ERA4CS European Research Area for Climate Services
Transnational Collaborative Research Services ERA4CS
Topic A – Researching and Advancing Climate Services
Development by Advanced co-development with users

INtegrating Sea-level Projections in climate services

for coastal adaptaTION

INSeaPTION

INSeaPTION First Global User Workshop and Climate Services Identification Report

Final Report

January, 2019

Authors : Sandy Bisaro (GCF), Gonéri Le Cozannet (BRGM), Roderik Van De Wal (IMAU), Erwin Lambert (IMAU)

Front matter

Study carried out as part of the INSeaPTION project supported by ERA4CS, an ERA-NET initiated by JPI Climate, and funded by BMBF (DE), MINECO (ES), NOW (NL) and ANR (FR) with co-funding by the European Union (Grant 690462).

In bibliography, this report should be cited as follows:

Bisaro, S., Le Cozannet, G., Van De Wal, R., Lambert, E. (2019) INSeaPTION First Global User Workshop and Climate Services Identification Report, final report, pp31.

Contact: Sandy Bisaro, sandy.bisaro@globalclimateforum.org

Executive summary

This report documents the outcomes of the first workshop on global coastal climate services of the INSeaPTION project held on September 25th and 26th in Haarlem, Netherlands. The workshop brought together 22 coastal experts and stakeholders from both the public and private sectors working within a range of different country contexts in order to identify a set of user needs that can potentially be translated into coastal climate services by the INSeaPTION project over the course of the next 2 years of project life. Key climate services were identified along 3 different types: decision problems; methods and tools for decision-making under uncertainty; and methodological guidance. Regarding decision-problems, in particular, long-term decisions, e.g. for siting and taking adaptation measures regarding critical infrastructure such as nuclear power plants, was found to be of great interest. Regarding methods and tools, developing a methodology for attributing climate change and sea-level rise to coastal risk and adaptation was found to be of high interest in the context of current discussions on adaptation finance. Regarding methodological guidance, support for developing SLR information to support in local decisions, particularly in developing country contexts, where data availability presents a significant challenge, was seen as a climate service of potentially high interest to be addressed within the project. A reflection emerging out of the workshop is that further work should be undertaken to enrol decision-makers with a more global perspective on coastal adaptation, such as, adaptation finance actors under the UNFCCC or development finance decision-makers more broadly. A key step in the next phase of the project will be to more narrowly define the set of key users and climate services, given the initial input of this first workshop.

Contents

1. Introduction

This document reports on outcomes of the First INSeaPTION Global User Workshop held in Haarlem, NL on Sept 25-26, 2018. The workshop provides a basis to identify i) key user needs of global users and ii) potential scientific methods that INSeaPTION can develop and apply to address these needs.

The workshop consisted in 22 participants, 14 of which were external to the INSeaPTION project, and included private sector stakeholders, public stakeholders, as well as researchers and consultants. The workshop was organised around an introductory session, in which Gonéri Le Cozannet (BRGM) introduced the INSeaPTION project and welcomed participants. This was followed by an overview of the state-of-the-art in sea-level rise science and implications for adaptation decision-making given by Roderik van de Wall (IMAU). Robert Nicholls (University of Southampton) provided a keynote on coastal impacts from a global perspective. Gonéri Le Cozannet and Sandy Bisaro (GCF) then gave a summary of work in the INSeaPTION case studies to date in French Polynesia and the Maldives respectively. The main points of the presentations and summaries of discussions are provided in Annex I below. The remainder of the workshop was organised around the two types of user groups, i.e. "global decision-makers", who face decisions across beyond a local setting, i.e. at a regional or global level, and "local users of global information". The sessions were structured around presentations from participants followed by break-out groups, the main points of which are again summarised in Annex II.

One initial overall aim of the workshop was to identify user needs and formalize them as 'decision problems' for two groups of users: "global decision-makers" and "local users of global information". However, for the "global decision-makers" group, the exercise of identifying global 'decision-problems' is challenging because there does not exist an actor with a clearly global decision-making mandate of decision with respect to sea-level rise. Moreover, the global user workshop discussions highlighted that most decisions to be taken are local, and therefore make use of local SLR information, and possibly extreme event statistics. Section 3 of this document therefore reports on key climate services identified in the workshop organized around the themes of Long-term decisions (local), Methods and tools for decision-making under uncertainty, Methodological Guidance, and Risk Communication. Before doing so, the Section 2 first gives an overview of some current trends and users identified in the workshop, based on the introductory presentations and discussion.

2. Overview of potential key users and global decision-context

The Introductory session raised several points regarding global trends in coastal development and coastal impacts.

