European Union's and its Member States' contribution for the twenty-first meeting of the United Nations Informal Consultative Process on Oceans and the Law of the Sea (June 2020): "Sea-level rise and its impacts"

European Union

Background: Climate change as threat multiplier

- Sea level changes have historically been measured using tide gauges: such measurements have long multi-decadal time series, with some exceeding more than 100 years. More recently, since the last 25 years, satellite altimeters have been used to enable absolute sea level measurement from space and provide much better spatial coverage (except at high latitudes).

- Average sea levels have increased about 23 cm since 1880; however, around 9 cm have been gained in the last 25 years and on average, every year, the sea rises by approximately 3.3 mm annually[1]. Global sea level rise has accelerated since the 1960s and as a result, the global mean sea level in 2018 was higher than any year since measurements started in the late 19th century, about 20 cm higher than at the beginning of the 20th century.

- These changes are linked to three primary factors, all induced by ongoing global climate change:

    - Thermal expansion due to heating of oceans is responsible for about half of the sea-level rise over the past 25 years.

    - Melting glaciers: Persistently higher temperatures in recent years due to global warming has caused to greater-than-average summer melting of glaciers as well as diminished snowfall. This has resulted in an imbalance between runoff and ocean evaporation, causing sea levels to rise.

    - Loss of Greenland and Antarctica's ice sheets: Similarly, as with mountain glaciers, global warmed is causing the Greenlandic and Antarctic ice sheets to melt more quickly.

- All coastal regions in Europe have experienced an increase in absolute sea level, but with significant regional variation[2]. Most coastal regions have also experienced an increase in sea level relative to land. The main differences between the different regional seas and basins are primarily due to the different physical processes that are the main cause of sea level change at the different locations. Inter-annual wind variability, changes in ocean circulation patterns, and the location of large-scale

[1]https://climate.nasa.gov/vital-signs/sea-level/
[2]https://www.eea.europa.eu/data-and-maps/indicators/sea-level-rise-6/assessment

gyres and small-scale eddies are further factors that can influence local sea level in the European seas.

- Coastal areas, including small island states, are also particularly vulnerable to climate change. Sea-level rise is not the only negative effect of climate change: changes in the frequency and intensity of storms, increases in precipitation, warmer sea and ocean temperatures and increasing acidity of warming oceans and seas negatively impact coastal and marine ecosystems and the people who rely on them.

- The rate of global mean sea level rise during the 21st century will very likely be higher than during the period 1971-2015. Process-based models considered in"Special Report on the Ocean and Cryosphere in a Changing Climate" of the Intergovernmental Panel on Climate Change, project a rise in sea level over the 21st century in the range of 0.29-0.59 m for a low-emissions scenario and 0.61-1.10 m for a high-emissions scenario, although substantially higher values cannot be ruled out. Several recent model-based studies, expert assessments and national assessments have suggested an upper bound for 21st century global mean sea level rise in the range of 1.5-2.5 m.[3]

- The rise in sea level relative to land along most European coasts is projected to be similar to the global average, with the exception of the northern Baltic Sea and the northern Atlantic coast, which are experiencing considerable land rise as a consequence of post-glacial rebound.

- The increase in extreme high coastal water levels at most locations along the European coastline appears to be predominantly due to increases in mean local sea level due to climate change. This trend in turn has increased the risk of coastal flooding.

- All available studies project that damages from coastal floods in Europe would increase many fold in the absence of adaptation, although the specific projections depend on the assumptions of the particular study.

- Sea-level rise compounds the risk of coastal flooding when a storm surge happens. With continued global warming, sea level is likely to rise by one to four feet globally by the end of the century, enabling the powerful surge associated with storms and hurricanes to penetrate further inland than today[4]. New studies have shown that global vulnerability to sea level rise has so far been underestimated[5].

- Coastal flood risk is also further amplified by economic growth – historically many cities developed along the coast and deltas all over the world, many of which can now be considered megacities. Cities on the east coast of the United States, along with major cities in Asia, are particularly vulnerable as well as low-lying delta cities in typhoon and hurricane zones. Sea level rise and flooding can impact essential services such as energy, transport, and health. It has been estimated[6]

[3]https://www.eea.europa.eu/data-and-maps/indicators/sea-level-rise-6/assessment

[4]Parris et al. 2012. Global Sea Level Rise Scenarios for the US National Climate Assessment. *NOAA Tech Memo* OAR CPO-1.

[5]Kulp and Strauss, 2019. New elevation data triple estimates of global vulnerability to sea-level rise and coastal flooding. *Nature Communications*, 10, 4844 (2019) doi:10.1038/s41467-019-12808-z.

[6]https://www.c40.org/other/the-future-we-don-t-want-staying-afloat-the-urban-response-to-sea-level-rise

that, by 2050, 800 million people will live in cities potentially affected by sea-level rise with consequent socio-economic implications including due to impacts on and destruction of real-estate and infrastructure.

- In addition, rising sea levels can have diverse impacts on coasts and coastal habitats through flooding, erosion, aquifer and agricultural soil contamination with salt, and destruction of important habitats for fish, birds, and plants. There could be significant impacts on ecosystem services as well economic impacts associated with this.

  - Contamination of fresh water and impacts on agriculture

  Rising sea levels will result in saline water seeping into ground freshwater sources (aquifers) that many coastal areas rely on for their drinking water. While it is possible to remove the salt from water, this is an expensive, energy-intensive and complicated process. The same freshwater sources used for drinking also supply the water used for agriculture irrigation. As saltwater can stunt or even kill crops and, some areas might become unsuitable for agricultural purposes.

  - Impacts on coastal biodiversity

  Coastal environments including beaches, estuaries, wetlands and marshes provide important habitats for many forms of wildlife, at different stages of their lives. Sea level rise will very likely amplify the already observed negative effects on coastal habitat, biodiversity loss and consequent ecosystems services, of the sea surface temperature, heatwaves, stratification, deoxygenation and acidification which, combined with coastal human activities stressors (overfishing and pollution, coastal development, mining).

  Erosion of coastlines and flooding of such areas will impact species such as sea turtles and shorebirds including through the destruction of nesting habitats. This is a serious problem for endangered species, like sea turtles, that cannot afford to lose further nesting sites or offspring.

  In addition, areas used by these species for other purposes including feeding may also so damaged by flooding or changes in the surrounding plant life, that they can no longer survive in the environment. Saltwater flooding of coastal areas will change the chemistry of the soil. As plants are particularly sensitive to changes in salinity, the flora of such areas will also change. Some plants will simply be unable to cope with the change in soil salinity and may disappear from the shoreline and this may have consequent impacts on animal species living there too. Trees will also be particularly affected since they will have to work harder to extract water out of salty soil. As a result, their growth can be stunted and if the soil salinity reaches sufficiently high levels, this could kill the trees.

European context

- Currently, around 200 million people live within a coastal zone[7] in Europe.

[7]Eurostat, 2013.

- As mean sea levels and the intensity of storm surges are expected to rise in coming decades, these factors are expected to increase the frequency of coastal flooding across EU coastlines[8], with North Sea countries, European Union Outermost Regions and the Overseas Countries and Territories being particularly vulnerable.
- The **PESETA III**[9] study, led by the Joint Research Centre of the European Commission, has looked into the impact of climate change on economic and human costs caused by coastal floods in Europe. Starting from a baseline (present conditions) of EUR 1.25 billion of yearly damage caused by coastal floods, the study demonstrates that even moderate global warming will trigger a very high increase of these costs in 30 years, beyond EUR 6 billion per year (in a static economic analysis) and more than EUR 20 billion per year when economic development is taken into account.
- When looking at numbers of people affected by coastal floods, PESETA III shows that from a starting number of 102,000 people affected every year today, under moderate global warming and also in 30 years, we could exceed 460,000 people affected in a static economic analysis and around 550,000 when economic development is included.
- Although transport infrastructures and operations are designed to be resilient to some extreme weather events, the increasing frequency and magnitude of extreme events due to climate change will pose a threat to the transportation sector. Results from PESETA III indicate that by the end of the century, under a high warming scenario, 196 airports and 852 seaports across Europe could face the risk of inundation due to higher sea levels and extreme weather events. The projected impacts highlight the importance of climate change mitigation and adaptation to reduce the impacts on airports and seaports.
- According to the projections from PESETA III, by 2100 figures become even more dramatic, with very stark increases of costs and people affected. In a high emission scenario, taking into account socio economic development, we could reach 961 billion € damage a year because of coastal flooding alone (no infiltration of saltwater in aquifers or other related impacts considered) and 65 million people affected.

