RESEARCH ARTICLE

Cross-over analysis of the climate-change delta situation of the cities Gdansk (Baltic-sea) and Rotterdam (Nord-sea)

[version 1; peer review: 2 approved with reservations, 1 not approved]

Reporting for the H2020 Marie Curie SOS Climate Waterfront research project

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Abstract

Gdansk and the city Haarlem in the Netherlands share a long-term relationship that started with the establishment of Dutch Mennonites in the Vistula delta in the 16th Century. A small city was founded called Holland and these immigrants reclaimed the surrounding delta area. This area of 1,000 km\(^2\), with hundreds of small ‘polders’ separated and defended by 17,000 dikes, has become an important agricultural area for the whole of Poland, similar to the Rhine delta in the Netherlands. Despite these civil defense works in the past, both coastlines nevertheless experienced floods: the Dutch southwest coast in 1953, Dutch Rhine riverbank in 1993 and 1995, and Vistula delta recently in 2001. Climate change figures show that both the Polish Gdansk and Dutch Rhine deltas will suffer flooding with sea level rises, with accumulating severe rainfall accompanied by high river levels. Although both the Baltic Sea and the North Sea are next to each other and coupled to the Atlantic Ocean, there are differences in how soon or severely climate change trends, such as seawater level rises and water thrust, become critical. From cross-over analysis it can be concluded that Poland and the Netherlands have a virtually identical approach when it comes to climate change impacts on their current situation. With regard to long-term climate change, the Netherlands is exploring the future in a planned manner with the development of new scenarios for the protection of cities. The enclosure of the Baltic Sea, on the other hand, probably offers more options for exchanging knowledge with neighbor states. In that respect, the Netherlands is more isolated in their situation with the North Sea and its Delta Plan. The situation of Gdansk and Rotterdam is quite similar; these cities can take steps forward by learning from each other’s actions.
Keywords
climate change, mitigation, adaptation, built environment, coastal cities

This article is included in the Excellent Science gateway.

Corresponding author: Fred Sanders (fredsanders.cpnh@gmail.com)

Author roles: Sanders F: Conceptualization, Methodology, Validation, Writing – Original Draft Preparation, Writing – Review & Editing; Sanders H: Conceptualization, Data Curation, Validation; Jonkers K: Investigation, Methodology, Validation

Competing interests: No competing interests were disclosed.

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The Gdansk Baltic-sea climate-change delta situation

The Baltic Sea borders nine countries, is 1,600 km long, 193 km wide at its maximum and only 55 meters deep on average. The climate differences are huge in this area: strong long winters in the north and a mild continental climate in the south. This affects the water conditions and therewith the coastal circumstances and its water-related threats. Climate change influences this situation due to sea level rises, winter sea level changes, changing pole-tides, wind-induced water backlash, and the increasing water level changes in the sea joining rivers (Ekman, 2009). The interaction of these influencing factors is complex, and the water level and the fluctuations therein are particularly location dependent (Omstedt et al., 2004). These factors have changed more drastically over recent years due to climate-change (BACC Author Team, 2008).

The situation of the Scandinavian land north of the Baltic Sea is quite extraordinary. Here the land still rises every year after the former ice ages. The weight of the melted ice sheets is taken away and the land is returning to its former position. This is quite different from the southern Baltic Sea shore where the land is subject to subsidence (Haerff et al., 2017).

There are many developing factors that together predict that the coasts around the Baltic Sea will change remarkably due to climate change in the years to come (Labuz, 2015). According to the EC Inventory, the Polish coastal zone is highly vulnerable to climate change, although relatively few people live along this 634 km coastline (see Figure 1).

Gdansk is situated along the coast in the Gulf of Gdansk, west of the great Zulawy polder area, also called the Vistula delta because of the river Vistula that dominates the area. The area is special because the Vistula delta is a nature reserve, is responsible for 6% of the Polish agricultural food production and is an important source of drinking water. Handling the climate change water-related impact on this delta is especially urgent because of the increasing accumulation of high river water levels and the impact of severe rainfall in the last decade, especially coming from the higher hinterland. For the city of Gdansk, the situation has become more urgent in recent years as the city border lies at a river waterfront open to the Baltic Sea, see Figure 2.

