Deltares

enabling delta life

Deltares

- We are working on **smart innovations** in the field of water and subsurface
- We are **the knowledge partner** of the Dutch government.
- We make our knowledge applicable **worldwide.**
- We are a **strategic partner** and **trusted advisor** internationally.
- We believe in **open source / freeware software**.

877

Number of employees

79%

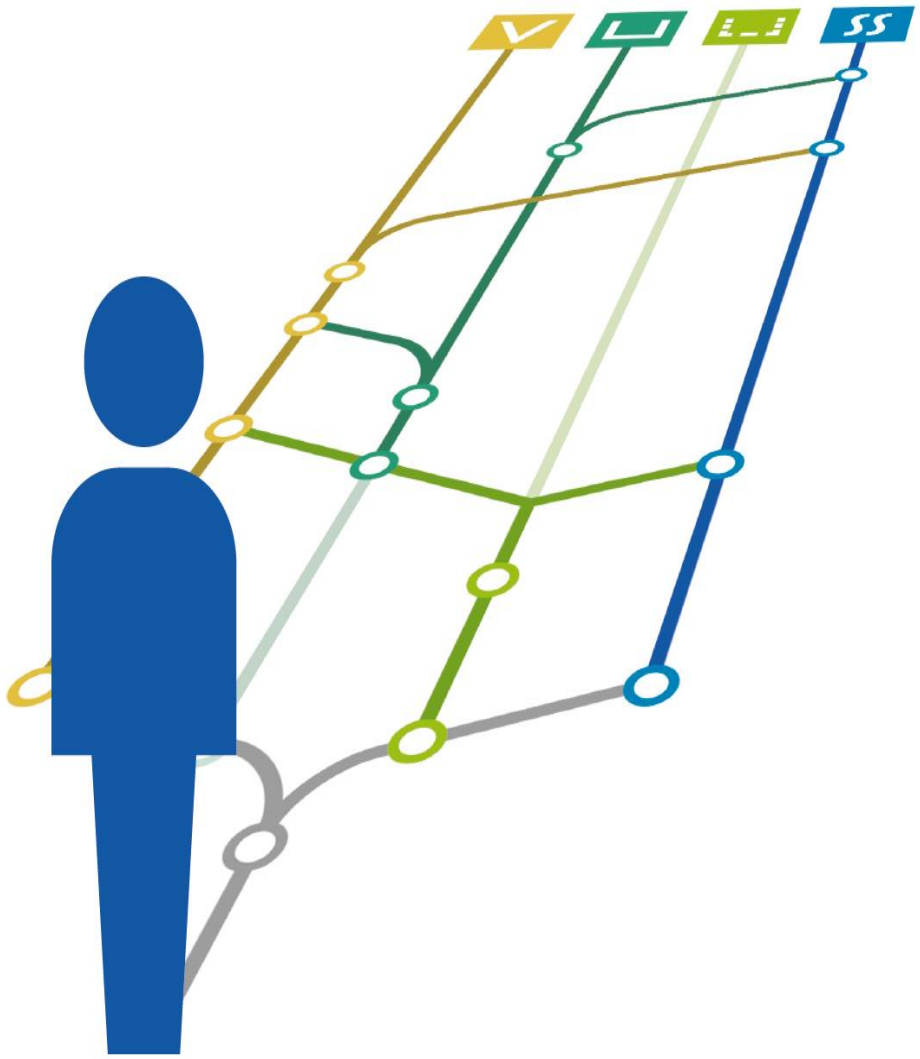
University / Ph.D.
39 nationalities

Regional offices in Abu Dhabi, Singapore and Indonesia

118
m€

Net turnover

ADB Deltares



Deltares

Adaptive planning under deep uncertainty

Dynamic adaptive policy pathways and climate adaptation

Marjolijn Haasnoot

Utrecht University

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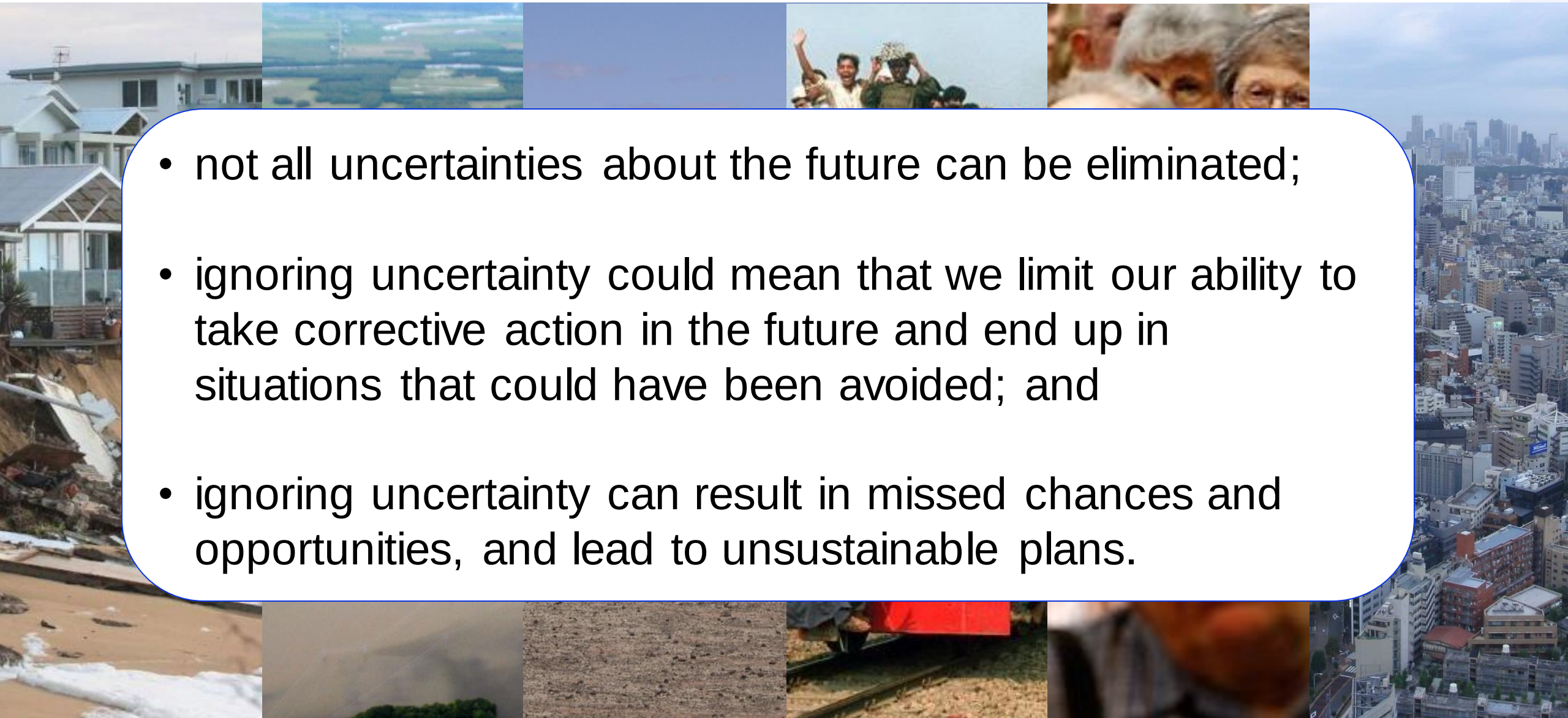
Potential Futures - uncertainty



- not all uncertainties about the future can be eliminated;
- ignoring uncertainty could mean that we limit our ability to take corrective action in the future and end up in situations that could have been avoided; and
- ignoring uncertainty can result in missed chances and opportunities, and lead to unsustainable plans.

Under deep uncertainty decision makers should aim for **robust** plans that can be **adapted** over time

Adaptive planning using Dynamic Adaptive Policy Pathways (DAPP)

A systematic framework for adaptive planning:

- Choose **short-term actions** and the **thresholds** beyond which they are no longer sufficient
- Identify the **additional actions** that are needed beyond the thresholds

Approach helps focus on important questions under deep uncertainty:

- What low-regret actions can we take now to that contribute to future goals? (and don't hinder future actions)
- What actions can we postpone? How to prioritize?
- What robust and flexible strategies perform well over a wide range of futures?

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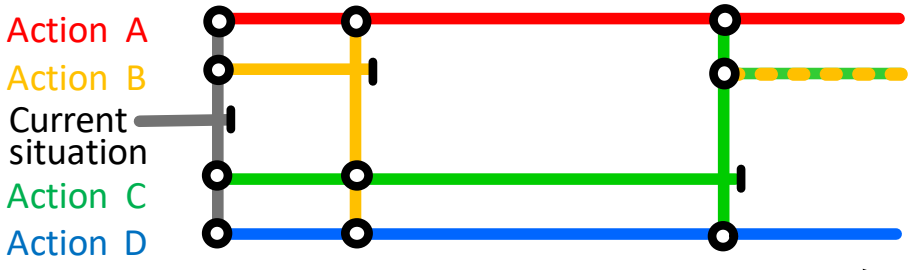
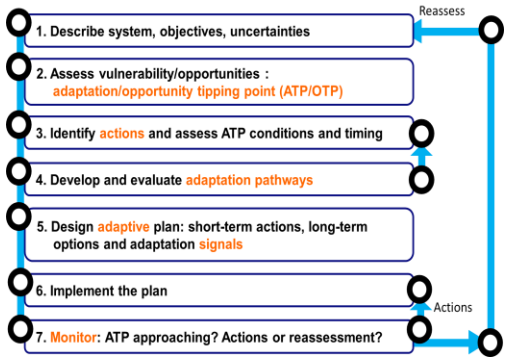
Haasnoot et al 2013, 2019

