Drivers of Coastal Change

Workshop Enabling Ecosystem-based adaptation
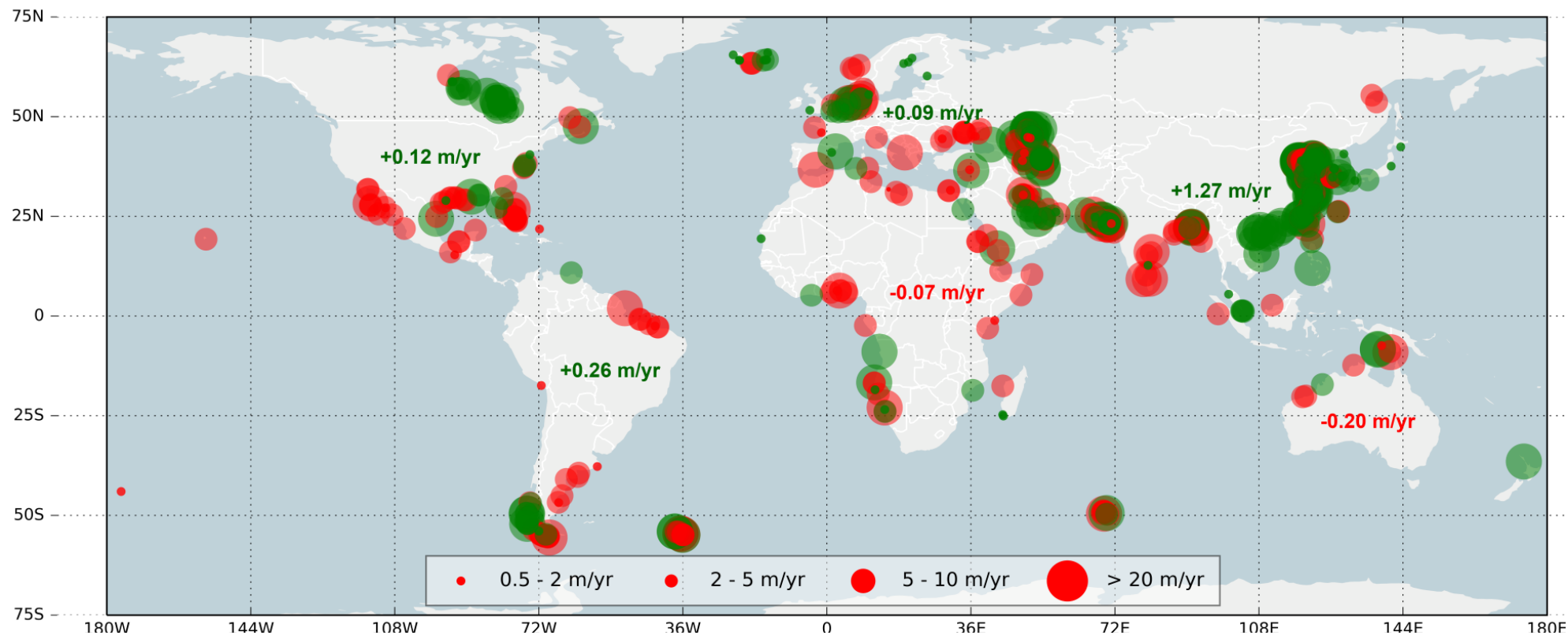
Arjen Luijendijk
13-10-2021

TUDelft

enabling delta life

Historic coastal change

➢ 2 million satellite images analysed

➢ 24% of the sandy beaches are eroding > 0.5 m/yr

➢ 72,000 km is eroding!

