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OUR COMMON BALTIC COURSE

Climate Crisis and Coastal Management in Latvia

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Latvian Green Movement

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Nordic Council of Ministers

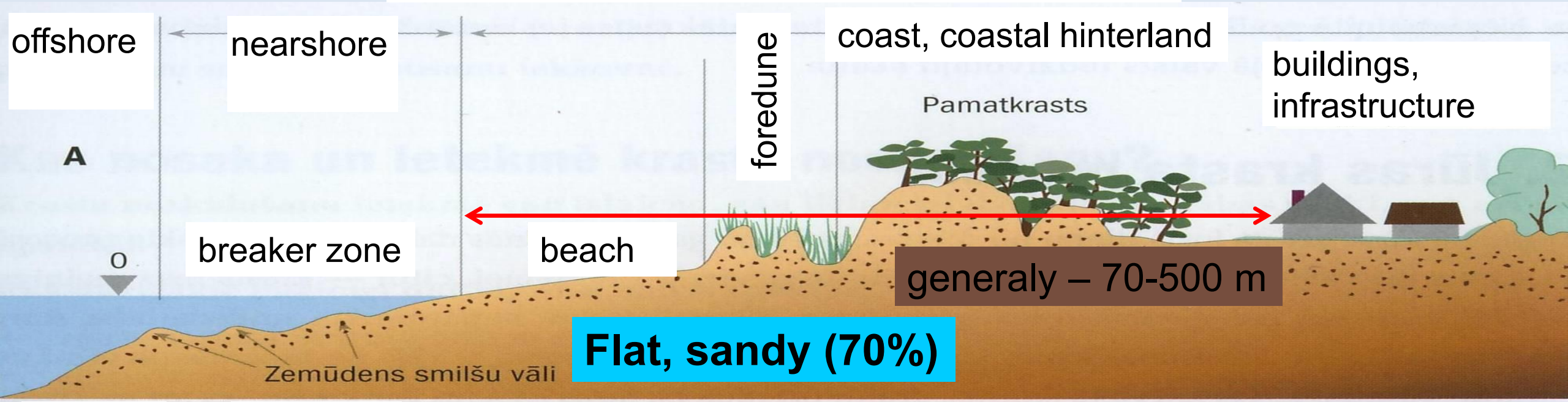
Credit Camille Fraizy

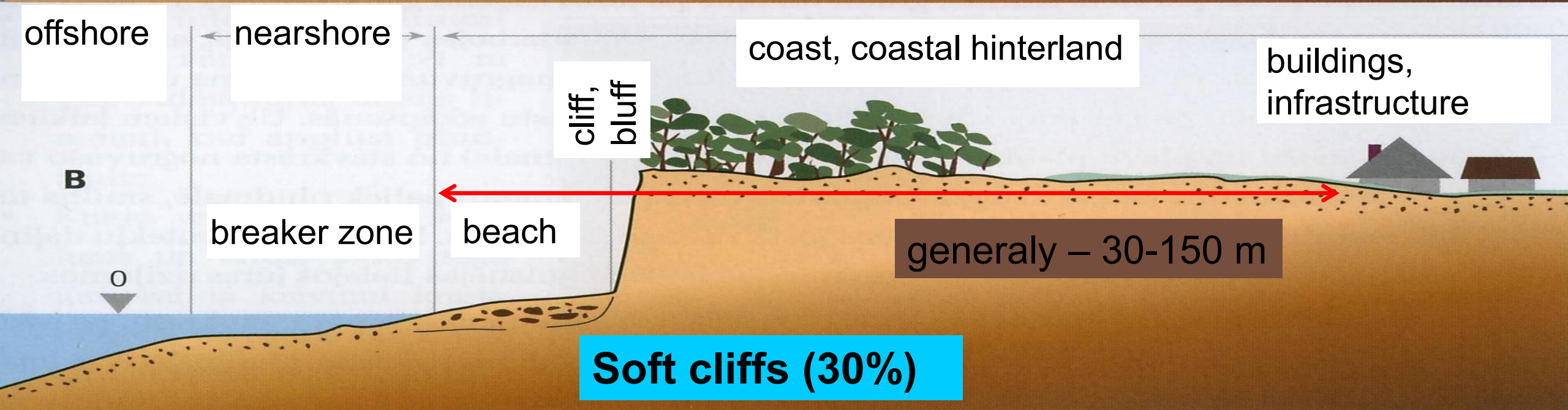
Coalition Clean Baltic

Contents of the presentation

- **Seacoast of Latvia** (introduction and background information)
- **Climate change** and related coastal transformations
- What are the **«coastal risks»** associated with the climate crisis?
- What to do with changing seacoast?

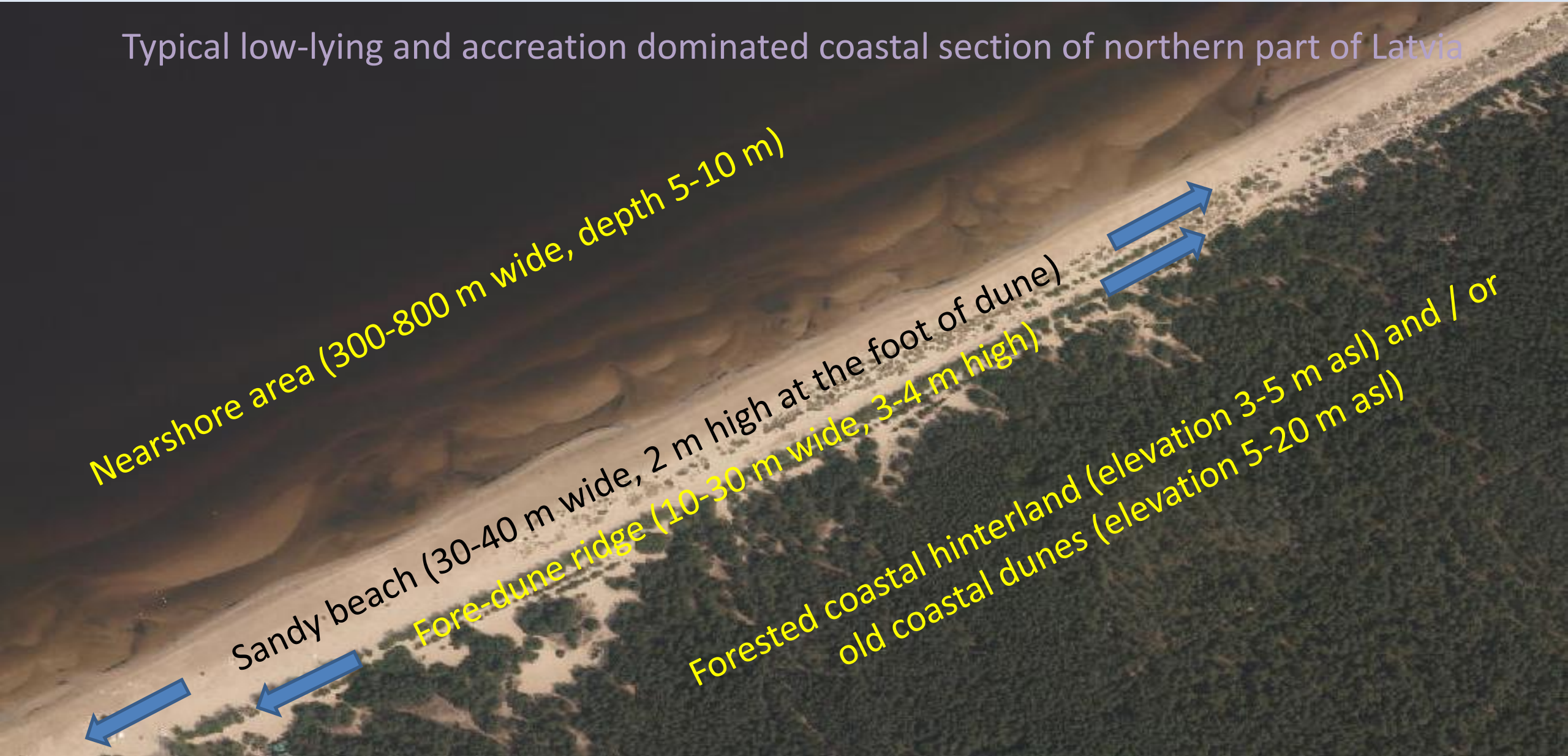
Typical coastal morphology in Latvia





Typical coastal layout and features in Latvia

Typical low-lying and accreation dominated coastal section of northern part of Latvia

