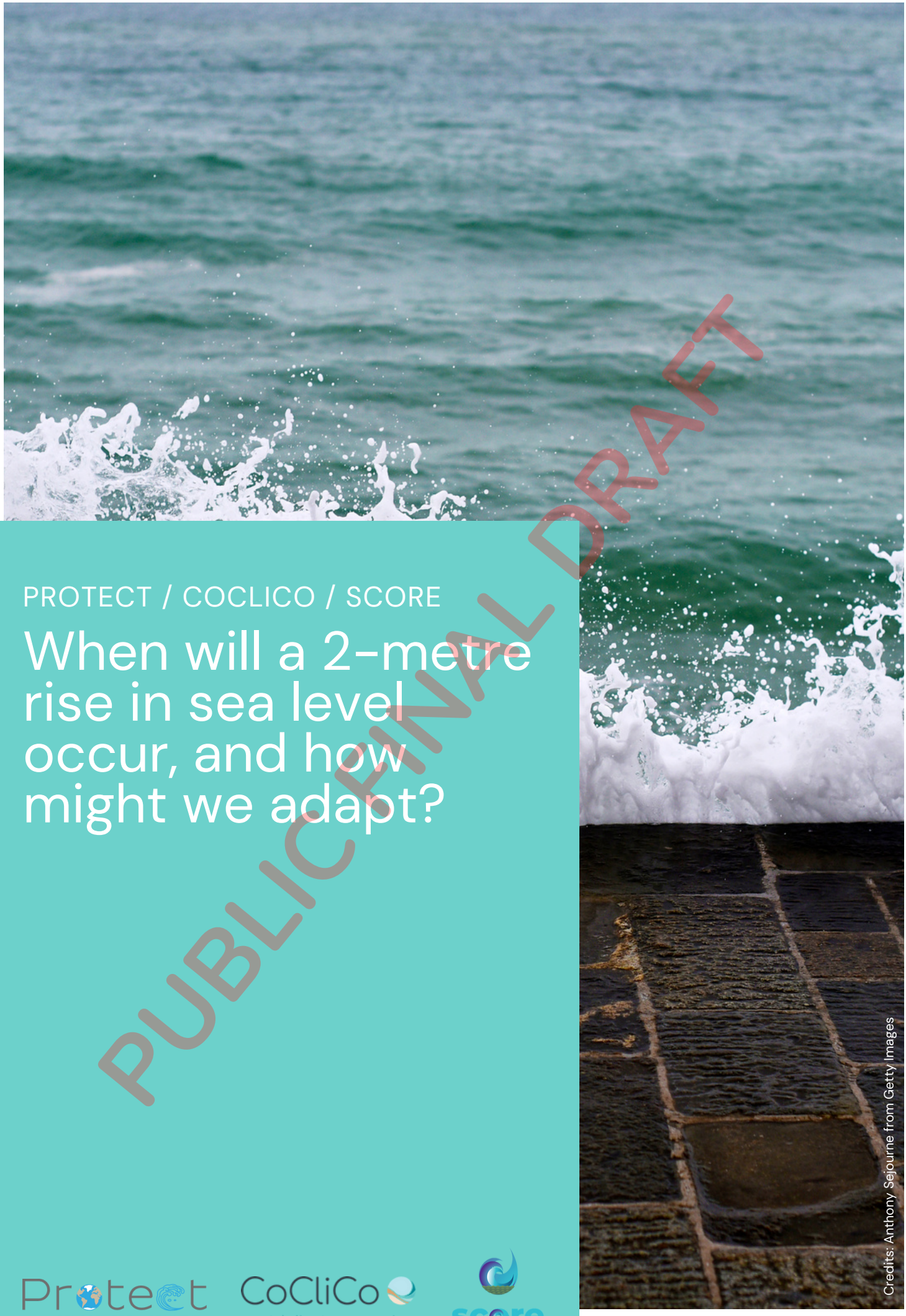


PROTECT / COCLICO / SCORE

When will a 2-metre rise in sea level occur, and how might we adapt?

Credits: Anthony Sejourne from Getty Images

Protect CRYOSPHERE & SEA LEVEL

CoCliCo coastal climate core services

score

Key messages

A 2-metre rise in sea level is almost inevitable. The uncertainty is on the timing, somewhere between one century and the next two thousand years. Exceeding 2 meters of sea-level rise will fundamentally change European coastal zones.

