

## ***Interactive comment on “An integrated open-coastal biogeochemistry, ecosystem and biodiversity observatory of the Eastern Mediterranean. The Cretan Sea component of POSEIDON system” by George Petihakis et al.***

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### Replies to Reviewers

We would like to thank all three reviewers for their constructive comments that helped improve our manuscript. Further we give our response to the comments:

#### Replies to Reviewer 1

General comments The present manuscript aims to describe the current POSEI-

C1

DON observing system (OS) in the East Mediterranean Sea which is based on multi-platforms and multi-parameters approach. The actual status of this OS is composed by coastal and open sea eulerian and lagrangian platforms (gliders, Argo floats, Ferrybox, moorings and buoys). This OS delivers variables which are essential to understand and predict the impacts of climate change and anthropogenic pressure on marine ecosystems in the Eastern Mediterranean Sea. The manuscript is well written but some parts are missing and some parts should be re-organized.

The section 2 is too long and it should be reduced. The authors should do a rapid state of arts of the situation in the eastern basin and describe the main characteristics of the basin (why is it important to implement and sustain an integrated OS in this region).

Reply 1: Section 2 was reduced by approximately 40%, with emphasis on the Eastern Mediterranean in relation to the importance of implementing and sustaining an integrated OS in this area.

In the section 3, the scientific questions, which are the backbone of each OS, should be detailed in the first part followed by the management aims and services.

Reply 2: The requested change was made.

In the section 4, the personnel section should be moved after the section 4.9 otherwise this is confusing to see the personnel skills between the description of Ferrybox and Argo floats.

Reply 3: The requested change was made.

In this section, there is no description of the POSEIDON buoys used for forecasting products. Why ?

Reply 4: As a reply to this question in section 4.7 the following text was added (p.10 lines 32-37). "Data from POSEIDON buoys such as E1-M3A have been extensively used for model validation/calibration and testing of model parameterization techniques adopted in the operational POSEIDON models. Although the assimilation of these data

C2

directly in the model forecasts would have a relatively limited effect, given their small spatial coverage, they are of paramount importance for the development and testing of data assimilation schemes, as well as in the analysis of specific processes and the underlying dynamics of the system."

After the data description in the section 5, a section on data analysis and data quality control is largely missing: How real-time data are managed ? Which protocols are used ? How the delayed mode data are adjusted ? Is there different correction levels (as for the remote sensing data) ? For example in Tables 1, 2 & 3, the authors should add some information on correction methods applied for each variables. In the same way, accuracy and measurements frequency should be added in these tables.

Reply 5: The section 6 "Metadata and data handling" was rewritten to include the information requested. Accuracy was added in all tables. Frequency of measurements was added as a separate column in Table 1. In tables 2 and 3 frequency was described in the table title.

An additional section on the POSEIDON management and governance is missing too: who decide the choice of variables ? sensors ? how the new scientific needs are taken into account ? for example nowadays, global OS are focusing more and more on biological variables for marine ecosystems change (e.g. genomics). What is the vision of the POSEIDON group on this question ?

Reply 6: The section 7, now entitled "Management, governance and sustainable development" was rewritten to include the information requested.

Regarding the scientific production, which is depending on the POSEIDON OS sustainability, how many publications, thesis, reports have been produced ? Any information regarding the DOI dataset statistics should be also included (at least on annex) to demonstrate the importance to maintain such OS.

Reply 7: At the last paragraph of section 7 in p.16 line 4, the number of peer review

C3

publications, conference presentations and PhD thesis was added.

Finally, a description and figure on integrated results from the different POSEIDON components are missing. This should prove the necessity to implement an integrated and multi-variables OS but also it will stress what are the actual gaps and needs.

Reply 8: Integrated results are now presented in the new figures 8 and 9, which are discussed in sections 4.4 and 4.6 respectively.

Ancillary comments The word "parameter" is often over-interpreted. A distinction with variable should be addressed here. Parameters are not natural quantities, variables are. A variable is an entity that changes over time or depth: this what we are measuring. In general, parameters are "constants" that define a specific instance of a general equation that is based on variables. That's why we used the term EOVS for Essential Oceanic Variables.

Reply 9: We agree with the reviewer on the use of those two words. The term "parameter" was changed to "variable" when appropriate.

