

# Venice, a window to the future.

## *Adapting to Sea Level Rise*



12 December 2023



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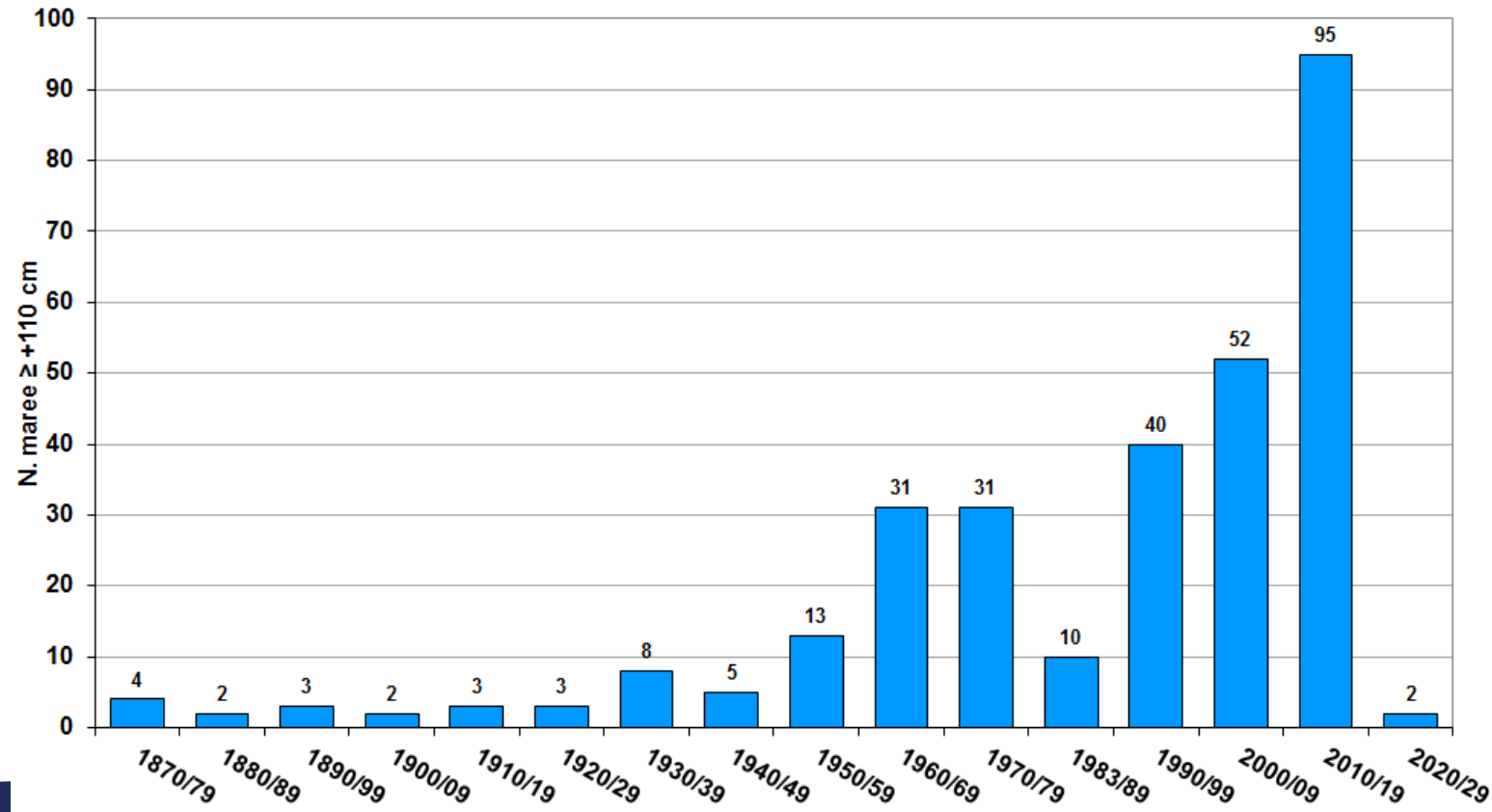


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# The Challenge:

## SLR and its decadal frequency



Distribuzione decennale delle alte maree  $\geq +110$  cm registrate a Venezia, dal 1872 al 2021