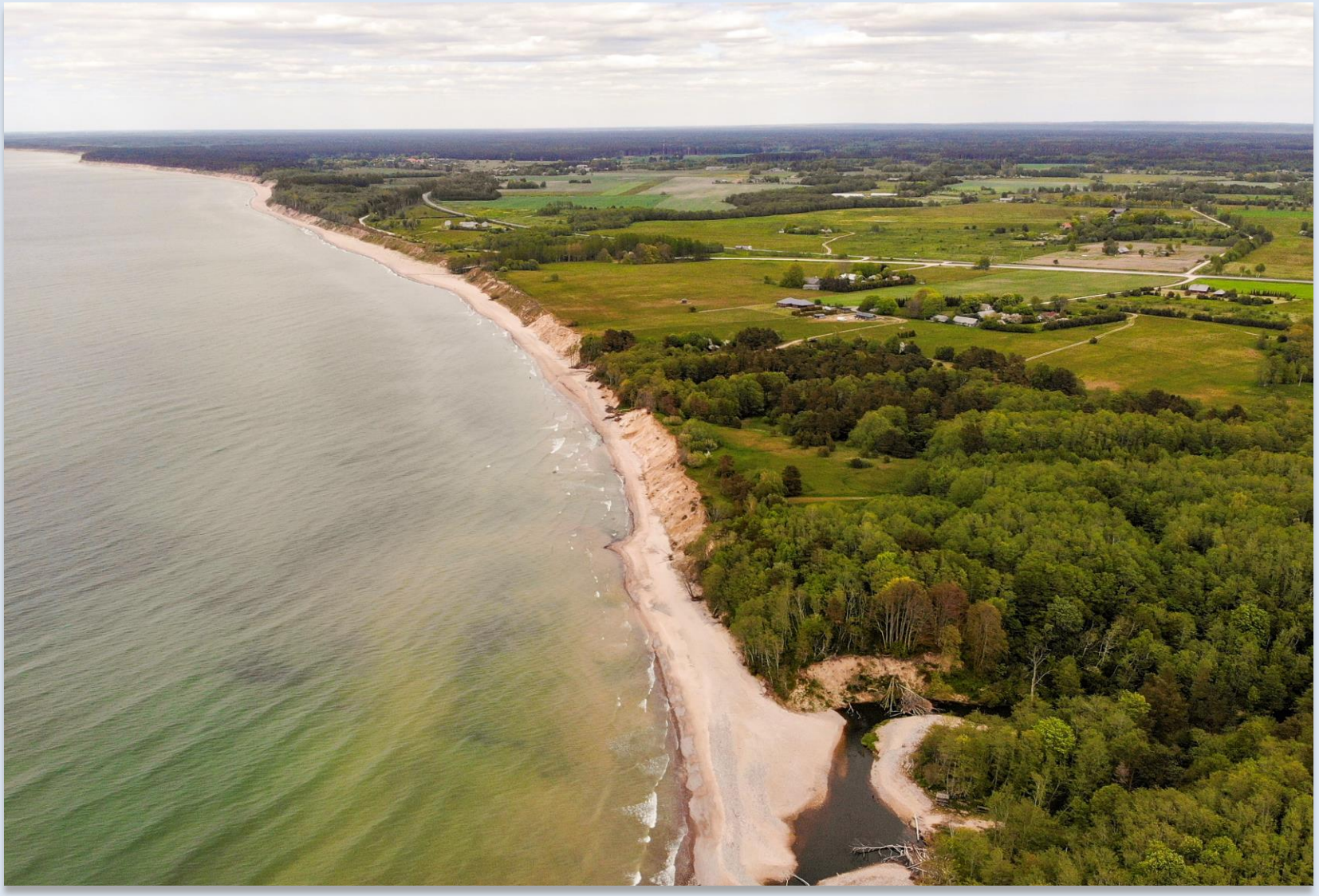


Coastal Geomorphology

	Coastline Ratio (in %) – **Europe**	Coastline Ratio (in %) – **Latvia**
Sandy, shalow	34	97
Hard, rocky	46	2
Muddy, flat	12	0
Artifficial	8	1

Coastal population and level of development

Unlike in many other European countries, comparatively **small number** of people live in the **direct vicinity** (100-200 m) of the sea.

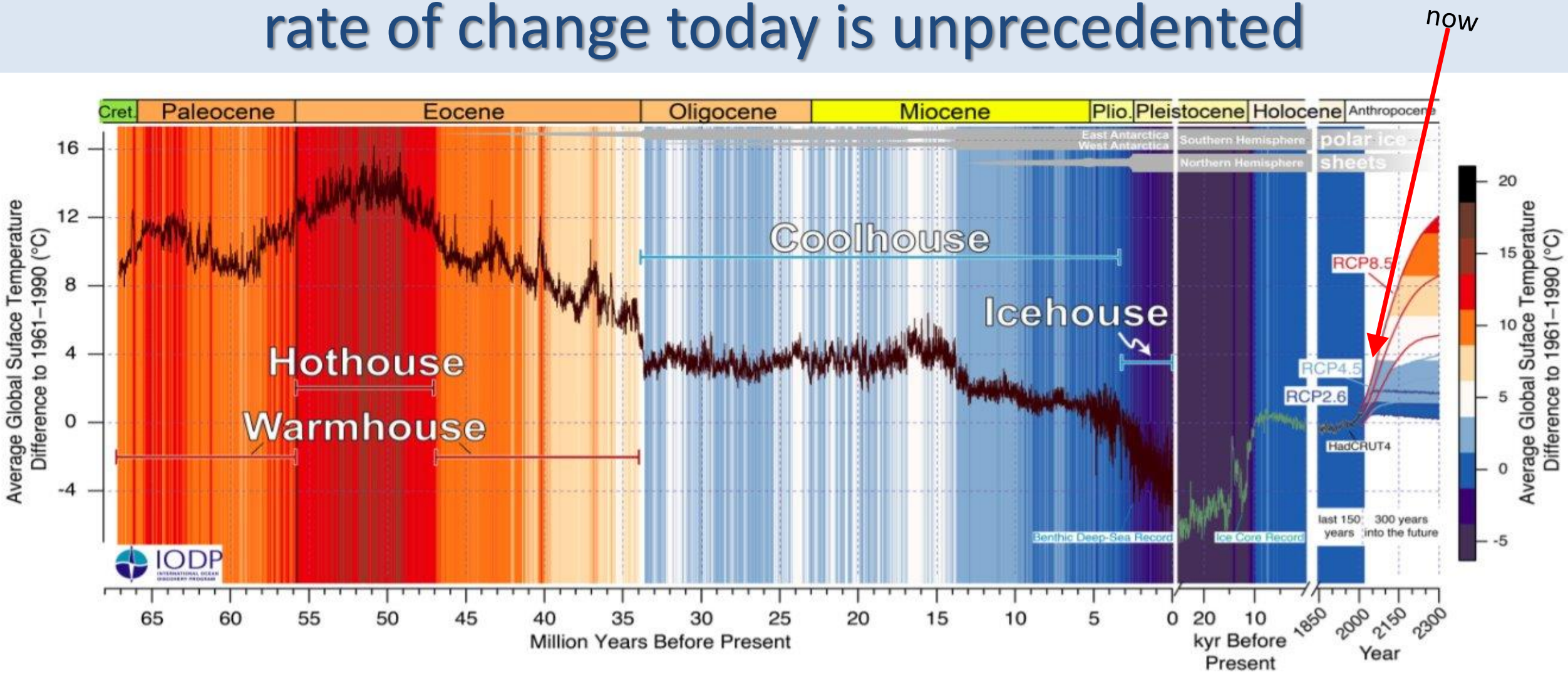


Coasts, history, politics and nature protection

- **Inaccessibility** for civillian development of coastal areas during Russian occupation (1940-1990) **has „saved" Latvia from some coastal management mistakes** specific to 20th century Western Europe.

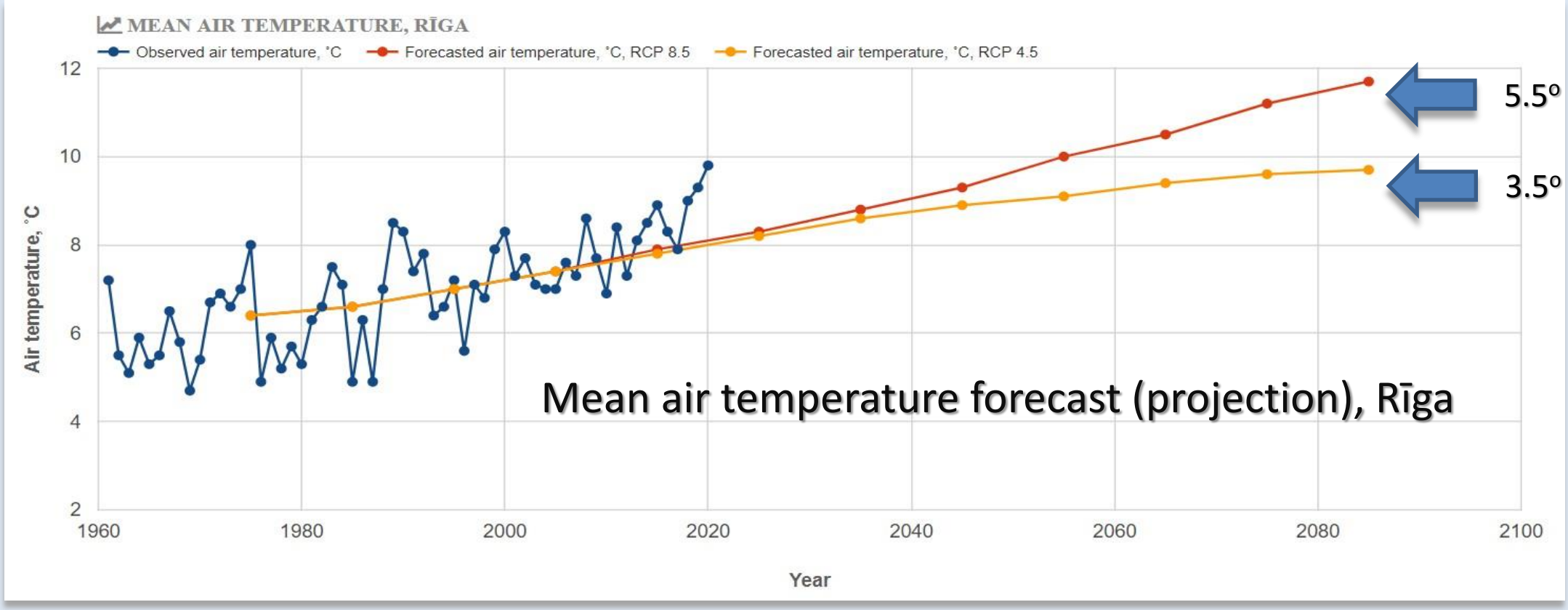
- This provaided **preservation** of natural coastal landscapes.

