# Comparing Robust Decision Making and Adaptation Pathways for Supporting Climate Adaptation

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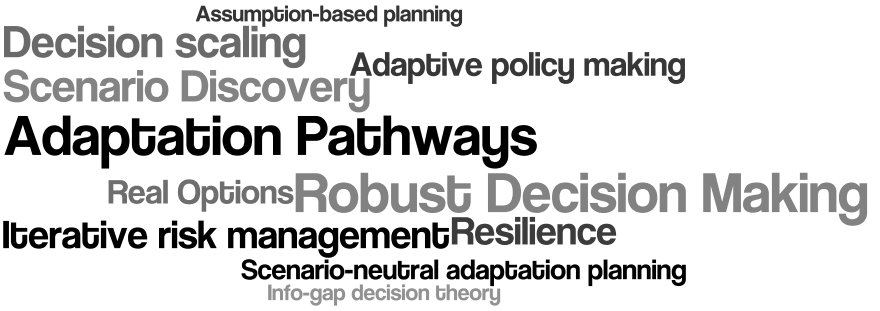


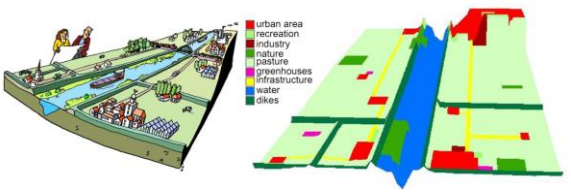
# How are all these approaches different?

- How do the approaches frame the problem?
- How do the approaches direct the analysis?
- What kind of information is needed for the approach?
- What kind of information is generated by applying the approach?

- Robust Decision Making as benchmark
  - info-gap decision analysis
  - real options
  - economic optimization

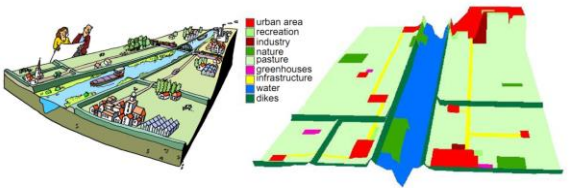
- No comparison with adaptation pathways yet

# Waas Case



# Waas Case

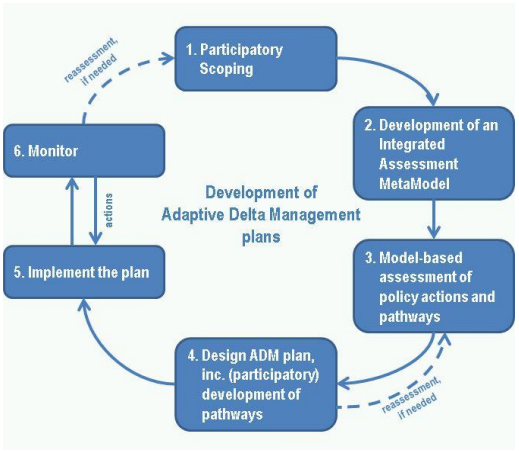
Possible actions:
- Strengthening and heightening of dikes
- Room for the river
- Multi level safety
- River basin management




Uncertainties
- River runoff
- Land use
- Relationship between water levels and failure of dikes
- Relationship between flood levels and economic damages
- Efficacy of actions

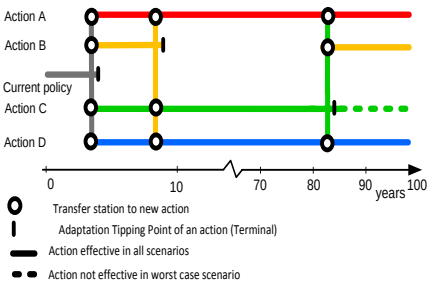
Outcomes:
- Casualties
- Economic damage
- Costs

# Dynamic Adaptive Policy Pathways




Haasnoot et al (2013) Dynamic Adaptive Policy Pathways: A New Method for Crafting Robust Decisions for a Deeply Uncertain World. *Global Environmental Change* doi: 10.1016/j.gloenvcha.2012.12.006

# DAPP approach




Adaptation Pathways Map

| | Path actions | Relative Costs | Target effects | Side effects |
|---|---|---|---|---|
| 1 | | +++ | + | 0 |
| 2 | | +++++ | 0 | 0 |
| 3 | | +++ | 0 | 0 |
| 4 | | +++ | 0 | 0 |
| 5 | | 0 | 0 | - |
| 6 | | ++++ | 0 | - |
| 7 | | +++ | 0 | - |
| 8 | | + | + | - - - |
| 9 | | ++ | + | - - - |