Mekong River Delta, Vietnam
Date: 1988-02
1984

+0.12 m/yr

+0.09 m/yr

+1.27 m/yr

-0.07 m/yr

+0.26 m/yr

-0.20 m/yr

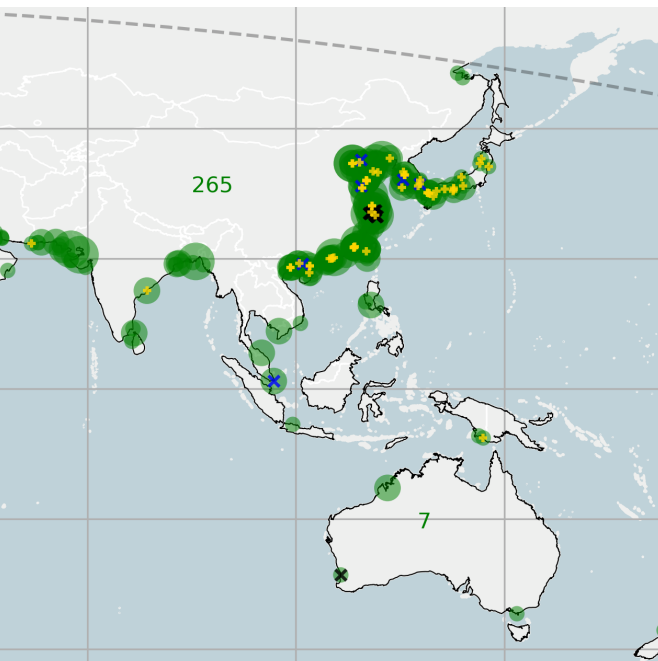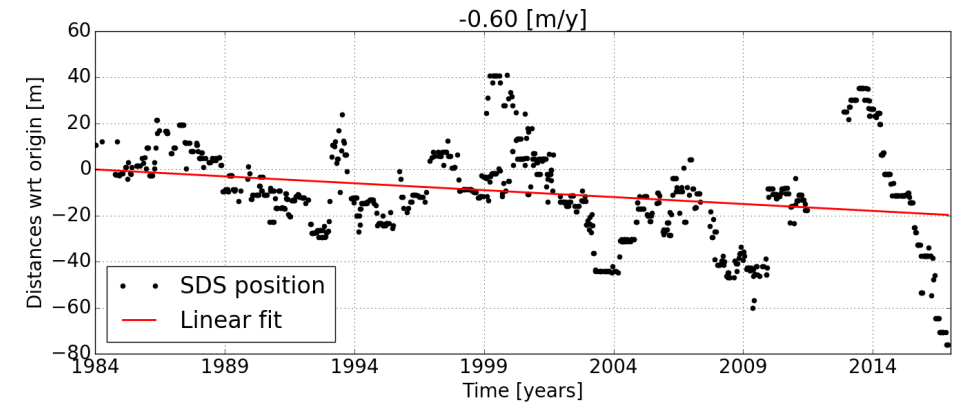| • 0.5 - 2 m/yr | • 2 - 5 m/yr | ● 5 - 10 m/yr | ● > 20 m/yr |

Global hotspots of dynamic beaches

Luijendijk et al. (2018)

Driving factors of coastal change

➤ Signal decomposition to look for drivers & response

   ➤ ML: driver of change per hotspot (Kras, 2020)

➤ Key for ecosystem-based adaptation – learn from the pa

Human drivers of shoreline evolution	Prograding (+) and / or retreating (-)	Influence
1. Nourishments	+	direct
2. Land Reclamations	+	direct
3. Port / Breakwaters	+ and -	indirect
4. River Sediment Supply	-	indirect