The Climate – it's not static, of course, but the rate of change today is unprecedented



Thomas Westerhold *et al.* **An astronomically dated record of Earth's climate and its predictability over the last 66 million years**. *Science,* 11 Sep 2020: Vol. 369, Issue 6509, pp. 1383-1387

The climate is not static



- **RCP**s (Representative Concentration Pathway) are a greenhouse gas concentration (not emissions) trajectories adopted by the IPCC.
- The RCPs are labelled after a possible range of **radiative forcing values** in the year **2100** (2.6, 4.5, 6, and 8.5 W/m^2, respectively).
- In recent years, **SSP**s (Shared Socioeconomic Pathways) has been used more widely.

So what? What does the climate change have to do with the coast?

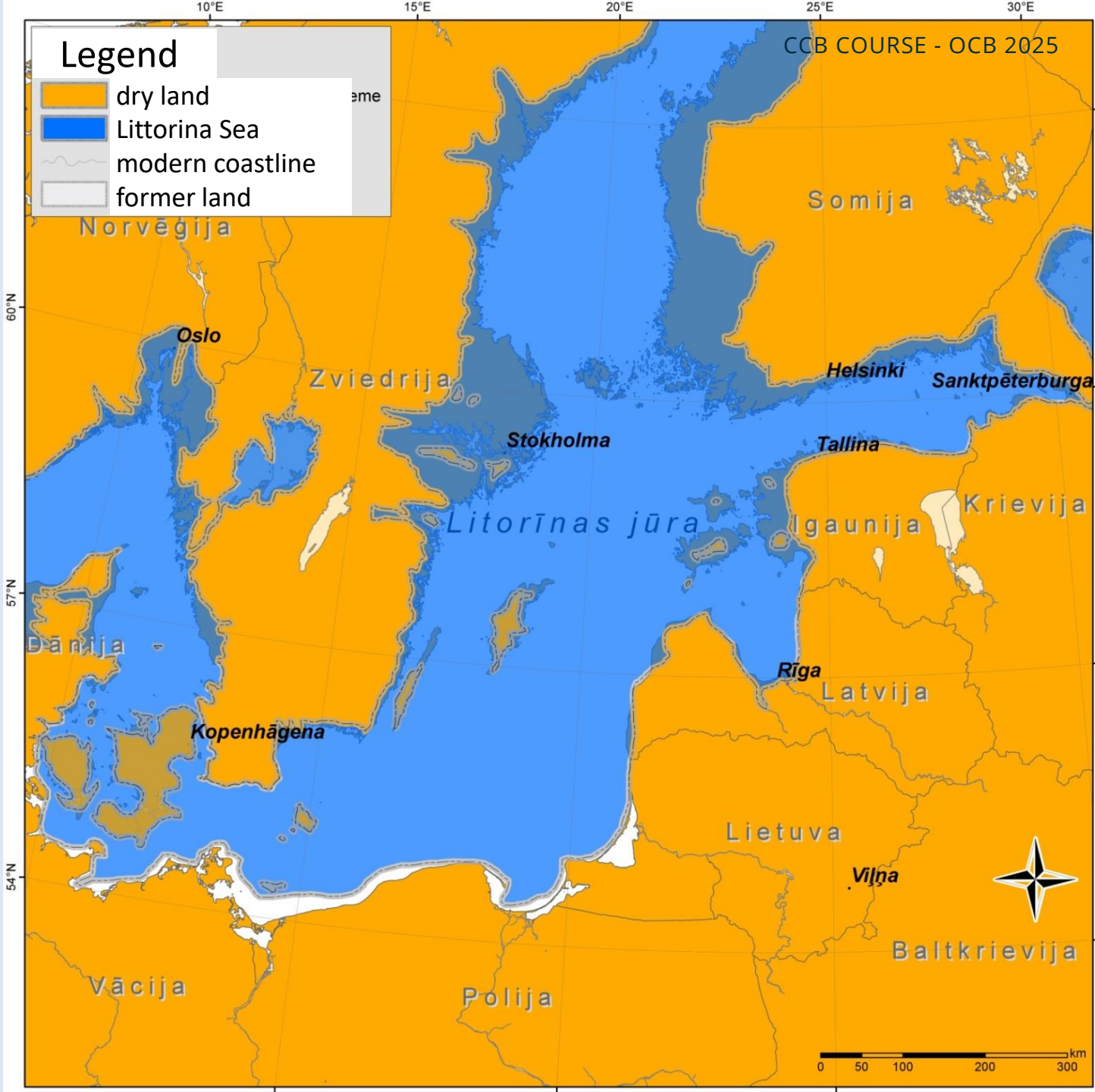
1. Rising **sea-level.**
2. **Warmer winters** (in temperate and cold climates) – more erosion.
3. Changes in the status quo of the **wind regime** (less frequent / more frequent storms, other prevailing wind direction) – erosion elsewhere / other type of erosion.

Changing sea level (past)

The Baltic Sea basin 7600-7200 years ago.

Littorina Sea stage.

Over the last 12,000 years, the **water-level** of the Baltic Sea at the coast of Latvia has **fluctuated** in the range of about **80 m**, significantly increasing and decreasing at least 10 times.



Changing sea level (future)

Why?

- Thermal **expansion** of water.
- Mass change (**melting**) of glaciers and ice sheets.
- Post glacial **rebound** of recently glaciated areas.

Ventspils, W Latvia

Rising sea level (future)

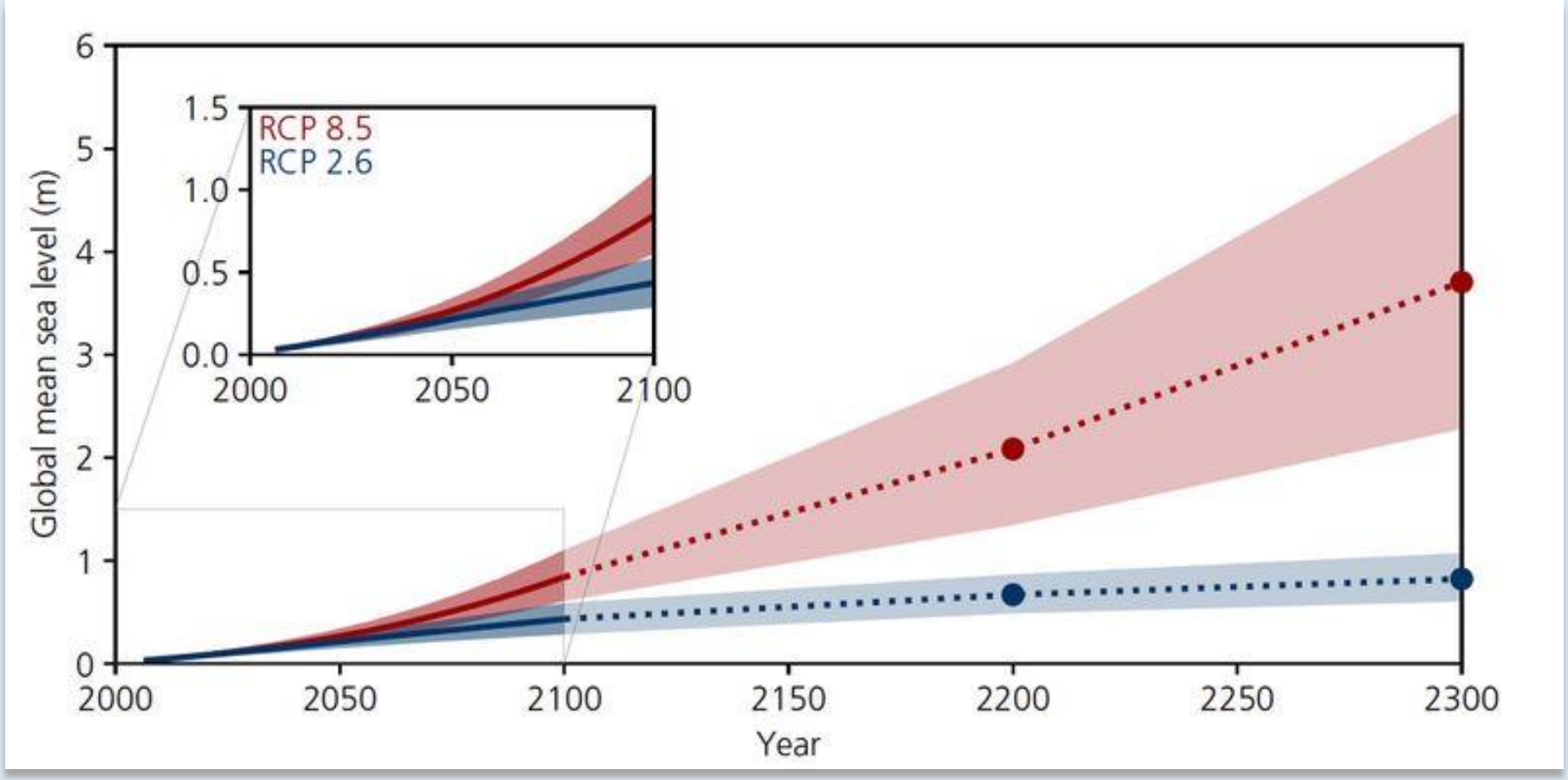
Sea **level will continue to rise for centuries** even if greenhouse gas emissions are sharply reduced, and global warming is limited to well below 2°C (IPCC 2023).