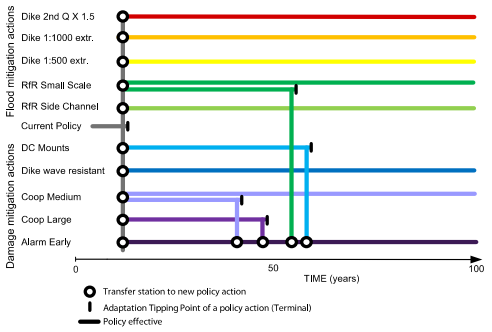
Scorecard for pathways

# Designing Adaptation pathways

- No standard design approach
  - Common sense / expert opinion
  - Participatory processes
  - Model based
- Curse of dimensionality
  - Many uncertain factors
  - Many policy options
  - Multiple outcomes of interest
- Multi-objective robust optimization

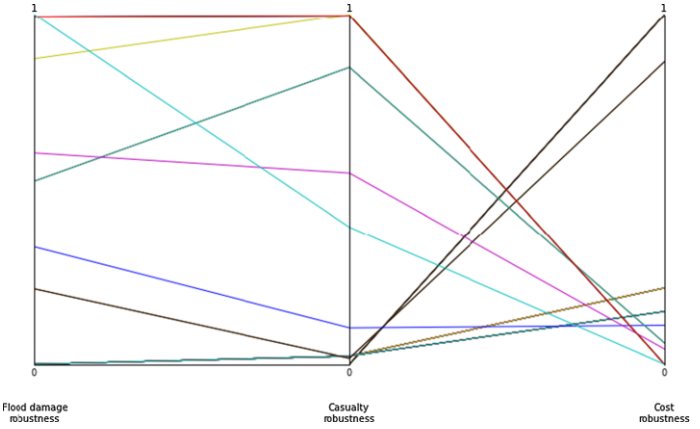
Kwakkel et al (2014) Developing dynamic adaptive policy pathways: a computer-assisted approach for developing adaptive strategies for a deeply uncertain world doi: 10.1007/s10584-014-1210-4

# DAPP pathway map

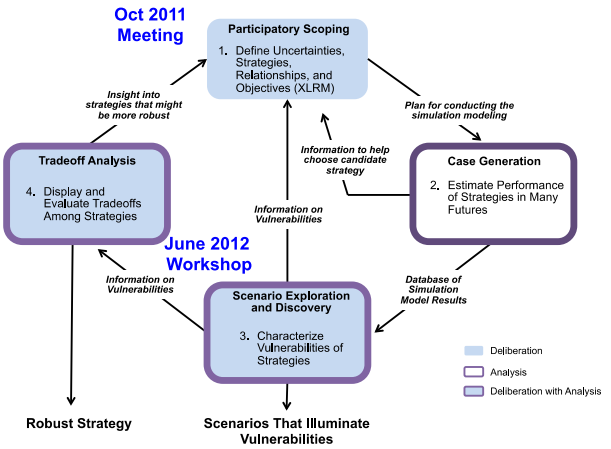



| | flood damage robustness | number of casualties robustness | costs robustness |
|---|---|---|---|
| Alarm Early | 1.00 | 0.34 | 0.00 |
| Coop Large, Alarm Early | 0.86 | 0.99 | 0.00 |
| Coop Medium | 1.00 | 1.00 | 0.00 |
| Coop Medium, Alarm Early | 1.00 | 1.00 | 0.00 |
| DC Mounts, Alarm Early | 0.37 | 0.20 | 0.86 |
| Dike 1:1000 extr. | 0.00 | 0.01 | 0.22 |
| Dike 1:500 extr. | 0.00 | 0.01 | 0.15 |
| Dike 2nd Q x 1.5 | 0.00 | 0.00 | 1.00 |
| Dike Wave resistant | 0.26 | 0.08 | 0.11 |
| RfR Side channel | 0.50 | 0.38 | 0.05 |
| RfR Small Scale | 0.53 | 0.63 | 0.06 |
| RfR Small Scale, Alarm Early | 0.53 | 0.63 | 0.06 |

