SPM Review Response to Reviewer

Thank you, Louis, for your review of the Summary for Policymakers (SPM). We are grateful for your constructive suggestions, which have contributed towards improving the overall quality and relevance of the SPM. We have based our revisions on your comments and suggestions, and hereunder answer your review points specifically as well as provide the modifications that have been made in the manuscript.

- Reviewer's comment is shown in black colour and *italic font style*
- Our responses are shown in blue colour
- Text from the manuscript (added or modified) in green colour
- The lines markers mentioned in some of our responses below are from the revised SPM manuscript copy which highlights all changes made

In addition to your general comments, we have also incorporated changes based on your specific comments (in the PDF you attached). These can be seen in the revised manuscript which highlights all our revisions. Where these changes were not accepted are explained below.

SPECIFIC COMMENTS (in PDF)

- *(In Abstract, line 35) Reviewer suggested deletion of word 'key' in:*
  *"The Summary for Policy Makers (SPM) distills the **key** findings of the report, presenting information specific to each European basin..."*

We retained the word 'key' as it is appropriate, since not all findings are listed in the SPM due to its concise nature.

- *(In Abstract, line 34) Reviewer suggested replacement of word 'identified' by 'closes' in:*
  *"In addition, it **identified** critical knowledge gaps supporting the development of actionable information."*

We retained the word 'identified', because closing the gaps is not (always) what the report is doing. We feel 'identified' is a more appropriate term to use here.

GENERAL COMMENTS

- *This reviewer acknowledges the challenge and complexity of writing for a policy audience. While the science content needs to be correctly and rigorously presented it also needs to be accessible, clear and conveyed in plain language. In parts of the SPM this goal is achieved, in others not. There remains a substantial amount of scientific jargon that is not required by policymakers.*

Thank you for this general comment on the language of the SPM, we have attempted to simplify the scientific/specific language, mainly in the text of Section 2 of the SPM wherever possible without the essence of the message being lost. This will be made clearer under specific points below.

- *It is recommended to use an acronym for the 1st SLR Assessment Report (possibly SLR AR1) This may be useful as a "branded report" name used throughout the SPM.*

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Thank you for the suggestion. We have indeed already used an acronym for the Assessment Report in agreement with the journal, which is 'SLRE1'. This abbreviation has now been used in certain places within the SPM as suggested by you.

- *Please include a sentence in the abstract that identifies the target audience of the SPM. Policy-makers is a very generic term across multiple scales. Please be specific as to who should read this SPM.*

We have more detailed information on 'target audience' in the Introduction chapter of the assessment report, also published on the SoP website as part of the report. Following your suggestion, this information was synthesised briefly and has now been added to the SPM abstract for clarity of the reader.

"The report's target audience includes national and sub-national bodies focused on research and policy advice for coastal management and climate adaptation, as well as European experts who contribute to shaping policy frameworks and collecting information at a pan-European scale."

- *Also, in the abstract: make a general statement on the state of SLR in the six European sea basins. There is such statements provided in Section 2 of the SPM. Give a clear reason or present a clear problem relating to SPM. Do not assume that the target audience is aware of the extent of the threat of SLR and the challenge to policy- and decision-makers at various scales. One statement on the potential impact sets the scene and provides a reason for policy-makers to continue reading.*

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The opening statement of Abstract now refers to the global concern on SLR. Additionally, we have added to the SPM a set of "key messages" at the start, to set the scene for what the following sections expand upon.

Addition in Abstract:
"Sea Level Rise (SLR) is a global concern for low-lying coastal areas, including many European coasts."

Addition of Key messages:
"Key statements from the First Assessment Report on Sea Level Rise in Europe