Adaptation, mitigation and prevention

- As sea level rise is a major climate adaptation concern, also for the EU, a number of EU-funded research projects (e.g. COACCH, SOCLIMPACT) have been undertaken in this respect. Coastal flooding, one of the most economically damaging impacts of climate change and with also important consequences for people, is also one of the most researched aspects including with respect to cultural heritage protection (e.g. Venice), infrastructure and urban development and marine spatial planning.

[8]From EEA, Climate change adaptation and disaster risk reduction in Europe: Enhancing coherence of the knowledge base, policies and practices, EEA Report No. 15/2017
[9]https://ec.europa.eu/jrc/en/peseta-iii

- **COACCH**[10] - CO-designing the Assessment of Climate Change Costs

  COACCH aims to advance knowledge regarding climate change impacts and policy that can be used directly by stakeholder communities.

  The study estimates that, annually that the number of people flooded in the EU could range from 1.8 to 2.9 million by the 2050s and, potentially, 4.7 to 9.6 million by the 2080s, if there is no investment in adaptation. The annual expected damage costs in Europe are estimated at €135 billion to €145 billion for the 2050s (combined effects of climate and socioeconomic change, based on current prices, with no discounting), rising to €450 billion to €650 billion by the 2080s. These costs include direct impacts and costs of land loss (with direct changes clearly dominating the overall cost by several orders of magnitude). Additional unquantified costs will occur due to ecosystem losses and possible knock-on effects of damage on supply chains.

  The study estimates that adaptation can reduce the number of people flooded very significantly, for example, with adaptation, the number of people flooded annually would fall from several millions to around 230,000 – 290,000 in the 2050s. Adaptation would also significantly reduce damage costs. The analysis finds that adaptation is an extremely cost-effective response, with hard (dike building) and soft (beach nourishment) significantly reducing costs down to very low levels. Adaptation can reduce the annual damage costs drastically (by two to three orders of magnitude), but adaptation to rising sea-level might cost between 15 and 40 billion EUR every year in 2100 in the EU. The benefit to cost ratios increase throughout the 21st century. However, hard defences will need ongoing maintenance to operate efficiently and to keep risk at a low or acceptable level, thus as the stock of coastal protection grows throughout the 21st century, so will annual maintenance costs.

- **SOCLIMPACT**[11]

  SOCLIMPACT aims at modelling downscaled climate change effects and their socioeconomic impacts in European islands for 2030–2100, in the context of the EU Blue Economy sectors, and assessing corresponding decarbonisation and adaptation pathways, complementing current available projections for Europe, and nourishing actual economic models with non-market assessment, by:

  • Developing a thorough understanding on how climate change will impact the EU islands located in different regions of the world.(Cyprus, Malta, Baltic islands (Übersetzun, Fehmarn, Rügen, Usedom), Balearic, Sicily, Sardinia, Corsica, Crete, Azores, Madeira, Canary, Martinique and Guadalupe)

[10]https://www.coacch.eu/
[11]http://soclimpact.org/

- Contributing to the improvement of the economic valuation of climate impacts by adopting revealed and stated preference methods.

- Increasing the effectiveness of the economic modelling of climate impact chains, through the implementation of an integrated methodological framework (GINFORS, GEM-E3 and non-market indicators).

- Facilitating climate-related policy decision making for Blue Growth, by ranking and mapping the more appropriate mitigation and adaptation strategies.

- Delivering accurate information to policy makers, practitioners and other relevant stakeholders.

SOCLIMPACT tries to provide advances in the economic valuation of climate induced impacts, and in climate and economic models, allowing downscaled projections of complex impact chains, and facilitating the resilience capacity of these vulnerable lands.

- A number of EU Member States[12] have identified coastal erosion/coastal flooding/sea-level rise as a disaster risk in their latest national risk assessments.
- Negative impacts of sea-level rise and coastal flooding could be diminished and prevented through investments in adaptation, prevention and disaster preparedness based on a sound risk assessment.
- Cities and regions are already adapting, by using more sustainable, nature-based solutions to lessen the impact of floods.
- The Union Civil Protection Mechanism has so far funded five (5) prevention and preparedness projects related to impacts of sea-level rise and other coastal hazards.
    - **SAVEMEDCOASTS-2** (2019)[13] and **SAVEMEDCOASTS** (2016)[14]

      The aim of SAVEMEDCOASTS was to mitigate risks from sea level rise (including to infrastructure and building integrity, people safety, economic assets and cultural heritage), in the Mediterranean area, providing multi-temporal scenarios of expected inland extension of marine flooding in consequence of sea level rise, preparing people to face the next changes. The SAVEMEDCOASTS-2 project aims to respond to the need for prevention from natural disasters in Mediterranean coastal caused by the combined impact of sea level rise and land subsidence in the major river deltas, lagoons and reclamation areas previously identified in the SAVEMEDCOASTS project, being the coastal zones most exposed to flooding of the Mediterranean region.

[12]Including Belgium, Cyprus, Denmark, the Netherlands, Portugal
[13]https://www.cmcc.it/projects/savemedcoasts-2-sea-level-rise-scenarios-along-the-mediterranean-coasts-2
[14]https://ec.europa.eu/echo/funding-evaluations/financing-civil-protection-europe/selected-projects/sea-level-rise-scenarios_en

- **ECOSHAZ** (2014)[15] - Economics of Prevention Measures Addressing Coastal Hazards

  This project aimed to establish a sustainable knowledge framework addressing the costs and benefits of prevention and response to coastal hazards resulting from hydro-meteorological events (flooding, shoreline erosion, storm surges, and sea level rise) and oil spill accidents.

- **iCoast** (2013)[16] - Integrated Coastal Alert system

  The scope of this project was to develop a tool to address coastal risks caused by extreme waves and high sea water levels in European coastal areas. The purpose of this tool was to be used as a coastal early warning system to forecast storm events and help managers in the decision making processes of the interventions. The main targets were urban beaches and coastal defences and infrastructures where most of the casualties are reported.

- **NEAMTIC** (2010)[17] - Tsunami information centre for the NE Atlantic and Mediterranean

  This project was intended at raising public awareness, dissemination of good practices and intergovernmental coordination pursued through support to the Tsunami Information Centre for the NE Atlantic and the Mediterranean at the UNESCO's Intergovernmental Oceanographic Commission. In particular, the project focussed on raising awareness among civil protection authorities on good practices in tsunami preparedness and other sea-level related risks and knowledgeable of safe behaviour, updating in parallel the Register of Tsunami National Contacts and Tsunami Warning Focal Points.

[15]https://ec.europa.eu/echo/funding-evaluations/financing-civil-protection-europe/selected-projects/economics-prevention_en
[16]https://ec.europa.eu/echo/funding-evaluations/financing-civil-protection-europe/selected-projects/integrated-coastal-alert_en
[17]https://ec.europa.eu/echo/funding-evaluations/financing-civil-protection-europe/selected-projects/tsunami-information-centre_en

Belgium

Belgian expertise on SLR is actively engaged in policy support processes at national/regional, European and global level.

National/regional

The Flanders (Belgian sub-national) regional authorities responsible for defence against flooding are preparing an update of the current Masterplan on Coastal Safety. This plan was approved by the Flemish (Belgian sub-national) Government in 2011 and comprises safety measures to protect against a 1000-year storm with a time horizon of 2050, taking into account a sea level rise of 30 cm up to 2050 and 80 cm up to 2100. To prepare for the longer term, time horizon 2100, the Complex Project Coastal Vision (www.kustvisie.be) was initiated. Parallel to both initiatives a four-year (2015-2019) project called CREST (www.crestproject.be) studied the coastal processes at the Belgian coast including sea level rise building upon the outcomes of the CORDEX.be project (http://cordex.meteo.be/). CORDEX.be produced local impact models for climate change at the Belgian coast focusing on waves and storm surges.