Ten-year distribution of high tides  $\geq +110$  cm recorded in Venice, from 1872 to 2021

- Before the Second World War, high tides occurred **only 2 or 3 times per decade**.
- Between 2010 and 2019, **95 flooding events** occurred, of which **26 during 2019**

# Adaptation:

The sole possibility prior to the advent of the MOSE solution



- “Acqua Alta”: **non-structural measures**
- **Up to 2020**, during “high water” events, Venice relied solely on the strong awareness of its citizens and their capacity to embrace **adaptation measures** to safeguard their assets

# The impacts:

## Cultural Heritage at Risk



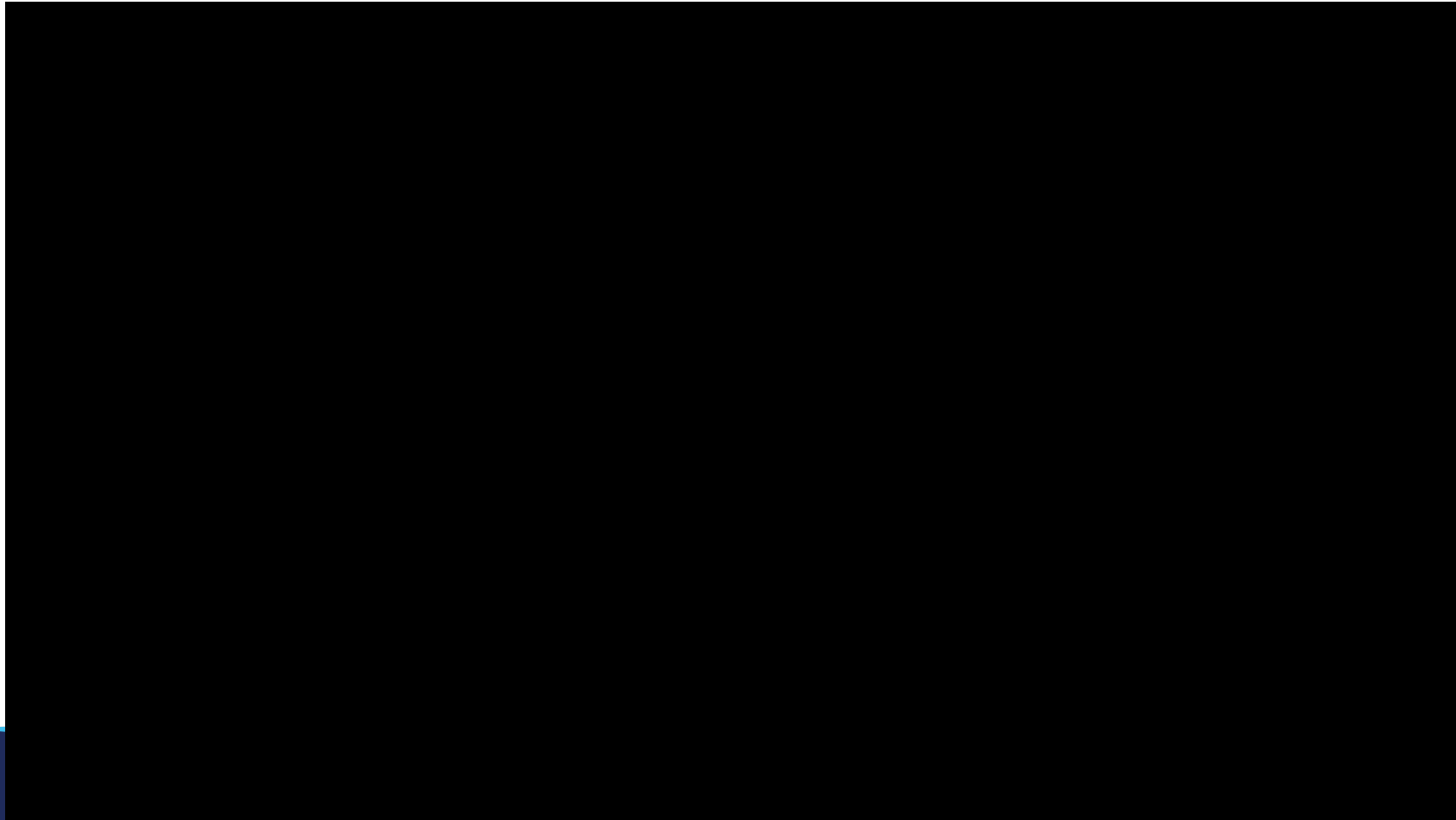
Pictures from St. Mark Basilica

Frequently occurring flooding events brought **saline water** in contact with the bricks, marbles and mosaics, causing drastic **acceleration of the ageing process** and **severe structural degradation**