Adaptation pathways

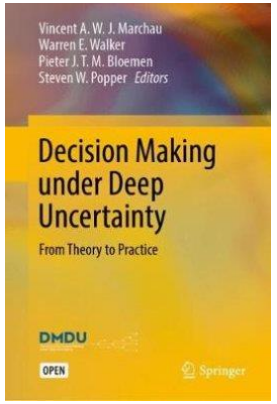




Signals

Anticipate with adaptive plan

Book chapters: Dynamic Adaptive Policy Pathways, Adaptive Delta Management



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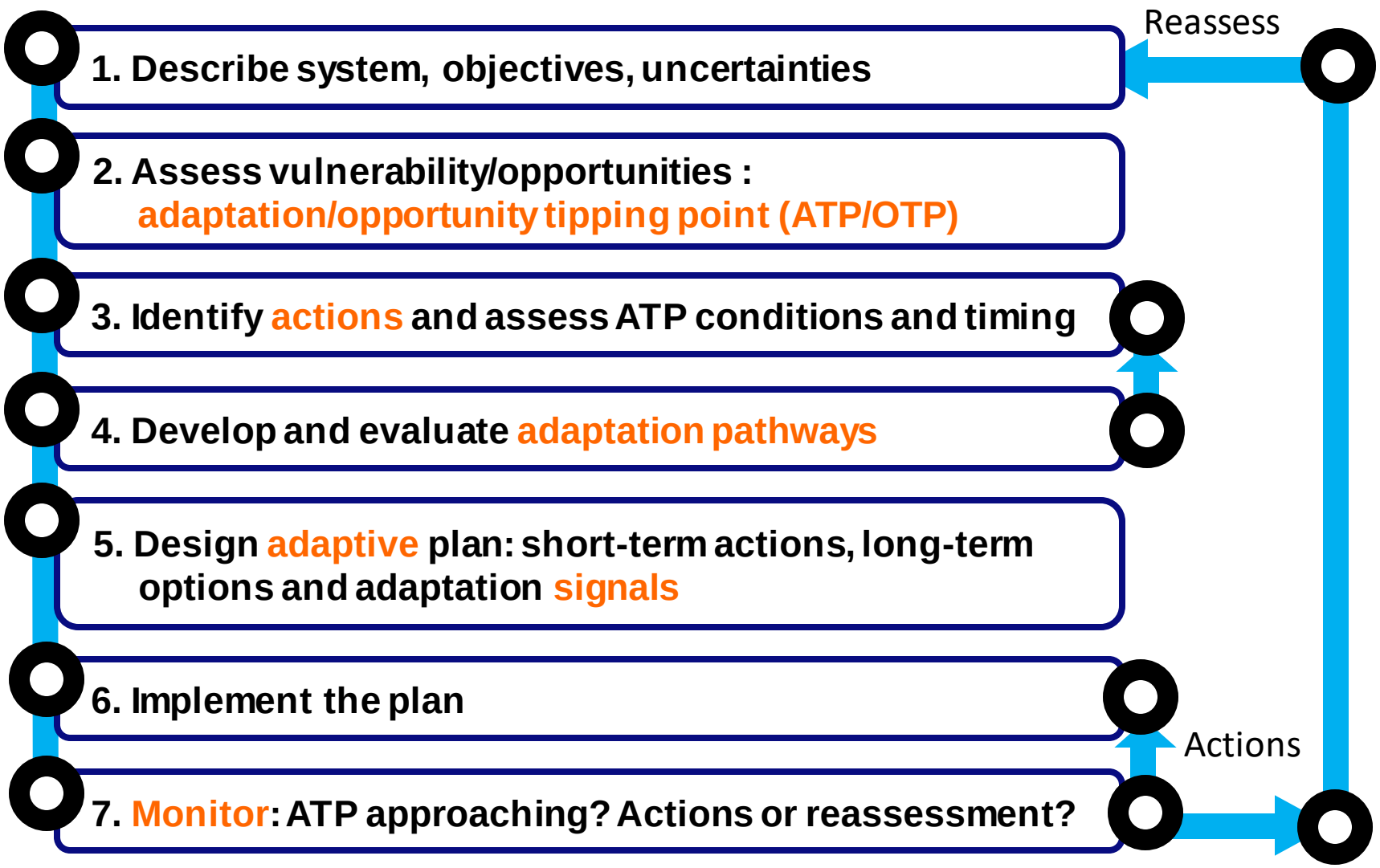
Haasnoot et al 2013 GEC, 2019

Steps - overview



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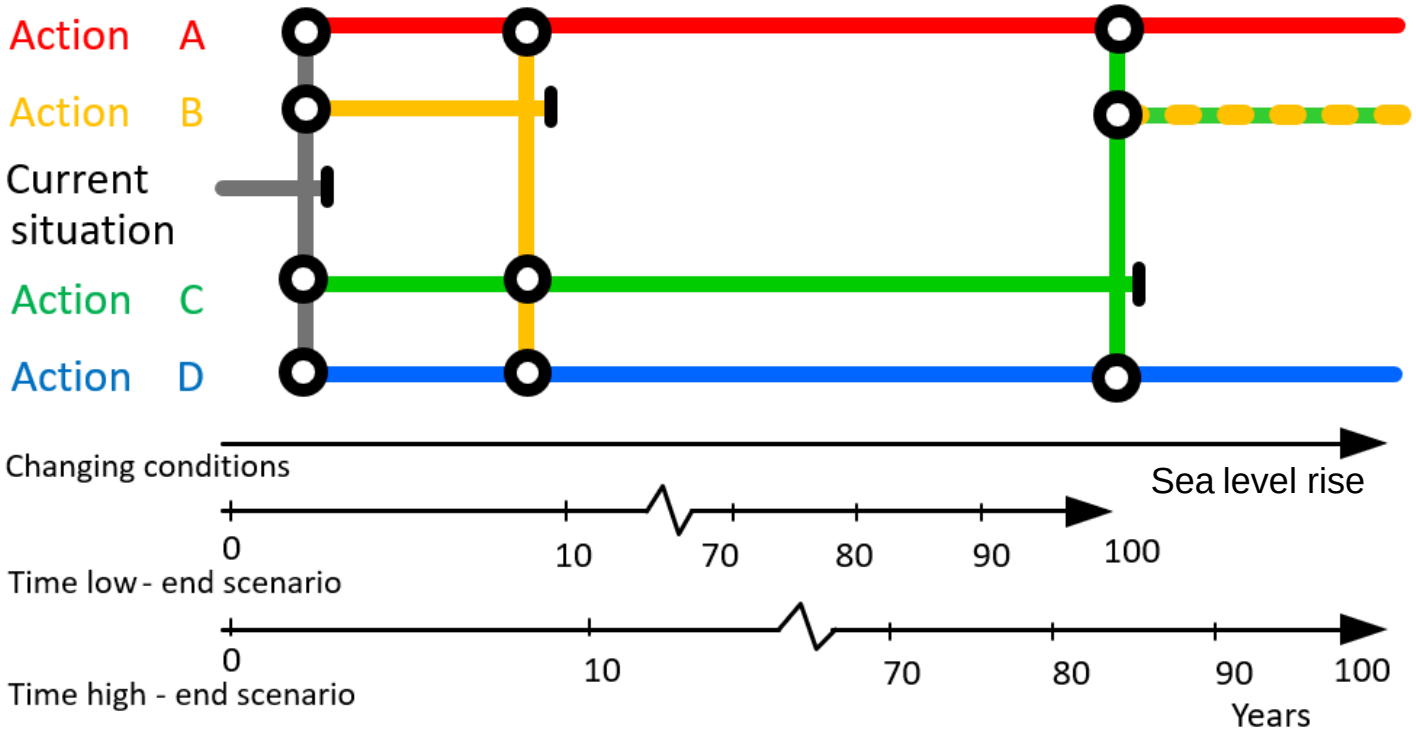
Adaptation pathways maps



Time horizon 100 years			
Pathway	Costs	Benefits	Co-benefits
1	+++	+	0
2	+++++	0	0
3	+++	0	0
4	+++	0	0
5	0	0	-
6	++++	0	-
7	+++	0	-
8	+	+	- - -
9	++	+	- - -

Transfer station to new policy action

Adaptation Tipping Point of a policy action (Terminal)

Policy action effective

The maps (left) show different possible sequences of decisions to achieve objectives. A scorecard (right) helps to evaluate the pathways and decisions.

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A phased approach to pathways

Awareness raising:

- Serious gaming.
- Introduction to adaptive planning method.

http://deltagame.deltares.nl

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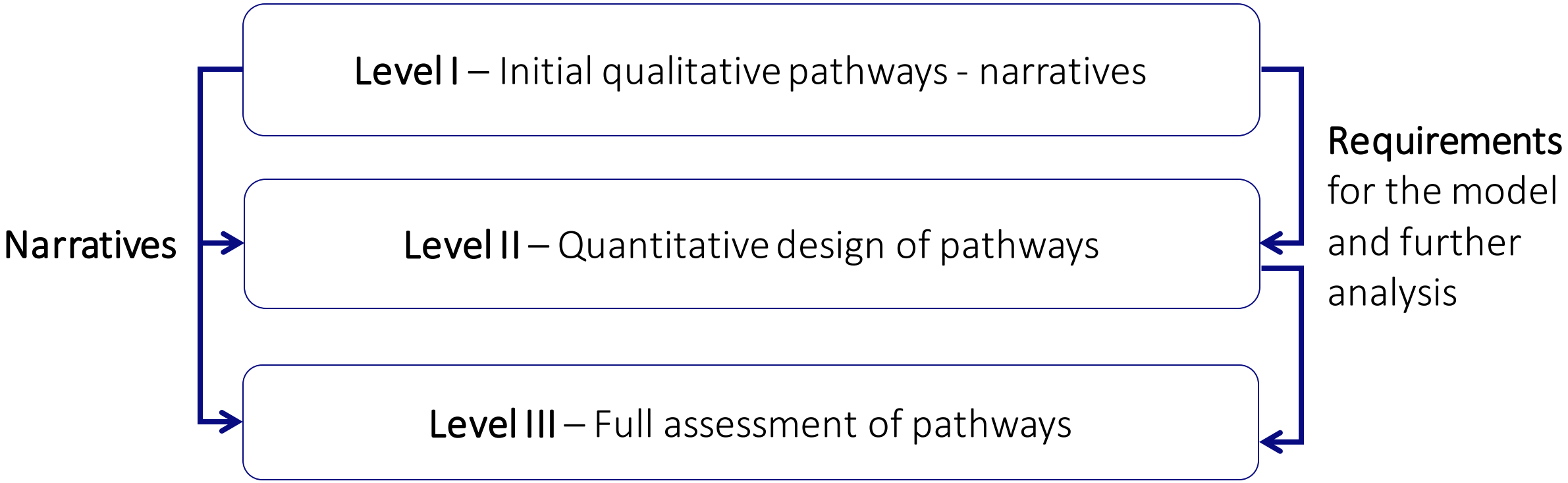
A phased approach to pathways



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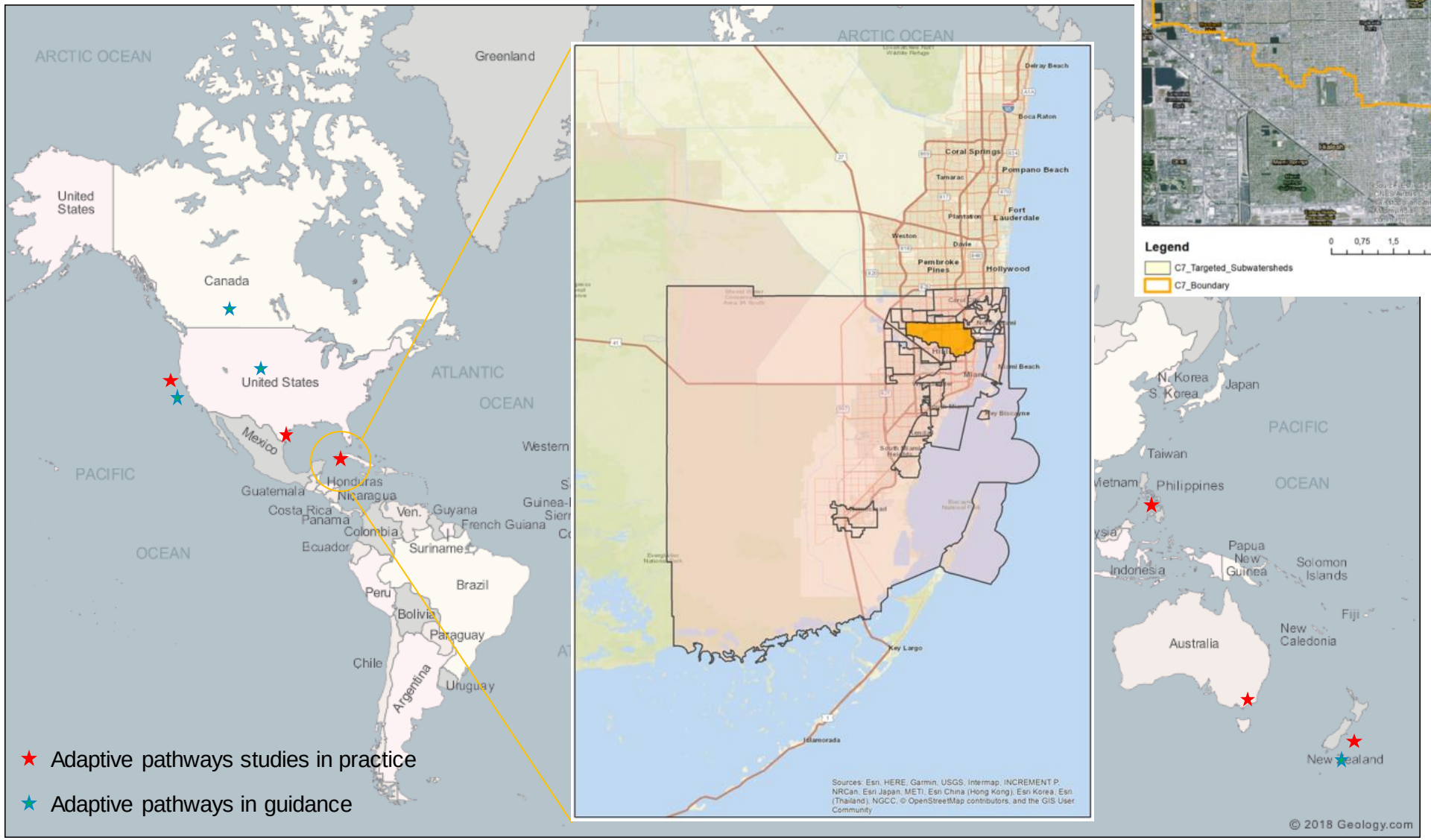
Example case studies