Table 2.2: A summary of the effects and characteristics of the natural drivers of sho in the introduction of this section.
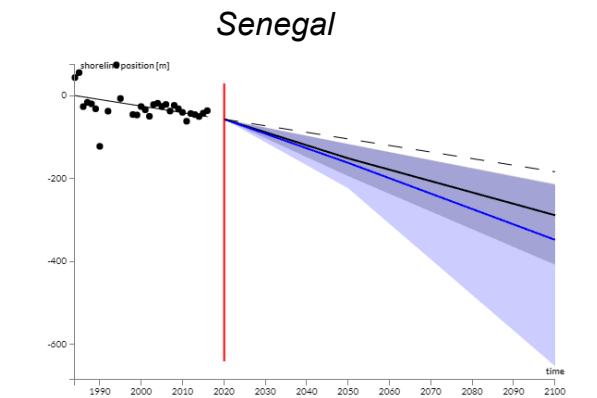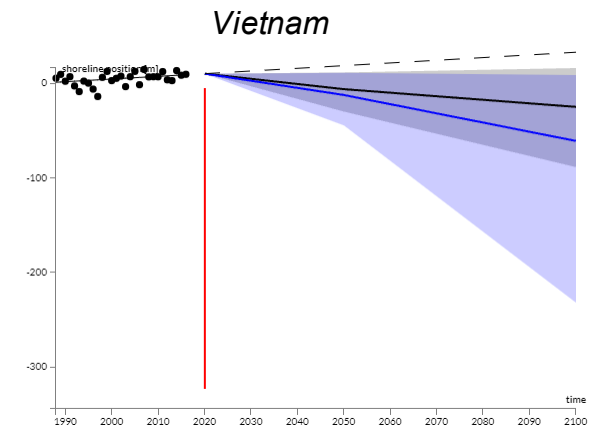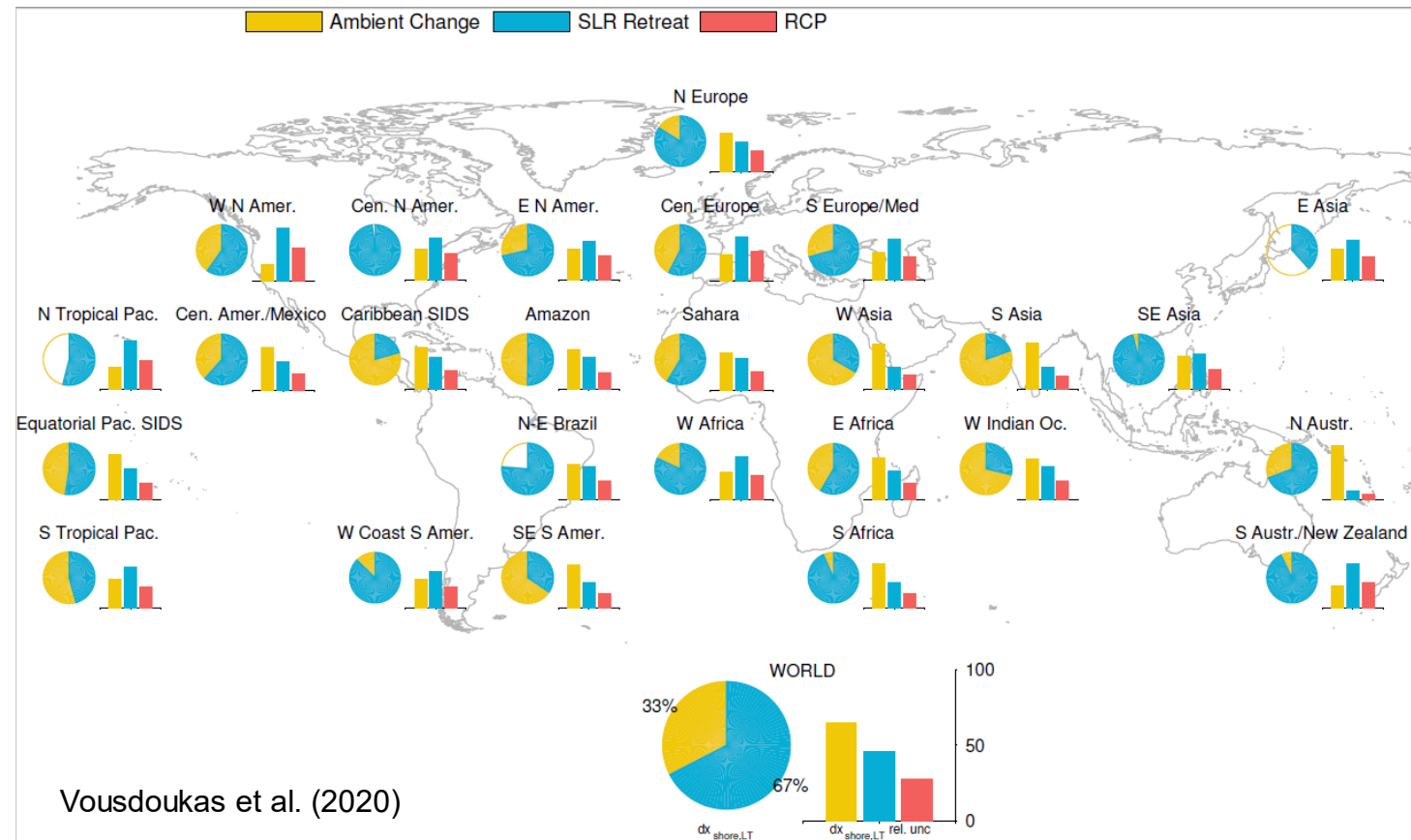
