

We would like to thank the second reviewer for their considered comments even if their overall evaluation of our manuscript was negative. To respond, we would like to firstly highlight what seem to be the main areas of the reviewer's concern, and then respond to these points one by one.

The main concerns of the reviewer seem to be focused around the following points:

1. The lack of clear reason why the UK MDA community should write their own review and vision paper, rather than just contributing to the standard international community papers (i.e. driven by OceanPredict).

We did not expect the paper's topic to be challenged at the review stage, as the submissions (with their exact topic) to Ocean Science's (OS) special issue "OS Jubilee: reviews and perspective" have to be first consulted with the OS editors, approved and subsequently invited by the editorial board, which was also our case. Nevertheless; not just national, but even Institution-specific papers, describing research plans and vision, are commonly published in OS, e.g. see a Met Office focused paper as an example (Siddorn et al, 2016, <https://os.copernicus.org/articles/12/217/2016/>). This suggests that OS finds such type of papers to be of interest and we expected this to be automatically considered by the reviewer.

However, let us emphasize the reasons why we decided to write this paper:

- a) The UK Marine Data Assimilation (MDA) community is not just a collection of different institutes, but a very close collaborating entity. Indeed, the paper is full of examples when at least two of the UK partners contributed jointly to a certain development, and often the development was by even more partners than two. We are sorry if this aspect has not come across clearly enough, and we are very happy to emphasize it better in the revised version of the manuscript. It is worth mentioning that the paper was written by an entity facilitating this close collaboration, by the UK National Partnership for Ocean Prediction (NPOP) MDA group.
- b) A vision for MDA needs to be shared by a team with the resources to implement it. We have tried and failed to agree a vision at a European level within Mercator-Ocean International (MOi). NPOP was set up to develop shared ocean prediction capabilities for the UK so it is entirely appropriate for NPOP to have its own vision for shared MDA systems. It is highly desirable for such a vision to be peer reviewed and published. It takes a substantial effort to develop such a vision and an articulation of the arguments supporting the vision that has been developed is likely to be of interest and value to groups in several countries.
- c) We also believe that focus on a closely collaborating community representing a country that contributes importantly to international MDA developments is of wide interest, as it enables one to go into far greater detail than would be ever possible in an international review covering the global community. Even though such detail reflects a specific country, we believe it is interesting from the international point of view as well, as many aspects of it might have analogues in other countries. Furthermore, the paper also demonstrates the substantial level to which the UK work feeds into international developments (e.g. on NEMOVAR, or within the many international collaborations with partners such as CERFACS, AWI, MOi, NERSC and many others).

- d) The ability to focus on far greater details is one of the reasons why we have gone in this paper much further than what has been summarized in the existing international community review papers mentioned by the reviewer (e.g. the ones from 2019 issue of Ocean Predict, such as Moore et al, 2019, <https://doi.org/10.3389/fmars.2019.00090>, Fennel et al, 2019, <https://doi.org/10.3389/fmars.2019.00089>). Examples include the detailed mapping of stakeholder use of UK MDA products, a detailed section on the observational requirements of the UK MDA community and detailed discussion of our hardware and software needs. Many of these sections are also meant to facilitate discussion across different scientific communities, from modelling to ocean observation scientists, with the expectation that they will hopefully be read by many scientists outside of MDA. Furthermore, unlike the OceanPredict reviews, our approach enables us to discuss the different MDA areas alongside each other, which provides an interesting opportunity to compare and contrast the differing needs and requirements across the different MDA topics, as well as find similarities. Such comparison is inherently contained within the bullet points presented in the Summary section, but we are happy to make it more explicit during the paper revision.
- e) Finally, the paper opens multiple new and timely topics not discussed in the previous MDA review papers, such as machine learning applications in MDA and the digital twin systems. This extra focus was possible thanks to the UK community being the source of many pioneering developments in those fields.
- f) Overall, we believe this paper to be complementary to the international reviews the reviewer mentions, with both types of reviews worthy being published.

2. That there is not enough close collaboration between the UK Institutes to justify this paper.

There are many examples of our close collaboration across the manuscript, e.g. large number of developments in both physics and air-sea coupled DA have been made jointly between the Met Office and the University of Reading, most of the developments in marine biogeochemistry DA have been done jointly by PML and the Met Office, with additional important contributions from the University of Exeter and University of Reading (with University of Reading providing the theoretical underpinning for wide range of applications developed at the other partners). This is documented by the papers: e.g. the manuscript references provide for the period of the last 5 years around 20 joint publications including multiple UK MDA partners. We would like to emphasize that the vision in the paper was written jointly by the UK community as part of the UK NPOP MDA and is not just a collection of strategies of different Institutes. NPOP MDA will also coordinate the implementation of this joint vision. Moreover, at the few instances where the collaboration between UK MDA could be closer, this paper has provided the opportunity to formulate this as part of the community vision. We propose to highlight a lot of this more clearly in the revised version of the paper, e.g. the connection between the theory provided by the University of Reading and its applications by the other partners (including financial mechanisms enabling this), as well as the role of NPOP in jointly implementing the UK MDA community vision.

3. Lack of novel material compared to existing reviews.

As already mentioned, we are discussing multiple new and timely topics compared to the existing reviews, such as machine learning and digital twins. We are also offering an untypically

broad overview of stakeholder applications in MDA and MDA community requirements. This review contains useful detail far beyond the OceanPredict review papers (e.g. on OSSEs and observing missions), which are usually very short. We are happy to better emphasize these novel points in our revised paper and refer to the existing OceanPredict papers to highlight the differences.

4. The lack of synthesis in the paper.

Due to the diversity of MDA areas discussed in this review, it is objectively hard to give a full synthesis across the different areas. This is not necessarily a disadvantage, as addressing the different areas of MDA in the same paper gives the reader an interesting perspective on both commonalities and differences among those areas. The logical synthesis of the vision for each area is presented in the summary section and some synthesis across the different areas in the abstract. We, however, completely agree that more could be done, and we are very happy to revise the summary section to present a deeper and more thorough synthesis, as well as better discussion of the differences in the vision of the different MDA areas.

On top of these main points the reviewer has raised several specific concerns about Figures and some parts of the text, including an interesting point about better linking our proposed developments with the discussed software. We believe these points can be easily addressed in the paper revision and are very happy to do so.

Best wishes,

Jozef Skakala and co-authors