

Planning for accelerated sea level rise

An exploratory study for the Delta Program



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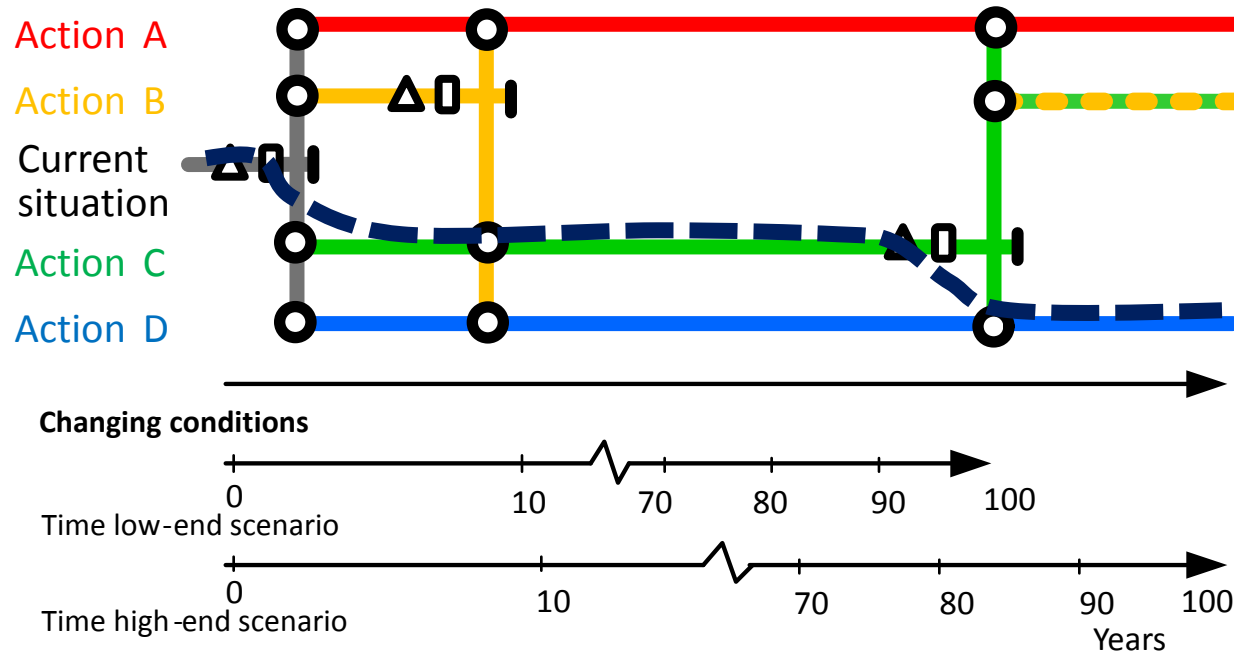
Dynamic Adaptive Policy **Pathways**

Supports planners to design **adaptive plans** for decision making under uncertainty:

- short-term actions,
- long-term options,
- adaptation signals.