Europe and National States can recognize that coastal adaptation is an ongoing process that involves short-term actions, long-term planning and strategic thinking.

Three actions are urgently needed to limit losses, damages and lock-ins:

- **Massive and immediate reductions of greenhouse gas emissions** in order to slow down sea-level rise, limit the amplitude of sea-level rise in the long term, thus giving more time and options for coastal adaptation.

- Engagement into **adaptation for multiple metres of sea-level rise**, including preparing the ground for adaptation, identifying challenges and options, monitoring trends and implementing options with high cobenefits.

- Support to science and climate service development to **reduce uncertainties** in future sea-level rise, **assess risks and associated adaptation options** and **provide useable information and climate services to coastal adaptation stakeholders.**

The climate is warming quickly, sea-level rise is accelerating and coastal adaptation takes time. Thus, the imperative to act now is clear.

When will a 2-metre rise in sea level occur?

Global mean sea-level rise will exceed 2 metres after 2100 and before a couple of millenia.

Accepted facts [1]

Observations

- Global mean sea level increased by 0.20±0.05 m between 1901 and 2018 and the average rate of sea-level rise has increased from 1.3±0.7 mm/yr between 1901 and 1971, to 1.9±1.0 mm/yr between 1971 and 2006, and to 3.7±0.5 mm/yr between 2006 and 2018.

Sea levels are committed to rise for centuries to millennia

- Even if the targets of the Paris Agreement are met and climate change stabilises at a 1.5°C globally, the commitment of global mean sea-level rise over the next two millennia is 2 to 3 metres.

The potential for ice sheet collapse

- A collapse of large ice sheet regions in Antarctica is an unfavourable scenario that cannot entirely be excluded, even if the world stays under 2°C global warming.
- The likelihood of ice-sheet collapse increases with warming. A rapid onset of these processes could result in 2 metres sea levels being exceeded in the early 2100's.
- Several decades of research have revealed continued surprises related to ice sheet behaviour. Uncertainties are likely to persist for the foreseeable future.
- Global mean sea-level rise can exceed 2 metres by 2120 if climate change remains unmitigated and exceeds a 4°C global warming level (under the very high emissions SSP5-8.5 scenario).
- Emerging climate policies and the ongoing deployment of new options (e.g. renewables energy) have made emission pathways following the SSP5-8.5 less likely than previously anticipated. Yet, global mean temperature above 4°C in 2100 cannot be excluded, for example in case of reversal of current mitigation trends or for high values of the climate sensitivity.

[1] The statements presented here are based on the 6th IPCC Assessment Report published in 2021

Global mean versus regional sea level rise

- In the majority of coastal locations, projected regional sea-level rise will be within +/-20% of the global mean.
- Under conditions of strong global warming and unfavourable collapse of large ice masses the 2 metres threshold may be exceeded between 2100 and 2150 in the vast majority of coastal locations (Figure 1).
- In areas affected by land subsidence due to processes such as groundwater extraction, two metres of sea-level rise can be exceeded earlier in the 21st century (e.g., Thessaloniki coastal plain in northern Greece, north-western Adriatic coast in Italy).

A 2-metre rise in sea level is almost inevitable.

The uncertainty is on the timing, somewhere between one century and the next two thousand years.