Natural drivers of shoreline evolution	Prograding (+) and / or retreating (-)	Influence
1. Beach Sediment Supply	+ and -	x
2. Sand Bar Migration	+ and -	x
3. Tidal Inlets	-	x
4. Storms	-	x
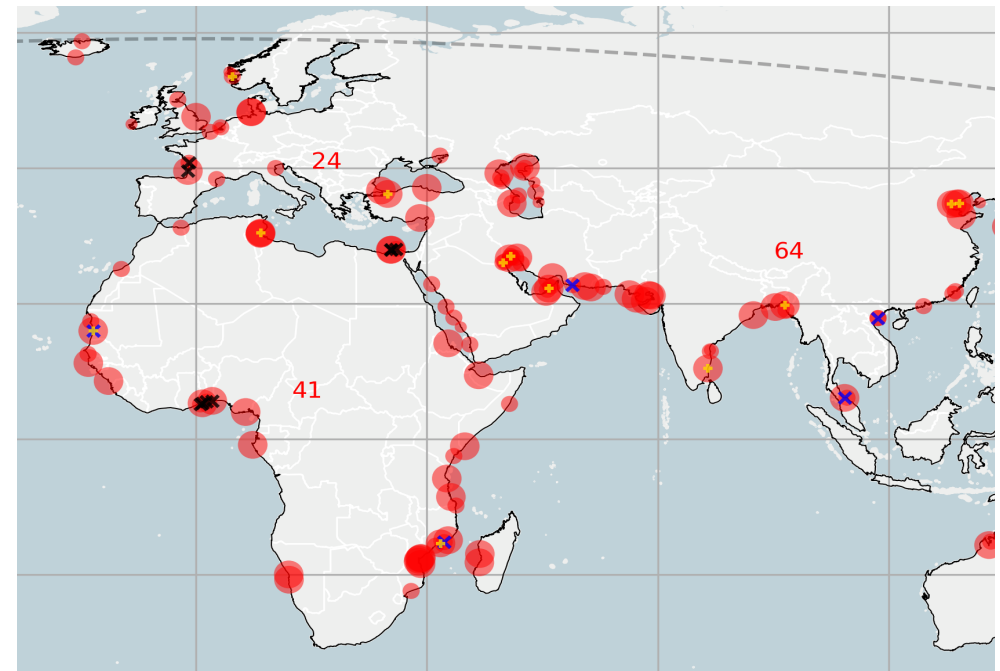
Future coastal projections