DAPP applications, Miami C7 basin (2017)



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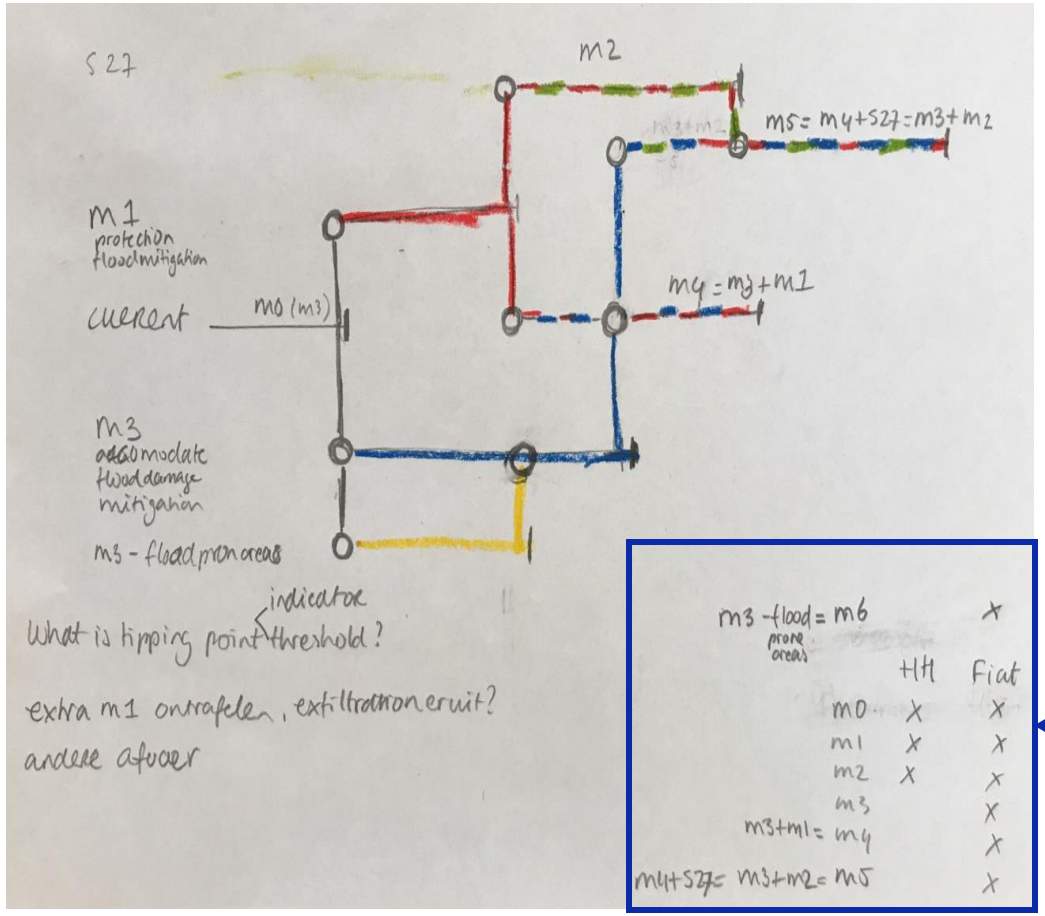
Workshop to explore pathways narratives



To be modeled

Pathways generator tool: http://pathways.deltares.nl

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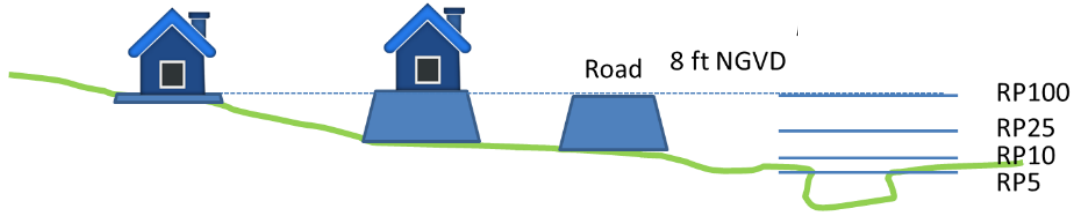
Portfolio of measures

- **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



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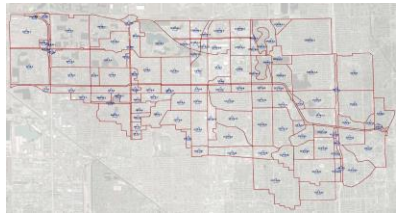
Quantitative analyses

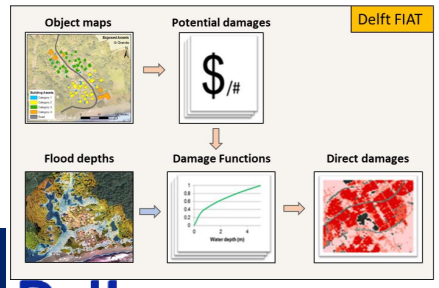
Dynamic Adaptive Policy Pathways (DAPP)

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

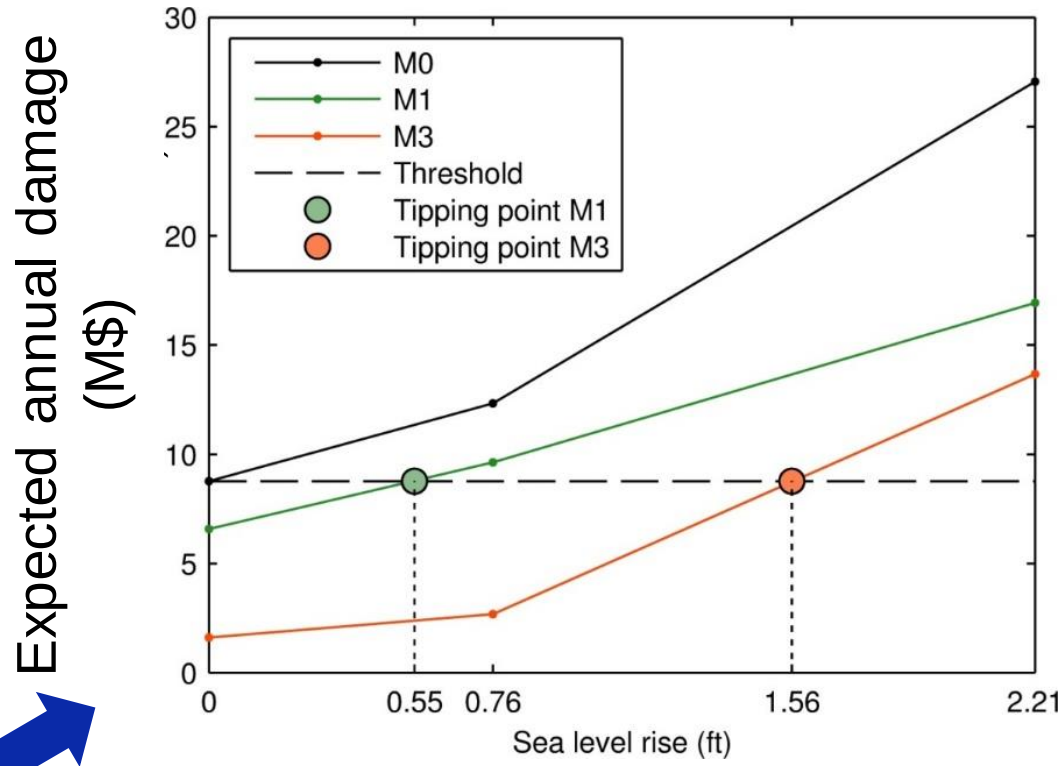
Hydrodynamic Model XPSWMM



Delft-FIAT



Adaptation Options



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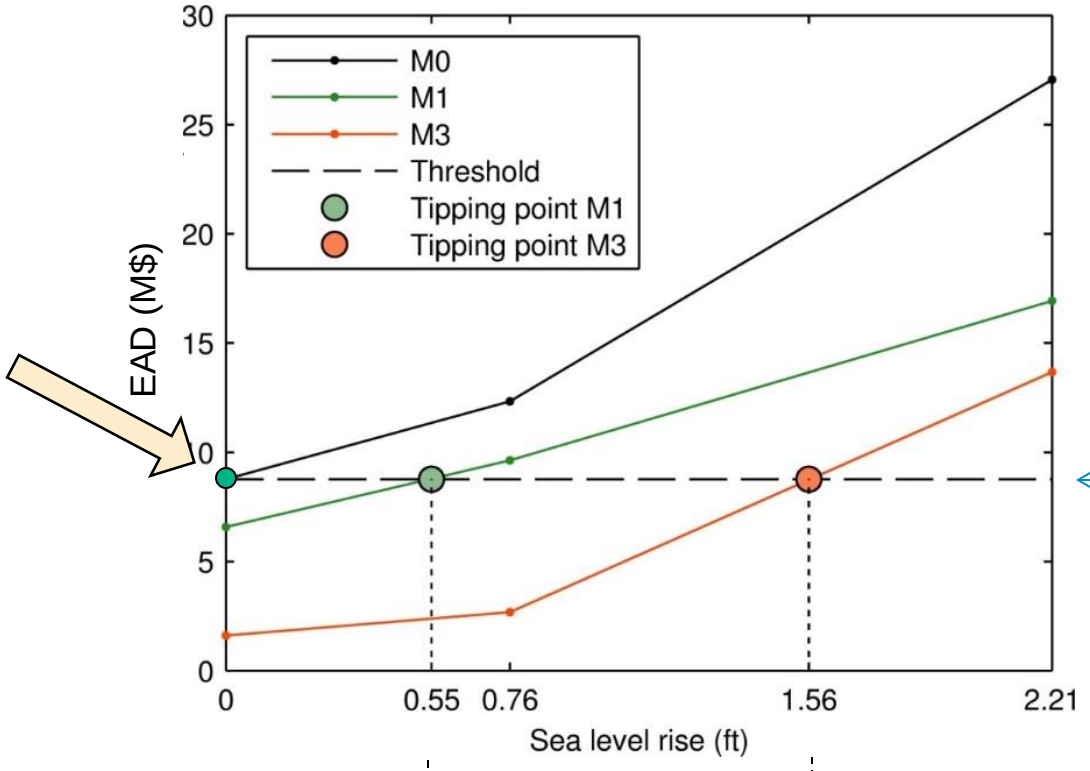
Adaptation tipping points based on modelling (hydrological and damage)



Current EAD

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

Threshold = current EAD

SLR1 → 2065 (0.76 ft)

2045

SLR3 → 2065 (2.21 ft)