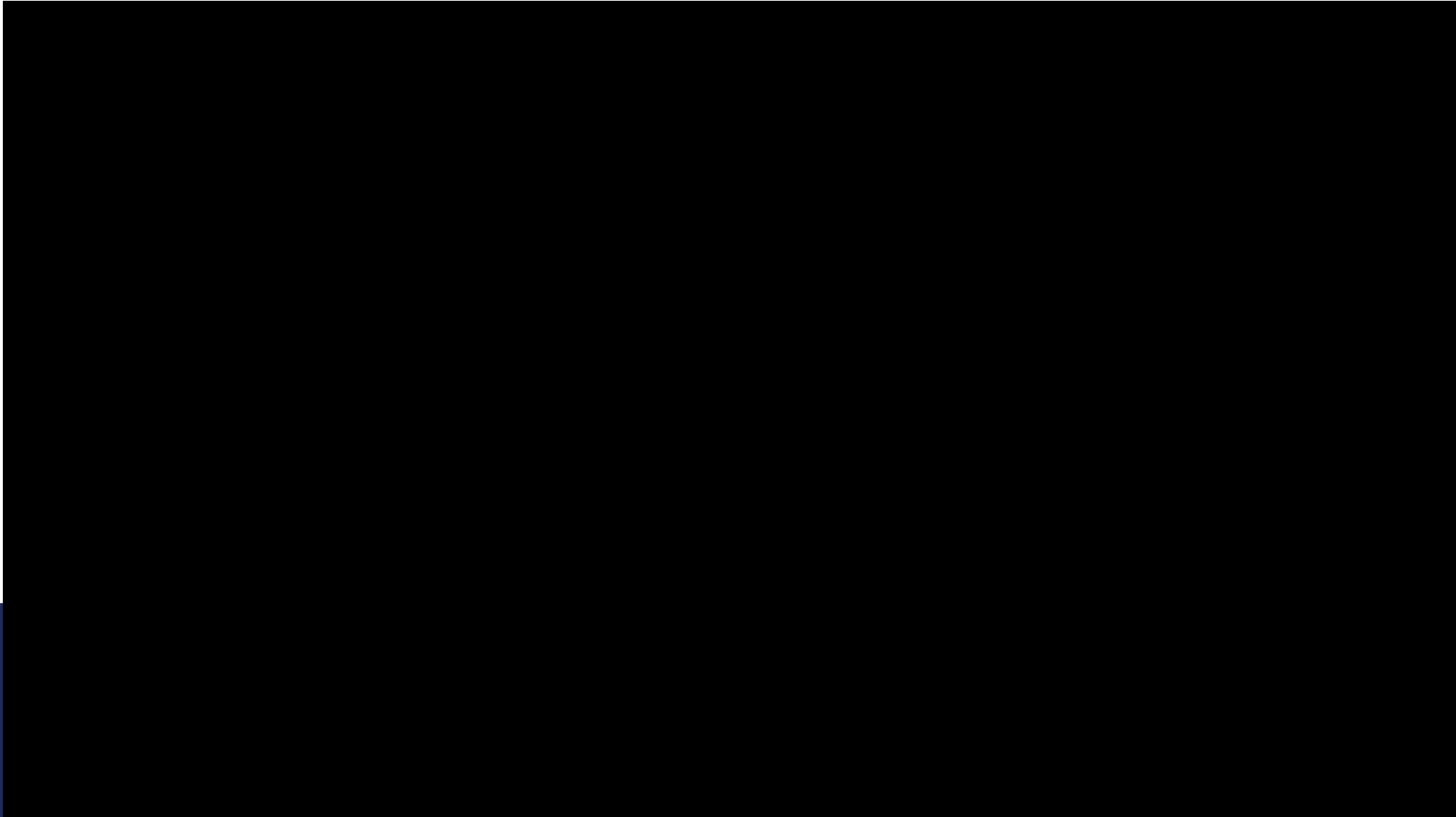


# November 2019

## Extreme weather event

