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Using RDM to Manage Climate and Other Uncertainties in EPA's National Water Program: Chesapeake Bay Case Study

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Project Introduction

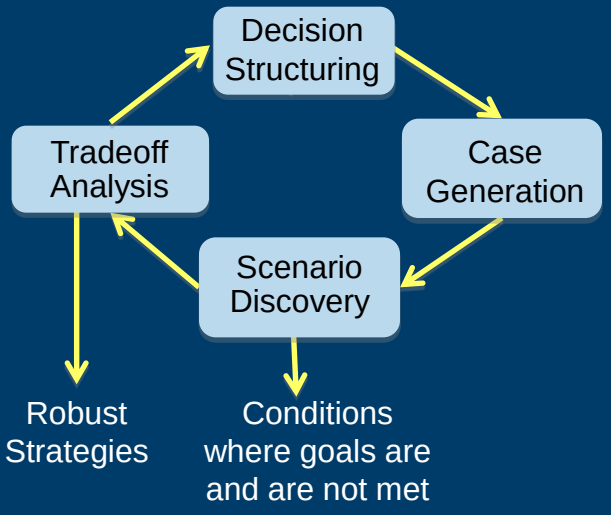
- Responding to climate change is complicated by its inherent uncertainty
- Robust Decision Making (RDM) is a new approach that could be useful to EPA for supporting climate-related decisions
- We want to evaluate RDM's ability to contribute toward these needs through conducting several case studies
- The Patuxent River is a good candidate to examine stormwater management choices under climate change

RDM Is a Quantitative Decision Framework Useful for Conditions of Deep Uncertainty

- Climate change confronts decision makers with deep uncertainties

  "Deep uncertainty" is when analysts do not know, and/or key parties to the decision do not agree on, the system model, prior probabilities, and/or "cost" functions

- Basic steps include:
  - Define key objectives, uncertainties, strategies, and relationships
  - Model each of many sets of assumptions to explore performance of strategies
  - Identify conditions under which goals are / are not met
  - Analyze tradeoffs among strategies and make potential modifications



RDM Has Proven Successful for Water Supply and Flood Control

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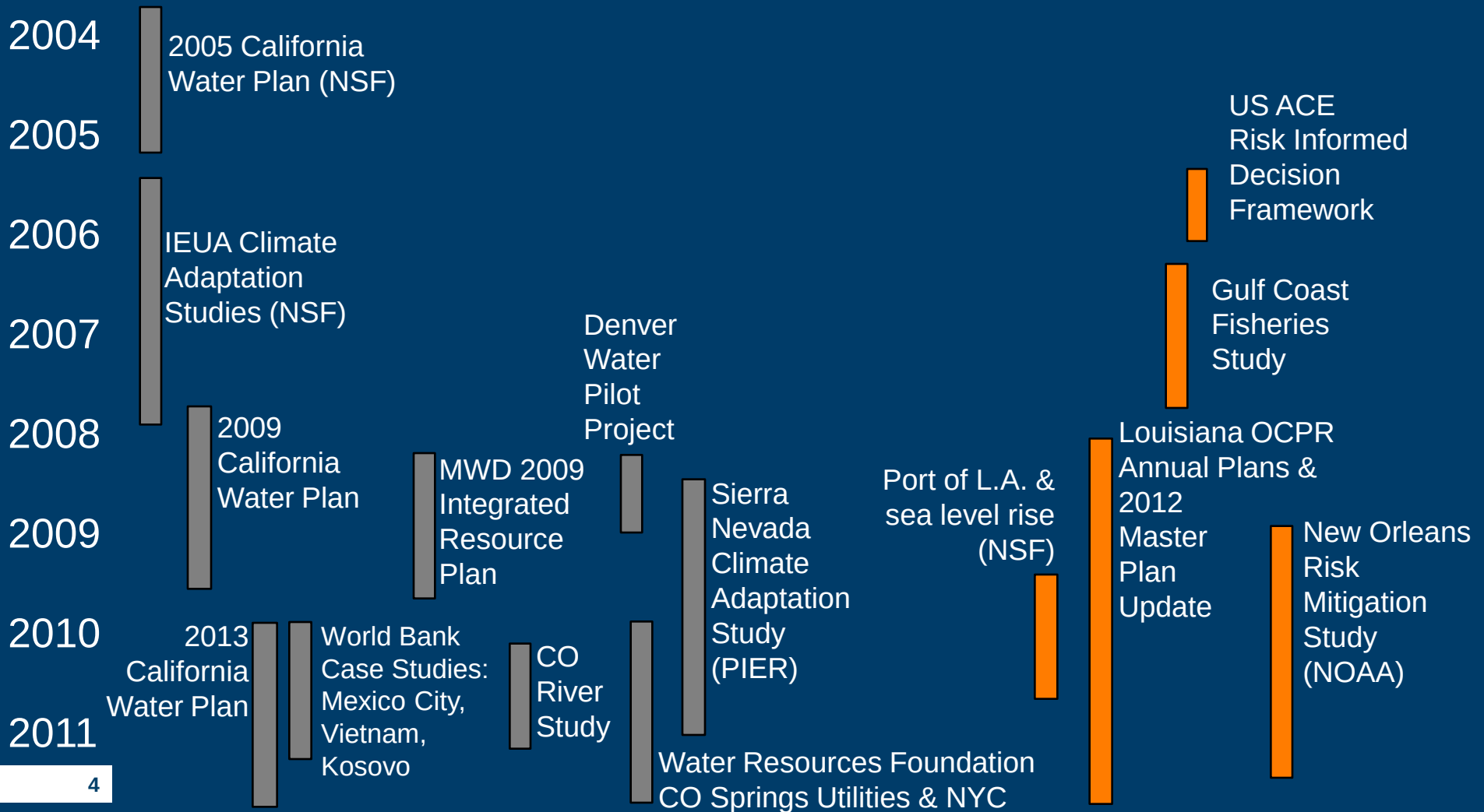
Long-term Water Resources Planning