2025

2050

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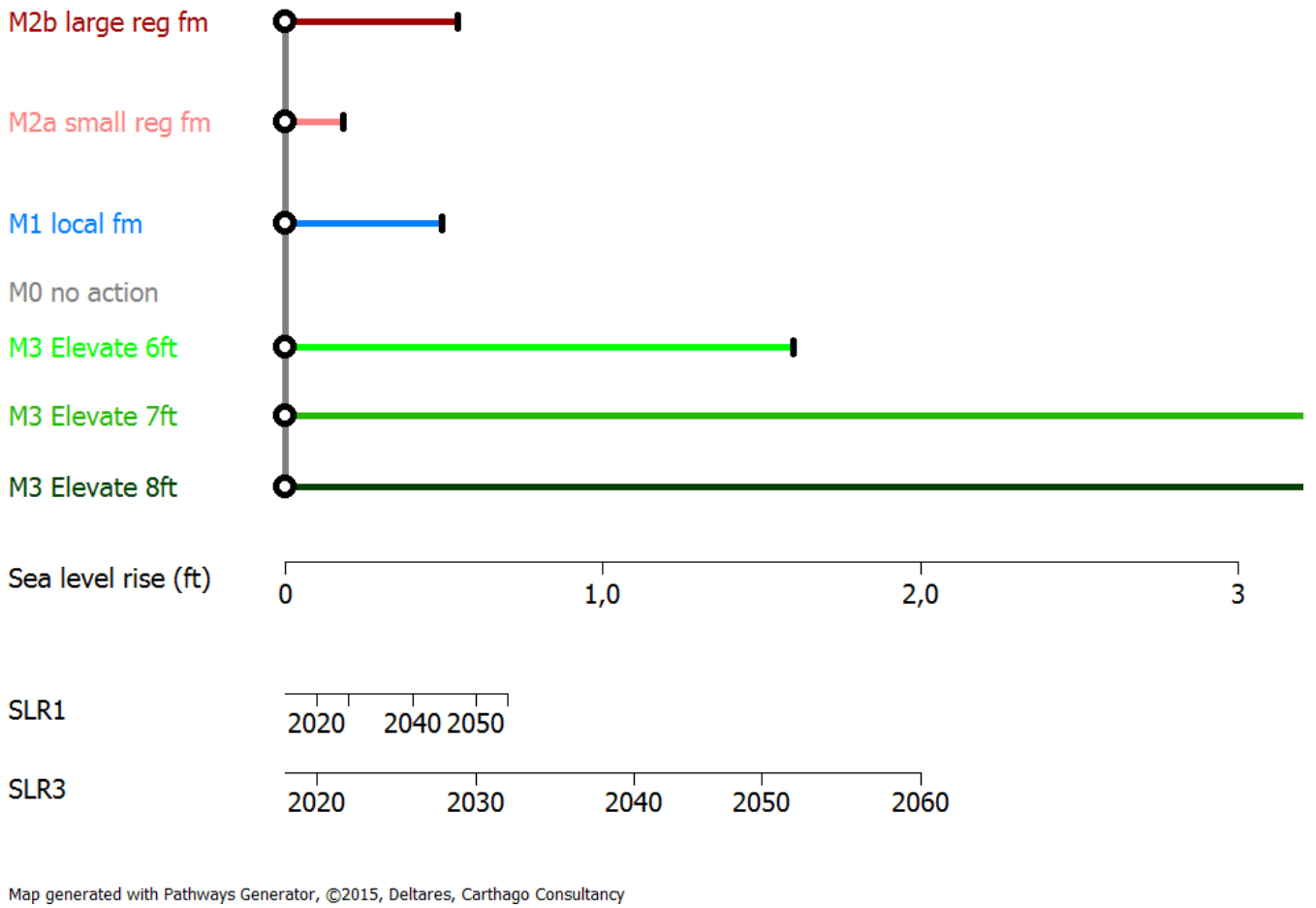
Adaptation pathways

Structural measures

Land use measures



Map generated with Pathways Generator, ©2015, Deltares, Carthago Consultancy

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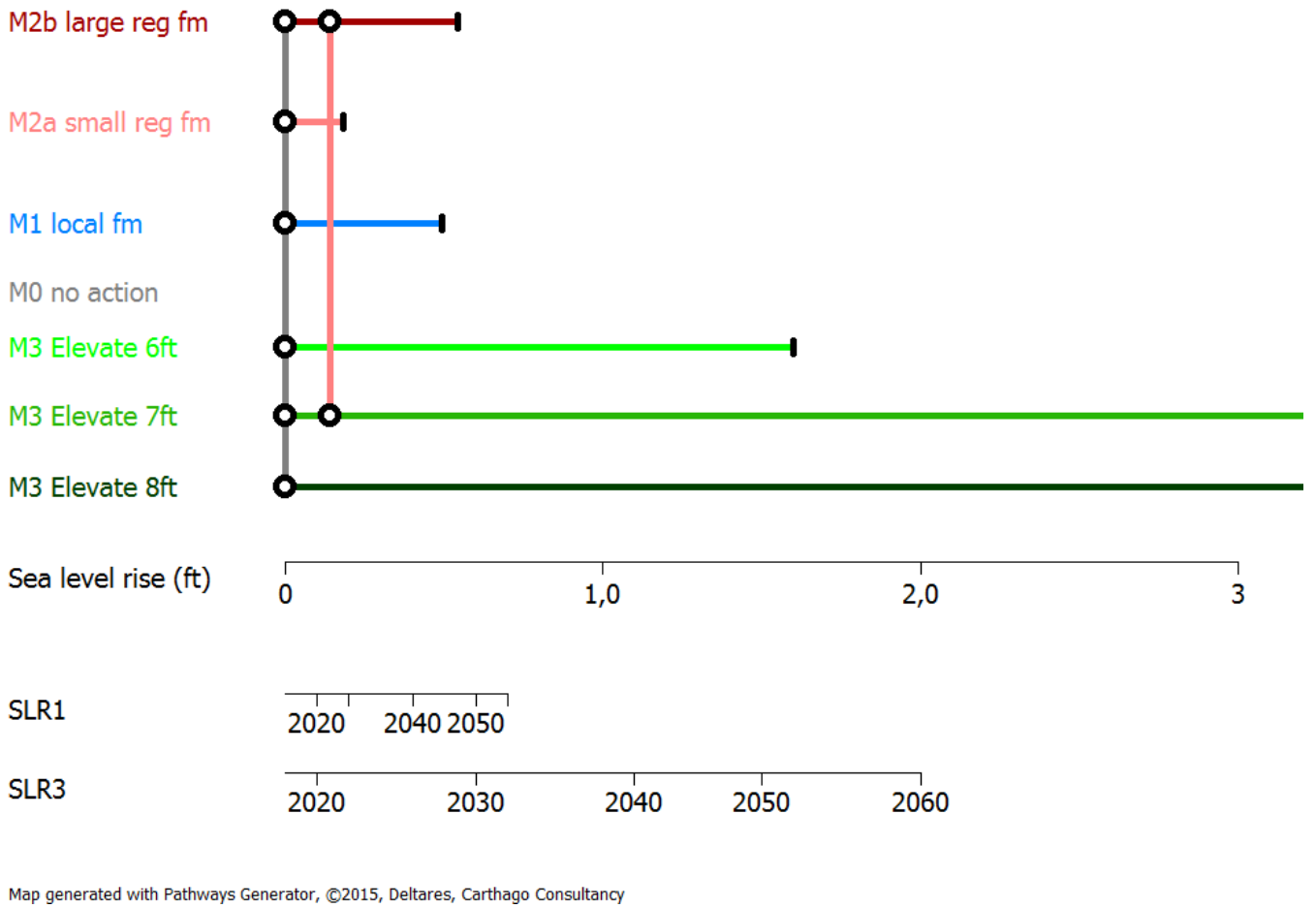
Adaptation pathways

Structural measures

Land use measures



Map generated with Pathways Generator, ©2015, Deltares, Carthago Consultancy

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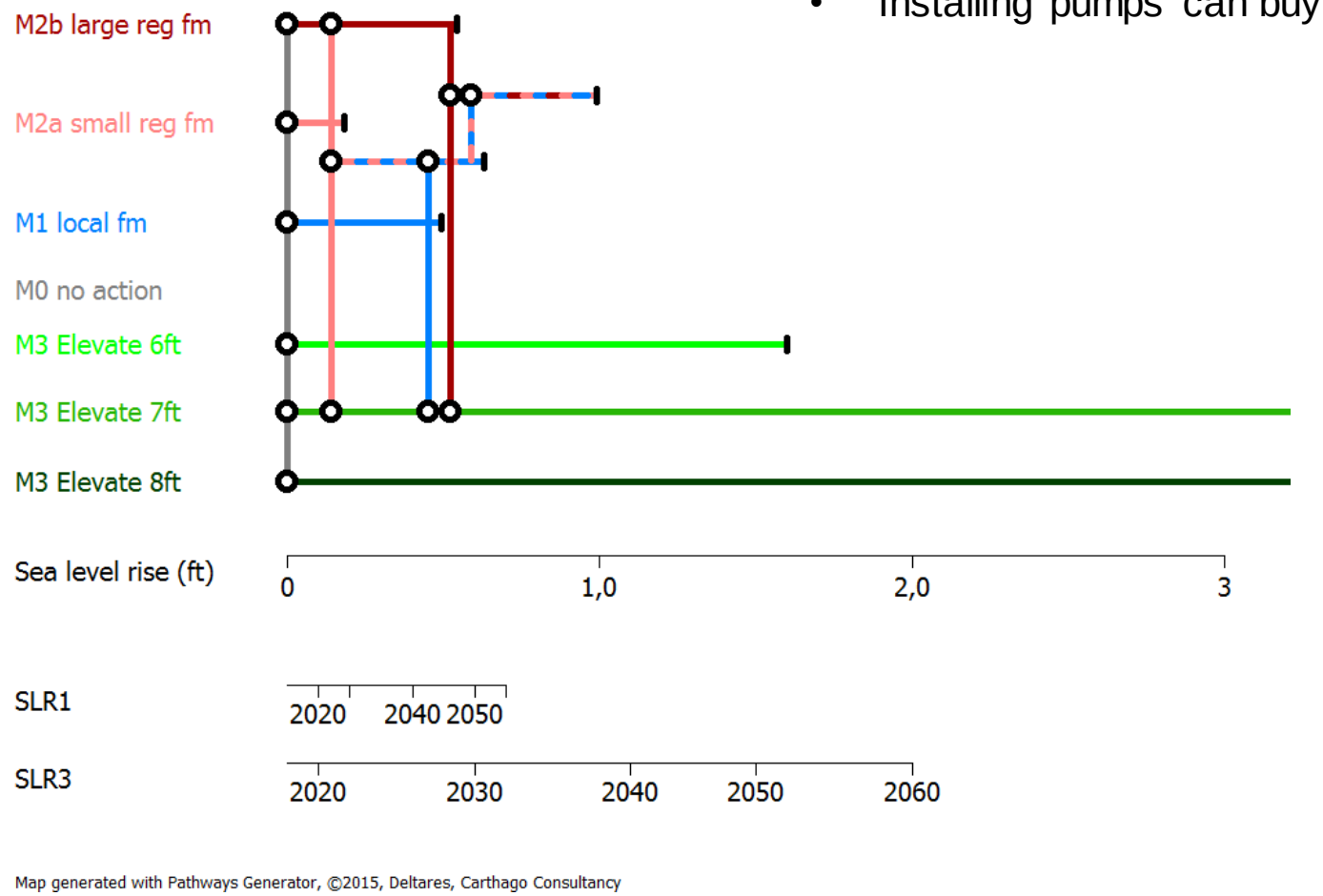
Adaptation pathways