During a workshop of experts, held in December 2018, different climate projections for the year 2100 were discussed based on input of the latest research. The state of play is summarised in https://kustvisie.login.kanooh.be/sites/default/files/atoms/files/Vertaling_Nl_Output_Workshop_Climate_Scenarios_FIN.pdf (in Dutch). Three IPCC (2018) climate projections (RCP 2.6, RCP 4.5 and RCP 8.5) including UKCP18 (Palmer et al., 2018) were translated to the Belgian coast and complemented by an extreme-value table. This resulted in sea level rise projections of +50 cm (38 - 73), +60 cm (39 - 86), +85 cm (56 - 112) and +295 cm (extreme-value) between 1990 and 2100. Between brackets the 5th and 95th percentiles are listed.

Belgian experts' involvement in activities coordinated at EU level

Member States' authorities responsible for research and innovation are joining their knowledge resources and capabilities through e.g. Joint Programming activities. A case in point is the initiative, of the JPI Climate, together with JPI Oceans, to set up a Knowledge Hub on "Integrating knowledge on sea level rise and variability for local scale decision making". Experts will gather in Spring 2020 on the basis of terms of reference for this new group adopted by the Management Boards of both JPIs.

Belgian contribution to relevant initiatives at global level

Established in 1985, The Global Sea Level Observing System (GLOSS) is an Intergovernmental Oceanographic Commission (IOC-UNESCO) programme whose purpose is to measure sea level globally for long-term climate change studies. https://www.gloss-sealevel.org/

Flanders Marine Institute (VLIZ) has developed, and operates, in the context of the GLOSS a real-time data system to capture sea level data from measuring stations around the world. https://www.gloss-sealevel.org/real-time-data-delivery. Tidal data for the Belgian coastline are contributed through the Flemish Banks Monitoring network (https://meetnetvlaamsebanken.be/) operated by the Flemish Hydrography, of the Agency for Maritime and Coastal Services – Coastal Division. This monitoring network has additional sea level sensors along the Flemish coastline and at selected offshore locations; which have been monitoring sea level height for several decades. The network of sea level sensors is vital for studying the impact of sea level rise on coastal communities.

The IOC sea level station monitoring facility system reads data from the WMO GTS, satellite, ftp servers and webservices from different data providers worldwide. The initial and main purpose for it was to monitor the status of the stations that are needed for Tsunami mitigation by the IOC Tsunami Warning Centers, where the sea level data is used to follow the progression of the Tsunami waves. The system is also one of the GLOSS data centers and focusses on providing high-resolution real-time data. The data is made available in real time to different Tsunami Warning Centers where it is incorporated in the alert management software. It is also used by Tsunami research centers and numerous other users download historical data. The system is now monitoring 1024 station from 140 institutes and has more than 80 registered users.
The operation of the sea level station monitoring facility is funded from the VLIZ budget provided by EWI, and is more or less permanent.

However, the system is under stress and faces challenges. One of the more difficult and urgent problems to solve is the data gaps around the southern coasts of the Pacific, Atlantic and Indian oceans. Over the last couple of years many new stations in the Caribbean and Chilean coast have been installed, and linked to the sea level monitoring system.
The biggest and most urgent gap now is around the African continent. http://www.ioc-sealevelmonitoring.org/map.php

For more information: http://www.ioc-sealevelmonitoring.org/index.php

Belgium's academic research

The University of Ghent (Belgium) is currently conducting academic research on the public legal status of island States which have become fully submerged due to climate change effects. This project studies, in particular, the links to refugee and migration law, international public law, loss of statehood, deterritorialised states, human rights and not in the least law of the sea.

https://www.ugent.be/re/epir/en/researchgroups/public-international-law/contact/staff/infosoete.htm

Estonia

Estonia is entirely located in the he catchment area of the Baltic Sea. In general, it is considered that the overall mean sea level change at the coasts of the Baltic Sea results from the combined effects of post-glacial rebound of earth crust, the increase of the global ocean mass largely due to the melting of ice on land, thermal expansion of seawater, and the contributions of regional factors that may cause an overall change in Baltic sea level and/or a redistribution of sea level within the Baltic Sea.

In this context we would like to emphasise three aspects: the effects of sea level rise on coastal areas, general global effects and knowledge on those effects and international cooperation to share the knowledge and data in relation to sea level rise.

In the effects of sea level rise on coastal areas

The recent research[18] concludes that that both the rate of increase in water level maxima and the contribution of different water level components into these maxima substantially vary in different regions of the Baltic

[18] https://www.sciencedirect.com/science/article/pii/S0278434319304121?dgcid=author

Sea. The fastest increase in the total water level maxima in 1961–2005 have occurred in the eastern Gulf of Finland (8–10 mm/yr), Gulf of Riga (6–9 mm/yr), near Klaipėda (6–8 mm/yr) and in the south-western Baltic Sea (5–7 mm/yr). The contribution from the increase in the maxima of water volume of the entire sea is around 4 mm/yr in the northern and eastern parts of the sea but much less, down to 1.5–2 mm/yr in the western and southern regions of the sea.

The hot spots of rapid increase in extreme water levels are located in the eastern and western sub-basins of the Baltic Sea, in particular, in the Gulf of Finland and Gulf of Riga and to a smaller extent in the south-western Baltic Sea.

In this context the research points out that in addition to sea level changes other aspects that contribute to the extreme sea level rise are important as well, such as the wind direction and rapid storm surges. This in turn concludes that the presence of extensive variations in the course of water level maxima in different segments of the Baltic Sea shore could thus be interpreted as an intrinsic feature of water level dynamics in this water body.

General global effects and knowledge on those effects

In order to develop national and regional policies there are some aspects that need to be further elaborated and outlined. These cold include the following:

a) From where does the sea level rise come from, what is the effect of ice melting in Antarctica and Arctic, how does the change in sea temperature relate to that and how does the change in sea temperature affect the oxygen conditions in the sea. Both, sea temperature and oxygen conditions affect the environmental status of the sea. Having better knowldeg on that helps to predict the harmful changes in that could occur in marine biota or marine living organisms, the extinction of marine species etc.

b) In relation to previous, also the changes in salinity could have similar effects on the environmental status of the sea.

c) The effects of coastal flooding, the extent of coastal flooding, the impact of flooding on coastal infrastructures, such as the salt water intrusion to aquafers, disruptions in storm water run-off, degradation of arable land etc.

International cooperation to share the knowledge and data in relation to sea level rise.

There are various cooperation platforms already in place to share the data and knowledge on the marine data, including on the sea level rise, such as the Global Ocean Observing System (https://www.goosocean.org/index.php?option=com_content&view=article&id=118&Itemid=109).

All states, in particular small islands states could benefit more, if such cooperation could be more effective in terms of participation in such cooperation platforms and sharing common knowledge.

France

Action de la France au niveau national face à l'élévation du niveau des eaux

En matière de politique publique d'atténuation du changement climatique, indispensable pour limiter les effets de la crise climatique dans les décennies à venir, la France a pris pour objectif d'atteindre la neutralité carbone d'ici 2050 et s'est dotée à cet effet d'une **Stratégie française pour l'énergie et le climat** déclinée en deux piliers majeurs : la Stratégie nationale bas-carbone (SNBC) et la Programmation pluriannuelle de l'énergie (PPE).

Biodiversité et climat sont liés : l'humanité a besoin d'écosystèmes terrestres et marins en bonne santé pour stocker le carbone et pour se protéger des conséquences du dérèglement climatique. Inversement, la disparition de la biodiversité ne fait qu'accélérer le changement climatique. Plan de protection et de restauration, le **plan Biodiversité** contribuera ainsi à la reconquête par l'être humain de son environnement et de son avenir.