- First, growing global trade may lead to growing demand for ports, and port authorities, international shipping companies, as well as, companies that depend on such international supply chains are potential key users.
- Second, larger damage events may become more important over time, as assets build-up behind greater protection, particularly in wealthier countries. Thus, flood damage events may be less frequent but cause more damage when they occurs. This gives rise potentially to the need for alternative adaptation measures to address the residual risks posed by low-frequency, high-impact events.
- Third, an observed trend in Europe important for critical infrastructure risks is the observed shift towards coastal locations of nuclear power infrastructure in Europe, as demand for cooling-water increasingly cannot be met by rivers.

Regarding the adaptation decision-context, it is important to note, first, that adaptation decisions differ between different types of users. That is, while the general objective of adaptation decisions is to manage the involved risk(s) (probability x consequences), locally specific objectives largely differ across users of sea-level information. Distinctions can be made between, for example, (1) public actors, e.g. long-term projections for decisions about infrastructure, (2) businesses, e.g. local SLR projections for global supply chain management, (3) local farmers that have short-term objectives and an interest in natural variability and near-term changes. Second, it is important to note that SLR information needs depend on the characteristics of these different decisions, and the measures considered in these decisions. For example, some dunes may still offer adequate protection under extreme SLR scenarios, whereas the performance of storm surge barriers may be greatly affected by changes in mean sea-level. Further, the decision horizon is also important for determining SLR information needs, and adaptation decisions differ in terms of the time horizon that is relevant to consider. For example, nuclear power plants not only have a long technical lifetime, but also a phase out horizon. Moreover, there are strategic decisions about long-term protection, while production performance may depend on short-term (intraday, seasonal) variability (e.g. surface water temperature, wind, river discharges), as well as decadal variability.

In terms of the state-of-art SLR science, as highlighted by Roderik van de Wal's presentation, beyond the range of 21st century SLR scenarios (0.3 – 0.8 m by 2100) summarised in IPCC AR5, high-end SLR above this range may still occur. High-end SLR could result from rapid melt of the Antarctic Ice Sheet, which is a source of large and poorly quantified uncertainty. More broadly, there remain further current gaps in terms of observations, large uncertainty in current extreme value distributions, changes in future extremes. The challenge for INSeaPTION is to identify decisions, and the respective SLR information needs that arise from there, which can be addressed, based on the current state-of-the-art, or by filling some of these gaps through new research.

3. Potential climate services

This section summarises potential climate services identified during the workshop. Three types of climate services are identified, and organised as sub-section below: decision problems; methods and tools for decision-making under uncertainty; and methodological guidance services.

3.1. Decision problems

3.1.1. Long term decisions beyond 2100

As noted in Section 2, one key trend in Europe is that over siting nuclear power plants in coastal areas, as opposed to river catchments, to make use of coastal waters for cooling needs. This gives rise to a challenging decision-problem due to the very long life of nuclear power plants (i.e. greater than 100 years, when including the decommissioning time in addition to the operating life of the plant). Further, nuclear power plants must meet stringent safety standards (e.g. 1/1000 or 1/10000 safety levels). Other potentially relevant regulations are those governing the coastal environment, e.g. water quality or habitat regulations. This case study also involves non-nuclear critical energy infrastructures such as geothermal and coal plants in outerseas territories (e.g. Guadeloupe, St Pierre and Miquelon, etc.).The decision problem can be characterised as follows:

Decision-problem: What measures are needed to guarantee safety of nuclear plants until full decommissioning?

Objectives:

- General objective: safety / protection of nuclear power plants as well as other plants
- Order of magnitude of safety levels: 10^{-4} to 10^{-5}
- Infrastructure with long lifespans (e.g. > 100 years)
- Other (environmental) objectives, e.g. water temperature max., etc.

Method: Decision-analytical approaches that can support meeting safety levels over time in an efficient way. For example: Statistical analysis, e.g. worst-case analysis, compound flooding events

Information needs:

- Low and high-end SLR scenarios, e.g. identify minimum investments option, and alternatives [e.g. low regret, robust options]
- Regional SLR projections that can be applied locally with time horizons beyond 2100 (e.g. France, Guadeloupe, St Pierre and Miquelon …)
- Coastal information for estuary questions (e.g. on surface water temperature, circulation, extreme events)

Current gaps: observations, appropriate statistical analysis (extreme value analysis), coastal impact modelling

3.1.2. Sizing a risk capital pool for flood (re)insurance

Interest is increasing in flood insurance as one measure in a portfolio of measures to manage coastal flood risk under SLR. This is due to the fact that insurance, when designed appropriately can enable faster recovery and provide incentives for risk reduction, while it can also help to manage residual risk noted in Section 2 above. Designing such an insurance scheme in the context of coastal gives rise to a decision-problem of sizing the risk pool in order to determine the needed capital for the pool, and subsequently determining insurance premiums. The decision-problem for a private (re)insurance provider can be characterised as follows.