The area of the city of Gdansk is characterised by an anthropogenic landscape of polders, dried marshlands and former oxbow lakes that have suffered periodic flooding during the last

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**Figure 1.** The land flooding at 1-, 5- and 10-meters sea level rise from left to right (pictures made by using www.floodmap.net, an open-access governmental website, with OpenStreetMap © OpenStreetMap contributors).

**Figure 2.** Impression of Gdansk city and waterfront (pictures by H.H.C Sanders, one of the authors).
few centuries. The situation changed with the construction of the bypass channel of the Vistula river east of Gdansk city in 1895, leading directly to the Gulf of Gdansk (WMO, 2005). However, climate change caused new flooding by cumulative sources in 1924 (huge snowmelt and rainfall), 1955 (strong storm), 1956 (ice-jam), 1983 (accident), and 2001 (torrential rainfall) (Cyberski et al., 2006). The coastal situation of Gdansk situated within the Gulf of Gdansk is thus determined by several climate change factors whereby the configuration of the Baltic Sea as a whole plays a role. The main influencing factors are: the higher seawater temperature; decreasing ice formation; increasing water import from rivers with their fluctuations along the Baltic Sea coast and in specific locations; increasing water backlog due to storm surges and more heavy clustered rainfall; the rising and falling of the land, which differs from the southern coast on the northern coast, whereby the effects differ locally along the 1,900 km long coast (Ekman, 2009). Although the first computer simulations are under development (at institutes in Poland and at NIOZ in the Netherlands), the interaction of these factors is difficult to predict (https://www.climatechangepost.com/poland/climate-change/).

The current situation is that Gdansk city and the eastern polder area remains dry by constant action: dike reinforcement and drainage pumping the water out of the delta by channels and the rivers to the sea. For the city of Gdansk, the planned climate change measures are: 1) long term coastal protection strategies; 2) flood warning system for the safety of residents; 3) canaling of the Vistula river to the Gulf of Gdansk in 1840 and 1895; 4) reservoirs for flood protection built on streams in cascades; 5) expansion of the city drainage system for capturing heavy rainfall; 6) education and support for rain gardens to residents (ModE, 2010; ModE, 2019).

Besides the situation in Gdansk and its surroundings, the question is: can the water-related approaches to the situation be seen as independent from the impact of climate change in the other corners of the Baltic Sea? For instance; the reduction in ice-formation in the northern part of the Baltic Sea will speed up the rise in seawater level on the southern coast as well (Ekman, 2009). Although the costs of extra defensive measures at this south coast will be less than the loss of value in the coastal area of Poland, the total investment will soon be too much for the region (Zeidler, 2015). The insights and experiences of other countries located around the Baltic Sea could be helpful for this, to copy successful measures or to cooperate with on this challenge of climate change.

Another, potentially faster, approach to determine the effect on the Polish coast and in particular on the largest city of Gdansk is to study the most critical factors and lessons learned about the Baltic Sea. This could be achieved through: 1) learning approaches from the highly similar situations of the Baltic states Estonia, Latvia and Lithuania; 2) studying the relationship of land-rise and the Baltic Sea, for instance the situation of nearby Finland; and 3) learning from the measures taken in Stockholm to safeguard the old town and the capital invested. Additionally, influences of climate change on nature and its biodiversity should get attention, because deforestation and destruction of river-vegetation accelerates the discharge of water from rivers; 4) the nearby situation of the Baltic States and Finland could be helpful in clarifying this influence besides conducting local studies.

The Rotterdam North Sea climate change delta situation
The last severe flood in the Netherlands, called ‘Watersnoodramp’, happened in February 1953 whereby 165 hectares of land flooded, mainly in the southwest of the country. In total, 1836 people lost their lives, 10k people lost their homes from the 72k that had to be evacuated, and approximately 50k cows and 150k chickens died. This unexpected disaster became the start of ‘Deltaplan’ to protect the Netherlands from the sea in the future. With the installation of the governmental ‘Delta Commission’ in 1953 two months later, plans to shorten the coast with 700 km of dikes started (Deltawet, 1958), see Figure 3. During the years after, the safety of the important city of Rotterdam was ensured by this program through construction of the ‘Maesland barrier’, the most Northern dam shown in the map in Figure 4.