- *Sea level rise is a chronic hazard that is addressed in the governance of environmental and economic development of European coastal regions in all surrounding sea basins (section 5, 5.1, 5.2, 5.3, 5.4, 5.5).*
- *The mean rate of European absolute sea level rise slightly exceeds the global mean trend and is accelerating. Regional variability is large, with lower (or negative) relative sea level rise in some Baltic regions due to vertical land movements and effects of loss of land ice masses. Future sea level rise rates are very uncertain and depend greatly on emission scenarios. Higher relative sea level rates are expected in the southern areas (section 2, 2.3, 2.4, 2.5).*
- *Sea level rise has several coastal impacts (such as increased likelihood of floods, shoreline retreat by coastal erosion, freshwater shortages by saltwater intrusion). Other human interventions can exacerbate these impacts, such as reduced sediment supplies due to streamflow obstructions, urbanization and habitat loss in exposed coastal areas, lack of sustainable groundwater strategies, or ageing coastal infrastructure (section 3.1, 3.2).*
- *Values of sea level rise considered in the management of coastal developments vary across countries, and depend on socio-economic developments in coastal areas, environmental constraints and options to take measures against negative sea level rise impacts. Many countries have mainstreamed sea level rise in national and regional policies for climate adaptation, and (marine) spatial planning and environmental conservation (section 4.3, 5.1)*
- *Selection of options against adverse sea level rise impacts usually must strike a balance between multiple objectives, available time windows, and long-term implications. Uncertainty in future sea level rise and socio-economic developments require long term flexibility by adopting an iterative decision process and monitoring progress in reaching policy objectives (section 4.2, 4.3).*
- *Many measures to reduce adverse sea level rise impacts exist, classified in broad categories (accommodate, protect, advance and retreat). They include hard (engineering) and soft (nature based) infrastructure measures, upgrading or restoring existing coastal assets (such as dikes) or resources (such as aquifer recharge), preventive (such as early warnings) or recovery (such as insurance) measures, and changes in land occupation (such as managed retreat) (section 4.1, 4.3)."*

- *In some places in the SPM there is a reference to communities. Is this group also included as a target audience for the SPM?*

A clarification of what 'coastal communities' refer to has been made, in section 1.2.1.

"...impacts on coastal communities (people living, working and residing in coastal zones) ..."

- *Please use the term "six European sea basins" consistently. Using regions, in some places in the SPM, is confusing.*

In places where it was used synonymously, we have replaced the word 'regions' with 'basins' to avoid confusion.
However, in some places in the text, 'region' refers to a combination of basins. For example, if talking about the Mediterranean and Black Sea basins together, the author may say 'region'. This has been retained in the text.

- *Please reconsider the Section and Sub-section titles. These were often unnecessarily long and not always clear and simple.*

We have reworded section and sub-section titles for simplification, as follows:

Section 1. ~~Assessment Scope and Stakeholder Needs on European SLR drivers, impacts, and policies information~~ → Assessment Scope and Stakeholder Needs for European SLR information

Section 1.2 ~~Stakeholder consultation on available and requested consultation~~ → Stakeholder consultation

Under Section 1.2.1:

Availability of SLR Information

Impacts of SLR ~~Impacts~~

- *The two stakeholder groups outlined in Section 1.2.1 are not intuitive. Is it intended to have "planning and research" as a single concept? If so, why? It makes more sense to target stakeholders in 1) planning, and 2) research. These are different stakeholder groupings requiring differentiation in survey methods. This relates to Line 54-55 (government and scientists as binary stakeholder groups). This is ambiguous. Many government stakeholders may also be involved with research. Please define what you mean by "government". Local government may have a substantive different understanding than national government experts or officials.*

While the 'Government' group refers to information users, the 'Researchers' group refers to information suppliers, and both were surveyed in the scoping process of the Assessment Report. We have clarified the difference between the nature of the two surveyed groups, in section 1.2.1, adding the following paragraph:

"The first group (labeled as "government") consists of potential users of SLR information for policy design and implementation, usually professionals in public regional and national governance and in private industry with advisory roles, and was represented by about one third of the respondents. The second group (labeled as "research") consists of information providers, and consists primarily of academic research staff (about two third of the respondents)."

- *Line 64-65 (Both government and scientists…similar gaps). The explanatory sentences that follow conflicts with this statement. Government officials identified a need for regional projections while scientists were interested in causality. These are not similar at all. Is it not more accurate and intuitive to point out the difference here, rather than the similarity?*

We have re-worded part of the text for clarity of the reader, now saying:

"*Government and scientist respondents identified similar gaps with slight variations in perspectives and priorities*."

It is now clear that the views do differ between the two groups.

The underlying paper (Jiménez et al., 2024, section 3.1, this volume) that has been referred to in section 1.2.1 of the SPM, discusses the results of the survey in detail.