Decision-problem: How to size the reinsurance risk capital pool for the coming year?

Objectives and constraints:

- Maximise profit through re-insuring high impact flood events
- Do not go bankrupt (!); avoid maximum probable losses exceeding available capital
- Time-horizon of the decision is short (1 year) due to insurance policies generally being issued annually

Methods:

- Cost-Benefit Analysis

Information needs:

- Flood protection standards
- Statistical analysis of extreme water levels
- Seasonal projections:

Current gaps:

- Flood protection standards are a major gap in many parts of the world (e.g. outside of North-Western Europe) and represent a major barrier to assessing coastal risks for insurers
- Seasonal forecasting, e.g. of tropical storms, is another major information need due to the annual time horizon of the decision, and is not likely to be addressed within INSeaPTION

3.1.3. Maximizing the operability of harbour infrastructures

Port and harbour operations may be subjected to interruptions due to wave agitation, as well as, due to the need for infrastructure upgrades. A key decision-problem for port and harbour operators is how to design infrastructure, and measures, to maximise their operations given current wave climate, and its future changes, as well as SLR. The decision can be formulated as follows.

Decision-problem: What measures are needed to maximize the port operations?

Objectives: minimize wave agitation within the port

Methods: Cost-benefit Analysis

Information needs: Waves variability and changes; Soil compaction affecting harbours infrastructures;

Decision problem	Decision method	Information need following from the decision method	Methodology for producing needed information
Critical infrastructures			
Which investments maximize **port** operations (minimize wave agitation within the port)?	CBA	- waves variability and changes - soil compaction	Wave modelling and downscaling (requires adequate winds time series, wave models and bathymetric data)
Which investments are necessary to guarantee current power plant operations (not nuclear)?	CBA Tipping points	- waves and sea level variability and changes - soil compaction	Projecting mean sea level projections
How can the safety levels of nuclear plants be guaranteed?	Tipping points: Upper bounds of waves and SLR projections over the lifetime of current coastal defences (0-30 years)	- upper bound of SLR projections for the coming 30 years? - Upper bound of wave changes for the coming 30 years?	This may not be obtained with the current knowledge
Which improvements should be performed on coastal infrastructures to guarantee that decommissioning of nuclear plants can be performed? When?	Tipping points? Upper bounds of waves and SLR projections over O(100years) or more)	- upper bound of SLR projections for the coming 30 years? - Upper bound of wave changes for the coming 30 years?	This may not be obtained with the current knowledge
Finance and insurance			
How to size the reinsurance risk pool and premium for the coming year?	CBA	Seasonal projections	Depending on region considered this may not be obtained with the current knowledge

Table 1. Summary of decision problems identified in the workshop.

3.2. Methods and tools for decision-making under uncertainty

Beyond specific decision-problems, several climate services where discussed in terms of cross-cutting methodological approaches.

One approach discussed in this regard are the related methods of Adaptation Tipping Point and Adaptation Pathways analysis. These approaches show that rates of change in SLR are important for decision-making. One implication of uncertainty in rate of SLR is that decision-makers need to either i) build long-term measures with more allowance; ii) build measures with short-term horizons more often. Further, the dynamic decision-making approach of Adaptation Pathways implies that a need for signal detection in order to identify rates of change and tipping points. There is thus discussion at the workshop identified a general need for **improved monitoring** (e.g. satellite data) and computing (enabling to process ultrahigh resolution data).

Related to this need for signal detection, it can be noted that the time at which divergence is projected to emerge between different SLR scenarios, e.g. between RCP2.6 and RCP8.5, differs across locations. While densely populated areas generally have an economic rationale to protect, across all SLR scenarios, for less densely populated this divergence between scenarios presents a dilemma, as appropriate action depends on SLR scenario. Therefore, a potential climate service is **metric of scenario divergence**, indicating at what point in time scenarios diverge, and thus represent a means to identify **adaptation tipping points** for a given location.

Another key methodological need discussed is that of the need for **attribution of coastal risks to climate change and SLR**. This is particularly important in the context of current discussion on adaptation finance, as for some funding mechanisms, e.g. those under the UNFCCC, demonstrating that an adaptation project addresses climate change related risks is a key condition for receiving funding. Other relevant concepts are ‘additionality’ and ‘incremental adaptation costs’ whereby a funding applicant should demonstrate the additional costs of a project caused by climate change. A key climate service thereby identified for both funding allocation decisions, and funding applicants is a **methodology for attribution SLR to coastal risks**, as well as, adaptation measures to the reduction of these risks.