"Biochemical" should be changed to "biogeochemical"

Reply 10: The change was made in the entire manuscript

Figure 1 Information is missing regarding the glider endurance lines, the Argo floats observation area, the sediment traps deployment, etc... A new figure should be proposed with the names of seas, straits, main countries, ...

Reply 11: The glider endurance line was added in addition to the geographical location of other observatories requested by reviewer 2 (see reply 24). The sediment traps location is the same as the E1-M3A buoy (as described in section 4.2 and in the new modified legend of Figure 1). The Argo floats observation area was not added as it is highly variable. Names of seas cited in the manuscript were added in the figure. We believe adding names of countries too will complicate the figure and remove the focus from the observing systems.

C4

Figure 3â€”This is not very clear and too small. It should be modified or removed

Reply 12: The figure was modified by being split in subplots as suggested by reviewer 3 (see reply 51)

Figure 4â€”To better illustrate the physical and biogeochemical variabilities in this region, different time series should be shown here (not only TChla). For example, T, S, O2, ...

Reply 13: Temperature and salinity were also added to in the Figure (see new figure 6).

Figure 6â€”This figure does not bring anything. It should be at least merged with an ocean color remote sensing map or something else.

Reply 14: Ocean color data were added as well as more and recent FB tracks (see new figure 8) as requested by reviewer 3. A description of the new figure was added in section 4.4

A figure on mooring dataset variability should be included too

Reply 15: Mooring dataset variability is shown in the new figure 4

Replies to Reviewer 2 General aspects: The manuscript written by Petihakis et al. describes the components part of the Cretan ecosystem observatory as the coastal and open sea buoys, ferry box, floats, gliders so as the land-based facilities and personnel capabilities. Special interest is given to biochemical measurements and ecosystem modelling. Finally, it gives an overview of future developments in the short term so as in the long one. The manuscript (hereafter ms) is well written and easy to read. The part concerning the sustainability development is very well addressed, touching important aspects mandatory to maintain the system in the long run, key point of the Observing Systems. MS deserves to be publishing; however some points I recommend to be reviewed and modified to improve it. Main parts: 1. Part 2 (A strategic location to study the unknown of the Eastern Mediterranean) should be reduced because it is

C5

true that it gives a global idea of the area by touching different aspects but also that it is too discursive and dispersive as regards the real purpose of the ms. I should be synthesized the importance of the Observatory, the role in the East Med, and the benefits the community gains from it measurements. Please reduce the references, it is not a review paper and makes very difficult the read;

Reply 16: This part was reduced. See Reply 1. Approximately 25 references were also removed.

2. The Cretan Sea Observatory describes itself as a complex and articulated system. In this context and in MS it is difficult to place it in the Poseidon network. If this is the goal I suggest that the approach used be revised giving a meaning to part 3. The naming of the other two buoys (Pylos and the one in the Athos peninsula) without making any connection between them (Page 9, line 20-25) does not make much sense. Again in this framework, the future vision of the Cretan Sea system would be applied also to the other two buoys?

Reply 17: In the first paragraph section 3 the Cretan Sea Observatory was better defined, as a subsystem of the Poseidon network. The last paragraph of section 4.1 p. 8 lines 13-24 was rewritten to show the connection between buoys. A sentence was added in section 8 p. 16 lines 21-22 to show the vision concerning the Pylos and Athos Buoys.

3. I suggest moving 4.5 after Biochemical Modelling to keep a logical thread in the description of the system components (types of instruments and then personal and support facilities).

Reply 18: The requested change was made.

Please provide the scheme of the payload of both coastal and open sea buoy.

Reply 19: A new figure (Figure 3) was added showing the scheme of the payload of both coastal and open sea buoy.

C6

Specific aspects: 1. Page 8 line 10: please provides some MSFD descriptors as example (useful for those not familiar with the argument)

Reply 20: Some MSFD descriptors were added as an example (p.7 lines 2-3).

2. Page 9 line 3: change in ... followed by two other M3A stations in the southern Adriatic (E2) and Ligurian Sea (W1).... This will help to connect this two other sites with what is said in 4.10

Reply 21: The requested change was made (p.7 lines 33-34).

3. Page 10 line 18-20: Please rephrase the sentence for better understanding

Reply 22: The sentence was rephrased (p.9 lines 15-17).