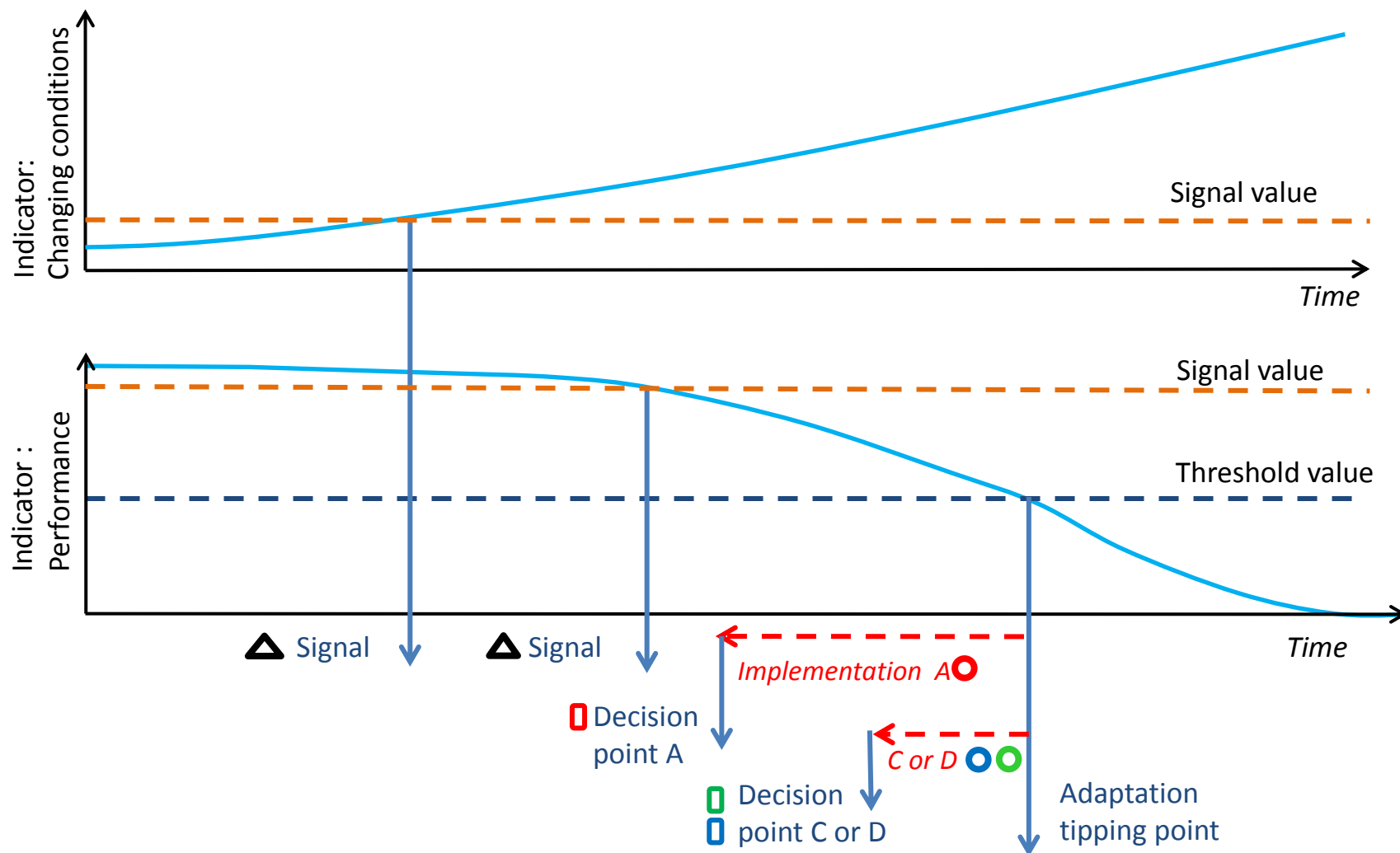


Dynamic adaptive policy pathways



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
- △ Signal
- Decision node

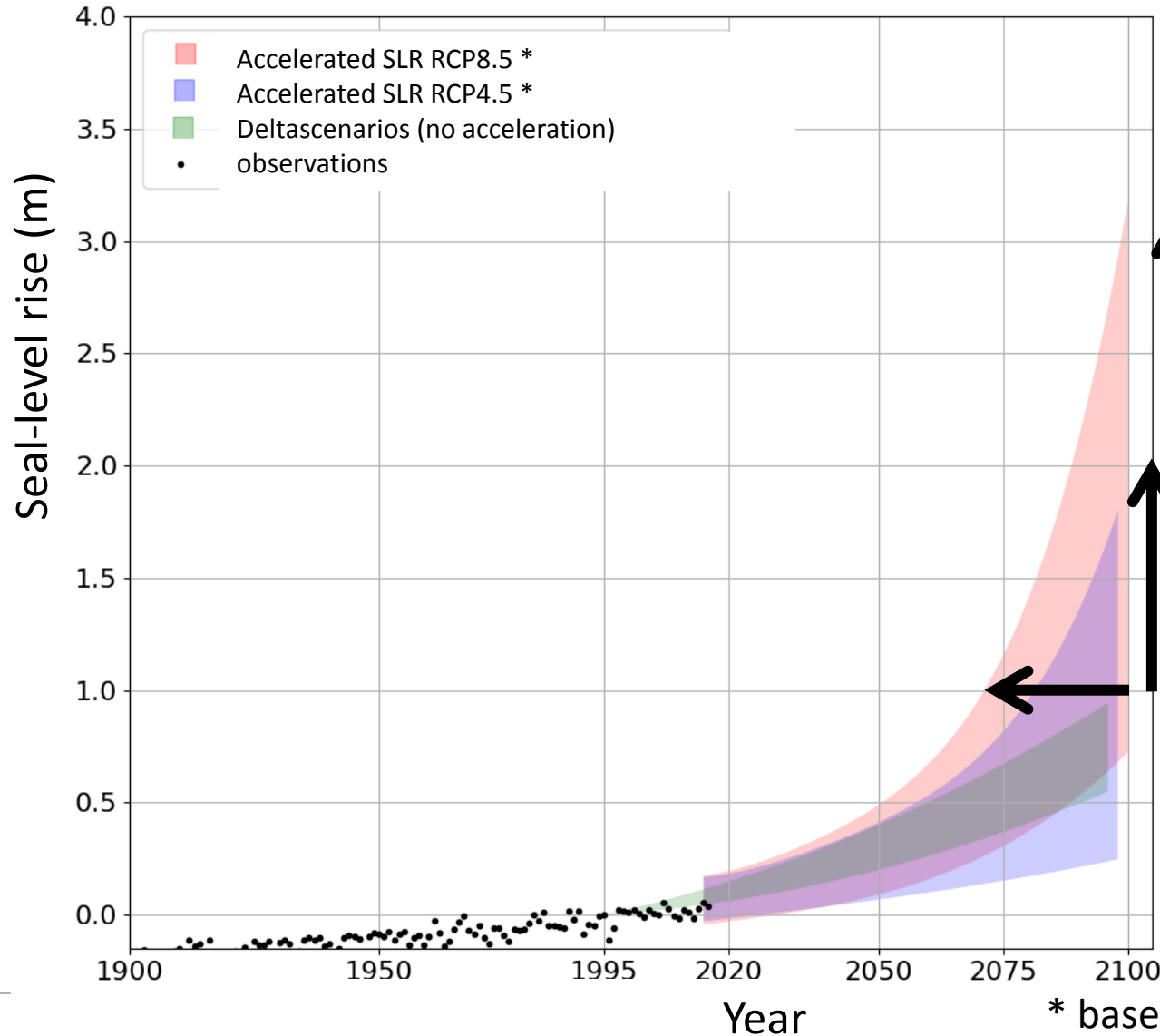


Designing a monitoring system to detect signals to adapt to uncertain climate change:

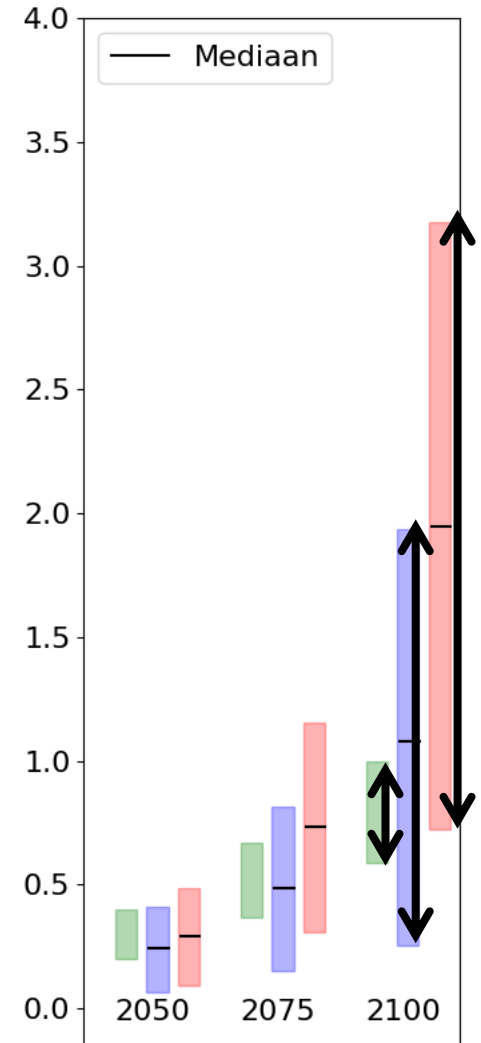
<https://doi.org/10.1016/j.gloenvcha.2018.08.003>

Haasnoot et al. (2015) Env. Res. Let. [10.1088/1748-9326/10/10/105008](https://doi.org/10.1088/1748-9326/10/10/105008), Stephens et al 2018 ERL, Hermans 2017 [10.1016/j.envsci.2016.12.005](https://doi.org/10.1016/j.envsci.2016.12.005), Haigh et al 2014 NCC