3.3. Methodological guidance

A final category of climate service was identified that can be termed ‘methodological guidance’. Here, it is important to note the widespread need for local information of sea-level that is largely not available in many parts of the world. For example, downscaling of global modelling, and data availability need to inform coastal adaptation decisions, is only available in a limited number of locations around the world (i.e., mostly in North-Western Europe). Guidance on how to make use of available SLR scenarios at the global level, and apply them in local contexts, particularly in developing countries would be a useful climate service. For instance, Nicholls et al. (2010) provide guidance on approaches to projecting relative sea-level changes, and such work could be usefully extended to inform coastal risk assessment in the context of sea-level rise.

One options discussed in this regard would be a **common portal for providing easily accessible sea-level specific data** (observations, SLR scenarios, etc.) that would also include clarification on how to make use of these data, on their validity and potentially on the uncertainties (where a common setting is currently lacking). This portal should be updated frequently (4-5 years) to follow the improvement of knowledge on projections within the scientific community. This portal could also include guidance on developing coastal adaptation plans, for example, based on a set of '**best practice case studies'**, e.g. Shoreline management plans, or the Delta Plan.

4. General reflections and feedback regarding global climate services

The closing session of the workshop collected reflections on the presentations and discussions over the 2 days, initiated with a summary reflection by Robert Nicholls. A key point of reflection was the need to narrow down the scope of the global climate services to be provided by INSeaPTION, and focus on a well-defined set of users, while avoiding the temptation (and attendant risks) of being over-ambitious. Further, the point was made that is may be fruitful to further pursue discussions with truly 'global' decision-makers, who were not necessarily represented at the workshop, because there are a number of decisions that were briefly discussed that have more of global character than the decision problems analysed in more detail at the workshop. Such potential global decision-makers include, UNFCCC actors, particularly those responsible for adaptation funding decisions, as well as, a number of other organisations responsible for allocating multilateral or bilateral adaptation finance, e.g. World Bank, Global Environmental Facility, etc, as well as national development banks, e.g. KfW, AFD, etc. Further stakeholders concerned with security (i.e. military) may also be concerned with the strategic implications of SLR. Finally, the effects of SLR on trade and migration represents another lens that may give rise to truly global/regional (i.e. non-local) decisions regarding SLR, and the project should further explore the decisions and involved stakeholders concerned with these issues.

A further point of reflection that is relevant to narrowing down the INSeaPTION project should be aware of, and responsive to the fact that some stakeholder/ participants that were a-priori classified as potential users, in fact did not show interest in our potential output. Two examples bear this out. First, the Dutch government, who expressed that they have enough technical knowledge themselves, and therefore to not have a great interest in external climate services. Second, (re)insurance companies, expressed that it is too difficult to price the risk from coastal flood events, e.g. due to lack of knowledge on existing protection, and therefore do not anticipate entering this market. The project should be aware that these arguments may apply to other users as well, and therefore should ensure buy-in from targeted end users before making definitive decisions on global climate service development.

In terms of the design of the workshop itself, the point was made it may have been fruitful to ask participants what general lessons on climate services and decisions using SLR information they had learned from their experiences, rather than trying to produce a (stylised) description of decision-problem they are currently facing. The focus of the workshop then would be more towards learning from the past, e.g. through synthesising different case studies, rather than trying to identify gaps in the current state-of-the-art looking forward. Both approaches appear to have strengths and weaknesses.

5. Conclusions

INSeaPTION is a step in developing coastal climate services, but global needs are very diverse and other projects will be required to respond to the needs that exist already. Further, there remains a particular challenge in identifying users and their specific needs. As mentioned above, RN recommends to focus on well identified users, even if those do not cover all potential users of coastal climate services.

At global scale, sharing knowledge is a climate service in itself: for example, for the 1.5°C IPCC report, UK funded research to ensure that a sufficient research material would be ready for the report. In this case, there are clients, but the decision-making that these services inform is not explicit. International organizations such as OECD, national security agencies or reinsurance also have a global perspective, but it remains mostly supported by researchers because the response to their needs is never straightforward. Hence, there is a demand, but it remains fuzzy.

At local scale, the situation is different: the need for information at local scale is apparent, interactions between coastal engineers and sea level science exist already, and decision-making schemes that underlie these needs can probably be identified within the project. Furthermore, the value of local studies for justifying mitigation should not be underestimated: for example, the Dutch case study shows that the Netherlands may be able to adapt to high-end scenarios, but this is clearly not the case in other countries, and the changes in other countries will affect the Netherlands.