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

Structural measures

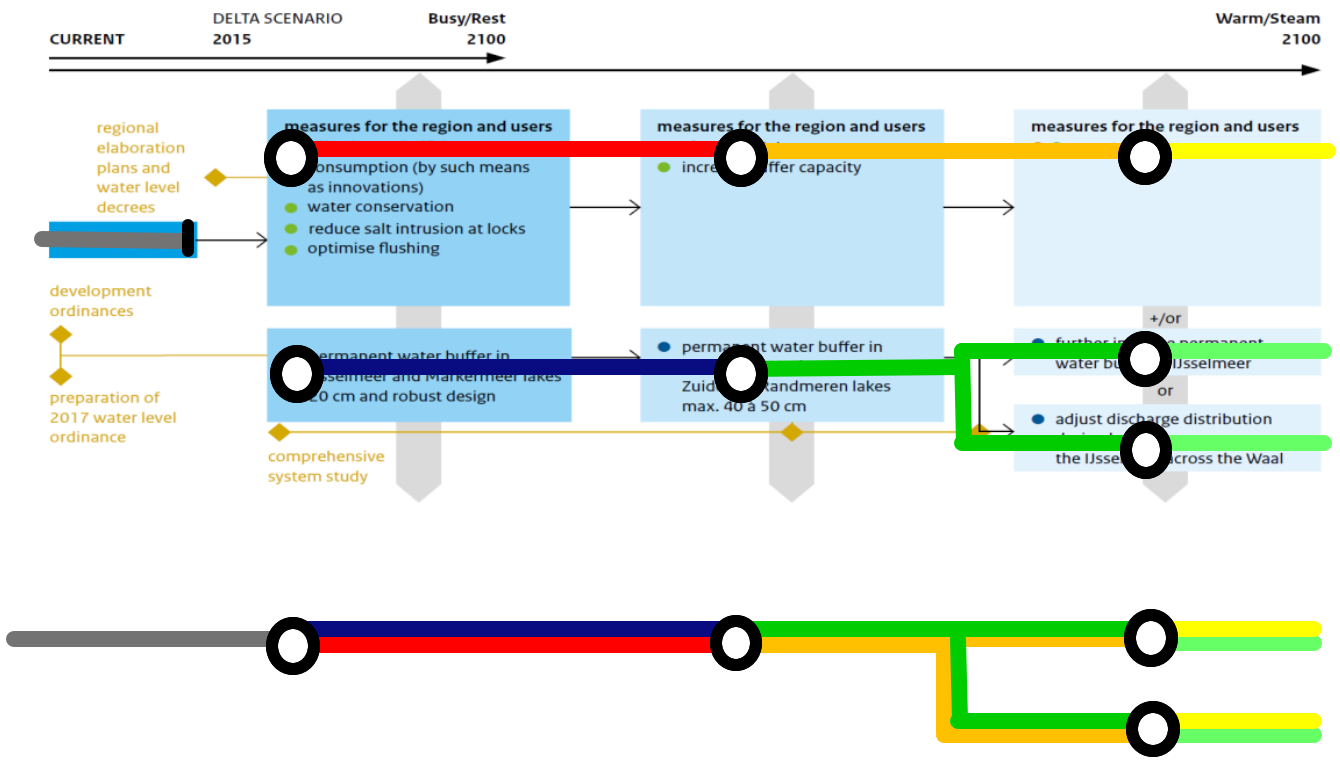
Land use measures



Map generated with Pathways Generator, ©2015, Deltares, Carthago Consultancy

ADB Deltares

Delta Programme, The Netherlands



- Iterative participatory process
- Opens solutions space
- Reduced number of pathways in the final plan
- Pathways based on short, medium, long term actions

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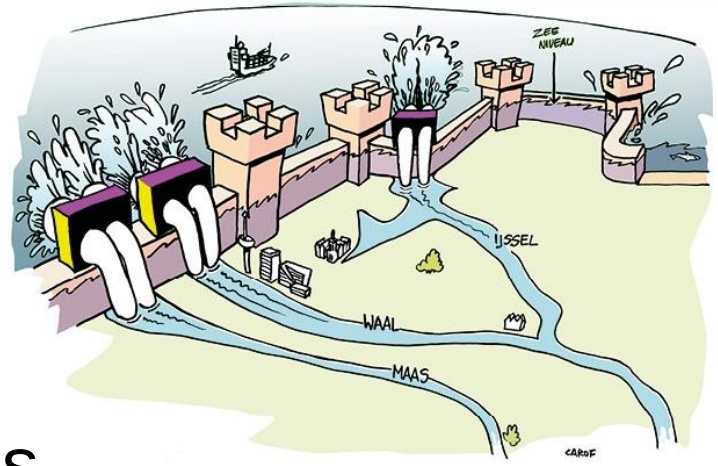
Policy hackathon to map solution space to high-end sea level rise

https://www.youtube.com/watch?v=wlBuEMTBW3w

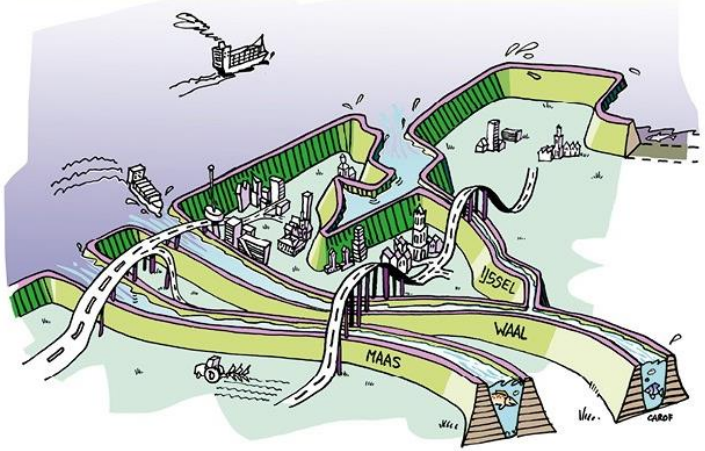
Solution space to high-end sea-level rise

Assessment of options, pathways, short-term actions

Protect-closed



Protect-open



Advance

Accommodate

Haasnoot et al 2019 (in Dutch)
https://www.deltacommissaris.nl/deltaprogramma/documenten/publicaties/2019/09/30/verkenning-deltares---strategieen-voor-adaptatie-aan-hoge-en-versnelde-zeespiegelstijging

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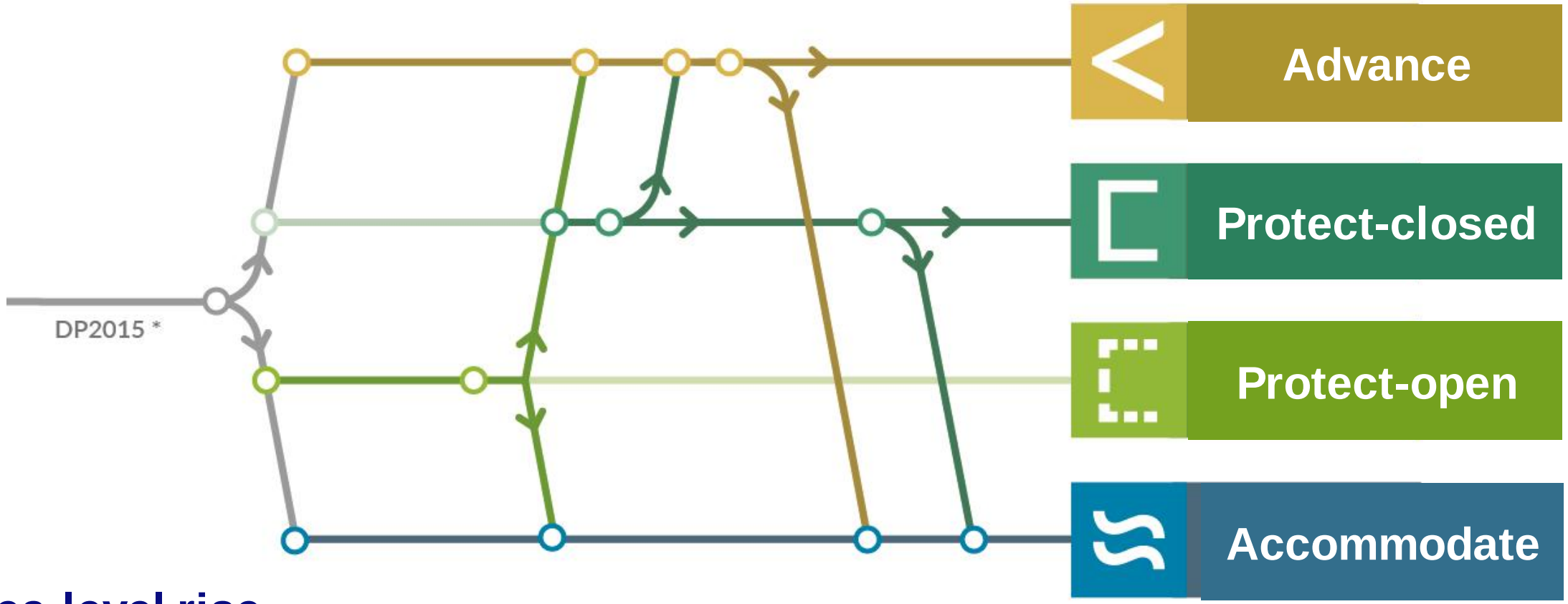
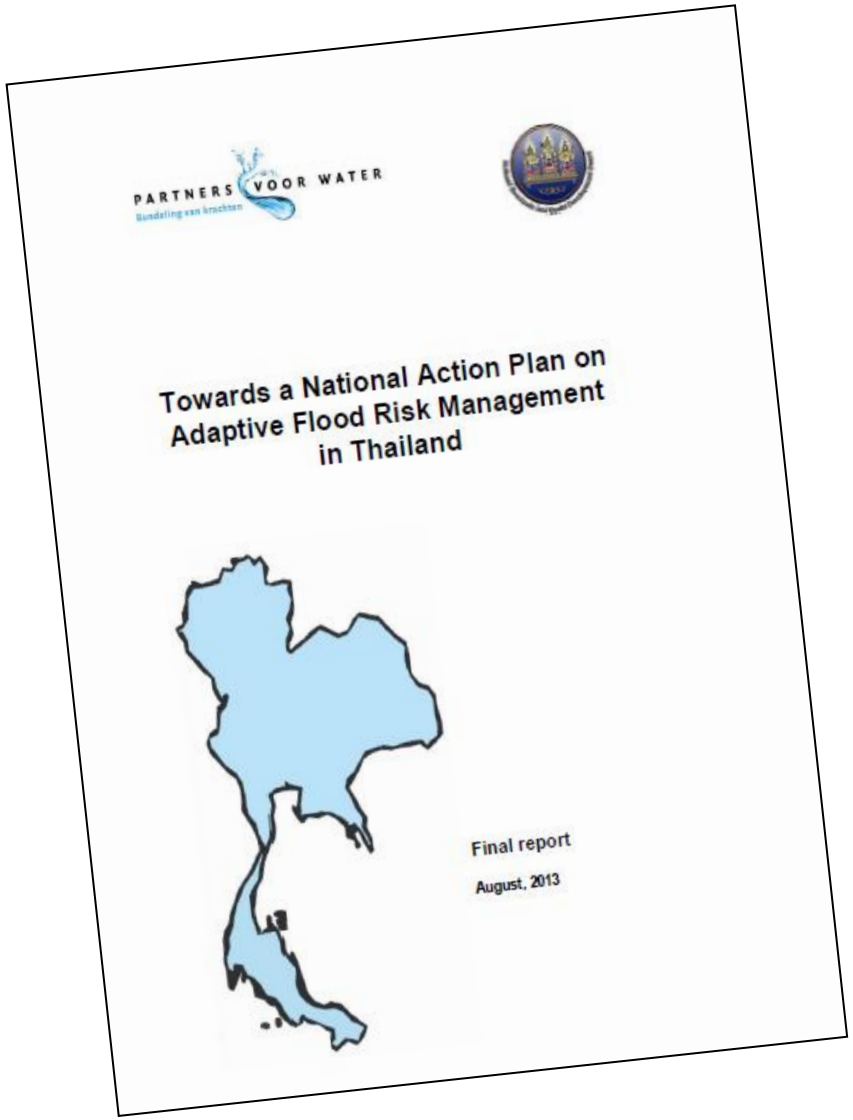
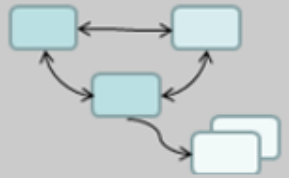
Solution space to high-end sea-level rise