Figure 3. Impression of the “Oosterschelde’ dam (left), and construction (right) (https://beeldbank.rws.nl, Rijkswaterstaat / Jaap Boelens (left) and Henri Cormont (right)).
In 2010 the construction ended unofficially; due to climate change, the Delta Commission was directed to make plans to address seawater level rises and other climate change coupled impacts in the future (Deltawet, 2011). The most recent advice from this commission of 15 September 2020 (Deltaprogramma, 2021) focussed on: 1) water security, 2) freshwater availability; and 3) spatial design, all related to climate change impact. The Delta Commission thereby concluded that the Dutch coastal defence system can handle the 100 cm sea level rise that may happen at the earliest in 2100 according to worse-case scenarios based on IPCC institute data. However, in case of a speeding up of sea level rise, some of the new coastal dikes have to be reinforced, especially the recent Maesland barrier, which offers safety for the important harbour of Rotterdam, see Figure 4.

Based on the recent Delta-Commission statement, the Dutch coast system can handle 10 meters of sea level rise totally, assuming there are no budget constraints. Flood scenarios show that 50% of the country will be flooded in that extreme situation (Haasnoot et al., 2020), which concerns the part of the country where almost 80% of the country population lives and where the cities Amsterdam and Rotterdam, the most important economic motors of the country, are situated, see Figure 5.

More worrisome with the rise in sea level is the major operation to gradually strengthen and raise all dikes, the primary sea defence and the polder dikes, and the increasing risk due to the effects of climate change to the primary sea defence. The most drastic factors behind this risk to the primary sea defence are higher temporary river levels, drier periods and more intense and prolonged periods of rainfall. These effects have an impact on the overload of sewer systems in cities, the subsidence of old houses, and the fertility of agricultural land for which salinization is an important factor. The production of Dutch tulip bulbs and potatoes already suffers easily from low salinization. The most drastic impacts, however, is the expected future flooding of the large cities in the western part of the Netherlands and the stagnation of economic growth in the adjacent industrial sites, which will then have a major impact on a national scale.

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**Figure 4.** Maeslant-barrier, Rotterdam ([https://beeldbank.rws.nl](https://beeldbank.rws.nl), Rijkswaterstaat/JoopvanHoudt).

**Figure 5.** The situation of the Netherlands in relation to sea level: actual situation behind the dikes (left), flooding in case of 1.0 meter higher sea level without dikes (middle), and in case of 10.0 meter (right) (pictures made by using [www.floodmap.net](http://www.floodmap.net), an open-access governmental website, with OpenStreetMap © OpenStreetMap contributors).
To stay ahead of this development, more drastic measures in the coming years will be needed according to the Delta Commissioner, advising his institute in 2019 on how to address this impact of water-related climate change. In 2017 a ‘Policy Hackathon’ was organized (Haasnoot et al., 2019) to explore robust scenarios and solutions for the long run, resulting in the three main scenarios for handling extreme sea level rise in the Netherlands: 1. defending the delta by fortification using a high dike around the country; 2. defending the delta by creating a new barrier off the coast with the advantage of new land for housing and tourism; 3. defending the most important economic areas including the cities using dikes with the sea coming into the land, see Figure 6.

These extreme scenarios come from the conclusion that in the case of sea level rises of more than 10 meters, the existing system of polders with primary and secondary dikes will collapse because the liveability due to salination, lack of fresh drinking water and impaired mobility at the end cannot be sustained. An old, far more drastic proposition was brought into this discussion recently; to close the North Sea from the ocean with dikes. The proposal has many disadvantages, especially for biodiversity as the area transitions from salt to freshwater at the end, but it would also lower many costs. It shows how the Dutch society is looking forward, no option being excluded. It also confirms the need for choices to be made this century.

Cross-over analysis and conclusions

When comparing the climate-change adaptive measures of the cities Gdansk in Poland and Rotterdam in the Netherlands, both are situated in the heart of the country’s most important delta and both located are similarly in relation to the sea and to the hinterland. Both cities: 1) are located by an enclosed sea in the northern hemisphere, in a delta with surrounding ‘polder’ areas; 2) are located in an area in which the land to the north is rising and the land is subsiding in the south; 3) face sea level rise; 4) experience backwater during storms; and 5) are located on a river in the delta where the river level fluctuates strongly, caused by meltwater upstream, heavy rainfall alternated with dry periods, with peaks occurring when these influences coincide. The situations are so similar that it becomes interesting to learn from each other’s experiences in the field of climate change interventions.