Projections for accelerated SLR: earlier and higher

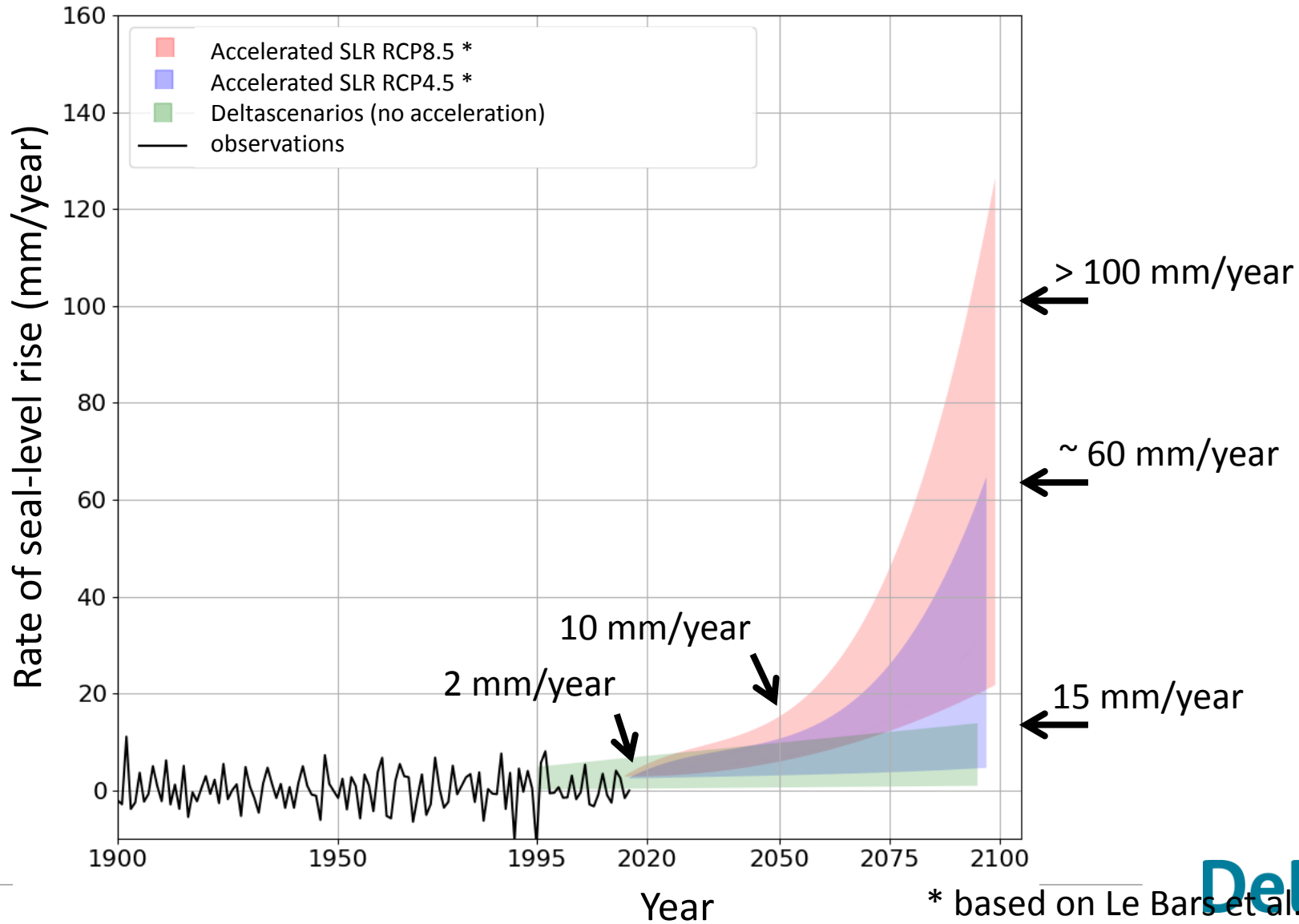


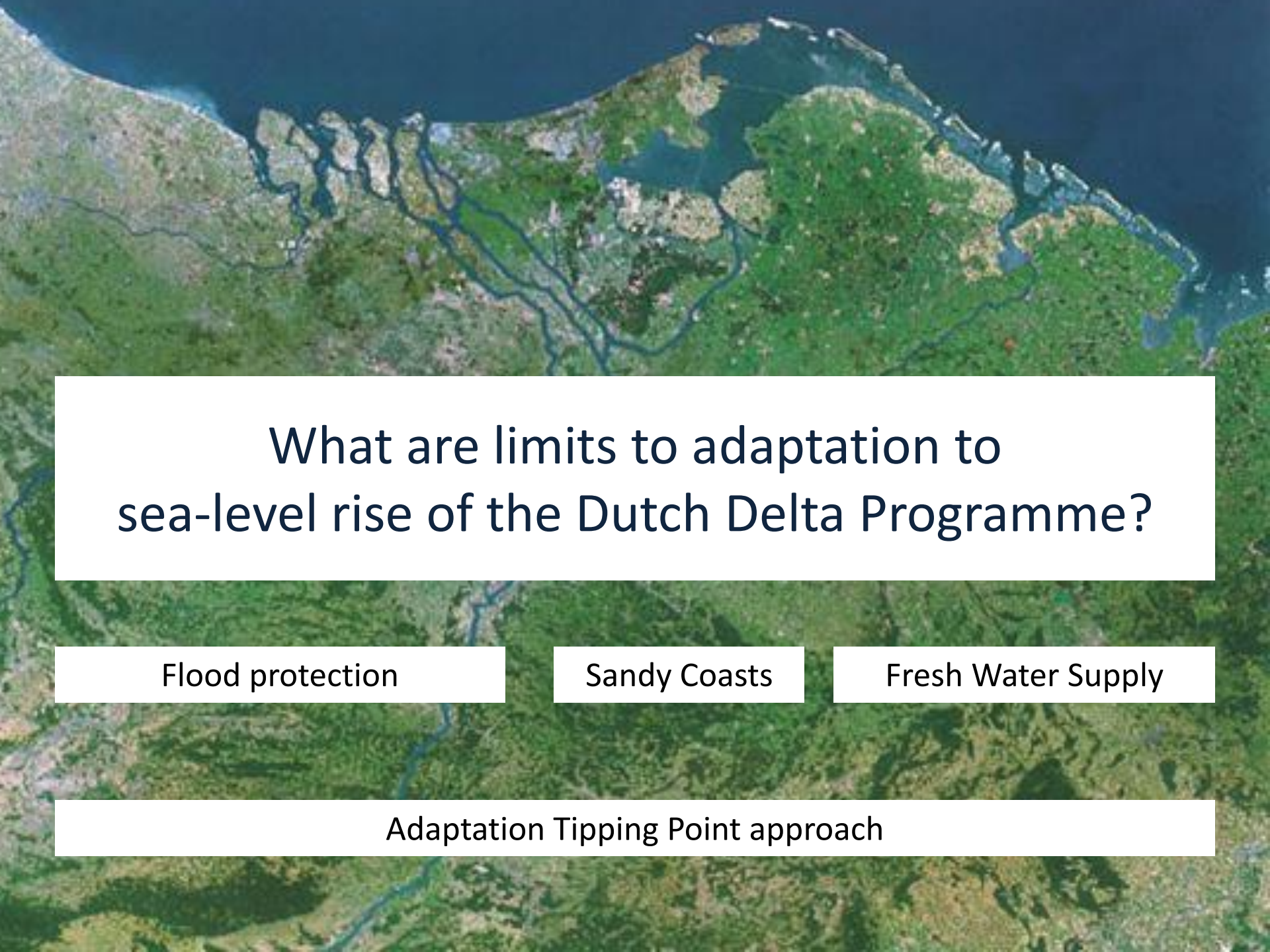
more uncertainty



* based on Le Bars et al. ERL, 2017

.. and much faster



An aerial photograph of a coastal region, likely the Dutch Delta, showing a complex network of waterways, green fields, and some urban areas. A large white rectangular box is superimposed in the center, containing the main title. Below the title, three smaller white boxes are arranged horizontally, and a fourth, wider box is at the bottom.

What are limits to adaptation to sea-level rise of the Dutch Delta Programme?