Sea-level rise

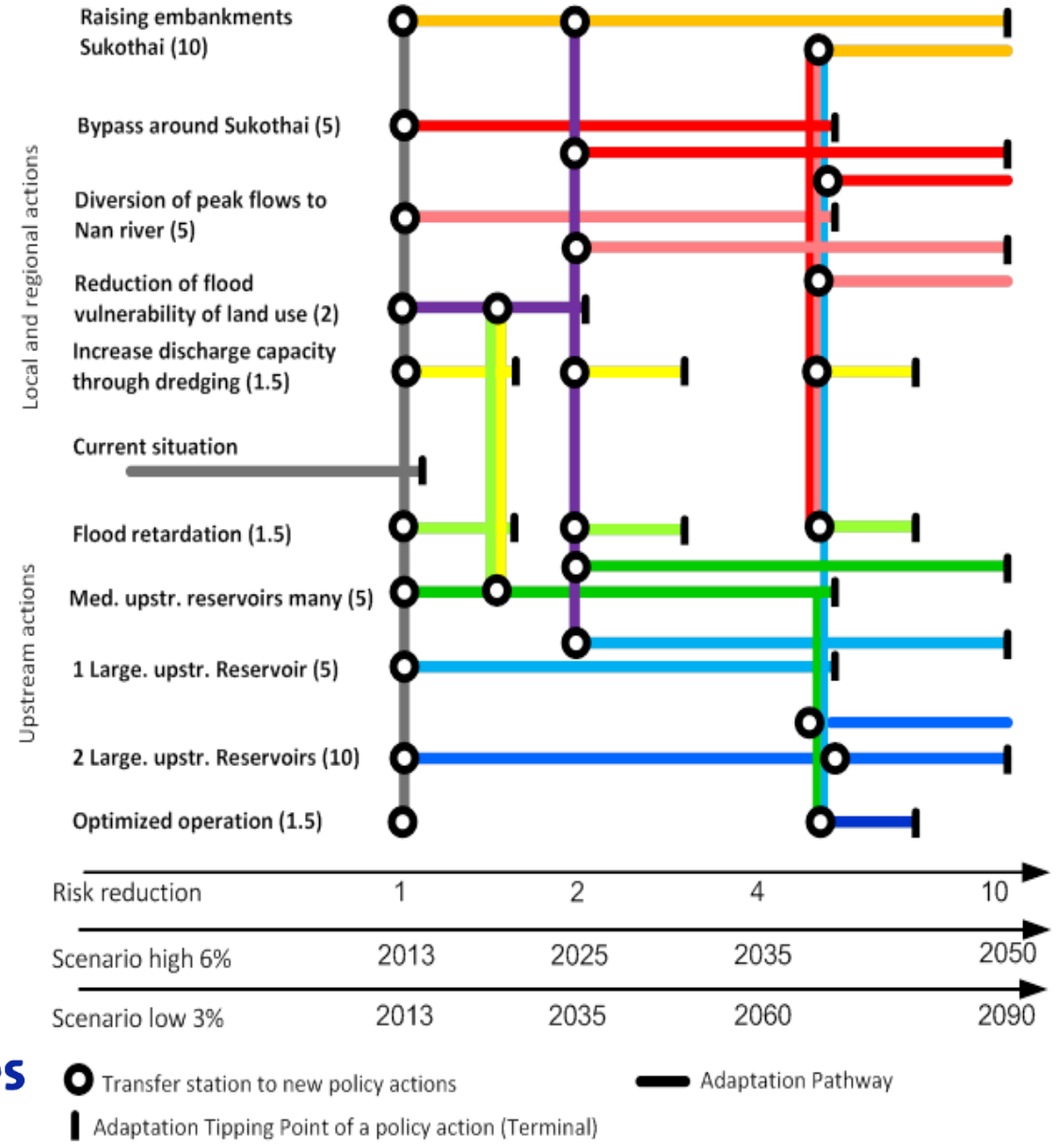
National Adaptive Flood Risk Management, Thailand

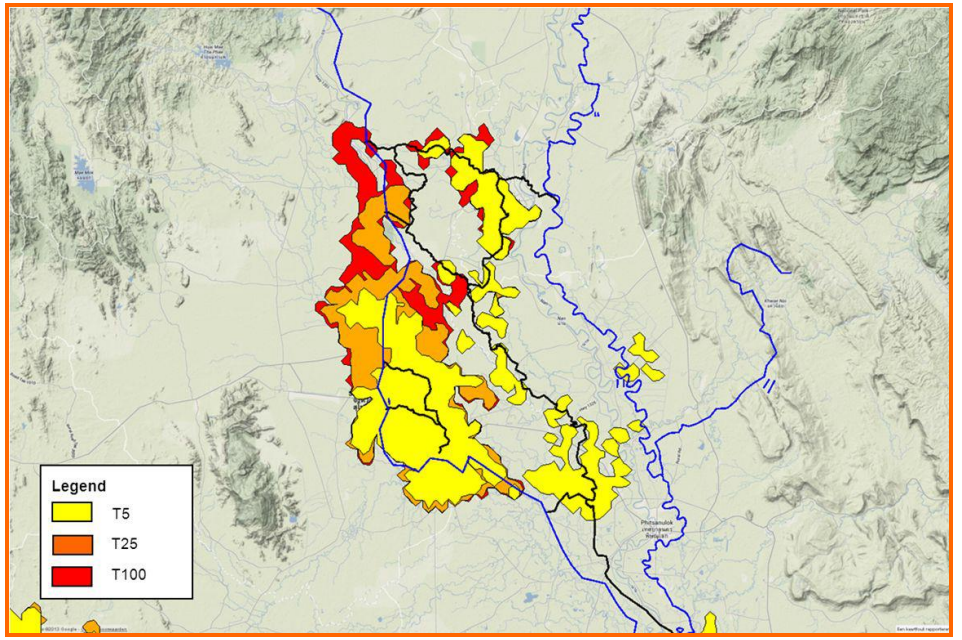


Stand-alone project	Compilation of projects	Conventional (master) planning	Adaptive management
			
Project-based	Package of indiviual projects	Strategy as a blue print for the future	Dynamic strategy
		Optimized and integrated	Dealing with an uncertain future
Low regret?	Low regret?	No regret?	No future regret
Immidiate implementation	Immiditate implementation	Implementation dirung planning period (± 25 years)	Implementation during plannind period ± 100 years
Short term	Short to medium term	Short to long term	Short to long term

ADB Deltares

Yom River – Sukothai (Thailand)





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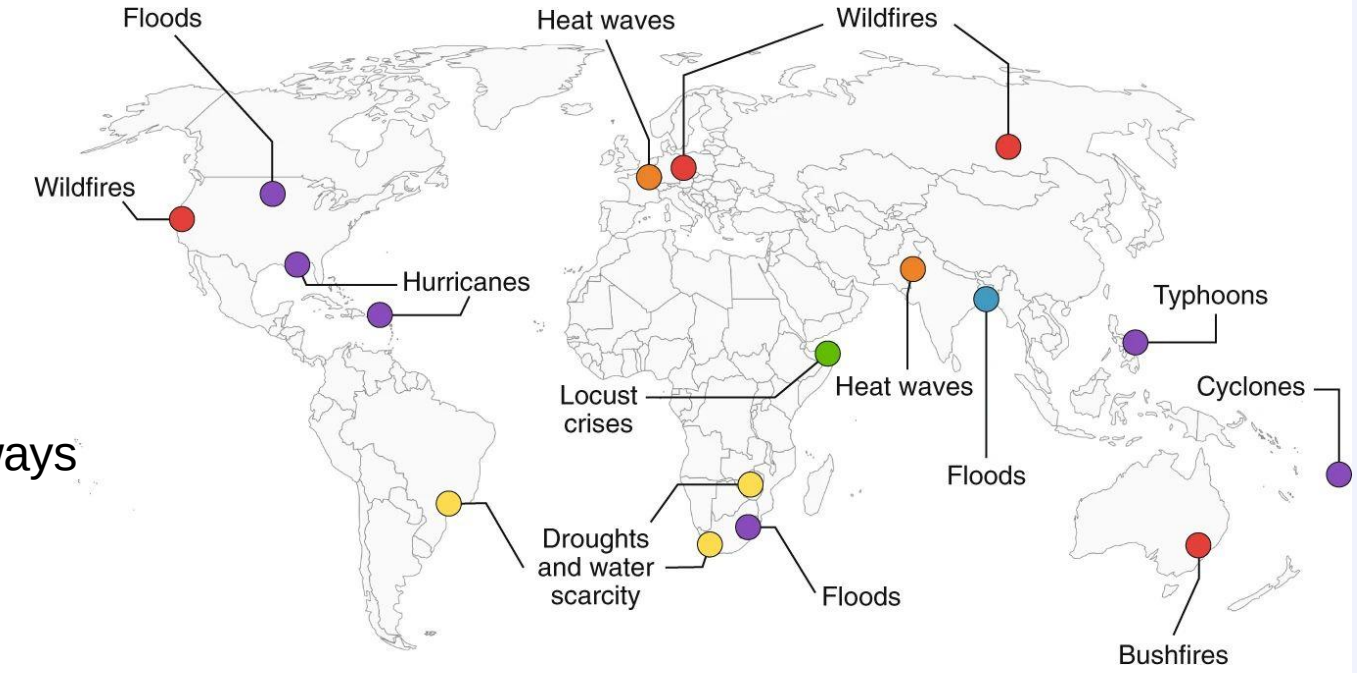
Use DAPP to build back better

- Consecutive/compound events occur and result in cascading impacts

- During crisis, under time pressure, crucial decisions are taken that do not always consider long-term impacts and options.



Likely upcoming climate hazards during the COVID-19 pandemic.