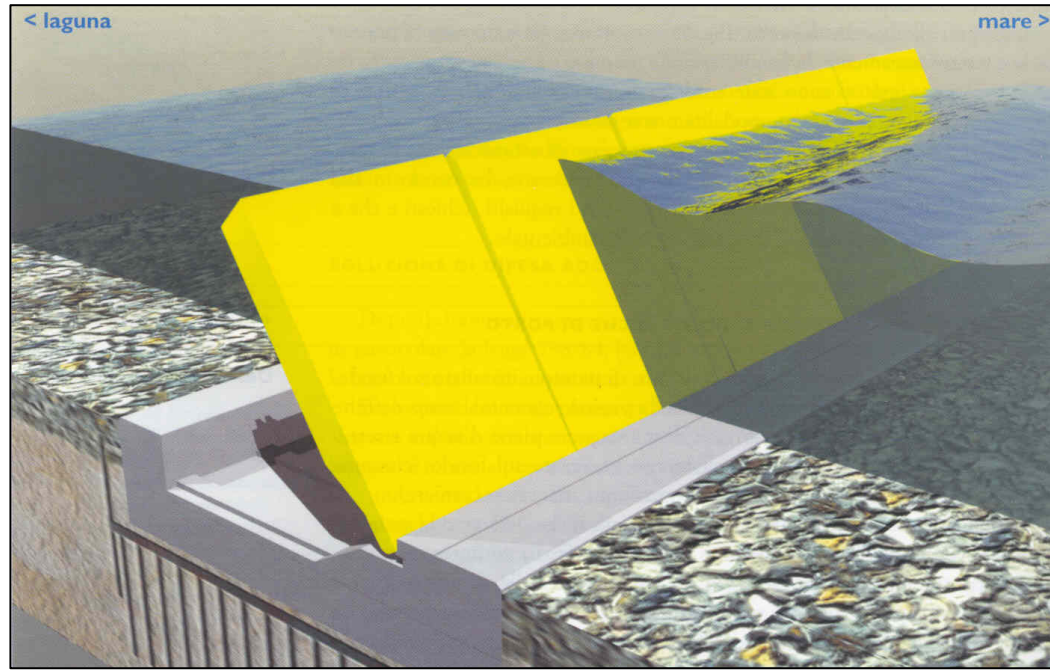
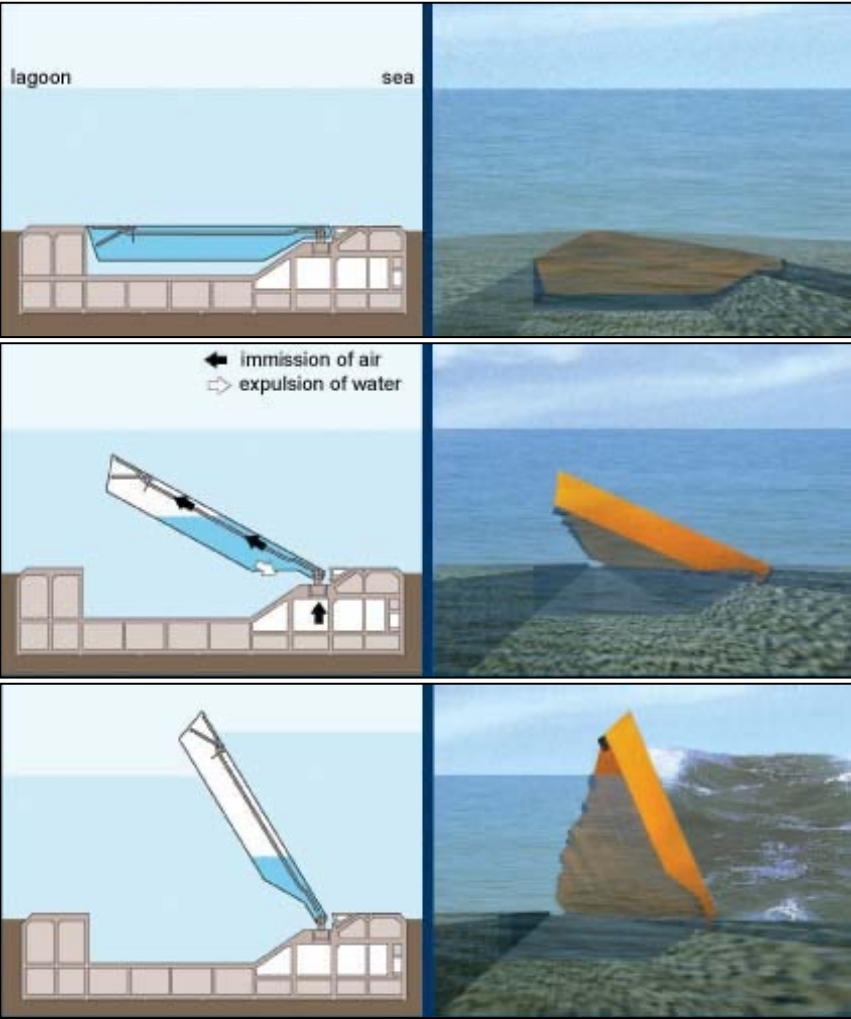