- **Will this really happen?**
- **Highly unlikely!**

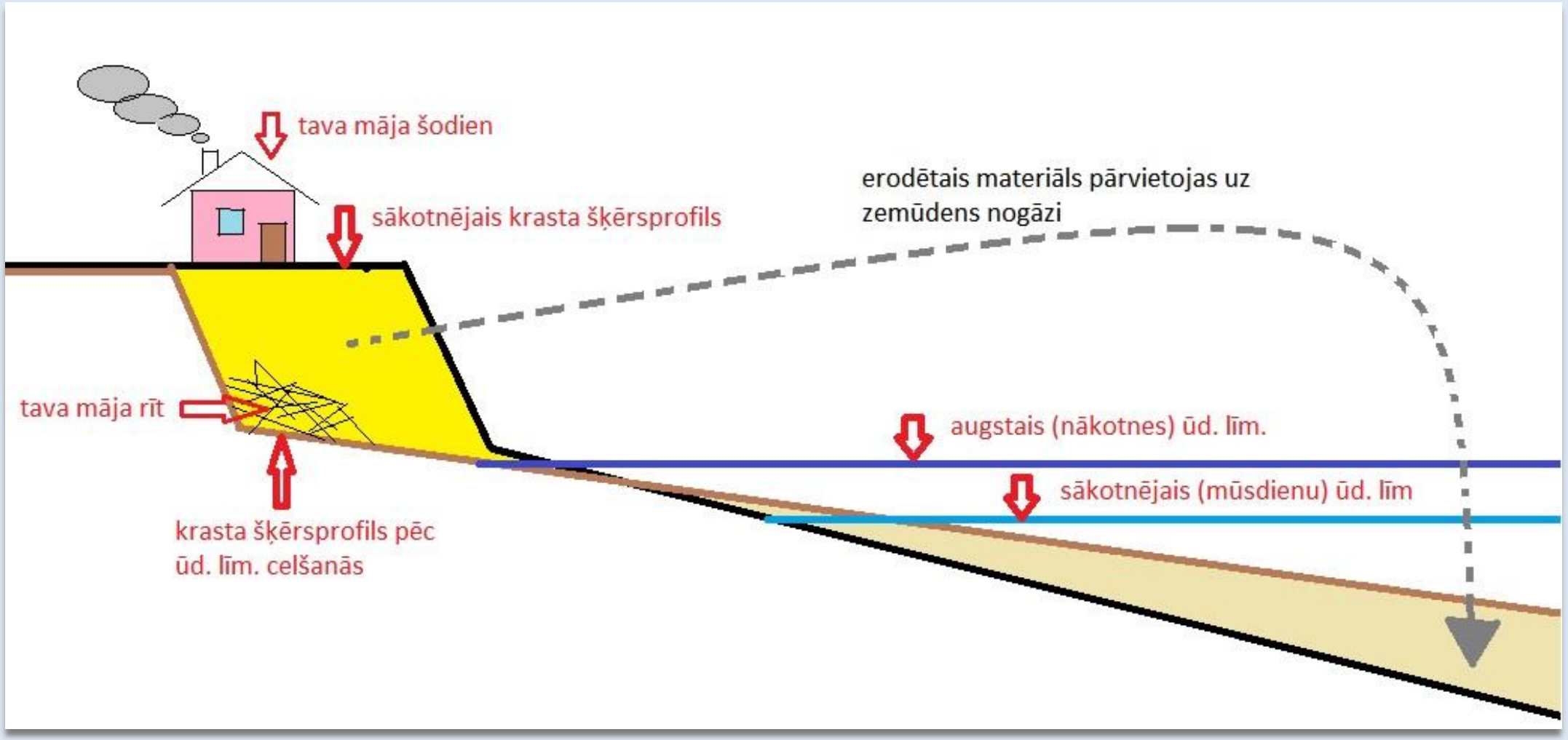
Territory of Latvia in a few thousand years
(the absolute worst-case scenario MSL +90 m).

Rising sea level (future) – most plausible scenarios

According to **IPCC** (United Nation's Intergovernmental Panel on Climate Change) expected global sea level rise by the end of this century: **0.30 – 1.20 m**.



Rising sea level (future) and permanent Coastal retreat



Coastal erosion as a result of rising sea level.

Rising sea level (future) and permanent Coastal retreat

Bruun's parametric equilibrium equation:

r = s*l /(h+b), where:

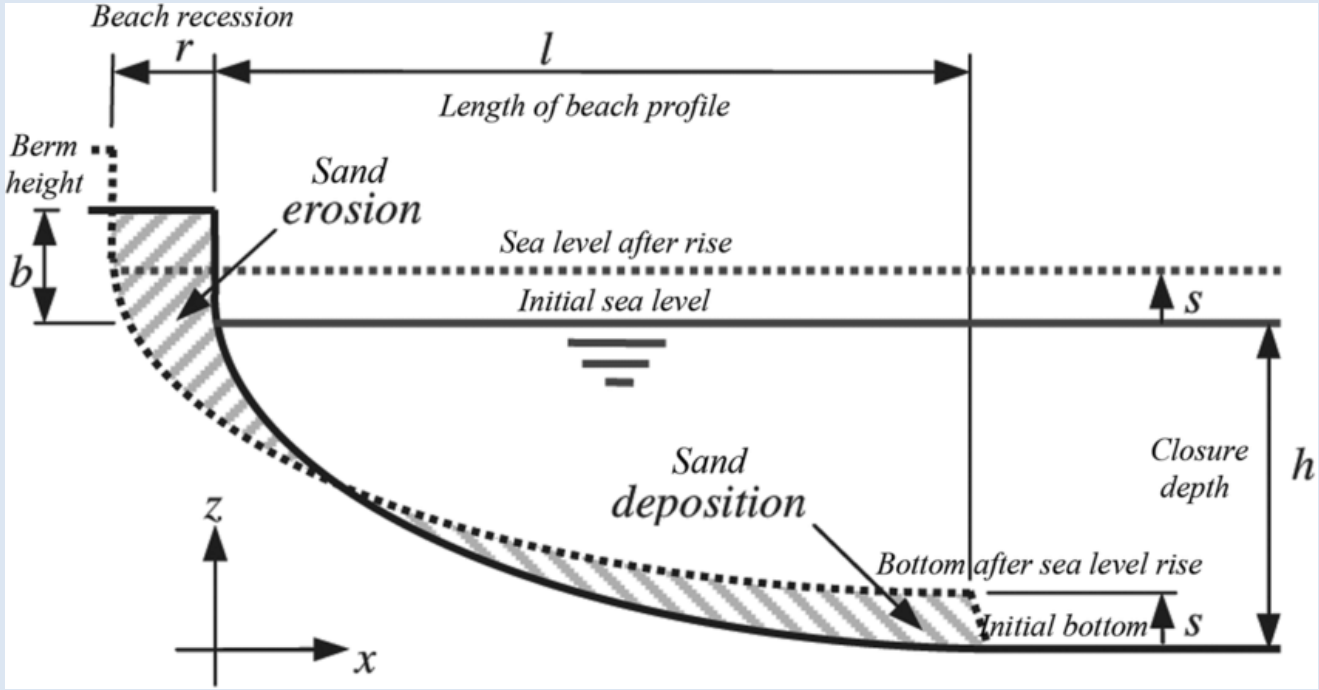
r – shore realignment distance(m),

s – water level rise (m),

l – distance from the shoreline to the edge of the underwater slope (m),

h – depth at the edge of the underwater slope (m),

b – average height of the coastal relief (m).



Bruun, P. (1962). "Sea-Level Rise as a Cause of Shore Erosion". American Society of Civil Engineers Journal of the Waterways and Harbours Division. 88: 117–130.

«Bruun Rule»: shoreface shift in response to sea-level rise. The shaded eroded and deposited volumes are equal.

Coastal change – acceleration

Jūrkalne, W Latvia

Coastal retreat due to erosion:

- (median 1930-1990 **-0.8** m/y^{-1})
- (median 1991-2024 **-1.2** m/y^{-1})

Coastal change – acceleration

Main reasons for accelerated Coastal Erosion and Retreat in Latvia?