Coastal Protection & Restoration



Will RDM Be Useful for Water Quality Decisions?

- Will it provide detailed understanding of future conditions where management strategies will and will not meet water quality goals?
- Will it provide useful information on tradeoffs among alternative strategies?
- Can a full and systematic identification of risk and a comparison of options be accomplished using existing data?
- Can this method be used to facilitate structured discussions among stakeholders to support decision making even in the face of deep uncertainty?
- Can adaptive strategies be used that may more effectively reduce deeply uncertain risk by evolving over time in response to new information?

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Selection Criteria for Case Studies

1. Locations are significantly influenced by climate change
2. Topics and decisions include deeply uncertain factors that potentially affect EPA's ability to achieve water quality goals
3. A range of policy options are available to address the intended goals (e.g., focus on regulatory decisions)
4. Existing models and data are relatively easy to adapt for an RDM analysis (scenario analyses)
5. Locations are in different parts of the country, with different types of jurisdictions, different sources of pollution, and willing participants

Available Models for Candidate Case Studies

- RDM analysis runs simulation models many 100's to 1000's of times for each of many different combinations of assumptions
- Case studies thus require existing, calibrated simulation model
  - For region of interest
  - Built in a modeling environment that supports automatic generation of multiple runs
- Example options:

Water Quality	Storm Water

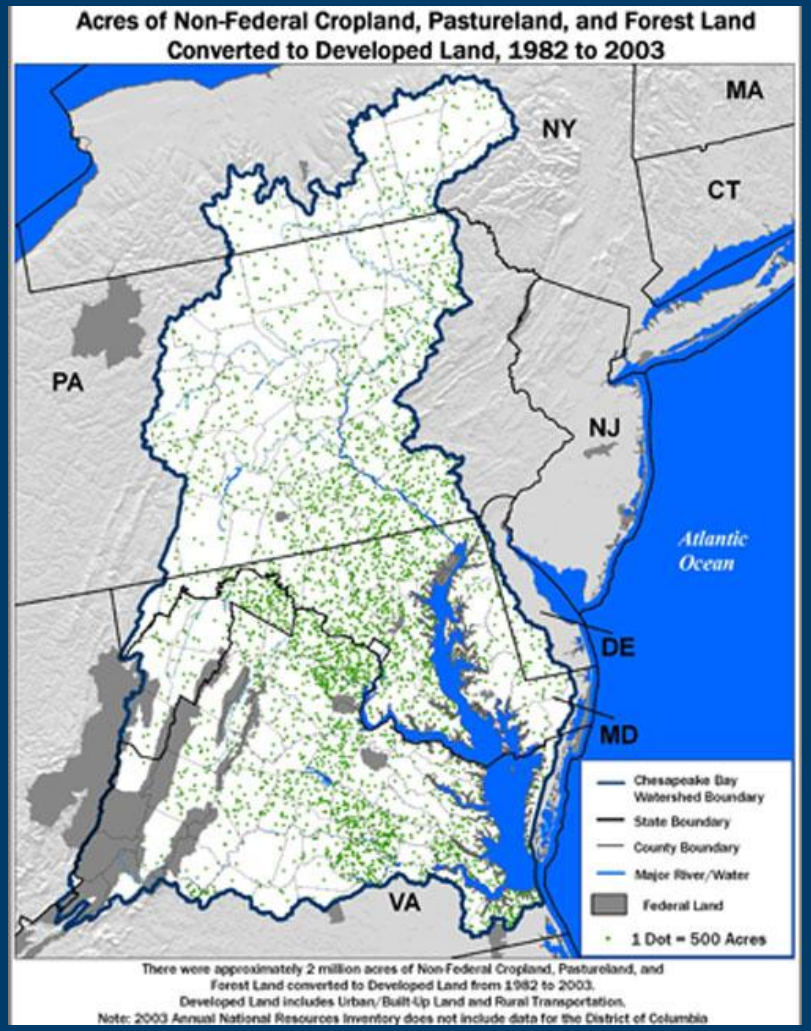
• BASINS-CAT
  • SWAT
  • HSPF
• USGS Sparrow
	• SWMM
	• HSPF (with new BMP capability)
	• Phase V Bay model