# The Solution: MOSE, the game changer



# The Solution:

## MOSE, the game changer



- **78** mobile flood barriers, **1.56** km of protection, **invisible** when not in operation

# Sea walls and beach nourishment

Before



After



- 11 km of beach, 2M m<sup>3</sup> of sand extracted at sea, 20 km from the coastline



- A new beach 9 km – 5M m<sup>3</sup> of sand. 18 containment groynes, connected by a submerged breakwater parallel to the coast, 300 m from the shore along the full length of coastline.



# St. Mark's Basilica:

## Absolute protection



The glass barrier project, designed by the *Procuratoria di S. Marco* in 2019, was realized by the Ministry of Infrastructures, Public Works and its concessionary CVN in 2022



# Integrated solutions for a complex system

Environmental protection



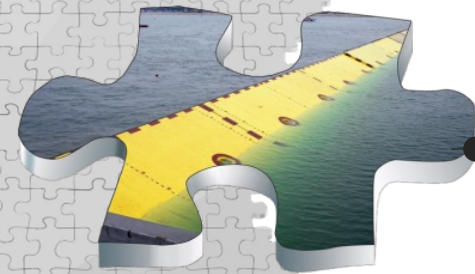
Maintenance and management



Increase of environmental resilience



Mobile barriers



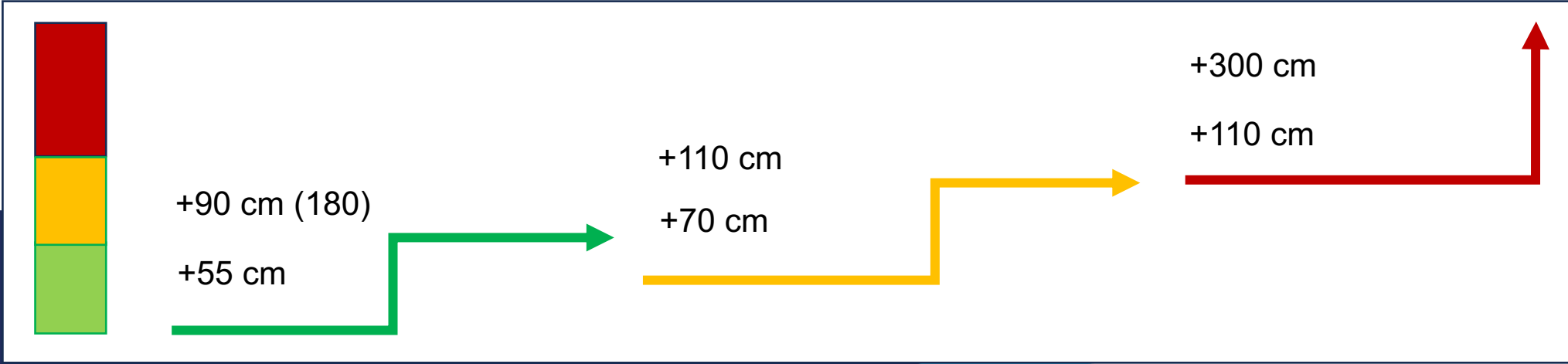
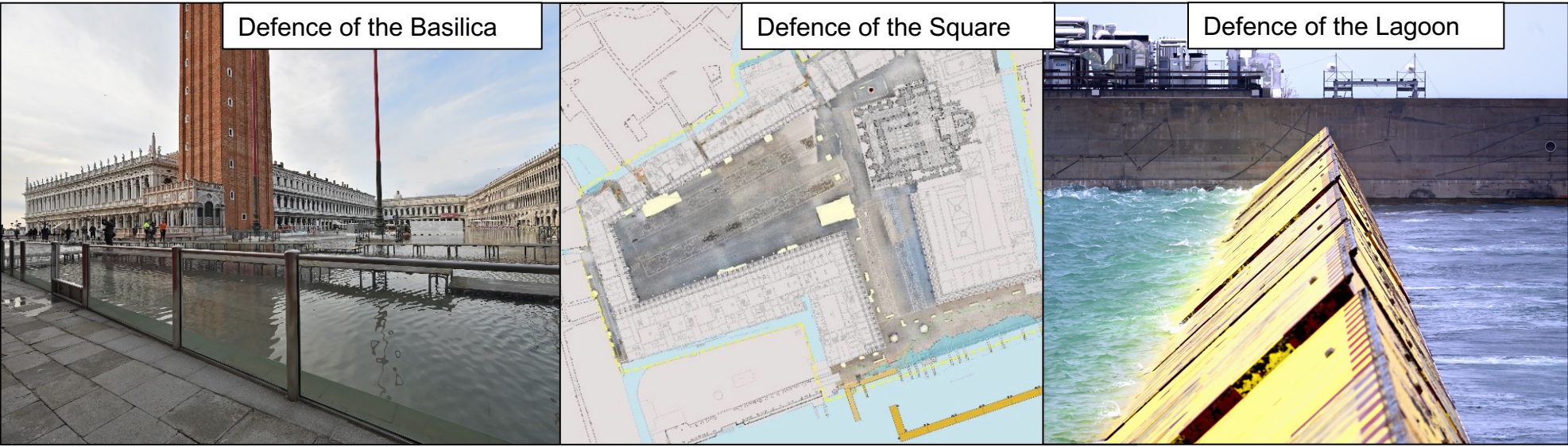
Local defences