Flood protection

Sandy Coasts

Fresh Water Supply

Adaptation Tipping Point approach

Storm surge barriers will close more frequently with higher and more pressure



Maeslantkering

0,4 m: 1 keer per 4 jaar gesloten
1 m: 3 keer/jaar gesloten
2 m: permanent
~1.2 m: waterstand eens in 10 jaar
hoger dan ontwerppeil

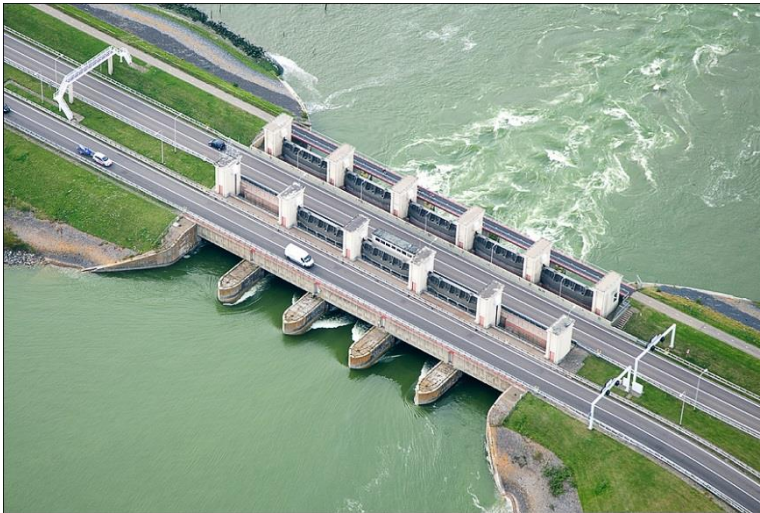


Oosterscheldekering

0,4 m: 3 keer/jaar gesloten
1 m: 45 keer/jaar gesloten
1,3 m: ieder getij gesloten
~2,1 m: waterstand eens in 10
jaar hoger dan ontwerppeil

IJsselmeer: larger pumps needed

- 0,65 m: permanent needed
- 1.75 m SLR: 1.000 m³/s - 3.200 m³/s pomp capacity needed



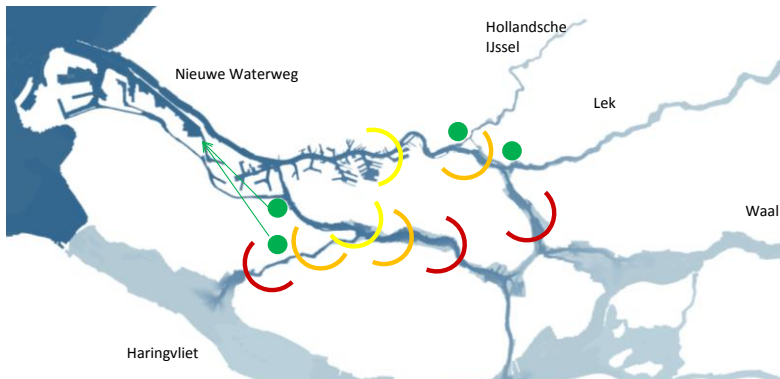
More sand needed, depending on the rate

- 3 to 4 times more sand ~2050 in all scenario's
- 4 to 5 times more at rate of ~14 mm/year
- > 20 times more at 60 mm/year (2100)
- Impacts from increased nourishment activities for ecology and recreation



Increase water demand and decrease availability due to salt intrusion

- Emergency inlet (KWA) frequently needed from 1 m onwards
- Inlet more upstream?
- Large increase water demand IJsselmeer



Zoutconcentratie (max) > 500 mg/l bij :

0 m 2 m 4 m En afvoer van 2200 m³/s Lobith ● water inlaat



24 juli 2018 - Michèle Blom, directeur-generaal Rijkswaterstaat, dijkgraaf Patrick Poelmann van het

