General comment

Review papers are always appreciated, though these are also quite difficult. The current manuscript aims to provide a review on the developments of modelling, management and climate adaptation at Cork Harbour in Ireland. The topic itself is very much welcomed and it certainly would have a great deal of interest from a wide range of disciplines. However, as the manuscript currently stands, it would need a considerable revisions to be considered for publication. All of the current concerns are presented below for summarized major comments and a list of minor comments (mixed with general comment and specific line nrs). Overall the existing contents can and should be significantly shortened (e.g. repetition and non-critical info) while well thought out additional nuance and detail are needed. It is my hope that the authors are willing to dedicate more time and detailed consideration for developing this manuscript, as the topic has a lot of good potential.

Major comments

(1) Introduction section needs a considerable revisit and more detailed nuance, especially for a review paper as this. Currently a lot of space goes into presenting similar concepts and ideas with slightly different (or at times almost the same) wording with many same references occurring every few sentences. I therefore hope the authors can significantly improve on this section with a more concise and logical approach (also lot of sentences that do not add much value). Another part that is crucially missing in the introduction, is actual detail of preceding body of work – what has actually been done and found so far? Most of the sentences repeat a general or broad idea, but introduction should bring in more nuanced information on the topic field in general. The structure should be clear and logical in terms of topical flow.

(2) While review articles tend to be longer that standard research articles, I would argue that does not need to be case if the presentation suffers from fillers, repetition or non to low-relevance topics. Looking at just the introduction, it should be much shorter considering the existing content, and should have considerably more structure and detail in other parts. It would be necessary to also improve this aspect throughout the paper. More comments about this come later as well.

(3) Naming of sections and their contents. For example, section 2.1 is named review rationale and methodological positioning, but I did not really follow this.. what is meant here with rationale and and positioning (are there alternative methodologies that are being compared and ultimately this one chosen?). Please check also if the chronological order of steps is currently the most sound? In section 2.2 some relevant info on sample sizes is presented and already raises questions how they were gathered, then see from 2.3 more info on the actual methodological process start to come in. For clarity, please consider organizing the information and methodological flow in a way that represents the concepts, steps, data etc. in a logical and easy to follow way.

(4) Methodology. This is quite confusing. More comments below. But essentially this should be made much more clear as it currently is. Both contents and structure build on this confusion. What was actually done, how and what was given out. More definitions and clear methodological steps and explanations would be needed. There are lot of phrases and words that are not explained or defined for the readers. E.g. in 2.4.1 what are “narrative synthesis approach”, what are “inter-relationships”, how is it systematic approach? Just one example, but many “buzz” words that are not really defined, conceptualized and presented in a clear way. Please check the whole methodological approach for this structural and content clarity.

(5) Results. The structure and presentation here is also somewhat confusing. I suppose part of this is because of Methodology in unclear. What is this SR here and why presented in the order it is? Are

the Results based on fully the methodology? Big issue I have here is that this jumps right into future projection study aspects, and if historical studies are included, it is confusing to pinpoint them. Few comments about it, but I do not understand why historical studies, trends etc. are not included here? I also do not follow the separation of contents – Cork city vs Cork Harbour vs. CHC vs. Cork vs. etc.? My understanding was that the methodological considerations aimed to to bring focus on Cork Habour, but the spatial domains and temporal (future only?) feel mixed and confusing. I understand and agree if wider area is included with main focus still leading to Cork Harbour, but there would need to be a logical connection and steps to these things. Please check these points in detail.