4. Page 11 (Section 4.7): are any measurements done yet? please indicate an estimate time for the start of the monitoring program

Reply 23: Time of the start of the Glider program was added in the text (p.10 line 5), and a new related figure (Fig. 9) was added. The Glider endurance line was added in Figure 1.

5. Page 13 line 4: the geographical location of the three observatories should be indicated to give more information to the reader.

Reply 24: The geographical location of the three observatories was added in Figure 1

6. Title 5.2 is not really representative of the section

Reply 25: The title was modified to be more representative of the section

References: Please review the reference part since many of them are missing in the text or are in the text and not cited. Page 3 line 20/28/30 misspelling Theocharis et.al Correct Cardin et al. 2014 to 2015 in the reference section Page 4 line 23: Correct Kress et al.2003 to Kress (2003) Page 5 line 16/line 18: Siokou et al. 2010 ? or Siokou-Frangou et al.2010 or reference is missing? Page 5 line 39: Turner, 2015? Year does

C7

not agree with the reference which state 2002? Misspelling or different paper? Page 6 line 10: Frangoulis et al. 2005 or 2004? not agree text and reference part Page 6 line 25: EEA 2015? —2006??? Page 7 line 26: Ruhl 2001? Page 9 line 8: Petihakis et al. 2006 — I'm not sure if Ocean Science Discussion paper can be cited Page 11 line 26: Baretta et al or Baretta-Bekker?

Missing: Mentioned in the text and not in the references: Lascaratos et al. 1999 Theocharis et al. 2009 Pitta and Giannakourou, 2000 Ruhl 2001 Hoteit et al. 2004 In the references but not in the text: Balopoulos and Collins, 1999 Danovaro et al. 2004 Krom et al. 2004 Mihalopoulos et al. 1997

Reply 26: References were checked and corrected

Replies to Reviewer 3 The manuscript proposed by G. Petihakis et al. aims giving a detailed overview of the POSEIDON observing system. The article introduces this observing system for the Eastern Mediterranean sea. Following this aim, no specific scientific question is addressed in the manuscript but it is more dedicated to the description of the POSEIDON objectives and components. The manuscript is well written and describes briefly each components of the network, including links with ongoing European and international initiatives on Ocean Observing Systems. A specific focus also appears on the representativeness of the Cretan Sea to monitor Eastern Mediterranean Sea.

As general comments, I suggest that the manuscript would benefit from some illustrations/examples of POSEIDON recent measurements. There are very few examples in the manuscript and it doesn't highlight the potential of such observing system.

Reply 27: New figures were added including recent measurements: Figure 4, Figure 6, Figure 8, Figure 9

Furthermore, authors take care of showing the interest of this observatory in this region. It would be interesting to mention how past measurements have contributed to

C8

the scientific knowledge of processes in the region.

Reply 28: An example of contribution of past measurements is shown in the new Figure 4

As the paper aimed to be published in Ocean Science with a wide reading audience, it would be important to be more explicit in acronyms as a lot of projects, initiatives, programs are mentioned in the manuscript. As I'm familiar with this community, I can follow the ideas but for a reader less familiar with those initiatives, it can be difficult to follow in some parts.

Reply 29: All acronyms were checked as to be cited full the first time

Considering the limited needed improvements included in general and specific comments, I recommend this paper for potential publication after minor revisions more related to illustrating more the paper contents.

Specific comments Abstract p. 1 / first sentence - The first sentence is mixing as the same kind of "object" processes (air-sea interactions and coastal-open ocean) and parameters. It would be more accurate if authors mentions either processes (physical and biogeochemical) or parameters.

Reply 30: The sentence was rephrased (p.1 lines 12-14)

p. 1 / l. 22 - Bio-Argo systems are not measuring Chlorophyll concentrations but fluorescence. I recommend using the latest parameter in the text.

Reply 31: The sentence was adapted to specify that, for Bio-Argo and other sensors, fluorescence is measured as a proxy of Chlorophyll-a (p.1 lines 23-24).

1. International need for observations p. 2 / l. 11 - EuroGOOS is the first example of the acronyms or notations not defined in the manuscript (as for example and without classification: CT, AT, GCOS, HCMR, NRT, POEM, PELAGOS, ...).

Reply 32: See Reply 29

C9

2. A strategic location to study the unknowns of the eastern Mediterranean p. 3 / l. 9 - "... depending on the parameter". I did not understand to which parameter the author is referring to.