Therefore, the ‘Astra’ model (based on IPCC models) that categorizes adaptive measures is used for comparison as a base for analyses (Hilpert et al., 2007). This model divides actions into ‘Autonomous’ and ‘Planned’ adaptation activities and divides these into ‘Reactive and ‘Anticipatory’ measures, see Figure 7.

The different choices made for Gdansk and Rotterdam are interesting, and these can be of interest to the other city. The cross-over analysis with a focus on ‘Planned Adaptation’ can be seen in Table 1.
The situations of Gdansk and Rotterdam are quite similar; these cities can take steps forward by learning from each other’s actions. Both cities and their countries are aware of their vulnerability to climate-change impacts because of their delta situated locations. Secondly, the situation in their deltas are quite similar, and they both have actual action plans to deal with climate change impacts. The difference for Gdansk is that the hinterland behind the city rises so that rainwater flows into the city faster. That is why Gdansk provides storage reservoirs in the city and an extensive sewerage system, more than Rotterdam. Due to the vulnerability of the coastal situation, Gdansk is looking towards a solution involving a warning system and movable barriers that has been built in the Netherlands. The differences may in approach be due to the different financial situations of both countries. The approaches of these cities to highwater levels in the rivers passing by appear to be the same, although the technical interpretations are different because of the landscape differences.

With regard to long-term climate change, the Netherlands is exploring the future in a planned manner with the development of new scenarios for the protection of cities, where Poland is entering a phase where more urban development and architectural solutions are sought for their coastal cities. The enclosure of the Baltic Sea, on the other hand, probably offers more options for exchanging knowledge with neighbor states. In that respect, the Netherlands is more isolated in their situation with the North Sea and their Delta Project.

### Data availability

All data underlying the results are available as part of the article and no additional source data are required.

### Table 1. Inventory of the Gdansk and Rotterdam ‘Adaptive measures’ related to climate change.

| Adaptive Activities | Gdansk Planned Adaptation | Rotterdam Planned Adaptation |
|---------------------|---------------------------|-----------------------------|
| Reactive Adaptation | • Plan coastal protection strategy | • New ‘1985 Deltaplan’ with update 2015 |
|                     | • Flood warning system residents. | • The ‘Maesland’ barrier |
|                     | • The ‘Vistula’ canals to ‘Gdansk Gulf’ | • Plan ‘Space adaptation’ |
|                     | • Reservoirs for flood in rivers | • Widening upstream river beds. |
|                     | • City drainage system for heavy rainfall | • City reservoirs for heavy rainfall. |
| Anticipatory Adaptation | • New riverfront architecture | • New ‘Deltaplan’ scenario development |

### References

- BACC Author Team: *Assessment of Climate Change for the Baltic Sea Basin.* Springer book. 2008.
- Cyberski J., Grzes M, Guty-Korycka M: *History of floods on the river Vistula.* Hydrolog Sci J, 2006; 51(5): 799–817.
- Deltawet, 1958.
- Deltawet, 2011.
- Dyrcc C: *Analysis of ice conditions in the Baltic Sea and in the Puck Bay.* Sci journal of Polish Naval Ac. 2017; 210(3): 13–31.
- EEA: *Policy research on the changing faces of Europe's coastal areas due to sea level rise.* 2006.
- Ekman M: *The Changing Level of the Baltic Sea During 300 Years: A Clue to Understanding the Earth.* PQR. 2009.
- Haasnoot M, Kwadijk J, Van Alphen J, et al.: *Adaptation to uncertain sea level rise: how uncertainty in Antarctic mass-loss impacts the coastal adaptation strategy of the Netherlands.* Environmental research, 2020; 15(3).
- Haasnoot, et al.: *Strategieën voor adaptatie aan hoge en versnelde zeespiegelstijging. Een verkenning.* Deltares Hackathon rapport 11203724-004. 2019.
- Hilpert K, Wolf F, Schmidt-Thomé P, et al.: *Towards climate change adaptation in the Baltic Sea region.* Astra EU project report. 2007.
- Haerff, et al.: *The Baltic Sea Basin, Book ‘Submerged Landscapes of the European Continental Shelf.* 2017.
- Haerff, et al.: *The Baltic Sea Basin, Book ‘Submerged Landscapes of the European Continental Shelf.* 2017.
- Labuz: *Environmental Impacts, costal erosion and coastline changes.* in Springer book ‘Second assessment of climate change for the Baltic Sea basin. 2015.
- ModE (Ministry of the Environment): *Report from the UBC Commission on Energy, Environment and Transportation.* 2010.
- ModE (Ministry of the Environment): *Report on ‘Climate change adaptation plans in 44 Polish cities’ 2019.
- Zeidler RB: *Sea Level Rise and Coast Evolution in Poland.* book of the 24th International Conference on Coastal Engineering. 2015; 3462–3475.