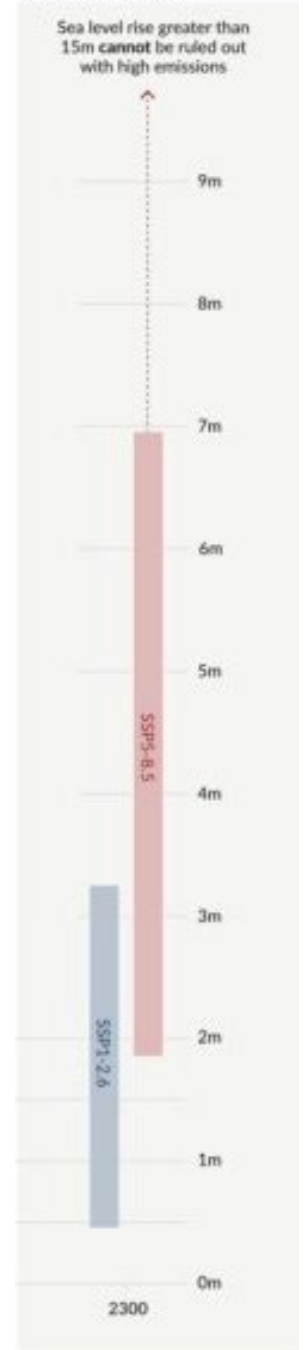~50% of all sandy beaches may experience >100m erosion 2100