- *Line 85 (Section on Policy Support). The subsection title makes the reader believe that it deals with SLR and its supporting role in policy. The allocation of resources for research and data collection is only broadly connected to policy support. After reading the sub-section heading and then the content I am not sure what was intended here. Please rethink the objective of this section and clarify.*

We think that to avoid confusion here, the sub-sections 'Adaptation' and 'Policy support and implications' need not be two different ones. In the underlying chapter of the SLRE1 (Jiménez et al. 2024) where this section of the SPM comes from, only 'Adaptation' is used. In the SPM we have now removed the 4th sub-heading and merged the content under 'Adaptation' as follows:

"Adaptation to SLR

~~Many existing adaptation plans are deemed inadequate, with scientists exhibiting a more critical perception than government respondents~~. The survey results show that many stakeholders deem existing adaptation plans to be inadequate, with scientists being more critical than government respondents. Flexibility of existing adaptation strategies in the face of SLR-induced impacts is considered insufficient, highlighting the need for adaptive planning approaches. ~~Neglected considerations in decision-making include SLR impacts~~ SLR impacts that were mostly neglected by stakeholders including those on coastal ecosystems, coastal urban planning frameworks, river discharge characteristics, and freshwater management.

~~**Policy Support and Implications**~~

Respondents unanimously agree on the usefulness of IPCC reports for informing policy and decision-making. Identified needs encompass periodic updates to SLR projections, comprehensive impact assessments, and enhanced exploration of adaptation strategies to mitigate SLR impacts on coastal communities (people living, working and residing in coastal zones) and ecosystems. Additionally, allocating resources for research and data collection to improve evidence-based and adaptive policymaking ~~is~~ was deemed necessary. Collaboration among government agencies, research institutions, and stakeholders to develop and implement effective adaptation measures is emphasized....."

- *Section 1.2.2. Online Workshops.*
  ***1.)** Propose to structure the summary of the outcomes of the workshops for each basin/basin group to explicitly report on i.) data and information gaps, and ii.) policy needs and gaps. Be more explicit about the separation of these. The policy-makers would like to know the state of affairs relating to data and information while also expressing the need for specific information.*
  ***2.)** I question the value of presenting the disaggregated outcomes of the workshops as unique and sufficiently important to stand alone by basin or basin group. I would propose a much higher degree of interpretation by the drafting authors to provide a much clearer signal as to the combined needs of all basins, with a much clearer expression of custom regional needs as a table. While the reporting on the various needs from the workshops is interesting, it does not create a strong policy message. Why did some basins identify extreme events and others did not? Is this not important information across the basins? This section must reconfirm the combined priorities for SLR information and policy support without providing unnecessary "raw" data from the workshops. I propose to strengthen the consistent message from all workshops and highlight regional-specific needs.*

This comment is relevant, thank you. We have synthesised the entire section of 1.2.2, replacing the entire text under the different basins with one summarised paragraph:

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"For all European sea basins, the workshops identified significant data and information gaps, particularly in climate projections that capture local processes and coastline details. Notably, there is insufficient resolution in estuaries and a lack of data on human activities, alongside the need for a robust data delivery and quality control system. The workshops also highlighted the need for a solid methodology to assess the effectiveness of coastal adaptation measures and to develop Integrated Coastal Zone Management and/or Maritime Spatial Planning that incorporates sea-level rise policies. Additionally, both scientists and policymakers emphasized the importance of community engagement and effective communication strategies. More details on the specific needs for each European basin are given in Jiménez et al. (2024, this volume)."

- *Section 2 Past, Present…The implications of the findings of past, and current future sea levels by basin were not easy to follow. While the science of SLR uses many complex terms and acronyms it does not make for easy digestion by policy makers. I would propose shortening the explanatory scientific statements and providing a separate plain language assessment of what this means for policymakers, if not also for local communities.*

We agree with your analysis here, and have reworded section 2, replacing domain-specific terms with simpler, more-commonly known terms wherever possible.

Changes are as follows:

Commented [NP1]: Kanika, please check the line numbers

Section 2.1 lines 202-210: Regional patterns of relative SLR are mostly explained by ~~ocean dynamics and gravitational patterns associated with~~ ocean current changes and mass loss from Greenland ice sheet and mountain glaciers. Climate ~~modes of~~ variability such as the North Atlantic Oscillation (NAO) significantly affects ~~regional sea level trends and extremes, impacting storm surges along western Europe. Changes in~~ storminess and atmospheric pressure patterns impacting ~~associated with NAO influence~~ the frequency and intensity of extreme sea level events, particularly storm surges.