En matière de planification de l'adaptation au changement climatique, la France a lancé en décembre 2018, le deuxième **Plan national d'adaptation au changement climatique** (PNACC) qui permet de mieux préparer la société française au changement climatique, en impliquant les principaux secteurs de l'économie et les territoires.

La France possède **un littoral important de 20 000 km de côtes** : celles-ci sont particulièrement attractives et dynamiques pour les Français. D'ici 2040, il est estimé que la population sur les littoraux augmenterait de 4 millions d'habitants. L'ensemble du littoral français est donc concerné par les risques littoraux, et, de fait, par leurs évolutions.

On estime que 1,4 millions d'habitants sont exposés à des risques de submersion marine. Certains territoires, dont les altitudes sont très faibles (sous le niveau de la mer pour certains) sont plus exposés au risque de submersion marine. Dans les Outre-mer, la submersion marine peut être aggravée par les cyclones.

Les **plans de prévention des risques naturels** (PPR) visent à empêcher ou encadrer les nouvelles installations exposées à un risque important. Spécifiquement pour le risque submersion marine, plus de 300 PPR littoraux sont approuvés. Sur le littoral, ils intègrent systématiquement, depuis déjà une dizaine d'année, l'élévation du niveau de la mer due au changement climatique (60 cm au minimum).

À l'instar des digues le long des cours d'eau, les digues de protection contre les submersions marines font désormais partie des outils dont se peuvent se doter les collectivités détentrices de la compétence en **Gestion des milieux aquatiques et la prévention des inondations** (GEMAPI), plus précisément les intercommunalités.

La prévention des inondations et des submersions, qui s'appuie sur des outils complémentaires comme la protection ou la prise en compte du risque dans l'aménagement, se fait dans le cadre de programmes d'actions stratégiques, notamment les **programmes d'actions de prévention des inondations** (PAPI), portés par les élus locaux et cofinancés par l'État.

La **stratégie nationale de gestion intégrée du trait de côte** a été mise en place en 2012 pour mieux anticiper les évolutions du littoral et faciliter l'adaptation des territoires à ces changements. Elle vise à **accompagner les espaces littoraux pour renforcer leur résilience**, notamment en s'appuyant sur le rôle des milieux naturels côtiers, véritables atouts pour atténuer l'effet de phénomènes naturels (submersion marine, érosion, inondation, etc.).

Si la mobilité du trait de côte est un phénomène naturel, l'érosion côtière peut menacer des enjeux environnementaux, sociaux et économiques dans ces territoires particulièrement attractifs à forte démographie. Or, les processus d'érosion sont bien souvent accentués par les activités humaines et par le changement climatique en cours (notamment l'augmentation du niveau de la mer). La gestion intégrée du trait de côte constitue donc aussi une politique d'adaptation au changement climatique qui a conduit à des actions concrètes dans différents domaines :

● L'**observation**, l'**amélioration des connaissances** et la diffusion des données : soutien à la recherche, publication de synthèse des connaissances, mise en réseau des nombreux observatoires locaux ou régionaux pour développer les bonnes pratiques d'acquisition et de partage de données sur le trait de côte et ses évolutions, etc. sont autant d'actions qui visent à fonder l'action sur un socle solide en matière de sciences physiques mais aussi sociales.

● Le développement de **projets de territoires résilients** : si l'aménagement du littoral doit être repensé pour prendre en compte la mobilité du trait de côte et préparer les territoires aux évolutions à venir, il est indispensable de développer des projets de territoires aux échelles temporelles et spatiales pertinentes, associant l'ensemble des parties prenantes, en veillant à la prise en compte des écosystèmes côtiers et des fonctions qu'ils assurent. La stratégie nationale de gestion intégrée du trait de côte promeut l'émergence de tels projets locaux et encourage la recomposition spatiale des territoires.

● La promotion sur le littoral des **solutions fondées sur la nature** : les milieux marins et côtiers rendent naturellement une multitude de services grâce à leur fonctionnement écologique. Ces bénéfices sont réels et peuvent être déterminants, c'est pourquoi la stratégie nationale de gestion intégrée du trait de côte souligne la nécessité de protéger et de restaurer les écosystèmes côtiers mais aussi de prendre en compte leurs rôles dans les stratégies territoriales, notamment au travers de la mise en œuvre de « solutions fondées sur la nature ».

<u>Action internationale de la France face à l'élévation du niveau des eaux</u>

Les côtes concentrent une majorité de la population mondiale. Or, certaines mégalopoles côtières (Bangkok, Jakarta…), mais aussi des villes secondaires, subissent le phénomène de subsidence (affaissement) en raison du pompage intensif des nappes phréatiques. Combiné à la hausse du niveau des mers et les fortes houles résultant du changement climatique, qui favorisent l'érosion côtière et la salinisation des eaux souterraines, les villes concernées sont à terme condamnées à plus ou moins brève échéance. Les autorités indonésiennes ont ainsi déjà annoncé le transfert de leur capitale sur l'île de Bornéo. Par ailleurs, les îles à faible niveau d'élévation sont particulièrement exposées. Certains Etats insulaires du Pacifique sont ainsi gravement menacés de disparition à terme.

Il devient par conséquent urgent, pour les villes qui peuvent encore être sauvées, d'y développer et mettre à l'échelle les **Solutions fondées sur la Nature** (SfN), Solutions que la France promeut, telles que, protection et restauration des récifs coralliens et des prairies d'algues, plantations de mangrove, plantations d'arbres sur le front de mer… Cette démarche peut également se combiner avec des solutions grises quand le besoin est particulièrement pressant.

La France participe dans ce cadre à des programmes ambitieux de résilience côtière, tels que WACA (gestion intégrée des zones côtières en Afrique de l'Ouest), dont elle cofinance déjà via l'AFD plusieurs projets). Elle est également et entre autres, membre observateur de l'alliance canadienne ORRAA (Ocean Risk and Resilience Action Alliance) qui vise à investir et protéger le capital côtier naturel par des solutions innovantes de financement.

La France est enfin 1er contributeur et à l'origine de l'initiative multi bailleurs CREWS, développant des systèmes d'alertes précoces face aux risques liés au changement climatique, au bénéfice des populations vulnérables des PMA et des Petits Etats Insulaires en Développement.

Germany

Germany proposes the following topics to be included in the discussion at ICP: the impact of accelerating sea-level rise on coast protection (esp. in densely populated areas), on agriculture, water supply and distribution, fishing and biodiversity.

As the intervals between unusually high tides become shorter, Germany recognizes that sea-level rise will have a notable effect on the coasts and lowlands in Germany and Europe, including islands in the North Sea and the Baltic Sea. These challenges can only be tackled internationally, which is why international cooperation should also be prominently discussed (and respective procedures strengthened) at ICP.

Italy

1. Introduction

In the last centuries, the study of sea-level changes along the world shores has been a primary scientific focus in the climate change studies, but also for scientists that would explore past landscape evolutions, geomorphological processes, human impact and system response, as well as issues of human adaptation to coastal modifications.

Italy, based on the Italian scientific community awareness, is highly engaged in studying and preventing the negative, and eventually catastrophic, effects of this phenomenon, especially with regard to sea level rise (SRL) of the Mediterranean Sea.

2. General features of the phenomenon

Global sea-levels are rising and this change is expected to accelerate in the coming century, as trends indicate sea-level rate increase from 2.1 mm yr–1 over the period 1970–2015 to 3.6 mm yr–1 over the period 2006–2015, due to anthropogenic contribution to climate change since 1970.

SLR causes the following main effects on the coastal systems: 1) shoreline erosion and retreat; 2) increased flooding and/or permanent submersion of exposed low elevated coastal zones; 3) saline intrusion in shallow unconfined alluvial aquifers.

In addition, in a scenario of higher SLR, the extreme marine events will have more relevant consequences on the coastal zones, threatening the biosphere and human activities. A SLR of just a few tens of centimetres is a serious hazard for the coastal populations and infrastructures built close to the shoreline. Given that humanity is preferentially concentrated in the coastal zones of the world and that these exhibit higher rates of population growth and urbanisation compared to the hinterland, the severity of the issue of SLR is appalling.