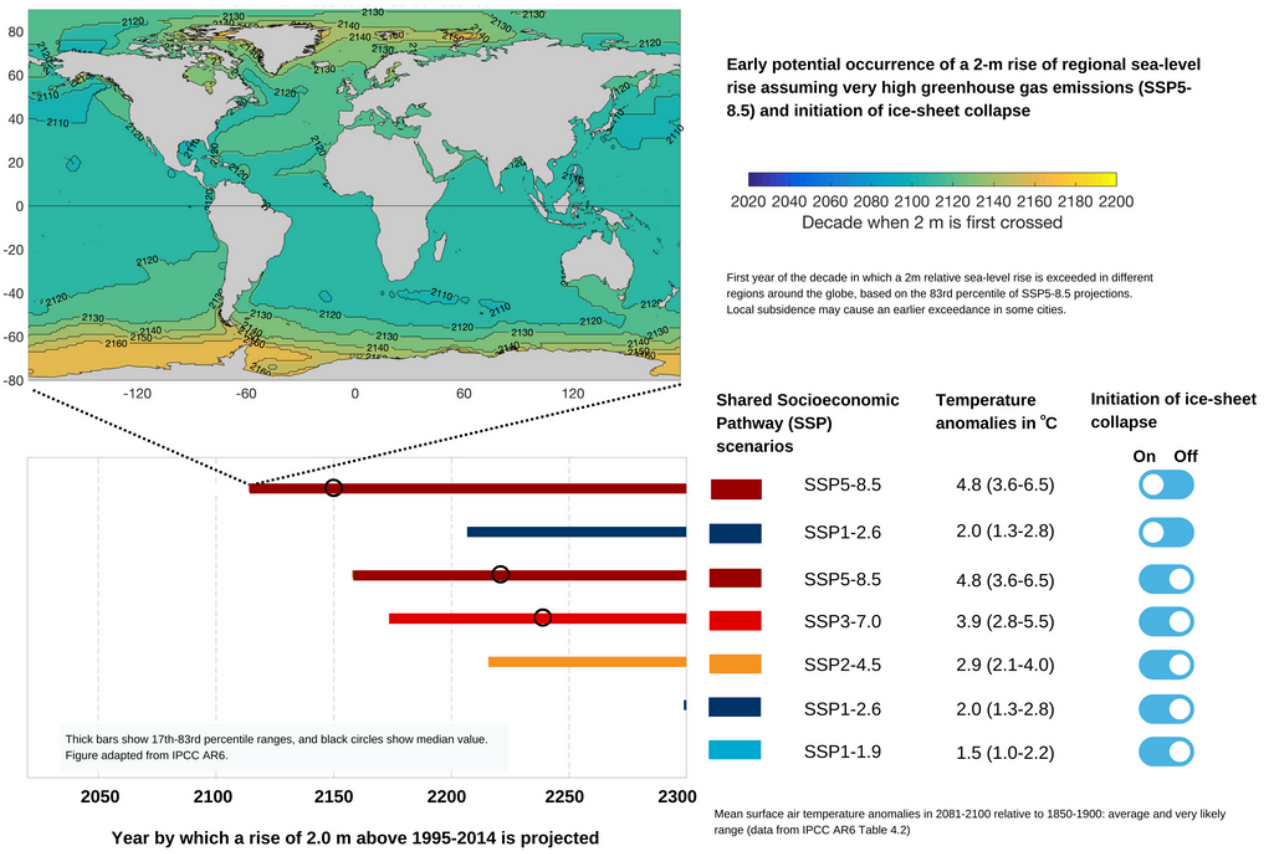
