Adaptive pathways: Little River Basin in Miami

Marjolijn Haasnoot, Jayantha Obeysekera, Kathryn Roscoe, Ferdinand Diermanse, Claire Jeuken
Changing Estimates of Sea level rise by 2100

Larger bandwidth, Uncertainty increased → Deep uncertainty

The New York Times
Rising Seas Will Erase More Cities by 2050, New Research Shows

By James Lu and Christopher Florell, Oct. 20, 2015

Note: The I.P.C.C.’s 2007 estimate of future sea level rise did not include satellite data on the contribution of melt water from Greenland and Antarctica because of disagreements among scientists.
Adaptive pathways planning using Dynamic Adaptive Policy Pathways (DAPP)

A **systematic framework** to support planning and decision making **under deep uncertainty**:

- What low-regret actions can we take now that contribute to future goals?
- What actions can we postpone? How to prioritize?
- What robust and flexible strategies perform well over a wide range of futures?
Anticipate with adaptive plan

Systematic framework of DAPP

Key features:

1. Describe system, objectives, uncertainties
2. Assess vulnerability/opportunities: adaptation/opportunity tipping point (ATP/OTP)
3. Identify actions and assess ATP conditions and timing
4. Develop and evaluate adaptation pathways
5. Design adaptive plan: short-term actions, long-term options and adaptation signals
6. Implement the plan
7. **Monitor**: ATP approaching? Actions or reassessment?
Application to Miami C7 basin (2017)

Adaptive pathways studies in practice
Adaptive pathways in guidance
Workshop to explore pathways of narratives

pathways generator tool: http://pathways.deltares.nl
Portfolio of measures

- **M0** – No action
- **M1** – Local flood mitigation: flood walls, exfiltration trenches, flap gates, and local pumps
- **M2** – Regional flood mitigation: forward pumps at S-27 coastal structure (small & large pumps)
- **M3** - Land-use mitigation: raise roads and buildings to 6, 7 or 8 feet elevation
Quantitative analyses

Hydrologic Drivers:
- Rainfall (4x)
- Storm Surge (1/10)
- Sea Level Rise (3x)

Adaptation Options

Hydrodynamic Model
XPSWMM

Delft-FIAT

Dynamic Adaptive Policy Pathways (DAPP)

Expected annual damage (M$)

Sea level rise (ft)
Adaptation tipping points

**Objective:**
Expected annual damage (EAD) should not exceed current levels

**Threshold** = current EAD

Current EAD

Sea level rise (ft)

- SLR1
  - 2045
  - 2065 (0.76 ft)
- SLR3
  - 2025
  - 2050
  - 2065 (2.21 ft)

Expected annual damage (EAD) vs. sea level rise (ft) for SLR1 and SLR3.
Adaptive pathways

Structural measures
- M2b large reg fm
- M2a small reg fm
- M1 local fm
- M0 no action

Land use measures
- M3 Elevate 6ft
- M3 Elevate 7ft
- M3 Elevate 8ft

Sea level rise (ft)
0 1.0 2.0 3

SLR1
2020 2050

SLR3
2020 2030 2040 2050 2060

Key: generated with Pathways Generator, JDOE, Others, Coastal Consultants
Adaptive pathways

Structural measures
- M2b large reg fm
- M2a small reg fm
- M1 local fm
- M0 no action

Land use measures
- M3 Elevate 6ft
- M3 Elevate 7ft
- M3 Elevate 8ft

Sea level rise (ft)
0 1.0 2.0 3

SLR1
- 2020
- 2040
- 2050

SLR3
- 2020
- 2030
- 2040
- 2050
- 2060
Adaptive pathways

- Land use measures are needed in the end
- Installing pumps can buy some time.

**Structural measures**

- M2b large reg fm
- M2a small reg fm
- M1 local fm
- M0 no action
- M3 Elevate 6ft
- M3 Elevate 7ft
- M3 Elevate 8ft

**Land use measures**

Sea level rise (ft)

- SLR1
  - 2020 2040 2050
- SLR3
  - 2020 2030 2040 2050 2060
Adaptation to high-end or accelerated SLR

Limits due to rate of change?

Functional life time of investments decreases:

\textit{adapt faster or larger}

\begin{itemize}
\item \textbf{~65 years}
\item \textbf{~20 years}
\item \textbf{~10 years}
\end{itemize}

Haasnoot et al. 2019
https://doi.org/10.1088/1748-9326/ab666c
Solution space to high-end sea-level rise

Sea-level rise

*) deltabeslissingen en voorkeursstrategieën uit Deltaprogramma 2015.
Summary

• **Pathways** open *decision space*, identify *path-dependencies* and overcome *policy paralysis*

• **Tipping points** identify under what conditions and *when* to act

• **Monitoring** to detect signal if adjustment or additional actions are needed

• **Assessment modes**: model-based, expert, participatory pathways

Corona-investments: mitigate, avoid, anticipate
Uncertainty in timing (when instead of if)