- The sea has become more "energetic" or in some places there has been a deficit of coastal sediment.
- Erosion dominates over accumulation (insufficient natural «coastal regeneration»).
- The coastal slope is mostly composed of easily erodable sediments, so the coastal change can occur very rapidly.

Climate Crisis and peculiarities of the Seacoast of Latvia

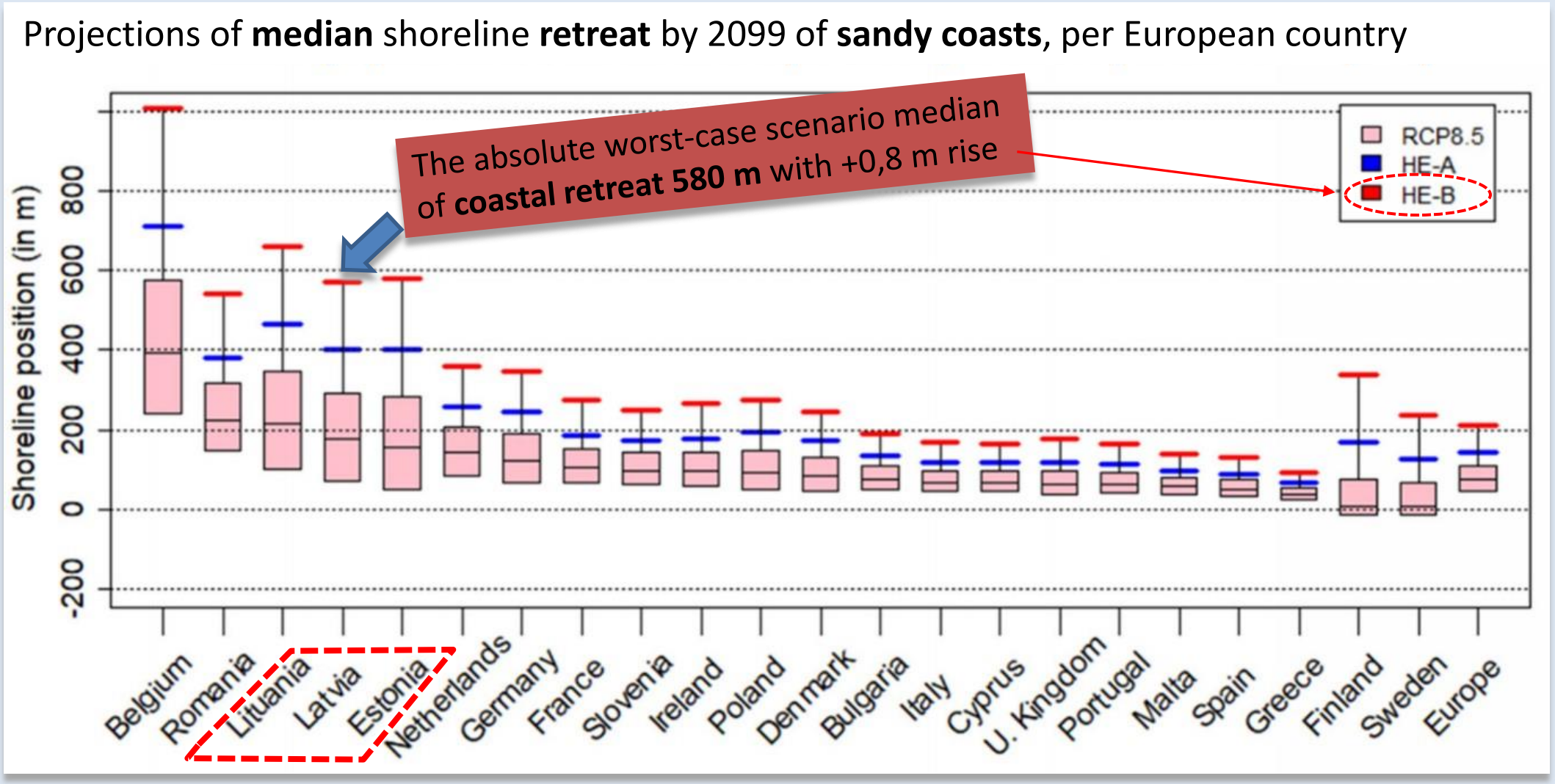
What does the future hold?

Overall, the impact of the Climate Crisis on the coast of the Baltic Sea is **difficult to predict**, because:

- Baltic Sea is **«poorly» connected** to the ocean,
- besides the impact of Climate Crisis, **other problems** will have an impact as well.

Rising sea level (future) and Coastal retreat

Projections of **median** shoreline **retreat** by 2099 of **sandy coasts**, per European country

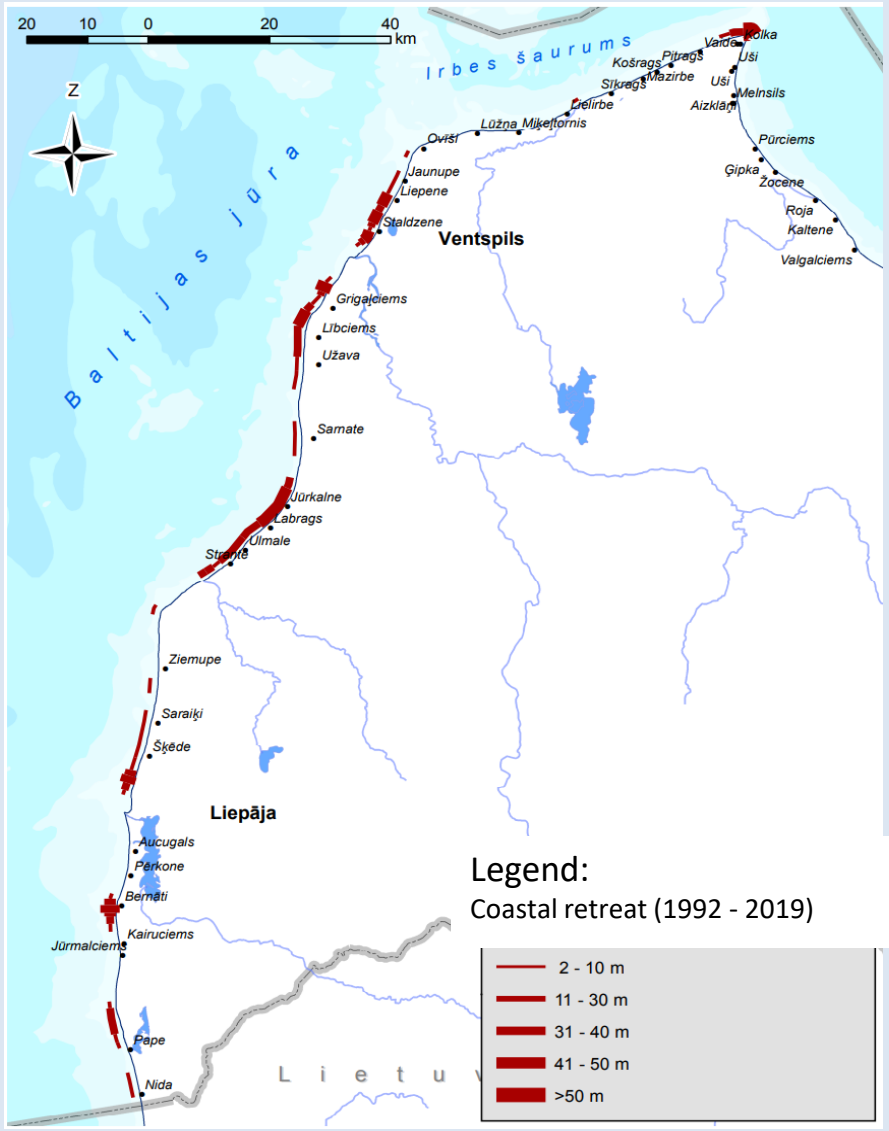


Thiéblemont R. *et al*, 2019. **Likely and High-End Impacts of Regional Sea-Level Rise on the Shoreline Change of European Sandy Coasts Under a High Greenhouse Gas Emissions Scenario**. *Water*, 11, 2607

Coastal erosion in Latvia – a somewhat diverse situation

Diversity is due to: differences in the **geological structure** of the coast, differences in the "severity" of disturbances caused by **anthropogenic factors**, differences in the **orientation of the coastline** in relation to the typical storm direction.

- In some coastal sections, retreat rate is 2-3 m/y.
- In total, there are about 50 km of sections where the coast retreats at an average rate of >0.5 m/y.



Should coastal erosion be considered a serious problem in Latvia? *Now? Tomorrow?*

- Substantial changes in coastal “shape” are occurring only during relatively rare **severe storm events**. There can be even more than 10 years in between such events.
- Flooding of low-lying areas only occurs **during severe storms** – it is a consequence of wind surges and is not permanent (for now).

Veczemju cliff during severe storm in 2005

Should coastal erosion be considered a serious problem in Latvia? *Now? Tomorrow?*

- **Observable increase in activity** of the coastal erosion over the last 20-30 years.
- Coastal system is experiencing **growing deficit of sand** (mostly due to **anthropogenic** intervention).