RCP4.5; 2100

Vousdoukas et al. (2020)

Future coastal projections

~50% of all sandy beaches may experience >100m erosion 2100

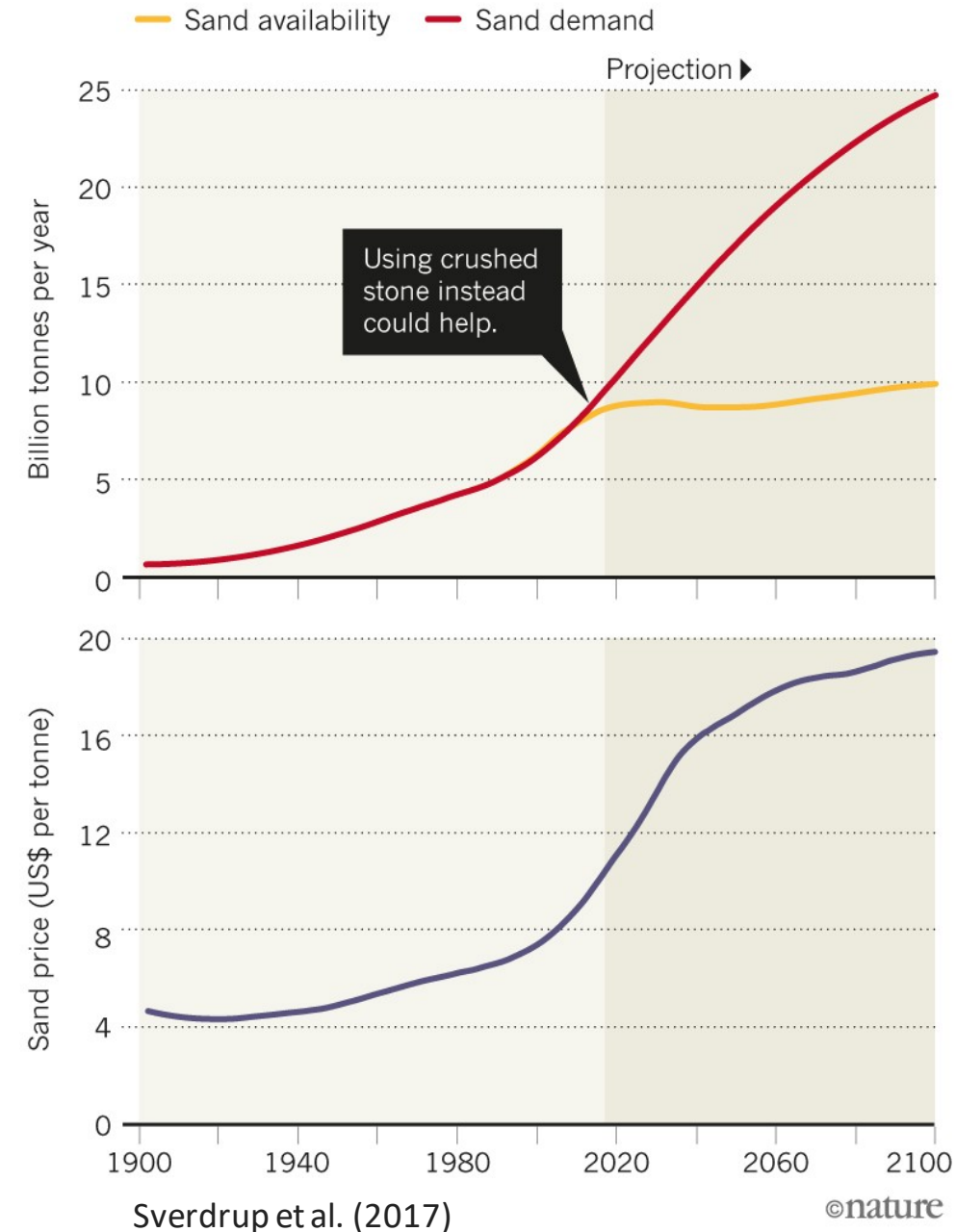Vousdoukas et al. (2020)
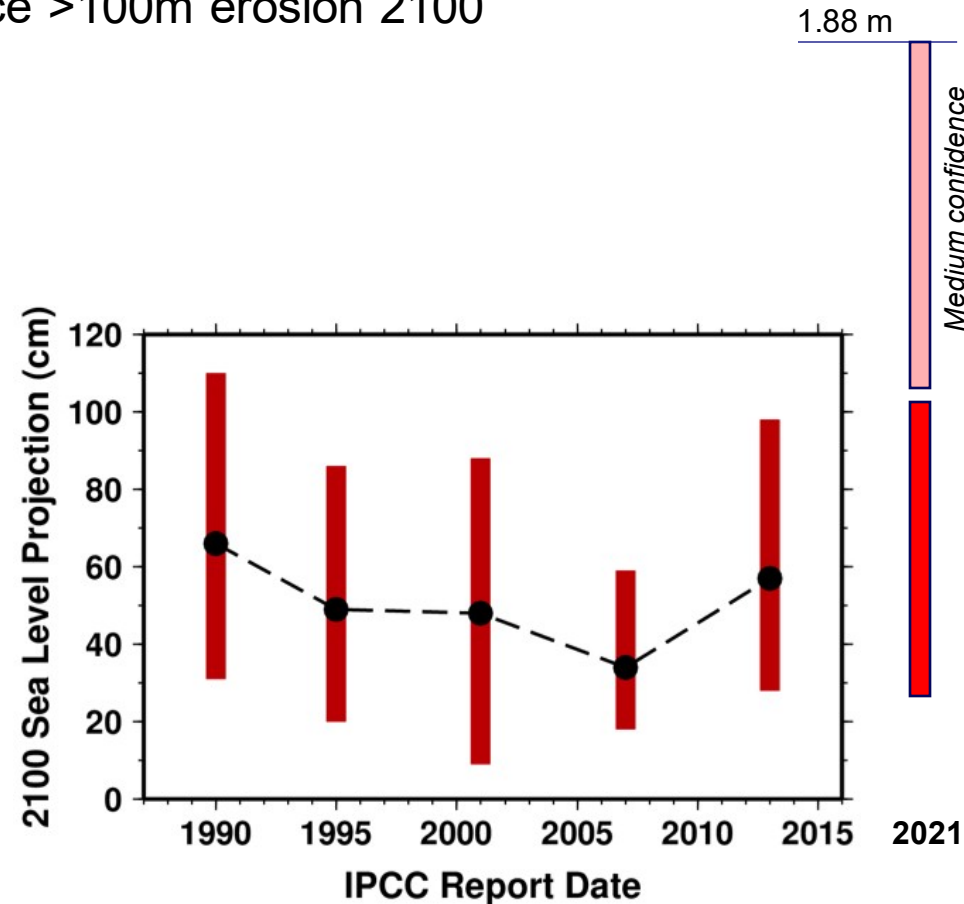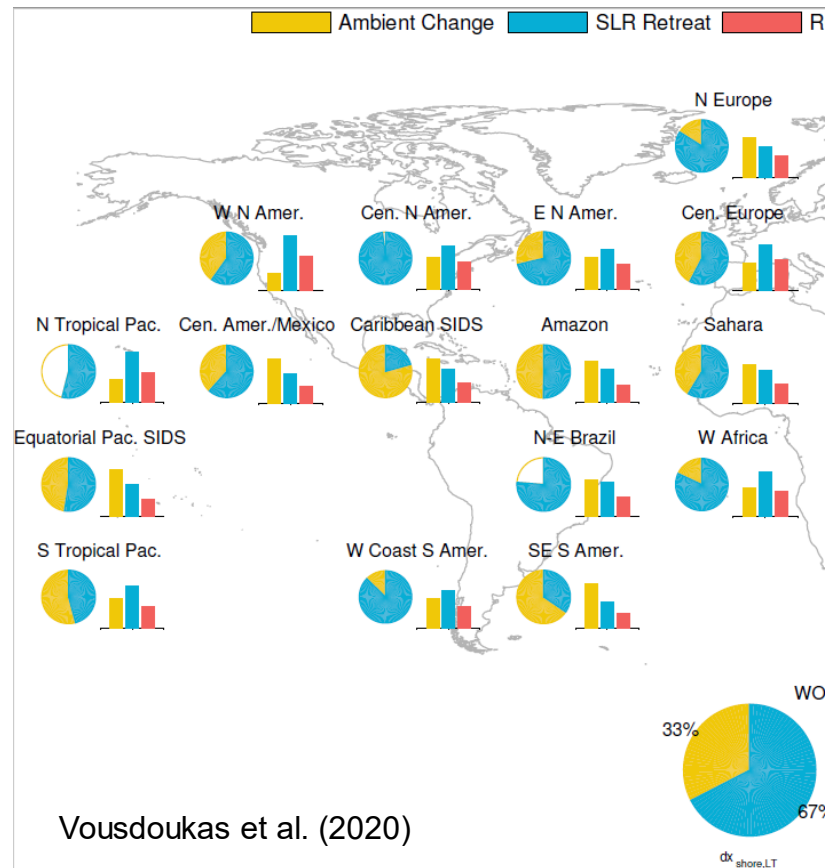
Conrad (2017)