Proposal: Two Cases to Explore Usefulness of the Approach

	Region	Sources	Climate	Jurisdiction
Water quality	Mid West	Agricultural	Precipitation Temperature	Several states
Storm water	Mid Atlantic	Urban	Extremes	One or more cities

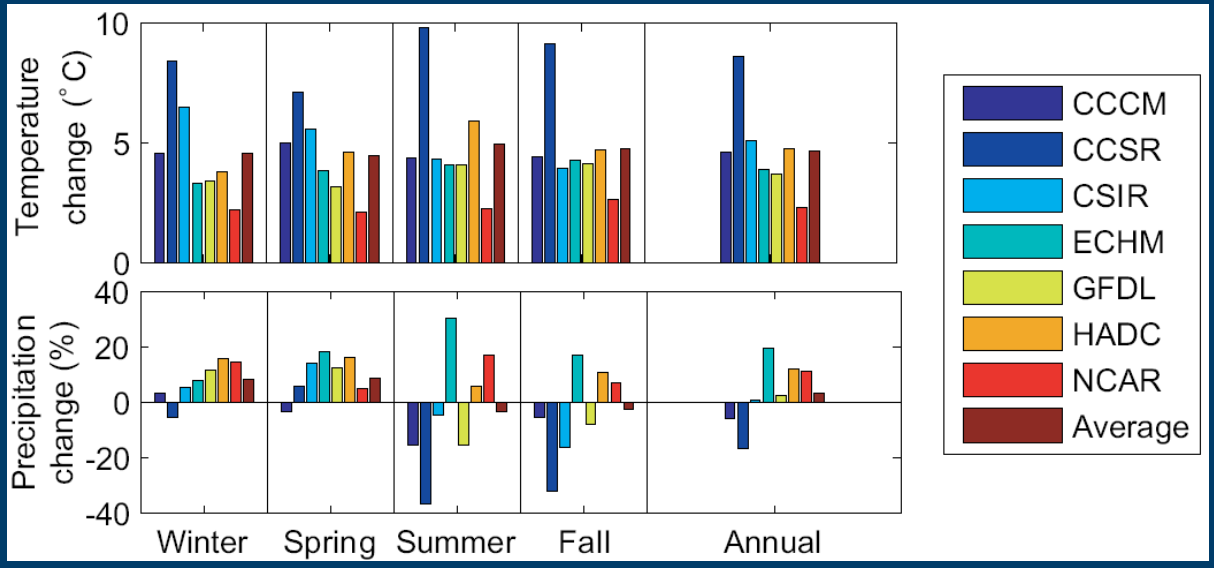
Stormwater Case Study: Chesapeake Bay

- Priority watershed for EPA
- Supports efforts to comply with Executive Order and TMDL
- Significant amount of modeling activities, data, and planning
- Synergies with other ongoing work



Key Uncertainties and Levers

- Climate change scenarios
- Land use scenarios
- BMPs (e.g., conventional, GI)



Specific Steps of Analysis

- Run Patuxent version of the Chesapeake Bay Watershed Model
- Scope the case study (land use change scenarios, measures of merit, BMPs to consider)
- Assemble experimental design
- Run automated version of Bay model with full experimental design
- Complete RDM analysis using the modeling results, with exact outputs to be determined in consultation with the Chesapeake Bay Program.
- Disseminate results of pilot to Chesapeake Bay Program

Scope the Case Study

Example of an 'xlrm' framework for Metropolitan Water District of Southern CA

Uncertainties (X)

- Future temperature and precipitation
- Demographic changes
- Condition of the Bay Delta
- Yields from local resources
- Timeliness of IRP implementation

Policy Levers (L)

- 2010 Integrated Resources Plan Update
  - Water use efficiency measures
  - Accelerated conservation
  - Local supply development
  - Stormwater capture
  - Large-scale seawater desalination

Relationships (R)

- IRPsim (mass balance planning model)
- Colorado River Decision Simulator (CORDS)
- WEAP Central Valley Model

Performance Metrics (M)

- Net Balance
- Total Storage

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Ultimately, we hope to determine if this approach will be useful to the Bay Program for incorporating climate change uncertainty into water quality decision making.

Thank you!