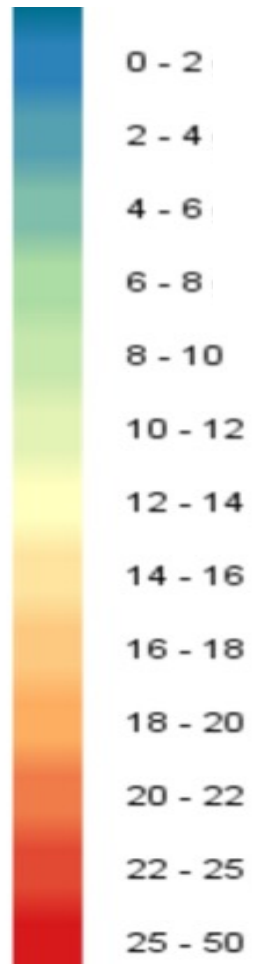
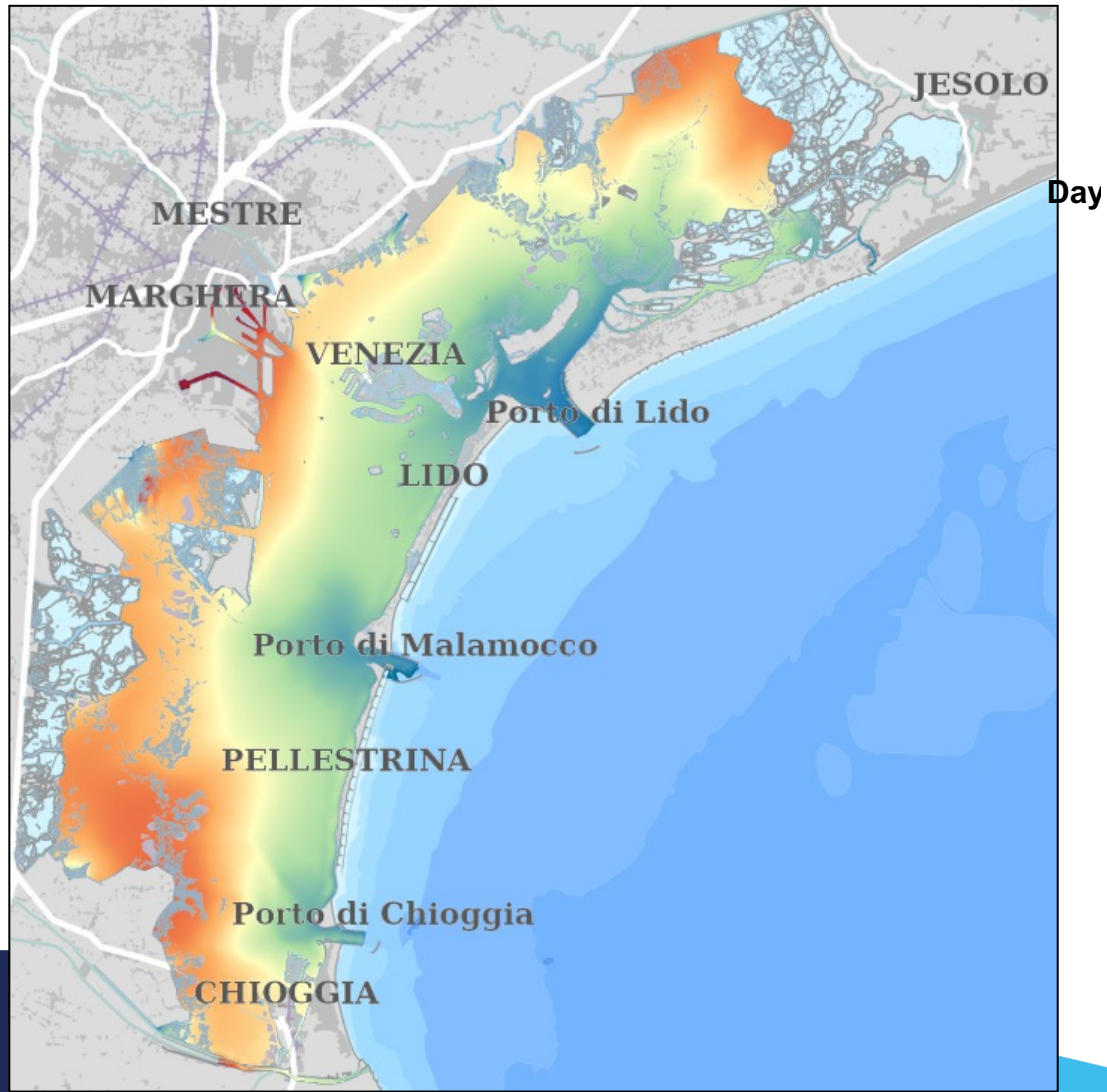
Storm defences