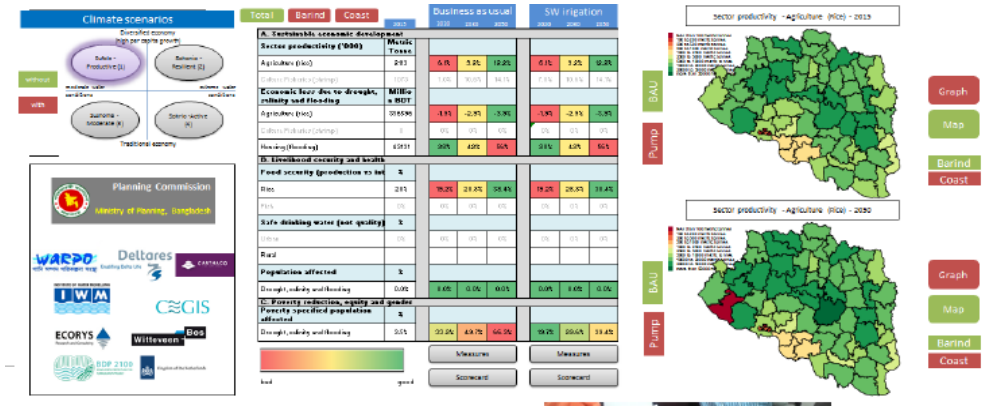
Phillips et al 2020

More information…

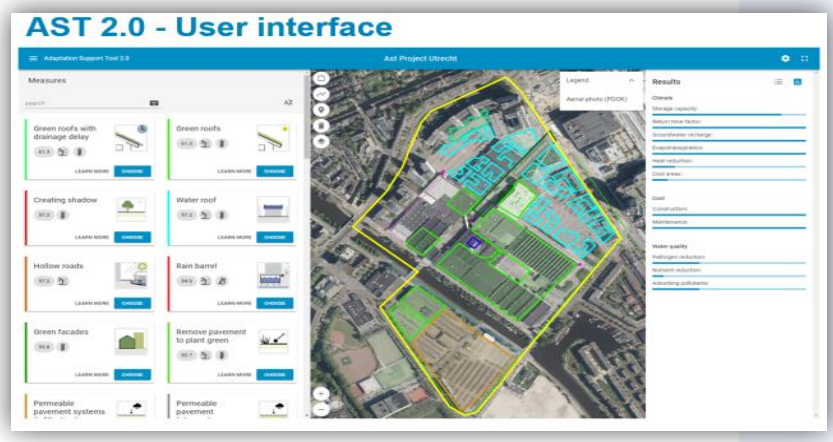
Tools supporting DAPP

Serious Gaming

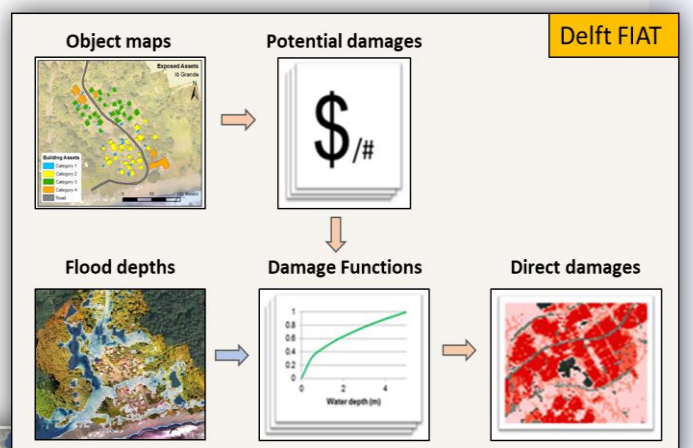
Fast integrated models



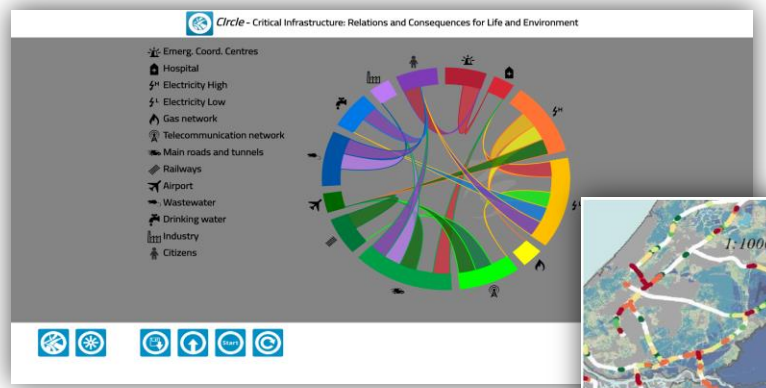
Adaptation Support Tool



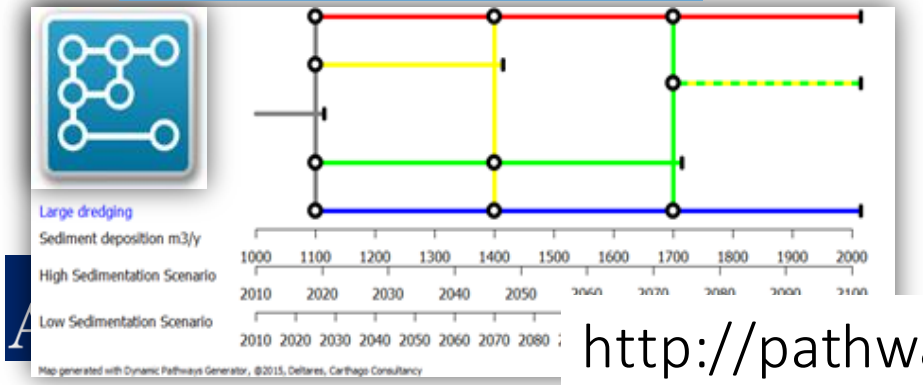
Delft-FIAT



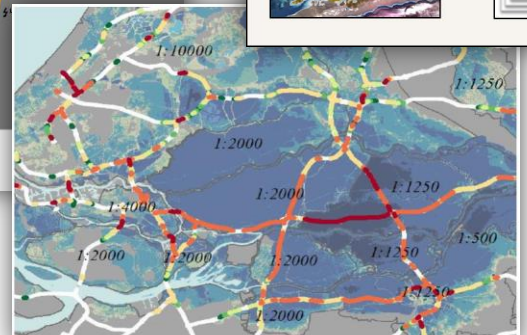
CIRCLE



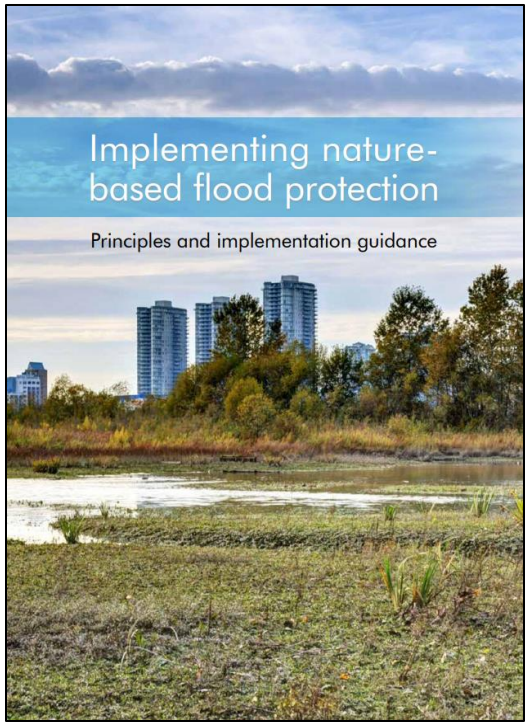
Pathways generator

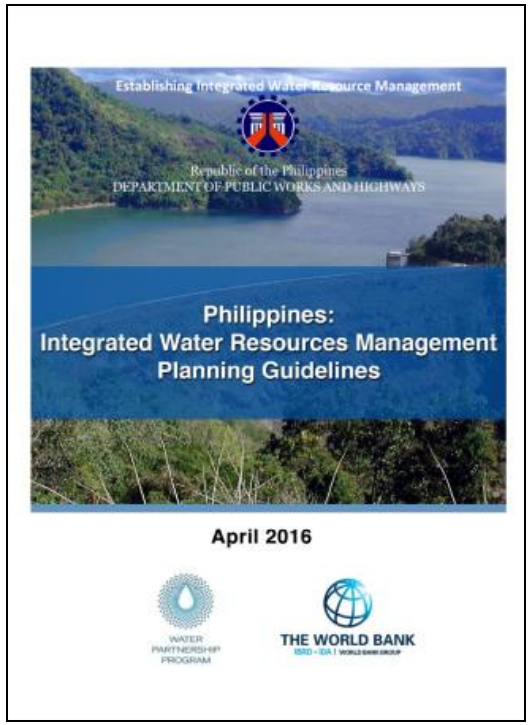


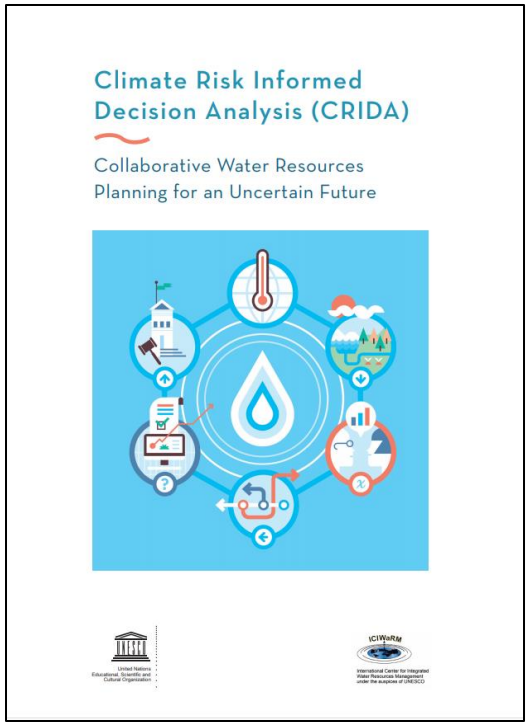
http://pathways.deltares.nl

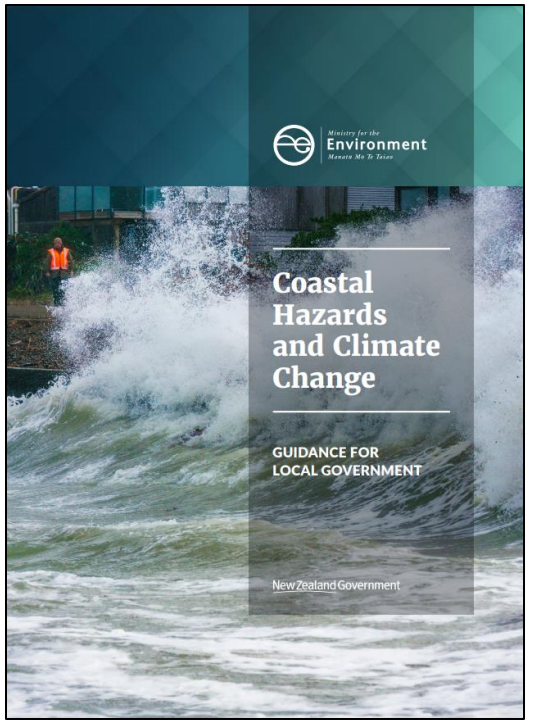


Pathways as part of other guidances









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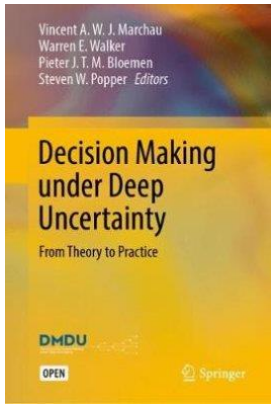
www.deepuncertainty.org

Annual meeting 10-12 november (virtual)



DMDU

a multi-disciplinary association of professionals dedicated to improving decision making under deep uncertainty

@deepuncertainty

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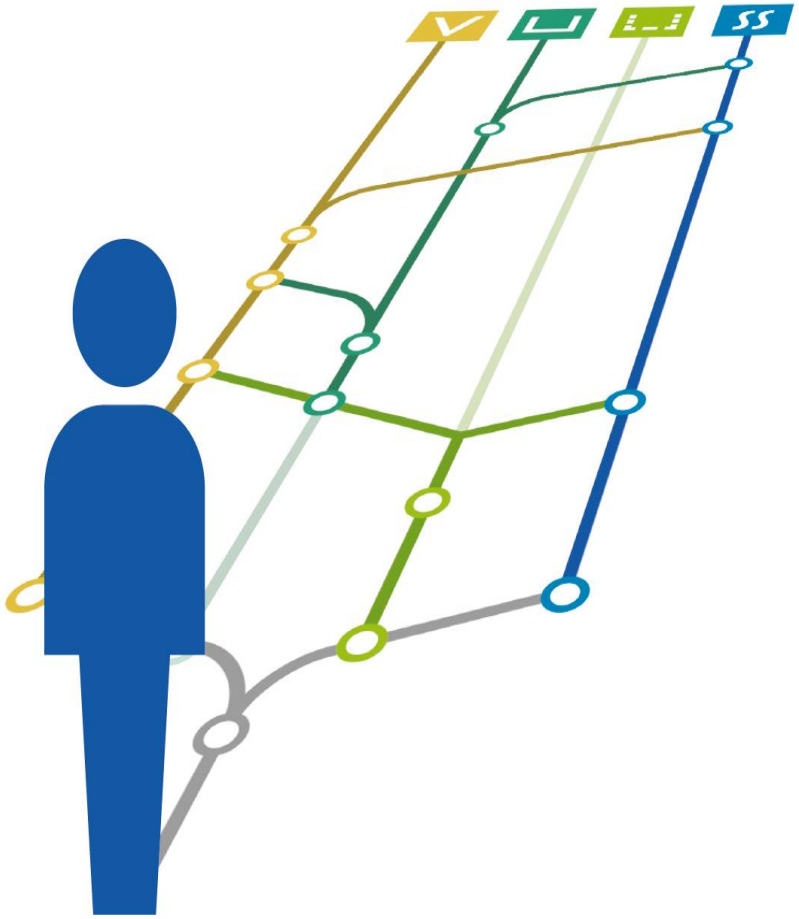
Summary