Section 2.2 lines 235-236: ~~a temporal variability~~ → large changes over time

Section 2.2 lines 244-245: ~~glacial isostatic adjustment~~ → past and present terrestrial ice mass loss

Section 2.2 lines 245-247: Changes in SLR, due to temperature, salinity and currents ~~is~~ are projected to be relatively uniform across the North Sea. However, ~~projections acknowledge the~~ uncertainty stemming from factors like the resolution of global climate models (GCMs) and local dynamics are still large.

Section 2.3 line 257: attributed to past ice mass loss ~~and glacial isostatic adjustment (GIA)~~.

Section 2.3 lines 258-259 → Recent studies highlight widespread ~~non-negligible elastic~~ VLM in the European Arctic due to ice mass loss from Greenland.

Section 2.3 lines 263-265 → Projections suggest that the European Arctic will experience a below ~~than~~ global average relative SLR, mainly due to land uplift ~~GIA and gravitational, rotational, and deformational (GRD)~~ effects, particularly from Arctic glaciers and the Greenland ice sheet melting.

Section 2.3 line 267: ~~steredynamic~~ SLR → temperature, salinity and current driven SLR

Section 2.4 line 277: ~~steric~~ component → temperature and salinity components

Section 2.4 line 284: ~~steric~~ SLR → SLR

Section 2.5 line 307: ~~GIA~~ → ice mass loss

Section 2.5 line 317: ~~Meridional~~ gradient → north-south gradient

Section 2.5 line 318: ~~GIA-induced effects~~ → the effects of ice mass loss

- *Section 3.2. For the sub-sections please use the same order in all sections, i.e., Flooding, SWI and Erosion. Please explain why there is no erosion or SWI input in some sub-sections.*

The order has been made consistent in all sections: Flooding, Erosion, Saltwater intrusion, following the order in which these are listed in section 3.1 Impacts.

- *Section 4.1. The four adaptation measures are not sufficiently and consistently defined with clear examples.*

Thank you for pointing this out. As per your general and specific comment that the 'Accommodation Measure' lacked a definition, it has been rewritten as follows:

> **"... 'Accommodation'** refers to measures that enable coping with the consequences of sea level rise, such as flood-proofing buildings and increasing resilience of critical infrastructure ~~are highlighted as effective responses to~~ which reduce the vulnerability of coastal communities to SLR impacts. These measures encompass a range of approaches, from flood-proofed materials to early warning systems and climate risk insurance schemes."

- *Review comment on section 4.1 'Advance measures': "This also means advancing towards the sea, often combined with protect measures."*

We believe that it is clear from the description that new land is created (sometimes but not always in sea territory) and that "conservation and restoration" may imply protection measures (but not always).

- *Section 4.3. A table with adaptation options as rows and ocean basins as columns will provide a clear and concise message about selected adaptation options.*

We choose not to include tables and figures in the SPM, but a large table *(with adaptation options as rows)* is present in the SLRE1 chapter on 'SLR: Adaptation Measures and Decision Making Principles' (Galluccio et al. 2024) and the reference to this table has been provided in the SPM section 4.1.

- *Section 5. Please explain or define what adaption governance means.*

A definition has now been provided under section 5. 'Governance Context and Challenges'. The definition incorporated in the text is as follows:

> *"The governance of coastal adaptation policies includes the institutional organization, stakeholder engagement and practice of decision-making, including the management of scientific knowledge, conflicting objectives and interests, and incorporating a diversity of perspectives and views. Assessment of ~~Progress in~~ coastal adaptation governance ~~in Europe is assessed~~ does require the incorporation of ~~in~~ the socio-economic and political contexts. In this Assessment Report this is carried out by reviewing relevant European coastal adaptation ~~relevant~~ policy frameworks in place at regional and national levels and their contexts within each of the selected sea basins."*

- *Sub-sections 5.1-5.2. I propose summarising the geopolitical and economic context in a single paragraph without a heading and concluding with a clear statement on the state of and recommendations for adaptation governance. This is the information that the policymakers will be looking for.*

We have taken this suggestion and merged the 'geopolitical context' and 'economic context and governance' paragraphs into one for sections 5.1 – 5.5, for format consistency across all basins:

Commented [NP2]: Please check all the cahnges I have put in the text, I did report only few of them here, thanks