# A mixed approach: Adaptation & Resistance



# What about the future?

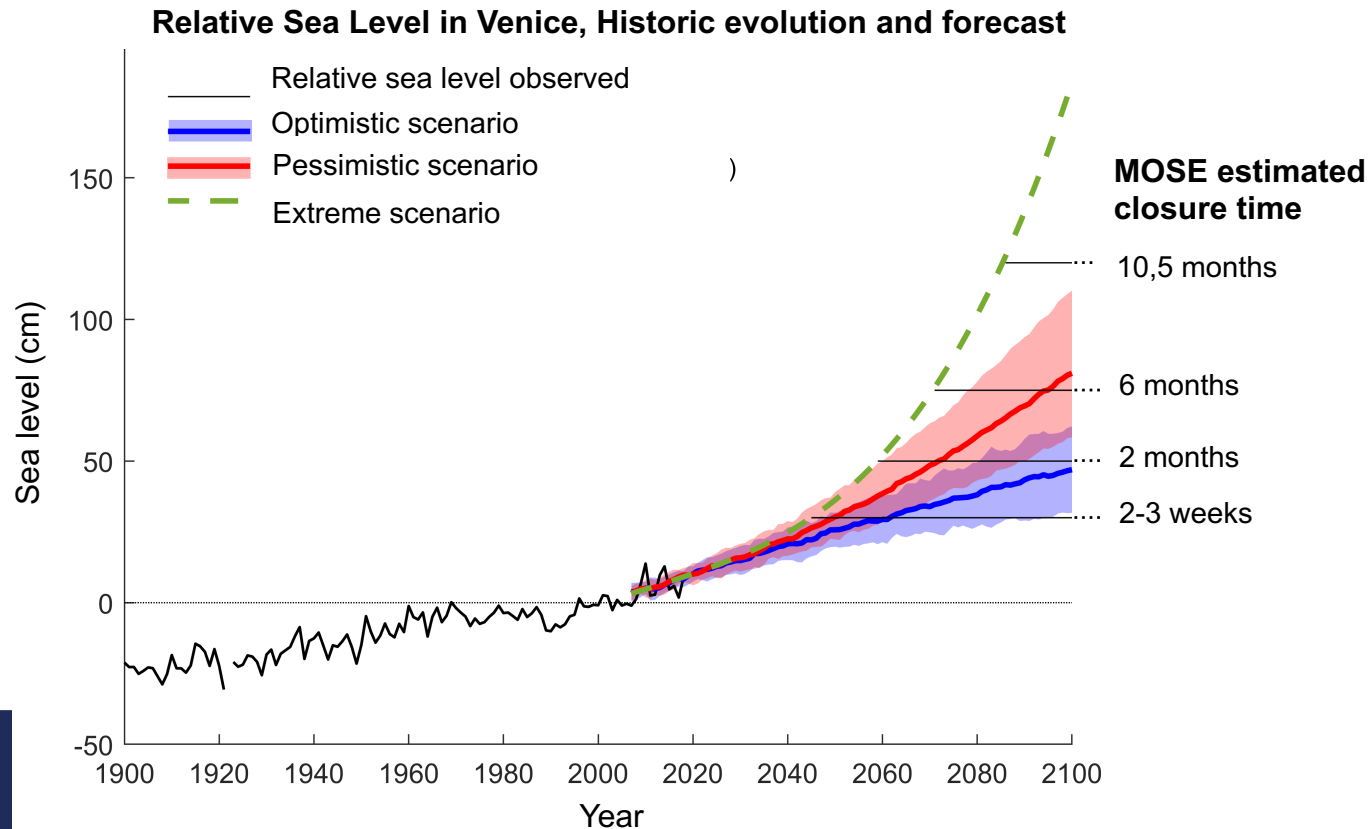


We need to maintain continuing the breath of the lagoon with the sea, modulated by tides

Residence time of the sea water in the Lagoon of Venice

# Mobile Barriers Paradigm

Effective up to 80-100 yrs from now



- A **yearly closure of up to 504h** (3 weeks) is not likely to occur in the next 25 years, though it is **almost certain by the end of the century**, even if the Paris Agreement will be respected,
- **At the end of the century, a 2-months closure is a concrete possibility (50%)** in the optimistic scenario and almost a certainty under the pessimistic one
- In the pessimistic scenario, the barriers will remain closed for 6 months, whereas the **extreme scenario will see a permanent closure**

# Venice: The oldest city of the future

- The operationality of MOSE represents for Venice a breaking point between two different eras, between "**fragile and endangered**" and "**regulated and resilient.**"
- What has happened in Venice **will happen in other coastal cities**
- Venice became a **Resilient hub** for the **MCR2030 campaign** in November 2023 and the city is ready to share its experience with other cities which are facing SLR, being a laboratory of excellence to increase the urban resilience and safeguarding the cultural patrimony



# Thank you for your attention



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