MOGELIJKE GEVOLGEN VERSNELDE ZEESPIEGELSTIJGING

Kustfundament
meer zand nodig

10 mm/jaar



14 mm/jaar



60 mm/jaar



Zoetwatervoorziening

Toename watervraag
IJsselmeer



Bij 1 m:
noodmaatregel
waterinlaat Gouda
structureel

Waterveiligheid
pompcapaciteit
IJsselmeer

Vanaf 0,65 m
altijd nodig



Vanaf 1,75 m



ANTARCTICA

Waterveiligheid
Maeslantkering

~1 m



3x dicht
per jaar

~1,5 m



30x dicht
per jaar

Waterveiligheid
Oosterscheldekering

~1 m



45x dicht
per jaar

~1,3 m



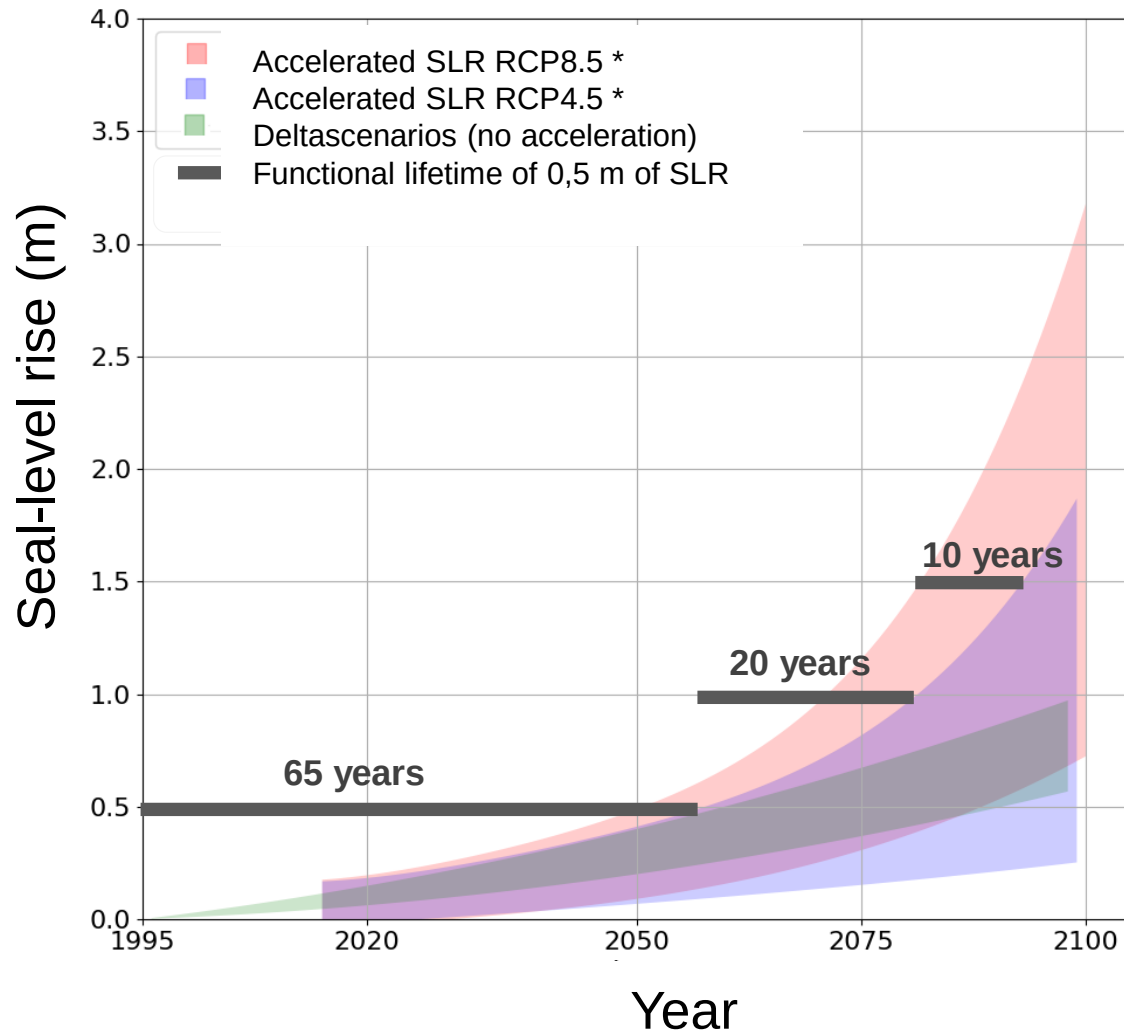
permanent

Deltares

Enabling Delta Life



Functional life time of investments decreases: adapt faster or larger



What next?

Not only magnitude but also rate!

→ Mitigation is important

Monitor

Consider accelerated SLR for large investments with a long lifetime

Impacts+

Plan B:

> 1 m and

> 14 mm/year

Scenarios: also > 2100
+ sensitivity analysis

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<http://bit.ly/2pcjwwj>

<http://www.deepuncertainty.org>



@deepuncertainty

<http://pathways.deltares.nl>

<http://deltagame.deltares.nl>

@lijnonline

THE SOCIETY FOR
Decision
Making under
Deep
Uncertainty



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