Whether it is due to natural or anthropogenic reasons, coastal erosion causes significant economic losses, social problems, and ecological damages to States and local Authorities. Coastal erosion causes the loss of extremely valuable land, such as recreational and tourist beaches and sites, and since may extend its influence along hundreds of kilometres alongshore in the case of large deltaic areas, may cause damages to urban infrastructures and having transboundary implications.

Coastal erosion may imply as well the loss of ecological values, such as nesting grounds of several species belonging to the IUCN Red list threatened with extinction (e.g. the Loggerhead sea turtle Caretta caretta, the Kentish plover Charadrius alexandrines) located on beaches as well as cultural values, especially in areas like the Mediterranean coasts where populations have settled since ancient times, and small and large of newly discovered archaeological sites are widespread

To combat costal erosion, land reclamation is one of the major actions undertaken by States. Although globally the majority of the demand for aggregates (sands and gravels) is met by land-based sources, the marine-based industry is expanding, to such an extent that aggregates are currently the most mined materials in the marine environment and demand for them is growing. In southern Europe and the Mediterranean, most of the extracted material is used for land reclamation, causing significant potential environmental impacts on the benthic habitats, including the meadows of Posidonia oceanica, interference with fishery grounds and other ecosystem services, creating turbidity in the water, having influence on marine currents and sediment transport and possibly on the costal impact of storm waves and surges.

More in general, many coasts are presently submerging or expected to be flooded as consequence of sea-level rise, storm surge and tsunamis, as inferred from seismic, geodetic, geological and archaeological evidence.

Because local SLR is accelerated by natural or anthropogenic land subsidence that can locally exceed the climatically-driven mean sea-level rise, vertical land movement (VLM) must also be included in local SLR projections. The reconstructions of the SRL changes for the past thousands of years in relationships with the climatic and geological history during Late Pleistocene and Holocene, have shown the contribution of vertical deformation of the mantle and lithosphere. Particularly, the global isostatic adjustment (GIA) is still active on global scale since the end of the last glaciation, including in the Mediterranean area.

Moreover, future local changes in sea level as a consequence of the ongoing global warming are expected to induce fresh/salty groundwater interface moving inland. Several local factors, such as coastal topography and natural recharge of the aquifers, could influence the extent of the seawater intrusion. Furthermore, the intrusion process can be accelerated by the increase in the exploitation of the natural resources (oil and fluid extraction, mining) and groundwater water demand for anthropic use, especially in semi-arid areas, where over-pumping activities are expected to rise as consequence of increasing intensity and frequency of drought events. The seawater intrusion has a number of environmental and economic impacts on different sectors including agriculture, forestry, and biodiversity.

In a scenario of sea-level rate increase, coastal freshwater resources and in particular coastal lagoons represent, with their fragile transitional ecosystems and link between surface water bodies and the coastal aquifer, the most sensitive environments to seawater intrusion.

3. Vulnerability of Italian coastal zones to SLR

Satellite altimeters and tide gauge data suggest that sea level rise is currently rising at about 2 mm/yr in the Mediterranean basin. Moreover, along the Italian coasts, GIA correspond to a subsiding signal at the rates of -0.1 to -0.8 mm/year, which contributes to the relative SLR.

In this framework, the vulnerability of Italian coastal zones to SLR is particularly high. The total coastline of Italy is of 7468 km, 15 out of 21 are coastal regions and the population living in coastal areas is up to 70%. About 70% of the Italian coast, corresponding to 3270 km, has low elevated morphology for an area of about 120 km2; 10060 km2 are represented by coastal plains. On these, about 30% of the Italian population is living, distributed in 646 coastal municipalities over an area of 43,000 km2, corresponding to about 13% of the Italian territory, with population density higher than the national average. These settlements, placed along the coastline, just above sea level, often include residential and infrastructures and industrial sites, infrastructures (such as ports, airports and roads), areas of high environmental value as well as valuable historical and archaeological areas (e.g. the Phoenician city of Nora in the southern coast of Sardinia), visited by large tourist flows.

The highest threatened areas belong to the coastal regions of Veneto, Emilia-Romagna, Apulia, Tuscany, Latium (especially the river Tevere mouth), Campania (especially the Volturno estuary), Liguria. Coastal geological types vary along the Italian coastline, including both rocky coasts and low-lying sandy beaches. The latter are most at risk of sealevel rise, coastal flooding and erosion. The Northern Adriatic basin is particularly at risk, due to the presence of the Po delta (Emilia-Romagna) and the Venice lagoon (Veneto). In this area, the coastline is rarely more than 2 meters wide and due to subsidence various zones presently lie below sea level. Besides these geographical factors, socio-economic characteristics also make the coastal zones of Italy quite vulnerable as the Italian seashore is home to many residential as well as industrial sites.

A recent study has depicted the relative sea-level rise scenarios for the year 2100 from four different settings of the Italian coast: the subsiding North Adriatic coast, two tectonically stable Sardinia coastal plains, and the slightly uplifting Taranto coastal plain, in Apulia, which also hosts Europe's largest steelwork production. The expected relative sea-level rise by 2100 will change dramatically the present-day morphology, potentially flooding up to about 5500 km2 of coastal plains at elevations close to present-day sea level.

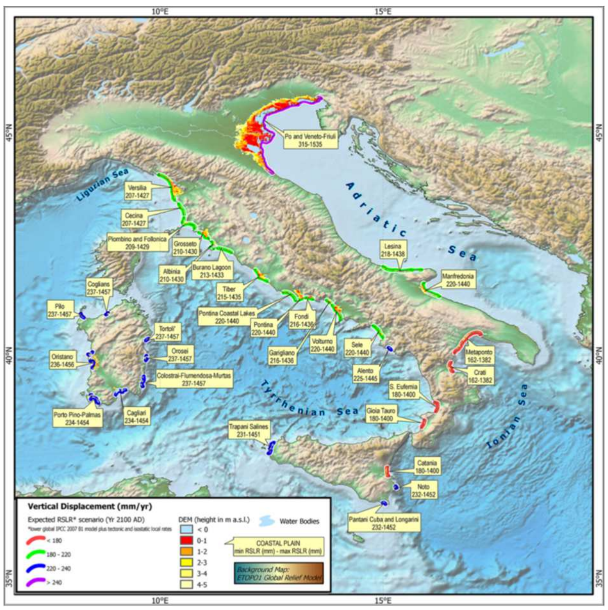

Fig. 1. Relative sea level rise (year 2100) for 33 Italian coastal plains. For the Po Delta and Venice Plain, mean values are reported. Data do not include the contribution of local compaction and fluid (gas and water) extraction (taken from Lambeck et al 2011).

4. The case of Venice

In this context, Venice's situation is peculiar. The city is located in the Venice lagoon, which has a total surface of 550 km², of which 420 km² directly facing the sea tides, making the largest wetland of the Mediterranean Sea. The entire city of Venice and its lagoon are a UNESCO World Heritage property since 1987. In this area, high tides have increased in terms of frequency and intensity due to the low elevation, the increase in SLR rate as well as land subsidence.

In 2018 and 2019, two intense and heavily damaging stormy seasons have hit Venice and the Northern Adriatic Sea. Contrary to what happened in the 1966 (and 2018), on November 12th, 2019, the peak of the storm was superimposed on the peak of the astronomical tidal and a high average sea level in the North Adriatic (effect of a stationary low-pressure atmospheric system), thus bringing a less intense storm surge, compared to 1966 and 2018, to lead to exceptional level values in Venice (187 cm on the msl, ranked 2 since the beginning of official measurements) flooding 85% of the town. It was also the first time that three events over 140 cm occurred within a 24h window. The high mean sea level of November 2019 (of some 30 cm above the yearly mean) determined a record-breaking sequence of flooding events. Venice was intermittently flooded almost every day for many days. 2019 was the year with the largest number ever (19) of events and the maximum number of hours (50) with the tide level over the threshold of 110 cm (the quote when more than 20% of the city pavements are flooded). The city local defences were overtopped by the level of lagoon water, while the main protection system (MOSE) is still under construction and is scheduled to be completed in 2021.

