

## ***Interactive comment on “The Coastal Observing System for Northern and Arctic Seas (COSYNA)” by B. Baschek et al.***

**B. Baschek et al.**

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Interactive comment on “The Coastal Observing System for Northern and Arctic Seas (COSYNA)” by B. Baschek et al.

Anonymous Referee #1 Received and published: 27 September 2016

**AUTHORS:** Many thanks for your time and very valuable comments. We have addressed them all in the revised version as explained in detail below.

**REVIEWER:** \*\*\* General comments The manuscript proposed by B. Baschek et al. aims giving a detailed overview of the COSYNA, an integrated pre-operational observing system in Northern and Arctic Seas. As we understand, the article introduces the Special Issue dedicated to COSYNA in Ocean Science. Following this aim, no specific

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scientific question is addressed in the manuscript but it is more dedicated to the description of the COSYNA components. As a main general comment, the description is too long and confusing to highlight and to describe the successful integration operated in COSYNA. The balance between the amount of details and sometimes missing information or imprecisions is harming the main idea. A suggestion could be to shorten the manuscript to emphasize more the strength and coherence of the integrated system.

**AUTHORS:** The document has been shortened, in particular in the introduction and description of the focus regions. Several figures have been removed.

**REVIEWER:** The description remains also difficult to follow for non-expert readers from the geographical region. A lot of places are mentioned without an illustration on a map. The manuscript will strongly benefit from a general map with zooms and mentioned names in the text (for example: Otzumer Balje, Jade Bay, island of Helgoland, North Frisian, Lena delta, Weser, Ems).

**AUTHORS:** Figure 1 has been completely redone.

**REVIEWER:** A final general remark is more on the "network" strategy behind COSYNA. The scientific aims and the justifications of geographical extent do not appear clearly from the manuscript.

**AUTHORS:** We have added text on page 3 of the manuscript to clarify the networking strategy behind COSYNA as well as to justify the choice of its geographical extent.

**REVIEWER:** \*\*\* Specific comments \* Abstract p. 2 / l. 2-3 - Authors mention that COSYNA is designed also to "assess the impact of anthropogenically induced change". This assessment is not directly provided by the network but after complex scientific analysis of the collected data. The sentence should be modified.

**AUTHORS:** Thank you. The sentence has been modified The automated observing and modelling system COSYNA is designed to monitor real time conditions, provide short-term forecasts, data and data products to help assess the impact of anthro-

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pogenically induced change.

REVIEWER: \* 1. Introduction p. 3 / l. 28-32 and p.4 / l. 1-7 - The list of contributors could be presented as a table to improve the sentence.

AUTHORS: Now moved to table 1.

REVIEWER: p. 4 / l. 9 - The paper does not introduce scientific studies but just illustrate the observation collected. AUTHORS: That is correct. It is an overview article introducing the entire Observing system. This has been clarified in the text.

REVIEWER: p. 4 / l. 10 - The "volume", I guess the Special Issue is just mentioned here. It should be mentioned before and more explicitly.

AUTHORS: A sentence has been added: The present Ocean Science and Biogeochemistry inter-journal special issue "COSYNA: integrating observations and modeling to understand coastal systems" collects contributions that highlight various aspects of the complex observing system.

REVIEWER: p. 4 / l. 11-15 - The structure of the paper needs to be given more explicitly. At least, different main parts must be linked to the section numbers.

AUTHORS: Section numbers are now explicitly given.

REVIEWER: \* 2. Coastal focus regions General comment: This section should be strongly reduced. A map could give an overview of the two regions. Some details in this context are not useful as, for example: - UNESCO reference - p. 5 / l.4-5 - p. 5 / l.21-26 - p. 6 / l.4-8 - p. 7 / l.4-8

AUTHORS: We have shortened the whole chapter. The residual coastal current paragraph is not included in the new version. The overview map has been completely redone. The UNESCO reference is now moved to the paragraph describing conflicting uses

REVIEWER: p. 5 / l. 6 - The North Sea should be describe before the German Bight.

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AUTHORS: The order has been changed.