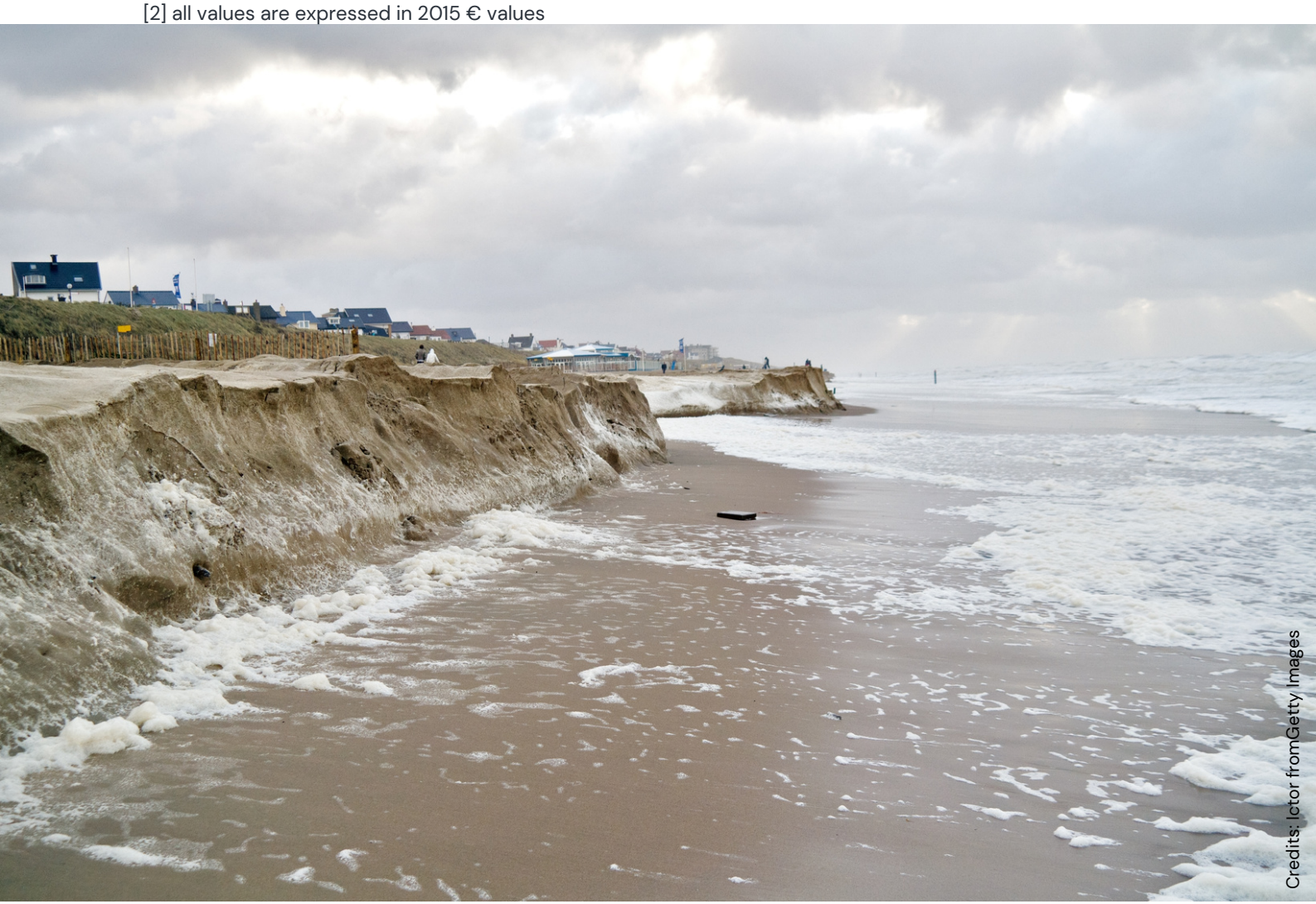