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Thank you for the opportunity to review this work. The option the portal gives me for recommendation is titled 'Not Approved', which sounds a lot more harsh than I intend my recommendation to be! If this was a more traditional academic journal, I would probably select 'Major Revisions'. I believe that this can become a scientifically sound piece of research with a bit of expansion and re-writing as follows. So please do not be put off by the 'Not Approved' recommendation.

This is an interesting and valuable paper which compares approaches to flooding in two delta areas in the northern part of Europe – Gdansk and Rotterdam. Approaches to dealing with flooding under conditions of rising sea levels and increasingly frequent extreme events are fast becoming an area of scholarly concern, so this is a timely contribution from a part of the world that has not received as much scholarly attention as other low-lying areas to date.

However, whilst the premise of the paper is valuable and I strongly believe there is important data in here, I believe the paper needs some reworking and development to really bring out the scientific insights. As it stands this is fine as a case report, however if it is to be developed into a scholarly contribution (either here or for publication in another venue) then more engagement with the existing research literature is needed. My suggestions for how to do this are as follows.

1. You should make much more of the comparison between the two cases. At present, there is a useful table on the adaptive activities of each city, and a few paragraphs on some of the similarities and differences between the cases. For an international readership, the comparison between the cases, and especially what we can learn from where there are differences and why, is going to be equally as valuable as the descriptive information on what is happening in each of the cities. I would therefore suggest you to significantly expand the comparison section and to consider how your findings build on what is already discussed in the literature. Looking at how the cities might learn from each other could be an especially valuable line of enquiry, given the growing scholarly interest in how cities can learn from each other (both formally and informally) to develop resilience. See e.g.
Acuto, M., & Leffel, B. (2020). Understanding the global ecosystem of city networks. Urban Studies, 004209802092926. https://doi.org/10.1177/0042098020929261

Bai, X., Nagendra, H., Shi, P., & Liu, H. (2020). Cities: build networks and share plans to emerge stronger from COVID-19. Nature, 584(7822), 517–520. https://doi.org/10.1038/d41586-020-02459-2

2. I was especially interested to read about the Policy Hackathon approaches to developing flood scenarios and solutions in Rotterdam. I wonder if this is something you could look into more in the discussion, perhaps as a response to my point above? For instance, what new and different ways are cities using to engage a range of knowledges and expertises in the governance of challenging and uncertain issues such as flooding, and how can these Hackathon-type approaches produce more robust outcomes compared to more traditional approaches to science-policy-practice interaction? (see for example the Presidential Hackathon organised in Taiwan in 2020, which used open data to encourage teams to develop solutions for each of the Sustainable Development Goals).

3. If the text here is going to stand as a scientific contribution, it would be helpful to add an introductory section which sets out the context of the work and the key scholarly (or even policy) issues that the work speaks to. For example, a lot of work has been done on adaptation in deltas in lower-latitude country contexts, however there is perhaps not much on adaptation in deltas at higher-latitudes. Nonetheless, the last year or so has seen a huge upswing in research into adaptation for coastal areas in higher-latitude countries (see e.g. this recent special issue https://link.springer.com/article/10.1007/s13412-021-00700-6) so there is an emerging science-policy requirement that your work comes at just the right time to engage with.

4. Methodology. Again reflecting the above, if the work is going to be developed it would be worthwhile having a more explicit Method/Methodology section, as readers will want to see this. So for example, you mention you did a cross-over analysis. What is meant by a cross-over analysis, and how did you do this in practice? Take, for example, the very helpful Table 1 you have – where does this information come from (e.g. policy analysis, interviews?) and how was it sourced/analysed? How can you be sure you got all the relevant information for each city, and how can you demonstrate to the readers that you did the analysis in a rigorous way? Reference to some standard methods textbooks and/or other papers which use a similar methodological approach will help to show the rigour of the work.