REVIEWER: \* 3. Objectives and Benefits p. 8 / l. 14-15 - I don't see how numerical model can integrate observations from turbulence (and from minutes) as it is scales which are not taken into account in assimilation (observations are generally degraded to be assimilated). This sentence must be clarified.

AUTHORS: This has been clarified: Numerical models of various resolutions are used to provide context for observations ranging from the turbulent to basin wide spatial scales while bridging time periods from minutes to decades. Observations are integrated into models using data assimilation techniques for resolutions, time-scales and quantities where such integration is possible and useful.

REVIEWER: \* 4. International context p. 9 / l. 20-27 - These statements are not necessary for the manuscript.

AUTHORS: This paragraph has been removed.

REVIEWER: \* 5. Observations p. 10 / l. 23 - What is the meaning of "(3)" and "(1)" ? Same for "(1)" and "(2)" in p. 11 / l. 8

AUTHORS: This has been clarified in text.

REVIEWER: p. 11 / l. 10-11 - The mention to CDOM, yellow substances, "gelbstoff" should homogenize in the manuscript. I would suggest keeping Coloured Dissolved Organic Matter (CDOM) as it is a name more commonly used.

AUTHORS: Gelbstoff, or yellow substance, comprise the dissolved absorbers (CDOM) as main part and the particulate. From remote sensing perspective these components are hardly distinguishable, but we always use the appropriate or both terms. At the first occurrence of CDOM on page 24 this is mentioned now.

REVIEWER: p. 11 / l. 30 - For the quality control processes, do you have references or standards to refer ?

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AUTHORS: This information has been added: Quality control processes are applied and data are flagged accordingly following SeaDataNet definitions [http://seadatanet.maris2.nl/v\\_bodc\\_vocab/browse.asp?order=entrykey&l=L201](http://seadatanet.maris2.nl/v_bodc_vocab/browse.asp?order=entrykey&l=L201)

REVIEWER: p. 16 / l. 29-30 - Could the authors explain more clearly the "order of 10m" ?

AUTHORS: This has been changed to: The radar signal propagates along the ocean surface beyond the horizon and is backscattered by surface waves with wave lengths between 5 and 50 m (half the electromagnetic wave length of the radar).

REVIEWER: p. 17 / l. 8 - The notion of "fusion" is not straightforward or I do not understand what is meant here. Authors should detail a bit more here.

AUTHORS: This has been clarified: Since 2013, the HF radar network is also used for ship detection, tracking, and fusing information of the radars with other sources of ship information such as from the Automated Identification System.

REVIEWER: p. 18 / l. 2-3 - The statement is already said before in the manuscript.

AUTHORS: Thank you. Sentence has been removed.

REVIEWER: 5.5 Underwater-Node System - It is not clear to me. What is the depth of the system ?

AUTHORS: The depth is now stated.

REVIEWER: p. 21 / l. 13 - Typical deployments times exceed 25 h but until how much time, it can be extended ?

AUTHORS: The sentence has been extended with: "Typical deployment times exceed 25 h to account for the diurnal inequality in tidal variations. This can be extended to longer periods (weeks) depending on measuring frequency, battery and storage limitations, and the increasing risk of damage by trawlers."

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REVIEWER: \* 6. Sensor and Instrument Development p. 26 / I. 26 - pH is not only a proxy for phytoplankton and primary production as the water pH is not only driven (even if largely influenced) by biology.

AUTHORS: This statement has been changed to “pH can be used to estimate a system’s state in terms of phytoplankton and primary production in regions of high biological activity, one of four parameters characterizing the oceanic inorganic carbon system, and an indicator for the increasing acidification of sea water.”

REVIEWER: \* 7. Modelling and Data Assimilation Are FerryBox data assimilated in COSYNA modelling system ?

AUTHORS: The data are used for model validation (Petersen et al., 2011; Haller et al., 2015) and assimilation studies (Stanev et al., 2011; Grayek et al., 2011; Fig. 11). This short information about FerryBox data assimilation is provided in FerryBox part of the paper.