“5.1 Eastern Atlantic

~~**Geopolitical context**~~

~~The Atlantic Ocean has transitioned from a zone of peaceful cooperation to one of growing instability, particularly in the Arctic Ocean. The region faces militarization and competition over natural resources and trade routes, necessitating strategic engagement and cooperation from the European Union (EU) and its member states (see Bisaro et al., 2024, section 5.2.1, this volume).~~

~~**Economic context and governance**~~

The Eastern Atlantic basin encompass several vital economic sectors such as maritime tourism, shipping, and blue economy sectors including renewable energy and green port infrastructure. However, the basin also faces militarization and competition over natural resources and trade routes. This necessitates strategic engagement and cooperation from the European Union (EU) and its member states. With the rise in maritime activities, challenges related to sustainable development and resource management emerge. Policy interventions are necessary to balance economic growth with environmental conservation. Atlantic Ocean Basin countries have adopted adaptation policy strategies, but challenges persist in addressing uncertainty in SLR and associated risks. Some countries incorporate SLR into their Maritime Spatial Planning, while others lack specific measures.

5.2 North Sea

~~**Geopolitical context**~~

The North Sea ~~region~~ basin is witnessing heightened attention due to its vast energy reserves and potential for renewable energy, notably offshore wind. The EU aims to leverage these resources for its energy transition to enhance economic growth and stability.

~~**Economic context and governance**~~

The North Sea ~~region boasts~~ basin hosts significant economic sectors like shipping, oil and gas and emerging sectors such as offshore wind energy. The EU aims to leverage these resources for its energy transition to enhance economic growth and stability. The North Sea Basin countries have reported SLR as a chronic hazard and adopted adaptation policy strategies. Coastal adaptation measures vary and funding approaches differ substantially among countries. Governance challenges include maintaining environmental sustainability amidst economic growth, while ensuring safe maritime activities and transitioning towards renewable energy sources.

5.3 European Arctic

~~**Geopolitical context**~~

The Arctic Ocean has become a geopolitical hotspot due to its rich energy resources and strategic positioning to face the growing territorial competition. The EU is actively engaged in Arctic policy, focusing on sustainable development, climate resilience, and cooperation with indigenous populations amidst growing global competition.

~~**Economic context and governance**~~

The European Arctic ~~region~~ faces economic opportunities in sectors like oil and gas, fishing as well as emerging sectors including data centres and raw material extraction. Governance challenges include balancing economic development with environmental conservation, addressing demographic shifts and indigenous peoples' rights alongside industrial growth. In the Arctic Ocean Basin, Norway considers mid-range SLR scenarios in planning approaches, highlighting a proactive stance towards coastal adaptation.

5.4 Mediterranean Sea and Black Sea

The Mediterranean and Black Sea region host crucial economic sectors like tourism, fisheries, mariculture and emerging sectors like offshore energy.

~~**Geopolitical context**~~

~~The Mediterranean and Black Seas present~~ In addition, complex challenges are present, including migration, territorial disputes and energy security concerns. In its policies and recommendations, the EU emphasizes partnership and cooperation to address conflicts, promote stability, and mitigate environmental degradation in these critical basins.

~~**Economic context and governance**~~

~~The Mediterranean and Black Sea regions host crucial economic sectors like tourism, fisheries, mariculture and emerging sectors like offshore energy.~~ Governance challenges include sustainable tourism management, ensuring seafood security and transitioning towards renewable energy sources to mitigate environmental degradation. The Mediterranean Sea Basin has regional instruments addressing coastal adaptation, albeit with limited effectiveness due to the absence of specific measures for SLR. In the Black Sea, regional instruments lack provisions for SLR and coastal adaptation.

5.5 Baltic Sea

The Baltic Sea basin features significant sectors such as shipping, fishing, and emerging sectors like offshore wind energy.

~~**Geopolitical context**~~

~~The Baltic Sea~~ However, the region also faces security challenges exacerbated by the Russia-Ukraine conflict and aggravated by its energy dependence. Efforts focus on diversifying energy sources, enhancing maritime security as well as promoting sustainable development through innovation and cooperation.

~~**Economic context and governance**~~

~~The Baltic Sea region features significant sectors such as shipping, fishing, and emerging sectors like offshore wind energy.~~ Other governance challenges involve addressing pollution concerns, sustainable resource management and promoting green technologies to reduce environmental impact. Baltic Sea Basin countries show varying levels of adoption of adaptation policies and measures addressing SLR. Maritime Spatial Planning is enforced across the basin, with some countries incorporating SLR into their plans.**"**