- Adaptation thresholds to assess if and use scenarios to assess when limits, thresholds, opportunities may occur
- Explore adaptation pathways to make adaptive plan for climate resilient development
- Timescales and path-dependency of options is important to consider (lead time, lifetime, flexibility)
- Various levels of assessment: narratives, model-based pathways
- Can be part of other planning approaches

Contact

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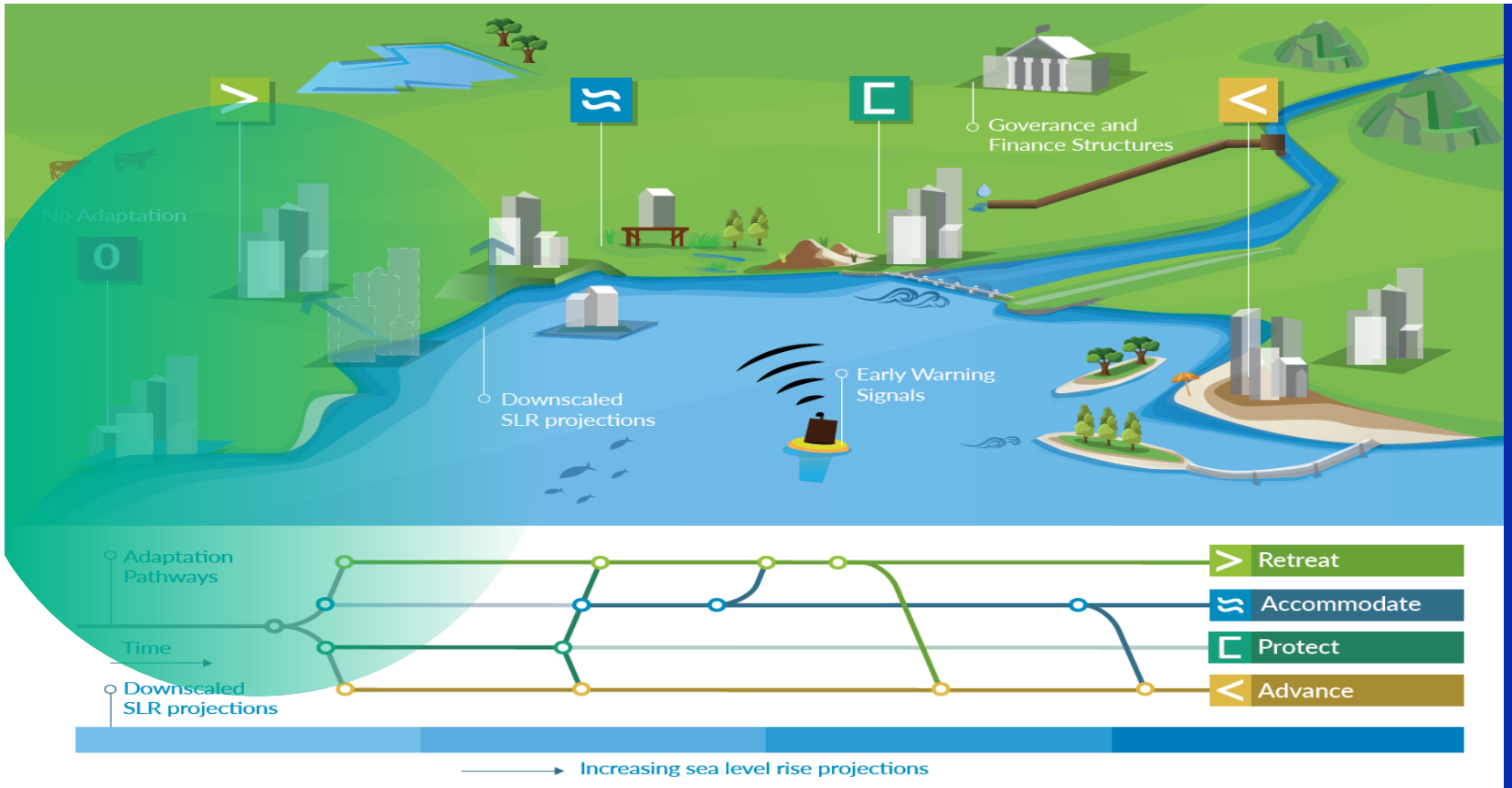
@Lijnonline



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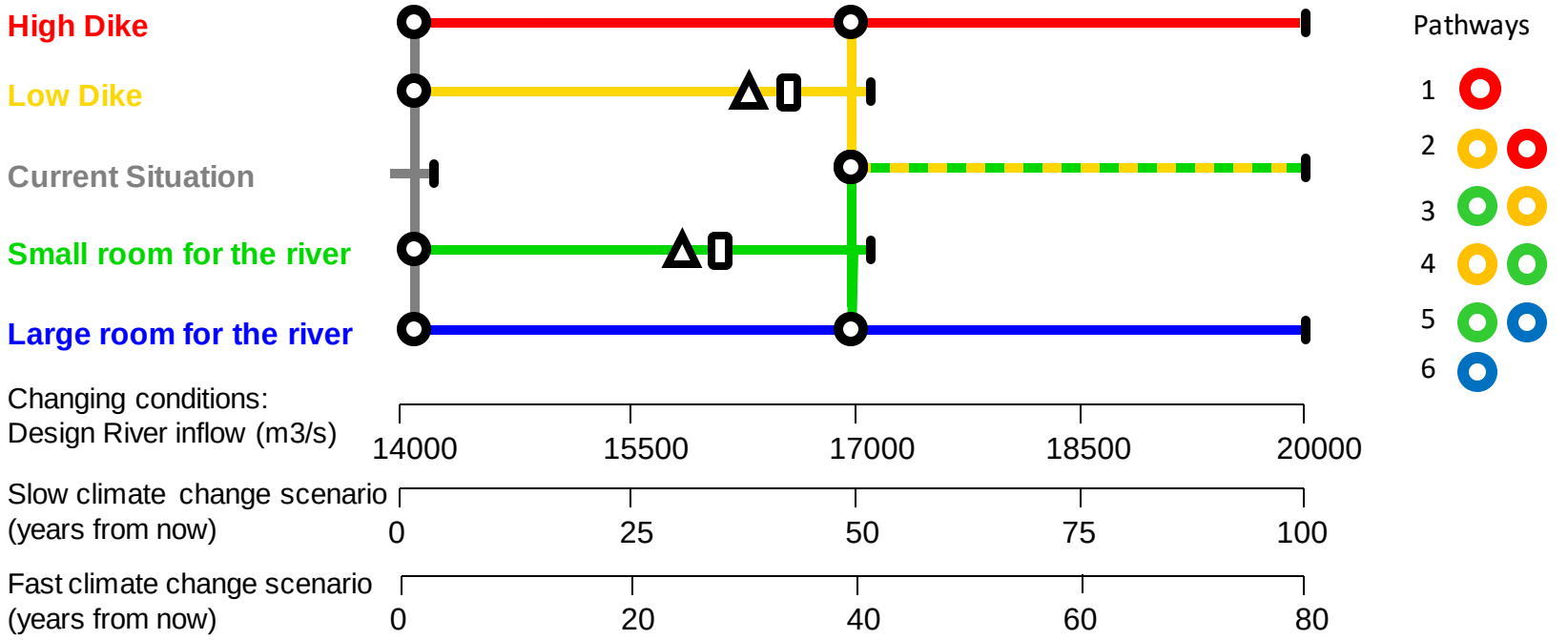
Net present value (pathway$_4$)

Expected costs

Expected benefits
(avoided damages, co-benefits)

Initial $Cost_{low\ dike}$ $(t=1)$ + Recurrent $Cost_{low\ dike}$ $(t_1 \ldots t_x)$ + Transfer cost (t_x) + Initial $Cost_{smallRfR}$ $(t_x \ldots T)$ + Recurrent $Cost_{smallRfR}$ $(t_x \ldots T)$ + $Benefits_{low\ dike}$ $(t_1 \ldots t_x)$ + $Benefits_{smallRfR}$ $(t_1 \ldots t_x)$



Transfer station to new action or investment portfolio

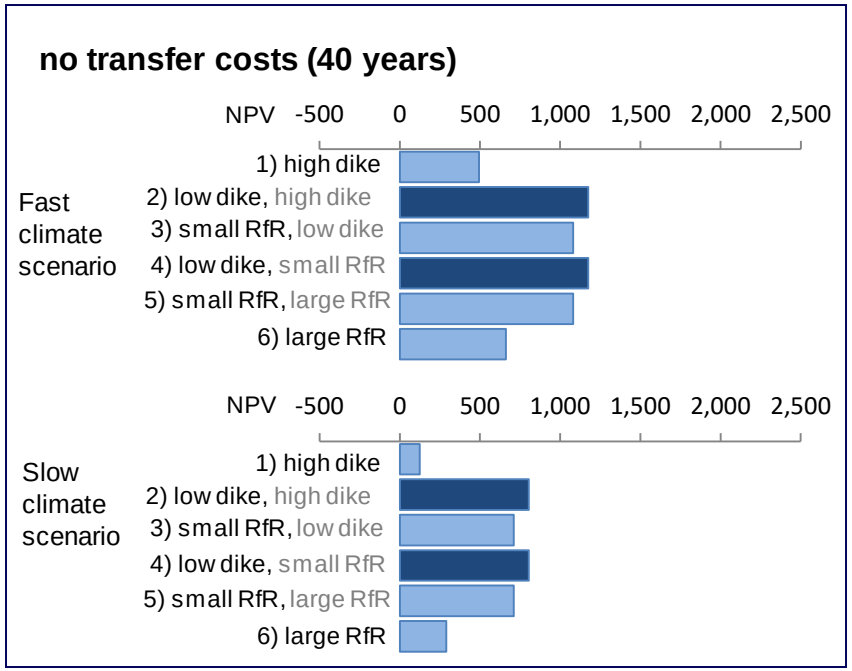
Adaptation Tipping Point of an action or investment portfolio

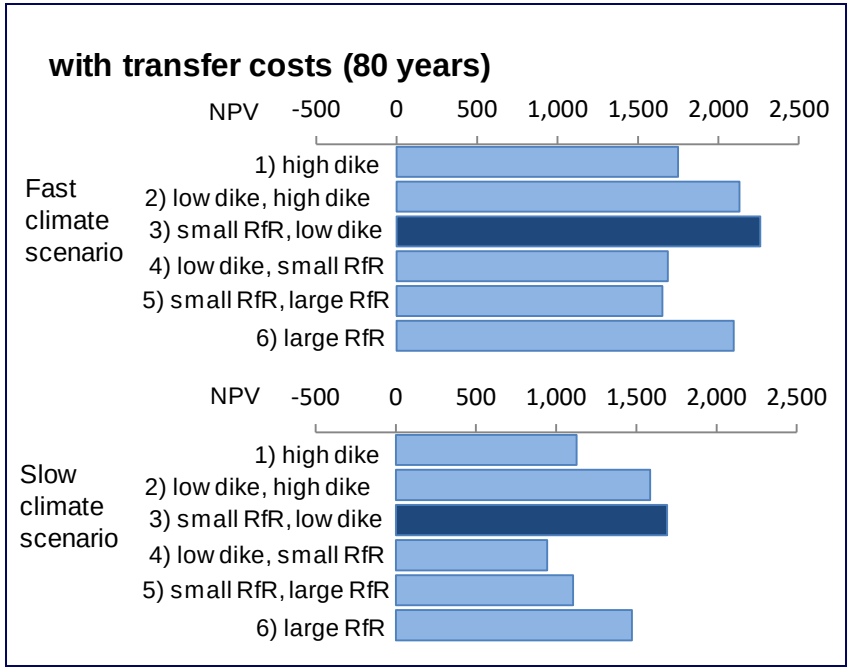
Action or investment portfolio is effective

Adaptation signal

Decision point

Haasnoot et al 2019





ADB Deltares

Haasnoot et al 2019