates risk premia net of diversifiable risk thereby assuming efficient diversification

More from the TAR

- Adaptation may or may not reduce damages significantly
  - SLR examples from developed coastlines (the US developed coastline work of Yohe shows significant cost savings from adaptation; corroboration in subsequent global coverage by Nichols and friends)
  - SLR examples from low-lying islands (Atoll states work by Adger shows abandonment only option to SLR, but earlier significant stress from other sources)

Including Adaptation can be Critical

- It follows that adaptation cannot be ignored in any credible calculation of the benefit side of mitigation
  - It passes the Lave test (factor of two)
  - But we are not sure where, when and how.

Two Asides from Neil Adger

- What can be attributed to SLR when atoll states are more vulnerable to extinction in the near term from internal development paths?

- How much mitigation would be forthcoming if the COP of the UNFCCC did not know which 5 of the 180+ members were facing extinction?

Fundamental Conclusions from Chapter 18

- “Current knowledge of adaptation and adaptive capacity is insufficient for reliable prediction of adaptations; it is also insufficient for rigorous evaluation of planned adaptation options, measures and policies of governments” (pg 880 or WGII Report)
- Vulnerability is a function of exposure and sensitivity; and both can be influenced by adaptive capacity
- All of these are path dependent and site specific

Recall the Determinants of Adaptive Capacity

- Availability of adaptation options
- Availability and distribution of resources
- Stocks of human and social capital
- Ability of decision makers to
  - Assume responsibility
  - Process information
  - Separate signal from noise
- Access to risk spreading mechanisms
- Public perception – attribution and responsibility

A Potentially Unsettling Conclusion

- Asking for estimates of the economic value of mitigation might be wrong question.

- Thinking about mitigation in the context of a cost-benefit framework might be the wrong approach

.....*at least for a while….*

A Risk-based Approach that Accommodates the Synthesis of Impacts *cum* Adaptation with Mitigation Targets

- Thinking about both mitigation and adaptation as tools to reduce the risk of troublesome, intolerable, etc…. climate change makes them complements rather than substitutes.
- Mitigation is then a means of hedging against bad outcomes measured, net of adaptation, in terms of the likelihood of crossing critical thresholds.
- Adaptation is then a means by which systems can expand their coping ranges or delay their contraction.

The Cost Side

- The cost side of mitigation (thought of as a risk-reducing tool whose outputs are measured in terms of a vector of impacts) is one of cost-effectiveness; i.e., minimizing the cost of achieving certain objectives.
- The cost side of adaptation (thought of as a risk-reducing tools whose outputs are measured in terms of the likelihood of crossing thresholds) is one of opportunity cost informed by understanding how the determinants of adaptive capacity help or impede adaptation.

Decision-makers' Context

- Their job is to assess the relative opportunity costs of achieving specific risk reductions.
- Double causality is required to assess the effectiveness of mitigation.
- Single causality is sufficient to assess adaptation; but not in a synthetic approach.
- ***Uncertainty becomes the reason for contemplating policy rather than the reason for contemplating delay.***

Can Science Support this Approach? Will there be Literature to Assess in the AR4?

- Recent MIT work (Webster, et. al., “Uncertainty Analysis on Climate Change and Research Policy Response”, *Climatic Change,* 2003) produces distributions of temperature change associated with a specific concentration threshold and translates that into SLR possibilities (at least for 2100, but could produce transcients).

Will there be Literature?

- Recent Schneider work (See OECD Workshop on the Benefits of Climate Policy and forthcoming special issue of *Global Environmental Change*) produces distributions of an extreme event (THC shutdown) conditional on
  - natural variables (climate sensitivity, etc…)
  - policy-related variables (the discount rate in an otherwise informed optimization exercise).

Will there be Literature?

- Roger Jones (See OECD Workshop on the Benefits of Climate Policy and forthcoming special issue of *Global Environmental Change*) : links site specific thresholds to adaptation and climate variables
  - SLR illustration with the likelihood of crossing critical thresholds at specific years
  - Episodes of coral bleaching and mortality with the likelihood of crossing critical ocean temperature thresholds at specific years

One Schematic of the Next Step to Mitigation

Temperature (climate variable) distributions →

Impact (vector) distributions →

Frequency of crossing critical thresholds

Adding adaptation assesses potential of changing the thresholds [or the correlation between temperature (climate variable) and impact].