Figure 1: Year by which a rise of 2 metres above 1995-2014 is projected following the different Shared Socioeconomic Pathways (SSP) from the IPCC AR6

What are the impacts of a 2-metre sea level rise in Europe?

- Sea-level rise since the late 19th century has already had demonstrable impacts on Europe's coasts in terms of reducing return periods of extreme water levels, increasing flood and erosion risks and promoting saltwater intrusion in estuaries, deltas and coastal aquifers.
- In the European Union plus the United Kingdom, 18 million people and €3.9 trillion of assets are currently located in the 100-year coastal flood plain [1]. If sea levels were 2 metres higher than today, 9 million additional people (total 27 million) and €1.8 trillion of additional assets (total €5.7 trillion) would be exposed across Europe's coastal flood plain.
- Risk grows faster than exposure. At present, coastal flood losses in EU/UK amount to €1.4 billion per year [2], and each year about 100,000 EU citizens are affected by coastal flooding. Under a high emissions scenario assuming a rise in sea levels exceeding 1 metre and no additional adaptation by 2100 these direct impacts to people and economic losses increase by at least two orders of magnitude in 2100. Indirect costs can propagate across sectors and regions.
- A 2 metres rise in sea level will transform our coastal areas and requires a choice between accepting major losses or proactive adaptation that prepares for these changes as outlined below. The rate of rise is an important factor: the slower the rise, the slower the emergence of the impacts, the more time is available to adjust and adapt and the more adaptation options remain feasible and efficient.
- This demonstrates a key benefit of strong mitigation action.