For these reason, RN recommends that the project proceeds as follows: i) Further investigate global decision making schemes, but knowing that the progresses in this are may be slow; ii) Further investigate a set of case studies in order to identify generic characteristics of coastal climate services that could be useful worldwide.

GLC concludes that there is still a challenge to formalize needs and identifying decision making schemes still requires investigations. The proposed next steps are therefore: i) Sharing presentations (see www.inseaption.eu); ii) workshop report (the present document) will appear in January 2019; iii) 2019: further interactions with specific users or groups of users, and scientific work; iv) 2020: 2nd user workshop (planned in Berlin), providing feedback to the group of participants.

6. Acknowledgements

The INSeaPTION project wishes to thank all participants for their active and constructive contributions. We extend a particular thanks to Robert Nicholls for advising the project, as well as, to Erwin, Roderik and Sandy for organizing the event.

7. References

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Annex I: Summary of presentations and discussions

This section summarizes the presentations and break-out group discussions of two breakout group discussions in the Global decision-making and national and local decision-making session respectively.

Global decision-making presentations

Public approaches to mobilising private adaptation finance, Lisa Danielson (OECD Climate Adaptation Team)

- roles national government in OECD countries are reviewed, particularly in terms of information (studies) and cooperation. Several common barriers to coastal adaptation are identified:
    - the risks are poorly known (there is not always a coastal risk map)
    - when they are known them, we do not know (or badly) to weight them in gravity / frequency) and therefore evaluate them
    - Authority to manage these risks is often distributed across levels
    - Often finance to meet the challenges is lacking
    - There is no ad hoc fund because who has to pay?

Decision-making from an engineering perspective, Stef Boersen (HaskoningDHV)

- Haskoning starts from the customer's need: "I want to protect myself from waves, build on the sea ...".
- In terms of SLR, we integrate issues of tides, subsidence, Evex ... We often leave the worst case and study technical solutions and the acceptability of associated risks. Here are 3 examples:
    - Reevediep (IJsselmeer Delta, Netherlands); the important thing is to show the projections at 15-20 years and to draw the consequences in terms of planning
    - Port Louis (Mauritius): the port is vulnerable to cyclones. We must think of an extension offshore. It will mobilize a special dyke that anticipates on the CC and associated SLR.
    - Fuvahmulah (Maldives): Raising an island to protect it from the SLR and Evex. A risk acceptance coefficient is then integrated to avoid an overly expensive project.

Decision-making: global sea-level rise information needs, Eberhard Faust (Munich Reinsurance)

- The objective is to build a conceptual model of coastal risk assessment.
- Generally, the criteria for conducting such an assessment are well defined (tide, waves, subsidence, pumping ...).
- The difficulty is in the risk assessment for the reinsurance fund. Major data gaps and data quality issues arise, e.g. regarding protection standardsThere is a great need for modeling the various scenarios.

Global decision-making break-out groups

Group 1

The group discussed the following points:

- Engaging into an energy and environmental transition remains a challenge, and that the set of decisions that can enable to do so remains unclear.
- For insurance companies, current variability is the key issue because the contracts are renewed on a yearly basis.
- Need to identify what science can provide besides local assessments with uncertainties
- Need to highlight the different approaches that exist to deal with uncertainties
- Need to communicate uncertainties, and being very transparent about the processes that are included (as well as those that are not included)

Group 2

The group identify the following key challenge: how do move from a reactive approach toward coastal disasters, to a proactive approach addressing risk prevention and coastal adaptation appropriately?

The following challenges were identified:

- Distributing adaptation funding more equally not only requires clearly identifying the main drivers of changes at the coast, but also a real “attribution” coastal climate service, but the model available today do not have the accuracy required to perform such attribution studies. (need for a coastal climate service on attribution, which INSeaPTION can probably not implement alone)
- In many case, sea level rise is not perceived as an urgent issue, but urgent action is needed in order to limit the risks of a strong acceleration in sea level rise. Furthermore, some adaptation strategies require time to be implemented (e.g., for relocation, this may exceed 30 years), and some adaptation strategies may lock in coastal communities in maladaptation traps. Hence, the need to raise awareness remains, and this should be part of a coastal climate service. The group discussed that it was unsure that the current IPCC reports and national initiatives are sufficient to mainstream adaptation and mitigation in current land use planning, energy, transport, risk prevention and environmental policies to the scale it is required (need for training, education and raising awareness)
- For engineering projects, well established data portals are required in order to distribute sea level projections and other data. This is especially relevant in non-OECD countries, which do not access easily to up-to-date information on sea level rise and impacts (need for well established data portals, besides reports and data distributed by the IPCC)
- Today, adaptative design is considered as a costy option. However, the boundary conditions are changing and a certain level of change is guaranteed (e.g., sea level low end scenarios). A

cultural shift in required in this area. (need for low end scenarios in order to identify minimum needs for adaptative design that are expected)

- Many climate services that exist today have been develop in order to comply with a specific regulation (e.g., water directive, flooding policies, etc.). An analysis of incentives and regulation supporting the development of coastal climate services and, ultimately, adaptation and mitigation, could be conducted.