The recent IPCC report on Ocean and Cryosphere suggests a global mean sea level higher between 24 and 32 cm for the horizon 2050, relatively close and therefore with relatively small uncertainties. In November 2019 Venice thus experienced something similar to what regular tides will probably be in the next decades with the forecasted sea level rise.

These events, in particular those with higher tidal levels, caused major damages to the city activities on the ground floor (housing, shops, restaurants, hotels, workshops, *etc*). The cultural heritage was severely damaged, in particular the nine centuries old St.Mark's Basilica, and further damages are attended, due to the crystallisation of salt present in the seawater. Very strong winds occurred during the events and caused additional damages.

For these reasons, the Italian Government, beside the actions to relief of the Venice's emergencies, decided to fund this year the "International centre for Studies on Climate Change" to be set up in Venice. This Centre will be devoted in particular to study the adaptation strategies and the cultural heritage safeguarding. The possible connections of this Centre with the EU and UN initiatives will be also discussed within the Mediterranean Workshop convened in Venice from 21st to 23rd January 2020, in the frame of the UN Decade of Ocean Science for Sustainable Development 2021-2030 (an event hosted by the Italian Oceanographic Commission and co-organized with the IOC-UNESCO, the European Commission, the United Nations Environment Mediterranean Action Plan / UNEP/MAP and the Mediterranean Science Commission).

5. Conclusions

Given the importance of this issue, it is necessary to accelerate and provide wider and stronger bases to adaptation strategies to the impacts of SLR, not only at national level, but also at international and regional scales. An holistic approach should drive an inter-disciplinary effort for giving a strong scientific support to "knowledge based "policy decisions on adaptation to the sea-level rise.

The Ministerial Declaration (UNEP/MED) adopted the 5th of December 2019 in Naples by the Contracting Parties to the Convention for the Protection of the Marine Environment and the Coastal region of the Mediterranean and its Protocols expressed its concern "*that the Mediterranean is recognized as a climate change hot spot, with average annual temperatures above the current global warming trends (+1.1°C), marine acidification and sea level rising at an accelerating rate, frequent and extreme events like droughts and rainfall, exacerbating the existing environmental and social problems*". It therefore recognized that "*climate change triggers important risks for our coastal and marine ecosystems – and, therefore, for the human well-being and security – affecting biodiversity and fresh water, food security, coastal infrastructures and cities, historic and cultural heritage, and that to address these challenges we must enforce the governance of our sea and coastal region*".

** based on contributions from Dr. Gemma Andreone, Dr. Marzia Rovere, Dr. Jacopo Chiggiato and Dr. Fabio Trincardi (Italian National Research Council / CNR), Prof. Giorgio Budillon and Prof. Pietro Aucelli (University of Studies of Naples Parthenope), and Dr. Pietro Campostrini (Consortium for the Coordination of Research on the Venice Lagoon System / CORILA).*

Latvia

Latvia is located in northern Europe and borders the Baltic Sea. The total length of Latvia`s coastline is 496 km, the shoreline is characterized by erosion patterns.
Research shows that globally coastal erosion and flooding will increase due to climate change and global sea level rise, and it is expected that this will also occur on the Latvian coast. Additionally, further studies are needed on the changes in salinity, which is expected to affect biodiversity etc.
Common trends over the last 20-30 years indicate increased activity of the coastal processes. There are two main reasons for this: the coastal system is experiencing increasing deficit of sediment supply and climate change related stressors in the system. Coastal processes are particularly influenced by: 1) the average sea level rise, 2) global temperature rise (warmer and shorter winters, leading to less ice); 3) potentially more frequent and intense weather extremes.

- **Assessment of coastal erosion in Latvia:**

Latvia is actively working on updating national coastal erosion assessment considering climate change scenarios (within EEA and Norway Grants programme '*Climate Change Mitigation, Adaptation and Environment'*, pre-defined project '*Integration of climate change policy in sectoral and regional policies'*). This project will result in up-to-date data on Latvia's coastal erosion to adjust coastal planning, as well as solutions for improvement coastal erosion prevention considering climate change scenarios (according to IPCC 6th report).

- **Adaptation to Climate Change**

On 17 July, 2019 Cabinet on Ministers approved the '**Latvian National Plan for Adaptation to Climate Change until 2030**' (CCA Plan) setting out more than 80 concrete actions on adaptation to be implemented. This will help the population and economy of Latvia to better adapt to climate change and thus reduce loss and damage caused by climate change. The adaptation activities are based on risk and vulnerability assessments, and identification of adaptation measures in six areas: landscape planning and tourism, biodiversity and ecosystem services, civil protection and disaster management, construction and infrastructure planning, health and welfare, and agriculture and forestry.

CCA Plan identifies sea level rise (SLR) (including long-term average SLR and coastal erosion development) as a significant risk in all areas except agriculture and forestry. The SLR will affect construction and infrastructure planning and civil protection and disaster management, health and wellbeing, biodiversity and ecosystem services, tourism and landscape planning.

Actions, such as enhancing the early warning system, developing a set of possible solutions to abate costal erosion, improving urban rain water systems, developing green infrastructure etc. are included in the CCA Plan.

Latvia's CCA Plan sets out a number of actions that will have an impact on coastal municipalities. For example, the action complex '*Protection of Nature (including protection of values of the Baltic Sea coast) and cultural and historical landscape from the negative impacts of climate change'*, includes assessment of costal erosion and developing a set of possible solutions to abate costal erosion, adaptation of designated swimming areas infrastructure to the risks of climate change, as well as restarting and ensuring continuous monitoring, evaluation, and modeling of sea coast erosion. The action '*Integration of climate change forecasting and risk mitigation solutions into spatial development planning and sectoral policies*' also creates a measure – 'develop or update flood risk management plans for coastal cities of Latvia, having previously evaluated which cities need it'.

- State Ltd "Latvian Environment, Geology and Meteorology Centre" has recently launched a publicly available **marine data portal** http://marine.meteo.lv/. The browser is designed to provide the public with free-access marine meteorological observation and forecast data, including drift calculation functionality (available at https://www.meteo.lv/jaunumi/laika-apstakli/lvgmc-izveidots-juras-datu-portals?id=2201&cid=100).

Netherlands

Sea level rise is a serious concern for the Kingdom of the Netherlands. It has consequences for both the Caribbean islands within the Kingdom (countries and communities) and the European part of the Kingdom of The Netherlands. This text will focus on the latter because under present conditions 26% of its territory is below sea level, and approximately 60% of its territory can be flooded, either from the North Sea or from the rivers and lakes. The Netherlands is a well-protected delta and aims to remain so in the future, even when sea level rise accelerates more than assumed by IPCC in its SROCC report. Therefore, a Sea Level Rise Research Programme has been started. The Netherlands would like to learn together with other delta-countries that experience similar challenges.

Present situation

The name ‘Netherlands’ means ‘low land’. The Dutch have been defending their delta against flooding from both rivers and the sea for ages. Over 10 million of 17.4 million inhabitants live and 70% of Gross National Product (GNP) is earned in flood prone areas. The last flood that led to casualties dates from 1953. Since then, vast investments have been made in the system of levees, storm surge barriers, dunes and dams protecting the low-lying regions. Whereas the so called Delta Works where the consequence of the 1953 flood, nowadays we anticipate and reduce risks. Water management is an ongoing process in our delta. All the partners involved (ministries, water authorities, provinces and municipalities) work together within the Delta Programme. This collaboration resulted in a new flood safety policy, with new flood protection standards for all flood defences and regional strategies. When all standards are met, the chance of drowning is less than 1:100.000 per inhabitant per year, and in most regions even less than 1:1.000.000. This current flood safety policy will protect the Netherlands at least until 2050, even when climate change and sea level rise continue as described by the IPCC scenarios in the SROCC report.

Sea Level Rise Research Programme

In the spring of 2018, the Minister of Infrastructure and Water Management announced further research into a potentially accelerating rise in sea level beyond 2050. Over the past year, the Minister and the Delta

Commissioner have taken significant steps towards the development of a national Sea Level Rise Research Programme. All the partners of the Delta Programme work together in this Research Programme, in collaboration with research institutes and representatives of NGOs and the business community.