REVIEWER: What are the forecast periods for hydrodynamics ? It is detailed for waves but not for transport.

AUTHORS: The hydrodynamical forecast period is 12 h as now stated in the document. FerryBox data are not pre-operationally assimilated in COSYNA modelling system. This issue is described in 1. Stanev E. V., Schulz-Stellenfleth, J., Staneva, J., Grayek, S., Grashorn, S., Behrens, A., Koch, W., and Pein, J.: Ocean forecasting for the German Bight: from regional to coastal scales, *Ocean Sci.*, 12, 1105-1136, doi:10.5194/os-12-1105-2016, 2016. 2. Grayek, S., Staneva, J., Schulz-Stellenfleth, J., Petersen, W., and Stanev, E. V.: Use of FerryBox surface temperature and salinity Stanev measurements to improve model based state estimates for the German Bight, *J. Marine Syst.*, 88, 45–59, 2011.

REVIEWER: p. 35 / I. 4 - I do not agree that it is "reproduced to a remarkable degree". The model is able to reproduce a deep chlorophyll maximum but its intensity and extent

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is not similar with observations.

AUTHORS: This has been changed as follows: Using an ecosystem model that includes turbidity fields, estimated from Scanfish observations (Section 5.9), and accounts for the acclimation capacity of phytoplankton, spatial variability in chlorophyll-a can be reproduced to a high degree (Fig. 26; Wirtz and Kerimoglu, submitted). Previous modeling attempts such as of van Leeuwen et al (2013) or Schrum et al (2006) do not capture the extreme vertical squeezing of chlorophyll-a within thin layers. Our new model results also reveal how reconstructed pelagic patterns decouple from benthic respiration patterns. Vertical deposition of freshly produced material greatly varies within the coastal ocean. In a few, mostly deeper regions, deposition prevails over resuspension, leading to depositional hotspots (Wirtz et al, in prep).

REVIEWER: \*\*\* Minor and technical corrections \* 2. Coastal focus regions p. 4 / l.25 - 26 - Sentences could be rephrased ... "It is .... It is ....".

AUTHOR: The suggested revision has been made

REVIEWER: p. 6 / l.24-25 - "a-1" needs to be placed by "y-1".

AUTHOR: The suggested revision has been made

REVIEWER: \* 3. Objectives and Benefits p. 8 / l. 30 - "radar" has to replaced by "HF radar".

AUTHOR: The suggested revision has been made

REVIEWER:\* 4. International Context p. 9 / l. 31-32 - "to providing ... and carrying" to be replaced by "to provide ... and carry"

AUTHOR: The suggested revision has been made

REVIEWER:\* 5. Observations p. 11 / l. 30 - CODM website could be given.

AUTHOR: The suggested revision has been made p. 12 / l. 2 - The number (4 or 5) of

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fixed stations can be explicitly written. AUTHORS: now provided (6)

REVIEWER: p. 12 / l. 22-23 - Please homogenize the writing. In this part we find back past verb when present is used in other parts.

AUTHORS: That is unfortunately hard to avoid since some units are not operational while others are still in use. Please refer to Table 3 and 4 for details. The writing has been homogenized where possible.

REVIEWER: p. 13 / l. 4-6 - The maintenance frequency could be given.

AUTHORS: We would like to keep the statement as is. We adapted the aimed intervals to the biological productivity, i.e. four times per month from mid of May to mid of September and two times per month during spring and autumn. Due to the dependency on the wave conditions, the planned maintenance frequency could generally not be achieved. To explain this would make the text quite lengthy. Our intention here was to give an impression about the effort that is needed to operate a pole in this area.