Another threat to our beaches…

- Annual sand consumption: 50 billion tons of sand
- 27x27 m wall around the globe every year!

You can only spend your ~~cent~~ once!
sand

Deltares

GLOBAL SCARCITY
Demand for sand and gravel for construction is rising faster than natural sources can sustain, so prices will soar.

Sverdrup et al. (2017)

©nature

My view on:

Potential of ecosystem-based adaptation at large scale:

- – Awareness (what is my problem and when will it hit me?)   *Knowledge comes with responsibility!*
- – Understand your system!
- – Portfolio of adaptation solutions to inspire
- – Mapping suitable solutions

Relevant knowledge gaps for upscaling

- – *How to move From pilot to Mainstreaming*
- – *Behavior of adaptation solutions over time*
- – *Lack of appropriate design tools* to forecast dynamics of solution and uncertainties
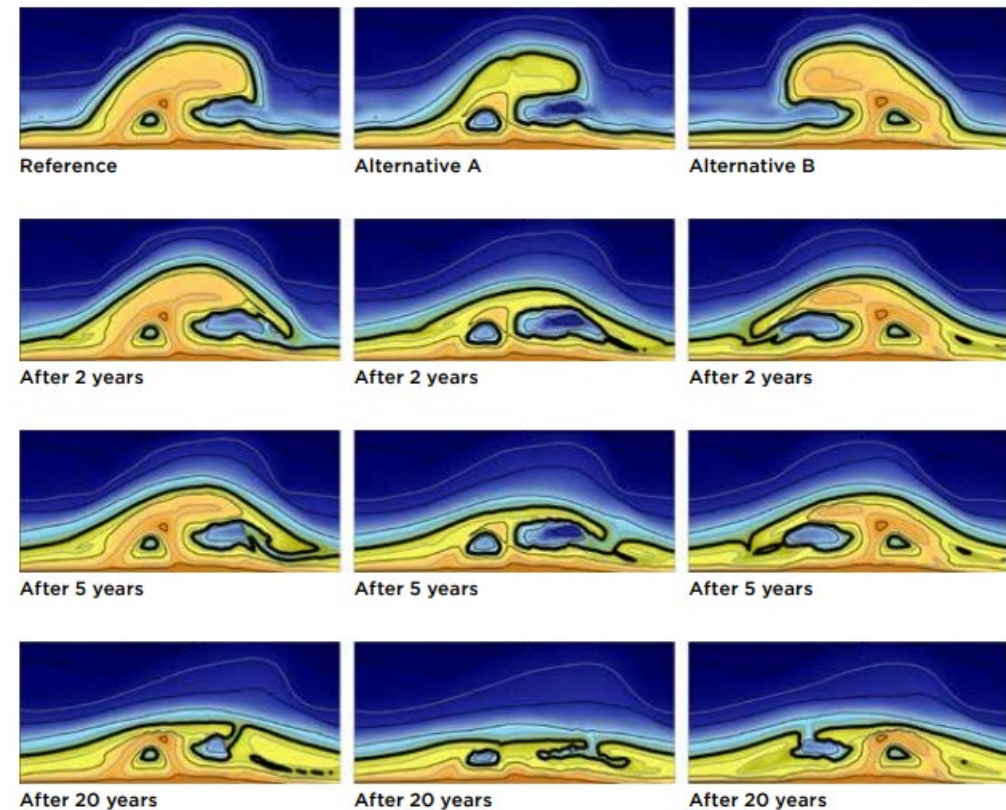
What are the first steps?

- – *Develop a full virtual pilot!*
- – *Develop a Global Coastal Atlas*

Deltares

Virtual Design Lab for exploring pathways

Artist impressions

Digital Twinning

COSTA VERDE PROPOSAL

Reference | Alternative A | Alternative B

After 2 years | After 2 years | After 2 years

After 5 years | After 5 years | After 5 years
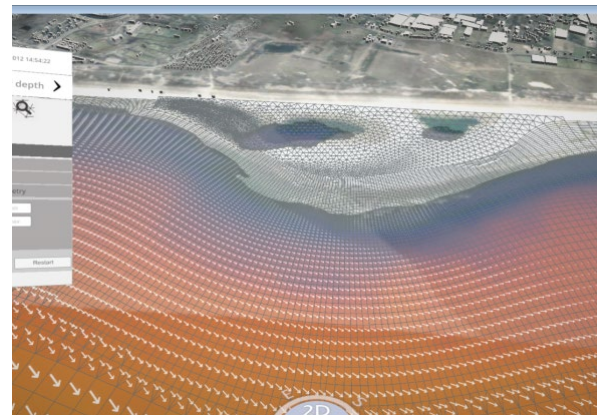
After 20 years | After 20 years | After 20 years

Luijendijk & Oudenhoven (2019)

Augmented Reality

Serious Gaming

- Stakeholder involvement
- Seeing is believing!
- Design optimization
- Promotes co-designing
- And more…

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Thank you.

Zandmotor
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B.E.A.C.H.: Best Escape Anyone Can Have