Contemplating mitigation influences the temperature (climate variable) distribution

Sea Level Rise is a Great Example – As Usual

- Distributions of temperature change support distributions of SLR.
- Local subsidence combines with this to produce distributions of local SLR.
- Distributions of impacts (inundation, salt-water intrusion, vulnerability to coastal storms, etc….) follow from local modeling links to SLR.
- Adaptations are obvious (protect or not; set-back rules, etc….)
- Mitigation effects distributions of temperature.

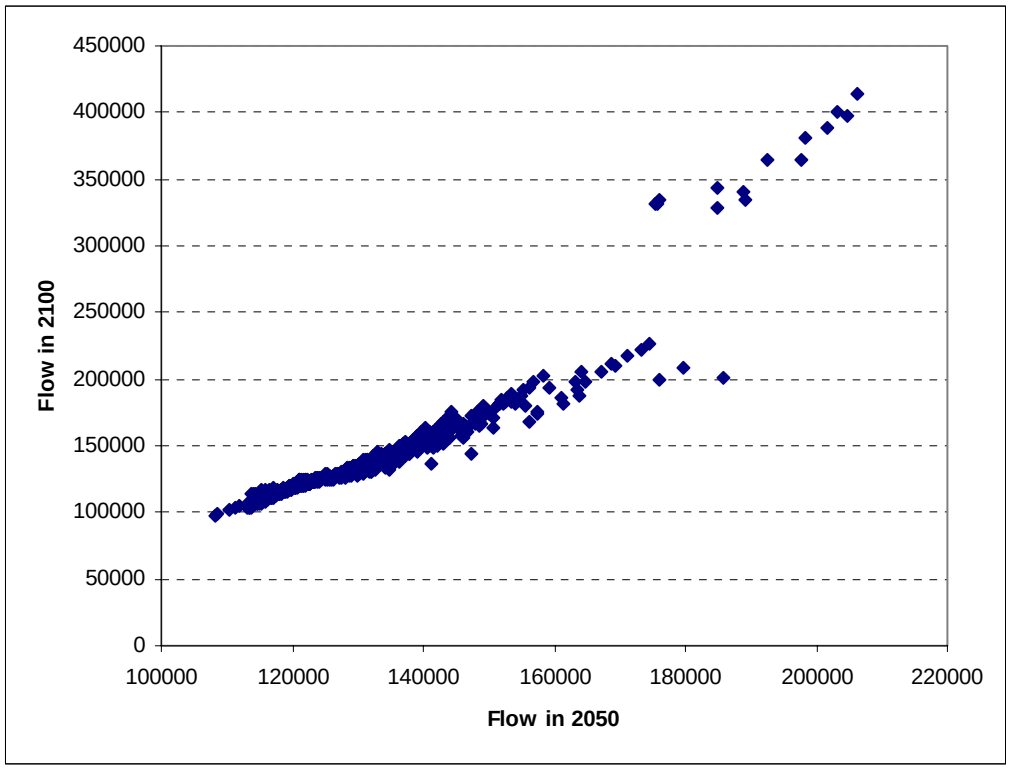
A Second Approach – Not Implausible Futures

- Not-implausible futures produce ranges of impacts across which adaptations must cope.
- The key on the adaptation side is to look for robust responses that handle many possible futures.
- The link to mitigation follows from changes in not implausible futures.
- The key on the mitigation side is to look at the effect on the range or timing of futures across which robustness might be measured.