Group 3

The group 3 raised the following issues:

- is there any global decision-making problem?
- Global information needs to be downscaled locally
- Local information is required
- Any coastal climate service should be well targeted to the audience, which has implications for risk communication, and mainstream SLR policy

Need for new approaches to SLR risk communication:

- **risk culture / perception**. Frequency of rare events might increase, but people are not used to live with flood anymore. The standards for risk protection in the Netherlands are so high that, paradoxically, any disaster (if it might happen) might lead to high losses. A broader vision on risks may be needed to nuance the risk associated to climate change coastal risks versus other risks.

Need for 'mainstreaming' coastal/SLR risk in decision-making:

- **Risk awareness.** Global warming, biodiversity are examples of cases which are (to some extend) accepted by the majority. Such a level of awareness is also needed for climate change coastal impacts. Today, integrating climate change impact assessment is often viewed an additional cost, but a shift in engineering practices is needed similarly as the shift in 90s on environmental impact assessments.

Need for communication / translation of uncertainty to policy makers:

- There is a need to be transparent, but what is the appropriate format for communication? Is it via the use of a range of values? But what is inside this range? What does it mean?

Wrap-up Plenary Discussion

The table below summarizes the main needs identified during the discussions on Day 1.

Needs	**Users**
Need for sea level and coastal information	
Global sea level information downscaled locally	All coastal stakeholders
Need for low end scenarios in order to identify minimum needs for adaptative design that are expected	Some energy infrastructures
Need for well established data portals, besides reports and data distributed by the IPCC	All coastal stakeholders
Need for research	
Coastal climate service on attribution	Adaptation funding stakeholders
Identify regulations that successfully integrated adaptation to sea level rise in current regulations	Policy makers
Need to highlight the different approaches that exist to deal with uncertainties	Possibly risk averse stakeholders
Need for research assessing predictability of sea level, waves and storms at seasonal to interannual timescales (*to note: I have seen many losing time in this area*)	Insurance companies
Need for training, education and raising awareness	
Need to communicate uncertainties, and being very transparent about the processes that are included (as well as those that are not included)	All stakeholders involved in coastal risk prevention and coastal adaptation
Raise awareness toward the public and policy makers able to mainstream adaptation and mitigation in current policies	General Public Policy makers in the area of land use planning, energy, transport, risk prevention and environmental policies

A few key unknowns remain:

- Who will fund adaptation in the coming decades?
- When will sea level rise accelerate?

- In the UK and in other OECD countries, IPCC scenarios are downscaled, but there is a need to do this globally. This raises the need for a commonly recognized database of sea level and impacts information. Is this feasible? Who would pay for this?
- Today, global information on sea level rise and impacts is used to support mitigation. Can it support adaptation as well? The discussion show that this is not straightforward, although national policies (e.g. security, energy), green climate and adaptation funds and reinsurance actually use such information.

National and local decision-making presentations and discussions

Presentations

Planning for an uncertain future in the Thames Estuary, Tim Reeder (former Thames Estuary 2100)

- Due to the growing threat of flooding the Thames Estuary, it has been decided to launch a 337 linear km development project by 2100. SLR, the Evex, the tide will have to be taken into account. .Scientific data are numerous but involve a wide range of uncertainties. It is therefore an exercise in "Planning for an uncertain future".
- The framework of the initial study was that of the European Space project.
- The challenge is to balance the costs and a reasonable degree of security for a given duration.
- If we give an average probable elevation of 1.5 to 3 m by 2100, three axes of work appear: improve defenses (up to 2 m), maximize storage (2.5 m) and provide for a new barrier (3 m +).
- Spent £ 600,000 on studies. The result: a PROBABLE scenario of elevation: 20 to 90 cm, but it would theoretically be necessary to consider a height of 2.7 as a plausible maximum at 2100.
- The cost: £ 1.5 billion over the first 25 years, then 1.8 to 2060 and between 6 and 7 to 2100.
- The acceleration of the SLR is for the moment less than predicted by DEFRA. The concept of pathways has been well-suited by policy makers; to develop.
- "After an era of procrastination, half-measures, and under-estimation, we have entered the era of consequences" (W.S. Churchill)

Climate services beyond sea-level rise for the French energy sector, Paul-Antoine Michelangeli (EDF)

- How has EDF seized the issue of the CC? From the 90s with a model, still used by the IPSL. The objective and to specify the impact of various CC scenarios on (1) the demand for electrical energy, (2) the environment, (2) the water resource (to cool the power plants).
- Our 3 pillars for our needs are data, expert support and various tools for analysis and scaling. We start from IPCC scenarios and then descend downscaling to the level of a given power station, or to a river scale.
- It is fundamental to communicate well internally and externally and to take care of the relationship with the client. The assumptions of climate variability must be maintained and a single simplified scenario avoided.