Skulte port, Latvia (ports usually cause disruption of coastal stability)

Should coastal erosion be considered a serious problem in Latvia? *Now? Tomorrow?*

- **Few developed areas** with infrastructure or buildings in proximity of retreating coastline.
- Erosion is **not threatening recreational value** of coastal areas (in fact – its quite the opposite!).

Liepāja, Latvia (a somewhat developed area with an important recreational value)

Should coastal erosion be considered a serious problem in Latvia? *Now? Tomorrow?*

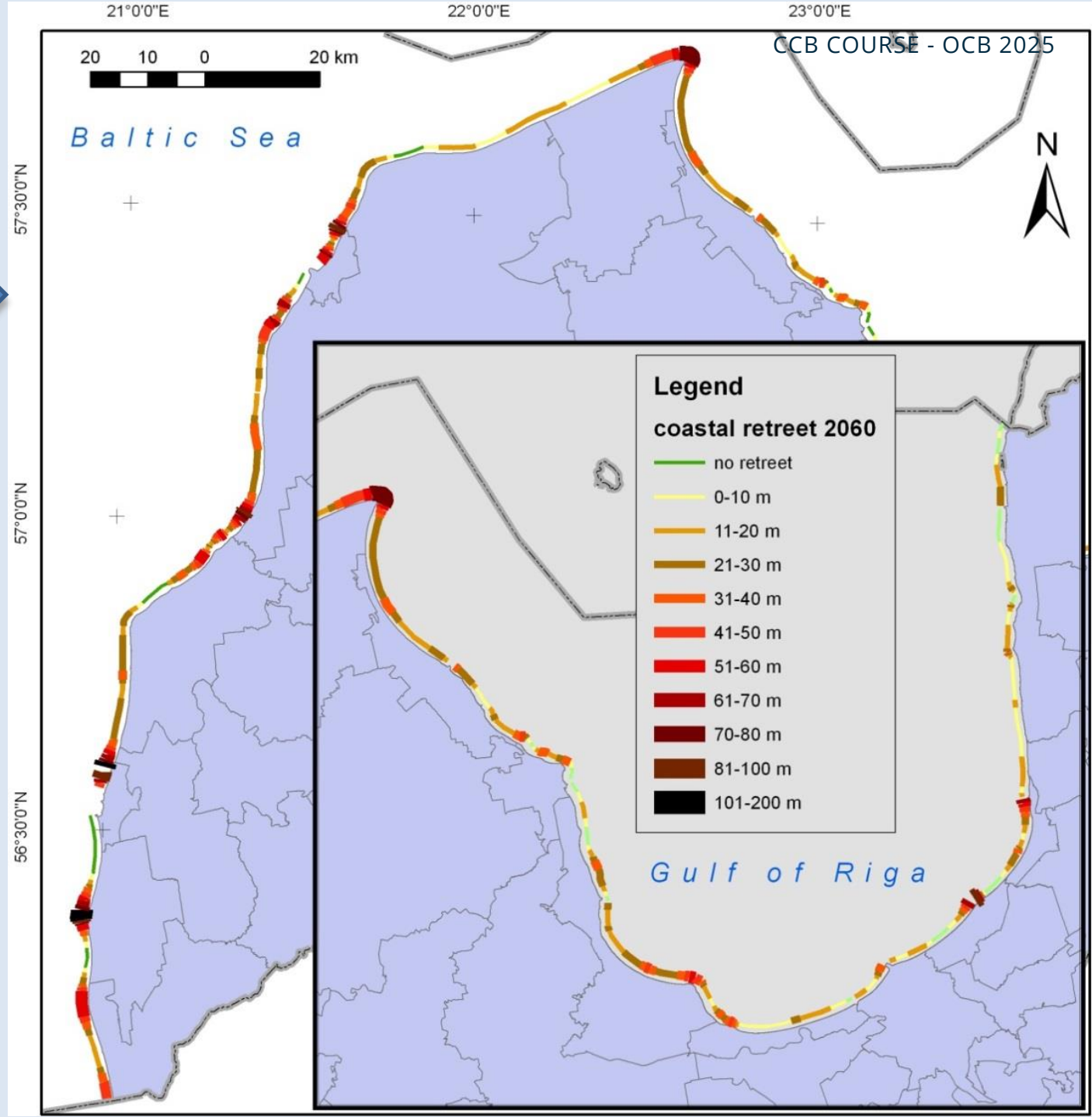
Main problem is insufficient understanding of sustainable coastal management practices:

- what to do in case of coastal erosion?
- how to decrease future risks?
- which course of action is more cost-efficient?

Liepāja town sewage treatment plant. Since its construction in 1972, the coastline has retreated by 120 m.

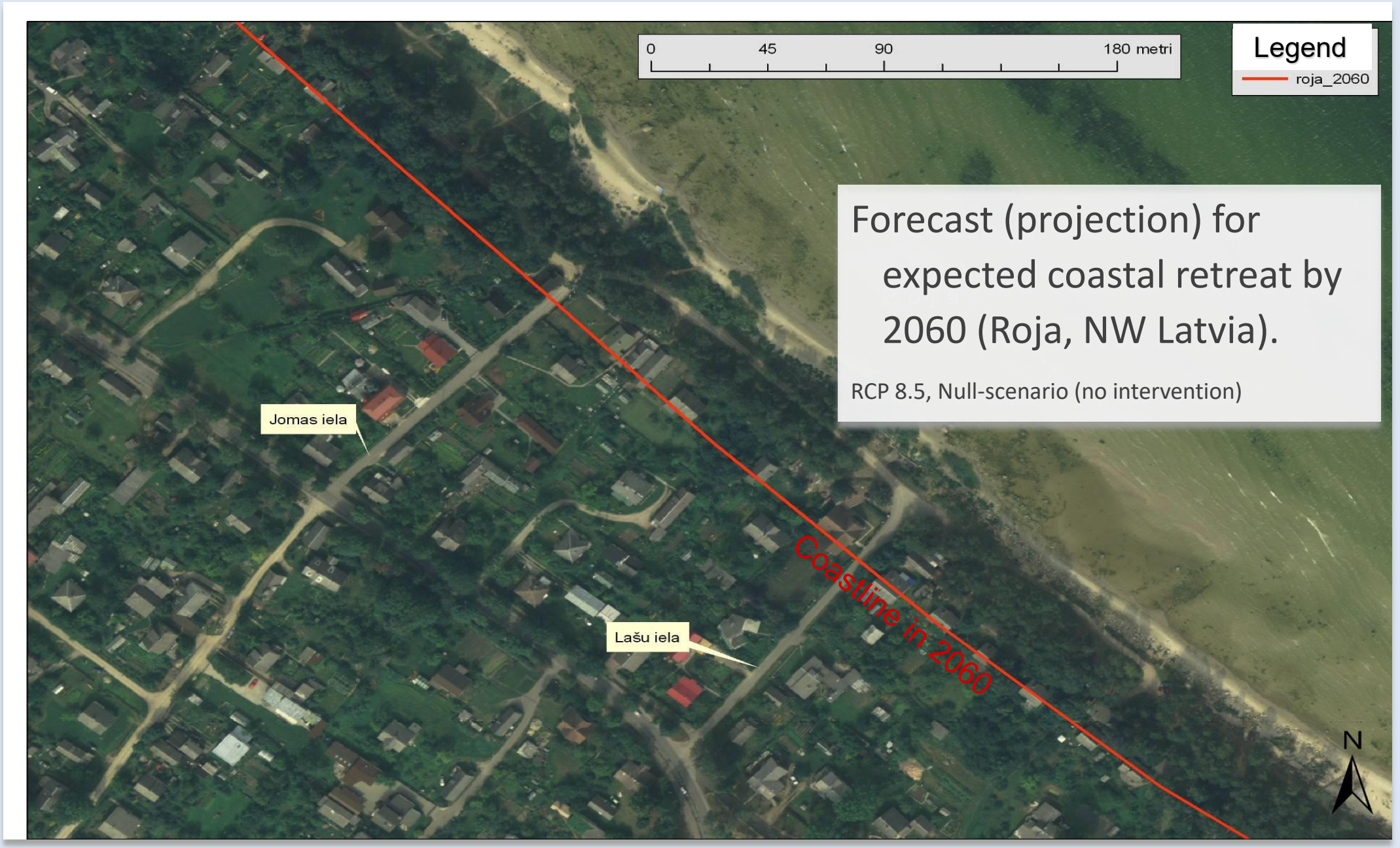
Risk level?

Coastal retreat forecast for 2060. Null-scenario (no intervention).



- Maximum expected coastal retreat – **150-200 m** (by 2060).
- Territory of Latvia will be reduced by approx. **9.0 km²** (by 2060).