[1] areas with a 1% annual chance of flooding
[2] all values are expressed in 2015 € values



Credits: Ictor fromGetty Images

Recommendations for climate policies

- Postpone the exceedance of a 2-metre sea-level rise as far as possible into the future: mitigation is crucial: all actors in Europe can reinforce and achieve their climate target to collectively contribute to keeping global temperatures well below a 2°C global warming level. This no-regret action will also slow down sea-level rise rates, give more time for adaptation and reduce all other climate risks.
- Acknowledge the commitment for adaptation: Europe and national states should inform all relevant stakeholders about the rise in sea level and its implications for adaptation. Anticipating sea-level rise and adaptation can avoid large damages, losses and lock-in. An adaptation process with multiple steps is likely to be required.
- Monitor for early warning signs of ice-sheet collapse: international implementation of monitoring systems to detect tipping points in ice sheet instabilities leading to more rapid sea-level rise can be developed.
- Develop climate services for coastal adaptation: governments have to make sure that information is available to inform societal actions, including implementing emergency plans where necessary.

Credits: Anne Chapuis, IGE-CNRS

How might we adapt?

Coastal practitioners can identify risks and initiate adaptation responses

Challenges

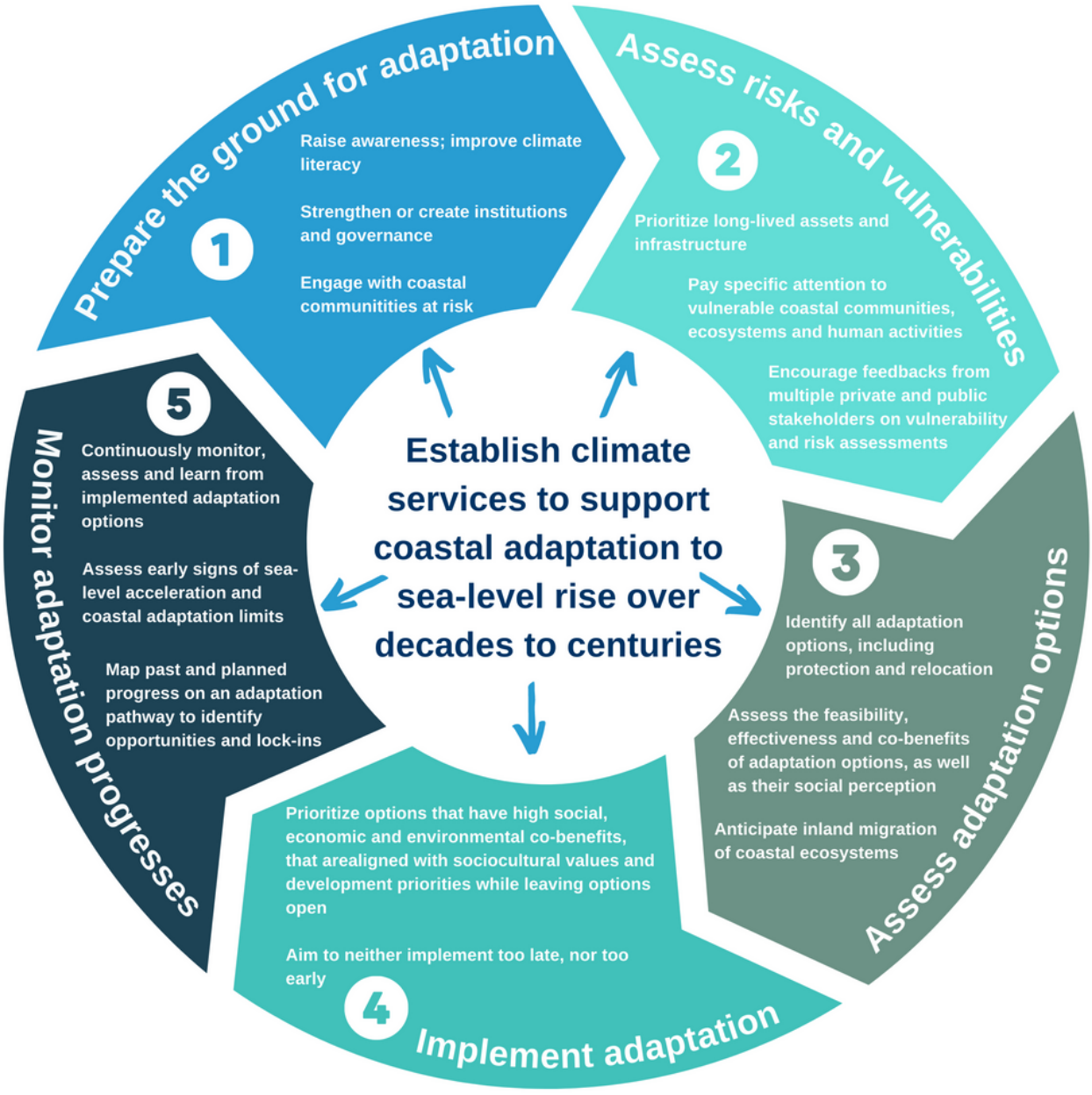
- Coastal adaptation practitioners need to consider that for the coming decades, sea-level science may not provide a more precise timing for the occurrence of a 2 metres rise in sea levels. This uncertainty may either paralyze coastal adaptation action, or alternatively lead to earlier-than-needed adaptation investments and over-adaptation.
- Coastal zones are still developing in Europe. While this can bring immediate social and economic benefits, this is increasing exposure and residual risk with the danger of lock-ins in the long-term.
- For existing infrastructure, adaptation to 2 metres of sea-level rise will require a forward-looking perspective, decades in advance, including appropriate funding and stable governance mechanisms.
- While adapting to 2 metres of sea-level rise, stakeholders will have to manage the consequences of having exceeded other planetary boundaries. This includes other impacts of climate change such as heatwaves, drought, heavy rains and their consequences for people, ecosystems, water management, agriculture, industry.