# Understanding the trade offs



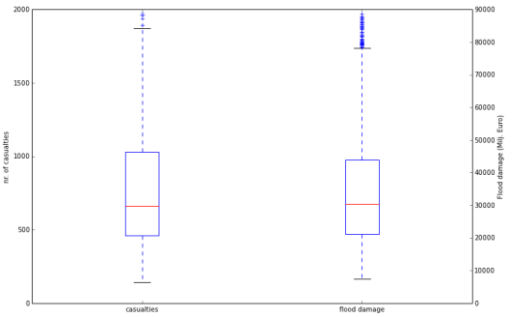
# Robust Decision Making




Lempert et al (2013) Ensuring robust flood risk management in Ho Chi Minh City

# First iteration

- 5000 experiments
- Strong correlation between casualties and damages



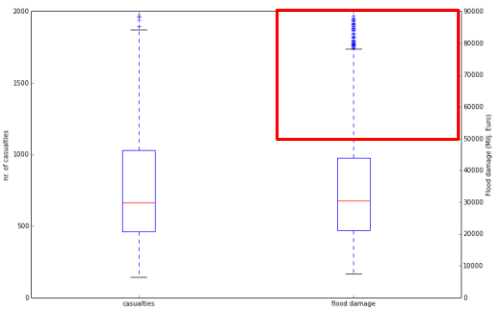
# First iteration

- 5000 experiments
- Strong correlation between casualties and damages

**Scenario discovery results**

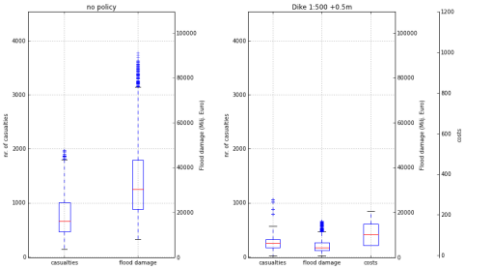
- 972 cases of interest
- Combination of W+ and any urbanization scenario

- Clear need for action




# Second iteration

- 5 policy options, out of which dike heightening appears to be the most promising
- Less correlation between damages and casualties



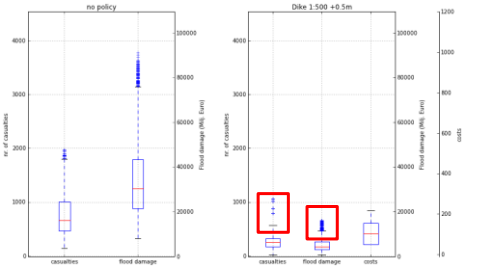
# Second iteration

- 5 policy options, out of which dike heightening appears to be the most promising
- Less correlation between damages and casualties

**Scenario discovery**

- Casualties due strong urbanization
- Damages more difficult to explain

- Need to expand or complement policy

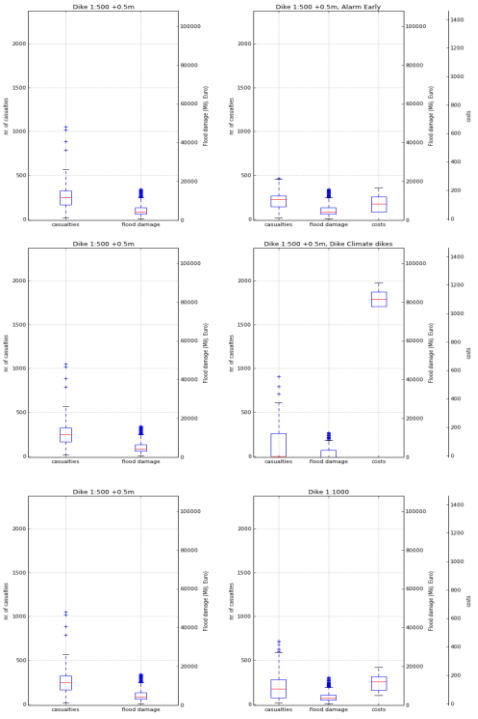



# Third iteration

- 3 potential solutions with different trade offs
  - Dike heightening + evacuation
  - Dike heightening + climate dikes
  - Substantial dike heightening

**Scenario discovery**

- inconclusive



# Resulting policy

- Three possible options
  - Dike 1:500 + 0.5 + early evacuation
    cheap, reasonable effective mainly for reducing casualties
  - Dike 1:500 + 0.5 + climate dikes
    very expensive, quite effective for reducing both casualties and damages
  - Dike 1:1000
    modestly cheap, reasonable effective for reducing both casualties and damages
- Preferences on outcomes will determine the final decision