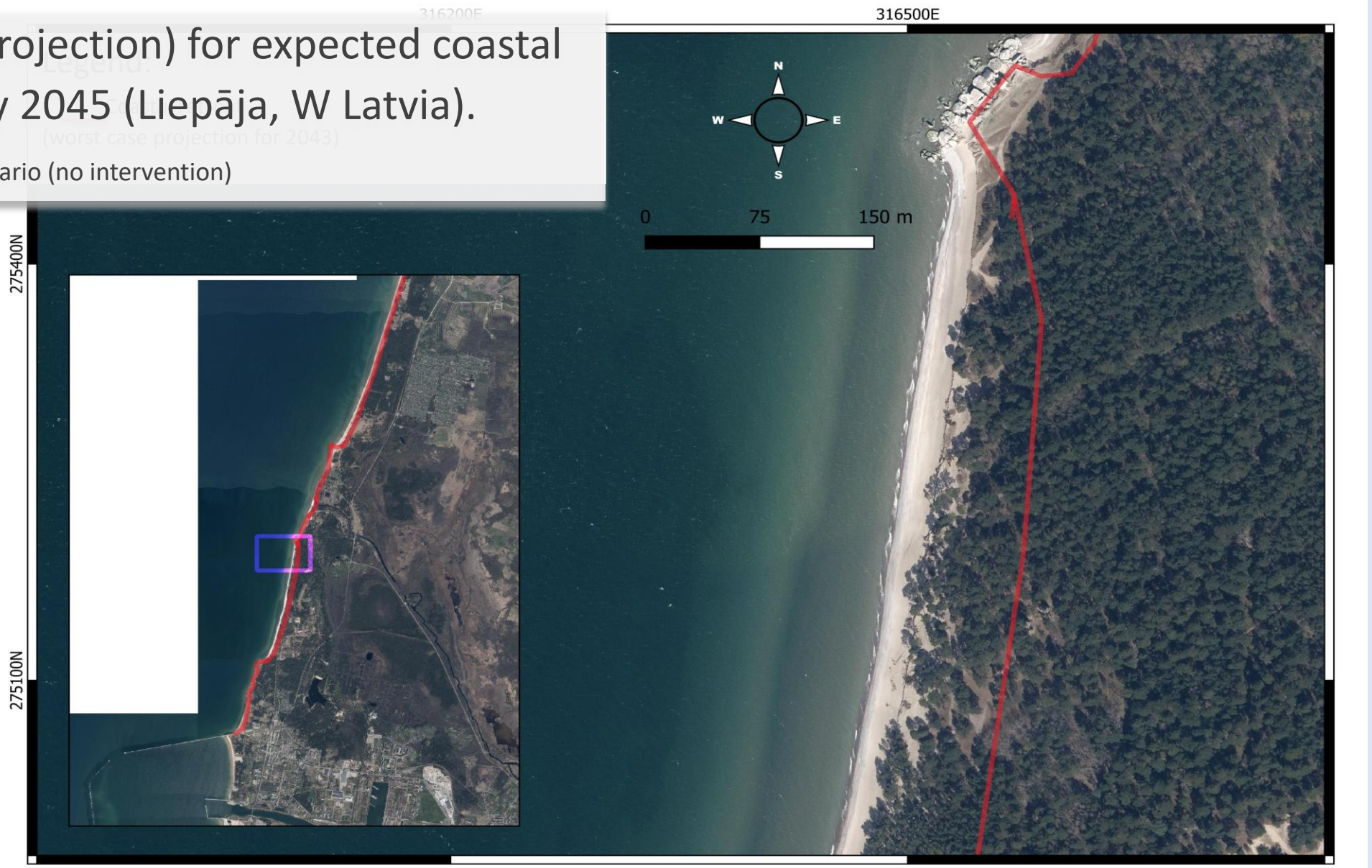
Roja – coastal retreat «hot-spot»



Liepāja – coastal retreat «hot-spot»

Forecast (projection) for expected coastal retreat by 2045 (Liepāja, W Latvia).

SSP5-8.5, Null-scenario (no intervention)



Pāvilosta – coastal retreat «hot-spot»

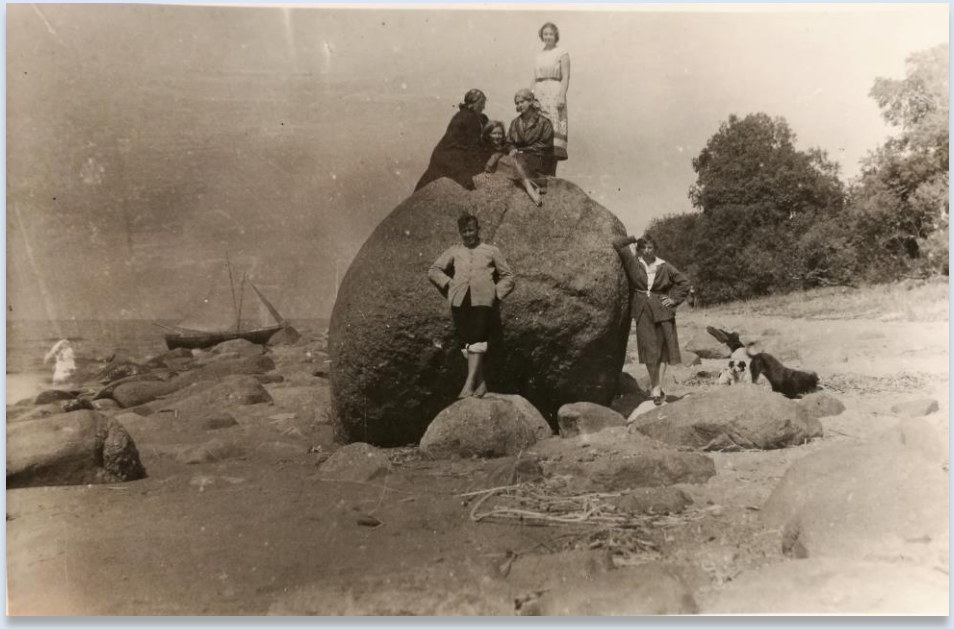
Forecast (projection) for expected coastal retreat by 2045 (Pāvilosta, W Latvia).

SSP5-8.5, Null-scenario (no intervention)

What to do then – Mitigation? Adaptation? *migration*?

The **choice** of preferable and / or available adaptation and «fighting» mechanisms **depends** very much on:

- how high the **water level** rise we plan to adapt to,
- **coastal section (location) in question** (developed or nature areas).



Skulte, Latvia, Lauču boulder in 1935 and 2020.

What to do then – Mitigation? Adaptation? *migration*?

The best course of action in the coming decades is to:

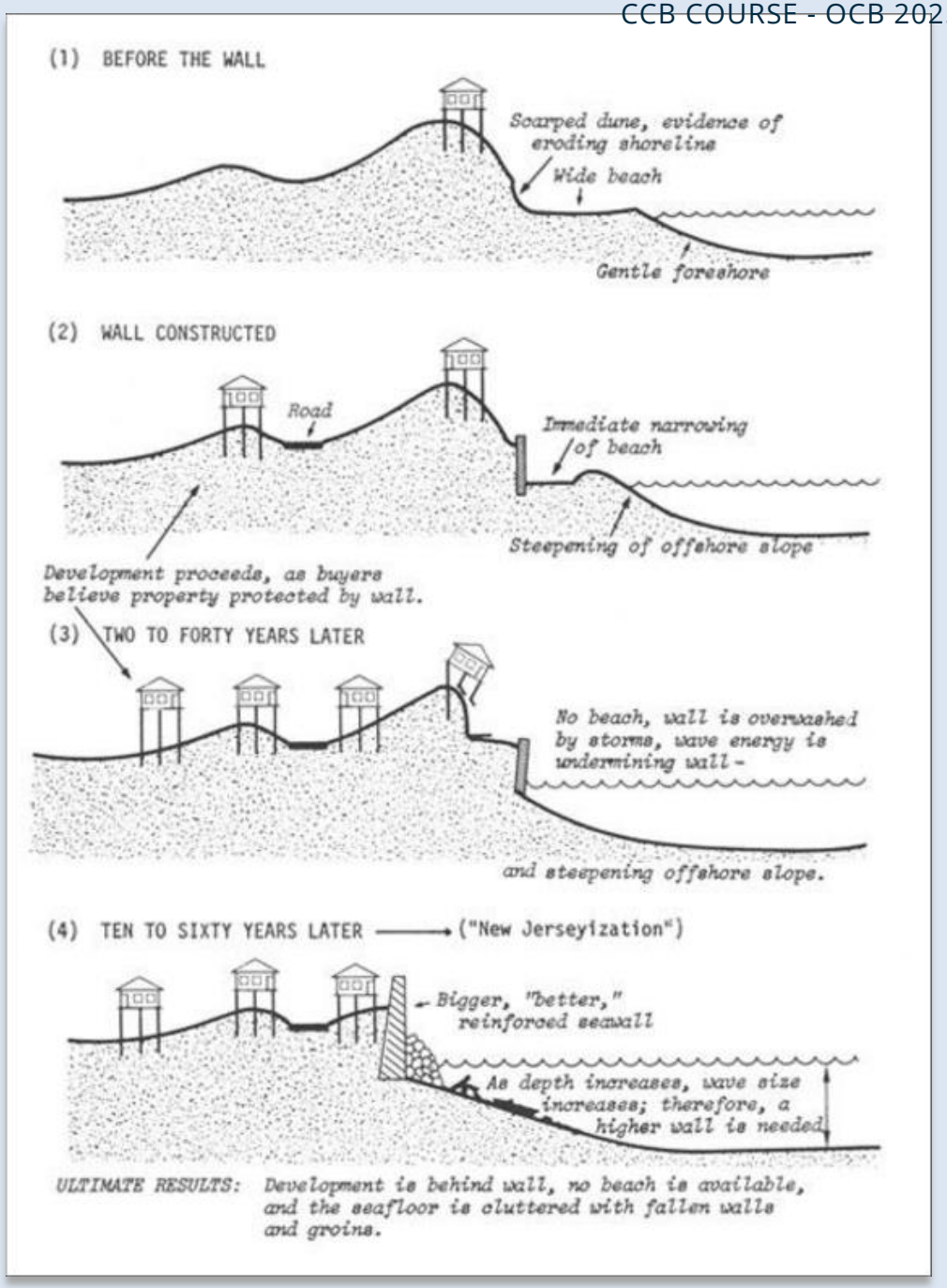
- **avoid massive projects of coastal erosion prevention** as much as possible;
- try to **restore and reinforce the existing natural barriers** inherent in the coastal system.