Because sea level rise also leads to increase in salinization, the Research Programme focusses on both flood protection as fresh water supply. The adaptive approach of the Delta Programme is reflected in the approach of the Research Programme, with a focus on reducing the uncertainties regarding the developments on Antarctica and the associated rise in sea level; determining to which extent the current flood safety policy, fresh water policy and regional strategies will be adequate or expandable; and exploring potential action perspectives for the distant future.

The Sea Level Rise Research Programme consists of five complementary tracks:

Track I: Antarctica: what can we expect?
This track aims to reduce uncertainties regarding the rate of sea level rise. In international collaborative efforts, the Netherlands will contribute its proportional share to fundamental, international research into Antarctica, based on our expertise and the specific significance for our delta. What mechanisms lead to loss of land ice on Antarctica, how do these impact the rate of global sea level rise, and what will be the regional impact along our North Sea coast?

Track II: System explorations: what is the sustainability of the regional Strategies?
The Research Programme will provide a better picture of what different sea level scenarios entail for the performance of the natural (sandy) system of the coast and rivers, for the flood defences and engineering structures, for the freshwater supply, and for the use of space for purposes such as living, agriculture, nature and shipping. After this will be determined which measures are able to enlarge the sustainability and longevity of the regional strategies in decades ahead.

As the uncertainties regarding the distant future are still large, the focus will be on track I and II for the time being. The information obtained from these tracks is crucial for the debate on long term strategies and measures, which demand vast investments and probably have a high impact on the future of the Netherlands.

III. Early warning system: how do we know when to act?
Because the realisation of (constructive) measures takes considerable time, a timely response to signals observed is important. The monitoring system of the Delta Programme has been focused on local physical models and measurements, such as along the Dutch coast. It will be further elaborated to detect specific relevant effects elsewhere in the world.

IV. Alternatives and action perspectives for the distant future
The Research Programme also pays attention to scenarios for the distant future. After all, the sea level will continue to rise after 2100. The results of this track should wherever possible be underpinned by facts generated by Tracks I and II. That is why Track IV will initially focus on surveying existing plans and channelling new initiatives to keep flood risk management and freshwater supply up to par in the long run. The interaction with other large transitions in the Netherlands, such as the energy transition and an agricultural transition will be taken into consideration.

Since uncertainties are large, it does not make sense to opt for a single, specific long-term solution strategy in the years ahead. Therefore, we will investigate no-regret options and measures that keep promising options for the distant future open. Nature-based solutions are often preferable because of their flexible character.

V. Implementation strategy

In addition to technical issues, the rising sea level also brings societal challenges. This track explores knowledge requirements relating to governance, communication, and transition management. What does the uncertainty regarding the rising sea level mean for decision-making procedures? How do we create sufficient awareness among governmental organizations, NGOs, and the public? Is there support for measures that could be necessary in the decades ahead? How can we benefit from expertise, energy and creativity available in our society? What can we learn from other transitions in terms of structuring the process?

The Research Programme will run until 2026. The outcome will be used in the six-year review of the strategies of the Delta Programme. Based on the recommendations of the Delta Programme, the minister will consider adjustments to the flood safety and water management strategy and policy in 2027. This will enable an adaptive response to a potentially accelerating rise in sea level beyond 2050.

Learning together

For the Kingdom of The Netherlands international cooperation on climate change adaptation is extremely important. For this reason the Global Center on Adaptation (GCA) is hosted by The Netherlands. The GCA is an initiative of the Netherlands, Japan, the United Nations, and the World Bank. Its goal is to foster climate adaptation across the globe. Offices have been opened in Rotterdam and Groningen. In 2018, the Netherlands also initiated the Global Commission on Adaptation, along with 16 other nations. The Commission consists of 30 members, originating from all over the world. They include several current and former government leaders, CEOs, and representatives of civil society. The Dutch Minister of Infrastructure and Water Management participates in the Commission. The Global Commission on Adaptation is chaired by Mr Ban Ki-Moon, Microsoft founder Mr Bill Gates, and World Bank CEO Ms Kristalina Georgieva. The Commission is supported by the Global Center on Adaptation and the World Resources Institute (WRI).

The recommendations of the Global Center on Adaptation (GCA) and the Global Challenges report underpin the international activities undertaken within the framework of the International Water Ambition of the Netherlands (NIWA). It focuses on deltas (flood risk management), cities (waterlogging), coastal plains (rising sea level and salinization), and hinterland catchment areas. Recently a focus on the relation between food and water has been added.

Improving our resilience to the changing climate is a long-term project. Within these frameworks, we would like to call for sharing knowledge and learning together how to keep low lying delta’s both safe and habitable.

Ambulatory baselines
The coast line of the European part of the Kingdom of the Netherlands is not stable as a result of the natural (sandy) system of the coast. This is reflected in our practice of ambulatory baselines. The relevant provisions in the 1982 Convention on the Law of the Sea (UNCLOS) concerning baselines are, with respect to the European part of the Kingdom, implemented through the Netherlands Territorial Sea (Demarcation) Act (Wet Grenzen Territoriale Zee) of 1985. This Act describes the method for determining the baselines and consequently the breadth of the territorial sea. The normal baselines are created from the low-water line along the coast, relative to the Lowest Astronomical Tidal chart datum as published in the official charts. Due to a high re-survey frequency and a dynamic seabed, especially in the southern North Sea, the low-water line has a dynamic behaviour. Additionally, low-tide elevations within the distance of the 12 nautical miles (NM) appear and disappear, causing further changes to the determination of the normal baselines. When such a change occurs at a distance exceeding 0.1 NM, the normal baselines are adjusted accordingly. When a Notice to Mariners or New Edition of a Chart is published, the newly adjusted normal baselines and associated maritime boundaries are published.

Portugal

Portugal's concern with sea level rise is not new and it has only increased through time. Regularly, Portugal and like-minded countries have supported the debate on this issue, and we are acutely aware of the impacts of sea level rise (SLR) in our coastal communities and around the world.

1. In 2012, the outcome document of the United Nations Conference on Sustainable Development, *The Future we Want*[19], noted (in §165) that sea-level rise and coastal erosion are serious threats for many coastal regions and islands, particularly in developing countries and small island developing states (in §178), and in this regard called upon the international community to enhance its efforts to address these challenges.

Several UNGA Omnibus Resolutions on Oceans and Law of the sea have addressed this important issue, by recognizing the importance of improving the understanding of the impact of climate change on oceans and seas and highlighting the conclusions of relevant reports published by the scientific community, *i.a.* the International Panel on Climate Change (IPCC).

[19] In https://sustainabledevelopment.un.org/futurewewant.html

In 2007, an IPCC report underlined that climate-related changes over the 21st century will include an acceleration in Sea Level Rise (SLR), further rise in sea surface temperature, more extreme weather events and storm surges, altered precipitation and ocean acidification.

Within coastal zones, these climate-related changes can be expected to have a range of impacts. Rising sea levels increase the flood-risk and erosion along the coast, impact in freshwater availability and result in an accelerated loss of coastal ecosystems. Climate experts emphasize the importance of adapting to these potential effects of climate change by developing and implementing coastal protection and adaptation strategies.

In fact, the latest IPCC special report on this issue, Oceans and Cryosphere in a changing climate (SROCC), published in September 2019, dedicated the entire chapter IV to this problem, highlighting *i.a.* that the risk related to SLR (including erosion, flooding and salinization) is expected to significantly increase by the end of this century along all low-lying coasts in the absence of major additional adaptation efforts.

The SROCC also notes that while only urban atoll islands and some Arctic communities are expected to experience moderate to high risk relative to today in a low emission pathway, almost high to very high risks are expected in all low-lying coastal settings at the upper end of the likely range for high emission pathways. Although ambitious adaptation will not necessarily eradicate end-century SLR risk, it will help to buy time in many locations and therefore help to lay a robust foundation for adaptation beyond 2100[20].