(6). Discussion. I do not argue with how the authors would like to position the importance of Cork Harbour in terms of international importance and potential implications for range of aspects listed in the discussion (e.g. from line 946). However, based on the current information and content (as discussed in various comments), I cannot fully see these aspects. A lot has seemingly been presented, but their international relevance from the aspect of what Cork Harbour can show and teach the international community as a “land-sea lab” needs deeper analysis (and/or more clarity). The Discussion repeats a lot what was said before in Results, but adds more emphasis why CHC is great location for study, without more quantified analysis/reasoning. Similarly there is lot of content here that need a look – most of section 4.1, what is the main discussion here? Section 4.2 – there is very wide range of studies around small-scale hazard risk (including compound) in urbanized and natural coasts around the world, I do not understand how few studies from one site make it more exceptional? Could argue for unique data etc, and emerging methodologies or operational initiatives for risk forecast. Section 4.6 – I do not understand this “source-to-sea” framework, what does this wording mean, it has not been explained. What is the logical connection between the three “layers”? How does the iteration work? The fig.5 looks very simple, yet unclear. Please explain this newly proposed conceptual framework in more detail. How is this different from any of the current tools, prospective tools (e.g. digital twins), and how is this ultimately better in terms of implementation, cost, administration and effect? This could have many discussions and detail, please consider carefully, as interesting to see such idea but need clarity and soundness. Please check other subsections critically as well, in respect to various comments so far. Some comment around this somewhere, but Cork vs Cork Harbour vs Cork City vs CHC. Please check. Most of the discussions are around CHC, is that correct? How about Cork Habrour as mentioned in the title?

(7) Focus. After reading through this manuscript, I feel left bit confused. Other than what has been mentioned above and in minor comment section, is the topic focus which should be on Cork Habour. But for much of the content around various administrative units / activities are thrown in without much direct connection to Cork Harbour specifically. Wider context is interesting and arguably necessary at times, but it becomes more a distraction if not carefully integrated with the main topic subject (i.e. Cork Harbour). I would then suggest the authors to consider, how to clearly and cleanly separate the focus on Cork Harbour from other topics (or logically connect). My feeling is that much of the content can be shortened (major comment 2), build the tight background necessary, and lead to more focal aspects related to Cork Harbour, this might bring the cohesion closer together.

Minor comments

mc: In the abstract the authors say CoMF "..has emerged as a critical natural hazard..". This framing to me sounds unnatural. Please check.

mc: Please consider adding country name after Cork Harbour in the title and abstract.
Most readers would not know this.

mc: Please check the wording on abstract for around line 20 for Results reveal. I do no follow what the meaning of that sentence. What does 30% increase mean, what future? Surge intensification from what - single extremes or some statistical metric, climatological time scales? – 400% amplification is massive, so bit more clarity in these type of statements would be appreciated.

mc: Lines 22-27. The logical connection between the two sentences are bit lost on me. The study offers a transferable scheme with various integrations (including AI), but then also say AI based real time forecasting is a critical gap. I suppose reading the review paper we find out why that particularly is considered a critical gap (update: after reading, not really sure). But please check these logical connections, if they are intended as written (more so if the focal topic is on Cork Harbour).

L40-43. It would better to separate the flood hazard risk based on the main cause and effect (e.g. global warming influences what on flood risk, human activities influence what on flood risk). Combined influence of e.g. climate change and increasing hydro-meteorological extremes are arguably just cause and effect.

L53-58. These two sentences are basically the same idea.

L59. Please check first mentions of abbreviations. CoMF has not been defined in the main body yet (only abstract).

L65. The sentence seems to be not finished. Please check.

L69. Exactly the same list of references used as a sentence before. Overall similar references are used and presented often. Please check and streamline this as a considerable chunk of visual text are from these references being repeated ever so often. While important that credit concepts and factual information where appropriate, they should not be dominating the written space.

L74. Another example of same conceptual ideas being repeated. Aspect of "nonlinearity" is presented around 4 or so times, but in their current context it should really not be more than once, unless there is valid contextual reasoning for more instances of its use.

L86. Authors say "growing evidence further suggests", but as in many other parts in the introduction, it is unclear who suggest what, to what degree, where and how? Please consider significantly adding more nuanced details about the body of literature on this topic.