Coastal adaptation should be seen as an iterative process that evolves over time. All stakeholders need to realize that relocation may be ultimately necessary in many locations. Effective adaptation requires coordination with all public and private stakeholders.

Recommendations on how to address adaptation

- Coastal practitioners might engage with communities exposed to flooding and erosion, as well as scientists and science educators in order to develop climate literacy and the foundations for adaptation action. Involvement of a broad range of stakeholders who can bring in their knowledge, expertise and resources supports climate change adaptation.
- Given the uncertainty in the timing of a 2 metres rise of sea-levels, priority can be given to identifying risks, vulnerabilities and adaptation challenges at high sea levels to reduce or avoid lock-ins (Figure 2).
- A climate service dedicated to coastal adaptation to sea-level rise could help to anticipate future risks and adaptation needs.

Figure 2: Enganging with adaptation to the range of sea-level rise possibilities: an ongoing iterative process with priorities for today



Think strategically: what is your vision for different coastal management units?

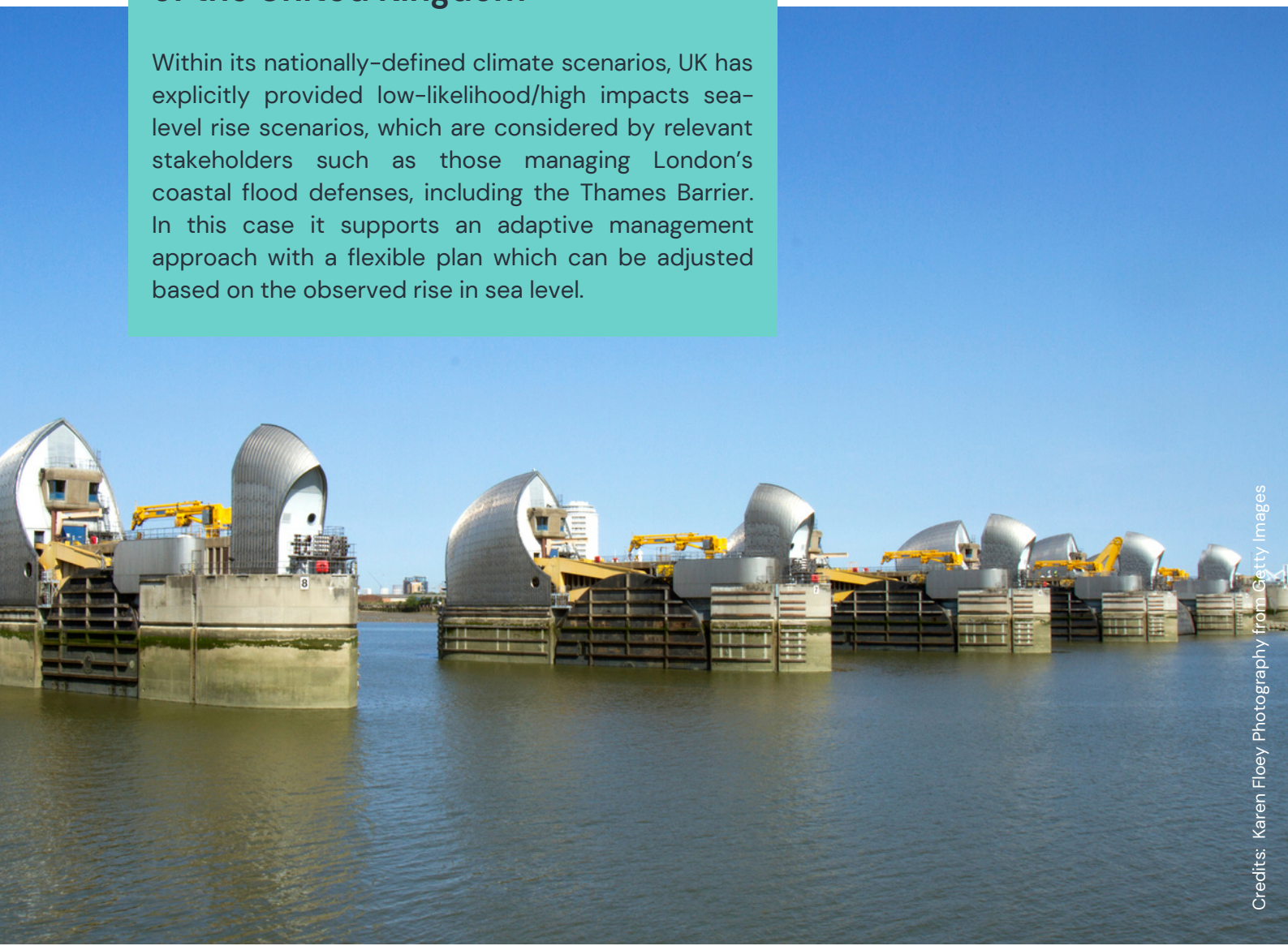
What we do

- Within the H2020-CoCliCo Project, we develop a climate service for coastal adaptation at European scale, informing broad scale flood risks and providing boundary conditions for users concerned with local adaptation in cities and ports.

- Within the H2020-SCORE project, different stakeholders are co-creating adaptation solutions with stakeholders in 10 coastal cities and regions in Europe. This allows for mutual exchange of knowledge and sharing expertise and success stories.

BOX 1 – Low-likelihood/ high-impacts sea-level rise scenarios in practice: the example of the United Kingdom

Within its nationally-defined climate scenarios, UK has explicitly provided low-likelihood/high impacts sea-level rise scenarios, which are considered by relevant stakeholders such as those managing London's coastal flood defenses, including the Thames Barrier. In this case it supports an adaptive management approach with a flexible plan which can be adjusted based on the observed rise in sea level.



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BOX 2 - Examples of coastal adaptation problems that require consideration of multi-metre of sea-level rise today:

- The management of critical and long living infrastructure in coastal and estuarine areas, such as ports, cities, barriers and industrial infrastructure (especially nuclear plants)
- Coastal landfills and contaminated soils that would pollute coastal waters if released by submergence or erosion
- The conservation of cultural heritage in coastal areas, such as Venice in Italy or the Er Lannic stonehenge in France.
- The conservation of coastal habitats such as wetlands and intertidal biotas, which require space for migration inland with rising sea levels to survive.

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Lead authors: Gonéri Le Cozannet (BRGM), Gaël Durand (CNRS), Robert Nicholls (University of East Anglia)

Extended drafting team & Figures: Aimée Slangen (NIOZ), Daniel Lincke (GCF), Anne Chapuis (CNRS)

Contributions & Reviews: Adina Creugny, Elena Marie Enseñado, Salem Gharbia, Geronimo Gussmann, Marjolijn Haasnoot, Klaus Keller, Arjen Luijendijk, Angélique Melet, Luís Campos Rodrigues, Jeremy Rohmer, Paul Sayers, Aimée Slangen, Mar Riera Spiegelhader, Rémi Thiéblemont, Fiona Turner, Roderik Van De Wal
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