This should be considered as the **last** (least preffered) option!

Avoiding fighting erosion?!

Newjerseyization – A self-reinforcing spiral of destruction that begins with the fortification of the sea-coast against erosion.

The phenomenon got its name from the Atlantic coast of the US state of New Jersey.



What to do then – Mitigation? Adaptation? *migration*?

When the water level rises by a few tens of cm, **local measures** could certainly suffice:

- **locks** could be installed at the mouths of rivers,
- lower areas at risk of frequent flooding can be converted into **polders.**

Flood gate (lock) in the river. Greifswald, Germany

What to do then? Mitigation, adaptation?

When the water level rises by a few tens of cm, **local measures** could certainly suffice:

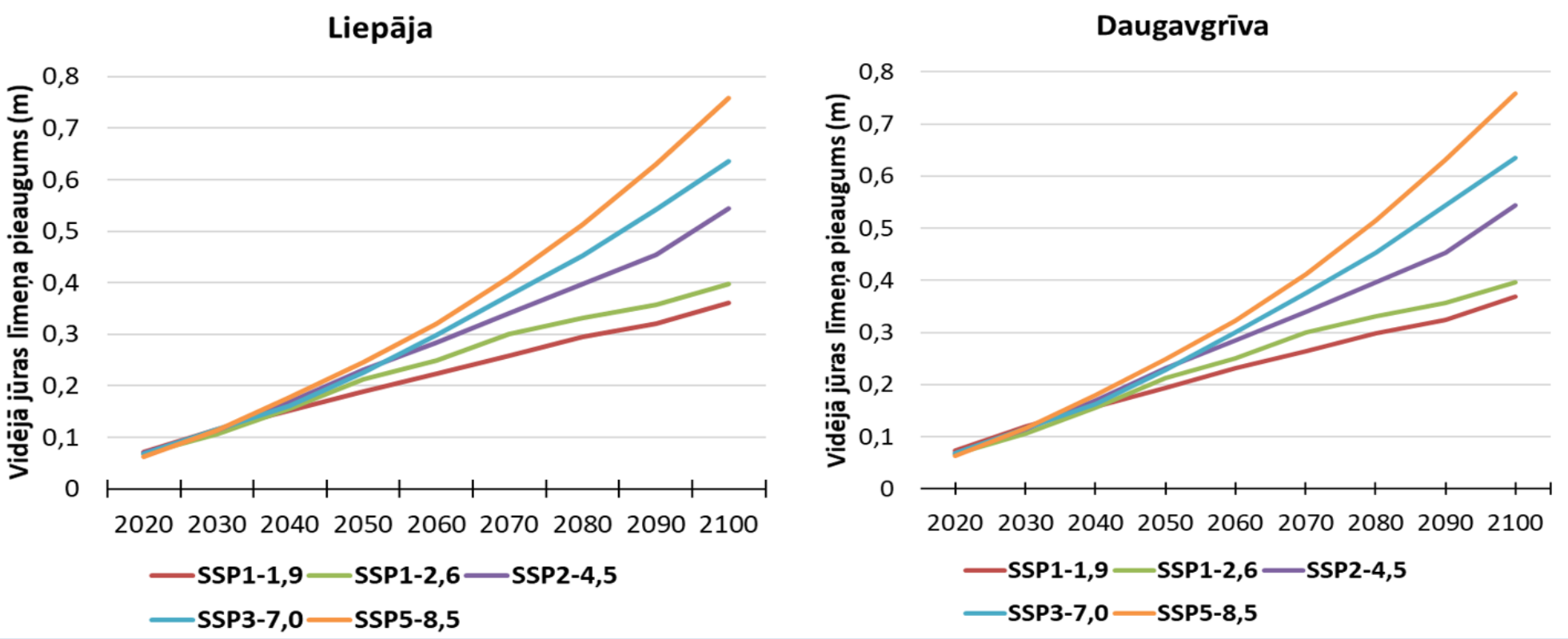
- the **barrier function** of the coastal area (beach / primary dunes) can be **improved** (adding extra sand and "building" more massive dunes),

Groynes, artificial beach, artificial dune.

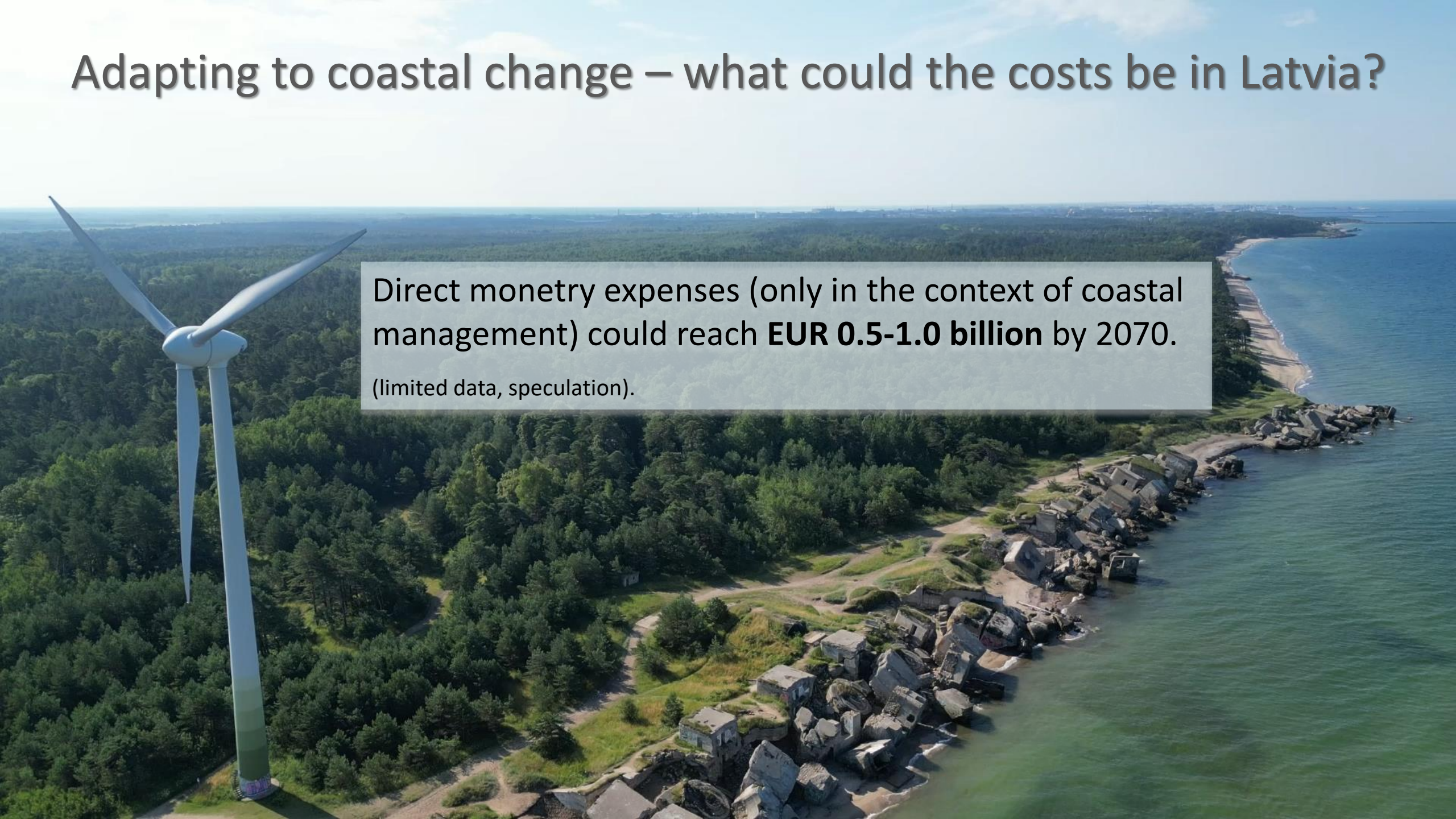
A very plausible set of **«must-have» solutions** over the coming decades in 20-30 km of the coast of Latvia.

What awaits us somewhere further down the dark path of time?

- If it is **1 m and above** of permanent water-level increase, then **local** adaptation and mitigation measures may prove **insufficient.**
- **Investing in** international **mega-projects** could prove worthwhile and **inevitable**. Probably.



Adapting to coastal change – what could the costs be in Latvia?



Direct monetry expenses (only in the context of coastal management) could reach **EUR 0.5-1.0 billion** by 2070.

(limited data, speculation).

THANK YOU

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