Nevertheless, to date, little is known about the actual climate change adaptation practices, legislation and strategies, including related investments, made by the different member states around the world to protect and adapt their coastal areas against the effects of climate change, in particular SLR.

2. At the request of the UN General Assembly, the UNICPLOS has already touched upon this issue in the past. At its Eighteenth Session, in June 2018, ICP discussions focused on "*The Effects of Climate Change on Oceans*", and the vulnerability of coastal regions to SLR was again in focus, with many presentations mentioning the relevance of the issue on its many dimensions and the estimated projections of average increase in particular regions of the Globe.

Given the fact that this year's theme is completely focused on this specific climate change impact, Portugal believes that it is a good opportunity for gathering experts and information the different dimensions of SLR, from a sustainable development perspective (economic, social and environmental).

In general, our view is that ICP-21 should contribute to a deepening of the knowledge (including scientific) on the matter, at the United Nations level, and for the exchange of experiences and good practices in respect to adaptation, which require responses on several levels:

- Structural (planning, organization, legislation);
- Physical (protection works, adaptation and institutional);
- Institutional (coordination, cooperation, synergy);

[20] In IPCC, SROCC, September 2019, chapter 4, pages 324/325: https://www.ipcc.ch/site/assets/uploads/sites/3/2019/11/08_SROCC_Ch04_FINAL.pdf

- Economic and social (sustainability, resilience, etc.); and
- Means of implementation (which depend on the capacity of financial availability; adaptive capacity; political will; governance).

In this context, Portugal proposes to have at the next ICP an overview and discussion on the actual climate change adaptation practices, legislation and strategies, including related investments, made by the different member states around the world to protect and adapt their coastal areas against the effects of climate change.

4. In addition, we would also like to see some specific issues to be addressed, such as

a) <u>The importance of salt marshes for healthy and productive ecosystems and climate change</u>:

Salt marshes, as defined in the first World Oceans Assessment (WOA-1) are intertidal, coastal systems that are regularly flooded with salt or brackish water and dominated by salt-tolerant plants adapted to regular or occasional immersion by the tides.

They serve as nesting, nursery and feeding grounds for numerous species of birds, fish, molluscs and crustaceans, including some commercially important species. Salt marshes are very effective 'blue carbon' sinks, sequestering carbon dioxide (CO_2) due their high levels of primary production and low rates of decomposition, but they can also produce emissions of greenhouse gases.

Salt marsh area is globally declining despite protections in many regions of the globe. Sea level rise poses the biggest threat; marshes must either increase their elevation to keep pace with rising seas or move inland. If coastal development or restrictions on sediment delivery make either adjustment difficult, saltmarshes are converted to open water. Some evidence suggests marshes with certain invasive plants may be better able to keep up with sea level rise.

The global extent of salt marshes is shrinking, due primarily to sea level rise, increasing temperatures, and more frequent and intense coastal storms (Cahoon 2008; Duarte et al., 2013)[21]. Global historical coverage has declined between by 25% to 50% (Crooks et al., 2011; Duarte et al., 2008)[22]. Many wetland ecosystems are showing evidence of eutrophication, waterlogging, and disease (Short et al. 2016)[23].

Salt marshes are key coastal ecosystems that provide ecosystem services to humans such as food, protection from storm surge and waves, attenuating flooding and pollutants, and "blue carbon" sequestration. According to Macreadie (2013)[24], the global carbon burial in salt marshes (up to 87.2 ± 9.6 Tg C yr^{-1}, based

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[21] Cahoon D.R. (2006). A review of major storm impacts on coastal wetland elevations. Estuaries and Coasts 29: 889–898.
Duarte C.M., Losada I.J., Hendriks I.E., Mazarrasa I., Marba N. (2013). The role of coastal plant communities for climate change mitigation and adaptation. Nature Climate Change 3: 961–968.

[22] Crooks S, Herr D, Tamelander J, Laffoley D, Vandever J. (2011). Mitigating climate change through restoration and management of coastal wetlands and near-shore marine ecosystems: challenges and opportunities. Environment department papers ; no. 121. Marine ecosystem series. World Bank; Washington, DC: 2011.
Duarte C M., Dennison W C., Orth J.W., Carruthers T. (2008). The charisma of coastal ecosystems: Addressing the imbalance. Estuaries and Coasts.31:233–238. doi: 10.1007/s12237-008-9038-7.

[23] Short, FT, Kosten S. Morgan P, Malone S, Moore G. (2016). Impacts of climate change on submerged and emergent wetland plants. Aquatic Botany 135: 3-17.

[24] Macreadie PI, Hughes AR, Kimbro DL (2013) Loss of 'Blue Carbon' from Coastal Salt Marshes Following Habitat Disturbance. PLoS ONE 8(7): e69244. https://doi.org/10.1371/journal.pone.0069244

on preliminary assessments) appears to exceed that of tropical rain forests (53 Tg C yr^{-1}), although they occupy a much smaller area (0.1-2%).

b) <u>The importance of conducting SLR risk assessments for evaluating socioeconomic impacts</u>:

Sea level rise, as consequence of global warming, has occurred in the past and has been occurring for more than a century. For a global temperature anomaly increase of around one degree Celsius, the global mean sea level (GMSL) has raised approximately 20 cm since the end of the 19th century, both globally and regionally[25]. Although there is a very low rate of regional uplifting, SLR on the west coast of Portugal's mainland is in line with GMSL, with a slow and progressive response to global warming[26].

Due to the oceans' well-known inertia, and with a slow response to global warming, SLR will continue to rise beyond the end of the 21st century. Even if global warming stops in the short term, the oceans would continue to rise due to the slow response of deep ocean warming and the melting dynamics of the glacier systems, either continental or Greenland and Antarctica[27].

The most recent studies conducted by our national experts[3] note the high exposure of the world's population that live along coastal areas less than 10 m above mean sea level (MSL), representing around 10% of world population and 13% of urban population with a higher share in the least developed countries (14%). In addition, there is the high importance of many types of infrastructure, namely, harbors and maritime transportation infrastructure, as well as economic activities, business, industry, tourism, and services (mainly in estuaries, deltas, and inlet areas).

Hence, in the context of climate change, these two facts make the subject of SLR assessment a current and very important issue with strong socioeconomic impacts in the near future.

Finally, it is worth noting that European Floods Directive 2007/60/EC[28], requires each member state to assess the risk associated to SLR and floods caused by extreme events. Therefore, coastal hazard on the Atlantic Coast of Portugal's mainland was evaluated for the periods 2025, 2050, and 2100.

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[25] Nerem, R.S.; Chambers, D.P.; Choe, C.; Mitchum, G.T. Estimating Mean Sea Level Change from the TOPEX and Jason Altimeter Missions. Mar. Geod. 2010, 33, 435–446.
Church, J.A.;White, N.J. Sea-Level Rise fromthe Late 19th to the Early 21st Century. Surv. Geophys. 2011, 32, 585–602.
Hay, C.C.; Morrow, E.; Kopp, R.E.; Mitrovica, J.X. Probabilistic reanalysis of twentieth-century sea-level rise. Nature 2015, 517, 481–484.
Sweet, W.V.; Kopp, R.E.; Weaver, C.P.; Obeysekera, J.; Horton, R.M.; Thieler, E.R.; Zervas, C. Global and Regional Sea Level Rise Scenarios for the United States. In NOAA Technical Report; NOAA: Silver Spring, MD, USA, 2017; NOS CO-OPS 083.

[26] Antunes, C. Assessment of sea level rise at west coast of Portugal Mainland and its projection for the 21st century. J. Mar. Sci. Eng. 2019, 7, 61. In https://www.mdpi.com/2076-3263/9/5/239

[27] Antunes, C. Assessment of sea level rise at west coast of Portugal Mainland and its projection for the 21st century. J. Mar. Sci. Eng. 2019, 7, 61.

[28] European Parliament; Council of the European Union. Floods Directive (2007/60/EC); European Environment Agency: Copenhagen, Denmark, 2007; pp. 27–34. ISSN 1725-2555.