# Comparison

**DAPP**

*Final plan*

- Several possible adaptation pathways
- Clear understanding of trade offs
- No motivation for design, optimization process is a black box

*process*

- Clear design principles for plan
- Alternative options for design support
- Reliance on robustness metric

**RDM**

*Final plan*

- 3 possible static policies
- Clear understanding of trade offs
- Clear motivation in light of identified vulnerabilities

*process*

- No design theory for the plan
- Clear methodological approach for design support

# Concluding remarks

- Both DAPP and RDM result in effective plans
- DAPP forces the analyst to consider flexibility
- DAPP has less design support
- RDM does not direct the analyst in any direction, it only illuminates the vulnerabilities
- RDM enhances understanding of vulnerabilities

- Complementarity between RDM and DAPP
  - Design pathways using RDM and scenario discovery

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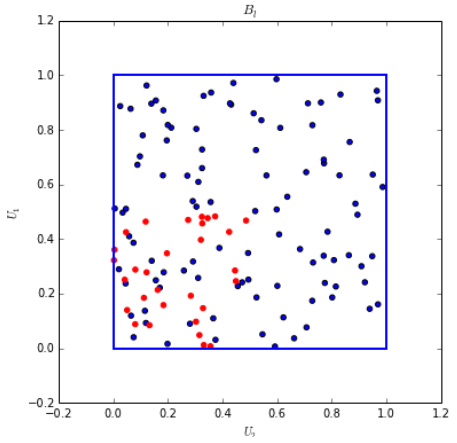


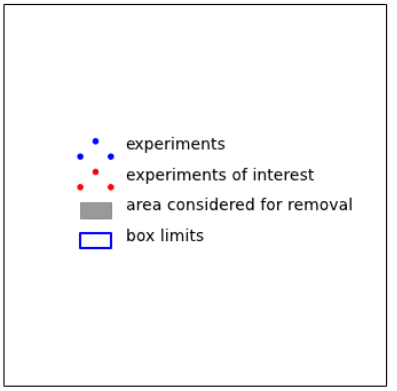


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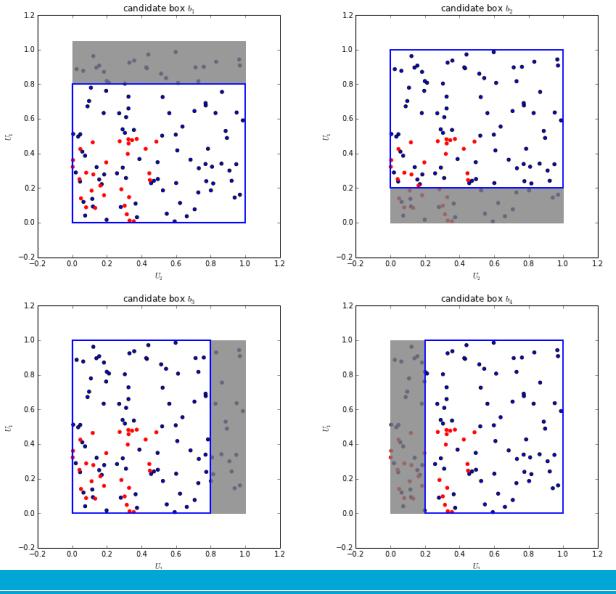


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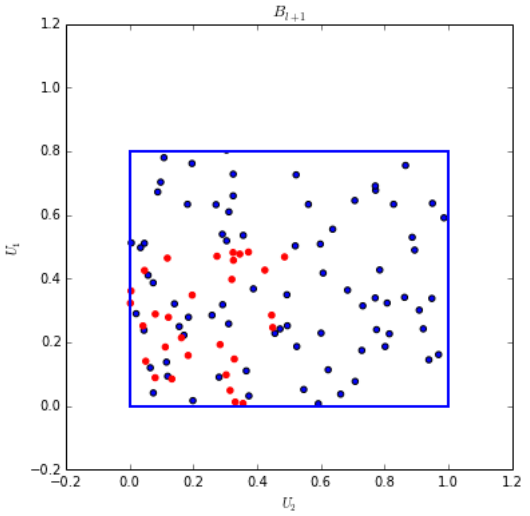


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