Reply 33: The sentence was rephrased (p.3 lines 8-9).

3. Aims and mission p. 7 / l. 4 - The reference to Perivoliotis EuroGOOS extended abstract is misleading as it sounds as it is describing the same content as the present paper. Please consider referring to this abstract for more specific points.

Reply 34: A sentence was added at the beginning of section 3 (p. 5 lines 26-27) to distinguish the CS observatory as a subsystem of POSEIDON system thus specifying that the reference Perivoliotis et al. includes the CSO subsystem.

p. 7 / l. 6 - 9 - Reading this part, we wonder about the POSEIDON activity between 2011 and 2017. We understand a bit more in the following sections but it is possible to be more explicit at this stage on this temporal gap ?

Reply 35: A sentence was added (p. 5 lines 33-35) to specify activities between 2011 and 2017.

p. 7 / l. 29-35 - This "b" topic sounds to me included in "a" topic. Please consider rephrasing those scientific objectives to be more explicit.

Reply 36: The topics "a" and "b" were rephrased.

4.4 Ferrybox p. 10 / l. 14-24 - The figure given for FerryBox does not highlight the long term FB activity. Please consider a figure including more track (and recent) for example to illustrate those platforms.

Reply 37: See Reply 14

4.7 Gliders p. 11 / l. 10-15 - A figure showing glider tracks and data would support this subsection in the manuscript.

C10

Reply 38: See Reply 23

5.3 Derived biochemical-ecosystem parameters and model state variables p. 14 / l. 24 - The figure 9 seems very interesting but there is a lack of explanation in the manuscript. Please consider adding more information on this figure or if you consider that it would need too much details, you can consider removing this figure and replacing by model results examples.

Reply 39: More information concerning the figure 12 (ex figure 9) was added in section 5.3 p.14 lines 8-14

6. Metadata and data handling p. 15 / l. 1 - Are ADCP and sediment traps available on a different portal ?

Reply 40: Unfortunately, ADCP and sediment trap data are not available yet, something that we are working and hope it will be solved in the near future.

Minor and technical corrections 1. International need for observations p. 2 / l.5 - "ocean bottom" could be replace by "bottom ocean"

Reply 41: The replacement was made.

p. 2 / l.15 and l.22 - In the manuscript, both terms are used: "biochemical" and "biogeochemical". Even if those terms are used often without distinction, this is not the same definition. Please, consider to be more homogeneous in the whole manuscript.

Reply 42: See Reply 10

p. 2 / l. 24 - Authors cite "recently" for a study from 2015. Please consider rephrasing the introduction of the sentence.

Reply 43: The sentence was rephrased. In addition, the term "recently" was removed in most locations in the text are the year was kept only.

2.1 Coupling of biochemistry with circulation patterns p. 3 / l. 34 - To keep the paper

C11

understood for the next century, I would suggest to use "1970s" instead of "70s".

Reply 44: The term "70s" no longer exists as the corresponding phrase was removed due to the requested reduction of section 2.

2.4 Basin to global anthropogenic impact p. 6 / l. 25 - The reference to EEA is 2006 and not 2015 in the reference list. Please double check the reference.

Reply 45: The reference was checked and corrected

4. Components-Platforms p. 8 / l. 20-31 - A reference to the map in Figure 1 is missing in this section introduction.

Reply 46: A reference to Figure 1 was made in this section

Tables Table 1 + pCO<sub>2</sub> and ADCP are missing in the list.

Reply 47: pCO<sub>2</sub> and ADCP were added in the Table 1

+ Please consider adding the sampling frequency range for each parameter.

Reply 48: The sampling frequency of each parameter was added in Table 1

+ The sensor replacement frequency would also benefit readers interested in managing an observing system.

Reply 49: The sensor replacement frequency was added in section 5.1

Figures Figure 1 + The figure 1 is a key figure for the paper. I think that a green less dark to highlight the are would help to see other system locations. + Please add a depth scale/colorbar

Reply 50: The requested changes were made

Figure 3 + this figure is tricky to read. Please consider splitting in 4 subplots (cruises, FB, buoy, sed trap + ADCP) for clarity.

Reply 51: The figure was split in 3 subplots (cruises, buoy+FB, sed trap+ADCP)

C12