L89-90. What are emerging challenges? What are the advances? Have similar questions throughout the introduction, almost for every sentence there, and will not write these out for all. But hopefully the authors can reconsider the level of detail (quantifiable results as well) included around most ideas and statements where logical and applicable.

L148-L153: please critically check what is written there.

L113. This has been presented/worded a few times, but CoMF being a natural hazard sounds strange to me. A winter cyclone is a natural hazard, compound flooding feels more like a hazard risk. Please consider this part. Also could the authors share, where does “CoMF” come from? Never seen this use before, usually, if at all just CF.

L138. Meaning of “encompassing the country’s second largest metropolitan area” in the context?

mc: There are several typos and odd language uses throughout the manuscript (missing punctuation marks, grammar etc.).

L294-295: This is very vague and needs far more clarity (if presented later, then should be done here).

L304: What is standardised extraction sheet? The authors did not use then text mining software or similar software? Is this then manual work “by full text content reading”? Please explain these in more detail. Overall the methodological approach leaves many questions. If manual, how to objectively evaluate, count etc.?

mc: Table 1, EC1. Why exclude this part? Does this mean that articles which focused on historical compound floods were left out? Please explain more as these are important considerations.

mc: Cork Harbour is the main focal point in this study, but there is no images, no background and more technical, operational, management etc information on it. There should be dedicated subsections for the area itself. What makes this an interesting study area. Various bits and pieces are presented throughout various parts, but they are scattered, not detailed and leave many questions about this main study site. Also more historical examples of compound events are needed, somewhere 2015-16 winter was mentioned, but that was confusing information (comment about it). Overall if an issue, historical examples and info should be more available.

L359: What does higher seasonality mean?

L364: Is it robust? Rainfall is difficult to model and capture. Uncertainty is everywhere regarding anything future, but more so for smaller scales. If say robust, more than one or two references or studies would be needed to support that. But how about historical trends from in-situ measurements (relates to previous questions about EC1 as well)? Overall, a historical perspective and analysis should be conducted and presented before setting stage for the future projections. This is very important, please consider.

L377. CHC – this as a spatial boundary needs to be better defined. The feeling at times is that focus is on the harbour, but then that the area is actually much larger? Fig.1 should clearly establish these bounds and difference between the harbour infrastructure bounds.

L408: What are MRFS, HEFS?

L416: Is 50-100 cm considered extreme? Like mentioned, just low pressure systems can bring water levels to this “extreme”.. but how about then tidal influence? Are these on top of high tide?

L436: That is the large increase shown in abstract. But 400% is all about perspective.. from what to what (extent, depth)? Please add this info. What is fluvial inundation now if currently dominant. More quantifiable data presentation is needed.

L440: Some double sentence issue here. Also this is contradiction to previous 400% sentence? Please check.

L448: Often time various place names are presented. These are interesting, and would be great to see overall really relevant maps and figures that cover these various locations etc. Also could reference to these figures then in the text, it would give more context about areas for people not familiar with them.

L454: Another example of repetition. This first sentence has little value. Please check the paper in full for various repetitions. Also in here mention “climate change”, but now thinking that so far the content and feeling is that future climate change (ongoing climate change), but does it also cover historical climate change? Please clarify these aspects throughout the paper.

mc: Consistency of units formatting in text, e.g. 3m vs 3 m.

mc: sections 3.2.1 I do not follow the modeling time frames and research works. Looking at references give, is it all about MSN_Flood in the first two paragraphs? Please check for logical clarity and reference use. Overall this section is confusing and seems to focus on MSN_Flood from papers from around same time (~2017). This could be shortened then a lot, please check this whole section. Also, again, referencing some events like “2009 event”, but there is no reference or context for the readers.

mc: Section 3.2.2 If basically the whole section is based on two bodies of litereature, then excessive referencing to them in-text does not make much sense (similar to what is in other places and major comment for introduction). Please streamline and more concise. Also are the authors sure “coupled” is the correct terminology here?

mc: Section 3.2.4, similar to before – based on few studies. Cite Olbert & Mordian, 2024 in the beginning and the next paragraph “expanding on this work, Olbert & Moradian, 2024. I think the confusion is clear, please check. Also in Line 554, ML models are mostly trained with independent and dependent variable sets, here only output (dependent) is mentioned. Training, validation and testing is important as well, what data was used, which models were used, how were the results, were they point or spatial, were they time-series or maxima estimates. Lot can and should be shared about these things (in concise way) to showcase the applicability of the method (e.g. here broadly ML) used.