REVIEWER: p. 16 / l. 14 - "The measurements taken with COSYNA gliders is ...." => "... gliders are ...". p. 16 / l. 17 - "The data was ..." => "The data were ...". p. 17 / l. 1 - "The Systems ..." => "The systems ...". p. 18 / l. 25 - "und ..." => "and ...". p. 21 / l. 15 - The acronym ADCP should be mentioned in brackets before to be used. p. 21 / l. 21 + p. 22 / l. 14 - The way of writing in situ (in situ, in-situ) must be homogeneous in the manuscript. p. 23 / l. 21 - "chlorophyll"-a concentration. p. 24 / l. 29 - "chlorophyll-a" => "chlorophyll-a concentration". p. 25 / l. 28 - PSICAM is not defined at this stage in the manuscript. \* 6. Sensor and Instrument Development p. 28 / l. 15-16 - "phytoplankton fluorescence" => "fluorescence". p. 28 / l. 16 - "dependents" => "depends". p. 30 / l. 4 - "Fig. 22" => "Fig. 22e". REVIEWER: \* Tables Table 1: REVIEWER: + "current vector" => "current" or "current velocity" AUTHORS: done REVIEWER: + "oxygen" => "dissolved oxygen" AUTHORS: done

AUTHORS: All of these minor corrections have been made

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REVIEWER: Table 2: + the level/depth of measurement is missing.

AUTHORS: Since the platforms often have several sensors at multiple depths it would be hard to integrate this in an overview table. The details are provided, however, in the individual sections.

REVIEWER: + For FINO-3, is it 2016 of now ?

AUTHORS: yes, but observations have stopped in 2016.

REVIEWER:\* Figures General comment: There is a gap between this manuscript and figures ready for publication because they are often blurred and some are even not readable.

AUTHORS: Agreed. Several figure have been improved.

REVIEWER: + Figure 1 is blurred in the pdf.

AUTHORS: Figure has been completely redone

REVIEWER:+ Figure 4, reference (left/right) to the pictures is missing in the caption.

AUTHORS: done

REVIEWER:+ Figure 5 is blurred and we do not distinguish axes label with the corresponding curves.

AUTHORS: The Figure has been improved

REVIEWER:+ Figure 6, the x-axis is not enough detailed; a number from 1 to 12 months could be helpful.:The colours red and brown are not distinguishable. A reference to "DO" is missing in caption. This has been changed

AUTHORS: Thank you. This has been changed

REVIEWER: + Figure 7 and Figure 20 can be removed, as it is a classical view of well-known systems.

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AUTHORS: Both Figure have been removed

REVIEWER: + In Figure 8 the caption and the information on the figure are incomplete: the meaning of the curve colour is not given on the left plot (is it the months represented on the right panel ?), is the theta in the caption different with the phi in the y-axis label ?, where is represented 2014 as mentioned in the caption ?

AUTHORS: The figure caption has been clarified.

REVIEWER:+ In Figure 9, the white-blue colorbar does not allow distinguishing current velocity classes. Please consider changing the colormap.

AUTHORS: The figure has not been changed yet, but will be redone before final submission.

REVIEWER: + Figure 12 is blurred and impossible to read. Then, we can't connect numbers in the caption with the diagram.

AUTHORS: The figure has been completely redone.

REVIEWER: + The Figure 13 can be removed, as it does not give major information for the paper purpose.

AUTHORS: Figure has been removed

REVIEWER:+ On Figure 14, which year is represented and what is the depth of measurements ? The meaning of CPUE could be explicitly called back in the caption.

AUTHORS: Caption has been redone: "Upper panel: The temporal abundances of the main biota groups assessed with a stereo-optic sensor attached to the Underwater-Node System in Spitsbergen from January 2014 to March 2014. CPUE (catch per unit effort) refer to total number of organisms per group counted per week. Lower panel: The temporal and spatial pattern of salinity in the depth range between 0 to 10 m assessed with one remote controlled vertical CTD profile per day during the same time period when the biota measurements (upper panel) were done."

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REVIEWER: + Figure 15. (a) and (b) must be added on the photo or (left) and (right) has to be added in the caption.

AUTHORS: done

REVIEWER:+ Figure 17. "chlorophyll concentration" => "chlorophyll-a concentration"

AUTHORS: changed

REVIEWER: + Figure 25 is blurred.

AUTHORS: The figure has been redone.

Please also note the supplement to this comment:

<http://www.ocean-sci-discuss.net/os-2016-31/os-2016-31-AC1-supplement.pdf>

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