- Finally, the demand must remain on projections to 10 years to be listened to by the decision-makers.

Decision-making for adaptation of the Dutch Delta, Marjolijn Haasnoot (Deltares)

- For adaptation to SLR, an uncertain context, data and all projections must be taken into account.
- For NL, SLR projections at 2100 range from 30 to 300 cm. It will probably be higher and earlier than the world average. Even if there is no acceleration of the SLR, the trend assumption is of the order of 1 m to 2100.
- What are the adaptation limits of the Delta plan?
    - Maeslant barrier should be permanently closed if the SLR reaches 2 m whereas this closure is only required once every 4 years with a 40 cm SLR.
    - Ijssel drainage pumps should go from 1000 m3 / sec to 3000 m3 / sec with an SLR of 1.2 m
    - The sand recharge of sensitive areas should be multiplied by 20 with an SLR of 1.2 m.
    - Water management would be more complex with too much water in winter and spring and not enough in summer, with increasing risks of saline intrusion.
- There is no urgency today but tomorrow?
    - We will have had 65 years to treat a 50 cm rise. But we will only have 20 years for the 50 cm to come, and only 10 years for the extra 50 cm. Should we already prepare for a rise of 1 m?
    - The priority is to better understand what will happen, especially in terms of impacts according to the scenarios in order to adapt in time in the most relevant and least costly way. (Ref: http://pathways.deltares.nl)

Group 1: the Netherlands case

Discussions focused on

- the need of assigning **probability to High end scenarios**. It seems that the problem is more on the need for a deeper understanding of (physical) processes to anticipate a sudden shift i.e. to anticipate a “surprise”. In other words, the problem is more related to a **timing issue** rather a probability issue. To put it simply, “big actions” take time to implement.

- **risk culture / perception**. Frequency of rare events might increase, but people are not used to live with flood anymore. The standards for risk protection in the Netherlands are so high that, paradoxically, any disaster (if it might happen) might lead to high losses. A broader vision on risks may be needed to nuance the risk associated to climate change coastal risks versus other risks.

- Need for **improved monitoring** (e.g. satellite data) and computing (enabling to process ultrahigh data).

Group 2: Siting power plants at the French coast

Supporting the electricity production sector in designing coastal climate services

The lifespan of infrastructures in the electricity production sector motivates considering sea level rise. Today, security levels are in the order of $10^{-5}/10^{-4}$, which raises the need for observations, appropriate statistical analysis and coastal impact models in order to ensure that the final estimates are accurate enough to comply with the required security of infrastructures. Climate variability at decadal timescales appears very relevant as well because this influences investments in electricity production units. Finally, there is the feeling that 2100 is a too short time horizon for some infrastructures such as coastal nuclear power plans (need for projections beyond 2100)

The following points were raised:

- In addition to high end scenarios there is a need for low end scenarios that help identifying the minimum adaptation needs. However, there is currently a lack of research in this area today. (need for low end scenarios)
- Risks in estuaries remain often poorly quantified, and some power plants are located in estuaries. Further more, other questions are relevant in estuaries, including water temperature (plant cooling), extremes and estuarine circulation
- The current locations relevant for EDF are China, UK, France, including outersees territories (Indian ocean, west indies…)
- There is a need for (1) sea level projections applicable locally; (2) sharing methodologies that are potentially applicable.

A specific workshop on the electricity sector could be organized in 2019

Group 3

This group also focused on coastal climate services for energy production (EDF). General outcome: a separate workshop may be useful.

1a. General objective: safety / protection of nuclear power plants.

1b. Minimum safely levels (10^-4 / 10^-5)

1d. Infrastructure with long lifespans

2. Statistical analysis, e.g. worst-case analysis, compound flooding events

4. (i) low end and (ii) high end SLR scenarios, e.g. to identify minimum investments that will be needed anyway [reference alternative], and other types of alternatives [e.g. low regret options, robust investments], (iii) regional (UK, France, China, Guadalupe, …) SLR projections that can be applied locally with time horizons beyond 2100, (iv) Sharing decision-analytical approaches that can support meeting

safety levels over time in an efficient way, (v) Coastal information to answer estuary questions (e.g. on surface water temperature, circulation)

5. observations, impact modelling

General plenary discussion

The table below presents a summary of the climate services and users discussed.