Again, Line560, are the authors sure it is coupled or just integrated framework?

L603: What is audio-based flood risk exploration?

mc: Section 3.2.5. Not sure I followed, how is flood exposure, vulnerability and risk estimates considered or being done. Please try to increase clarity.

mc: Section 3.3.1. Interesting info on LLFRS, more would be good to know about how and what type of compounding hazard risk are being considered. Is it finished, ongoing? Does it considered future projections, if so which projections, etc?

mc: Lines647-654. Very interesting info, and very relevant these days (green vs gray vs hybrid).

L778: Check wording.

mc: Any research, initiatives, programmes etc around digital twins?

mc: In terms of governance and and supporting mechanisms, how are national, regional, local and business related policy frameworks/tools interconnected (top-down, bottom-up etc.?). Specifically regarding Cork Harbour, a clear distinction (from other administrative public entities) would be good. For instance, does Cork Harbour need to follow some specific local government action plans or they do their own assessment and adaptation work? In around lines 820, several frameworks are mentioned, though a clear overview of these would be needed, especially for the context of Cork Harbour. I would also recommend the authors to develop some visual graphs that logically tries to tie in various policy frameworks and supporting mechanisms and point out which is specifically relevant (and how) to Cork Harbour. It would make understanding this particular, but very important aspect, much better. Other various info is presented and could be logically included in such a graph.

mc: In NbS talk, there is lot of conceptual repetition with previous subchapters. There are not many specifics about NbS, but there is phrase in line 905: “NbS implementation in the CHC remains fragmented and largely project-based” – what are these implementations? Specific info would be highly valuable.

L917: What is this evidence? Would be interesting to know more details.

mc: section 3.3.3. It would be better if the authors could clearly define nature-based, hybrid and grey infrastructure. In this case the focus is hybrid and line 923 says “NbS could play an essential complementary role within hybrid portfolios” – but what is the other “natural” role in hybrid infrastructure if NbS could be complimentary? Clear definitions would be needed, as later mention the use of smart planning, IT etc for “hybrid”. In the classical sense, for flood control you have these soft measures and hard measures, but the definition needs clarity. For coastal engineers for example, hybrid might really mean largely infrastructure/physical intervention (green + grey + possibly smart/planning measure). NbS could be largely seen as same, as at the end of the day goal is to mitigate and ideally fully adapt to inundation risk (so need physical intervention for that), so nourishment or dune restoration etc could be considered.
But what about in the context of Cork Harbour? Please look into this bit more, this topic itself while emerging fast, is still quite broad and nuanced.

Figures and tables

Fig.1 Other than it missing standard map elements (longitude/latitude, scale bar etc.), it is not possible to read the figure contents in full. For instance, where is Cork Harbour? Other main landmarks/locations? The subplots b and c seems like they are cropped perhaps? Where is River Lee, as it also important element here.

Fig.2 I do not follow the schematic of this framework. Please add more detail. What is systematic literature review here .. software based? What are the arrows for Scopus, WoS etc? What conditions are used to fetch information? Is it automatic? Which parts are automated, which manual? What is R.P etc? What is the Refined finding.. i.e. what output is coming out finally? Many questions, please consider making this as clear as possible. A figure like this should be able to stand alone with a caption and readers should understand the overall logic behind it.

Fig.3 How does this connect with Fig.2? Could they be shown on a single figure for increased clarity?

Table 1. Please add more description for Table caption. E.g. inclusion and exclusion criteria for what (subject)?