References
1. Acuto M, Leffel B: Understanding the global ecosystem of city networks. Urban Studies. 2021; 58 (9): 1758-1774 Publisher Full Text
2. Bai X, Nagendra H, Shi P, Liu H: Cities: build networks and share plans to emerge stronger from COVID-19. Nature. 584 (7822): 517-520 PubMed Abstract | Publisher Full Text
3. Siders A, Ajibade I: Introduction: Managed retreat and environmental justice in a changing climate. Journal of Environmental Studies and Sciences. 2021. Publisher Full Text

Is the work clearly and accurately presented and does it cite the current literature?
Partly

Is the study design appropriate and does the work have academic merit?
Partly

Are sufficient details of methods and analysis provided to allow replication by others?
Partly

If applicable, is the statistical analysis and its interpretation appropriate?
Not applicable

Are all the source data underlying the results available to ensure full reproducibility?
Partly

Are the conclusions drawn adequately supported by the results?
Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: climate change adaptation; environmental governance; environmental policy

I confirm that I have read this submission and believe that I have an appropriate level of expertise to state that I do not consider it to be of an acceptable scientific standard, for reasons outlined above.

Reviewer Report 01 June 2021

https://doi.org/10.21956/openreseurope.14195.r27000

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Michael Nones
Institute of Geophysics, Polish Academy of Sciences, Warsaw, Poland

General comment: even if the study goals can be derived from the last section, I suggest adding a few more details at the very beginning of the article, to better pinpoint what is the scope of the research, and how your work combines with the existing literature.

Abstract: please add the country of Gdansk (as done for Haarlem).

Figure 1: please add a graphical scale and the coordinates, to better place the study area. (same for Fig. 5)

Figure 2: what is the scope of presenting these photos? What is the added value of this figure?
(same comments for Figs. 3 and 4)

**Language**: even if I am not a native English speaker, I would like to advise you that a double-checking of the language is needed

**Is the work clearly and accurately presented and does it cite the current literature?**
Partly

**Is the study design appropriate and does the work have academic merit?**
Yes

**Are sufficient details of methods and analysis provided to allow replication by others?**
No

**If applicable, is the statistical analysis and its interpretation appropriate?**
Not applicable

**Are all the source data underlying the results available to ensure full reproducibility?**
Yes

**Are the conclusions drawn adequately supported by the results?**
Yes

**Competing Interests**: No competing interests were disclosed.

**Reviewer Expertise**: River morphodynamics.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Review Report 28 April 2021

https://doi.org/10.21956/openreseurope.14195.r26652

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Tineke van de Schoor
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This article compares the approaches of the cities Gdansk and Rotterdam to the protection for future consequences of climate change. The authors argue that there are many similarities between the situation of these two cities, and that they could profit from exchanging knowledge
and experiences. The article starts out with a description of the local and regional situation of the two cities in their surrounding environment, the current water management measures as well as the planned climate change measures for long term protection. For the situation in Poland, much can be learned from comparisons with other Baltic sea cities and regions. On the other hand, the situation in the Netherlands is seen as more isolated. A few remarks on this article are the following. Firstly, the method and research design should be included in the article. What research methods are used, what is cross-over analysis and how is it performed. Secondly, the section on analysis and conclusions is rather short. It could be useful to divide this in two sections and take more room to compare the different approaches. For example, the monetary and ecological costs of approaches are only briefly mentioned, these could be further discussed. Third, the situation in the Netherlands is not as isolated as argued, for example the new ‘Deltaplan’ would entail cooperation with all countries bordering the North Sea. Furthermore, there are comparable situations in other North Sea countries, for example in Germany (Hamburg) and Denmark. Such examples from farther afield could be added to or referred to in the article.

Is the work clearly and accurately presented and does it cite the current literature?
Yes

Is the study design appropriate and does the work have academic merit?
Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Partly

If applicable, is the statistical analysis and its interpretation appropriate?
Not applicable

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Yes

Competing Interests: No competing interests were disclosed.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.