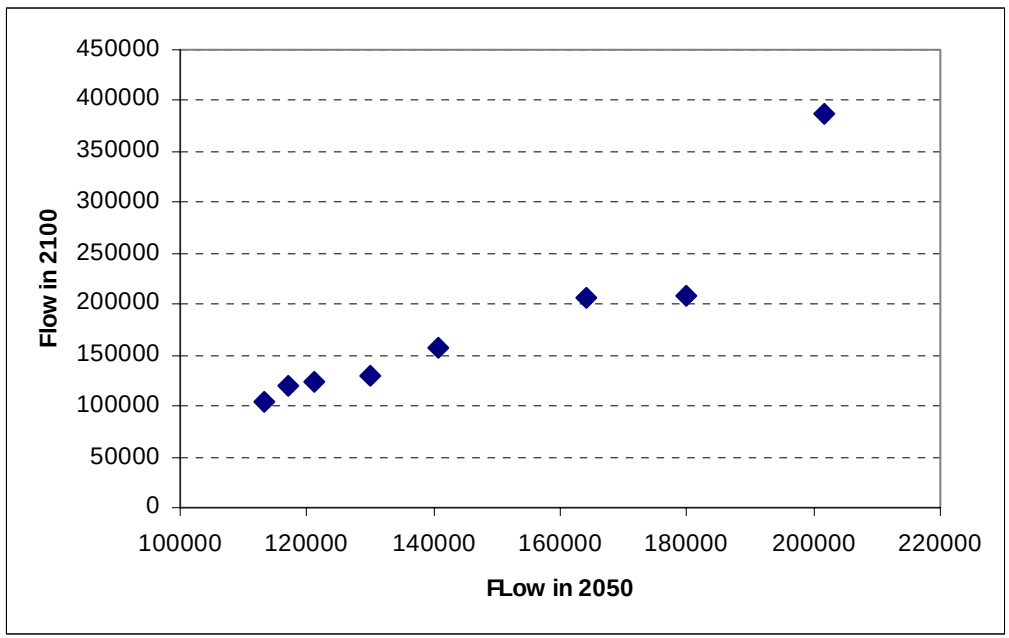
A New Example – Flooding in Bangledesh

- Strzepek has calibrated a hydrologic model of the Ganges and Brahmaputra rivers to COSMIC output to produce trajectories of maximum monthly flow; critical variables include
  - Monthly precipitation in lowlands (monsoon months)
  - Monthly precipitation and temperature (winter months) in highlands (determines timing and significance of snowmelt)
- Strzepek has also calibrated the likelihood of various degrees of flooding to maximum flows