Needs	**Users**
Need for sea level and coastal information	
Global sea level information downscaled locally	All coastal stakeholders
Sea level projections beyond 2100	Energy production sector
Low end and high end scenarios	Some energy stakeholders
Need for research	
Improving quantifications of flooding risks in estuaries	e.g., power plants, harbours
Need for training, education and raising awareness	
Sharing methodologies that are potentially applicable to adapt to sea level rise (e.g., adaptation pathways…)	All stakeholders involved in coastal risk prevention and coastal adaptation

Appendix II

Agenda of the workshop

Global sea-level rise information and decision-making

25-26 September 2018
Carlton Square Hotel, Haarlem, the Netherlands

Tuesday 25 September

12:00 – 12:30	Registration	
12:30 – 13:30	Lunch	
13:30 – 15:00	**Session 1: The INSeaPTION project**	
	13:30 – 13:50	Welcome and overview of state-of-the-art sea-level research Roderik Van De Wal
	13:50 – 14:10	INSeaPTION introduction Gonéri Le Cozannet
	14:10 – 14:40	Coastal impacts of sea-level rise: a global perspective *Keynote by Robert Nicholls (University of Southampton)*
	14:40 – 14:50	Case study: the Maldives Sandy Bisaro
	14:50 – 15:00	Case study: French Polynesia Gonéri Le Cozannet
15:00 – 15:30	Coffee and refreshments	
15:30 – 18:00	**Session 2: Global decision-making**	
	15:30 – 15:40	Introduction Sandy Bisaro
	15:40 – 16:00	Public approaches to mobilising private adaptation finance *Lisa Danielson (OECD Climate Adaptation Team)*
	16:00 – 16:20	Decision-making from an engineering perspective

Filip Schuurman (HaskoningDHV)

16:20 – 16:40 Decision-making: global sea-level rise information needs

Eberhard Faust (Munich Reinsurance)

16:40 – 16:45 Introduction to break-out session

Sandy Bisaro

16:45 – 17:45 Break-out session

17:45 – 18:00 Feedback from break-out groups

19:00 – 20:30 Dinner

Wednesday 26 September

08:00 – 09:00 Breakfast buffet

09:00 – 11:30 Session 3: National and local decision-making

09:00 – 09:10 Introduction

Roderik Van De Wal

09:10 – 09:30 Planning for an uncertain future in the Thames Estuary

Tim Reeder (former Thames Estuary 2100)

09:30 – 09:50 Climate services beyond sea-level rise for the French energy sector

Paul-Antoine Michelangeli (EDF)

09:50 – 10:10 Decision-making for adaptation of the Dutch Delta

Marjolijn Haasnoot (Deltares)

10:10 – 10:15 Introduction to break-out session

Roderik Van De Wal

10:15 – 11:15 Break-out session

11:15 – 11:30 Feedback from break-out groups

11:30 – 11:45 Perspectives

Robert Nicholls (University of Southampton)

11:45 – 12:00 Lessons learned for INSeaPTION

Gonéri Le Cozannet and Roderik Van De Wal

Appendix III

Workshop participants

Tuesday : global decision making

Group 1	Group 2	Group 3
Roderik van de Wal	Gonéri Le Cozannet	Sandy Bisaro
Erwin Lambert	Jeremy Rohmer	Thomas van der Pol
Tim Reeder	Robert Nicholls	Angel Amores
Miroslav Petkov	Lisa Danielson	Edmund Penning-Roswell
Marjolijn Haasnoot	Renske de Winter	Quirijn Lodder
Koos Poot	Frank Hallie	Filip Schuurman
Patrice Walker	Denis Lacroix	Paul-Antoine Michelangeli
Eberhard Faust		

Wednesday : national and local decision making

Group 1	Group 2	Group 3
Roderik van de Wal	Gonéri Le Cozannet	Sandy Bisaro
Jeremy Rohmer	Thomas van der Pol	Erwin Lambert
Tim Reeder	Paul-Antoine Michelangeli	Marjolijn Haasnoot
Edmund Penning-Roswell	Miroslav Petkov	Lisa Danielson
Frank Hallie	Koos Poot	Robert Nicholls
Patrice Walker	Renske de Winter	Angel Amores
Denis Lacroix		

INSeaPTION

Homepage : www.inseaption.eu

Social network : @INSeaPTION