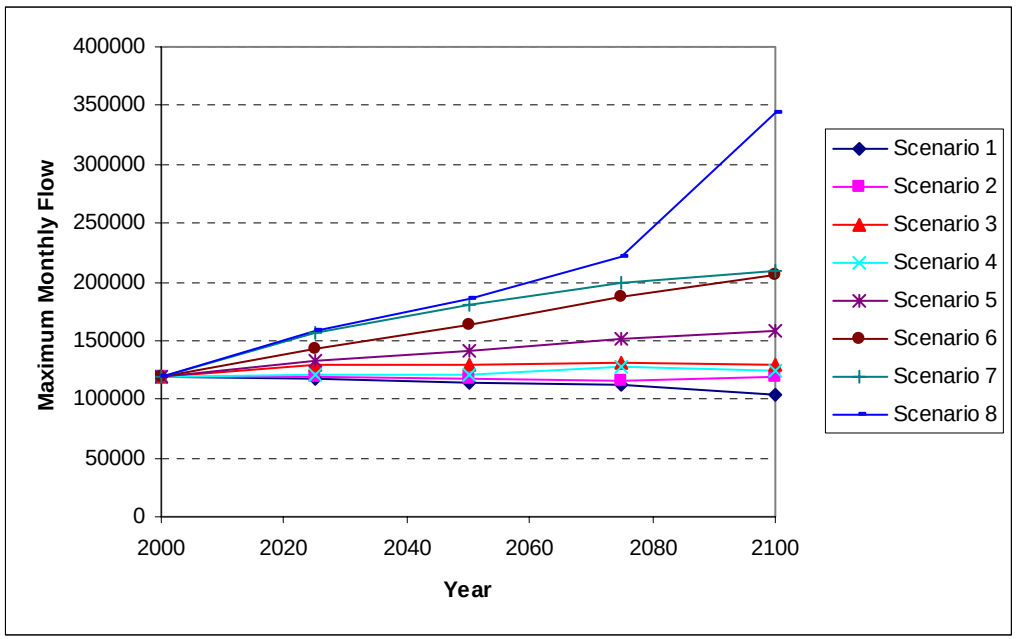
Preliminary Results – 684 Scenarios



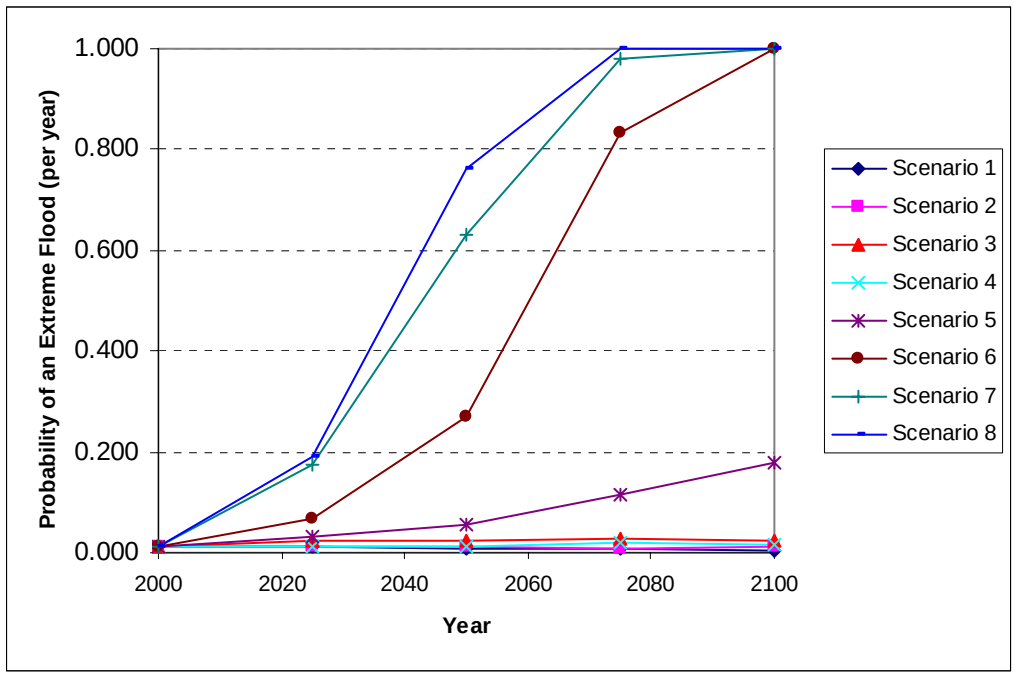
Representative Scenarios



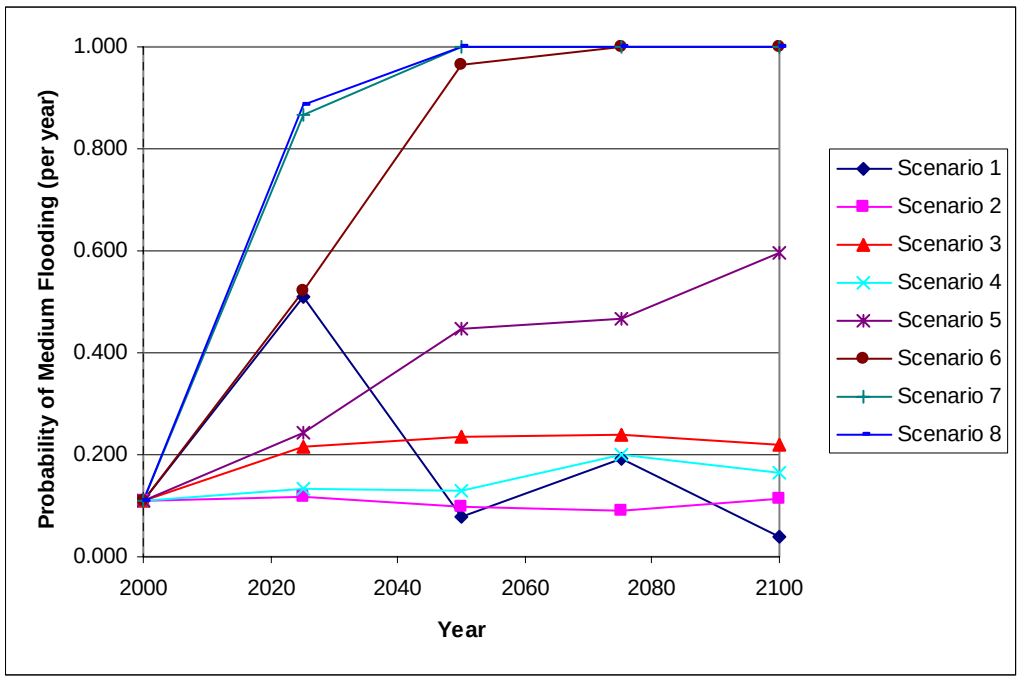
An Alternative View of the Representative Scenarios



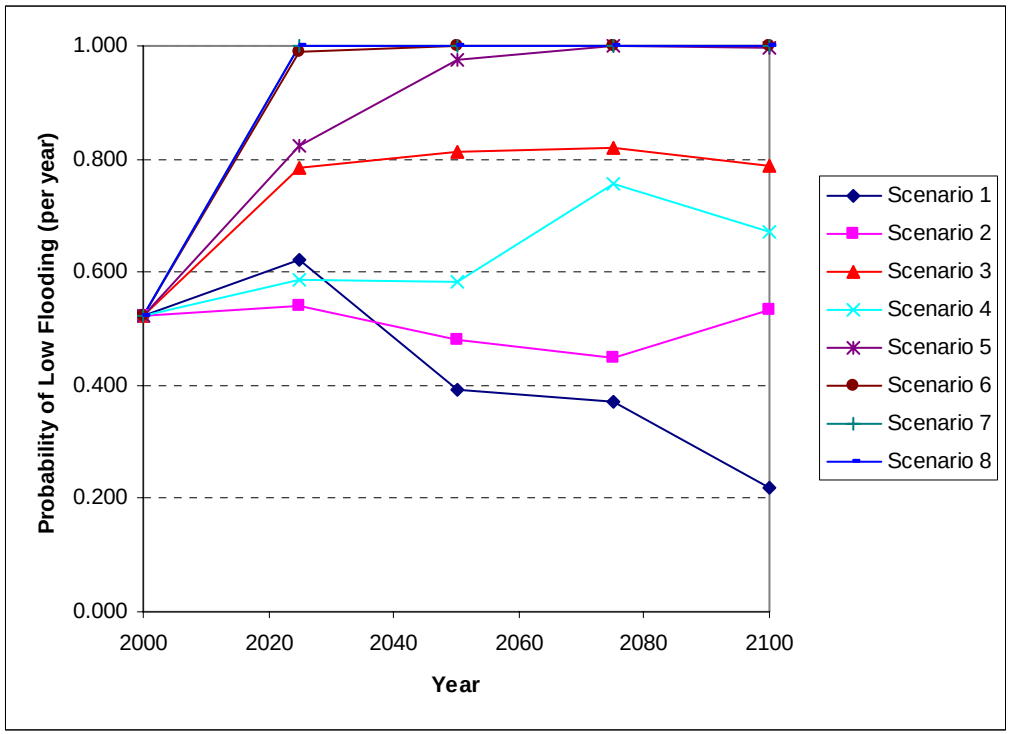
The Likelihood of Severe Flooding



The Likelihood of Moderate Flooding



The Likelihood of Modest Flooding



Two Stabilization Options

- Limit concentrations – temperature uncertainty persists, particularly with 5% to 10% of the tail of the cumulative probability distribution at 9 degrees or more.

- Limit temperatures – produces significant uncertainty about the cost of compliance.

- *Implementation uncertainty – the ability to achieve the target and/or effect midcourse corrections.*

A Working Hypothesis

- Implementation uncertainty is greater with temperature than concentration targets.

- Perhaps AR4 should include a discussion of any literature that speaks to implementation uncertainty.

In Any Case

- AR4 will include a chapter on synthesis in WGII (because the temptation to add things up globally is smaller than in WGIII)
- Analysis of mitigation should focus on cost-effectiveness, the ability to make mid-course corrections, and implementation uncertainty.
- Analysis of adaptation should focus on understanding the roles played by the various determinants of adaptive capacity and the antecedents of robust options.

A Two Way Street

- Adaptation must be included in any assessment of what may or may not be accomplished by mitigation in terms reducing the likelihood crossing critical impact thresholds.

- The degree to which mitigation complements adaptation in reducing those likelihoods must be explored with full recognition of associated uncertainties in the outcome of mitigation.